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20457

DISTR.  
LIMITED

IPCT.186(SPEC.)  
10 November 1993

UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

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ORIGINAL: ENGLISH

Workshop for Asia and Pacific Region  
Representatives from the  
Telecommunications Software and  
Equipment Industries  
(through Participation at the  
Electronics Trade Fair)  
Beijing, China  
22-26 September 1993

REPORT

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V.93-90112

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## I. INTRODUCTION

1. The Workshop for Asia and Pacific Region Representatives from the Telecommunications Software and Equipment Industries (through participation at the Electronics Fair) was held in Beijing, People's Republic of China, from 22 to 26 September 1993. The Workshop was organized by the United Nations Industrial Development Organization (UNIDO) in cooperation with the Beijing University of Posts and Telecommunications and the Asia-Pacific Telecommunity. The Workshop was attended by 76 participants from Asia and Pacific countries representing both private and public telecommunications institutions.

2. The main objective of the Workshop was to develop closer cooperation among Asia and Pacific countries in the production and marketing of telecommunications software and equipment. In particular, the Workshop:

- (i) reviewed the status of development of telecommunications software in the region;
- (ii) provided a forum for the exchange of information on major telecommunication software packages, manufactured products and technologies available in the region;
- (iii) discussed relevant prerequisites for entry into production of telecommunications software;
- (iv) made specific action-oriented recommendations on future activities to be undertaken by UNIDO in the field of telecommunications software; and
- (v) featured bilateral negotiations aimed at fostering technological cooperation among participating countries. These negotiations led to 38 working agreements and memoranda of understanding<sup>2</sup> on various aspects of technological cooperation including joint ventures, transfer of technology, equipment delivery, information exchange, expert service, training and other forms.

## II. AGREED CONCLUSIONS AND RECOMMENDATIONS

1. The Workshop recognizes the need to strengthen institutions that support development of the telecommunications sector in the region. An important function of such institutions is to develop telecommunications software appropriate to the needs of the different countries. The Workshop recommends that sub-regional centres and a regional network be promoted to facilitate cooperation among these centres and national institutions. The Workshop invites the Governments and industry associations of the countries in Asia-Pacific region to render support for the establishment of such networking of telecommunications software development centres. UNIDO and the APT in cooperation with the APCTT and ITU are requested to undertake a feasibility

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<sup>1</sup> See Annex I: List of Participants

<sup>2</sup> See Chapter V: Results of Bilateral Discussions on Cooperation Projects

study with a view to prepare a proposal for the establishment of the sub-regional centres and regional network. In this connection the Workshop recommends that a committee be formed that will evaluate the feasibility report and identify national agencies that will participate as focal points. Membership in the committee should be drawn from telecommunications organizations.

2. There is a need to increase awareness on the specific issues related to the development of telecommunications software. To facilitate this need, international and regional organizations are requested to support study tours for software development managers to have technical discussions with their counterparts at telecommunications research development centres that are internationally recognized as centres of excellence.

3. Research and development institutes are essential in supporting telecommunications equipment manufacturers in developing appropriate software systems. The workshop invites R&D institutes, software houses and University Computer Science Departments to convene regional meetings to facilitate exchange of information on major achievements in new telecommunications software packages. UNIDO and APT in cooperation with APCTT and ITU are requested to support these meetings. The proceedings of these technical meetings should be published and widely disseminated among telecommunications administrations and equipment manufacturers in the region.

4. Software accounts for the largest proportion of the cost of telecommunications equipment. This is particularly so for digital switching systems which represent a very high investment for a telecommunications network. Promotion of local manufacturing of telecommunications equipment should therefore emphasize support for building software development capability. Countries like the People's Republic of China, India and the Republic of Korea have made significant progress in developing switching software products and opportunities exist for greater transfer of technology among countries of the region. UNIDO is requested to continue promoting transfer of technology in this field at the enterprise-to-enterprise level.

5. The rapid growth of telecommunications services in the forthcoming years will lead to increasing demand for software for telecommunications services management. Some examples are software packages for planning, service order management, outdoor plant management, billing and financial management. The Workshop recognizes the need to develop such software packages and recommends that a Working Group be formed to undertake a survey of requirements in participating countries. The findings of the Working Group should be brought to the attention of the software industry in the region.

6. Software design activities should be supported with sufficient quality tools. The Workshop recommends that UNIDO examines feasibility of establishing a regional software engineering laboratory with the objective of providing hands-on experience on latest set of tools and methodologies. The laboratory may also provide consultancy to participating countries.

7. For countries which require expertise in building very large and complex systems, the Workshop recommends that UNIDO should examine the possibility of providing them with technical assistance.

8. The Workshop recognizes that quality assurance and reliability are of utmost importance in telecommunications software. Software products should conform with the requirements of ISO 9000 and should be subjected to the most stringent standards of testing. UNIDO in cooperation with the International Institute for Software Technology based in Macau is requested to develop and promote a region-wide scheme for software quality assurance. The scheme should include training of national experts charged with the responsibility of certifying telecommunications software products. Training workshops for this purpose should preferably be organized annually subject to availability of funds. A forum for exchange of experiences on use and availability of different telecommunications software packages should be established. Such information should be widely disseminated, preferably through existing publications of UNIDO, APT and UNU/IIST.

9. In order to promote greater interaction among telecommunications software specialists in the region, UNIDO is requested to prepare a directory of R&D institutes, University Computer Science Departments, Software houses and experts engaged in telecommunications software development. The directory should be updated periodically and circulated among all countries in the region.

10. Human resource development is crucial in the software industry. There is a need to develop educational materials to provide adequate training in telecommunications software. UNIDO is requested to consider preparation and publication of a book on "Telecommunications Software" and organize training workshops based on the book.

11. The Workshop commends UNDP for supporting some telecommunications software development projects in the People's Republic of China. Participants recommend that UNDP along with other development and financial institutions should continue supporting telecommunications software development projects in the region.

### III. ORGANIZATION OF THE WORKSHOP

#### Opening of the Workshop

1. The opening ceremony was addressed by Mr. Song Zhiyuan, President of the Science and Technology Committee of the Ministry of Posts and Telecommunications (MPT). Mr. Song is also the President of the Chinese Institute of Communications (CIC). Mr. Song welcomed the foreign delegates, representatives of Chinese enterprises and institutions and officials representing international and regional organizations. He stated that with the rapid rate of economic development in the region, telecommunications is recognized as an important infrastructure of society receiving high attention by Governments. Due to the reform and opening policies adopted by the Chinese Government, telecommunications has been given high priority. Over the last 14 years, the switching capacity has increased by 775 percent to 29 million lines by the end of 1992. By June 1993, 99.4 percent of all exchanges were automatic of which some 70 percent were digital.

2. There are currently 370,000 cellular mobile telephone users in China. 4 million radio paging systems are in use. 47 percent of long distance transmission lines use optical fibres while 48 percent of microwave systems are digital. China plans to increase telephone penetration from the present 1.63 per 100 population to 3.0 per 100 population by the end of 1995. By the year 2000, it is foreseen to increase telephone penetration to around 5 to 6 percent representing a switching capacity of more than 100 million lines. The big challenges for telecommunication authorities are thus quantitative growth coupled with quality improvement and increase in value-added services. In this respect a forum for exchange of experiences among different countries is very beneficial and the UNIDO Workshop which is the first of its kind in China provides such a forum. He stated that UNIDO's efforts to promote telecommunications software training, development and technical cooperation is very much appreciated.

3. A representative of the UNIDO Secretariat also addressed the opening ceremony. He presented the main objectives of the Workshop and described some of the previous UNIDO activities in telecommunication in the region which have led to the current Workshop. UNIDO organized the Workshop for African and Arab Representatives from the Telecommunications Industry in New Delhi in 1990. As a direct follow-up to that Workshop, UNIDO is promoting a roving demonstration of telecommunications equipment and technologies in Eastern and Southern Africa in collaboration with the Government of India. UNIDO also convened the Meeting on Technological Cooperation for the Development of the Telecommunications Industry in the Asia-Pacific Region in Bangalore, India in 1991 and the Workshop for Asia and Pacific Region Representatives from the Telecommunications Industry in New Delhi in 1992. The current Workshop is a direct follow-up of the New Delhi Workshop where participants, in recognizing the importance of software in telecommunications and the comparative advantages of the region in this field, requested UNIDO to convene a meeting on the subject. The UNIDO representative also stated that UNIDO is promoting a regional type approval testing and certification centre and a regional study on telecommunications equipment manufacturing capacities.

4. The Workshop was also addressed by Mr. Xiong Bingqun, President of the China Academy of Posts and Telecommunications of the Ministry of Posts and Telecommunications. He stressed the importance of software engineering in the telecommunications industry and called upon UNIDO to continue promoting telecommunications software development in the region using existing facilities such as the telecommunications software development centre at the Academy which was supported in the past by UNDP. The China Academy of Posts and Telecommunications is the largest R&D institution in telecommunications in China. The Academy is willing to participate in international cooperation with other countries.

5. The UNIDO Country Director who was also representing the UNDP Resident Representative informed participants about UNIDO's programme in China. For 1993, the UNIDO programme in China is valued at about US\$ 5 million focusing on technical assistance to pilot industrial projects and research and technology institutions. Increasingly since 1992, UNIDO is putting greater emphasis on foreign investment project promotion, technology transfers, enterprise-to-enterprise cooperation and environmental issues. The current Workshop which features enterprise-to-enterprise cooperation is in line with the current trends of the UNIDO programme in China which encourages ECDC activities.



6. The Vice-President of the China National Electronics Import & Export Corporation, Ms. Qi Shuhua, informed participants about the Electronics Fair that was being held in Beijing. She invited participants to visit the fair.

7. Mr. Zhu Wengen, Director of Division in the China International Centre for Economic and Technical Exchanges (CICETE), Ministry of Foreign Trade and Economic Cooperation (MOFTEC) stated that this workshop was one of many joint activities that the Government of the People's Republic of China sponsors in cooperation with UNIDO. In addition to workshops of this type, China supports the organization of investment promotion meetings such as those held in Guangzhou City, Fujian Province and North West China. Another investment promotion meeting will be held in Yingkou City. The workshops and investment promotion meetings are designed to provide opportunities for exchange of information and promotion of cooperation.

8. A representative of the Asia-Pacific Telecommunity (APT) delivered a statement on behalf of Mr. Sonoki, Executive Director of that organization. He expressed APT's support for the Workshop and cooperation with UNIDO in promoting regional cooperation in transfer of telecommunications technology in the Asia-Pacific region. In August 1993, APT organized a meeting on transfer of technology in Bangkok which was attended by 54 delegates from various countries in the region and representatives of UNIDO and ITU. APT sees the current Workshop as an important step taken by UNIDO in the field of telecommunications software and equipment industries and APT would extend all possible cooperation. Since all recent developments in the field of telecommunications are based on software applications, it is essential to develop skills and exchange views on the problems associated with software development.

#### 9. Election of officers

The following officers were elected

Chairman:	Prof. Zhong Yixin (China) Deputy President Beijing University of Posts and Telecommunications
Vice-Chairman:	Mr. Leong Keng Thai (Singapore) Director (Planning) Telecommunications Authority of Singapore
Rapporteur:	Dr. Vijay Kumar (India) Deputy Director General Telecommunication Engineering Centre

#### 10. Adoption of the agenda

The Workshop adopted the following agenda:

- a) Presentation and discussion of country papers.
- b) Guided tour of the Electronics Fair.
- c) Factory visits to selected telecommunications equipment manufacturers, R&D institutes and testing and certification centre.

- d) Presentation of major telecommunications software packages, manufactured products and technologies from China and other Asia and Pacific countries.
- e) Bilateral discussions on technological cooperation.
- f) Seminar on Conditions of Entry into Production of Telecommunications Software.
- g) Conclusions and recommendations.

The Work Programme is attached as Annex I. The list of documents distributed at the Workshop is provided in Annex III.

#### IV. SUMMARY OF SELECTED PRESENTATIONS

##### 1. People's Republic of China

##### a) Production and Development Situation of the Chinese Communication Industry

Prior to 1949, the telecommunications industry in China was at a very low level. The total telephone exchange capacity was then only 310,000 lines and the telephone density was only 0.05 per 100 inhabitants. Development of the telecommunications sector has been particularly rapid since 1977 following a series of policy decisions by the Government. By the end of 1992, the total exchange capacity had risen to 30 million lines and the telephone density reached 1.6 per 100 inhabitants. At the same time several mobile communication enterprises were producing more than 200,000 sets per annum. 71 factories produce exchange equipment with capacity of 3.4 million lines in 1992. Of these, 58 have the capability to produce stored program controlled (SPC) exchanges with output capacity of 2.7 million lines in 1992. 14 factories produce optical fibres with annual production reaching 600,000 km. Some 10 factories produce optical communication equipment. Production of satellite communication equipment has also achieved great success. By the end of 1992, China had 10 large-sized factories engaged in production of satellite earth station equipment.

Over the next 8 years, it is planned to increase the installed exchange capacity to 100 million lines from the current 30 million lines. The telephone density is projected to increase to between 5 and 6 per 100 inhabitants. Long distance communication network will be largely based on optical fibres, satellite and digital microwave systems. The phenomenal expansion of China's telecommunications network will result in a huge demand for equipment and services from the national and international markets.

##### b) Network-Access Licensing and Test Centres of China's Telecom system

Office-use switch equipment is handled by the Directorate General of Telecommunications (DGT). The international bidding procedure is followed for each switch project. Vendors are not managed by licences but by precedent. Switch types are strictly controlled. The

transmission systems, mainly fibre optic and digital microwave, are handled by the Construction Department. The international bidding procedure is followed for each transmission project. The multi-vendor situation has been formed, however, vendors of transmission systems have not been controlled yet. The Customer Premise Equipment (CPE) market is open to manufacturers and dealers. Strict rules on test and network-access licensing are imposed by the Ministry of Posts and Telecommunications (MPT). The DGT handles mobile phone and radio paging equipment. The Communications Department handles other CPE.

c) Telecommunications Software Development in China

As China's telecommunications network grows larger, more sophisticated and more digitalized, software applications are widely developed and installed in the network. China developed two large-scale, office-use SPC switch systems DS30 and HJD04 and a prototype of switch software support system. In areas of network management, centralized operation and maintenance, operation support, service support and management information system, many software packages have been developed and applied in the network. There are four models of software developments in China: self-use development, pool-use development, country project and commercial development. Although China has great potential in developing telecommunication software, a lot still needs to be done to raise the level of this industry to internationally competitive levels.

d) Opportunities for technological cooperation between China and other Asia-Pacific countries in Telecommunication

(i) In the planned expansion of China's telecommunication network, a large quantity of equipment for optical fibre, satellite, mobile radio, digital microwave and SPC switching systems as well as terminal equipment (e.g. facsimile machine and etc.) will be needed. The preferred mode of cooperation sought by China is through joint ventures in production and marketing. Shanghai-Bell Telephone Equipment Company Ltd. established by China and Belgium in Shanghai is one successful joint venture of this type. In this way, not only the issue of supplies of equipment required in China's telecommunication network is resolved, but also importation of products from the cooperating country into the Chinese market becomes easier.

(ii) China actively seeks the cooperation of foreign telecommunications companies, R&D institutes and universities to establish joint R&D programmes with Chinese institutions. Examples of areas of joint R&D programmes include optical fibres, digital microwave and design technology for digital SPC switching software.

(iii) The most critical part of modern telecommunications equipment is the application specific integrated circuit (ASIC). In recent years, China has made great progress in the design of ASICs, training of advanced and skilled ASIC designers, as well as development tools for ASIC designs. In some universities and research institutes, the required large scale or super large scale application specific integrated circuits can be designed, and in some factories (e.g. Shanghai Beiling Microelectronic Manufacturing Company, Ltd.), large quantities of ASICs can be produced according to integrated circuit

maps designed in other countries. The ASIC design capability is however still limited in China and production capacities cannot meet demand. China seeks the cooperation of other Asia-Pacific countries in the design and production of ASICs for telecommunications equipment. A flexible approach is adopted whereby design and production activities could be undertaken either in China or foreign countries by joint teams of experts.

(iv) China also seeks cooperation in the area of surface moulding components/devices (SMC/SMD) and surface moulding technology (SMT). Several SMC/SMD production lines have been established in China to produce components for optical fibre, mobile radio and SPC switching equipment. The existing capacity is however low in comparison with the demand and furthermore production efficiency needs to be improved.

## 2. India

### a) Telecommunication Organization

The Indian Telecommunication network has grown rapidly during the last four decades. Furthermore, infrastructure facilities and related organizations have also correspondingly been created to meet the various needs of telecommunications. A large variety of telecommunications equipment is being manufactured by a number of firms to meet the needs of Indian telecommunication network and for export. These firms are in central government public sector, state government public sector and in private sector. Indian Telephone Industries (ITI) is the major manufacturer of telecom equipment in India. Telecommunications Consultants India Limited (TCIL) under the Dept. of Telecommunications (DOT) provides consultancy both to Indian users as well as abroad on all telecommunication matters. TCIL also undertakes turnkey projects in telecom related services and in computer areas. C-DOT (Centre for Development of Telematics), an autonomous society under the Telecom Commission undertakes research and development work in switching/transmission products. For ensuring the quality of products and installations the DOT has 3 wings namely, Telecommunication Engineering Centre (TEC), Quality Assurance Wing and Technical and Development Circle for type approvals, quality assurance during production, and acceptance testing of telecom installations respectively. The Advanced Level Telecommunication Training Centre provides training facilities in various disciplines of Telecommunications, Data Communications, Computers and Management to both national and international participants. In addition, there are a number of training centres to cater to the needs of training DOT staff.

### b) Computerization of Telecommunications

In the following areas Computerization has already been implemented:

- Network Planning and Dimensioning using optimization techniques and computer tools
- Issuing Telephone Bills
- Directory Enquiry Service
- Fault Repair Service

- Subscriber Metering in Electro-mechanical Exchanges
- Preparation of Project Estimates
- Availability of computerized data for Directory printing
- Telephone Billing and Accounting
- Telecom. Revenue Accounting
- Issue of duplicate Telephone Bills etc. at Customer Service Centres
- Information to Subscribers regarding Status of 'shifts' to other exchanges, if they apply for shifts
- Office Automation
- Material Inventory status
- Commercial working for new telephones, shifts etc.
- Signature Verification
- Paperless Trunk Working

Following is a select list of packages under development:

- Cable Records (Graphics) Management
- On-line Commercial system
- Human Resource Development System
- On Line availability of Management Information
- Material Management System
- Project Management
- Finance Management
- Nationwide Directory Enquiry
- Networking of existing applications
- Providing WAN capabilities to various applications on LANs
- Distributed databases

c) **Transfer of technology at C-DOT**

C-DOT was established as an autonomous scientific society in 1984 to develop switching products. Subsequently it became a permanent institution doing pioneering development work in telecom - both switching products like 128P PBX/256P PBX, 128P RAX, 512P SBM RAX, and large MAX of 10,000 lines. Consequent to the merger with the Telecom Research Centre, C-DOT started development of transmission products. C-DOT has transferred the technology of these products to various manufacturers in private, public and joint sectors. The main aim of technology transfer by C-DOT has been to set up infrastructure facilities for telecom equipment manufacturing. The technology transfer package involves identification of capital equipment, product, documentation, manufacturing methodology and training.

d) **Software development**

As a result of the various R&D projects that it has undertaken, C-DOT has developed expertise in handling from small sized software project to very large sized software projects. C-DOT has acquired a state of art Software Development Environment consisting of a number of VAX machines, VME -1000's, Workstations and PCs, all of them networked together. Consequently it has a lot of experience in software development under VMS, UNIX and DOS environments. From small to very large products, C-DOT has handled software development both in 'C' language as well as in assembly language. In its Main Automatic

Exchange which is a Digital Switching System with a connectivity of 40,000 lines. C-DOT uses software which has nearly 0.8 million lines of C code and 0.1 million lines of assembly code.

### 3. Indonesia

PT Telekomunikasi Indonesia plans to instal 1 million lines a year during the sixth 5-year development plan. The market for telecommunications equipment is therefore enormous. Indonesia produces various kinds of terminal, switching and transmission equipment. Efforts are continuing by two local firms to produce fully automatic electronic digital exchanges suitable for rural applications, with capacities ranging from 60 to 3,500 lines. Standardization in accordance with ISO 9000 and indigenous technological development are emphasized in Indonesia. Telecommunications products that Indonesia can offer include:

#### a) Satellite System

- Demand Assigned Multiple Access (DAMA)
- Complete Earth Stations
- Earth Station Electronics and Sub-Assemblies
- Very Small Aperture Terminals
- Satellite Data Networks

#### b) Terrestrial System

- Radio Transmission Systems: HF, VHF, MW
- Analog and Digital Systems: FM, PCM
- Cable Transmission Systems: FDM, PCM
- Mobile System, Cellular systems
- Data Communication System

#### c) Telephone Systems

- Telephone switching equipment (digital exchange)
- Telephone Handsets
- Private Automatic Branch Exchange (PABX)
- Teleprinter
- Mobile Telephone
- Coin Box Telephone
- Cables and Outside plant equipment

### 4. Myanmar

Myanma Posts and Telecommunications (MPT), is the sole provider of telecommunication services in Myanmar. MPT has implemented a computerized bill processing Cyber system for telephone and telex services. The initial bill processing programmes were developed in-house with the help of programmers from Thailand. Following introduction of a new system in 1990, Myanma engineers and programmers received training on the VAX/VMS operating system and programming on VAX/VMS platforms. This training was arranged in Singapore. Recognizing increased demand, MPT is currently carrying out feasibility studies for the implementation of a fully computerized Management Information System and a Financial Management System utilizing VAX

machines. To cope up with the growing economy, MPT plans to implement a packet switching data network between Yangon and Mandalay. Besides facilitating faster and more reliable data transfers, the packet switching network will also provide international database access through the international exchange.

## 5. Philippines

To attain the Government's vision for the year 2000, the telecommunications sector shall pursue more vigorous development through intensified private sector participation supported by the Government; a more dynamic telecommunications industry which is responsive to user's needs and operates under a spirit of free competition, and with wider public access to basic telecommunications services. The National Telecommunications Development Program (NTDP) seeks to focus ongoing and future efforts in the sector to support both sector development goals and national development objectives.

The entities involved in the Philippine telecommunications sector include relevant government agencies, private and public telecommunications network operators, equipment manufacturers and suppliers, users of telecommunications services, and local industry associations.

The Philippine Government's involvement in the sector is carried out primarily through the following agencies:

- a. The Department of Transportation and Communications (DOTC) as the policy making body for telecommunications:
- b. The National Telecommunications Commission (NTC) as the regulatory arm, with quasi-judicial powers:
- c. The Telecommunications Office (TELOF) as the operating arm, providing telephone and telegraph services in rural areas:  
and
- d. The Municipal Telephone Projects Office (MTPO) as the implementing arm for the Government's municipal telephone program.

The local manufacturing sector specifically for telecommunications equipment and support components has been in existence in the country for the past two to three decades. The primary telecommunications equipment and components manufactured locally include telephone handsets, telephone wires and cables, telecommunications line hardware, modems, consumer electronics and support facilities. This sector has very good potential for growth, because of the size of the market.

The country's software industry has been largely spearheaded by private entities. A number of foreign firms have made some form of software development arrangements with local software houses to take advantage of the country's relatively inexpensive but highly skilled labour. Most of the products end up being exported to meet the demand of foreign customers.

## 6. Singapore

Following the successful implementation of the National Information Technology Plan over the past decade, Singapore has set into motion a future vision for Information Technology (IT) development. The IT2000 Vision of An Intelligent Island was formulated in 1991, after a rigorous study by the government and the National Computer Board (NCB) covering eleven major economic sectors of Singapore. In the vision, some 15 years from now, Singapore will be among the first few countries in the world with an advanced nationwide information infrastructure. This information infrastructure will permeate the physical nationwide computer and telecommunication infrastructure, making telecomputing possible, and homes, work place, airport, seaport "smarter". A wide range of new services, linking Government, business and the people, will be created to take advantage of new IT and communications network technology. The vision of the IT2000 is based on the extensive use of IT. Undoubtedly, telecommunication plays a vital role in the IT2000 by ensuring that advanced and efficient infrastructures are in place as well as to stimulate applications in these advanced services. Besides NCB, the Telecommunication Authority of Singapore (TAS) and the National Science and Technology Board (NSTB) are amongst the key government agencies which will drive the development of this national vision. They will collaborate with research institutions and industry on projects which can contribute toward the realization of the IT2000 Vision.

In collaboration with industries, there are currently six R&D institutes and four centres set up in Singapore. These are:

- \* Information Technology Institute (ITI);
- \* Institute of Microelectronics;
- \* Institute of Systems Science (ISS);
- \* Information Communication Institute of Singapore (ICIS);
- \* GINTIC Institute of manufacturing Technology;
- \* Institute of Molecular and Cell Biology;
- \* Centre for remote Imaging Sensing and Processing;
- \* Centre for Wireless Communications;
- \* Magnetics Technology Centre; and
- \* The National Supercomputing Research Centre.

Broadly, these institutes and centres focus on five technology areas that have been identified as being economically relevant to Singapore, namely manufacturing technology, electronics, microelectronics, information technology and communications, and biotechnology. Opportunities for R&D are abundant in Singapore and look set to increase. In fact, excellence in Science and Technology will be one of the engines that will power Singapore's future growth. Based in the recent findings from the national R&D survey by NSTB, Singapore spent a total of S\$894.5 million on research and development in 1992, up from S\$756.8 million in 1991. It is estimated that telecommunication, data communication and IT software development in Singapore, accounted for about 15% of the R&D expenditure in the private sector alone.



## 7. Handbook of telecommunications software

A representative of the UNIDO Secretariat presented a draft of the above-mentioned handbook under preparation by UNIDO. The presentation covered the importance of software in telecommunications, the main types of telecommunications software, the special characteristics of telecommunications software and the prerequisites for entering the market.

Among the main prerequisites for entering the market, the following were stressed:

- (i) A creative environment for skilled and motivated university educated personnel, providing contact between industry and university, and able to draw on a technological tradition.
- (ii) Research and development centres where feasibility studies can be made, basic designs proposed and evaluated, and basic technologies developed (e.g. real-time distributed operating systems).
- (iii) Standardization of development tools, concentrating on CCITT standards, using SDL, CHILL and MML as the basis for the development of tools for specification and implementation on industry standard development platforms (UNIX workstations, PCs, UNIX servers, Ethernet LANs, graphical tools with industry standard interfaces X-Windows, and conformance to X-Opens XPG4 where possible).
- (iv) Conformance testing facilities, including hardware and software, for shared and local development of software components.
- (v) Technological concentration encompassing computer and communications technologies.
- (vi) Conformance to international switching standards (e.g. SS No. 7, ISDN) is important to obtain components and know-how at competitive rates and take advantage of world-wide design experience.
- (vii) Integrated framework for systematic development, starting with subsystems and smaller exchanges and including design, manufacture and system support. Long-term (at least 15 years) financial and political support administered by a senior technical administrator are essential.
- (viii) Wide range of educational material must be introduced into conventional tertiary education courses in Computer Science and Engineering.

**V. RESULTS OF BILATERAL DISCUSSIONS ON COOPERATION PROJECTS**

INSTITUTION A	INSTITUTION B	Type of cooperation & brief description
1. Bangladesh Telegraph & Telephone Board Dhaka, Bangladesh	Beijing University of Posts & Telecommunications Beijing, China	Information exchange on MFC Single Chip Transmitter/Receiver.
2. Telephone Factory Tongi Dhaka, Bangladesh	Indian Telephone Industries Bangalore, India	Information exchange on packet switching network.
3. Bangladesh T&T Board Dhaka, Bangladesh	CrossTech Electronics & Information Company Haidian, China	Information exchange on Super Root-A peer based network operating system.
4. Telephone Factory Tongi Dhaka, Bangladesh	Beijing University of Posts & Telecommunications Beijing, China	Information exchange on Computer Aided Network Planning software package.
5. Bangladesh T&T Board Dhaka, Bangladesh	Telecommunication Engineering Centre New Delhi, India	Detailed information on (a) Switching equipment: - C-DOT 256, 512 - 1.4K, 1.5K - 10K ports; (b) Transmission equipment/systems: - single channel VHF, 2/15 multi-access radio, optical fibre system, jelly filled cable; (c) Software Packages: - network planning, cable fault repairing, material management. Exchange of visits on the above.
6. Bangladesh T&T Board Dhaka, Bangladesh	Beijing University of Posts & Telecommunications Beijing, China	Information exchange on local network planning tool.

INSTITUTION A	INSTITUTION B	Type of cooperation & brief description
7. Telephone Factory Tongi Dhaka, Bangladesh	Beijing University of Posts & Telecommunications Beijing, China	Information exchange on MATS series automatic dialling mobile telephone system.
8. Beijing Yin He Science & Technology Company Beijing, China	Beijing Huahang Electronics Ltd. Beijing, China	Technology transfer, equipment delivery and information exchange on PCM signalling monitor, multifrequency signalling monitor and single chip for multifrequency transmitter and receiver.
9. Beijing Yin He Science & Technology Company	China National Post & Telecommunications Application Corporation Beijing, China	Technology transfer, equipment delivery, expert services and information exchange on PCM signalling monitor, multifrequency signalling monitor and single chip for multifrequency transmitter and receiver.
10. Beijing Yin He Science & Technology Company Beijing, China	INCOM Import & Export Company Beijing, China	Technology transfer, equipment delivery and information exchange on PCM signalling monitor, multifrequency signalling monitor and single chip for multifrequency transmitter and receiver.
11. Beijing University of Posts & Telecommunications Beijing, China	Centre for Development of Telematics New Delhi, India	Joint research in advanced DSP techniques.

INSTITUTION A	INSTITUTION B	Type of cooperation & brief description
12. Asia-Pacific Electronics (China) Co. Ltd. Beijing, China	Telecommunications Engineering Centre New Delhi, India	Information exchange on radio paging systems.
13. Indian Telephone Industries Ltd. Bangalore, India	Stone SinoSoft Corporation Beijing, China	Information exchange on software packages for modems, fax and voice cards.
14. Information Science Institute Xian, China	C-DOT New Delhi, India	Joint research in design methodology and tools for B-ISDN simulation.
15. Telecommunications Engineering Centre New Delhi, India	Telecommunications Software Development Centre, China Academy of Posts & Telecommunications Beijing, China	Information Exchange on further developments in software packages for service order, outdoor plant and graphic display of cable records system.
16. C-DOT New Delhi, India	Telecommunications Software Development Centre, China Academy of Posts & Telecommunications Beijing, China	Information exchange on software development methodologies.
17. Myanma Posts & Telecommunications Yangon, Myanmar	C-DOT New Delhi, India	Investigate possibility of using C-DOT digital switching system. Exchange information.
18. Indian Telephone Industries Bangalore, India	Communication Telemetry & Telecontrol Research Institute Shijiazhuang, China	Exchange information on digital communication equipment such as subscriber line digital transmission equipment, digital multiplexer etc.

INSTITUTION A	INSTITUTION B	Type of cooperation & brief description
19. Beijing University of Posts & Telecommunications Beijing, China	Telecommunications Engineering Centre New Delhi, India	Information exchange on local network planning tool.
20. India Telephone Industries Bangalore, India	Beijing University of Posts & Telecommunications Beijing, China	Technology transfer & information exchange on PCM signalling monitor, multifrequency signalling monitor and single chip for multifrequency transmitter and receiver.
21. Asia-Pacific Electronics Corporation (China) Beijing, China	C-DOT New Delhi, India	Investigate possibility of using radio paging system in India and C-DOT switching systems in China.
22. Telephone Organization of Thailand Bangkok, Thailand	Ministry of Industry Jakarta, Indonesia	Explore joint venture, technology transfer and expert service in fibre optic cables.
23. CrossTech Electronics & Information Company Haidian, China	Ministry of Industry Jakarta, Indonesia	Explore joint venture and expert services to introduce GIAX Antivirus Card and Super Root Network Operating System in Indonesia.
24. Ministry of Communications Seoul, Korea	Ministry of Industry Jakarta, Indonesia	Technology transfer and expert services to develop telecommunications switching and transmission equipment.
25. Myanma Posts & Telecommunications Yangon, Myanmar	Beijing University of Posts & Telecommunications Beijing, China	Explore the possibility of utilizing CAPLTN network planning software in Myanmar.

INSTITUTION A	INSTITUTION B	Type of cooperation & brief description
26. Myanma Posts & Telecommunications Yangon, Myanmar	Asia-Pacific Electronics (China) Corporation Beijing, China	Exchange information on radio paging systems.
27. Telecommunications Office Manila, Philippines	Telecommunications Software Development Centre, China Academy of Posts and Telecommunications Beijing, China	Training in telecommunications software development methodologies.
28. Singapore Communications Investment Pte. Ltd. Singapore	Beijing Three-Xing Communications Company Beijing, China	Joint venture, technology transfer on videophones and Chinese character pagers.
29. Telecommunication Authority of Singapore Singapore	Myanma Posts & Telecommunications Yangon, Myanmar	Explore possibility of establishing a packet switching network in Yangon, Singapore to provide training and expert services.
30. Singapore Communications Investment Pte. Ltd. Singapore	Beijing University of Posts & Telecommunications Beijing, China	Exchange information on network planning software tools.
31. Singapore Telecommunications Authority Singapore	Telecommunications Engineering Centre New Delhi, India	Singapore to provide information on methodology adopted in preparing IT2000 strategy.

INSTITUTION A	INSTITUTION B	Type of cooperation & brief description
32. Telecommunications Authority of Thailand Bangkok, Thailand	Computer-Aided Design Centre, Beijing University of Posts & Telecommunications Beijing, China	Exchange information on PLD TOOL, CUPL and PROLINK software packages used for making logic designs on PLD chips.
33. Beijing University of Posts & Telecommunications Beijing, China	Telephone Organization of Thailand Bangkok, Thailand	Joint research in computer aided design for network planning.
34. Fourth Research Institute, Ministry of Posts & Telecommunications Xian, China	Telephone Organization of Thailand Bangkok, Thailand	Exchange information on transmission equipment.
35. Telephone Organization of Thailand Bangkok, Thailand	C-DOT New Delhi, India	Exchange information on C-DOT switching equipment.
36. Communications Authority of Thailand Bangkok, Thailand	Beijing University of Posts & Telecommunications Beijing, China	Exchange information on X.25 Protocol Control Board.
37. Telephone Organization of Thailand Bangkok, Thailand	Telecommunications Software Development Centre, China Academy of Posts & Telecommunications Beijing, China	Exchange information on telecommunications software packages.

INSTITUTION A	INSTITUTION B	Type of cooperation & brief description
38. Directorate General for Posts & Telecommunications Hanoi, Vietnam	Beijing University of Posts & Telecommunications Beijing, China	Exchange information on local network planning software packages.



WORKSHOP FOR ASIA AND PACIFIC REGION REPRESENTATIVES  
FROM THE TELECOMMUNICATIONS SOFTWARE AND EQUIPMENT INDUSTRIES  
(THROUGH PARTICIPATION AT THE ELECTRONICS TRADE FAIR).

BEIJING, PEOPLE'S REPUBLIC OF CHINA.  
22 TO 26 SEPTEMBER 1993

WORK PROGRAMME

WEDNESDAY, 22 SEPTEMBER 1993

- 08.30 Registration of participants
- 10.00 Opening ceremony
- 11.00 Election of Chairman, Vice-Chairman and Rapporteur  
Adoption of agenda
- 11.15 Presentation and discussion of country papers
- (i) Study of the Science & Technology and International Cooperation & Exchange in China's Communication Industry
  - (ii) Production and Development Situation of the Chinese Communication Industry
  - (iii) Network-Access Licensing and Test Centres of the China Telecommunication System.
  - (iv) Telecommunication Software Development in the People's Republic of China
- 14.30 Continuation of presentations and discussion of country papers.  
Bangladesh, India, Indonesia, Myanmar, Philippines, Republic of Korea, Singapore, Thailand, Viet Nam
- 16.30 Country papers
- 17.30 Adjournment

**THURSDAY, 23 SEPTEMBER 1993**

- A.M.                    Guided tour of China International Electronics Trade Fair  
                             - organized by BUPT
- P.M.                    Technical visits to Beijing Hangxing Company and China  
                             Academy of Posts and Telecommunications - organized by BUPT

**FRIDAY, 24 SEPTEMBER 1993**

- 09.00                    Presentation of major telecommunications software packages.  
                             manufactured products and technologies from China and other  
                             Asia and Pacific countries - by participants
- 11.00                    Continuation of presentation of software packages.  
                             manufactured products and technologies - by participants
- 14.30                    Bilateral discussions on technological cooperation -  
                             organized by UNIDO and BUPT
- 17.30                    Adjournment

**SATURDAY, 25 SEPTEMBER 1993**

- 09.00                    UNIDO seminar on "Conditions of Entry into Production of  
                             Telecommunications Software"
- 11.00                    Continuation of Seminar
- 11.30                    Plenary discussions on draft conclusions and  
                             recommendations
- 14.00                    Continuation of bilateral discussions on technological  
                             cooperation - organized by UNIDO and BUPT
- 16.00                    Technical visit to Asia Pacific Electronics (China)  
                             Corporation

**SUNDAY, 26 SEPTEMBER 1993**

- 08.30                    Adoption of conclusions and recommendations of the Workshop
- 10.00                    Closing ceremony

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**(THROUGH PARTICIPATION AT THE ELECTRONICS TRADE FAIR)**

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**22-26 September 1993**

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ANNEX III

**WORKSHOP FOR ASIA AND PACIFIC REGION REPRESENTATIVES**  
**FROM THE TELECOMMUNICATIONS SOFTWARE AND EQUIPMENT INDUSTRIES**  
**(THROUGH PARTICIPATION AT THE ELECTRONICS TRADE FAIR)**

**Beijing, People's Republic of China**  
**22-26 September 1993**

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