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ODISHA STATE OPEN UNIVERSITY, SAMBALPUR

MAEC

MASTER OF
ECONOMICS
(ELECTIVE-II)

E-GOVERNANCE

E-GOVERNANCE-I

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Master of Arts

ECONOMICS (MAEC)

MECE-02

ELECTRONIC GOVERNANCE

BLOCK-1

UNIT 1 **E-GOVERNANCE: CONCEPT AND SIGNIFICANCE**

UNIT 2 **INFORMATION AND COMMUNICATION TECHNOLOGY: CONCEPT AND COMPONENTS**

UNIT 3 **ICTs: ROLES AND APPLICATIONS**

UNIT 1 E-GOVERNANCE: CONCEPT AND SIGNIFICANCE

Structure

1.0 LEARNING OUTCOMES

After studying this Unit, you should be able to:

- discuss the concept and significance of e-governance;
- explain the various stages of e-governance;
- examine the various models of e-governance; and
- analyse the issues and challenges

1.1 INTRODUCTION

Reinventing government has been a dominant theme since 1990s, wherein governments world over are attempting to improve the systems of public service delivery. Rapid strides made in the field of Information and Communication Technology (ICT) have facilitated the reinvention of governments and prepared them to serve the needs of a diverse society. In other words, the information age has

redefined the fundamentals and transformed the institutions and mechanisms of service delivery forever. The vision is the articulation of a desire to transform the way government functions and the way it relates to its constituents. The concept of electronic governance, popularly called e-governance, is derived from this concern. Democracies in the world share a vision of the day when e-governance will become a way of life.

India has been at the forefront of the IT revolution and has had its effect on the public administration systems, as we would see later in this Unit. In fact, if the potential of ICTs are harnessed properly, it has a lot of opportunities, especially, in the social and economic growth of the developing world.

1.2 CONCEPT OF E-GOVERNANCE

E-governance is the application of ICT to the processes of government functioning for good governance. In other words, e-governance is the public sector's use of ICTs with the aim to improve information and service delivery, encourage citizen participation in decision-making and make government more accountable, transparent and efficient.

The Ministry of Information and Technology states that e-governance goes far beyond mere computerisation of stand alone back office operations. It implies fundamental changes in government operations; and new set of responsibilities for the legislature, executive, judiciary and citizens.

According to the Comptroller and Auditor General, UK, e-governance means providing public access to information via the internet by government departments and their agencies.

So in essence, e-governance is the application of ICT in government functioning to bring in **SMART** governance implying: simple, moral, accountable, responsive and transparent governance.

SMART GOVERNANCE

Simple- meaning simplification of rules, regulations and processes of government through the use of ICTs and thereby providing for a user-friendly government

Moral- connoting emergence of an entirely new system of ethical values in the political and administrative machinery. Technology interventions

improve the efficiency of anticorruption agencies, police, judiciary, etc.

Accountable- facilitating design, development and implementation of effective Management Information System and performance measurement mechanisms and thereby ensuring accountability of public service functionaries.

Responsive- streamlining the processes to speed up service delivery and make system more responsive.

Transparent- bringing information hitherto confined in the government documents to the public domain and making processes and functions transparent, which in turn would bring equity and rule of law in responses of the administrative agencies.

SMART governance, thus, helps in:

- improving the internal organisational processes of governments;
- providing better information and service delivery;
- increasing government transparency in order to reduce corruption;
- reinforcing political credibility and accountability; and
- promoting democratic practices through public participation and consultation.

E-governance and E-government

E-governance and e-government are often used interchangeably, so distinguishing between them at this stage is imperative. According to Thomas B. Riley government and governance are both about getting the consent and cooperation of the governed. But whereas government is the formal apparatus for this objective, governance is the outcome as experienced by those on the receiving end…. E-government can be more productive version of government in general, if it is well implemented and managed. E-governance can evolve into participatory governance, if it is well supported with appropriate principles, objectives, programmes and architectures.

E-government is, thus, the modernisation of processes and functions of government using the tools of ICT as to transform the way it serves its constituents. As per the World Bank, e-government refers to the use by government agencies of information technologies (such as wide area networks, internet and mobile computing) that have the ability to transform relations with citizens, businesses and other arms of government. It is the use of technology to enhance the access to and delivery of government services to benefit citizens, business partners and employees. E-governance, on the other hand, goes beyond the service delivery aspects and is seen as a decisional process. It is about the use of ICTs in the systems of governance, that is, using ICT to involve multi stakeholders in decision-making and in making governments open and accountable.

1.3 STAGES OF E-GOVERNANCE

Different stages of e-governance are identified on certain set of criteria. These stages are:

- **Simple information dissemination** (one-way communication) - is considered as the most basic form, as it is used for merely disseminating information;

- **Two-way communication** (request and response) - is characterised with e-mail system and information and data-transfer technologies in the form of website;

- **Service and financial transactions**- is online services and financial transactions leading to web based self-services;

- **Integration** (both vertical and horizontal) - in this stage the government would attempt inter and intra-governmental integration; and

- **Political participation**- this stage means online voting, online public forums and opinion surveys for more direct and wider interaction with the government.

Another classification of e-governance has six stages of which the first two are similar to that of the above classification. The remaining four are:

- **Third stage**- refers to multi-purpose portals, which allow customers to use a single point of entry to send and receive information and to process transactions across multiple departments;

- **Fourth stage**- consists of portal personalisation, wherein customers are allowed to customise portals with their desired features;

- **Fifth stage**- is when government departments cluster services along common lines to accelerate the delivery of shared services and clustering of common services; and

- **Sixth and final stage**- technology is integrated further to bridge the gap between the front and back office.

After our discussion of the concept and stages of e-governance, we will now deal with significant models of e-governance that can be used in designing e-government initiatives.

1.4 MODELS OF E-GOVERNANCE

Prof. Dr. Arie Halachmi in his paper, namely, ' E-Government Theory and Practice: The Evidence from Tennessee (USA),' has given five important models of e-governance, which can be used as a guide in designing e-government initiatives depending on the local situation and governance activities that are expected to be performed. These models are:

- The Broadcasting Model
- The Critical Flow Model
- The Comparative Analysis Model
- The E-Advocacy/Mobilisation and Lobbying Model
- The Interactive-Service Model

We will now discuss these models individually.

- **The Broadcasting Model**

  The model is based on dissemination/broadcasting of useful governance information, which is in the public domain into the wider public domain with ICT and convergent media. The strength of the model rests upon the fact that a more informed citizenry is better able to judge the functioning of existing governance mechanisms and make an informed opinion about them. Consequently, they become more empowered to exercise their rights and responsibilities. Widespread

application of this model corrects 'information failure situations' by providing people with the relevant information relating to the governance sphere to make informed opinion and impact governance processes.

Further, the use of ICT opens an alternative channel for people to access information as well as validates existing information from different sources.

- **The Critical Flow Model**

The model is based on disseminating/channelling information of critical value to the targeted audience or into the wider public domain with ICT and convergent media.

The strength of this model is that ICT makes the concept of 'distance' and 'time' redundant when information is hosted on a digital network, and this could be used advantageously by instantly transferring the critical information to its strategic user group located anywhere or by making it freely available in the wider public domain.

- **The Comparative Analysis Model**

This model is highly significant model for developing countries and can be used for empowering people. Essentially, the model continuously assimilates best practices in the areas of governance and then uses them as benchmarks to evaluate other governance practices. It then uses the result to advocate positive changes or to influence 'public' opinion on these governance practices. The comparison could be made over a time scale to get a snapshot of the past and present situation or could be used to compare the effectiveness of an intervention by comparing two similar situations. The strength of this model lie in the infinite capacity of digital networks to store varied information and retrieve and transmit it instantly across all geographical and hierarchal barriers.

- **The E-Advocacy/Mobilisation and Lobbying Model**

This model builds the momentum of real-world processes by adding the opinions and concerns expressed by virtual communities. This model helps the global civil society to impact on global decision-making processes. It is based on setting up a planned, directed flow of information to build strong virtual allies to complement actions in the real world. Virtual communities are formed which share similar

values and concerns and these communities in turn link up with or support real-life groups/activities for concerted action.

Hence, it creates a diversity of virtual community and the ideas, expertise and resources are accumulated through this virtual form of networking. In addition, it is able to mobilise and leverage human resources and information beyond geographical, institutional and bureaucratic barriers and use it for concerted action.

- **The Interactive-Service Model**

  It opens avenues for direct participation of individuals in governance processes and brings in greater objectivity and transparency in decision-making processes through ICT. Fundamentally, ICT has the potential to bring in every individual in a digital network and enable interactive (two-way) flows of information among them.

  Under this model, the various services offered by the Government become directly available to its citizens in an interactive manner. It does so by opening up an interactive Government to Consumer to Government (G2C2G) channel in various aspects of governance, such as election of government officials (e-ballots); redressing online of specific grievances; sharing of concerns and providing expertise; opinion polls on various issues; etc. (adapted from Prof. Dr. Arie Halachmi 'E-Government Theory and Practice: The Evidence from Tennessee, USA').

  After our discussion about the models of e-governance, we will now focus on the legal and policy framework for the implementation of ICT and e-governance in the country.

1.5 LEGAL AND POLICY FRAMEWORK

The following provisions have laid down the legal and policy framework for ICT and e-governance.

- **Information Technology Act 2000**

  The Action Plan endorsed by the Conference of Chief Ministers in 1987 had already addressed the pertinent issues of accountable and citizen friendly administration; and transparency and right to information. In pursuance of these

issues, the Information Technology Act was promulgated in 2000. The objective of the Act is "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 methods of communication and storage of information'; to facilitate electronic filing of documents with the Government agencies; and further to amend the Indian Penal Code, the Indian Evidence Act, 1872, the Banker's Book Evidence Act, 1891 and the Reserve Bank of India Act, 1934 and for matters connected therewith or incidental thereto."

Both e-commerce and e-governance transactions are covered under the ambit of this Act, which facilitates acceptance of electronic records and digital signatures. The Act, thus, stipulates numerous provisions. It aims to provide for the legal framework so that legal sanctity is accorded to all electronic records and other activities carried out by electronic means. The said Act further states that unless otherwise agreed, an acceptance of contract may be expressed by electronic means of communication and the same shall have legal validity and enforceability.

CHAPTER III of the Act details about 'Electronic Governance' and provides interalia amongst others that where any law provides that information or any other matter shall be in writing or in the typewritten or printed form, then, notwithstanding anything contained in such law, such requirement shall be deemed to have been satisfied if such information or matter is:

i) rendered or made available in an electronic form; and

ii) accessible so as to be usable for a subsequent reference.

- **Report of the Working Group on Convergence and E-governance 2002-07**

Report of the Working Group on Convergence and E-governance proposed the need for administration to transform itself from a passive information and service provider to a platform/ forum for the active involvement of citizens. This Report primarily concerned itself with public investments. It could not visualise the extent of private initiative that could be expected to come forth in the convergence area or in e-commerce or allied segments.

It felt the need to set up a central body for taking stock of the total IT picture in the country. This central body could be a 'Council for E-governance' or an adhoc 'Commission on Reengineering Administrative Procedures for E- governance.'

Another alternative it suggested was to set up a National Institute of Smart Governance.

- **Common Minimum Programme**

The importance of e-governance has been recognised in the Common Minimum Programme of the UPA Government, which inter-alia states that e-governance will be promoted on a massive scale. It made a solemn pledge to the people of the country with a government that would be corruption free, transparent and accountable; and an administration that would be responsible and responsive at all times.

- **National E-Governance Plan**

Three important elements of the National E-Governance Plan, which form the core infrastructure for effective service delivery are- Data Centres, State Wide Area Networks and Common Service Centres. The 10-point agenda of the Department of Information Technology announced for growth of ICT in the country includes expeditious implementation of a 'National E-Governance Plan' to bring about transparency and citizen centric approach in administration.

- **Expert Committee**

An expert committee had also been constituted for the amendments in the IT Act 2000 to include the technological developments post IT Act 2000. The Expert Committee completed its deliberations and submitted its report in August 2005. Now the Expert Committee's recommendations have been put on the website of the Department of Information Technology for inviting public views and suggestions. The Committee, during its deliberations, analysed some of the relevant experiences and international best practices. The Committee, while formulating its recommendations, kept in view the twin objectives of: (i) using IT as a tool for socio-economic development and employment generation; and (ii) further consolidation of India's position as a major global player in IT sector.

- **Right to Information Act 2005**

The Right to Information Act 2005 confers on the citizens the right to:

i) inspect works, documents and records of the government and its agencies;

ii) take notes, extracts or certified copies of documents or records;

iii) take certified samples of material; and

iv) obtain information in form of printouts, diskettes, floppies, tapes, video cassettes or in any other electronic mode.

This has ensured a transparent and accountable government to the people. It has also established a two-way dialogue between the citizens and the government. It has enabled citizens to make well-informed decisions. Further, it is an important step towards tackling corruption and has ensured better monitoring of services provided by the government.

1.6 SIGNIFICANCE OF E-GOVERNANCE

ICT applications impact upon the structures of public administration systems. Technological advancements facilitate the administrative systems by enabling:

- Administrative Development; and
- Effective Service Delivery

We will now discuss them individually.

Administrative Development

Administrative reforms, often, have focused on procedural details and restructuring of systems and processes of government organisations. The basic objective of these reforms is to enhance capacities of the systems. ICTs can be used and are being used now to give further impetus to the process. They help in the following manners:

- **Automation of Administrative Processes**

  A truly e-governed system would require minimal human intervention and would rather be system driven. While initially the solutions that were offered were quite primitive with poor information layout, inadequate navigation provisions, occasional disruption in services, periodic outdated content and little or no 'back office' support. However, technological advancements and increased pressure from citizenry have prompted improvements in these areas. Now administrative departments are computerised and connected through network. Software has been built and designed around government departments ensuring efficiency in

operations. The departments have launched individual websites carrying information of their respective departments. This has enabled online carrying of operations and file movements. Budgeting, accounting, data flow, etc. has become easy. This has increased the efficiency of office operations and processes and has reduced unnecessary delays.

- **Paper Work Reduction**

An immediate impact of automation would be on the paperwork. Paperwork is reduced to a greater extent with communication being enabled via electronic route and storage and retrieval of information in the electronic form. All this has led to emergence of 'less paper office'. This concept is defined as an office situation where all the information (file and mail) amongst various functionaries is distributed online. In the words of Dubey, less paper office is the implementation of effective electronic communication processes that enable elimination of reproductive works and unnecessary papers. The concept is where files and mails (information) are transmitted over wires to small computers at each employee's desk. Office work, such as, file movements, notings, etc. is computerised and documentation, report preparation, databases are now maintained in computers. Due to interconnectivity through LAN, transfer of information and files take place online, thus reducing the physical movements and consumption and storage of huge piles of paper.

- **Quality of Services**

ICT helps governments to deliver services to the citizens with greater accountability, responsiveness and sensitivity. Quality of services improves, as now the people are able to get services efficiently and instantaneously. As volumes of transactions and information can be electronically handled and delivered over a wider area through the net and web, qualitative services become possible in least time, in least cost, in least difficulty and in greater convenience.

By ensuring online redressal of grievances the accountability of officials is ensured. They have become sensitive to the issues affecting people. Monitoring by way of video teleconferencing has further facilitated central monitoring, reporting and face to face communication that has assured effective service delivery by the officials.

- **Elimination of Hierarchy**

  ICT has reduced procedural delays caused by hierarchical processes in the organisation. Through Intranet and LAN, it has become possible to send information and data across various levels in the organisation at the same time. Computerisation and communication patterns facilitated by ICT have increased efficiency and have led to the involvement of all levels in decision-making.

- **Change in Administrative Culture**

  Bureaucratic structures have been plagued by characteristics aptly described by Victor Thompson as 'bureau-pathology'. From the days of New Public Administration, efforts have been made to find ways to deal with the pathological or dysfunctional aspects of bureaucratic behaviour and to make delivery of public services effective and efficient. With e-governance, public actions coming under public glare would certainly induce norms and values of accountability, openness, integrity, fairness, equity, responsibility and justice in the administrative culture. Rather, administration would become efficient and responsive.

Effective Service Delivery

ICTs play an important role in effectively delivering services to the people. ICTs ensure:

- **Transparency** by dissemination and publication of information on the web. This provides easy access to information and subsequently makes the system publicly accountable. Also as web enables free flow of information, it can be easily accessed by all without any discrimination.

- **Economic Development**

  The deployment of ICTs reduces the transaction costs, which makes services cheaper. For example, rural areas suffer on account of lack of information regarding markets, products, agriculture, health, education, weather, etc. and if all this could be accessed online would lead to better and more opportunities and thereby prosperity in these areas.

- **Social Development**

The access to information empowers the citizens. Informed citizenry can participate and voice their concerns, which can be accommodated in the programme/ project formulation, implementation, monitoring and service delivery. Web enabled participation will counter the discriminatory factors affecting our societal behaviour.

- **Strategic Information System**

Changing organisational environment and increasing competitiveness have put pressures on the performance of the functionaries. Information regarding all aspects need to be made available to the management at every point to make routine as well as strategic decisions. ICTs effectively enable putting such strategic information systems in place.

After the above-mentioned discussion on the significance of ICTs in governance, we will now highlight certain measures that will enable its effective implementation.

1.7 SUGGESTIONS

The above discussion highlighted the important role of ICTs in governance. In order to harness the benefits of ICTs maximally, we need to develop sufficient and adequate infrastructure, provide sufficient capital and investment, enable easy and wider accessibility and generate ample and skilful human resources. These are some of the immediate and pertinent challenges to effective implementation of ICT and e-governance. We will now discuss these issues individually.

- **Infrastructure**

The foundation of e-governance is based on the telecommunication services. To develop telecommunication, infrastructures are to be created so that the end-user is able to access the services promptly and effectively. To strengthen the infrastructure, 'The National Task Force on Information Technology and Software Development' in 1998 recommended broadband connection (also known as 'the last mile') linkage for IT Applications Service Providers (ASPs), Internet Service Providers (ISPs) and IT promotional organisations, either by fibre optics or by radio communication, with the aim to 'boost efficiency and enhance

market integration' through Internet/Intranet for sustainable regional development.

- **Capital**

  A high rate of investment in IT capital and a supportive environment is necessary to achieve digital economy. In view of the resource crunch with the government, there is need to generate resources from the market and private sector. Public-private partnership may be beneficial in this regard, as the private sector can participate and contribute with capital and expertise support.

- **Access**

  At present, there are more than 10 million users of internet in the country. But the irony is that more than 75 percent of these users are in urban India. Internet has still to reach the rural and disadvantaged sections. However, efforts are being made to expand ICT connectivity into rural areas through involvement of Gram Panchayats. NIC has developed a comprehensive web-based software for panchayati raj and rural applications, which is being implemented in states like Andhra Pradesh. With most of the panchayats getting computerised, accessibility to various services has become easy.

- **Utility of Information**

  There is a need to provide information, which is useful. The content of the information should be such that it should be interesting, beneficial and appealing to the people. In this regard, Government of India and some of the state governments have prepared a vision document for e-governance keeping in mind the needs of the citizens. Though Citizens' Charters of many departments are available on the net, further publicity of such facilities is required to enable the public to access the necessary information.

- **Human Resource Development**

  Despite the ascending growth rate observed in employment in IT sector, there is dearth of quality manpower. There exists a demand and supply gap in the IT manpower market. India apparently needs to have more technical institutes to impart education and training to build a pool of human resources in the field.

- **Capacity Building**

  Service delivery will be effective if there is a trained manpower. Though computer training is being imparted to all the basic public functionaries, except in few cases, an effective use of ICT is yet to be seen. Moreover, there is an immediate need to launch a nation wide 'Train the Teachers Programme' (3T Programme). This should be done at all levels including schools and colleges. A combination of physical and virtual training also needs to be imparted.

- **Changing the Mindset of Government Functionaries**

  To accept the change there is a need to change the mindset of service providers and receivers. The government functionaries need to be made aware that they are there to serve the clients as per the policies and programmes and that technological advancement is only a facilitator to solutions of problems faced by people and not a solution in itself. To change the mindset of the service providers there is a need to impart orientation and training programmes to them.

- **Language**

  Success of e-government also depends on communication with the people in their local languages. Currently, the most widely used language is English for e-government. But given the Indian social conditions, unless we develop interfaces in vernacular languages, it would remain out of reach of many people who are not capable of accessing these services in English. In this context, it is essential that a clear strategy be formulated to provide access to local level databases maintained in regional and local languages as well as to use appropriate interfaces to aggregate such data. However, it may be mentioned here that organisations like Centre for Development of Advanced Computing (CDAC) has developed multilingual software for the purpose.

- **Standardisation in Data Encoding**

  Once multiple access points maintained in various languages at various levels are established, there is a need to update them in conformity with similar standards for data encoding-an application logic for a common horizontal application and data dictionary. This is also important for finding aggregates in the national context.

- **Grievance Redressal Mechanism**

  The mechanism planned for various functions need to make provision for grievance redressal as well. Interactive platforms on the internet may speed up the process and may be useful in this regard. The BMC-Praja Foundation's joint initiative of the Online Complaint Management System (OCMS) is perhaps the world's first in citizen-government partnership for solving public grievances in municipal services. Inaugurated in April 2003, the OCMS has been receiving grievances on behalf of citizens availing services of municipalities in Mumbai. It uses IT as a tool to bring in efficiency and effectiveness into the system. One can register his/ her complaint online regarding various municipal services and the Municipal Corporation will redress this complaint in the time stipulated in the Citizens' Charter adopted by the Corporation.

  Central Vigilance Commission has also provided such a platform for people to register their complaints against corrupt officials. Such sporadic instances need to be made broad-based and effective, though it may be conceded that more and more public service agencies are now providing or contemplating such facilities.

- **Cyber Laws**

  The government needs to enact appropriate laws, especially those, which are necessary to enable transactions over the internet. Safety concerns regarding use of credit cards or other modes of payment stops the consumers from using such facilities. The Mahanagar Telephone Nagar Limited, Delhi for example has provided the online facility for payment of telephone bills, but not even one percent of its consumers are making use of this provision. Hence, security has to be ensured for generating confidence in the system.

1.8 CONCLUSION

According to Traunmuller and Lenk, e-governance is a global phenomenon today and it is the most recent paradigm in public administration. The speed and transparency associated with e-governance has the potential to make public administration responsive and effective. As the development of e-governance gets past the phase of pilot projects, it becomes apparent that sustainable development of e-governance will depend on an adequate institutional framework that will enable public administration to manage and harmonise the emerging multitude of technical and organisational changes at all levels of government….

The time has come to focus on the challenges in implementation, especially those related to cross-level applications and institutional framework, which would enable to bring in broader changes in governance.

1.9 ACTIVITY

Form a group and discuss in detail the provisions of the IT Act 2000 and Right to Information Act 2005.

Let us know about some of the measures that you can suggest to make the Right to Information Act effective.

1.10 KEY CONCEPTS

E- governance	:	use of technology to enhance the access to and delivery of government services to benefit citizens, business partners and employees.
ICTs	:	are the information and communication technologies such as, radio, computers, Internet, Intranet, Websites, and satellites; providing database, knowledge database, expert systems, Geographic Information System, Management Information System, video and audio teleconferencing.
State Wide Area Network	:	networks linking the state headquarters right up to the block level through National Informatics Centre Network.
National E-governance Plan	:	seeks to implement 25 Mission Mode Projects at the Centre, State and integrated service levels so as to create a citizen-centric and business-centric environment for governance, create governance and institutional mechanisms, set up core infrastructure, formulate key policies and channelise private sector technical and financial resources into the national e-governance efforts.

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UNIT 2 INFORMATION AND COMMUNICATION TECHNOLOGY: CONCEPT AND COMPONENTS

Structure

2.0 LEARNING OUTCOMES

After studying this Unit, you should be able to:

- explain the concept of ‘information,’ ‘communication’ and ‘information and communications technology’; and

- describe the various types of technologies used in information dissemination, communications and delivery of services.

2.1 INTRODUCTION

Webopaedia defines ‘information’ as a word, which has many different meanings in everyday usage and in specialised contexts, but as a rule, it is a concept that is closely related to data, instruction, knowledge, meaning, communication, representation and mental stimulus. Information is knowledge derived from data/ data placed within a context. It is a message, something to be communicated from the sender to the receiver. Information in an organisation is the collection of expertise, experience and database that individuals and workgroups use for discharging their responsibilities. It is produced and stored by individual minds, or implicitly encoded and documented in organisational processes, services and systems. It is required for better planning and control. Shannon and Weaver define information as the amount of uncertainty that is reduced when a message is received.

‘Communication,’ on the other hand, is the process of information, usually via a common system of symbols. Communication can be interactive, transactive, intentional or unintentional; it can also be verbal or nonverbal.

‘Information and Communication(s) Technology’ (ICT) is then about use of technology in information processing and communication. In particular, it deals with the use of electronic computers and computer software to convert, store, protect, process, transmit and retrieve information. ICT may be discussed in terms of all the uses of digital technology that already exist to help individuals, businesses and organisations use information. ICT covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form. For example, personal computers, radio, ham, telephone, broadband, digital television, email, robots etc. are all equipment, which can be classified as ICTs. Importantly, it is also concerned with the way these different uses can work with each other.

In this Unit, we will be discussing some of the important technologies that are used in information processing and communication.

2.2 TECHNOLOGIES FOR INFORMATION AND COMMUNICATION

Various technologies have been developed over the years in terms of information and communication. Some of them had many versions as well. However, the feasibility of technology is to the extent it is cost effective to its users and it survives till it is taken over by an alternative far more superior and cost effective technology.

Some of the important and useful technologies used for information and communication are discussed as below:

2.2.1 Telephone

Telephone is a telecommunications device, which is used in transmitting and receiving sound across distance. In this device, electric signals are transmitted over a complex telephone network, which allows the user to communicate with the other user. Usually, there are four ways to connect to a telephone network:

- a traditional fixed phone that is the 'landline,' which uses dedicated physical wire connections connected to a single location;

- wireless and radio telephones, which use either analogue or digital radio signals;

- satellite telephones, where communication is through telecommunications satellites; and

- Voice over Internet Protocol (VoIP) telephones, which use broadband internet connections.

Now-a-days, fibre optic cable, point-to-point microwave or satellite relay, carry transmissions across a network. This has increased the usage of cordless and mobile phones considerably in recent times.

Telephone technology has undergone many changes and innovations since the time it came into being. This has been due to increased demand for this communication device. Today, electrical telephones have been replaced and electret microphones are now used in almost all telephone transmitters. Besides, there are other technologies as well that include manual switchboard, rotary dial, automatic telephone exchange, computerised telephone switch, Touch Tone® dialling (DTMF), and digitisation of sound using different coding techniques including Pulse Code Modulation (PCM). We will discuss some of them briefly.

- **Digital Telephony**
  The Public Switched Telephone Network (PSTN) has improved the capacity and quality of the networks. Digital transmission has made it possible to carry multiple digitised switched circuits on a single transmission medium, known as multiplexing. While today the end instrument remains analogue, the analogue

signals reaching the aggregation point (Serving Area Interface (SAI) or Central Office (CO i.e. telephone exchange) are typically converted to digital signals. Digital Loop Carriers (DLC) are often used, placing the digital network even closer to the customer premises.

- **Cordless Telephone**
  Cordless telephone consists of a base unit that connects to the landline system and a remote handset, which uses low power radio. This permits use of the handset from any location within range of the base. Because of the power required to transmit to the handset, the base station is powered with an electronic power supply. The range of cordless phones, today, is normally a few hundred metres because of various factors like quality of voice or interference with other communication devices using the same frequency.

- **Cellular Phone**
  Mobile phone systems are cell-structured. Radio is used to communicate between a handset and nearby cell site. When a handset gets too far from a cell site, a computer system commands the handset and a closer cell site to take up the communications on a different channel without interrupting the call.

- **Voice Over Internet**

  Protocol Telephony Protocols used to carry voice signals over the IP network are commonly referred to as Voice over Internet Protocol or VoIP, or IP Telephony or Internet Telephony or Digital Phone. It is the routing of voice conversations over the internet or any other IP-based network. The voice data flows over a general purpose packet-switched network, instead of traditional dedicated, circuit switched voice transmission lines. In general, phone service via VoIP costs less than equivalent service from traditional sources. Some cost savings are due to using a single network to carry voice and data, especially where users are having existing under-utilised network capacity, which they can use for VoIP at no additional cost.

  VoIP makes easy some things that are difficult with traditional phone networks, such that incoming phone calls can be automatically routed to the VoIP phone, irrespective of where one is connected to the network. One can take one's VoIP phone on a trip and anywhere connect it to the internet and receive incoming calls. VoIP phones can integrate with other services available over the Internet, including sending and receiving messages or data files in parallel with the voice conversation, audio conferencing, managing address books and passing

information about whether others (e.g. friends or colleagues) are available online to interested parties.

VoIP technology still has a few shortcomings that have led some to believe that it is not ready for widespread deployment, as it does not provide any mechanism to ensure that data packets are delivered in a sequential order, or for any quality of service guarantees.

2.2.2 Radio

Radio owes its development to two other inventions: the telegraph and the telephone. These three technologies are closely related. Mostly radio broadcasts are sent over telephone wires. However, a few radio broadcasts travel through the air exclusively. Guglielmo Marconi, an Italian inventor, sent and received his first radio signal in Italy in 1895. By 1899, he was able to flash the first wireless signal across the English Channel and two years later in 1902, received the letter 'S', telegraphed from England to Newfoundland. This was the first successful transatlantic radiotelegraph message.

Wireless signals proved effective in communication for rescue works when sea disasters occurred. A number of ocean liners installed wireless equipment. In 1915, speech was first transmitted across the continent from New York City to San Francisco and across the Atlantic Ocean from Naval radio station at Arlington, Virginia to the Eiffel Tower in Paris. Military radiotelephony was also experimented between ground and aircraft in the First World War.

Today, Radio Frequency Identification (RFID) is used in transmission, which is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. RFID tag is a small object that can be attached to or incorporated into a product, animal or person. RFID tags contain antennas to enable them to receive and respond to radio-frequency queries from an RFID transceiver. (See Annexe)

2.2.3 Television

Television is a telecommunication system for broadcasting and receiving moving pictures and sound over a distance. Baird transmitted live, moving, and half-tone (grayscale) images in 1925, and gave the world's first public demonstration of a working television system to members of the Royal Institution on 26 January 1926 at his laboratory in London. These were vertically scanned images, using a scanning

disc embedded with a double spiral of lenses, having only 30 lines, just enough to reproduce a recognisable human face. By 1934, all electromechanical television systems were outmoded, although electromechanical broadcasts continued on some stations until 1939.

On 25 August 1934, at the Franklin Institute in Philadelphia, Farnsworth gave the world's first public demonstration of a working, all-electronic television system with 220 lines per picture, 30 pictures per second. The first field test broadcast of colour television was by NBC, USA on 20 February 1941. The post-war development of colour television was dominated by three systems namely:

- the field sequential system, which was incompatible with existing black and white sets without an adaptor;

- dot sequential system, which in 1949 became compatible with existing black and white sets; and

- Colour Television Inc.'s system (also incompatible with existing black and white sets), which used three camera lenses, behind which were colour filters that produced red, green, and blue images side by side on a single scanning tube, and a receiver set that used lenses in front of the picture tube (which had sectors treated with different phosphorescent compounds to glow in red, green, or blue) to project these three side by side images into one combined picture on the viewing screen.

Programmes are broadcast on television stations, also called channels. At first, terrestrial broadcasting was the only way television could be distributed because bandwidth was limited. Development of cable and satellite means of distribution in the seventies pushed businessmen to target channels towards a certain audience and enabled the rise of subscription-based television channels. Today, television has grown up all over the world and has become a major source of disseminating information.

Broadcasting

There are many means of distributing television broadcasts, including both analogue and digital versions:

- **Terrestrial Television**
  Terrestrial television is the traditional method of television broadcast where signal delivery is by radio waves transmitted through open space. The signals are usually unencrypted and the system is described as "free-to-air"

- **Stratovision (From aircraft flying in a loop)**
  Stratovision is an airborne television transmission relay system from aircraft flying at high altitudes. This system was used for domestic broadcasting in the USA and by US military in Vietnam and other countries.

- **Satellite Television**
  Satellite television is delivered by way of communication satellites, as compared to the conventional terrestrial television. In many countries, satellite television services supplement older terrestrial signals, providing a wider range of channels and services, including subscription-only services also.

- **Cable Television**
  Cable television is a system of providing television, FM (frequency mode) radio programming and other services to consumers via radio frequency signals transmitted directly to people's televisions through fixed optical fibres or coaxial cables as opposed to the over-the-air method used in traditional television broadcasting (via radio waves) in which a television antenna is required.

  Modern cable TV systems employ digital cable technology, which uses compressed digital signals, allowing them to provide many more channels than they could with analogue alone.

- **Other Cable-Based Services**
  Coaxial cables are capable of bi-directional carriage of signals as well as transmission of large amount of data. Cable television signals use only a portion of bandwidth available over coaxial lines. This leaves plenty of space available for other digital services such as broadband internet and cable telephony.

  Broadband internet is achieved over coaxial cable by using cable modems to convert the network data into a type of digital signal that can be transferred over coaxial cable.

  Another service being added to many cable systems is cable telephone service. This service involves installing a special telephone interface at the customer's premises that converts the analogue signals from the customer's in-home wiring

into a digital signal, which is then sent on the local loop to the company's switching centre, where it is connected to the PSTN. Data can be compressed, resulting in much less bandwidth used than a dedicated analogue circuit-switched service for digital cable telephone service. Other advantages include better voice quality and integration to a VoIP network providing cheap and unlimited nationwide and international calling.

- **Multi-Channel Multipoint Distribution Service (Wireless Cable)**
  Multi-channel multipoint distribution service, also known as MMDS or wireless cable, is a wireless telecommunications technology used for general-purpose broadband networking or, more commonly, as an alternative method of cable television programming or programme reception usually in sparsely populated rural areas, where laying cables is not economically viable.

2.2.4 Computer Hardware

Computer hardware means the physical parts of a computer, which enable the computer software or computer programmes and data to operate within the hardware. Computer hardware is also enclosed as embedded systems in automobiles, microwave ovens, electrocardiograph machines, compact disc players and many other household appliances.

A typical personal computer consists of a cover box or chassis and the following parts:

- **Motherboard**: it is also known as a main board, logic board or system board. It is the central or primary circuit board making up a complex electronic system. It has slots for expansion cards and holding parts including:

  i. **Central Processing Unit (CPU)** -or sometimes simply processor, is the component in a digital computer that interprets instructions and processes data contained in software. CPUs provide the fundamental digital computer trait of programmability.

  ii. **Random Access Memory (RAM)** – it enables programme execution and short-term data storage, so the computer does not have to take time to access the hard drive to find something. More RAM can contribute to a faster PC.

iii. **Buses**- in computer architecture, a bus is a subsystem that transfers data or power between computer components inside a computer or between computers. Unlike a point-to-point connection, a bus can logically connect several peripherals over the same set of wires. Each bus defines its set of connectors to physically plug devices, cards or cables together.

There are two types of buses:

a. PCI bus: the Peripheral Component Interconnect standard specifies a computer bus for attaching peripheral devices to a computer motherboard. These devices can take the form of:

- integrated circuits fitted on the motherboard itself (called planar devices in the PCI specification); or
- expansion cards that fit in sockets

b. US bus: Universal Serial Bus provides a serial bus standard for connecting devices, usually to computers such as PCs. A USB system has an asymmetric design, consisting of a host controller and multiple devices connected in a tree-like fashion using special hub devices, called USB hubs.

- **Storage Controllers**: control hard disk, floppy disk, CD-ROM and other drives. The controllers sit directly on the motherboard (on-board) or on expansion cards.
- **Video Display Controller**: produces the output for the computer display
- **Computer Bus Controllers** (parallel, serial, USB, FireWire): to connect the computer to external peripheral devices such as printers or scanners.
- **Removable Media Writer**: some of its types are:

i. CD (Compact Disk) – they are the most common type of removable media:

a. CD-ROM (Compact Disc Read Only Memory) Drive
b. CD Writer

ii. DVD (Digital Video Disk) – they are comparatively costly but more reliable:

a. DVD-ROM Drive
b. DVD Writer
c. DVD-RAM (Random Access Memory) Drive

iii. Floppy Disk

iv. Zip Drive- is a medium-capacity removable disk storage system.

v. Tape Drive - is a peripheral device that reads and writes data stored on a magnetic tape or a punched tape. It is mainly used for backup and long-term storage.

- **Internal Storage** – it keeps data inside the computer for later use:

  i. **Hard Disk** - for medium-term storage of data

  ii. **Disk Array Controller** -disk array is an enterprise storage system, which contains multiple disk drives. In computing, a disk array controller is a computer hardware device, which provides secondary storage services to computer systems, often in large servers.

- **Sound Card** – it translates signals from the system board into analogue voltage levels and has terminals to plug in speakers.

- **Networking** - to connect the computer to the Internet and/or other computers:

  i. **Modem** - for dial-up connections

  ii. **Network Card** - for DSL/Cable Internet and/or connecting to other computers.

- **Other Peripherals**
  In addition, hardware can include external components of a computer system. The following are either standard or very common.

  i. Input or Input Devices

  a. Text Input Devices, such as keyboard
  b. Pointing Devices, such as Mouse and Trackball

c. Gaming Devices, such as Joystick and Game Pad
d. Image, Video Input Devices, such as Image Scanner and Web Cam
e. Audio Input Devices, such as Microphone and Headset

ii. Output or Output Devices

a. Image, Video Output Devices

- Printer
- Monitor

b. Audio Output Devices

- Speakers

2.2.5 Computer Software

Computer software consists of encoded information (or computer instructions). The term is roughly synonymous with computer programme but is more generic in scope. Software is loaded into RAM and executed in the central processing unit. It is an ordered sequence of instructions for changing the state of the computer hardware in a particular sequence to obtain a particular result. It is generally written in 'high-level languages' (html) that are easier and more efficient for people to use. Software may also be considered an interface between hardware, data, and/or (other) software.

- **Types of Software**

Practical computer systems divide software into three major classes:

i. System Software
ii. Application Software; and
iii. Programming Software.

System software helps run the computer hardware and computer system. It includes operating systems, device drivers, diagnostic tools, servers, windowing systems, utilities, etc.

Application software allows a user to accomplish one or more specific tasks. Typical applications include business software, educational software, databases and computer games. Most application softwares have a Graphical User Interface (GUI).

Programming software usually provides some useful tools to help programmer in writing computer programmes and software using different programming language in a more convenient way. The tools include text editor, compiler, interpreter, linker, debugger, etc.

2.2.6 Local Area Network

Local Area Network (LAN) is a computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings and connect workstations and personal computers. Each node (individual computer) in a LAN has its own CPU with which it executes programmes. It is also able to access data and devices such as laser printers, anywhere on the LAN. This allows many users to share data and devices. Users can also use the LAN to communicate with each other by sending e-mail or engaging in chat sessions.

There are different types of LAN. The following characteristics differentiate one LAN from another:

- **Topology**: the geometric arrangement of devices on the network. For example, devices can be arranged in a ring or in a straight line.

- **Protocols**: the rules and encoding specifications for sending data. The protocols also determine whether the network uses peer-to-peer or client/server architecture.

- **Media**: devices can be connected by twisted-pair wire, coaxial cables or fibre optic cables. Some networks do without connecting media altogether, communicating instead via radio waves.

LANs are capable of transmitting data at very fast rates, but the distances are limited, and there is also a limit on the number of computers that can be attached to a single LAN.

A wireless LAN uses radio waves for transmitting data. The last link with the users being wireless, it acquires the capability to give a network connection to all users in the surrounding area. Areas may range from a single room to an entire campus. The backbone network usually uses cables with one or more wireless access points

connecting the wireless users to the wired network. Many laptop PCs now have wireless networking built in, thus eliminating the need for an additional plug-in PCMCIA (Personal Computer Memory Card International Association) card.

2.2.7 Wide Area Network

Wide Area Network (WAN) spans a relatively large geographical area. Typically, a WAN consists of two or more LANs. Computers connected to a WAN are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites.

It enables communication between users and computers in different locations. Many WANs are built for one particular organisation and are private. Others, built by Internet Service Providers, provide connections from an organisation's LAN to the Internet. WANs are most often built using leased lines. At each end of the leased line, a router connects to the LAN on one side and a hub within the WAN on the other. Network protocols including Typical Computer Protocol/Internet Protocol deliver transport and addressing functions. Internet is the largest WAN in existence.

- **Internet**
  The Internet, or simply the Net, is the publicly accessible worldwide system of interconnected computer networks that transmit data by packet switching using a standardised Internet Protocol (IP). It is made up of thousands of smaller commercial, academic, domestic and government networks. It carries various information and services, such as electronic mail, online chat, interlinked web pages and other documents of the World Wide Web.

  Contrary to common perception, Internet and World Wide Web are not synonymous. Internet is a collection of interconnected computer networks, linked by copper wires, fibre-optic cables, etc., whereas web is a collection of interconnected documents, linked by hyperlinks and URLs. Web is a global information space, which people can read and write via computers connected to the Internet.

2.2.8 Satellite

A satellite is an object that orbits another object in the space. The space age began in 1946, as scientists began using captured German V-2 rockets to make measurements in the upper atmosphere. Before this, scientists used balloons (that went up to 30 km) and radio waves to study the ionosphere. From 1946 to 1952, upper-atmosphere

research was conducted using V-2s and Aerobe rockets. On October 4, 1957 Sputnik I was launched into orbit. Today, the largest artificial satellite currently orbiting the earth is the International Space Station.

- **Types of Satellites**

i. Astronomical Satellites: are satellites used for observation of distant planets, galaxies and other outer space objects.

ii. Communication Satellites: are artificial satellites stationed in space for the purposes of telecommunications using radio at microwave frequencies. Most communication satellites use geo-synchronous orbits or near geostationary orbits, although some recent systems use low Earth-orbiting satellites as well.

iii. Reconnaissance Satellites: are Earth observation satellites or communications satellite deployed for military or intelligence applications. Little is known about the full power of these satellites, as governments who operate them usually keep information pertaining to their reconnaissance satellites classified.

iv. Earth Observation Satellites: are satellites specifically designed to observe Earth from orbit, similar to reconnaissance satellites but intended for nonmilitary uses such as environmental monitoring, meteorology, map making, etc.

v. Navigation Satellites: are satellites, which use radio time signals transmitted to enable mobile receivers on the ground to determine their exact location. The relatively clear line of sight between the satellites and receivers on the ground, combined with ever-improving electronics, allows satellite navigation systems to measure location to accuracies often to the order of a few metres in real time.

vi. Solar Power Satellites: are built in high Earth orbit that use microwave power transmission to beam solar power to very large antenna on Earth where it can be used in place of conventional power sources.

vii. Space Stations: are man-made structures that are designed for human beings to live on in outer space. A space station is distinguished from other manned spacecraft by its lack of major propulsion or landing

facilities instead, other vehicles are used as transport to and from the station. Space stations are designed for medium-term living in orbit for varying periods- weeks, months, or even years.

viii. Weather Satellites: are satellites that are primarily used to monitor the weather and/or climate of the Earth.

ix. Miniaturised Satellites: are satellites of unusually low weights and small sizes. Classifications are used to categorise these satellites: mini satellite (500–200 kg), micro satellite (below 200 kg), nano satellite (below 10 kg).

- **Orbit Types**
  Many times satellites are characterised by their orbit. Although a satellite may orbit at almost any height, satellites are commonly categorised by their altitude:

  i. Low Earth Orbit (LEO: 200 - 1200kms above the Earth's surface)
  ii. Medium Earth Orbit (MEO: 1200 - 35286 kms)
  iii. Geosynchronous Orbit (GEO: 35786 kms above Earth's surface)
  iv. Geostationary Orbit (GSO: zero inclination geosynchronous orbit)
  v. High Earth Orbit (HEO: above 35786 kms)

2.2.9 Very Small Aperture Terminal

A Very Small Aperture Terminal (VSAT) is a 2-way satellite ground station or may be called an earthbound station. It is used in satellite communications of data, voice and video signals (excluding broadcast television). It consists of two parts:

- a transceiver with a dish antenna (that is smaller than 3 meters, as compared to around 10 meters for other types of satellite dishes) that is placed outdoors in direct line of sight to the satellite; and

- a device that is placed indoors to interface the transceiver with the end user's communications device, such as a PC.

The transceiver receives or sends a signal to a satellite transponder in the sky. The satellite sends and receives signals from a ground station computer that acts as a hub for the system. Each end user is interconnected with the hub station via the satellite, forming a star topology. The hub controls the entire operation of the network. For one end user to communicate with another, each transmission has to first go to the hub

station that then retransmits it via the satellite to the other end user's VSAT. VSAT can handle up to 56 Kilo bite per second. It transmits real-time data back for processing.

VSAT is most commonly used for point of sale transactions such as credit cards and RFID applications. VSAT is also used by local dealers affiliated with manufacturers (such as car companies) for transmitting and receiving sales figures and orders, as well as for receiving internal communications, parts ordering, service bulletins and interactive distance learning training courses from the manufacturer. Stockbrokers also make extensive use of VSAT technology.

VSAT technology is also used by 2-way satellite internet providers. These services are used across the world as a means of delivering broadband internet access to sites, which cannot get ADSL or cable Internet access, which are usually the remote or rural locations. Nearly, all VSAT systems are now based on IP with a very broad spectrum of applications.

There are two typologies of VSAT-Star VSAT and Mesh VSAT. The deployment of these topologies depends on their commercial viability. Mesh VSAT systems are preferred for deployment where the number of users is high as they minimise the overall cost of the network. Star topology services can be used to provide broadband WAN or broadband internet access. Star systems are also useful in front and back office applications and manage, store and forward solutions, such as, digital signature and interactive distance learning.

2.2.10 Ham Radio

It is not known where the nickname ‘ham’ radio operator came from but it is thought to have originated as a Morse Code short hand notation for ‘amateur’ radio operator. Once licensed, ham operators are able to use a wide variety of communication technologies including:

- World Wide Voice, CW (the technical term for Morse Code communication) and data communications using the short wave bands;

- use of FM voice repeaters at VHF and UHF frequencies - repeaters retransmit a weak signal from a handheld radio (the same size as a cellular phone) so that it can be heard over a wider area;

- access to telephone phone patches for making phone calls over radio system;

- direct access to 9-1-1 emergency communications systems (in many areas);

- packet radio data communication networks, from short wave to high speed microwave networks; and

- satellite communications systems, including numerous U.S., Russian and internationally built amateur spacecraft;

- colour television transmissions both direct and through repeaters.

Amateurs often use a multi-element ‘beam’ antenna. Such antennas produce ‘gain’ in both reception and transmission so that a signal ten times weaker can be received. This type of gain is important to enable long distance communications. The typical amateur beam antenna is mounted at about 50 feet above ground level, with significant variations depending on space and costs of installation, resulting in probably most amateur beam antennas being mounted in the 35 foot to 70-foot range above ground level. However, some installations do go higher than this. Height is important for several reasons. If using VHF or UHF radio frequencies, where line-of-sight communications is typical, height overcomes ground level obstructions.

The type of equipment used by ham operators vary from home built or kit built radios to the state-of-the-art communication systems. Probably, the most typical radios are:

- handheld VHF or UHF two-way radio;

- short wave or HF two-way radio transceiver;

- mobile VHF and/or UHF radio for mounting in car; and

- kit-built, particularly low power radios for HF short wave communications.

2.3 CONCLUSION

The various technologies described above are not exhaustive but give a fairly good idea of their applicability in governance structures. It may be stressed here that most of these technologies require massive investments and governmental approvals.

2.4 ACTIVITY

1. Give examples of satellite versions that India has so far placed into the Earth's orbit. Also let us know about their applications.

2. Narrate a VSAT based project (e.g. Edusat or Maharashtra------) that has been implemented in our country.

2.5 KEY CONCEPTS

Digital — is one that uses numbers, especially binary numbers, for input, processing, transmission, storage, or display, rather than a continuous spectrum of values (an analogue system) or nonnumeric symbols such as letters or icons. The distinction of 'digital' versus 'analogue' or 'symbolic' can refer to method of input, data storage and transfer, the internal working of an instrument, and the kind of display. The word comes from the same source as the word digit and digitus i.e. Latin word for finger (counting on the fingers) as these are used for discrete counting.

Electret Microphone — it is the most ubiquitous microphone in use. It can be found in everything from telephones to children's toys to medical devices. Nearly 90 percent of the approximately one billion microphones manufactured annually are electret designs. They are small, high quality and inexpensive to produce. Electret-- is a thin plastic film that after exposure to a strong electrical field, retains its electrical polarisation without requiring a power source -- something like the electrical equivalent of a magnet, with a positive and a negative side. In an electret microphone, the film is drawn taut like the head of a drum and is suspended just above a metal surface. As you talk into the microphone, pressure fluctuations in the air distort the film. Charges in the metal surface experience fluctuating forces as the polarised electret moves above it. As a result of these forces, a very small current flows from the metal surface through a wire that touches it. It is simple,

	rugged, versatile and provides high quality sound, especially for telephony. Electret microphones can be made extremely small -- smaller than a shirt button.
Digital Loop Carrier	is a system which uses digital transmission to extend the range of the local loop farther than would be possible using only twisted pair copper wires. A DLC digitises and multiplexes the individual signals carried by the local loops onto a single data stream on the DLC segment. Loop carrier systems were ordained to solve two problems: to reduce copper cable pair requirements; and to overcome electrical constraints on long loops. It would also reduce cable pair deployments.
Public Switched Telephone Network (PSTN)	is the concentration of the world's public circuit-switched telephone networks, in much the same way that Internet is the concentration of the world's public IP-based packet-switched networks. Originally, a network of fixed-line analogue telephone systems, the PSTN is now almost entirely digital, and now includes mobile as well as fixed telephones. A circuit switched network is one where a dedicated connection (circuit or channel) must be set up between two nodes before they may communicate. For the duration of the communication that connection may only be used by the same two nodes and when the communication has ceased, the connection must be explicitly cancelled.
Grayscale	In computing, a grayscale or greyscale digital image is an image in which the value of each pixel is a single sample. Displayed images of this sort are typically composed of shades of gray, varying from black at the weakest intensity to white at the strongest, though in principle the samples could be displayed as shades of any colour, or even coded with various colours for different intensities. Grayscale images are distinct from black and white images, which in the context of computer imaging are images with only two colours, black and white; grayscale images have many shades of gray in between. In most contexts other than digital imaging, however, the term

‘black and white’ is used in place of ‘grayscale’; for example, photography in shades of gray is typically called ‘black-and-white photography’. The term monochromatic in some digital imaging contexts is synonymous with grayscale, and in some contexts synonymous with black-and-white.

Cryptography

is the field concerned with linguistic and mathematical techniques for securing information, particularly in communications. In cryptography, encryption is the process of obscuring information to make it unreadable without special knowledge. While encryption has been used to protect communications for centuries, only organisations and individuals with an extraordinary need for secrecy have made use of it. In the mid-1970s, strong encryption emerged from the sole preserve of secretive government agencies into the public domain, and is now employed in protecting widely used systems, such as Internet e-commerce, mobile telephone networks and bank automatic teller machines.

Encryption can be used to ensure secrecy, but other techniques are still needed to make communications secure, particularly to verify the integrity and authenticity of a message; for example, a Message Authentication Code (MAC) or digital signatures.

Pixel

is one of the many tiny dots that make up the representation of a picture in a computer’s memory. Each such information element is not really a dot, nor a square, but an abstract sample. With care, pixels in an image can be reproduced at any size without the appearance of visible dots or squares; but in many contexts, they are reproduced as dots or squares and can be visibly distinct when not fine enough. The intensity of each pixel is variable; in colour systems, each pixel has typically three or four dimensions of variability such as Red, Green and Blue, or Cyan, Magenta, Yellow and Black.

Analogue	describes a device or system that represents changing values as continuously variable physical quantities. A typical analogue is a clock in which the hands move continuously around the face. Such a clock is capable of indicating every possible time of day. In contrast, a digital clock is capable of representing only a finite number of times (every tenth of a second, for example). In general, humans experience the world analogically. Vision, for example, is an analogue experience because we perceive infinitely smooth gradations of shapes and colours. When used in reference to data storage and transmission, analogue format is that in which information is transmitted by modulating a continuous transmission signal, such as amplifying a signal's strength or varying its frequency to add or take away data. For example, telephones take sound vibrations and turn them into electrical vibrations of the same shape before they are transmitted over traditional telephone lines. Radio wave transmissions work in the same way. Computers, which handle data in digital form, require modems to turn signals from digital to analogue before transmitting those signals over communication lines, such as, telephone lines that carry only analogue signals. The signals are turned back into digital form (demodulated) at the receiving end so that the computer can process the data in its digital format.
Chassis	In computers, the chassis refers to the rigid framework (metal frame) onto which the assembly-worker mounts the motherboard, memory, disk drives and other equipment.
Peripheral	is a type of computer hardware that is added to a host computer in order to expand its abilities. More specifically, the term is used to describe those devices that are optional in nature, as opposed to hardware that is either demanded or always required in principle.

	The term also tends to be applied to devices that are hooked up externally, typically through some form of computer bus like USB. Typical examples include joysticks, printers and scanners. Devices such as monitors and disk drives are not considered peripherals because they are not truly optional as they are internal devices.
Tape Drive	also known as a streamer, is a peripheral device that reads and writes data stored on a magnetic tape or a punched tape. It is typically used for archival storage of data stored on hard drives. Tape drives are sequential-access and must wind past all preceding data to read any one particular piece of data. They are not the fastest form of data storage, as they are sequential, but are long lasting and cost efficient
Router	is a device that forwards data packets along networks. A router is connected to at least two networks, commonly two LANs or WANs or a LAN and its ISP's network. Routers are located at gateways, the places where two or more networks connect. Routers use headers and forwarding tables to determine the best path for forwarding the packets, and they use protocols such as ICMP to communicate with each other and configure the best route between any two hosts. Very little filtering of data is done through routers.
Packet Switching	Refers to protocols in which messages are divided into packets before they are sent. Each packet is then transmitted individually and can even follow different routes to its destination. Once all the packets forming a message arrive at the destination, they are recompiled into the original message. Most modern Wide Area Protocols, including TCP/IP, X.25, and Frame Relay, are based on packet-switching technologies. In contrast, normal telephone service is based on a circuit switching technology, in which a dedicated line is allocated for transmission between two

	parties. Circuit switching is ideal when data must be transmitted quickly and must arrive in the same order in which it is sent. This is the case with most real time data, such as live audio and video. Packet switching is more efficient and robust for data that can withstand some delays in transmission, such as e-mail messages and web pages. A new technology, ATM, attempts to combine the best of both worlds- the guaranteed delivery of circuit-switched networks and the robustness and efficiency of packet-switching networks.
Uniform Resource Locator	URL or web address, is a standardised address name layout for resources (such as documents or images) on the internet (or elsewhere). First created by Tim Berners-Lee for use on the World Wide Web, the currently used forms are detailed by Internet Standard RFC 1738. It is also known as Universal Resource Locator.
GEO	meaning geo-synchronous or geo-stational earth orbit used to place satellites for purposes of telecommunications. GEOs orbit is at 22,300 miles above the earth's surface. They are tied to the earth's rotation and are, therefore, in a fixed position in space in relation to the earth's surface. The satellite placed in GEO goes around once in its orbit for every rotation of the earth. The advantage of a GEO system is that the transmission station on earth needs to point to only one place in space in order to transmit the signal to the GEO satellite. GEO systems are used for transmissions of high-speed data, television signals and other wideband applications.
ADSL	short for Asymmetric Digital Subscriber Line, a new technology that allows more data to be sent over existing copper telephone lines. ADSL supports data rates from 1.5 to 9 Mbps when receiving data (known as the downstream rate) and from 16 to 640 Kbps when sending

data (known as the upstream rate). ADSL requires a special ADSL modem. ADSL is growing in popularity as more areas around the world gain access.

Operating System

is the most important programme that runs on a computer. Every general-purpose computer must have an operating system to run other programmes. Operating systems perform basic tasks, such as recognising input from the keyboard, sending output to the display screen, keeping track of files and directories on the disk, and controlling peripheral devices such as disk drives and printers. For large systems, the operating system has even greater responsibilities and powers. It is like a traffic cop- it makes sure that different programmes and users running at the same time do not interfere with each other. The operating system is also responsible for security, ensuring that unauthorised users do not access the system. Operating systems can be classified as multi-user that allows two or more users to run programmes at the same time. Some operating systems permit hundreds or even thousands of concurrent users; multiprocessing that supports running a programme on more than one CPU; multitasking that allows more than one programme to run concurrently; multithreading that allows different parts of a single programme to run concurrently; and real time that responds to input instantly.

Operating systems provide a software platform on top of which other programmes, called application programmes, can run. The application programmes must be written to run on top of a particular operating system. Your choice of operating system, therefore, determines to a great extent the applications you can run. For PCs, the most popular operating systems are DOS, OS/2 and Windows, but others are available, such as Linux.

As a user, you normally interact with the operating system through a set of commands. For example, the DOS operating system contains commands such as

	COPY and RENAME for copying files and changing the names of files, respectively. The commands are accepted and executed by a part of the operating system called the command processor or command line interpreter.
Wireless Application Protocol	a secure specification that allows users to access information instantly via handheld wireless devices, such as, mobile phones, pagers, two-way radios, smart phones and communicators. WAP supports most wireless networks. These include CDPD, CDMA, and GSM.

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UNIT 3 ICTs: ROLES AND APPLICATIONS

Structure

3.0 LEARNING OUTCOMES

After studying this Unit, you should be able to:

- explain the roles of ICTs; and
- discuss their various applications.

3.1 INTRODUCTION

In the previous Units, you have read about the significance of ICT in governance. ICT in governance is much more than mere digitisation of processes. It is rather a 'tool' for good governance and human development. The roles of ICTs in governance are fourfold. They:

- enhance the quality and delivery of public services;
- enhance the quality of citizen-government interface;
- enable people's participation in governance; and
- provide greater access and outreach so as to include the disadvantaged in governance.

In this Unit, an attempt is made to explore the applications of ICTs, which can enable governance to achieve the above-mentioned objectives.

3.2 ROLES OF ICTs

Before embarking upon a discussion on various ICT applications, we will briefly explain the roles of ICTs.

- **Information Browsing**

  Browsing is defined as 'an exploratory, information seeking strategy that depends upon serendipity … especially appropriate for ill-defined problems and for exploring new task domains' (G. Marchionini). Remote access systems to information databases on personal computers and via the internet have grown exponentially in the last few years. World Wide Web browsers allow a user to quickly access a wide variety of information sources. Internet contains textual as well as audio and video resources. Hence, there is a growing interest in multimedia retrieval of information today.

  At present, only primitive browsing of audio/video data is possible, since there is very little structure available in digitised audio/video data. Although visual metaphors for browsing text files and images have been explored, there is little on the classification (Brazil et. al.). Moreover, there is a flip side to this information availability. Woods refers this to as the data availability paradox, as more and more data is available, but our ability to pickup what is available has not increased.

- **Electronic Publishing and Dissemination**

  Access to online databases, electronic resources, online information transactions and digitised services have revolutionised the way information is disseminated. People can access information at the click of a button.

  Electronic publishing provides for unfettered access to reliable information to academicians, researchers, practitioners and policy makers alike from any part of the world.

- **Modelling and Simulation**

  Modelling and simulation help in developing a level of understanding of the interaction of the parts of a system, and of the system as a whole. ICTs play a

very important role in modelling and simulation, which are crucial in improving systems' capacities in delivering services. For example, almost all airlines look towards weather forecast for scheduling their flights in inclement weathers. Indian Meteorological Department and similarly elsewhere, the weather departments use various ICTs, supercomputers and software to produce models through simulation and are thus able to give weather forecast-most of the time pretty accurate.

Modelling and simulation requires huge database, which are managed through various ICTs and a pattern is derived based on certain parameters, which give shape to models. A simulation generally refers to a computerised version of the model, which is run over time to study the implications of the defined interactions. Simulations are generally iterative in their development. A model is developed and then simulated and then learnings from the simulation are used to revise the model and iterations continue till an adequate level of understanding is developed. In fact, ICTs have enabled the related processes to handle complex scenarios.

- **Online Business and Government Transactions**

Land records have been made available by many state governments. Birth and death certificates can be procured without physically visiting the government offices. One can pay his / her telephone bills over internet, saving crucial time in the process. Paying income tax or property tax is no longer a cumbersome process. All this and much more has become possible due to increased use of online business and government transactions.

Such initiatives are designed to improve the efficiency and effectiveness of the government's transactions through the use of improved technology. These e-government initiatives eliminate redundant systems and significantly improve the government's quality of services for citizens and businesses. They streamline service delivery to citizens, reduce paperwork burdens on businesses and apply the best commercial practices to improve government operating efficiency. Such projects have the potential to generate huge resources in savings by reducing operating inefficiencies, redundant spending and excessive paperwork.

- **Electronic Conferences (Meetings and Discussions)**

Meetings and conferences provide arenas for dissemination of information and immediate presentation of new results and cutting edge research. However, there are some disadvantages to meetings- travel is expensive and this dramatically

reduces the potential audience. Similarly, time constraints imposed by meetings often conflict with duties. Electronic conferences can offer many of the same features of traditional conferences. The main purpose of a conference is the exchange of new results.

Electronic conferences offer an excellent medium for this exchange. Internet provides a robust environment for presenting information, allowing for extensive use of text, graphics, and multimedia. The major advantages of electronic conferences are their low cost and the lack of travel time. A physical conference is located at a single venue at a set period of time. Electronic conferences lift this restriction. While the web server is located at a physical site (which might be mirrored at a few other locations), the participants can access the conference from anywhere and at any time.

After discussing the various roles, we will now explain the applications of ICTs.

3.3 APPLICATIONS OF ICTs

Various applications of ICTs enable them to perform the above-mentioned roles. These are:

- Data Base- Relational Data Base Management Systems, Knowledge Base Expert Systems;
- Decision Support Systems;
- Geographic Information Systems-Data Capture, Data Integration, Data Modelling; and
- Management Information Systems

Now we will discuss these applications in detail.

Data Base

A database is information set with a regular structure. It is usually but not necessarily stored in some machine-readable format accessed by a computer. There are a wide variety of databases, from simple tables stored in a single file to very large databases with millions of records stored in rooms full of disk drives or other peripheral

electronic storage devices. Databases resembling modern versions were first developed in the 1960s.

- **Relational Data Base Management Systems (RDBMS)**

  Databases can be compiled using RDBMS so that it will be possible to subject the database to queries for more informed decision-making. It is also possible to interface such an RDBMS to a Geographic Information System of the area, which will act as a front-end so that scenario analysis results can be simulated to see the options on the GIS. Such systems can also support forecasting and predictive models, especially if time series data sets are available for such areas and communities.

  The database can form a very valuable resource, especially when it is properly archived with the facility for retrieval for specific purposes through well-designed query interfaces. (N. Vinod Chandra Menon)

- **Knowledge Base Expert Systems**

  Knowledge-Based Systems focus on systems that use knowledge-based techniques to support human decision-making, learning and action. The quality of support given and the manner of its presentation are important issues with such systems. The primary goal of expert systems is to make expertise available to decision makers and technicians to enable them to respond swiftly with effective and efficient solutions to problems. Computers loaded with in-depth knowledge of specific subjects can help in accessing information to solve a problem. The same systems can assist supervisors and managers with situation assessment and long-range planning.

  These knowledge-based applications of artificial intelligence have enhanced productivity in business, administration, science, engineering, military, etc. With advances in the last decade, expert systems clients can choose from dozens of commercial software packages with easy-to-use interfaces. Each new deployment of an expert system yields valuable data for what works in what context, thus fuelling the research that provides even better applications.

Decision Support Systems (DSS)

The systems that facilitate, expand, or enhance a manager's ability to work with one or more kinds of knowledge are called DSS. These are a specific class of

computerised information system that supports decision-making activities. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or models to identify and solve problems and make decisions.

In the late 1960s, model-oriented DSS or management decision systems were found to be very useful. According to Peter Keen and Charles Stabell, the concept of decision support evolved from 'the theoretical studies of organisational decision making done at the Carnegie Institute of Technology during the late 1950s and early 1960s, and the technical work on interactive computer systems mainly carried out at the Massachusetts Institute of Technology in the 1960s.'

In an earlier article, little had identified four criteria of robustness, ease of control, simplicity and completeness of relevant detail for designing models and systems to support management decision-making. These four criteria are used even today to evaluate modern DSS. The late 1970s developed many interactive information systems that used data and models to help decision-makers analyse semi-structured problems. Now, DSS can use structural multidimensional data, unstructured documents and also spatial data in a system like Geodata Analysis and Display System (GADS) (Grace, 1976 and Swanson and Culnan, 1978).

Today, DSS can be designed to support decision-makers at any level in an organisation. They can support operations, financial management and strategic decision-making. There is growing interest in DSS that directly supports distributed decision-making at the group, organisation and inter-organisation levels. DSS differ with respect to the kinds of knowledge they help manage. While majority of conventional DSS have been devised to help manage primarily descriptive and procedural knowledge, there is a class of artificially intelligent DSS, which focuses on representation and processing of reasoning knowledge. However, it may be noted that often DSS are created to solve particular problems on an adhoc processing basis and are not needed on a regular basis.

Geographic Information Systems (GIS)

A geographic information system or geographical information system is a system for creating and managing spatial data and associated attributes. In the strictest sense, it is a computer system capable of integrating, storing, editing, analysing, and displaying geographically referenced information. According to Encyclopaedia of Earth System Sciences, GIS is a computer-based system for the manipulation and analysis of spatial information in which there is an automated link between the data and their spatial

location. A GIS consists of computer hardware and software for entering, storing, transforming, measuring, combining, retrieving, displaying and performing mathematical operations on digitised thematic data (e.g. soils, vegetation, hydrology) that have been registered to a common spatial coordinate system.' In a more generic sense, GIS is a 'smart map' tool that allows users to create interactive queries (user created searches), analyse spatial information and edit data.

- **Data Capture**

  GIS data represents real world objects (roads, land use, elevation) with digital data. A GIS can also convert existing digital information, which may not yet be in map form, into forms it can recognise and use. For example, digital satellite images generated through remote sensing can be analysed to produce a map-like layer of digital information.

  Existing data printed on paper or PET film maps can be digitised or scanned to produce digital data. A digitiser produces vector data as an operator traces points, lines and polygon boundaries from a map. Scanning map results in raster data that could be further processed to produce vector data. Survey data can be directly entered into a GIS from digital data collection systems on survey instruments. Positions from a Global Positioning System (GPS), another survey tool, can also be directly entered into a GIS. Remotely sensed data also plays an important role in data collection and consists of sensors attached to a platform. Sensors include cameras, digital scanners etc., while platforms usually consist of aircraft and satellites.

  Satellite remote sensing provides another important source of spatial data. Here satellites use different sensor packages to measure the reflectance from parts of the electromagnetic spectrum or radio waves that were sent out from an active sensor, such as, radar. Remote sensing collects raster data that can be further processed to identify objects and classes of interest, such as land cover. When data is captured, the user should consider if the data should be captured with either a relative accuracy or absolute accuracy, since this could not only influence how information will be interpreted but also the cost of data capture.

- **Data Integration**

  In addition to collecting and entering spatial data, attribute data is also entered into a GIS. For vector data this includes additional information about the objects represented in the system. After entering data into a GIS, it usually requires

editing, to remove errors or further processing. For vector data it must be made 'topologically correct' before it can be used for some advanced analysis. For example, in a road network, lines must connect with nodes at an intersection. Errors such as, undershoots and overshoots must also be removed. For scanned maps, blemishes on the source map may need to be removed from the resulting raster.

- **Data Modelling**

  It is impossible to collect data over every square metre of the Earth's surface. Therefore, samples must be taken at discrete locations. GIS can be used to depict two and a three-dimensional characteristic of the Earth's surface, subsurface and atmosphere from points where samples have been collected.

GIS can provide a great deal more problem-solving capabilities than using a simple mapping programme or adding data to an online mapping tool. The Website GIS.com suggests that GIS can be viewed in three ways:

- **Database View**

  A GIS is a unique kind of database of the world–a geographic database (geo-database). It is an 'Information System for Geography.' Fundamentally, a GIS is based on a structured database that describes the world in geographic terms.

- **Map View**

  A GIS is a set of intelligent maps and other views that show features and feature relationships on the earth's surface. Maps of the underlying geographic information can be constructed and used as 'windows into the database' to support queries, analysis and editing of the information. This is called geo-visualisation.

- **Model View**

  A GIS is a set of information transformation tools that derive new geographic datasets from existing datasets. These geo-processing functions take information from existing datasets, apply analytic functions, and write results into new derived datasets.

In other words, by combining data and applying some analytic rules, one can create a model that helps find solutions to problems being faced. Today, many local bodies in India are using GIS data for city development planning.

Management Information Systems (MIS)

MIS is the study of the design, implementation, management and use of information technology applications in organisations. Peter Keen defines MIS as 'the effective design, delivery and use of information systems in organisations.' It focuses on providing managers with structured periodic reports. Much of the information is from accounting and transaction systems. Apparently, MIS are not concerned with day-to-day operations, but rather with the management of activities that do support operations.

MIS became extremely relevant with the emergence of global economy, where the managers / administrators can no longer afford to ignore how the information is handled by their organisations. Expectations of the people have also increased in terms of more and better services with lesser costs. Laudon and Laudon identify three activities associated with producing information for making decisions, controlling operations, analysing problems and creating new products or services. These are:

- **Input**: it captures or collects raw data from within the organisation or from its external environment;

- **Processing**: it converts raw input into a more meaningful form; and

- **Output**: it transfers the processed information to the people or activities where it will be used.

Feedback emanating from the use of this information serves as the input for the same process again.

Today, we are using second generation of MIS. First generation MIS were concerned with the capture of information and experience so that it was easily accessible. Technology had primacy in this phase. Emphasis was given to developing sophisticated data analysis and retrieval systems with little concern towards how the information they contained would be developed or used. This led to the theoretical and practical failure of first generation techniques to live up to its promise. How well information is organised allows individuals to understand and make sense of it or leaves them lost in a maze of irrelevant information overload. Consequently, the

attention was paid towards developing system that gave priority to the way in which people construct and use knowledge. This is the second generation MIS.

Characteristics of MIS

Some of the important characteristics of modern MIS are given below:

- MIS are management oriented, where the management concerns all the employees of the organisation. The system is designed from top to bottom. Development of the system starts from appraisal of organisational needs and its objectives;

- management actively directs, reviews and participates in system development efforts to ensure that the implemented information system meets the requirements of the organisation.

- an integrated system and MIS are not synonymous. However, the integrated concept is a necessary characteristic of MIS;

- due to the integrated nature of MIS, it is prudent to capture relevant data close to the source where the event occur and use it throughout the functional areas. The common data flow concept supports several tenets of systems analysis- avoiding duplication, combining similar functions and simplifying necessary functions, wherever necessary;

- while the integrated approach makes it appear a single entity, it is broken down into desirable sub-systems;

- MIS needs to be planned carefully and evolves in due course of time;

- MIS should be developed with the flexibility so that future changes in the organisational needs may be accommodated in the system; and

- MIS includes every type of systems that gives information, whether it is formal or informal (Srivastava).

Components of MIS

There are five components of MIS:

- **Hardware**- the physical equipment used in computing;

- **Software**- the set of instructions that controls the hardware;

- **People**- in the early days of computers, programmers, design analysts and a few external users were directly involved in MIS. Today, almost everyone in the organisation is involved with the information system;

- **Procedures**- are instructions that help people use the systems. They include items such as, users manuals; and

- **Databases**- are collections of related data that can be retrieved easily and processed by the computers.

MIS: Some Challenges

Some of the challenges pertaining to the use of MIS are mentioned below:

- **How to use information technology to design organisations to introduce new products and improve service delivery?**

  Technical change moves much faster than the individuals and organisations. It becomes difficult to adapt to these changes in a large bureaucracy. Various restructuring efforts by various levels of government world over indicate the need for redesigning the organisations in order to become competitive in introducing new products or improving the service delivery from the existing standards.

- **How to understand the system requirements in a global economic environment?**

  In the new world order if a government takes a decision, it also has to conform to several international agreements. MIS needs to incorporate those critical features so that the required inputs are available to policy maker and products remain competitive. To develop integrated MIS, organisations need to have access to global level hardware, software and communication standards.

- **How to develop the architecture of MIS that helps in achieving goals?**

  While information technology can suggest new ways of doing things, organisations need to have a clear picture of their objectives and how these can be supported best by MIS. Many organisations are not able to meet their goals

because they are crippled by incompatible computer hardware, software and information systems. Integrating these 'islands of information' into a coherent architecture is now a priority.

- **How to secure investments for new MIS?**

  A look at the budget of various ministries would reveal the kind of investment that is required to put effective MIS in place. It requires massive investment from government both for hardware and software. Besides, people have to be trained so that most optimal use of resources can be made by the organisations. Developing countries, like India, have problems of resource constraint. This challenge can be overcome only if the business value of information systems can be ensured.

- **How to ensure that MIS are used in an ethically and socially responsible manner?**

  Information systems need to be designed in a manner that they function as intended but at the same time it needs to be ensured that health, safety, job security and social well being are considered as carefully as meeting the organisational objectives.

3.4 CONCLUSION

ICTs have penetrated all areas of governance and have made management of information and knowledge and service delivery more efficient, cost-effective and virtually real time. Design and development of databases, GIS, MIS and DSS has made governance more dynamic and functional. Internet and websites have facilitated easy information browsing, electronic information publishing and dissemination, speedy governmental and commercial transactions, meetings, discussions, etc. IT interfaces with satellite communication has further enabled facilities of e-learning, e-training and teleconferencing.

Thus, ICT applications have prompted effective decision-making, policy analysis and problem solving by governments at all levels and across the globe. Appropriate use of such applications can have a substantial impact and improve governance qualitatively.

3.5 ACTIVITY

1. Discuss among your peer group about the usability of database in e-governance.

2. Cite an example of a project where GIS and MIS have been used in policy planning and implementation.

3.6 KEY CONCEPTS

Vector data : a coordinate-based data structure commonly used to represent map features. Each liner feature is represented as a list of ordered x, y coordinated. They are mathematical descriptions of geometric entities and are employed by applications like Geographic Information Systems (GIS), Computer-Aided Design (CAD), and Computer-Aided Manufacturing (CAM).

PET Film : this is a kind of polyester and acronym of Polyethylene terephthalate.

Raster Data : is a method of storing, representing or displaying spatial data in digital form. It consists of using cell data (not necessarily square) arranged in a regular grid pattern in which each unit (pixel or cell) within the grid is assigned an identifying value based on its characteristics.

Attribute Data : data that relate to a specific, precisely defined location. Attributes data are qualitative data that can be counted for recording and analysis. The data are often statistical but can also be in text, images or multi-media. These are linked in the GIS to spatial data that define the location.

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