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Industrial Technology and Market Information Network

DP/SRL/91/007

SRI LANKA

Technical Report
Prepared for the Government of Sri Lanka
by the
United Nations Industrial Development Organization (UNIDO)

based on work by:

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United Nations Industrial Development Organization

Vienna, July 1992

The views expressed in this report are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO

Explanatory Notes

Value of local currency "Sri Lankan Rupies (Rs)"
USD 1.00 = 43.10 Rs (June, 1992)

ABSTRACT

The report is summarizing the results of one month field mission undertaken under the UNIDO/UNDP preparatory assistance project DP/SRL/91/007 in Colombo, Sri Lanka to investigate the technological aspects of Industrial Technology and Market Information Network (ITMIN) development.

ITMIN telecommunication solution is proposed, based on the analysis of Sri Lanka communication infrastructure, to provide for the efficient international and islandwide information exchange. DataNet is recommended as ITMIN turn-key telecommunication services and telecommunication equipment provider.

ITMIN computer hardware architecture is developed on the basis of alternative configuration solutions. Cost comparison analysis of two architectural platforms is presented. Telecommunication and computer hardware solutions proposed herewith are to compose the technology part of ITMIN Methodological Toolkit.

Recommendations and action programme are elaborated to follow up ITMIN implementation.

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LIST OF ABBREVIATIONS

ADB	- Asian Development Bank
bps	- bit per second
CCITT	- International Consultative Committee on Telephony and Telegraphy
DNIC	- Data Network Identification Code
EDI	- Electronic Data Interchange
E-mail	- Electronic Mail
FP	- Focal Point
ID	- User Identification Code
IDA	- International Development Assosiation
IDD	- International Direct Dialling
ISO	- International Organization for Standardization
ITC	- International Trade Centre
ITMIN	- Industrial Technology and Market Information Network
LAN	- Local Area Network
LCSL	- Lanka Communication Services Ltd.
MIST	- Ministry of Industries, Science and Technology of Sri Lanka
NUA	- Network User Address
NUI	- Network User Identity
OSI	- Open Systems Interconnection
PCM	- Pulse Code Modulation
PSN	- Packet Switching Node
PSTN	- Public Switched Telephone Network
PVC	- Permanent Virtual Circuit
RPOA	- Recognized Private Operator Agency
SLT	- Sri Lanka Telecom Corporation
UNDP	- United Nations Development Programme
UNIDO	- United Nations Industrial Development Organization
VAN	- Value Added Network
WAN	- Wide Area Network

I. INTRODUCTION

Industrial Technology and Market Information Network (ITMIN) being proposed within the UNIDO project under reference is aimed at helping Sri Lankan industrialization strategy to strengthen and upgrade its industrial and market activities. The network is to be an advanced communications facility to support the information requirements in Sri Lanka and to enhance collection, processing and dissemination of market and industrial technology information.

Conceptually, ITMIN as an *information network* is a closely coordinated heterogeneous and geographically distributed structure comprising various interconnected existing and future information entities and facilities to collect and process information and disseminate it through convenient local outlets and with a minimum of delay to the end users who need it. From the structural point of view the network may be regarded as an interconnection of industrial libraries, information services, information departments of industrial research institutes, governmental bodies generating industry and market related regulations, and other interested institutions, e.g. banks.

From the *technological* point of view ITMIN as a WAN (wide area network) is a secondary network linking computer systems over a geographically widespread area using both public and private communication connections. It is designed on the basis of Open Systems Interconnection (OSI) principles developed by the International Organization for Standardization (ISO) to allow participation of/in other networks and to provide for the flexible grouping capable to adjust and evolve in response to changing environment and demands.

Systematically, ITMIN could be decomposed into the following basic elements:

- *Data Communication Network*, to allow for the efficient information exchange and to provide facilities to access domestic as well as international databases and worldwide information systems;
- *Focal Point Node*, where advanced computer and telecommunication hardware/software facilities, including CD-ROM, are installed;
- *End-User Nodes*, equipped with computer and telecommunication facilities.

Presented below are the results of an investigation into the technological aspects of ITMIN, including analysis of existing communications infrastructure in Sri Lanka, definition of network topology and configuration, choice of data communication carrier and means and types of user access into the network, as well as recommendations on the architecture and specifications of the computer and telecommunication hardware to be used within the network. Computer and telecommunication hardware alternative solutions found are the integral part of Methodological Toolkit, one of the key instruments of the ITMIN concept development.

II. CONCLUSIONS AND RECOMMENDATIONS

As a result of investigations undertaken in accordance with the mission's objectives the following conclusions and recommendations are drawn related to the technological aspects of ITMIN.

1. Existing communications infrastructure developed in Sri Lanka makes it possible to rely on its Public Switched Telephone Network facilities in order to provide user connections into ITMIN telecommunication network.

2. Due to recent Government decisions to introduce competition in some areas of telecommunication technology in Sri Lanka public data communications has received special attention from the private sector resulted in establishing Packet Switching Networks services.

As a very important consequence, ITMIN telecommunication network will be created as an application overlay on the existing facilities to cost-effectively provide for the national and international coverage.

3. As a result of cost comparison analysis it is shown that for most of ITMIN applications international data communications should be done through the local public data network rather than via international telephone calls. International dial option is justifiable if the remote resource, e.g. database, is not connected to any public data communication network.

4. It is recommended that ITMIN' access into worldwide Electronic Mail systems is established via INTERNET gateway in the University of Moratuwa, which is to be connected to the public data network. This solution based on so called "batch-mail" technology, as opposed to the costly "real-time" communications (vital for the e.g. database access), is particularly effective when a few hours delay in message delivery is allowed.

5. ITMIN telecommunication network architecture has been developed based upon Open Systems Interconnection (OSI) principles featuring use of internationally adopted protocols and interfaces (CCITT recommendations of the X and V series), international connectivity, choice of access methods (dedicated for the Focal Point and local databases, dial up for the user clusters) and speeds (300 - 9600 bps), alternative physical channels (land and radio lines). The importance of ITMIN' Value Added Services, including DataBases, Electronic Mail, Computer Teleconferencing, EDI is emphasised.

DataNet is recommended as ITMIN data network services provider.

6. It is suggested that a demonstration of the international database access via DataNet (including ITMIN an ITC databases)

should be arranged to the UNIDO/MIST/Potential Cluster' Organizations authorities during Computer&Information Technology Exhibition to be held in Colombo in October, 1992. It will allow to demonstrate the potential of new information technologies and will

emphasise the significance of ITMIN implementation.

DataNet specialist and UNIDO expert on telecommunication and on-line databases are required to facilitate the demonstration.

7. Computer hardware solutions for the Nodes and the Focal Point are elaborated to meet the ITMIN requirements. The fundamental principles include integrated UNIX/DOS environment, open modular architecture, database host server, local area network, X.25 link to DataNet. Alternatives for hardware configurations based on centralised versus decentralised approaches are discussed. Computer hardware specifications are developed for Sun and Hewlett Packard platforms. Price comparison is presented for ITMIN "benchmark" configuration showing the advantage of the Sun platform.

It is recommended that a local vendor is contracted to deliver complete hardware/software solutions for ITMIN.

III. ACTIVITIES

The paragraph is summarizing findings and results of the field mission undertaken in accordance with the Consultant's Duties outlined in the Job Description (post 11-05) of the UNIDO/UNDP ITMIN project under reference.

Analysys of Sri Lanka communications infrastructure is given to decide on the availability and characteristics of the primary PSTN (Public Switched Telephone Network) to be used for the access into ITMIN. Existing Public Data Network Services are studied in order to make a choice on a Data Network Provider. Alternatives for telecommunication and computer hardware vendors are outlined.

III.1. A Note on Sri Lanka Communications Infrastructure

III.1.1. Historical Retrospect

"History" was created on the 1st September 1991 when the Corporation Sri Lanka Telecom took over the property rights and liabilities of the Telecommunications Department. The Sri Lanka Telecommunications Department came into being in 1980 after the bifurcation from the integrated Post&Telecommunication Department which operated the telecommunications in the country ever since Orient Telephone Company was taken over by the then colonial government in 1986.

III.1.2. Some Basic Figures on Sri Lanka Communication Infrastructure

Description	Year 1980	Year 1991
Telephones(total)	82,000	175,000
Main Lines	61,500	128,000
Exchange Capacity: Electromechanical	93,000	54,239
Digital	0,000	112,461
Percentage of Digitalisation	0%	70%
Telex Lines	900	1,662
Net fixed assets in operation (Mil.Rs.)	1,200	10,000
Operating income (Mil.Rs)	200	1,900

International telephone service is available to 192 countries while International Direct Dialling (IDD) service covers 85 countries.

III.1.3. Five Year Development Programme

1990-1994 Development Programme is under way to reach by 1995 around 260,000 main telephone lines and have 350,000 telephones with access to the public network (70% of demand).

The programme developed with the Asian Development Bank (ADB) assistance includes foreign aid financial package comprising of:

a. ADB funding (USD 41 million) to build up International system (Satellite Earth Station, new International Exchange, digital microwave link), to upgrade Trunk Transmission System, to create Computerised Management Information System and to render technical assistance;

b. World Bank of International Development Association (IDA) funding (USD 57 million) to upgrade exchange capacity of Colombo Metropolitan area and other districts and provinces;

c. OECF of Japan funding (USD 80 million) to establish Cable plant in Colombo Metropolitan area, to upgrade exchange capacity and to develop cable network in several areas.

Several other projects are expected to be funded by Finnish, USA and French organisations.

Over the next three years Sri Lanka Telecom Corporation is planning a vast expansion and modernization programme costing over USD 250 m. It will centre over development of modern tele-communications technologies including cellular radio, fiber optic links, digital communications, etc.

III.1.4. Competitive Environment

An important step was taken by the Sri Lanka Government in 1991 to introduce competition in certain areas of telecommunication technology. Competition is likely to result in better value of services and prices. To ensure fairplay under the new legislation Sri Lanka Telecom Authority has been established with the mission to:

- supervise and administer the deregulation of the telecommunications services, including licensing of vendors of telecommunication equipment and services;
- promote competition, fairness and efficiency in the industry;
- protect customers;
- encourage growth and technical excellence in Sri Lanka telecommunications.

In Sri Lanka so far only one operator (the Government owned corporation "Sri Lanka Telecom") has been licensed to provide basic telephone services, two operators licensed to provide cellular mobile services and two operators to provide switched data communications.

III.1.5. Sri Lanka Telecom IDD Charges

The table below presents excerpts from "International telephone calls tariffs" grouped in four region categories. Listed are only IDD calls' charges relevant to the present study.

Region/Country	Per Minute Rate, Rs	Off Peak Rate, Rs
Europe, Africa	94.00	57.00
America	105.00	63.00
Asia, Japan, Australia	72.00	43.00
India	50.00	30.00

III.1.6. Sri Lanka Telecom Charges for Leased Lines (Voice-Grade Circuits)

Type of Circuit	Connection Charge (one-time), Rs	Annual Charge Rs
Both ends of the circuit terminate within the same exchange area	90,000	50,000
Two ends of the circuit terminate in different exchange areas	180,000	100,000

Extra Charges for Speedy Delivery:

Provision of service within one month	- Rs 15,000
Additional fee for priority connection	- Rs 5,500

Note: According to the DataNet and Lanka Telenet specialists in practical terms delivery time for a new leased land line may be as long as 3 to 6 months. Similar timing problem may arise when damaged connection needs to be restored

III.2. Public Data Communication Services in Sri Lanka

Presently, two vendors have been licensed to provide data communication services in Sri Lanka, namely:

- Lanka Communications Services (Pvt) Ltd. (LCSL), which operates public packet-switching network called DataNet, and
- Electroteks (Pvt) Ltd., running Lanka Telecom network.

Note: "Sri Lanka Telecom" itself has a licence as well, and has even reserved a DNIC (Data Network Identification Code), 4131, to be used when its network exists. In practical terms, though, data communication services have not been so far provided by SLT.

This section describes companies' profile, the services being provided, along with the pricing policy. Prices quoted are used only as estimations and may differ when official proposals are submitted.

III.2.1. DataNet (DNIC 4132)

III.2.1.1. Company Profile

Lanka Communication Services was established in 1991 as a Joint Venture between Singapore Telecom International and the Capital Development and Investment Company Limited of Sri Lanka. LCSL is licensed to operate DataNet domestic and international and to provide switched and non switched services under section 17 of Sri Lanka Telecom Act (Licence No. LCN 5/24/6/91). LCSL has been granted Recognized Private Operator Agency (RPOA) status which permits LCSL to provide for international connectivity.

Currently, the company has around 60 staffers, including solid marketing/sales team and customer support group. It serves about 30 customers, mostly multinationals and local business companies.

III.2.1.2. Network Configuration

DataNet has 3 Packet Switching Nodes (PSN) in Colombo, Katunayake and Ratmalana interconnected via 64 kbps radio links. Nodal equipment is based on professional "US Sprint" switches. Control Centre is located in Colombo, where network/user statistics (on the doubled Prime Processor) is being handled. Colombo node is linked via leased 9,6 kbps satellite circuit with Singapore gateway to provide for international connectivity. Submarine cable connection to Singapore is planned while the satellite one will be used as a back-up. DataNet supports CCITT X.3, X.28, X.29, X.25 and X.75 internationally standardized communication protocols to allow for an easy computer/terminal interconnections through the network. The network is operational 24-hours a day, 365 days a year.

III.2.1.3. DataNet Services

DataNet provides data communications both islandwide and internationally. Presently, connections to over 120 public data networks in 60 countries are available.

The following types of user connections to the DataNet are supported:

- * Public Dial-up Access - the subscriber is connected to the DataNet access point via PSTN by dialling the DataNet public port numbers. Each subscriber is given a confidential user name known as Network User Identity (NUI). It serves as a password for access through DataNet.

- * Private Dial-up Access - similar to the public dial-up access except that the subscriber is given a dedicated port number to dial in. The number is exclusive for his use.

- * Dedicated Access - the subscriber is connected to DataNet access point by land leased line or radio link. The subscriber occupies a dedicated DataNet port which carries a port identity known as Network User Address (NUA) to facilitate receiving data calls from others.

- * Telex Access - the subscriber establishes a connection to DataNet by calling the telex access port using a telex machine. Similar to the public dial-up access, the subscriber requires a NUI for access through DataNet.

DataNet supports the following range of user terminal equipment:
 - ASCII terminals using asynchronous mode of operation (X.28). Examples are PCs, word processors, video-display units, or hardcopy terminals;

- Packet terminals using synchronous mode of operation (X.25). These are usually mini and mainframe computer, or intelligent terminals (e.g. workstations);

- Telex terminals.

The table below summarizes types of modem/transmission speeds supported.

Types of Access	Mode of Operation	Speed Available	Types of Modem (*)
Public Dial-up, Private Dial-up & Dedicated	Asynchronous (CCITT X.28)	300 bps	CCITT V.21 & Bell 103, CCITT V.22 & Bell 212A, CCITT V.22bis
		1200 bps	
		2400 bps	
Dedicated	Synchronous (CCITT X.25)	2400 bps	CCITT V.22bis V.26 CCITT V.27 CCITT V.29
		4800 bps	
		9600 bps	
Telex	--	50 baud	--

(*) Modems recommended and used by DataNet are OSI-8000 series (multistandard dial restoral modems) by Octocom Systems Ltd., USA

III.2.1.4. DataNet Charges

The following tariff structure is adopted in DataNet:

- * monthly subscription charge;
- * usage charges (duration, plus volume);
- * dedicated line charges (if applicable);
- * subscriber's end modem rental/purchase (optional).

Monthly Subscription Charge

Public Dial-up Access 50, 300, 1200, 2400 bps per port	Rs. 500
Private Dial-up & Dedicated (Asynch. Access) 300, 1200, 2400 bps per port	Rs. 3500
Dedicated X.25 Access per 2400 bps port	Rs. 4000
Dedicated X.25 Access per 4800 bps port	Rs. 6000
Dedicated X.25 Access per 9600 bps port	Rs. 7500
Telex Access	Rs. 500

Usage Charge

	Local Call Rs.	S.T.D. Call (btw 2 exchgs) Rs.	Internatl. Call Rs.
Duration Charge per min.	1.50	15.00	30.00
Volume Charge per 10 segments	0.12	1.30	8.00

Notes: 1. Ten segments consist of 640 characters
2. Usage charges are invariant to call destination

Optional Facilities Charges

Closed User Group	Rs.500/=per month/user/group
Access Security	Rs.500/=per month/NUI
Permanent Virtual Circuit(PVC)	Rs.750/=per mnth/each user end

Terminal Equipment Charges (incl. 1 yr warranty)

	Purchase, Rs.	Maintenance/ Month, Rs.	Rental/month, Rs.
Radio Modem(*) (9600 bps)	450,000 (usage charge)	2,000	21,000
Line Modem (9600 bps)	107,500	850	4,350
Line Modem (2400 bps)	72,000	550	2,900

(*) Radio modems used are RAN series (digital RF data communication modems) by Multipoint Networks Inc., USA

Leased Land Line Charges - according to the Sri Lanka Telecom tariffs (as per III.1.5)

Delivery Time: leased land line - 3 to 6 months,
leased radio line - 1 week.

III.2.2. Lanka Telenet (DNIC 4133)

III.2.2.1. Company Profile

Electroteks (Pvt) Ltd. has been in the data communications field of Sri Lanka for over four years, concentrating mostly at the creation and running the private departmental networks. It claims to hold 90% of the banking networks market.

Electroteks has also installed private networks for big national

companies like "John Kills", "Ceylon Tobacco Co." and some others. Currently, the company has about 20 corporate customers with total 200 terminal locations. In September 1991 Electroteks Ltd. obtained a licence to provide domestic data communications services over its Lanka Telenet network. International services has not been started yet and are only planned for the end-1992, licence application pending. There are about 35 staffers, mostly admin, engineers and technicians, and no dedicated marketing and sales people. The company has a strong manufacturing division producing an array of electronic communication devices, including radio modems.

III.2.2.2. Network Configuration

Lanka Telenet has 3 X.25 nodes in Ratmalana, Colombo and Kandy interconnected via 2 Mbit/s PCM (Pulse Code Modulation) cable lines. Additional nodes are planned to establish in Katunayake and Galle. Existing PSNs are based on the General Datacom equipment with limited performance/throughput capacity. They are subject to replacement by the powerful Northern Telecom switches when the traffic so justifies. International connectivity is planned to be added by installing Fl Earth Station in Colombo to be linked via satellite either to Indian or Australian hubs. Customer private networks, typically of the star topology, are connected to Lanka Telenet PSNs via 19,2 kbps radio links by X.25 protocol. The network is operating on the 24-hour non-stop basis.

III.2.2.3. Lanka Telenet Services

User access to Lanka Telenet is provided mostly by the dedicated connections (land lines and radio). Although, dial-up access is also available (up to 9,6 kbps). Major types of user terminal equipment (except for telex terminals) and CCITT communication protocols are supported (X.3, X.28, X.29, X.25). Services are provided islandwide.

Telecommunication equipment used in Lanka Telenet:

- * line modems: Multistandard series of MultiTech Co., USA
- * radio modems: Proprietary.

III.2.2.4. Lanka Telenet Charges

Lanka Telenet public access charges have been submitted to the STL authorities for approval. Prices below were quoted to the Consultant by General Manager.

Subscription Charges

Leased land line (9,6 kbps)	- Rs. 75,000 (one time)
	- Rs. 60,000/yr (incl. modem rent)
Radio Line (up to 19,2 kbps)	- Rs. 160,000 (one time)
PSTN Dial-up (up to 9,6 kbps)	- Rs. 4,000/yr

Usage Charges

Duration (connect time)	- Rs. 1.00 per minute
Volume (info. transmitted/ received)	- Rs.10.00 per ksegment (64K char)

Line Modem Purchase Charges (incl. 1 yr warranty)

2400 bps V.22bis Multitech	- Rs. 28,000
9600 bps V.32 Multitech	- Rs. 48,000

III.3. Computer Hardware Vendors

Computer hardware market in Sri Lanka is fairly well developed and is represented by about 100 private companies, many of them officially distributing computer hardware solutions of world leading companies including IBM, Apple Computers, Hewlett Packard Sun Microsystems, UNISYS, Siemens/Nixdorf, ICL, NCR, Wang, et al. This makes it feasible for the ITMIN development to seek for "turn-key" hardware/software solutions from a local vendor, once the architecture, software environment and hardware specification for the ITMIN Focal Point and Nodes are chosen.

IV. OUTPUTS

The section presents justification for choosing telecommunication and computer hardware solutions for ITMIN network' basic technological components, based on the comparative analysis of alternatives described in the previous section. Suggested solutions will compose technology part of ITMIN Methodological Toolkit.

IV.1. ITMIN Telecommunication Solutions

IV.1.1. Requirements to ITMIN Telecommunication Network

- * Open System Concept (OSI Model)
- * Internationally Adopted Communication Protocols and Interfaces
- * International Connectivity (X.75, X.400):
 - Real-Time Access to Worldwide DataBases
 - Batch-Mode Access into INTERNET
 - Incoming Calls to ITMIN DataBases
- * Internal Interconnectivity
- * Turn-Key Telecommunication Services/Telecommunication Hardware Provider
- * Choice of Access Methods (dial-up/leased X.28, X.25)
- * Alternative Physical Channels (land/radio)
- * Data Integrity and Security
- * Reliable Communications
- * Multistandard Adaptive Error-Correction Modems
- * Value Added Services (E-mail/Teleconferencing/EDI/DBs)
- * Priority Customer Support
- * 24-h Operation/Maintenance

IV.1.2. ITMIN International Access Options

One of the main services to be provided by ITMIN network is international connectivity and access into worldwide information systems and databases. This can be achieved either by placing an international long distance telephone call and get the computer connection established, or via local data communication network.

Though the simplest, IDD calls have the following limitations which narrow the scope of its applications to computer communications:

- normally, the highest speed achievable for secure computer connections is 1200 (2400) bps;
- reliability is dependant on the quality of telephone connection and may vary substantially. As a result delays, or even interruptions may occur thus requiring to renew the interrupted session;
- busy line (local/remote) might require to redial;
- not suitable for certain applications, e.g. file transfer, high speed PC-to-Host data exchange, etc.

Use of data communication network is free of the above drawbacks and, additionally, has a number of very attractive

features:

- only local call into regional data access node is required to get international connectivity;
- private dial-up access port can be ordered to ensure for "no-busy-line" connection;
- reliable 2400 bps local dial-up connection over PSTN lines is available. Higher speeds (9600 bps and beyond) can be used over local dedicated line (land, or radio);
- error-free communication is ensured over the local MNP error-corrected lines and international X.75 circuits;
- all types of data applications can be communicated, namely, Electronic Mail (E-mail), computer teleconferencing, databases access, PC-to-Host data exchange, telex/fax gateways, etc.

Finally, let us make a cost comparison of the two alternatives based on the two most typical data communication applications: E-mail, which is usually a few minutes session, and database search, which might take half an hour and more. It is assumed that inter-national dial-up speed is 1200 bps and data network call is at 2400 bps. IDD charges as per paragraph III.1.4 and DataNet usage charges (see para. III.2.1.4) were used in the table below.

Duration, Min.		Volume, Kbyte		Usage charge, Rs.	
Int.Dial	DataNet	Int.Dial	DataNet	Int.Dial	DataNet
Electronic Mail Message (one page of printed text)					
1,0	0,5	2,0	2,0	94 Eur.	40
				105 Am.	40
				72 Jap.	40
				50 Ind.	40
Database Search (30 minutes)					
30	30	32	64	2,820 Eur	1,700
				3,150 Am.	1,700
				2,160 Jap	1,700
				1,500 Ind	1,700

Clues: Eur.- Europe, Am.- America, Jap.- Japan, Ind.- India

It is evident that to ensure for ITMIN international connectivity data network approach is preferable both in terms of reliability and cost effectiveness.

IV.1.3. Choice of ITMIN Network Provider

Given the above ITMIN network requirements and descriptions of the two public data communication operators available in Sri Lanka (sections III.2.1 and III.2.2) the choice is in favor of DataNet since, while meeting most of the criterias, it has the following advantages in comparison to Lanka Telenet:

- international connectivity assisted by Singapore Telecom, a recognized world telecommunications authority;

- alternative user access methods, including well developed PSTN connections;
- professional nodal and user telecom equipment to ensure secure and reliable communications;
- developing nationwide topology with the local regional access points;
- attractive facilities features, including Closed User Group, Access Security, PVC;
- customer-oriented services backed by the solid customer support team;
- professional corporate development policy featuring tariff reduction trends, plans to introduce VANS (Value Added Network Services), e.g. EDI, Cellular Radio, wider international connectivity, regional nodes expansion.

Those advantages justify the choice, notwithstanding 20% higher domestic volume charges over Lanka Telenet (compare Rs.12/ksegm versus Rs.10/ksegm) and higher radio link set up fees. This may be taken as a price for professional services which is essential for ITMIN applications.

Proposed ITMIN network configuration is pictured in Fig.1.

Regretfully, some of the ITMIN VAN services, specifically, domestic E-mail, has not been so far implemented by public data network providers. There exists an INTERNET Mailbox Gateway in the University of Moratuwa (UM) to provide batch-mode (delayed) E-mail communications with the variety of international academic and research networks. DataNet is currently planning to provide connectivity to this gateway. This effective and inexpensive Electronic Mail mechanism should be made available to ITMIN users through DataNet.

Hence, Electronic Mail System has to be included in the Focal Point architecture to serve as the domestic information exchange facility for ITMIN clusters.

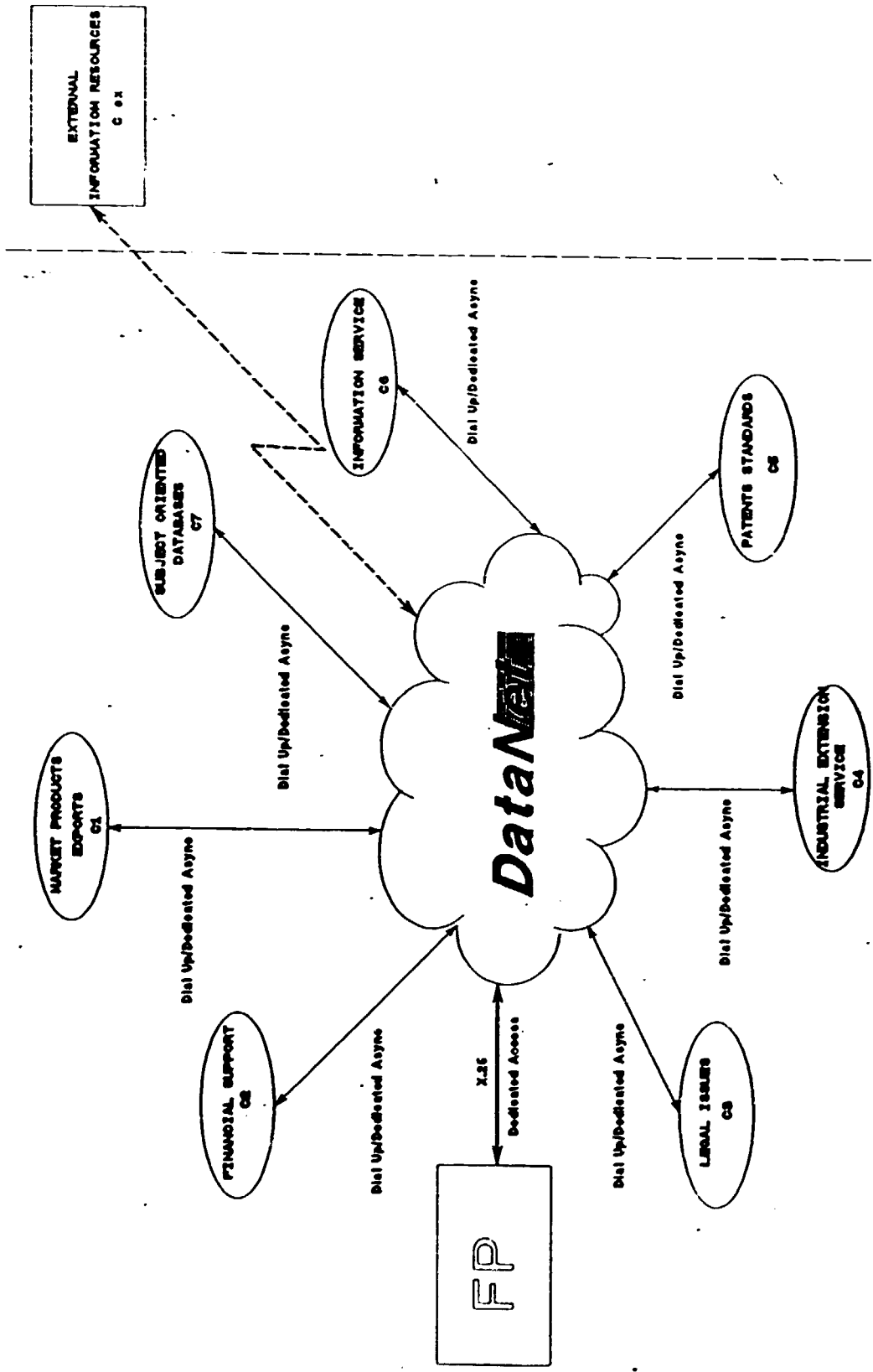
IV.2. ITMIN Computer Hardware Solutions

Note: Computer Hardware Solutions proposed here for ITMIN Nodes and the Focal Point as well as its specifications should be considered provisional at this stage of ITMIN feasibility study and may evolve as the final ITMIN information and database requirements along with detailed software environment investigations are drawn by the successive project missions. Nevertheless, they might be usefull estimates to facilitate ITMIN design.

IV.2.1. Requirements to Focal Point Computer Hardware

- * Open Modular Hardware Architecture
- * Integrated UNIX/DOS Environment
- * DataBase Host Server
- * Terminal Computer Stations
- * Local Area Network to Integrate FP computer Hardware
- * CD-ROM Facilities
- * X.25 Link to DataNet
- * Radio Modem/Dial-Up Modem Facilities
- * Electronic Mail

Fig.1. Proposed Network Configuration for Industrial Technology and Market Information Network - ITMIN



- * Hardware Back-Up Facilities
- * Shared Laser Printing Facilities
- * Portability/Expandability Features
- * Consistency Based on Single Platform
- * Turn-Key Hardware/Software Solutions
- * Local Hardware/Software Vendor
- * Maintenance/Support/Training

IV.2.2. Requirements to Nodal Computer Hardware

- * Application Workstation
- * Single Platform
- * Integrated UNIX/DOS Environment
- * DataBase Applications
- * CD-ROM Facilities
- * Dial-Up Link to DataNet
- * Dial-Up Modem Facilities
- * Printing Facilities
- * Turn-Key Hardware/Software Solutions
- * Local Hardware/Software Vendor
- * Maintenance/Support/Training

IV.2.3. ITMIN Computer Hardware Configuration

Solution #1 - Cluster Server Configuration with a Host Server

Proposed solution comprises Host DataBase Server as the main machine at Focal Point and Application Workstations at Clusters. ITMIN databases are maintained at the Focal Point Server while at the nodes only applications are running, e.g. local application database is being actualised to prepare for the update in the Focal Point.

This solution allows for centralised data management and ensures that Server is focused on data integrity while clusters concentrate on usability.

Host Server is permanently connected to the X.25 packet switching network (DataNet) via dedicated line and clusters can use dial-up option to connect to the Server through DataNet when it is so required.

Solution #2 - Cluster Server Configuration on a Distributed DataBase Environment

This is more sophisticated and hence more costly approach requiring multiple server installation. The main server is installed at the Focal Point, each cluster has its own server to run local databases. FP can access data from any cluster and reversely, a cluster can access FP server provided the access rights are granted. Any ITMIN user can get a transparent connectivity to databases from either FP, or any of the clusters.

All servers are connected to DataNet over dedicated X.25 (X.28) lines to be able to permanently establish incoming and outgoing calls.

In practical terms, while initially starting with the first solution, ITMIN may further require a synergetic evolution into the second variant, as local clusters' databases mature.

IV.2.4. Model Cost Estimation

For the sake of clarification and in order to probe the level of prices "benchmark" ITMIN configuration is suggested based on the following assumptions:

- * Solution #1: Host Server and LAN with 5 stations at FP
- * Four clusters connected
- * Two architectures compared - Sun versus HP
- * Local turn-key vendors
- * Prices quoted are duty-free, indicative

Sun Microsystems		Hewlett Packard	
Description	Price, Rs.	Description	Price, Rs.
FOCAL POINT			
SPARCstation2 16in Mono VDU 32MB RAM 424MB HDD	818,362	HP9000/720 18in Mono VDU 16MB RAM N/A	(break-down N/A)
File Server Option Pack, 1,3GB HDD 2,3GB 8mm Tape 644MB SunCD	521,817	1,3GB HDD N/A N/A	
SunLink X.25	158,705	N/A	
Subtotal	1,498,884	Subtotal	1,444,518
CLUSTERS			
SPARCstation IPC x4, 18in Color VDU 6MB RAM 207MB HDD	1,180,000	N/A	
CDROM 644MB x4	244,520		
424MB HDD	522,000		
16MB RAM	296,000		
Subtotal	2,242,520		

Clue: N/A - comparable HP item not available through local vendor

The above table shows that under the assumptions Sun platform is preferable for ITMIN computer hardware solutions.

V. ACTION PROGRAMME (FOLLOW UP)

This section is an outline of the steps to be taken in order to implement ITMIN telecommunication and computer hardware solutions proposed in the course of mission development and presented hereby.

V.1. ITMIN Telecommunications

Given the findings presented in section IV.1 the following actions need to be undertaken:

- * Demonstration of international databases access via DataNet to the UNIDO/MIST/Potential Cluster's Organizations authorities. This may be done during the Computer&Information Technology Exhibition to be held in Colombo in October, 1992. Access to the UNIDO INTIB databases in Vienna and databases of the International Trade Centre (ITC) in Geneva should be demonstrated (NUA for the above databases is 0228468115010). It was agreed with DataNet authorities that the company would be willing to render telecommunications support for the demonstration, provided there is a database NUA, User ID and Password information available, as well as an expert who could perform the database search.

- * ITMIN mailbox should be opened at the INTERNET gateway in the University of Moratuwa to be able to access worldwide E-mail systems. Connection to this gateway through DataNet need to be followed up.

- * DataNet should be contracted as ITMIN turn-key telecommunication services/telecommunication equipment provider as soon as the project enters the implementation stage.

V.2. ITMIN Computer Hardware

According to sections IV.2, IV.3 the following actions should be pursued:

- * Computer hardware requirements to ITMIN Focal Point and Nodes outlined in IV.2.1 and IV.2.1 should be matched with the respective software and database information requirements when completed, and enlarged accordingly, if necessary.

- * The above will make it possible to decide on a particular configuration of the proposed ITMIN computer hardware architecture and define its final specifications.

- * A choice on a local turn-key hardware/software vendor should be made, which is to be contracted when ITMIN is at the implementation stage.

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