ESE 2019

UPSC ENGINEERING SERVICES EXAMINATION

Preliminary Examination

General Studies and Engineering Aptitude

Information and Communication Technologies (ICT)

Comprehensive Theory *with* Practice Questions
and ESE Solved Questions

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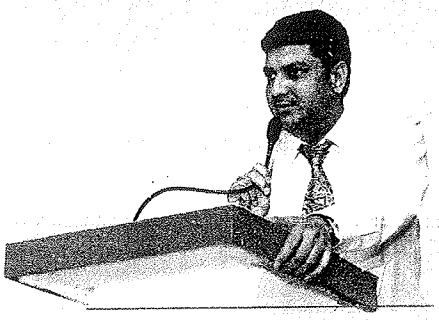
Preface



B. Singh (Ex. IES)

The compilation of this book **Information and Communication Technologies** was motivated by the desire to provide a concise book which can benefit students to understand the concepts of this specific topic of General Studies and Engineering Aptitude section.

This textbook provides all the requirements of the students, i.e. comprehensive coverage of theory, fundamental concepts and objective type questions articulated in a lucid language. The concise presentation will help the readers grasp the theory of this subject with clarity and apply them with ease to solve objective questions quickly. This book not only covers the syllabus of ESE in a holistic manner but is also useful for many other competitive examinations. All the topics are given the emphasis they deserve so that mere reading of the book clarifies all the concepts.

We have put in our sincere efforts to present detailed theory and MCQs without compromising the accuracy of answers. For the interest of the readers, some notes, do you know and interesting facts are given in the comprehensive manner. At the end of each chapter, sets of practice question are given with their keys, that will allow the readers to evaluate their understanding of the topics and sharpen their question solving skills.

Our team has made their best efforts to remove all possible errors of any kind. Nonetheless, we would highly appreciate and acknowledge if you find and share with us any printing and conceptual errors.

It is impossible to thank all the individuals who helped us, but we would like to sincerely thank all the authors, editors and reviewers for putting in their efforts to publish this book.

With Best Wishes

B. Singh

CMD, MADE EASY

Information and Communication Technologies

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Chapter 7

1 Introduction to ICT

1.1 Overview of ICT

- ICT or Information and Communication Technology are the various infrastructure and components that used to transmit, process, store, create, display, share or exchange the information by the means of computing.
- Different views on ICT as given by different people and organisation are:
  (i) **OECD's View:** The term 'Information and Communication Technology' is "used to cover technologies used in the collection, processing and transmission of information. It includes micro-electronic and info-electronic based technologies incorporated in many product and production process and increasingly affecting the service sector.
  (ii) **UNESCO's View:** "Information and Communication Technology (ICT) is scientific, technological and engineering disciplines and management techniques used in information handling and processing, their application, computer and their interaction with man and machines and associated social, economic and cultural matters".
  (iii) **Smith and Cambell's View:** "A mosaic of technologies, products and technologies have combined to provide new electronic dimensions to information management. The mosaic is known by the name of information and communication technology".
  (iv) **Darnton and Gigcoletto's View:** "It is the systematic study of artifacts that can be used to give form or descriptions to facts in order to provide meaning or support for decision making and artificial that can be used for the organization and application of information."
- Information and Communication Technology can be considered to be built on the 4C's: computing, communication, content and capacity. When considering the use of ICT for development, computing and other hardware continue to be less and less expensive, whereas communications, softwares and training make ICT more expensive.
- Information and Communication Technology is much more than computers and the internet or telephony. The Internation Telecommunications Union (ITU) has segmented the world wide ICT market into three categories as Telecom services, software and services and hardware. The issue of "Digital Divide" and "Internet Governance" are of more focus in ICT world today.
- Applications of Information and Communication Technology are divided into two broad categories:
  (i) The first are those largely dependent on traditional telecommunication networks (including the internet) that enables on-demand communications to provide information tailored to the user's convenience and needs. Distance education programs, e-commerce or e-governance fall into this category.
  (ii) The second group of Information and Communication Technology applications are human independent, where information is processed and decisions are arrived on the basis of preset criteria without human intervention at the time of decision making. These can nearly be passive systems, or part of a larger system (embedded ICT). Eg-Sensor based networks.

A major challenge is how to design Information and Communication Technology or other complex engineering or societal system such that two applications can be integrated.

1.2 Measuring ICT

- Various organisations have set up different indices for measuring ICT. Data and statistics on ICT ar abound but some of these lack transparency and standardization. Most popular metrics are base on weighted sub-metrics spanning various facts of ICT.
- The Global Information Technology Report (GITR) ranks 82 economies according to Networke Readiness Index (NRI) which measures the "degree of preparation of a nation or community to participate in and benefit from ICT developments".
- The UNCTAD ICT Development Index (2003) uses a Gini coefficient equivalent to measure ICT distribution inequally.
- The ITU (International Telecommunication Union) published the World Telecommunication Development Report 2003, to provide updated and standardized data on ICT. This report proposes a new Digital Access Index (DAS), a transparent metric encompassing numerous factors including infrastructure, affordability, knowledge, use and quality. It establishes explicit benchmarks such as literary rates, total international uplinking bandwidth etch to measure DAI for a country.

1.3 ICT and Development

- ICT is viewed as both a means an end for development. With roughly two-third of the world economy based on services, and rise of many nations as global IT players, many developing nations have accepted ICT as national mission. Even with manufacturing and industry, ICT has an increasingly important role to plays.
- The ITU has published a report on how ICT can help in achieving the goals and target in its World Telecommunication Development Report (2003) which can be tabulated as below:

	Goal/Target	Role of ICTs
1.	Eradicate extreme poverty and hunger. Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day. Halve, between 1990 and 2015, the proportion of people who suffer from hunger.	Increase access to market information and reduce transaction costs for poor farmers and traders. Increase efficiency, competitiveness and market access of developing country firms. Enhance ability of developing countries to participate in global economy and to exploit comparative advantage in factor costs (particularly skilled labor)
2.	Achieve universal primary education Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.	Increase supply of trained teachers through ICT-enhanced and distance training of teachers and networks that link teachers to their colleagues. Improve the efficiency and effectiveness of education ministries and related bodies through strategic application of technologies and ICT-enabled skill development. Broaden availability of quality educational materials/resources through ICTs.
3.	Promote gender equality and empower women	Deliver educational and literacy programs specifically targeted to poor girls and women using appropriate technologies. Influence public opinion on gender equality through information or communication programs using a range of ICTs.

4.	Reduce Child mortality	Enhance delivery of basic and in-service training for health workers.
5.	Improve material health	
6.	Combat HIV/AIDS, malaria and other diseases Reduce infant and child mortality rates by two-thirds between 1990 and 2015. Reduce material mortality rates by three-quarters between 1990 and 2015. Provide access to all who need reproductive health services by 2015.	Increase monitoring and information sharing on disease and famine. Increase access of rural caregivers to specialist support and remote diagnosis. Increase access to reproductive health information, including information on AIDS prevention, through locally appropriate content in local language.
7.	Ensure environmental sustainability. Implement national strategies for sustainable development by 2005 so as to reverse the loss of environmental resources by 2015. Halve, by 2015, the proportion of people without sustainable access to safe drinking water. Halve achieved, by 2020, a significant improvement in the lives of at least 100 million slum dwellers.	Remote sensing technologies and communications networks permit more effective monitoring, resource management, mitigation of environmental risks. Increase access to/awareness of sustainable development strategies, in areas such as agriculture, sanitation and water management, mining, etc. Greater transparency and monitoring of environmental abuses/enforcement of environmental regulations. Facilitate knowledge exchange and networking among policymakers, practitioners and advocacy groups.

Table: Role of ICT in Achieving Goals

- The table above has been set to achieve the Millennium Development Goals (MDG) through ICT. The role of ICT should be best seen as an enabler, primarily spanning in several dimensions:
  (a) Efficiency and competitiveness
  (b) New business models and opportunities
  (c) Transparency and empowerment
- The value of ICT lies in the gathering, storing and analysing information with greater accuracy and granularity. This enables tailoring development efforts to suit specific social, economic, gender, age and geographic conditions and requirements.

1.4 ICT Targets

- The International Telecommunication Union (ITU) in conjunction with United Nations organized a summit with emphasis on the growing relevance of ICT in the global domain. The summit also called 'The world summit on the information society' brought to the fore front the role of ICT for development. A set of developmental targets were set up in the summit to be achieved on the field of Information and Communication Technology.
- A summary of the targets emerging out of the World Summit on The Information Society (WSIS) are:
  (i) To connect villages with ICTs and establish community access points.
  (ii) To connect universities, colleges, secondary schools and primary schools with ICTs.
  (iii) To connect scientific and research centres with ICTs.
  (iv) To connect public libraries, cultural centres, museums, post offices and archives with ICTs.
  (v) To connect health centres and hospitals with ICTs.

(vi) To connect all local and central government departments and establish websites and e-mai addresses.

(vii) To adapt all primary and secondary school curricular to meet the channels of the Information Society, taking into account natural circumstances.

(viii) To ensure that all the world's population have access to television and radio services.

(ix) To encourage the development of content and to put in place technical conditions in order to facilitate the presence and use of all world languages on the internet.

(x) To ensure that more than half of the world's population have access to ICT within their reach.

- A set of ICT targets have been seen to accelerate actions on the Sustainale development Goals (SDG) which is expected to be achieved by 2030. To achieve SDGs, ICT needs to be combined with innovative policies, services and solutions to deliver transformation at unprecedented speed and scale. It can be a powerful means of implementation of ICT into five major ways:

(i) Accelerated upscalling of critical services in health, education, financial services, smart agriculture and low-carbon energy systems.

(ii) Reduced deployment costs addressing urban and rural realities.

(iii) Enhanced public awareness and engagement.

(iv) Innovation, connectivity, productivity and efficiency across many sectors.

(v) Faster upgrading in the quality of services and jobs.

1.5 Technology Mapping with ICT

- Many hypothesis have developed over years to integrate technology with development. In one such hypothesis, in a keynote address, Richard Newton stated that the most ICT for development is simply "trickle down" instead of purposely development regions.
- Any viable solutions for developing countries will involve sizeable investment in R and D, ranging from enabling technologies to applications as shown in figure below:

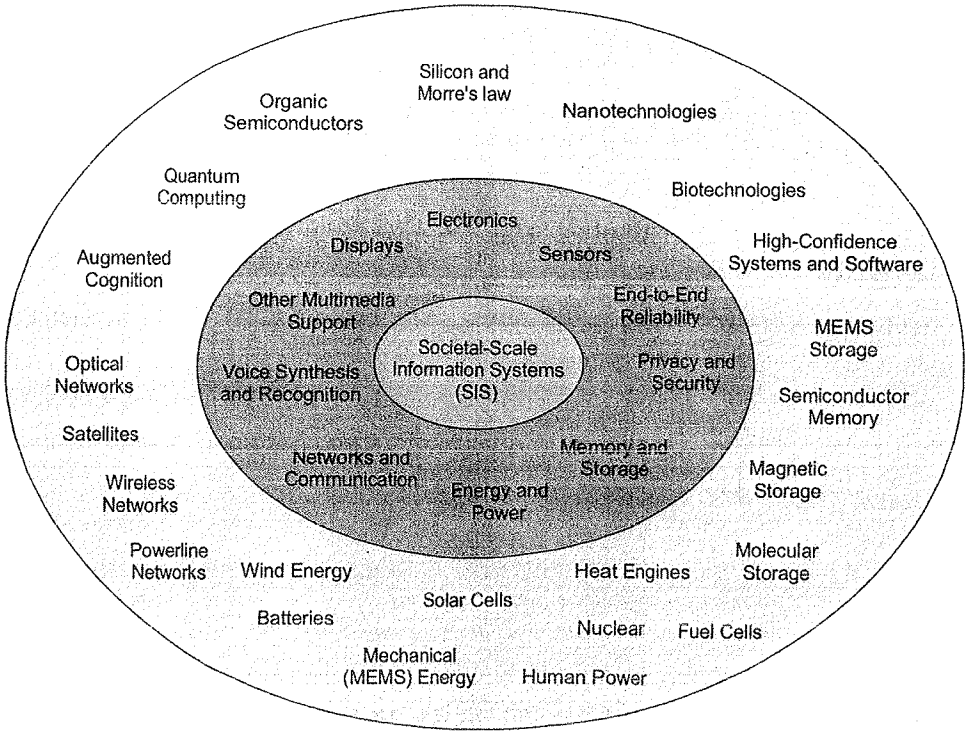


Fig. 1.5 Components of Societal-Scale Information System

- A generalised model for ICT and R and D is needed to make ICT relevant for development which is entirely within the technology domain.
  The generalised model for ICT in technology domain can be presented as:

Sensors (S)	Acquire and convert observations into information in digital formats.
Communication (C)	Reach and richness of networks.
Database/Information Systems (DB/IS)	Global databases of information spanning all media. Availability of information in appropriate formats, language and specifications. Creating knowledge and contextual bases and algorithms for processes and decision-making.
Controllers/Actuators /Effectorss (CTRL)	Effecting change (feedback) in nature and the operating domain.
Human-Computer Interaction (HCI)	Managing and Interfacing with ICT (Includes new devices for ICT-handhelds, all-in-one devices, etc.)

Table: Generalised ICT Model

1.6 Impact of ICT

- The primary ICT components as per the generalised model, where ICT could make major impact on various areas of human and economic development can be illustrated by the following factors:
  1. **Infrastructure Development:** Advanced urban transport, electricity and efficiency and loss/ theft reduction, electricity load management etc.
  2. **Basic Human needs Development:** Disaster/weather forecasting and waning, health monitoring and epidemiology, remote medical detection/diagnosis, water management etc.
  3. **Economic Development:** Agricultural/commodity price discovery, expanding markets for rural/ traditional goods, drip and advanced irrigation methods etc.
  4. **Empowerment:** Distance and e-learning, e-governance, national and global inclusiveness, digital libraries etc.

1.7 Advantages and Disadvantages of ICT

Advantages of ICT:

1. **Globalization:** It has not only brought the world closer together, but has allowed the world's economy to become a single independent system. This means that not only information can be shared quickly and efficiently, but also bring down barriers of linguistic and geographic boundaries.
2. **Communication:** With the help of IT, communication has become cheaper, quicker and more efficient. Various modes of communication such as mobile phone or internet have generated instantaneous response by simply text messaging or sending an e-mail. The interest has also opened up face-to-face direct communication from different parts of the world.
3. **Cost Effectiveness:** Information technology has helped to computerise the business process, thus streamlining business, to make them extremely cost effective, money-making machines. This in turn increases productivity, which ultimately give rise to profit, resulting in better pay and less strenuous working conditions.
4. **Bridging the Cultural Gap:** Information technology has helped to bridge the cultural gap by helping people from different structures to communicate with one another, allow exchange or views and idea, thus increasing awareness and reducing prejudices.

5. **Round the Clock Service:** Information technology has made it possible for business to be open a the time all over the globe, making purchases from different countries easier and more convenient. I also means one can have goods delivered right into another's doorstep without having to move a single muscle.
6. **Creation of New Jobs:** Probably the best advantages of information technology is the creation o new and interesting jobs like computer programmers, systems analyst, hardware and software developers and web designers are just some of the many new employment opportunities created with the help of IT.

Disadvantages of ICT:

1. **Unemployment:** While information technology may have streamlined the business process, it has also created job redundancies, down sizing and out sourcing. This means that a log of lower and middle level jobs have down away with, causing more people to become unemployed.
2. **Lack of Job Security:** Technology keeps on changing constantly, therefore one has to be in a continuous learning mode.
3. **Domination of Language:** Language like English is dominating over other languages as most of the content on the internet is in English language.
4. **Privacy:** Though information technology may have made communication quicker, easier and more convenient, it has also brought along privacy issues. From cell phone signal interceptions to e-mail hacking, people are now worried about their once private information become public knowledge.
5. **Dominant Culture:** Culture of rich countries are dominating the lives of people of developing or poor nations.
6. **Moral and Ethical Issue:** Information technology has also created problem of morality; younger generation is getting corrupted because of the content of internet.

1.8 ICT Challenges

Several issues that determine the viability of ICT for sustainable development, primarily focused on traditional computing and connectivity are listed below:

1. Digital Divides
   - The digital divides is actually a manifestation of other underlying divides, spanning economic, social, geographic, gender and other divides. Attempting to address the digital divide as a cause instead of a symptom of other divides has led to many failure of ICT driven development projects.
   - The digital divide is more than differences in availability of hardware and connectivity. The four interrelated feature determine the value of ICT for a user which are as:
     (i) **Awareness:** People must know what can be done with ICT; they must also be open to using ICT.
     (ii) **Availability:** ICT must be offered within reasonable proximity, with appropriate hardware/ software.
     (iii) **Accessibility:** Related to the ability to use the ICT (spanning literacy, e-literacy, language, interfaces etc.)
     (iv) **Affordability:** All ICT usage together should be only a few percent of one's income, this covers life-cycle costs, spanning hardware, software, connectivity, education etc.
   - As per Markle Foundation's report on National Strategies of "ICT for development" states, "Digital divides are not just the result of economic differences in access to technologies, but also in cultural capacity and political will to apply these technology for development impact".

2. Hardware and Software Cost
   - Until hardware and software cost decreases, ICT may remain beyond the reach of many users. Most of the developing nations may face higher hardware cost due to important duties or other artificial constraints or a lack of local production capabilities.
   - While hardware speeds may scale with increase in number of transistors and components on a chip, software scales only with skilled humans. Open-source software has the potential for bringing down software costs, but the interface and use have often been difficult for semi-skilled and un-skilled users.
   - So until there is a possibility for developing economies to produce their own software, including building upon existing source code for new programs and applications, this may remain a change to ICT.
3. Connectivity Cost
   - As per ITU data report, using dial-up to access the internet can cost more than the average annual Gross National Income (GNI) in many countries. This implies that a shared access model becomes costlier for ICT to be affordable.
   - While many worry about basic access (i.e. dial-up) connection, the target should actually be broadband because of higher bandwidth that rich applications and interfaces require. Broadband represents even bigger disparity in prices which creates a major challenge to ICT.
4. Robustness
   - Telecommunications equipment is designed to have much higher reliability with about 99.99% uptime or just 5 minutes of downtime per year. However, in developing countries, the reliability of ICT is much lower which is mostly due to failure in electricity, software or other complementary systems, including limited availability of spares.
   - From the above and other reasons, manufacture's reliability figures do not translate in to real-world uptimes. Given the complete absence of ICT and other infrastructure in many parts of the world, it would not be unreasonable to consider technology solutions that are slightly less robust or have low functionality by design for dramatically lower costs.
5. Content
   - Not only issues such as literacy and multitude of language are yet to be addressed, there are also concerns over control of data, accuracy and transaction costs. In addition, most content is not locally relevant or actionable.
   - Today's ICT systems are largely geared towards passive consumption of information, instead of active production of information and content. Non-ICT knowledge networks in rural areas are often peer-to-peer and it is therefore necessary to develop tools to enable people to share information better, combining local knowledge with experts and ICT-enhancements.
   - Restrictions on access to content and information are another policy challenge, in addition to the view by many policy-makers that much of the online content is societally inappropriate. This impacts the willingness to use public funds for ICT infrastructure development.
6. Usability and Interface
   - The prime means of interfacing with data has been the computer, which assumes a certain level of literacy, both lingual and technical. Until local language and graphical interfaces are improved, users will only be from upper socio-economic strata or developed nations.
   - Greater attention needs to be paid to making hardware and software easier to use for even the most sophisticated user. Similar innovation is needed in computer-communication system.

7. Security
   - From end user perspectives, issues of privacy, thrust and verifiability are key concerns. Wi the evolution of internet, security is a concern even for uninformed or unaware end-users places an implicit cost on all transactions.
   - Information security and its aspects encompassing integrity, confidentiality, privacy an assurance is a major concern for all countries, including the developed ones. Due to lack institutions of tackle cyber security, a few developing nations become victims and also launchin pads for a number of attacks.
   - An added concern is the physical security of equipment and systems in the field. Even copp cables are often dug out and resold on the market. However with replacement of such wires wi wireless technology, such challenges can be mitigated.
8. Internet control, Architecture and Addressing
   - One of the major debates ongoing in the ICT and development community is over interne governance. The structure of internet governance largely does not include issues relatin accountability and various stakeholders are struggling to define roles and responsibilities.
   - From a practical perspective, developing countries face a lack of physical (IP) address space in addition to issues of internet name space. The current version of Internet Protocol, IPv4 ha been unevenly distributed between nations.

1.9 ICT in Daily Life

ICT includes all technical component that are used for handling information and achieving communicatior It includes network hardware, communication lines and all necessary software.

We can say, ICT is comprised of information technology, telephony, electronic media and all types o process and transfer of audio and video and all control and managing functions based on networ technologies.

The ICT used in various parts of daily services are:

1. **Internet services:** It includes e-commerce, e-banking and e-governance.
   - 'e-commerce' is a form of trade that allow customers to see and purchase products online.
   - 'e-banking' allows users to have control over their accounts (view balance and transaction), transactions from one account to another, credit payment, vouchers for mobile phone etc. The benefits are time saving, lower service fee and access from anywhere, anytime.
   - 'e-governance' means use of technology to provide better public access to government information, therefore providing citizens their human right of information.
2. e-learning
   - It consists of all form of learning or transfer of knowledge based on electronic technologies. It is mostly used to describe a learning technique, in which there is no direct teacher-student contact while using ICT technology.
   - Advantages of e-learning is that books come only in text and graphical form on paper, while e-learning materials has multimedia features and the ability to remotely monitor lectures in real-time. One of the best example is students attending the class, which is taking plate at some other place with the help of VSAT technology.
   - e-learning is advantageous to student as:
     (i) Adaptive time, place and pare of learning
     (ii) Access and availability of education

(iii) Unlimited repetition of lectures
(iv) Reduces cost of education
(v) Multimedia environment (video, audio, text)

- e-learning is benefited to teachers and institutions as:
  (i) It reduces cost of teaching
  (ii) Once created it is easy to upgrade
  (iii) e-education allows educational staff to invest a much shorter time commitment to implement the respective education.

3. Tele-networking
   - It includes Public Switched Telephone Network (PSTN). It operates on the basis of circuit switched by national, regional or local telephony operators. Various factors like quality of IT infrastructure, good computer literacy etc. affect the performance of tele-networking.
   - Tele-networking is advantageous as:
     (i) It reduces cost and employees transportation reimbursement.
     (ii) It reduces travelling time from one place to another.
     (iii) It allows the possibility of working in the convenient place.
4. E-mail, IM, VOIP, BLOG, PODCAST
   - E-mail is the transmission of text messages using internet. With the help of internet, users can exchange files like image, multimedia, documents etc. E-mail consists of a user name and a domain name.
   - IM (Instant Messaging) service is used for instant message exchange and real time communication. It allows video conferencing also. Most popular IM services are: Windows Live Messenger, Skype etc.
   - VOIP (Voice Over Internet Protocol) is a term of technology that allows digitalization and transfer of voice over the internet. It enables sound communication like telephone call over internet.
   - BLOG is form of internet media in which one can post or write their opinion on any topic. It can be personal or in the form of journals. Blogs are popular because end-users's don't need to have advanced computer knowledge or knowledge of webpage creation etc. Blogging allows exchange of interests, ideas and opinions etc.
   - PODCAST (POD-Personal on Demand + Broadcast) is a digital like containing audio or video content subscribed to and downloaded automically through web syndication or streamlined online to a computer or mobile device.
5. Virtual Communities
   - It includes a group of people who communicates via social-networks, forums, IM service, blogs. It is called a community because there are a collection of people who participates in a group of their interests thus forms of a virtual community as the people involving are not in physical contact but connected by means of ICT technologies.
   - Social networking like Facebook, Twitter, Google+ are one of the application of ICT tools in our daily life.
6. Forum
   - Forum is a service that allows users to exchange opinions. It can be compared to bullet in boards on which participants leave their messages, while other leave their comments. One of the example of forum is TED conversational.

Objective Brain Teasers

Q.1 ICT is:
(a) A processing information for the use of hardware and software.
(b) Use of hardware and software for distributing useful information.
(c) Various components that are used to transmit, process, store, create, display or exchange information by means of computing.
(d) A principle of physical and social sciences for processing of information of many kinds.

Q.2 Which of the following issues are of important concern in the field of ICT
1. Digital divide
2. Internet governance
3. Security
4. Cost of content
5. Connectivity
(a) 1, 2 and 4 only (b) 2, 3 and 4 only
(c) 1, 3 and 4 only (d) All of the above

Q.3 The scientific methods to store information and arranges it for communication is called:
(a) Information technology
(b) Electromagnetic communication
(c) Telecommunication
(d) Codes

Q.4 Which of the following is/are a challenge to the viability of ICT?
1. Robustness
2. Hardware and software cost
3. Digital divide
(a) 3 only (b) 1 and 2 only
(c) 1 and 3 only (d) 1, 2, and 3

Q.5 Consider the following statements:
1. Information and Communication Technology (ICT) is considered a subset of Information Technology (IT).
2. The 'right to use' a piece of software is termed as copyright.
Which of the following statements are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Q.6 Blog is defined as
(a) Online music application
(b) Internet
(c) A personal or corporate website in the form of an online journal
(d) A personal or corporate google search

Q.7 Which of the following facilities are included in information and communication technology:
1. Online learning
2. Instant messaging
3. Job security
4. Distant education
(a) 1, 2 and 3 only (b) 1, 2 and 4 only
(c) 2, 3 and 4 only (d) 1, 2, 3 and 4

Q.8 Which of the following is a principle of effective communication?
1. Persuasive and convincing dialogue.
2. Participation of the audiences.
3. One-way transfer of information.
4. Strategic use of informal communication.
(a) 1, 2 and 3 only (b) 1, 2 and 4 only
(c) 2, 3 and 4 only (d) 1, 2, 3 and 4

Q.9 The combination of computing, telecommunication and media in a digital atmosphere is referred to as:
(a) Convergence
(b) Integrated media
(c) Digital combination
(d) Online communication

Q.10 Which of the following are the benefits of e-learning in ICT?
1. Reduced cost of education
2. Unlimited repetition of lectures
3. Adaptive time and place of learning
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Q.11 Which of the following components had a major impact of ICT in its development?
1. Expansion of rural market
2. Health monitoring and diagonosis
3. Digital libraries
4. Transparency
(a) 1, 2 and 3 only (b) 1, 3 and 4 only
(c) 2, 3 and 4 only (d) 1, 2, 3 and 4

Answers

1. (c) 2. (d) 3. (a) 4. (d) 5. (d)
6. (c) 7. (b) 8. (c) 9. (a) 10. (d)
11. (d)

2 ICT Based Tools

Information and Communication Technologies (ICT) tools are the various goods, products and services used in the form of digital infrastructures such as computers, tablets, projectors, interactive white boards, digital signage, printer, networking switches, wi-fi, cables, servers and so on. The basis function of ICT tools are primarily intended to fulfil or enable the function of information processing and communication by electronic and digital means, including transmission and display.

As per OECD (Organisation for Economic Co-operation and Development) guide to measuring the information society 2011, the ICT products classifications are as:

Computer and peripheral equipment/tools	• Point of sale terminals, ATM's • Laptop, notebook • Input peripherals (keyboard, mouse) • Scanners • Printers (Inkjet, Laser and others) • Media storage units (Fixed/Removable) • Parts and accessories of computing machines • Monitors and projectors • Solid-state non-volatile storage devices
Communication equipment	• Transmission apparatus • Television cameras • Line telephone sets with cordless handsets • Telephones for cellular network • Various parts for above mentioned subclasses
Consumer electronic equipment	• Video game consoles • Video camera recorders • Digital cameras • Radio broadcast receivers • Television receivers, monitors and projectors • Sound/Video recording • Microphone, loudspeakers, headphones etc.
Miscellaneous ICT components and goods	• Printed circuits, CRT's, diodes etc. • Magnetic and optical media • Card with a magnetic strip • Smart cards • LCD, lasers and other optical appliances
Manufacturing services for ICT equipments	• Electronic component and board • Computer and peripheral equipment • Communication equipment • Consumer electronic • Magnetic and optical media
Business and productivity software and licensing services	• Operating system, system software, application software, network software • Database management software • Development tools and programming language software • Licensing services, online software

Information technology consultancy services	• Business process management services • IT consulting and support services • IT design and development services for applications networks and systems • Web hosting services • Network services • Computer system management services
Telecommunication services	• Mobile telecommunication services • Carrier services • Private network services • Data transmission services • Internet services (Narrowband/Broadband)
Leashing or rental services for ICT equipments	• Leasing or rental services concerning computers without operator telecommunication equipment without operator, television, radio etc.
Other ICT services	• Engineering services for telecommunication and broadcasting projects. • Maintenance and repair services of computer and peripheral equipment, telecommunication equipment. • Installation service of computers, radio, television and communication equipment.

2.1 Computer

Computer is a programmable machine that can execute a programmed list of instructions and simultaneously work upon new instructions given to it. It is a electronic device that has the capacity of storing and retrieving information from its memory and can generate the required output as per the processing instructions given to it by the users with high speed, accuracy and reliability.

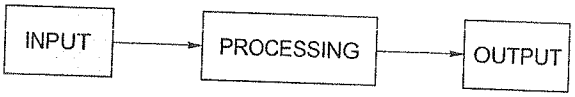
It a simpler sense, a computer can:

(i) Take data as input

(ii) Store data in its memory

(iii) Retrieve data when necessary

(iv) Generate the output



Advantages	Disadvantages
• **Speed:** Can perform very large calculations in fractions of second. • **Accuracy:** Can run a program and give output without any error. • **Storage:** It can store large amount of data which can be retrieved later.	• **Dependency:** In a digital world almost all works are dependent on computers. • **No self-awareness:** It has no intelligence on its own and user has to manipulate it.

2.2 Computer Generations

In the era of digitalization, there have been upgrades in the advancement of technology leading to updates in computer technology both in hardware components as well as software. As of present day, there have been five generations of computers.

All the five generations of computers have been discussed in details as follows:

Generation	Period	Technology based on
First	1945-1955	Vacuum tubes
Second	1955-1965	Transistors
Third	1965-1975	Integrated Circuits (IC's)
Fourth	1975-1989	Very Large Scale Integration (VLSI) microprocessor
Fifth	1989-till date	Ultra Large Scale Integration (ULSI) microprocessor

First Generation of Computers (1945-1955):

The first generation computers used vacuum tubes as the basic components of memory and circuitry for CPU. These vacuum tubes were invented by Lee De Forest. The first operational electronic general purpose computer, namely ENIAC (Electronic Numerical Integrator and Computer) was built using about 18000 vacuum tubes.

Some **basic features** of first generation computers are:

- Vacuum tube technology based.
- Mainly batch processing operating system.
- Punch cards, paper tape and magnetic tape as input and output devices.
- Machine language as programming language:

Disadvantages:

- Bulky and costly.
- Generates high heat and consumes lot of electricity.
- Performance very slow and unrealiable.
- AC required.

Examples:

- ENIAC, EDVAC, UNIVAC, IBM-701, IBM-650, EDSAC.

Second Generation of Computers (1955-1965):

The second generation computers used transistors in place of vacuum tubes, that were cheaper, less power consumption, more compact in size, more fast and reliable than first generation machines.

Best features:

- Transistor technology based.
- Batch processing and multiprogramming operating system.
- Magnetic cores used as primary memory and magnetic tape and magnetic disks as secondary memory.
- Assembly language and high-level language like FORTRAN, COBOL as programming language.

Disadvantages:

- Still very costly.
- Still large amount of heat generated.
- AC required.

Examples:

- IBM 7030, IBM 1620, CDC 3600, CDC 1604, UNIVAC 1108, Honey well 400

FORTRAN: Fortran, stands for formula translation, is a general purpose imperative programming language. It was originally developed by John Backus and IBM for scientific and engineering applications.

COBOL: COBOL, stands for Common Business Oriented Language, is a high-level language initially developed by CODASYL and later approved by ANSI as a standard language for commercial use.

Third Generation of Computers (1965-1975):

Third generation computers came with the invention on Integrated Circuit (IC) in place of transistors. An IC is a combination of many transistors, capacitors and resistors along with the associated circuitry. Due to this improvement, sizes were substantially reduced with increased reliability and efficiency.

Basic Features:

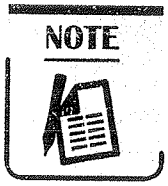
- IC technology based.
- Remote processing, time-sharing multi-programming, micro-programming operating system.
- Small scale integration and medium scale integration were implemented in CPU, I/O processors.
- Faster processors with magnetic core memories. (Later on replaced by RAM and ROM)
- High level language as FORTRAN-II to IV, PASCAL, BASIC, ALGOL-68 etc. as programming language.

Disadvantages:

- Costly and required AC.

Examples:

- IBM-360 series, PDP-8 Mini Computer, Honey well 6000 series, TDC-316



PASCAL: Pascal is a general purpose, high level language that was originally developed by Niklaus Wirth in 1970 intended to encourage good programming practices using structured programming and data structuring.

BASIC: Basic, stands for (Beginner's All-purpose Symbolic Instruction Code), originally designed as an interactive mainframe timesharing language by John Kemeney and Thomas Kurtz in 1963 became widely used on personal computers.

ALGOL: ALGOL, stands for Algorithmic Language was designed by an international committee of the Association of Computing Machinery (ACM) for publishing algorithms as well as for doing computations. It was the most influential of the four high level language mentioned earlier.

Fourth Generation of Computers (1975-1989):

The fourth generation computers were based on the microprocessors which employed Large Scale Integration (LSI) and Very Large Scale Integration (VLSI) techniques to pack thousands or millions of transistors on a single chip. Fourth generation computers became more reliable, compact in size powerful and less costly which gave rise to personal computer revolution.

Basic features:

- VLSI technology based.
- Time-sharing, real time networks, distributed operating system.
- CRT screen, laser and ink jet printers, scanners etc. along with LAN and WANS were developed.
- High level language as C, C++, UNIX, DBASE etc. as programming language.

Examples:

- Intel's 8008, 80286, 80386 etc, Motorola's 68000, 68030 etc, Apple II, CRAY 1/2/X/MP, DEC 10, STAR 1000, PDP 11

Fifth Generation of Computers (1989-till date):

In the fifth generation computers, VLSI technology became updated to ULSI (Ultra Large Scale Integration), resulting in the production of microprocessor chips having ten million electronic components.

Basic features:

- ULSI technology based.
- Extensive parallel processing, multiple processing, super conductor technology.
- Advancement of AI (Artificial Intelligence which included Robotics, Virtual Reality, Neural Networks).
- High level language like C, C++, Java, .Net etc. as programming language.

Examples:

- IBM notebooks, Pentium PCs-Pentium 1/2/3/4/Dual core/Quad core, SUN work stations, PARAM 10000, IBM SP/2.

2.3 Types of Computers

Computers are categorized into various types based on their speed and performance level as:

Type	Description
Personal Computer (PC)	Single user, moderately powerful microprocessor.
Workstation	Single user, more powerful microprocessor than PC.
Mini Computer	Multi-user, capable of supporting hundreds of users simultaneously.
Main Computer	Multi-user, capable of supporting hundreds of users simultaneously. Software technology is different from mini computer.
Super Computer	Extremely fast, capable of executing hundreds of millions of instructions per second.

Least powerful

Most powerful

2.3.1 Personal Computers

- PC's are small, relatively inexpensive computer designed for an individual user.
- All PC's are based on the microprocessor technology that enables manufacturers to put an entire CPU on one chip.
- PC's are used popularly at home for playing games, surfing the internet etc.
- PC's are used in business purposes for accounting, word processing, desktop publishing, running spread sheet and database management applications.
- Based upon size and portability criteria, PC's are further sub-classified as - Desktop, Notebook, Laptop, Subnotebook, Hand-held, Palmptop and PDA (Personal Digital Assistant).

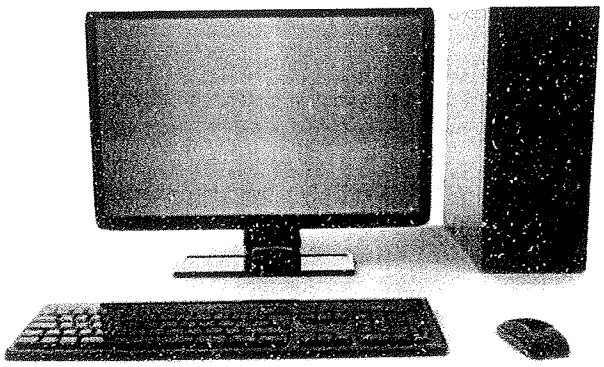


Fig. 2.3.1 Personal Computer

2.3.2 Workstation

- Workstation is a type of computer used for engineering application (CAD/CAM), desktop publishing, software development etc.
- Workstation is preferably used where a moderate amount of computing power and relatively high quality graphics are required.

Fig. 2.3.2 Workstation

- Workstation generally comes with a large, high-resolution graphics screen, large amount of RAM, built-in network support and a graphical user interface.
- Most workstations also have a mass storage device, but disk less workstation is a special type of workstation, which comes without a disk drive.
- Workstation are usually a single user computers but can be linked together to form a network of computer, although they can be used as stand along systems.
- UNIX and Window NT are the common operating systems for workstations.

2.3.3 Mini Computer

- A mini computer is a type of mid-range computer that possesses most of the features and capabilities of a large computer but is smaller in physical size.
- Mini computers emerged in the mid-1960's and were first developed by IBM corporation.
- Mini computers can contain single or multiple processors, support multi-tasking, have resilience to high work load and support multiple user simultaneously.
- Some common examples of mini computers are: IBM mid-range computers, HP 3000/2100 series, DEC PDP, Varian 620 100 series, CDC 160A/1700 etc.

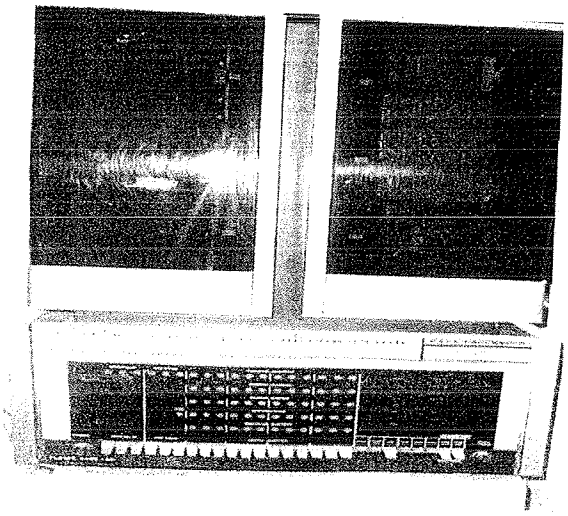


Fig. 2.3.3 Minicomputer

2.3.4 Mainframe

- Mainframes are the type of computers that are generally known for their large size, amount of storage, processing power and high level of reliability.
- Mainframe is a large and expensive computer capable of supporting hundreds or thousands of users simultaneously.
- Mainframe are different from super computer from the fact that a mainframe uses it power to execute a reliable volume of computations concurrently whereas super computer uses it power into executing a few programs as fast as possible.
- Mainframe computer play a vast role in the foundation of modern business such as banking, insurance, finance, health care, public utility, government and private enterprises.
- Some common examples of mainframe computers are: IBM Z-series, Unisys's Clear Path Libra and Clear Path Dorado, Fujitsu-ICL VME etc.

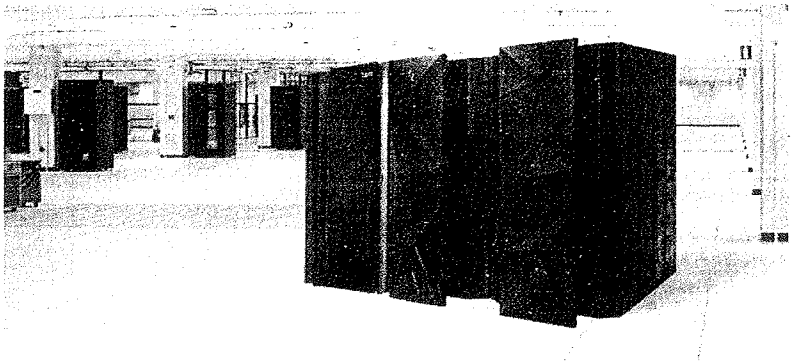


Fig. 2.3.4 Mainframe

2.3.5 Super Computer

- Super computer are the fastest and most expensive computers that are used for specialized applications which require very large amount of mathematical calculations.
- Super computers are very high performance computing machine designed to have extremely fast processing speeds.
- Super computers are applied to perform complex scientific calculations, modelling simulations and rendering large amount of 3D graphics. They may also be built to simply show case the leading edge of computing technology.

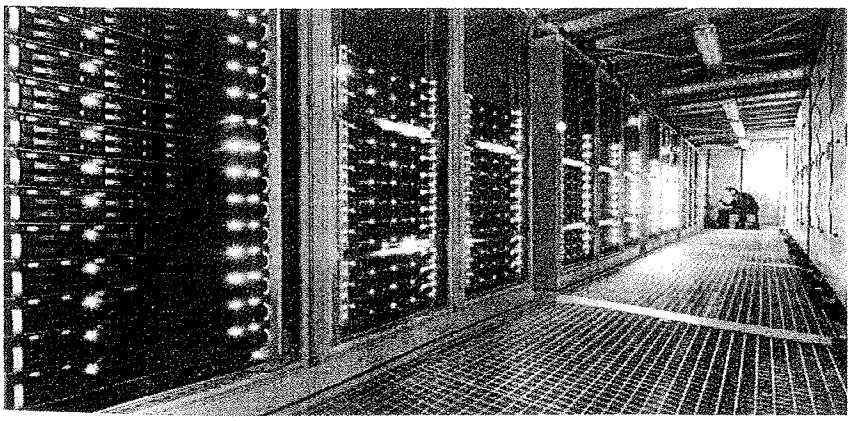


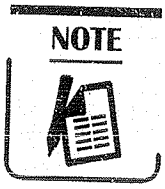
Fig. 2.3.5 Super Computer

- Some common applications of super computers are in the field of scientific simulations, weathe forecasting, (animations) graphics, fluid dynamics calculations, nuclear energy research, electroni design, analysis of geological data etc.
- Some of the fastest super computers in the world are as:

Rank	Name	Country	Processing Power
1	Sunway Taihu Light	China	93 petaflops
2	Tianhe-2	China	33.86 petaflops
3	Titan	U.S.	17.6 petaflops
4	Sequoia	U.S.	17.17 petaflops
5	Cori (Crey XC40)	U.S.	14 petaflops

- Some of the fastest super computers in India are:

World Wide Rank	Name	Site	Rmax (Tflops)	Rpeals (Tflops)
165	Sahasra T (Cray XC40))	SERC, IISC, Bangalore	901.51 (CPU-only)	1294.00 (CPU-only)
260	Aaditya (IBM/Lenovo System X)	Indian Institute of Tropical Meterology, Pune	719.2	790.7
355	TIFR - (Cray XC30)	Tata Institute of Fundamental Reaserch, Hyderabad	558.7	730.00
391	HP Appolo 6000	Indian Institute of Technology, Delhi	524.40	861.74
414	Param Yuva 2	Center for Development of Advanced Computing (C-DAC), Pune	388.44	520.44



- Performance of a normal computers is measured in terms of its CPU speed. The speed of CPU is measured in either Megahertz (MHz) or Gigahertz (GHz). 1 MHz CPU can carry out 1 Million Instruction Per Second (MIPS) and a 1 GHz CPU can carry out 1 Billion Instruction Per Second (BIPS).
- Performance of super computer is measured in terms of its processing speed. Its processing speed is measured in Floating Point Operations Per Second (FLOPS) or the number of calculations a super computer can perform in 1 second. These units of super computer are measured as Tera Flops/TFLOPS (10^{12} Floating Point Operations Per Second), Peta Flops/ PFLOPS (10^{15} Floating Point Operations Per Second) and Exa Flops/EFLOPS (10^{18} Floating Point Operations Per second).

2.4 Structure of Computer

The primary function of the computer is to take data from input devices, process the data in the CPU and display the processed data on the output devices. The mains parts of computer include:

(a) Input Unit

(b) Central Processing Unit (CPU)

(c) Output Unit

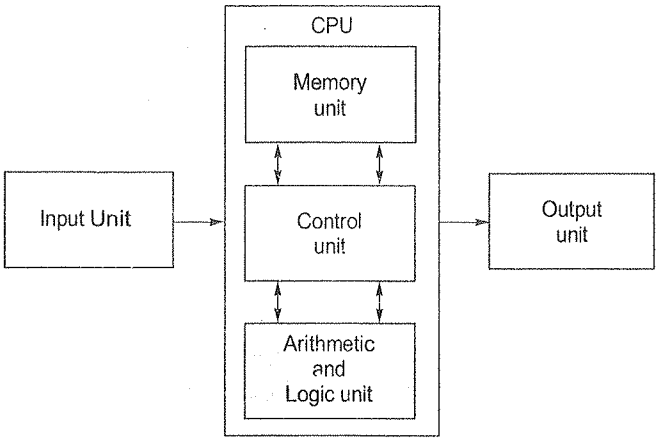


Fig. 2.4 Basic Structure of a Computer

2.4.1 Input Unit

Input unit plays a significant role in creating a link between the user and the computer. Before a computer can process the data, some method are required to input the data into the machine. This method is accomplished with the help of input devices which will further depend on what form the data takes (like text, sound, artwork etc.)

The various peripheral devices used for computer input unit are discussed below:

- Mouse
- Trackball
- Graphic Tablet
- MICR
- OMR
- Webcam
- Keyboard
- Joystick
- Scanner
- OCR
- MIDI Devices
- Digital Camera
- Touchpad
- Light Pen
- Microphone
- Bar Code Reader
- Touch Screen

Mouse

- Mouse is the most popular pointing device with two buttons on the left and right and a wheel in between the two buttons.
- Moving the mouse allows to reposition the pointer or cursor, an indicator on the screen that shows where the next interaction with the computer can take place.
- A mouse can be optical, which uses a light and small optical sensor to detect the motion of the mouse or it can be cordless or wireless which communicates with the computer via radio waves (like Bluetooth).

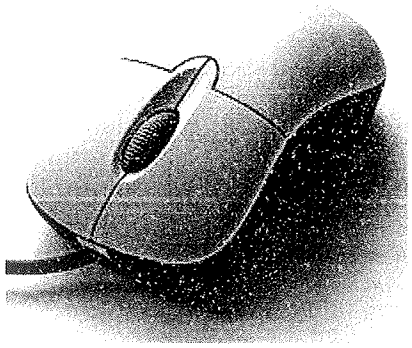


Fig. Mouse

Keyboard

- The computer keyboard is used to enter text information into the computer. The keyboard can also be used to type commands directing the computer to perform certain actions.
- Most of the windows keyboard has total number of 104 keys as the de facto standards. However certain keyboards can have 84 keys or 101/102 keys.
- The keys in the keyboard are as:
  (i) **Typing keys:** Letters (A - Z) and numbers (0 - 9).

(ii) **Numeric keypad:** Contains a set of 17 keys, used independently in ATM's, Electronic Point of Sale (EPOS).

(iii) **Function keys:** 12 function keys with unique purposes.

(iv) **Control keys:** Provide cursor and screen control. Arrow Keys, Home, End, Insert, Delete, Page Up, Page Down, Ctrl, Alt, Esc are Control keys.

(v) **Special purpose keys:** Enter, Shift, Caps Lock, Num Lock, Space Bar, Tab, Print Screen.

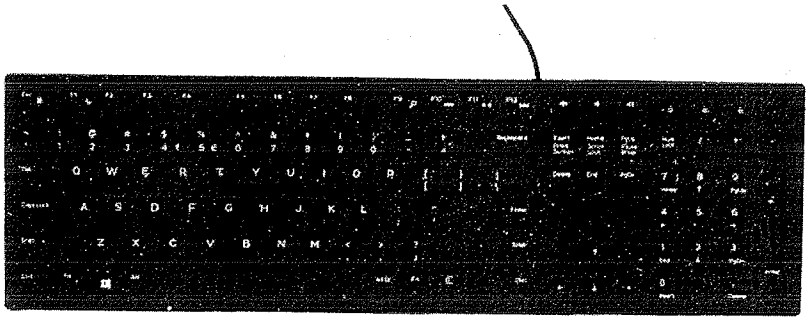


Fig. Keyboard

NOTE: A modifier key modifies the action of another key when the keys are pressed at the same time. Individually these keys hold no purpose. Shift, Function, Control and Alt are the common modifier keys.

Touchpad

- Touchpad have been most commonly used in laptop computer. The on-screen cursor is moved by sliding finger along the surface of the touchpad.
- The buttons are located below the pad, but most touch pad allows one to perform "mouse clicks" by tapping on the pad itself.
- Touch pad are advantageous over mouse as they require less space to use.

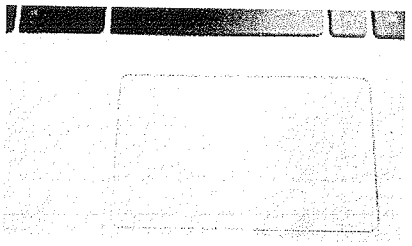


Fig. Touchpad

Trackball

- Trackball is sort of like an upside-down mouse, with the ball located on top. Fingers are used to roll the trackball and internal rollers sense the motion which is transmitted to the computer.
- The body of the trackball remains stationary on the desk and much space is not needed to use the trackball. Hence it is advantageous over mouse.
- Trackball is mostly used in notebook or laptop computer.

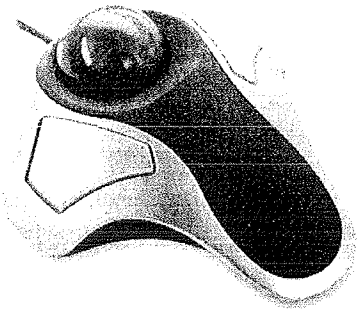


Fig. Trackball

Joystick

- Joystick is a pointing device, used to move the cursor position on a monitor screen. It is a stick having a spherical ball at its both lower and upper ends.
- The lower spherical ball moves in a socket. The joystick can be moved in all four directions.
- Joystick is mainly used for playing computer games and in Computer Aided Designing (CAD).

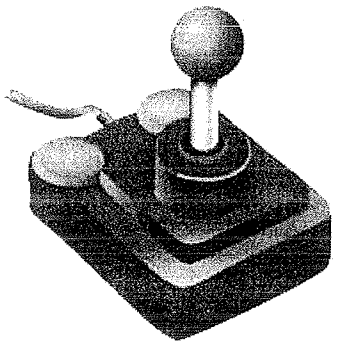


Fig. Joystick

Light Pen

- Light pen is a pointing device similar to pen. A light pen has a light sensitive cell at one end and an optical system placed in a small tube.
- When the light pen is pressed against the screen, it closes a photo electric circuit that pin points the spot the pen is touching. This tells the computer where to enter or modify pictures or data on the screen.

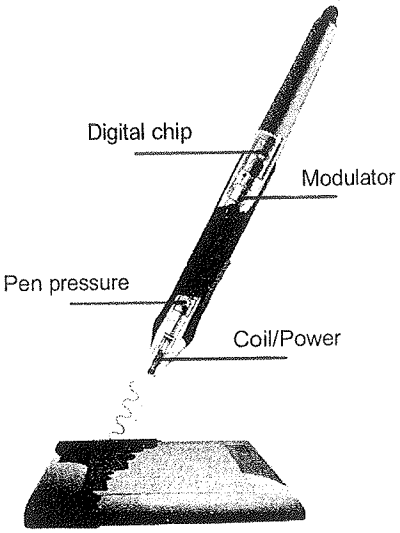


Fig. Light Pen

Graphics Tablet

- A graphics tablet consists of an electronic writing area and a special pen that works with it. The pen of the graphics tablet is pressure sensitive, so pressing harder or softer can result in brush strokes of different width.
- Graphics tablet allows artist to create graphical images with motion and action similar to using traditional drawing tools.
- Screens for graphics tablet are made of CRT (Cathode Ray Tube) monitors.

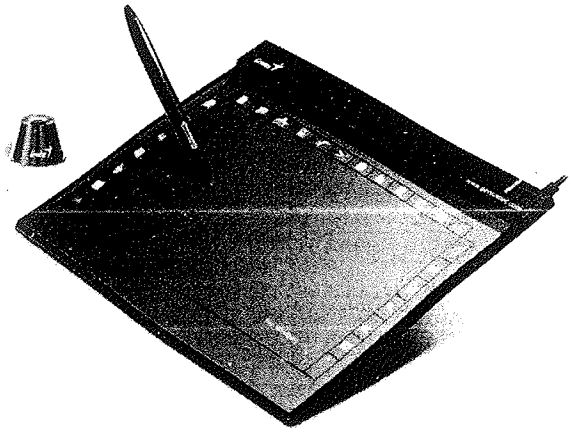


Fig. Graphics Tablet

Scanner

- A scanner is a device that images a printed page or graphic by digitizing it, producing a image made of tiny pixels of different brightness and colour values which are represented numerically and sent to the computer.
- Scanners scan graphic, but can also scan pages of text which are then run through OCR software that identifies the individual letter shapes and creates a text file of the page's content.

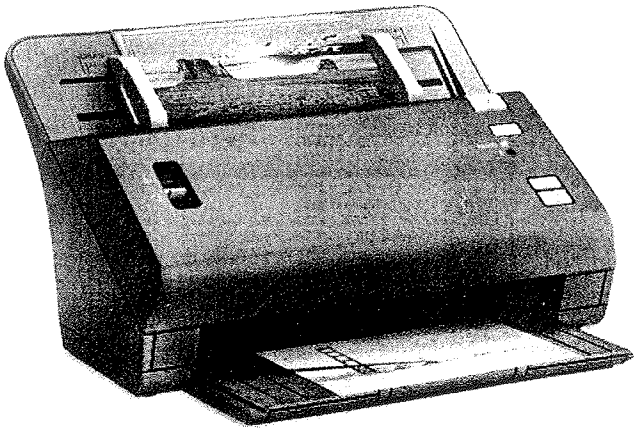


Fig. Scanner

Microphone

- Microphone is an input device which takes sound as input and it is then converted and stored in digital form.
- Speech recognition devices accept the spoken work through a microphone and converts it into binary code (0s and 1s) that can be understood by computer.
- The microphone is used for various application such as in public addressing, adding sound to a multimedia presentation or for mixing music.

Fig. Microphone

Magnetic Ink Character Reader (MICR)

- MICR is a method of machine reading characters made of magnetized particles.
- The most common example of magnetic characters is the array of numbers across the bottom of a check generated by a bank.
- Most magnetic-ink character are preprinted on the check. These characters are added before hand by a person at the bank by using a MICR inscriber.

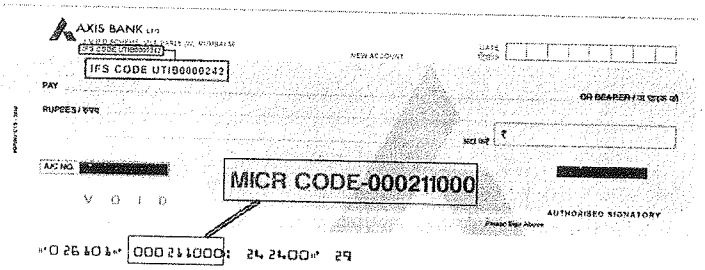


Fig. Magnetic Ink Character Reader

Optical Character Recognition (OCR)

- OCR device uses a light source to read special characters and convert them into signals to be sent to the central processing unit.
- The characters, letters, numbers and special symbols can be read by both humans and machines. They are often found on sales tags on store merchandise.
- A standard typeface for optical characters, called OCR-A has been established by American National Standards Institute (ANSI).

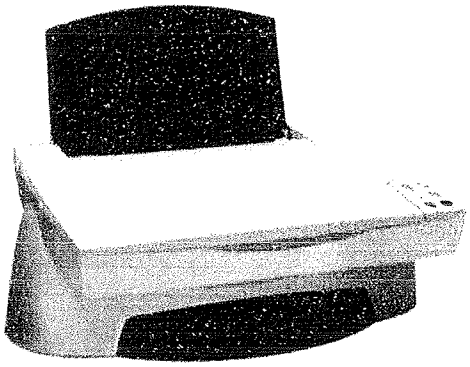


Fig. Optical Character Recognition

Bar Code Reader

- Each product on the store shelf has its own unique number, which is a part of the universal product code. This code number is represented on the product label by a pattern of vertical marks, or bars called bar codes.
- The vertical strips or bars can be sensed and read by a bar code reader which reads bar coded data in the form of reflected light.
- Bar code readers scans a bar code image, converts it into an alpha numeric value, which is then fed to the computer that the bar code reader is connected to.

Fig. Bar Code Reader

Optical Mark Reader (OMR)

- Optical Mark Reader or Optical Mark Recognition, sometimes called as mark sending, is a special type of optical scanner used to recognize the type of mark made by pen or pencil.
- OMR is commonly used in various MCQ based examinations for checking the answer sheets. The answer sheet is graded by the device that uses a light beam to recognize the marks and convert them to computer recognizable electrical signals.

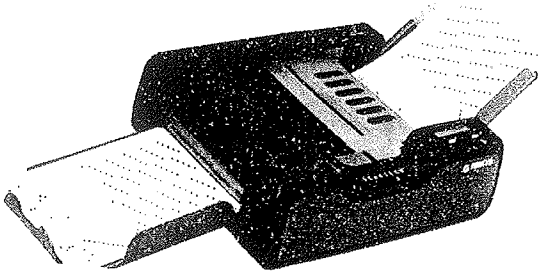


Fig. Optical Mark Reader

MIDI Device

- MIDI, stands for Musical Instrument Digital Interface is a system designed to transmit information between electronic musical instruments.
- A MIDI musical keyboard can be attached to a computer and allow a performer to play music that is captured by the computer system as a sequence of notes with the associated timing (instead of recording digitized sound wave).

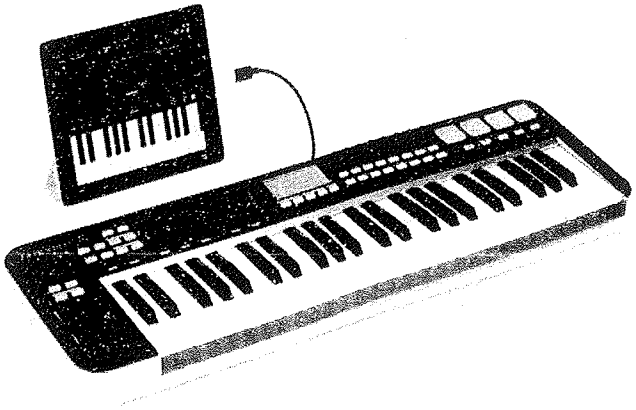


Fig. MIDI

Touch Screen

- Some computers, especially small hand-held PDAs have touch sensitive display screens. The user can make choices and press button images on the screen.
- The edges of the monitor of a touch screen emit horizontal and vertical beams of light that criss-cross the screen. When a finger touches the screen, the interrupted light beams can pin-point the location selected on the screen.
- Kiosks in public places such as malls, ATM's, etc. offer a variety of services via touch screens.

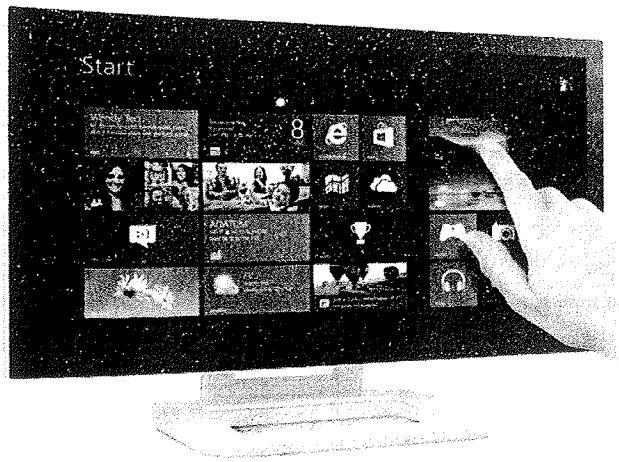


Fig. Touchscreen

Webcam

- The term webcam is a combination of "Web" and "Video camera". The purpose of the webcam is to broadcast videos on the web.
- Webcams are typically small cameras that is either attached to a user's monitor or sit on a desk. Most webcams connect to the computer via USB, through some use a Firewall connection.
- Webcams can be used for video chat sessions with other people. The maximum resolution of a webcam is lower than most handled video cameras, hence they are relatively inexpensive.

Fig. Webcam

Digital Camera

- A digital camera is similar to a traditional film based camera, but it capture images digitally. Instead of saving the picture on analog film like traditional cameras, digital camera saves photos in digital memory, such as SP or Compact Flash card.
- The light passing through the lens of digital camera is digitized by special servers that are sensitive to light. The image formed is stored in camera's storage memory.

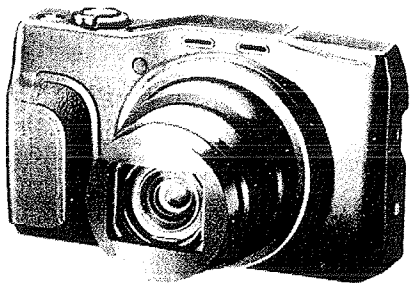


Fig. Digital Camera

2.4.2 Central Processing Unit (CPU)

- CPU is considered as the brain of the computer. The primary function of CPU is related to data processing operation, is convert data input to information output. CPU stores data, results and any instruction or program. The CPU is linked closely with primary storage or main memory, referring to it for both instructions and data.
- The various components of a CPU are:
  (a) Memory or Storage Unit
  (b) Control Unit
  (c) Arithmetic Logic Unit (ALU)

  (a) **Memory or Storage Unit:** This unit is responsible for storing of data, instructions and intermediate results. This unit transfers information to other units of the computer. It is also known as internal storage unit (Main memory/RAM). All the inputs and outputs are transmitted through the main memory.

  (b) **Control Unit:** The control unit of the CPU contains circuitry that uses electrical signals to direct the entire computer system to carry out, or execute, stored program instructions. The control unit does not execute program instructions; rather, it directs other parts of the system to do so. The control unit communicates between the ALU and memory. It does not process or store data.

  (c) **Arithmetic Logic Unit (ALU):** The arithmetic logic unit contains the electronic circuitry that performs two kinds of operations namely,

  (i) Arithmetic operations, (ii) Logic operations

  The arithmetic logic unit can perform four kinds of arithmetic operations, or mathematical calculations: addition, subtraction, multiplication and division. All complex operations are done by making repetitive use of the above operations.

  A logical operation is usually a comparison. The unit can compare numbers, letters or special characters. The computer can then take actions based on the results of the comparison. Logical operations can test for three conditions: Equal-to condition, Less-than condition and Greater-than condition.

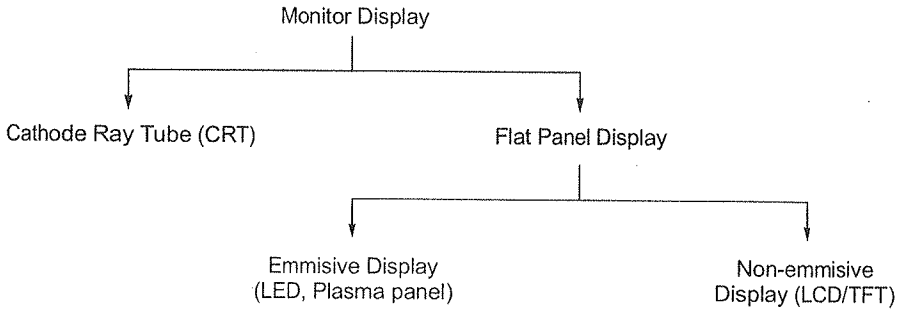
2.4.3 Output Unit

The output unit consists of devices with the help of which the information is received from the computer. This unit acts as a link between the computer and the user. Output devices displays the computer's output into a form understandable to the users. The function of an output device is to present processed data to the user.

The various peripheral devices used for computer output unit are discussed below:

- Monitor: CRT, LCD, LED, Plasma Panel
- Printer: Dot Matrix, Daisy Wheel, Drum, Chain, Laser, Inkjet, 3D printing
- Plotter
- Projector
- TV

Monitor: Monitors, also known as Visual Display Unit (VDU) are the main output device of a computer. It displays information in a similar way to that shown on TV screen. It forms images from tiny dots, called pixels that are arranged in a rectangular form. The sharpness of the image depends upon the number of pixels.



(i) Cathode Ray Tube (CRT) Monitor

- The CRT display is made up of small picture elements called pixels. The smaller the pixels, the better the image clarity or resolution.
- It contains an electron gun at the back of glass tube. This fires electrons at groups of phosphor dots, which coat the inside of the screen. When electron strike the phosphor dots they glow to give the colours.
- CRT monitors are large in size, heavy and consume high electric power as compared to flat panel displays, but they are preferred by some graphic artists for their accurate colour rendition and preferred by some gamers for faster response to rapidly changing graphics.

(ii) Flat Panel Display

As compared to CRT monitors, flat-panel display is a class of video devices that have reduced volume, weight and power consumption. The best examples of flat-panel displays are seen in calculators, video games, laptops and graphic display.

The two basic categories of flat-panel display are:

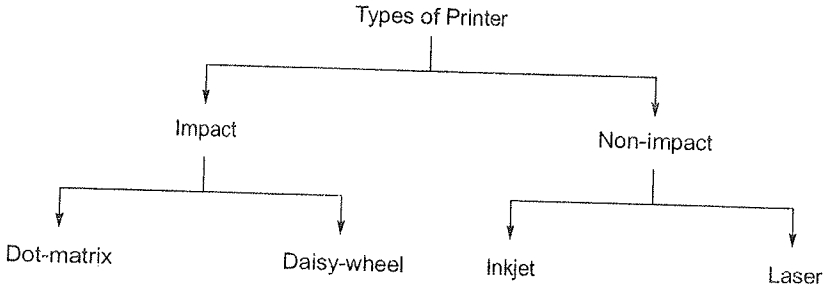
(a) **Emissive Display:** Emissive display are devices that converts electrical energy into light. Light Emitting Diodes (LED) and plasma panel displays are such examples of emissive display.

(b) **Non Emissive Display:** Non emissive displays use optical effects to convert sunlight or light from some other sources into graphical patterns. Liquid Crystal Display (LCD)/Thin Flim Transistor (TFT) are examples of non emissive display.

NOTE

TFT Monitors: TFT, stands for Thin Flim Transistor. These transistors are used in high-quality flat panel Liquid Crystal Displays (LCD). This allows the electric current that illuminates the display to be turned on and off at a faster rate, which makes the display brighter and shows motion smoother. LCDs that use TFT technology are called "active matrix" displays, which are high quality than older "passive matrix" displays.

Printer: Printer is an output device used to create paper copies of output/information from computer.



(i) Impact Printer

- The term impact refers to the fact that impact printers use physical contact with the paper to produce an image, physically sticking paper, ribbon and print hammer together.
- The impact printers may produce impact by a print hammer character, like that of a type writer key sticking a ribbon against the paper, or by a printing hammer hitting paper and ribbon against a character.
- Characteristics of an impact printer are bulk printing, low cost, noisy and physical contant with the paper to produce an image.
- Dot-matrix printer and Daisy-wheel printer are common examples of impact printer.

(a) Dot-Matrix printer:

- Dot-matrix printer are popular in the market because of their ease of printing and economical price. Dot-matrix printer use small electromagnetically activated pins in the print head and an inked ribbon, to produce images by impact.
- Dot-martix printer are noise with slow speed and poor quality of printing. However they are used because of being inexpensive and other language characters can also be printed.

(b) Daisy-Wheel printer:

- A Daisy-wheel printer is a special type of impact printer that uses individual letter, number and symbol keys to imprint text on paper. These printers are generally used for word-processing in offices that requires a few letters to be sent with very nice quality.
- Daisy-wheel printers are more liable and produce better quality print as compared to dot-matrix printer but are slower and more expensive than dot-matrix.

(ii) Non-Impact Printer

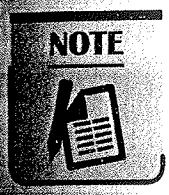
- A non-impact printer places an image on a page without physically touching the page. These printers print a complete page at a time and thus they are sometimes referred to as page printers.
- Non-impact printer are advantageous over impact printers as they are faster and noise-free, has the ability to change interfaces automatically and produce high quality graphics.
- Inkjet printer and laser printer are the examples of non-impact printer.

(a) Ink-jet printer:

- Inkjet printer prints by spraying ink from multiple jet nozzles. They can print both black and white as well as in several different colours of ink to produce excellent graphics.
- Inkjet printer produce high quality printing with presentable features. Some models can produce multiple copies of printing also. They are however slower as compared to laser printer.

(b) Laser printer:

- Laser printers use a light beam to help transfer images to paper, producing extremely high-quality results. Laser printers print a page at a time at impressive speeds.
- Large organizations use laser printers to produce high volume customer oriented reports. They produce good graphics quality and supports many fonts and different character size. However, they are quite expensive.



3D printing: 3D printing is a form of additive manufacturing technology where a three-dimensional object is created by laying down successive layer of materials. In this method, 3D objects are made on a reasonable sized machine connected to a computer containing blue print of the object.

This revolutionary method for creating 3D models with the use of inkjet technology saves time and cost by eliminating the need to design; print and glue together separate models. The basic principle include materials cartridges, flexibility of output and translation of code into visible pattern.

The various 3D printing technologies are:

(i) Stereo Lithography (SLA)
(ii) Fused Deposition Modelling (FDM)
(iii) Selective Laser Sintering (SLS)
(iv) Multi-jet Modelling (MJM)
(v) Selective laser Melting (SLM)
(vi) Digital Light Processing (DLP)

Plotter

- A plotter is a vector graphics printing device that interprets commands from a computer to make line drawings on paper with one or more automated pens. Unlike a regular printer, the plotter can draw continuous point-to-point lines directly from vector graphics files or commands.
- There are different types of plotter:
  (a) A drum plotter draws on paper wrapped around a drum which turns to produce one direction to the plot, while the pens move to provide the other direction.
  (b) A flatbed plotter draws on paper placed on a flat surface.
  (c) An electrostatic plotter draws on negatively charged paper with positively charged toner.
- Plotters are much expensive as compared to printers and are primarily used in technical drawings and CAD applications, where they have the advantage of working on very large paper sizes while maintaining high resolution.

Projector

- A projector is a device that projects whatever a computer is showing but on a much bigger screen than a TV or a monitor.

- The most common type of projector used today is a video projector. These are digital replacements for early projectors like slide projectors and over head projectors.
- The latest projectors are hand held projectors that use lasers or LEDs to project images. The multimedia projectors category includes the latest projectors technologies such as 3LCD, DLP, 1080p home theater projectors and computer projectors.

TV: From big screens to flat screens there have been rapid change in technology in television sets. Initially Cathode Ray Tube (CRT) technology was the dominant technology in the TV sets.
The functioning of CRT is such that it consists of an electron gun which emits a beam of electrons (cathode rays) which further passes through focusing and deflection systems that direct it towards specified positions on the phosphor-coated screen. When the beam hits the screen, the phosphor emits a small spot of light at each position contacted by the electron beam.
However with advancement of technology. CRT's were outcasted with the introduction of LCD, Plasma and LED televisions. Each of these new technologies has its strong points in the method that it displays image.

(i) Liquid Crystal Display (LCD) TV

- A liquid crystal cell in LCD consist of a thin layer of a liquid crystal sandwiched between two glass sheets with transparent electrodes deposited on their inside faces. With both glass transparent, the cell is known as transmitted type cell and when one glass is transparent and the other has a reflecting coating, the cell is called reflecting type.
- The LCD does not have any illumination of its own. It depends entirely on illumination falling on it from an external source for its visual effect.

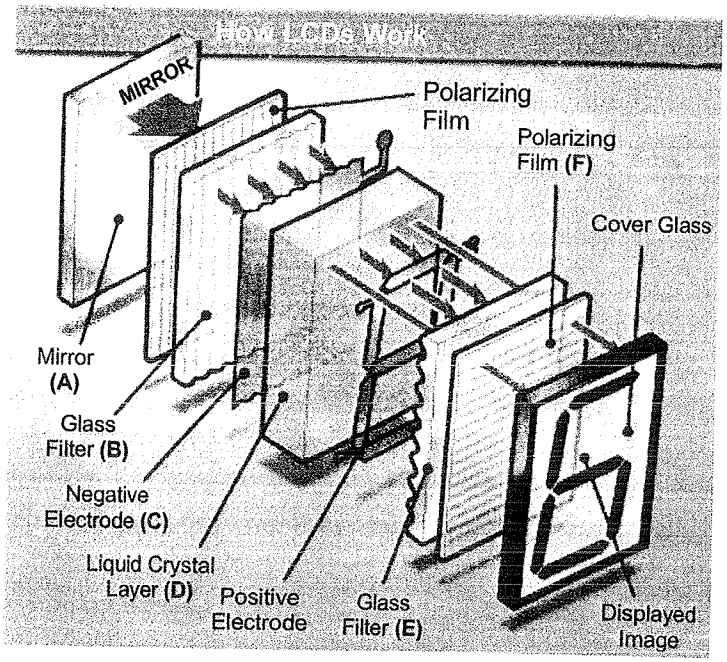


Fig. Liquid Crystal Display

- The liquid crystal display has the distinct advantage of having a low power consumption, low cost and good contrast. The major drawbacks are additional requirement of light source, low reliability, poor visibility in low ambient lighting slow speed and the need for an ac drive.

(ii) Plasma TV

- Plasma is referred to be the main element of a fluorescent light. It is actually a gas including ions and electrons where photons of energy are released, if an electric current is allowed to pass through it.

- A plasma display consists of fluorescent light which cause the formation of image on screen. Each pixel has the three composite fluorescent colour lights. These fluorescent lights are illuminated and the different colours are formed by combining the composite colours. Plasma display mostly make use of xenon and neon atoms.
- Plasma TV are very slim with high contrast ratios, less weight and better viewing angles. However energy consumption is more and the brightness is greatly diminished in poor lighting condition.

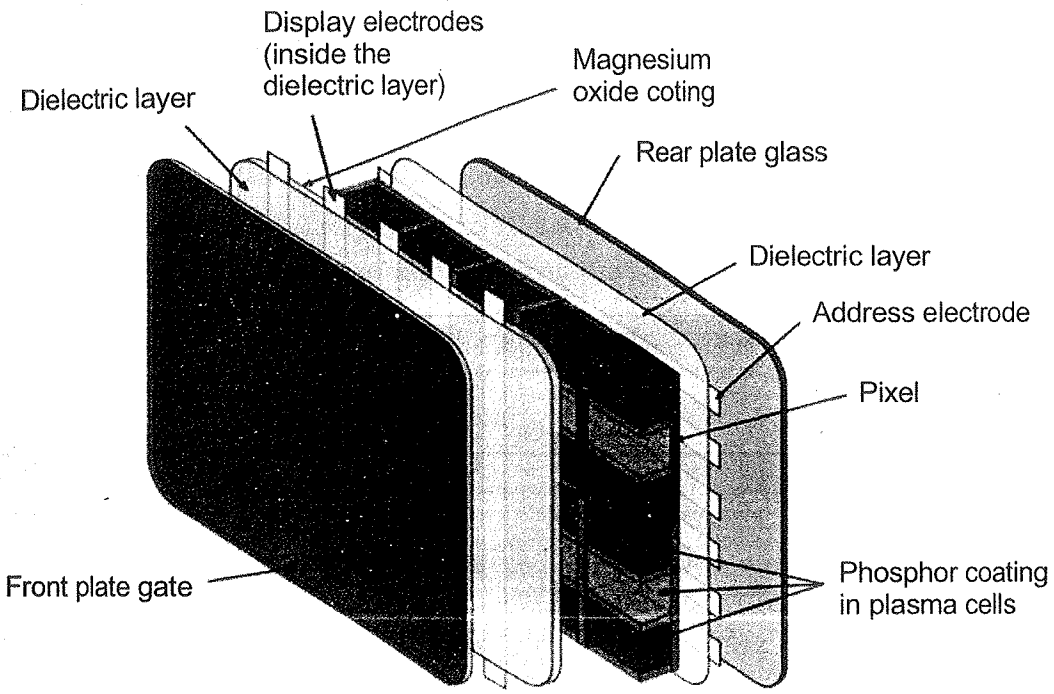


Fig. Plasma TV

(iii) Light Emitting Diode (LED) TV

- LED TV is a more advanced technology in television display. LED TV is a type of LCD television that uses Light Emitting Diodes (LEDs) to back light the display instead of the traditional Cold Cathode Fluorescent Lights (CCFLS) used in standard LCD televisions. LED TVs are more formally known as LED backlight LCD television.
- There are three different LED technology used:
  - (i) **Edge-lit LED:** LEDs around the edge of the screen, a diffusion panel to illuminate the display evenly, thin display.
  - (ii) **Dynamic RGB LED:** Dimming more precisely, truer reproduction of black and whites, LEDs positioned behind the panel.
  - (iii) **Full-array LEDs:** LEDs positioned behind the panel, no capacity for localized dimming.

  Quantum dot display LED are in research stage.
- LED TV has a major advantage that it eliminated the numerous black spots that were as a result of using fluorescent lights. LED TV has the best colour levels and contrast ratio with wider viewable angles, low power consumptions, shock resistant and longer lasting than its predecessors. The only shortcoming to an LED TV is that it is more expensive than an LCD TV and a plasma TV.

(iv) Organic Light-Emitting Diode (OLED)

- OLED TV is a television display technology based on the characteristics of organic light emitting diodes, OLED TV is a different technology than LED TV.

- The OLED display is based on organic compounds being used in the electro-luminescent layer. These organic compounds have a special property of creating lights when electricity is applied to it. The display is created by sandwiching organic thin films between two conductors. Thus a bright light is created when electric current is passed to it.
- OLEDs are advantageous as no backlight is produced by this device and the power consumption is also very less. The contrast ratio is even higher with much faster refresh rate. However, they are quite expensive.

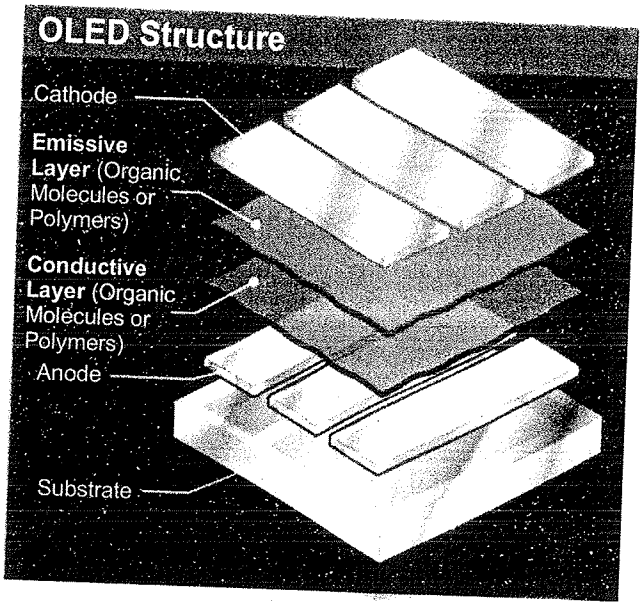


Fig. Organic Light-Emitting Diode

2.5 Computer Memory

Memory is that part of computer which is used to store data and information. Computer memory is the storage space in the computer, where data is processed and instructions required for processing are stored. The memory is divided into large number of small parts called cells which has a unique address. The memory system is a hierarchy of storage devices with different capacities, costs and access times. Figure below shows a typical memory hierarchy from registers to secondary memory.

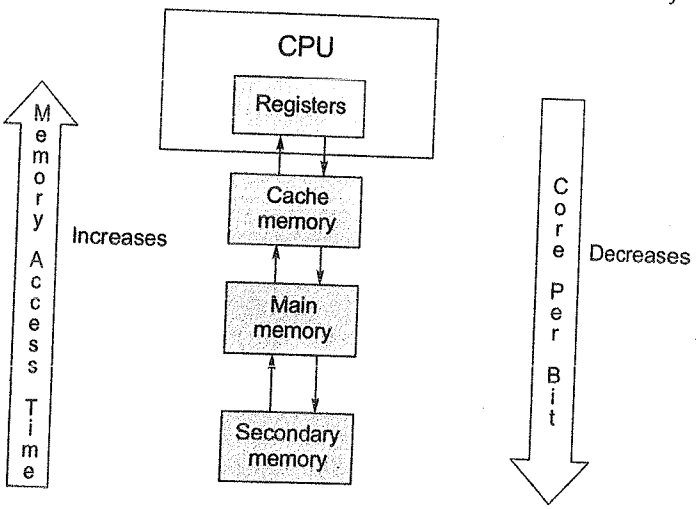


Fig. Memory Hiearchy

- CPU register
- Cache memory
- Main memory/primary memory (RAM and ROM)
- Secondary memory (Magnetic, Optical, Flash Drives)

2.5.1 CPU Registers

- Internal register in a CPU are temporary storage areas for instructions of data. They are not a part of memory, rather they are special additional storage locations that offer the advantage of speed.
- Registers work under the direction of the control unit to accept, hold and transfer instructions or data and perform arithmetic or logic operations at much faster speed. Accessing data from internal register is the fastest way to access memory.
- Computer usually assign special roles to certain register such as:
  (a) Accumulator - collection of result of computations.
  (b) Address register - keeps track of instruction stored in memory.
  (c) Storage register - temporarily holds data taken from or about to be sent to memory.
  (d) General purpose register - for several other functions.

2.5.2 Cache Memory

- The very next level to registers is the cache memory near the CPU. It act as a buffer between the CPU and the main memory. It is used to hold those parts of data and instructions which are most frequently used by the CPU.
- There are often two or more level of cache. Cache can be further subclassified as L1, L2 and L3 cache. L1 cache is accessed without delay whereas L2 and L3 takes more clock cycles to access respectively.
- Cache is much faster than main memory and consumes less access time. However cache memory has limited capacity and are very costly.

2.5.3 Primary Memory (Main memory)

- Primary memory stores those data and information currently being used by the computer. The data gets lost after the power is switched off. It is usually made up of semiconductor devices and holds limited capacity.
- Primary memory can be further sub-classified into two categories: RAM and ROM.

Random Access Memory (RAM)

- RAM is the internal memory of the CPU for storing data, program and output. RAM is a temporary storage that the processor uses to store programs, while they are running.
- The idea of a program running from a computer's main memory is known as the 'stored program concept'. When invoked a program will be loaded from hard disk into RAM and any data entered is stored in RAM as well.
- RAM is a volatile memory, which means its content is lost as soon as the machine is turned off.
- Access time in RAM is independent of the address, that is each storage location inside the memory is as easy to reach as other locations and takes the same amount of time.
- Generally, the capacity of RAM in a typical computer varies from 256 MB to 8 GB installed. The more the installed memory the faster system will be.
- RAM is of two types: (a) Static RAM (SRAM), (b) Dynamic RAM (DRAM)

(a) Static RAM (SRAM)

- Static RAM has the capacity to retain contents in its memory by having a constant source of power applied. However data is lost when the power goes of due to its volatile nature.
- SRAM consists of a matrix of 6-transistors and no capacitors. As transistors do not require power to prevent leakage, so SRAM need not be refreshed on a regular basic.
- The application of SRAM is more likely to be on the processor itself or in the form of a small but very fast cache memory.

(b) Dynamic RAM (DRAM)

- DRAM is the most common type of main memory found in computer systems. This type of memory is dynamic because its storage cells must be refreshed. This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second.
- DRAM can store more data and is therefore more suited to low cost, high capacity systems. All the DRAMs are made up of memory cells, which are composed of one capacitor and one transistor.
- SDRAM (Synchronous Dynamic Random Access Memory) is a special type of DRAM. It is faster than asynchronous memory because the memory is synchronized with the system bus and clock and therefore the processor.

Difference between SRAM and DRAM:

SRAM	DRAM
Long life	Short data lifetime
Periodic refresh not necessary	Needs to be refreshed continuously
Faster than DRAM	Slower than SRAM
Large size and high cost	Small size and less expensive
Used as cache memory	Used as RAM
High power consumption	Less power consumption

Read Only Memory (ROM)

- ROM is a special type of non-volatile memory that is permanently built into the computer at the time of production.
- The information from ROM can only be read and it is not possible to write fresh information into it. It permanently stores a set of instructions which instruct the computer how to work. This operation is referred to as bootstrap.
- After the computer is switched on, it uses instruction stored to carry out a series of tasks automatically, before the computer is actually ready for use.
- ROM can be further categorised as:
  (a) Programmable Read-Only Memory (PROM)
  (b) Erasable Programmable Read-Only Memory (EPROM)
  (c) Electrically Erasable Programmable Read-Only Memory (EEPROM)

(a) Programmable Read-Only Memory (PROM)

- PROM is a read only memory that can be modified by a user only once.
- This type of ROM can be programmed by using a special device called a PROM programmer.
- Once the data in them is programmed it becomes permanent and cannot be changed.

(b) Erasable Programmable Read-Only Memory (EPROM)

- EPROM is a type or ROM that can its contents erased by using ultraviolet light. It can be then reprogrammed by an RPROM programmer.
- During programming, an electric charge is trapped is an insulated gate region which can be erased by exposing the change to ultra-violet light.
- The procedure of reprogramming can be carried out multiple times; however, constant erasing and rewriting will eventually render the chip useless.

(c) Electrically Erasable Programmable Read-Only Memory (EEPROM)

- EEPROM is programmed and erased electrically and the process can be continued to about ten thousand times.
- This type of ROM works in a similar way to flash memory in that its contents can be 'fashed' for erasure and then written to without having to remove the chip from its environment.
- EEPROMs are used to store a computer system BIOS and can be updated without returning the unit to the factory.

2.5.4 Secondary Memory

- Secondary memory is also known as external memory or auxiliary memory and are non volatile in nature. It is slower than the main memory.
- Secondary memory are used to store data permanently even if the power is turned off, i.e. it acts as a back up memory.
- CPU does not directly access these memories, instead they are accessed via input-output routines. The consists of secondary memory are first transferred to the main memory and then only the CPU can access it.
- Secondary memory can be broadly categories into two parts as:
  (a) Fixed storage: Hard disk
  (b) Removable storage: Floppy Disk, CD ROMs, DVDs, Blue-ray Disk, Flash drives

Hard Disk Drive (HDD)

- A hard disk is a magnetic storage device which stores data as changes in magnetic field of an area. A hard disk actually consists of more than one disk or platter in a vacuum sealed compartment.
- A modern hard disk is a complex, high precision device that contains a mixture of electrical and mechanical parts. The data is stored on both sides of rigid circular disks, called platters. These platters are covered with a special magnetic coating.
- There are three different ways by which a hard disk can be connected to the motherboard:
  (a) Parallel Advanced Technology Attachment (PATA)
  (b) Serial Advanced Technology Attachment (SATA)
  (c) Small Computer Systems Interface (SCSI)

Floppy Disk Drive (FDD)

- Floppy disk technology was pushed to the limits by the mid 1990's, when it was no longer possible to expand the amount of data that could be stored on the disk.
- The floppy disk works in a similar way to the hard disk except the fact that only a single magnetic platter is used and that the read/write head actually makes contact with the disk surface rather than float above it.
- The most common type of floppy disk was the $3\frac{1}{2}$ inch high density disk which could store upto 1.44 MB, which became obsolete with the invention of flash drives.

CD-ROM

- The Compact Disk (CD) has taken over the floppy disk drive as the most common removable storage media and associated drive as it is compatible with energy PC as standard similar to the way floppy disk drive did.
- A CD is created by imprinting the data onto a layer making tiny indentations in the media's surface. These are called pits and the area that is not changed are called lands.

- The data is stored on the disk digitally and a laser beam is used to read the data off the disk.
- Modern CD drives are usually differentiated by their speeds as x44 and x50 meaning that they are upto 44 and 50 time faster than the original single speed CD drive. A typical CD can hold upto 700 MB capacity.

DVD

- Digital Versatile Disk (DVD) is a type of optical drive used for storing digital data similar to CD, but has a larger storage capacity.
- A standard DVD can store 4.7 GB of data, which is enough to hold over 2 hours of video in 720p resolution. A dual layer DVD can store 8.5 GB of data.
- Writable DVD formats provide a way to store a large number of files and back up data. These include DVD-R, DVD-RW, DVD+R, DVD+RW and DVD-RAM.

Blu-ray

- Blue-ray is an optical disk such as CD and DVD which was developed for recording and playing High Definition (HD) video and for storing large amounts of data.
- A single Blu-ray disk can hold up to 25 GB of data as compared to 700 MB for CD and 4.7 GB for a basic DVD. Dual-layer blu-ray disks can store up to 50 GB of data.
- Blu-ray disks can hold more information than other optical media because of the blue laser the drive uses. The blue laser has a shorter wavelength than the red laser used for CDs and DVDs which allows blue laser to focus on a smaller area to cram significantly more data on to the disk.

Flash Drives

- Flash drives are a form of flash memory which is based on recent type of storage technology known as solid state devices. This type of portable storage is becoming very popular because of its low price and high storage capacities.
- Commonly known by other names as USB drive or pen drive, it consists of a NAND type flash memory data storage integrated with a USB (Universal Serial Bus) interface.
- USB flash drives are typically removable and rewritable, with storage capacity ranging from 64 MB to 256 GB with steady improvements in size and price per capacity.
- Flash drives has become increasingly popular because of their compact shape, high capacity, more durable design, faster operation and more reliability due to lack of moving parts.

2.6 Motherboard

- The motherboard is a part of a computer which serves as a single platform to connect all the parts of a computer together. It is considered as the back bone of a computer.
- The motherboard connects the CPU, memory, hard drives, optical drives, video card, sound card and other ports and expansion cards directly or via cables.
- Motherboard contains ports to connects all of the internal components. It provides a single socket for CPU, whereas for memory, normally one or more slots are available.
- Some ports are available to attach hard drive and optical drives. Motherboard also carries fans and a special port designed for power supply.
- Some popular manufacture of motherboard are Intel, Asus, MSI, Gigabyte, AOpen, ABIT etc.

Memory Unit: Memory unit is the amount of data that can be stored in a storage unit. This storage capacity is expressed in terms of bytes.

Bit = Binary Digit (0 and 1)	1 Megabyte (MB) = 1024 KB
1 Nibble = 4 bits	1 Gigabyte (GB) = 1024 MB
1 Byte = 8 bits	1 Terabyte (TB) = 1024 GB
1 Kilobyte (KB) = 1024 bytes	1 Petabyte (PB) = 1024 TB

2.7 Computer Ports

- A port is a physical docking point using which an external device can be connected to the computer. It can also be programmatic docking point through which information flows from a computer or over the internet.
- Ports are basically the slots on the motherboard into which a cable of external devices such as mouse, keyboard, mircophone, speaker, USB drives etc. are plugged in.
- A few commonly available ports are:

(a) Serial port	(b) Parallel port	(c) PS/2 port
(d) USB port	(e) VGA port	(f) Power connector
(g) Firewire port	(h) Modem port	(i) Ethernet port
(j) Game port	(k) DVI port	(l) Sockets

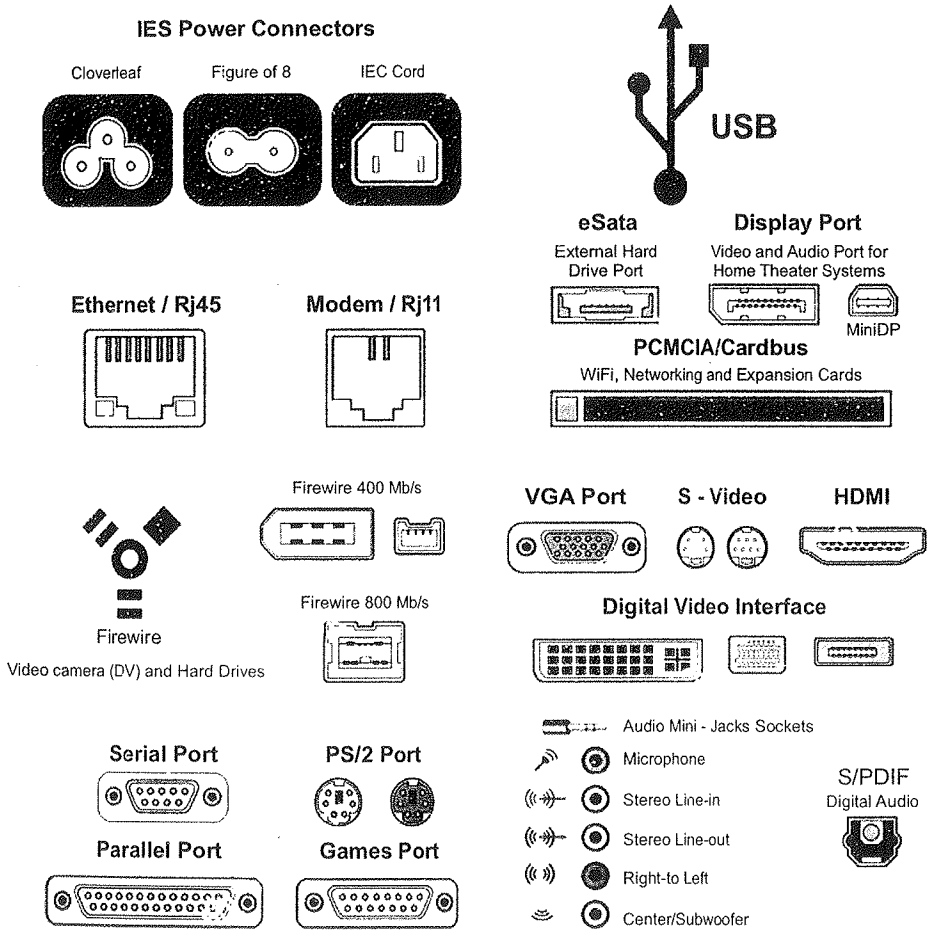


Fig. 2.7 Ports

Serial Port: A serial port is an interface that can be used for serial communication, in which only one bit is transmitted at a time. This port is basically of 9 pin or 25 pin model and used for external modems and old computer mouse.

Parallel Port: A parallel port is a connector for a device than can send or receive several bits of data simultaneously by using more than one wire. This port is basically a 25 pin model and used for scanners and printers.

PS/2 Port: PS/2 port, abbreviated for Personal System/2 port is a type of port used by older computers for connecting input devices such as keyboard and mouse. The PS/2 port has 6 pins and is roughly circular in shape.

USB Port: Stands for "Universal Serial Bus", USB port is the most common type of computer ports that can connect keyboard, mouse, game controllers, printers, scanners, flash drives and so on.

USB is also faster than serial and parallel ports. A single USB port can be used to connect upto 127 peripheral devices. USB 1.1 supports data transfer rate of 12 Mbps, while USB 2 can transfer at a rate of 480 Mbps. USB 3.0 can transfer at a maximum rate of 5 Gbps.

VGA Port: VGA, abbreviated for video graphic array is a connector with 3 rows 15 pin that is used to connect monitor to a computer's video card. It is a standard monitor or display interface used in most PCs. The common resolutions supported in VGA interfaces are 640 × 480, 800 × 600 or 1024 × 768.

Power Connector: A power connector connects to the computer's power cable that plugs into a power bar or wall socket.

Firewire Port: Firewire port, also known as IEEE1394 is an I/O interface developed by Apple computer. There are two primary versions of Firewire interface - Firewire 400 (IEEE 1394a), which uses a 6 pin connector and supports data transfer rates of 400 Mbps and Firewire 800 (IEEE 1394b) which uses a 9 pin connector and supports data transfer rates of 800 Mbps.

Firewire pot is used for connecting peripheral devices as external hard drives, video cameras and audio interfaces that require a fast data transfer speeds.

Modem Port: A modem port is connects a PC's modem to the telephone network.

Ethernet Port: Ethernet port connects the computer to a network and high speed internet. Ethernet cables are plugged into this port to connect wired network hardware in an Ethernet LAN (Local Area Network), MAN (Metropolitan Area Network) or WAN (Wide Area Network). This port resides on an ethernet card and data transfer occurs at a rate of 10 Mbps to 10 Gbps depending upon the network bandwidth.

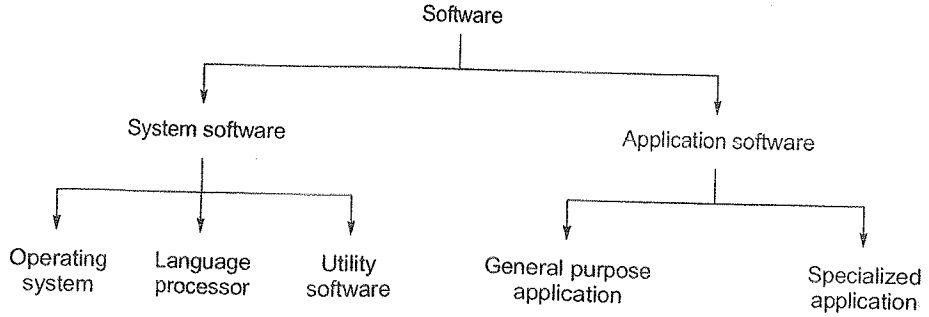
Game Port: A game port is used to connect gamepad or joystick to a PC. It has become outdated and is now replaced by USB port.

DVI Port: DVI, abbreviated for digital video interface is a port the connects flat panel LCD monitor to the computer's high end video graphics card. DVI port is very popular among video card manufactures.

Sockets: Sockets connect the microphone and speakers to the sound card of the computer.

2.8 Hardware and Software

- Hardware represents the physical and tangible parts of a computer, i.e. the component exist physically which can be seen and touched.
- Some examples of hardwares are:
  - (a) **Input devices:** Mouse, Keyboard, Light Pen etc.
  - (b) **Output devices:** Monitor, Printer, Projector etc.
  - (c) **Interal components:** CPU, RAM, Motherboard etc.
  - (d) **Secondary storage device:** Hard Disk, CD, DVD etc.
- Software is a set of programs, designed to perform a well-defined function. A program is a set of instructions written to solve a particular problem. Software are the tangible parts of a computer.



- There are basically two types of software: (a) System software, (b) Application software

(a) System Software:

- System software is a collection of programs designed to operate, control and extend the processing capabilities of the computer.
- System software serves as the interface between the hardware and the end users. These software products comprises of programs written in low-level languages, which interact with the hardware at a very basic level.
- Operating system and all utility program like compiler, interpreter, loader and debugger are some examples of system software.
- Operating system such as Microsoft Windows, Linux, Mac OS X, GNU etc. are prominent example of system software.

(b) Application Software:

- Application software, simply referred to as application, are often called productivity programs or end user programs because they enables the user to complete tasks.
- Application software is specific to the task it is designed for and can be a simple as a calulator application or as complex as a word processing application.
- Application software help to complete various tasks such as creating documents, spread sheets, database and publications, doing online research, sending e-mail, designing graphic and so on.
- Some examples of application software are Microsoft office suit, railway reservation software, inventory management software, payroll software etc.

Other Types of Software

(i) Shareware:

- Shareware is software that is distributed free on a trial basis before paying for it.
- Some software developers offer a shareware version of their programs with a built-in expiration date. Once one pays for a shareware program, the program becomes fully functional and time limit is removed.

(ii) Freeware:

- Freeware is a software that does not require any payment and is free to use. One can legally download and use it as long as one wants without having to pay for it.
- While freeware is free to use, it is still copy righted and may include a license agreement that restricts usage or distribution of the software.

(iii) Open Source Software:

- When a software program is open source, it means the program's source code is freely available to the public.
- Unlike commercial software, open source programs can be modified and distributed by anyone and are often developed as a community rather than by a single organisation.
- Some of the significant open source projects include Linux operating system, Mozila Firefox web browser and open office.org productivity suit.

ESC Prelims Questions

Q.1 Which type of output device creates coloured images which look and feel like photographs?
(a) Electrostatic plotter
(b) Laser printer
(c) Dye sublimation printer
(d) Inkjet plotter

[ESE-2018]

Ans. (c)

Objective Brain Teasers

Q.1 Which of the following technology was introduced in the development of third generation computers?
(a) Transistors (b) Vacuum tubes
(c) Integrated circuits (d) VLSI

Q.2 Under which one of the following category, does the programming language 'C' fall into?
(a) Assembly language
(b) Machine language
(c) High level language
(d) None of the above

Q.3 BASIC is abbreviated for
(a) Beginner's All-purpose Symbolic Instruction Code
(b) Beginner's All-purpose System Information Code
(c) Basic Algorithm Syntax Information Code
(d) Basic Algorithm System Instruction Code

Q.4 Which of the following function is performed by MIDI device?
(a) It is a method of machine reading characters made of magnetized particles.
(b) It converts graphical data into binary inputs.
(c) It is used for debugging.
(d) It is designed to transmit information between electronic musical instrument.

Q.5 Consider the following statements:
1. The control unit of the CPU is used to process and store data.
2. ALU of the CPU can perform both arithmetic as well as logic operations.
Which of the following statements is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None of these

Q.6 Consider the following statements:
1. A mainframe computer uses its power to execute a reliable volume of computations concurrently.
2. Super computer uses it power in executing a few programs as fast as possible.
Which of the following statements is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None of these

Q.7 Which of the following device uses laser beam technology to read and write data?
(a) Optical device (b) Magnetic device
(c) Flash device (d) Solid state device

Q.8 Consider the following statements regarding 'QR code':
1. It is abbreviated for 'Quick Response' code.
2. QR code can hold more than 100 times data than bar code and can also be digitally scanned.
3. QR code is used in inventory tracking, to shipping and logistics, online ticketing etc.
Which of the above statements are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Q.9 Which among the following memory has faster access time?
(a) RAM (b) ROM
(c) Cache memory (d) Register

Q.10 Which among the following display has a thin film transistor?
(a) LCD (b) LED
(c) CRT (d) Plasma panel

Q.11 Digitizer is an
(a) Input device
(b) Output device
(c) Processing device
(d) Both input and output device

Q.12 Consider the following statements:
1. Inkjet is a type of impact printer.
2. Dot-matrix is a type of non-impact printer.
Which of the following statements is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) None of these

Q.13 Consider the following statements regarding non-impact printers:
1. An image is placed by striking a ribbon on the page.

2. These printers print a complete page at a time.
3. These printers are also referred to as page printers.

Which of the following statements are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Q.14 Which of the following is not a type of Plotter?
(a) Drum (b) Flatbed
(c) Daisy wheel (d) Electrostatic

Q.15 Which of the following checks the syntactic correctness of a source program?
(a) Assembler (b) Interpreter
(c) Compiler (d) None of the above

Q.16 Electronic card reader performs which of the following function
(a) Convert graphical input into digital form
(b) Read data encoded on card
(c) Read graphical data existing on cards
(d) Read optically operated devices

Q.17 Which of the following satisfies the terms high quality, high performance and speed high volume and non-impact?
(a) Laser printers (b) Inkjet printers
(c) Dot matrix printers (d) Plotters

Q.18 Which of the following is a volatile memory?
(a) Cache memory (b) SRAM
(c) DRAM (d) All of the above

Q.19 Which of the following is used as a data storage element in computers?
(a) Rectifier (b) Attenuator
(c) Flip-flop (d) Comparator

Q.20 The memory which is programmed at the time of its manufacture is
(a) SRAM (b) DRAM
(c) ROM (d) Hard disk

Q.21 Consider the following statements regarding Blue-ray technology:
1. Blue laser is used in Blu-ray technology.
2. Blue laser has longer wavelength than red laser that is used for CDs.
3. A single Blue-ray can hold up to 4.7 GB of data.

Which of the following statements is/are incorrect?
(a) 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Q.22 A coding structure in which characters are represented by means of a series of parallel bars is
(a) QR code (b) Bar code
(c) OMR (d) OCR

Q.23 Bubble memory is a type of
(a) Non-volatile memory
(b) Volatile memory
(c) Permanent memory
(d) DRAM

Q.24 Which of the following is not used as a secondary storage?
(a) Semiconductor memory
(b) Magnetic disks
(c) Optical disks
(d) Magnetic tapes

Q.25 Which software is distributed trial before sale?
(a) Freeware (b) Shareware
(c) Open source (d) Firmware

Q.26 Which of the following port transfers one bit of information at a time?
(a) Serial port (b) Parallel port
(c) Firewire port (d) Ethernet port

Q.27 Consider the following statements:
1. SRAM does not require periodic refresh to re-write data into memory.
2. Application of SRAM is more likely on the processor in the form of small but very fast cache memory.

Which of the following statements are correct?
(a) 1 only
(b) 2 only
(c) 1 and 2 only
(d) None of these

Q.28 Which of the following is the most common size of floppy disk drive?
(a) $2\frac{1}{2}$ inches (b) $3\frac{1}{2}$ inches
(c) $4\frac{1}{2}$ inches (d) $5\frac{1}{2}$ inches

Q.29 Which among the following is not a modifier keys in a keyboard?
(a) Ctrl (b) Alt
(c) Shift (d) Caps Lock

Q.30 Which of the following is not an application software?
(a) Page Maker (b) Windows NT
(c) Winword XP (d) MS Office

Q.31 Which of the following is a system software?
(a) Operating System (b) Compiler
(c) Utilities (d) All of the above

Q.32 The port which connects flat panel LCD monitors to the computer's high and video graphic card is
(a) Game port (b) Modem port
(c) DVI port (d) PS/2 port

Q.33 Consider the following statements regarding graphics tablet:
1. It is an output device.
2. Screens of graphics tablet are made of CRT monitors.
3. As of now, TFT and LCT is not compatible in graphics table.
Which of the following statements are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Q.34 SCSI is a method a hard disk can be connected to the mother board. It is abbreated for
(a) Small Computer System Interface
(b) System Code Small Interface
(c) System Connector Small Interface
(d) Specific Connector System Interface

Q.35 In which of the ROM category, contents can be erased using ultraviolet light?
(a) PROM (b) EPROM
(c) EEPROM (d) Flash EEPROM

Q.36 Which type of software can be easily modified and distributed by editing the program's source code?
(a) Shareware
(b) Freeware
(c) Open source software
(d) Utility software

Q.37 Mozila Firefox web browser is an example of
(a) Shareware
(b) Freeware
(c) Open source software
(d) Utility software

Answers

1. (c)	2. (c)	3. (a)	4. (d)	5. (b)
6. (c)	7. (a)	8. (d)	9. (d)	10. (a)
11. (a)	12. (d)	13. (b)	14. (c)	15. (c)
16. (b)	17. (a)	18. (d)	19. (c)	20. (c)
21. (c)	22. (b)	23. (a)	24. (a)	25. (b)
26. (a)	27. (c)	28. (b)	29. (d)	30. (b)
31. (d)	32. (c)	33. (b)	34. (a)	35. (b)
36. (c)	37. (c)			

Explanations

1. Vacuum tubes: 1st gen; Transistors: 2nd gen; IC: 3rd gen; VLSI: 4th gen

5. The control unit communicates between ALU and memory. It does not process or store data.

12. Dot-matrix and Daisy-wheel are impact printers laser and inkjet are non-impact printers.

13. A non-impact printer places an image on a page without physically touching the screen.

21. Blu laser has shorter wavelength than red laser that is used for CD's. A single Blu-ray can hold upto 25 GB of data.

24. Semiconductory memory are used in primary storage.

30. Windows NT in a system software developed by microsoft.

33. Graphics tablet is an input device which screen is made of CRT.

3 Communication

- Mobile communication
- Television communication
- Satellite communication

The exponential growth in the field of technology and rapid advancement in communications has been witnessed over the recent period. This development has brought about significant changes in several spheres of human activity life styles, entertainment, work culture, modes of communication and has also influenced social and cultural values in the society. In the wake of these developments, the focus now has shifted to computerized communication and digitization, satellite communication, mobile technology and so on.

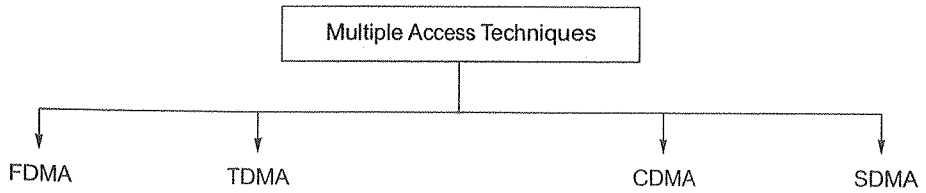
3.1 Mobile Communication

Mobile communication, in broader terms is a form of wireless communication which involves the transmission of information over a distance without the use of any wired connections, cables or any form of electrical conductors.

This form of communication incorporates all procedures and forms of connecting and communicating between two or more devices using a wireless signal through wireless communication technologies.

Multiple Access Techniques

- The cellular network technology is based on the availability of radio frequency spectrum. This radio frequency spectrum is a finite natural resource which is usually defined in terms of bandwidth.
- To allow many mobile users to share simultaneously, a finite amount of radio spectrum, various technologies have been developed to handle as many calls as possible in a given bandwidth. This concept is called "multiple access".



- Multiplexing can create channels in frequency, time, code and space and hence can be classified as mentioned above. Sharing the limited bandwidth efficiently among many users is one of the main objectives of multiple access techniques.

(i) FDMA (Frequency Division Multiple Access)

- The method of providing multiple access capability by transmitting the signals simultaneously in a non-overlapping frequency bands is called FDMA.
- FDMA provides multiple access in analog transmission, where the radio frequency spectrum is divided into several frequency bands separated by a certain guard band. Each frequency band can be used simultaneously.

- FDMA permits only one user per channel. Thus when the FDMA technique is employed, as long as the user is engaged in conversation, no other user can access the same spectrum space.

(ii) TDMA (Time Division Multiple Access)

- The method of providing multiple access capability by transmitting the signals simultaneously in a non-overlapping time slot is called TDMA.
- TDMA provides multiple access in digital transmission, where the radio frequency spectrum is divided into time slots and each user is allowed to either transmit or receive in each time slots.
- TDMA can accommodate more users in the same spectrum space than an FDMA system which improves different use of the spectrum.

(iii) CDMA (Code Division Multiple Access)

- The method of providing multiple access capability based on a spread-spectrum system is called CDMA. All users share same frequency and at the same time, but each user has own spreading code to encode data.
- CDMA uses spread-spectrum techniques to increase efficiency over FDMA and TDMA system. It allows transmission to occupy the entire bandwidth at the same time without interference.
- CDMA assigns a unique code sequence to each user that is used to code data before transmission.
- Qualcomm is the developer of the CDMA air interface used in cellular systems.

(iv) SDMA (Space Division Multiple Access)

- SDMA is a channel access method which reuses the same set of radio wave frequencies in a given service area.
- SDMA increases the capacity of the system and transmission quality by focussing the signal into narrow transmission beams. Through the use of smart antennas with beams pointed at the direction of the mobile station, SDMA serves different users within the same region.
- One of the prime advantage of using SDMA is frequency reuse. Interference can be nearly zero, even if mobile stations use the same allocated frequencies.

Mobile Generation Technologies

There has been great evolution of cellular technologies from a expensive technology for a few selected individual to today's global mobile communication systems used by more than half of the world's population.

With the advancement of technology in successive mobile generations, there have been increase in reliability, faster and longer connectivity, real-time experience and seamless mobility.

The various cell phone generations have been discussed briefly:

(i) 1G (First Generation)

- 1G technology was introduced in 1980s which used analog transmission technique for traffic, which was almost entirely voice.
- 1G technology used FDMA to achieve radio communications. With the FDMA, the voice channels are carried by different radio frequencies.
- The most successful examples of 1G standards were Nordic Mobile Telephone (NMT), Advanced Mobile Phone Service (AMPS) and Total Access Communication Systems (TACS).
- Limitations in 1G: Analog modulation is sensitive to interference, voice quality vulnerable to various kinds of noise and international roaming was not possible.

(ii) 2G (First Generation)

- To over come shortcomings of 1G, 2G was launched in 1990s with the introduction of D-AMPS (Standardized by IS-54 in North America) and GSM (Global System for Mobile in Europe).
- The prime benefit of 2G networks over their predecessors were that the phone conversations were digitally encrypted.
- 2G technologies can be divided into TDMA and CDMA based standards depending upon the type of multiplexing used.
- 2G introduced the data services for mobile, starting with SMS text services.
- Some disadvantages of 2G technologies are weaker digital signals and reduced range of sound with limited data bandwidth.

(iii) 2.5G (Two Point Five Generation)

- 2.5G is a designation that includes all advanced upgrades for the 2G networks such as increased data rates for data transfer.
- 2.5G standard includes the following technologies:
  (a) HSCSD (High Speed Circuit Switched Data)
  (b) GPRS (General Packet Radio Services)
  (c) EDGE (Enhanced Data Rates for Global Evolution)
  (d) CDMA (IS-95B) (Code Division Multiple Access)
- Generally a 2.5G GSM system includes at least one of the HSCSD, GPRS and EDGE technologies.

2.5G		Technology	Modulation	Multiple access	Bandwidth	Features
GSM	HSCSD	High-speed Circuit Switched Data	GMSK	TDMA	9.6-57.6 Kbps	Extension of GSM Higher data speeds
	GPRS	General Packet Radio Services	GMSK	TDMA	9.6-115 Kbps	Extension of GSM Always on connectivity Packet switched data
	EDGE	Enhanced Data Rates for Global Evolution	8-PSK	TDMA	64-384 Kbps	Extension of GSM Always on connectivity Faster than GPRS
IS-95B or CDMA 2000	CDMA	High Data Rate (HDR), Code Division Multiple Access	QPSK	CDMA	64 Kbps-2.4 Mbps	Extension of CDMA one or IS-95 Faster than 2.5 GSM standard

Fig. Technology and Features of 2.5G

(iv) 3G (Third Generation)

- 3G refers to the third generation cellular data technology with a set of standards for mobile phones and mobile telecommunication services fulfilling the International Mobile Telecommunication-2000 (IMT-2000) specifications given by International Telecommunication Union (ITU).
- 3G systems are referred to as UMTS (Universal Mobile Telecommunications System) in Europe and IMT-2000 worldwide.
- The two standard of 3G technology that are most popular in the world are:
  (i) WCDMA (Wideband CDMA), (ii) CDMA 2000
- WCDMA technology is being used by UMTS (Universal Mobile Telecommunication System) of Europe and parts of Asian countries for its 3G networks. Unites States is using CDMA 2000 for its 3G networks.

- 3GPP (3G Project Partnership) and 3GPP2 (3G Project Partnership 2) are the major organizations formed for the research and development of WCDMA and CDMA 2000 respectively.
- 3G mobile systems offer high bit rate services, high quality videos, images and fast web access. It is aimed to provide communication services with guaranteed quality of service (QoS) and security.

(v) 4G (Fourth Generation)

- 4G is collection of fourth generation cellular data technologies whose standards must conform to a set of specifications created by International Telecommunication Union (ITU).
- A number of 4G technologies are in fact actually evolution of 3G technologies, e.g. Long Term Evolution (LTE) from 3GPP and Ultra Mobile Broadband (UMB) from 3GPP2.
- 4G-LTE is designed with the goal of evolving the radio access technologies with all services being packet-switched, rather than following the circuit-switched model of earlier systems.
- LTE can operate in FDD (Frequency Division Duplex) and TDD (Time Division Duplex) modes. LTE advanced has further been evolved from LTE expanding into new frontiers.

	1st	2nd	3rd	4th
Name	Analog Cellular (1970s)	Digital Cellular, PCS (1980s~)	IMT-2000 (2000~)	(Beyond IMT-2000) (2005~)
Core Network	Circuit based Analog (PSTN)	Circuit based Digital (GSM, IS-95)	IP-based (GPRS, Mobile-IP)	All IP-based
Air Network	FDMA	FDMA + TDMA. CDMA	WCDMA, CDMA 2000	Smart Antenna
Frequency (MHz)	900	900, 1800 MHz	2000 MHz	5-60 GHz

	1st	2nd	3rd	4th
Main services	Voice phone	Voice phone, Low bit rate data (short msg.)	Voice phone, High rate data (web surfing)	Same services as fixed telecomm.
Data service bandwidth	NA	<10 Kbps	<2 Mbps <384 Kbps <144 Kbps	<20 Mbps <2 Mbps
Main organizer	Nation based	SDO (IETF, ETSI)	ITU-R (TG8/1), 3GPP/3GPP2	ITU-R (WP8F/WP8D)

Table: Generations of Mobile Technology

(vi) 5G (Fifth Generation)

- 5G is the next proposed telecommunication standards beyond the current 4G standards planning to aim to further higher capacity.
- 5G research and development aims to further reduce latency as compared to 4G, lower power consumption and better implementation of Internet of Things (IoT).
- Data rates of 100 Mbps for metropolitan areas and 1 Gbps simultaneously to many workers in the same office floor are expected to be incorporated in 5G technology.

3.2 Television (TV) Communication

(i) High Definition Television (HDTV)

- HDTV and SDTV (Standard Definition Television) are the two standard categories of display formats for Digital Television (DTV) transmission. HDTV has far better picture resolution than SDTV.
- SDTV systems are characterized by interlaced scanning, i.e. each frame is split into two fields, one field in the odd numbering lines and the other in the even lines. Each frame is displayed alternatively and our brains put them together to create complete image of each frame. This has adverse effect on picture quality.
- HDTV provides a high quality display with a vertical resolution display from 720p to 1080i. The 'p' stands for progressive scanning, which means that each frame is shown in it entirely rather than being split into fields which is done in case of interlaced spacing denoted by 'i'.
- The frame rate of HDTV is upto 60 frames per second (fps) which is twice that of conventional TV. HDTV uses 16 : 9 wide screen as its aspect ratio (width : height) so wide screen pictures are transmitted properly and not letter boxed or panned.
- HDTV has an advanced audio quality system which receives, reproduces and outputs Dolby Digital. To receive an HDTV broad cast one need a TV with a built-in HDTV tuner or receiver which can pick-up off the air HDTV channels.

(ii) DTH (Direct to Home) Broadcasting Technology

- Direct to home broadcasting or DTH is the distribution of television signals through a high power geostationary satellites to satellite receivers and dish antennas. DTH facilitates transmission of several digital channels through a single powerful Ku-band transponder on satellite that is in the range 11 GHz to 14 GHz satellite.
- The process involves two stages. First one involves uplinking, where broadcaster transmits audio and video programmes in the form of signals in a digital format to designated transponder fitted into satellite. The transponder amplifies and changes that signal to a different format.
- The second stage, called downlinking where signals sent by transponders is captured by dish antenna that feeds signal to the set-top box which converts the signal back to its original format for TV set. It is integrated receiver and decoder gadget, in fact the heart of the DTH system.
- The advantages of DTH service is that of superior display quality alongwith High Definition (HD) channels. Also in DTH services, the consumer has the power of selecting the mode of payment, i.e. consumer has the liberty to select particular channels and pay only for those channels.
- However there also lies some disadvantages to DTH services. Signal and transmission loss often occurs if the dish antenna malfunction, specially during rainy season. The quality of transmission is affected in bad weather condition.
- Some DTH service providers in India include Dish TV, Airtel Digital TV, Reliance Digital TV, Sun Direct, Tata Sky, Videocon D2H etc.

(iii) Internet Protocol Television (IPTV)

- IPTV refers to the system through which television services are delivered using the internet protocol suit over a packet switched network such as the internet to provide the required quality of services and experience, security, interactivity and reliability.
- IPTV services may be classified into three main groups:
  (a) **Live Television:** With or without interactively related to current TV show.
  (b) **Time Shifted Television:** Catch-up TV, start-over TV.
  (c) **Video on Demand (VOD):** Browse a catalogue of videos, not related to TV programming.

- The consumer requests and receives TV shows and Video content is delivered to the viewer via Internet Protocol (IP) based networks instead of cable or satellite. IPTV has the ability to store the programming on servers at transmitting end, allowing users to request the content over the internet at any time.
- IPTV offers significant advantages, including the ability to integrate television with other IP based services like high speed internet access and voice over IP. The Video on Demand (VOD) service permits a viewer to browse an online program or film catalogue, watch trailers and then select a selected recording. Another advantage of an IP based network is the opportunity for integration and convergence.
- However, IPTV is sensitive to packet loss and delays if the streamed data is unreliable. IPTV has strict minimum of frames per second to deliver moving pictures. Streaming IPTV across wireless links with the home has proved trouble some; not due to limited bandwidth, but due to issues with multipath and reflection of the RF signal carrying the IP data packets.

NOTE

Hybrid IPTV: Hybrid IPTV is the combination of traditional broadcast TV services and video delivered over either managed IP networks or the public internet. A hybrid set-top allows content from a range of sources, including terrestrial broadcast, satellite and cable, to be brought together with video delivered over the internet via an ethernet connection on the device.

(iv) Peer-to-Peer Television (P2PTV)

- P2PTV refers to peer-to-peer software applications designed to redistribute video streams in a real time on a P2P network; the distributed video streams are typically TV channels from all over the world but may come from other sources.
- P2PTV applications broadcast hundreds of channels, each carrying a live audio/video content to thousands of peers. Each channel corresponds to an overlay integrating peers wishing to receive its content and then these peers can switch channels at any time adding an extra dynamic factor.
- In a P2PTV system, each peer, while downloading a video stream, is simultaneously also uploading that stream to other users, thus contributing to the overall available bandwidth. More the number of peers, better is the video quality.
- If a user wishes to view a certain channel, the P2PTV software contacts a "tracker server" for that channel in order to obtain addresses of peers who distribute that channel, it then contacts these peers to receive the feed. The tracker records the user's address, so that it can be given to other user who wish the view the same channel. In effect, this creates an overlay network on top of the regular internet for the distribution of real time video content.

(v) Voice over IP (VoIP)

- Voice over Internet Protocol (VoIP) is a technology that allows users to make voice calls using a broadband internet connection instead of a regular phone line. The data is sent digitally, using the Internet Protocol (IP) instead of analog lines.
- To use VoIP, user needs a computer, an internet connection, VoIP software and a microphone or VoIP telephone. Many VoIP programs allows users to use a basic microphone and speaker setup. Others require VoIP phones, which are like regular telephone handsets, but typically connected to the computer via USB.
- VoIP are also referred to as IP telephony, internet telephony, Voice over Broadband (VoBB), broadband telephony and broadband phone. Internet telephony refers to the communication services such as voice, fax, SMS, voice-messaging applications, that are transported via the internet, rather than Public Switched Telephone Network (PSTN).

- One significate provider of VoIP services is Vonage which charges a monthly service fee. Other programs such as Skype and Peer Me allow users to connect and talk for free.
- VoIP has several advantages, including advanced features that are not available with a traditional phone. The biggest advantage VoIP has over standard telephone system is cost. International calls using VoIP are inexpensive. Also some VoIP providers provides free service, i.e. users can call one another at no cost.

3.3 Satellite Communication

The scope of satellite communication has extended the range of line-of-sight propagation paths and made possible transoceanic transmission of electromagnetic waves with their potentiality for large bandwidths.

Satellite forms an essential part of telecommunication systems worldwide carrying large amount of data (internet, e-mail) and telephone traffic in addition to TV signals. The efficiency of the satellite communication are being increased by using higher band of frequency, by increasing spectrum efficiency, developing high gain multiple spot beam antennas and frequency reuse technique.

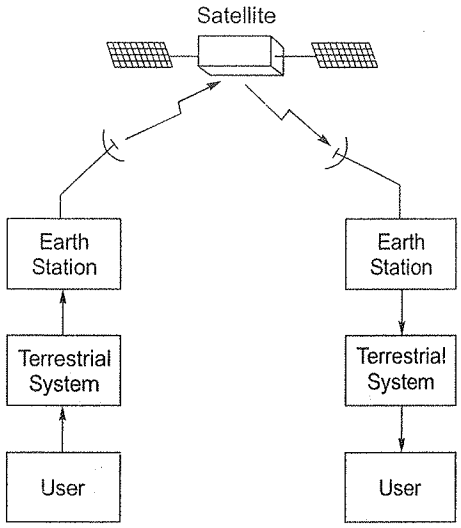


Fig. Structure of a Satellite Communication

Advantages of satellite communication over terrestrial link:

- Long distance transmission without using relay with high capacity.
- Satellite relays are point to multipoint whereas terrestrial relays are point to point.
- Mobile communication can be easily achieved by satellite systems.

Disadvantages of satellite communication:

- Due to very large distance between transmitter and receiver, there is a delay of signal.
- Requires large free space and repairing any part of satellite after launch is difficult.
- Requirement of very powerful launch vehicle and thereby the cost.

The block diagram shows the general structure of a satellite communication system in general, there are three types of satellite system, such as

(a) Ground to ground

(b) Ground cross link ground

(c) Ground to relay platform

On 4th October 1957, USSR launched the first satellite, i.e. a low orbit satellite "SPUTNSK-I" and in the very next year on December 18th, USA launched "SCORE" (Signal Communication by Orbital Relay Equipment).

3.3.1 Active and Passive Satellites

- An active satellite is one which has transmitting equipment abroad, such as a transponder, a device which receives a signal from earth, amplifies it, and retransmits the same signal back to earth (either immediately or without delay).
- The required power of transmitting earth station in active satellite is low. 'SCORE' was the first active satellite, which was launched by USA.
- A passive satellite merely reflects or scatters incident radiation for the earth, a portion of the radiation being reflected or scattered back in the direction of the earth.

- In passive satellites, the transmitter of the ground station requires large power and the receiving station receives a fraction of that power and then it is amplified by active electronic means. 'ECHO-I' was the world's best known passive communication satellite, which was launched in 1960.

3.3.2 Satellite Orbit

- The path in which satellite goes around the earth is called orbit path and the distance from the centre of the earth to the satellite is called orbit radius. An orbit is characterized by two attributes - altitude and inclination.
- Satellites can be classified in terms of altitude as:
  (a) Low Earth Orbit (LEO) satellite
  (b) Medium Earth Orbit (MEO) satellite
  (c) Geo-stationary Earth Orbit (GEO) satellite
  (d) Highly Eccentric Orbit (HEO) satellite

Types of satellite	LEO	MEO	GEO	HEO
Altitude Relation period Time in sight Example uses	500-1500 km 90 minutes 15 minutes Iridium Mobile communication and for surveying	5000-10000 km 5-12 hours 2-4 hours GPS Global Communication on such as e-mail, FAX, telephony	36000 km 24 hours Always VSAT Global communication on such as TV and radio transmission data transmission	15000-30000 km Less than 24 hours 8 hours Molnya Communication amount the polar countries

Table: Performance Characteristics of Different Altutude Satellites

3.3.3 Satellite Applications

There are innumerous applications of satellite but can be broadly classified into the following category:

(a) **Communication:** Includes TV, telephony, data transfer such as e-mail and internet etc.

(b) **Remote Sensing and Earth Observation:** Can be done with the help of Lower Earth Orbit (LEO) satellite.

(c) **Meteorological:** Includes weather survey, to study different layer and amount of oxygen content in atmosphere.

(d) **Military:** Includes short distance local communication from one camp to another, to study location of the enemy etc.

3.3.4 Satellite Bands Spectrum

Band	User	Downlink bands (in GHz)	Uplink bands (in GHz)
UHF	Military	0.25 to 0.27	0.29 to 0.31
C-band	Commercial	3.7 to 4.2	5.9 to 6.4
X-band	Military	7.2 to 7.7	7.9 to 8.4
Ku-band	Commercial	11.7 to 12.2	14.0 to 14.5
K-band	Commercial	17.7 to 21.2	27.5 to 30.0
Ka-band	Military	20.2 to 21.2	43.5 to 45.5

Table: Frequency Bands for Satellite Communication

In addition to the frequency listed above, a few bands within the frequency range 0.8-265 GHz are used in aeronautical, marine and general mobile system. Also some bands with in the frequency range 2.5-275 GHz are used for Fixed Satellite Services (FSS) and Broadcasting Satellite Services (BSS).

3.5 Geostationary and Geosynchronous Satellite

- The orbital period of the satellite is expressed in terms of mean solar time. A side real day is defined as the time required for the earth to rotate once on its axis relative to the stars. A sidereal day is measured as 23 h, 56 min and 4.09 s of mean solar time.
- A satellite with circular orbital period of one sidereal day, i.e. approximately 24 hours is called as geo-synchronous satellite and has an orbit radius of 42,164 km. It orbits in the same direction as earth rotates, i.e. from west to east.
- A geosynchronous satellite orbit is not properly aligned with the equator, the orbit is an inclined orbit. When the angle between the orbit and the equator decreases, the magnitude of oscillation becomes smaller.

When the orbit entirely lies over the equator, the satellite remains stationary in relation to earth's surface, the orbit is known as geostationary orbit and the satellite is known as geostationary satellite.

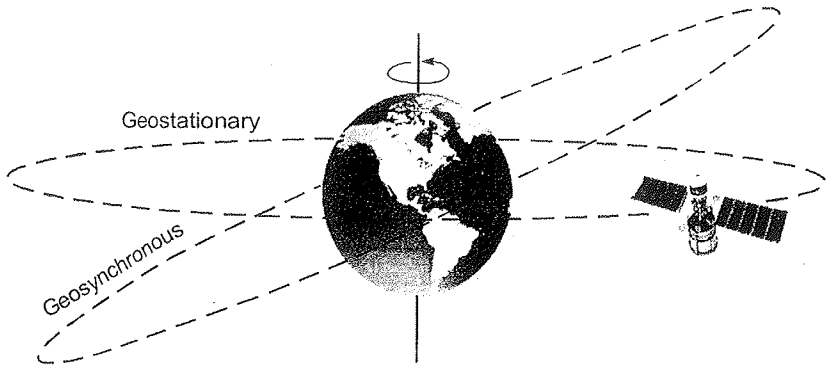


Fig. Geostationary and Geosynchronous Orbit

- A geo-stationary satellite is at an altitude of approximately 35,800 km directly above the equator having a circular orbital period of 24 hours. The term geo-stationary is used as a satellite would appear stationary in the sky as seen by a ground-based observer.
- While the geostationary orbit lies on the same plane as the equator, the geosynchronous satellite has a different inclination. This is the key difference between the two types of orbits.
- Geostationary satellites have revolutionized television broadcasting, global telecommunications and weather forecasting because of its stationary position relative to the earth's rotation.

3.3.6 Global navigation Satellite System (GNSS)

- GNSS is the standard generic term for satellite navigation system that provides 3-Dimensional positioning with global coverage. GNSS receivers calculate the position of the object in terms of latitude, longitude, altitude, speed, direction and time using a mathematical process called trilateration.
- The established fields for GNSS usage are surveying, shipping, missile guidance and aviation. The existing GNSSs are:
  (a) United States "GLOBAL POSITIONING SYSTEM (GPS)".
  (b) Russian "GLONASS".
  (c) European "GALILEO" positioning system.
  (d) China's "COMPASS" navigation system.

GLOBAL POSITIONING SYSTEM (GPS)

- The Global Positioning System is a 24 satellite constellation that can locate a position in three dimensions. By measuring the distance by four GPS satellites, it is possible to establish three coordinates of a user's position (latitude, longitude and altitude) as well as GPS time.

- GPS was originally developed by the Department of Defence (DOD), USA to meet military requirements and was quickly adopted by the civilian world.
- Transit, Timation and System 621B were the predecessors to GPS sponsored by US Navy and Air Force which became the building blocks for Global Positioning System. By combining these three systems that a new system emerged, what is known today as Navigation Signal Time And Ranging Global Positioning System (NAVSTAR GPS).
- GPS receivers calculate the position of objects in two-dimensional or three-dimensional space using a mathematical process called trilateration. Trilateration is a method of determining the positions of an object by measuring its distance from other objects with known location.
- GPS has 24-satellite constellation in six orbital plane at an altitude of 20,180 km with an orbital inclination of 55°.

GLONASS

- The GLONASS space segment consists of 24 operational satellites, distributed over three orbital plane. There are eight satellites per plane, separated 45 degree in argument of latitude.
- GLONASS satellites operate in circular orbits at an altitude of 19,100 km and each satellite completes the orbit in approximately 11 hours and 15 minutes. The orbital inclination of GLONASS is 64° 8′.
- The satellites carry atomic clocks and the payload needed for receiving, processing and transmitting navigation data. They also have reflectors to allow laser ranging from dedicated ground stations.

GALILEO

- Galileo is Europe's own global navigation satellite system, providing a highly accurate, guaranteed global positioning services under civilian control. By offering dual frequency as standard, Galileo is set to deliver real time positioning accuracy down to the metre range.
- Galileo is still in development stage and the fully developed Galileo system will consist of 24 operational satellites plus 6 in-orbit spares, positioned in three circular Medium Earth Orbit (MEO) planes at 23,222 km altitude above the earth and at an orbital inclination of 56°.

COMPASS

- In the first decade of the 21st century, China is in the process of developing its own navigation satellite constellation known as Compass Navigation Satellite System (CNSS), or Beidou-2. 'Beidou' is the chinese name of the Big Dipper constellation.
- The new system is still in development stage and will be constellation of 35 satellites, which includes 5 Geostationary Orbit (GEO) satellites and 30 Medium Earth Orbit (MEO) satellites, that will offer complete coverage of the globe.

3.3.7 Satellite based Augmentation

Satellite Based Augmentation Systems (SBAS) are used to improve the functions of navigation satellite system such as GPS, GLONASS and GALILEO. It is a system that supports wide area or regional augmentation through the use of a geostationary satellite broadcast message.

The various SBAS's are

(a) WASS (Wide Area Augmentation System)

It was the first SBAS, initiated by USA for providing coverage of continental United States region. It provides two types of corrections: clock corrections and ionosphere delay corrections.

(b) EGNOS (European Geostationary Navigation Overlay Services)

EGNOS is a regional augmented system for satellite navigation using GPS and GLONASS and is interoperable with other SBAS. EGNOS is designed to improve the navigation accuracy and to protection against hazardous misleading information to civil aviation users.

(c) MSAS (MTSAT Satellite Based Augmentation System)

MSAS is the wide area augmentation system being developed by Japan Civil Burea. This space based augmentation system will provide en-rough through precision approach navigation services for all aircraft within Japan airspaces.

(d) GAGAN (GPS Aided Geo Augmented Navigation)

GAGAN system is being developed jointly by ISRO and AAI (Airport Authority of India) to implement an indegenous satellite based regional GPS augmented system as a part of the communication, navigation and surveillance requirement of civil aviation in India.

The objective of GAGAN are to provide the navigation performance parameters such as accuracy, integrity, time to alert, continuity and availability to the Global Navigation Satellite System users over the Indian Service region.

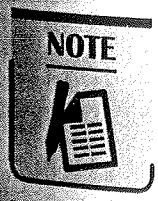
3.3.8 Regional Satellite-based Navigation Systems

QZSS (Quasi-Zenith Satellite System)

- QZSS is a Japanese satellite positioning system composed mainly of satellites is Quasi-Zeneth Orbits (OZO), comprising 3 satellites in geosynchronous orbit to improve the availability in urban or mountainous areas.
- The advantage of QZSS is that one satellite can be placed at Zenith, which means the users can receive signals without much obstruction.
- This system is considered to be an augmentation to GPS satellites transmitting L1, L2 and L5 signals. This system provides broadcasting of differential data providing higher accuracies and communication and broadcasting signals to mobile users.

IRNSS (Indian Regional Navigation Satellite System)

- IRNSS is an independent regional navigation satellite system being developed by India. It is designed to provide accurate position information system to users in India and region extending 1500 km from its boundary.
- IRNSS will provide two types of services, namely Standard Positioning Services (SPS) which is provided to all the users and Restricted Service (RS) which is an encrypted service provided only to authorised users.
- The space segment consists of the IRNSS constellation of seven satellites, called NAVIC (Navigation Indian Constellation). Three satellites are located in the geo stationary orbit and the remaining four are located in geo synchronous orbits. These seven satellites are named a IRNSS - 1A, 1B, 1C, 1D, 1E, 1F and 1G.
- IRNSS satellite have wide application in terrestrial, aerial and marine navigation, disaster management, mapping and geodetic data capture, integration with mobile phones, vehicle tracking and fleet management etc.



VSAT:

- VSAT, abbreviated for Very Small Aperture Terminal is a small telecommunication earth station that receives and transmits real time data via satellite.
- VSAT end users have a box that acts as an interface between the computer and the external antenna or satellite dish transceiver. The satellite transceiver sends data and receives data from the geo-stationary satellite in orbit.
- The satellite sends and receives signals from an earth station, which acts as the hub for the system. Each end user is connected to this hub station through the satellite in a star topology network.

ESC Prelims Questions

Q.1 What does CDMA stand for?
(a) Code Division Mobile Access
(b) Code Division Multiple Access
(c) Code Division Multiple Applications
(d) Code Division Mobile Applications

Ans. (b)

[ESE-2018]

Objective Brain Teasers

Q.1 The multiple access techniques used in first generation of mobile is
(a) Frequency division (b) Time division
(c) Code division (d) Space division

Q.2 Which of the following technology does not fall under 2.5 G standard?
(a) HSCSD (b) EDGE
(c) WCDMA (d) GPRS

Q.3 2G standards are based on
(a) TDMA
(b) CDMA
(c) Both TDMA and CDMA
(d) FDMA

Q.4 The group responsible for development process in WCDMA systems in 3G mobile is
(a) ITU (b) 3GPP
(c) IEEE (d) IETF

Q.5 The developer of CDMA air interface used in cellular systems is
(a) Motorola (b) Microsoft
(c) ITU (d) Qualcomm

Q.6 EDGE technology, a 2.5 G standard is an abbreviation for
(a) Enhanced Data Rates for GSM Evolution
(b) Encrypted Data Rates for GSM Expansion
(c) Encrypted Digital Generation Enhancement
(d) Enhanced Digital Generation Evolution

Q.7 3G W-CDMA is also known as
(a) 3G PP (b) UMTS
(c) HSDPA (d) ETACS

Q.8 Which among the following features are supported in 1G?
(i) Analog transmission
(ii) Digital transmission
(iii) Voice service
(iv) Data capability
(a) (iii) only (b) (i) and (ii) only
(c) (ii) and (iii) only (d) All of the above

Q.9 Second generation of cellular phone network was developed, to provide higher-quality mobile
(a) Video communication
(b) Real time services
(c) Frame communication
(d) Voice communication

Q.10 Which generation cellular phone system was developed to provides global personal communication?
(a) First generation
(b) Second generation
(c) Two point five generation
(d) Third generation

Q.11 Consider the following statement regarding 4G:
(i) Its standards are set by International Telecommunication Union (ITU).
(ii) Long Term Evolution (LTE) and Ultra Mobile Broadband (UMB) are the emerging 4G technologies.
(iii) The radio access technology services are circuit switched.
Which of the above statements are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.12 Which duplexing are supported in LTE technology?
(a) FDD (b) TDD
(c) Both (a) and (b) (d) None of the above

Q.13 The standards of LTE are developed by
(a) IEEE (b) 3GPP
(c) ITU (d) IETF

Q.14 Consider the following statements regarding 'Mobile Computing':
(i) It is a technology to allow transmission of data, voice and video via a wireless enabled device without having to be connected to a fixed physical link.
(ii) It enables users to work from any location.
(iii) The advent of PDA, tablets and smart phones, have made mobile computing very convenient.
Which of the above statements are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.15 Consider the following statements regarding Mosquito Net:
(i) It is a Mobile IP developed by a group from Stanford University.
(ii) The protocol allows a mobile host to switch seamlessly between network interfaces.
Which of the above statements is/are correct?
(a) (i) only (b) (ii) only
(c) Both (i) and (ii) (d) None of these

Q.16 Consider the following statements regarding Mobile IP:
(i) Mobile IP is a standard protocol created by IEEE.
(ii) It aims to make mobile computing a reality by freeing the user from a fixed location.
(iii) It is able to track and deliver information to mobile devices without needing to change the device's long term Internal Protocol address for that session.
Which of the above statements are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.17 The data bandwidth allocated in 3G network is
(a) 64 Kbps (b) 2 Mbps
(c) 200 Mbps (d) 1 Gbps

Q.18 IETF is an organization which is abbreviated for
(a) Internet Engineering Task Force
(b) International Engineering Task Force
(c) International Engineering Telecommunication Federation
(d) Internet Engineering Telecommunication Federation

Q.19 Digital Advanced Mobile Phone Services (D-AMPS) was designed to be backward compatible with
(a) FDMA (b) AMPS
(c) CDMA (d) FSK

Q.20 Which of the following is associated with internet speed in mobile communication?
(i) NFC (ii) GPRS
(iiii) LTE (iv) HSPA
(a) (i), (ii), (iii) only (b) (i), (ii), (iv) only
(c) (i), (iii), (iv) only (d) (ii), (iii), (iv) only

Q.21 Video-on-Demand refers to
(a) A service that delivers videotapes to consumers for a monthly fee.
(b) A way to change to contents of programs while viewing them.
(c) TV channels that allow consumers to order programs over fiber-optic lines.
(d) The ability to order network programming without commercials.

Q.22 The process involved in DTH technology is
(a) Uplinking (b) Downlinking
(c) Both (a) and (b) (d) Interlacing

Q.23 Which of the following television system broadcast channels through a peer network?
(a) DTH (b) IPTV
(c) P2PTV (d) HDTV

Q.24 Consider the following statements regarding VoIP:
(i) VoIP allows users to make voice calls using a broadband internet instead of regular phone line.
(ii) Internation calls through VoIP are cheaper than traditional phone calls.
(iii) Skype, Peer Me are programs that support VoIP.
Which of the above statements are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.25 Which of the following features are available in IPTV:
(i) Video on Demand (ii) Video calling
(iiii) Time-shifted TV (iv) E-ticketing

(v) Video games
(a) (i), (iii) and (v) only (b) (ii), (iv) and (v) only
(c) (i), (ii) and (iii) only (d) All of the above

Q.26 The altitude of MEO for GPS system is about
(a) 20,200 km (b) 19,100 km
(c) 23,200 km (d) 26,200 km

Q.27 The number of satellites and orbital planes in the satellite constellation of GPS system is
(a) 12 and 3 (b) 12 and 6
(c) 24 and 3 (d) 24 and 6

Q.28 Europe's own global navigation satellite system is
(a) GLONASS (b) GALILEO
(c) COMPASS (d) QZSS

Q.29 Which of the following are satellite based augmented systems?
(i) WASS (ii) NAVIC
(iii) EGNOS (iv) GAGAN
(v) NAVSTAR GPS
(a) (i), (iii), (v) only (b) (i), (iii), (iv) only
(c) (ii), (iv), (v) only (d) (ii), (iii), (iv) only

Q.30 VSAT is an abbreviation for
(a) Very Small Aperture Terminal
(b) Very Small Amplitude Terminal
(c) Very Small Analogue Terminal
(d) None of the above

Q.31 Consider the following statement related to QZSS:
(i) It is a Chinese satellite navigation system.
(ii) It consists of 3 satellites in geosynchronous orbit.
(iii) The system provides differential data proving communication and broadcasting signals to mobile users.
Which of the above statements are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.32 The constellation of seven satellites developed by IRNSS is called
(a) GAGAN (b) NAVIC
(c) LAPAN (d) AVATAR

Q.33 A transponder is a satellite equipment which
(a) Receives a signal from earth station and amplifies
(b) Changes the frequency of the received signal
(c) Retransmits the received signal
(d) All of the above

Q.34 For global communication, minimum number o satellites needed is
(a) 1 (b) 3
(c) 5 (d) 12

Answers

1.	(a)	2.	(c)	3.	(c)	4.	(b)	5.	(d)
6.	(a)	7.	(b)	8.	(b)	9.	(d)	10.	(d)
11.	(a)	12.	(c)	13.	(b)	14.	(d)	15.	(c)
16.	(b)	17.	(b)	18.	(a)	19.	(b)	20.	(d)
21.	(c)	22.	(c)	23.	(c)	24.	(d)	25.	(d)
26.	(a)	27.	(d)	28.	(b)	29.	(b)	30.	(a)
31.	(b)	32.	(b)	33.	(d)	34.	(b)		

Explanations

2. WCDMA is a technology of 3G standard.

8. 1G support analog transmission and voice services only.

11. The radio access technology services of 4G standard are packed-switched (IP based).

16. Mobile IP is a standard communication protoco created by IETF (Internet Engineering Tas Force), designed to allow mobile devices user to move from one network to another while maintaining a permanent IP addresses.

31. QZSS, stands for Quazi-Zenieth Satellite Syster is a Japanese satellite navigation system.

32. The constellation of seven satellites developec by IRNSS is called NAVIC (Navigation Indiar Constellation).

4 Networking

4.1 Introduction

- A network is a group of connected, communicating devices such as computers and printers. Significant influence have occurred on the computer system by the merging of computers and communication giving rise to the present day networking.
- The internet, which is a part of network is one of the largest engineered system ever created with millions of computers connected through proper communication links and switches.
- Computer networks are built primarily from general purpose programmable hardware and they are not optimized for a particular application like making phone calls or delivering television signals. Instead they are able to carry many different type of data and they support a wide and ever-growing, range of applications.
- Computer networks are however different from a distributed system. In a distributed system, a collection of independent computers appears to its users as a single coherent system. It is actually a software system built on top of a network. A distribution system is actually distinct from a computer network in terms of software (especially the operating system), rather than the hardware.
- A brief history of the 'internet' which is the major backbone of a network system is briefly discussed below:

(i) **ARPANET:** In 1967, at an Association for Computing Machinery (ACM) meeting, the Advanced Research Project Agency (APRA) in the Department of Defense (DOD), USA first gave a brief idea about a small network of connected computers which they termed as ARPANET. In this idea, each host computer would be connected to a specialized computer called an Interface Message Processor (IMP).

In 1969, four nodes ARPANET was established with the four nodes being at:

(a) University of California at Los Angles (UCLA)

(b) University of California at Santa Barbara (UCSB)

(c) Stanford Research Institute (SRI)

(d) University of Utha

These nodes were connected via IMPs to form the ARPANET by providing a software called Network Control Protocol (NCP) to provide communication between the hosts of these four institutes.

NOTE: ARPANET stands for 'Advanced Research Projects Agency Network'. It became the technical foundation of the present day internet.

(ii) **Birth of the Internet:** In 1972, Vint Cerf and Bob Kahn, developed a project called intermitting project which basis was to link different networks together to provide communication between hosts of different network.

To overcome the problems of diverse packet sizes, diverse interfaces, diverse transmission rates and differing reliability requirements, the idea of a device called 'Gateway' was established, which would act as the intermediary hardware to transfer data from one network to another.

(iii) **Development of TCP/IP:** In 1973, the concept of 'Protocols', which a modified version of NCP was developed by Cerf and Kahn. The modification was to incorporate the concepts of encapsulation, the datagram and the functions of a gateway. Defence Communication Agency (DCA) took up the responsibility of the ARPANET.

In 1977, an internet consisting of three different networks (ARPANET, packet radio and packet satellite) was successfully demonstrated. Transmission Control Protocol (TCP) was split up into two protocol: Transmission Control Protocol (TCP) and Internet Protocol (IP) with the new combination became known as TCP/IP. IP would serve the purpose of datagram handling and TCP would perform higher level functions such as segmentation, reassembly and error detection.

In 1981, UC Berkley modified the UNIX operating system to include TCP/IP and in 1983, the original ARPANET protocols were abolished to include TCP/IP as the official protocol of the ARPANET.

(iv) **MILNET:** In 1983, ARPANET split up into two networks: MILNET for military use and ARPANET for civilian use. MILNET stands for military network.

(v) **CSNET:** Developed in 1981, yet another milestone of internet, CSNET was developed for those universities who were not eligible to join ARPANET. It was sponsored by National Science Foundation (NSF).

CSNET was less expensive and had slower transmitted rate. It featured connections to ARPANET and Telenet. Telenet was the first commercial packet data services. CSNET stands for computer science network.

(vi) **NSFNET:** In 1986, NSFNET was developed and sponsored by National Science Foundation (NSF). It became the backbone of connecting super computers.

In 1990, ARPANET was officially retired and replaced by NSFNET. In 1995, NSFNET reverted back to its original concept of a research network. NSFNET stands for National Science Foundation Network.

(vii) **ANSNET:** In 1991, to overcome the limitations of NSFNET due to rapidly increasing internet traffic an organization called Advanced Network and Services (ANS) was formed by three companies IBM, Merid and MCI. The purpose was to build a new, high-speed internet backbone called ANSNET. It is abbreviated for advanced network and services network.

(viii) **World Wide Web:** In 1990, with the invention of 'www', the phase of internet changed completely. The emergence of World Wide Web (www) led to the massive explosion of the internet application in the field of commercialization. The web was invented at CERN by Tim Berners Lee.

4.2 Protocols and Standards

Protocols

- Protocol are set of rules that defines the format and the order of message exchanged between two or more communication entities, as well as the actions taken on the transmission and receipt of a message or other events.
- For a communication to occur between two system the entities must agree on a protocol. A protocol defines what is to be communicated, how it is communicated and when it is communicated.
- The primary elements in a protocol are syntax, sematic and timing.
  (a) 'Syntax' is simply a format or structure of the data, i.e. the order in which they are presented. Different computers may store data in different bit orders. When these computers communicate, this difference needs to be solved.

(b) 'Sematics' refers to the meaning of each section of bits. It is a process of interpreting a particular pattern and take actions based on the interpretation.

(c) 'Timing' refers to two characteristics: when data should be sent and how fast it can be sent.

Standards

- Standards differ from protocol from the fact that protocols are mantory governing rules for a communication to occurs where as standards are simply guidelines to maintain proper interconnectivity in the communications.
- Standards provide guidelines to manufactures, vendors, government agencies and other service providers to ensure the kind of interconnectivity necessary in today's market place and in international communication. Standards ensure the national and international operability of data and telecommunication technology and processes.
- There are two categories of data communication standards: de facto (by fact) and de jure (by law).

(a) 'De facto' standards are not approved by any organized body but have been adopted as standards through widespread use as de facto standards. Examples of de facto standards are MS office and various DVD standards.

(b). 'De Jure' standards are those that have been legislated by an officially recognized body.

4.3 Standards Organizations

1. International Standards Organization (ISO)

- ISO is a multinational body whose membership is drawn mainly from the standards creation committees of various governments throughout the world.
- ISO is an entirely voluntary organization for an worldwide agreement of international standards. It aims to facilitate the international organization of goods and services by providing models for compatibility, improved quality, increased productivity and decreased prices.
- The ISO is an active organization in developing co-operations between scientific, technological and economic activity. The ISO has significant role in the creation of Open Systems Interconnection (OSI) model for network communication.

2. International Telecommunication Union (ITU)

- ITU was formed to define International Standards for Telecommunication to make communications internationally compatible.
- As a part of ITU, a committee was formed by the United Nations called Consultative Committee for International Telegraph and Telephony (CCITT) to look into the research and establishments of telecommunication standards.

3. American National Standards Institute (ANSI)

- ANSI is a completely private, nonprofit corporation of the United States formed for the welfare of the United States and its citizens occupying primary importance.
- ANSI's serve as the national co-ordinating institution for voluntary standardization in the United States and ensuring the participation and protection of public interests.
- ANSI members include professional societies, industrial organizations, governmental and regulatory bodies and consumer groups.

4. Institute of Electrical and Electronic Engineers (IEEE)

- IEEE is the largest professional engineering society in the world which aims to advance theory, creativity and product quality in the fields of electrical engineering, electronics and radio as well as in all related branches of engineering.

- IEEE oversees the development and adoption of international standards for computing and communication.

5. **World Wide Web Consortium (W3C)**
   - W3C was founded by the inventor of World Wide Web (www), Time Berners Lee to provide computability in industry for new standards.

6. **Electronic Industrial Association (EIA)**
   - EIA is a non-profit organization developed for the promotion of electronic manufacturing concerns. EIA has significant contributions in the field of Information Technology by defining physical connection interfaces and electronic signaling specifications for data communications

7. **Open Mobile Alliance (OMA)**
   - OMA was formed to gather forums in computer networking and wireless technology. Its mission is to provide unified standards for application protocols.

In addition to the above mentioned organization, many other general organizations have been formed for the internet administration:

1. **Internet Society (ISOS)**
   - ISOS is an international, non profit organization formed to provide support for the internet standards process. ISOS also promotes research and other scholarly activities relating to the internet.

2. **Internet Architecture Board (IAB)**
   - IAB is a technical advisor to the ISOC which functions to oversee the continuing development of the TCP/IP protocol suit.
   - The two primary components of IAB are:
     (a) Internet Engineering Task Force (IETF)
     (b) Internet Research Task Force (IRTF)

3. **Internet Engineering Task Force (IETF)**
   - IETF is a forum of working groups which is responsible for identifying the operational problems and proposing solution to these problems.
   - The areas in which IETF works are application internet protocols, routing, operations, user services, network management, transport and security.

4. **Internet Research Task Force (IRTF)**
   - IRTF focuses on long-term research topic related to internet protocols, applications, architecture and technology.

4.4 Switching Techniques

Switching is a technique of selecting a path for the transmission of data out of many available path from sender to the receiver. There are two fundamental approaches to moving data through a network of links and switches:

(i) Circuit switching
(ii) Packet switching

Circuit Switching

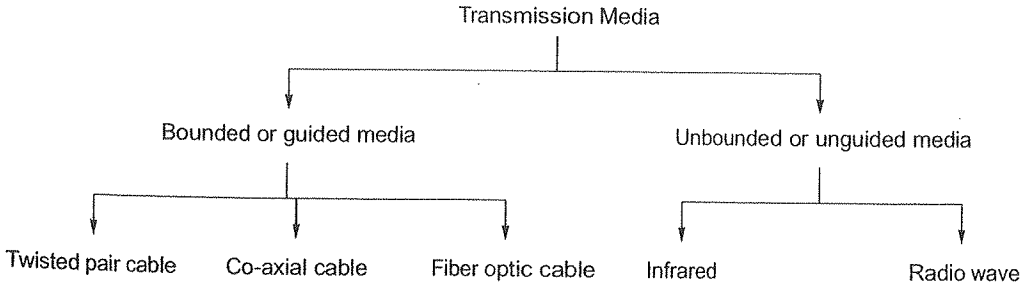
- In circuit switched networks, the resources needed along a path (buffers, link, transmission rate) to provide for communication between the end systems are reserved for the duration of the communication session between the end systems.
- There is a bonafide connections for which the switches on the path between the sender and receiver maintain connection state for that connection. This connection is called circuit.
- When the network establishes the circuit, it reserves a constant transmission rate in the network's links for the duration of the connection. Hence there is no problem of congestion in the connection.
- A circuit in a link is implemented with either Frequency Division Multiplexing (FDM) or Time Division Multiplexing (TDM). Traditional telephone networks are examples of circuit switches networks.

Packet Switching

- To send a message from a source end system to a destination end system, the source breaks long messages into small chunks of data known as packets. Between source and destination, each packet travels through communication links and packet switches.
- Packets are transmitted over each communication link at a rate equal to the full transmission rate of the link. However packet switching has multiple links and hence can result in queuing delays and packet loss.
- Packet switching is more efficient and less costly to implement than circuit switching as it offers better sharing of transmission capacity.

4.5 Transmission Media

- The transmission medium is the physical path between transmitter and receiver in a data transmission system. Transmission media are determined both by the characteristics of the medium and the characteristics of the signal.
- Different types of transmission media is used for different data transfer rates and distances. The selection of the transmission media is defined in terms of bandwidth, noise, speed, delay, attenuation and radiation.
- Higher bandwidth transmission media supports at higher data rates.
- Attenuation limits the usable distance that data can travel on the media.
- Noise is related to electrical signal that can cause distortion of datal signal and data errors.
- Radiation is the leakage of signal from the media caused by undesirable electrical characteristics of the transmission media.
- The transmission media can be categorized into two types:
  (i) Bounded or guided media
  (ii) Unbounded or unguided media



4.5.1 Bounded or Guided Media

In bounded or guided media data transmission travel through cabling system that has a fixed path. The bounded media is also called as wired media. The further classification of bounded or guided media are described briefly as:

(i) Twisted Pair Cable

- Twisted pair cable is the least expensive and most commonly used transmission medium in telephone networks.
- Twisted pair consists of two insulated copper wires, arranged in a regular spiral pattern to reduce the electromagnetic interference from similar pairs close by.
- Data rates for LAN using twister pair ranges from 10 Mbps to 10 Gbps which depends on the thickness of the wire and the distance between transmitter and receiver.
- Twisted pair can be used for both analog and digital transmission and the entire network is not affected if a part gets damaged. However, the error rate is very high for large distances and are not suitable for broadband connections.

(ii) Co-axial Cable

- Like twisted pair, coaxial cable consists of two copper conductors, but the two conductors are concentric rather than parallel.
- With concentric arrangement of wires and special insulation and shielding, co-axial cable can achieve high data transmission rates over longer distances.
- Co-axial cable is commonly used in cable television systems. In the system, the transmitter shifts the digital signal to a specific frequency band and the resulting analog signal is sent from the transmitter to one or more receivers.
- Co-axial cables has excellent noise reduction and can send signals over longer distance at higher speeds. However they are a more expensive than twisted pair and are not compatible with twisted pair as well.

(iii) Fiber Optic Cable

- An optical fiber is a thin, flexible medium that conducts pulses of light, with each pulse representing a bit. A single optical fiber can support tremendous bit rates, up to tens or even hundreds of gigabits per second.
- Each fiber is made up of three layers, i.e. core (silica or plastic), cladding (silica or plastic with refractive index lower than the core) and buffer (protective outer covering).
- Fiber optic cables have strong resistances to electromagnetic interference, a very low signal attenuation and are very hard to tap. Hence, they are preferred for long-haul guided transmission overseas links.
- However due to high cost of optical devices such as transmitters, receivers and switches, its application has been hindered for deployment in short-haul transport, such as in a LAN or in any residential access network.

4.5.2 Unbounded or Unguided Media

In unbounded or unguided media, the wave propagation is through free space in the form electromagnetic waves. It is also termed as wireless media as it does not require any physical media for its transmission.

Depending upon the method of transmission, the unbounded media can be further classified into two types.

(i) Infrared

- Infrared waves are low frequency waves which are used for very short distance communication. Due to such short distance, it is considered as one of the most secure transmission modes.
- Infrared wave finds application in daily life such as TV remote, hand held devices, wireless speakers etc.
- Due to limitation of short distance communication, it cannot be widely used for long distance transmission. It's applicability is limited within a room and also cannot penetrate solid boundaries.

(ii) Radio Waves

- Radio waves carry signals and transmission of data in the electromagnetic spectrum. The characteristics of a radio channel depends significantly on the propagation environment and the distance over which a signal is to be carried.
- The medium does not require any physical wire to be installed, can penetrate walls, provide connectivity to a mobile user and can potentially carry a signal for long distance.
- However for such wirelsss transmission, various environmental factors such as path loss and shadow fading, multipath fading and interference should be taken into consideration.
- Various wirelsss technologies which use the radio waves for transmission of data or signals are Bluetooth, Wi-Fi, Wi Max, NFC etc.

4.6 Transmission Modes

- Device may be connected by a bundles of wires in called interface. Data transmission refers to movement of the bits over some physical medium connecting two or more digital devices. It also defines whether bits may travel in both directions simultaneously or whether devices must take turns sending and receiving.

  These are two types of transmission:

  (i) Serial transmission

  (ii) Parallel transmission

(i) Serial transmission

- Serial transmission uses one line and transmits all the bits along it one after another. The least significant bit transmitted first. Serial transmission is more reliable and cheaper. Speed of data transmission is slow because the bits are sent one at a time.

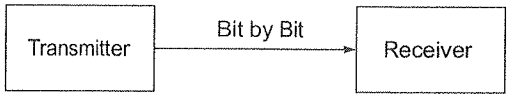


Fig. Serial Transmission

- There are two way to provide serial communication : synchronous and asynchronous. The transmitter device and receiving device have an additional complexity.
- Figure below shows the serial transmission.

Advantages:

1. It is cheaper.
2. Suitable for long distance communication.
3. More reliable.
4. It requires single communication channel

Disadvantages:

1. Data transmission speed is slow.
2. Throughout is depends on bit rate.

(ii) **Parallel transmission:** Parallel transmission means that a group of bit is transmitted simultaneously by using a separate line for each bit. Parallel transmissions are common especially where the distance between the two devices is short.

Figure show parallel transmission.

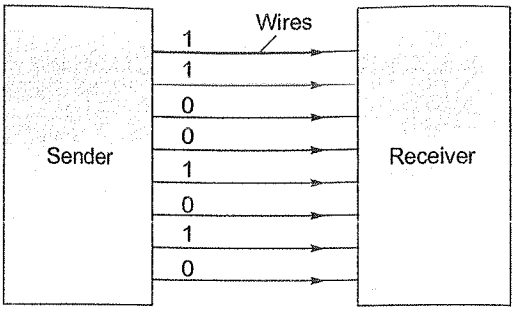


Fig. Parallel Transmission

Advantages:

1. Data transmission speed is more.
2. Suitable for short distance communication.
3. Group of bits are transmitted simultaneously.

Disadvantages:

1. Cost is more.
2. Transmitting over long distance requires thicker wires to reduce signal degradation.
3. It requires multiple communication channel.

- Further we can show comparison between serial and parallel transmission as shown below:

Serial Transmission	Parallel Transmission
1. It sends data bit by bit.	It sends data simultaneously.
2. Used for long distance transmission.	Used for short distance transmission.
3. Transmission cost is less.	Transmission cost is more.
4. Speed of data transmission is slow.	Data transmission speed is fast.
5. Throughout depends on bit rate.	Throughout is constant.
6. It requires single communication channel.	It requires eight communication channels.
7. Synchronous and asynchronous transmission are the modes of serial transmission.	No modes in parallel transmission.

Table: Comparison Between Serial and Parallel Transmission

4.7 Network devices

Network devices are the physical hardware devices that are used to connect various ICT tools to a well-defined network. Such devices are used to transfer data in a fast and secure way over a network which may be inter network or intra network.

- Repeater
- Hub
- Bridge
- Router
- Switch
- Modem
- Gateway
- Ethernet card
- Wi-Fi card

Repeater

- A repeater is a network device that forwards digital signals, much like an amplifier forwards analog signals.
- A repeater is a device that operates only in the physical layer. Signals that carry information within a network can travel a fixed distance before attenuation endangers the integrity of the data.
- A repeater receives a signals and before it becomes too weak or corrupted, regenerates and retimes the original bit pattern. The repeater then sends the refreshed signal.
- It is a two port device used in the past to connect two segments of a LAN to overcome the length restriction of the co-axial cable.

- Repeaters do not understand frames, packets or headers. They understand the symbols that encode bits as volts.

Hub

- Hub is simply a repeater with multiple ports. That can be used to serve as the connecting point and at the same time function as a repeater.
- Hub is a network broadcasting device that operates in the physical layer of the OSI model to connect a number of computers together in a network.
- A hub has a number of input lines that it joins electrically. Hubs differ from repeaters in that they do not incoming signals and are designed for multiple input lines.
- Hubs do not have any data link address and also do not check the data link address of the received frame. They just regenerate the corrupted bits and send them out from every port.
- Hubs do not have intelligence to find out best path for data packets which results in wastage of bandwidth.

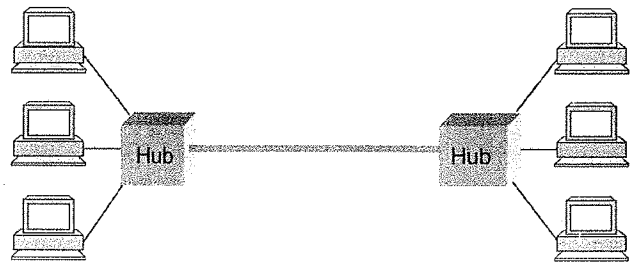


Fig. Hub Network

Bridge

- A bridge is used for interconnecting two LANs working on the same protocol. It is usually a 2 port working on the same protocol. It is usually a 2 port device with single input and single output port.
- A bridges operates at data link layer of the OSI model.
- As a data link layer device, bridge can check the MAC addresses (source and destination) contained in the frame.
- A bridge has filtering capacity by which it can check the destination address of the frame and can decide which outgoing port the frame should be send out.

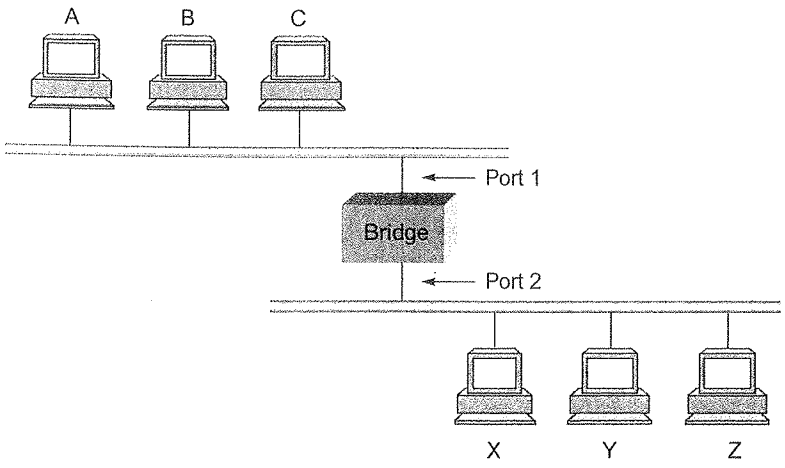


Fig. Bridge

Router

- A router is a network device that routes data packet based on their IP address in between different networks.
- A router operates at network layer of the OSI model to transmit data from one LAN to another provided they support the same protocols.
- A router has a physical and logical IP address for each of its interfaces. The physical address of the packet is changed when a router forwards the packet from one network to another.
- Router can connect LANs together, WANs together as well as LANs and WANs together. It limits broadcast domains.

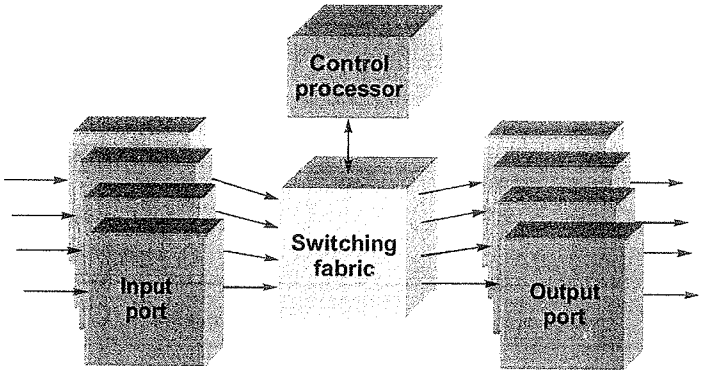


Fig. Router

Switch

- A switch is a multi port bridge with a buffer and a design that can boost its efficiency and performance with a large number of ports.
- Switch is a data link layer device in the OSI model and performs better than hub in a more intelligent way.
- Unlike hubs, switches examine each packet and process it accordingly rather than simply repeating the signal to all ports.
- Switches map the ethernet address of the nodes residing on each network segment and the allow only the necessary traffic to pass through the switch.
- In switch, full duplex method is used to increases bandwidth to dedicated workstations or servers. Full duplex doubles the potential bandwidth on that link.

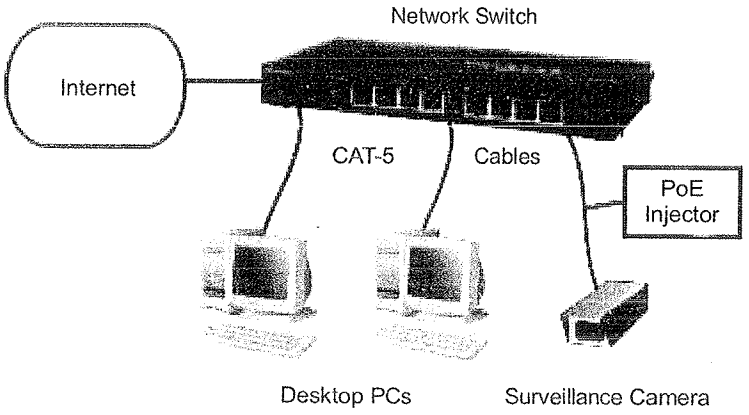


Fig. Switch

Modem

- Modem is a combination of modulator and demodulator which serve the purpose of converting signals from digital to analog and vice-versa.
- Modulator converts digital data into analog form when the data is sent by the computer and demodulator converts analog data into digital form when the data is received by the computer.
- During transmission, the message signal is modulated with a carrier signal to convert it to a appropriate signal for transmission, which is then demodulated to recover original message signal.
- The three types of data transmission in modem based on their direction are:
  (i) **Simplex:** Data transfer in one direction only.
  (ii) **Half Duplex:** Data transfer in both directions but only one at a time.
  (iii) **Full Duplex:** Data transfer in both the directions simultaneously.

Gateway

- A gateway is a network device to connect two networks together that may work upon different networking models.
- It is the communication processor, also called protocol converters and operate at the network layer of the OSI model.
- Packet switching techniques is used to transmit data from one network to another network.
- Gateway is very much similar to a router, but the only difference is that gateway can transmit data over network that used different protocols whereas routers only use same protocols to transmit data.

Ethernet Card

- Ethernet card is a kind of network adaptor, also known as Network Interface Cards (NIC).
- It is used in computers to connect LAN and communicate with other devices connected to that LAN.
- Ethernet cards operate at different network speeds depending on the protocol standards they support. Old ethernet cards support only of 10 Mbps maximum speed whereas modern ethernet adaptors supports 100 Mbps as well as 1 Gbps standard.
- However, with the expansion of wireless technologies the decline of wired ethernet connections has reduced the need for ethernet cards.

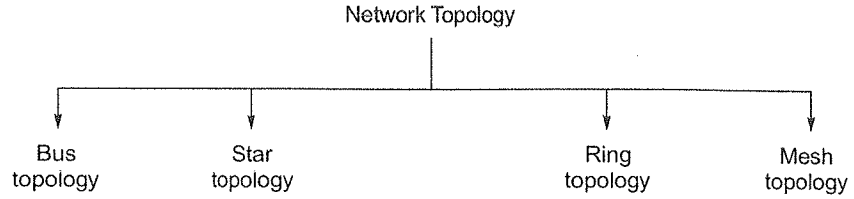
Wi-Fi Card

- Wi-Fi card is a network adaptor used to connect any device to the local network wirelessly.
- It uses the concept of wireless technology to achieve wireless connection to any network.
- Wi-Fi hotspot is created to provide wireless connection over a physical area of the network to provide internet access through Wi-Fi.
- Today, all modern devices come with heir built-in wireless network adaptor. It enhances the use of application such as data transfer, online video chat, tele-conferencing, downloading data etc.

4.8 Network Topologies

- Network topology is defined as the structure of a network including physical arrangement of its constituent elements. The interconnection may be either real or logical.
- Real interconnection refer to actual (physical) connection of a network, whereas logical interconnection refers to the way data is exchanged between the constituent elements.
- The factors which affect the selection of a network topology depends upon cost, flexibility, reliability, scalability, ease of installation and maintenance.

- The classification of network topology are:



Bus Topology

- In a bus topology, the various network devices and computer are attached along the length of a linear transmission cable.
- When one computer sends a signal upto a cable, all the computers on the network receive the information, but the one with the address that matches the one encoded in the message accepts the information while all other reject the message.
- Transmission of data occur in both the direction along the bus. The data is copied to a local disk once the destination terminal receives the data.
- In bus topology, the speed is slow as only one computer can send message at a time on the bus. A computer must wait until the bus is free before it can transit.
- Advantages of bus topology are:
  (i) Easy to understand, install for small networks.
  (ii) Less cabling cost as amount of cable required to connect computer is less.
  (iii) Easy to expand by joining two cables with a BNC (Bayonet Neill-Concelman) connector.
  (iv) Repeaters can be used in expansion to boost the signal and increase the distance.
- Disadvantages of bus topology are:
  (i) Slower bus speed during heavy network traffic.
  (ii) Only one computer can transmit at a time.
  (iii) Cable break or loose connection can bring the whole network down.
  (iv) No dumb terminals can be connected to the bus.

NOTE: A dumb terminal is an output device that accepts data from the CPU. They are not as fast as smart terminals and do not support as many display features. Smart terminals has its own processor for special features. Due to such limited display commands and little processing power, terminals are termed as dumb terminals.

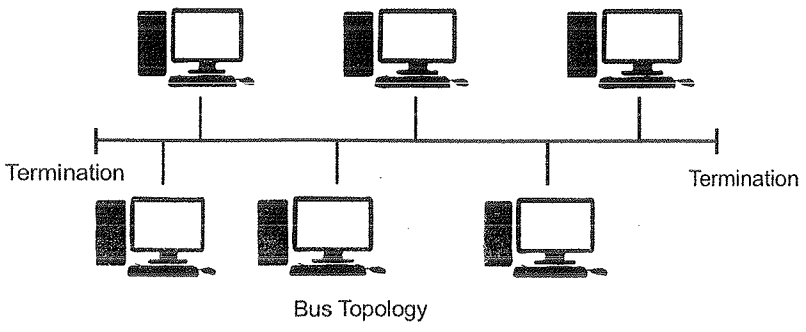


Fig. Bus Topology

Star Topology

- A star topology is designed with each node (file server, computers and peripheries) connected directly to a central network hub or switch.
- Hub is the central node through which exchange of data must take place. This central node can process the data received from the source node before sending it to the destination node.
- The hub in the broadcasting star can be active or passive. An active hub generates the electrical signal and sends it to all computer connected to it. Active hubs needs power supply while passive hub's don't need it.
- This configuration is most common with twisted pair cable; however it can also be used with co-axial cable or fiber optic cable.

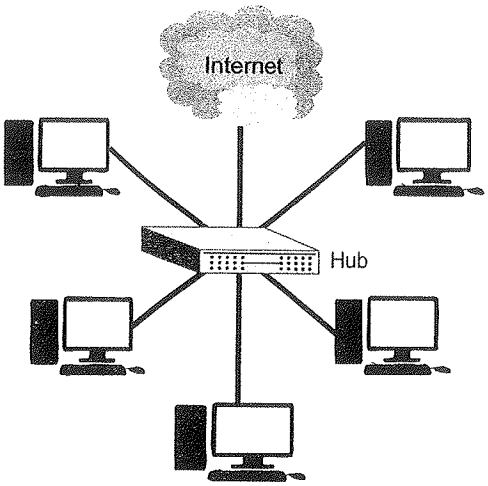


Fig. Star Topology

- Advantages of star topology are:
  - (i) Easy to install and wire. Also easy to detect faults and to remove parts.
  - (ii) New nodes can be added/removed without affecting rest of the network.
  - (iii) Failure of one node or link doesn't affect the rest of network.
- Disadvantages of star topology are:
  - (i) Failure of central node causes the whole network to fail.
  - (ii) Requirement of long cables to connect each node to the server increases cabling cost.
  - (iii) Require a device at the central hub to rebroadcast or switch the network traffic.

Ring Topology

- In ring topology each terminals is connected to the next terminal, with the last one connected to the first in the form of a ring.
- Rings are used in high performance network where large bandwidth is necessary. Computer is connected to next peer on the ring and each retransmits and receives from the previous computer.
- Transmission of data occurs in only pre-determined direction and there is no termination of the ring as there is no end.
- A short message called token is passed around the ring from one computer to another. The token circulates in the ring until a station is ready to send and capture the token.

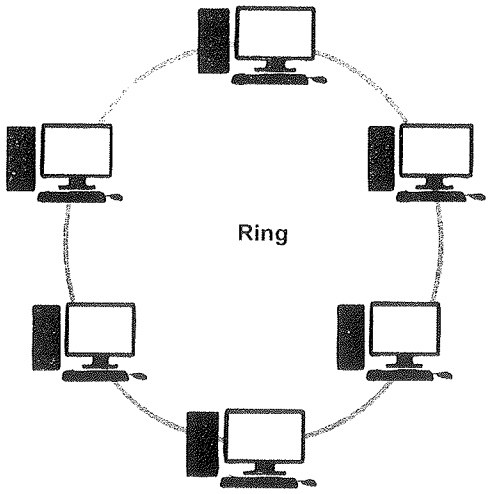


Fig. Ring Topology

- Advantages of ring topology are:
  - (i) Can be used in high performance network where large bandwidth is necessary.
  - (ii) Ideal for optical fiber as data transmission occurs in one direction only.
  - (iii) Equal access is given to every computer.

- Disadvantages of ring topology are:
  (i) Failure of one node can affect the whole network.
  (ii) Difficult to removes any nodes while keeping the rest of the nodes intact.
  (iii) Initial installation cost is high.
  (iv) Closed nature of ring topology makes it necessary to remove the circulating packets.

Mesh Topology

- In mesh topology, there is a dedicated point to point link from one device to another.
- For 'N' number of nodes, a fully connected network will have $\frac{N(N-1)}{2}$ physical channels to link devices. Each device in the network will contain $(N-1)$ input/output ports.
- The link between the device in this case are dedicated link, i.e. traffic is carried on it between two devices.
- Advantages of mesh topology are:
  (i) Eliminates traffic problem as each connection can carry its own data load.
  (ii) Failure of one node does not affect the entire network.
  (iii) More security and privacy as each message is sent along dedicated line.
  (iv) Easy trouble shoot in case of failure.
- Disadvantages of mesh topology are:
  (i) Difficulty in installation and reconfiguration.
  (ii) More cabling cost.
  (iii) Hardware required to connect each link input/output and cable is expensive.

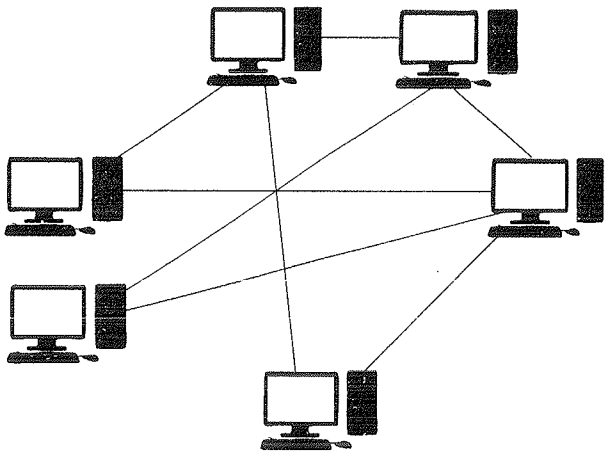


Fig. Mesh Topology

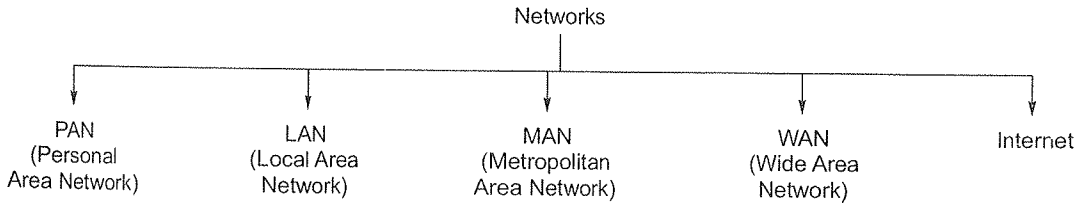
4.9 Types of Network

- There is no general taxonomy to categorize the types of network but in general two dimensions stand out as important:
  (i) Transmission technology and
  (ii) Scale or network extent
- Transmission technology are further classified in two categories that are widely used: point-to-point links and broadcast links.

- Point-to-point links connects individual pairs of machines. Short messages, called packets are sent from the source to destination on a network made up of point-to-point protocols.
- 'Unicast' is a term used to describe communication when a piece of information is sent from one point to another. In this case, there is just one sender and one receiver.
- In broadcast communication, a piece of information is sent from one point to all other points. In this case, there is just one sender, but information is sent to all connected receivers.
- A wireless network is a common example of a broadcast link, with communication shared over a coverage region that depends on the wireless channel and the transmitting machine.
- 'Multicast' is a term used to describe communication where a piece of information is sent from one or more points to a set of other points. In this case there may be one or more sender with a set of receivers.
- 'Scale' or 'Network extent' classification of network is based on the distance. Based on distance, different technologies are categorized on different scale as:

Interprocessor distance	Processor located in same	Example
1 m	Square meter	Personal area network
10 m	Room	Local area network
100 m	Building	
1 km	Campus	
10 km	City	Metropolitan area network
100 km	Country	Wide area network
1000 km	Continent	
10000 km	Planet	The internet

Fig. Classification of Network Based on Scale



4.9.1 Personal Area Network (PAN)

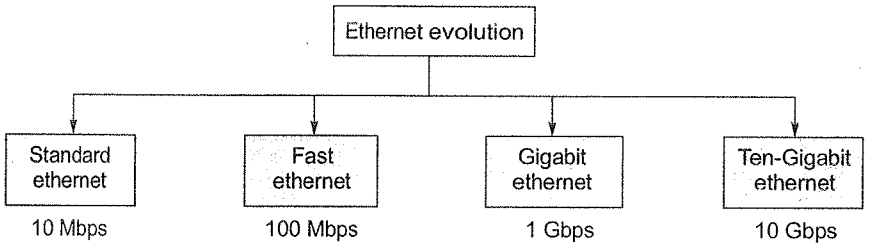
- Personal Area Networks are used for communication within the range of a person ranging from a few matters within a room.
- PAN can be used for communication between the devices such as smart phones, laptop, PDA etc. at home or even for larger network such as the internet.
- PAN network could be wireless such as Wi-Fi or a combination of both wired and wireless.
- A typical example of PAN network is Bluetooth. It can also be built with other technologies such as RFID (Radio Frequency Identification) used on library books and smart cards.

4.9.2 Local Area Network (LAN)

- LAN or Local Area Network is a wired network restricted over a single site such as business enterprises, office, buildings etc.
- LANs are widely used to connect personal computers, network servers, printers and other network entities for the purpose of exchanging information and sharing resources.

- LAN can be a wired or wirelsss connection. The common forms of LAN are described by IEEE 802 standard. For wireless LANs (WLAN), the standard is IEEE 802.11 and is popularly known as Wi-Fi.
- Most of the wired LANs are built using copper wires and now a days for faster transmission, it is being replaced at some places by optic fiber.
- Transmission speed of wired LANs typically ranges from 100 Mbps to 1 Gbps with low delay and few errors.
- Point-to-point links are used in many LANs for communicating directly without any intermediate switching nodes. The different station have peer relationship.
- The most commonly used type of wired LAN is ethernet, which is a IEEE 802.3 standard.
- LANs are capable of transmitting data at a very fast rates, but distance are limited and there is a limit on number of computers that can be connected on a single LAN.

Ethernet: Ethernet is by far the most dominant wired LAN technology since its creation in 1976 at Palo Alto Research Center (PARC). The evolution of ethernet has gone through four generations as shown below:



(i) Standard Ethernet

- Also known as traditional ethernet, IEEE 802.3 defines carrier sense multiple access with collision detection (CSMA/CD) as the access method.
- The summary of standard ethernet implementation can be tabulated as shown below:

Characteristics	10Base5	10Base2	10Base-T	10Base-F
Medium	Thick coax	Thick coax	2 UTP	2 Fiber
Maximum length	500 m	185 m	100 m	2000 m

Table: Standard Ethernet Implementation

In the nomenclature 10 Base X, the number (10) represents the data rate, i.e. 10 Mbps and the base means baseband (digital) signal. X approximately defines the maximum length of the cable or the type of cables.

For example, X = 5 represents maximum length of cable as 500 m
X = 2 represents maximum length of cable as 185 m
X = T represents type of cable as UTP (Unshielded Twisted Pair cable)
X = F represents type of cable as fiber-optic.

Also, 10 base 5 and 10 base 2 are made up of thin coaxial cables as mentioned in table above.

(ii) Fast Ethernet

- Created under the name IEEE 802.3u, fast ethernet is backward compatible with standard ethernet.
- The goal of fast ethernet is to achieve a data rate of 100 Mbps (10 times faster than standard ethernet) keeping the frame format and 48 bit address same.

- The summary of fast ethernet implementations can be tabulated a shown below:

Characteristics	100Base-TX	100Base-FX	100Base-T4
Media	STP	Fiber	UTP
Number of wires	2	2	4
Maximum length	100 m	100 m	100 m

Table: Fast Ethernet Implementation

In the table above, TX represents two wire implementation, FX represents four wire implementation and T4 represents four wire implementation for unshielded twist pair, UTP. STP represents shielded twisted pair.

(iii) Gigabit Ethernet

- Also known as IEEE 802.3z standard, the need for upgradation to 1 Gbps data rate resulted in the design of Gigabit ethernet protocol.
- Gigabit ethernet is made compatible with standard as well as fast ethernet keeping the same frame format and 48 bit address same.
- The summary of Gigabit ethernet implementation can be tabulated as shown below:

Characteristics	1000Base-SX	1000Base-LX	1000Base-CX	1000Base-T4
Media	Fiber short wave	Fiber long ware	STP	Cat 5 UTP
Number of wires	2	2	2	4
Maximum length	550 m	5000 m	25 m	100 m

Table: Gigabit Ethernet Implementation

In the table above, 'SX' stands for short wave implementation and 'LX' stands for long wave implementation with 'CX' meaning copper cable implementation.

(iv) Ten-Gigabit Ethernet

- Ten-Gigabit ethernet was created under IEEE 802.3ae standard for upgradation of data rate to 10 Gbps.
- It is made compatible with standard, fast and Gigabit ethernet and allow interconnection of existing LANs into a Metropolitan Area Network (MAN) and Wide Area Network (WAN).
- The summary of ten gigabit ethernet implementation can be tabulated as below:

Characteristics	10GBase-S	10GBase-L	10GBase-E
Media	Multi-mode fiber	Single mode fiber	Single mode fiber
Number of wires	2	2	2
Maximum length	300 m	10000 m	40000 m

Table: Ten-Gigabit Ethernet Implementation

4.9.3 Metropolitan Area Network (MAN)

- Metropolitan Area Network (MAN) is a network that span over a geographical area the size of a city with its range more than LAN and smaller than WAN.
- MAN uses similar technology as LAN and is created by connecting several LANs. MAN provides a transfer rates from 34 to 150 Mbps.

- Cable network television is the best known example of Metropolitan Area Network (MAN) in most of the cities. WiMAX technology (to be discussed later) is another recent developments of Metropolitan Area Network.
- MAN are based on fiber optic transmission technology and provide high speed interconnection between sites. It can support both data and voice.

4.9.4 Wide Area Network (WAN)

- A Wide Area Network (WAN) spans over a large geographical area as compared to LAN or MAN, spanning multiple countries or continents.
- WAN is usually a combination of LANs, MANs and WANs. The connection can be wired or wireless.
- WAN ranges over a distance of few thousand kilometers. Bandwidth plays a significant role in WAN.
- Mostly Wide Area Networks are connected over long distances via telephone lines, fiber optic cables or satellite links.
- Various network devices such as modem, routers, switches etc. are used in combination with WAN using TCP/IP protocol.
- The internet is the biggest WAN in the word. The cellular telephone network is another example of WAN that uses wireless technology.

4.9.5 Internet

- The internet is a computer network that interconnects hundreds of millions of computing devices across the world.
- It is the world's largest WAN, the global network, the worldwide network of networks, backbone and gateways, a window of the 'information superhighway over the world'.
- Transmission Control Protocol (TCP) and Internet Protocol (IP) are the two significant protocols of the internet collectively known as TCP/IP.
- The Internet Engineering Task Force (IEFT) develops the internet standards to look into the network and protocols of the internet.

Virtual Private Network (VPN):

- A virtual Private Network (VPN) is a network technology commonly used in large organizations that use the global internet for both intra and inter organization communication, but require privacy in their intra organization communication.
- VPN is a private network that is virtual. It is private because it guarantees privacy inside the organization. It is virtual because it does not use real private WANs; the network is physically public but virtually private.
- ESP (Encapsulating Security Payload) protocol of IPSec (Internet Protocol Security) is used in VPN technology.
- VPN provides an access of a corporate organization to the global internet by providing a privacy to access corporate's mail and share files via internet.

4.10 Network Models

- The OSI reference model and the TCP/IP reference models are two most network architectures or layered model that dominate the data communication and network literature.
- However the TCP/IP protocol suit became the dominant commercial architecture because of its extensive use in the internet.

- Although the protocols associated with the OSI model are not used any more, yet the model is quite general and still valid. However the protocols of TCP/IP are now being widely used.

10.1 The OSI Model

- The OSI model stands for open system interconnection model and is developed by International Standards Organization (ISO).
- An open system is a set of protocols that allows any two different systems to communicate regardless of their underlying architecture.
- The OSI model facilitates communication between different systems without requiring changes to the logic of the underlying hardware and software.
- The OSI model is a layered framework for the design of network systems that allows communication between all types of computer systems.
- It is a seven separate layer models related to one another and ordered as shown in figure.

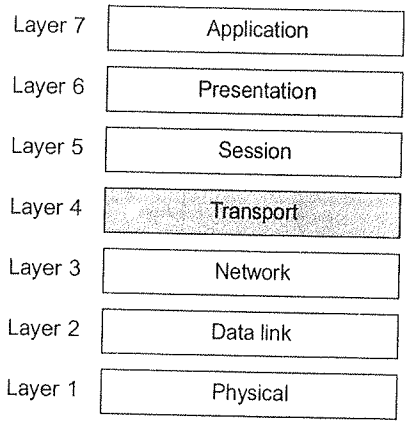


Fig. The OSI Model

Physical Layer (Layer 1)

- The physical layer is responsible to carry a raw bit stream over a physical media. It deals with the mechanical and electrical specifications of the interface and transmission medium.
- The physical layer defines the procedures and functions that physical devices and interfaces have to perform for transmission to occur.
- The physical layer is concerned with connection of devices to the media. In a point-to-point connection, two devices are connected through a dedicated link. In a multi point configuration, a link is shared between several devices.
- The transmission mode is also defined in the physical layer. The direction of transmission between two devices can be simplex, half-duplex or full-duplex.

  Simplex mode is a one way communication, half-duplex is both way (both device can send and receive) but not at the same time, in full-duplex communication is both way and can be sent and received at the same time.

Data Link Layer (Layer 2)

- The data link layer transforms the physical layer to a reliable link by making the physical layer appear error-free to the upper layer (network layer).
- The primary function of this layer is to transform a raw transmission facility into a line that appears free of undetected transmission errors.
- The real errors from physical layer are masked by having the sender break up the input data into data frames and transmit the frames sequentially.
- The data link layer provides a flow control mechanism in case the data rate absorbed by the receiver is less than the rate produced at the sender.
- The MAC (Medium Access Control) sublayer is a special sublayer in the data link layer deals with the issue of access control to the shared channel.

Network Layer (Layer 3)

- The function of the network layer is to deliver a packet across multiple networks from source to destination.

- The network layer is necessary if two systems are connected to different links with connecting devices between the links to ensure the source-to-destination delivery.
- When a packet of data travels from one network to another, the logical addressing of the two networks may differ. Thus network layer helps to handle the addressing problem.
- The network layer also provides the mechanism for the connecting device (such as routers and switches) to route or switch the packets to their final destination in the internet or any large network.
- The network layer plays a great role when the physical addressing or the protocols differ and also when the packets are too large. In broadcast networks however, the network layer is thin or even non-existent.

Transport Layer (Layer 4)

- The primary function of transport layer is to accept data from above it, split it into smaller units and pass these to the network layer and ensure that the pieces all arrive correctly at the other end.
- This layer is responsible for process-to-process delivery of the entire message ensuring that the whole message arrives intact.
- The transport layer also determines the type of service to provide to the session layer and ultimately to the users of the network. It is a true end-to-end layer; it carrier data all the way from source to destination.
- The transport layer can be either connectionless or connection-oriented. A connectionless transport layer treats each segment as an independent packet and delivers it to the transport layer at the destination.

  A connection-oriented transport layer makes a connection with the transport layer at the destination first before delivering the packets.
- Transport layer is responsible for flow control as well as error control. Flow control is performed end to end and error control is achieved through retransmission.

Session Layer (Layer 5)

- The session layer allows users on different machines to establish sessions between them. It is a network dialog controller.
- This layer is responsible to establish, maintain and synchronize the interaction between communicating systems.
- Various services offered in session layer include:
  (a) **Dialog Control:** Allow two systems to enter into a dialog, keeping track of whose turn it is to transmit.
  (b) **Token management:** Prevent two parties from attempting the same critical operation simultaneously.
  (c) **Synchronization:** Add check points into a stream of data in long transmissions to allow them to pick up where they left off in the event of a crash and subsequent recovery.

Presentation Layer (Layer 6)

- The presentation layer is responsible for the syntax and sematics of the information exchanged between two systems, i.e. the correct representation of data.
- The presentation layer is responsible for interoperability between the different encoding methods being used in different computers.
- The presentation layer at the sender changes the information from its centre-dependent format into a common format and is changed back to receiver dependent format at the receiver.
- The presentation layer also ensures translation, encryption and compression of sensitive information and data.

Application Layer (Layer 7)

- The application layer contains a variety of protocols that enables the user, whether human or software to access the network.
- It provides user interfaces and support for services such as electronic mail, remote file access and transfer, shared database management and other types of distributed information services.
- HTTP (Hyper Text Transfer Protocol) is one of the most widely used application protocol which is the foundation of the World Wide Web (www).

Finally, the summary of applications of seven layers of the OSI model can be tabulated as follows:

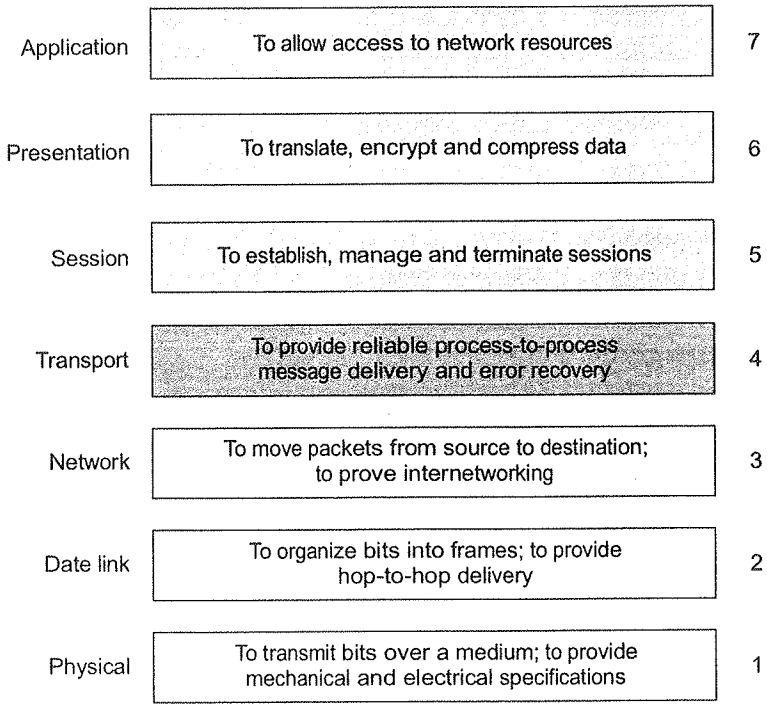


Fig. Functions of OSI Layers

4.10.2 The TCP/IP Model

- The layers in the TCP/IP protocol suit do not exactly match with those in the OSI model. It is just in conjunction for Transmission Control Protocol (TCP) and internet protocol.
- It is originally defined as a four software layers built upon the hardware. However to keep it similar with OSI model, it can be thought of as five layer model and the comparison is shown as:

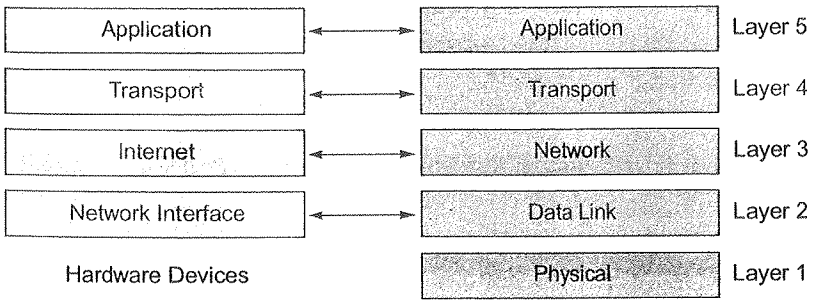


Fig. Layers in TCP/IP

- Application, transport, internet and network interface are the four original layers of the TCP/IP protocol suit.

Network Interface Layer

- Also known as link layer it describes the links such as serial lines and classic ethernet in needs of the connectionless internet layer.
- It is actually an interface between hosts and transmission links of a packet-switched network.

Internet Layer

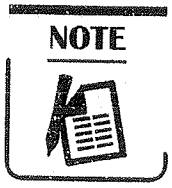
- The internet layer holds the whole architecture together and its job is to permit hosts to inject packets into any network and have them travel independently to the destination.
- The internet layer defines the Internet Protocol (IP) alongwith its companion Internet Control Message Protocol (ICMP) that helps it function. The layer also helps to deliver the IP packets to its destination.

Transport Layer

- The transport layer is designed to allow peer entities on the source and destination hosts to carry on a conversation.
- Two end-to-end transport protocols defined in this layer are Transmission Control Protocol (TCP) and User Datagram Protocol (UDP).
- TCP is a reliable connection oriented protocol that allows byte stream to be delivered without any error over the internet. UDP is an unreliable connectionless oriented protocol that do not want TCP's sequencing or flow control and wish to provide their own.

Application Layer

- The application layer in TCP/IP model is equivalent to the combined session, presentation and application layers in the OSI model.
- This layer contains all higher level protocols including TELNET, FTP, SMTP, DNS, HTTP and RTP.



TELNET	–	Terminal Network
FTP	–	File Transfer Protocol
SMTP	–	Simple Mail Transfer Protocol
DNA	–	Domain Name System
HTTP	–	Hyper Test Transfer Protocol
RTP	–	Real-time Transport Protocol

4.11 Internet and E-mail Protocols

4.11.1 Internet Protocol (IP)

- Internet protocol is a network layer protocol in the TCP/IP mode that holds the whole internet together. IP was designed from the beginning keeping inter networking in mind.
- As there are many possible paths between two hosts due to redundant connectivity in the internet, with backbones and ISPs (Internet Service Provider), hence the IP routing protocols decides which path to use.
- Internet address or IP address is the identifier used in the IP layer of the TCP/IP protocols suit to identify each device connected to the internet.
- There are two IP addresses developed as of now, namely IPv4 (Internet Protocol Version 4) and IPv6 (Internet Protocol Version 6).

IPv4

- IPv4 is a 32-bit address that uniquely and universally defines the connection of a host or a router to the internet.

- IPv4 address are unique as two different device on the internet cannot have same address at the same time. It is also universal as, the addressing system is accepted by any host connected to the internet.
- The address space of IPv4 is 2^{32}, i.e. 4,294,967,296 which means more than 4 billion devices could be connected to the internet without any restrictions.

IPv6

- IPv6 is a replacement design to overcome the address depletion of IPv4 protocol as it can move to larger address.
- IPv6 is a 128-bit address, the address space is 2^{128} which is 2^{96} times of the IPv6 address, which means more than 16 billion people can connect to the internet using IPv6 addressing.
- Thus IPv6 is an advancement to improve all the limitations of IPv4. It aims to support billions of hosts, allow routers to process packets faster, provide better security, improve real-time data and also allow protocols to evolve in the future.

In addition to Internet Protocol (IP), several companion control protocols are being used in the internet which are present in the network layer. These are ICMP, ARP and DHCP.

ICMP

- Stands for Internet Control Message Protocol, ICMP defines a collection of error messages that are sent back to the source host whenever a router or host is unable to process the IP datagram successfully.

ARP

- Known as Address Resolution Protocol, it is a dynamic mapping method for obtaining the physical address of a node when the internet address is known. An ARP request is broadcast to all devices on the network. An ARP reply is unicast to the host requesting the mapping.

DHCP

- Abbreviated for Dynamic Host Control Protocol, DHCP is a client-severe application that delivers vital network information such as internet IP address, IP addresses of a router, name server and its subnet mask to either diskless computers or computers at first boot.

4.11.2 E-mail Protocols

- Electronic mail (e-mail) is one the most popular internet services worldwide. It is one of the most common applications on the internet to exchange messages, voice and video.
- The general architecture of the e-mail system consists of three main components user agent, message transfer agent and message access agent.
- Some of the most significant e-mail protocols are SMTP, POP3, IMAP and MIME which have been discussed below:

SMTP

- Short for Simple Mail Transfer Protocol, SMTP is used in the application layer of the TCP/IP model to exchange electronic mail (e-mail).
- The MTA (Mail Transfer Agent) transfers the mail across the internet, a LAN or a WAN. The protocol that implements the MTA is called SMTP.
- SMTP uses commands and responses to transfer message between an MTA client and on MTA server. The steps in transferring a mail message are: connection establishment, mail transfer and connection termination.
- In web based e-mail systems part of the data transfer is done through the SMTP protocol and part through the HTTP protocol.

POP3

- Post Office Protocol, version 3 (POP3) is a simpler protocol with fewer features and less secure in typical usage adding to its limitations.
- It is an application layer protocol of the TCP/IP model used by e-mail clients to retrieve, e-mail message from mail servers. Mail is usually downloaded on the user's computer instead of remaining on the mail server.
- POP3 supports only one mail server for each mailbox and it is not easy to read mail on multiple computers. Eventually, POP3 is being replaced by IMAP.

IMAP

- Internet Message Access Protocol (IMAP) was defined by RFC 3501 (Request for Comments) having similarities to POP3 but more powerful, complex and more features than POP3.
- IMAP has the ability to address mail not by message number, but by using attributes. It is designed to retrieve messages from multiple mail server and show then all in the user's mailbox.
- G-mail, Yahoo, Outlook are some of the modern e-mail clients and servers that use the IMAP protocol.

MIME

- Multipurpose Internet Mail Extensions (MIME) is a supplementary protocol that allows non ASCII data to be sent through e-mail.
- MIME converts the non ASCII data to ASCII format and delivers it to the client MTA to be sent through the internet. The message is again transformed back to original data at the receiving end.
- MIME thus allows transfer of multimedia messages. SMIME (Secure MIME) is a technology used for secure e-mail.

Mobile IP:

- Mobile internet protocol or mobile IP is designed for mobile communication and is an advanced version of the internet protocol.
- A mobile host has a home address on its home network and a care-of-address on its foreign network. When the mobile host is on a foreign network, a home agent relays message to a foreign agent. A foreign agent sends relayed information to a mobile host.

4.12 Wireless Technologies

4.12.1 Wi-Fi

- Wi-Fi is the most successful wireless LAN standards also commonly known as IEEE 802.11 wireless LAN. Wi-Fi technology is used to achieve wireless connection to the internet today.
- Like the ethernet, Wi-Fi is designed for use in a limited geographical area (home, office building, campus) and its primary challenge is to mediate access to signals propagating through space.
- The range of Wi-Fi lies approximately within 100 yards. It can operational 2.4 GHz and 5 GHz frequency bands. Wi-Fi in 2.4 GHz frequency block has slightly better range than Wi-Fi in the 5 GHz frequency block.
- The physical area of the network which provides internet access through Wi-Fi is called Wi-Fi hotspots. Users can connect to the hotspots through their laptops or mobiles which have built in Wi-Fi card within them.
- The connection through Wi-Fi is usually insecure. However a secure protected connection can be achieved through WPA2 (Wi-Fi Protected Access Encryption).

4.12.2 WiMAX

- WiMAX stands for Worldwide Interoperability for Microwave Access and it also goes by the name IEEE 802.16.
- WiMAX operates similar to Wi-Fi but a higher speeds, over greater distance and for a greater number of users.
- WiMAX was developed further by WiMAX forum to provide wireless broadband access with multilevel encryption at a higher data transfer rate.
- A WiMAX system consists of two parts:
  (a) A WiMAX tower station, to provide coverage over a very large area, as big as 3000 square miles.
  (b) A WiMAX receiver, built into a device to access the signal.
- A WiMAX tower station can directly connect to the internet using a high-bandwidth wired connection. It can also connect to another WiMAX tower using a line of sight, microwave link.
- The various specifications of IEEE 802.16 are:
  (a) Range - 30 mile (50 km) from base station.
  (b) Speed - 70 Mbps
  (c) Frequency bands - 2-11 GHz and 10-66 GHz.
  (d) Line of sight not needed between user and base station.

WiMAX versus Wi-Fi

WiMAX	Wi-Fi
• Long range system covering kilometers (50 km).	• Short range system of about 100 feet (30 m).
• Uses both licensed or unlicensed spectrum to deliver connection to a network.	• Uses unlicensed spectrum to provide access to a local network.
• Uses a Quality of Service (QoS) mechanism and each connection is based on specific scheduling algorithm.	• Uses contention access, i.e. all subscriber station competing for Access Point (AP)'s attention to pass data.
• WiMAX connection metropolitan, i.e. over a city.	• Wi-Fi provides connection within the home or buildings.
• Data transfer rate is about 70 Mbps.	• Data transfer rate is about 54 Mbps.

4.12.3 Bluetooth

- Bluetooth is a proprietary low-power, short-range, low rate "cable replacement" wireless technology standard for interconnecting notebooks, peripheral devices and mobile phones.
- Bluetooth is a IEEE 802.15.1 Personal Area Network (PAN) with high levels of security.
- Bluetooth network operates in the 2.44 Hz unlicensed radio band in a TDM manner, with time slots of 625 microseconds and transmits on upto 79 channels.
- Ericsson together with four companies (IBM, Intel, Nokia and Toshiba) for a Special Internet Group (SIG) in 1998 to develop a wireless standard for short range communication which was later termed as Bluetooth.
- A Bluetooth LAN is an Ad hoc network, hence the network can be form spontaneously; the devices find each other and make a network called a Piconet.

- Bluetooth uses a radio technology called Frequency Hopping Spread Spectrum (FHSS) to spread transmission in time over the frequency spectrum.
- Bluetooth defines two types of networks: Piconet and Scatternet.
  (a) **Piconet:** A Piconet is simply a bluetooth network or a small net. A Piconet can have up to eight stations, out of which one is called the primary and the rest are called secondaries. A Piconet can have only one primary station.
  (b) **Scatternet:** Scatternet is simply a combination of Piconets. A secondary station in one Piconet can be primary in another Piconet. A station can be member of two Piconets.
- With the advancement of technology, Bluetooth has also kept evolving up. Recognizing the need to connect an increasing range of devices more quickly and more securely, Bluetooth's developer are regularly coming up with improved versions.
  (a) First there was Bluetooth BR/EDR (Basic Rate/Enhanced Data Rate, Technically Bluetooth Version 2.1), offering simpler connectivity between devices and better security.
  (b) Next evolution of Bluetooth was Bluetooth HS (High speed technically Bluetooth 3.0), which offered faster communication and lower power consumption.
  (c) With the evolution of Bluetooth smart or Bluetooth low energy, technically Bluetooth version 4.0+, new features as internet of Things (IoT) were introduced to the further versions of Bluetooth.
  (d) Latest version of Bluetooth is Bluetooth 5.0, which includes key features as longer range, faster speed and larger broadcast message capacity, as well as improved interoperability and co-existence with other wireless technologies.

  Bluetooth 5.0 continues to advance the Internet of Things (IoT) experience by enabling simple and effortless interaction across the vast range of connected devices.

4.12.4 Zigbee

- Zigbee is a wireless personal area network also known by IEEE 802.15.4 developed to enable low cost and low power wireless network.
- Zigbee supports much lower data rates and uses a mesh networking protocol to avoid hub devices and create a self-healing architecture.
- Zigbee aims to provide Internet of Things (IoT) feature to support low cost, highly reliable networks for device-to-device communication.
- Zigbee technology is used by variety of cable and telecommunication companies in the set-top box, satellite transceivers and home gateways.

  It is also used in smart home products such as LED bulbs, remotes, switches etc.

4.12.5 NFC

- NFC, short for Near Field Communication is an offshoot of Radio-Frequency Identification (RFID) used in smart phones and similar devices to establish radio communication with each other.
- NFC works using magnetic induction, i.e. a reader emits a small current which creates a magnetic field that in turn bridges the physical space between the device.
- NFC works in 13.56 MHz radio frequency spectrum using less than 15 mA of power to communicate data over distance usually less than 20 cm.
- Three forms of NFC technology exist: Type A, Type B and Felica. All are similar but communicate in slightly different ways.
- NFC devices may be active or passive:
  (a) A passive device, such as NFC tag, contains information that other devices can read but does not read any information itself.

(b) An active device, such as smartphone, would not only be able to exchange information with other compatible devices.

- NFC often establishes a secure channel and uses encryption while sending sensitive information such as credit card numbers in order to ensure security.
- A recent development have placed NFC tags inside book covers. This allows shopper to scan the book cover with smartphone and is taken to a website or other destination with extra content.

4.12.6 RFID

- RFID (Radio Frequency Identification) is a wireless communication that uses electromagnetic or electrostatic coupling in the radio frequency range to uniquely identify an object, animal or person.
- RFID technology takes many forms and is commonly used in smart cards, implants for pets, passports, library books and more.
- RFID system consists of three components: a scanning antenna, transceiver and transponder. An RFID tag consists of a microchip, memory and antenna.
- Active RFID and passive RFID are two main type of RFID tag. An active RFID tag has its own power source and a passive RFID receives power from the reading antenna.
- RFID is finding its way to multiple industries for tracking and management including manufacturing, retail, business and health care. Inventory management, asset tracking, supply chain logistics and vehicle tracking are some of the RFID applications.
- RFID system are being increasing used for the next generation Internet of Things (IOT) deployments.

4.13 Recent Advancements Related to Networking

(i) Li-Fi

- Li-Fi is unique in that the same **visible light** energy used for illumination may also be used for communication. LiFi is a category of Optical Wireless Communications (OWC). OWC includes infrared and ultra-violet communications as well as visible light.
- The term Li-Fi was coined by pure LiFi's CSO, Professor Harald Haas and refers to **light based communications** technology that delivers a high-speed, **bidirectional networked**, mobile communications in a similar manner as Wi-Fi.
- Although Li-Fi can be used to off-load data from existing Wi-Fi networks, implementations may be used to provide capacity for the greater downlink demand such that existing wireless or wired network infrastructure may be used in a complementary fash.on.
- LiFi is the use of the visible light portion of the electromagnetic spectrum to transmit information at very high speeds. This is in contrast to established forms of wireless communication such as Wi-Fi which use traditional radio frequency (RF) signals to transmit data.
- Modulating the intensity of the light transmits the data. A photosensitive detector receives the transmitted data, and the light signal is demodulated into electronic form.

(ii) White-Fi

- White-Fi' technology uses the unused spectrum in frequencies used for broadcasting of television signals. Microsoft's pilot project is likely to offer solution to tackle the problem of last mile broadband connectivity in the country.
- The 200-600 MHz frequency is used for TV channels to carry data. Sufficient space has to be left so that even when tropospheric propagation conditions increase the distances over which signals can be received, interference does not normally occur.

- This means that there are significant areas where these channels are unused and this leads to very poor spectrum use efficiency. In India, 93 per cent of this spectrum is not utilized.
- White-Fi' will use this **vacant spectrum** to provide connectivity.
- In technology parlance, these unused spectrum spaces are called White Space, and many technology companies are looking at using this to provide free last mile internet access to users.
- Under the 'Digital India' initiative, the government plans to use the national optic fibre network project to deliver e-services to all corner of the country. While this network will be deployed at the gram panchayat level, reaching the end consumer may still require wireless technology, particularly in far-flung areas.
- Microsoft has helped implement the technology in Kenya, Singapore, the U.S. and London.

(iii) Project Loon

- It is a research and development project developed by X (google X) with a network of balloons traveling on the edge of space, designed to connect people in rural and remote areas, help fill coverage gaps, and bring people back online after disasters.
- Project Loon balloons float in the **stratosphere approximately** 20 km above the earth surface, twice as high as airplanes and the weather. In the stratosphere, there are many layers of wind, and each layer of wind varies in direction and speed. Loon balloons go where they're needed by rising or descending into a layer of wind blowing in the desired direction of travel. With moving wind the balloons can be arranged to form one large communications network. The signal is then passed across the balloon network and back down to the global Internet on Earth. This connects to the balloon network directly from their phones and other LTE-enabled devices.
- Project Loon began in June 2013 with an experimental pilot in New Zealand, where Loon technology was tested. The results of the pilot test, as well as subsequent tests in New Zealand, California's Central Valley and in Northeast Brazil, are being used to improve the technology in preparation for the next stages of the project.
- Situated on the edge of space, between 10 km and 60 km in altitude, the stratosphere presents unique engineering challenges: air pressure is 1% that at sea level, and this thin atmosphere offers less protection from UV radiation and dramatic temperature swings, which can reach as low as -80°C. By carefully designing the balloon envelope to withstand these conditions, Project Loon is able to take advantage of the stratosphere's steady winds and remain well above weather events, wildlife and airplanes.
- The inflatable part of the balloon is called a balloon envelopemade from sheets of polyethylene plastic. A well-made balloon envelope is critical for allowing a balloon to last around 100 days in the strat*osphere.*

(iv) Internet of Things (IOT)

- The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and covers a variety of protocols, domains, and applications. IoT is a scenario in which objects are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.
- According to Gartner, there will be nearly 26 billion devices on the Internet of Things by 2020. ABI Research estimates that more than 30 billion devices will be wireless:, connected to the Internet of Things (Internet of Everything) by 2020.

4.14 Cloud Computing

- A desktop computer cannot be used in isolation, as one has to go online for various reasons. Sharing of articles, notes, photos or videos with colleagues, co-professionals, friends, relatives, etc., has been a long passion of net users, but online sharing has gone beyond this type of sharing. With the increase in the speed and ease of availability of internet, online remote servers have become a new medium to store data and retrieve the same just like a hard-disk of a desktop computer.

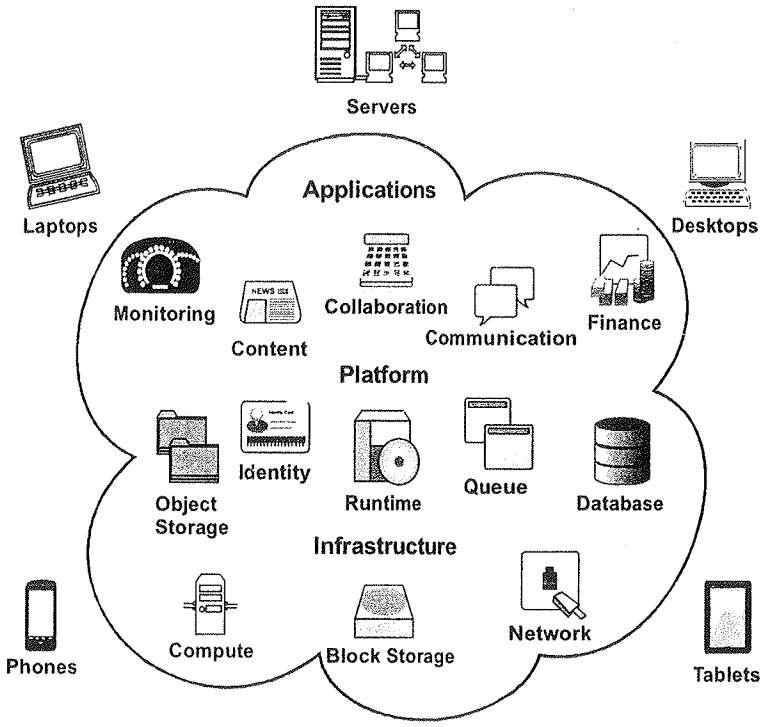


Fig. Cloud Computing

4.14.1 Meaning of Cloud Computing

- Cloud computing is a technology that uses the **internet and central remote serves** to maintain data and applications. It allows consumers, businesses, educational institutions etc. to use applications without installing costly software in their computers. For example, to send an e-mail, all one need just an internet connection, the server and e-mail management software is all on the cloud and is totally managed by the cloud service provides like Yahoo, Google, etc.
- Here, cloud computing comes into the picture, **instead of installing a suit of software for each computer, only an application has to be installed**. This application would allow all the employes to **log into a web-based service** which hosts all the programs the user would need for his or her job. This is called cloud computing. In a cloud computing system, there is a significant workload shift, local computers no longer have to do all the heavy lifting when it comes to running applications. The network of computers that make up the cloud handles them instead.
- Hardware and software demands on the user's side however decreases. The only thing the user's computer needs to be able to much is the cloud computing system's interface software, which can be as simple as a web browser, and the cloud's network takes care of the rest. Like G-mail, Yahoo, etc. are also examples of cloud computing as instead of running an e-mail programme on our computer, we just log into a web e-mail account remotely. The software and storage for this account does not exist on the user's computer, it is on the service's computer cloud.

4.14.2 Cloud Computing Architecture

- In a cloud computing system, it is helpful to divide it into two sections the front end and the back end. The front side is the side, the computer user sees. The back end is the 'cloud' section of the system. The front end includes the user's computer and the application required to access the cloud computing system.

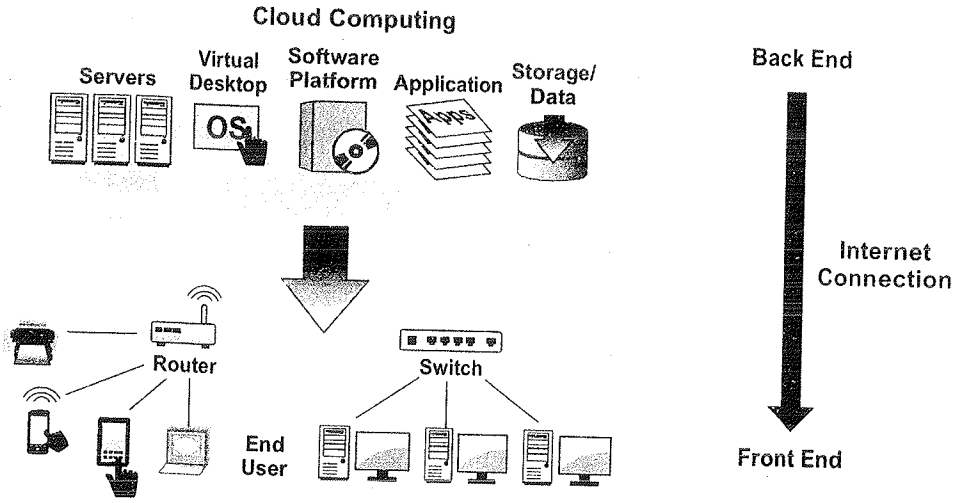


Fig. Cloud Architecture

- Not all cloud computing systems have the same user interface. Services like web based e-mail programs leverage existing web browsers like internet explorer or firefox. Other systems have unique applications that provide network access to clients. **On the back end of the system one the various computers, servers and data storage system that create the 'cloud' of computing services.** In theory, a cloud computing could include practically any computer program you can imagine, from data processing to video games. Usually, each application will have its own dedicated server.
- A central server administers the system, monitoring traffic and client demands to ensure everything runs smoothly. It follows a set of rules called protocols and uses a special kind of software called middleware. Middleware allows networked computers to communicate with each other. Most of the time, server's don't run at full capacity. That means there is unused processing-power going to waste. It is possible to tool a physical server into thinking there are actually multiple servers, each running with its own independent operating system. This technique is called server virtualisation. By maximizing the output of individual servers, server visualization reduces the need for more physical machines.
- If a cloud computing company has large number of clients, there is likely to be high demand for a huge storage space ; some companies require hundreds of digital storage devices. Cloud computing system need atleast twice the number of storage devices it required to keep all its client's information stored. A cloud computing system must make a copy of all its client's information and store it on other devices. The copies enable the central server to access backup machines to retrieve data that otherwise would be reachable. Making copies of data as a backup is called redundancy.

4.14.3 Essential characteristics of Cloud Computing

- **On demand self services:** Computer services such as e-mail, applications, network orserver service can be provided without requiring human interaction with each service provider. Cloud service providers providing on demand self services are Microsoft, Google and IBM

- **Broad network access**: Cloud Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms such as mobile phones, laptops and PDAs.
- **Resource pooling**: The provider's computing resources are pooled together to serve multiple consumers using multiple-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. The resources include among others storage, processing, memory, network bandwidth, virtual machines and e-mail services. The pooling together of the resource builds economies of scale.
- **Rapid elasticity**: Cloud services can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.
- **Measured service: Cloud computing resource usage** can be **measured, controlled** and reported providing transparency for both the provider and consumer of the utilised service.

  Cloud computing services use a metering capability which enables to control and optimise resource use. This implies that just like air time, electricity or municipality water IT services are charged per usage metrics – **pay per use**. The more you utilise the higher the bill. Just as utility companies sell power to subscribers, and telephone companies sell voice and data services, IT services such as network security management, data center hosting or even departmental billing can now be easily delivered as a contractual service.
- **Scalability:** It refers to cloud computing in which the service change in size and volume as per users need. This is a very useful characteristics of cloud computing as the user group large in number, with the help of cloud computing they are easily accommodated over a service offered by server.
- **Multi Tenacity:** It refers to the need for policy-driven enforcement, segmentation, isolation, governance, service levels, and charge back/billing models for different consumer constituencies. Consumers might utilize a public cloud provider's service offerings or actually be from the same organization, such as different business units rather than distinct organizational entities, but would still share infrastructure

4.14.4 Cloud Services

- Users interact with cloud computing environments with the services that the cloud environment provides. The following examples are of services that are provided by a cloud (cloud services):
  1. Virtual servers
  2. Database services
  3. E-mail applications
  4. Storage
- A company can use cloud services that are provided by third parties, or it can build its own cloud. The company can then provide services from the cloud to internal company users, to selected business partners or customers, or to the world at large.

  For a service to be considered a "cloud service," it needs to exhibit the following characteristics:
  1. Support self-service provisioning.
  2. Be accessible through the Internet or corporate intranet.
  3. Provides resources from a resource pool, without the user needing knowledge of the pool.
  4. Provides simple and fast resource elasticity, as users demand changes.

5. Provides the ability to monitor resources with a dashboard view on cloud health status.
6. Support a metering capability, which enables a dynamic charge back model.

- To provide these characteristics, the infrastructure that enables the cloud services takes advantage of two key enablers:
  1. **Virtualization:** Allows computing resources to be pooled and allocated on demand. It also enables pay-per-use billing to be implemented.
  2. **Automation:** Allows for the elastic use of available resources, and for workloads to be moved to where resources are available. It also supports provisioning and de provisioning of service instances to support scalability.

4.14.5 Cloud Service Models

- Service models are sometimes referred to as **delivery models** because they describe the services that are delivered by the cloud model.

Software as a Service (SaaS)

- In SaaS model a software provider license a software application to be used and purchased on demand. This service run on cloud and multiple end users uses it. Basically it runs on web browser e.g. G-mail- a popular SaaS product. It is usually billed based on usage and have multi-tenant environment. In Saas model a software provider license a software application to be used and purchased on demand.
- Applications can be accessed through network from various client (web browser, mobile phone etc.) by application use. It does not require client installation but just a browser or other client device and network connectivity. SaaS applications similarly support what is traditionally known as application customization. In other words, like traditional enterprise software, a single customer can alter the set of configuration options Each customer may have its own settings for the configuration options.
- The application can be customized to the degree it was designed for based on a set of predefined configuration options. For example: to support customer's common need to change an application's look-and-feel so that the application appears to be having the customer's brand. Many SaaS applications let customers provide interface or by working with application provider staff) a custom logo and sometimes a set of custom colors.
- **Characteristics of SaaS:** It is important for Cloud Computing, to ensure that solutions sold as SaaS in fact comply with generally accepted definitions. Characteristics of SaaS include,
  1. Commercial software for Web access.
  2. A central location, managed by software.
  3. "**One to Many**" model of Software delivers.
  4. To handle software upgrades and patches, users are not required.
  5. APIs allows integration between different pieces of software.

Advantages of SaaS:

- **Easy to use:** SaaS applications do not require more than a web browser.
- **Cheap:** SaaS makes it affordable to small businesses and individuals for the pay as you go pricing model.
- **Scalability:** To meet consumer demand, SaaS application can be easily scaled up or down. To scale up, Consumers do not need to worry about additional computing infrastructure.
- Since data is being stored in the cloud, Applications are less prone to data loss.

- **SaaS applications are less clunky**, compared to traditional applications. They do not require users to install/uninstall binary code on their machines. SaaS applications are able to run on a wide variety of devices, due to the delivery nature of Sass through the internet.
- For better collaboration between teams since the data is stored in a central location.
- Much faster of change in Velocity for SaaS applications.
- SaaS favors an agile development life cycle.
- Software changes and frequent and on-demand.

Platform as a Service (PaaS):

- Platform as a Service (PaaS) is a way to rent a hardware, operating systems, storage, network capacity over the Internet. The service delivery model allows the customer to rent virtualized servers and associated services for running existing applications or developing and testing new ones.

  Characteristics of PaaS:

  1. Customizable /Programmable User Interface.
  2. Unlimited Database Customizations.
  3. Robust Workflow engine/capabilities.
  4. Granular control over security/sharing (permissions model).
  5. Flexible "**services-enabled**" integration model.

Advantages of PaaS to Application Developers:

- **They don't have to invest in physical infrastructure**; being able to 'rent' virtual infrastructure has both cost benefits and practical benefits. They don't need to purchase hardware themselves or employ the expertise to manage it. This leaves them free to focus on the development of applications. What's more, clients will only need to rent the resources they need rather than invest in fixed, unused and therefore wasted capacity.
- **Makes development possible for 'non-experts'**; with some PaaS offerings anyone can develop an application. They can simply do this through their web browser utilising one-click functionality.
- **Flexibility**; customers can have control over the tools that are installed within their platforms and can create a platform that suits their specific requirements. They can 'pick and choose' the features they feel are necessary.
- **Adaptability**; Features can be changed if circumstances dictate that they should.
- **Teams in various locations can work together**; as an internet connection and web browser are all that is required, developers spread across several locations can work together on the same application build.
- **Security**; security is provided, including data security and backup and recovery.

Infrastructure as a Service (IaaS):

- Infrastructure as a Service is a model in which an organization outsources the equipment used to support operations, including the storage, hardware, servers and networking components. The service provider owns the equipment and is responsible for housing, running and maintaining it. The client typically pays on a per-use basis. IaaS is sometimes referred to as **Hardware as a Service (HaaS).**
- Automation of administrative tasks, dynamic scaling, desktop virtualization, Internet connectivity these are the various characteristics or we can say components of an Infrastructure as a Service.

  Figure shows the various service models of cloud computing and their interrelation.

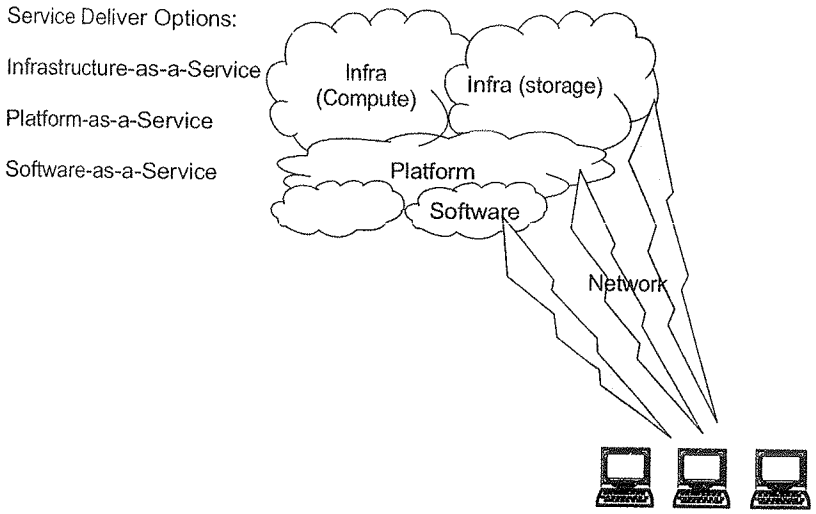


Fig. Service Model of Cloud Computing

Further we can compare between the various service models of cloud computing.

	Paradigm shift	Characteristics	Key terms	Advantages	Disadvantages
Infrastructure as a Service (IaaS)	Infrastructure as an asset	Usually platform independent; infrastructure costs are shared and thus reduced; service level agreements (SLAs); pay by usage; self-scaling	Grid computing, utility computing, compute instance, hypervisor, cloud brusting, multi-tenant computing, resource pooling	Avoid capital expenditure on hardware and human resources; reduced ROI risk; low barriers to entry; streamlined and automated scaling	Business efficiency and productivity largely depends on the vendor's capabilities; potentially greater long-term cost; centralization requires new/ different security measures
Platform as a Service (PaaS)	License purchasing	Consumes cloud infrastructure; caters to agile project management method	Solution stack	Streamlined version deployment	Centralization requires new/ different security measures
Software as a service (SaaS)	Software as an asset (business and consumer)	cloud components; communication via APIs; stateless; loosely coupled; modular; semantic interoperability	Thin client; client-server application	Avoid capital expenditure on software and development resources; reduced ROi risk' streamlined and iterative updates	Centralization of data requires new/ different security measures

4.14.6 Cloud Delivery Models

- Cloud delivery models refer to how a cloud solution is used by an organization, where the data is located, and who operates the cloud solution. Cloud computing supports multiple delivery models that can deliver the capabilities needed in a cloud solution.

The cloud delivery models are as follows:

(i) Public cloud

(ii) Private cloud

(ii). Hybrid cloud

(iv) Community cloud

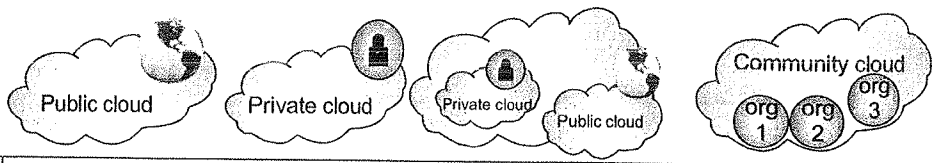
- **Public clouds:** A public cloud is one in which the cloud infrastructure is made available to the general public or a large industry group over the Internet. The infrastructure is not owned by the user, but by an organization that provides cloud services. Services can be provided either at no cost, as a subscription, or as a pay-as-you-go model.
- **Private clouds:** A private cloud refers to a cloud solution where the infrastructure is provisioned for the exclusive use of a single organization. The organization often acts as a cloud service provider to internal business units that obtain all the benefits of a cloud without having to provision their own infrastructure. By consolidating and centralizing services into a cloud, the organization benefits from centralized service management and economies of scale.

  A private cloud provides an organization with some advantages over a public cloud. The organization gains greater control over the resources that make up the cloud. In addition, private clouds are ideal when the type of work being done is not practical for a public cloud because of network latency, security, or regulatory concerns.

  A **private cloud can be owned, managed, and operated by the organization, a third party, or a combination.** The private cloud infrastructure is usually provisioned on the organization's premises, but it can also be hosted in a data center that is owned by a third party.
- **Hybrid clouds:** A hybrid cloud, as the name implies, **is a combination of various cloud** types (public, private, and community). Each cloud in the hybrid mix remains a unique entity, but is bound to the mix by technology that enables data and application portability.

  The **hybrid approach allows** a business to take advantage of the **scalability and cost-effectiveness** of a public cloud without exposing applications and data beyond the corporate intranet. A well-constructed hybrid cloud can service secure, mission-critical processes, such as receiving customer payments (a private cloud service), and secondary processes such as employee payroll processing (a public cloud service).

  The challenge for a hybrid cloud is the difficulty in effectively creating and governing such a solution. Services from various sources must be obtained and provisioned as though they originated from a single location, and interactions between private and public components make the implementation even more complicated.
- **Community clouds:** A community cloud shares the cloud infrastructure across several organizations in support of a specific community that has common concerns (for example, mission, security requirements, policy, and compliance considerations). The **primary goal of a community cloud is to have participating organizations realize the benefits of a public cloud,** such as shared infrastructure costs and a pay-as-you-go billing structure, with the added level of privacy, security, and policy compliance that is usually associated with a private cloud. The community cloud infrastructure can be provided on-premises or at a third party's data center, and can be managed by the participating organizations or a third party.



Host	Provider	Enterprise, 3rd Party	Enterprise, 3rd Party	Community 3rd Party
Owner	Provider	Enterprise	Enterprise	Community
Access	Internet	Internet, VPN	Internet, VPN	Internet, VPN
Users	Public individuals organizations	Business Units	Business Units	Community Members

Fig. Cloud Delivery Method

Figure above illustrates these cloud delivery models, and identifies some of their characteristics in terms of roles, users, and accessibility.

4.14.7 Severs in the Cloud

- Servers are the backbone of cloud computing. Platform. virtualization, a technology used by cloud computing providers to offer servers to users

Platform Virtualization: Platform virtualization is a technology to abstract physical hardware resources of a single server into a number of virtual computing environments, allowing multiple operating systems to be installed into each of these environments.

The heart of the virtual machine is the **hypervisor**. This is the software that sits between the hardware and operating systems. Its main role is allocating system resources. Each of these individual operating systems behaves as if it has the resources of the whole server to itself. This is illustrated in Figure above.

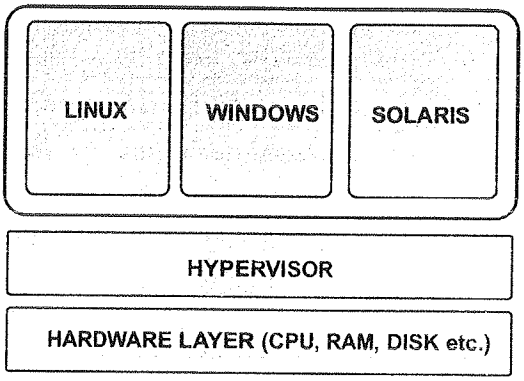


Fig. Platform Virtualization

Each of the three operating systems is in fact three different virtual machine image. Each of these machine images is a snapshot of an operating system, and these images are then loaded onto the virtual machine environment.

It is important to realize that you do not pay for an entire server. Instead, cloud providers provide you with a **virtual machine image**, one of many that is loaded on the virtual computing environment.

- **Features of Platform Virtualization:** Through the features of platform virtualization, cloud computing service providers are able to offer servers that are cost-effective, rapidly deployable and scalable. These features are namely,
- **Increased server utilization:** The average server in an enterprise data centre without platform virtualization has a typical utilization of 5 to 10 percent. Even at peak loads, the maximum is around 20 percent. Cloud computing providers leverage on this fact by running multiple virtual servers on one physical server through platform virtualization and are thus able to lease out more servers (virtual) with the same amount of hardware resources.
- **Removal of hardware dependencies:** Cloud computing service providers and users no longer need to bother about hardware compatibility issues. They just need to focus their software applications and service-level agreements. Furthermore, developers only need to worry about the operating system they need, and how much performance they require.

- **Removal of software dependencies:** With virtualization, there is no need to worry about device driver dependencies as they are handled by the virtual machine environment.
- **Quick Deployment and Teardown:** Virtualization makes it extremely easy to deploy a "server"– simply load the virtual machine image. It is also easy to tear down a machine image.
- **Quick Deployment and Teardown:** Virtualization makes it extremely easy to deploy a "server"– simply load the virtual machine image. It is also easy to tear down a machine image.

EXAMPLE 1.1

Consider the following statements regarding Cloud computing:
1. Private cloud describes a 'cloud services' that can be accessed only by a pre-defined group of people
2. Private cloud provides elastic behaviour as well as scalability
3. Scalability is that feature of cloud computing which alters the service to change in size or volume so as to meet user's needs
4. A cloud environment can be accessed from anywhere in the world so long as the user has access to the internet

Which of the above statements are correct?

(a) 1, 2 and 3 only
(b) 1, 3 and 4 only
(c) 2, 3 and 4 only
(d) 1, 2, 3 and 4

[Sample Question for ESE 2017 : Released by UPSC]

Ans. (d)

EXAMPLE 1.2

Which of the following is a software distribution model in which the applications are hosted by a service provider and are made available to users over a network?

(a) Information as a service
(b) Platform as a service
(c) Software as a service
(d) Platform and Software jointly as a service

[Sample Question for ESE 2017 : Released by UPSC]

Ans. (c)

4.15 Grid Computing

Grid Computing is an emerging computing model that provides the ability to perform higher 'throughput computing by taking advantage of many networked computers. It creates a model of virtual computer architecture that is able to distribute a process execution across a parallel infrastructure. **Grids use resources of many separate computers connected by a network** (usually the internet) to solve large-scale computational problems. Grids provide the ability to perform computations on large data sets, by breaking them down into many smaller ones, or provide the ability to perform many more computations at once than would be possible on a single computer, by modelling a parallel division of labour between processes.

4.15.1 Common Features of Grid Computing

1. It offers a model for solving massive computational problems by making use of the unused resources (CPU cycles or disc storage) of large numbers, of disparate, often desktop computers treated as a virtual cluster embedded in a distribution telecommunication infrastructure.
2. It is ability to support computation across administrative domains set it apart from traditional computer clusters.

3. It has the design goal of solving problems too big for any single super-computer, whilst retaining the flexibility to work on multiple smaller problems. Thus it provides multi-user environment.
4. It involves **sharing heterogeneous resources** (based on different platforms, hardware/software architectures and computer languages) located in different places belonging to different administrative domains over a network using open standards. In short, it involves virtualising-computing resources.

4.15.2 Applications

Today corporates, small and large, have realized, that to be ahead of the competition, they need to improve enterprise infrastructure both computational and storage and improve business processes.

Grid computing offers a way to solve grand challenge problems like protein folding, financial modelling, earthquake simulation, climate modelling by optimizing use of information technology resources in organisation.

Some Examples of Applications

(i) **Meteorology or Climate Modelling:** It offers way to solve massive computational problems, by means of combining unutilized power in thousands of personal computers, world-wide.

(ii) **Educational Institutes:** It is cheaper option of a cluster of standard computers, which can achieve teraflop performance by clever distribution of the-task at hand, as they cannot afford the cost of supercomputer.

(iii) **Government Agencies:** It can be used to combine geographically spread high performance computing resources to tackle national tasks like electoral rolls or tax data bases.

4.15.3 Current Development in Grid Computing

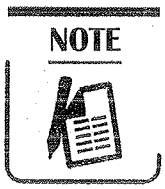
The various industry groups are making concerted efforts as grid computing is no within the power of any one player to deliver, but an ecosystem where low cost and high volume processors, combine with 'blade server' technology, and storage options like storage area networks, with connectivity technology like Ethernet or Fibre Channel, all driven by a cost-effective and enterprise ready operating system.

Oracle has marked on its flagship database and what has emerged, is version 109, claimed to be the industry's first relational database optimized for grid computino Storage networking leader Network Appliance (Net APP) has launched technology called Snapshot, which allows several 'cloned' data sets to share the same 'physical data block'.

4.15.4 Indian Scenario

With an increased awareness of technologies, Indian Companies are leading the world in perceptions of shifting towards a "Grid IT environment" with about 48% of organisations polled in an oracle survey stating that they had already opted for or were in process of embracing grid technology.,

The results of the Latest Oracle Grid Index Research indicate an increased awareness of enabling technologies. The Grid Index -maps the grid computing maturity based on three underlying indices foundation readiness, knowledge and interest and adoption life style. India Oracle Grid Index moved from 2.9 to 4.4, registering the fastest grid index growth worldwide (52%)



GARUDA

Grid computing has been identified by C-DAC as next thrust area and government has approved recently a prototype Grid Computing Initiative (GARUDA) for implementation over the next 12 months. It provides an underlying network fabric at 100 mbps at 17 locations to enable remote access to Param-Padma and Param-IOOOO vComputers and other systems.

4.16 Web

4.16.1 WWW

- The web, popularly known as World Wide Web is the architectural framework for accessing linked content spread out over millions of machines all over the internet.
- The web began in 1989 at CERN, the European Centre for Nuclear Research. 'www' was then invented by Tim Berners Lee who was a physicist at CERN.
- A personal demonstration of the web led other researches develop the first graphical web browser. It was called 'Mosaic' and released in 1993.
- In 1994, CERN and MIT formed an organization called W3C (World Wide Web Consortium) devoted to further develop the web, standardize protocols and encourage interoperability between sites.
- By 2000, web sites and web pages grew exponentially until there were millions of sites and billions of page.
- Alongwith the evolution of internet, there have been recent developments in the field of web. The development of web generations from web 1.0 to web 2.0 and subsequently web 3.0 can be summarized by comparison as shown in table below:

S.No.	Web 1.0	Web 2.0	Web 3.0
1.	1996	2006	2016
2.	The Web	The Social Web	The Semantic Web
3.	Tim Berners Lee	Tim O'Reilly	Sir Tim Berners Lee
4.	**Read only web**	**Read and write web**	**Read, write and execute web**
5.	**Information sharing**	**Interaction**	**Immersion**
6.	Million of users	Billion of users	Trillion of users
7.	Ecosystem	Participation	Understanding itself
8.	**Connect information**	**Connect people**	**Connect knowledge**
9.	Brain and Eyes (= Information)	Brain, Eyes, Ears, Voice and Heart (= Passion)	Brain, Eyes, Ears, Voice, Heart, Arms and Legs (= Freedom
10.	**The Hypertext/CGI Web. (the basics)**	**The community Web(for peiple: apps/sites connecting them).**	**The Semantic Web (for machines).**
11.	Pushed web, text/graphics based flash	Two way we pages, Wikis, Video, pod casts, shading, Personal publishing, 2D portals	30 portals, avtar representation interperable profile, multi-user virtual environment (MUVEs).
12.	Companies publish content that people consume (e.g. CNN)	People publish content that other people can consume, companies build platforms that let people publish content for other people (e.g. Flickr, YouTube, Adsense, Wikipedia, Blogger, MySpace, RSS, Digg)	People build applications that people can interact with, companies build platforms that let people publish services by leveraging the associations between people or special content (e.g. Facebook, Google, Maps, My Yahoo!)

13.	In Web 1.0 search engines retrieve macro contents. Search is very fast but many times results are inaccurate or more than users can chew.	In Web 2.0 search engines retrieve tags with micro contents (Furl even retrives tags with macro contents). The process of tagging is manual, tedious and covers negligble percents of the WWW. Web 2.0 tags everythings: pictures, links, events, news, Blogs, audio, videoand so on. Gooogle base even retrives micro content texts.	In Web 3.0 search engines will hopefully retrieve micro content texts which were tagged automatically. This implies translating billions of Web 1.0 macro contents into micro contents. The result could be more precise search because tagging can solve part of the ambiguity that homonyms and synonyms introduce into the process of search.
14.	Web 1.0 web all about static content, one way publishing of content	Web 2.0 is more about 2 way communication through social networking, blogging, wikis, tagging, user generated content and video.	Web 3.0 is curiusly underfined. AI and the web learning what you want and delivering you a personalized web experience.
15.	The web in the beginning when it was first developing web 1.0	New advances that allow a much more sophisticated user interaction with web pages – citizen journalism social networks and Wikis are all products of web	Thought to be the future - where the web is more interactive with users, loading to a kind of artificial intelligence web 3.0
16.	Content Management system	Blogs	Semantic Blogs; emiBlog,Haystack, Semiblog, Structured Blogging
17.	Personal web sites	Wikis, Wikipedia	Semantic Wikis: Semantic MediaWiki, SemperWiki, Platypus, dbpedia, Rhizome.

Example 1.

Statement (I): The anchoring concept of Web 2.0 is 'Data is the king', i.e., we can create a web Mashup by dragging data from other websites or services.

Statement (II): Web Services refers to a loosely-coupled distributed computing architecture.

(a) Both Statement (I) and Statement (II) are individually true; and Statement (II) is the correct explanation of Statement (I)

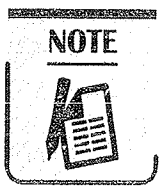
(b) Both Statement (I) and Statement (II) are individually true; but Statement (II) is *NOT* the correct explanation of Statement (I)

(c) Statement (I) is true; but Statement (II) is false

(d) Statement (I) is false; but Statement (II) is true

[Sample Question for ESE 2017 : Released by UPSC]

Ans. (d)



Web 4.0

Web 4.0 is still a developing web generation and is considered a 'Symbiotic web' with ultra intelligence. The idea of symbiotic web is that there will exist symbiotic interaction between user and machine. In web 4.0, machine would read the contents of the web and decide what to execute first for better performance and superior quality and build more commanding interfaces. Web 4.0 will be able to read and write concurrency web and ensure good governance, better transparency, distribution and participation into various social, political and industrial communities.

4.16.2 HTML

- Stands for Hyper Text Markup Language, HTML is a language of the web which has vast application for creating web pages and web applications.

- HTML allows users to produce, web pages that include text, graphic, video, pointers to other web pages and more. It is a markup language which describes how documents are to be formatted.
- HTML has evolved over ages from HTML 1.0 upto HTML 5.0 till now. HTML 1.0 was the version of HTML used with the introduction of web.
- HTML 2.0, 3.0 and 4.0 version appeared in rapid succession in the space of only a few years as the web exploded.
- HTML 5.0 is the latest version of HTML that includes many features to handle the rich media that are now being used on the web. Video and audio can be included in pages and played by web browser without installing any plug-ins.

4.16.3 XML

- XML stands for Extensible Markup Language is a language for specifying structured content designed to store and transport data in a safe and secured way.
- XML is designed to be both human and machine readable and is much similar to HTML. It is a W3C recommended language designed to be self-descriptive.
- The only way XML differs from HTML is that XML is designed to carry data with focus on what data is and HTML was designed to display data with focus on how data looks. XML tags are not predefined like HTML tags.
- XML stores data in plain text format. This provides a software and hardware independent of storing, transporting and sharing data.

NOTE: Java, Java Script, Python, CSS, PHP, Ruby, C++, C are the top level programming language used for creating and developing websites.

4.16.4 HTTP

- HTTP stands for Hyper Text Transfer Protocol and is the most significant protocol of world wide web for transferring text, images, audio, video and other multimedia files.
- HTTP is a simple request-response protocol that normally runs over TCP. It specifies what message clients may send to servers and what responses they get back in return.
- HTTP is implemented in two programs: a client program and a server program. The client and server program, executing on different end systems, connect each other by exchanging HTTP message.
- When a user request a web page, the browser sends HTTP request message for the object in the page to the server. The sever receives the request and responds with HTTP response message that contains the objects.

4.16.5 URL

- The Uniform Resource Locator (URL) is a standard locator that refers to the location of a web resource on a network and mechanism to retrieve it.
- The URL defines four things: protocol, host, port and path as shown in figure below:

As for example: https://www.madeeasy.in/home

(a) The protocol is the client-server application program used to retrieve the document. In the example 'https' (hypertext transfer protocol secured) is the protocol.

(b) The host is the domain name of the computer on which information is stored. In the example "www.madeeasy.in' is the host.

(c) Port in URL is optional and represents the port number of the server. As in the example, port is not present in the URL.

(d) Path is the path name of the file where the information is located. In the example 'home' is the path.

4.16.6 Domain Names

- A domain name is a website name or the address to identify a server in the World Wide Web.
- Each website is assigned to a unique IP address for it to be accessible. Due to difficult in remembering the string of numbers in IP addresses, domain names were developed.
- The domain name comes with an extension or label to categorize the type of website. Some of the common domain name extension are:

  .com → for commercial websites

  .net → for networking websites

  .org → for organization

  .gov → for government website

  .in → for Indian website

4.16.7 Web Browsers

- Webpages or websites are generally viewed with an application software called web browser. Any resources on the World Wide Web can be accessed by presenting a particular URL in the Web Browsers.
- 'Mosaic' was the first web browser developed. Some other example of web browsers are Internet Explorer (IE), Chrome, Firefox, Safari, Opera, Microsoft Edge, Epic, Maxthon, Avant, UC Browser, Midori, NetSurf etc.

4.16.8 Web Service

- It is a service offered by an electronic device to another electronic device, communicating with each other via world wide web.
- In web service, web technology such as HTTP originally designed for human to machine communication, is utilized for machine to machine communication for transferring machine readable file formats such as XML.
- A web service is a client server application for communication. It is a method of communication between two devices over network.
- It is also a collection of standard or protocols for exchanging information between two devices or application. Eg. Java application can interact with JAVA, Net and PHP applications so, web service is a language independent of communication.

4.16.9 SOAP

- Simple Object Access Protocol (SOAP) is an XML based protocol consist of three parts:
  (a) An envelope that defines the message structure and how to process it.
  (b) A set of encoding rules for expressing instances of application defined data types.
  (c) A convention for representating procedure calls and responses.
- SOAP has three main characteristics:
  (a) **Extensibility:** Security and WS-routing are among the extensions under development.
  (b) **Neutrality:** SOAP can operate over any protocols such as HTTP, SMTP, UDP etc.
  (c) **Independence:** SOAP allows for any programming model.

4.17 Network Security

To ensure protection of data, from official documents to personal details, it is necessary to ensure security to prevent misuse of network resources and also prevent unauthorized access to those data and information. The various forms of security that are provided in the world of networking are discussed below:

4.17.1 Cryptography

- 'Cryptography' is a Greek word meaning "secret writing". This technique allow a sender to disguise data so that an intruder cannot gain any information from the intercepted data.
- 'Plain text' is a message to be encrypted and transformed by a function that is parameterized by a key.
- 'Ciphertex' is the output encrypted message that is then transmitted by messenger or radio. A cipher is a bit for bit transformation to the linguistic structure of the message.
- Another form of cryptography called quantum cryptograph uses the concept that light comes in little packets called photons, which have some peculiar properties (like polarization).
- 'Symmetric Key Cryptography' is a form of cryptographic algorithm in which the keys of both sender and receiver are same and are secret. Data Encryption Standards (DES) and Advanced Encryption Standards (AES) are the approved stands for this cryptography.
- 'Public key algorithm' is another form of cryptography in which the encryption algorithm is made public but keys of sender and receiver are not identical and is kept secret.
- Block ciphers and stream ciphers are the two broad classes of symmetric key encryption. Block cipher is used in many securing protocols including PGP (for e-mail security), SSL (for securing TCP connection) and IPSec (for securing communication).

4.17.2 Digital Signature

- A digital signature is basically a way to authenticate electronic documents. The authenticity of many legal, financial and other digital documents is determined by the digital signature.
- Digital signature is required in financial system to authenticate the customer and the service provider as well as to protect the system from fraud.
- In principle, any public key algorithm can be used for digital signatures. RSA public key algorithm is the de facto standard used in many security products.

4.17.3 Communication Security

Communication security looks into the aspect of transferring bits secretely without modification from sender to receiver and how to keep unwanted bits outside the door.

IP Sec

- IP Sec stands for IP security is a collection of protocols designed by IEFT to provide security for a packet at the network level.
- IP Sec helps create authenticated and confidential packets for the IP layer and operates in two different modes: transport mode and tunnel mode.
- IP Sec defines two protocols - the Authentication Header (AH) and the Encapsulating Security Pay Load (ESP) to provide authentication and encryption for packets at the IP level.

Firewall

- A firewall is a specially programmed router that is connected to two or more physical networks and forwards packets from one network to another.
- Firewall protects and secures the internal network for any external network such as the internet. It can be implemented in both hardware and software as well as their combination.

- Firewalls are conceptually very simple device that can be classified in two broad categories:
  (a) Filter based - configured with a table of address that characterize the packets they will or will not forward.
  (b) Proxy based - a process that sits between a client process and server process by implementing a security policy.

Wireless Security

- WPA2 (Wi-Fi Protected Access 2), also called 802.11i is a data-link level security protocol for preventing a wireless node from interfering with messages sent between another pair of wireless nodes.
- It is a replacement for WEP (Wired Equivalent Privacy) which is the first generation of 802.11 security protocols.

Bluetooth Security

- Bluetooth security provides full data encryption and integrity control in four security modes. It provides security in multiple layers.
- A shared key also known as pass key is used to provide secret connectivity between two bluetooth device.

4.17.4 E-mail Security

PGP

- Stands for Pretty Good Privacy, PGP is a complete e-mail security package that provides privacy, authentication, digital signatures and compression, all in an easy-to-use form.
- PGP encrypts data by using a block cipher called IDEA (International Data Encryptional Algorithm) which uses 128-bit-keys.

S/MIME

- S/MIME stand for Secure Multipurpose Internet Mail extension is an e-mail security ventured by IEFT.
- S/MIME provides authentication, data integrity, secrecy and nonrepudiation. It is quite flexible and supports a variety of cryptographic algorithms.

4.17.5 Web Security

With the wide expansion of internet, web security have become an essential requirement for individuals and organization. Such measure can reduce errors, fraud and any loss of data.

SSL

- SSL is short for Secure Socket Layer and is a security package used for web security. This software and its protocol is being widely used in web browsers like Firefox, Internet Explorer, Safari etc.
- Once the secure connection has been established, SSL's main job is handling compression and encryption. When HTTP is used over SSL, it is called HTTPS (Secure HTTP).

TLS

- Short for Transport Layer Security, TLS is a modification of SSL by IETF standardization. TLS was built on SSL version 3.
- Due to incompatibility between TLS and SSL, most browsers often use both the protocols. This is referred to as SSL/TLS.

4.17.6 Social Security

Steganograph

- Steganography is the science of hiding message. It is a Greek word meaning 'covered writing'. People who want to communicate secretely often try to hide the fact that communication is taking place at all.

- To use steganography for undetected communication, dissidents could create website bursting with politically correct pictures with the picture being riddled with steganographic message.

NOTE: Privacy, freedom of speech and copyright are the other form of social security issue in the internet world today.

4.17.7 Security Threats

With the huge expansion of internet, the vulnerability of information systems and networks also increases to attacks by criminals and hackers. Some of the common security threats in the computer and internet world are described below:

Trojan: A Trojan or Trojan horse is a type of malware that often disguises as a legitimate software. Trojans can enable cyber-criminals to spy, steal sensitive data and gain back-door access to any system. Once activated Trojans can delete, block, modify or copy data and also disrupt the performance of computers and networks. Trojans are not self-replicative.

Virus: Virus is a form of malware that infect other programs by adding to them a virus code to get access at an infected file start-up. It can replicate itself and ensures that a victims computer never operates properly.

Worms: Worm is a type of malware that uses network resource for spreading. It is harmless as compared to Trojan and virus but can replicate at a much faster speed and can spread from one network to network occupying hard disk space as well as bandwidth of network.

Spyware: It is an software that allows to spy on any computer without the owner's knowledge. It is often used to trace user's actions on computer, collect information about hard drive contents and the information about the quality of connection, way of connecting etc.

Keylogger: Keylogger is a software that keeps record of every keystrokes made using a keyboard. Keylogger is a powerful threat to steal sensitive information such as peoples login credentials like user name and password.

Adware: Adware is not actually a harmful threat but it allows websites to pop out a log of advertisement which can be pretty annoying. Adware often gathers and transfer personal information of the user to its distributor.

Backdoor: Backdoor is not really a malware, but it is a form of method where once a system is vulnerable, attacker can bypass all regular authentication service. If a backdoor is already installed, it becomes very easy for the system to be attacked by Trojans or viruses.

Botnet: The word Botnet is formed from the words 'robot' and 'network'. Cyber criminal can act as the master of a larger 'zombie network' or 'bot network'. The result of this attack is that the victim's computer, which is a bot can be used for a large scale attack like DDoS (Distributed Denial of Service) attack.

DDoS: Distributed Denial of Service, also known as DDoS is a trick to sent a lot of traffic to a system or network. By sending millions of traffic to a single server, the system may cause the security features to be disabled thereby allowing the data vulnerable to be stolen by an anonymous party.

Phishing: In phishing attack, a fake website is created which almost looks like the actual website. The link is then send through mail delivery which tricks the users into believing that it is an original site and lets them enter their sensitive information into that fake login form. Passwords, credit card details, banking details are often attacked through this form of cyber crime.

Pharming: Pharming is similar to phishing but a little tricker. In one form of pharming, also called DNS poisoning, user's DNS is being poisoned and compromised such that all the traffic will be redirected to the attacker's DNS. In other form of pharming, it edits the user's host file and redirects to another website.

Bluesnarfing: Bluesnarfing is a form of attack in which the attacker has unauthorized access to the targeted mobile phones, laptops or PDA via a Bluetooth connection. By such unauthorized access, attackers can steal photos, calender, contacts and SMS.

Rootkit: Rootkit is a program designed to conceal malicious activity from its detection. Rootkit can disguise malware and prevent them from being detected by an antivirus applications. Rootkits can also modify operating system and substitute its main functions to disguise its presence and actions the attacker makes on the infected computer.

Spam: Spam is an anonymous, mass undesirable mail correspondence. It is a political and propaganda delivery, mail asking to help somebody. Another category of spam are message suggesting one to cash a great sum of money or inviting to financial pyramid with the intention to steal passwords and credit card numbers. Spam increases load on mail server and increases the risk of losing information that is important for the user.

Spoofing: Spoofing is a malicious practice employed by cyber scammers and hackers to deceive systems, individuals and organizations into perceiving something to be what actually is not. IP spoofing allows the hacker to edit the source address or IP by altering the header detail. IP spoofing are of two types:

- Man in the middle attacks.
- Denial of Service (DoS) attacks.

Ransomware: Ransomware infects a computer system by encrypting sensitive data such as personal documents or photos and demands a ransom amount for their release. Some ransomware variants lock out all the access to a computer system.

4.18 IT Act

The Information Technology Act, 2000 is an act of Indian law to deal with cyber crimes and e-commerce. It is an act to provide legal recognition for transactions carried out by means of electronic data interchange and other means of electronic communication, commonly referred to as "electronic commerce", which involves the alternatives to paper-based methods of communication and storage of information, to facilitate electronic filing of documents with the government agencies.

As per IT Act, formation of controller of certificate authorities to regulate digital signatures and establishment of Cyber Appelate Tribunal to resolve disputes due to new law were formed. Also, some major amendments were made in 2008 to the IT Act to address issue like cyber terrorism, data protection etc.

ESE Prelims Question

Q.1 Consider the following statements on 'firewall' used in computing systems:

1. It controls and monitors the data traffic flow between inside and outside network
2. It protects and secures the inside network from any outside network
3. It can be implemented in software or hardware or a combination of both

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

[ESE-2017]

Ans. (d)

Q.2 Consider the following statements regarding Holostore:

1. It is a device that reads and writes data in an optical form
2. It is a computer storage device
3. It refers to Institutions where holography is taught

Which of the above statements are correct?

(a) 1, 2 and 3 (b) 1 and 3 only
(c) 1 and 2 only (d) 2 and 3 only

[ESE-2017]

Ans. (c)

Q.3 Consider the following statements regarding internet of things (IoT):

1. IoT extends the communication via internet to all the things that surround us
2. IoT is M2M communication
3. IoT uses only wireless technology
4. The major objectives for IoT are the creation of smart environments/spaces and self-aware things.

Which of the above statements are correct?

(a) 1 and 3 (b) 2 and 3
(c) 1 and 4 (d) 2 and 4

[ESE-2017]

Ans. (d)

Q.4 Consider the following statements concerning e-governance and technology:

1. Rich Site Summary (RSS) is not a very useful tool for working on Web-service technology
2. Myspace is one of the most visited networks in the world
3. Facebook.com is not the most useful social networking site of choice for most students
4. Wiki- is a group collaboration software tool working on Web-service technology.

Which of the above statements are correct?

(a) 1 and 4 (b) 2 and 4
(c) 1 and 3 (d) 2 and 3

[ESE-2017]

Ans. (a)

Objective Brain Teasers

Q.1 NSFNET is abbreviated for

(a) National Secured Foundation Network
(b) National Science Foundation Network
(c) National Secured Forum Network
(d) National Science Forum Network

Q.2 Consider the following statement:

(i) The primary elements in a protocol are syntax, sematics and timing.
(ii) Standards are mandatory governing rules for a communication to occur.

Which of the above statements is/are correct?

(a) (i) only (b) (ii) only
(c) Both (i) and (ii) (d) None of these

Q.3 Consider the following statement:

(i) 'De facto' standards are those standards that have been legislated by an officially recognized body.
(ii) MS office is a 'De facto' standard.

Which of the above statements are correct?

(a) (i) only (b) (ii) only
(c) Both (i) and (ii) (d) None of these

Q.4 'IEEE' is abbreviated for

(a) Institute of Electronic Engineers
(b) Institute of Electrical Engineers
(c) Institute of Electrical and Electronic Engineers
(d) Electronic Industrial Institute of Electrical Engineers

Q.5 Which of the following standard organisation was founded by Tim Berners Lee to provide computability for new standards?

(a) IEFT (b) IEEE
(c) ITU (d) W3C

Q.6 Which of the following administration focuses on long-term research topic related to internet protocol and its application?

(a) ISOS (b) IEFT
(c) IRFT (d) IEEE

Q.7 Which of the following do not fall into the category of guided transmission media?

(a) Twisted pair (b) Infrared
(c) Co-axial (d) Fiber optic

Q.8 Consider the following statements related to switching techniques:

(i) FDM and TDM are the common multiplexing techniques being implemented in circuit switching.
(ii) Packet switching has single link and hence can result in queuing delays and packet loss.

(iii) Packet switching offers better sharing of transmission capacity than circuit switching.

Which of the above statements are correct?

(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.9 Which of the following network device can be used for interconnecting network on different protocols?

(a) Router (b) Bridge
(c) Hub (d) Gateway

Q.10 In a modem, data transfer can take place simultaneously in both direction in which of the following transmission mode

(a) Simplex
(b) Half duplex
(c) Full duplex
(d) Simultaneously transfer cannot take place in both direction

Q.11 Consider the following statement regarding Dumb terminals:

(i) A dumb terminal is an input device.
(ii) It has little processing power and display commands.
(iii) It is not as fast as smart terminal

Which of the above statements are correct?

(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.12 TCP stands for

(a) Transfer Control Protocol
(b) Transmission Communication Protocol
(c) Transmission Control Protocol
(d) Transfer Communication Protocol

Q.13 The maximum length of the cable in a 10 base 5 ethernet is

(a) 100 m (b) 500 m
(c) 1000 m (d) 5000 m

Q.14 The topology which contains a central hub or controller is:

(a) Star (b) Bus
(c) Ring (d) Mesh

Q.15 Which of the following types of network scale represents data communication across states and countries?

(a) LAN (b) PAN
(c) MAN (d) WAN

Q.16 Radio channels are advantage for:

(i) They can carry signals over long distance.
(ii) Being a wireless network, it can provide seamless connection to a mobile user.
(iii) They can penetrate walls.

Which of the above statements are correct?

(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.17 The number of layer in OSI model is

(a) 4 (b) 5
(c) 6 (d) 7

Q.18 Which of the following guided transmission media has the highest speed in a network?

(a) Twisted pair cable (b) Co-axial cable
(c) Optical fiber (d) Electrical cable

Q.19 The layer of the OSI model responsible to provide inter networking by moving packets from source to destination is:

(a) Data Link Layer (b) Network Layer
(c) Transport Layer (d) Application Layer

Q.20 The layer of the OSI model responsible for translating, encrypting and compressing data is:

(a) Physical layer (b) Network layer
(c) Session layer (d) Presentation layer

Q.21 Which of the following is not an E-mail protocol?

(a) SMTP (b) ICMP
(c) IMAP (d) POP3

Q.22 IPv6 is an address of

(a) 32 bit (b) 64 bit
(c) 128 bit (d) 256 bit

Q.23 MIME stands for

(a) Multipurpose Internet Mail Extensions
(b) Multipurpose Internet Message Extensions
(c) Multipurpose Internet Mail Evolution
(d) Multipurpose Internet Message Evolution

Q.24 Which of the following is provided to the client by DHCP?

(a) IP address (b) URL
(c) MAC address (d) DNS address

Q.25 An inter connected collection of Piconet is called

(a) Micronet (b) Scatternet
(c) Minimet (d) Macronet

Q.26 Which of the following do not fall into the category of Personal Area Network?

(a) Bluetooth (b) NFC
(c) Zig bee (d) Ethernet

Q.27 Consider the following statement regarding VPN:
(i) It stands for Virtual Private Network.
(ii) It provides a secured connecting link between the intranet of an organization and the global internet.
(iii) ESP protocol of IP security is used in VPN technology.
Which of the above statements are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.28 FTP stands for
(a) File Transfer Protocol
(b) Frame Transmission Protocol
(c) Frame Transfer Protocol
(d) File Transmission Protocol

Q.29 The protocol which allows an application program on one machine to send a datagram to an application program on another machine is
(a) VMTP (b) ICMP
(c) UDP (d) SMTP

Q.30 WiMAX is a wireless communication of which type of network?
(a) PAN (b) MAN
(c) LAN (d) None of the above

Q.31 Which of the following protocol is used in internet
(i) HTTP (ii) DHCP
(iii) DNS
(a) (i) and (ii) only (b) (i) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.32 TELNET is abbreviated for
(a) Telephone network
(b) Telecommunication network
(c) Terminal network
(d) Transmission network

Q.33 WPA is a security level used in
(a) Ethernet (b) Bluetooth
(c) Wi-Fi (d) NFC

Q.34 Which of the following is used for E-mail security?
(a) PGP (b) S/MIME
(c) Both (a) and (b) (d) None of these

Q.35 Which of the following attack blocks the victim's traffic network and sends it to a single server?
(a) DDoS (b) Pharming
(c) Phishing (d) Bluesnarfing

Q.36 Which of the following can work even without the availability of internet services?
(a) Cloud computing (b) Wide area network
(c) Local area network (d) None of these

Q.37 The DoS attack in which the attacker establishes a large number of half-open or fully-open TCP connections at the target host is called
(a) Vulnerability attack
(b) Bandwidth flooding
(c) Connection flooding
(d) All of the above

Answers

1. (b)	2. (a)	3. (b)	4. (c)	5. (d)
6. (c)	7. (b)	8. (c)	9. (d)	10. (c)
11. (b)	12. (c)	13. (b)	14. (a)	15. (d)
16. (d)	17. (d)	18. (c)	19. (b)	20. (d)
21. (b)	22. (c)	23. (a)	24. (a)	25. (b)
26. (d)	27. (d)	28. (a)	29. (c)	30. (b)
31. (d)	32. (c)	33. (c)	34. (c)	35. (a)
36. (c)	37. (b)			

Explanations

2. Standards are guidelines to maintain proper connectivity in the communication. Protocols are mandatory governing rules for a communication to occur.

3. 'De facto' standards are those standards that are accepted by facts. 'de jure' standards are legislated by an officially recognized body.

7. 'Infrared' is a category of unguided or unbounded transmission media.

8. Packet switching has multiple links and hence can result in queuing delays and packet loss.

11. A dumb terminal is an output device.

21. ICMP stands for Internet Control Message Protocol is a companion of internet protocol.

5 e-Governance

5.1 Introduction

The 'e' in e-Governance stands for electronic. The e-Governance means using Information and Communication Technology (ICT) to transform functioning of the Government as it provides efficient storage, retrieval and transmission of data compared to the physical Government.

It differs from e-Government as Governance is wider than Government. e-Governance may refer to governance of a household by a housewife. However, in this chapter e-Governance refers to the Governance of the country.

5.2 Smart Governance

SMART stands for

S : Simple → The use of ICT brings simplicity in Governance through electronic documentation, online submission, online service delivery etc.

M : Moral → It brings morality to Governance as immoralities like bribing, red-tapism etc. are eliminated.

A : Accountable → It makes the government accountable as all data and information of Government is available online for consideration of every citizen, the NGO and the media.

R : Responsive → Due to reduced paper work and increased communication speeds and decreased communication time, the Government agencies become responsive.

Responsible → Technology can help convert an irresponsible Government responsible. Increased access to information makes more informed citizens which in turn make a responsible Government.

T : Transparent → With increased morality, online availability of information and reduced red-tapism the process of Governance becomes transparent leaving no room for the Government to conceal any information from the citizens.

These objectives of e-Governance are achievable with the use of ICT and therefore the concept is very alluring and desirable.

5.3 Types of Interactions in e-Governance

e-Governance facilitates interaction between different stake holders in Governance. The flow of information occurs interchangeably be among Government, citizens, business. These interactions may be described as:

(a) G2G (Government to Government)

In this case, ICT is used not only to restructure the Governmental process involved in the functioning of Government entities, but also to increase the flow of information and services within and between different entities. This kind of interaction is only within the sphere of Government and can be both horizontal, i.e. between different Government agencies as well as between different functional areas within an organisation or vertical, i.e. between national, provincial and local Government agencies as well as between different

levels within an organisation. The primary objective is to increases efficiency, performance and output.

G2G relationship would include the relationships between central and state government and also the relationship between two or more government departments.

1. **E-Administration:** E-administration would include the implementations of ICT in the functioning of the government, internally and externally. Implementation of ICT can reduce the communication time between the government departments and governments. It can substantially reduce paper work if properly used. E-administration will also bring morality and transparency to the administration of government departments.
2. **E-Police:** The concept of E-police is little different from cyber police. Cyber police require technology experts to curb the electronic/cyber crimes. E-police refers to the use of ICT for the purpose of facilitating the work of the police department in investigation and administration. The concept of e-police includes databases of police officers, their performances, Criminal databases wanted as well as in custody, the trends in crimes and much more. ICT can help reduce the response time of the police department and also reduce cost by reducing paper work.
3. **E-Courts:** The concept of E-court include the ICT enablement of the judicial process. Technology may help distant hearing, online summons and warrants and online publication of judgements and decrees.

(b) G2C (Government to Citizen)

In this case, an interface is created between the government and citizens which enable the citizens to benefits from efficient delivery of a large range of public services. This expands the availability and accessibility of public services on the other. It gives citizens the choice of when to interact with the government (e.g. 24 hours a day, 7 days a week), from where to interact with the government (e.g. service centre, unattended kiosk or from ones home/work place) and how to interact with the government (e.g. through fax, telephone, e-mail, face to face etc.). The primary purpose is to make governance, citizen friendly.

E-governance in G2C relationship will involve facilitation of the services flowing from government towards citizens with the use of Information and Communication Technology (ICT).

1. **E-Citizenship:** E-Citizenship will include the implementation of ICT for facilitation of government services relating to citizenship of an individual. It may involve online transactions relating to issue and renewal of document like Ration Cards, Passports, Election Cards, Identity Cards etc. It will require the government to create a virtual identity of every citizen so as to enable them to access the government services online. For the same, government would need to create a citizen database which is a huge task.
2. **E-Registration:** E-Registration will cover the online registration of various contracts. An individual enters into several contracts during his life. Many of these contracts and transactions require registration for giving it legality and enforceability. Such registration may also be made ICT enabled. E-registration will help to reduce a significant amount of paperwork.
3. **E-Transportation:** E-Transportation service would include ICT enabled services of government relating to transport by road, rail, water or air. This may involve online:
   (i) Booking and cancellation of tickets.
   (ii) Status of vehicles, railways, boats and flights.
   (iii) Issue and renewal of driving licences.
   (iv) Registration and renewal of vehicles.
   (v) Transfer of vehicles.

(vi) Payment of fees for licenses.

(vii) Payment of fees and taxes for vehicle registration.

4. **E-Health:** E-Health services would be ICT enablement of the health services of the government. Under this interconnection of all hospitals may take place. A patient database may be created a local pharmacy database may also be created.
5. **E-Education:** E-Education would cover the implementation of ICT in imparting education and conducting courses. Distant education as well as classroom education will be facilitated with the use of ICT. Use of internet can reduce the communication time required in distant education; internet may also help in conducting online classes.
6. **E-Help:** E-Help refers to facilitation of distance and crisis management using ICT. It includes the use of technologies like internet, SMS, etc. For the purpose of reducing the response time of the government agencies to the disasters. NGOs help government in providing help in situations of disasters. Online information relating to disasters, warnings and calls for help can help the government and the NGOs co-ordinate their work and facilitate and speed up the rescue work.
7. **E-Taxation:** E-Taxation will facilitate the taxing process by implementing ICT in the taxing process. Online tax due alerts and online payment of taxes would help transact faster.

(c) C2G (Citizen to Government)

Citizen to government relationship will include the communication of citizens with the government arising in the democratic process like voting, campaigning, feedback etc.

1. **E-Democracy:** The true concept of democracy includes the participation of the citizens in the democratic and governing process. Today due to the increased population the active participation of the citizens in governing process. The ICT can help enable the true democratic process including, voting, public opinion, feedback and government accountability.
2. **E-Feedback:** E-feedback includes the use of ICT for the purpose of giving feedback to the government. Lobbying is pursuing the government to take certain decision. Use of ICT can enable online feedback to the government, online debates as to the government services.

(d) G2B (Government to Business)

Here e-Governance tools are used to aid the business community providers of goods and services to seamlessly interact with the government. The objective is to cut red tape, save time, reduce operational costs and to create a more transparent business environment when dealing with the government. The G2B initiatives can be transactional, such as in licencing, permits, procurement and revenue collection. They can also be promotional and facilitative such as in trade, tourism and investment. These measures help to provide a congenital environment to business to enable them perform more efficiently.

1. **E-Taxation:** Corporate sectors pay many taxes, duties and due to the government. Payment of these taxes and duties will be made easier by E-taxation. Online taxing and online payment of taxes can help reduce cost and time required for physical submission of taxes. ICT can also help cross-check the frauds and deficiencies in payment, further bringing accuracy and revenue to the government.
2. **E-Licensing:** Companies have to acquire various licences from the government, similarly the companies have to acquire various registrations, ICT enablement of the licencing and registration can reduce time and cost.
3. **E-Tendering:** E-tendering will include the facilities of online tendering and procurement. It will provide online alerts as to new opportunities of business with the government and also online submission of tenders and online allotment of work. It will reduce time and cost involved in the physical tendering system.

(e) G2E (Government to Employee)

Government is by far the biggest employer and like any organisation, it has to interact with its employees on a regular basis. This interaction is a two-way process between the organisation and the employee. Use of ICT tools help in making these interactions fast and efficient on one hand and increase satisfaction level of employees on the other.

5.4 Objectives of e-Governance

1. Building an informed society	By providing access to all information related to government and the public interest to the citizens, the society can be empowered. This in turn will help to create a responsible government.
2. Increase Government Citizen interactions	By providing a feedback framework, the government can be made aware of the problems/grievances/satisfaction of the citizens. This will help to build a healthy interaction system.
3. Encourage citizen participation	By encouraging the citizens for the overall participation in decision making (feedback, information access, volunteer activity), a true representation of democracy can be achieved.
4. Transparency in Government process	By making all the government data, information, decisions, policies etc. available to the people for access a transparent system can be achieved.
5. Accountability of the Government	By creating a transparent system, the government can be made responsible and answerable for every act or decision taken by it.
6. Reduction in cost of Governance	By cutting down on expenditure on physical delivery (stationary, postal etc.), a considerable cost of governance can be reduced.
7. Reduction in the reaction time of the Government	By reducing the physical communication and related red tapism, a considerable time of the government can be saved while reacting to the public's problems/grievances. This in turn helps to build on efficient government.

Example 1.

Consider the following objectives being addressed by e-governance:

1. Dissemination of information about policies and schemes of the Government
2. Follow-up on implementation of Government's welfare schemes
3. Providing information on public queries
4. Facilitating settlement of dues to the Government

Which of the above statements are correct?

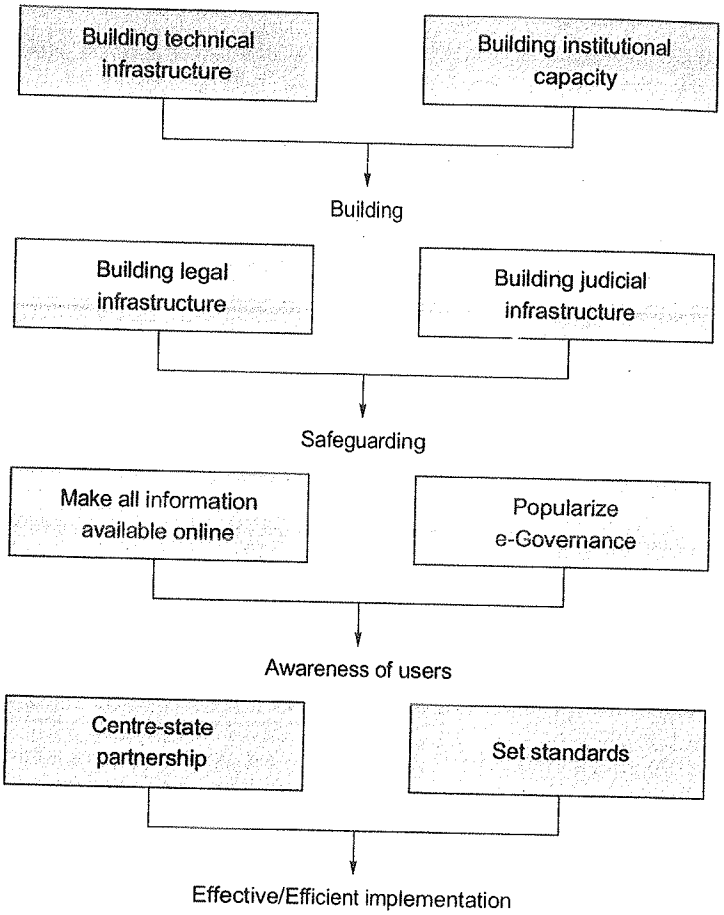
(a) 1 and 2 only (b) 2 and 3 only

(c) 3 and 4 only (d) 1, 3 and 4

[Sample Question for ESE 2017 : Released by UPSC]

Ans. (d)

5.5 Strategies for e-Governance



1. The complete technical infrastructure will include:
   (a) Building hardware and softwares.
   (b) Providing better and faster connectivity (broadband, wireless network such as 3G, 4G etc.)
   (c) Promotion of internet cafes, information and interactive Kiosks.

   Involvement of both government and private sectors are necessary for building the infrastructure. However while building the technical infrastructure the convenience of disabled people should also be considered.
2. The institutional capacity includes:
   (a) Training of government employees, appoinments of experts.
   (b) Creating expert database for utilization of intellectual resources.
   (c) Equipping the departments with high technology.
   (d) Setting up special investigating agency.
3. The legal infrastructure include framing laws which will fully incorporate both emerging and already established technology.

   The IT laws need to be flexible to adjust with the rapidly changing technology. Currently India has only the IT Act, 2000 which is mainly an e-commerce legislation. India has also modified many laws to include electronic technology, however it is not sufficient to cover e-governance completely.
4. The judicial infrastructure includes:
   (a) The training of judiciary in new technology, its benefits and drawbacks and its various usages.
   (b) Appointing new judges and setting up special courts to deal with the matter relating to ICT.
   (c) Setting up special tribunals to deal with matters relating to ICT.

5. The making of all information online, through websites will make the citizens empowered, which in turn will empower the base of democracy. This can be facilitated through centralized storage of information, localization of content and content management.
6. In order to popularize the e-Governance, at first India should be e-literate. This can be done through:
   (a) Educating the people about the advantages of e-Governance over physical governance.
   (b) Raising awareness of the leaders who can motivate the people to go online.

   Therefore, in order to increase people's awareness towards e-Governance, the government needs to campaign for it. Government can only encourage people to go online if it can make people feel comfortable with e-Governance.
7. Since India is a quasi-federal state, therefore centre-state and inter-state co-operation is necessary for smooth functioning of the democratic process and as such successful implementation of e-Governance. To attain this:
   (a) The Government can set-up a central hub like the current Government of India portal, for accessing the information of all the organs of the central government and also all the state governments.
   (b) The states can co-operate with the centre to create a National Citizen database.
8. In order to bring e-Governance to the quality and performance level of private corporate sector, it is important to set various standards. The government of India is currently working on various standard management and has various drafts prepared for the same. These standards include:
   (a) Inter-operability standards
   (b) Security standards
   (c) Technical standards
   (d) Quality standards

   Government websites in India currently have no uniform standards. Thus it is very important for the government to set uniform national standards to be followed by all the governments and agencies.

5.6 Advantages for e-Governance

1. Technology makes communication faster. Internet, phones, cell phones have considerably reduced the time taken in normal communication.
2. Paper-based communication needs continuous expenditure on stationary, printers, computers etc. Technology can save a lot of cost increased in physical communication.
3. All the information of the government (data, decisions, policies etc.) would be made available on the internet which would enhance transparency in the government services.
4. Accountability is answerability of the government to the people. It is the answerability for the deeds of the government. Since the governing process is made transparent the government is automatically made accountable.
5. Technology can make the government services available to every nook and corner of the country. Hence all the people, irrespective of geographical difficulties can have easy accessibility to all the services.
6. An informed society is an empowered society which will consequently lead to social development. It makes e-Governance simple, efficient and an expanded reach of e-Governance.

1. Reduction in time
2. Reduction in cost
3. Transparency
4. Accountability
5. Easy accessibility
6. Empowerment of citizens

5.7 Challenges in e-Governance

Any major changes in governance, specially in a big democracy like India, is bound to meet resistances. There are large number of potential barriers in the implementation of e-Governance. Some of the challenges thus identified are discussed below:

- Trust
- Resistance to change
- Digital divide
- Cost
- Privacy and security

1. The implementation of public administration functions through e-Governance requires the presence of trust in the two levels. At first, the user must be confident, comfortable and trusting of the tool or technology with which they will internet. Secondly, the trust of the government should also exist to avoid any doubt and confusions.

   Unless there is an assurance regarding the prevention of fraudulent activities by providing extensive checks, the trust of the users will be difficult to win.
2. As per the innovation diffusion theory, over time an innovation will diffuse through a population and the rate of adoption will vary between those who adopt early, referred to as early adopters and to those who adopt the innovation much later, referred to as laggards.

   The resistance to change phenomenon can explain the hesitation that occurs on the part of the constituents in moving from a paper based to a web based system for interacting with government.
3. The digital divide refers to the separation that exists between individuals, communities and business that have access to information technology and those that do not have access to information technology. The presence of such divides can be explained on the basis of social, economic, infrastructure and ethno-linguistic variations across the nations.
4. Although e-Governance is expected to reduce the cost incurred in stationary items as a part of physical communication, but the installation of an entire technical and administrative framework will require a huge amount of expenditure. However once installed, it is expected to prove cost-effective in the long run.
5. Alongwith the implementation of e-Governance, effective measures must be taken to protect sensitive personal information. A lack of clear security standards and protocols can limit the development of projects that contain sensitive information.

5.8 Disadvantages in e-Governance

Every coin has two sides and therefore e-Governance also posses certain disadvantages as well:

1. The main disadvantages of an electronic government is to move the government services into a electronic based system. This system loses person to person to interaction which is valued by a lot of people.
2. The implementation of an e-Government services is that, with many technology based services, it is often easy to make the excuse that problems with the service provided are because of the technology.
3. The implementation of an e-Government may face literacy of the users as one of the constraints.

   The efficient running of e-Government, will depend hugely on the ability of the end users to use a computer. It provides scope for middle men (providing assistance to the technically illiterate section) to distort information.

4. As per certain studies, there is potential for a reduction in the usability of government online due to factors such as access to computers, access to internet technology and usability of services.
5. Even though the level of confidence in the security offered by government websites are high, the public are still concerned over security, fear of spam from providing e-mail addresses and government retention of transactions or interaction history.

   The security of cyber space and misuse of data is still holding back the citizens to full adaptation of Aadhar card.

5.9 National e-Governance Plan (NeGP)

- The National e-Governance Plan (NeGP) takes a comprehensive view of all the e-Governance initiative across the country and unifying them into a single ultimate vision.

VISION: "Make all the government services accessible to the common man in his loyalty, though common services delivery outlets and ensure efficiency, transparency and reliability of such services at affordable costs to realise the basic needs of the common man".

- Based on this idea, a large-scale country side infrastructure is evolving which will reach every nook and corner of the nation and digitization of rewards which are massive in scale and reliable access over the internet.
- NeGP has been formulated by the Department of Information Technology (DIT) and Department of Administrative Reforms and Public Grievances (DAR&PG).
- NeGP comprises of 31 Mission Mode Projects (MMPs) and 8 components. 27 MMP's were approved on May 18, 2006 and 4 MMP's (Health, Education, PDS and Posts) were introduced in the year 2011.
- The approval of the MMP's by the government is only in terms of its vision, approach, strategy, key components, implementations, methodology and management structure for NeGP. There is no inclusion of financial support in the approval.

5.9.1 Implementation Strategy for NeGP

Since the implementation of e-Governance is a highly complex process requiring provisioning of hardware and software, networking, process re-engineering and change management, there has to be a proper approach and methodology for the application of NeGP. The following are the key features:

1. Common Support Infrastructure: This includes
   - State Wide Area Networks (SWANs)
   - State Data Centres (SDCs)
   - Common Services Centres (CSCs)
   - Electronic Services Delivery Gateway
2. Governance:
   - Suitable arrangements for monitoring and co-ordinating the implementation of NeGP under the direction of competent authorities have been made.
   - The programme also involves evolving standards and policy guidelines, providing technical support, undertaking capacity building, R & D etc.
3. Centralized Initiative, Decentralized Implementation:
   - e-Governance is being promoted through a centralized initiative to the extent necessary.

(i) To ensure citizen centric orientation.

(ii) To realise the objective of inter-operability of various e-Governance applications.

(iii) To ensure optimal utilisation of ICT infrastructure and resources.

While allowing for a decentralized implementation model.

- It also aims at identifying successful projects and replicating them with required customization whenever needed.

4. **Public-Private Partnership (PPP) model:** It is to be adopted whenever feasible, to enlarge the resource pool without compromising on the security aspects.
5. **Integrative Elements:** It involves adoption and promotion of unique identification codes for citizens, business and property.
6. **Programme Approach at the National and State Level:**
   - For implementation of the NeGP, various Union Ministries/Departments and State Governments are involved.
   - Considering the multiplicity of agencies involved and the need of overall aggregation and integration at the national level, NeGP is being implemented as a programme with well defined roles and responsibilities of each agency involved.
   - For facilitating this, appropriate programme management structure have also been put in place.
7. **Facilitatory roles of DIT:** The role of DIT involves
   - Acting as facilitator and catalyst for the implementation of NeGP by various Ministries and State Government.
   - Providing technical assistance.
   - Serving as a secretariat to the apex committee and assisting in the management of programme.
   - Implementation of pilot/infrastructure/technical/special projects and support components.
8. **Ownership of Ministries:**
   - Under the NeGP, various MMPs are owned by the concerned ministries.
   - In case, any ongoing projects falls under the MMP category, they would be suitably enhanced to align them with the objectives of NeGP.
   - States have been given the flexibility to identify a few additional state-specific projects, which are relevant for the economic development of the state.

5.9.2 Components of NeGP

The various component of the National e-Governance Programme includes:

I. Institutional Structure

II. Common Support Infrastructure

III. Mission Mode Projects

I. Institutional Structure

1. **Macro (National and State) Level:** In order to make sure that all the projects being implemented by the Union and State Governments and consistent with a broad policy and to stick to common standards, NeGP has established well-defined institutional structure as given below:

Programme management - NeGP

Overall Governance Structure

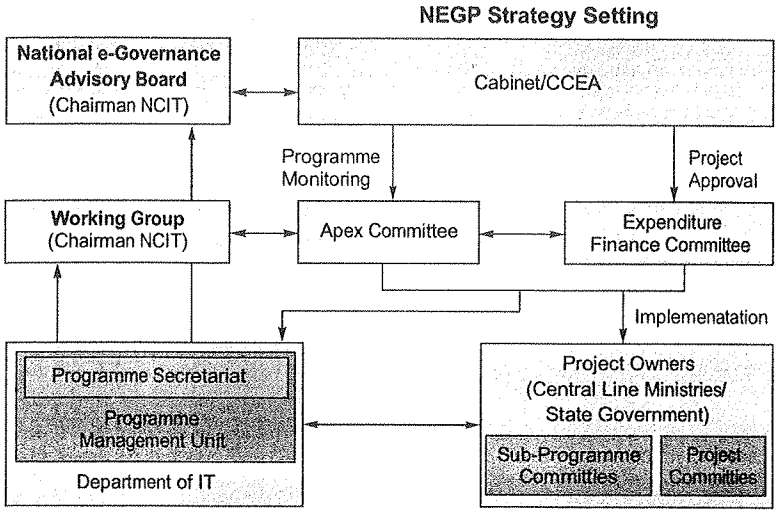


Fig. NeGP, Overall Governance Structure

2. **Governance Structure:** These are decision-making bodies which are empowered to formulate policies, take decisions and in general guide the project implementers.

Governance Structure at State level-NeGP

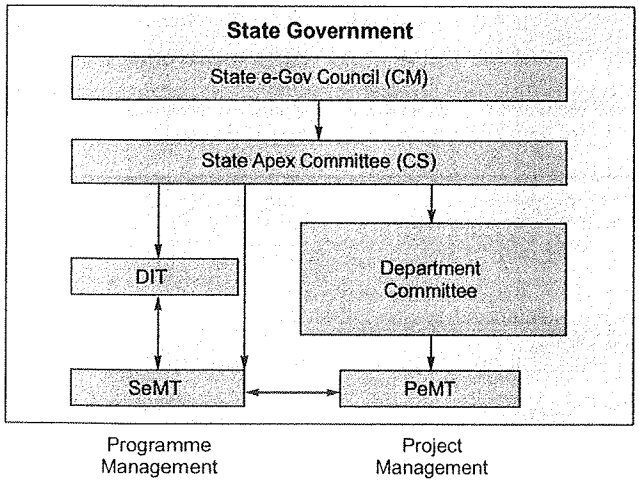


Fig. NeGP, Governance Structure of State Level

3. Programme Management Structure:

Components	Responsibilities and Duties
(i) Prime Minister's office	• To provide leadership to the NeGP. • To prescribe deliverables and milestones. • To monitor periodically the implementations of NeGP.
(ii) National e-Governance Advisory Group (Chairman-Union Minister for C & IT) for C & IT)	• To obtain views of external stakeholders. • To advice the government on policy issues and strategies interventions.

(iii)	Apex Committee (NeGP) Chairman - Cabinet Secretary	• To oversee the NeGP programme and to provide policy and strategic directions for its implementation. • To resolve inter-ministreal issues. • To moderate and drive services, process re-engineering and service levels of each MMPs.
(iv)	Planning Commission and Ministry of Finance	• To allocate funds for NeGP through plan and non-plan budgetary provisions.
(v)	Line Ministries/Departments	• To take ownership of the MMP and conceptualize the project by fixing the objectives. • To hold consultants with all the stakeholders. • To prepare comprehensive project document including identification of e-services and service levels. • To obtain sanction for schemes and implement the project and its various components.
(vi)	State Governments/UT Administrations	• To implement state sector MMPs under the overall guidance of the respective line ministries in cases where central assistance is also required. • At state level, an apex committee is headed by the chief secretary.
(vii)	Department of Information Technology (DIT) including National Informatics Centre (NIC)	• To serve as a secretariate to the apex committee. • To assist National e-Governance Advisory Group and PMO. • To facilitate implementation of NeGP and to carry out technical appraisals of all NeGP projects and prepare suitable templates for preparing documents (for use by individual departments). • To provide technical assistance to various ministries and state Governments either directly or in collaboration with external professional consultants; under-takes monitoring of all the MMPs.
(viii)	Department of Administrative Reforms and Public Grievances (DAR & PG)	• For generic process re-engineering and change management. • To promote initiatives for Human Resource Development and training and awareness building.

II. Common Support Infrastructure

1. State Data Centres (SDC):

- Its key functions include:
  - (a) To act as the central repository of the state.
  - (b) To provide secure data storage, disaster recovery and remote management functions.
- It also functions to consolidate services, applications and infrastructure to provide efficient electronic delivery of G2G, G2C and G2B services through common delivery platform seamlessly supported by SWAN connecting up to the villages through CSCs.

- The DIT has already provided the "Guidelines for Technical and Financial support for Establishment of State Data Centre", which offer two options before the states.
  (a) The state/UT and NIC together form a composite team for the SDC, where the NIC team would provide services for infrastructure upkeep, operations etc.
  (b) The capabilities of existing commercial internet data centre are leveraged.

NOTE: The scheme was approved in January 2008 and so far, all the 23 states whose proposals have been approved till now, have opted for the first option.

2. State Wide Area Network (SWAN):
   - It is aimed at establishing wide area networks in all states and UT's across the country, from the head-quality of each state/UT to the blocks.
   - It would serve in providing G2G and G2C services, especially for the various MMPs comptemplated under the NeGP.
   - The salient features include:
     (a) One PoP (Point of Presence) at each State/District/Block headquarter.
     (b) Each PoP has configurable aggregation equipment to enable vertical and horizontal connectivity gateway to NICNET (National Backbone) for inter-state connectivity.
     (c) State/NIC would receive discounted price for BSNL BW cost (MOU signed).

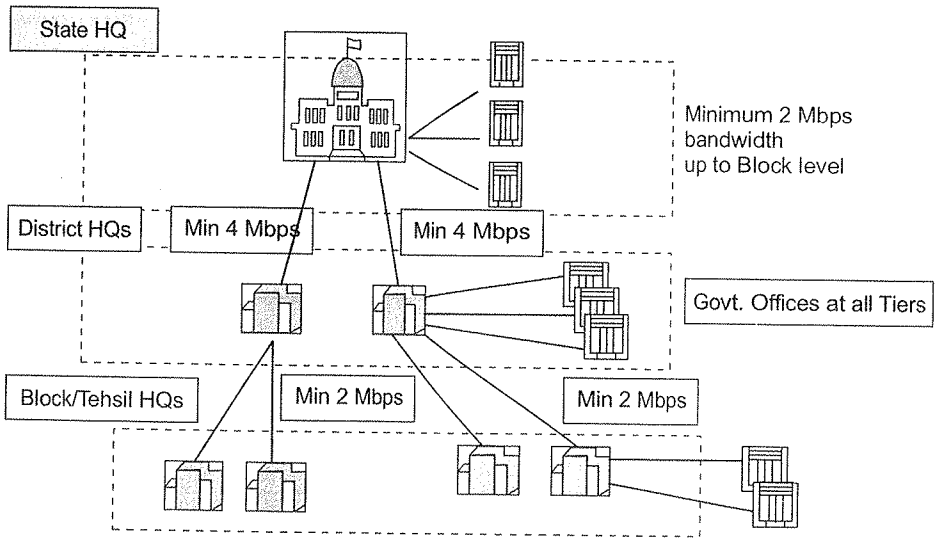


Fig. SWAN Structure

Funding Support	Capacity
• Upto 34 Mbps from SHQ to DHQ.	• Upto 660 Mbps from SHQ to DHQ.
• Upto 8 Mbps from DHQ to BHQ.	• Upto 100 Mbps from DHQ to BHQ.

   - In a vertical hierarchial structure, a minimum bandwidth of 2 Mbps capacity per link is provided.

3. Common Service Centres (CSCs):
   - The CSCs are intended to serve as front end delivery points for government, private and social sector services in an integrated manner to rural citizens of India.
   - The CSC scheme aims at establishing about 100,000 common service centres across the country, one each for every six census villages.
   - The placement of CSC in a cluster of villages is supposed to follow a 'honey-comb' structure so that the services provided by it are easily accessible to the rural population residing in the cluster.

- The scheme is being implemented as a PPP model. The CSCs are designed as ITC enabled Kiosks having a PC along with basic support equipment like private scanner and UPS.
- The CSC scheme has a 3 tier implementation framework.

The local Village Level Entrepreneur (VLE)	The Service Centre Agency (SCA)	The State Designed Agency (SDA)
This would form the cutting edge of the whole scheme, with the responsibility of providing services to the rural customer in a cluster of 5-6 villages.	This would be responsible to operate, manage and build the VLE network and business SCA would be a private entity and would be given the territorial responsibility for rolling out the CSCs in one or more districts. (One district would cover about 100-200 CSCs)	This would facilitate implementation of the scheme within the state and provide requisite policy, content and other support to the SCAs. The SDA would be a PSU/society or any other entity controlled by the state government.

- The scheme envisages the involvement of two other entities:
  (a) The National Level Service Agency (NLSA):
    - This would provide program management support to the DIT for rolling out the CSS scheme.
    - This would also monitor implementation of the scheme to enable DIT to review its progress.
  (b) The special purpose vehicle:
    - CSC e-Governance Service India Limited, a special purpose vehicle, has been set up by the Ministry of Electronics and IT under the Companies Act 1956, to oversee implementation of the CSC scheme

CSC 2.0 Scheme

- Based on the assessment of CSC scheme, the government launched the CSC 2.0 scheme in 2015 to expand the out reach of CSCs to all Gram Panchayats across the country.
- It aims for establishing self sustaining network of 2.5 lakh CSC centres at Gram Panchayat (GP) level under Digital India-Pillar 3- Public Internet Access Programme, National Rural Internet Mission and deliver various citizen centric services. This is to be ensured by 2019.
- CSC 2.0 model is envisaged as transaction based and service delivery model, delivering a large bouquet of e-services through a single delivery platform, which would increase the sustainability of the CSCs across the country.

NOTE: CSC scheme was under NeGP while CSC 2.0 : "A way forward" is under Digital India Programme.

Objectives of CSC 2.0

(a) Non-discriminatory access to e-services to rural citizens by making the CSCs complete service delivery centres, utilizing the backened infrastructure already created in terms of other MMPs.
(b) Expansion of self sustaining CSC network till the Gram Panchayat Level 2.5 lakhs CSCs, i.e. atleast one CSC per Gram Panchayat.
(c) Empowering Distinct e-Governance society (DeGS) Under District Administration for implementation.
(d) Creating and strengthening the institutional framework for the rollout and project management, thereby, supporting the state and district administrative machinery and handholding of the VLEs through local language help desk support.
(e) Enablement and consolidation of online services under one technology platform, hence making the service delivery at CSCs outlets accountable, transparent, efficient and tracable, with a technology-driven relationship between all stakeholders.
(f) Increasing sustainability of VLEs by sharing maximum commission earned through delivery of e-services and encouraging women as VLEs.

III. Mission Mode Project (MMP)

- The 27 Mission Mode Projects are grouped into central (10, state (10) and integrated (7) projects. However in the year 2011, 4 new MMPs were introduced.
- The Mission Mode Projects and the corresponding features and the organisation responsible for its implementation are tabulated as follows:

The Central Mission Mode Programmes		
MMPs	**Line Ministry/Department responsible**	**Key features**
1. Banking	D/o Financial Services	Integrated core banking solutions of various banks.
2. Central excise and customs	D/o Revenue/Central Board of Excise and Customs	Enables filling of service tax and excise returns, e-payment of custom duties, automated clearance of courier assignments etc.
3. Income Tax (IT)	M/o Finance/Central Board of Direct Tax	Includes 19 defined services to be provided online like e-filling of tax returns, online payment of taxes through selected banks, issue of refunds through electronic clearance system etc.
4. Insurance	D/o Financial Services	Provides insurance related services through the four public sector general insurance companies.
5. MCA21	M/o Company Affairs	Offers availability of all Ministry of Company Affairs (MCA) services including filling of documents, registration of companies and public access to corporate information through a secure portal.
6. Passport	M/o External Affairs	Enables applications for new passports, renew old passport and track application status.
7. Visa, immigration and foreigners registration and tracking	M/o Home Affairs	Handles immigration formalities for all international incoming flights.
8. Pension	D/o Pensioners and Pensioners Welfare and Department of Expenditure	Tracks and handless pension settlements.
9. e-office	D/o Administrative Reforms and Public Grievances	Provides a middleware for stream lining, aligning, optimizing and automating all internal process across government boundaries.
10. National ID/UID	M/o Home Affairs/Registrar General of India (RGI)	Creates a central database and generates unique identities for residents across the country primarily for effective reach of social sector benefits.
11. Posts (newly added in 2011)	D/o Posts	Modernization of postal services through computerization and networking of all post offices using a central server base system and setting up of computerizes registration centres.

The State Mission Mode Projects		
1. Land Records	M/o Rural Development	Identifies and automates 14 services like integration of textual and spatial land records, integration of registration and mutation processes, automatic updating of land updating of land records providing conclusive title to land owners etc.
2. Road Transport	M/o Road Transport and Highway	Includes services like vehicle registration and driving licenses.
3. Property Registration	D/o Land Resources and D/o Electronics and Information Technology	Replaces manual systems of verification and security of documents, capturing and preserving copies of documents and conducting searches and of maintaining back office records.
4. Agriculture	D/o Agriculture and Co-operation	Provides services like market prices, soil information, crop diseases and management, good practices for horticulture; sericulture etc.
5. Treasuries	M/o Finance	Involves payment of salaries of government employees, payment of expenses etc.
6. Municipalities	M/o Urban Development and Poverty Aleviation	Provides G2C services like issuing birth and death certificates, payment of utility bills, issuing licenses etc.
7. Gram Panchayats	M/o Panchayat Raj	Issue trade licences, certificates, house related services, receipt of fund progress reports, individual beneficiaries of various schemas etc.
8. Commercial Taxes	M/o Finance	Improves efficiency of VAT administration by enabling electronic filing of returns and clearance of refunds, online payment of taxes etc.
9. Police (UTs initially)	M/o Home Affairs	Implements Common Integrated Police Application (CIPA) and hardware in Police stations.
10. Employment Exchange	M/o Labour and Employment	Enables to match the requirements of employers and potential employees, provides guidance to the unemployed and facilitates online registration of vacancies by employers.
11. School Education (newly added in 2011)	D/o School Education and Literacy	To make school books accessible in digital forms as e-books, projects to increase digital literacy etc.
12. PDS (newly added in 2011)	D/o Food and Public Distribution	End-to-end project covering e-functional area such as supply chain management including allocation and utilization, reporting storage and movement of food grains.
12. Health (newly added in 2011)	D/o Health and Family Welfare	More comprehensive use of ICT, supply chain management of drugs and vaccines, providing ICT tools to training etc.

The Integrated Mission Mode Projects		
1. Electronic Data Interchange (EDI) for trade or e-commerce	M/o Commerce and Industry	Introduces electronic filing and clearance of import and export documents, e-payments of duties of changes by ports, airports, customs etc. and electronic exchange of documents between community partners and customs ports and other government agencies
2. E-Biz	D/o Industrial Policy and Promotion	Seeks to address several issues related to approvals and permissions for business, reducing the points of contact between the business entities and the government agencies, standardizing required information, establishing a single-window services and reducing the burden of compliance.
3. Common Service Centres (CSC)	M/o Electronics and Information Technology	Already discussed in details.
4. India Portal	D/o Electronics and Information Technology and D/o Administrative Reforms and Public Grievances	Provides one-step access to government services.
5. E-courts	D/o Justice	Offers online availability of judgements and cases list, e-filling of cases and notification through e-mails.
6. E-procurement	M/o Commerce and Industry/DGS and D	Establishes a one-stop shop providing all services related to government procurement.
7. National Service Delivery Gateway (NSDG)	M/o Electronics and Information Technology	Acts as messaging middleware providing intelligent routing services from a service seeker to a service provider.

Note:
M/o refers to 'Ministry of'
D/o refers to 'Department of'

5.9.3 NeGP 2.0 - e-Kranti

- The implementation of e-Kranti is vital for Digital India and for the delivery of e-Governance, easy governance and good governance in the country.
- The Union Cabinet in its meeting held on 25th of March, 2015 has approved the approach and key components of e-Kranti.
- The vision of e-Kranti is "Transforming e-Governance for Transforming Governance" and its mission is "To ensure a government wide transformation by delivering government services electronically to the citizens through integrated and inter operable systems via multiple modes, while ensuring efficiency, transparency and reliability of such services at affordable costs".
- The key principles of e-Kranti are as follows:
  1. **Transformation and Not Translation:** All projects proposal in e-Kranti must involve substantial transformation in the quality, quantity and manner of delivery of services and significant enhancement in productivity and competitiveness.
  2. **Integrated Services and Not Individual Services:** A common middleware and integration of the back end processes and processing systems is required to facilitate integrated service delivery to citizens.

3. **Government Process Re-engineering (GPR) to be Mandatory in Every MMP:** The degree of GPR should be assessed and enhanced for the existing MMPs. Without GPR, new MMP may not be sanctioned.

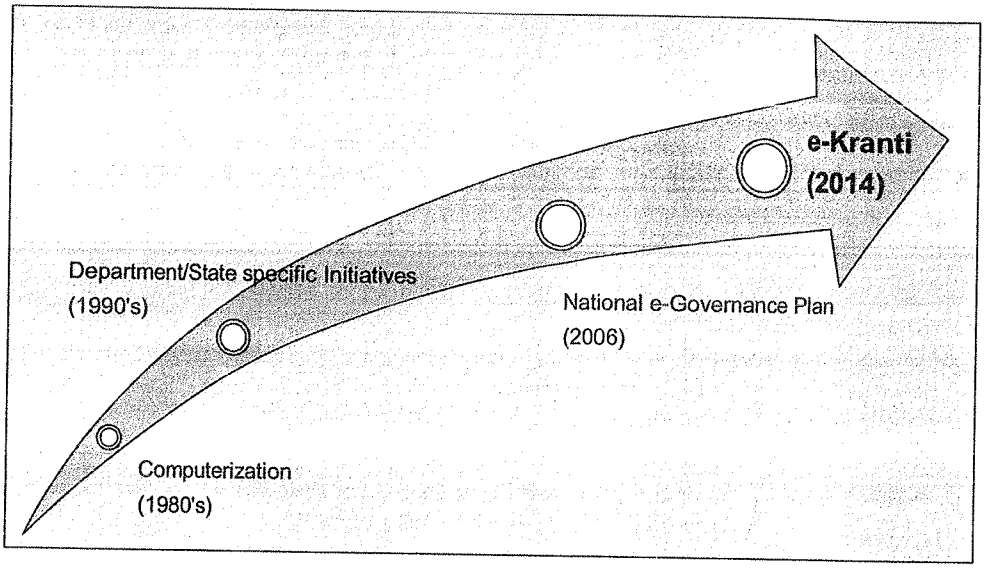


Fig. NeGP 2.0 e-Kranti

4. **ICT infrastructure on Demand:** Government departments should be provided with ICT infrastructure, such as connectivity, cloud, mobile platform on demand. In this regard, National Informatics Infrastructure (NII), which is at an advanced stage of project formulation, would be fast tracked by DieTY.
5. **Cloud by default:** The flexibility, agicity and cost effectiveness offered by cloud technologies would be fully leveraged while designing and hosting applications. Government cloud shall be the default cloud for government departments. All sensitive information of government departments shall be stored in the government cloud only.

   Any government department may use a private cloud only after obtaining permission from DieTY which shall do so after assessing the security and private aspects of the proposed cloud.
6. **Mobile First:** All applications are designed/redesigned to enable delivery of service through mobile.
7. **Fast Tracking Approvals:** To establish a fast track approval mechanism for MMPs, once the Detailed Project Report (DPR) of a project is approved by the competent authority, empowered committees may be constituted with delegated powers to take all subsequent decisions.
8. **Mandating Standards and Protocols:** Use of e-Governance standards and protocols as notified by DieTY be mandated in all e-Governance projects.
9. **Language Localization:** It is imperative that all information and services in e-Governance projects are available in Indian languages as well.
10. **National GLS (Geo-Spatial Information System):** NGIS is to be leveraged as a platform and as a service in e-Governance projects.
11. **Security and Electronic Data Preservation:** All online applications and e-services to adhere to prescribed security measures including cyber security. The National Cyber Security Policy 2013 notified by Diety must be follows.

NOTE: All new and ongoing e-Governance projects as well as the existing projects, which are being revamped should now follow the key principles of e-Kranti.

NeGP 2.0 Programme Management Structure

- The key components of the programme management structure of NeGP 2.0 would be as follows:
  1. Cabinet Committee on Economic Affairs (CCEAA) for programme level policy decisions.
  2. A Monitoring Committee on Digital India under the chairpersonship of Prime Minister, consisting of representatives from ministries/departments.
  3. A Digital India Advisory Group headed by the Minister of Communications and IT.

     The composition of the Advisory Group would include representation from the Planning Commission and 3 to 4 representatives from States/UTs and other Line Ministries/Departments on a rotational basis.

     The function are the same as that of National e-Governance Advisory group, i.e. to provide leadership, prescribe deliverables and milestones and monitor periodically the implementation of the Digital India programme.
  4. Apex committee headed by the cabinet secretary.
  5. Expenditure Finance Committee (EFC)/Committee on Non Plan Expenditure (CNE), headed by Secretary Expenditure, to financially appraise/approve projects as per existing delegation of financial powers.
  6. A council of Mission Leaders on Digital India headed by Secretary, Diety would be established as a platform to share the best practices in various existing and new e-Governance initiatives under Digital India including e-Kranti and also to sensitize various government departments about ICT projects of DieTY.
  7. Institutional mechanism of e-Kranti programme of state level would be spearheaded by state committee on Digital India by the Chief Minister.

     Apex committees on Digital India are headed by Chief Secretaries would be constituted at State/UT level.
  8. DieTY is enshouldered with the responsibility of the technical appraisal of all e-Kranti projects prior to a project being placed before the EFC/CNE.

NOTE: It may be mentioned that DieTY has already set up a Programme Management Unit, namely National e-Governance Division (NeGD), within Media Lab Asia, under the Ministry of Communication and Information Technology, to provide support to departments in conceptualizing, developing, apprasing, implementing and monitoring respective MMPs/e-Governance initiatives.

- There are 44 Mission Mode Projects under e-Kranti Programme. 31 MMPs have already been mentioned before. The remaining 13 MMPs are as follows:

The Central Mission Mode Projects

	MMP	Line Ministry/Department Responsible
1.	e-Sansad	M/o Parliamentary Affairs
2.	Common IT Road map for Para Military Forces	M/o Home Affairs

The State Mission Mode Projects

1.	e-Vidhaan	M/o Parliamentary Affairs
2.	Agriculture 2.0	D/o Agriculture
3.	Rural Development	D/o Rural Development
4.	Women and Child Development	M/o Women and Child Development

The Integrated Mission Mode Projects

1.	Financial Inclusion	D/o Financial Services
2.	National Geographic Information System	D/o Science and Technology
3.	Social Benefits	M/o Social Justice and Empowerment as the leader and other welfare departments as co-owners.
4.	Roads and Highway Information System (RAHI)	M/o Road Transport and Highways
5.	e-Bhasha	M/o Electronics and Information Technology
6.	National Mission on Education through ICT (NMEICT)	D/o Higher Education
7.	Urban Governance	M/o Urban Developments

MMPs Status

CENTRAL-15	STATE-17	INTEGRATED-12
■ Banking	■ Transport	■ India Portal
■ Insurance	■ Land Rec./NLRMP	■ NSDG
■ Income Tax	■ e-District	■ CSC
■ Central Excise	■ Commercial Taxes	■ Financial Inclusion*
■ MCA 21	■ Treasuries	■ E-Trade
■ Pensions	■ Municipalities	■ e-Courts
■ Passport	■ Agriculture	■ e-Procurement
■ National ID/UID	■ PDS#	■ e-Biz
■ Immigration/Visa	■ Employment Exchange	◆ NGIS*
■ e-Office	■ Education#	❑ Road and Highway Information System*
● Posts#	■ Health#	❑ Social Benefit*
◆ Central Armed Paramilitary Forces*	● e-Panchayat	❑ Urban Governance*
◆ e-Bhasha*	● CCTNS	
❑ NMEICT*	❑ Agriculture2.0*	■ Delivering Service-15
❑ e-Sandad*	❑ e-Vidhaan*	#MMPs added in 2011
	❑ Rural Development*	■ Delivering Services partially-15
	❑ Women and Child Development*	● Under implementation-3
		◆ Design and Development-3
		❑ Design stage-9
		*New MMPs added in 2015

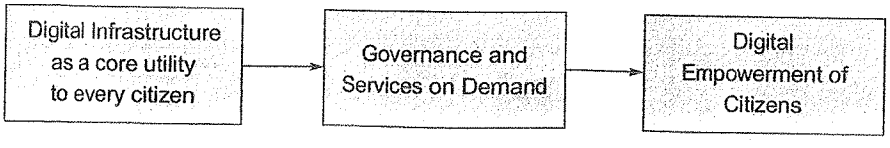
Fig. All the MMPs so far

5.10 Digital India

- The Digital India is a flagship programme of the Government of India with a vision to transform India into a digitally empowered society and knowledge economy.

VISION: "To transform India into a digitally empowered society and knowledge economy".

- The programme was launched on July 1, 2015 by Hon' Prime Minister Shri Narendra Modi.
- Digital India encompasses key vision areas of:



• Availability of high speed internet as a core utility for delivery of services to citizens. • Cradle to grave digital identity that is unique, lifelong, online and authentic to every citizen. • Mobile phone and bank account enabling citizen participation in digital and financial space. • Easy access to a common service centre. • Shareable private space on a public cloud. • Safe and secure cyber space.	• Seamlessly integrated service across departments or jurisdictions. • Availability of services in real time from online and mobile platforms. • All citizen entitlement to be portable and available on the cloud. • Digitally transformed services for improving case of doing business. • Making financial transactions electronic and cashless. • Leveraging Geospatial information Systems (GIS) for decision support systems and development.	• Universal digital literacy • Universally accessible digital resources. • Availability of digital resources/services in Indian language • Collaborative digital platforms for participative governance. • Citizens not required to physically submit Govt. documents/certificates.

5.10.1 Approach to Digital India Programme

The following are the approach and methodology for the Digital India Programme:

- Ministries/Departments/States would fully leverage the Common and Support ICT Infrastructure established by GoI. DeitY would also evolve/lay down standards and policy guidelines, provide technical and handholding support, undertake capacity building, R & D, etc.
- The existing/ongoing e-Governance initiatives would be suitably revamped to align them with the principles of Digital India. Scope enhancement, Process Reengineering, use of integrated and interoperable systems and deployment of emerging technologies like cloud and mobile would be undertaken to enhance the delivery of Government services to citizens.
- States would be given flexibility to identify for inclusion additional state-specific projects, which are relevant for their socio-economic needs.
- e-Governance would be promoted through a centralised initiative to the extent necessary, to ensure citizen centric service orientation, interoperability of various e-Governance applications and optimal utilisation of ICT infrastructure/resources, while adopting a decentralised implementation model.
- Successes would be identified and their replication promoted proactively with the required productization and customisation wherever needed.
- Public Private Partnerships would be preferred wherever feasible to implement e-Governance projects with adequate management and strategic control.
- Adoption of Unique ID would be promoted to facilitate identification, authentication and delivery of benefits.
- Restructuring of NIC would be undertaken to strengthen the IT support to all government departments at Centre and State levels.
- The positions of Chief Information Officers (CIO) would be created in at least 10 key Ministries so that various e-Governance projects could be designed, developed and implemented faster. CIO positions will be at Additional Secretary/Joint Secretary level with over-riding powers on IT in the respective Ministry.

5.10.2 Management Structure of the Digital India Programme

Since the "e-Kranti: National e-Governance Plan 2.0" is already integrated with Digital India Programme, the existing programme management structure established for National e-Governance Plan at both national and state level has also been decided to be integrated appropriately with the programme management structure being envisaged for Digital India Programme at national and State/UT level.

Hence the structure consists of:

1. Cabinet Committee on Economic Affairs (CCEA).
2. A Monitoring Committee on Digital India under the chairmanship of the Prime Minister.
3. A Digital India Advisory Group headed by the Minister of Communications and IT.
4. An Apex Committee headed by the Cabinet Secretary.
5. Expenditure Finance Committee (EFC)/Committee on Non-Plan Expenditure (CNE).
6. A Council of Mission Leaders on Digital India headed by Secretary, DeitY.
7. State Committees headed by the Chief Ministers and Apex Committees headed by the Chief Secretaries.
8. Technical Appraisals by DeitY.

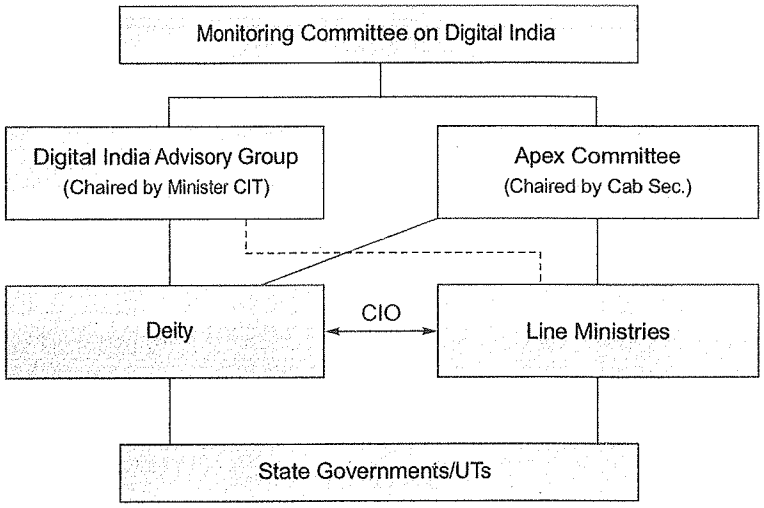


Fig. Industrial Mechanism of the Digital India Programme at National Level

The roles and responsibilities of each of the components of the management structure has already been discussed in the NeGP 2.0 section.

5.10.3 Pillars of Digital India

Digital India is an umbrella programme that covers multiple Government Ministries and Departments. It weaves together a large number of ideas and thoughts into a single, comprehensive vision so that each of them can be implemented as part of a larger goal. Each individual element stands on its own, but is also part of the larger picture. Digital India is to be implemented by the entire government with overall coordination being done by the Department of Electronics and Information Technology (DeitY). Digital India aims to provide the much needed thrust to the nine pillars of growth areas. These pillars are:

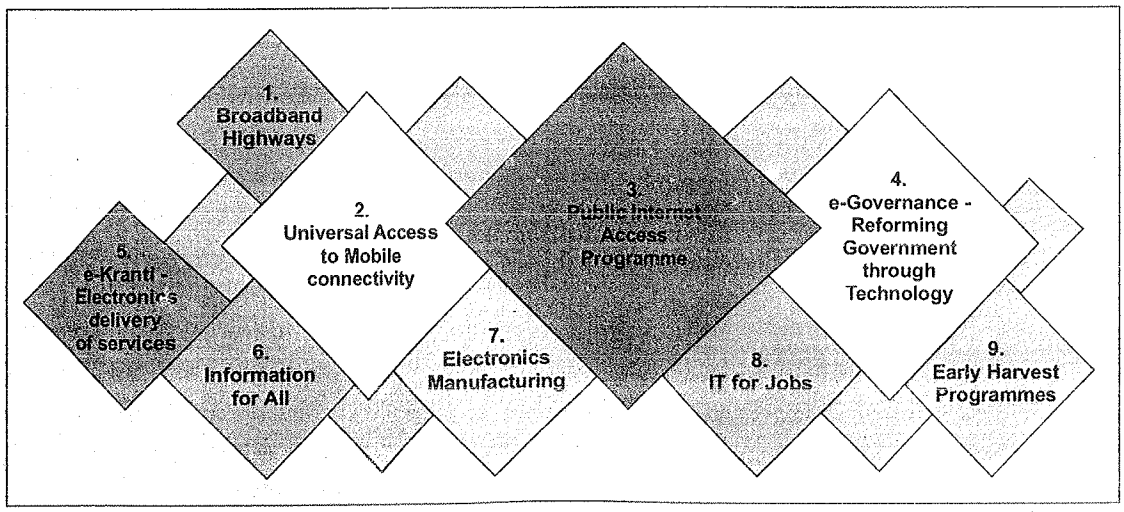


Fig. Nine Programme Pillars of Digital India

1. **Broadband Highways:** This covers three sub components, namely Broadband for All-Rural, Broadband for All-Urban and National Information Infrastructure (NII).

   Broadband for All - Rural: 2,50,000 village Panchayats would be covered under the National Optical Fibre Network (NOFN) by December 2016. Department of Telecommunications (DoT) is the nodal Department for this project.

   Broadband for All - Urban: Virtual Network Operators would be leveraged for service delivery and communication infrastructure in new urban development and buildings would be mandated.

   National Information Infrastructure (NII): NII would integrate the network and cloud infrastructure in the country to provide high speed connectivity and cloud platform to various government departments up to the Panchayat level.

   These infrastructure components include networks such as State Wide Area Network (SWAN), National Knowledge Network (NKN), National Optical Fibre Network (NOFN), Government User Network (GUN) and the MeghRaj Cloud. DeitY will be the nodal Department for this project.

2. **Universal Access to Mobile Connectivity:** This initiative focuses on network penetration and filling the gaps in connectivity in the country.

   There are around 55,619 villages in the country that do not have mobile coverage. As part of the comprehensive development plan for North East, providing mobile coverage to uncovered villages has been initiated. Mobile coverage to remaining uncovered villages would be provided in a phased manner. The Department of Telecommunications will be the nodal department.

3. **Public Internet Access Programme:** The two sub components of Public Internet Access Programme are Common Services Centres (which already has been discussed in this chapter) and Post Offices as multi-service centres. A total of 150,000 Post Offices are proposed to be converted into multi service centres. Department of Posts would be the nodal department to implement this scheme.

4. **e-Governance: Reforming Governance through Technology:** Government Process Re-engineering using IT to simplify and make the government processes more efficient is critical for transformation to make the delivery of government services more effective across various government domains and therefore needs to be implemented by all Ministries/Departments. The guiding principles for reforming Government through technology are:
   - Form simplification and field reduction.
   - Online applications and tracking.
   - Online repositories.
   - Integration of services and platforms.

5. **e-Kranti:** Electronic delivery of services: e-Kranti or NeGP 2.0 already has been discussed in details in this chapter.

NOTE: Through e-Governance: Reforming Governance through Technology and e-Kranti: Electronic delivery of services (the 4th and the 5th pillar) NeGP 2.0 has been incorporated in the Digital India Programme.

6. **Information for all:** Open Data platform facilitates proactive release of datasets in an open format by the ministries/departments for use, reuse and redistribution. Online hosting of information and documents would facilitate open and easy access to information for citizens.

   Government shall pro-actively engage through social media and web based platforms to inform and interact with citizens. **MyGov.in,** a platform for citizen engagement in governance, has been launched by the Hon'ble Prime Minister on 26th July, 2014, as a medium to exchange ideas/suggestions with Government. It will facilitate 2-way communication between citizens and Government to bring in good governance.

Online messaging to citizens on special occasions/programs would be facilitated through e-mails and SMS. Open Data platform, Social Media Engagement and Online Messaging would largely utilise existing infrastructure and would need limited additional resources.

7. **Electronics Manufacturing:** This pillar focuses on promoting electronics manufacturing in the country with the target of NET ZERO Imports by 2020 as a striking demonstration of intent. This ambitious goal requires coordinated action on many fronts, such as:
   - Taxation, incentives
   - Economies of scale, eliminating cost disadvantages
   - Focus areas - Big Ticket Items

     FABS, Fab-less design, Set top boxes, VSATs, Mobiles, Consumer and Medical Electronics, Smart Energy meters, Smart cards, micro-ATMs.
   - Incubators, clusters
   - Skill development, Enhancing PhDs
   - Government procurement
   - Safety Standards - Compulsory registration, Support for Labs and MSMEs
   - National Award, Marketing, Brand Building
   - National Centres - Flexible Electronics, Security Forces
   - R and D in electronics

     Demand for electronic goods is increasing with a Compound Annual Growth Rate (CAGR) of 22% and is expected to touch 400 Billion USD by 2020. Indian government is also taking several steps to promote manufacturing and investment in this sector, which puts India high on the list of potential places to invest.

National Policy on Electronics (NPE)

Government of India has approved National Policy on Electronics launched in 2012 (NPE 12) which is holistic, investor friendly and market driven towards creating a conducive environment to attract global and domestic companies to invest towards the growing Electronics System Design and Manufacturing (ESDM) sector in India. This gives unique opportunity for companies to consider India as a destination in ESDM sector and be part of the next largest Electronic Manufacturing Hub of the world and also provide value added manufacturing involving medium and high technologies.

8. **IT for Jobs:** This pillar focuses on providing training to the youth in the skills required for availing employment opportunities in the IT/ITES sector. There are eight components with specific scope of activities under this pillar:
   - IT Trainings to people in smaller towns and villages.
   - The target of this component is to train one crore students from smaller towns and villages for IT sector jobs over 5 years. DeitY is the nodal department for this scheme.
   - IT/ITES in North-eastern States.
   - This component focuses on setting up BPOs in every north-eastern state to facilitate ICT enabled growth in these states. DeitY is the nodal department for this scheme.
   - Training Service Delivery Agents.
   - The focus is on training three lakh service delivery agents as part of skill development to run viable businesses delivering IT services. DeitY is the nodal department for this scheme.
   - Training Rural Workforce on Telecom and Telecom related services.
   - This component focuses on training of five lakh rural workforce the Telecom Service Providers (TSPs) to cater to their own needs. Department of Telecommunications (DoT) is the nodal department for this scheme.

North East BPO Promotion Scheme (NEBPS)

The Indian BPO industry has witnessed significant growth over the past years and India has gradually emerged as one of the preferred BPO destinations globally. Several factors including operational cost effectiveness, availability of skilled manpower and ever-increasing demand for employment opportunities have increasingly contributed to the growth of BPO industry in the country. However, the BPO industry has largely been concentrated in and around large (Tier-I) cities where skilled manpower drawn from various parts of the country including NE Region seek employment.

In large (Tier-I) cities, the recurring manpower cost to the company is considered to be higher particularly keeping in view the relatively higher cost of residential accommodation and larger travelling distance for employees. Thus, it would be prudent for a BPO Company to migrate to smaller (Tier-II/III) cities including those in North Eastern Region, as it would result in significantly reduced manpower related expenses and thus making its operations far more profitable. It is understood that key concerns for setting up of BPO operations in the N.E. Region are related to various issues including reliable internet connectivity and power supply.

9. **Early Harvest Programmes:** Early Harvest Programme basically consists of those projects which are to be implemented within short timeline. The projects under the Early Harvest Programme are as follows:
   - IT Platform for Messages
   - Government Greetings to be e-Greetings
   - Biometric attendance
   - Wi-Fi in All Universities
   - Secure E-mail within Government
   - Standardize Government E-mail Design
   - Public Wi-Fi hotspots
   - School Books to be e-Books
   - SMS based weather information, disaster alerts
   - National Portal for Lost and Found children

5.10.4 Agencies for Implementation of the Digital India Initiatives

	Agency	About
1.	Controller of Certifying Authorities (CCA)	The IT Act provides for CCA to license and regulate the working of Certifying Authorities and also to ensure that none of the provisions of the Act are violated. The Certifying Authorities (CAs) issue Digital Signature Certificates (DSC) for electronic authentication of users. Its aim is to promote the growth of e-commerce and e-Governance through a wide use of digital signatures.
2.	Centre for Development of Advanced Computing (C-DAC)	It is the premier organization of the Ministry of Electronics and Information Technology (MeitY) for carrying out research and development in IT, Electronics and associated areas. C-DAC works on strengthening national technological capabilities in the context of global developments in the field and responds to change in the market need in selected foundation areas.
3.	Centre for Railway Information Systems (CRIS)	CRIS is an autonomous organization under the Ministry of Railways. It develops and manages the Information Technology applications of the Indian Railways.

4.	Department of Agriculture Co-operation and Farmers Welfare (DAC&FW)	DAC&FW is organized into 27 divisions and has five attached offices and twenty-one subordinate offices which are spread across the country for coordination with state level agencies and implementation of Central Sector Schemes in their respective fields.
5.	Small Farmers Agribusiness Consortium (SFAC)	SFAC is an autonomous society promoted by Ministry of Agriculture Cooperation and Farmers' Welfare, Government of India. SFAC is an exclusive society focused on increasing incomes of small and marginal farmers through aggregation and development of agribusiness.
6.	Department of Empowerment of Persons with Disabilities (DEPWD)	DEPWD in the Ministry of Social Justice and Empowerment facilitates empowerment of the persons with disabilities, who as per Census 2011 are 2.68 crore and are 2.21 percent of the total population of the Country. These include persons with Seeing, Hearing, Speech, Movement, Mental Retardation, Mental Illness, Multiple Disability and any other disabilities.
7.	Department of Finance Services	The mandate of the Department of Financial Services covers the functioning of Banks, Financial Institutions, Insurance Companies and the National Pension System.
8.	Department of Science and Technology (DST)	It promotes new areas of Science and Technology and to play the role of a nodal department for organising, coordinating and promoting S&T activities in the country.
9.	Directorate General of Supplies and Goods (DGS&D)	DGS&D is tasked primarily with fixing Rate Contracts (RC) for common user items required by various government organizations through an online e-procurement portal.
10.	Education and Research in Computer Networking (ERNET)	ERNET India is an autonomous scientific society under the administrative control of Ministry of Electronics and Information Technology, Government of India, having one of the largest nationwide terrestrial and satellite network with 15 points of presence located at the premier academic and research institutions in major cities of the country.
11.	Indian Computer Emergency Response Team (ICERT)	CERT-In was formed with an aim to secure Indian cyber space. It provides Incident Prevention and services as well as Security Quality Management Services.
12.	Indian Council of Agricultural Research (ICAR)	It is an autonomous organisation under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture, Government of India. The Council is the apex body for co-ordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country.
13.	Ministry of Corporate Affairs (MCA)	The Ministry is primarily concerned with administration of the Companies Act 2013, the Companies Act 1956, the Limited Liability Partnership Act, 2008 and other allied Acts and rules and regulations framed there-under mainly for regulating the functioning of the corporate sector in accordance with law.

14. Ministry of Electronics and Information Technology (MeitY)	MeitY aims to promote e-Governance for empowering citizens, promoting the inclusive and sustainable growth of the Electronics, IT & ITeS industries, enhancing India's role in Internet Governance, adopting a multipronged approach that includes development of human resources, promoting R & D and innovation, enhancing efficiency through digital services and ensuring a secure cyber space. It envisions e-Development of India as the engine for transition into a developed nation and an empowered society.
15. Ministry of Labour and Employment	The main responsibility of the Ministry is to protect and safeguard the interests of workers in general and those who constitute the poor, deprived and disadvantage sections of the society, in particular, with due regard to creating a healthy work environment for higher production and productivity and to develop and coordinate vocational skill training and employment services.
16. National Asset Directory (NAD)	National Asset Directory (NAD) is one of the software applications envisaged as part of Phase II of e-Panchayat MMP. NAD aims to keep stock of all the assets created, controlled and maintained by the RLB/ULB/Line Department in the country and assign a code to each asset for its unique identification leading to effective utilization of the Assets.
17. Ministry of External Affairs	The Ministry of External Affairs of India, also known as the Foreign Ministry, is the government agency responsible for the conduct of foreign relations of India.
18. National Council of Educational Research and Training (NCERT)	NCERT is an autonomous organisation set up by the Government of India to assist and advise the Central and State Governments on policies and programmes for qualitative improvement in school education.
19. National Health Mission (NHM)	The National Health Mission (NHM) encompasses two Sub-Missions, National Rural Health Mission (NRHM) and National Urban Health Mission (NUHM).
20. National Informatics Centre (NIC)	NIC of the Ministry of Electronics and Information Technology provides network backbone and e-Governance support to Central Government, State Governments, UT Administrations, Districts and other Government bodies. It offers a wide range of ICT services including Nationwide Communication Network for decentralized planning, improvement in Government services and wider transparency of national and local Governments.
21. National Institute of Electronics and Information Technology (NIELIT)	NIELIT (erstwhile DOEACC Society), an Autonomous Scientific Society under the administrative control of Ministry of Electronics and Information Technology, Government of India, was set up to carry out Human Resource Development and related activities in the area of Information, Electronics and Communications Technology (IECT).

22. National Institute of Health and Family Welfare (NIHFW)	NIHFW, an autonomous organization, under the Ministry of Health and Family Welfare, Government of India, acts as an 'apex technical institute' as well as a 'think-tank' for the promotion of health and family welfare programmes in the country.
23. National Internet Exchange of India (NIXI)	NIXI is a not for profit organization under section 25 of the Companies Act 1956 and was registered on 19th July, 2003. NIXI was set up for peering of ISPs among themselves for the purpose of routing the domestic traffic within the country, instead of taking it all the way to US/Abroad, thereby resulting in better quality of service (reduced latency) and reduced bandwidth charges for ISPs by saving on International Bandwidth.
24. National Skill Development Corporation, (NSDC)	NSDC is a one-of-its-kind, Public Private Partnership in India, under the Ministry of Skill Development and Entrepreneurship. It aims to promote skill development by catalyzing creation of large, quality, for-profit vocational institutions.
25. The National Association of Software and Services Companies (NASSCOM)	NASSCOM is the industry association for the IT-BPM sector in India. A not-for-profit organisation funded by the industry, its objective is to build a growth led and sustainable technology and business services sector in the country.
26. National Payments Corporation of India (NPCI)	NPCI is an umbrella organization for all retail payments system in India. It was set up with the guidance and support of the Reserve Bank of India (RBI) and Indian Banks' Association (IBA). The core objective is to consolidate and integrate multiple systems with varying service levels into nation-wide uniform and standard business process for all retail payment systems.
27. NSDL Database Management Ltd. (NDML)	NSDL Database Management Ltd. (NDML) is a wholly owned subsidiary of National Securities Depository Ltd. (NSDL). NDML is part of NSDL Group comprising of National Securities Depository Limited (NSDL), NSDL Database Management Limited (NDML) and NSDL e-Governance Infrastructure Limited.
28. The National University of Educational Planning and Administration (NUEPA)	NUEPA established by the Ministry of Human Resource Development, Government of India, is a premier organization dealing with capacity building and research in planning and management of education not only in India but also in South Asia.
29. Unique Identification Authority of India (UIDAI)	The Unique Identification Authority of India (UIDAI) is a statutory authority established under the provisions of the Aadhaar (Targeted Delivery of Financial and Other Subsidies, Benefits and Services) Act, 2016 ("Aadhaar Act 2016") under the Ministry of Electronics and Information Technology (MeitY). UIDAI was created with the objective to issue Unique Identification numbers (UID), named as "Aadhaar", to all residents of India that is (a) robust enough to eliminate duplicate and fake identities and (b) can be verified and authenticated in an easy, cost-effective way.

30.	National Centre for Geo-Informatics	NCoG provides a 'GIS platform' for sharing and collaborating GIS data source, location based analytics and 'Decision Support System' serving to Central/State/UT government departments, businesses as well as provide hosts of citizen services.

M-Governance

- M-Governance is the use of mobile or wireless to improve Government service and information anytime anywhere. It is a not a replacement for e-Governance, rather it complements e-governance.
- Mobile applications also rely on good back office ICT infrastructure and work processes. It has potential of using mobile phones as input devices in certain areas where the last mile connectivity becomes issue for simple data inputs of critical importance for decision making in government departments.
- M-Governance is not a new concept. The private sector has been greatly leveraging these of mobile phones for delivery of value added services for the following which however are mostly SMS based: Banking, Media, Airlines, Telecom, Entertainment, News, Sports, astrology, and Movie Tickets etc.
- M-Governance has increased the productivity of public service personnel, thereby improving the delivery of Government information and services, increasing channels for public interactions and lower costs leading to higher participation of people.

National Informatics Centre (NIC)

- National Informatics Centre (NIC) was established in 1976 and has since emerged as a "prime builder" of e-Government/e-Governance applications up to the grassroots level as well as a promoter of digital opportunities for sustainable development.
- NIC, through its ICT Network, "NICNET", has institutional linkages with all the Ministries /Departments of the Central Government, 36 State Governments/Union Territories, and about 688 District administrations of India.

  "Informatics-led-development" programme of the government has been spearheaded by NIC to derive competitive advantage by implementing ICT applications in social and public administration. The following major activities are being undertaken:

  (a) Setting up of ICT Infrastructure
  (b) Implementation of National and State Level e-Governance Projects
  (c) Products and Services
  (d) Consultancy to the government departments
  (e) Research and Development
  (f) Capacity Building
- NIC has set up state-of-the-art ICT infrastructure consisting of National and state Data Centres to manage the information systems and websites of Central Ministries/Departments, Disaster Recovery Centres, Network Operations facility to manage heterogeneous networks spread across Bhawans, States and Districts, Certifying Authority, Video-Conferencing and capacity building across the country.
- With increasing awareness leading to demand and availability of ICT infrastructure with better capacities and programme framework, the governance space in the country witnessed a new round of projects and products, covering the entire spectrum of e-Governance including G2C, G2B, G2G, with emphasis on service delivery.
- ICT support is also being provided in the States/UTs by NIC. Citizen centric services are also being rendered electronically at the district level, such as Income Certificate, Caste Certificate and Residence Certificate etc. along with other services like Scholarship portals, permits, passes, licenses to name a few.

- Thus, NIC, a small program started by the external stimulus of an UNDP project, in the early 1970s, became fully functional in 1977 and since then has grown with tremendous momentum to become one of India's major S & T; organizations promoting informatics led development. This has helped to usher in the required transformation in government to ably meet the challenges of the new millennium.

5.10.5 Some Digital India Initiatives

1. Digital Locker System:
   - Digital Locker is aimed at minimizing the usage of physical documents and enable sharing of e-documents across agencies.
   - Digi Locker ties into Digital India's visions areas of providing citizens a shareable private space on a public cloud and making all documents/certificates available on this cloud.
   - With the help of this Portal, the sharing of the e-documents will be done through registered repositories thereby ensuring the authenticity of the documents online.
   - Residents can also upload their own electronic documents and digitally sign them using the e-sign facility.
   - These digitally signed documents can be shared with government organizations or other entities.
   - Components of the Digital Locker:
     (a) **Repository** is a Collection of e-Documents which are uploaded by issuers in a standard format and exposing a set of standard APIs for secure real-time search and access.
     (b) **Access Gateway** provides a secure online mechanism for requesters to access e-documents from various repositories in real-time using e-Document URI (Uniform Resource Indicator). The URI is a link to the e-Document uploaded by an issuer in a repository. The gateway will identify the address of the repository where the e-Document is stored based on the URI and will fetch the e-Document from that repository.

     It dedicates 10 MB free personal storage space, linked to each resident's Aadhaar, to securely store e-documents and to store URI link of e-documents for accessing them directly from the repositories.
   - It provides sharing of secured e-documents with requesters.
   - It is currently accessible via web portal, will be made accessible through mobile application also.
   - It also provides integrated e-Sign service to digitally sign documents.
2. MyGov Mobile App:
   - MyGov Mobile App is Government of India's innovative citizen engagement platform for direct citizen participation in governance by providing an avenue for channelizing their ideas, comments and creative suggestions to Central Ministries and associated organizations.
   - Citizens can participate in policy formulation and program implementation to usher in an era of direct participatory democracy.
   - MyGov platform has become a key part of the policy and decision making process of the country. Where the platform has been able to provide the citizens a voice in the governance process of the country and create grounds for the citizens to become stakeholders not only in policy formulation and recommendation bit but also implementation through actionable tasks.
   - Given the importance of this platform in transformation of India through participatory governance, the platform has been constantly undergoing upgrades to ensure an enhanced level of user experience.
   - The major attributes of MyGov includes Discussion, Tasks, Talks, Polls and Blogs on various groups based on the diverse governance and public policy issues.

3. National e-Governance Service Delivery Gateway (NSDG):
   - The National e-Governance Plan (NeGP) of the Govt, of India aims to make all Government services accessible to the common man in his locality, through common service delivery outlets and ensure efficiency, transparency and reliability of such services at affordable costs to realize the basic needs of the common man.
   - The National e-Governance Service Delivery Gateway (NSDG), a MMP under the NeGP, can simplify this task by acting as a standards-based messaging switch and providing seamless interoperability and exchange of data across.
   - NSDG is an attempt to reduce such point to point connections between departments and provide a standardized interfacing, messaging and routing switch through which various players such as departments, front-end service access providers and back-end service providers can make their applications and data inter-operable.
   - NSDG aims to achieve a high order of interoperability among autonomous and heterogeneous entities of the government (in the Centre, States or Local bodies), based on a framework of e-Governance Standards.

4. eSign:
   - eSign is an online electronic signature service which can be integrated with service delivery applications via an API to facilitate an eSign user to digitally sign a document.
   - This service facilitates issuing a Digital Signature certificate and performing signing of requested data by authenticating the Aadhaar holder.
   - Aadhaar is mandatory for availing the eSign Service.

   Benefits of eSign:

   (a) Easy and secure way to digitally sign information anywhere, anytime - eSign is an online service for electronic signatures without using physical cryptographic token. Application service providers use e-KYC service to authenticate signers and facilitate digital signing of documents.

   (b) Facilitates legally valid signatures - eSign process includes signer consent, Digital Signature Certificate issuance request, Digital Signature creation and affixing as well as Digital Signature Certificate acceptance in accordance with provisions of Information Technology Act. Comprehensive digital audit trail, in-built to confirm the validity of transactions, is also preserved.

   (c) Flexible and easy to implement - eSign provides configurable authentication options in line with e-KYC service and also records the e-KYC ID used to verify the identity of the signer. The authentication options for e-KYC include biometric or OTP of the e-KYC service provider. eSign enables eSign users easy access to legally valid Digital Signature service.

   (d) Respecting privacy - eSign ensures the privacy of the signer by requiring that only the thumbprint (hash) of the document be submitted for signature function instead of the whole document.

   (e) Secure online service - The eSign service is governed by e-authentication guidelines. While authentication of the signer is carried out using e-KYC services, the signature on the document is carried out on a backend server of the e-Sign provider.

   - eSign services are facilitated by trusted third party service providers - currently Certifying Authorities (CA) licensed under the IT Act.
   - To enhance security and prevent misuse, eSign user's private keys are created on Hardware Security Module (HSM) and destroyed immediately after one time use.

5. e-Hospital:
   - e-Hospital is an open source Health Information Management System (HMIS) which is configurable and easily customizable with multi-tenancy support. It is designed to deploy in cloud infrastructure to manage multiple hospitals seamlessly.

- This portal aims to:
  (a) Provide a unified platform for citizens to avail healthcare services online.
  (b) Establish identity of patients through Aadhaar number.
- Modules of e-Hospital:
  (a) Patient Registration
  (b) Emergency Registration
  (c) Clinics
  (d) Billing and Accounts
  (e) Path Lab (LIS)
  (f) Radiology /Imaging (RIS)
  (g) PACS Interface
  (h) Blood Bank Management
  (i) IPD (ADT)
  (j) OT Management
  (k) Pharmacy Management
  (l) Electronic Medical Records (EMR)
  (m) Birth and Death Registration
  (n) Care Provision
  (o) Stores and Inventory
  (p) Dietary Services
  (q) Laundry Services
  (r) Personnel Management
  (s) Telemedicine Suite
  (t) Student Management System (For Teaching Hospital)

6. **National Optical Fibre Network (NOFN):**
   - National Optical Fibre Network (NOFN) is an ambitious initiative to trigger a broadband revolution in rural areas.
   - The National Optical Fibre Network (NOFN) aims to connect all the 2,50,000 Gram Panchayats in the country and provide 100 Mbps connectivity to all Gram Panchayats (GPs).
   - To achieve this, the existing fibres of PSUs (BSNL, RailTel and Power Grid) were utilised and incremental fibre was laid to connect to Gram Panchayats wherever necessary.
   - Dark fibre network thus created was lit by appropriate technology thus creating sufficient bandwidth at the Gram Panchayats.
   - Non-discriminatory access to the NOFN was provided to all the service providers like Telecom Service Providers (TSPs), ISPs, Cable TV operators and Content providers to launch various services in rural areas. The NOFN project was funded by the Universal Service Obligation Fund (USOF).
7. **BharatNet:**
   - Based on NOFN experiences, newer, updated and upgraded version - BharatNet was conceived as a nation-wide broadband network.
   - BharatNet shall be a project of national importance to establish, by 2017, a highly scalable network infrastructure accessible on a non-discriminatory basis, to provide on demand, affordable broadband connectivity of 2 Mbps to 20 Mbps for all households and on demand capacity to all institutions, to realise the vision of Digital India, in partnership with States and the private sector.

- The entire project is being funded by Universal Service Obligation Fund (USOF), which was set up for improving telecom services in rural and remote areas of the country.

8. **PRAGATI:**
   - PRAGATI (Pro-Active Governance And Timely Implementation) is a unique integrating and interactive platform. The platform is aimed at addressing common man's grievances and simultaneously monitoring and reviewing important programmes and projects of the Government of India as well as projects flagged by State Governments.
   - The PRAGATI platform uniquely bundles three latest technologies:
     (a) Digital data management.
     (b) Video-conferencing.
     (c) Geo-spatial technology.
   - Key features of the PRAGATI application are as follows:
     (a) It is a three-tier system (PMO, Union Government Secretaries and Chief Secretaries of the States).
     (b) Prime Minister will hold a monthly programme where he will interact with the Government of India Secretaries and Chief Secretaries through Video-conferencing enabled by data and geo-informatics visuals.
     (c) The first such programme was launched on 25th March, 2015 (Wednesday) at 3.30 PM.
     (d) Now onwards, it will be held once in every month on Fourth Wednesday at 3.30 PM-to be known as PRAGATI Day.
     (e) Issues to be flagged before the PM are picked up from the available database regarding Public Grievances, on-going Programmes and pending Projects.
     (f) The system will ride on, strengthen and re-engineer the data bases of the CPGRAMS for grievances, Project Monitoring Group (PMG) and the Ministry of Statistics and Programme Implementation. PRAGATI provides an interface and platform for all these three aspects.
     (g) It will also take into consideration various correspondences to PM's office by the common people or from high dignitaries of States and/or developers of public projects.
     (h) The issues flagged are uploaded seven days prior to the PRAGATI day (i.e. on third Wednesday of every month).
     (i) These issues can be viewed by the Union Government Secretaries and Chief Secretaries after entering into the application.
     (j) User ID and Password for each of the Union Government Secretaries and Chief Secretaries have been created and made available.
     (k) Union Government Secretaries and Chief Secretaries will be able to see the issues pertaining to their Department/State.
     (l) Union Government Secretaries and Chief Secretaries have to put their comments and updates about the flagged issues within three days (i.e. by next Monday),
     (m) One day - Tuesday is available to the PMO team to review the data entered by the Union Government Secretaries and Chief Secretaries.
     (n) The design is such, that when PM reviews the issue he should have on his screen the issue as well as the latest updates and visuals regarding the same.

9. **Meghraj (GI cloud):**
   - Cloud Computing Services provide the new model of offering services (Platform as a Service (PaaS), Infrastructure as a Service (IaaS), Software as a Services (SaaS) and Storage as a Service (STaaS)) to the users at fast pace which is also cost effective.

- In order to utilise and harness the benefits of Cloud Computing, Government of India has embarked upon an ambitious initiative - "GI Cloud" which has been named as 'MeghRaj'.
- This initiative is to implement various components including governance mechanism to ensure proliferation of Cloud in the government.
- The focus of this initiative is to accelerate delivery of e-services in the country while optimizing ICT spending of the Government.
- MeghRaj will ensure optimum utilization of the infrastructure and speed up the development and deployment of e-Gov applications.
- The architectural vision of GI Cloud encompasses a set of discrete cloud computing environments spread across multiple locations, built on existing or new (augmented) infrastructure, following a set of common protocols, guidelines and standards issued by the Government of India.
- The National Informatics Centre (NIC) is providing National Cloud services under the initiative MeghRaj.

10. RailTel:

- RailTel Corporation a "Mini Ratna (Category-I)" PSU is one of the largest neutral telecom infrastructure providers in the country owning a Pan-India optic fiber network on exclusive Right of Way (ROW) along Railway track.
- The OFC network covers all important towns and cities of the country and several rural areas covering 70% of India's population. RailTel with strong nationwide presence is committed to bring cutting edge technology and offer innovative services to the Indian Telecom market.
- RailTel is in the forefront in providing nationwide Broadband Telecom and Multimedia Network in all parts of the country in addition to modernization of Train operations and administration network systems.
- With its Pan India high capacity network, RailTel is working towards creating a knowledge society at various fronts. Presently, RailTel has created over 45000 RKMs of fiber network connecting over 4500 cities/towns on the network including several rural areas.

11. TRI-NETRA:

- Ministry of Railways, Railway Board has initiated a proposal to install TRI-NETRA systems on locomotives for enhancing the vision of Locomotive Pilots in inclement weather. TRI-NETRA stands for - Terrain imaging for diesel drivers infra-red, Enhanced optical and Radar Assisted system.
- TRI-NETRA system shall be made up of high-resolution optical video camera, high sensitivity infra-red video camera and additionally a radar-based terrain mapping system.

  These three components of the system shall act as three eyes (Tri-Netra) of the Locomotive Pilot.
- TRI-NETRA is designed to "see" the terrain ahead of the running locomotive during inclement weather by combining the images captured by the three sub-systems and to create a composite video image which shall be displayed in front of the Loco Pilot on a computer monitor.
- During fog, heavy rain and also during night, the locomotive pilots face serious challenges in looking out ahead to spot any obstruction on the track such as vehicles which get stuck while crossing the track or trees or boulders which have fallen across the track etc. Because of the heavy momentum of the running train, the train driver has to always adjust the speed of the train such that he or she can stop the train on visually seeing the obstruction. This is where TRI-NETRA will come into picture and give the locomotive pilot a clear view of the track ahead in bad visibility conditions so that he can apply brakes well in time.

12. Digital Payment Methods:

- As part of promoting cashless transactions and converting India into less-cash society, various modes of digital payments are available. These modes are:

(i) **Banking Cards:** Banking cards offer consumers more security, convenience and control than any other payment method. The wide variety of cards available - including credit, debit and prepaid - offers enormous flexibility, as well. These cards provide 2 factor authentication for secure payments e.g. secure PIN and OTP. RuPay, Visa, Master Card are some of the example of card payment systems.

(ii) **USSD:** The innovative payment service *99# works on Unstructured Supplementary Service Data (USSD) channel. This service allows mobile banking transactions using basic feature mobile phone, there is no need to have mobile internet data facility for using USSD based mobile banking. It is envisioned to provide financial deepening and inclusion of under banked society in the mainstream banking services.

(iii) **AEPS:** AEPS is a bank led model which allows online interoperable financial transaction at PoS (Point of Sale/Micro ATM) through the Business Correspondent (BC)/Bank Mitra of any bank using the Aadhaar authentication.

(iv) **UPI:** Unified Payments Interface (UPI) is a system that powers multiple bank accounts into a single mobile application (of any participating bank), merging several banking features, seamless fund routing and merchant payments into one hood. It also caters to the "Peer to Peer" collect request which can be scheduled and paid as per requirement and convenience. Each Bank provides its own UPI App for Android, Windows and iOS mobile platform(s).

(v) **Mobile Wallets:** A **mobile wallet** is a way to carry cash in digital format. You can link your credit card or debit card information in mobile device to mobile wallet application or you can transfer money online to mobile wallet. Instead of using your physical plastic card to make purchases, you can pay with your Smartphone, tablet, or smart watch. An individual's account is required to be linked to the **digital wallet** to load money in it. Most banks have their e-wallets and some private companies, e.g. **Paytm, Freecharge, Mobikwik, Oxigen, mRuppee, Airtel Money, Jio Money, SBI Buddy, itz Cash, Citrus Pay, Vodafone M-Pesa, Axis Bank Lime, ICICI Pockets, SpeedPay** etc.

(vi) **Banks Prepaid Cards:** A bank prepaid card is the one where the card is loaded with money prior to the usage. When the balance on the card dips low, it needs to be recharged. Unlike a Debit card, a prepaid card is not linked to the bank accounts.

(vii) **Point of Sale:** A Point of Sale (PoS) is the place where sales are made. On a macro level, PoS may be a mall, a market or a city. On a micro level, retailers consider PoS to be the area where a customer completes a transaction, such as a checkout counter. It is also known as a point of purchase.

(viii) **Internet Banking:** Internet banking, also known as online banking, e-banking or virtual banking, is an electronic payment system that enables customers of a bank or other financial institution to conduct a range of financial transactions through the financial institution's website.

Different types of online financial transactions are:

(a) National Electronic Funds Transfer (NEFT) is a nation-wide payment system facilitating one-to-one funds transfer. Under this Scheme, individuals, firms and corporate can electronically transfer funds from any bank branch to any individual, firm or corporate having an account with any other bank branch in the country participating in the Scheme.

(b) Real Time Gross Settlement (RTGS) is defined as the continuous (real-time) settlement of funds transfers individually on an order by order basis (without netting).

(c) Electronic Clearing System (ECS) is an alternative method for effecting payment transactions in respect of the utility-bill-payments such as telephone bills, electricity bills, insurance premia, card payments and loan repayments, etc., which would obviate the need for issuing and handling paper instruments and thereby facilitate improved customer service by banks/companies/corporations/government departments, etc., collecting/receiving the payments.

(d) Immediate Payment Services (IMPS) offers an instant, 24X7, interbank electronic fund transfer service through mobile phones. IMPS is an emphatic tool to transfer money instantly within banks across India through mobile, internet and ATM which is not only safe but also economical both in financial and non-financial perspectives.

(ix) **Mobile Banking:** Mobile banking is a service provided by a bank or other financial institution that allows its customers to conduct different types of financial transactions remotely using a mobile device such as a mobile phone or tablet.

(x) **Micro ATMs:** Micro ATM meant to be a device that is used by a million Business Correspondents (BC) to deliver basic banking services. The platform will enable Business Correspondents (who could be a local kirana shop owner and will act as 'micro ATM') to conduct instant transactions.

13. **Bharat Bill Payment System (BBPS):**

- The Reserve Bank of India (RBI) proposes to set up anytime anywhere bill payment system under Bharat Bill Payment System (BBPS). RBI has issued guidelines for implementation of BBPS on November 28, 2014.
- The BBPS is designed to function as a tiered structure for operating the bill payment system in the country with a single brand image providing convenience of 'anytime anywhere' bill payment to customers.
- The National Payments Corporation of India (NPCI) has been designated as the authorized Bharat Bill Payment Central Unit (BBPCU) to set the standards for BBPS processes which need to be adhered to by all authorized operating units under the system.

14. **Bharat Interface for Money (BHIM):**

- Bharat Interface for Money (BHIM) is a payment app that lets people make simple, easy and quick transactions using Unified Payments Interface (UPI).
- Anyone can make direct bank payments to anyone on UPI using their UPI ID or scanning their QR with the BHIM app. One can also request money through the app from a UPI ID.
- Pioneered and developed by National Payments Corporation of India (NPCI), BHIM has been conceived and launched by the Hon'ble Prime Minister of India, Narendra Modi on 30th December 2016 to bring in Financial Inclusion to the nation and a digitally empowered society.

15. **BharatQR:**

- Bharat QR code is an interoperable payment acceptance solution that supports Visa, Master Card Amex and RuPay cards & BHIM-UPI for wider acceptance. Here, the customer scans the QR code of the merchandise and then transfers the money from his/her wallet.
- The only difference with Bharat QR Code is that just as BHIM, the customers at the merchandise point do not have to create and then draw money from the wallet. The funds are directly transferred from the customer's account and transferred instantly to that of the merchant or service provider.

- Unlike credit or debit cards used at the points of sales, there are no charges involved. There is an ease of using App with no cost. As far as the integrity and safety of the system is concerned, the RBI is giving assurance about it.

16. **Rapid Assessment System (RAS):**
    - Under the overarching vision of Digital India, Government of India (GoI) aims to make seamlessly integrated services across all Government departments accessible to citizens.
    - As the country prepares for Digital India programme, National e-Governance Division, a division of Ministry of Electronics and Information Technology, has developed a Rapid Assessment System (RAS) for continuous feedback for e-services delivered by Government of India and State Governments.
    - This system has multiple channels for receiving feedback and is backed by analytics. These analytics will help integrated departments for continuous system improvement and better governance.
17. **Single Window Interface for Facilitating Trade:**
    - As part of the "Ease of Doing Business" initiatives, the Central Board of Excise and Customs, Government of India has taken up implementation of the Single Window Project to facilitate the Trading across Borders in India.
    - The **'India Customs Single Window'** would allow importers and exporters, the facility to lodge their clearance documents online at a single point only. Required permissions, if any, from other regulatory agencies would be obtained online without the trader having to approach these agencies.
    - The Single Window Interface for Trade (SWIFT), would reduce interface with Governmental agencies, dwell time and the cost of doing business.
18. **Government e-Marketplace (GeM):**
    - Government e-Marketplace (GeM) is a very bold step of the Government with the aim to transform the way in which procurement of goods and services is done by the Government Ministries/ Departments, PSUs, autonomous bodies etc.
    - Directorate General of Supplies and Goods (DGS&D) with technical support of NeGD (MeitY) has developed GeM portal for procurement of both Products and Services. The portal was launched on 9th August, 2016 by the Hon'ble Commerce and Industry Minister.
19. **Cyber Swachhta Kendra:**
    - The Cyber Swachhta Kendra (Botnet Cleaning and Malware Analysis Centre) is a part of the Government of India's Digital India initiative under the Ministry of Electronics and Information Technology (MeitY).
    - It aims to create a secure cyber space by detecting botnet infections in India and to notify, enable cleaning and securing systems of end users so as to prevent further infections.
    - The Cyber Swachhta Kendra (Botnet Cleaning and Malware Analysis Centre) is set up in accordance with the objectives of the "National Cyber Security Policy", which envisages creating a secure cyber eco-system in the country. This centre operates in close coordination and collaboration with Internet Service Providers and Product/Antivirus companies.
    - Its mission is to enhance the cyber security of Digital India's IT infrastructure by providing information on botnet/malware threats and suggesting remedial measures.
20. **Vikaspedia:**
    - This portal has been developed as part of the national level initiative - India Development Gateway (InDG), dedicated for providing information/knowledge and ICT based knowledge products and services in the domain of social development.

- InDG is a Ministry of Electronics and Information Technology, Government of India initiative and is executed by Centre for Development of Advanced Computing, Hyderabad.
- It is available in 23 Indian languages other than English for all the six sectors of Agriculture, Health, Education, Social Welfare, Energy and e-Governance.

21. **e-NAM (National Agriculture Market):**
    - National Agriculture Market (NAM) is a pan-India electronic trading portal which networks the existing Agriculture Produce Market Committee (APMC) mandis to create a unified national market for agricultural commodities.
    - The NAM Portal provides a single window service for all APMC related information and services. This includes commodity arrivals and prices, buy and sell trade offers, provision to respond to trade offers, among other services.
    - While material flow (agriculture produce) continues to happen through mandis, an online market reduces transaction costs and information asymmetry.
    - NAM creates a unified market through online trading platform, both, at State and National level and promotes uniformity, streamlining of procedures across the integrated markets, removes information asymmetry between buyers and sellers.
    - It promotes real time price discovery, based on actual demand and supply, promotes transparency in auction process, and access to a nationwide market for the farmer, with prices commensurate with quality of his produce and online payment and availability of better quality produce and at more reasonable prices to the consumer.
22. **DigiSevak:**
    - DigiSevak is an online volunteering platform for interested citizens who want to contribute to the success of Digital India program.
    - Various government department and agencies can create volunteering tasks and volunteers can choose tasks based on their skills and interest areas.
    - The platform provides means for end-to-end execution of a volunteering task, right from registration of volunteers to creation of tasks, evaluation of tasks and rewards and recognition of contribution by volunteers.

    Objectives:
    - To provide a platform to citizens to volunteer for Digital India related tasks and activities.
    - To provide a platform to ministries and government agencies to find volunteers for Digital India related tasks and activities.
    - To provide an opportunity to citizens to contribute to the success of Digital India by volunteering in their interest and skill areas.
    - To create mass awareness about key focus areas of Digital India like cyber hygiene, digital literacy, e-waste, MyGov, Digital Locker, CSCs etc.
    - To reward and recognise the work of volunteers through peer review, social media and point redeem system.

    Who can use this platform?

    (a) **Task Owners:** Implementing any project under Digital India
        - Ministries/Department of Central Government.
        - Ministries/Department of State Governments India.
        - Autonomous Organisation/PSUs/Agencies of Central Government.
        - International Organisations (UN Bodies) looking for volunteers for ICT/Digital services projects.
        - Other Organisations having working relations with Central Government Ministries and working on Digital India vision areas.

(b) **Volunteers:** Citizens of India, who are willing to contribute to the goals of Digital India program by volunteering in their key interest and skill areas and abide by the DigiSevak pledge.

23. **eTaal:**

- eTaal stands for e-Transaction Aggregation and Analysis Layer.
- It is a web portal for dissemination of e-Transaction statistics of Central and State level e-Governance Projects including Mission Mode Projects. It receives transaction statistics from web based applications periodically on near real time basis.
- eTaal presents quick analysis of transaction counts in graphical form (Bar Chart, Pie Chart, Bubble Chart, etc.) and as Tabular Statements to give quick view of transactions done by various e-Governance projects.
- It provides visibility for the National/State level services of e-Governance Projects and presents status on actual utilization of various systems running at various locations.
- The target group is any department or government organization offering G2C, G2B or G2G services.

What is e-Transaction?

A transaction in delivering a public service which uses Information Technology (IT) while also satisfying the following four conditions:

(a) Service is requested through electronic means including mobile devices.

(b) Workflow/approval process is electronic.

(c) Database is electronic/digitized.

(d) Service delivery is electronic.

in order to improve access, enhance transparency and reduce response time.

Objectives:

- To measure the number of e-Transactions per month (TPM) performed by various e-Governance applications.
- To provide quick view of e-Transactions performed electronically (self or assisted access).
- To act as an indicator of scale of services being delivered to the citizens.
- To provide quick exploration of e-Transactions in tabular as well as graphical form.
- To enable the ministries/departments implementing e-Governance projects get a real time view of the impact of their projects and take remedial steps or interventions where needed.

24. **e-Sampark:**

- e-Sampark is a mechanism to connect the government directly with citizens across India by running mailer, outbound dialling and SMS campaigns.
- The platform is used for sharing informational and public service messages.
- The concept of e-Sampark has been introduced to establish proactive communication by digitization of campaigns.
- The multi-faceted platform facilitates not only seamless communication between the government and citizens, but also maintains a database of contacts of the nodal officers, representatives and citizens.
- In addition, users can also view the previous campaigns conducted.
- e-Sampark signifies the essence of Digital India. It enables the government to communicate with the citizens about several programs and initiatives.
- e-Sampark is designed, developed and hosted by National Informatics Centre, Ministry of Electronics and Information Technology, Government of India.

25. Internet of Things (IoT):

- IoT can be defined as interplay for software, telecom and electronic hardware industry and promises to offer tremendous opportunities for many industries.
- With its advent, the number of connected sensors soon will reach trillions; working with billions of intelligent systems involving innumerous applications will drive new consumer and business behaviour.
- The demand for increasingly intelligent industry solutions based on IoT will drive trillions of dollars in opportunity for IT industry and even more for the companies that take advantage of the IoT.
- One of the top most initiatives in the form of Digital India Program of the Government is expected to provide the required impetus for development of the IoT industry ecosystem in the country.
- Department of Electronics and Information Technology, (DeitY) has come out with a draft IoT Policy document which focuses on following objectives:
  (i) To create an IoT industry in India of USD 15 billion by 2020. It has been assumed that India would have a share of 5-6% of global IoT industry.
  (ii) To undertake capacity development (Human and Technology) for IoT specific skill-sets for domestic and international markets.
  (iii) To undertake Research and development for all the assisting technologies.
  (iv) To develop IoT products specific to Indian needs in all possible domains.
- The Policy framework of the IoT Policy has been proposed to be implemented via a multi-pillar approach.
- The approach comprises of five vertical pillars:
  (i) Demonstration Centres.
  (ii) Capacity Building and Incubation.
  (iii) R & D and innovation.
  (iv) Incentive and Engagements.
  (v) Human Resource Development.
- It also comprises of 2 horizontal supports:
  (i) Standards
  (ii) Governance Structure

26. UMANG:

- UMANG (Unified Mobile Application for New-Age Governance) is one of the key initiatives under the Digital India program to develop a common, unified platform and mobile app to facilitate a single point of access to all government services.
- It is developed by Ministry of Electronics and Information Technology (MeitY) and National e-Governance Division (NeGD) to drive Mobile Governance in India.
- It is envisaged to act as a master application, which will integrate 200 applications which will offer around 1,200 services of various government departments of the Centre, states and local bodies, and even some important utility services from the private sector.
- Its primary aim is to abridge inconvenience faced by users in managing multiple mobile apps and facilitate a one-stop-solution to avail varied government services.
- Umang service has been made available on multiple channels like mobile application, web, IVR and SMS which can be accessed through smart phones, feature phones, tablets and desktops.

27. UDAAN:
    - Udaan, the Special Industry Initiative (SII) for J&K is funded by Ministry of Home Affairs and implemented by National Skill Development Corporation (NSDC).
    - The programme is a part of the overall initiative for addressing economic issues in J&K. While steps are being taken by the State and Central Government to revive economic activity in J&K, Udaan programme is a special initiative to address the needs of the educated unemployed in J&K.
    - The aim is to provide skills and job opportunities to the youth. Simultaneously, the aim is also to provide exposure to corporate India towards the rich talent pool available in J&K.
    - The Udaan programme is designed to encourage corporate to travel to J&K meet with the youth and hire aspiring youth in J&K who wish to explore the opportunity to work with corporate. Udaan provides a framework of support to the youth to travel, undergo training in firms and transit to work.

28. Startup India portal and mobile app:
    - Startup India is a flagship initiative of the Government of India, intended to build a strong eco-system for nurturing innovation and Startups in the country that will drive sustainable economic growth and generate large scale employment opportunities.
    - The Government through this initiative aims to empower Startups to grow through innovation and design.
    - The Department of Industrial Policy and Promotion under the Ministry of Commerce and Industry holds the responsibility for this project.

29. Parivahan Portal:
    - The portal was launched to improve the quality of service delivery to the citizen and the quality of work environment of the RTOs (Regional Transport Office).
    - Its mission has been to automate all Vehicle Registration and Driving License related activities in transport authorities of country with introduction of smart card technology to handle issues like inter-state transport vehicle movement and to create state and national level registers of vehicles/DL information.
    - The portal belongs to the Ministry of Road Transport and Highways (MoRTH), Government of India.
    - The initiative has been to centralize both applications- VAHAN (database for vehicle registration across all RTOs) and SARATHI (database for issuance of driving license across all RTOs), for ensuring higher transparency, security and reliability of operations through a countrywide unified database and provision of a highly citizen and trade centric web enabled environment.

30. National Voters Service Portal (NSVP):
    - The portal was developed with an aim to provide single window service electors.
    - Through NVSP, a user can avail and access various services such as access the electoral list, apply for voter id card, apply online for corrections in voter's card, view details of Polling booth, Assembly Constituency and Parliamentary constituency, and get the contact details of Booth Level officer, Electoral Registration Officer, among other services.
    - This portal is designed and maintained by C-DAC GIST, Pune.

31. National UJALA Dashboard:
    - The initiative is part of the Government of India's efforts to spread the message of energy efficiency in the country.

- UJALA (Unnat Jyoti by Affordable LEDs for All) scheme aims to promote efficient use of energy at the residential level; enhance the awareness of consumers about the efficacy of using energy efficient appliances and aggregating demand to reduce the high initial costs thus facilitating higher uptake of LED lights by residential users.
- The scheme and the dashboard is under the supervision of Ministry of Power, Government of India.

32. Nirbhaya App:
    - **Nirbhaya:** Be Fearless is an android emergency application, which can send a distress call or emergency message to a specified contact or group in an emergency situation faced by a woman or any other individual in general.
    - Correct Location, Information and Communication, with and from the app is dependent upon the basic hardware/software requirements, like - Active Data plan, SMS plan, minimum talk time and active GPS functionality.
33. Himmat App:
    - Himmat is an initiative by Delhi police especially for women.
    - Himmat is an emergency service, comprised of an android emergency application, which can send a distress call or emergency message to Delhi Police officials and specified contact or group in an emergency situation faced by a woman.
    - The Police personnel will get these SOS alerts and locations on a portal and as a sms on their mobile phones as well.
34. eVISA:
    - The Tourist Visa on Arrival enabled with Electronic Travel Authorisation (ETA) (renamed as e-Tourist Visa), enables the prospective visitor to apply for an Indian Visa from his/her home country online without visiting the Indian Mission and also pay the visa fee online.
    - It's a joint initiative by the Ministry of Tourism, Ministry of Home Affairs, Ministry of External Affairs and Ministry of Civil Aviation.
35. mRAKTKOSH:
    - The web-based mechanism interconnects all the Blood Banks of the State into a single network.
    - The Integrated Blood Bank MIS refers the acquisition, validation, storage and circulation of various live data and information electronically regarding blood donation and transfusion service.
    - Such system is able to assemble heterogeneous data into legible reports to support decision making from effective donor screening to optimal blood dissemination in the field.
    - The objectives of mRAKTKOSH include Safe and Adequate Blood Supplies, Reduced Turnaround Time, Preventing wastage of blood, Restrict Professional Donors, Networking of Blood Banks and Maintaining Donors Repository.
    - The portal is designed and developed by Centre for Development of Advanced 'Computing (C-DAC) and the ministry in responsibility is Ministry of Health and Family Welfare.
36. m-KAVACH:
    - MKavach is a comprehensive mobile device security solution with an emphasis and approach on protecting mobile device resources rather than scanning for malwares signatures.
    - The major threats on mobile devices can be broadly categorized into data compromise, malicious applications, physical thefts and mis-utilization of hardware resources.
    - M-Kavach is designed to provide protection against the above mentioned threats, through its features such as Secure Storage, Application Manager, Anti-Theft, Call/SMS filter and authorized access to device resources like Wi-Fi, Bluetooth and Camera.

- It helps the users in tracking SIM card changes on the device in case of device loss/theft and provides an option to remotely wipe Contacts/Call-Logs and Factory Reset the device.
- The features of the app includes:
  (a) Restricted access to critical applications.
  (b) Hardware resource control in terms of access to Wi-Fi, Bluetooth, Camera and Mobile Data.
  (c) Intimates unauthorized SIM changes to trusted mobile number through SMS.
  (d) Remote wipe of Contacts and Call-Logs using SMS.
  (e) Option to Factory Reset the device remotely using SMS.
  (f) Blocks unwanted Calls and SMS.
  (g) Easy backup and restore.
  (h) Protects against Java Script Malware.
- The app is supported in Android devices.

37. Sugamya Bharat Abhiyaan or Accessible India Campaign:
- Sugamya Bharat Abhiyaan or Accessible India Campaign is a nation-wide flagship campaign for achieving universal accessibility that enables people with disabilities to gain access for equal opportunity, live independently and participate fully in all aspects of life in an inclusive society.
- The campaign targets at enhancing the accessibility of built environment, transport system and Information and communication ecosystem.
- Organizations, both public and private are encouraged to use their CSR funds for building accessible infrastructure. They may adopt projects of their interest e.g. making a hospital accessible or creating an accessible toilet in a school.
- These organizations will also be rewarded and recognized in annual award ceremony of the Department of Empowerment of Persons with Disabilities, Ministry of Social Justice and Empowerment, and Government of India.
- The mobile application is a crowd sourcing platform to comprehensively obtain information on inaccessible places across the country.
- The mobile application is available on IOS, Android and Windows platform and can be downloaded from the respective App Stores.

38. Khoya Paya Portal:
- The Khoya Paya portal is a citizen-based website to exchange information on missing and found children.
- It has been developed by the Ministry of Women and Child Development and the Department of Electronics and Information Technology (DeitY).
- The website is an enabling platform, where citizens can report missing children, as well as sightings of their whereabouts without wasting much time.
- The "Found" children can also be reported on this web portal. The reporting can be done through text, photographs, videos and other means of transmitting and uploading information to the site.

39. Kisan Suvidha:
- Kisan Suvidha is an omnibus mobile app developed to help farmers get relevant information instantly.
- The app provide information on various details such as weather, market prices, seeds, fertilizers, pesticides, agriculture machinery, dealers, agro advisories, plant protection and IPM (Integrated Pest Management) practices etc.

- Other unique features like extreme weather alerts, market prices of commodity in nearest area and the maximum price in state as well as in India have been added to empower farmers in the best possible manner.

40. **SMS based Mid Day Meal Monitoring Scheme:**
    - Mid-Day Meal mobile app is meant for effective monitoring of daily and monthly mid-day meal data to be sent by the schools.
    - The app provides additional data communicating mechanism for the MDM in-charge/teacher who has to send the daily/monthly data using SMS.
    - The app, once installed on android device, does not need Internet to send MDM figures as user has option to send the figure through SMS from the app. This simplifies the job of MDM in-charge, who even does not have to remember the SMS formats.
    - The higher authorities at Block, District and State level have a very simple and effective mechanism in shape of this app on their mobile devices for effective and efficient monitoring of daily as well as monthly data transmission by all the MDM in-charge falling under their jurisdiction.
    - The responsible authority for this scheme is Department of School Education and Literacy under the Ministry of Human Resource Development.

ESE Prelims Question

Q.1 **Statement (I):** Digital India is a program to transform India into a digitally empowered society.
Statement (II): Digital India is a program to institute smart cities.
(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I)
(c) Statement (I) is true but Statement (II) is false
(d) Statement (I) is false but Statement (II) is true
[ESE-2017]

Ans. (c)

Q.2 Consider the following statements:
Vision of Digital India launched by the Government of India is centered on
(i) Digital infrastructure as a utility only to senior citizens.
(ii) Governance and Services on demand
(iii) Digital Empowerment of every citizen
Which of the above statements are Correct?
(a) (i), (ii) and (iii) (b) (i) and (ii) only
(c) (i) and (iii) only (d) (ii) and (iii) only
[ESE-2017]

Ans. (d)

Q.3 PRAGATI is the acronym
(a) Pro-active governance and transparency in India
(b) Pro-active governance and timely implementation
(c) Primary governance for transparency in India
(d) Promoting and accomplishing governance with assured and timely implementation
[ESE-2017]

Ans. (b)

Q.4 The main goal of G2B (Government to Business) is:
1. To increase productivity by giving more access to information
2. To lower the cost of doing business
3. To create more transparency
Select the correct answer using the codes given below:
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3
[ESE-2017]

Ans. (d)

Q.5 Which of the following are the benefits of e-governance system?
1. Simplicity, efficiency and accountability.
2. Quality service to citizens.
3. Better access to information.
4. Expanded reach to governance.

(a) 1, 2 and 3 only (b) 1, 2 and 4 only
(c) 3 and 4 only (d) 1, 2, 3 and 4

[ESE-2018]

Ans. (d)

Q.6 Consider the following statements:
1. National Agricultural Portal, eNAM, is designed to create a unified national market for agricultural commodities.
2. Farmers can showcase their produce online from the nearest market and the buyer can quote his price from anywhere.

Which of the above statements is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

[ESE-2018]

Ans. (c)

Q.7 **Statement (I) :** Information and communication technologies can play a key role in the development and economic growth of rural India.

Statement (II) : Successful ICT application in e-governance giving respective one-stop solutions for rural communities is an absolute need of the hour.
(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
(b) Both Statement (I) and Statement (II) are individually true, but Statement (II) is not the correct explanation of Statement (I)
(c) Statement (I) is true, but Statement (II) is false
(d) Statement (I) is false, but Statement (II) is true

[ESE-2018]

Ans. (a)

Objective Brain Teasers

Q.1 Which of the following statements are correct regarding e-Governance in India?
(i) Quality service for citizens.
(ii) Transparency of information.
(iii) Better access to information.
(iv) Speed and cost reduction.
(v) Socio-economic development
(a) (i) , (ii) and (iii) (b) (i), (iii), (iv) and (v)
(c) (ii), (iv) and (v) (d) All of the above

Q.2 Which of the following is a vision of e-Kranti also known as NeGP 2.0?
(a) One stop service centre
(b) Electronic change of rural villages
(c) Transforming e-Governance for transforming governance
(d) Increase in agricultural productivity

Q.3 Digi-Dhan Vyapar Yojana is a scheme to promote digital payments and is implemented by
(a) NITI Aayog (b) UIDAI
(c) Ministry of Finance (d) Meity

Q.4 Which of the following are the Pillars of Digital India programme?
(i) Universal access to mobile connectivity.
(ii) Information to all.
(iii) Electronic delivery of services.
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.5 Which of the following statements are correct regarding Internet Governance Forum (IGF)?
(i) It is a forum to discuss on public policy issues relating to the internet.
(ii) It contributes to capacity building for internet governance.
(iii) The third annual IGF meeting was held in India.
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.6 Consider the following statement:
(i) Common Service Centre (CSC) is a Digital India initiative envisaged in every panchayat.

(ii) It is a one-step solution for G2C and B2C services.

Which of the above statements is/are correct?

(a) (i) only (b) (ii) only
(c) Both (i) and (ii) (d) Neither (i) nor (ii)

Q.7 NIC a government body for e-Governance, is abbreviated as

(a) National Industrial Centre
(b) Network Internet Centre
(c) National Informatics Centre
(d) Nodal Industrial Centre

Q.8 The National e-Governance Plan (NeGP) consist of how many Mission Mode Projects with the newly added MMP's in 2011?

(a) 27 (b) 31
(c) 35 (d) 40

Q.9 The total number of Mission Mode Projects (MMPs) under e-Kranti (NeGP 2.0) programme is

(a) 31 (b) 35
(c) 41 (d) 44

Q.10 Gyandoot, a mass based information technology revolution is implemented in which of the following states?

(a) Uttar Pradesh (b) Madhya Pradesh
(c) Karnataka (d) Andhra Pradesh

Q.11 'SWAN' is a term used in e-Governance stands for

(a) Static Wide Area Network
(b) Stable Wide Area Network
(c) Static Wireless Area Network
(d) State Wide Area Network

Q.12 B2G deals with actions of business towards government that includes which of the following activities.

(i) Providing goods and services to government.
(ii) Providing suggestions for government to improve its service to business.
(iii) Bidding for government projects.
(iv) Applying for government assistance and lobbies.

(a) (i) and (ii) only (b) (iii) and (iv) only
(c) (i), (iii) and (iv) (d) All of the above

Q.13 Which of the following are the results of ICT being implemented on e-Governance?

(i) Ease of access to information.
(ii) Centralized scheme
(iii) Intra and inter governmental database connectivity.
(iv) Online services

(a) (i), (ii) and (iv) (b) (i), (ii) and (iv)
(c) (ii), (iii) and (iv) (d) (i), (ii), (iii) and (iv)

Q.14 'e-Biz' is an integrated Mission Mode Project (MMP) of the NeGP and is being executed by

(a) Department of Industrial Policy and Promotion
(b) Ministry of Home Affairs
(c) Department of Food and Public Distribution
(d) Ministry of Commerce and Industry

Q.15 Which of the following service are provided in Aadhar Enabled Payment System (AEPS)?

(i) Balance enquiry (ii) Cash deposit
(iii) Cash withdrawal (iv) Fund transfer
(a) (i), (ii) and (iii) (b) (i), (ii) and (iv)
(c) (ii), (iii) and (iv) (d) (i), (ii), (iii) and (iv)

Q.16 Consider the following statements regarding 'Mobile Seva':

(i) It aims to provide government services to the people through mobile phones and tables.
(ii) It enables a government department to integrate web and mobile based services seamlessly.

Which of the above statements is/are correct?

(a) (i) only (b) (ii) only
(c) Both (i) and (ii) (d) Neither (i) nor (ii)

Q.17 Consider the following statements regarding 'Khajane' project:

(i) It is a major e-Governance initiative by the state government of Andhra Pradesh.
(ii) It is a comprehensive online treasury computerization project.
(iii) The system has the ability to track every activity right from the approval of state budget to the point of rendering accounts to the government.

Which of the above statements are correct?

(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.18 Which of the following statements are correct regarding "TRI-NETRA"?

(a) It is an initiative for enhancing the vision of locomotive pilots in increment weather.

(b) It is an initiative to accelerate e-service delivery while optimizing ICT spendings of the government.
(c) It aims to address common man's grievances and simultaneously monitor important programmes and projects.
(d) It is an initiative to promote e-Health through e-Governance.

Q.19 Consider the following statements regarding 'BBPS':
(i) It stands for Bharat Bill Payment System.
(ii) RBI has issued guidelines for implementation of BBPS.
(iii) NPCI (National Payments Corporation of India) has been designated as the authorized BBPCU (Bharat Bill Payment Central Unit).
Which of the above statements are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.20 Consider the following statements regarding "Rapid Assessment System" RAS:
(i) It was developed by National e-Governance division, Meity.
(ii) It is a feedback mechanism system for continues feedback of e-services delivered by government.
(iii) This system has multiple channel and is backed by analytics.
Which of the above statements are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.21 Consider the following statements regarding Bharat QR code?
(i) It is a payment acceptance solution supporting visa and RuPay cards only.
(ii) A small transaction charge is involved while transferring funds from one account to another.
Which of the above statements are correct?
(a) (i) only (b) (ii) only
(c) Both (i) and (ii) (d) Neither (i) nor (ii)

Q.22 'UMANG' a key initiative under Digital India programme is developed by
(a) Ministry of Electronics and Information Technology
(b) Department of Science and Technology
(c) Department of Telecommunication
(d) NITI Aayog

Q.23 Consider the following statements regarding "Vittiya Saksharta Abhiyan (VISAKA)":
(i) It was launched by Union Ministry for Human Resource Development.
(ii) It is a campaign to create awareness among people about digital economy and cashless transactions.
Which of the above statements is/are correct?
(a) (i) only (b) (ii) only
(c) Both (i) and (ii) (d) Neither (i) nor (ii)

Q.24 A Task Force on Artificial Intelligence (AI) for India's Economic Transformation was constituted by
(a) Department of Science and Technology
(b) Ministry of Commerce and Industry
(c) Ministry of Electronics and Information Technology
(d) Ministry of Human Resource Development

Q.25 Consider the following statements regarding Cyber Surakshit Bharat initiative:
(i) It has been launched by Ministry of Electronics and Information Technology.
(ii) Its objective is to strengthen the cyber security ecosystem in line of Government's vision for 'Digital India'.
Which of the above statements is/are correct?
(a) (i) only (b) (ii) only
(c) Both (i) and (ii) (d) Neither (i) nor (ii)

Q.26 Consider the following statements regarding "GIAN":
(i) It is an acronym for Global Internet for Academic Network.
(ii) It is a program under MHRD and is actively supported by NITI Aayog.
(iii) It aims to boost the quality of country's higher education through international collaboration.
Which of the above statements are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.27 Consider the following statement regarding "e-HRMS":
(i) It stands for electronic-Human Resource Management system.
(ii) It was launched on the occasion of Good Governance Day to be in line of government's goal of minimum government, maximum Governance.

(iii) It is an online platform for central government employees to apply for leaves and access their service related information.

Which of the above statements are correct?

(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.28 Which of the following is a free Doordarshan DTH channel launched by Law and Information Technology (IT) to educate and inform the people about various modes of digital payments?

(a) Digital World (b) Digishala
(c) E-Mitra (d) Tech Zone

Q.29 Which of the following ministry has launched its e-office in December as a part of Good Governance initiative?

(a) Ministry of Home Affairs
(b) Ministry of Environment
(c) Ministry of Information and Technology
(d) Ministry of Women and Child Development

Q.30 A mobile application launched by Union Government to provide speedy redressal of consumer grievances is:

(a) E-mitra (b) E-Kranti
(c) E-Seva (d) Smart Consumer

Q.31 Which of the following are the advantage of Meghraj India's GI cloud?

(i) Increased infrastructure of Government as per citizen's demand.
(ii) Optimum utilization of existing resources.
(iii) Improved cloud seeding technique to achieve custom rainfall.

(a) (i) and (ii) only (b) (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.32 Which of the following are the objectives of National e-Governance Plan (NeGP)?

(i) Make all government services accessible to citizens through common service delivery outlets.
(ii) Decentralized initiative but centralized implementation.
(iii) Adoptation of unique identification codes for citizens, to facilitate integration and avoid ambiguity.

(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.33 Which of the following are the objectives of e-Seva?

(i) Online issuing of certificates.
(ii) Online payment of utility bills.
(iii) Online licenses and permits.
(iv) e-forms for different exams and admission.

(a) (i) and (ii) only
(b) (i) and (iii) only
(c) (i), (ii) and (iii) only
(d) All of the above

Answers

1. (d)	2. (c)	3. (a)	4. (d)	5. (d)
6. (a)	7. (c)	8. (b)	9. (d)	10. (b)
11. (d)	12. (d)	13. (d)	14. (a)	15. (d)
16. (c)	17. (b)	18. (a)	19. (d)	20. (d)
21. (d)	22. (a)	23. (c)	24. (b)	25. (c)
26. (b)	27. (d)	28. (b)	29. (d)	30. (d)
31. (a)	32. (c)	33. (d)		

Explanations

6. Common Service Centres (CSC) are designed as ICT enabled Kiosks to serve as front end delivery points for government, private and social service sector in an integrated manner to rural citizens of India.

17. 'Khajane' project is a major e-Governance initiative of the state government of Karnataka, India.

21. Bharat QR is an interoperable payment acceptance solution that supports Visa, Master card Amex and Rupay cards and BHIM-UPI for wider acceptance.

Unlike credit or debut cards used at points of sales, there are no charges involved.

26. 'GIAN' stands for Global Initiative for Academic Network and is a program under MHRD and is actively supported by NITI Aayog.

32. The objective of NeGP is centralized initiative but decentralized implementation of services.

■■■■

6 Technology Based Education

6.1 Introduction

ICT based education can be defined as the delivery of devices, tools, content, resources, forums and services in digitized from in order to achieve to goal of teaching, learning and enhancing access to and reach of resources, building of capacities, as well as management of the education system.

As the lead United Nations Organization for Education, called UNESCO (United Nations Educational, Scientific and Cultural Organization) guides international efforts to help countries understand the role, such technology can play to accelerate progress towards Sustainable Development Goal (SDG).

The discussion in the chapter will not only include hardware devices connected to computers and software applications, but also interactive digital content, internet and other satellite communication devices, radio and television services, web based content repositories, interactive forums learning management systems and management information systems.

6.2 Objectives of ICT in Education

(i) To **blend technology** with conventional classroom teaching-learning process.

(ii) To **broadcast educational** lessons and provide on-line facilities in different subjects.

(iii) To use **electronic devices** to develop awareness and psychomotor control.

(iv) To carry **out internet based** research to enhance educational process.

(v) To provide **satellite based education.**

(vi) To provide **computer simulation.**

(vii) To **encourage the students to use e-mail, social networking sites,** etc. for educational discussion, chats etc.

(viii) To establish **virtual classroom.**

(ix) To manage books e.g. **library automation system.**

(x) To facilitate **video conferencing** between teachers and students in distance education programme.

(xi) To **exchange and share ideas among teachers** for their professional growth.

(xii) To **facilitate communication** for pupils with special needs.

Development of ICT and ICT based tools has led to the various important applications in the field of technology based education. Some of the application are:

(i) Smart learning

(ii) e-learning

(i) Smart Learning

- In today's world, classroom is different from the traditional one. ICT is changing methods of teaching and learning in the educational institutions. The age of blackboards and chalk is now been replaced by **smart boards and the Internet.**

- In some modern cities of our country, slowly and gradually blackboards and chalks are disappearing. With the modern technology, **i-pads have replaced books, school diaries, forms and circulars**. Teachers and students are using the latest technology to make teaching and learning convenient and easier. **Smart learning includes:**

Smart Diary

- Nowadays schools are going away from the troublesome plastic-covered book embossed with the school's logo called as school diary or calender, filled with teacher's remarks, or a note from parents to excuse the child from attending the school. But now, **cloud computing technology such as Google Docs, Groups, Dropbox etc. keep students posted about events, projects and homework. Children can no longer hide details about their homework as parents can simply log in and check on one of the portals with which the school has tied up.**

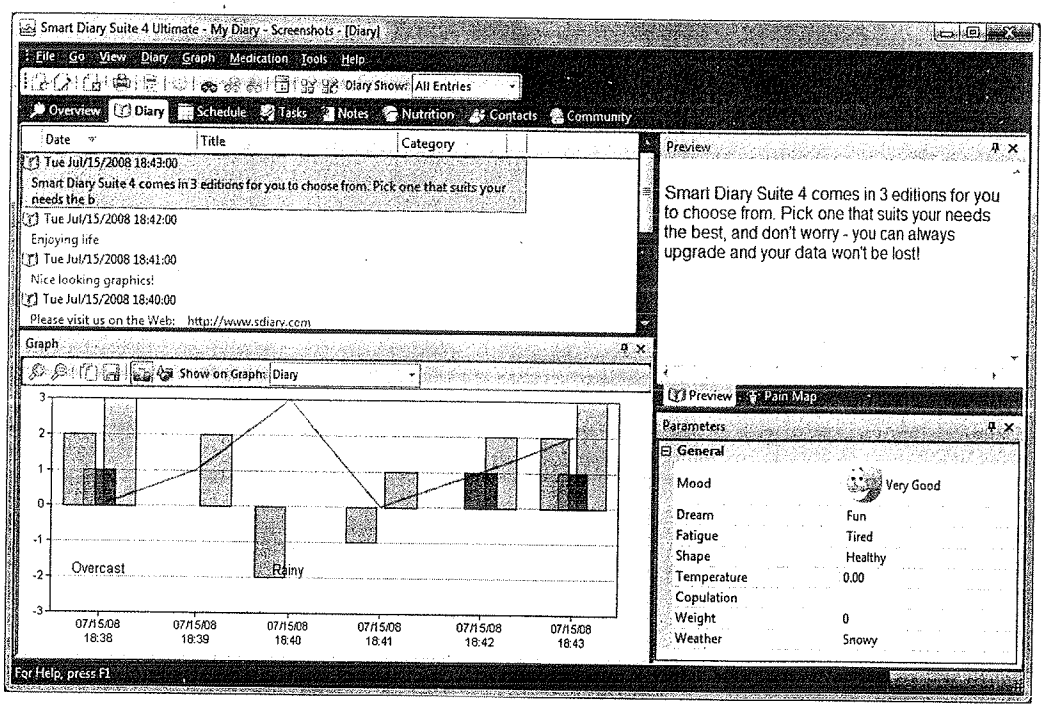


Fig. Smart Diary

- One of the major roles of technology in school life is real-time updates, e.g. during heavy rains, accidents or other disasters. For example if a school bus is going to arrive late due to some reasons then parents can be informed through SMS. Schools are also installing GPS in their buses, which enables the school authorities to monitor the movement of their buses at any time.

Smart Board

- Schools have started using smart boards which allows a teacher to do multi-tasking such as project slides, show a video or connect to the internet. Chalk, which teachers often used as a discipline tool by throwing little pieces at an in attentive child, will no longer be in the school stationery list. Schools are now having white boards and teachers are using broarkers to write on them.

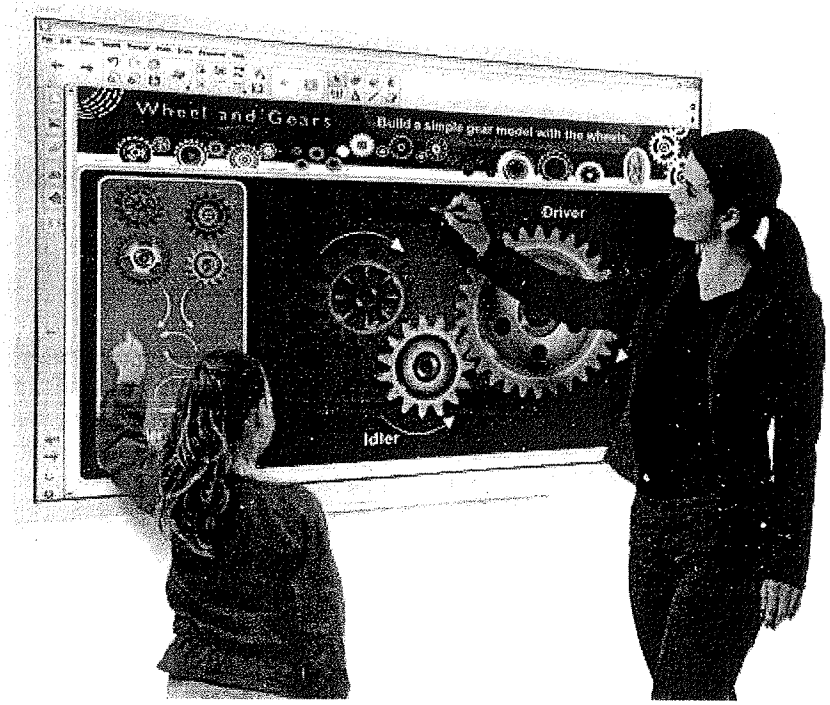


Fig. Smart Board

- If a **teacher writes on a smart board in one class, it gets replicated in another class. It also saves time.** Teachers are now able to plan their lectures and load them on the board. The teaching process has becoming faster involving worksheets, class work or homework.
- **On-line Assignments :** Students seldom have to carry worksheets as even homework has gone online. Now, teachers create and post assignments online and share them with students. Neither teachers nor students have to worry about misplacing a file, Everything is saved online, accessible from anywhere. The system helps keep track of assignments given to students.
- **Online forms and notices :** Moreover, in an effort to go paperless, forms of any kind are one their way out. Instead of asking parents to fill forms, schools are sending forms online. This is very helpful during admissions.
- **Attendance :** In a classroom of 50 to 60 students, about 10 – 15 minutes of a 40 minute period are wasted in the teacher calling out students's name for attendance. The latest technology has been introduced which can take care of student's attendance by face recognition technology within seconds.

Smart Classes

- Over the last few decades, everything has changed in our lives with the increment of technology. Chalk and blackboard, text books, a teacher painstakingly explaining abstract concepts with the limited tools at her disposal, etc. Still exists. But now things are changing very fast. **ICT is revolutionizing every aspect of classroom-teacher's teaching, student's learning, audio-visual aids and even evaluation.** The whole classroom setup is now getting changed.
- **Meaning of Smart Class:** Smart class is a solution **designed to help teachers in meeting with new challenges and developing student's abilities and performance.** It helps the teachers to access multimedia content and information that can be used for teaching students more efficiently. It helps the teachers in expressing their views and ensures them that every student is understanding and learning.

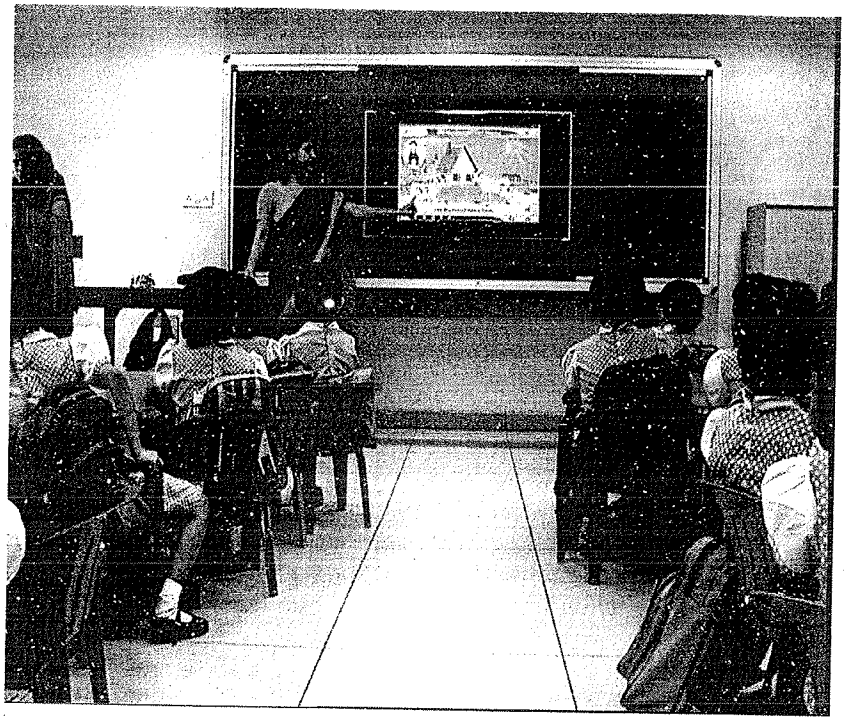


Fig. Smart Classes

- Smart class brings in technology right next to the blackboard for teachers in the classroom. Students learn difficult and abstract curriculum concepts by watching highly engaging visuals and animation. This makes learning an enjoyable experience for students while improving their overall academic performance in school. It also **enables the teachers to instantly assess and evaluate the learning achieved by their students in the class.**
- **Smart class has an instructor station from where various technological devices** and equipments are controlled by the teacher; these equipments are smart board, LCD projector, internet etc.
- **Smart class is nothing, but a unique and latest way to teach children.** In this technique, a smartboard is fixed on a wall just like a blackboard and a projector is suspended from the roof. It is very easy to learn things. The board works like a computers screen and if required, can also be used as a simple whiteboard.
- **Smart class is an effective way of teaching.** It is entirely different from the old ways of oral and verbal instructions. In this new area of technology, smart class is a step towards development and definitely this technique is going to create a revolution in the educational field.

(ii) e-learning

- Another important innovative application of computer in the learning process of the academic side of an educational institution is e-learning. e-learning allows one to learn anywhere and usually at any time, as long as one has a properly configured **computer, e-learning can be CD-ROM-based, Network-based, Intranet-based or Internet-based.** It can include text, video, audio, animation and virtual environments. It can be a very rich learning experience that can even surpass the level of training you might experience in a crowded classroom. **It is self-paced, hands-on learning.** The quality of the electronic-based training, as in every form of training, is in its content and its delivery, **e-learning can suffer from many of the same pitfalls as classroom training, such as boring slides, monotonous speech, and little opportunity for interaction.** The beauty of e-learning, however, is that new software allows the creation of very effective learning environments that can engulf the learner in the material.

Concept of e-learning

- e-learning is an all-encompassing term generally used to refer to **computer-enhanced learning**, although it is often extended to include the use of mobile technologies such as PDAs and MP5 players. It may include the use of **web-based teaching materials** and **hypermedia** in general, multimedia CD-ROMs or websites, discussion boards, collaborative software, e-mail, blogs, wikis, text chat, computer aided assessment, educational animation, simulations, games, learning management software, electronic voting systems and more, with possibly a combination of different methods being used.
- e-learning can also refer to **educational websites** such as those offering **worksheets** and **interactive exercises** for children. The term is also used extensively in the business sector where it generally refers to cost-effective online training. It has been stated by many in different forms. Some of them are given below:
  (a) e-learning is learning on Internet time.
  (b) e-learning is the convergence of learning and the Internet.
  (c) e-learning uses the power of networks, primarily those that rely not only on Internet technologies but also satellite networks, and digital content to enable learning.
  (d) e-learning is the use of **network technology to design**, deliver, select, administer, and extend learning.
  (e)] e-learning is **Internet-enabled learning**: Components can include content delivery in multiple formats, management of the learning experience, and a networked community of learners, content developers and experts. e-learning provides faster learning at reduced costs, increased access to learning, and clear accountability for all participants in the learning process. In today's fast-paced culture, organizations that implement e-learning provide their work force with the ability to turn change into an advantage.

Levels of e-learning

It may be categorized into four levels, from the very basic to the very advanced. They are:

- **Knowledge Databases** -while not necessarily seen as actual training, these databases are the most basic form of e-learning. You've probably seen knowledge databases on software sites offering indexed explanations and guidance for software questions, along with step-by-step instructions for performing specific tasks. These are usually *moderately* interactive, meaning that you can either type in a key word or phrase to search the database, or make a selection from an alphabetical list.
- **Online Support** -Online support is also a form of e-learning and functions in a similar manner to knowledge databases. Online support comes in the form *of* **forums, chat rooms, online bulletin boards, e-mail, or live instant-messaging support**. Slightly more interactive than knowledge databases, online support offers the opportunity for more specific questions and answers, as well as more immediate answers.
- **Asynchronous Training** -This is e-learning in the more traditional sense of the word. It **involves self-paced learning, CD-ROM-based, Network-based, Intranet-based or Internet-based.** It may include access to instructors through online bulletin boards, online discussion groups and e-mail. Or, it may be totally self-contained with links to reference materials in place of a live instructor.
- **Synchronous Training** -Synchronous training is **done in real-time with a live instructor facilitating the training.** Everyone logs in at a set time and can communicate directly with the instructor and with each other. **You can raise your cyber hand and even view the cyber whiteboard.** It lasts for a set amount of time -from a single session to several weeks, months or even years. This type of training usually takes place via Internet Web sites, audio or video-conferencing. *Internet telephony,* or even two-way live broadcasts to students in a classroom.

Important Features of e-learning

The following are some of the important features of e-learning:

- Learning is self-paced and gives students a chance to speed up or slow down as necessary
- Learning is self-directed, allowing students to choose content and tools appropriate to their differing interests, needs, and skill levels
- It accommodates multiple learning styles using a variety of delivery methods geared to different learners; more effective for certain learners
- Designed around the learner
- Geographical barriers are eliminated, opening up broader education options
- 24 × 7 accessibility makes scheduling easy and allows a greater number of people to attend classes
- On-demand access means learning can happen precisely when needed
- Travel time and associated costs (parking, fuel, vehicle maintenance) are reduced or eliminated
- Overall student costs are frequently less (tuition, residence, food, childcare)
- Fosters greater student interaction and collaboration
- Fosters greater student/instructor contact
- Enhances computer and Internet skills
- Draws upon hundreds of years of established pedagogical principles

Components to be Included in e-learning

- e-learning can incorporate many elements that make learning new material, a new process or a new programme more fun. Making learning more fun -or interesting -is what makes it more effective. If you aren't pulled into the material, you really aren't learning as well as you could be. This is what makes e-learning so great for so many types of learning. Obviously, every type of training can't be turned into e-training, but many can with excellent results.

The components that are to be included to make e-learning successful are:

- **Varying the Types of Content:** Images, sounds and text work together to build memory in several areas of the brain and result in better retention of the material.
- **Creating Interaction that Engages the Attention:** Games, quizzes and even just required manipulation of something on the screen creates more interest, which in turn builds better retention.
- **Providing Immediate Feedback:** e-learning courses can build in immediate feedback to correct misunderstood material. The more immediate the feedback the better, because each step of learning builds upon the previous step. If no feedback is given, then the next step may be building upon an incorrect interpretation.
- **Encouraging Interaction with other e-learners and an e-Instructor:** Chat rooms, discussion boards, instant messaging and e-mail all offer effective interaction for e-learners, and do a good job of taking the place of classroom discussion. Building an online community significantly influences the success of online programs.

Benefits of e-learning

Some of the significant benefits of e-learning are given below. They are:

(i) Convenience and Portability
(ii) Cost and Selection
(iii) Flexibility
(iv) Higher Retention
(v) Greater Collaboration
(vi) Global Opportunities

(i) Convenience and Portability

- Courses are accessible on your schedule
- Online learning does not require physical attendance
- Learning is self-paced (not too slow, not too fast)
- You're unbound by time -courses are available 24 x 7
- You're unbound by place -study at home, work, or on the road
- Read materials online or download them for reading later

(ii) Cost and Selection

- Choose from a wide range of courses to meet your needs
- Degree, Vocational, and Certificate programs
- Continuing Education
- Individual courses
- Wide range of prices to fit your budget
- Go back to school to get a degree, learn a new skill, learn a new craft, or just have fun!
- From art to zoology you can do it all online in a price range to fit your budget.

(iii) Flexibility

- Online learning accommodates your preferences and needs -it's student-centered
- Choose instructor-led or self-study courses
- Skip over material you already know and focus on topics you'd like to learn
- Use the tools best suited to your learning styles

(iv) Higher Retention

- Online learning will draw you to topics you like and enjoy. Studies show that because of this and the variety of delivery methods used to reach different types of learners retention is frequently better than in a traditional classroom.

(v) Greater Collaboration

- Technology tools make collaboration among students much easier. Since many projects involve collaborative learning, the online environment is far easier (and often more comfortable) to work in since learners don't have to be face-to-face.

(vi) Global Opportunities

- The global learning community is at your fingertips with online learning. The technologies used give online instructional designers the ability to build tools that take you to resources you may never see in a traditional classroom.

Problems in e-Learning

1. Highly dependent on internet Speed
2. Digital Divide
3. Language Domination
4. Less interaction as compared to conventional classroom
5. Some health issues
6. Internet literacy
7. Technology gap in education system
8. No match for face to face teaching
9. Reliant on human support

6.3 A Continum of a Approach

Studies of ICT development in both developed and developing countries identify at least four broad approaches through which educational systems and individual schools proceed in their adoption and use of ICT. These four approaches, termed **emerging, applying, infusing, and transforming, represent a continuum depicted** as the model in figure below:

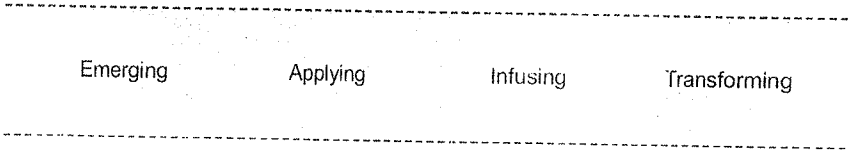


Fig. Model depicting a continuum of approaches to ICT development in schools

The emerging approach: Schools at the beginning stages of ICT development demonstrate the emerging approach. Such schools begin to purchase, or have had donated, some computing equipment and software. In this initial phase, administrators and teachers are just starting to explore the possibilities and consequences of using ICT for school management and adding ICT to the curriculum. Schools at this emerging phase are still firmly grounded in traditional, teacher-centered practice. The curriculum reflects an increase in basic skills but there is an awareness of the uses of ICT. This curriculum assists movement to the next approach if so desired.

The applying approach: Those schools in which a new understanding of the contribution of ICT to learning has developed exemplify the applying approach. In this secondary phase, administrators and teachers use ICT for tasks already carried out in school management and in the curriculum. Teachers largely dominate the learning environment. Schools at the applying approach phase adapt the curriculum in order to increase the use of ICT in various subject areas with specific tools and software. This curriculum assists movement to the next approach if so desired.

The infusing approach: At the next stage, the infusing approach involves integrating or embedding ICT across the curriculum, and is seen in those schools that now employ a range of computer-based technologies in laboratories, classrooms, and administrative offices. Teachers explore new ways in which ICT changes their personal productivity and professional practice. The curriculum begins to merge subject areas to reflect real-world applications.

The transforming approach: Schools that use ICT to rethink and renew school organization in creative ways are at the transforming approach. ICT becomes an integral though invisible part of daily personal productivity and professional practice. The focus of the curriculum is now learner-centered and integrates subject areas in real-world applications. ICT is taught as a separate subject at the professional level and is incorporated into all vocational areas. Schools have become centres of learning for their communities.

6.4 ICT in Schools

Information and Communication Technologies have enabled the convergence of a wide array of technology based and technology mediated resources for teaching learning. It has therefore become possible to employ ICT as an omnibus support system for education. The potential of ICT to respond to the various challenges the Indian education system poses are:

1. ICT can be beneficially leveraged to disseminate information about and catalyze adaptation, adoption, translation and distribution of sparse educational resources distributed across various media and forms. This will help promote its widespread availability and extensive use.
2. There is an urgent need to digitize and make available educational audio and video resources, which exist in different languages, media standards and formats.
3. Given the scarcity of print resources as well as web content in Indian languages, ICT can be very gainfully employed for digitizing and disseminating existing print resources like books, documents, handouts, charts and posters, which have been used extensively in the school system, in order to enhance its reach and use.

4. ICT can address teacher capacity building, ongoing teacher support and strengthen the school system's ability to manage and improve efficiencies, which have been difficult to address so far due to the size of the school system and the limited reach of conventional methods of training and support.
5. Using computers and the Internet as mere information delivery devices grossly underutilizes its power and capabilities. There is an urgent need to develop and deploy a large variety of applications, software tools, media and interactive devices in order to promote creative, aesthetic, analytical and problem solving abilities and sensitivities in students and teachers.

6.5 ICT Enabled Teaching-Learing Processes

ICT enabled teaching-learning encompasses a variety of techniques, tools, content and resources aimed at improving the quality and efficiency of the teaching learning process. Ranging from projecting media to support a lesson, to multimedia self-learning modules, to simulations to virtual learning environments, there are a variety of options available to the teacher to utilize various ICT tools for effective pedagogy. Each such device or strategy also involves changes in the classroom environment, and its bearing on effectiveness. Availability of a wide range of such teaching-learning materials will catalyze transformation of classrooms into ICT Enabled classrooms.

Teachers will participate in selection and critical evaluation of digital content and resources. They will also be encouraged to develop their own digital resources, sharing them with colleagues through the digital repositories.

In schools equipped with EDUSAT terminals, DTH or other media devices, relevant activities will be planned and incorporated into the time schedule of the school.

Initially the teachers may use the Computer lab for teaching-learning but progressively more classrooms will be equipped with appropriate ICTs, making way for ICT Enabled classes

6.6 ICT for Children with Special Need

Use of ICT will catalyze the cause and achieve the goals of inclusive education in schools.

ICT software and tools to facilitate access to persons with disabilities, like screen readers, Braille printers, etc. will be part of the ICT infrastructure in all schools. Special care will be taken to ensure appropriate ICT access to students and teachers with special needs.

All teachers will be sensitized to issues related to students with special needs and the potential of ICT to address them. All capacity building programmes will include components of ICT enabled inclusive education.

All web based interfaces developed for the programme including digital repositories, management information systems, etc. will conform to international guidelines for accessibility.

Accessibility norms will be adopted as per the world wide web consortium, W3C guidelines to enable the content to be accessed by children with special needs. Web based digital repositories with W3C compliance will address the lack of availability of resources for persons with disabilities. Digital content and resources, for the exclusive use of persons with disabilities, talking books for example, will also be developed and deployed.

The absence of appropriate vocabulary for different subject areas in the different Indian languages and the unfamiliarity of the cultural context can make digital communication and resources inaccessible to students and teachers across the country. Efforts will be initiated to develop appropriate word lists and dictionaries in Indian languages and wide spread translations encouraged.

6.7 ICT for Open and Distance Learning

Open and Distance Learning with the use of ICT opens out alternate possibilities for students who have dropped out, cannot continue formal education or are students of the non-formal system of education. Existing formal systems of Education will be strengthened with ICT based instruction available in Open and Distance Learning Systems so as to cater to the needs of such learners.

Present Open Schooling systems (e.g. National or State level Open Schools) will be strengthened by harnessing ICTs innovative. Access to e-books, digital learning resources, Digital Repositories (with relevant learning resources) etc. will be developed by these institutions as student support services. This will also be used for online capacity building for open and distance teacher training.

All Open and Distance Learning Systems will be automated and provide online, all services including admissions, examinations, e-Accreditation and grievance redressal on the lines of the National Institute of Open Schooling.

The proposed monitoring system for students involving expert teachers will be extended to these students also. Online courses, online on demand exams, and digital repositories and content, media broadcasts planned through DTH/Satellite based, open learning systems allowing multiple entry and exit points, opening out the school resources to non-formal students, guidance and counselling, will result in effective use of ICT for open and distance learning.

6.8 ICT for School Management

Automated and ICT managed school processes States will adopt or adapt an e-governance and automated school administration programme for schools, build capacities for its implementation and deploy school based Management Information Systems (MIS). These MIS will be integrated with the proposed state wide web based School Education Management Information System.

A school wide local area network enables automation of a variety of processes. Beginning with library automation, locally cached offline access to internet resources, office automation, maintenance of records, student tracking, resource planning, using the existing ICT infrastructure will increase efficiencies. At the same time, savings in cost, time and effort will also accrue. The school wide local area network will be used to facilitate this automation.

6.9 School Management Information System (School MIS)

A nationwide network will be established in which schools, teachers, students, school managers, and the community at large participate. This implementation will include the School Management Information Systems (School MIS); digital repositories of tools, content and resources; professional development and continuing education platforms; and guidance, counselling and other student support services.

School MIS will emerge as a single window clearing house on all information related to the secondary school system. The information will facilitate research and analysis activities and guide decision making at different levels in the education system, contributing to enhanced efficiencies.

The scope of information to be collated by the MIS will be broad and include student and teacher tracking, particularly for their academic needs. The norms will also define standards of technology including language fonts, word processors, technical dictionaries, etc. Open standards facilitating universal access to information, content and resources will be ensured.

6.10 Tools Used for ICT in Education

1. Interactive white board
2. Audience Response system
3. Learning Tablets
4. Digital projector
5. Classroom Management Software
6. Video Conferencing

7. Intelligent Autonomous system
8. Multiple Displays
9. Mind mapping tools
10. Tablet PCs
11. Smart Boards
12. NMEICT

Example 1.

Consider the following statements regarding employing ICT tools in engineering projects as by current practice:

1. They must, and do, provide a clearer overview of the project details and interfaces
2. They must be capable of sharing of information appropriately
3. They must help to cut down the overall cost of the project with effective monitoring to safeguard against delays

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

[Sample Question for ESE 2017 : Released by UPSC]

Ans. (a)

6.11 Advantage of ICT in Education

ICT as a tool in education gives the advantages like

1. Provides Scalable solution
2. Provides cost effective learning
3. Provides Distance Education
4. Gives Multiple Interactions
5. Saves travelling time thus cost
6. Provides multiple new methods
7. Available all time 24 × 7
8. Provides paperless environment
9. Even provide education to differently-abled people
10. Provide education even at work place

6.12 Limitation of ICT in Education

Teacher Related

1. Teaching methods and capabilities have to be changed
2. Highly depends on teachers attitude i.e. sometime teacher have to take class without students sitting in same class, they may be seeing at far location
3. Teachers interest towards technology

Student Related

1. Used for entertainment not for education
2. Student attitude dependent
3. More dependence on ICT may also reduce critical thinking ability

Technology Related

1. Cyber Security is an important issue
2. High initial investment cost
3. Software changes frequently
4. Troubleshooting is difficult

6.13 ICT in India: Government initiatives

6.13.1 National Mission on Education through ICT (NMEICT)

- The National Mission on Education through Information and Communication Technology (NMEICT) has been envisaged as a Centrally Sponsored Scheme to leverage the potential of ICT, in teaching and learning process for the benefit of all the learners in Higher Education Institutions in any time anywhere mode.
- It seeks to bridge the digital divide, i.e. the gap in the skills to use computing devices for the purpose of teaching and learning among urban and rural teachers/learners in Higher Education domain and empower those, who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.
- The three cardinal principles of Education Policy viz., access, equity and quality could be served well by
  (a) Providing broadband connectivity to all colleges and universities.
  (b) Providing low cost and affordable access-cum-computing devices to students and teachers.
  (c) Providing high quality e-content free of cost to all learners in the country.

  NMEICT encompasses all the three elements.
- Sakshat is considered as the educational portal to facilitate lifelong learning of the students, teachers provides knowledge at free which of cost. This platform is expected to be the main delivery platform for contents developed under NMEICT.
- Sakshat shall be fully equipped with intelligent navigation techniques for easy and smooth browsing. The education portal shall integrate the scholarship programme of the Ministry of Human Resource Development and ensure disbursement of Scholarship electronically.
- The main philosophy for the effort is:
  (a) No talent of the country should go waste.
  (b) All the services available through the content delivery portal Sakshat should be free.
  (c) Free available material on the web should be used.
- The main objectives of the mission are:
  (a) To empower and enable students by ensuring equity and access to education through the use of ICT.
  (b) To connect over 400 universities and 22,000 colleges all over India.
  (c) To improve faculty quality by using a unique synchronous training methodology.
  (d) To ensure equity by providing access to expensive equipment to students even in remote corners through innovative use of ICT.
  (e) To make available e-content and e-education videos created by the best teachers across all disciplines for UG and PG classes.

  Thus the mission provides an opportunity for all the teachers and experts in the country to pool their wisdom for every learner and thereby reducing the digital divide and reaching out the section deprived from these for e.g. in rural/underdeveloped areas.

6.13.2 E-content

1. NPTEL:
   - NPTEL is an acronym for National Programme on Technology Enhanced Learning which is an initiative by seven Indian Institutes of Technology (IIT Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee) and Indian Institute of Science (IISc) for creating course contents in engineering and science.
   - NPTEL provides E-learning through online Web and Video courses in Engineering and Science. The mission of NPTEL is to enhance the quality of engineering education in the country by providing free online courseware.
   - As on August 2015, we have 420 web courses and 509 video courses developed and hosted, which can be accessed freely through the website http://nptel.ac.in.
2. CEC:
   - The Consortium for Educational Communication popularly known as CEC is one of the Inter University Centres set up by the University Grants Commission of India.
   - It has been established with the goal of addressing the needs of Higher Education through the use of powerful medium of Television along with the appropriate use of emerging Information Communication Technology (ICT).
   - Today 21 Media Centres are working towards achieving this goal under the umbrella of CEC.
   - In phase-I, e-content for 19 UG subjects and in phase-II e-content for 68 subjects are being generated by the CEC in collaboration with its media centres.
   - Content generation of CEC is divided in 4 quadrants:

2nd quadrant:	1st quadrant:
PDF/e-books/illustrations, video demonstration/documents and interactive simulations.	Video and audio content in an organized from animations, simulations, virtual labs.
3rd quadrant:	**4th quadrant:**
Web Resources: Related links, wikipending, development of course, open content of internet, case studies, historical development of subject.	Self assessments: MCQ, Problems, Quizzes, Assignments and solutions, feedback through discussion, clarifications on general misconceptions.

3. Virtual Labs:
   - The basic objective of the virtual lab is to provide remote-access to Labs in various disciplines of Science and Engineering. These Virtual Labs would cater to students at the undergraduate level, post graduate level as well as to research scholars.
   - Virtual labs essentially comprises a user friendly graphical form-end, working in synchronization with a backend, possible consisting of a simulation-engine running on a server or actual measurement data.
   - Virtual lab does not require any additional infrastructure setup for conducting experiments at user premises. One computer terminal with broadband internet connectivity is all that is needed to perform the experiments remotely over hundred virtual labs are currently ready for use.
   - The participating institutes include 7 IITs (Delhi, Bombay, Kanpur, Madras, Kharagpur, Roorkee and Guwahati), HIT Hyderabad, Amrita Vishwa Vidyapeetham, Dayalbagh University, NIT Karnataka and COE Pune.

4. e-Pathshala:
   - e-Pathshala is a web portal which hosts educational resources for Students, Teachers, Parents, researchers and educators.
   - It is also available through especially developed mobile apps interface on Android, IOS and windows platforms for wider access and contains textbooks and other e-books as E-Pub 3.0 and Flipbooks in English, Hindi and Urdu.
   - e-Pathshala helps in the following ways:

Students	Teachers	Educators	Parents
Access digital textbooks and eResources, participate in exhibitions, festivals, contests, workshops, etc.	Enrich schooling through digital textbooks, eResources, participating in research activities etc.	Enhance quality through curricular documents, eContents, participating in research activities etc.	Nurture creative talents through curricular documents, learning outcomes, digital, textbooks, eResources etc.

5. Talk to a Teacher:
   - It is an initiative of the Ministry of Human Resource Development under the National Mission on Education through ICT in collaboration with IIT Bombay.
   - This Initiative includes:

Researchoscope	Courses on View	Ask a Question
It is a series of talks given by Ph.D. students at IIT Bombay regarding their research work.	It comprises of courses taught by IIT Bombay faculty that have been recorded live in the classroom.	It is Q & A series where a panel of IIT Bombay faculty answer conceptual doubts in Engineering and Science.

6. Spoken Tutorial:
   - The Spoken Tutorial project is the initiative of the 'Talk to a Teacher' where spoken tutorials are used to popularize software development and its use will be coordinated through a website developed by IIT Bombay.
   - A spoken tutorial is a ten minute audio video tutorial on open source software, created to train students on important IT topics.
   - The spoken part of these tutorials is dubbed in all Indian languages to help children who are weak in English.
   - Using a series of such tutorial, one can learn even a complicated IT topic easily. The main objective is to improve employment potential of student.

7. FOSSEE:
   - It stands for Free and Open Source Software for Education.
   - The project promotes the use of FOSS (Free and Open Source Software) tools to eliminate the use of commercial/proprietary software in education.
   - The project activity includes:
     (a) Support for self workshop on FOSS.
     (b) Textbook combination to create documentation for FOSS through students.
     (c) Lab Migration activity to provide help in shifting proprietary software based labs to FOSS.

- The FOSSEE project is part of the National Mission on Education through Information and Communication Technology (ICT), Ministry of Human Resources and Development, Government of India and is developed by IIT Bombay with other technical institutions as partners.

8. e-Yantra:
   - e-Yantra is an initiative to incorporate Robotics into engineering education with the objective of engaging students and teachers through exciting hands-on application of math, computer science, and engineering principles.
   - An initiative by IIT Bombay that aims to create the next generation of embedded systems engineers with a practical outlook to help provide practical solutions to some of the real world problems.
   - The project aims to help in the following ways:

Students	Colleges	Teachers
• **e-Yantra Robotics Competition:** Annual Robotics competition for Engineering, Diploma and Science undergraduates. • e-Yantra Summer Internship Program: We give in internship opportunity at e-Yantra Lab, IIT Bombay to the winners of e-Yantra Robotics Competition. • Uses a Quality of Service (QoS) mechanism and each connection is based on specific scheduling algorithm.	• **e-Yantra Lab Setup Initiative:** Enable colleges to set up robotics labs and provide training to teachers. • **e-Yantra Ideas Competition:** Provides a platform for eLSI college students to implement and showcase their innovative ideas. • **e-Yantra Symposium:** Brings together all eLSI colleges for discussions and seminars on how to turn these labs into Innovation Hubs.	• **Two-day Workshop on Introduc -tion to Robotics:** An introductory workshop on robotics and embedded systems involving hands-on training exclusively for teachers. • **Task Based Training:** A series of interesting tasks based on Firebird V platform blend theory and practical experimentation. • **Task Based Training Challenge:** Here, teachers trained by the TBT test their skills by implementing a project based on the abstraction of a real life scenario.

9. ERP mission:
   - Educational Resource Planning (ERP) Mission proposes to build, deploy and manage web based software system for use of Indian academic institutes.
   - It is a multi-institutional initiative headed by IIT Kanpur.
   - Major modules developed in this system includes online admission system e-portfolio, project management, general accounting system, payroll generation within an institute, purchase and inventory management, library automation etc.

10. VLE:
   - Virtual Learning Environment (VLE) is an online environment of e-resources caters to several disciplines taught at undergraduate and postgraduate level.
   - It is an initiative of Institute of Life-Long Learning, University of Delhi.
   - Conceived in 2012, VLE today boasts state of art material that addresses emerging needs of a diverse student body, not only of Delhi University but other universities as well.
   - The lessons are developed by highly qualified faculty members across the universities and are continually edited and reviewed, primarily by discipline-expert Fellows employed to edit, oversee and coordinate the content.
   - The content goes through several levels of rigorous peer reviewing and academic vetting to ensure quality and standardization.
   - VLE also contains multimedia repository in form of audio, video and short films to expose students to new technologies in pedagogy.

11. DTH:
    - 50 DTH (Direct-to-home) educational channels on 24×7 basis under NME-ICT was kept to generate and deliver structured education content to reach homes, the most cost effective way.
    - It aims to achieve composite goals of ensuring "Access, Equity and Excellence" and bridging the digital divide in higher education.
    - The MHRD DTH programme has the potential to be watched by 67% names in India. Under this programme, teacher shall be delivering 8 hours of live lectures a day/channel and same will be repeated twice a day to benefit student who miss live session.
12. Digital Library Inflibnet:
    - The UGC-Infonet Digital Library Consortium was formally launched in December, 2003 by Honourable Dr. A.P.J. Abdul Kalam, the President of India soon after providing the Internet connectivity to the universities in the year 2003 under the UGC-Infonet programme.
    - The Consortium provides current as well as archival access to more than 7500+ core and peer-reviewed journals and 10 bibliographic databases from 26 publishers and aggregators in different disciplines.
    - The benefit of subscription to e-resources would also be extended to the colleges, to begin with the College for Potential with Excellence (CPE) and autonomous colleges.
13. SOS Tools:
    - Software and simulation (SOS) packages are useful tools for the analysis of systems and solving problems by the students of Science, Social Science, Engineering, Management and related disciplines.
    - Many commercial software packages are available for the above. But many of these software packages are quite costly and require yearly license fee for updates and maintenance.
    - Many open source software are available which can perform similar functions but are not user friendly and do not have proper documentation.
    - An initiative by Ministry of Human Resource Development (MHRD) under the National Mission on Education through ICT, the objective of this project is to develop software tools for analysis of systems and computations, create adequate manpower to teach students to use open source software and to develop simulation tools.
    - The developed software should be user friendly and properly documented.
14. Quantum and Nano Computing:
    - The Quantum-Nano Centre is a multidisciplinary centre at Dayalbagh Educational Institute, Agra set up under MHRD National Mission on Education through ICT, with partners as IIT Kanpur, I IT Delhi and IIT Madras, besides several international collaborators.
    - With a focus on the rapidly growing area of quantum-nano computing and quantum information sciences, the Quantum-Nano Centre provides an environment for scientists and mathematicians to explore the fundamental physical characteristics of quantum systems, to devise and implement prototype quantum computers, and to develop quantum algorithms and novel applications.
    - Through a vigorous program of lectures, seminars, and workshops, the Centre stimulates intellectual exchange among students, faculty, and academic partners.
    - The mission is to aggressively explore and advance the application of quantum-nano systems to a vast array of relevant information processing techniques.

- It will be accomplished by creating a truly unique environment that fosters cutting-edge research and collaboration between researchers in the areas of computer science, engineering, mathematical, chemical and physical sciences.

6.13.3 Other initiatives

1. National Knowledge Network (NKN):

- National Knowledge Network (NKN) project is aimed at establishing a strong and robust Indian network which will be capable of providing secure and reliable connectivity.
- Globally, frontier research and innovation are shifting towards multidisciplinary and collaborative paradigm and require substantial communication and computational power.
- In India, NKN with its multi-gigabit capability aims to connect all universities, research institutions, libraries, laboratories, healthcare and agricultural institutions across the country to address such paradigm shift. The leading mission oriented agencies in the fields of nuclear, space and defence research are also part of NKN.

Vision	Mission
• NKN is a state-of-the-art Pan-India network and is a revolutionary step towards creating a knowledge society without boundaries. • It will provide unprecedented benefits to the knowledge community and mankind a large. • Using NKN, all vibrant institutions with vision and passion will be able to transcend space and time limitations in accessing information and knowledge and derive the associated benefits for themselves and for the society. • It will facilitate the development of India's information infrastructure, stimulate research, and create next generation applications and services.	• NKN is designed to provide high availability, Quality of Service, security and reliability. • The purpose of NKN goes to the very core of the country's quest for building quality institutions with requisite research facilities and to create a pool of highly trained professionals. • The participating institutions at the edge would seamlessly connect to NKN at gigabit speed. • NKN shall be a critical information infrastructure for India to evolve as a knowledge society. • NKN is a significant step which will enable scientists, researchers and students from across the country to work together for advancing human development in critical and emerging areas.

Objectives of NKN:

- To bring together all the stakeholders in science, technology, higher education research and development, and governance with speeds of 10s of Gbps coupled with extreme sole latency.
- To interconnect all institutions engage in research, education and scientific development in the country, over a period of time.

Role of NKN:

- Establishing a high-speed backbone connectivity which will enable knowledge and information sharing amongst NKN connected institutes.
- Enabling collaborative research, development and innovation amongst NKN connected institutes.
- Facilitating advanced distance education in specialized fields like engineering, science, medicine etc.
- Facilitating an ultra-high speed e-governance backbone.
- Facilitating connection between different sectoral networks in the field of research.

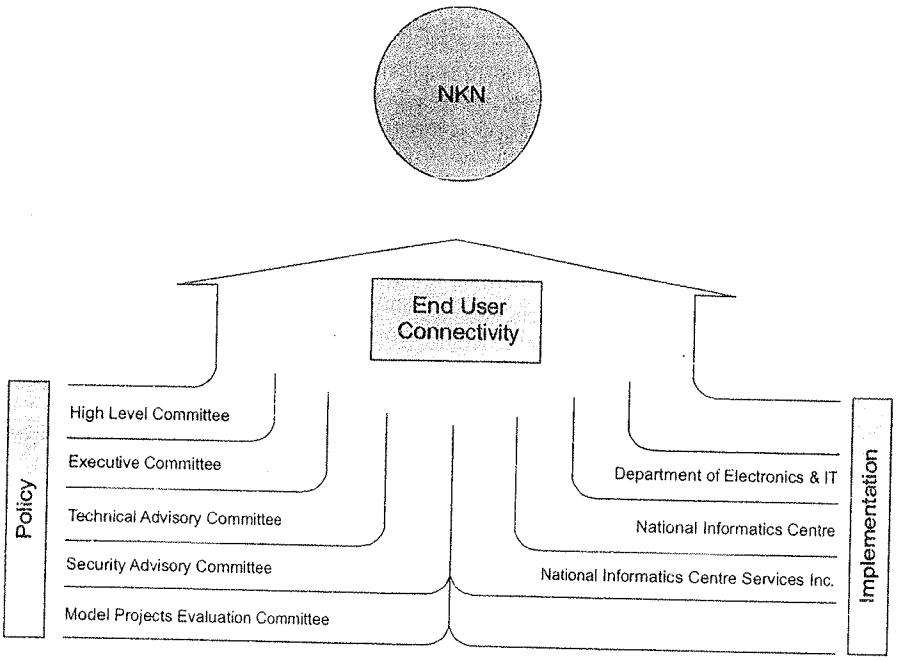


Fig. Organizational Structure of NKN

NKN Design and Architecture: NKN design philosophy is to Encourage, Enable, Enrich and Empower the user community to test and implement innovative ideas without any restriction from the network technology and its administration. Based on that philosophy, as a next generation network, NKN will cater to the following requirements:

Network design	Security requirements	Service requirements	Network requirements
NKN design follows all the current standards to permit seamless inter-operability amongst technologies seamless amongst different original equipment manufactures.	With the growing number of incidences reported by CERT and the increasing challenges posed by innovations in convergence, the network alive can be possible only with very stringent security measures designed, implemented and deployed. Any specific requirement for limiting access to services should be deliverable as part of a security policy. The Central Command Control created to react to such situations should address till-date and forecasted attacks.	These requirements are essential for transparent delivery of services based on either heritage (as in telephony) or the general requirements for a particular service. These requirements might differ between service providers, and possibly even between different tiers of a similar service.	These requirements are network-specific and can be tied to specific services, specific delivery mechanism (client could be variety of devices like PC/PDA/any other device) and access mechanisms like (intranet / Internet). The design will cater to the overall performance goal of the NKN infrastructure. Operational requirements -The NKN is designed to cater to the requirements of tracking, troubleshooting, health monitoring and proactive performance monitoring. With the converged network it becomes more important to proactively monitor the network for impending issues.

- NKN is a hierarchical network divided into three basic layers - Core (Level 1), Distribution (Level 2), and Edge (User Level). Depending on the type of connectivity required by the user organization, geographical presence, and the location of Points of Presence (PoP) of NKN, (belonging to Core

and Distribution), connectivity would be provided to the institutes. NKN backbone will typically have 18 Core PoPs and around 25 Distribution PoPs across the country.

- The core has ultra high speed starting with multiple 2.5/10G and progressively towards 40/100 Gigabits per second (Gbps).

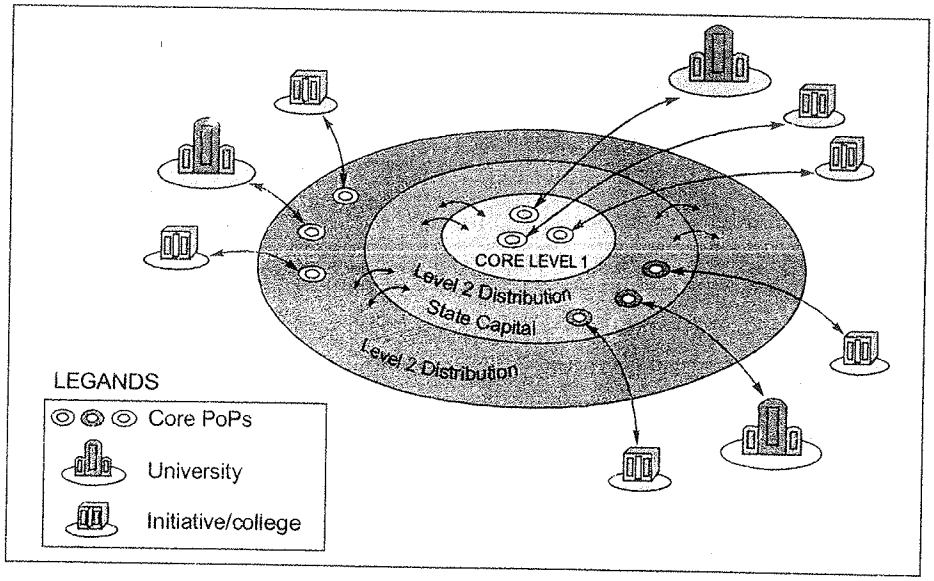


Fig. NKN Design and Architecture

Application of NKN:

- **Virtual Classroom:** The NKN is a platform for delivering effective distance learning where teachers and students can interact in real time. The network enables co-sharing of information such as classroom lectures, presentations and handouts among different institutions.
- **Virtual Library:** The virtual library involves sharing of journal, books and research papers across different institutions are an application of NKN.
- **Sharing of Computing Resources:** High-performance computing is critical for national security, industrial productivity and advancement in science and engineering. The network enables large number of institutions to access high-performance computing to conduct advanced research in areas such as weather monitoring, earthquake, engineering and other computationally intensive field.
- **e-Governance:** NKN act as a super highway for integrating e-Governance infrastructure such as government data centres and networks. NKN provides bulk data transfer facility required for e-Governance applications.
- **Collaborative Research:** The NKN enables collaborative research among different entities. NKN also enables sharing of scientific database and remote access to advance research facilities.

2. Education Satellite (EDUSAT):

- GSAT-3, known as EDUSAT is meant for distant class room education from school level to higher education. This was the first dedicated "Educational Satellite" that provide the country with satellite based two way communication to class room for delivering educational materials.
- It is specially configured to meet the growing demand for an interactive satellite-based distance education system for the country through audio-visual medium, employing Direct-to-home (DTH) quality broadcast.
- It was launched on September 20, 2004 by Indian Space Research Organization (ISRO) to meet ever increasing demand for an interactive satellite-based distance education system for the country.

- The scope of EDUSAT programme is planned to be realised in phases. While ISRO has provided the basic ground segment and committed to continue the support for space segment for EDUSAT system for interactive distance education.
- Consortium for Educational Commission (CEC) is one amongst the five primary users of this educational satellite.
- At present, there are over hundred Satellite Interactive Terminals (SITs) and Receive only Terminals (RoTs) under CEC EDUSAT network, installed at various colleges, Academic Staff Colleges and Universities across the country.
- The Expert can address the queries of the students in the live mode. The students can interact and ask questions using the following three methods.
  (a) Audio Video Conferencing
  (b) Text Mode
  (c) Through Telephones
- The recorded lectures delivered during the EDUSAT transmission are also available on YouTube.
- The multiple objectives of EDUSAT are:
  (a) Broad access to quality education and teaching resource person.
  (b) Supplementing Curriculum based education.
  (c) Support to teacher training.
  (d) Enhancing Distance education efforts.
  (e) Quality education even to remote areas.
  (f) Community Partnership and monitoring.

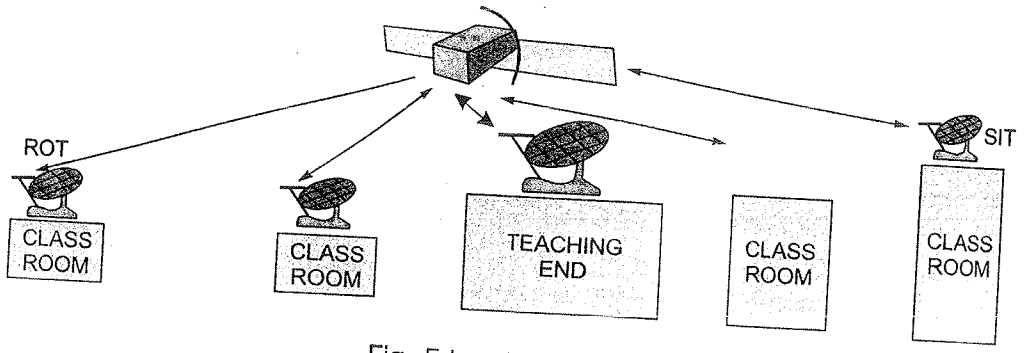


Fig. Education Satellite

3. **Digishala:**
   - The Union Ministry of Electronics and Information Technology (MeitY) has launched a TV channel named 'DIGISHALA' to promote cashless transactions.
   - The channel will help people understand the use of unified payments interface (UPI), USSD, Aadhaar-enabled payments system, electronic wallets, debit and credit cards.
   - It will also telecast
     (a) Talk shows and panel discussions with experts.
     (b) Case studies on business transformation using digital payments.
     (c) Information about products and services under the Digital India programme.
   - Digishala will be available through GSAT- 15.
4. **Rashtriya Madhyamik Shiksha Abhiyan (RMSA):**
   - ICT in Schools is a component of the RMSA.

- The Information and Communication Technology (ICT) in Schools was launched in December, 2004 and revised in 2010 to provide opportunities to secondary stage students to mainly build their capacity on ICT skills and make them learn through computer aided learning process.
- The Scheme is a major catalyst to bridge the digital divide amongst students of various socio-economic and other geographical barriers. The Scheme provides support to States/UTs to establish computer labs on sustainable basis.

Components: The scheme has essentially four components:

- The first one is the partnership with State Government and Union Territories Administrations for providing computer aided education to Secondary and Higher Secondary Government and Government aided schools.
- The second is the establishment of smart schools, which shall be technology demonstrators.
- The third component is teacher related interventions, such as provision for engagement of an exclusive teacher, capacity enhancement of all teachers in ICT and a scheme for national ICT award as a means of motivation.
- Fourth one relates to the development of an e-content, mainly through Central Institute of Education Technologies (CIET), six State Institutes of Education Technologies (SIETs) and 5 Regional Institutes of Education (RIEs), as also through outsourcing.

5. ERNET:

- Education and Research Network (ERNET) is an autonomous scientific society under the administrative control of Ministry of Information Technology, Government of India.
- It is having one of the largest nationwide terrestrial and satellite network with 9 points of presence located at the premier academic and research institutions in major cities of the country.
- Focus of ERNET India is not limited to just providing connectivity, but to meet the entire needs of the academic and research institutions by providing consultancy, project management, training and other value added services such as web hosting, e-mail services, video conferencing, domain registration, CUG services.
- ERNET India is serving more than thousands of institutions in various sectors, namely, health, agriculture, higher education, schools and science and technology.
- It also supports for Campus Area network and currently serves over 1300 institutions.

6. e-Basta:

- In line with the government's Digital India initiative, this project has created a framework to make school books accessible in digital form as e-books to be read and used on tablets and laptops.
- The main idea is to bring various publishers (free as well as commercial) and schools together on one platform.
- In addition to the portal, a back-end framework to facilitate the organization and easy management of such resources has also been made, along with the web based applications that can be installed on tablets for navigating the framework.
- The framework, implemented as a portal, brings together three categories of stakeholders: the publisher, the school and the student. It provides them with the following primary functionalities:

Students	Schools	Publishers
• Reduces the burden of book. • Easy access to structured resources created by School. • Long-term reduction in cost. • Access to richer resources animations, audio, videos etc. • Access to e-Basta of other schools.	• Teachers can choose and bundle content according to their teaching methods. • Facility to add variety of resources-animations, audio books, videos etc. to e-Basta. • Faster access to updated editions of contents. • Help schools with lesser teaching resources to gain from the resources of better schools.	• Single point interface for reaching out of thousands of schools, across the country. • Overcome the logistical problems of book printing, transport and delivery, especially at remote locations. • Significantly shortens the cycle of content editing/changes and facilitates faster release of updates. • Support of DRM where needed.

- e-Basta has 329 textbooks, in e-book format, from the National Council of Educational Research and Training (NCERT), for classes 1 to 12, and these are available in Hindi, English, Urdu and Sanskrit.
- The e-Basta Mobile Application can access the basta created using the portal framework, and renders it for easy navigation by the student. The e-Basta App, freely downloadable from the portal, runs on any Android/Windows Device.

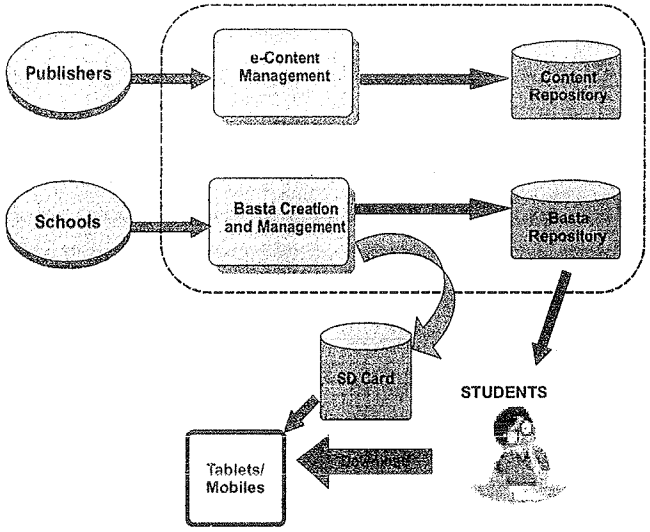


Fig. e-Basta Framework

7. Virtual Classrooms (VCR):

- VCR is an advanced learning environment, created using internet, computers, supplicated video conferencing devices, in which either teacher is not physically present (for remote learning) or students are not present (distance education) in the classroom.

Objectives of VCR:

- To support live online classes for distance learning and remote education.
- To pool academic resources thereby improving access to advanced educational experiences.
- To improve the quality and effectiveness of education by collaborative learning and teaching process.
- To hold and participate in the meetings, webinars, Conferences/Symposium/Workshop, interviews, etc. through video conferencing.

Advantages of VCR:

- **Offers Anytime Access:** Offers live classes, office hours, and group discussions at times that are convenient for instructors and students, not just when the physical facilities are available.
- **Ensures Comprehension:** Ensure students understand their lessons by asking for immediate feedback, answering questions, and giving in-depth verbal explanations of complex material.
- **Electronic White Boards and Polls, Quizzes and Surveys:** A best practice of live instruction is to regularly offer interactive exercises. By offering whiteboard exercises and asking polling questions, students will remain highly engaged.
- **Recording of The Class:** Archives retain everything that happened from voice, to chat, to content- during the live class, allowing all classes to be played back, verbatim.
- **Access to Person with Disabilities:** Live and archived classes can be close-captioned for the hearing impaired persons while also reaching out to the visually impaired persons by offering numerous keyboard shortcut keys, hot keys and compatibility with most screen readers. These accessibility features will ensure this technology is inclusive to all.
- **Appeal to Different Learning Styles:** Enable students to meet their developmental objectives by appealing to different learning styles, as many students are auditory and visual learners.
- **Create Community:** Create a sense of community among students and instructors who might not otherwise interact with one another.
- **Application Sharing:** Application sharing allows working on any application, as everyone logged-in will follow every action the cursor makes.
- **Public and Private Text Chat:** Some students are more comfortable writing than speaking, and the chat messaging allows the shy students to communicate textually so they can participate with their more talkative classmates.

8. **Digital Classrooms:**
   - Digital Classrooms combines the best of the hardware, software, content and service that delivers new-age technology and traditional classroom teaching.
   - The Digital Classroom helps the teacher in creating and delivering content digitally in the classroom.

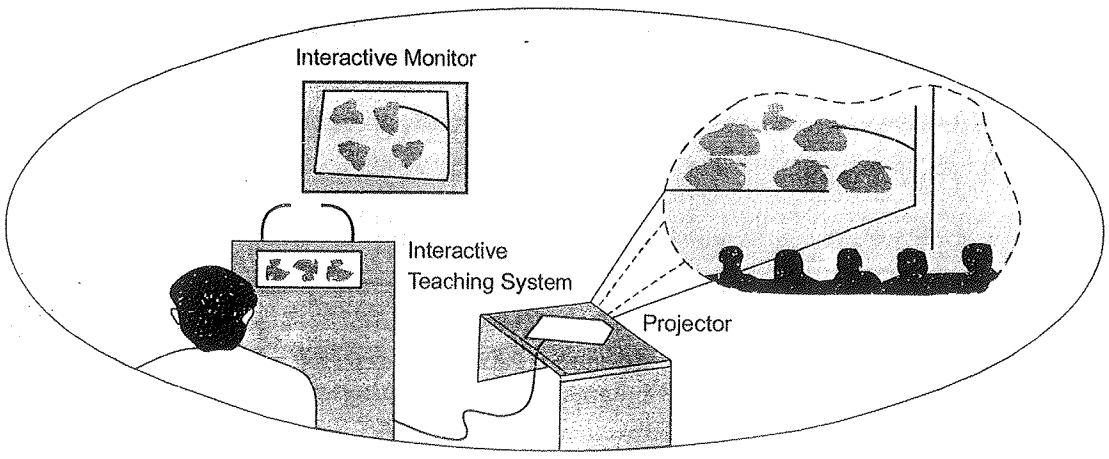


Fig. Digital Classrooms

   - Digital Classrooms are providing more than 800 syllabus based multimedia learning resources (for IIT's, Polytechnics, Engineering colleges) and presentation tools and technologies.

9. **Massive Open Online Course (MOOC):**
   - A **massive open online course** is an online course aimed at unlimited participation and open access via the web.

- In addition to traditional course materials such as filmed lectures, readings, and problem sets, many MOOCs provide interactive user forums to support community interactions among students, professors and teaching assistants (TAs).

  M: Massive → An online course designed for large number of participants.

  O: Open → Course can be accessed by (almost) anyone, anywhere as long as they have internet connection. Open as in freedom of place, pace and time and to everyone without any entry qualification.

  O: Online → Complete course online.

  C: Course → The course offers a full course experience including.

  (a) Educational content.

  (b) Facilitation interaction among peers (including some but limited interaction with academic staff)

  (c) Activities/tasks, tests, including feedback.

  (d) Some kind of (non formal) recognition options.

  (e) A study guide/syllabus.

10. SWAYAM:

- Study Webs of Active Learning for Young Aspiring Minds (SWAYAM) is India's MOOC.
- It aims at creating a comprehensive and integrated system for enhancing the efficiency and effective education at all levels and especially a transformational change in the mode, pedagogy and style of learning for students.
- The courses hosted on SWAYAM will be in 4 quadrants:

2nd quadrant:	1st quadrant:
Specially prepared reading material that can be downloaded/printed.	Video lecture
3rd quadrant:	**4th quadrant:**
Self-assessment tests through tests and quizzes.	An online discussion forum for clearing the doubts.

- In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: They are NPTEL for engineering, UGC for post-graduation education, CEC for under-graduate education, NCERT and NIOS for school education, IGNOU for out of the school students and, for management studies.

School Education	Out of School Education	Undergraduate Education	Postgraduate Education
National Institute of Open Schooling National Council of Educational Research and Training	Indira Gandhi National Open University	Engineering: National Programme on Technology Enhanced Learning Management: Indian Institute of Management, Bangalore Consortium for Educational Communication	Engineering: National Programme on Technology Enhanced Learning Management: Indian Institute of Management, Bangalore University Grants Commission

- Courses delivered through SWAYAM are available free of cost to the learners, however students wanting certifications shall be registered, shall be offered a certificate on successful completion of the course, with a little fee.
- At the end of each course, there will be an assessment of the student through proctored examination and the marks/grades secured in this exam could be transferred to the academic record of the students.
- SWAYAM platform is indigenously developed by Ministry of Human Resource Development (MHRD) and All India Council for Technical Education (AICTE) with the help of Microsoft and would be ultimately capable of hosting 2000 courses and 80000 hours of learning: covering school, under-graduate, post-graduate, engineering, law and other professional courses.

11. Digital Saksharta Abhiyan (DISHA)/National Digital Literacy Mission (NDLM):
    - The Digital Saksharta Abhiyan (DISHA) or National Digital Literacy Mission (NDLM) Scheme has been formulated to provide digital literacy to every Indian.
    - The National Digital Literacy Mission has come a long way since its inception in August 2012. The program started as an industry initiative with 9 partners, the IT industry coming together to accelerate digital literacy in India in keeping with the government's vision of having 1 e-literate person in every household.
    - NDLM initially envisages providing Information and Communication Technology (ICT) training to 10 lakh (Ten lakh) persons, one in every eligible household in selected Blocks in each State/UT of the country.
    - The two levels of IT training envisaged under the Scheme will have the following broad objectives:

      Appreciation of Digital Literacy (Level 1)

      To make a person IT literate, so that he/ she can operate digital devices, like mobile phones, tablets, etc., send and receive e-mails and search Internet for information, etc.

      Basics of Digital Literacy (Level 2)

      Besides IT literacy at a higher level, the citizen would also be trained to effectively access the various e-Governance services being offered to the citizen by the Government and other agencies.
    - The objective is to impart basic ICT skills relevant to the need of the trainee, which would enable the citizen to use IT and related applications and participate actively in the democratic process and further enhance opportunities for their livelihood.

12. National Digital Library of India:
    - Ministry of Human Resource Development under its National Mission on Education through Information and Communication Technology has initiated the National Digital Library of India (NDL India) to develop a framework of virtual repository of learning resources with a single-window search facility.
    - It is being developed at IIT Kharagpur.
    - Filtered and federated searching is employed to facilitate focused searching so that learners can find out the right resource with least effort and in minimum time.
    - NDL India is designed to hold content of any language and provides interface support for leading Indian languages (currently Hindi and Bengali).
    - It is being arranged to provide support for all academic levels including researchers and life-long learners, all disciplines, all popular form of access devices and differently-abled learners.
    - It is being developed to help students to prepare for entrance and competitive examination, to enable people to learn and prepare from best practices from all over the world and to facilitate researchers to perform inter-linked exploration from multiple sources.

13. National Scholarship Portal (NSP):

- National Scholarships Portal is one-stop solution through which various services starting from student application, application receipt, processing, sanction and disbursal of various scholarships to Students are enabled. National Scholarships Portal is taken as Mission Mode Project under National e-Governance Plan (NeGP).
- This initiative aims at providing a Simplified, Mission-oriented, Accountable, Responsive & Transparent **'SMART'** System for faster and effective disposal of Scholarships applications and delivery of funds directly into beneficiaries account without any leakages.

Objectives:

- Ensure timely disbursement of Scholarships to students.
- Provide a common portal for various Scholarships schemes of Central and State Governments.
- Create a transparent database of scholars.
- Avoid duplication in processing.
- Harmonisation of different Scholarships schemes and norms.
- Application of Direct Benefit Transfer.

Benefits:

- Simplified process for the students:
  (a) All scholarships information available under one umbrella
  (b) Single integrated application for all scholarships
- Improved transparency
  (a) System suggests the schemes for which a student is eligible.
  (b) Duplicates can be reduced to the maximum extent
- Helps in standardisation
  (a) Master data for Institutions and courses at all India level.
  (b) Scholarships processing.
- Serves as a decision support system (DSS) for Ministries and departments as up-to date information will be available on demand.
- Comprehensive MIS System to facilitate monitoring every stage of Scholarships distribution i.e. from student registration to delivery of funds.

14. National Supercomputing Mission (NSM):

- The Mission envisages empowering our national academic and R&D institutions spread over the country by installing a vast supercomputing grid comprising of more than 70 high-performance computing facilities.
- These supercomputers will also be networked on the National Supercomputing grid over the National Knowledge Network (NKN).
- The Mission would be implemented and steered jointly by the Department of Science and Technology (DST) and Department of Electronics and Information Technology (DeitY) at an estimated cost of Rs. 4500 crore over a period of seven years.

Objectives:

- To make India one of the world leaders in Supercomputing and to enhance India's capability in solving grand challenge problems of national and global relevance.
- To empower our scientists and researchers with state-of-the-art supercomputing facilities and enable them to carry out cutting-edge research in their respective domains.

- To minimize redundancies and duplication of efforts, and optimize investments in supercomputing.
- To attain global competitiveness and ensure self-reliance in the strategic area of supercomputing technology.

Application areas:

- Climate Modelling
- Weather Prediction
- Aerospace Engineering including CFD, CSM, CEM
- Computational Biology
- Molecular Dynamics
- Atomic Energy Simulations
- National Security/ Defence Applications
- Seismic Analysis
- Disaster Simulations and Management
- Computational Chemistry
- Computational Material Science and Nanomaterials
- Discoveries beyond Earth (Astrophysics)
- Large Complex Systems Simulations and Cyber Physical Systems
- Big Data Analytics
- Finance
- Information repositories/ Government Information Systems

15. Shaala Siddhi:
    - Shaala Siddhi is a comprehensive instrument for school evaluation which enables the schools to evaluate their performance in more focused and strategic manner to facilitate them to make professional judgement for continuous improvement.
    - The web-portal of the framework will help all schools to assess themselves and the results can be seen by all enabling them to provide feedback.
    - The programme is initiated by National University of Educational Planning and Administration (NUEPA), under the aegis of Union Ministry of Human Resource Development.
16. Saransh:
    - Saransh is a tool for comprehensive self-review and analysis for CBSE affiliated schools and parents.
    - It enables them to analyze students' performance in order to take remedial measures. Saransh brings schools, teachers and parents closer, so that they can monitor the progress of students and help them improve their performance.
    - Saransh helps in the following ways:
        (a) **Self Review:** Equip schools and parents to review student's performance in various subjects
        (b) **Performance:** It helps school to look performance in scholastic areas at an aggregate level and at the level of each student.
        (c) **Data Visualisation:** All the performance metrics are presented through numbers as well as in charts/ graphs for easy understanding.
        (d) **Take Decisions:** Data driven analysis empowering Schools and Parents to take best decisions for students.
        (e) **Communications:** Facilitates interaction between Parents and Schools.
        (f) **Data Uploading:** Facility of data uploading for the CBSE/Schools and Real time generation of Statistics.

17. Shaala Darpan:
    - Shaala Darpan is an e-Governance platform for all Kendriya Vidyalayas in the country.
    - The first phase of "Shaala Darpan Project" to cover all the 1099 Kendriya Vidyalayas was launched on 05.06.2015.
    - The same is presently under implementation through National Informatics Centre Services Inc. (NICSI).
    - It aims to improve quality of learning, efficiency of school administration, governance of schools and service delivery to key stakeholders namely, students, parents, teachers, community and schools.
    - The objective of this project is to provide services based on School Management Systems to Students, Parents and Communities. The School Information Services includes School Profile Management, Student Profile Management, Employee Information, Student Attendance, Leave Management, Report Cards, Curriculum Tracking Custom and SMS Alerts for Parents/ Administrators on student and teacher attendance.
18. Sahapedia:
    - Sahapedia is an open online resource on the arts, cultures and heritage of India.
    - "Saha", Sanskrit for "together with", is an invitation to explore together the richness of our cultural landscapes.
    - Most of what Sahapedia shares is curated in the form of multimedia modules, made up of articles, interviews, photographs, videos of performances, timelines, walkthroughs and bibliographies.
    - The President of the governing body of Sahapedia is S. Ramadorai who is currently the Chairman of National Skill Development Agency in the rank of a Cabinet Minister.
19. Traditional Knowledge Digital Library (TKDL):
    - The Ministry of AYUSH had established Traditional Knowledge Digital Library (TKDL) in collaboration with Council for Scientific and Industrial Research (CSIR).
    - Traditional Knowledge Digital Library (TKDL) is a pioneer initiative of India to prevent misappropriation of country's traditional medicinal knowledge at International Patent Offices on which healthcare needs of more than 70% population and livelihood of millions of people in India is dependent.
    - As per the information provided by the CSIR, TKDL consisting of more than 2.90 lakh medicinal formulations of Ayurveda, Unani and Siddha which are available in the public domain, in five international languages namely English, Japanese, French, German and Spanish.
    - TKDL is proving to be an effective deterrent against bio-piracy and is being recognized as a global leader in the area of traditional knowledge protection.
    - TKDL has made waves around the world, particularly in TK-rich countries by demonstrating the advantages of proactive action and the power of strong deterrence.
    - The idea is not to restrict the use of traditional knowledge, but to ensure that wrong patents are not granted due to lack of access to the prior art for Patent examiners.
20. e-PG Pathshala:
    - Ministry of Human Resource Development under its National Mission on Education through Information and Communication Technology has assigned work to the UGC for development of high quality, curriculum-based, interactive content in different subjects at postgraduate level.
    - The content and its quality is the key component of education system.

Objectives:

- Develop e-content in 77 subject areas at PG level drawing expertise from subject experts in colleges and universities.
- Impart training to subject experts in the process of e-content creation;
- Make e-content available to students and peers using different delivery modes to impart formal and informal education and for supplementing and complementing the process of teaching and learning in higher education.
- Promote usage of e-content amongst students and peer.

Subject Disciplines:

- Social Sciences
- Arts
- Humanities
- Natural and Mathematical Sciences
- Linguistics and Languages

Components of e-Content:

- e-Text: Textual description for each module.
- Self-learning: Audio/video/animated explanation.
- Self assessment: Self evaluation mechanism.
- Learn more: Web resources, source for further study and supporting materials.

21. Vidwan:

- VIDWAN is the premier database of profiles of scientists/researchers and other faculty members working at leading academic institutions and other R&D organisation involved in teaching and research in India.
- It provides important information about expert's background, contact address, experience, scholarly publications, skills and accomplishments, researcher identity, etc.
- The database developed and maintained by Information and Library Network Centre (INFLIBNET) with financial support from the National Mission on Education through ICT (NME-ICT).
- The database would be instrumental in selection of panels of experts for various committees, taskforce, established by the Ministries/Govt, establishments for monitoring and evaluation purposes.
- The subject category includes Agricultural Science, Arts and Humanities, Biological Sciences, Chemical Sciences, Engineering and Technology, Medical and Health Sciences, Physical Sciences and Social Sciences.

Objectives:

- To quickly and conveniently provide information about expert to peers, prospective collaborators, funding agencies policy makers and research scholar in the country.
- To identify peer reviewers for articles and research proposal.
- To discover prospective collaborators for on-going research projects.
- To establish communication directly with the experts who possess the expertise needed by users.
- To create information exchanges and networking opportunities among scientists.

22. Swayam Prabha:

- The Swayam Prabha is a group of 32 DTH channels devoted to telecasting of high-quality educational programmes on 24×7 basis using the GSAT-15 satellite.

- Every day, there will be new content for at least (4) hours which would be repeated 5 more times in a day, allowing the students to choose the time of their convenience.
- The channels are uplinked from Bhaskaracharya Institute for Space Applications and Geo-Informatics (BISAG), Gandhinagar.
- The contents are provided by NPTEL, IITs, UGC, CEC, IGNOU, NCERT and NIOS. The INFLIBNET Centre maintains the web portal.
- The DTH Channels shall cover the following:
  (a) **Higher Education:** Curriculum-based course contents at post-graduate and under graduate level covering diverse disciplines such as arts, science, commerce, performing arts, social sciences and humanities, engineering, technology, law, medicine, agriculture, etc. All courses would be certification-ready in their detailed offering through SWA YAM, the platform being developed for offering MOOCs courses.
  (b) **School Education (9-12 levels):** modules for teacher's training as well as teaching and learning aids for children of India to help them understand the subjects better and also help them in preparing for competitive examinations for admissions to professional degree programmes.
  (c) Curriculum-based courses that can meet the needs of life-long learners of Indian citizens in India and abroad.
  (d) Assist students (class 11th and 12th) prepare for competitive exams.

23. **Sugamya Pustakalaya:**
- Sugamya Pustakalaya is a collaborative effort of several organizations to end the book famine faced by people with print disabilities.
- It is an online platform that makes accessible content available to print-disabled people. The library houses publications across diverse subjects and languages and multiple accessible formats.
- It has been created by Department of Empowerment of Persons with Disabilities (Divyangjan), Ministry of Social Justice and Empowerment in collaboration with member organizations of Daisy Forum of India and powered by TCS Access.
- DAISY Forum of India is a consortium of Not for Profit organizations from India who are involved in production and distribution of books and reading material in accessible formats for persons who cannot read normal print due to visual, cognitive or physical disabilities.
- Over 2 lakhs books in diverse languages. Integrating libraries across India and the Globe, including the largest international library, Bookshare.

24. **e-Granthalaya:**
- e-Granthalaya is a **Digital Agenda For Library Automation and Networking** is an Integrated Library Management Software from National Informatics Centre,(NIC), Ministry of Electronics and Information Technology, Government of India.
- The software has been developed by a team of experts from software as well as Library and Information Science discipline and is useful for automation of in-house activities of libraries and to provide various online member services.
- The software provides built-in Web OPAC interface to publish the library catalogue over Internet and is UNICODE Compliant thus, supports data entry in local languages.
- Latest version of e-Granthalaya i.e. Ver.4.0 is a 'Cloud Ready Application' and provides a Web-based data entry solution in enterprise mode with a centralized database for cluster of libraries.

25. A-VIEW:
- A-VIEW (Amrita Virtual Interactive e-Learning World) is an award winning indigenously built multi-modal, multimedia e-learning platform that provides an immersive e-learning experience that is almost as good as a real classroom experience developed by Amrita e-Learning Research Lab.
- A-VIEW is part of Talk to a Teacher program coordinated by IIT Bombay and are funded by the Ministry of Human Resource Development (MHRD) under the Indian Government's National Mission for Education using Information and Communication Technology (NME-ICT).
- A-VIEW is now deployed at several IITs, NITs and other leading educational institutions across the nation.

ESE Prelims Question

Q.1 Consider the following as advantages of ICT tools in educational systems:
1. Increased capacity and cost effectiveness of the educational system
2. Achievement by target groups that had limited access to traditional education
3. Support for improvement of the quality and relevance of existing structures of education
4. Provision of links between various educational institutions for knowledge sharing

Which of the above statements are correct?
(a) 1, 2 and 3 only (b) 1, 2 and 4 only
(c) 3 and 4 only (d) 1, 2, 3 and 4
[ESE-2017]

Ans. (d)

Q.2 Which of the following sets of free software tools are suitable for ICT-based education as well as an open source?
(a) Scilab, Osdag, PHP and Latex
(b) Java, LibreOffice, Audacity and Matlab
(c) Scilab, Arduino, LibreOffice and Latex
(d) Scilab, Octave, Netduino and Latex
[ESE-2018]

Ans. (a, c)

Objective Brain Teasers

Q.1 Which of the following is not one of the cardinal principles of Education Policy?
(a) Access (b) Equality
(c) Equity (d) Quality

Q.2 ERP stands for
(a) Educational Resource Programming
(b) Educational Revival Programme
(c) Educational Resource Planning
(d) Educational Repository Phase

Q.3 Which educational institute is at the core of the initiative e-Yantra-incorporation of robotics into engineering education?
(a) IIT Bombay (b) IIT Kanpur
(c) NIT Tiruchirapalli (d) IIIT Hyderabad

Q.4 e-Basta is a project to make school books accessible in digital form. In which of the following language are these available
(i) English (ii) Hindi
(iii) Sanaskrit (iv) Urdu
(a) (i) and (ii) only
(b) (i), (ii) and (iii) only
(c) (i), (ii) and (iv) only
(d) (i), (ii), (iii) and (iv)

Q.5 What does CEC stands for?
(a) Consortium for Educational Committee
(b) Committee on Educational Communication
(c) Consortium for Educational Communication
(d) Consortium for Educational and Communication

Q.6 Which of the following statements is/are correct about FOSSEE?
(i) The project promotes the use of free and open source software tools to eliminate the use of commercial/proprietary software in education.
(ii) The project is a part of NMEICT, Ministry of Human Resources and Development.
(iii) It is developed by IIT Bombay with other technical institution as partners.
(a) (i) and (ii) only
(b) (ii) only
(c) (i) and (iii) only
(d) (i), (ii) and (iii)

Q.7 Which of the following is not a participating institution for the initiative of virtual lebs?
(a) Amrita Vishwa Vidyapeetham
(b) COE Pune
(c) Dayalbagh University
(d) IISc Bangalore

Q.8 Consider the following statements regarding EDUSAT?
(i) The satellite for EDUSAT is GSAT-15.
(ii) The students can ask queries through audio-video conferencing, text modes and telephones.
(iii) The recorded lectures delivered during the EDUSAT transmission are also available on YouTube.
Which of the above statements are correct?
(a) (i) and (ii) only
(b) (ii) and (iii) only
(c) (i) and (iii) only
(d) (i), (ii) and (iii)

Q.9 Which of the following is not included in the initiative "Talk to a Teacher" conducted by IIT Bombay?
(a) Research oscope
(b) Courses on a view
(c) Access to virtual labs
(d) Ask a question

Q.10 TKDL is abbreviated for
(a) Traditional Knowledge Digital Library
(b) Traditional Knowledge Depository Limited
(c) Traditional Knowledge Deposits Library
(d) None of the above

Q.11 Which of the following is responsible for the development of content on 77 subjects for e-PG Pathshala?
(a) CEC (b) AICTE
(c) C-DAC (d) UGC

Q.12 Which of the following statements is/are correct regarding SOS tools?
(i) SOS stands for Software and Simulation.
(ii) It is an initiative by Ministry of Human Resource Development (MHRD) under the National Mission on Education through ICT.
(a) (i) only
(b) (ii) only
(c) Both (i) and (ii)
(d) Neither (i) nor (ii)

Q.13 What does the acronym A-VIEW stands for?
(a) All Virtual Ineractive Education Web
(b) All Virtual Interactive e-Learning Web
(c) Amrita Virtual Interactive e-Learning World
(d) Atal Virtual Interactive e-Learning Web

Q.14 Who is responsible for maintaining the database for VIDWAN-premier directory of the profiles of scientiests/researchers?
(a) NIC (b) INFLIBNET
(c) ERNET (d) NASSCOM

Q.15 Consider the following statements regarding National Digital Literacy Mission (NDLM)?
(i) NDLM initially aims at providing Information and Communication Technology (ICT) training ten lakh persons, one in every eligible household.
(ii) Digital Saksharta Abhiyan is another name of the National Digital Literacy Mission.
Which of the above statements is/are correct?
(a) (i) only
(b) (ii) only
(c) Both (i) and (ii)
(d) Neither (i) nor (ii)

Q.16 How many DTH channels does Swayan Prabha consists of?
(a) 25 (b) 32
(c) 42 (d) 18

Q.17 Which of the following statements are correct about ERNET?

(i) It stands for Education and Research Network.
(ii) Focus of ERNET India is not limited to just providing connectivity, but to meet the entire needs of the academic and research institutions.
(iii) It is an autonomous scientific society under the administrative control of Department of Science and Technology.
(a) (i) and (ii) only
(b) (ii) and (iii) only
(c) (i) and (iii) only
(d) (i), (ii) and (iii)

Q.18 In what language will the content of National Digital Library India be available?
(a) English and Hindi
(b) English, Hindi and Urdu
(c) All Leading Language of India
(d) English only

Q.19 Virtual Learning Environment (VLE) is an online environment of e-resources caters to several disciplines taught at undergraduate and postgraduate level. It is an initiative of which university?
(a) University of Delhi
(b) Amrita Vishwa Vidapeetham
(c) Anna University
(d) None of the above

Q.20 Which of the following statements is/are correct regarding Sahapedia?
(i) Sahapedia is an open online resource on the arts, cultures and heritage of India.
(ii) The President of the governing body of Sahapedra is S.Ramadorai.
(a) (i) only
(b) (ii) only
(c) Both (i) and (ii)
(d) Neither (i) and (ii)

Q.21 Consider the following statements regarding the objectives of ICT in education:
(i) To carry out internet based research to enhance educational process.
(ii) To establish a virtual classroom.
(iii) To increase employment opportunities.
Which of the above statements are correct?
(a) (i) and (ii) only
(b) (ii) and (iii) only
(c) (i) and (iii) only
(d) (i), (ii) and (iii)

Q.22 Which of the following are the tools for ICT in education?
(i) Digital portfolio
(ii) Satellite based education
(iii) VSAT technology
(iv) Flipped classroom
(a) (i), (ii), (iii) only
(b) (ii) and (iii) only
(c) (i), (ii), (iv) only
(d) (i), (iii) and (iv)

Answers

1.	(b)	2.	(c)	3.	(a)	4.	(d)	5.	(c)
6.	(d)	7.	(d)	8.	(b)	9.	(c)	10.	(a)
11.	(d)	12.	(c)	13.	(c)	14.	(b)	15.	(c)
16.	(b)	17.	(a)	18.	(c)	19.	(a)	20.	(c)
21.	(a)	22.	(b)						

Explanations

8. The satellite for EDUSAT is GSAT-3.

17. ERNET is an autonomous scientific society under the administrative control of Ministry of Information Technology Government of India.

■■■■

7 Recent Development Related to ICT

7.1 Quantum Computing

- In quantum computing, all the computations are done based on the laws of quantum mechanics.
- Unlike classical computers, which use binary digits (0 and 1) to encode the data, quantum computers use qubit or quantum bit as their unit of information.
- The main difference between a bit and a qubit is that a bit can take either of the two states i.e. either 0 or 1, but a qubit can exist in the form which exhibits both the states simultaneously. Thus it follows the principle of superposition which is a fundamental property of quantum mechanics.
- Another distinguishing feature between a bit and qubit is that the qubit can exhibit quantum entanglement which is a phenomenon where a group of particles are connected in such a manner that the quantum state of any particle cannot be described independently from each other even if they are spatially separated.
- These two properties of the data unit enable the quantum computers to store enormous amount of data and also with less energy compared to the classical computers.
- Although the advent of quantum of computing is set to revolutionize the world of computing, the level of complexity involved in its development is the present challenge to be addressed.
- Also Quantum computing is not well suited for tasks such as word processing and e-mail, but it is ideal for tasks such as cryptography and indexing very large database.

Advantages of Quantum computing:

- It can perform calculations quickly and easily that are incredibly time saving.
- It can bring down space needed to store the data.
- It will increase the speed at which the data can be processed.

7.2 Optical Computing

- An optical computer (also known as photonic computers) uses photons in visible light or infrared (IR) beams in order to carry out the computations.
- Unlike the quantum computers, optical computers work with classical bits. But instead of an electric current (as in used in case of classical computers), they use photons produced by diodes or lasers for their operations.
- Electric current approximately travels at $1/10^{th}$ speed of light and hence possess problem with long distance transmission of data. This eventually led to the development of optical transmission and fibre-optic communication.
- Also a photon provides more bandwidth than an electron thereby providing a significant advantage of optical computing over its classical counterpart.
- However challenges in the form of constraints in bandwidth due to dispersion, or difficulty when multiple signals interact are to be addressed.

7.3 DNA Computing

- DNA computing is a branch of computing, where computations are done with the help of biological molecules or DNA as hardware instead of traditionally used silicon chips.
- Instead of classical binary code (0 and 1), it uses four character genetic alphabet which consists of the following:

A-Adenine	G-Guanine	C-Cytosine	T-Thymine

- Any computation in any form of computer is carried out as the execution of a step-by-step well formulated algorithm.
- In DNA computing, an algorithm is encoded in DNA molecules with specific sequences. Such molecules can further be sorted into certain subsequence according to their length and chopping strands.
- The result of the algorithm is then defined as some property of the final encoded set of the molecules as per the presence or absence of certain sequence or subsequence. Also with the help of DNA hybridization, trillions of new sequences can be created based on the initial sequence.
- Thus, DNA computers can solve complex problem by providing different possible solutions all at the same time. This phenomenon is known as parallel computing which is contrary to linear computing (one process at a time) adopted by most of the classical computers. Another benefit of the DNA computers is their expected small size of storage.

7.4 Cryptocurrency

- Cryptocurrency is a form of digital money which can be purchased, transferred or sold using cryptography for security.
- Cryptography is used to encrypt and protect data to help identify and track all transactions.
- Cryptocurrency exists as a decentralized currency, i.e. it is not affiliated to a single organisation like the central bank of any country.
- It is an intangible form of currency unlike the regular currency and its value is subjected to the market supply and demand fluctuations.
- The most recognized Cryptocurrency is the Bitcoin, created in 2008.

1. **Bitcoin:**

- Bitcoin is a Cryptocurrency which came into existence in the year 2009 by an unknown person or group of persons under the name of Santoshi Nakamoto.

  [**Note:** The website www.bitcoin.org came into existence on August 2008, however the first transaction was made on 2009]

- Bitcoin is open source (design is public) and its operation is based on peer to peer networking technology i.e. transactions take place directly between two parties without any intermediary. Peers are equipotent participants in the application.

How does the Bitcoin work?

- Balances are maintained with the help of Block chain technology:
- Block chain is a public, open and distributed ledger that records Bitcoin transactions thereby providing transparency. It is secured by cryptography.
- It is a continuously growing list of records called blocks, which are linked chronologically.
- The block chain is maintained by a network of communicating nodes which runs the Bitcoin. Every time a transaction takes place, a node validates it and updates their copy of ledger which is then visible to the other nodes.
- Apparently Block chain is the only place where Bitcoin can be said to exist.

Transactions can be made with the help of private keys:

- When a transaction takes places using Bitcoin, a secret piece of data in the form of a private key is generated which ensures the authenticity of the owner.

Further processing is done using Block chain Mining:

- Mining is the process of including transactions into the block chain with the help of distributed consensus system.
- The confirmed transactions are packed in a block which is strongly encrypted using strict cryptographic rules.
- The concept of consensus prevents any individual to control what can be included or replaced in the block chain.

Other Cryptocurrencies:

(a) Litecoin (Charlie Lee in the year 2011)
(b) Ethereum (Vitalik Buterin in the year 2015)
(c) Ripple
(d) Monero
(e) Dogecoin
(f) Dash
(g) Zcash

7.5 Big Data

- Big Data is a term that describes the large volume of data both structured and unstructured that overrun business on a day-to-day basis.
- It describes any voluminous amount of data that has the potential of being mined. It can be characterized by 3 Vs:
  (a) The extreme volume of data.
  (b) The wide variety of types of data.
  (c) The velocity at which the data must be processed.
- The database is so huge that a single computer cannot manage it and hence requires a highly scalable database management system.
- Big data is often distributed across multiple storage devices which may or may not be at the same location.
- Big data usually includes data sets with sizes beyond the ability of commonly used software tools to capture, curate, manage and process data within a tolerable elapsed time.

- Some of the examples of big data includes:
  (a) Search index of search engines.
  (b) User profiles database of social networking sites.
  (c) Product list of e-commerce websites.

7.6 Sunway Taihulight

- As of now, Sunway Taihulight is the fastest supercomputer in the world. The number one supercomputer is capable of performing some 93 quadrillion calculations per second (otherwise known as petaflops).
- The supercomputer was developed by the National Research Centre of Parallel Computer Engineering and Technology (NRCPC) in the city of Wuxi.
- The system is developed for various research and engineering work, in areas such as climate, weather and earth systems modelling, life science research, advanced manufacturing, and data analytics.

7.7 Pratyush

- Pratyush is India's first multi-petaflops supercomputer inaugurated at Indian Institute of Tropical Meteorology (HTM), Pune on 8th January 2018.
- Pratyush, meaning "the sun", will serve the nation with improved weather and climate forecasts.
- It comes under the umbrella of Ministry of Earth Sciences (MoES), Government of India.
- India will be ranked 4th in the world for dedicated high power computing (HPC) resources for climate community. India will follow Japan, UK and USA in the rankings.
- The capacity of Pratyush is 4 Petaflops.
- Pratyush is expected to improve the following services:
  (a) Weather forecasts which can eventually lead upto extreme weather events.
  (b) High resolution forecasts of Monsoon spells.
  (c) Very high resolution prediction of Cyclones with more accuracy and lead time.
  (d) Accurate Tsunami forecast with greater lead time.
  (e) Air quality forecasts for different SMART cities.
  (f) Ocean state forecasts including marine water quality.

7.8 Aaditya

- Aaditya is a supercomputer which is manufactured by IBM X system. Indian Institute of Tropical Meteorology Pune, the India's finest meteorological department uses IBM X system supercomputer for research and development.
- This supercomputer helps the institute to operate and provide accurate data regarding the Nation's weather conditions, simulating weather models of the country, predicting rainfall cycles for the monsoon, and air quality forecasting.

7.9 PARAM Yuva - II

- The Department of Electronics and Information Technology (DeitY), Government of India, launched PARAM Yuva - II, the new 500 TeraFlop version of its earlier PARAM Yuva at C-DAC Pune.
- The launch of PARAM Yuva - II was conducted as part of the Workshop on National Mission on Supercomputing being organised by C-DAC, Pune.

- PARAM Yuva - II provides more than half a Petaflop of raw compute power using hybrid compute technology with compute co-processor and hardware accelerators. PARAM Yuva -II has 200 Terabytes of high performance storage and support software for parallel computing.

7.10 Net Neutrality

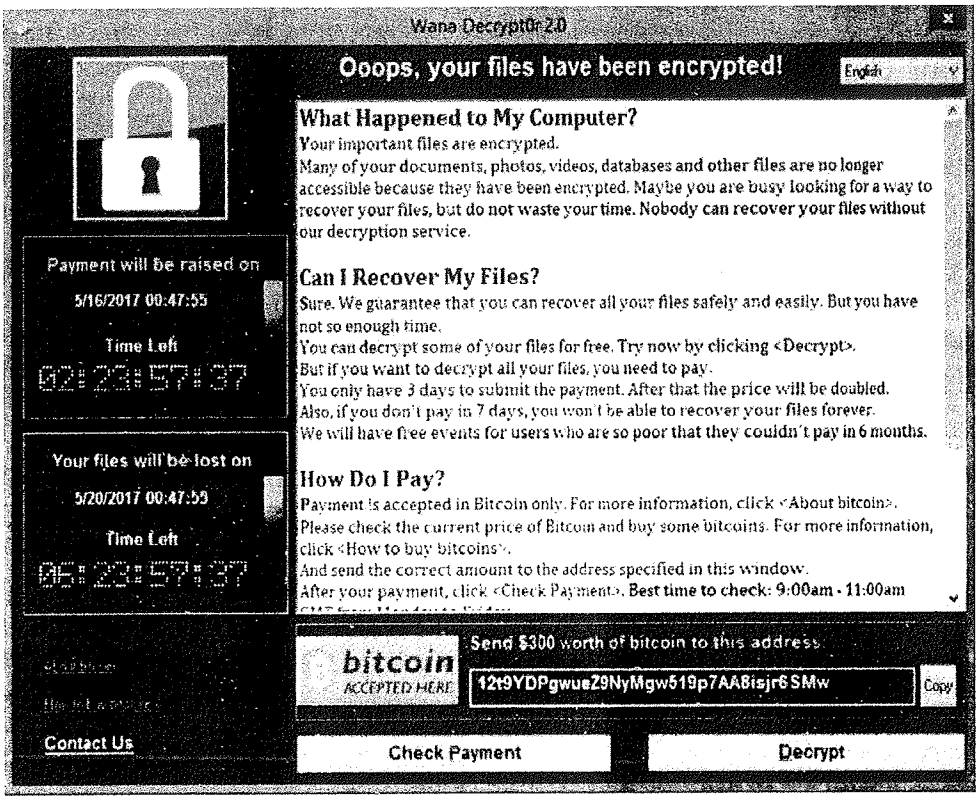
- Net neutrality is the principle that individuals should be free to access all content and applications equally, regardless of the source, without internet service providers discriminating against specific online services or websites.
- In other words, Net neutrality (also known as network neutrality) is the principle that internet service providers and governments should treat all data on the internet same, not discriminating or charging differentially by user, content, site etc.

7.11 Petya

- Petya is a family of ransomware that came into light in the year 2016. It belongs to the class of Trojan horse which encrypts the files on the compromised computer.
- Petya targets Microsoft Windows based systems after attacking any system encrypts important files and documents stored thereby disabling the owner's access.
- In lieu of the digital key required to unlock the files, they demand ransom, typically in Bitcoin. The victims can either pay the ransom or lose all the encrypted files.
- There are two variants of Petya, the original 2016 variant and the new 2017 variant which uses EternalBlue exploit kit.
- USA, Ukraine and Russia are among the worst hit nations followed by France, Germany, China, UK and Japan.
- India has been the worst hit in the Asia-Pacific region and globally among top 10 victim nations.

7.12 WannaCry

- WannaCry is a ransomware which emerged in the year 2017 and spread like a wild fire to infect millions of systems across 150 nations.
- It is a Trojan Horse which targets Microsoft Windows based systems and demands ransom in Bitcoin in exchange of the encrypted files.
- WannaCry takes advantage EternalBlue exploit kit and uses phising e-mails to infect the target systems.
- EternalBlue is an exploit developed by the U.S. National Security Agency (NSA), but was leaked online by a group of hackers named Shadow Brokers.
- According to the Kaspersky Lab, the four most affected countries were Russia, Ukraine, India and Taiwan.



- Although Petya and WannaCry uses the same exploit kit and phising e-mails to create havoc, but there are certain differences which are observed between the two:
  (a) WannaCry encrypts files whereas NotPetya (2017 Petya variant) encrypts a certain segment of the hard drive which makes the entire computer inoperable.
  (b) NotPetya seemed to aim only at disrupting rather than the monetary profits. Hence often it is also known as the "disguised ransomware".
  (c) WannaCry spread all across the world however NotPetya seemed to target specific nations, particularly Ukraine.

7.13 STUXNET

- Stuxnet is a computer worm discovered in 2010 that infected the software of at least 14 industrial sites in Iran, including a uranium-enrichment plant. Although a computer virus relies on an unwitting victim to install it, a worm spreads on its own, often over a computer network.
- This worm was an unprecedentedly masterful and malicious piece of code that attacked in three phases.
  (a) First, it targeted Microsoft Windows machines and networks, repeatedly replicating itself.
  (b) Then it sought out Siemens Step7 software, which is also Windows-based and used to program industrial control systems that operate equipment, such as centrifuges.
  (c) Finally, it compromised the programmable logic controllers.
- Stuxnet could spread stealthily between computers running Windows — even those not connected to the Internet.

7.14 Intrusion detection system

- An intrusion detection system (IDS) is a security software system that monitors network traffic for suspicious activity and issues alerts when such activity is discovered.
- The most common classifications are network intrusion detection systems (NIDS) and host-based intrusion detection systems (HIDS).
- A network intrusion detection system (NIDS) is deployed at a strategic point or points within the network, where it can monitor inbound and outbound traffic to and from all the devices on the network.
- Host intrusion detection systems (HIDS) run on all computers or devices in the network with direct access to both the internet and the enterprise internal network.
- An IDS works by monitoring system activity through examining vulnerabilities in the system, the integrity of files and conducting an analysis of patterns based on already known attacks. It also automatically monitors the Internet to search for any of the latest threats which could result in a future attack.

7.15 Chronicle - Cyber Security

- Chronicle is an independent Cyber Security business under the umbrella of Alphabet Inc., Google's parent company.
- It was launched on 24th January 2018, with an aim of detecting, tracking, fighting and stopping cyber-attacks.
- Chronicle with start of two services:
  (a) A security intelligence and analytics platform (mainly for enterprises and organizations).
  (b) The online malware and virus scanner: Virus Total (founded in 2004 and acquired by Google in 2012).
- Chronicle along with the Google's infrastructure claims to be able to serve its purpose faster and at a broader scale.

7.16 PSLV-C40 Cartosat-2 series satellite Mission

- On 12th January 2018, India's polar satellite launch vehicle on its forty second flight (PSLV-C40) successfully launched 31 satellites from the First Launch Pad (FLP) of Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota.
- It launched the Cartosat-2 series satellite (weighing 710 kg) for earth observation along with 30 co-passenger satellites (together weighing about 613 kg). The total weight onboard PSLV-C40 is 1323 kg.
- Cartosat-2 series satellite is a remote sensing satellite and the imagery sent by it will be useful for cartographic, various Land Information System (LIS) and Geographical Information System (GIS) applications.
- The co-passenger satellites consist of one Microsatellite and one Nanosatellite from India.
- It also consist of 3 Microsatellites and 25 Nanosatellites from 6 countries namely Canada, Finland, France, Republic of Korea, UK and USA. The 28 International customer satellites were launched as part of the commercial arrangements between Antrix Corporation Limited (Antrix), a Government of India company under Department of Space (DOS), the commercial arm of ISRO and the International customers.

7.17 Evolved EDGE Technology

- EDGE stands for Enhanced Data rates for GSM Evolution.
- EDGE, also known as Enhanced GPRS, is a digital mobile technology, enables data to be delivered at rates up to 384 Kbps on a broadband.
- It uses TDMA (Time Divide Multiple Access) multiplexing technology and can function on any network with GPRS enabled on it.
- Evolved EDGE is the modified and upgraded version of EDGE, where transmission time is further reduced.
- Bit transfer rates are increased upto 1 mbit/second with relatively lower cost and ease.
- Signal Quality is also improved by using dual antennas improving average bit rates and spectrum efficiency.

7.18 SONAR

- Sonar, short form for Sound Navigation and Ranging, is a technique of determining the distances under water and also the location of underwater objects with the help of sound waves.
- The physics behind the working of Sonar is the reflection of sound waves when it strikes the sea bed or any object.
- There are primarily two types of Sonar:
  (a) **Active Sonar:** Here, transducers emit acoustic signals. If an object is in the path of the sound waves, it gets reflected back to the transducers. By determining the time elapsed between the sending and receiving of signals, the distance and orientation of the object can be detected.
  (b) **Passive Sonar:** Here, the transducers detect sound or noise from the marine objects. Unlike the active sonar, passive sonar does not emit signals of their own, which is required for military vessels like submarines as they don't want themselves to be spotted. It is also very much in use for scientific studies, where the objective is to just observe the marine world.
  The Passive sonar alone cannot determine the range of any object. It requires at least two other passive sonar to find the location of an object by triangulation.

7.19 LIDAR

- Lidar, short form for Light Detection and Ranging, is a remote sensing technique where light in the form of laser to determine the location of various objects on earth.
- The working principle of Lidar is to illuminate the target with laser beams and to measure the time taken by the reflected pulse to reach the sensor.
- A LIDAR instrument principally consists of a laser, a scanner, and a specialised GPS system. Generally aeroplanes and helicopters are used to carry out the surveying with Lidar accompanied by proper data recording system.
- There are two types of Lidar:
  (a) **Topographic Lidar:** It uses a near-infrared laser to map the land.
  (b) **Bathymetric Lidar:** It uses water-penetrating green light to also measure seafloor and riverbed elevations.
- Lidar helps to record precise and accurate three dimensional information about the Earth and its surface characteristics.
- Lidar technology is also sometimes use for the control and navigation of autonomous cars.

7.20 RADAR

- Radar, short form for Radio Detecting and Ranging, is a system which detects the location (distance and orientation) and velocity of objects using radio waves.
- Sometimes Radar can also be useful to determine the size and shape of the objects.
- The Radar system consists of:
  (a) **A transmitter:** To emit electromagnetic waves.
  (b) **Antennas:** A receiving antenna and a transmitting antenna. Sometimes a single antenna can serve dual purpose.
  (c) **A receiver and processor system:** To determine the properties of the objects.

  [**Note:** Another component of a Radar system is the Hybrid Junction. During Transmission cycle, it couples microwave energy from transmitter to antenna and allows no energy to reach to the receiver, while during the Receiver cycle, it couples energy from the antenna to the receiver and allows no energy to reach the transmitter. Any Device that performs both these functions is called Duplexer. In Duplexers, Hybrid Junctions are used to isolate the transmission and reception signals for more efficient duplex communication. A type of Hybrid Junction is the Rat Race.]
- The advantage of Radar over Lidar is that it can be used under adverse climatic conditions. Radar can also distinguish one class of targets from another. For e.g. it can detect whether the target is an aeroplane or a bird.

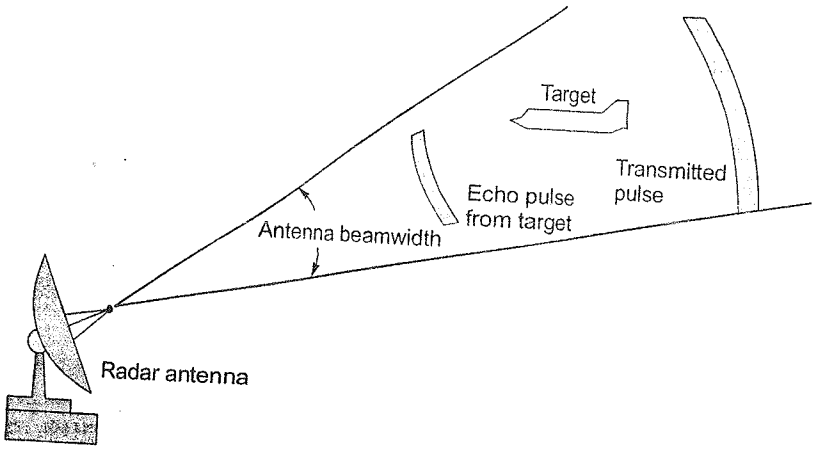


Fig. RADAR

- Radar finds its application in remote sensing, terrain surveying, weather information etc. But the most important application of radar is in military where it is helpful to detect guided missiles, aircrafts, ships etc.
- Some of the important Radars used by the Indian Defence and developed by Defence research and Development Organisation (DRDO) are:
  (a) **Indian Doppler Radar (INDRA-I):** INDRA is a 2D mobile surveillance radar for low level target detection.
  (b) **Indra-II PC Radar:** It is a variant of INDRA radar for ground controlled interception of targets for the Indian Air Force.
  (c) **Battle Field Surveillance Radar-Short Range (BFSR-SR):** The system has capability to detect, track and classify variety of moving ground surface targets.
  (d) **Maritime Patrol Airborne Radar XV - 2004** is versatile maritime surveillance airborne radar delivering excellent performances in maritime surveillance, search and rescue missions.
  (e) **3D Medium Range Surveillance Radar:** Rohini: Rohini is a ground based mechanically scanning S-Band pulse Doppler radar for air space surveillance to detect and track air targets with reliability, even under hostile EW operational environment for the Indian Air Force.

(f) **3D Surveillance Radar System - Revathi:** The scope of the radar is: Medium Range 3D air surveillance for interception, 3D Target tracking and indication, and sea surface surveillance as primary sensor.

(g) **3D Tactical Control Radar (3D TCR):** It is a Tatra VVL mounted, mobile stand-alone medium range, all weather 3D surveillance Radar for detection and identification of aerial targets.

(h) **Low level Light Weight 2D Radar - BHARANI:** It is a light weight, battery powered and compact sensor which provides 2D surveillance solution to alert Army Air Defence Weapon Systems mainly in mountainous terrain against hostile aerial targets like UAVs, RPVs, helicopters and fixed wing aircraft flying at low and medium altitudes.

(i) **Low level Light Weight 3D Radar - ASLESHA:** ASLESHA is a multifaceted ground based S-Band 3D Low Level Light Weight Surveillance Radar for deployment in diverse terrains like plains, deserts, mountain tops and high altitude regions.

(j) **Long Range Solid State Active Phased Array RADAR:** LSTAR system developed under the Technology Demonstration Programme is a Long Range, Multifunction Solid-State Active Phased Array Radar, mainly for surveillance, detection and tracking of airborne targets.

(k) **FLR: Flight Level Radar for Air Force (RAJENDRA):** It is a multifunction electronically scanned phased array Radar, is the primary sensor at the Flight level for Akash Weapon System which is an air defence system for the Armed Services. The radar has the capability to perform extensive search, track multiple targets and missiles, and to command and guide own multiple functions missiles concurrently.

(l) **Upgrades for Weapon Locating Radar (WLR) - Swathi:** WLR is a coherent, electronically scanned C-Band pulse Doppler radar. The radar automatically locates hostile artillery, mortars and rocket launchers and tracks friendly fire to locate the impact point of friendly artillery fire to issue necessary corrections.

(m) **Primary Radar for Airborne Early Warning and Control (PR for AEW&C):** DRDO is developing primary radar (PR) for the Airborne Early Warning & Control (AEW&C) programme.

(n) **Development of Medium Power Radar (MPR) - Arudhra:** The objective of this project is to develop 4D Medium Power Radar (MPR) as a sophisticated multi-function sensor using advanced active array technology.

(o) **Low Level Transportable Radar (Ashwini):** LLTR is a state-of-the-art 4D active array technology based multifunction radar. This radar is being developed by LRDE to provide airspace awareness about high maneuverable targets to gain superiority.

7.21 Holographic Storage

- Holographic storage is a computer storage that uses laser beams to store computer data in 3D and hence achieves more data storage than conventional optical and magnetic storage.
- The holographic method can be compared with the holographic sticker which can display three dimensional objects, even though the sticker is only two dimensional.
- The idea in holographic storage is to use this type of technology to store computer information. This can store large amount of data in a small space.
- Unlike the currently used magnetic and optical data storage devices (computer hard drive and CD-ROM) that rely on individual bits being stored as distinct magnetic and optical changes on the surface of the recording medium, holographic storage records information throughout the volume of the medium and is capable of recording multiple images in the same area utilizing light at different angles.
- Magnetic and optical data storage records, information a bit at a time in a linear fashion. Holographic storage on the other hand is capable of recording millions of bits in parallel enabling data transfer rates greater than those attended by optical storage.

7.22 HVD

- HVD stands for Holographic Versatile Disc.
- It is an optical disc technology that uses holographic storage and can store 1-10 terabytes of data.

7.23 Holographic Display

- A holographic display is a display which uses diffraction of light to create virtual three dimensional image of an object even though the object is two-dimensional.
- The striking difference between a holographic display and other 3-D displays is that the viewers don't require additional glasses or devices to see the image.
- The various types of holographic displays are:
  (a) Laser Plasma
  (b) Micro magnetic Piston Display
  (c) Holographic Television Display
  (d) Touchable Holograms

7.24 Network Virtualization

- Network Virtualization (NV) is defined by the ability to create logical, virtual networks that are decoupled from the underlying network hardware to ensure the network can better integrate with and support increasingly virtual environments.
- In the IT industry, virtualization and cloud computing are often used as synonyms. The basic difference between these two is that virtualization is a part of physical infrastructure, while cloud computing is nothing but a service.
- Network virilization (NV) abstracts networking connectivity and services that have traditionally been delivered via hardware into a logical virtual network that is decoupled from and runs independently on top of a physical network in a hypervisor.
- NV solves a lot of the networking challenges in today's data centres', helping organizations centrally program and provision the network, on-demand, without having to physically touch the underlying infrastructure. With NV, organizations can simplify how they roll out, scale and adjust workloads and resources to meet evolving computing needs.

7.25 Artificial Intelligence (AI)

- Artificial Intelligence is a simulation of human intelligence processes by making a machine or computer system think intelligently, in the similar manner the intelligent humans think.
- AI was coined by John McCarthy, an American computer scientist, in 1956 who defined it as the science and engineering of making intelligent machines, especially intelligent computer programs.
- AI has the processes of learning, reasoning and self-correction. Particular applications of AI include expert systems, speech recognition and machine vision.
- Apart from Big Data application, AI can have profound application in the field of Education, Healthcare, Finance, Business, Manufacturing, Telecommunications, Online games, Expert systems. Neural Networks, Robotics, Weather forecasting etc.

7.26 Virtual Reality (VR)

- Virtual reality is a three-dimensional, computer generated environment which can be explored and interacted with by a person. That person becomes part of this virtual world or is immersed within this environment and whilst there, is able to manipulate objects or perform a series of actions.

- Today virtual reality is usually implemented using computer technology. There are a range of systems that are used for this purpose, such as headsets, omni-directional treadmills and special gloves. These are used to actually stimulate our senses together in order to create the illusion of reality.
- Virtual reality can lead to new and exciting discoveries in these areas which impact upon our day to day lives. Wherever it is too dangerous, expensive or impractical to do something in reality, virtual reality allows us to take virtual risks in order to gain real world experience.
- As the cost of virtual reality goes down and it becomes more main stream in the fields such as education or productivity applications, architecture, sports, medicine, entertainment and many more.
- All modern VR displays are based on technology developed for smartphones including: gyroscopes and motion sensors for tracking head, hand, and body positions; small HD screens for stereoscopic displays and small, lightweight and fast processors.

7.27 Augmented Reality

- Augmented reality (AR) is a technology that layers computer-generated enhancements atop an existing reality in order to make it more meaningful through the ability to interact with it. AR blurs the line between what's real and what's computer-generated by enhancing what we see, hear, feel and smell.
- AR is developed into apps and used on mobile devices to blend digital components into the real world in such a way that they enhance one another, but can also be told apart easily.
- Augmented reality is quickly changing the way its users see the world. It is used to display score overlays on telecasted sports games and pop out 3D e-mails, photos or text messages on mobile devices. Leaders of the tech industry are also using AR to do amazing and revolutionary things with holograms and motion activated commands.
- However its technology is a bit different from virtual reality. Virtual reality offers a digital recreation of a real life setting, while augmented reality delivers virtual elements as an overlay to the real world.
- Augmented reality is being used more and more in mobile devices such as laptops, smart phones, and tablets to change how the real world and digital images, graphics intersect and interact.

7.28 Dye Sublimation printer

- Traditional screen-printing is replaced by digital textile printing solutions like sublimation printing for shorter production runs and prints that require multiple colours and photographic imagery.
- A dye-sublimation printer is a computer printer which uses heat to transfer dye onto materials such as a plastic, card, paper, or fabric. The digital alternatives are ideal for the personalization of prints, which is extremely popular nowadays.
- Sublimation printing is a technique that uses heat sensitive inks. These inks turn into gas under the influence of heat and combine with a 100% polyester medium. Since the ink becomes part of the structure of the material, the images on the fabric don't fade or crack - even after multiple washings.

7.29 Machine Learning

- Machine learning is the science of getting computers to act without being explicitly programmed. It is the best way to make progress towards Artificial Intelligence.
- The basic concept of machine learning is to build algorithms that can receive input data and use statistical analysis to predict an output value within an acceptable range.
- Within the field of data analytics, machine learning is used to devise complex models and algorithms that lend themselves to prediction; in commercial use, this is known as predictive analytics.
- These analytical models allow researchers, data scientists, engineers, and analysts to "produce reliable, repeatable decisions and results" and uncover "hidden insights" through learning from historical relationships and trends in the data.

- Machine learning algorithms are often categorized as being supervised (parametric/non-parametric algorithms, support vector machines, kernels, neural networks) or unsupervised (clustering, dimensionality reduction, recommender systems, deep learning).
- As for example, Facebook's News Feed uses machine learning to personalize each member's feed. The software is simply using statistical analysis and predictive analytics to identify patterns in the user's data and use those patterns to populate the News Feed.

7.30 Automation

- Automation is the creation of technology and its application in order to control and monitor the production and delivery of various goods and services. Automation accomplishes a task repeatedly without human intervention.
- Automation is quickly evolving in a number of areas such as manufacturing, transport, utilities, defence, facilities, operations and lately, information technology. The technological impact of automation is increasing rapidly, both in the software/hardware and machine layer.
- Automation is expected to gain further steam in future, as automation adoption increases, more percentage of the workload can be handled by machines, without the need for humans to intervene. This may further lead to killing of IT jobs and causing unemployment problem in the future.

7.31 Aadhaar

- Aadhaar is a 12-digit unique identification number issued by the Indian government to every individual resident of India.
- The Unique Identification Authority of India (UIADI), which functions under the Planning Commission of India, is responsible for managing Aadhaar numbers and Aadhaar identification cards.
- Aadhaar numbers will eventually serve as the basis for a database with which disadvantaged Indian residents can access services that have been denied to them due to lack of identification documents.
- A resident Indian can apply for the Aadhaar number and card by submitting the existing proof of identity (passport, PAN card, driving license, etc.) and proof of address (phone/power bill, bank statements, etc.) and by undergoing biometric profiling (Ten Fingerprints, Two Iris Scans, and Facial Photograph) at any Aadhaar centre.
- The Union Government has mandated the linking of Aadhaar with PAN (Permanent Account Number), SIM card and Banks to prevent misuse of various Government services and also preventing Tax evasion by making it a sole identification proof for every citizen.

7.32 eMulazim

- eMulazim is an web based open source Human Resource Management software for small and medium enterprises (SMEs).
- It can host and manage critical employee data increase reliability and minimize compliance risk. It provides an easy to use, intuitive interface for HR departments with many features.
- eMulazim is a powerful tool to relieve the user from the complicated task of handling employee scheduling manually. This system automates the complete employee scheduling process and allows the user to maintain employee attendance records, leaves, payroll, claims, inventory, File Tracking Info in the easiest way.
- eMulazim is an web based open Source Human Resource management software that comprises of following features:
  (a) HUMAN RESOURCE: Leave, Attendance, Payroll, Claims etc.
  (b) INVENTORY MANAGEMENT: Stock items, material issue, depreciation etc.

(c) FINANCIAL MANAGEMENT: General Ledger, Accounts Payable, Accounts receivable, Asset Management and Cost Management

(d) PROJECT MANAGEMENT: Projects, Tasks, and resources allocation.

7.33 EduBOSS

- EduBOSS - educational variant of BOSS Linux is a full-featured, user-friendly Linux operating system, has educational applications that are useful for schools (primary and higher levels).
- Adapted from BOSS GNU/Linux, it features graphical installer, office application suite, on screen keyboard, Smart Common Input Method, web browser, educational games, paint and graphic tools, typing tutor, screen reader, text to speech application and a host of tools and packages for learning, and also for teaching.
- EduBOSS comes in a single DVD easily installable on a desktop. It also contains utility with add-on applications.

7.34 Rich Site Summary

- Rich Summary Site (RSS) enables publishers to syndicate data automatically. It benefits users who want to receive timely updates from favourite websites or to aggregate data from many websites.
- RSS removes the need for the user to manually check the website for new content. Their browser constantly monitors the site and informs the user of any updates.
- RSS 2.0.1 now stands for Really Simple Syndication. Bit Torrent clients support RSS. Sites such as Facebook and Twitter have removed RSS support which were being previously used.
- Reader services such feebly provides synchronization between desktop RSS reader and mobile devices.

7.35 Exocortex

- An exocortex is a wearable (or implanted) computer used to augment a brain's biological high-level cognitive processes and inform a user's decisions and actions. Brain-computer interfaces (BCIs) are a special type of exocortex used to interact with the environment via neural signals.
- An individual's exocortex would be composed of external memory modules, processors, IO devices and software systems that would interact with, and augment, a person's biological brain.
- Typically the interaction is described as being conducted through a direct brain-computer interface, making these extensions functionally part of the individual's mind.

7.36 Smart Speaker

- A smart speaker is a type of wireless speaker and smart audio playback device with an integrated virtual assistant (artificial intelligence) that offers interactive actions and hands-free activation with the help of one "hot word" (or several "hot words").
- Examples include Google Home and Amazon Echo. Alexa Voice Services (AVS), the suite of services built around Amazon's voice-controlled AI assistant, was introduced with Echo. AVS enables voice interaction with various systems in the environment and online.
- Smart speakers can also act as a smart device that utilizes Wi-Fi, Bluetooth and other wireless protocol standards to extend usage beyond audio playback, such as to control home automation devices.

7.37 Networked Readiness Index

- Networked readiness is a key indicator of how countries are doing in the digital world. It is given measured by World Economic Forum.

- The Networked Readiness Index measures how well an economy is using information and communications technologies to boost competitiveness and well-being.
- Networked readiness depends on whether a country possesses the drivers necessary for digital technologies to meet their potential, and on whether these technologies are actually having an impact on the economy and society.
- As per 2016 report of WEF's Networked Readiness Index, Iceland ranked 1st in the global index. India's rank is 91st in the 2016 report.

7.38 Internet Readiness Index

- Internet Readiness Index is a composite index to measure usability of Internet in the states of India. The report is prepared by Internet and Mobile Association of India (IAMAI).
- Internet Readiness Index is measured by four components which are e-infrastructure, e-participation, IT-environment and government e-services.
- As of 2017 report, Delhi ranks first in Internet Readiness Index followed by Karnataka, Maharashtra, Kerala and Tamil Nadu.

7.39 ICT Development Index

- The ICT Development Index (IDI) is a composite index of 11 indicators into single benchmark that measures the state of ICT development across countries. It is published annually by the United Nations International Telecommunication Union.
- The main objectives of the IDI are to measure:
  (a) the level and evolution over time of ICT developments within countries and the experience of those countries relative to others;
  (b) progress in ICT development in both developed and developing countries;
  (c) the digital divide, i.e. differences between countries in terms of their levels of ICT development; and
  (d) the development potential of ICTs and the extent to which countries can make use of them to enhance growth and development in the context of available capabilities and skills.
- Iceland ranked 1st in the 2017 ICT Development Index report. India ranked 134th in the 2017 ICT Development Index report.

ESE Prelims Question

Q.1 Consider the following statements regarding Holostore:
1. It is a device that reads and writes data in at optical form
2. It is a computer storage device
3. It refers to Institutions where holography is taught.

Which of the above statements are correct?
(a) 1, 2 and 3 (b) 1 and 3 only
(c) 1 and 2 only (d) 2 and 3 only
[ESE-2017]

Ans. (c)

Q.2 In a radar system, the term 'Rat-Race' is used in connection with
(a) Modulator
(b) Pulse characteristics
(c) Receiver Bandwidth
(d) Duplexer
[ESE-2018]

Ans. (d)

Objective Brain Teasers

Q.1 What is the unit of information in Quantum Computing?
(a) Q-bit (b) Qubit
(c) Qit (d) Q-digit

Q.2 Which of the following is not a Cryptocurrency?
(a) Litecoin (b) Zcash
(c) Cryp Cash (d) Monero

Q.3 Which of the following represents the four digit genetic alphanet used in DNA computing?
(a) AGCT (b) ACBT
(c) ACBG (d) ACFT

Q.4 Which ministry/department is responsible for the functioning of 'Pratyush'?
(a) Ministry of Electronics and Information Technology
(b) Department of Science and Technology
(c) Ministry of Earth Science
(d) Ministry of Defence

Q.5 Which of the following countries are ranked above India in terms of using HPC for climate community?
(a) UK, USA and Japan
(b) USA, China and Japan
(c) USA, Russia and South Korea
(d) USA, Russia and China

Q.6 Petya, recently in news is classified as
(a) Ransomware (b) Botnet
(c) Zombie virus (d) Spyware

Q.7 What is the name of the group of hackers who leaked the eternal blue exploit kit?
(a) Trojan hackers (b) Shadow brokers
(c) Ninja exploiters (d) Blue stealers

Q.8 How many international satellites did PSLV-C40 launch on 12th January, 2018?
(a) 32 (b) 29
(c) 31 (d) 28

Q.9 Chronicle is the cyber security company under which parent company?
(a) Microsoft (b) Alphabet inc.
(c) Apple (d) Opera

Q.10 Which of the following is not a radar developed by Defence Research and Development Organization (DRDO)?
(a) Bharani (b) Arudhra
(c) Garud (d) Rohini

Q.11 Which of the following has an application of virtual reality?
(i) Education
(ii) Architecture and sports
(iii) Entertainment and gaming
(iv) Productivity application
(a) (i) and (ii) only (b) (ii) and (iv) only
(c) (i), (iii), (iv) only (d) All of the above

Q.12 A new technology which provides the ability to create an artificial world and have people internet with it is called?
(a) Tele virtuality
(b) Artificial intelligence
(c) Neorealism
(d) Cybernetics

Q.13 Which of the following country didn't have any satellite launched by PSLV C-40?
(a) Canada (b) Russia
(c) France (d) USA

Q.14 Which is the worst hit nation by the ransomware not Petya?
(a) USA (b) Russia
(c) Ukraine (d) South Korea

Q.15 Which phenomenon of light is used by the holographic display?
(a) Dispersion (b) Diffraction
(c) Reflection (d) Refraction

Q.16 Which of the following is an example of big data?
(a) Google's search index
(b) Facebook's user list
(c) Amazon's product list
(d) All of the above

Q.17 Which of the following statements are correct regarding Bitcoin?
(i) Bitcoin exists as a decentralized currency.

(ii) The Bitcoin transactions are added into the block chain with the help of distributed consensus system.
(iii) Santoshi Nakamot put the first block of the block chain in the year 2008.

Which of the above statements is/are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.18 Which of the following statements is/are correct regarding Sonar?
(i) An active Sonar transmits as well as receives acoustic signals.
(ii) A single passive sonar determines the location of an object.
(a) (i) only (b) (ii) only
(c) Both (i) and (ii) (d) Neither (i) nor (ii)

Q.19 Consider the following statements regarding network readiness index:
(i) It is an index prepared by International Telecommunication Union (ITU).
(ii) It is a key measure of ICT use of countries in the digital world.
(iii) India is ranked 91st in 2016 Networked Readiness Index.

Which of the above statements is/are correct?
(a) (i) and (iii) only (b) (ii) only
(c) (ii) and (iii) only (d) (i), (ii) and (iii)

Q.20 Which of the following mechanism are involved in biometrics?
(i) Finger print sensor (ii) Retina Scan
(iii) Password (iv) Voice matching
(a) (i) and (ii) only (b) (i), (ii), (iii) only
(c) (iii) and (iv) only (d) (i), (ii), (iv) only

Q.21 Consider the following statements regarding Machine Learning:
(i) It is the science of getting computers to act without being explicitly programmed.
(ii) It uses statistical analysis and predictive analytics to predict an output value for an input data.
(iii) Self-driving cars, speech recognition, effective web search are some applications of machine learning.

Which of the above statements are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.22 Consider the following statements:
(i) Block chain technology is transforming the way IoT is viewed and is impacting on a vast range of industries.
(ii) As an unchangeable leader of transaction, block chain offers a sense of trust and accountability making it a very useful tool to regulate IoT devices.
(iii) Block chain is a single distributed ledger which does not change or lose the record even if one mode or connection is affected.

Which of the above statements are correct?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i) and (iii) only (d) (i), (ii) and (iii)

Q.23 Quantum Dot display
(a) Uses nano-particles made up of any semiconductor material of nanometer size.
(b) Are better than OLED in terms of much higher resolution.
(c) Both A and B
(d) None of the above

Q.24 Consider the following statements about Big data:
(i) It is used in Aadhar, Digital Locker etc.
(ii) It is used in predictive analytics, user behaviour and other advanced data etc.
(iii) It is defined in terms of volume, velocity and variety.

Which of the above statements is/are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1, 2 and 3 (d) 1 only

Q.25 Net neutrality
(a) Is a principle that ISP and government should treat all data flow equally.
(b) Create a level playing field for all web sites as it provides same connection speed.
(c) Both (a) and (b)
(d) None of the above

Q.26 Consider the following statements about crypto currency.
(i) It is a digital currency that uses cryptography for security.
(ii) India has recently legalised Bitcoins.
(iii) It uses public and private keys to transfer crypto-currency between two parties.

Select the correct answer using codes given below:

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3 only

Q.27 Which of the following statements about e-Pragati is/are correct?
(i) e-Pragati is a comprehensive framework for implementing e-Governance and provide e-Services to people of Karnataka.
(ii) It is developed in association with WIPRO.
(a) Only (i) (b) Only (i)
(c) Both (i) and (ii) (d) None of these

Q.28 Which of the following statements about m-Aadhar is correct?
(i) It is possible to share QR code through m-Aadhar.
(ii) It is not possible to lock or unlock bio-metric data e-feature through m-Aadhar.
(a) (i) only (b) (ii) only
(c) Both (i) and (ii) (d) None of these

Q.29 Consider the following statements about Big Data:
(i) It is used for predictive analytics user behavior and other advanced data.
(ii) It is used in Aadhar, Digilocker etc.
(a) (i) only (b) (ii) only
(c) Both (i) and (ii) (d) None of these

Q.30 What is the name of digital signature service launched on Aadhar plateform?
(a) Online signature (b) e-sign
(c) Digi sign (d) None of these

Q.31 Which of the following statement is/are true about quantum computing.
(i) It is an outcome of Moore's law.
(ii) It can process prime numbers much faster than simple computing.
(iii) Quantum computers can match the computing speed of supercomputer.
(a) (i) only (b) (i), (ii) only
(c) (i), (ii) and (iii) only (d) (iii) only

Q.32 Which of the following statements about Meghraj is/are correct?
(a) It is also called as GI cloud.
(b) Services under it are public cloud, virtual private cloud and government community cloud.
(c) It is to accelerate the delivery of e-services in the country.
(d) All of the above

Answers

1. (b)	2. (c)	3. (a)	4. (c)	5. (a)
6. (a)	7. (b)	8. (d)	9. (b)	10. (c)
11. (d)	12. (b)	13. (b)	14. (c)	15. (b)
16. (d)	17. (a)	18. (a)	19. (c)	20. (d)
21. (d)	22. (d)	23. (c)	24. (c)	25. (c)
26. (b)	27. (b)	28. (a)	29. (c)	30. (b)
31. (c)	32. (d)			

Explanations

3. AGCT represents Adenine-Guanine-Cytosine-Thiamine.

10. Garud (Commando Force) is a special force unit of the Indian Air Force.

17. Santoshi Nakamoto put the first block of the block chain, also known as the genesis block and subsequently opened the software public in the year 2009.

18. A single passive sonar cannot determine the location of an object. It needs at least two more passive sonar to do the same using triangulation.

19. Network readiness index is an index prepared by World Economic Forum (WEF).

23. Quantum dot display uses semiconductor nano crystals. It is considered as a next generation technology after OLED.

24. The act of gathering and storing large amounts of information is called as Big data. According to Doug Laney. Big data consist of three V's: Volume, Velocity and Variety.

29. Big Data is the large volume of data whose analysis can be used for predictive analysis. It is used for data created through Aadhar and Digital locker.

30. e-sign is an encrypted information launched on Aadhar plateform.

31. Quantum computing is an outcome of Moore's law. Its computing functions are in exponential increments, hence it matches the computing sped of supercomputer.

■■■■