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GLOBALIZATION OF INFORMATION TECHNOLOGY AND COMPUTER-COMMUNICATION IN INDIA*

Prepared by

UNIDO Secretariat**

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* This document has not been edited.

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Contents

I. INTRODUCTION

GLOBALIZATION OF INFORMATION TECHNOLOGY AND COMPUTER-COMMUNICATION IN INDIA

INTRODUCTION

Since 1985, a major transition in the world economy is taking place with the globalization of an increasing set of products, capital markets and service markets. Competition, intra-national and inter-national, is coming fiercer. The transition of the economy from the traditional distribution of labour force in agriculture, industry and services in the ratio of 60 : 25 : 15 is getting reversed into 15 : 25 : 60 on an average. The evolution of the industrial economies is bringing about an increasing dependance on the transfer, management and use of information, increasingly, in the electronic form. The demand for computer-communication network based service is becoming critical to corporations and even national survival. To realize a competitive edge in the dominant global markets, corporations and countries must adopt globalization strategies - worldwide distribution of standardized products, worldwide access to and delivery of services and consequentially, worldwide network based delivery of and access to information. Inter-country competition is forcing customs and tax policies, money market, industrial and trade policies to morphose in the direction of giving a competitive edge and hence introducing an element of globalization even of national policies. It is for this reason that the information technology sector, including telecommunications, has attracted an unprecedented investment globally estimated at $ 1 trillion so far. Global spending on telecommunications products and services is estimated at US$ 750 billion in 1993 and will exceed US $ 1.5 trillion by 2000 AD. By this time, information technology will become the largest single sector of the global economy.

Cost effective and reliable networks giving value added services are increasingly in demand. In spite of the diversity of business, commonality of technology and services are emerging through such frame works, like FDDI, ISDN, Intelligent Network Management, global private virtual networking, SONET and SDH, among others, in a global broad-band network infrastructure. The international services gateway provided broad-band services including ATM, SONET and SDH between countries and between continents. These switches also support several advanced access services, in the evolution of global networking. An important enabling technology is international bandwidth on demand, followed by video on demand, multimedia workstations and high capacity high quality

imaging systems. These will be supplemented by increasing memory and processing capabilities of computer platforms and higher band-width of communication problems.

In this background, the evolution of national Computer-Communication (C-C) networks towards globalization has already started taking place in countries like India. An example of this is NICNET, the extensive nation-wide computer-communication network of the National Informatics Centre (NIC) of India, which is mainly dependant upon space communication. The evolution of NICNET is so oriented that the integration of computer and communication as well as globalization of the network is progressively implemented utilizing low cost technologies available in the international market.

The present report describes the status, plans and perspectives of globalization of Information Technology (IT) and Computer-Communication (C-C) infrastructure in India, on and off line linkages with various databases and the awareness creation and training requirements related to IT and C-C according to the following terms of reference:

1. Survey contemporary developments and applications of Information Technology (IT) including Computer-Communication infrastructure in India and diagnose the problems and niche areas for technological thrust of India in this field.

2. Analyse the trends towards globalization of Information Technology including Computer-Communication infrastructure, Value Added Services and Informatics Applications in promoting social and economic development of India.

3. Survey the current status of policy instruments and forecast the direction of evolution of new policy instruments which tend to accelerate the process of globalization of the Indian IT sector.

4. Describe the current status of the IT industry in India and diagnose the trends in the restructuring of the industry to cope with and promote globalization.

5. Examine the awareness creation and training requirements of such restructuring of the IT industry to enable a smoother transition towards globalization.

In what follows in this report, Section-II surveys the IT and C-C scenario in India with illustrative application areas like water resources, rural development, decentralised planning, bibliographic databases, IT and C-C in banks, financial institutions and Stock Exchanges. An outline survey of the public and private data networks available in India are highlighted, followed by a detailed application profile of the major informatics network, NICNET.

Section-III addresses the evolution of policy instruments in IT and C-C, beginning with 1984 Computer Policy and 1986 Software Policy to the policy instruments which enabled the setting up of a number of C-C networks. The IT and C-C policy are examined within the ambit of the faster pace of liberalization of the industrial policy. The gradual reduction in the State control of telecommunications sector is highlighted pointing to the widening disparity between the faster pace of liberalisation of the economy and the slower pace of liberalisation in the telecommunications sector. The details of the liberalization process and its effect on IT and C-C for the present and the immediate future are presented. The actual policy instruments which set the liberalization process on the move and the EXIM policy announced for the 1993-97 duration, the interest these generated in US, Canada, Europe and Japan, are highlighted. While pointing out that much desires to be still done towards appropriate liberalization, a mention is made of the implications of the Dunkel Draft to the Indian software industry vis-a-vis the balance of advantages to India in the face of US Visa clamp, paucity of funds and the slow pace of growth of user awareness. The question whether the indigenous computer industry is getting de-emphasized in the face of a fast liberalisation is examined. In particular, the impact of liberalization on the Indian software industry, both domestic and exports, as well as on the telecom services, with particular reference to global C-C, are examined. A discussion on what takes India to become a global player in IT and C-C is presented.

Section-IV describes the technological aspects of globalization of IT and C-C in India. The Indian experience in the beneficial role played by VSATs in the globalization process, with specific illustration of the evolution of NICNET towards gloablization, is given along with the description of the role being played by external gateways and value added services in promoting international communication from India.

A survey is made of the global trends in the globalization of IT and C-C. The role of trans-national systems and MNCs in fostering cost-effective international competition is described. The rapid growth of global information access through global networks is pointed out as the available global resources for prodding the economic development in India. The VSAT enhanced ISDN is identified as an important technology for India for achieving these ends. In this background a review is made of the satellite systems available in or being planned to be made available to India. The role of cooperative and commercial global networks in the background of the survey of such networks is made identifying the potential areas of cooperation with them. Further, the efforts in restructuring of the IT and C-C sectors for accelerated globalization is surveyed. As an illustration, the hurdles to software exports from India are identified suggesting the shape of restructuring yet to come. With particular reference to C-C, the status and perspectives of restructuring in the telecommunication sector are suggested.In this background, the changing but increasing relevance of R&D investments in strengthening the process of indigenization in India are highlighted to enable the country to make the most out of liberalization.

In the background of all the above, Section-V examines what is needed in awareness creation and manpower development for India to take a big leap forward in globalization. In particular, the manner in which the quality awareness can be inculcated among the sellers and buyers in India are suggested. Appropriate strategies of marketing and the growth of consultancy capabilities are identified as two major props for extensive and intensive awareness creation. Some suggestions for bolstering up India's image abroad in IT and C-C are made with a view to increase the scope of acceptability of Indian IT and C-C products in the international market place.

II. SURVEY OF IT AND C-C IN INDIA

II. SURVEY OF IT AND C-C IN INDIA

The Information Technology and Computer-Communication application scenario in India is becoming not only extensive, but also intensive. In this Section, a survey of the public and private data networks available in India are highlighted followed by a detailed application profile of a major informatics network, NICNET, along with illustrative application areas like Water Resources, Rural Development, Decentralised Planning, Bibliographic Databases and Computerisation in Banks, Financial Institutions and Stock Exchanges.

2.1 Survey of the Public and Private Data Networks in India

In India there is a public data network under the Department of Telecommunications (DOT) and several private data networks in operation which serve various socio-economic sectors.

Public Data Networks:

INET & RABMN: INET is a public data network of the DOT. It has eight packet switches in various metropolitan cities with inter-node speed of 64 kbps. The network is being expanded to several other cities in the next few years. The DOT has installed a Satellite-based low speed data network called, Remote Area Business Message Network (RABMN) which uses micro earth stations or very small aperture terminals (VSATs) at customers' locations. The master earthstation or the hub of the network is situated at Sikanderabad near Delhi. More than 250 VSATs connected to the hub is presently servicing more than 70 customers in the public and private sectors. This public data network is based on Spread Spectrum Multiple Access/Code Division Multiple Access (SSMA/CDMA) Technology. The PDN provides various non-voice services, mainly, interactive computer-communication, connection to public telex networks, connection to packet switched networks, connection to international gateway networks and Facsimile transmission. It is mainly used in real time applications in power line control, pipeline control, airlines, hotel industry, tourism industry, banking and stock exchanges.

Private Data Networks:

There are numerous private data networks in India, some catering to wider spectrum of applications and many directed to specialised sectors. A brief description of these are given below:

NICNET: This is the biggest data communication network in India with 650 Satellite earthstations connected to more than 2000 computers and 5000 terminals. As the first VSAT network outside the United States, NICNET provided a role model for spreading the VSAT networks around the world. RABMN described above was a beneficial copy of NICNET. NICNET was set up by the National Informatics Centre (NIC) under the Planning Commission of the Government of India. It is a private data network of the Government bridging the Central Government, 32 State/Union Territory Governments and more than 500 District Administrations. Its master earthstation is located in Delhi. It is also setting up sectoral Close User Groups (CUGs) for sectors identified by the Planning Commission for online monitoring of Plan projects totalling a plan investment of over US $ 50,000 million. At present, the VSATs have a baud rate of 1200 and 9600. The main network is based on Spread Spectrum Multiple Access (SSMA)/Code Division Multiple Access (CDMA) Technology and is therefore interference free and secure. NIC is in the process of setting up a high speed Info Highway with a variable data transmission rate between 16 kbps and 2 mbps. Whereas the main network utilises C-band transponder of INSAT-1D, the Info Highway makes use of Ku-band transponder on INTELSAT Satellite. To the Info Highway will be connected, 15 cities by January 1994, 35 cities by June 1994 and 70 citieis by December 1994. A video conferencing facility is parallelly being installed in these cities based on the Info Highway. NICNET has two external gateways each with 64 kbps transmission rate linked through SPRINTNET and TRANSNET/UUNET to 47 networks around the world in 39 countries. A full-fledged Electronic Data Interchange (EDI) facility has been installed on NICNET for giving facility to 500 exporters by mid 1994, 2000 by end 1994 and 5000 by 1995. Over 200,000 transactions are taking place every day on NICNET at present and is expected to cross a million transactions per day by end 1994.

INDONET: This is the first private commercial computer network in India which became operational in March 1986. INDONET which is a network set up by the CMC limited, comprises of computers located at Bombay, Madras, Calcutta, Delhi and Hyderabad with

access points at Bangalore, Ahmedabad and Pune. Access to INDONET is possible not only from CMC's computer centre, but also by means of terminals at customer premises through dial-up or dedicated data links.

SAILNET: SAILNET of the Steel Authority of India Limited (SAIL) is basically a CUG of NICNET with 32 VSATs connected to NICNET in full scale operation. SAILNET connects all the steel plants in India, stocking yards and marketing offices.

POWERNET: This is a network planned by the Ministry of Energy and the mega corporations under it, namely, the National Thermal Power Corporation, National Hydro-Electric Power Corporation, National Power Transmission Corporation, Damodar Valley Corporation etc. for an integrated energy management over the entire country. A part of the POWERNET operates as a CUG of NICNET with several VSATs already commissioned along with several power projects of NTPC having access to NICNET terminals.

COALNET: This is an integrated data network of Coal India Limited connecting the Corporate headquarters of public sector units to the subsidiaries and important mining units. COALNET is being established under the Department of Telecommunications with a subset becoming a CUG of the PDN of Department of Telecommunications.

BANKNET: This is primarily to connect all the nationalised Banks as well as branches of individual nationalised banks. A major application is inter-branch reconciliation of accounts apart from integrated MIS. 500 Branches and zonal offices in more than 100 cities are expected to be connected. So far, the BANKNET has come up only in bits and pieces and an integrated BANKNET is still a long way off. A number of Indian Banks are connected to the SWIFT network for external financial transactions.

RAILNET: The proposal comprises of three components of the network: (a) Passenger Reservation Sub-net, (b) Freight Operations Information System (FOIS) sub-net, and (c) MIS sub-net. With the assistance of CMC limited, the Passenger Reservation Network has started functioning in several cities. However, FOIS, which is a major part of the network with an estimated investment of US $ 500 million for computer and communication infrastructure is yet to be commissioned.

AIRNET: Started in 1984, the Indian Airlines network operating from nearly 70 Indian cities is the first inhouse data network in India. Terminals are connected directly or

through multiplexers to its reservation computer in Delhi. The Air India, which has a large computer in Bombay provides access to it from major Indian cities and abroad through SITA.

OILCOMNET: Both the Oil and Natural Gas Commission (ONGC) and the Oil Coordination Committee (OCC) have small networks connecting crucial decision points.

ERNET: It is a network giving link to UUNET from 150 educational and research institutions in India. It has a pad in Bombay linked via the VSNL Gateway to UUNET, though it relies heavily on dial-up terminal at user premises in various cities.

There are several other inter-city and intra-city private data networks that are in a fledging stage like the INFLIBNET for wide area connection of libraries and CALIBNET, DELNET, BANNET and MALIBNET for intra-city library network in Calcutta, Delhi, Bangalore and Madras respectively.

With the liberalisation of the Indian economy and the opening out of the Telecom sector for private investment, a number of private data networks for E-Mail, Data Fax and other services have started coming up in 1993. Some of the initial ones are ICNET, DARTNET, etc.

EXTERNAL DATACOM GATEWAYS

A brief description of the Datacom Services given by Videsh Sanchar Nigam Limited (VSNL) for public and private networks and individuals desiring external gateway is given below:

Telecom Gateways: Videsh Sanchar Nigam Limited (VSNL) a Government of India Enterprise, covers india's international telecommunication needs through four international Telecom Gateways at Bombay, New Delhi, Madras and Calcutta.

International Data Transmission Services: The demand for high speed, reliable data communications is met by VSNL through the International Gateway Packet Switching Service (GPSS). VSNL has expanded this service in cooperation with the Department of Telecommunications by installing Remote PAD at New Delhi, Madras, Calcutta, Bhubaneswar, Trivandrum, Bangalore, Hyderabad, Pune and Ahmedabad. Customers can

avail X.28 or X.25 connectivity from above cities. Data can be transferred at 300, 600, 1200, or 2400 BPS in asynchronous mode. In synchronous mode, data can be transferred at 2400, 4800 or 9600 BPS. VSNL handles approximately 14,000 minutes/250 kilosegments of data transmission per day.

Voice/Data (AVD) Leased Service: These provide cost effective solutions for large companies sending more than three to four hours of voice, data and facsimile traffic per business day to a particular destination. Data upto 9600 bps can be handled on these circuits.

High Speed Data: VSNL provides digital data circuits at speeds of 64 kbps or higher to many countries from its Bombay Gateway.

INTELSAT Business Service(IBS): With IBS, large volumes of digital voice, data, text, facsimile, and video teleconferencing can be transmitted quickly, economically and efficiently. IBS service is also suited for meeting the software export requirements at speeds of 64 kbps or multiples thereof.

Leased Services for Press: Press Bulletin Service (PBS) and Developmental Press Bulletin Service (DPBS) and VSAT Receive only service are offered.

E-Mail Service: VSNL has provided X.400 based E-mail service via its Gateway Packet Switching System (GPSS).

2.2 Application Profile of NICNET for Development Catalysis

The government administration in India has undergone successive administrative reforms to fulfil the needs of the public in the past four decades. Decision making on development activities of the nation call for efficient discharge of functions at all levels of the government administration - ministries in the central government, the secretariats of 32 state governments/union territories and more than 500 district administrations.

With the implementation of NICNET, the National Informatics Centre has become a bridge between the state governments and the central government on the one hand and the state governments and their district administration on the other.

The need for reliable and timely information for decision making requires no emphasis. Already there exist information sources in sectors like agriculture, power, health family welfare, industries, education, employment, labour, transport, communication, forest, roads, etc., at the district level. Information gets manually validated and consolidated progressively at the districts, state and the centre. This manual process has inherent delays, apart from lack of completeness and accuracy of data. This problem can be overcome by capturing data at the source by establishing District Informatics Centres. Keeping this in view, NIC has launched its District Information System Programme (DISNIC). With the active cooperation of the state governments, through their support to numerous pilot projects, NIC has developed DISNIC database templates for the following 26 sectors:

1. Agriculture
2. Animal Husbandry
3. Buildings and Works
4. Civil Supplies
5. District Collectorate
6. Collegiate Education
7. District Planning
8. Employment
9. Fisheries
10. Ground Water
11. Industry
12. Irrigation
13. Health
14. Rural Development
15. SC/ST Development
16. Social Forestry
17. Labour
18. Panchayat
19. Power
20. Public Instruction
21. Roads and Bridges
22. Social Welfare
23. Town Planning
24. Transport
25. Water Authority
26. District Treasury

With the setting up of NICNET, a stage has been set for developing a distributed Geographic Information System (GIS) on the network. The Distributed Database Management System (DDBMS) concept has been extended to GIS software package. This is paving the way for the setting up of GISTNIC, a nation-wide GIS on NICNET accessible through a query system.

To equip the District level administration with a computer assisted cartographic tool, DISNIC has embarked on an ambitious project which aims to amalgamate spatial and non-spatial data with the help of the computer system installed at the district headquarters. The present effort is an experimental step in this direction. This minimal system is undergoing

field trials in a number of districts. The following modules are being implemented progressively:

1. Interactive, feature based map editor
2. Choropleth mapping software
3. User defined symbols library
4. Programmable interface for thematic mapping
5. Merging adjacent map sheets
6. Network based distributed operations
7. Distributed GIS query system on NICNET
8. Link software between pre-GIS and stuructred GIS
9. Link software between Space Image formats and GIS
10. Link software between GIS and distributed DBMS

Besides development of a number of integrated on-line data bases and related applications, various planning models are being developed on NICNET. NICNET is fully equipped to cater to the needs of various planning agencies in the Government for building simple to complex planning models as an aid to decision process. One of the important areas is the on-line progress monitoring of various central sector projects and schemes. NIC is providing turn-key service to the Ministry of Programme Implementation for the monitoring of all central sector projects each costing more than Rs.1000 million. The computer based system is operational in the office of the Ministry of Programme Implementation on the NEC system for generating various reports for indepth monitoring and control through the concerned administrative ministry in each sector.

However, it is now proposed to cover all the central sector projects costing even less than Rs.200 million with respect to time and cost monitoring.

The success of any organisation, in particular of large corporations, depends mainly on how powerful is the system for project planning, monitoring and control. The project planning approach developed by NIC anticipates the various sequential steps needed to complete a project. At the micro-level this includes identification of tasks and their sequences, establishing a project schedule that includes mile-stones and deadlines as well as estimating the resources and raw materials that will be needed, when they will be needed, and at what cost. A project plan is prepared as a complete model that reflects project components and their logical and structural relationship.

Time and cost over-run status of various central sector projects costing over Rs.1000 million falling under 14 different economic sectors are being moitored by the government on quaterly basis followed by detailed analysis of various projects. At present, time and cost over-runs, accoun: for an overall increase of 48.4 per cent over the original project cost. NIC is developing a number of project monitoring (PM) software systems for various government departments and public sector undertakings. It has the following broad features :

- It can build and refine a project on the screen as a network (called `A Roadmap') along with the critical path.

- It can translate time and cost of tasks into schedule bar charts and cost graphs respectively.

- By inputing resources, PM draws upon allocations and loading graphs to show how each resource is allocated and how much each resource is in use. It is thus, easier to minimise time and cost, and use resource efficiently.

- For large and complex projects, one can break it down into a number of sub-projects, and combine them into one project. PM handles all the computations and automatically carries information from sub-projects to the next higher project level.

- It can print a variety of reports on projects and one can transfer PM data to make database and later on use it for preparing spreadsheets.

One hundred nodes of NICNET is planned for the infrastructure for such online project monitoring of as many projects representing a total plan investment of Rs.900 billion with the following approximate sectorial break-up:

Power sector	:	Rs.300 billion
Fertilizer sector	:	Rs.100 billion
Irrigation sector	:	Rs.120 billion
Steel sector	:	Rs.100billion

Cement sector	:	Rs. 60 billion
Coal sector	:	Rs.12,0 billion
Oil sector	:	Rs.100 billion

Utilising NICNET, it is expected that such online project monitoring would reduce time over-runs and cost over-runs atleast by 10 per cent through timely identification of bottlenecks and getting them rectified. Monetarily, this would amount to a contribution of Rs.90 billion upto the end of VIII Five year Plan 1992-97 with a cumulative investment by NIC of Rs.5 billion upto 1997.

2.3 Water Resources Information System

The Central Water Commission (CWC) under the Ministry of Water Resources and the National Informatics Centre (NIC) under the Planning Commission have collaborated in developing a Water Resources Information System which is increasingly getting network-based. A brief description of the evolution of this system is given below:

The assessment, planning, design, development and maintenance of water resources require a dynamic database of surface and ground water profile, operation of water systems like reservoir regulation and optimal distribution of water and field management of irrigation, among others. A number of large, medium and small surface water projects and ground water development projects help in the consumption of 300 cubic kilometers per annum out of the total water resources of nearly 2000 cubic kilometers per annum. Half of this is the live storage through large and medium projects. The magnitude of the small projects can be gauged by the fact that there are about 230,000 tanks, 140,000 surface diversions, 500,000 lifts, 5 million shallow tube wells, 100,000 deep tube wells and 10 million dug wells, which together have created nearly 80 million Hectares of irrigation potential. This clearly underscores the importance of water in the life of the majority of the Indian population. Adequate, accurate and timely information regarding water resources is a major national requirement.

The requirement of data is given in Fig. 2.3.1 which mainly concerns hydrological data, water utilization data, both of which are dynamic and project data, soil data, topographical data, etc. which are static and catchment area details, water distribution networks and cropping pattern, among others, which are slowly changing.

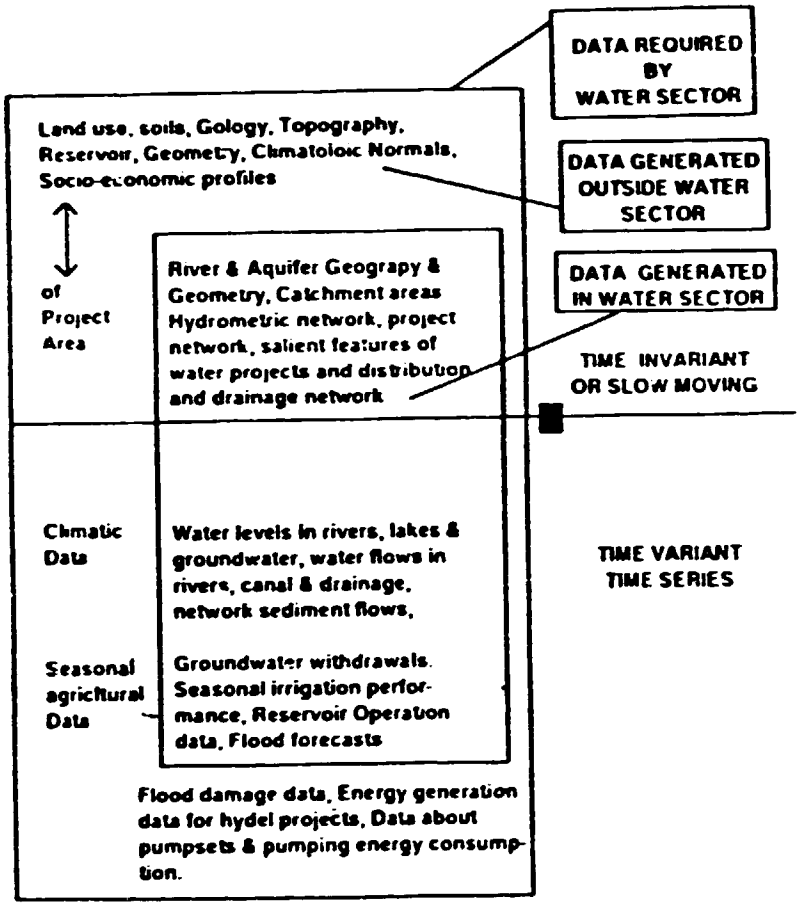


Fig. 2.3.1 Main Data Requirements of Water Sector (Courtesy: CWC)

Computerisation of hydrological data has made considerable strides in the past one decade. A network classification and coding system as well as hydrological data processing, storage and review system has been developed and utilised in CWC. A National Hydrological Data Management System in an integrated manner has been identified as one of high priority for the immediate future. Automatic quality control through machine processing has been recommended for immediate implementation.

A software has been developed for storing salient information about the very large number of minor irrigation structures in the country including the dug wells, surface lifts, surface flow schemes, minor tanks, shallow tube wells, etc. which have proved to be highly successful. A data management system for storing and retrieving salient features of large dams in the country has already been developed. A major lacuna sofar is in the development of water utilization database for which sufficient attention has not so far been accorded.

Integrated Database Management System which has been recognised as necessary, but has met with considerable difficulties in the past due primarily to the inhibitions of agencies to share their partial databases and the cumbersome administrative procedures involved in data retrieval. For example, obtaining uptodate rainfall data from Climatological Data Bank of India Meteorological Department (IMD) has been cited as an important lacuna in the system. Sharing hydrological data between various States of the Indian union has also been developing very slowly. The water data bank structure proposed in the national hydrological project is given in Fig. 2.3.2 where regional centres [illegible]ed as focal points. As partial databases are distributed geographically as well as organ[illegible]wise, and subject wise, considerable efforts in the inter-organisational negotiations are necessary.

With considerable amount of remote sensing data accumulating, an integrated hydrological data system would necessarily require a Geographical Information System (GIS) based approach, so that the various layers of spacial databases can be created with respect to population, land, forestry, soil, topography, rainfall, weather data, etc.

Hydrological analysis has been identified as an area requiring immediate attention. The applications that are evolving include, rainfall-run off relations, yield studies for reservoir sediment transport, reservoir sedimentation, river hydraulics, water balance,

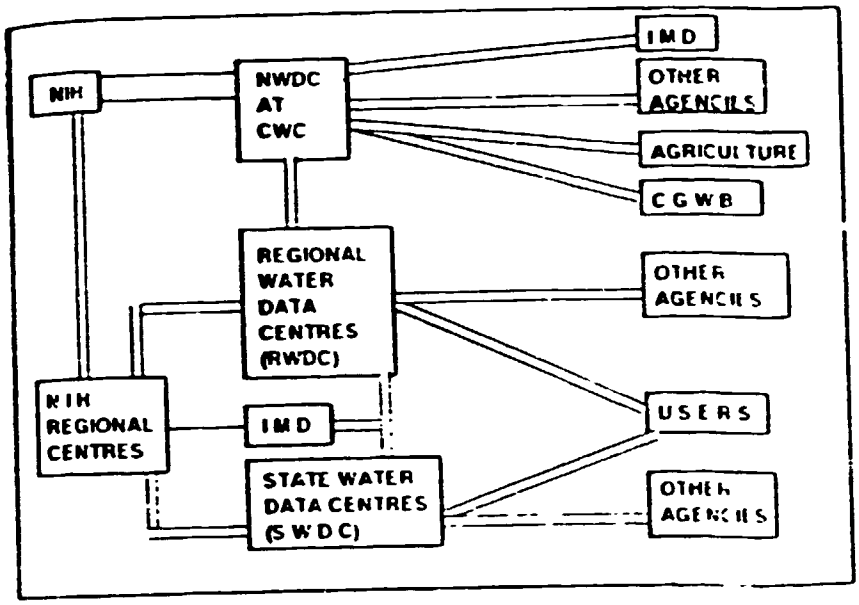


Fig. 2.3.2 Proposed National Data Systems (NWDS) (Courtesy: CWC)

ground water models and balances, storm analysis, unit hydrology determination, flood analysis, flood routing methods, dam break studies, etc.

The water technology centres and water and land management institutes in the country have carried out computer-aided calculations of water requirements of crops, irrigation water requirements, potential evapo-transpiration, effective rainfall etc. VALMI at Aurangabad and IMTI at Tiruchi have developed databases and software for crop yield simulation. The Water Technology Centre at Delhi, National Informatics Centre Delhi, Anna UNiversity, VALMI and CWPRS at Pune have developed scheduling of canal deliveries, some of which like the projects in Gujarat, have reached the farmers in the field.

CWC and NIC have collaboratively developed a software called, COMP-MON which is a DBMS package for project monitoring in water resources area.

Real time water management requires not only good facilities for computerisation and data storage, but also for utilization of computer-communication networks. Satellite telemetry has been tried for the River Yamuna. The satellite-based NICNET is operating satisfactorily in some aspects of real time water management. NICNET has also been used in monitoring reservoir levels and monitoring flood forecasts.

A comprehensive management information system for the water resources sector is being evolved which is capable of generating online reports about the disasters which have occurred or anticipated. Periodical reports of unusual events like high floods, droughts, unusual high or low water reservoir levels etc. and periodical reports of performance and assessment. Though considerable strides have been made by CWC and the institutions under it, a need has been felt for the development of an integrated water information system over NICNET within the next five years for which the following plan of action has been suggested by CWC.

(A) ***Data bank management:***

Establishing a national DBMS for Water

i) Standardizing formats of water data for computer storage, for different data types and hardware, for use by all agencies in India;

ii) Preparing standard data retrieval programmes after considering user requirements so that processed data and information is available in standard formats;

iii) Preparing standardized statistical quality control software for checking internal and external collection of data, data corrections, gap-billing, etc., as part of the DBMS-water;

iv) Interlinking organisational and regional databases networks for water,

v) Organisational and policy changes to facilitate free exchange of data.

(B) ***Analysis of data:***

i) Classification and cataloguing of available software;

ii) Changing software formats, in such a way that input and outputs formats are standardized;

iii) Linking small software programmes into sequences so that output of one programme can be used directly as input to another; providing options of assembly of such sequences;

iv) Developing expert system from sequences, by systematic debriefing of experts; and

v) Developing interactive packages to link analysis with designs, designs of drafting software and drafting with estimate preparation.

(C) ***Real-time Operation of Water Systems:***

i) Development of better sensors;

ii) Establishing one or a few national water data transmission systems, after considering their reliability under adverse weather, maintainability, costs, etc.

iii) Development of designs of canal cross regulators, gates and hoists, etc. to suit canal automation,

iv) Design of micro-processor based stand alone flood warning system which would sense catchment rainfall and cloud cover and directly warn downstream population.

(D) ***A National Management Information System for Water***

Designing and implementing a water MIS, having attributes as discussed earlier. Design and implementation activities can start ahead of establishing either a national Water DBMS or a national water data transmission system (see A&C above mentioned) by using available network and conventional transmission. When the pilot DBMS - Water for one basis is available, this will be linked to water - MIS.

(E) ***Organisational and Education and Training Aspects:***

i) Establishing a standing machinery such as a national committee for use of information technology in water sector to periodically review progress and give policy directions;

ii) Undertaking a large training programme for upgrading capabilities of personnel.

iii) The training needs of water sector personnel would be two types:

(a) General training in use of computers,
(b) Training in use of computers for problems of water sector.

Since training faculty for (b) above mentioned would be extremely short, training of type (a) should, as far as possible, be conducted by persons not

in water sector, so that experts in IT use for water sector can be utilised as trainers for type (b) use.

iv) Developing water-related overlays for a national geographic information system, covering both the time invariant and time variant data.

(F) ***Action Plan for Pilot Projects***

Immediately starting pilot projects in some areas, such as:

(a) Installing and operation of a computerised water database management system in one basin about 5000 sq.kms, covering all subsectors and data types;

(b) Automated water distribution and scheduling for one major project;

(c) Saturation computerisation of one planning and design office in water sector; and

(d) A pilot project can be taken up for logging of instrumentation data to a micro processor, and for conducting real-time preliminary analysis at the dam site. Periodic detailed analysis may be carried out by further analysis of the logged data in a larger computer centre. However, the in-site processing, should detect unusual behaviour and give early warning.

2.4 *Information System for Rural Development Management*

In the management of rural development programme including planning, monitoring, Information Technology (IT) streamlines and improves the information flow and analysis.

Rural development is a planned process of resource inputs into rural areas. The task of rural development is a major challenge comprising demand and supply of inputs, management of available resources, infrastructure and utilisation of these in various development sectors at different levels of administration.

The rural development programmes in India are of two kinds. The aim is to assist individual family and the individual below poverty line by (a) offering subsidy and

institutional credits and (b) also providing wage employment to the people. The objective is to assist the poor people with the help of above schemes to bring them above poverty line. This involves lot of financial inputs from Government of India and State Governments. The management of financial information is an aspect to be addressed effectively.

District Rural Development Agency (DRDA) is the nodal agency involved in implementation of Rural Development Schemes. In some states like Karnataka, Zilla Parishad (ZP) looks after these schemes implementation. In the entire process of implementation of these poverty allevbiation schemes, the Block Development Officer (BDO) plays a very important role. He implements these schemes at field level and collects the data and sends various reports to the Districts. There are two levels of data collection in the districts.

First Level: BDO collects the data from all the Panchayats of the Block.
Second Level: The reports from all the Blocks will be coming to the DRDA/ZP.

The district report is sent to the State/Central Government. Here they do not have any mechanism to cross-check the information provided by BDOs.

The concept of concurrent evaluation is to find out the impact of schemes and bottlenecks in the implementation. It is an analytical exercise which often does not take place because of target-meeting exercise.

In this context, the Department of Rural Development gave NIC the responsibility to design and develop the software for DRDAs to process the data related to povery alleviation schemes at district level.

The main purpose of the MIS is to strengthen monitoring of the centrally sponsored schemes. Effective monitoring would require development of detailed information systems at district level which is the area of DRDA's activities. Initially software is designed to serve the following objectives:

a) Help DRDA staff to quickly understand simple data storage (input) and data retrieval (output);
b) Create basic records of beneficiaries and works under rural development programme;

c) Provide an easy method of generating various r eports prescribed by the State and the Centre; and

d) Gather basic information about villages to support planning activity for anti-poverty schemes.

NIC installed PC/AT machine with all peripherals in pilot DRDA's across the country

The Computerized Rural Information System Project (CRISP) package has been developed in dBase III Plus environment with utilisation of power of clipper. Foxplus has been used in XENIX environment which is available in each district on DISNIC machine (80386-based). These packages are user-friendly and easy for modification to meet local needs.

CRISP version 2.0 is more user-friendly and very flexible in design. Many modules on other poverty-alleviation programmes like DWCRA and TRYSEM have been included. The free query system was also added to village database and IRDP.

The most frequently required reports for monitoring are made available under output option of the package. Some of the typical reports are given below:

IRDP:

1. Key indicator report
2. Monthly physical/financial performance (district/block)
3. Cumulative physical/financial performance (district)
4. Conditional beneficiary listing
5. Bank physical/financial performance for a given block/sector (primary/secondary/tertiary) etc.

JRY:

1. Quarterly progress report (QPR)
2. Summarised MPR (telex form)
3. Detailed MPR with block level break-up
4. Money allocation to Panchayat, etc.

Similarly, many other reports in village database, TRYSEM and DWCRA provide detailed information required for programme's planning and monitoring.

NIC is supporting project implementation in most of the States. The State level MIS for DRD has been developed in most of the States in which data are received from district with the help of NICNET. After required analysis is done at State level, the relevant reports are sent to DRD using NICNET.

2.5 *Database for Decentralised Planning:*

Since India has different types of terrain, resources, climate, socio-economic levels and distinct problems, preparation of a comprehensive micro-level plan either for a village, or cluster of villages, requires a strong spatially area/region oriented geo-integrated socio-economic-cum-natural resources database for planning, management and decision-making at grassroot level. Over the years, increasing emphasis has been placed on multi-level planning, from the national level to the state and to the district level and to the small area (development block) which was considered as a "suitable and manageable geogrphical unit area" for planned development within the frame of district planning and other levels in the multi-level planning structure.

The micro-level planning approach is essentially to meet the objectives of: (i) optimum utilisation of human as well as natural resources available in the area, (ii) improvement in income and employment opportunities for rural masses, and (iii) integration of area development with the development of people residing therein, and also to address itself to the problems of the rural poor and formulate realistic targets for reducing: (i) poverty, (ii) unemployment, and (iii) inequality.

Data requirements for micro-level planning at block level may be grouped as follows :

A. Plan Formulation: (i) Assessment of the available resources and additional resources required for the development, (ii) To consider the need of the people with particular reference to the weaker section of the society, (iii) Formulation of schemes/programmes with specific objectives on the basis of the above details; here national priorities should be given utmost importance and wherever it is necessary linkage between local programmes and special programmes should be established,

and (iv) Setting physical and financial targets to be achieved within the specific time-frame under each scheme/programme.

B. Plan implementation which is a sensitive aspect of the planning process, involves the issues such as: (i) to find out suitable agencies for assigning the responsibility for implementation of the scheme/programmes; (ii) to provide suitable infrastructure to ensure a timely and healthy progress; and (iii) monitoring the progress and timely solution of the problem arisen.

C. Evaluation is a systematic and proper assessment of a programme with reference to the objectives of the schemes/programmes; the data generated at the implementation and evaluation stages should be input data for future plan formultion.

As per the recommendations of the committee of "Study Group on Information Gap" of the Planning Commission, proformae for information collection for micro-level planning at district, block, and village level were designed and distributed to the State governments, under the DISNIC-PLAN programme. The DISNIC-PLAN programme aims at : (i) creation and maintenance of district, block and village level databases in respect of socio-economic, agro-economic and natural resources, etc., (ii) expert systems development, and (iii) also integration of GIS Techniques for micro-level planning, using NICNET facilities at the district level. Voluntary agencies can look into the data for its utility with respect to their requirements. Many State Governments are in the process of information collection to create the database. Agencies like NABARD would like to use the village data for their credit plans.

With the implementation of DISNIC programme, NIC has initiated information revolution at district level through its various databases to provide demographic, socio-economic and development indicators. With the quick availability of information, the administrators can now devote more time to the actual planning and decision-making. As the block is the smallest developmental unit, especially in implementing development programmes and the block generates basic information, the development of block level information system is expected to go a long way in increasing the availability of information for decision-making, monitoring, evaluation and planning. The GRID programme is expected to facilitate the grass-root level development planning and administration which has been emphasised during this Plan period. Implementation of GRID programme will take place during the enhancement of NICNET facilities.

GRID programme is expected to cater to the following areas:

(a) Tehsil/Block level Database Project on Development sector, e.g. (Rural Labour, Agriculture Development, Animal Husbandry Development, Dairy Development, Minor Irrigation, Soil Conservation, Industry (SSI, Rural Agro-based), Social Forestry, Wasteland Development, Wetland Development, Fisheries Development, Community Development, Rural Development), Social Services (Health and Nutrition, Education, Drinking Water Supply, Housing Sanitation, Welfare Programmes, Local Transport), Cooperation, Banking and Financial Institutions for credit facilities, etc.;

(b) Land Records Informatics;

(c) Panchayati Raj Institutions Informatics;

(d) Nagarpalika Informatics;

(e) Employment and Training;

(f) Information System on Women in Agriculture, Women and Rural Development, Women and Environment, Legal Provisions protecting women, Employment opportunities for women, Science and Technology component assisting Women, Women and Education, Women and Health, etc.

(D) Invovement of Voluntary Agencies for Government Informatics Development Programme.

2.6 Bibliography Database

A number of large specialised libraries in India are turning to automation of functions such as cataloguing, circulation, preparation of bibliographies, union catalogues, etc. A number of libraries are giving computerised Selective Dissemination of Information (SDI) services, like the National Centre for Science Information (NCSI) providing SDI service to the Indian academic community in Physics, Geology, Mathematics, Chemistry and Life Sciences. The Central Technical Information Centre (CTIC) has developed an SDI service for engineers. The databases used for such services include Current Abstracts, INSPEC, COMPENDEX, NTIS, MEDLARS, BIOSYS, INPADOC, etc. The Indian books in print published by Indian Bibliographies Bureau in Delhi has been maintaining

more than 300,000 bibliographic records in machine-readable form. A database on Indian Library Science Abstract is being created by IALSIC of Calcutta. Indian National Science Documentation Centre (INSDOC) is working on Computerised Index of India Science Abstracts and the National Index of Translations. A number of specialised computerised information systems are being maintained in the areas of Bio-energy, Bio-medical sciences, Environmental sciences, Health sciences, Statistics, Education, Management, Agriculture, Economics, Geo-sciences, Food sciences, Leather Industry, Social sciences, Transportation, Patents and Technology. The National Information System for Science & Technology (NISSAT) has established the following 9 sectoral information systems: Leather Technology, Food Technology, Machine Tools, Drugs & Pharmaceuticals, Textiles and allied subjects; Chemicals and allied industries; Bibliometrics, Advanced Ceramics and Compact Disc Source Information.

INSDOC, New Delhi, is maintaining a computerised Indian Science Abstract. The National Library at Calcutta is maintaining an Indian National Bibliography in 14 major languages of India. INSDOC also maintains a National Union Catalogue of Scientific Serials in India (NUCSSI) with holding data relating to 35,000 titles, of which 18,000 are current including 2300 of Indian origin. NISSAT and INSDOC are collaborating to convert files into a database for custom searches and preparation of sectoral subjects or city-wise catalogues. The bibliometric studies for evaluating research outputs have resulted in a Science Citation Index (SCI) which serves the information requirements of the S&T industry. For supplementing the SCI datbase, a National Citation Index is being implemented at the National Centre on Bibliometry (NCB).

The National Social Science Documentation Centre (NASSDOC) of the Indian Council of Social Science Research (ICSSR) has prepared a Union Catalogue of social science periodicals in Delhi libraries. City-wise and State-wise proliferation of NASSDOC is also being planned.

Under the NISSAT programme, sectoral information centres are being set up developing indigenous databases on leather at the Central Leather Research Institute (CLRI), Madras; Food at the Central Food Technology Research Institute (CFTRI) Mysore; Machine Tools at the Central Machine Tools Institute (CMTI) at Bangalore; Drugs and Pharmaceuticals at Central Drug Research Institute (CDRI) at Lucknow, Chemicals at the National Chemical Laboratory (NCL), Pune; Textiles at Ahmedabad Textile Industry

Research Association (ATIRA) at Ahmedabad and Advanced Ceramics at the Central Glass and Ceramics Research Institute (CGCRI) at Calcutta.

The National Institute of Science, Technology and Development Studies (NISTADS) has developed a database called, CLOSS (Current Literature on Science of Science) on Indian S&T policy studies, resource, practices, implementation and monitoring. NISTADS also maintains a Science Policy Literature Database and Science & Technology Archival Resources (STAR) system.

The Publication and Information Directorate (PID) of the Council of Scientific and Industrial Research (CSIR) is maintaining a database on Medicinal and Aromatic Plants Abstracts (MAPA) compiled from the Wealth of India series.

The National Institute of Oceanography (NIO) maintains a bibliographic database called, OCEANLINE. The Ministry of Environment and Forests is promoting the development of an Environmental Information System (ENVIS).

A number of databases on CDROM have been acquired by various orgnisations for giving services to the scientific and commercial users, the major ones being the Science Citation Index (SCI) by INSDOC and Acquatic Science & Fisheries Science Abstract database by NIC, MEDLARS, CANCER-CD, CHEMBANK, COMPU-INFO, POPLINE by ICMR-NIC Bio-medical Information Centre, apart from those provided on Science and Technology from NCSI.

A number of collaborative database development activities are also under way internationally. The Agricultural Research Information Centre (ARIC) of the Indian Council of Agricultural Research (ICAR) maintains and provides Indian inputs for AGRIS. The Bhabha Atomic Research Centre (BARC) maintains and provides Indian inputs to the INIS database. The International Food Information Service (IFIS) of UK and CFTRI are collaborating in the compilation of the Food Science and Technology Abstracts (FSTA) database.

A number of specialised information networks for bibliographic information services are developing. Some of the more important ones are given below:

1. CSIRNet - A Computer-Communication network for CSIR for exchanging information among its 40 laboratories.

2. ERNET - it is an Internet-based computer to computer connectivity for academic and research community utilising the intra-city and inter-city dial-up facilities provided by the Department of Telecommunications.

3. BTISNet - A Close User Group (CUG) of NICNET, set up by the Department of Bio Technology of the Government of India with specialised information centres in Genetic Engineering, Cell Culture and Virology, Plant Genesis, Plant Molecular Biology, Oncogenesis, Reproductive Physiology, Cell Transformtion, Nucleic Acid, Immunology and Bio-process engineering.

4. CALIBNET - An Intracity library network in Calcutta promoted by NISSAT for ensuring better utilsing of S&T information resources.

5. DELNET - An Intracity Library network in Delhi supported by NIC, NISSAT and UGC.

6. INFLIBNET - a proposed Information and Library Network on a national scale under the UGC.

7. VIDYANET - a proposed computer-communication network to stimulate cooperative research and exchange of research information between leading R&D institutions.

2.7 C-C for Indian Banking Industry

In a geographically and demographically widespread country like India, the complexity of banking operations requires intensive and extensive use of computers and communication networks. The Indian banking system has more than 60,000 branches. As many as 12,000 branches of scheduled commercial banks in 100 centres, account for nearly 70 percent of the total deposits and advances. Efforts are, therefore, under way for connecting these 100 branches effectively using a computer-communication network. The

optimum utilisation of SWIFT International Network in India also requires an effective nation-wide network to connect the banks for domestic inter-bank fund transfer.

To meet the above growing requirement, BANKNET is conceived as a cooperative network jointly owned by the Reserve Bank of India and Public Sector Banks. Private sector banks and financial institutions are also allowed to use the network. At present, the network covers 7 major cities - Bombay, Delhi, Calcutta, Madras, Nagpur, Hyderabad and Bangalore. The user banks have the provision to access BANKNET from their premises through leased lines at the respective local centres using asynchronous PADS and using PC/UNIX systems with a software called, 'COMET' (Computerised Message and File Transfer). The core network of the BANKNET is monitored and controlled by centralised network management system installed in Bombay.

The BANKNET is being utilised for the following applications: Quick settlement in RBI/Banks for Government transactions taking place at branches of public sector banks through their link/main offices; inter-bank fund transfer on their own and on customers' account and inter-bank fund transfer of banks for their own accounts PP and on account of customers/public. It enables improvemnents in payment system by facilitating automated clearing services. It facilitates data transmission between banks and RBI and between zonal/regional offices and head offices of banks. It also gives access to SWIFT international network from different centres in the country.

A number of public sector and private sector banks are planning to install their own computer-communication networks connecting their headquarters and zonal units to important branches around the country.

2.8 Computer-Communication in the Stock Exchanges

With the liberalisation of the Indian economic and financial systems, a major change is taking place in India in the investment climate, the Stock Exchanges have become the focal points for mobilising capital both Indian and foreign. With the growth of the primary and secondary markets, the complexity of the stock market operations is increasing. IT and C-C is the main answer to cope with the sudden increase in this complexity. The Bombay Stock Exchange alone will be spending by 1994 Rs. 700million towards computerisation. Apart from several Government-backed initiatives, a number of private enterprises are also planning to provide value added services to the Stock Exchange system. An example is

BHARATNET promoted by the Delhi-based NRI Financial Services. M/s. Over the Counter Exchange of India (OTCEI) has introduced an automated Stock Exchange including a teletext broadcast system through NICNET in cooperation with NIC.

The market transparency afforded by IT and C-C is expected to guarantee fair trading practices which may lead to faster settlement and improved liquidity. The setting up of the National Stock Exchange (NSE) on the lines of the US Securities Market (NASDAQ) at New York, expects to link all major trading centres by computers and set up a national electronic clearing and settlement depository. The Cochin Stock Exchange (CSE) is one of the earliest users of computers in clearing, trading and post settlement work. The Vadodara Stock Exchange (VSE) in Gujarat has introduced electronic processing of daily transaction reports from the day of its inception. All members have PC/AT/386-based computers conneted through ethernet accessible to the main computers of the Stock Exchange.

III. EVOLUTION OF POLICY INSTRUMENTS IN IT AND C-C

III. EVOLUTION OF POLICY INSTRUMENTS IN IT AND C-C

The evolution of policy instruments in IT and C-C is described below beginning with the 1984 computer policy and 1986 software policy as well as policy instruments which enabled the setting up of a number of C-C networks. The IT and C-C policies are examined in the background of the pace of liberalisation of the industrial policy. The gradual reduction in the control of telecommunications sector is highlighted pointing to the widening disparity between the faster pace of liberalisation of the economy and the slower pace of liberalisation in the telecommunications sector. The prime motivators and policy instruments that are evolving for a fast absorption of IT and C-C in the Indian work place, is examined with specific reference to the globalization imperatives.

The impact of the liberalisation process of IT and C-C for the present and for the immediate future are examined including the actual policy instruments which set the liberalisation process on the move and the EXIM policy announced for the 1993-97 duration as well as the interest these generated in the US, Canada, Europe and Japan. It is pointed out that while much has been done, much more is still required to be carried out towards appropriate liberalisation. The Dunkel Draft has its impact on the Indian software industry vis-a-vis the balance of advantages to India in the face of US Visa clamp and paucity of funds. The question whether the indigenous computer industry is de-emphasized in the face of a fast liberalisation, in particular, with respect to the Indian software industry, is sought to be answered. A discussion on what takes India to become a global player in IT and C-C is presented.

3.1 The Industrial Policy Environment

In the 1956 Industrial Policy Resolution, the industrial sector was partitioned into three categories: (a) industries that are a State monopoly, (b) industries where the State is allowed to take progressively increasing role and (c) industries open to the initiatives of the private sector. Under this resolution, telecommunications, broadcasting and electronics came under the first category. In the background of this, the Industrial Policy Resolution (IPR) allowed for an industrial licensing system, an import licensing system, a trade policy system and a fiscal poicy regime. The licensing system provided for direct or indirect subsidising of the small scale industry, industries in backward areas and allowed for the control of monopolis utilizing the Industrial development and Regulation Act of

1988 and the Monopolis and Restrictive Trade Practices Act of 1973. The import licensing and trade policy which were administered by the Directorate General of Technical Development (DGTD) was intended to protect the indigenous products even beyond economic viability considerations. This policy was protected by the Foreign Exchange Regulation Act of 1974.

The fiscal policy regime, apart from serving the revenue collection measures of the Government, was also a price regulating and market intervention device.

The application of IPR in the above frame work gradually gathered a momentum of control, regulation and protection which influenced the pattern of investment down to the product level, choice of technology with respect to scale, expansion, location, import content, foreign collaboration, knowhow level, etc. The eventual effect of this was the creation of a high cost and low investment efficiency type of industrial economy.

By the middle of 1975, the distortions in the economy created by the IPR of 1956, was beginning to be realized. A number of Committees were set up to review the policy instruments, like the Alexander Committee of 1978 for import classification strategy, Sondhi Committee of 1979 on Capital Goods Import, Tandon Committee Report of 1980 on areas and incentives for export, Abid Hussain Committee of 1983 on policies for export promotion etc.

The negative impact of the 1956 IPR was very pronounced on high-tech industries like telecommunications, broadcasting and electronics. Listing them under category (1) gave a monopolistic role for the State which resulted in a high cost production and low growth propensity. The rate of change of technology in these areas being very high, the restrictive regime of the IPR stiffled the influx of new cost effective technologies and India missed the bus in its ability to compete in the international market for cornering its due share of exports of these products. In contrast, countries which had more liberalised industrial frame work like Japan, Hongkong, Philippines, Singapore, South Korea, etc. showed more viability, productivity, quality and quantity of industrial production in these areas. With the unprecedented foreign exchange crisis of 1991, attention of economists and politicians turned to the need for a massive restructuring of the economy. Overcoming the foreign exchange crisis require significant dollar inputs from international financial institutions like the World Bank and the IMF who in turn, advise the Indian Government to take up drastic measures for industrial and economic liberalisation. Irrespective of the party

in power a broad consensus among different political parties in favour of liberalisation has emerged which has given the much needed political will for the transformation.

3.2 Evolution of policy instruments in Information Technology

In the early 70s in the wake of the creation of the Electronics Commission and the Department of Electronics, emphasis was laid on self-reliance in the electronics and computer industry. The action plan of the Department of Electronics for this was broadly as given below:

- Ensuring that the direction and pace of advance of production capacity for computers and allied equipment as also the availability of appropriate computational facilities both for direct use and for supporting the development of software tools, are determined by national needs, priorities and requirements;

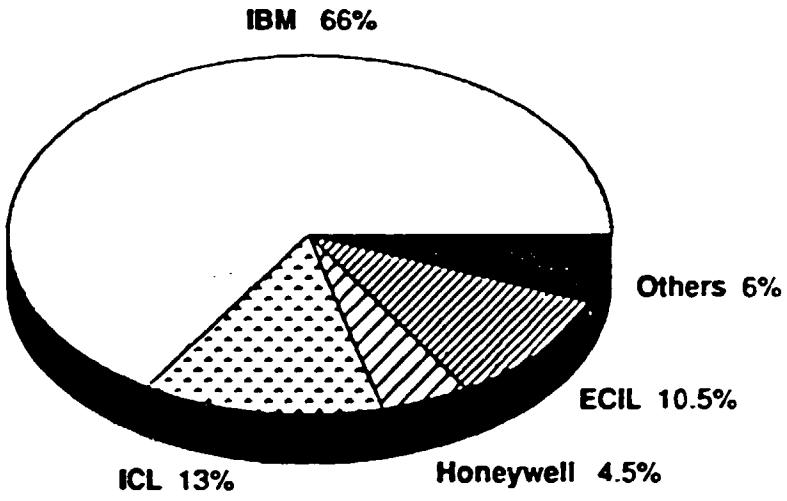
- Ensuring that the key-segments of the computer-industry are under national control and free from any monopolistic trends;

- That a visible indigenous programme of production of computer hardware and software is built up to meet national requirements and to generate surpluses for export; and

- That over a period of time a substantial part of the technology needed for the design and production of systems, sub-systems, components and materials and also the supporting software is generated through indigenous research and development; and appropriate to the country's needs and over a period of time become contemporary in terms of international availability.

The scenario of the share of the computer market in India at the beginning of 1974 is depicted in Fig. [Source: Public Accounts Committee (1975-76) 221st report]:

In order to implement the strategy for self-reliance as outlined above, the Department of Electronics took a series of actions in properly assessing the user needs along with action plan for meeting them, increasing national control over IBM and ICL dominated market, built up indigenous manufacturing capability and promoting indigenous



ICL: International Computers Limited
ECIL: Electronic Corporation of India Limited

Source: *Computerisation in Government Departments*, Public Accounts Committee (1975–76) (Fifth Lok Sabha), 221st report, Department of Electronics (New Delhi, India, April, 1976)

research. The Foreign Exchange Regulation Act of 1973, restricted trading and services of foreign companies and required conversion of all foreign companies into Indian companies diluting their equity to 40 percent. Accordingly, both IBM and ICL were asked to terminate their maintenance and training activities and transfer the maintenance activites to the newly formed Computer Maintenance Corporation and reduce their equity to 40percent or restrict themselves to 100percent export operations. While ICL conformed to this policy, IBM could not do so and therefore, had to suspend their Indian operations.

3.3 The first phase of liberalisation of licensing policies in Electronics

The period 1986-90 saw a series of initial measures towards liberalisation of the licensing policies in the electronics and computer industry. The Table presents the scenario given in the December 1987 report of the Bureau of Industrial and Financial Reconstructions, Ministry of Industry, entitled, "Studies on the Structure of Industrial Economy, Report on Electronics". The turning point in the Information Technology industry was the computer policy of 1984 and the software policy of 1986 implemented by the Department of Electronics. These two policies were aimed at the first level liberalisation to attract foreign investments, reduce import controls and in general, promote the spread of computer culture through myriads of applications, adopt a 'flood-in' and 'flood-out' strategy for software development and export, substantially reduce the licensing procedures and provide incentives for mass training. By 1987, the outline of the policy related to computer hardware was as given below:

Hardware Manufacture

- All Indian companies are eligible to manufacture micro/mini computers including personal computers.

- There is no restriction on capacity except for a minimum requirement of a viable capacity and a phased manufacturing programme (PMP).

- No MRTP clearance is required under Sections 21 and 22 of MRTP Act.

- Single point technical scrutiny is done for all applications by Inter-Ministerial Standing Committee (IMSC).

Table

Broad Features of Liberalised Licencing Policies in Indian Electronics, 1986-90

Policy Features

Generalised liberalisation:
- Promotion
- Nonregulation
- Fiscal controls in place of physical
- No upper limits on capacities

No-entry restrictions:
- Co-existence facilitated
- Large/small sector
- Public/private sector
- Joint sector

Tariff rationalisation:
- Primary raw materials lowest
- Intermediate components medium
- Equipment and systems maximum

Components	Defence and Aerospace Equipment	Consumer Electronics	Communication and Broadcast Equipment	Computers	Control Instrumentation and Industrial Electronics
Delicenced, except for companies under purview of Monopolies & Restricted Trade Practices Act (MRTP) and Foreign Exchange Regulations Act (FERA) Foreign equity companies (with more than 40% foreign equity) allowed in high-tech areas VLSI/LSI MRTP companies exempted IC assembly permitted investments above Rs. 50 million	All items reserved for public sector Only components and subcontracts to private sector	All Indian companies (including those with foreign equity up to 40%) allowed to operate "Broadbanding" to optimise capacity utilisation and allow production without new licensing Delicensed if resources from financial institutions not sought	Subscriber premise telecom equipment — private components allowed Other telecom equipment public sector equity 51% essential Electronics switching system (ESS) based on indigenous technology Equity holding: • 26% Central Government • 25% private • 49% general public Centralised acquisition of technology for telephone instruments, electronics PABXs and RAX	CPU mainframe/ super mini production reserved for public sector for two years PC manufacturers— all eligible No small scale reservation No capacity restriction—no minimum Phased Manufacturing Programme (PMP) No MRTP clearance Word processors delicensed	Same as for computers Broadband license for testing and measuring instruments All Indian components allowed

Source: Adapted from Bureau of Industrial Costs & Prices, Ministry of Industry, *Studies on the Structure of the Industrial Economy: Report on Electronics*, 17 (New Delhi, December, 1987)

- Word processors have been delicensed.

Excise Duty

- There is a 10 percent excise duty on computers including CPU and peripherals.

Import Policy

- Import of computers costing less than Rs. 1 million CIF, subject to a minimum configuration in one consignment, are allowed under OGL(Open General Licence).

- No Second-hand computers can be imported under OGL.

- Import of computers and predominantly computer-based systems costing more than Rs. 1 million would need DOE clearance.

- Import of 11 peripherals have been put on OGL list.

- Most of the electronic components required for computers are on OGL list.

- Floppy diskettes/media have been canalised through ET&T.

Import Duty on Systems

- 142 percent duty on all systems imported under OGL

- No import duty on certain advanced computers.

Import Duty on Peripherals and their parts

- 76 percent duty on peripherals (11 Nos. with DOE certification and 11 Nos. without DOE certification).

- 76 percent import duty on all peripherals.

- 45 percent import duty on parts (other than electronic components) for the manufacture of line printers, serial printers, terminals, magnetic drives, digitisers, etc.

Import Duty on Components for Computers

- 75 percent duty on electronic components
- 140 percvent on certain memory ICs other than 8 standardised types.
- 150 Percent duty on electronic sub-assembly for computers.
- 75 percent duty on spares.

In the software area, the objective of the 1986 policy was specified as follows:

The main basis is that any policy framework and its implementation has to take an integrated view of both local development of software and software export.

The policy is broadly aided at accomplishing the following basic objectives:

1. To promote software exports to take a quantum jump and capture sizeable share in international software market.

2. To promote the integrated development of software in the country for domestic as well as export markets.

3. To simplify the existing procedures to enable the software industry to grow at a faster pace.

4. To establish a strong base of software industry in the country.

5. To promote the use of computer as a tool for decision making and to increase work efficiency and to promote appropriate applications which are of development catalysing nature with due regard for long term benefit of computerisation to the country as a whole.

With the liberalisation measures, the computer industry began growing at a significant pace with the application of computers in various sectors of the economy. A wide manufacturing base consisting of micro, mini, supermini and mainframe computers including engineering workstations have been established in the country. The production base of less than Rs. 1000 million in 1984-95 grew very significantly to Rs. 5600 million during 1988-89 and to nearly Rs. 800 crores in 1989-90. The industry grew both in terms of physical outputs as well as the range of products introduced into the market. More than 80 manufacturing units became operational. During this period, the software export grew significantly as shown in the enclosed figure.

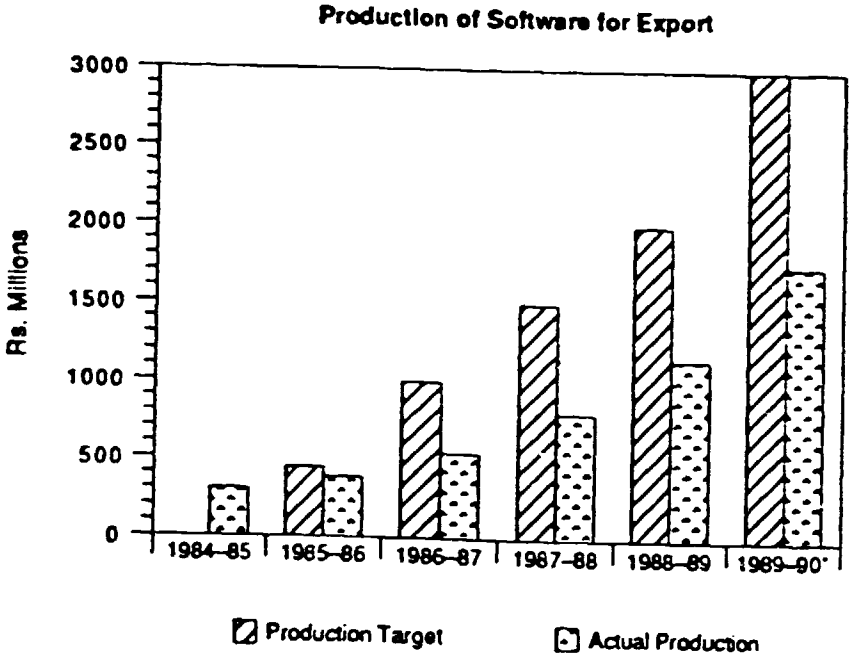
Though the export growth was substantial, it fell short of the target. The reasons cited were: inability to manage the higher growth rate due to inexperience in software product design, the domestic software market not keeping pace with the export demand, restrictions in the way of the availability of contemporary hardware, overseas credibility of new Indian software exporters and lack of utilisation of viable marketing outlets. In 1990, just two private companies accounted for 60 percent of software exports. To reach the projected goal for 1990-95, 200,000 additional software people have to be trained. The investment in training was not commensurate with this manpower demand. Added to this, the direct and indirect brain-drain of software specialists took place due to the considerable disparity in wages offered in the United States and in India. The evolution of the Indian software industry is undergoing the following five step transformation:

i) Building a credibility and reputation by providing cheap programming services on site at the customer's location in the form of "body shopping".

ii) Shifting the programming services back to India with well specified programmes and systems delivered through computer-communication links to overseas customers.

iii) Shifting the emphasis from low cost services to high quality services and lower cost clone products.

iv) Shifting from a service industry to a product industry by finding market niches.



*Estimated

Source for data: Government of India, "Electronics Industry Eighth Five Year Plan (1990–95, Working Group Report, Part II," Chapter 7, "Computers, Office Automation and Data Communication," *Electronics Information and Planning* (November 1990), 18, 2, pp. 112, 136.

v) Finding a true value added software intensive product in some application areas where the country has intrinsic expertise.

3.4 Telecommunications Policy Instruments

The IPR of 1956 and the Indian Telegraphs Act of 1885 gave a monopolistic status to the State. As until the 1980s the status of the economic infrastructure was not accorded to this sector, adequate priority for Government investment was not given The result was an inevitable lag of supply with respect to the demand and a high cost of telecommunication services compared to the developed countries.

The impact of the restrictive policies of the Government in the telecommunication sector between 1947 and 1986 is described in a self contained manner in the Table.

This poor performance encouraged a number of policy makers to work towards liberalisation of the sector and freeing it from the monopolistic control of the State.

Between 1984 and 1989, the Government took certain decisions having far reaching implications for reformation of this sector. They are, among others,

- making the Department of Telecommunications and Department of Posts as two separate entities;

- creation of Mahanagar Telephone Nigam Limited and Videsh Sanchar Nigam Limited as corporate entities for internal and external telecommunication services in Delhi and Bombay;

- creation of a Telecom Commission with wide ranging powers, and

- allowing participation of the private/joint sectors into the telecom industry and services.

The Athreya Committee report submitted to the Government in February 1991, recommended many policy instruments for liberalisation of the sector including a review of

Control of Indian Telecommunications

Government	Parent organization	Industry
Total government control: ▸ Government is service provider and has regulatory roles and powers ▸ Government is exclusive authority under Indian Telegraph Act of 1857	**Government departmental structure:** ▸ Imposes government procedures and policies ▸ Is dependent on central budget ▸ Makes commercial borrowing impossible ▸ Makes investments from internally generated funds ▸ Makes telecommunications tariffs high, partly because of small user base	**Exclusively for public sector:** ▸ Operates according to Industrial Policy Act of 1947 ▸ Controlled tightly by single user/monopoly purchaser

⇩

Implementation of Strategies, 1947–1986

Implementation problems:

- ▸ Failure of technology absorption and innovation
- ▸ Funds constrained because of exclusive dependence on budgetary support or internally-generated funds

⇩

Consequences*

- ▸ Low telephone density — per 100 persons
- ▸ Huge waiting list: 1.2 million people, waiting time up to 7 years
- ▸ Poor call completion rate and telephone traffic congestion
- ▸ Poor staff productivity ratio: 1 person per 12 telephones
- ▸ 50% of 4 million workforce is in the worker category with poor entry-level literacy: incompatible with high-tech image of modern telecommunications
- ▸ Charges are incomparably high in relation to income levels; for example, a one minute ISD call from India to the U.S. compares as follows:

1.88% of India's per capita income (Rs. 3,300)	U.S. = .0083% of per capita income
.6% of monthly wages of the highest paid Indian executive	U.S. = .02%
7 hours of wages for Indian blue collar worker	24 minutes for corresponding U.S. worker

- ▸ Annual per telephone customer revenue (of about Rs. 8000) more than twice the per capita income
- ▸ 25% of population living in urban areas (226 cities and 3700 towns) have 90% of telephones, and 75% of total population living in 560,000 villages have only 10% of the country's telephones. Out of these, only 30,000, representing 5.3% of total villages, have telephones.
- ▸ Poor track record in introduction of new services (data communications, etc.) and new technologies

*Source: T.H. Chowdry. *Telecommunications — Towards a New Philosophy and Regime*. Talk delivered at Hyderabad Management Association, January 31, 1989. Background paper for workshop on Consumer Interest and Monopoly Services: Tele...one Services, March 22-24, 1991.

the Telecom Commission, corporatisation of Telecom services in various cities countrywide, etc

The Committee recommended that the DOT field operations should be structured into six corporations. It further recommended that the Telecom Commission should focus on regulatory activities and that value added services should be thrown open to the private sector. Setting up of an India Telecom Operating Company, as a holding company for DOT's field operations was also recommended. The recommendations were not implemented even as of 1993.

3.5 Absorption of IT and C-C

Several prime motivators and policy instruments are evolving towards a faster absorption of IT and C-C in the Indian work place. Considerable promotional efforts are still required with awareness creation and training policies oriented towards retraining of workers affected by the introduction of information technology so that a change of work culture results with increased production but without displacement of manpower.

3.6 The EXIM Policy : 1993-97

The Government has announced a long term export-import policy to help the Indian enterpreneurs to increase their exports. Though there is no change in the negative list of imports of electronics items, a number of innovative policy instruments have been introduced with a view to make the Indian IT industry globally competitive. A brief excerpt from the policy is outlined below with specific reference to information technology industry and telecommunications.

Negetive list of imports: The negative list of imports pertaining .to import of electronic items remains unaltered.

Computer systems: The entry with regard to computer systems in the negative list of imports remains unaltered as:

"Computer systems,including personal computers,upto a CIF value of below Rs.150,000 lakhs or keyboards or monitors each with a CIF value of below Rs.7500/-.

For this purpose, a computer system will consist of a single CPU including one keyboard and monitor and inbuilt peripherals, but excluding any add on peripherals."

All other computer systems other than the above can be imported freely.

Circuits Boards: The entry with regard to import of populated PCBS in the negative list of import remains unaltered as "Populated,loaded or stuffed printed circuit boards".

However, populated PCBS will be allowed without a licence in the following cases:

* As spares for operation and maintenance of capital goods installed or used by the importer. The value of import permitted in a licensing year shall be equivalent to 1% of the CIF value of imported equipment or purchase price of indigenous equipment in which the populated PCB has been used as a component. This import has been allowed only to the actual user and not to companies providing maintenance for such equipment.

* Research and Development units recognised by the Department of Science and Technology for use either as spares or for research and development purposes for meeting their annual bonafide requirements.

The populated PCBS imported under above provisions shall not be transfered or disposed off in any other manner without the prior permission of the Director General of Foreign Trade.

Capital goods scheme: The new policy provides only a single concessional import duty rate of 15% for the existing EPCG scheme by deleting the 25% duty window. This has been done in view of the general lowering of customs duty in the budget of 1993-94. This benefit under this scheme is available subject to an export obligation of four times the CIF value of the imports to be fulfilled within a period of five years from the date of issue of the licence.

In the case of export of computer sofware, the export obligation shall be limited to four times the CIF value of imports to be fulfilled within a period of five years and the past

average level of hard currency earning of the licence holder if any in the preceding three licensing years need not be maintained.

The service sector: In order to tap the potential of the service sector, a new scheme called the "Export Promotion Capital Goods Scheme for the Service Sector" has been introduced in the policy. Under this scheme, capital equipment at a concessional rate of duty of 15% subject to an export obligation of four times the CIF value of imports may be allowed to those who render professional services.

The list of capital equipment to be allowed under this scheme shall be notified through a public notice. However, the items of capital equipment that may be imported under this scheme shall have a direct nexus with the services rendered. Computer systems shall certainly be covered under this scheme as and when notified. The export obligation to be fulfilled under the scheme shall be the payments received in freeely convertible currency for the services rendered by the licence holder,regardless of whether the services are rendered in India or abroad. The export obligation shall be over and above the average level of hard currency earnings of the licence holder if any in the preceding three licensing years.

An applicaiton for grant of a licence under the scheme shall be forna minimum CIF value of imports of Us $10000 thereby implying that lower end systems/pc cannot be imported until such import is clubbed with other items to make an applicaiton for a minimum value of US $10000.

Duty exemption scheme: The policy provisions with regard to grant of advance licence under duty exemption scheme remains unaltered. Import of spares/mandatory spares for supply alongwith the export product will bot be allowed. The period of meeting the export obligation has been altered to 12 months from the date of issue of advance licence as against 12 months from the date of clearance of the first consignment.

Export oriented units and units in export processing zones: The policy provisions pertaining to governance of scheme of Export Oriented Units and units in Export Processing Zones remain unaltered. However, the value addition norms have been eased to encourage indigenous purchases. Henceforth, the value of all indigenous purchases shall not be treated as imports for purposes of calculation of value addition.

Special import licence: The scheme for grant of special import licences against certain export products listed has been slightly amended,e.g.;

(a) Audio and video magnetic tape, floppy diskettes

(b) Consumer telecommunicaion equipment (all types of telephone instruments,EPABX,DRS,modems,ISDN-terminals, cellular mobile telephones,car phones, transportable phones, paging receivers,Video conferencing terminals equipment, video text terminal equipment).

Exporters of the above products would be entitled to the grant of special import licences limited to

(i) 30% of FOB value of export realisation in case the exporter has not availed the facility of advance licence.

(ii) 15% of the FOB value of export realisation in case the exporter has availed the facility of advance licence.

All items as listed under the entry "Electronic Items" in the negative list of imports will be allowed to be imported against these licences.

Export houses: The policy with regard to the criteria for recognition of export houses has been amended. As per the revised guidelines, recognition as an Export House will be given to such parties whose average FOB value of physical exports during the preceding three licensing years is over Rs.100 million or whose FOB value of physical exports during the preceding licensing year is over Rs.150 million.

3.7 Beneficial impact of liberalisation

In 1985, the number of hardware collaborations in the Indian IT industry was 11. By 1992, this figure increased to 180 - more than 90 from United States, 65 from Europe and 18 from Japan. The collaborations were in the areas of minicomputers, micro compuers and peripherals. A number of cumbersome trading procedures have been simplified. Customs and Excise duties have been lowered. Foreign investment policy encouraged foreign equity participation upto 51 percent which dramatically increased the volume of foreign investment from 0.18 million dollar in 1981 to 3.8 million dollar in

1991. Several industries have been de-licensed. The trade policy allows free import of capital goods, raw materials, etc. for production of export goods. Profits from exports were exempt from taxation. These have made exports to developed countries highly attractive.

India has a large pool of skilled manpower. Intellectual labour cost is considerable lower than that in developed countries which gives a much lower overheads. However, the material costs are somewhat higher. There is a nett savings of about 12-14 per cent which encouraged offshore track manufactue in India.

The subcontracting market is offered ten billion dollar in US alone. With liberalisation, a good part of this market can be catered to by India. Subcontracting jobs can be in design and manufacture in the IT industry, especially in the hardware, peripherals, cable assembly, testing and product assembly.

3.8 Short term difficulties precipitated by liberalisaion

The 1980s witnessed the emergence of an indigenous orientation in the IT sector, with the ability to bring to the market, the state of the art products like micro and minicomputer range developed indigenously. Because of the liberalisation, 1990s has set in a reversal of this trend forcing these companies to turn to foreign equity or technical collaboration to bring new products into the market. The issue for survival is that technology is changing very fast. The product life cycle in the IT industry is now less than two years. Indian companies, at present, cannot invest considerable money in purely indigenous research and development and be able to survive as a viable profit making orgnisations . This however, does not necessarily mean the end of indigenous product development. The research and development efforts in the past were in the areas of minis and superminis. Now it is moving towards networking and database support. The present indigenous lines are endowed with newer processes and newer buses through major development projects. R&D is concentrated in critical areas rather than across the board. A careful analysis is being made by every company as to which technology is commercially viable to develop in India and which is not. The trend towards collaboration in the Indian IT industry only reflects a world-wide trend. The development in the IT sector are taking place on so many different fronts that any single company cannot develop and produce a state of the art product on all these fronts. As the manpower cost of an Indian R&D engineer is one-tenth of that in the developed country and as R&D is a manpower

Indian Computer Industry: Foreign Collaborations			
Item-Wise	**USA**	**EUROPE**	**JAPAN**
Large Computers	2	2	-
Mini/Micros	28	30	1
Data Loggers Data (Seismic)	4	1	-
Acquisition System	5	1	-
Data Acquisition & Handling System	3	5	2
Cash Registers Microprocessor-based Systems (Misc)	5	1	2
Data Storage/Memory Systems	1	-	-
Line Printers	3	3	1
Dot Matrix Printers	3	7	4
Computer Plotters	3	1	-
Printers (Misc)	3	1	-
Card/Paper Tape Readers	1	1	-
Conventional Comp Eqpt	1	1	-
CRT Terminals	1	2	-
Magnetic Tape Drives	1	-	-
MICR Equipment	4	1	1
Computer Keyboards	1	-	1
Comp Peripherals (Misc)	6	3	1
SMPS	3	1	-
Total Number Of Collaborations	**91**	**66**	**18**

Source: MAIT

intensive activity, a well motivated Indian company can commit enough R&D investment to offer state of the art development in niche areas.

One handicap with foreign technology products, as compared to the indigenously designed and produced products, which is proven significantly in certain segments of the minicomputer market, is that the foreign companies and joint ventures expect a higher rate of return than what the Indian companies take. Higher reliability and quality have exponentially increased the cost. Many indigeneous product oriented companies are moving towards areas which are invulnerable even in a free economy. Software applications, where there are no import substitutes, are patronized.

Liberalisation and the entry of multinationals in the Indian market has put a temporary strain on indigeneous hardware research and development, though however, a few indigenous product oriented companies are successfully holding out. Their research and development capabilities are poised to provide the necessary base for export thrust by the computer industry. The multinationals operating in India ae now being encouraged to help in the creation of an indigenous R&D base. This is already taking place in the software export area. It is anticipated that the same outlook will also percolate hardware design, development and manufacture. The hardware is becoming a commodity item. Here the foreign companies have an edge over the Indian companies. Value addition by Indian companies is possible in the application of software and the integration of heterogeneous systems as well as system engineering efforts.

Liberalisation has brought in a few unresolved questions with reference to the Dunkel Draft. The inclusion of IPRs in the Urugway negotiations has significant ramifications. Patents, copyrights and trade marks have complex connotations with respect to software. The USA allow s software patenting while India does not. A mathematical algorithm which is a scientific principle can be patended in USA just because it was part of a software. On this analogy, if even the programming languages are patented, it is feared that this may come in the way of software development efforts in India. Though the Dunkel Draft is still being debated, the Indian software industry fears that acceptance of the draft may result in a very strict IPR regime. Opinions vary from the belief that it can exploit the growing Indian software market to that of protection for programs implying that developers will have to shell out higher licence fees and royality. As the Indian software industry is composed of a large number of smaller companies, the process of

obtaining patents and copyrights will cost time and money which they cannot afford, thereby weakening their bargaining position with big companies during cross licensing. Fears have been expressed by the software industry in India that this will enable multinational companies to control the direction of research and development in software. The infrastructure needed to identify patentable innovations in software is not available in India. As there is no experience in India on such matters, it will make the IPR litigation expensive in cost and time, if the Indian software is found to have been infringed. Getting patents and copyrights in the United States by Indian companies will entail an expenditure of several thousands of dollars which many Indian software companies cannot afford. It is argued that all these may prove detrimental to the growth of small software companies in India. Proponents of stringent patent and copyright laws argue that the patent laws are powerful incentives to inventions. It is cited that a number of software companies active in the United States doubled after explicit application of copyright and patent laws. There are a number of supporters of this view among Indian software companies also. Their arguments is that India is a goldmine of intellectual manpower resources and that rigorous IPR regime will only benefit the country in the long term.

Of the total software export from India, about 70 percent are onsite projects of which 60 percent are to the United States. Visa restrictions on software professionals clamped by the US Government in early 1993, is expected to hit the Indian software exports substantially. Earlier, the US Government issued two types of Visas to Indian personnel undertaking jobs in the United States: B-1 Visa for short term business purposes and H-1 Visa for those being employed by American firms. To get short term visa for software services, the US government created a special 'B-1 in lieu of H-1' visa. In July 1993, the US Government amended the federal registry rules stipulating that the foreign professionals entering the United States will have to take a H-1B visa even for short visits and that applications for this visa have to be filed in US and not in India. The US Government has further stipulated a mandatory presence of physical product such as machinery for the issue of a B-1 visa which automatically preclude software services out of this purview. This new procedure has already affected the software exports from India both on site and off shore.

3.9 Telecom Liberalisation - Status and Perspective

As Telecom is a major change agent of the economy, numerous efforts are being made to introduce liberalisation and privatisation in the telecom sector. A robust telecom

network is essential for the functioning of multinational companies as flexible and fast fund transfer between countries is a pre-requisite for higher velocity of business. These requirements are forcing the government to reliquish the bureaucratic control and encourage private investment in telecom services. An adequately developed telecom can give India access to global markets, reduce cost of goods and services and generate revenue. A World Bank Report of 1992 recommended immediate restructuring of the Department of Telecommunications and privatisation of the carrier networks in addition to the privatisation of value added services. The report points to the bureaucratic resistance from the Department of Telecommunications, poor investment in the telecom sector, obsolete equipment and inefficient work culture which contribute to India's backwardness in telecommunications.

The telephone density of 5.4 direct exchange lines per 1000 population is among the lowest in Asia with nearly 25000 villages with a population of over 2000 having no access to a single telephone. The obsolete technologies used are conducive to high fault rate and high congestion resulting in poor call completion rates. The poor telecom facilities have added significantly to transaction costs, thereby undermining the country's competitiveness in the international market. This has inhibited the business development and investment. The World Bank Report points out that inspite of some minor organisational adjustments and recent decision to allow private sector participation in the provision of Cellular Mobile telephones, the service provider (DOT) is a monopolistic bureaucracy employing over 450,000 employees. The report gives reasons why the World Bank feels that the Department of Telecommunications will not be able to provide all the growing services in the country and that therefore, privatisation of the telecom production and services is an essential step. The report points out that the privatisation of value added services is unlikely to bring major improvements because of serious difficiency in the telecom policies. The Eighth Five Year Plan for the telecom sector calls for an immediate investment of US $ 77 billion between 1991 and 1995 and US $ 117 billion between 1996 and 2000 AD. While the Department of Telecommunications projects that 93 percent of the resources will be generated internally and the remaining will be borrowed from the local market, this position is doubted by a number of policy makers.

Three million applicants have been waiting for years and the queue line is continuously growing. Many new services like E-mail, Datacom, paging, cellular radio, store& forward fast FAX, etc., are not yet available adequately. The lease finance approach for capital construction in the Department of Telecommunications is likely to come in the

way of liberalisation of telecom sector. For liberalisation to have its full beneficial impact, sectors of the networks and facilities and as many value added services as possible must be allowed to be invested and operated by competing private companies. Therefore, there is no alternative to a widespread and sustained liberalization and privatisation of the Indian Telecom Sector.

IV. GLOBALIZATION OF I.T AND C-C IN INDIA

IV. GLOBALIZATION OF I.T. AND C-C IN INDIA

Identifying Value Added Network (VAN) as the cutting edge of gloablization of IT and C-C in India, the evolutionary development of Indian VANS is outlined followed by an evaluation of technical factors that may help the projection of Indian VANS efforts towards International VANS Services. Towards this latter goal, the appropriate design of an International Gateway Packet Switching System (GPSS/IGPS) is diagnosed along with its intrinsic beneficial economics. As an example of this economics, the efforts of the Department of Electronics in promoting software exports through the concept of Software Technology Parks (STP) endowed with global communication facilities is described. A global view of IT market opportunities for India is presented by analyzing the market for online/database industry utilizing IGPS and other global communication facilities along with an outline of broad strategies for success. In the background of these illustrative IT and C-C market opportunities, the road map of evolution of NICNET towards globalization of C-C is outlined as a typical contemporary Indian initiative in this direction.

The Evolutionary Development of VANS

The entrenched predominance of the `Plain Old Telephone Services (POTS)' is slowly getting digitalised with the introduction of E 10B Electronic Exchanges and in the near future, the CDOT-ESS. Unlike in developed countries, the digitalisation transition is likely to take a decade for the entire Indian telecom network to become electronic. Whether during this transition in the 90s one more transition can be introduced by upgrading POTS by a growing range of Value Added Network Services (VANS) in a cost-effective manner is the subject of the following discussion :

VANS can be classified in several ways :

1. 'Vertical' services which are designed for a specific sector, e.g., NICNET for the Government Sector, databases for travel agents, databases for Tourism and Hotels etc.

2. 'Horizontal' services by contrast are designed for a diverse groups of users but offer a specific functional service, e.g. electronic mail, electronic fund transfer etc.

These classifications may be recast as follows :

a) Application specific, like computerised Yellow Pages or Electronic Fund transfer at point of sale.

b) Customer specific, like SAILNET, Tour-net, Power-net, Irri- net, etc.

c) Facilities specific, such a electronic mail where the service is open to the public and the casual user.

The above clearly point to the need for open inter- connection as a requirement for success of the VANS. ISO/OSI should be more a primary requirement for all the major providers of VANS. This will ensure that the users have easy access to several VANS that there is wider choice of terminal equipment and competition is carefully groomed among VANS Operators as well as terminals suppliers.

A particular ilustration of standardisation will be felt when electronic mail services proliferate with subscribers in danger of being locked to the system they happened to have selected in the first place. Ideally, they should be able to communicate with any other user. In India, the adoption of X.400 Standard of E-MAIL is likely to solve this problem and enable exchange of messages with members of other services.

The initial phase of evolution of VANS will be confined to non-speech services. Further, the monopoly position of DOT in voice telephony is likely to be protected for a few years ahead. Voice related VANS will be secondary motivators for the development of VANS. The non-voice area of VANS can be classified as follows :

Managed Data Network Services (MDNS)
Electronic Mail Services (EMAIL)
Electronic Data Inter-change (EDI)
Electronic Fund Transfer at the point of Sale (EFTPOS)
Online Database (OLDB)

It is argued here that the introduction of VANS in India as the cutting edge of telecom liberalisation would call for a launch pad for VANS and networks independent of

DOT like NICNET can act as a backbone for the evolution of VANS in the public domin. This would call for a number of government initiatives broadly along the following lines:

1. A policy framework has to be disigned to allow the telecommunication industry composed of both public sector and private sector, greater freedom to use the P&T inland network so as to quickly satisfy the growing demand for more sophisticated services. This will enable Indian business to exploit information technology in the formation of telecommunications network service more effectively.

2. VANS may be opened up to the private sector by issuing VANS general licence requiring companies to register their proposed services. For the magnitude and complexity of the Indian economy at the present stage several hundreds of services are possible by more than hundred companies to discourage less serious enterpreneurs,the Government may impose an adequate licence fee. In order to reduce the monopoly of DOT, it is necessary to quicken the process of spinning off of numerous autonomous public sector corporation like MTNL, one for each major State, one for the entire North-East with the smaller States and Union Territories being served by one of the neighbouring publicsector corporations. As a measure for the introductin of the private sector, the North-East Corporation as well as a number of limited services networks should be allowed for the private sector. This has to be done carefully so that the new competitive environment would not be such as to cause confusion, but would allow for a gradual restructuring to meet the demand for new telecom services.

3. After careful consideration, a Managed Data Network Service(MDNS) classification in the form of a value added network service licensed with certain transitionary limitations, for example, basic voice telephony, basic telex, cable programme, etc. are excluded from the licence. From the VANS licence, it is also desirable to exclude during the initial period of the transition, the basic packet switched service as also `sample resale' which involves taking a packet switch call conveying over a leased line as and then return to the public switch network.

4. During the tansition period, it may also be stipulated that if the basic conveyance of live speech is provided as part of a total service, the rate charged must be atleast equal to that for the equivalent public switch network.

5. It is desirable to ensure that VANS operations are not cross subsidised from elsewhere in the business.

6. International Standards Institution (ISO)/Open /System Inter connection (OSI) protocols should be utilised as standards by the vendors as far as possible.

7. Conglomerate organisations with large internal networks may be permitted to charge within their groups for the conveyance of basic voice and telex traffic spare capacity for business would be subjected to the foregoing conditions.

Managed Data Network Services (MDNS)

In order to pre-empt the need for customers to rent and maintain a dedicated network of leased lines, the Managed Data Network Services (MDNS) is coming into being which is related to the network which is interposed between the two ends points of the users' systems. In accordance with the VANS licence conditions, enhanced services like speed/protocol conversion, System Management, System security and packet assembly/disassembly services are provided by the MDNS supplied simultanesouly sharing the network with other clients. The major participants in the MDNS business are those with an existing and substantial network.

Electronic Mail Services (EMAIL)

The E-MAIL service competes with telex. For popularising this service and realise its full potential, the interconnection between competing systems should be considerably enhanced. Teletex which is considered as the natural succesor to telex, in turn, is facing competition from Facsimile services.

Electronic Data Interchange (EDI)

Electronic Data Interchange (EDI) is the electronic shuffling of comercial documentation such as purchase orders, delivery notes, receipts and invoce between trading partners. The design has to allow organisations equipped with incompatible computer systems and document formats to transfer such information across the network.

Electronic Fund Transfer at Point of Sale (EFTPOS)

This technology seeks to do for the retailers what the automatic teller machines have done for the Banks. It allows the customers automatic transaction at the point of sale by presenting a plastic card with magnetic strips (or micro chips) which authorise transfer of funds from the customers' account in the bank to the merchants' account in the form of an online transaction. Each terminal should be able to read any valid type of card credit/debit) from any authorised issuer. The network should also be nation-wide.

Online Databases (OLDB)

Online databases will become increasingly available in India through NICNET and other similar networks for subjects ranging from specialised database design for a particular vertical market sector to widely accessible generic services where the diversity of information represents the principal benefits. The system- based videotex standards and technology have a tendency to become pervasive, there is a need for DOT to allow private videotex system (PVS) VANS designed to give services specific to industries like the travel agents. Because of the user-friendly features, the videotex is also popular as a management information system tool and in retail stock management applications a major factor which can make possible a sustained growth of videotex based VANS in India is proliferation of the off-the-shelf software packages designed to facilitate the adaptation of existing data processing hostocomputers in order to provide access for videotex terminals which will encourage the closer ineraction of videotex with main stream data processing.

NICNET as a launchpad

The potential of satellite communication networks to serve as vehicles for various types of interactive services has long been recognised. Satellite services with dedicated channels and transponders for internatinal value added data services is now steadily evolving. In a liberalised scenario, one could install a micro earth station dish antenna on the roof of his building to receive and transmit signals directly via satellite bypassing the terestrial cable network. Over NICNET, a large number of Closer User Groups (CUGs) are possible; each CUG representing SAIL-net, Oil-net,Coal-net,etc. and the scale of investment and operation can be justified by such shared CUGs. Satellite VANS around

networks like NICNET can become the cutting edge for introducing VANS in India which otherwise may take considerably more time to spread.

4.2 Projecting India into Global VAN Services

Electronic messaging backbone networks promoting a range of multi-country value added services such as E-Mail, EDI, etc. and providing inter-connectivity around the globe for applications in a number of fields including manufacturing, trading, transport, medicine and research, have become an indispensable tool for international business. In the mid-80s, X.400 has made possible the world-wide electronic messaging network. India's first international Packet Switched Network which forms the backbone for value added services commenced operation in 1988 while the national packet switched services were first launched in 1987 by NIC over NICNET. India at this juncture is at the threshold of a fast growth curve which is anticipated to lead to over two orders of magnitude growth in services over this decade. This makes value added services of considerable interest to the users as well as service providers in India

The international value added service is monopolised by large VANs, most of them, giving services from nodes located in several countries, who have proprietary protocols and interconnect standards between nodes. Their capacity to offer identical or seamless services anywhere is considered as a major advantage for enterprise-wide networking with units scattered in many countries.

The PTTs and the national carriers provide data and value added services through bilateral interconnect agreements with other PTTs, network providers and VANs. X.400 messaging networks are the backbone of the global VANs. The interconnection of network operating in different countries is vital for providing a wide reach for messaging services. However, the progress on international interconnection is very slow and tedious. The extensive technical validation tests required for connection and the administration as well as commercial agreement required to put an interconnect pose many difficulties. In the Asia-Pacific region, the interconnect position is somewhat weak as global VAN operators are shying away from establishing new connections, because, they would rather establish their own network in a country instead of providing an early interconnect to a national network operator. Interconnect problems gets further complicated in a deregulated environment where multiple ADMDs in a country are required to establish interconnects with multiple

carriers in every other country. The network operators have attempted to realise a wide inter-connectivity in this environment by adopting various strategies.

Where many network operators provide services through their own ADMD, there is a complexity of addressing an interconnection. A viable alternative is to simplify the interconnect problem by forming ADMD operators group, a user or main network is required only to connect to one operators group and be able to send messages around the globe leaving it to the ADMD operators group to achieve interconnect with other ADMDs or groups. In Asia also an operators group is getting established which will provide a forum for network operators in India to derive the benefits of the international value added services.

Major VANs provide "global" ADMD in which the users in any country will be able to access all subscribers on the network from whichever country they may reside. Though the network may support multiple MTAs internally, it would appear as a single seamless ADMD to the subscribers. The interconnection to other networks or ADMDs would still require agreements for interconnections and operations.

Most of the VAN based on X.400 or other proprietary standards capability to the users to transport information like E-mail, EDI, File Transfer, Real Time Data, etc. The availability of X.400, EDIFACT and X.435 are now changing towards more open EDI message implementation. Implementation of EDI poses more intense problems of EDI interconnectivity because, proprietary gateways have to be implemented for each EDI network. Most of the operators are reluctant to provide inter-connectivity on a global scale and require protracted bilateral discussions and persuation.

Enterprise integration with their existing inhouse computer or information system is important in the utilisation of value added services by customers. The problem at present is one of standardised application programme interface.

In the Asia Pacific region, serious attempts are being made to form an Asia ADMD Operators Group for providing a platform for wide interconnectivity services and directory services that are expected to serve as backbone in the region. Though there is considerable growth potential in India for VANs and when most of the growth in the area is yet tobe realized, the global scenario in VANs is a nascent opportunity for working towards efficient and standardised network providing wide connectivity keeping the tariff as low as

possible. To protect the customer interest, Government has to step in as an independent regulator for ensuring open standards. India should immediately take all measures for multiple membership in ADMD operators group of the Asia Pacific forum.

4.3 International Gateway Packet Switching System (IGPS/GPSS) Design fc. India

Packet Switched Data networks constitute th- backbone around which networks of computers interact. They are as versatile for applications like electronic mail as they are for information retrieval from remote databases. IGPS is versatile, reliable and cost effective to a high degree. It is the ideal gateway for international data communication.

IGPS can be accessed through dedicated lines using four wire circuits operating at speeds of 1200 or 2400 bps with a reasonable reliability. The connection between the IGPS unit at the Department of Telecom and the computer support centre which is the focal point in the country can be through dedicated lines connected by two modems, one at the data terminal end and the other at the IGPS end.

It is worth mentioning that message communication throughIGPS is nearly 15 to 20 times cheaper than telex communication, apart from giving direct access to computers for information retrieval.

Technical Descriptions of IGPS:

IGPS is based on a dedicated computer switching system. The packet switching technology underlying it uses error detection and retransmission techniques to minimise transmission errors and achieves high network efficiency by utilising the system resources optimally. Packetisation involves digitisation, coding and formatting the information. The information is divided into small segments each accompanied by control information to form 'packets'. Other control bits superposed on the packet to form a 'frame' is transmitted through the network.

The IGPS basically consists of (i) packet switching exchange (PSE), (ii) packet assembler-disassember (PAD) and (iii) network control centre (NCC). The PSE is the main switching centre with a PC performing multiplexing function. The PAD is a translation facility enabling character mode X.28, data terminal equipment (DTE) to access IGPS. The

PAD assembles the characters into packets and vice versa without modifying the message content. At the network control centre, the supervision, control and management functions of the network are carried out.

It is recommended that IGPS for Indian Gateways preferably conform to CCITT standards: X.3, X.25,and X.75. A typical IGPS system configuration is shown in Fig.1.

Data Terminal Equipment (DTE):

There are two types of DTEs: (i) Synchronous packet mode X.25 and (ii) Asynchronous Character Mode X.28. The former type of DTEs are generally host computers and intelligent terminals and will be able to operate at 2400 bps minimally required. Higher bps rating where possible within the telecom network, can be made use of. They can work with IGPS directly while conforming to X.25 interface protocol. The latter types of DTEs are typically visual display units operating at 2400 bps and less operating in the character mode and hence cannot work with IGPS directly. They need PADs conforming to X.3 interface protocol.

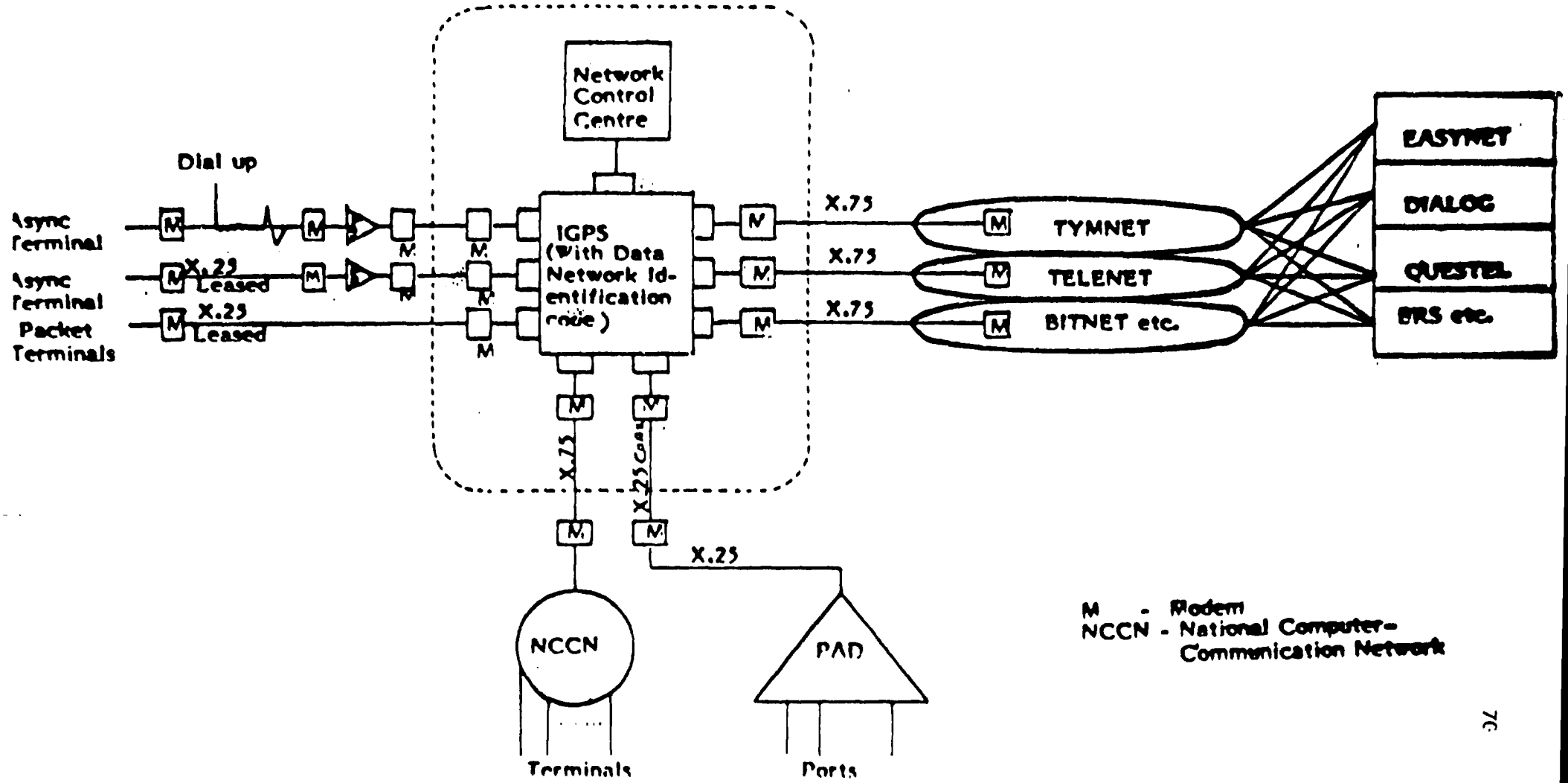
Access procedures of IGPS:

The various possible access modalities to IGPS are shown in the diagram. There are two basic methods: (i) dedicated access using voice grade circuits operating at speeds of 1200/2400 bps normally. HIgher speeds are possible. (ii) Dial up Access over the public switch telephone network (PSTN) operating at speeds of 2400 bps or less. A pair of modems would be required if communication of data is over voice grade analog circuits.

Typical cost of using IGPS:

The typical cost of online retrieval of information are given for some representative systems.

Fig 1 : INTERNATIONAL GATEWAY PACKET SWITCHING SYSTEM(IGPS)



System	US $ for one hour connect time	US $ for one document online
DIALOG	60 - 100	0.2 - 0.4
BRS	40 - 60	0.25 - 0.35
ORBIT	50 - 70	0.15 - 0.30
QUESTEL	50 - 65	0.20 - 0.35

The tariff for international communication for IGPS access varies from country to country. Typical range of costs are as follows (in US $):

Connection Charge : $ 0.1
Traffic charge : $ 0.005 per segment of 64 characters

Transmission of 9000 characters at 1200 bps will take about one minute and cost between one and two US dollars. Transmission of the same message via telex would cost US $ 15 and 30. Therefore, communication via IGPS can be cheaper by 15 to 30 times for online access type of applications.

It is necessary to negotiate with ITU for obtaining the same tariff concession as is given to international press. If this materialises, the tariffs may be as follows:

Connection charge : $ 0.05
Tariff charge : $ 0.002 per segment

Similar negotiations with major database vendors for bulk subscription may help to standardise and minimise the cost of information retrieval as follows:

One hour connect time on information system: US $ 40
One document online on information system : US $ 0.15

Typical procedures for online connection:

It is estimated that more than 5000 databases around the world are available online if an IGPS system is installed. These databases are accessed through certain umbrella service facilities like EASYNET, DIALOG, BRS, etc.

To access an online system from a computer terminal, a telephone call has to be made to the online system through datacom lines at the domestic and international levels. IGPS facilitates a low cost, high speed and reliable access to online systems which can link up to international data networks like TELENET, BITNET or TYMNET. Depending upon the location of the user organisation, the following alternative is available for connecting to IGPS:

Local PADs have to be set up in various important cities. From these locations, the PAD can be reached through a local telephone call. The PAD itself may be connected to IGPS by a leased circuit. Users from other locations may be required to reach one of these local PADs nearest to them through a subscriber trunk dialing call.

The IGPS will be connected to several international data networks like TELENET, TYMNET, PSS,. BITNET, etc. Most online databases coming under DIALOG or EASYNET are connected to one or more of these networks.

4.4 Global C-C promoting Software Exports

With the upward trend of growth of software exports from India. the demand for access to global communication network is increasing. Promotion of Indian IT development can be catalysed by software export related services, which can generate foreign exchange and expertise. The reverse situation is also equally possible with a growing IT market creating software and services export. Added to this is the large number of English speaking low cost well trained intellectual manpower.

Software export has grown from about $ 60 million to $ 230 million between 1988-89 and 1992-93. In the year 1992 alone, a growth rate of 55 percent in rupee terms and 35 percent in dollar terms has been registered which is considered very high for an industry which is only a few years old.

From 1990, the Indian Software industry has been demanding high speed telecom facilities so that exports through high speed global data communication links can be considered to overcome the problem of visa and other restrictions encountered in the practice of body shopping approach.

Such high speed data communication facilities are being set up by the Software Technology Parks (STPs) at Bangalore and Hyderabad. The network facilities called, SOFTNET, gives a milieu of services catering to the various types of needs of software exporters. STPs have made transit arrangement with international carriers with USA via Europe. SOFTNET provides high speed data communication facilities and VAN services by using its dedicated satellite earth stations and point to point multi -point radio equipment. SOFTPOINT is a point-to-point n x 64 kbps digital private line service which connects software exporters in India to their clients abroad who have full 64 kbps digital connectivity.

SoftLINK is a transmission control protocal based on Internet TCP/IP protocol for VANs providing round the clock access to the global commercial Internet. This service is available over ethernet LAN at the STP complex as well as dial up and radio links.

SoftPAC is X.25 Packet Switching Services which allows access to other international PDNs using direct access facility of one of the PDNs in USA.

4.5 Global Context for Online/Database Industry in India

The emerging Indian prospects for the online/database industry is reviewed below taking a global view of the market and in the context of the infrastructural requirements for promoting the industry. The opportunities in the export market are examined along with an outline approach strategies for success.

The absence of collection, collation, compilation, structuring and process of information into databases and delivery through various electronic and print areas as well as consolidation and repackage are engaging more than 100,000 people in the US alone. By the beginning of the next decade, the online database industry and the services sector associated with it will become a $ 100 billion industry world-wide.

The production and distribution in this industry are based on three technologies - electronic publishing, computer technology for high volume storage and processing of data and text; and data communication. India is conspicuously absent in the global information market as database producing country as can be seen from the fact that out of the 5500 commercial databases in the world, the Indian contribution is in single digit. Many international database producers are covering Indian information purely as a matter of their coverage policy.

In India, the database activities is dominated by the Government sector which has significantly contributed to the building of awareness in this area. There are a large number of Government Agencies who have invested substantially in various databases development, e.g., NIC, NISSAT, TIFAC, NMIS, INSDOC, BTIS, NSIC, DESIDOC, etc.

In the private sector serveral companies have become active in this area in the last four to five years. Historically, ORG (Operations Research Group at Ahmedabad) and CMIE (Centre for Monitoring Indian Economy at Bombay) have pioneered this industry in the private sector. Several Trade and Industry Associations as well as directory publishers are also quite active. From the Press, the number of newspaper companies are having ambitious plans to enter this area in a big way. Yellow Page publishers have created a commercially viable niche. In the financial information segment, three organisations have made a good beginning : CRISYL in collaboration with EXTEL of UK have started database vending. Some major companies set up in this field are DART which is also setting up its own C-C network, DARTNET based in Bombay. Another enterprise, ICNET which is based in Madras has its own C-C network, ICNET.

Database production is a laborious manpower intensive activity. Its infrastructural needs are similar to that of a production environment. Though India has a large pool of educated manpower, it does not have adequated trained manpower for database production activity. Data entry accounts for a small portion of the database production costs. Trained manpower needed for the functions involving selection, collation, compilation, coding and structuring of data, all of which require specific professional skill and technical domain knowledge.

A major cause for concern at present is the data communication costs. While carrier to network charges are based on data volume and the circuit time sharing, the network to

subscriber charges in the world are largely based on the connect time. However, in India, the subscriber has to pay for the data and time for using the circuit. When GPSS was introduced by VSNL, they not only named the services, but also fixed the tariff. The additional charges for data on this account would increase the cost per hour to as much as Rs. 800 to Rs. 1200 per hour for file transfer type of jobs.

Though the global market is dominated by the US, which is 60 percent of the market, the European and Far East market is growing fast. The rest of the world which is currently at 7 percent, is slated to increase its share to 10 percent by 1996 which in monetary terms corresponds to US $ 2 billion from the present market of $ 0.5 billion. This clearly shows that India has considerable opportunity to grow a major export market in this area.

4.6 Road Map of Evolution of NICNET Towards Globalization of C-C

A view is advocated here that the application of computers and communication as an integrated technology, has more impact on social and economic development than computer technology alone. As social and economic integration cannot be localised artificially in a world moving towards a `global village', globalisation of computer-communication networks will become the major enabling instrument for this evolution.

The evolution of NICNET, the computer communication network of the National Informatics Centre, is so oriented that such an integration and globalisation is progressively implemented utilising the latest low cost technologies available in the international market. Tracing the evolution of NICNET from its genesis in 1985, the choice of the various technologies to date, and, the road map for NICNET till 2000 AD is projected in step with the forecasting of technological evolution towards integration and globalisation of computer and communication resources.

Stage-I : Integration of Computer and Communication in NICNET

As the demand for customer services cannot be assessed accurately at this point in time, network cannot be planned merely on the basis of presently projected user services requirements. The long term approach is to design the network as a whole anticipating the user requirements for the next several years. The example of the design of NICNET will illustrate this point. NICNET has a computer and a satellite earth station in each of the 500

District headquarters, the 32 State/UT capitals and the national capital. Though this, a decision support information system for the Indian government is being evolved based on the design of a predominantly query based computer network with hierarchic distributed databases and random access communication. The district level NICNET was completed by 1991.

The Basic Decision

With interference tolerance and random access as two guiding principles behind the choice spread spectrum transmission and Code Division Multiple Access system of satellite communication was adopted. Each node of the network is a 32-bit computer which is capable of local bulk storage of upto three units of 300 megabytes each for purposes of query-accessible distributed databases. The design and implementation of such a distributed database has endowed the network with the capability to distribute the data related to such databases over various nodes in the network so as to be able to accept a query from any of the nodes. Each of the technology features of this network is mentioned below to show how technology forecasts and appropriate technology choice have been made so that the network will remain contemporary technologically and otherwise for a decade.

Features of the Network :

To achieve the data network, a number of features have been built into the communication system.

Flexible Network Structure :

Terminals can be connected to the system directly or via telephone, telex or circuit switched network; remote terminals can be connected via packet multiplexer or PADs through satellite circuits.

Board terminals Integration :

Packet terminals, non packet terminals and host computers of different speeds can be integrated.

Network access :

The system should facilitate access to the communication network, be it via leased or dedicated lines, switched telephone network or satellite circuits.

Line utilisation

Each packet terminal can communicate with a number of other terminals over one physical line.

Error-free transmission

The system checks the data for errors step by step as it transmit.

Considering the above requirements and the need for a low duty cycle interactive network with a large number of stations, a satellite based system was selected to meet the requirements of NICNET. Adjacent satellite interference, as well as interference to and from the terrestrial system must be minimal for enabling free siting of the small aperture earth stations. In view of these considerations, a Spread Spectrum Code Division Multiple Access System was chosen for NICNET.

Spread Spectrum

Spread Spectrum is a means of transmission in which the signal occupies a bandwidth in excess of the minimum necessary to send the information; the band based spread is accomplished by means of a code which is independent of the data and synchronized reception in which the code of the receiver is used data despreading and subsequent data recovery. It is, in fact, based upon a principle which is a direct antithesis of reducing bandwidth, namely, deliberately employing a larger bandwidth.

A characteristic advantage of this approach is that it minimizes interference from other satellites and terrestrial sources. Further due to the fairly uniform power spread over the entire bandwidth, it offers a low interference potential to other satellite and terrestrial sources. As such, site clearance problems for interference even in congested areas are substantially lower. While spread spectrum uses a larger spectrum, this is compensated for

by the significant interference reduction capability inherent in its use. Consequently, it is possible that a number of users might share the same spectral badn simultaneously.

CDMA Technology

Code division multiple access (CDMA) allows efficient multiple access in extremely large network of low duty cycle terminals. The fact that no satellite power is allocated except during actual transmission permits thousands of relatively in frequently transmitting earth stations to share the same 5MHz transponder channel. CDMA takes advantage of the unique way in which spread spectrum technology allows transmission of signals without interference problems.

The information spectrum is spread by a direct pseudo-randum noice (PN) sequence, where each data bit is encoded with a binary (chip) sequence with 15 to 2047 binary (1 or 0 "chips:) per bit. The expansion is achieved by an exclusive - OR operation on the data and the chip sequence so that a "I" bit contains the chip sequence in inverted form. A "0" bit is a non-inverted chip sequence. Although the encoding chip sequence is pseudo-random, it is perfectly replicable for decoding by the authorized receiver using the same chip sequence to recover the data, is operated by exclusive - OR with the chipped data (the inverse of the operation used to encode the data) to obtain the data.

The code sequence modulates the carrier using 180 deg biphase shift keying (BPSK). Data are converted to 0 and 180 deg phase modulations of the carrier, where the carrier is transmitted with one phase when the encoded sequence chip (exclusive - OR operation with the data) is a "1" and the oposite phase when the encoded sequence is a "0". The chipped data is then transmitted as if they were the original data bits, producing the phase shifted signal corresponding to each chip.

Evolution of NICNET High Speed InfoHighway

The existing NICNET in the C-band is of contention type which is more suitable to distict level traffic. Whereas this is designed for district linkages which are bursty and short duration type it is unsuitable for linkages with state capitals where the traffic is steadier and of fixed type. In view of this a fixed assignment option is more suitable for the high speed network. There are two candidates for fixed assignment type the TDMA

and FDMA/SCPC. Whereas both of them offer roughly the same capacity, delay and stability properties the two differ in robustness, cost, complexity and flexibility.

The overlay network is a star SCPC system on a Ku-band transponder providing typically the 64 kbps dedicated satellite links to each of the remote earth stations. The network will have the expansion capability to increase to any number of earth stations and each link will be capable of operating at a variety of speeds from 64 kbps to 2.2 mbps. (See Fig.1).

Each remote site on the SCPC network will have an earth station with a 1.8 meter antenna. The network will have multiple data channel capabilities combined upto an aggregate of 128 kbps. The Star hub will be in New Delhi with a 6 meter antenna. For each remote site a dedicated modem at the hub is provided. As each data link will have its own dedicated channel, blocking or congestion in satellite resources is avoided. The network is configured for modular expansion with not only modular additional sites, but also data rates can be altered as required and multiple data circuits to any centre can be added by installing a multiplexer.

The satellite system characteristics like coding tape and power levels can be modified to match the required link characteristics. The network contol at Delhi will configure all aspects of the network utilizing a Star Network Management System (SNMS). The SNMS is a monitoring and control system that will operate at the hub station so as to monitor the status of the hub and remote site. The SNMS typically runs on a 486 microprocessor operating under WINDOWS environment.

The data broadcast network over NICNET overlay operating in the Ku-band will have a multiplexed hub which can be located to go with the SCPC hub in Delhi and controlled by an appropriate Network Management System. Initially, the data broadcast network will be uplinked from the Delhi hub, but later, it will be carried out also at a few other locations. The network can either operate in a multiplexed or multichannel mode at aggregate speeds upto 256 kbps or in a clear channel mode without multiplexer at speeds upto 2 mbps.

The NICNET InfoHighway, which is in an advanced stage of implementation, is a satellite based universal broad band network (UBN). Efforts are being made for UBN to have a uniform, universal and suitable standard for basic switching and transmission to

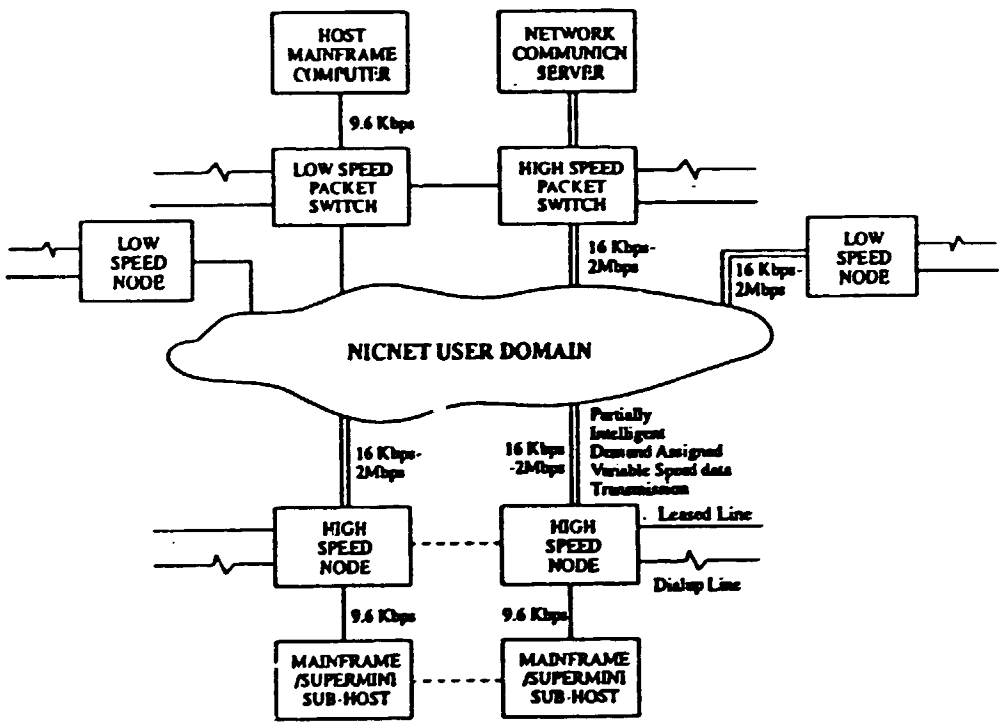


Fig. 1: PRESENT NICNET ARCHITECTURE

encourage users who will be willing to invest in the facilities required for the network. The standard requirement is critical and some flexibility will be built in. The NICNET InfoHighway has network hardware, basic control and software which will enable such standardization so that any conceivable service application may travel on the highway. The least common denominator of digital encoding and signalling allows for service integration without perceptible loss of transmission speed.

Each node has 2.2 mbps maximum rate of transmission per module. The variability will be adjusted between 16 kbps and 2.2 mbps. An intelligent network management system will adjust the rate at each node depending upon the forecast of the demand. An hour or two ahead, however taking care to see that the summation of the rates over all the nodes does not exceed the value corresponding to the total available bandwidth on the satellite transponder.

The Star hub at Delhi should not be construed in the same sense as the hub of the SSMA/CDMA hub of NICNET. Though there is a network management control system used at the Star hub, it is to be considered only as a cluster of point-to-point communication in which one of the points for each pair is located at the Star hub.

Each node of the network can also be clustered as parallel pairs connected to the Star hub in order to increase the overall transmission rate modularly in mutiples of 2.2. mbps. Thus, the InfoHighway is being designed for modular expansion spacially as well as capacity-wise.

On the ground segment, special low cost technologies for effectively linking widely separated local area networks, Network FAX & Image servers and multimedia communication services are proposed. Special features for accommodating a large number of close user groups and offering virtual private networks are designed to increase the propensity for the spread of the IT culture as well as prod the growth of demand.

A widespread BISDN use is expected to take place in [illegible]. BISDN protocol and services can be effectively provided over satellite links. The fast cell switching technique of ATM can be used so that all services such as voice, video, image and data, can be provided using the ATM adaptation layer (AAL) and ATM protocol layers with 150 megabit per second access. Digital television and high definition television can be

acommodated. With ATM, voice and video are broken up and packaged in 53 byte cells carried from the source across multiple nodes and perhaps multiple networks and finally, reconstructed as continuous stream at the destination. The network will not distinguish between voice, video or data cells.

Satellite based networks are flexible and can quickly be set up for meeting communication services to business and government customers from distributed locations using small and medium ground terminals located at the customer premises. In the near future, ATM can be provided over satellite by introducing an ATM earthstation interface line card. Such cards are already under development and pilot scale experimentation. Two major facilities proposed to be provided on the NICNET InfoHighway are the close user group facility and virtual private network facility.

A close user group (CUG) facility as a shared network is possible in which membership is limited by some a-priori specified restrictive criterion,e.g. corporate headquarters along with all its branch offices, a bank along with all its branches, a super market and its customers, a large multi-branch central Government office, etc. This helps the users to pool their demand for a customised service or solution and thereby obtain the same advantage as a very large user. This facility helps in globalization by external linkages to users with shared concerns. For example, when a number of Indian banks become members of the SWIFT, the internatinal banking network, they become part of a CUG. With NICNET Highway becoming available, this would enable a very large number of banks and their main branches to be connected to SWIFT through NICNET InfoHighway. There are many other applications where CUG of NICNET can help the enterprise go globally.

With NICNET InfoHighway acting as a computer-communication carrier, virtual private network can be offered for using software control to carve out a portion of NICNET and place it at the virtually exclusive disposal of the user. Such virtual private networks have several advantages. Users need not make large investments in network facilities. They would need a minimum skilled technical staff to operate their network. The amount of capacity of network can be altered and network can be reconfigured on demand. The users gain access to some of the network management systems of the public carriers. More importantly, users begin to share in network economies of scale and scope.

NICNET is connected to international networks through GPSS of VSNL located at Bombay. Through linkage, X.25 networks worldwide are being accessed. For example, NICNET users access the National medical Library at Bethesda through the MEDLARS as well as DIALOG databases. NICNET is also connected to UUNET for international E-mail services for its users. E-mail and NICMAIL are the electronic mail services available on NICNET. UUNET is a UUCP network connecting a number of UNIX hosts and acting as a gateway to many other networks. NIC is providing UUNET connection to the users to send E-mail to various international sites which are also on UUNET or are accessible via UUNET. All mails generated on NICNET are routed through the gateway machine located at Delhi. NIC provides connection to GEMS-400 based E-mail service provided by VSNL. GEMS-400 is resident on a VAX system located at Bombay. EDI, a value added service,based on an OLTP system is being implemented in the first half of 1993. This value added system is being interconnected to international EDI networks through VSNL gateways for global transaction of NICNET users.

Two 64 kbps external gateways are being connected to NICNET, one through the GPSS of VSNL and the other as ADMD. These will make use of the SPRINT transit network in USA to enable NICNET users to access more than 47 networks in 39 countries around the world. With the NICNET InfoHighway, the number of high speed external gateway links can be modularly increased depending upon the demand.

Imperatives of Globalization of NICNET

Certain concepts of data networks have been forecast which is taken as the current basis for the design of NICNET at the third level of integration and globalization. Based on the concept of NICSAT earlier proposed a series of very low cost microsats are proposed to be launched for an internally operable dedicated space-com data network with user end to end communication capabilities, built in features for promoting specialized value added services, built in access security and expert system based network management. Low cost on-board features, a versatile space link scenario and low cost ground infrastructure are under consideration.

It is proposed that NICNET should be incrementally converted for providing global intelligent network services over a strong skeleton of data highway utilizing application gateways in a global intelligent network, inter-operability of the service management system, service creation environment and operations system as well as support the

interaction of the intelligent network components in intra-network and inter-network cases. Initially the connectivity will be provided and the basic network infrastructure will be put in place over which global private networking facilities will be created. Subsequently new services will be made available on the basic international network infrastructure built on global intellegent networking like those proposed for GLOBALSTAR or IRIDIUM. By this time, a full band-width-on-demand is likely to become global with the extension of Asynchronous Transfer Mode (ATM) from national networks to the global networks.

To integrate new cost effective technologies and services with existing operations of NICNET, for facilitating transparent network access by users for their computers, a protocol intependent transparent network design will be adopted until all major telecom standards of ISO are implemented. Greater through-put from communication lines connected to host computers and the ability to interconnect with public data networks, will have to be provided for. To become a global network, in addition, round the clock availability must be ensured. The demand of the user having multi locations business systems over spacially spread functional entities performing the same or similar transactions, to the point of accommodating multimedia EDI services, are required to be addressed while catering to reliability, quick response, information security, information integrity, data veracity and localised maintenance. The network design should be incremental, in the sense of modular expansion of the network, to accommodate growth, simply by blocking modules, with least disruption to the users. The network recovery operation should be incrementally automated. The design should be made insensitive to network topology. The network resources should be optimised automatically. Above all, the total system cost should be minimised at every stage of the expansion of the network.

As NICNET is basically a data communication network, the network architecture during global expansion in the initial stages, will continue to be hierarchically packet switching. The remote user access nodes are connected to central nodes or central concentrator in a tree structure. The traffic from a number of remote user access nodes may be multiplexed before passing on to the central concentrator over high bandwidth links. The central nodes themselves are connected in a star topology to switchers. The switchers are, in turn, connected to each other as a mesh network. An intelligent multiplexer can be installed between the user and the remote user access node so that a number of user terminals can be multiplexed as a synchronous error correction data stream to the port of a single remote user access node.

A packet switching mechanism delivers data over the less congested routes. The remote user access nodes internalise the external communications protocols. Data integrity can be maintained through packet acknowledgement.

Network gateways are provided between NICNET and the PDNs over an X.25 synchronous link with multiple logical channels accessed over corresponding switched virtual circuits. PADs are located with the user enabling the multiplexing of a number of asynchronous terminals over a single high speed X.25 synchronous link analogous to the intelligent multiplexer. With host PADs we can interface NICNET and non-NICNET hosts for enabling the translation of NICNET internal network protocols to the protocols recognised by the receiving host.

The effective operation of the network on the above basis is possible only when an effective network management and control system is designed along with. In the face of a continuous expansion of NICNET towards globalization, such a management and control would require an incrementally intelligent management and an incrementally adaptive control. This is the subject matter of the next Section.

Intelligent Network Service Management

Services creation and provision environment is conditioned by the user-demand for variation in service capability, flexibility and convenience, which is satisfied by intelligent network functions. Such a provision can also be made through powerful networking functions and signaling capabilities faciltated by ISDN at the user-network interface and within the network. Service customisation can be realised by providing services which allow the customer or network providers to freely define newly required services. It may be required to provide an applied interface with service control processors in the real network under multi-vender conditions. Such an interface should have facilities for handling databases and protocol. For the former, an SQL is utilized while for the latter, signaling system No. 7 (SS7) is utilized. Both are widely accepted standards. The system has a service description language, network initiated service and user-initiated service.

The requirement of shortening the response time of the network to the service request of the customer as well as the freedom for customer in-service provision, as required by the service customisation, require computer-based processing. For maximum flexibility and efficiency of such a computer processing we require intelligent hypermedia

with imbedded expert system. Such intelligently programmable network based services are intrinsically more convenient and powerful tending to the introduction of ISDN in the IN architecture. An intelligent signaling capability provided in ISDM inside the network as well as at the network-user interface would enable service customisation to take full advantage of the ISDN features. With the creation of not only a network database, but also network knowledge-base, direct registration of service parameters by a customer to the service database and knowledge-base would be provided.

We assume that the basic Bellcore model to IN comprising of service switching point (SSP), signal transfer point (STP) as part of the SS7 Network, service control point (SCP), service management system (SMC), etc. for global coverage, multiplicity of SCP atleast one in each region or country would be required with the service data distributed to the database of these SCPs. As far as possible, it is necessary to ensure that SSP to SSP signaling is independent of IN services and should not be used for transfer of information related to IN services. This calls for a direct SCP to SCP communication for transfer of information related to the services. The design is such that the ISDN user accesses an SCP and SMC easily. The design also should ensure that the service network is independent of both hardware systems and services provided.

In service customisation, one has to cope with not only a variety of services, but also their unpredictability thereby calling for flexibility in the environment for service creation and provision. As multiple service components cooperate to provide a service, a standard interface is necessary to bridge the various components. Portability of service components is another requirement for achieving flexibility.

Service creation and execution is carried out in four basic steps. A language is required for describing individual services by an appropriate combination of service components and their control flow. A translator subsequently translates the service description into an executable form as an object programme referring to a library of service component software parts. Subsequently, the service object programme is loaded into appropriate nodes in the network so as to additionally keep track as to where each service programme has been loaded and decide where to load new programmes. Lastly, the service execution provides for execution of programme services according to the control sequences.

For providing a service requested by the customer, the necessary components required for each service has to be prepared which would include service control processes, like database access and authentification of service access codes, call processing routines, resource management message storage control and switching control. If the service control processes and call processing routines can be divided into components, the synthesis of an appropriate set of service components along with their control sequences would represent the service. Such an integrated scheme is conducive to more flexibility in service creation.

The Kokusai Denshin Denwa Co (KDD) of Japan has developed an experimental system in ISDN development for advanced services. The system proposed here for implementation on NICNET has a broad conceptual similarity with the KDD system. However, in the KDD system, a marginal extrinsic use of AI is made which cannot lead to intelligent service management. In the Figure, we describe an adaptive incrementally intelligent service management system for development as an overlay to NICNET.

SSP, SCP and SMS will be implemented by dedicated minicomputers - Call Controllers (CC), Service Handlers (SH) and Service Managers (SM). The minicomputers are interconnected through an SS7 network along with SS7 protocol in addition to the communication between SCP and SMS.

A brief description of the hypermedia based expert system for service object creation, network management database and knowledgebase, intelligent service execution, expert interpreter function and adaptive scheduling function are given below:

Service Object Creation: For the definition of the service to be provided, the source scenario is described in the service description language after obtaining the customer's inputs and marketing inputs for the creation of service specifications (See Fig.). The source scenario so constructed is then translated by the translator in the SMP into an object scenario by a hypermedia based navigation in a scenario management library with source information such as identification codes, parameters of already defined scenarios, definition of reserve words and the library consisting of databases as well as knowledgebases. The expert system decides which of the rules, decision trees or objects in its knowledgebase correspond to the situation described in its database through an inference mechanism. For each CC or SH node in the network, scenario is defined along with conditions under which each scenario is invoked.

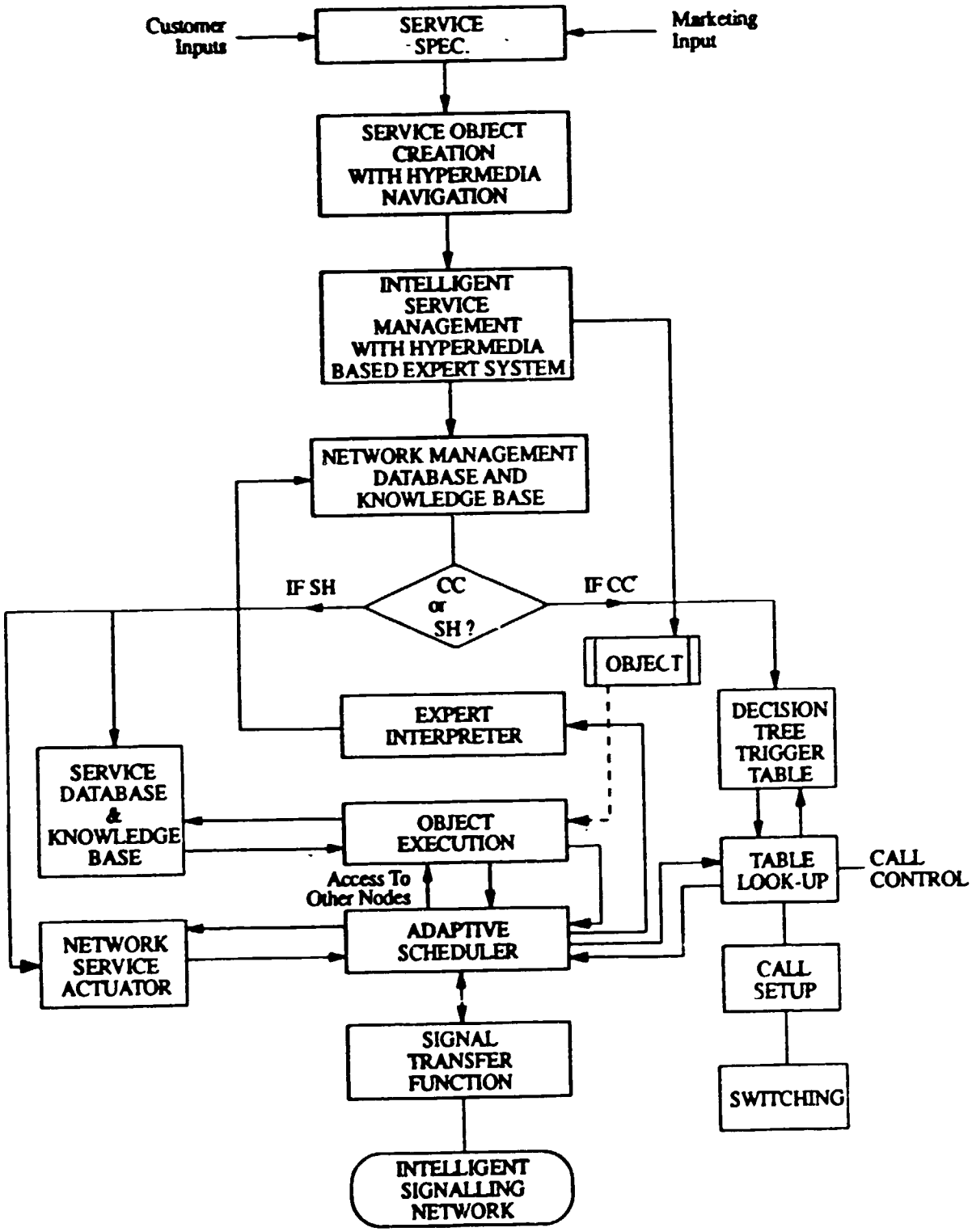


FIG. Adaptive Incrementally Intelligent Service Management

Network Management Database and Knowledge-base: An object scenario so created is loaded into the computer nodes in the networks and becomes the input to a subsequent stage of intelligenet service management with hypermedia-based expert system. To enable efficient retrieval when the scenario is executed, information about which nodes the scenario has been loaded into is registered into the network management database in the target nodes. A corresponding knowledge-base is created in the form of a combination of production rules, decision trees and object oriented networks. The trigger conditions are also registered in a decision tree structure of a trigger table in the target call controllers based on the information received in the service definition stage. The trigger table identified is a table to be invoked for each subscriber at each face of a call.

Intelligent Service Execution : The call processing routine looks up the decision tree trigger table to get the scenario number for invocation. If a scenario is required to be executed for a particular subscriber at a particular call face, the call processing routine requests its invocation to the adaptive scheduler with the scenario number.

Expert Interpreter Function: The adaptive scheduler refers to an expert interpreter routine to execute specific scenario. To enable this, an interpretation knowledgebase is created for the expert interpreter to operate on. Such a knowledge-base can be part of the network management database and knowledgebase. By accessing this database and knowledgebase, location at which specified scenario is stored is read out for execution. If the scenario in the CC calls another scenario guided by the network management DB and KB, the expert interpreter requests its invocation to the remote node through the adaptive scheduler. A similar system exists for the service handler. However, the SH is assisted by a service database and knowledgebase for being accessed by service scenarios. A network service actuator in the Service Handler realises the network initiated services in the same way as the call processing routine functions in call controllers. An example of such a service is the reservation based call service for which a call between users concerned is initiated at specified point in time from the network.

Adaptive Scheduling Function: For processing multiple services, the adaptive scheduler controls multiple expert interpreter routines in each service execution environment and appropriately allocates or de-allocates them to various scenarios. The adaptive scheduler also manages all dialogues between the expert interpreter routine and external routines including call processing routines, network service actuator and the

interpreter routines. The adaptive scheduler works on the basis of a hypermedia navigation through information in a non-linear manner. Hypermedia also enables the adaptive scheduler to organise and retrieve information by referential links in the form of relational object oriented network. The non-linearity helps in moving or jumping from one point in the programme to another based on the patters of relationships that are explicitly defined.

The above described adaptive incrementally intelligent service management system utilizes a development tool called, KNOWLEDGEPRO Windows which can combine hypermedia with imbedded expert system. The software, KNOWLEDGEMAKER, can introduce a rule set from a group of examples that developers can directly import into the KNOWLEDGEPRO. In the above context, the inference mechanism in KNOWLEDGEPRO makes use of an upward chaining predominently and forward chaining supplementarily.

Intelligent Integration with Flexible Routing and Capacity Control

The design of the global IN overlay of NICNET allows flexible band-width allocation technique at the link layer and flexible routing technique at the network layer, so as to maximise network performance quality through intelligent capacity control mechanisms.

Each node in the NICNET overlay has 2.2 Mbps maximum rate of transmission per module with the vairability adjusted between 16 Kbps and 2.2 Mbps. The intelligent network management system will adjust the rate at each node depending upon the forecast of the demand a hour or two ahead. However, the summation of the rates over all the nodes will not exceed the value corresponding to the total value of band-width on the satellite transponder.

Band-width allocation methods, signaling protocols and per call control of network components can permit the capacity sharing in a multimedia environment. For the advance packet switch environment, we may either specify the maximum band-width to be used for each service at a specified time or assign a portion of digital capacity to be shared by all traffic types and split the remaining bandwidth into one or more band-width categories dedicated to particular services.

The global IN overlay would increasingly depend upon intelligent flexible routing strategies enabling high availability under a range of network conditions including failures and overloads. Such flexibility enables quick, automated response to rapid changes in network loading to maximise utilisation of available capacities. At the design stage both time dependent routing and state dependent routing were considered. The latter was finally chosen because, the network state information gets determined online for responding to real time traffic fluctuations. Out of the three possible main flexible routing methods, viz., flow optimisation, state dependent strategy and learning automaton, the latter which adopts a decentralised call by call strategy with either linear reward inaction automaton or dynamic alternative routing or a combination thereof, is preferred in view of the scope for the application of AI techniques in a natural manner. The adaptive facility restoration and the strategies of integration of traffic and facility leads to an intelligent integration of traffic and facility with adaptive flexible routing. In the adaptive facility restoration method, automatic cross-connects are implemented under intelligent control of the In control nodes such that failed facilities are reconnected in accordance with the provision of facility restoration capacity, which is used until physical repair can be attended to. A provision is provided for multiple infow/outflow routing which allows the concept of toll switches, end offices or homing to more than one switch. It is possible to combine AI techniques with operations research models to determine economical network solutions.

NICNET hooks for linking to low and medium earth-orbiting satellite constellation

A number of world-wide message networks based on constellation of low and medium earth-orbiting satellites are planned for the Nineties. Three of the major ventures are: IRIDIUM of Motorola, GLOBALSTAR of Laurel Qualcomm Satellite Services Inc., PROJECT-21 of INMARSAT, etc. A network like NICNET which is evolving to an incrementally intelligent network, can cut development time and costs substantially by providing adequate number of hooks for tagging along to one of these three global networks when they get stabilized. Negotiations are under way in this direction. Until a firm alliance with one of them is established, the evolution of IN overlay of NICNET will emphasize the design of generic hooks which can be easily re-designed when a collaboration or alliance gets firmed up.

4.7. Regional and Global Networks of Importance to India

Globalisation of telecommunication network services is taking place at an accelerated pace. Of long term interest to India is the increasing availability of global and cooperative networks linking most countries of the Asia Pacific Region. Some of the more important networks which are relevant to India in the short and medium term are outlined below:

Internet - The Internet is a network of networks worldwide, most of which built using the Transmission Control Protocol/Internet Protocol (TCP/IP). Protocol suite share a common name and address space. Currently there are more than 100 countries accessing Internet and nearly 40,000 networks assigned unique IP network numbers. There are more than one million hosts known to the domain name systems and there are atleast five million users worldwide. The Internet exist to facilitate the sharing of resources among participating organisations, which include Government agencies, educational institutions and private coroporations as well as to promote collaboration among researchers and to provide a test bed for new developments in networking.

BITNet - An Acronym for 'Because It is Time NETwork', it is a cooperative network serving nearly 2000 hosts located in several hundreds of sites, mostly universities, in many countries. It is a communications link between universities and research centres with the only constraint that a site must acquire a leased line to facilitate connection to another BITNet node and in a cooperative spirit be willing to serve as a connection node for atleast one new member. This virtually unresticted access and absence of high membership fee is characteristic of BITnet. This policy is similar to that of UUNET and USENet except that it is more limited to academic institutions. AsiaNet in Japan is a constituent of this network. The network is steadily expanding to link several countries of the Asia Pacific region. Presently BITNet operated by the Corporation for Research and Education Networking (CREN), is providing a store and forward network for every one of the 2000 computers at every one of the 500 higher education institutions and research centres in USA and nearly 1000 sites connected transparently to cooperating networks throughout the world. Electronic Mail may be sent through gateways to the Internet and other networks.

FidoNet - It is basically an extension of the FIDO Bulletin Board System (BBS) which provides the electronic mail along with Bulletin Board services. It provides a network for PC users in the academic community in the spirit of BITnet. There are no special requirements or fees for membership. The software is sharable, there is no distribution cost though the users are asked to donate a small sum. It gives access to UUNET News Groups for personal computer users.

UUCP - An acronym for UNIX to UNIX CoPy, it was originally a Transport service used over dial up between adjacent systems. File transfer and remote command execution were the original and main objectives of UUCP. The UUCP mail network proper developed from the early networks with incentive to spread is provided by the UUCP programmes distributed as part of the UNIX system. The network connects very diverse set of machines and users with the host machine running the UNIX operating system. Much traffic is generated as responses to USENET news in addition to the usual mail. There is no central administration. Each host pays for its own links. Some hosts encourage others to connect to them in order to shorten mail delivery paths.

USENET - It combines the idea of mailing lists used on the Arpanet with the Bulletin Board services giving freedom for subject matter catering to a heterogeneous set of users. More than 90 percent of USENET articles reach 90 percent of the hosts on the network within three days. It is estimated that several hundreds of hosts are there in the Asia Pacific region.

PeaceSat - An acronym for 'Pan-Pacific Education and Communication Experiment by Satellites', it links more than 30 pacific sites in about 20 countries. This project is funded by NASA for the Social Science Research Institute of the University of Hawaii. Services include library access, a bulletin board, E-Mail and File Transfer.

Pactock - It is a low cost user friendly computer-communication service to countries of the South Pacific region for providing E-mail, tele-conferencing and file transfer facilities. It is a joint project of the Australian Foundation for Space of South Pacific, the IDEA Centre of Sydney, Centre for South Pacific Studies, University of New South Wales and Pegasus Network (APC).

DataNet - It is a data communication service for fast, reliable, flexible and cost-effective transport of information. It is supported by packet switching and supports X.3,

X.25, X.28, X.29, X.75 and Sprint's X.28 plus protocols. It gives OLDB application support.

NSFNet - It provides networking resources worldwide to the academic community extending the ideas of resource sharing promoted by ARPANET. NSFNet is the main research and education backbone of the Internet today. It is a hierarchical network of networks.

INMARSAT - Though initially set up to promote worldwide maritime communication through satellite technology, the scope of INMARSAT in recent times has widened to give mobile communication on land also.

COMNET-IT - It is a proposed worldwide network to link commonwealth countries for delivering the following information resources: A regular Newsletter, Seminar/Workshops/Regular meetings proceedings and minutes, CDROM publications of shared IT information.

Global Value Added Network (VAN) Services

Value Added Network Services are telecom application services super-posed over the routine network transmission and includes Electronic Mail (E-mail), Electronic Data Interchange (EDI), Videotex, Video-conferencing, Managed Data Network (MDN), Online Database (OLDB), Electronic Fund Transfer at Point of Sale (EFTPOS) and Data Broadcast. Some of the more important global players of relevance to India in the long run, are given below:

ARI Network Services Inc - It is a public Data Network of the PSTN type giving network and information services to agriculture sector, agricultre business and agriculture industry.

The BT Global Network Services (GNS) - It provides EDI, E-mail, Videotex, MDNS, Database Access and Store & retrieve messaging system. It is packet switched public data network in X.25 protocol using TYMNET world wide network.

SWIFT - It is a managed Data network of the Northern Telecom in X.25 protocol. In conjunction with ACCORD, it gives a store and forward system for foreign exchange dealings of various countries.

Compu Serve Inc. - It is a value added packet switching public data network service with more than 500,000 subscribers. It supports asynchronous dial up access at 300-9600 bps as well as dedicated access for synchronous between 300 and 9600 bps and X.25 upto 56 Kbps. It gives an online information service for personal computer users numbering nearly a million.

Telerate - It is a PSTN network with nearly 100,000 users offering international databases of real time financial information, decision support broadcast and electronic transaction services. The trading service enables traders anywhere in the world to monitor and execute transactions online.

DunsNet - It is a private X.25 packet switching network of Dun and Bradstreet Inc. delivering their online products to subscribers. In addition, a relayed service on DUN SPRINT gives financial information on 18 million businesses world-wide.

Easylink - It is a PSTN X.25 network of AT&T providing a single source of contact for the multimedia messaging requirements of businesses. They have offered video-conferencing upto 64 Kbps to Australia, CIS, Hongkong, Japan, NewZealand, Singapore, Taiwan and India.

IBM Information Network - It is an SNA based X.25 network giving EDI, E-mail, MDNS and Database Services.

InfoNet - It is a managed data network with PDN giving EDI, E-mail and Network Management support.

SITA - It is the largest and oldest global EDI network which is application specific to air transport and related industries.

SPRINT-Mail - It is an SDLC based X.25 network with more than 400,000 users with its E-mail service running over SPRINTNET. It has an X.400 based service called, SPRINTMAIL-400 and started operating global frame relay services.

TradaNet - It is an MDNS network for EDI applications provided by INS Limited and GE Information Services with over 13,500 trading partners world-wide.

TradeNet - It is an EDI service of Singapore network service available with overseas links to international network providers like GEIS in USA and FENICS in Japan.

Venus-LP - It is an international high volume high speed data transmission system provided by KDD/NTT of Japan with over 20,000 subscribers in 53 countries.

In addition, there are several specialised VAN Services like Geomail, Globedat, Lexis, etc.

4.8 Geostationary and Global Satellites of Importance to India

There are a number of geostationary and global satellites and satellite systems of importance to India in its efforts to globalize IT and C-C. The more important of these which have a stable and viable foot print over India are catalogued in Annexure with self-explanatory details. This list comprises of satellites which are already operational or expected to be launched by 1996.

In the long term, India's requirement can be supplemented by satellite constellations like IRIDIUM of MOTOROLA, GLOBALSTAR of LORAN-QUALCOMM and PROJECT-21 of INMARSAT.

V. MANPOWER DEVELOPMENT AND AWARENESS CREATION FOR GLOBALIZATION

V. MANPOWER DEVELOPMENT AND AWARENESS CREATION FOR GLOBALIZATION

India which has the world's second largest population and third largest scientific and technical manpower, is in an anomalous position of having to face acute shortage of trained manpower in the IT and C-C industry. The manpower position is examined here with specific reference to certain non-traditional approaches to manpower development which has to be promoted in order to make India a global player in IT and C-C. Globalization also requires a careful nurturing of awareness building regarding quality in the IT industry and C-C infrastructure. The present status of quality awareness building in India and the suggestions for future directions are outlined.

Development of consultancy capabilities is diagnosed as a major lacuna at present which has to be bridged as soon as possible to assist the enterpreuners going global. Promotion of IT and C-C through awareness creation is best carried out through the marketing drives. For this, new approaches like tele-marketing, mailers, structured demos and even TV media are recommended. For improving India's image abroad as a global IT player, a careful grooming of its image has to be carried out utilizing professional associations like MAIT, NASSCOM and CSI.

5.1 IT Manpower Development in India

The first meaningful statistical projection of the demand and supply situation of IT manpower appeared only around 1984. These projections showed that the formal education system cannot cope up with the spiralling requirements of the industry and the non-government organizations have to play a significant role. Each successive projections showed that the earlier one had under-estimated the demand and the role of the private sector assumed greater and greater importance.

The new education policy brought out by the Government in 1986 focussed on the need for the non-government sector in playing a dominant role in solving the education problem of the country. With plan investments in education falling from nearly 8 percent in the first Five Year Plan to 3.5 percent in the seventh Five Year Plan, it clearly underscrored the fact that the education sector is highly under-financed. The priority given to universalization of primary education further chiselled away the meagre resources from the higher education.

With a view to promote the computer training industry in the country, the 1984 computer policy and the 1986 software and training policy, brought out by the Department of Electronics of the Government of India, gave an important role to the private institutions in the development of IT manpower, thereby buiiding the foundation for a stable and mature training structure in the country. Though the accreditation of courses was clearly recommended and approved by the Cabinet in 1986, it was implemented by the Department of Electronics only in 1991. However, this initiative is now supplemented by initiative of MAIT which has brought out an empanelment process for teaching shops to bring about a higher turn out of manpower. Both the DOE initiative and the MAIT initiative have reinforced the building up of a computer training industry in India. These initiatives address themselves mainly to the entry level requirements of the domestic and export industry in software. However, as this is only a small portion of the more complex problem, a number of new and interesting changes are taking place that are likely to provide more number of skilled and experienced manpower. The leading software firms have started recruiting peoeple with many years of expertise in non-computer specialisations. Its domain specialists are provided with intense IT related training and education which is supplying the manpower with many years of domain experience, coupled with the necessary computer skills to be able to solve complex problems arising in the IT industry in India.

The analysis of the computerisation process in medium to large organisations show that there are five distinct categories of manpower required. They are: Information System professionals, functional specialists, de-facto PC experts, Active users and other users. Of these, the middle three are filiing new roles in the growth of the IT industry. The active end-user is the Executive who has become conversant with the PC and is in a position to use various IT techniques with certain proficiency and can make simple reports and analysis on its own. The de-facto PC experts are a smaller, but definite number of executives and other professionals in organisations which have discovered a flair for PC operations and therefore, have acquaired a high degree of skills in the use of a vast range of software tools on PCs. The functional specialists are senior executives and professionals from various departments who have a high level of skills in their functional roles and have taken interest in computers. Such functional specialists are becoming the source of many powerful applications of computers. Added to this, the need for life long learning is being encouraged which has become necessary not only because the technology

obsoletes itself continuously, but also because the skills are required to be updated on a regular basis to fill in new roles that are getting created by a growing IT industry.

5.2 Awareness building regarding Quality in IT and C-C Industries

Awareness building regarding quality of IT hardware and software has become the most important issue for sustaining software export from India. Total Quality Management (TQM) and ISO-9000 are the main systems that need to be propagated in the Indian IT industry as speedily as possible. The entire IT industry in India is increasingly becomming conscious of these quality standards so as to enable them to corner a sizeable part of the global software and services market.

There are two paths for achieving quality. While achieving ISO Standard is the main aim, some go straight for ISO certification while others attempt towards a more comprehensive TQM so that in the process they can achieve the ISO standard. In particular, the IT industry is clamouring for ISO-9000 certification. This makes sense because the European market has sspecified ISO-9000 certification as a de-facto requirement. India is targetting at the European Common Market which came into being in 1993. The over $ 6000 billion ECM economy with a population of 350 million, is deemed as the most lucrative market for Indian IT industry. The European IT, Electronics and Telecommunication industry is worth over $ 200 billion which is approximately a quarter of the world-wide business in these areas. In this, the software and services market by itself account for over $ 60 billion. It is for this reason that the Indian IT industry is concentrating on this market.

There are three important issues to be resolved by India for getting maximum advantage in the European market:

- ECM specifications and standards have to be complied with meticulously and consistently.

- Modification and changes in regulation have to be monitored along with national requirements within the ECM, taking note of the local variation.

- Planning careful strategies for marketing, distribution, dealership, brand image at affordable cost.

- The most important factor, however, is quality through ISO-9000 certification.

Quality awareness building exercise has already started in full swing in all parts of India. A system called Knowledge-integrated Quality Management System (Ki-QMS) is a method developed by Sundaram Information Systems of Madras, a Division of Sundaram Fastners Limited, the first company in India to obtain the ISO-9000 certification. They help various organisations in setting up quality systems and maintaining documentation in accordance with ISO-9000 standards. The Quality Assurance Institute (QAI) of United States is represented in India through INTECOS of Delhi. QAI promotes state of the art quality assurance methods, tools and techniques. QAI members in India include CDOT, CMC, COSL, EIL, NIIT, TISL, TUL and so on. Juran Institute of USA is represented in India by Quimpro Consultants Private Limited at Bombay. They conduct public seminars to create national awareness on matters of customer driven quality, especially quality planning, quality control and quality improvement. A Juran Club has been formed in Bomay indicating that the Juran system has found a base in India.

A number of other organisations like the Confederation of Indian Industry (CII) are propagating quality awareness through intensive training programmes among IT and C-C professionals. A number of universities are now planning to introduce quality awareness programmes in the curricula. A number of private teaching shops have also taken up quality awareness creation through commercial courses to the public at large.

5.3 Awareness building through the promotion of consultancy services

Higher level awareness building in the IT and C-C sectors can be carried out through a sustained promotion of consultancy service in the public sector, private sector, research institutions and academic institutions. Consultancy service in these areas is gaining credibility in the Indian scenario only since the past few years. Liberalisation of the economy has prodded the need for more extensive consultancy services in a wide variety of IT and C-C areas.

In order to establish credibility of Indian consultancy services in India and abroad, a number of steps are required to be taken. A Directory of Consultants along with information on their capabilities and experience should be prepared through an online

database accessible through terminals. Further a system of registration of consultants through authentication of the capabilities of consultants and consultancy services should be carried out not only by a Government body but also by non-government bodies.

A good track record within India is essential to establish credibility of Indian consultancy companies for undertaking projects in other countries. Their presence in the foreign market has so far been limited due to several reasons, some of which are as follows. Facilities and procedures for information distribution is deficient. Participation in foreign trade fairs, seminars and presentations is made difficult because of certain foreign exchange regulations. The Indian Missions abroad, by and large, do not have adequate information to promote Indian consultancy. The online database developed should be accessible through international networks from commercial attaches of various Indian Missions abroad. Periodic advertisements in foreign technical magazines are also necessary. Reciprocally, information about foreign markets and opportunities for marketing consultancy services should be propagated within India so that those who have the knowhow will respond appropriately to such projected requirements. In general, the profession of consultancy services in India suffers from acute lack of incentives which are normally given for promoting the industrial sector.

A number of Government policies and regulatory measures are required for promoting consultancy services in India. Participation of consultants in decision making should also be encouraged. Procedures for associating competent Indian consultants along with foreign consultants in jobs carried out in India, should be worked out. Private consultancy services should be given the same level of encouragement as public sector consultancy services. In short, an Act of Parliament should be enacted to govern, regulate and promote consultancy profession with a view to enable them to be competitive internationally.

A widespread interaction of consultants with the business, research orgnisations, academic institutions, export houses and industrial establishments will enable cross-fertilization of knowhow and experience and incease the level of technological and market awareness. among all the component factors in economic growth. In view of their being high-tech and fast obsolescence with high rate of growth, the IT and C-C industries will particularly benefit through awareness creation catalysed by the consultancy organisations.

5.4 Awareness Creation through Marketing Drive

In any sector, competitive marketing drive is one of the most potent means of awareness creation among the users as well as the service providers. This is especially so in the IT and C-C industries, because of the diversity of competing products and technologies as well as marketing strategies. For this, new approaches like tele-marketing, mailers, structured demos and even TV media are being utilised in India. Recently, a number of computer venders have aggressively launched new products utilising unconventional means of market promotion like tele-marketing, mailers, structure demos and TV advertisements so as to create awareness among prospective users about their products. Such market drives are steadily building pursuasive direct marketing strategies like sending direct mailers, targetting specific clientale in different segments like Top Managers, Designers, Salesmen, Secretariat Staff etc. Direct marketing in the IT industry has been found to be one of the most effective ways of reaching the customers in India. Press advertisements are non-specific with resference to their target population and therefore, the media costs may not justify the outcome. Direct mailing on the other hand, is less expensive and a persuasive awareness for selling the IT products. If cost effective demos can be arranged, every direct marketing effort, whether it is mailers or tele-marketing, has an important bi-product, viz., awareness creation among segments of users. The success of direct marketing campaign depends critically on the accuracy of the database directory that they use for the target addresses. As awareness creation has a long term benefit even for marketing, such database directories should also include opinion leaders, as well as primary and secondary awareness creation promoters. For the IT industry which has to provide indepth information to customers and users, direct marketing has proved to be an effective way of getting the message across in an appropriate manner. However, many more innovative strategies have to be developed for direct marketing to attract buyers' attention especially from the point of view of incidental awareness creation for long term marketing gains.

5.5 Awareness Creation for Improving India's Image Abroad in IT and C-C

With Indian software talents distributed all over the world in tens of thousands numbers, they act as message carriers of India's image abroad in IT and C-C. Non Resident Indians, therefore, have a major role to play in boosting India's image in countries which are potential importers of Indian IT and C-C products.

India's Software Association, NASSCOM, conducted an International Seminar called, NASSCOM '92, at Delhi. The Association went all out to ensure that the delegates were offered the best in speakers and topics in IT and C-C, especially on software. Issues that were debated included global opportunity for potential alliance, exports and any obstacle faced by exporters in setting up export ventures. The International Seminar was a success in the sense that it created awareness about Indian IT and software capabilities among a large number of important foreign delegates who attended the seminar. Government should give substantial financial support for conducting such seminars and conferences by professional associations interested in promoting India's image abroad. There is a perception among prospective buyers of Indian IT products abroad, that India does not give adequate attention to quality as required by European market. This concern has been voiced by businessmen in Europe and USA. With India going in for a major promotional effort for building quality in all aspects of the IT industry, especially software, awareness building measures should be promoted on this important initiative in other countries.

ANNEXURE

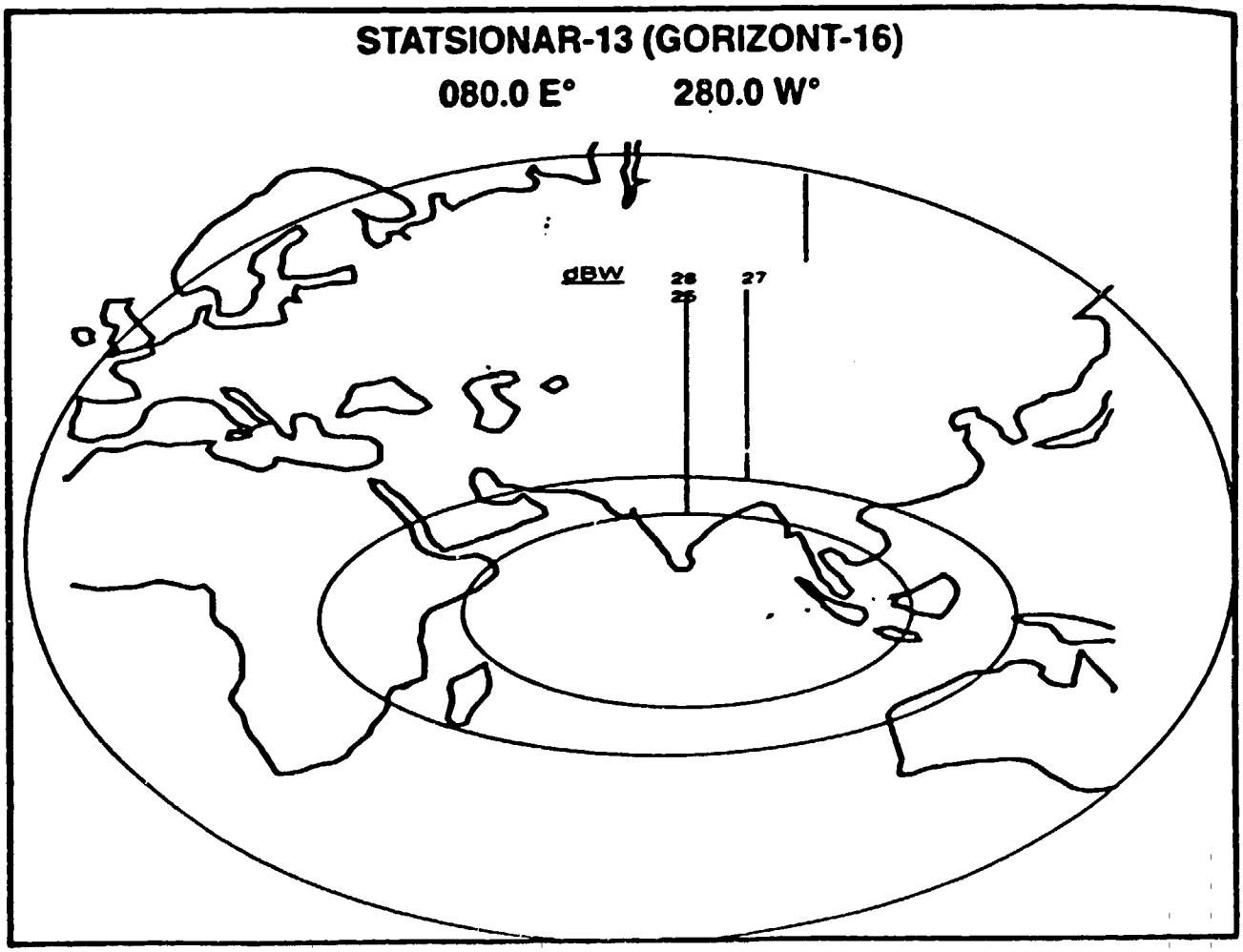
GEOSTATIONARY AND GLOBAL SATELLITES OF IMPORTANCE TO INDIA

STATSIONAR-13 (GORIZONT-16) (080.0E° 280.0 W°)
INTERSPUTNIK (Operator) USSR PTT ADMINISTRATION
(Owner) RUSSIA

Lunch Date: 16 August, 1984

Frequency Band(s): Uplink 5.925-6.225 and 14.308-14.342 GHz; Downlink 3.650-3.950 and 11.508-11.542 GHz
Number of C-Band: 6 @ 36 MHz Bandwidths
Number of Ku-Band: 1 @ 36 MHz Bandwidths
Channel Bandwidth: 36 MHz
Channel Polarization: Circular

Geographics Coverage: Europe, Asia, Aftrica & Australia via global, northern hemispheric, zone and spot beams
EIRP - Main Beam: C-band zone 33 dBw, north hemispheric 31 dBw, global 28 dBw
EIRP - Spot Beams: C-band spot 33 dBw spot 33 dBw; Ku-and spot 38 dBw

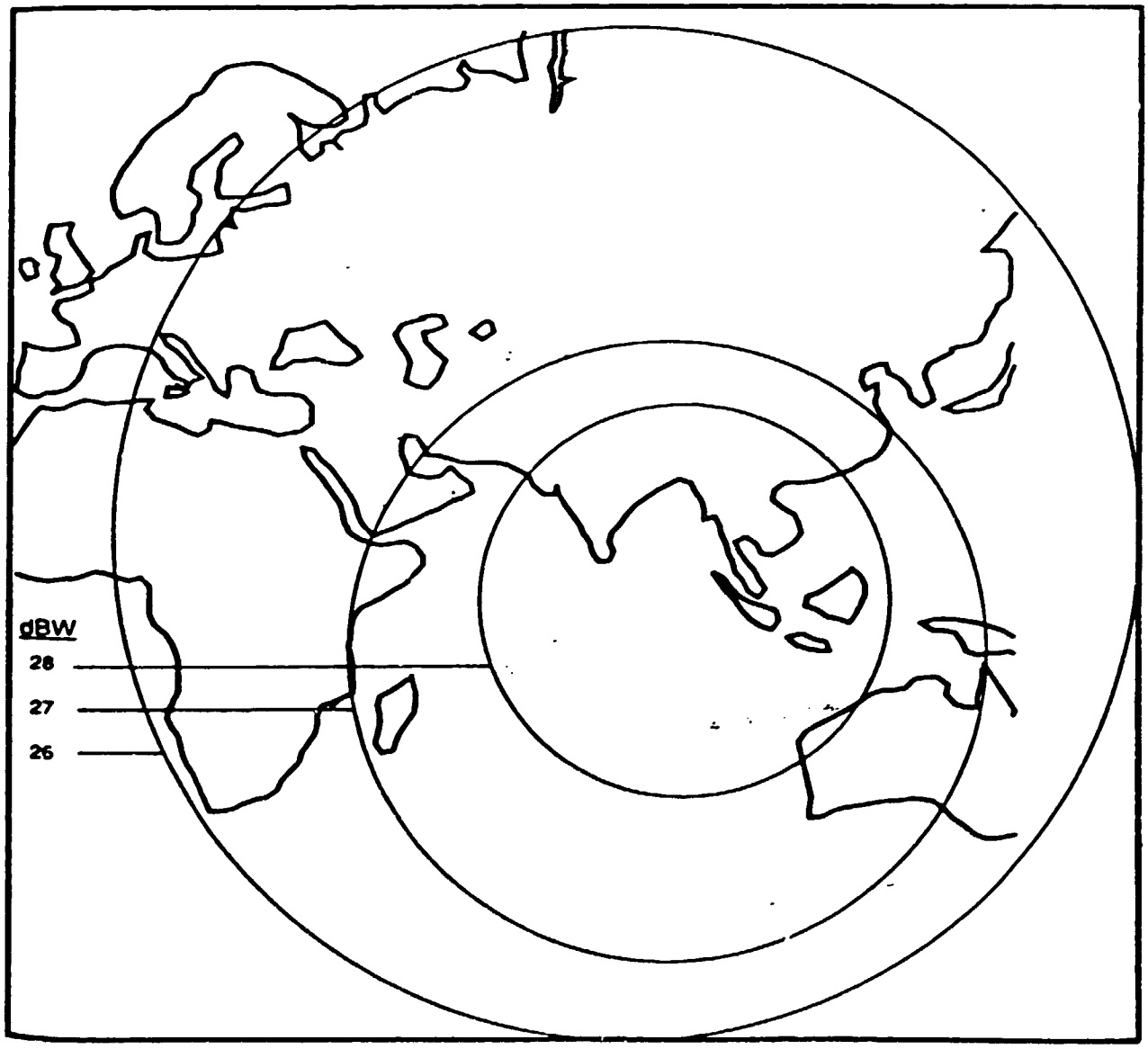


STATSIONAR-06 (GORIZONT-20) (090.0 E° 270.0 W°)
INTERSPUTNIK RUSSIA

Launch Date: January 20. 1986

Frequency Band(s): Uplink 5.925-6.255 GHz and 14.308-14.342 GHz; Downlink 3.650-3.950-11.508-11.542 GHz
Number of C-Band: 6
Number of Ku-Band: 1

Geographics Coverage: Russia via global, northern hemispheric, zone and spot beams
EIRP - Main Beam: C-band global 28 dBw at beam edge, north hemispheric 31 dBw at beam edge
EIRP - Spot Beams: C-band spot 42 dBw; Ku-bank spot 38 dBw



INTELSAT 501 (091.5 E^{o} 268.5 W^{o}) INTELSAT USA

Launch Date: 23 MAY, 1981

Frequency Band(s): C & Ku
Number of C-Band: 16 @ 72 MHz, 5 @ 36 MHz Bandwidths
Number of Ku-Band: 4 @ 72 MHz & 2 @ 241 MHz Bandwidths
Channel Bandwidth: Varies from 36 MHz to 241 MHz
Channel Polarization: C-band - circular; Ku-band - Linear

Geographics Coverage: Asia/Pacific Region
EIRP - Main Beam: C-band (23.5 dBw-29 dBw); Ku-band (41.4 dBw- 44.1 dBw)
EIRP - Spot Beams: West 44.4 dBw, East 41.4 dBw

INTELSAT 505 (066.0E^{o} 294.0W^{o}), INTELSAT USA

Launch Date: September 28, 1982

Frequency Band(s): Uplink 5.929-6.417 GHz and 14.004-14.498 GHz; Downlink 8.704-4.192 GHz and 10.954-11.698 GHz
Number of C-Band: 16 @ 72 MHz, 5 @ 36 MHz Bandwidths
Number of Ku-Band: 4 @ 72 MHz & 2 @ 241 MHz Bandwidths
Number of Other: 2 L-band
Channel Bandwidth: Varies from 36 MHz to 241 MHz
Channel Polarization: C-band - East/west hemispheric RHCP, east/west zone LHCP, global RHCP; Ku-Band - ;iner; L-band RHCP

Geographics Coverage: Indian Ocean Region & Inmarsat MCS via global, hemispheric, zone and spot beams
EIRP - Main Beam: C-band (23.5 dBw-29 dBw); Ku-band (41.4 dBw- 44.1 dBw)
EIRP - Spot Beams: West 44.4 dBw, East 41.4 dBw

INTELSAT 507 (057.0E^{o} 303.0W^{o}) INTELSAT USA

Launch date: 18 October, 1983

Frequency Band(s): Uplink 5.295-6.417 GHz; Downlink 14.004-14.498 GHz, 3704-4.192 GHz and 10.954-11.698 GHz
Number of C-Band: 16 @ 72MHz, 5 @ 36 MHz Bandwidths
Number of Ku-Band: 4 @ 72 MHz & 2 @ 241 MHz Bandwidths
Number of Other: 2 L-band
Channel Bandwidth: Varies from 36 MHz to 241 MHz
Channel Polarization: C-Band - East/west hemispheric beams RHCP;east.west zone LHCP; global RHCP; Ku-Band Linear; L-band Global RHCP

Geographics Coverage: Indian Ocean Region via east and west C- band hemispheric and zone beams, global L- and C-band beams and steerable spot beams
EIRP - Main Beam: C-band(23.5-29 dBw);Ku-band (41.4-44.1 dBw)
EIRP - Spot Beams: West 44.4 dBw, East 41.4 dBw

INTELSAT 602 (063.0E° 297.0W°) INTELSAT USA

Launch Date: October, 27, 1989

Frequency Band(s): Uplink 5.854-6.423 GHz and 14.004-14.498 GHz;Downlink 3.629-4.198 GHz and 10.954-1.698 GHz
Number of C-Band. 26 @ 72 MHz, 12 @ 36 MHz, 2 @ 41 MHz Bandwidths
Number of Ku-Band: 8 @ 72 MHz, 2 @ 77 MHz, 2 @ 150 MHz Bandwidths
Channel Bandwidth: Varies from 36 MHz to 150 MHz
Channel Polarization: C-Band - global RHCP and LHCP, east/west hemispheric RHCP, zone beams LHCP; Ku-Band - Linear

Geographics Coverage: Indian Ocean Region via global, hemispheric, zone and spot beams
EIRP - Main Beam: 23.5 to 31 dBw
EIRP - Spot Beams: West 44.7 dBw 44.7 dBw

INTELSAT 604 (060.0E° 300.0W°)INTELSAT USA

Launch Date: June 23. 1990

Frequency Band(s): Uplin 5.854-6.423 GHz and 14.004-14.498 GHz; Downlink 3.629-4.198 GHz and 10.954-11.698 GHz
Number of C-Band: 26 @ 72 MHz, 12 @ 36 MHz and 2 @ 150 MHz Bandwidths
Number of Ku-Band: 8 @ 72 MHz, 2 @ 77 MHz and 2 @ 150 MHz Bandwidths
Channel Bandwidth: Varies from 36 MHz to 150 MHz
Channel Polarization: C-Band - Circular; Ku-Band - Linear

Geographics Coverage: Indian Occean Region via hemispheric, zone and spot beams
EIRP - Main Beam: 23.5 to 31 dBw
EIRP - Spot Beams: West 44.7 dBw, East 44.7 dBw

INTELSAT 501

This diagram illustrates a possible spacecraft platform pointing bias and spot beam pointings.

POINTINGS

BEAM	AZIMUTH	ELEVATION
Platform Bias (Hemi, Zone)	1.80W	0.00
(Global Transmit)	0.00	0.00
West Spot Ku-Band	5.24W	5.31N
East Spot Ku-Band	5.70E	5.48N

NOMINAL BEAM EDGE CONTOURS ILLUSTRATED

BEAM	NOMINAL EIRP (dBw)
Global (A Pol)	23.5
East/West Hemispheric	29.0
East/West Atlantic Zone	29.0
West Spot Ku-Band	44.4
East Spot Ku-Band	41.1

INTELSAT 507

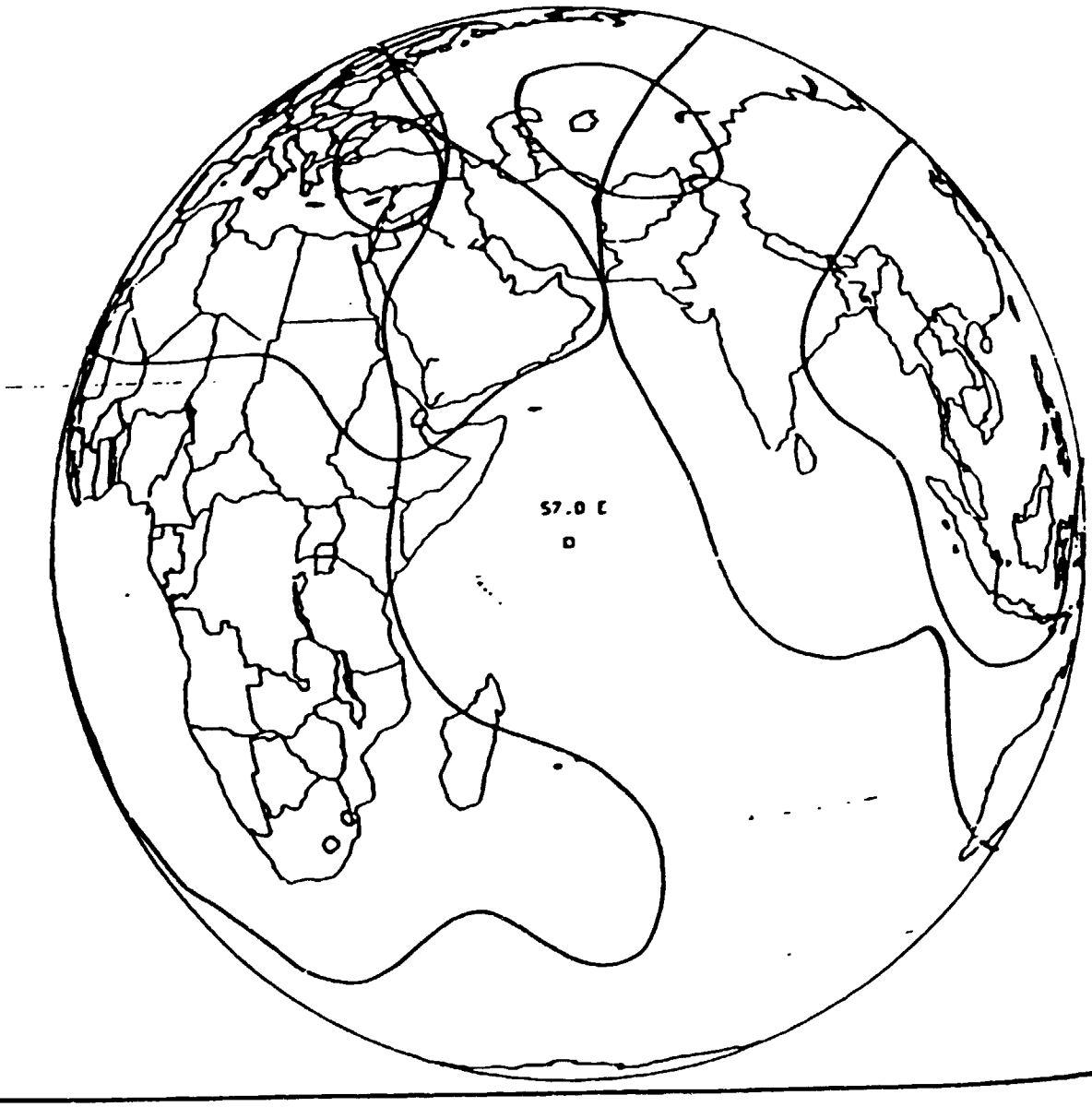
This diagram illustrates a possible spacecraft platform pointing bias and spot beam pointings.

POINTINGS

BEAM	AZIMUTH	ELEVATION
Platform Bias (Hemi, Zone)	1.50E	0.00
(Global Transmit)	0.00	0.00
West Spot Ku-Band	2.84W	6.07N
East Spot Ku-Band	0.89E	6.69N

NOMINAL BEAM EDGE CONTOURS ILLUSTRATED

BEAM	NOMINAL EIRP (dBw)
Global (A Pol)	23.5
East/West Hemispheric	29.0
East/West Atlantic Zone	29.0
West Spot Ku-Band	44.4
East Spot Ku-Band	41.1



INTELSAT 602

This diagram illustrates a possible spacecraft platform pointing bias and spot beam pointings

POINTINGS

BEAM	AZIMUTH	ELEVATION
Hem. Zone Pointing	0.450E	0.230N
(Receive-Not Shown)	0.470E	0.230N
(Global A&B Pol)	0.00	0.00
West Spot Ku-Band	5.08W	6.38N
East Spot Ku-Band	1.22W	5.18N

NOMINAL BEAM EDGE CONTOURS ILLUSTRATED

BEAM	NOMINAL EIRP (dBw)
Global (A&B Pol)	26.5
East/West Hemispheric	31.0
NE, SE, NW, SW Indian Zone	31.0
West Spot Ku-Band	44.7
East Spot Ku-Band	44.7

INTELSAT 604

This diagram illustrates a possible spacecraft platform pointing bias and spot beam pointings.

POINTINGS

BEAM	AZIMUTH	ELEVATION
Hemi/Zone Pointing	0.580E	0.210N
(Receive-Not Shown)	0.610E	0.090N
(Global A&B Pol)	0.00	0.00
West Spot Ku-Band	3.09W	6.04N
East Spot Ku-Band	4.46E	6.99N

NOMINAL BEAM EDGE CONTOURS ILLUSTRATED

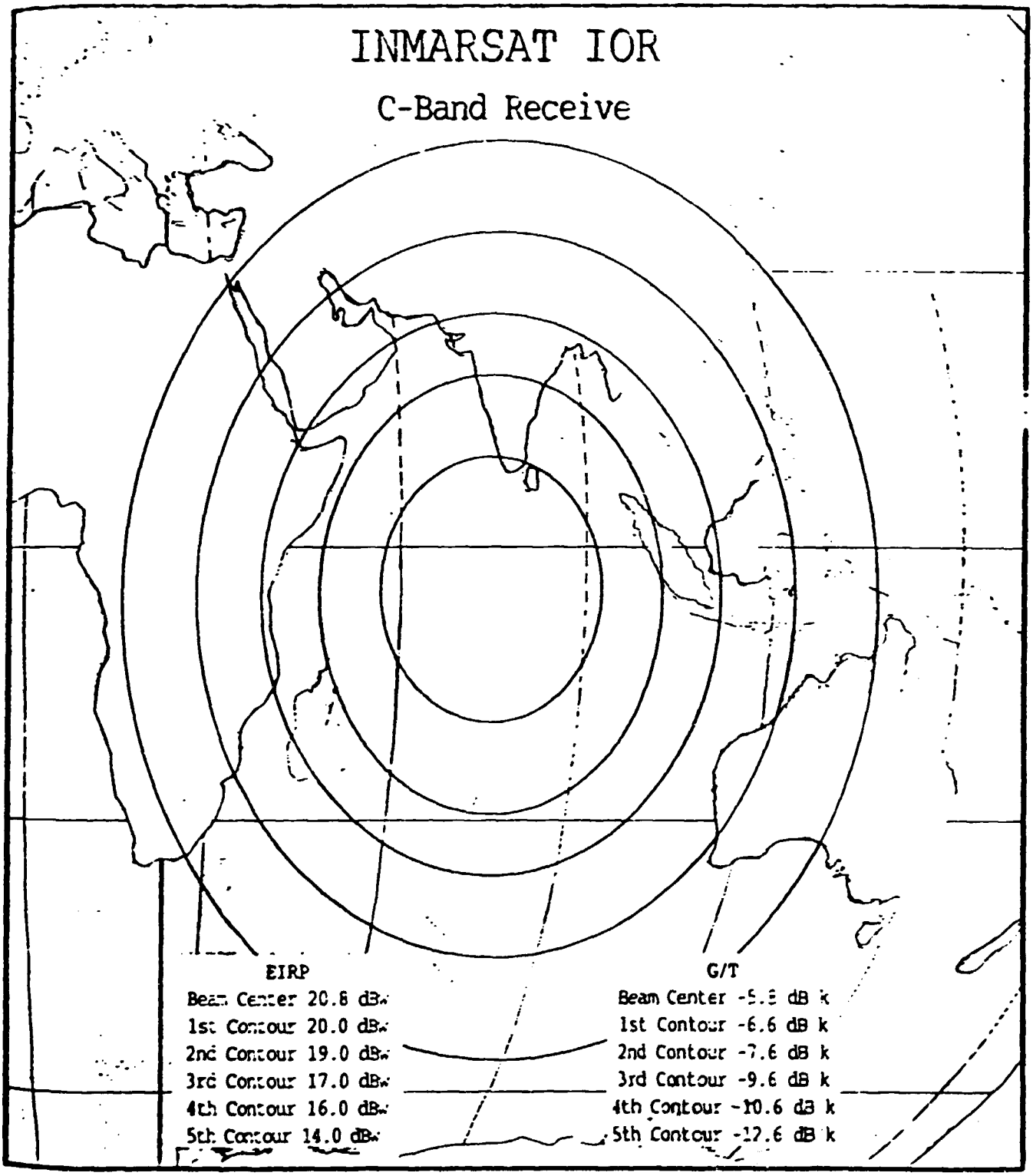
BEAM	NOMINAL EIRP (dBw)
Global (A&B Pol)	26.5
East/West Hemispheric	31.0
NE, SE, NW, SW Indian Zone	31.0
West Spot Ku-Band	44.7
East Spot Ku-Band	44.7

INMARSAT 2- F1 (INDIAN OCEAN) (064.5E° 295.5W°)
INMARSAT U.K.

Launch Date:October 30, 1990

Frequency Band(s): C-Band 6.4/3.6 GHz Feeds; L-Band 1.5/1.6 GHz Mobile
Number of C-Band: 1
Number of Ku-Band: 1 L-Band
Channel Bandwidth: C-L (18MHz); L-C (23 MHz)
Channel Polarization: C-Band (Up-RHCP, Down=LHCP); L-Band (RHCP)

Geographics Coverage: Global
EIRP - Main Beam: L-39 dBw; C-25 dBW
Saturation Flux Density: C-Band approx. 92 dBw/M at Beam Center

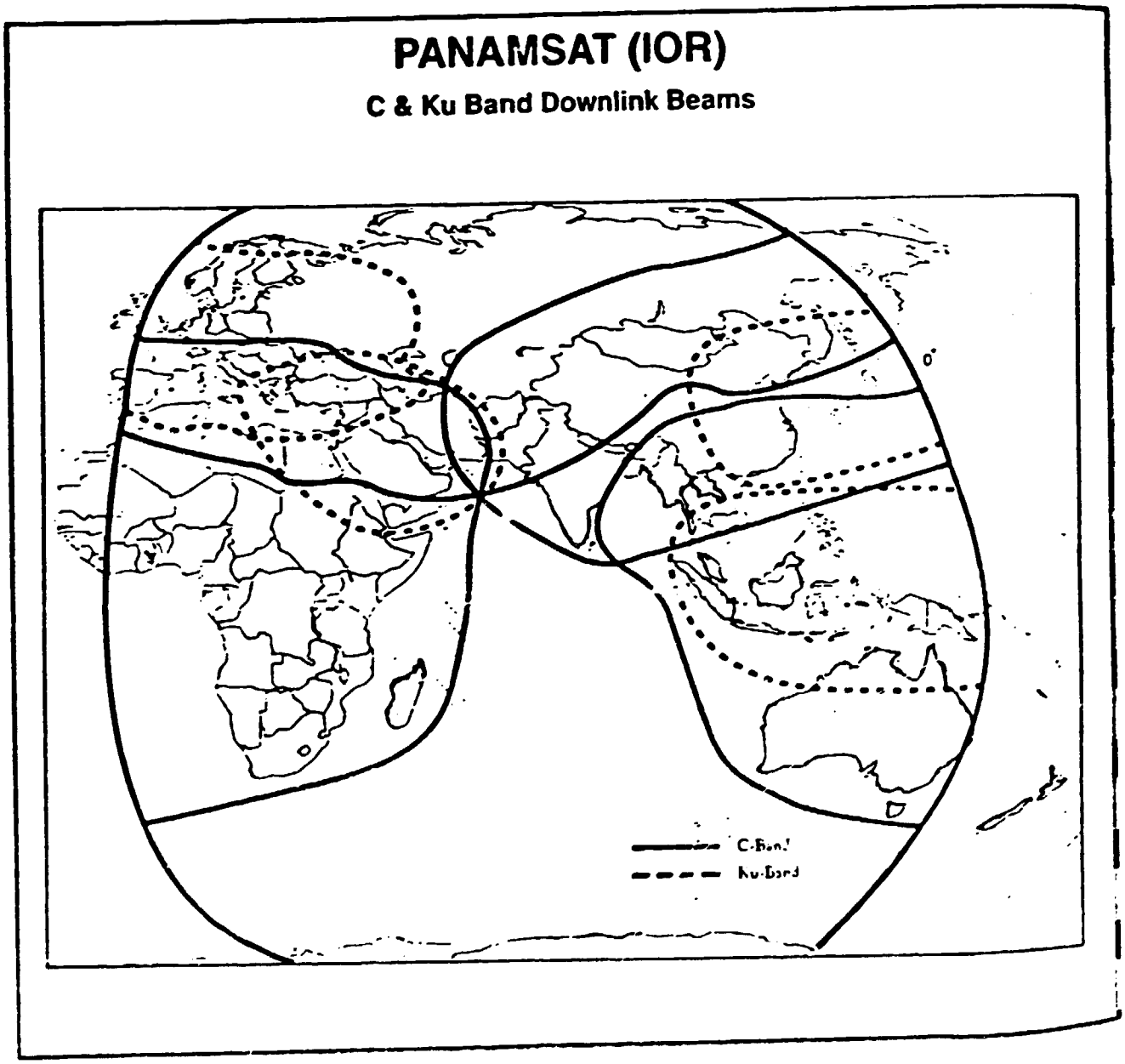

INMARSAT IOR
C-Band Receive
EIRP
Beam Center 20.8 dBW
1st Contour 20.0 dBW
2nd Contour 19.0 dBW
3rd Contour 17.0 dBW
4th Contour 16.0 dBW
5th Contour 14.0 dBW
G/T
Beam Center -5.6 dB k
1st Contour -6.6 dB k
2nd Contour -7.6 dB k
3rd Contour -9.6 dB k
4th Contour -10.6 dB k
5th Contour -12.6 dB k

PANAMSAT (PAS-4), (072.0E^{o} 288.0W^{o}), PanAmSat USA

Launch Date: January, 1995

Number of C-Band: 24
Number of Ku-Band: 16
Channel Bandwidth: C-Band @ 63 Watt; C-Bank @ 30 Watt
Channel Polarization: Linear

Geographics Coverage: Indian Occean Region
Notes: Cross strapping: 8 transponders Ku to C and 8 C to Ku



INSAT-1D (082.9 E° 277.1 W°) ISRO - INDIAN SPACE RESEARCH ORGANIZATION INDIA

Launch Date: June 1990

Frequency Band(s): Uplink 5.935-6.425 GHz and 5.855-5.935 GHz; Downlink 3.710-4.200 GHz and 2.555-2.635 GHz
Number of C-Band: 12
Number of Ku-Band: 2 - S-band
Channel Bandwidth: 36 MHz
Channel Polarization: C-band Linear; S-band Circular

Geographics Coverage: India
EIRP - Main Beam: C-band FSS 32 dBW beam edge, S-band BSS 42 dBw beam edge
Saturation Flux Density: Approx. -70 dB with a gain setting at 22

INSAT-2A (074.0E° 286.0W°) ISRO - INDIAN SPACE RESEARCH ORGANIZATION INDIA

Launch Date: July 10, 1992

Frequency Band(s): S.C & Extended C
Number of C-Band: 18 C-band
Number of Ku-Band: 2 S-band of 50 watts
Channel Bandwidth: 36 MHz
Channel Polarization: C-band Linear; S-band LHCP

Geographics Coverage: National
EIRP - Main Beam: FSS: SIXTEEN 32 dBw (at edge) & TWO 34 (at edge)
TRANSPONDER; BSS: 4 dBw (at edge)
Saturation Flux Density: Approx. -70 dB with a gain setting at 22

INSAT-2B (091.0 E° 269.0 W°), ISRO - INDIAN SPECE RESEARCH ORGANIZATION INDIA

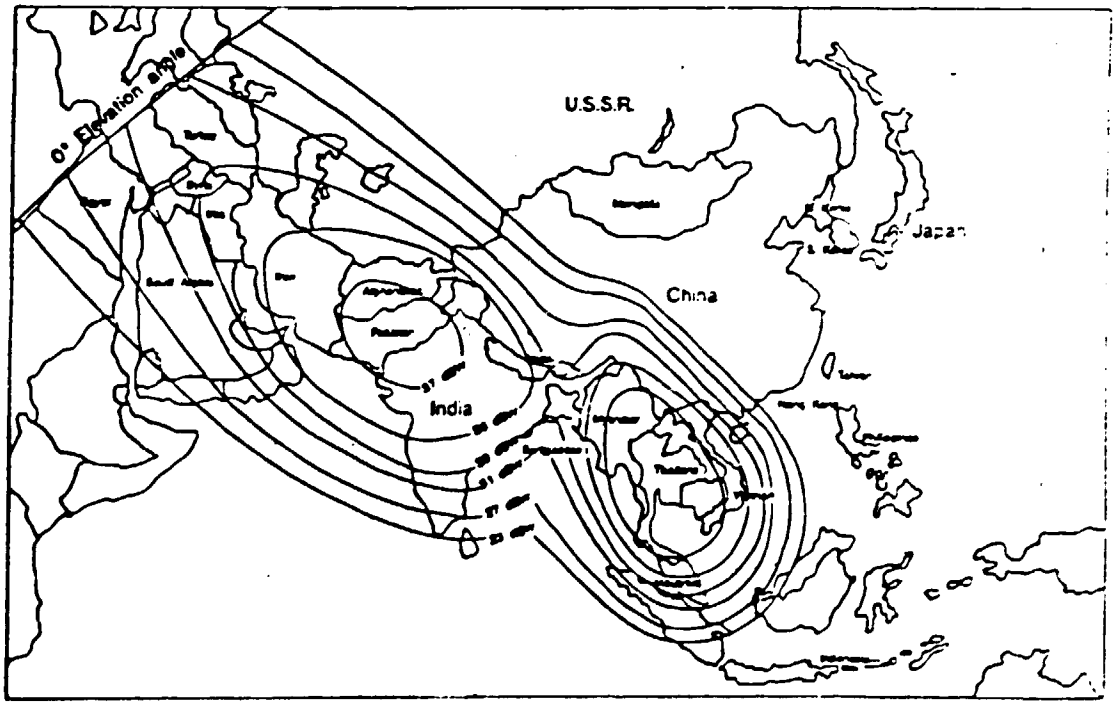
Launch Date: March, 1993
Frequency Band(s): S,C & Exended C
Number of C-Band: 18 C-Band & 2 S-Band
Channel Bandwidth: 36 MHz
Channel Polarization: C-Orthogonal Linear;S-LHCP
Geographics Coverage: National
EIRP - Main Beam: FSS: Sixteen 32 dBw (at edge) & two 34 dBw(at edge) transponders;
BSS: 42 dBw (at edge)
Saturation Flux Density: Approx. -70 dB with a gain setting at 22

ASIASAT 1 (105.5 E^{O} 254.5 W^{O}) ASIA SATELLITE TELECOMMUNICATIONS CO. LTD (ASIASAT) HONG KONG

Launch Date: April 7, 1990
Frequency Band(s): Uplink 3.7-4.2 GHz; Downlink 5.925-6.425 GHz
Number of C-Band: 24
Number of Ku-Band: 36 MHz
Channel Polarization: Linear, 12 horizontal and 12 vertical
Geographics Coverage: Mainland Asia, China, Thailand, Pakistan & other Asian Countries.
EIRP - Main Beam: 36 dBw
EIRP - Spot Beams: 36 dBw
G/T: 1.0 dB/K maximum
Saturation Flux Density: -81 to -90 dBw/msq.
Notes: Originally launched as Westar VI in 1984

ASIASAT 1

Southern Footprint



ASIASAT 2 (077.5E^{O} 282.5W^{O}) ASIA SATELLITE TELECOMMUNICATIONS CO. LTD (ASIASAT) HONG KONG

Launch Date: Late 1994

Frequency Band(s): C & Ku
Number of C-Band: 24
Number of Ku-Band: 9
Channel Bandwidth: C-Band (20 @ 36 MHz; 4 @ 72 MHz); Ku-Band - 54 MHz
Channel Polarization: Linear

Geographics Coverage: China, Japan, Indonesia, India, Middle East & Eastern Europe
EIRP - Main Beam: C-Band - 42 dBw; Ku-Band - 53 dBw
EIRP - Spot Beams: 36 dBw
Saturation Flux Density: C-Band - 97 dBw/M square; Ku-Band -94 dBw/M square

GLOSSARY OF ACRONYMS

GLOSSARY OF ACRONYMS

AAL	-	ATM Adaptation Layer
ADMD	-	Administrative Management Domain
ATIRA	-	Ahmedabad Textile Industries Research Association
ATM	-	Asynchronous Transfer Mode
AT&T	-	American Telephone and Telegraph Company
BANNET	-	Bangalore Library Network
BARC	-	Bhabha Atomic Research Centre
BBS	-	Bulletin Board System
BDO	-	Block Development Officer
BISDN	-	Broad-based ISDN
BITNET	-	Because It is Time Network
BTIS	-	Bio Technology Information System
CALIBNET	-	Calcutta Library Network
C-C	-	Computer-Communication
CC	-	Call Controller
CCITT	-	Consultative Committee on International Telegraphy and Telephony
CDOT	-	Centre for Development of Telematics
CDRI	-	Central Drug Research Institute
CDROM	-	Compact Disk Read Only Memory
CFTRI	-	Central Food Technology Research Institute
CGCRI	-	Central Glass & Ceramics Research Institute
CGWB	-	Central Ground Water Board
CII	-	Confederation of Indian Industry
CIS	-	Commonwealth of Independent States
CLOSS	-	Current Literature on Science of Science
CLRI	-	Central Leather Research Institute
CMC	-	Computer Maintenance Corporation
CMIE	-	Centre for Monitoring Indian Economy
COMET	-	Computerised Message & File Transfer
CPU	-	Central Processing Unit
CREN	-	Corporation for Research and Education Networking
CRISP	-	Computerised Rural Information System Project
CSE	-	Cochin Stock Exchange

CTIC	-	Central Technical Information Centre
CUG	-	Closed User Group
CWC	-	Central Water Commission
CWPRS	-	Central Water and Power Research Station
DBMS	-	Database Management System
DDBMS	-	Distributed DBMS
DELNET	-	Delhi Library Network
DESIDOC	-	Defence Science Information & Documentation Centre
DGTD	-	Directorate General of Technical Development
DISNIC	-	District Information System of NIC
DOE	-	Department of Electronics
DOT	-	Department of Telecommunications
DPBS	-	Developmental Press Bulletin Service
DRD	-	Department of Rural Development
DRDA	-	District Rural Development Agency
DTE	-	Data Terminal Equipment
DWCRA	-	Development of Women and Children in Rural Areas
ECM	-	European Common Market
EDI	-	Electronic Data Interchange
EIL	-	Engineers India Limited
EPCG	-	Export Policy on Capital Goods
EFTPOS	-	Electronic Fund Transfer at Point of Sales
EMAIL	-	Electronic Mail
ENVIS	-	Environmental Information System
ERNET	-	Educational & Research Network
ESS	-	Electronic Switching System
ET&T	-	Electronic Trade & Technology Development Corporation Ltd.
EXIM	-	Export-Import
FOIS	-	Freight Operations Information System
FSTA	-	Food Science & Technology Abstracts
GB	-	Giga Byte
GEMS	-	Gateway EMAIL Service of VSNL
GEIS	-	General Electric Information System

GIS	-	Geographical Information System
GISTNIC	-	General Information System Terminal of NIC
GRID	-	Grass Root Input to Districts
IASLIC	-	Indian Association for Special Libraries and Information Centres
IBM	-	International Business Machines Corporation
IBS	-	Intelsat Business Service
ICAR	-	Indian Council of Agricultural Research
ICL	-	International Computers Limited
ICMR	-	Indian Council of Medical Research
ICSSR	-	Indian Council of Social Science Research
IFIS	-	International Food Information Service
IGPS/GPSS	-	International Gateway Packet Switching System
IMD	-	India Meteorological Department
IMSC	-	Inter-Ministerial Standing Committee
IN	-	Intelligent Network
INET	-	A network of DOT
INFLIBNET	-	Information & Library Network
INSDOC	-	Indian Scientific Documentation Centre
INTELSAT	-	International Telecoms Satellite Consortium
IPR	-	Industrial Policy Resolution 1956
ISDN	-	Integrated Services Digital Network
INSAT	-	Indian National Satellite
ISD	-	International Subscriber Dialling
ISO	-	International Standards Organization
IT	-	Information Technology
ITU	-	International Telecommunication Union
KB	-	Kilo Byte
KDD	-	Kokusai Denshin Company, Japan
LAN	-	Local Area Network
MAIT	-	Manufacturers' Association for Information Technology
MALIBNET	-	Madras Library Network
MAPA	-	Medicinal and Aromatic Plant Abstracts
MB	-	Mega Byte
MDNS	-	Managed Data Networks

MHz	-	Mega Hertz
MIS	-	Management Information System
MNC	-	Multi-National Corporation
MPR	-	Monthly Progress Report
MRTP	-	Monopoly & Restrictive Trade Practices Commission
MTNL	-	Mahanagar Telephone Nigam Limted
NABARD	-	National Bank for Rural Development
NASA	-	National Aeronautics & Space Administration
NASSDOC	-	National Social Science Documentation Centre
NASSCOM	-	National Association of Software and Service Companies
NCB	-	National Centre on Bibliometry
NCC	-	Network Control Centre
NCL	-	National Chemical Laboratory
NCSI	-	National Centre for Science Information
NEC	-	Nippon Electric Company, Japan
NIC	-	National Informatics Centre
NICNET	-	C-C Network of National Informatics Centre
NIH	-	National Institute of Hydrology
NIIT	-	National Institute of Information Technology
NIO	-	National Institute of Oceanography
NISSAT	-	National Information System for Science & Technology
NISTADS	-	National Institute of Science & Technology Development Sudies
NMIS	-	Natural Resource Management Information System
NRI	-	Non Resident Indians
NSE	-	National Stock Exchange
NTIS	-	National Technical Information System (USA)
NTPC	-	National Thermal Power Corporation
NUSSI	-	National Union Catalogue of Science Serials in India
NWDS	-	National Water Data Systems
OCC	-	Oil Coordination Committee
OGL	-	Open General Licence
OILCOMNET	-	C-C Network of Oil Coordination Committee

OLDB	-	Online Databases
ONGC	-	Oil and Natural Gas Commission
OSI	-	Open System Interconnect
OTCEI	-	Over the Counter Exchange of India
PAD	-	Packet Assembler-Dissembler
PBS	-	Press Bulletin Service
PC	-	Personal Computer
PCB	-	Printed Circuit Board
PDN	-	Public Data Network
PID	-	Publication and Information Directorate
PM	-	Project Monitoring
PMP	-	Phased Manufacturing Programme
POTS	-	Plain Old Telephone System
PSE	-	Packet Switching Exchange
PSTN	-	Public Switched Telephone Network
P&T	-	Posts & Telegraph
QAI	-	Quality Assurance Institute
QPR	-	Quarterly Progress Report
RABMN	-	Remote Area Business Message Network
RBI	-	Reserve Bank of India
R&D	-	Research and Development
SAIL	-	Steel Authority of India Limited
SCI	-	Science Citation Index
SDI	-	Selective Dissemination of Information
SITA	-	Societe Internationale de Telecoms Aeronautiques
SH	-	Service Handler
SM	-	Service Manager
SMS	-	Service Management System
SNMS	-	Star Network Management System
SONET	-	Synchronous Optical Network
SOFTNET	-	C-C Network of STP
SPRINTNET	-	SPRINT Inc. Network
SS7	-	Signalling System No. 7
SSMA	-	Spread Spectrum Multiple Access
SSP	-	Service Switching Point
STAR	-	Science & Technology Archival Resources System

STP	-	Software Technology Park
STP	-	Signal Transport Point
SWDC	-	State Water Data Centres
SWIFT	-	Society for Worldwide Interbank Financial Telecommunications
TCP/IP	-	Transmission Control Protocol/Internet Protocol
TIFAC	-	Technology Information Forecasting & Assessment Council
TQM	-	Total Quality Management
TUL	-	Tata Unysis Limited
UBN	-	Universal Broadband Network
UUCP	-	UNIX-to-UNIX CoPy
VAN	-	Value Added Network
VANS	-	Value Added Network Services
VSE	-	Vadodara Stock Exchange
VSNL	-	Videsh Sanchar Nigam Limited

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