

**Government of India Sponsored Delegation
To
Select Universities in Canada and USA**

May 24 - June 04, 1999

END OF TOUR REPORT

*By K.R. Srivathsan
Professor & Head
Department of Electrical Engineering*

INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

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By K.R. Srivathsan, Professor & Head, Department of Electrical Engineering, Indian Institute of Technology, Indian Institute Kanpur

INTRODUCTION

The Department of Electronics (DOE), Government of India has undertaken a major initiative to train a large number of personnel in the area of Information Technology. As per GOI estimates, if the current software exports of the order of US\$ 3 bn. is to be increased to about US\$ 50 bn. per year over the next decade, the number of skilled persons in software needs to be pushed to about one million in the next several years. All the available means of education – universities, IITs/IISc, RECs, engineering colleges, private institutions, etc. do not produce more than a few 10s of thousands in software, IT or computer science. The country too needs to induct a large number of IT literate workers and professionals in various sectors of the economy. A massive effort is needed to train existing manpower in industry, business and government to conduct their work using IT as the means.

DOE also has undertaken a major initiative in ensuring that all government organizations to set aside a few percent of their budget to invest in and absorb IT within themselves. DOE has been studying the use of IT as a vehicle to provide quality training for large number of students and for manpower training of existing personnel. The approach being studied is to come up with IT enabled Distance Learning or On-line learning so that quality training materials and evaluation methods are made available to promote and maintain some uniformity of standards can be maintained. One specific program that DOE is considering is to promote a one-year PG training in IT for the large number of engineering graduates from the large number of engineering colleges to be collectively offered by the IITs/IISc, RECs, BITS, IGNOU, NCST and others.

The university systems the world over are being profoundly influenced by extensive usage of IT within the educational system. Flexible learning programs and inter-university collaboration take on a totally different dimension in the Internet era. It is therefore important for leading academic institutions in India to know in what way these developments in Internet and IT can be profitably utilized.

Keeping the above requirements and the need to know how leading universities are coming to grip with and getting to use the Internet and IT in their systems, the DOE arranged a tour by a Government of India delegation to visit select universities in Canada and USA during the period May 24 to June 04, 1999. The delegation consisted of the following members.

1. Mr. Ravindra Gupta, Secretary Department of Electronics (DOE)
and Head of the delegation.
2. Dr. S. Ramani, Director, National Centre for Software Technology, Mumbai
3. Prof. M.M. Pant, Indira Gandhi National Open University, New Delhi
4. Dr. Gautam Soni, Advisor HRD, DOE, New Delhi
5. Dr. B.K. Murthy, Joint Director, DOE, New Delhi
6. Dr. K.R. Srivathsan, Professor & Head, EE Department, IIT Kanpur

The delegation's formal itinerary went as follows.

25-26 May, 1999	-	Visit to Concordia University, Montreal, Canada
27 May, 1999	-	Visit to Athabasca University, Athabasca, Canada
28 May, 1999	-	Visit to University of British Columbia, and Commonwealth of Learning, Vancouver, Canada
1 June, 1999	-	Visit to Stanford Centre for Professional Development, Stanford University, California and discussions with Deans of University of California, USA
2-3 June, 1999	-	Visit to Carnegie Mellon University, Pittsburgh, USA

In all the venues, the delegation had scheduled visits to the facilities, concerned R&D activities, discussions with concerned Deans and officials related to IT enabled learning programs, inter university collaborations, electronic courseware authoring/generation facilities, study of their approaches to pedagogy and academic program management over the Internet, etc. A summary of the discussions, observations and some comments on the way these approaches may be of use under Indian conditions is given in the following sections.

1. Visit to Concordia University, Montreal (May 25 - 26, 1999):

The meetings and visits were coordinated by Dr. Balbir Sahni, Director, Centre for international Academic Cooperation at Concordia. On May 25th, a meeting was held between the Deans, Vice-Rector and some of the Professors of Concordia. The meetings were held in the Faculty of Engineering and Science. Some of those present in the meeting include Prof. Rama Bhatt, and Prof. Li of the CSE faculty, Prof. Esmail, Vice-Rector Dr. Lightstone, Dr. Rakheja, Prof. Richard F. Schmid, Dr. Rakheja, A profile of the university will be of some use. Mr. Ravindra Gupta explained the purpose and objectives of the GOI delegation.

Concordia has about 25 thousand students registered under three major faculty groups: Engineering and Computer Science; Commerce and Business Administration and Arts and Science. The faculty of Fine Arts can be called as the fourth group. It has about 700 full-time and 700 part-time faculty. The city of Montreal in which the university is located has large ethnic diversity and has a large French speaking population. The university has interaction at international level with institutions in countries such as Mexico and Brazil. Some Indian institutions have MOUs with Concordia.

It was explained how Concordia has managed to be sensitive and responsive to the needs of the community. The greater Montreal's demands for a large number of graduates in IT and the fact that 40% of the 17000 students in the Faculty of Engineering and Computer Science are part-time has forced them to give a lot of emphasis to IT enabled education. Their program in IT is well recognized. For 17 years they have been running a program of Diploma in Computer Science under Continuing Education. Recently, they have started a bachelor's program in Software Engineering leading to BSE degree. The program is supported by 30 faculty and has a registration of about 1000 Students.

Due to large number of part-time students, many classes are held between 4.00 PM and 10.30 PM. Some of the distance education programs are difficult to manage due to non-homogeneity of enrolled students. Methods of on-line testing and evaluation are being introduced.

Visit to Faculty of Arts and Science

On 26th, the delegation visited the Loyola Campus of Concordia that houses the Arts and Science faculty. Prof. Andrew McAusland and Dr. Martin Singer hosted the delegation. They showed how they generate courseware for Web based education and conduct the classes over Internet. As an example, I could take a peep into the organization and management of the

Statistics Course INTE296 that is conducted entirely over the Internet without any regular lectures. The course uses a mix of sophisticated Internet utilities and Web browser based presentations to deliver the materials. The studio facilities for recording lectures were economically configured. The editing facilities and conversion to Web server compatible courseware were essentially organized in a medium sized room. The basic infrastructure in this facility enabled two independent functions.

1. A large NT based Web server with 200 GB space with two video cassette players connected through TARGA 2000 hardware interface and MCXpress software. This enabled development of video/audio courseware with variable compression – for T1 bandwidth or 28.8 Kbps modem bandwidth (or others, say, 384 Kbps quality) as options. The T1 quality is used for distribution over LAN with full screen video, while the 28.8 Kbps version runs a 2” X 1” frame video over dial-up links. The PC clients use the widely available RealMedia.G2 software for playing the lectures.
2. Another set up had an NT based Web server with a Fujitsu document scanner attachment used to convert printed documents to compressed HTML format. This can be interleaved or supplemented with PC edited versions of HTML documents to produce Web based electronic courseware.
3. NetObjects Fusion 4.0 package was used to “author” and organize the courseware into modules and disseminate over the network. Cold fusion package was used to assist grading and evaluation of the students. One feature of NetObjects is that it provides ODBC to Excel, Oracle, Access and Dbase.

One example course – INTE296 on Statistics for the Faculty of Arts and Science was conducted entirely without formal classroom lectures over the net. The students registered in the course get chat rooms over the Web and email. The chat room facility was built using Java. A large test bank of questions is sometimes used to generate assignments automatically. Mid-term exams are conducted on-line. Final examination is invigilated as in conventional courses. Some idea of the features of the Web home page for the management of this course may be got from the following address: http://132.205.57.9/inte/html/inte_296.html

The student can study the course material or go over the video lectures on demand either at home over modem line or in the university at designated access facilities.

The Web based courseware generation and classroom recording facilities were manned by about 3 or 4 persons under faculty supervision. A typical class may be managed by a faculty and two TAs. Phone contact, email, chat rooms and personal assistance were made available to all registered students. Differential fee structure for campus and distance students was used.

The same facility is used for several regular on-campus courses to serve as classroom reference and supported by a course administrator. In future, Concordia is planning to invest more in video and use of E-Commerce for course management.

On 26th May, a presentation was given by Dr. Dennis Dicks in the Management School of Concordia to the delegation on their programmes and efforts in supporting distance learning for persons in industry. Their programme for special training for executives in ICAO (whose Headquarters are in Montreal) was explained. This program used a WebCT server for on-line instruction. WebCT permitted setting up of calendar, duration of a test and constructive feedback from participants. One of the courses was in the area of Multimedia Design and Production. Dr Dicks outlined their Aviation MBA program for ICAO and the production software using Director package. The charges were about \$2000 per course.

A videoconference was organized between the delegation and a small team at Athabasca University headed by Prof. Jonathan Baggaley. The communication was set up over standard ISDN dial-up links. This permitted advance interaction with the members of Athabasca, the next destination of the delegation. The conferencing was reasonably effective – about 7 members at Concordia and 3 from Athabasca. With ISDN costs in India having come down substantially, this is also likely to become common in India as well.

A concluding discussion was held with the host towards the evening of 26th. The hosts stated briefly about their program with China, where they have started a diploma in Computer Science Program and joint guidance agreement for doctoral program in IT. This was facilitated by CIDA. An MOU between DOE and Concordia was prepared and it was proposed to have a joint committee to assist the DOE's efforts to bring IT enabled education in IT within India. Senior officials of Concordia also promised to return the visit in the next few months.

MAY 27, 1999: VISIT TO ATHABASCA UNIVERSITY

The visit effectively began with the morning bus ride from the hotel in Edmonton where the delegation was staying through the prairie lands to the campus of Athabasca University, located some 150 Kms north in Athabasca. The campus has the offices, discussion rooms, some seminar rooms, electronic courseware development, servers, printing and publications facilities set amidst beautiful countryside. Prof. Jonathan Baggaley and Mr. Iain Grant, Coordinator, International Projects received the team. During the introductory meetings with the university officials, the following profile of its programs emerged.

The university has about 17,000 course-registrations from students. About 50% of the students are in Alberta and the rest from across Canada. They also have some international students registered from their respective home countries. The university boasts maximum productivity per faculty. There are agreements at international level with some institutions from a few countries. In India, IGNOU has been interacting with Athabasca.

The programs are managed by about 100 faculty mainly located at Edmonton and Athabasca. The campus is connected by a T1 link to Internet at Edmonton. 5 full-time faculty and 10 TAs manage the Computer Science program. Annual course registration in CS is about 3000.

Athabasca, when it started around 1978, used correspondence method for conducting its programs. It is now entirely Internet based. The Internet based courses are supported by toll-free phone services to the TAs and Instructor. The university has a Department of Course Materials. Less than 9 of the courses are purchased from other universities. The rest have been designed and developed entirely by the local faculty. Typical B.Tech. degree program requires completion of about 40 courses. The charges per course is among the lowest in developed countries – about \$350 per course. AU conducts a part-time 3 years duration MBA program.

AU has a unique program leading to Masters degree in Education Technology. Prof. Jonathan Baggaley heads this program. IGNOU has asked for assistance by AU in running a similar program.

Any students can register for a course at any time and courses are begun every month on-line over Internet. The courses are reinforced by classroom type seminars at Edmonton and some other centres. The first course quiz is conducted by a tutor visiting the concerned centre and helps in establishing direct contact with the student. Immediately after registration and receipt of payment, the university publications centre mails a package of text books, reference materials and a CD-ROM that gives both the content and access rights to the student to register on-line from any Internet linked PC.

Programs by AU are well sought after a continuing education support by persons who are already employed. The average age is high. There is a problem of large drop-out, or non-completion of the program. In many cases, the students (mostly adults consciously working to learn) complete a few select courses for their job needs, get the certificates and then drop out of the remainder of the degree programs. Each course demands about 8 to 12 hours of effort per week.

COURSE DEVELOPMENT PROCESS AT AU

During the discussion and presentations in Athabasca, several senior officials explained in detail the various aspects of course development process and its maintenance cycle. Typically a course in IT has about 2years lifetime. It is constantly revised and updated. A course development process looks as follows:

Phase-1: Program Proposals including objectives, specifications, requirements, etc.

Phase-2: Courseware development, brochure and packaging. This phase includes incorporation of study guides, Assignments and support materials.

A variety of tools are used for courseware authoring. The relevant materials are checked for Web conformance. Facilities such as Chatroom registration, Audio lectures and Power point presentations are included in the CD-ROM of the course supplied to the students. The registration CD includes electronic help desk access. Streaming Video over WebCT of about 8 to 12 mts. duration is being provided as a supplement. RealMedia for lectures and PowerPoint for presentations are used in the client systems. A typical Java based course material was demonstrated.

AU has a unique ViTAL Programme Coordinated by Mr. Martin Husch. An objective of ViTAL is to package course material as .exe file in CD-ROM. The material requires no unzip. A variety of tools – Lotus Notes, PowerPoint-6, Domino Server and Adobe Acrobat (.PDF files) are used. The different files are attached and linked. Although Lotus Notes supports synchronous chat-room, it has been found difficult to use. An interesting use of Lotus Notes was to monitor the activity in a course – such as when a student submitted an assignment over email, whether it was responded in time by the tutor or alert a tutor to respond in time, etc. A lot of thought needs to be given to provide back-office support and monitor the progress of the course.

In the evening, a meeting was held with the President of AU, Dr. Dominique Abrioux. Mr. Iain Grant explained the proceedings earlier. He suggested that involvement of IITs/IISc and AU in a consortia effort for content development can lead to a combination of quality courseware and excellent Internet based pedagogical approach. Prof. M.M. Pant of IGNOU said that IGNOU is planning to launch a Diploma programme in IT by September, 99. The need to draw upon the experiences and content development across the world was spelt out. Dr. Ramani emphasized the need for courses in areas other than IT through this media. Mr. Grant suggested the formation of a consortium by AU, Concordia and India.

President Dr. Abrioux spoke about the successful programme in Accounting being conducted by AU in Japan for about 750 students with 70% pass rate. He said that AU has a balanced approach to course development in all its three aspects: (i) Course materials, (ii) Support systems involving on-line assistance, supplementary materials and pedagogy, and (iii) Testing and evaluation – all well adapted to the Internet environment. AU is willing to share its expertise and help in providing optimal mix for its own and local needs of the concerned institutions. At international levels, outside of North America, AU always works with a local partner. AU credit can be given to courses conducted elsewhere under joint partnership with

leading institutions. AU can also franchise its program through local partners. Joint courseware development with good institutions needs to be explored.

May 28: Visit to University of British Columbia

The visit to UBC was a short one with just one long meeting with officials connected with the Director Mackie Chase of the Centre for Intercultural Communications(CIC) represented by its, Mr. Peter Moroney Director of Diploma and Certificate Programs, Mr. William Koty, Manager of Internet Programs (both from the Continuing Studies office). Dr. Michael Davies, Head of Electrical and Computer Engineering, Dr. Dinesh K. Pai of the Department of Computer Science and Mark Bullen, Asstt. Director of Continuing Studies joined the team later.

UBC is among the four large universities of Canada with worldwide renown (the other three being Toronto, McGill and Montreal). Its budget is around \$800mn from federal grant and \$300mn from others. It has \$268mn endowment. Some 6% of the endowment are earmarked as margin for excellence.

It pioneered the development of WebCT package that has become popular for developing and conducting Web based courses. UBC has standardized its courseware around WebCT. It reduces development time. Faculty is encouraged to put their course materials on their respective web sites for on-campus programs. In UBC, the Open Learning Agency forms its Open University component. The Continuing Studies division coordinates the different efforts related to distance learning system. Those who are registered in distance learning courses are organized into groups of twenty or less and provided facilities for on-line chatroom support. Some glimpse of their programs can be had from the site courses.cstudies.ubc.ca/-bullen/.

Some issues concerning distance education technologies and virtual institutions were highlighted. One is to carry out ERP for virtual organizations. Dr. Michael Davies observed that lectures posted over networks were more in the style of magazines. He outlined the recent developments in xml – the extended markup language as a medium for presentations over Web. This permits matching database objects with learning objects.

Mark Bullen spoke about the need for organizational restructuring for distance learning. In a sense, the Internet forces us to “renegotiate our social contract and social responsibility”. UBC is looking for strategic understanding and relations at international level. UBC has some arrangements with IIT Delhi and Guru Nanak School of Nursing in India.

The visit concluded with a post lunch meeting with Mr. Larry Sproul, Director, International Liaison in the Office of the President.

May 28, Visit to Commonwealth of Learning

The visit to UBC was followed by a visit in the afternoon to the Commonwealth of Learning, which is headquartered in Vancouver. CoL is about ten years old. India is a joint partner of CoL under the Commonwealth program. It has been set up to promote Distance and Open Learning in the commonwealth countries. It has core budget of \$5.5mn and gets additional support from special projects. It has a staff strength of 23 to 25 persons. It has a wing in India called Commonwealth Education and Media Centre in New Delhi.

Mr. David Walker, Education Specialist, Education Technology, Mr. Patrick Julien, Chief Operating Officer, International Development and Steven Gibbons represented the CoL during the discussions. Mr. Patrick mentioned that the CoL had undertaken special training projects in Malaysia for the imparting training skills required for the servicing of the large number of

outboard motors in boats used widely there. The CIDA - DOT (India) MoU for a \$15mn. project that includes R&D component was mentioned. CoL has specialized in special distance learning projects that empower persons for subsequent economic applications. They act as a consultative body that can put together funding and user agencies, identify technology suppliers and support issues, etc. so as to implement pilot projects, or institutional mechanisms for education and training in diverse areas. They mentioned that for activities like the one DOE is contemplating for IT enabled education for IT sector, we can jointly approach major funding agencies such as World Bank, ADB, CIDA, etc.

It was brought out that strategic thinking in IT enabled learning is extremely essential. The issue should also cover concepts of credit banks, students' support systems that can enable almost boundary free virtual institutions. The need for high bandwidth Internet backbone within India to support this activity was emphasized. It was mentioned that Canada is already planning an INET-3: a 100 Gbps national network.

May 29 –31, 1999: The Long Weekend

This was a memorial weekend in North America. The author had a visit on May 29th to Simon Fraser University environs with his IITK colleague – Prof. Ashish Mukhopadhyay, who was on a visiting appointment at SFU. On 30/5/99 the author reached San Francisco and stayed with Dr. Raj Raghuram, ex-Professor of EE at IIT Kanpur and currently working with the Applied Simulation Technologies in San Jose. With Dr. Raghuram as a guide, the author could tour around much of the Silicon Valley of San Jose. He could get in touch with several IITK alumni in the area. He had an opportunity to visit Fri's – one of the largest electronic shops in USA. A close look at some of the latest Digital Handicams from Sony and other Japanese companies was revealing. At a cost of \$1000 to 1600, one can get an all digital camera with IEEE 1394 interface. Combined with AvidXpress type package and digital VCP connected to a Win-NT server, it is possible to set up compressed streamed video production of lectures for delivery over Web at fairly low cost.

June 01, 1999: Visits to Stanford and UCSC Extension Centre

The visit to the sylvan surroundings of Stanford University was extremely brief. The only location where some discussions took place was the Stanford Centre for Professional Development (SCPD). Mr. Michael Rouan, Stanford On-Line Manager, hosted the meetings. Stanford has remote classrooms with many of the large Silicon Valley corporate such as Intel, CISCO, etc. They are connected by high bandwidth fiber optic (ATM – OC1?) links.

There are 9 classrooms in the SITN building of Stanford where the SCPD is located. Each classroom is fairly hi-tech, but equipped more for a classical studio type recording of lectures and with projection / TV equipments. The teacher's table houses necessary systems for capturing projection of OHPs, PC based illustrative materials, written papers and sound recording facilities. The blackboard is segmented into TV-aspect ratio based blocks for ease of camera coverage. At least three cameras are used – one to capture the lecturer, another for projection material on the table, third one to capture the blackboard area and a fourth one to capture the audience.

All lectures offered in SITN classrooms are multicast live to participants in the subscribing R&D companies of the Silicon Valley. They are also recorded for archival and playback as lecture-on-demand for distant students. There was no time to see how and what kind of web or Internet based courseware is developed at Stanford. Stanford essentially serves its own part-time distant students who have already spent sometime in its campus and who are in its own

region of California. It does not seem to have a program for distance learning in the sense open universities attempt to provide.

Since Stanford has been attempting a paradigm of on-line learning over wide-band links with live remote classrooms and very different from other universities, we need to study it more closely. The famous attempts of Prof. Gibbons of the Department of Electrical Engineering at Stanford in learning wherein he had experimented with different on-line and off-line formats of remote “classrooms” are worth studying. One important feature of that was how to arrive at a pedagogic approach that ensures that the effectiveness of “distance learning” can equal or even surpass conventional classroom approach. He had done several quantitative studies in this area.

Discussions with University of California (Santa Cruz) Officials at Santa Clara

The meetings took place in the UC Extension Center at Santa Clara. From the UCSC side, Dan Clarke, Director, Software Technologies Department and Dale Stansbury, Assoc. Dean for Economic Development were present. Dr. Gary Matkins, Dean of UCB Extension Program from Berkeley joined them. UCSC Extension Centre conducts a large number of courses (over 100 courses to choose from) over the Internet using America On-Line (AOL) services. The courses are tailored for the large number of working professionals in industry and R&D who need to pick up allied specialization for increasing their productivity.

Their courses are very popular with the professionals in the Silicon Valley. They are not restricted to IT related areas only. These programs are also referred to as Global Education through Mixed Media (GEMM). Courses may be delivered through CD-ROM or through AOL or via Internet. The type of courses range from Project Management, Marketing, Business Administration, to Hazardous Materials and many others. There is tremendous demand from professionals for such courses. The UCSC Extension Centre at Santa Clara, being located in the Silicon Valley has large local registration and conducts regular classes in some cases. It supports access to Stanford On-Line programs also.

UCB Dean Gary Matkins informed that UCB has over 90 courses in Engineering developed and approved by UCB faculty. The entire material is owned by the University and can be made available to Institutions through suitable MOU.

The meetings at Stanford and UCSC Extensions Centres were organized and hosted by Dr. Venkat Rayapati of National Semiconductors at San Jose.

June 02-03, 1999: Visit to Carnegie Mellon University

The delegation reached Carnegie Mellon University at Pittsburg after a weary red eye flight from San Francisco. Dr. Raj Reddy and Dr. V.S. Arunachalam hosted the team for the two days. The two were among the prime movers to motivate the Indian delegation to undertake the tour.

During the first meeting in the morning with Dr. Raj Reddy’s group, presentations were made on some current initiatives and projects under progress at CMU where India can participate and contribute very substantially. These were related to Digital Library, Software Policy and Digital Government. Of them, two are of great importance.

CMU has begun a major initiative to create a wholly digitally stored version of all books and literature that have been published in the world and make them available on the Internet of the future. This project is called the Universal Library. In the presentation, it was mentioned that there are perhaps about 100mn books, music and arts titles in the entire world produced till

date, of which about 10mn need to be made easily available. Every one of these printed titles need to be scanned, compressed using OCR or other means, digitally archived and made available over the Internet. If the cost of conversion is about \$20 to \$50 per title, it only takes a few million dollars to convert about a million titles. In terms of storage costs, it was pointed out that the entire published information in the world can be stored in affordable memory. For example, one petabyte (or 1000 terabytes costing less than \$30mn today) can store a billion books, a billion photographs and 3000 years of music. There are about 100,000 hours of video material that can as well come into this memory. Average density of 1 petabyte dispersed over the earth's surface works out to less than 4 bytes per square meter of area!

The creation and availability of this universal library will set the concept of "Global Village" into concrete terms. It can be used for research, technology transfer, democratization of information, education, distance learning and promotion of understanding across the world.

CMU has developed a set up for scanning, OCR and archival of books in English language (that can be extended to European languages). This, they are willing to share. Dr. Raj Reddy was keen that DOE expedites projects relating to OCR of Indian language scripts. CMU has been studying and developing appropriate GUI or MMI for browsing such voluminous number of titles. The group demonstrated the Hyperbolic Tree based browser. Xerox has a browser package called Insight for such applications. The Web address alpha.ulib.org/web.root/-htree may be accessed for further details.

A small, but interesting adaptation of Visioneer Paperport 6000 Scanner by Vivitar was shown. It enabled manual scanning of pages of thick books without removing the binding. It is a low cost scanner that can easily be set up in any institution. The associated software for driver and image server are being made available from www.bookscanner.com, www.vtiscan.com and scannerver.ulib.org. A mention was made of the **Infomedia** package from CMU intended for Digital TV and Digital Movie projection using MEMS. A course on Multimedia Information Processing (MMIP) is offered by CMU.

Dr. Raj Reddy pointed out that Tera PC will be a reality by 2016 to 2020. A major objective of his group is to enable socially useful applications that can exploit the future Internet and Tera PC. These can range from Commerce, Healthcare, Quality of Work and Life, Communications, Design and manufacturing, Research and "Digital Government".

In the major initiative on Digital Government by the federal government of USA, a think tank (called PTAC, a technical Advisory Committee) has been set up where Dr. Raj Reddy is a member. The objectives of Digital Government were many – Responsive Government, Government services and information available to all regardless of location, literacy levels, etc., minimize transportation costs, Digital Democracy and E-voting, response to natural disasters, automated processes and accelerated responses, one stop location of information and shopping, etc. It was pointed out that in US, \$500bn of tax revenue comes from IT persons and industry. A report of the Coordination Committee on IT and Communications that deals with the above issues may be had from www.ccic.gov.

Dr. V.S. Arunachalam led a discussion on the proposed Sankhya Vahini Network in India and its progress. He specifically asked the author to discuss with Doordarshan and AIR to utilize its services for the entertainment media sector. The Sankhya Vahini proposes to provide a multi-gigabit network as backbone over two reserved fibers from the DOT trunk. It proposes to raise the necessary investment beginning with 2.45Gbps (or SDH-16) with ATM equipment to commence its services. D. Anand Patwardhan made a presentation on Sankhya Vahini.

A proposed first phase route diagram of Sankhya Vahini showed that it leaves out much of India, emphasizing some big cities in the western and southern India with Bhopal and Delhi

added. While an MOU with DOT for the reservation of fibers is under progress, it will require necessary legislation to become an independent backbone service provider. It is not clear what relation it will have with the DOT's own national backbone venture for which an order for supply and installation against a tender has already been awarded. It will be wonderful if Sankhya Vahini succeeds with an enlarged scope and vision. The continued bureaucratic fragmentation of networking efforts in the country by different well-meaning agencies is a serious drag on the country and this brings out the necessity to get the acts of DOT, Sankhya Vahini, ERNET India and other national efforts in networking together through an active consultative body.

June 04-09, 1999: Visits to Queen's and Memorial Universities in Canada

With the visit to CMU at Pittsburgh, the official part of the delegation's tour was complete. While the other members of the delegation were returning to India, the author visited Queen's University and Royal Military College at Kingston, Ontario. He delivered a seminar on "Approximate Modeling of Call-Level Traffic in an ATM Network" at the Department of Electrical Engineering at Queen's. He visited the Piezo-Ceramics Characterization laboratory at the RMC.

On June 06, he reached St. John's, Newfoundland. On 8th June, he visited the Telemedicine facilities at the Health Sciences Centre of the Memorial University. Newfoundland has a small population sparsely spread over a large geographical region. This necessitated means to deliver cost effective, timely and quality medical care to the population. The HSC has set up an operational Telemedicine Network that has been in use since 1978. It is headquartered at the TM Centre in HSC. The doctors and the officials of the TM Centre felt that even in populated developing countries, their experience would be useful, as the distance between specialists and the needy patients is often large.

The TM Network is based on a combination of IP over VSAT network and narrowband ISDN. The remote centres have video conferencing for consultations over 128, 384 and 512kbps bandwidths. Off-line teleradiology with store and forward networking has been very useful to get the advice of radiologists who are otherwise scarce. A demonstration showed that the quality is good. The TM services get no funding from the Memorial University. They are keenly looking for international projects to share their experience. The main medico-legal issues they had to contend with were the problems with billing agencies. The TM services have brought in greater collaboration between health and non-health sectors. They are constantly attempting to improve the quality. Satellite appears to be the preferred medium. The Advanced Satellite Communication Initiative by Canada is including their services as a major component.

Some Observations

The observations and insights gained during this tour highlights several approaches that can be taken by the DOE in facilitating IT enabled education and services in India. The first obvious one is to have direct associations with concerned universities in sharing their experience, courseware, joint developments, etc. The medium of delivery is converging to be the Internet and Web based dissemination. Streamed video, as part of Web delivery for lectures is certainly becoming a de facto standard. A lot of back-office support for managing courses is needed, being tried and yet to get standardized. Excellent tools for Web courseware authoring and course management support are available.

The network in India is too feeble to support IT enabled education over a distance. The country as such has no backbone. The experience with DOT, particularly in providing quality terrestrial inter-city links has been worrisome at the least. Most small towns' DOT entities are not even

able to produce a demand note for a leased line request. There is thus a strong need to support satellite based delivery for IT enabled education. Encouragement of multimedia authoring and Web based course delivery and management with back-office support needs to be done in a very substantial way. Some efforts in standardizing content generation, delivery and evaluation will help in accelerating the absorption of IT enabled education across the country.

In all the above contexts, ERNET India can play a significant role. There is a need to synergize the ERNET India plans with those of IT enabled education. This role will remain with the ERNET community even if the country gets good network connectivity from other agencies such as VSNL, DOT or others.

(K.R. Srivathsan)

Submitted July, 1999.