UNIT 4 FUTURE OF COMMUNICATION TECHNOLOGY

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4.0 INTRODUCTION

As the title of this unit indicates, it deals with the future possibilities and promises in terms of the applications of communication technologies for educational purposes. Our attempt is to identify and comment on some basic issues pertaining to various communication technologies, in order to generate awareness about the uses of such technologies for distance education.

It needs to be noted here that the Unit gives you an account of the present state of communication technologies, but technologies change so quickly that it could well be that some of the discussion here is already outdated when you read it.

You have read about the growth and the application of communication technology in Units 2 and 3 respectively. You have also studied various possibilities for using communication technologies for education, information and entertainment. Besides, you have already been exposed to the possible problems we face in using communication technologies for various purposes, including those of education.

This unit takes you a step further and reflects on the current and projected uses of communication technologies in education and training. Here we present some information about the educational uses of communication technologies, with emphasis on the prevailing conditions in the developing countries including India.
Some of the technologies we have discussed here are not available for educational purposes, though they are being used by people elsewhere e.g., for business purposes. Nevertheless, we hope these technologies will be used for educational purposes as and when the appropriate climate for such uses is created.

We are using the term communication technology and communication technologies just for the purpose of making clear the singular and plural usage of the term in different areas. We do not have any other specific intention in using either term.

4.1 OBJECTIVES

Having gone through this unit carefully, you should be able to:

- describe the trends in communication technology in the developing countries;
- identify the strengths and weakness of communication technology, with special reference to the developing countries;
- explain the future trends in communication technology with special reference to its applications in education; and
- describe the possible uses of communication technology for students with disabilities.

4.2 COMMUNICATION TECHNOLOGY IN DEVELOPING COUNTRIES: A CHALLENGE

In recent decades the world has taken giant strides into the information age. The diversity and the capabilities of various media — print, radio, television, data processing and telecommunication — have increased enormously and these devices are playing an ever increasing and significant role in the economic and social growth of a country (Baur, 1982).

Communication technology has immense social implications. It is concerned with every aspect of human life such as education, environment, health, safety, quality of life and so on. The contribution made by communication technologies has been decisive for the socio-economic progress of every country we know of. In both the developed and developing countries, the human resource and information industry, according to Haque (1991), are seen as criteria to judge their status as information societies, linking information with quality of life. Hence the level of economic development of a nation will probably be the determining factor for the different media of information delivery systems in a society.

The continuing development of communication technologies has significantly expanded the range of communication services and enhanced the efficiency of telecommunications, so that today almost any type of information — voice, text, data, or image — can readily be exchanged with people anywhere in the world. And yet the increase in the demand for
information, whether commercial, entertainment or educational, continues to grow rapidly in both the developed and the developing countries. With rapid developments in communication technologies, attractive options present/provide better and cost effective ways of meeting the current and the future requirements of communication/education.

Most developed countries are currently moving into, (though some of them have already moved into it), the information age, which depends on the rapid exchange of information. In other words, the requirements for communication technology in developed countries are constantly increasing. What is expected in the future is individual person-to-person telecommunication in voice, text and images, information transfer between technical systems, retrieval of information stored in central locations and access to information and knowledge processing in the future (Armbuster, 1986). The conditions in the developing countries, however, are not so promising. Nevertheless, the demand for communication technologies has increased in recent years in these countries as well.

We agree with Verges (1992) that information is a basic resource for today’s human survival. The influence of communication technologies has opened the door to the information age, in which information has become not only one of the essential resources for social progress, commercial outcomes, research and quality of life but the most important of such resources. The information age has provided immense benefits for every country. In the coming years, telecommunication centres will become focal points for social interaction, public awareness and life-long education in the developing countries.

The information gap between developed and developing countries is reflected in their access to communication technologies and the growing importance of information in all aspects of human life. Access to information, and to the facilities to produce, store and transmit information makes the difference between societies (Hudson, 1989).

In India, communication technology has entered a period of rapid growth. It is being used with good results in production units, planning and development process, education, human resource development, banking, telecommunication, rural development, weather forecasting and management functions, to list only a few of its common uses. Indians have excellent environment for the successful manufacture and use of communication technology in many more areas. To take advantage of this favourable environment they need better access to communication technologies, besides the will and requisite initiation to use them with vision.

Despite their diversity, developing countries share certain basic characteristics. The problems faced by most developing countries are essentially economic, political and social. Their economic and social problems are compounded by the explosive growth of their populations. They also suffer from illiteracy, poor technical training, extensive prevalence of child labour, poor status of women, etc. Introducing and using appropriate technologies can solve these problems.
One of the important points to be emphasised is that communication technologies are not easily available. They have to be invented, produced, adopted, mastered, controlled and implemented. The people (producers as well as consumers) are required to be mentally ready to produce and use such technologies. In other words, the application of communication technologies depends on the existing capabilities of people. The required readiness is lacking in a vast majority of developing countries. Secondly, we have to ensure that the new technologies introduced in the socio-economic structure of developing societies should not destroy their existing cultures. The point that we want to bring home is that intelligent application of new technologies in developing countries can indeed contribute to speeding up the process of development, without invading the socio-cultural system of the country.

Research and development is yet another area of concern. Developing countries have to pay due attention to research and innovation to make communication technologies flexible and suitable for the masses. It seems that only those countries that maintain a strong scientific base will be able to acquire competitiveness and the required momentum to keep up with the headlong pace of progress. Thus to see developing countries to step towards full industrialisation, the investments (i.e. resources) are to be diverted to advancement and innovation in communication technologies. These countries must devise new strategies for mobilising their all too scanty resources, including science and technology, in the most effective way to promote indigenous means of development. Universities and institutions of higher education can play a crucial role in the innovation and transfer of technologies.

However, we should not forget that despite the limitation of resources and the limited adoption of the new communication technologies, developing countries have visions of catapulting themselves into the information age bypassing the long industrial phase that the developed countries have gone through. New communication technologies are being introduced in many developing countries that are going through rapid change in technology, communication and lifestyles with far reaching social consequences. Despite a poor economic climate, communication technologies have been growing fast in the developing countries. Many of them now have access to a variety of communication technologies. Besides, they are ready to invest further to make sure that they are not deprived of the benefits of the information age. Thus, some countries are making significant progress towards becoming information societies. India is a clear example.

Communication technologies have made a significant impact on the means and methods of education and development. The future holds great promise for new developments and advancements in communication technologies in developing countries too. It is to be hoped that communication technologies will be increasingly demanded by educational institutions.

To conclude, there are numerous issues pertaining to the development of communication technologies in relation to the emergence of a new type of society in the developing countries. We, in these countries, have before us a
great challenge and also a great opportunity. It is vital for us to ensure that technology makes a definite contribution to our development.

Check Your Progress 1

Notes: a) Write your answer in the space given below.

b) Compare your answer with the one given at the end of the unit.

Why is research and development an area of concern to technologists in developing countries?

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4.3 ASSESSMENT OF COMMUNICATION TECHNOLOGY

We have touched upon various strengths and weakness of communication technologies in Units 2 and 3 of this Block. We shall now critically assess some of these strengths and limitations in the following subsections.

4.3.1 Achievements

The use of communication technologies is likely to reinforce traditional methods and media of instruction. Media can improve the flavour of the message to be conveyed and knowledge to be gained. Besides, they provide alternative methods of conveying the content. Effective and efficient communication technologies offer a substitute for a face-to-face meeting/teaching.

Technologists are engaged in providing the students with the means and facilities necessary to make their learning a success without overburdening them. But we have to keep in mind that communication technologies demand different roles from both the teacher and the student.

One of the major contributions of communication technologies to education is the individualisation of learning. Individualised learning is planned so as to allow for self-paced, mastery learning. Human element is provided through the use of group work and activities, which fulfil the demand of social interaction. However, before adopting a technology or a combination of technologies, we should ensure that it works effectively, improves the pedagogic process and hence helps to meet the terminal objectives set before the students, the institution and the country. At this point of time, however, we would like to emphasise that communication technologies not only aim at making educational opportunities more accessible, but also make them extremely attractive to the students. They motivate and hence
Future of Communication Technology

involve the students in learning; attract and hold their attention for optimum learning, and help them retain knowledge thus gained. With appropriate technologies, learning is no more confined to the four walls of the school. It can take place anywhere and at anytime, irrespective of age, sex or socio-economic and demographic constraints. Creating an informal learning environment especially designed to provide a solid educational experience, which is easily used whenever the students choose to learn, is a genuine contribution of communication technologies. Thus, it is hoped that communication technologies, coupled with flexible homework (i.e. assignments), and learning schedules (i.e. study habits/skills) will provide more productive time for education, training and work. As a consequence, possibilities of life-long learning will generate birth-to-death curriculum and dependable delivery systems. This is the area where we, as educators, have to contribute substantially in designing the most appropriate curricula to meet the changed requirements of the masses. If the futurists can be believed, societal needs in the 21st century will be very different from those which most of us experience now. Learning will be a life-long, multifaceted process that will focus on students’ specific needs at a given time in a given situation.

4.3.2 Limitations

Communication technologies have come in and will remain with some inherent problems particularly for the developing countries. Wellenius (1989) opined that the slow growth and poor performance of telecommunication services in the developing countries are mainly attributable to three inter-related factors. These are as follows:

- Shortage of investment capital, i.e., overall scarcity of resources for investment and the cost of expanding and modernising telecommunication infrastructure are the main reasons for its poor performance. The use of communication technology in the developing countries has always been criticised for being too costly to afford.

- Ineffective organisation and management of the operational aspects of educational systems which are heavily dependent on communication technology — inadequate internal organisation and management results in high expansion and operating costs, poor maintenance and limited capacity. The effectiveness of communication technology depends on its implementation and utilisation. If it is not properly and adequately implemented, it is not reasonable to expect returns and effective outcomes envisaged by their developers.

- Inadequate sector policies constitute the third and the most pervasive constraint on the development of telecommunication. As a result, there is a lack of incentive for improving performance and generating investment for the expansion of telecommunication in the area of education and training.

Besides, the following are the other five reasons, which work against communication technology:
• **Planning, Monitoring & Evaluation.** The implementation of communication technology is normally not planned with clear-cut objectives to be achieved. The monitoring mechanisms with respect to their utilisation are also either not designed or not strictly monitored to adhere to required standards. Also there is no continuous evaluation to provide feedback services to improve the system.

• **Quantity:** The number of telephone connections, access to TV, VCR, etc. is very important for success of communication technology. Poor teledensity and inaccessibility of modern gadgets to people in general makes the application of communication technology most elitist.

• **Quality of services:** For example, the quality of telecom services are noisy and unreliable, as the technology used in most of the developing countries is not contemporary.

• **Price:** The cost of communication technology is very high and for most in the developing countries, it becomes difficult to use. For example, in India the cost of telecom facilities are 100% higher than the fair price of these services elsewhere in the world (Shah, 1997).

• **Instructional Design knowledge:** Most of our teachers are comfortable with lectures or the 'talk and chalk' method. Use of communication technology makes them very uncomfortable and hence the immediate objection to its utilisation for educational purposes comes to the forefront. Though every one will accept it as entertaining media, there are only very few who accept communication technology for teaching-learning purposes. What is required is a receptive mindset and a proper attitude. Therefore, the training of teachers on instructional design to use new communication technology is highly essential.

Providing telecommunication access, particularly access to computers for the students, who are scattered across the country as well as the neighbouring countries, has been both a logistic and a technical problem. Besides, the creation and utilisation of modern electronic devices are difficult, challenging and often dangerous for those who do not belong to a technological culture.

The successful implementation of any educational media in a country depends largely on the preparedness and the readiness of the implementers — the teachers — who constitute an inevitable pivotal component of any innovation in the educational enterprise (Mnoja, 1992). Their involvement in and attitude towards the use of technology is a major factor in its success. For example, Perraton (1981) reported that television use in El Salvador led to a strike by teachers.

Pioneers of new communication technologies hoped that one of the major uses of their inventions would be to bring education to the masses — at least to those who want to have it. But we have to take another look at the entire education system in the country and review whether we succeeded in exploiting fully the potential of technologies available to us for educational purposes. We might come out with discouraging findings. You may start
your investigation with the most popular mass media — the radio and television.

Check Your Progress 2

Notes: a) Write your answers in the space given below.
   b) Compare your answers with the ones given at the end of the unit.

Identify three major contributions of communication technology to education. Also identify three major problems in implementing such technology in a given situation.

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4.4 FUTURE TRENDS

Though we cannot predict the future, yet with careful examination of the present trends, the resources available, and the enthusiasm for implementing innovations, we can make some estimates as to what the future of communication technologies might be. Much depends on the actual use of the technologies for education and development at the present moment. The challenge of today’s educators is to guide technologies towards a developmental/educational path allowing access to technologies by all the interested users/learners. This is a fact that advanced communication technology is available or is being made available to business houses for commercial purposes. But our (educators’) concern is to keep pace with technological developments and ensure the optimum utilisation of appropriate technologies for pedagogic purposes, about which we don’t have much to say.

One fact is clear beyond doubt — we are entering an era, which will be characterised by widespread ‘use of technology’. High speed processing or more user-friendly devices are being developed/created world-wide and possibilities are being explored as to how technologies can be used to meet their objectives with reduced costs.

Let us take a look at some of the recent advancements in communication technologies and their future projections.

4.4.1 Communication network

The success of communication technology will be determined primarily by the nature of transmission networks, i.e., the means of allowing access to technology. The public in general and educational institutions in particular is making ever increasing demands for telecommunication networks. They
need the most sophisticated electronic devices/system such as videotext, video-disc, videophone, rapid access to documents, data processing, intelligent support, individualised services and so on. You might have observed that to promote their business, business person would like to have all the possible communication technologies to react as quickly as possible to any market demands in any part of the country or the world. This is possible through efficient and effective telecommunication network. It should be possible to also make it available for educational purposes.

As mentioned earlier, the progress of a country depends on the capabilities and the flexibility of its telecommunication network. It is hoped that by the year 2010 most of the Indian homes, offices and places of work would be connected by radio, television and telephonic networks. This futuristic vision is based on the rapidly developing electronic networks in the country. Devices such as satellites, computers, fibre optics and so on will allow the transmission of video images, text, sound and pictures at a faster speed. The chances of acceptance and success of such devices are quite high, because an appreciable number of people, institutions and business houses already have them on a reasonably large scale, to the extent which, however, is not an easy task for want of resources. The technological options available includes satellite, optical fibres, VSATS, ISDN, etc. For example, Fibre optic cables can be used to make technological networks more accessible to users, who can have immediate access to information through networks, which are flexible and cost effective. Fibre optic cables with their large communication capacity will meet the diverse needs of people whose increasing telephone, mobile television, etc., are now developing into a means of mass communication. You can instruct your student directly by means of the cordless phone in your pocket.

Communication network can be controlled by human interface or/and by machines, such as, computers. These requirements will grow in the future because of trend towards the increasing emphasis on distance education/open learning, to meet the communication requirements of information society (Baur, 1992). However, three basic issues will always remain in the fore-front. These are bandwidth, connectivity, and cost effectiveness. Bandwidth refers to the capacity of a system to transfer large amount of data at high speed. The more the bandwidth the more data transfer. Similarly connectivity means, interactive connectivity and this is where the user can interact with any one, at any time, anywhere. And finally, of course, the cost, which will go down in the years to come. In the next sub-section we will be discussing a few technologies, which have one and more of these characteristics. We are sure that technologies having these characteristics will be more predominant in future.

4.4.2 Satellite communication

One of the most pressing areas of today's concern and debate is the future role of communication satellites. Receiving signals directly at home from a satellite orbiting at 36,000 km from the surface of the earth is widely perceived by the public today as an innovation. An enormous diversification of services (such as telecommunication, remote sensing, etc.) offered
through satellites exist to cater for demands of communication. This certainly indicates the scope of and need for communication technology.

With the advent of communication satellites, communication itself, which is at the root of human civilisation, has gone through a dramatic transformation (Rao, 1991). Communication satellites have virtually shrunk time and distance enabling people even in the remotest corner of the world to share their experiences with each other. Rao (1991) revealed that only 13 out of a total of 130 satellites in geo-stationary orbits belong to developing countries, while 3/4th of the population of the world lives in the developing countries. He opined that by the year 2000, counted at the present rate of growth, with around 3000 communication satellites in the geo-synchronous orbit, the share of developing countries is unlikely to exceed ten per cent. He predicted that the extent to which space technology is in the next 40 years (from 1991) and its diffusion to benefit grassroots in developing countries would essentially determine the possibilities of global survival.

Telephone by satellite has long been seen as the solution in the areas of low population density, which need telecommunication services. Remote telephone by satellite offers many benefits. Telephone through satellite operates just like an ordinary public telephone network, bringing signals straight into the corporate telephone networks. Unlike terrestrial cable systems, satellite telephony is not vulnerable to long distance environmental factors, etc. The world-wide success of telephony by satellite is amply demonstrated by its diverse use these days. For example, coal mines in China, the police in Taiwan, the Indian Government, and networks in Germany, Denmark, Canada and CIS, etc., make use of satellite telephony system for communication purpose (Hughes, 1982).

**Satellite radiotelephone projects**

With the potential of satellites, the world of telecommunication is set to revolutionise the entire global network. This technology involves the use of large number of low earth orbit satellites and compact hand held terminals. Using advances in mobile satellite capabilities and technology, it is aimed at introducing a range of affordable, increasingly portable and convenient global personal communication services. Such a system makes global personal communication independent of national networks, such as VSNL of India. Unlike conventional telecommunication networks, the satellite-based system will track the receiver telephone anywhere in the world. These systems are being designed to transmit voice, data, fax, paging and multimedia based information at a high speed. At present there are a number of competitors in the satellite radiotelephone sector. Table 1 gives a broad picture of these projects and their services.

**4.4.3 Integrated services digital network (ISDN)**

Integrated Services Digital Network (ISDN) is perhaps the most important development to emerge in the field of communication since 1980s, and will in all probability, continue to dominate developments in the future. The early phone network consisted of a pure analog system that connected telephone users directly by an interconnection of wires. This was very much prone to breakdown and noise, and did not lend itself easily to long distance
connection. However, telephone system has already begun to change converting its internal connection to a packet-based digital switching system. Still the final connection to end-users is basically twisted cable in most countries. Optical fibre will replace this in future. ISDN is a system of digital phone connection which allows data to be transmitted using end-to-end digital connectivity and support a wide range of services, including voice and non-voice services, to which users have access by a limited set of standard multi-purpose user network interfaces.

### Table 1

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Main Investors</th>
<th>Industrial Partners</th>
<th>Operators</th>
<th>Cost of Project in US $</th>
<th>No. of satellites</th>
<th>Date of start-up</th>
<th>Type of services</th>
<th>Cost of communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Globalstar</td>
<td>Loral Space and communications and Qualcomm</td>
<td>Arespatiale, Alcatel, Daimler Benz, Hyundai, Ericsson</td>
<td>France telecom, Vodafone Air Touch communication</td>
<td>2.5 billion</td>
<td>48 (low orbit)</td>
<td>1998 Telecom</td>
<td>$0.05 to 0.65/ min</td>
<td></td>
</tr>
<tr>
<td>Iridium</td>
<td>Motorola</td>
<td>Lockheed, Raytheon, DEVCOM, Siemens</td>
<td>O.tel.O., STET, Sprint, Korea Mobile, Telecom corp.</td>
<td>3.8 billion</td>
<td>66 (low orbit)</td>
<td>1998 Telecom</td>
<td>$2 to 3/min</td>
<td></td>
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<tr>
<td>Odyssey</td>
<td>TRW and Teleglobe</td>
<td>Mitsubishi i, Magellan, Panasonic, Northern Telecom</td>
<td>—</td>
<td>3 billion</td>
<td>12 (Medium orbit)</td>
<td>2000 Telecom.</td>
<td>$1/min</td>
<td></td>
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<tr>
<td>Teledesic</td>
<td>Microsoft and McCaw Cellular Communication</td>
<td>AT&amp;T</td>
<td>—</td>
<td>9 billion</td>
<td>840</td>
<td>2001 Inf. highway, videoconf, multime-dia</td>
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</table>


With ISDN, voice and data are carried by bearer channel (B channels) occupying a bandwidth of 64 kbps, (kilo bits per second). A data channel (D channel) handles signalling at 16 kbps, or 64 kbps, depending on the service type. There are two basic types of ISDN services. Basic Rate Interface (BRI) having two 64 kbps B channels and one 16 kbps D channel and Primary Rate Interface (PRI) with 23 or more B channels plus one 64 kbps D channels. To access BRI service, it is necessary to have an ISDN phone connection and the customer must be within 5.5 km of the telephone switching centre. Beyond that special repeater devices are required.

Once you subscribe to an ISDN connection, a simple two wire telephone line, called U-interface is extended to your premises from the telephone exchange. This is terminated into a device called NT1 (Network Terminator) to which multiple ISDN devices can be connected through S/T interface, which allows to connect up to seven ISDN devices.
Advantages of ISDN

**Speed:** The speed of data transfer is amazingly high. Also a modem is not required, as the data is already digitised and do not require a modulator demodulator (modem). Normal modems have a maximum speed of 56 kbps, whereas ISDN supports speed beyond 64 kbps.

**Multiple devices:** Previously it was necessary to have one telephone line for each device to be used. For example, one for fax service, one for e-mail, etc. ISDN allows the use of up to seven devices in one single connection.

**Broadband ISDN**

Broadband ISDN (BISDN) is defined as a network capable of supporting data rates greater than the primary rate supported by ISDN. The main aim of BISDN is to support video and image-based services. The broadband channels proposed for BISDN are:

- H_2 channel, 30 – 45 Mbps
- H_3 channel, 60 – 70 Mbps
- H_4 channel, 120 – 140 Mbps

The services on BISDN can be both interactive as well as distribution oriented. This will allow real-time teaching using video conferencing at low costs.

**4.4.4 Internet**

The phenomenal growth of the Internet with its multimedia capabilities makes it a technology of the future. We shall discuss this in a special unit in Block 5, Unit 3. Here we mention certain specialities of this technology, which is highly important to review it in futuristic parlance. Started as a purely text-based system to send and receive messages (e-mail) it is now a fully multimedia-based system with capacity to deliver video, sound, picture, images, etc. The interactivity that this technology provides is tremendous. Today, many universities of the world are using this to deliver courses. Internet will revolutionise the whole communication system through three basic services — the e-mail, the World Wide Web, and the Internet phone. Certainly, every educational institution will be influenced by these developments in the 21st century.

**E-mail:** E-mail is primarily a store and forward messaging service. The messages/data are sent and stored electronically into the user's mailbox and remain waiting till they are retrieved. E-mail uses computer, text-processing and communication tools to provide a high-speed information exchange service. The e-mail utility on a computer system enables one computer-user to communicate with another user or a group of users via the user's terminal.

E-mail, unlike paper-based communication, is fast and can transmit information (mail as the term indicates) in seconds or minutes across a continent. Replies can flow back just as rapidly. E-mail is text-based. Unlike fax or telephone, e-mail has no picture or sound component. Information can be conveyed only in the form of a text like the normal postal mail, but
 unlike conversations, as the senders and the receivers do not attend to communication act simultaneously. Thus communication through a e-mail is asynchronous or non-simultaneous.

**WWW:** The World Wide Web (WWW) unlike e-mail is Graphical Use Interface (GUI) based and also allows audio and video to be used. According to Mason (1998) the "Web is the most phenomenally successful education tool to have appeared in a long time. It combines... text, text-based interaction, multi-way interactive audio and video".

**Internet phone:** Using the Internet you can talk to someone on real-time mode. This is called web phone or Internet phone. This technology is currently in the developing stage and thus the quality of sound remains somewhat of a problem. Also there is as yet problem of interportability standards. You and your friend must all have the same software now to talk to each other. However, it allows international calls to be metered as local, thus being a very cost efficient method.

### 4.4.5 Technology for people with disabilities

The most important application of any technology is to make life easy, and who needs this more than the people with disabilities? We are falling behind in providing necessary assistance (communication or education) to the deaf, physically or the visually disabled. There are millions of people in the developing world, who require special and improvised communication technology.

Some efforts are going on in the developed countries to meet the communication requirements of the disabled, particularly the deaf and the blind students/learners. ACCESS (1992) reported that the Database Company, U.K., recently unveiled the dataphone — a telephone that does a lot more than just talking to the caller. It allows the institution and the caller (the student) to type messages simultaneously for a live text conversation. Besides, its variable modern and flat screen makes it possible for it to be turned into a terminal to access external database. But that is not all. Combined with database is a calculator, a personal organiser/computer and message pad, a diary and a clock/calendar. It can also be connected with a printer, and when combined to a data reader, it can send fax messages in digital form to another dataphone or personal computer. The screen of the personal computer can be split to accommodate outgoing and incoming messages, and store the incoming text to be read when you are back in the office or your study. An interesting feature of the system is that it is very useful for communication between deaf people. Telecommunication network would enable the deaf and the non-deaf to communicate using telephone networks. The computer would convert speech into text and the text into speech. The message can be typed and the typed message can be converted into a synthesised voice. Taking these fast changes in technologies into account, it is hoped that using speech generated text, a deaf person will be able to use telephone to converse with other telephone users without the assistance of any special operator. One more variation: written/printed messages, such as fax messages, will be converted into voice and delivered to you over your cordless or car phone. These services have
proved technically feasible and could well become a reality within this decade. Many more new services and improvements will be available in the 21st century.

This was an example provided just to give you an idea of the future possibilities in telecommunication to meet the communication needs of the disabled students. There are many more experiments going on to optimally exploit the potential of communication technology to make education accessible to the disabled. For this, technologists are engaged in developing appropriate telecommunication devices. For instance, devices are being developed to provide a flexible keyboard that makes computers more easily accessible to the physically disabled. The inexpensive learning devices to help young disabled students — including mentally retarded persons — to communicate and develop thinking skills have come to be known as enabling technologies.

Wagner (1992) explores various means to help the disabled. He opined that a search for technology to assist people with disabilities is a major concern of society. Wagner (1992) presented another example in this connection. The goal of Johns Hopkins University Search for Computing Applications to Assist Persons with Disabilities, U.S.A. was to apply computer creativity to help people with disabilities overcome barriers to communication, education or employment. The University provides incentives for the development of such devices. As a result, US technocrats are engaged in suitably modifying the available technology to make the operation of computers easy for disabled users — such as to accommodate the natural posture of the user. Such devices will bring in a revolution by enabling independent communication among people with cerebral palsy, muscular dystrophy, arthritis or other physically impairing conditions. Moreover, at the same time, the devices would also help in preventing disabilities. For instance, many people who use a computer every day suffer from carpal tunnel syndrome resulting from repetitive hand and wrist movements in awkward positions. Modified devices will reduce/prevent such health hazards.

Check Your Progress 3

Notes: 
a) Write your answer in the space given below.

b) Compare your answers with those given at the end of the unit.

i) Outline briefly three major educational uses of communication satellites.

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ii) Describe briefly the special features of ISDN.

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4.4.6 Networked society

Having discussed a variety of communication technologies that are likely to influence the educational scenario in the future, let us turn now to a broad framework — networked society. It is certain that we are moving fast towards a society which will be a network of people, information, resources and so on. In this sub-section, we present to you a lecture by an eminent computer and communication technologist. It is a futuristic paper that fits our requirement in this unit. While going through this, give special attention to the following:

- try to relate the concepts, technologies etc. to education;
- think of how educational transactions would take place in a networked society;
- make an assessment of your own situation vis-à-vis the technology options.

Though the kind of scenario discussed in this paper may not be feasible in all developing countries in the near future, it seems more certain and realistic when we make comparisons with regard to the developed nations.

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**Networked Society: Vision and Technology Option**

**Prof. T. Vishwanathan**

**THE WORLD IN TRANSITION**

The world is perceived to be in transition at present. To appreciate the phenomenon of transition, it is necessary to peep into the theory of creation a little. Let us take a glimpse at the big bang theory of the formation of the Universe. In its simplest form, the theory says that the Universe started with a big bang from an egg-like shell and since then had been expanding continuously. In the first few seconds, the shape of expansion was so large that very little was known about the formation. Since then, the rate of expansion is diminishing and it continues to diminish further and further. The logical conclusion is that one day in the distant future, the rate of expansion would become zero and a process of contraction would start. Initially, the rate of contraction will be very low and increase as the time passes. After a very long time the rate contraction may become so high that the whole universe will condense into an egg-like shell in a few seconds of time. Then there is no creation or universe. The egg-like shell may remain dormant for a very long time before it bursts forth once again with a big bang.

Now compare this with India’s ancient theory of creation stated with the concept of Pralaya and Mahapralaya. As per this theory, every cycle of creation has four Yugas in it; Satya Yuga, Treta Yuga, Dwapara Yuga and Kali Yuga. The end of each of the three Yugas is marked by land mass becoming water bodies and water mass becoming land bodies. During Mahapralaya everything is involved and the entire creation turns, into unmeasurable stretch of light. In modern scientific terms, this ancient theory may be stated as follows:

"The creation and dissolution of the Universe proceeds in cycles. Each cycle has four minor cycles in it. At the end of each minor cycle, life on the earth comes to an end and the water bodies and land masses are interchanged. At the end of a major cycle, the entire universe goes through a process of dissolution and everything reaches a state of light (Jyothi). After having been in the state of light for a long time, the Universe projects itself to start a new cycle."
The ancient Indian theory goes much farther. For example, it states that each minor cycle is divided into four quarters. Every day mantra that is chanted in many families even today in India talks of the present age being the part of the first quarter of the fourth minor cycle (Kali Yuga) of the 28th cycle of creation. According to Indian Almanac (Panchanga) we have spent over 5000 years in this quarter and 1,25,000 years are still remaining as part of this quarter. These are interesting figures that are not to be brushed aside just like that. The findings of paleobotanists often agree with these figures.

According to Indian scriptures, the creation is a play of God (read as Nature if you like). God sets in motion a play, which may last a few centuries. At the end of it, the current play is terminated and a new play is set in motion with a transition period. This postulate is substantiable by the fact that major changes come about in the world every few centuries.

There is a little doubt that the world is currently in transition. The present world order is going out and a new world order is setting in. Unlike many other upheavals in the world, the current transition is happening in a very smooth manner. One might term this as a silent revolution in the making. What one witnesses as economic crises, political instabilities, scandals and scams in different parts of the world are perhaps a part of the chaos that usually precedes a new order.

What is in store for us in the new world order is anybody’s guess at present. However, a few indicators seem to be apparent, which include:

- Humane aspects of Science and Technology
- Restoration of human values and societal considerations
- Information Technology (IT) at the centrestage
- True partnership with nature

It is in this context that one must view the evolving networked information society.

**NETWORKED INFORMATION SOCIETY OF TOMORROW**

Rapid advances in information technology have unleashed forces, which are shaping and affecting the basic structure of our society. New perceptions on how to organise work, how to produce and trade, how to manage and how to create wealth have placed knowledge, information and connectivity at the centre-stage of human endeavour. What occupation will people pursue? Will there be offices for people to go and work? Will the networked society automatically solve some of the problems of environment such as pollution that threaten the very existence of humanity at the present time? What will be the impact of the networked information society on the culture of people all over the world? With the Global Information Infrastructure (GII) evolving and the networks spanning all over the globe, will the concept of borderless nations become a reality? These are major societal issues to be addressed but certain macro shifts appear to be visible.

**Office-centred to Home-centred**

In the networked society, the homes rather than the offices are likely to be the activity centres. Going by the indication of the fact that 35% of the corporate workers in the United States are telecommuters today, it appears that the networked society would definitely result in less-travel society if not travel-less society. Physical location may become irrelevant for being able to receive or deliver services. This would bring about radical changes in work culture. Flexihours of working coupled with innovative management of resources and manpower promise enhanced productivity. It is estimated that on an average, the working persons in the world spend over 20% of the active time in a day on travel. With travel time saved, home centred activities would lead to better creativity, innovation and productivity. Telecommuting culture with home-centred activities would eventually lead to a home-centred economy.
Work Community to Social community

The present society is characterised by community formation based on centres. Persons who work in the same office or factory tend to form a bond of such as association, union or a club. Social activities are usually centred around such formations. In a home-centred environment, the communities will comprise of groups from among people pursuing different jobs and professions in life. Under those circumstances, a true social community is likely to emerge.

Mass Production to Production by Masses

The last few centuries have been characterised by mass production with large industrial houses being set up. This has led to power brokering between work force and the management characterised by strikes, lock outs etc. In a networked society, small community dwellings, which are self-contained would emerge. The community needs will be met locally from products available in its natural surroundings. The concept of associations and unions may vanish in the networked society. This would also imply that production will take place locally with a large number of persons engaged in producing goods that are required. This is an interesting scenario for largescale employment and for overcoming the present problems of unemployment.

Other Factors

There are a variety other macro shifts that one may discuss and debate. These include:

- Centralised to Distributed
- Driven Society to Driving Society
- Group Education to Personalised Education
- Competition to Co-operation
- World as a Corporate
- Libraries to Electronic Knowledge Houses
- Broadcast to Interactive

CHARACTERISING NETWORKED INFORMATION SOCIETY

The network society can be characterised as “A” raised to the power of five:

- anyone
- anytime
- anywhere
- any information
- any format

A full-fledged networked society implies that every human being on the planet has an access to the network. Network connectivity to home would become an essential infrastructural facility much as electricity or water supply connection. When the networked information society is fully developed, it should be possible for a person from the poorest of the villages in the world to access information resources in the richest of the cities in the world.

Network infrastructures which are expected to operate 24 hours a day and 365 days a year would make time zones and holiday patterns irrelevant in the life style of people. Cost of accessing resources across the nations may become independent of time of access or day of the week. What would matter is the need and convenience of the person accessing information. “Any time” facility would foster the growth of “on demand” culture enabling greater flexibility in the life style of individuals and communities.

“Anywhere” has implication for persons who are accessing information resources being accessed. It should be possible for a person from anywhere in the world to access an information resource located anywhere else in the world. The concept of location independent access would become a reality when a person would be able to access information from anywhere in the world irrespective of his
Future of Communication Technology

Implementation of such a scheme would call for universal identification of individuals, which remains permanent for the lifetime of the individual. In fact, a child may be assigned an universal code as soon as she/he is born and would be identified by that code throughout his/her life on the planet. These ideas sound somewhat far fetched but are not unrealisable.

With more and more emphasis towards right to access information, any information should become available to any individual on the planet. Some information may be priced where as some other may be free but access to any information should be a reality. A shift to this scenario is already visible in the information policies of different nations.

A networked society should pose no transborder barriers and be able to communicate information in any format that is assimilable by the recipient. Real time machine translation may become a reality. In this context, an intermediate language to represent knowledge becomes very important.

The present day communication environment is predominantly broadcast in nature: newspaper, magazines, journals, television, radio etc. In the networked society, the environment will be predominantly interactive.

COMMUNICATION TECHNOLOGIES

There are three communication technologies that are expected to play complementary roles in shaping the networked society of tomorrow; Optical fibres, satellites and short-haul radio. Each is capable of meeting certain important requirement of the network society: optical fibres provide the bandwidth, satellite communication provides quick remote area connectivity and the short-haul radio links promise to be excellent last-mile links. Thus, all of them are expected to co-exist happily in tomorrow's world.

Optical fibre

Optical fibre is fast replacing the traditional copper wires in certain segments of telecommunications because of its extremely high data carrying capacity. Unlike copper wires, fibre has the advantage of total immunity to electromagnetic interference and is lightweight and inexpensive. Theoretically a single optical fibre can support a bandwidth of 10 tera ($10^{12}$) bits per second. However, the performance of the commercially available systems is limited to about 5 Gigabits per second. The main hurdle is in the electrical-optical interfaces whose operating speeds are limited by today's technology. With continuous advances in photonic electronic technology, bit rates of the order of 20 Gigabits per second or higher are likely to become feasible in the near future. Even so, we are nowhere near exploiting the full capacity of the fibre. Perhaps, this is a boon in the sense that the growth path in the fibre technology appears to be unlimited at least for a century or two.

The video services envisaged in the networked society demands bandwidths, which can only be provided by the optical fibres. The world is estimated to have buried about 1.8 billion kilometers of copper cable in the earth since the beginning of modern telecommunications in 1879. It is almost impossible to replace all this copper by fibre for the networked society in short span of time. The segments where fibre can be easily introduced are intercontinental, intercountry and intercity trunk links.

Taking fibre to home or to the street kerb appears to be a long-term dream. Although, Japan is hoping to bring fibre to home in the near future. Clearly, as of now, the optical fibre promises to provide the estimated bandwidth requirement of the networked society.

Satellite systems

While laying fibre appears to be a formidable task, establishing connectivity via satellite links is by far the quickest. Even remotest areas can be brought on to the world network map in a matter of few hours by using satellite links. But the satellite
bandwidth is limited. There are about 100 communication satellites in the sky at present and by the year 2000 there would be about 500 of them. The aggregate bandwidth of all these satellites would be about one-hundredth of bandwidth that can be offered by a single fibre. Clearly, the strength of satellite communication lies in providing quick connectivity but not large bandwidth.

Most operating communication satellite transponders use either C-band or Ku-band frequencies. In case of C-band, the uplink is in the range of 6 GHz while downlink is in the range of 4 GHz. Ku-band has 14/12 GHz as uplink/downlink frequencies. C-band signals are relatively immune to atmospheric changes but are affected by interference from microwave signals. Conversely, Ku-band signals, though immune to microwave interference, are affected by atmospheric changes. Ku-band offers much higher bandwidth capability compared to C-band. Research is in progress to move further up in the frequency spectrum to Ka-band in the frequency range of 18-30 GHz in quest for higher bandwidth capabilities.

Very Small Aperture terminal (VSAT) based networks using communication satellite are becoming popular the world over for data communication. A number of VSAT service providers who offer turn-key solutions have appeared in the market. Data channels, i.e. outroutes and inroutes with different bandwidths and structures can be set up to run different applications. Outroute is normally used for broadcast traffic while inroute is required for interactive traffic. A quarter transponder in C-band, i.e. 9 MHz bandwidth supports a data rate about 1 Mbps. Most of the user-end VSATs support 64 or 128 Kbps data rates as of now.

Signal delay which comprises about 1500-2000 milliseconds for a round trip in 2-hop VSAT networks using goosynchroneous satellites is a constraint for real time applications involving voice and video. A new generation of satellite communication based on low-earth orbit (LEO) satellites is likely to alleviate the problem of large turn around delay. The LEO satellites with orbits in the range of 600-1200 kilometers altitude have smaller transmission power requirement, lower build and launch costs and neglible transmission delay. However, dozens of LEOs are needed to provide continuous coverage to all areas and the implementation cost of such a system may become prohibitive. Motorola’s Iridium system (66 satellites), Loral Corp’s GlobalStar (48 satellites) and Teledesic Corp’s (840 satellites) are some of the projects which are being watched with great interest.

Reasonable data rates, low error rates, easy installation even at remote sites and low cost are some of the advantages that VSAT-based satellite communication offers to the networked society. As a result, satellite-based connectivity is growing and satellites are establishing themselves. Developing countries stand to gain by adopting satellite technology for entering the connectivity map of the world in relatively a short time span of a few years.

Short-haul radio links

Fibre can provide the bandwidth and the satellites the connectivity to remote areas. But, how about the connectivity to home? Problems in laying fibre preclude its reach to home in the near future. Limited bandwidth of the satellite would not allow a dish to be mounted on the top of every house except for one way broadcast reception applications. The networked society which demands interactive connectivity needs a different solution for bringing the end-user (homes and offices) on to the network. This is where short-haul microwaves radio links have a great promise.

Microwaves have been on the scene for quite some time but only in recent years their role and potential in modern communication systems were explored and put to use. Microwaves communications involves point-to-point radio transmission between line of sight towers at frequencies ranging from 1 GHz to 30 GHz of the electromagnetic spectrum. Super microwaves with frequencies ranging from 30 GHz to 300 GHz are evoking a lot interest in communication circles, in view of higher bandwidth availability.
In most of the countries, the frequency range of 2 to 4 GHz is not covered under regulatory rules and hence a radio link in this band can be set up fast without any clearance issues. Radio links once established are highly reliable and cost effective. Unlike VSATs there are no recurring charges on bandwidth utilization. Advancement in radio modem technology has facilitated high bit rates on radio links. Commercial systems are available today which support bit rates upto 8 Mbps comfortably.

The present areas of applications of short-haul microwave systems include intra-city transmission, radio LANs, home-to-fibre connectivity, LAN-to-LAN links and others. As a result, short-haul microwave video links promise to eliminate the ‘last mile’ problem posed by the present cable technology and bring high bandwidth links to homes.

BROADBAND INFRASTRUCTURE

Many of you would appreciate that what we witness as Internet services today represent only the tip of the iceberg that would unfold in a fully developed networked society. Everyone knows that today’s Internet services are predominantly text and data oriented with only sprinkles of graphics and still pictures. Tomorrows services, placed broadly under two categories of Interactive services and Distribution services, would handle fullfledged voice, motion video and all other forms of information. Support of such services call for a broadband infrastructure and the most promising worldwide infrastructure is Broadband Integrated Services Digital Network (B-ISDN).

Broadband ISDN

Integrated Services Digital Network (ISDN) is perhaps the most important organised development in the field of telecommunication in the 20th century pioneered and guided by CCITT (International Consultative Committee for Telegraphy and Telephony). Integration of many services on a common digital network, which is the basic idea behind ISDN, calls for digitalisation of transmission, switching, signalling and end equipments which form the major subsystems of any telecom network. Over the last 40 years all these subsystems have been fully digitalised making available the promised end-to-end digital connectivity of ISDN. Two user network interfaces, viz. basic rate interface and primary rate interface are offered by ISDN supporting aggregate bit rate of 144 Kbps and upto 2048 Kbps respectively. Although ISDN is just moving from planning stage to prototype and implementation, CCITT’s vision of the networked society has resulted in much of the present planning and design being directed towards broadband ISDN. It appears that much of the world may skip the implementation of ISDN and move directly to B-ISDN.

Conceived as a blueprint for future networks, B-ISDN would support channels operating at bit rates as high 155 Mbps at the user premises. B-ISDN connection will support both circuit mode and connectionless services of a single media, mixed media and multimedia. Whereas narrowband ISDN makes extensive use of the existing network infrastructure, BISDN would require major changes in the network infrastructure and the methods by which the network is operated. The promising features of B-ISDN that make it suitable to function as GII are that B-ISDN

- uses internationally standardised user interfaces and protocols
- provides end-to-end digital connectivity supporting high bandwidths (at least 2.0 Mbps initially and evolving to 155 Mbps)
- efficiently supports a variety of both packet-switched and circuit-switched applications.

Integration of wideband services on a common network not only calls wideband medium but also an efficient switching technique. Asynchronous Transfer Mode (ATM) based on cell switching concept is most favoured switching technique for B-ISDN.
Asynchronous transfer mode (ATM)

Asynchronous Transfer Mode (ATM) is a set of international standards that define a new method for sending large quantities of voice, data and video information simultaneously over network. It is a packet-switching technology where information is broken up into fixed length packets or cells each of 53 bytes including 5 bytes used for addressing and directing the data through the network. Since packet size is fixed switching can be done entirely in hardware, which is much faster than software switching. This system allows low overhead, very high speeds, negligible delay, and constant time interval among cells. The latter two characteristics are crucial to real time voice and video. Therefore, ATM is ideal for a wide range of applications including traditional data communication, imaging, video, and multimedia. Of all switching technologies, ATM is the one that holds the promise of handling all types of traffic effectively and providing a common telecommunication switching architecture for both public and private networks. Conceived for implementation at high speeds (155 Mbps and above) on broadband public digital networks, its initial implementation will be on private networks at lower speeds (2.5 Mbps). First generation ATM products are already available in the market at the chip, board and system level. An interesting feature of ATM is its upward compatibility. ATM is capable of supporting its predecessor switching techniques like frame relay and Switched Multimegabit Data Service (SMDS). Both frame relay and SMDS are the forerunners of ATM designed specifically for high speed networks.

It is well known worldwide that developing countries like India have great strengths in systems and software areas. In my opinion, ATM systems, products and services represent a potential area of development in which countries like India can contribute significantly. If this happens, we would also see costs of telecommunications coming down to affordable levels. I must state that the present telecommunication costs are too high to be afforded by common man in most developing countries. For example, a cellular call cost seven times more than a cable phone in India, with the result only business segment is using cellular services. Even the Government of India considers cellular service to be too expensive to permit its own departments to use these services. It is, hence, very important that the cost of telecommunication services come down significantly to enable large populations in developing countries to make use of these services. Only then, the dream of realising a networked society would come true.

COMPUTER TECHNOLOGIES

Personal computers or computer-based systems would constitute bulk of end equipments in the networked society. With the continuing advancements in microprocessor technology, the personal computer systems are under going substantial changes. Two clear trends are already discernible with regard to personal computers for the networked society. On the one hand, emphasis is being placed on network capabilities in the personal computers and on the other hand, emphasis is being placed on powerful computing capabilities in the PCs. Accordingly, two classes of computers viz. network computers and multimedia personal computers, are emerging. Both classes of computers have to tackle the issue of multimedia information processing and management.

Network Computers (Net PCs)

Increased emphasis on network computing is bringing about metamorphism in conventional PCs to suit the connectivity and access requirements. Network personal computers or simply NetPCs are based on advanced microprocessors and are specially architected using hardware and software techniques to provide maximum efficiency under network environment. NetPCs would support a variety of sophisticated network access protocols and navigation mechanisms in an attempt to make network access as user friendly as possible. Network computing implies powerful server machines on the network instead of powerful client or end-user
systems. NetPCs are expected to free the users from a number of connectivity and access issues.

When multimedia applications are run on a network, different data types especially voice and video must arrive at their destination at the right time for the application to run effectively. This aspect assumes great importance as it calls for larger bandwidth links on the network. This is an area, which would require considerable attention in the future.

**Multimedia PCs**

On the line of network computers meant for the network environment, multimedia PCs will have specially designed architecture and configuration to handle multimedia applications. The emphasis on multimedia PCs is to provide adequate local computing power to run multimedia applications. The efforts are to bring the power of workstations to personal computers. Conventionally, workstations, which are based on RISC microprocessors have built in support for networking and run on operating systems that provide multitasking features. PC systems are now available with RISC microprocessors and built in network interfaces. PC operating systems are also advancing to match the operating systems of workstations. Dwindling hardware costs and popularity of graphic-based applications may make workstations as the entry level computer systems of tomorrow. In other words, today's workstations are tomorrow's personal computers.

**Transputer PCs**

A little reflection will show that a balance between network access and local computing power is what is desirable. The transputer technology which emerged from the United Kingdom promised to be an excellent approach to building both computing and communication capabilities on the chip. Guided by the parallel processing concept, the transputers were originally designed for high performance computing applications but the fundamental approach of giving emphasis to both communication and computing makes transputers an ideal choice as a platform for building future personal computers for the networked society. I am not aware of any major efforts in this direction around the world and I would like to see a shift from super computing area to personal computing in the field of transputers.

**LANGUAGE FOR MACHINE COMMUNICATION**

In 1984, an article was written by an American in AI (Artificial Intelligence) magazine, which states that Samskrit is ideally suited as an intermediate language for machine translation. That is, if we have to translate Japanese into English, first we translate Japanese into Samskrit and then to English. This model is shown in fig.1.

Fortunately, this first paper from the US on the Samskrit for machine translation generated a lot of interest in India that three conferences have already been organised on using Samskrit for computer applications. One of the most exciting applications is the use of Samskrit as a natural language interface for computers. When compared to English, Samskrit has many advantages for computers processing. This is due to the structural properties of Samskrit. For example, Samskrit is free from word ordering whereas English is not. The following Samskrit sentences mean only one thing irrespective of the order in which the words appear i.e. Lisa reads a book

लिसा पुस्तक पढ़ति (Lisa pustakam pathati)
Whereas, if the words are interchanged in the English sentence Lisa reads a book, the meaning changes completely; A book reads Lisa!! This one property of Samskrit alone leads to tremendous simplification in computer processing. There are also other properties of Samskrit that make it suitable for computer processing. Samskrit words are self-expressive as they all are derived from about 4000 basic roots. They are usually a combination of two or more roots. Once the meaning of the roots are known and a word is split into its basic roots, the meaning of the world becomes derivable and thus is self-expressive. In effect, this amounts to saying that the dictionary of Samskrit can be limited to 4000 words as long as the rules for combining roots and splitting words are unambiguous which, in fact, is the case.

There is a need to search for a suitable language for machine communication. English is not the ideal language. The structural, grammatical and semantic properties of Samskrit make it a suitable candidate for machine communication.

INFORMATION AND KNOWLEDGE MANAGEMENT

Communication infrastructure and powerful personal computers tell only one-half of the story of the networked society. Other important components include data, information and knowledge bases and the associated data management techniques and the navigation mechanisms required for accessing these 'bases'. It is now well established that there has been a continuous explosion in the generation of information on the earth in the last about 20 years. Indications are that the explosion will continue for many more decades to come. Perhaps, the ground is being prepared for the information society to evolve.

In order to substantiate the view point of information explosion, one tends to quote the annual publication figures such as one million journal issues, hundred thousands monographs, one million patents and tens of thousands of reports and dissertations. Such citations ignore a major source of information in the world today, viz the data from the bulk of information that would be generated in the coming decades. An estimate shows that all the planned remote sensing and weather satellites by the year 2000, would generate one terabyte of data per day. A little reflection will reveal that this is equivalent to about one million books of 300 pages each being published every day. If we compare today's volume with this, what we are generating is only a miniscule.

Apart from the current information, the world has been accumulating information over millions of years which are stored in different forms in different parts of the world. This information, when digitised would perhaps run into several million terabytes. All these statistics should give us an idea about what is in store for us in the ensuing information society. Perhaps, a large section of the population would spend its time in evolving effective and efficient data, information and knowledge management techniques.

Knowledge warehousing

Data warehousing covers data storage and archival techniques as applicable to large volumes of data. Advances in optical storage technology are expected to usher in phenomenal increase in the capacities of compact disks. Optical disks with capacities of 50 Gigabytes and more are likely to be available in the market soon with the Digital Versatile Disks (DVD) coming up and the blue lasers replacing infrared lasers. Clearly, optical storage is the most promising data warehouse medium for the networked society. While clear trends are visible to develop very large
capacity storage devices, efforts appear to be lacking in improving the access time from these storage devices. We are still in the milliseconds domains in accessing information from these devices. While storage architecture techniques like virtual storage may offer temporary solution to the problem of access time, the real solution would lie in improving the basic access mechanism for the optical storage devices.

Current data warehousing software efforts are directed towards corporate data resource, which needs to be managed effectively to maintain leadership in a competitive world. These efforts need to be scaled up by orders of magnitude before even the simple applications of the networked society can be managed effectively.

**Knowledge mining**

Data mining, also called knowledge discovery in databases, pertains to retrieval techniques used for handling voluminous mass of data. Very Large Databases Management Systems (VLDBMS) require new approaches to handling massive data the future databases would contain. Data mining ensures fast retrieval of specific data items from very large databases. It also attempts to enforce the condition that no stored data remains unretrievable.

Today's data mining techniques range from online application processing tools that query multidimensional databases to advanced artificial intelligence techniques like machine learning, neural networks, rule-based systems and genetic algorithms. To efficiently mine gigabytes and terabytes of data in a timely fashion, use of parallel processing techniques would become inevitable.

Data mining today is centred around local databases. For a networked society, data mining has to be implemented in large scale telecommunication networks. This is an area in which hardly any significant work has been done. In the networked society, the world would move from mining for coal or gold to mining for data, information and knowledge.

The present data mining techniques are not ideally suited for information and knowledge discovery and there is a need to look for new techniques. Traditional knowledge organisation and classification techniques used in libraries promise to offer to form a basis for innovative computerized techniques for information and knowledge mining.

**POSSIBLE ILLS OF NETWORKED INFORMATION SOCIETY**

Virtual reality is considered as the ultimate evolution of a networked society. It is not clear whether one should move towards virtual reality at all when we are very concerned about not partnering with nature adequately. As an example, in a virtual reality environment, a person may go for a swim in one of the most exotic swimming pools of the world and experience the pleasure and pain of swimming during Virtual reality session. At the end of the session, the fact would remain that the person had not actually entered the water. Should one take the society towards such a non-realistic virtual world? I feel that the role of virtual reality should be limited to training human beings to handle hazardous operations like operating a nuclear plant or flying a fighter bomber. At least, I am not in favour of the direction in which virtual reality is now evolving.

**CONCLUDING REMARKS**

There is little doubt that we are at the threshold of a new world order which may set in within the next one or two decades. A networked society would emerge as the central theme of living with the society's trade, economy, occupation, development, education, culture and leisure all centred around networking. There is a great promise for happier living in the new world order with the expected sea change in the value systems practised by the humanity leading to restoration of time-tested great traditional values.
The networked society promises to bring about a new style of existence for the humanity. Such an existence may be a solution for a large number of problems experienced by the society presently. However, ills, if any, of the new society is a matter that needs to be pondered upon. Even at the risk of being accused of being dogmatic; I would like to summarise my vision of the networked information society as a panacea for all ills of the present society.

I see nothing but a 'super golden millennium or two' ahead for the humanity, the glimpses of which we would witness in our own lifetime. Let us all look forward to the great joyous living that the new millennium promises and prepare ourselves to do each one’s bit in the process.

Thank you

Notes:
1. Plenary talk at the 49th Conference and Congress of International Federation for Information and Documentation held at New Delhi from 15-17, October 1998.
2. Director, Indian National Scientific Documentation Centre, 14, Satsang Vihar Marg, New Delhi-110067. Prof. Vishwanathan is a hard core technologist in the Computer & Communication field with nearly 30 years of experience.

4.5 LET US SUM UP

The advancements in the spread of telecommunication technology indeed offer practical and potential solutions to the difficult problems of human learning/interaction. This unit must have given you an idea of the future scenario of communication technologies. This short account of communication technologies for sharing knowledge and expanding understanding has been presented to indicate how communication technologies might be used in education. The major sub-themes touched upon in this unit are as follows.

- Most developed countries have either already achieved the status of ‘information society’ or are close to achieving it. New communication technologies are also being introduced in the developing countries; consequently, they are also on the doorstep of the ‘information age’. However, the developing countries lag far behind the developed ones as far as access to communication technology is concerned. They have to divert considerable portions of their limited resources towards manufacturing, adopting, mastering, controlling and implementing these technologies for the welfare of their populations.

- Communication technology has contributed or is contributing to the effectiveness of education and its development. However, these technologies have come in with some inherent problems with which they will continue in the developing countries for quite sometime to come. These problems are lack of resources, inefficient organisations, inappropriate policy, poor utilisation, indifferent attitude of teachers and students, and the like.

- Communication technology has a revolutionary role to play, Satellites have enormous potential to cater to ever increasing and diverse demands of communication. Today’s world has shrunk into a global village/society. More and more countries are acquiring communication satellites for domestic and international telecommunication.
The size of the communication networks of a country reflects its socio-economic and educational status. These networks make the flow of information more quick and efficient. Integrated Service Digital Network (ISDN) and Broadband Integrated Service Digital Network (BISDN) are sophisticated and advanced communication technologies/system which allow users to send and receive voice, data, images and other value added services over a telephone line. Fibre optics has added to the effectiveness of communication systems. Besides, the marriage between the computer and the telephone has further revolutionised the telecommunication systems, making them still more versatile. Through this marriage these powerful devices complement each other to pave the way for highly efficient interpersonal/interactive communication.

Communication technology has to play a crucial role for the disabled. Technologists are engaged in developing appropriate devices and technologies for disabled students to overcome barriers to communication, education and employment. This area is poised for major development in the near future.

4.6 CHECK YOUR PROGRESS: THE KEY

1. R&D makes communication technology more suitable for the requirements of the country concerned. It makes technology flexible and efficient, which in turn puts the country on the path of rapid development, socio-economic and educational.

2. Contributions:
   - Individualisation of learning
   - Access to learning resources
   - Creation of appropriate learning environment

   Problems:
   - Lack of resources
     (capital as well as human)
   - Ineffective management
   - Inadequate policies

3. i) Wide coverage
   - Fast and flexible communication
   - Variety of applications
     (telephone, radio, TV, disaster warning, remote-sensing, weather forecasting)

   ii) ISDN communicates by means of a variety of delivery modes/media, e.g. voice, images, and data.
REFERENCES AND FURTHER READINGS


Moses, Sir Charles and Maslog, Cripin (1978) 'Mass Media in Asia', *Asia Mass Communication Research and Information Centre*, Singapore.


Dear Student,

While studying the units of this block, you may have found certain portions of the text difficult to comprehend. We wish to know your difficulties and suggestions, in order to improve the course. Therefore, we request you to fill out and send us the following questionnaire, which pertains to this block. If you find the space provided insufficient, kindly use a separate sheet.

**Questionnaire**

Enrolment No. □ □ □ □ □ □ □ □ □

1. How many hours did you need for studying the units?

<table>
<thead>
<tr>
<th>Unit no.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tr>
<td>No. of hours</td>
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2. Please give your reactions to the following items based on your reading of the block:

<table>
<thead>
<tr>
<th>Items</th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Poor</th>
<th>Give specific examples, if poor</th>
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<tbody>
<tr>
<td>Presentation Quality</td>
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<tr>
<td>Language and Style</td>
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<tr>
<td>Illustrations Used (diagrams, tables, etc.)</td>
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<td>Conceptual Clarity</td>
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<td>Check Your Progress Questions</td>
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<td>Feedback to CYP Questions</td>
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</tbody>
</table>

3. Any other comments:

Mail to:
Course Coordinator (ES-318)
STRIDE, IGNOU, Maidan Garhi
New Delhi – 110068, India.