A proposal to set up a Lankan Experimental Academic and Research Network (LEARN)

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Introduction

The Government has declared at the highest policy level its intentions to develop Sri Lanka as an Asian Centre for Trade and Commerce. However, in today's context it is difficult to imagine how such a Centre could be internationally competitive without the availability of modern communication services including networking facilities allowing computers to communicate with other computers. Already there is evidence of needs emerging in the major sectors of national economy such as banking, trade and shipping. In practice, however, networking is almost non-existent in Sri Lanka and there has been no concerted effort so far to introduce a service so vital to the economic development of the country.

The aspects of networking computers for academic and research users were first discussed by the author in 1984 [1, 2] and the setting up of such a network was recommended to the UGC in 1988 [3]. The usefulness was further emphasised in a Report on the Keele - Ruhuna Link in 1988 [4]. Through this Link arrangement, the ODA/BC have been keenly participating in a programme to develop expertise in Computer Science in Sri Lankan Universities, since 1983. However, one of the areas which has not received sufficient attention is the **wide area networking of computers in the academic and research institutions.** Therefore the introduction of computer networking technology has to be considered as yet another important aspect of this development programme.

This paper describes a scenario for the development of a **Lankan Experimental Academic & Research Network (LEARN).** The Computer Technology Centre (CTC) of the University of Moratuwa, which was initiated with the funding made available by the British Council, Colombo, is proposed as the principal investigator. In order to be successful, there are many issues to be looked at and a number of questions to be answered.

However, the outcome of such an effort is of particular relevance to Sri Lanka where resources, especially manpower, are limited. Further, the experience and confidence thus gained will become an extremely useful asset in future networking exercises in Sri Lanka.

Why Networking ?

In todays context, networking has become essential owing to the convergence of two important technologies namely, computer technology and communications technology, brought about by advances in software engineering and microelectronics. The convergence has been easily possible because both share the same kind of logic, storage, switching and transmission technology and both are used for the handling of information.

Therefore effective networking allows the users of the network to enjoy the facilities offered by the new technology. A computer network thus created connects computers, terminals, databases, etc, at a distance from one another using the communication technology and hence becomes part of a general trend towards distributed information processing. In this the prime benefits are that networking enables the users to effectively

- share resources;
- share information

which are geographically distributed.

In the particular scenario presented here, networking will improve the means of communication between researchers in various Universities and Research Centers and promote collaborative R & D activities. This would also help to remove redundancy in research and allow free flow of information on current research. When fully developed, this network will serve as a gateway to reach the international research community giving opportunities to Sri Lankan academics and researchers to promote international collaboration.

Why Standard Protocols?

The creation of a networking community does not stop with the creation of a physical network. Much more effort and investment is needed to establish common high level protocols and to provide internetworking between the networked systems. This is necessary in order to provide the expected services to the users on the network.

In this exercise the adoption of any vendor specific protocols would not only limit the choice of communication equipment, but more seriously, would give rise to a heavy expenditure in maintaining them. Moreover, the variety of different conventions used would make internetworking virtually impossible. Therefore it is imperative that, wherever possible, the protocols which are defined independently of any particular manufacturer be used. Such protocols are said to be *open.*

The first logical step in the adoption of an internetworking set of open protocols is the establishment of an agreed architecture which gives a framework for protocol definitions. The work of the *International Standards Organisation (ISO)* has led to the well known reference model for *Open Systems Interconnection (OSI)* and the corresponding international standards for OSI protocols. Therefore any future network development should try to draw benefits from

the widespread support expected from a large number of computer suppliers conforming to the ISO-OSI model.

The absence of any major networking efforts in Sri Lanka is somewhat an advantage because it gives the possibility of a clean start with the preferred ISO-OSI technology. The others who started networking exercises before the emergence of the OSI model are now having to migrate to this model regardless of how successful their own protocols have been. In this respect some of the well known examples are the **JANET** in the UK with their *coloured book protocols* [*5*] and the **ACSnet** in Australia with their *Sydney Unix Software (SUN)* [6].

The Networking Needs of the Academic Community

In an academic environment, the aim is to offer networking facilities to Universities, Research establishments and other similar organisations throughout the country. This paper describes a proposal to provide a single network system capable of meeting the needs of the users in the academic community. However, it is important to note that the underlying principles will apply equally well to networks for other types of applications.

The single network would contain several local area networks, a wide area network and protocol software products. Eventually this would have to support a variety of terminals, host computers and local area networks, each under local management. Therefore, for the success of a networking exercise such as this, it is absolutely essential to adhere to an aggressive policy of insistence on the use of standardised protocols. This should apply equally to purchases made with Government funding as well as to equipment received under grant and aid agreements. For instance, the Computer Board in the UK (which is the body responsible for computer development in Universities, Polytechnics and Research Institutes) has issued a statement of policy in 1985 indicating that Open Systems Interconnection (OSI) Standards should, when stable, become mandatory for computer systems procured under its auspices. Further, it is reported that in China, the use of OSI is required by law and forms part of the Chinese 5 year plan. *(Source: Network News, Number 26, July, 1988.)*

The network so designed would allow easy integration of LANs and a variety of hosts, and support both batch and interactive computing. For the academic community the following have been identified as the major application components to be supported on the network.

1. File transfer
2. Terminal access
3. Job transfer
4. Electronic mail

In parallel with the development of LEARN, it is also important to introduce Local Area Networking (LAN) technology in order to fully exploit the facilities offered by LEARN. Therefore as part of a long term plan, the participating institutions should be encouraged to consider networking their computers, especially the IBM PC/PC compatibles, using LANs. Once connected by a LAN, this would provide a single entry point to the X.25 packet switched network. In the selection of a particular LAN technology, it is extremely important to carefully select an appropriate LAN technology which would allow easy interworking with the X.25 network and to avoid the need to use expensive protocol converters. In this respect Ethernet - ISO 8802/3 would be a suitable candidate. Moreover, the use of a single LAN technology

throughout the academic and research community will enable the sharing of expertise rather than segmenting whatever the little expertise available.

A typical mix of services that could exist in academic environments is shown in Figure 1. As stated earlier, in order to fulfil the objectives it is recommended that a minimum number of variations are used.

The objectives of the LEARN project

The principal objective of the LEARN project is to introduce **packet switched data communication technology** to Sri Lanka. It is proposed to achieve this in three stages.

Stage I (Pilot Project)

1. In the stage I of the project, it is proposed to set up an X.25 network on a pilot scale. For this a three node network involving the Universities of Moratuwa, Colombo and the Open University is proposed with the Computer Technology Centre (CTC) of the University of Moratuwa playing the role of the principal investigator (Fig. 1). The development work is proposed to be undertaken in collaboration with the Arthur Clarke Centre for Modern Technologies (ACCMT).

2. In the LEARN project it is proposed to use standard X.25 switches [7] as packet network nodes interconnected by analogue telephone lines leased from the Department of Telecommunications and operating on CCITT V.24 recommendations at the level 1 of the X.25 network.

3. In the pilot stage of the LEARN project it is proposed to demonstrate the following data communication possibilities, as depicted in Figure 1.

3.1 the connection of terminals / PCs to the network through X.25 PADs.

3.2 the connection of remote users to the packet nodes via telecom dial-up lines using modems. For example, the connection of a terminal at the University of Sri Jayawardanepura to the Moratuwa NCC (Network Control Centre) through a dial up line thereby providing access to the facilities on the X.25 network.

3.3 the connection of an international node to the packet network through an IDD (International Direct Dialing) line using modems. For this, the University of Keele (through the University of Kent) is chosen as the remote end and the use of UUCP is suggested.

3.4 the connection of a local area network through a gateway to the X.25 network.

3.5 the connection of a distant Sri Lankan site, for example the Agriculture Research Institute (ARI) at Mahailuppallama, by a radio link using packet controllers and transceivers conforming to AX.25 communication protocols. A project on the software development for AX.25 radio link is already being undertaken by the CTC of the University of Moratuwa.

3.6 the possibility of File Transfer, Access and Management (FTAM), Job Transfer And Management (JTAM), Terminal Access (VT) and Electronic Mail (e-mail) on the network.

3.7 the resilience of the network to single line contingencies (ie. single line failures in the network).

3.8 the ability to undertake software development locally for the above common applications at the CTC.

4. One of the prime objectives of this project is to accumulate experience on networking and to develop expertise at the CTC in order to be able to assist future networking at national level.

Stage II

In the second stage of the project, it is proposed to investigate the possibility of using digital 64 Kbps streamers as backbone connections to connect the packet switching nodes. When this is achieved, the inter exchange trunks will have sufficient capacity to carry the traffic envisaged on the network.

Stage III

On the satisfactory demonstration of the packet switched data communication services in Sri Lanka in the pilot project, and with the experience thus gained on the aspects of networking, it is believed that the following will be undertaken by the appropriate authorities.

1. Expand LEARN, the academic network, to connect all Universities and Research Institutes in Sri Lanka (Fig. 2).

2. Set up a **National Packet Switched Service (NPSS)** run by the Department of Telecommunications.

3. Give assistance through the CTC to set up networks for groups of users such as banks and government agencies requiring separate networks.

Implementation Strategy

1. Three X.25 network switch pads to be purchased out of Government / CINTEC funding.

2. CINTEC to negotiate with the Department of Telecommunications to obtain three leased lines to connect the three nodes in the pilot project for a trial period of one year.

3. CINTEC to provide funds to employ two engineers initially for a period of one year to carry out the project at the CTC.

4. A request to be made to the Overseas Development Administration (ODA) of the British Council for limited support in the pilot stage to cover expenses in connection with a visit

to the CTC of a Network Expert who will assist the CTC staff to install the networking software and will identify possible software development projects, and to cover the IDD connection charges.

5. On the successful implementation of the pilot stage of the LEARN project, the Government / Aid agency will be requested to provide funding to extend the network to connect all Universities and Research Centres in Sri Lanka.

Participating Institutions

The following institutions are expected to directly participate in the project.

1. Computer Technology Centre of the University of Moratuwa.
2. University of Keele.
3. University of Colombo and the Open University of Sri Lanka.
4. Arthur Clarke Centre for Modern Technologies.
5. Computer & Information Technology Council of Sri Lanka.
6. Department of Telecommunications.

Financial Considerations (Pilot Project)

It is interesting to note that with the cooperation of the Department of Telecommunications, the cost of the pilot stage is extremely modest, of the order of Rs 1 million. The ODA/BC contribution is certainly welcome as this would enhance the scope of the project.

i) from the Sri Lankan Government (through CINTEC /UGC)

	Rs
cost of 3 switchpads (10 + 4 ports)	500,000
cost of leasing 3 lines	free
2 man-years of engineering time	120,000
cost of six modems	120,000
cost of software	?
miscellaneous	30,000

ii) from the ODA / BC

	UK£
visit of an expert to the CTC	4000
IDD connection charges (for UUCP)	3000
cost of training on the maintenance of switch pads	3000

Benefits to the Country

In the long term, the country as a whole will benefit from Project LEARN. However it is easy to identify the following as the institutions which would derive the immediate benefits from this exercise.

1. The academics, researchers and students of all **nine** Universities of Sri Lanka.

2. The **research scientists** in the Research Institutes.

3. The **Computer Technology Centre** (by building expertise which would help it to discharge its designated functions).

Conclusions & Recommendations

The demand for networks dedicated for data and computer communications has intensified as data communication needs become more sophisticated and penetrates diversified fields of social and economic activities. As a result, in most countries, Packet Switched Communication (PSC) services from the public carrier were available before networks for particular user communities started emerging. However in the case of Sri Lanka, the public carrier, ie. the Department of Telecommunications, is not planning to provide PSC services in the near future.

The absence of computer networking technology is viewed by the author as a major obstacle for Sri Lanka to fully exploit the benefits from the application of Information Technology. The implementation of LEARN will not only mark the beginning of the PSC services in Sri Lanka, albeit at a very small financial commitment, but also provides an opportunity to develop local expertise which will become useful when the country is ready to embark on the setting up of a national PSC service.

The following are major recommendations for the successful implementation of the project LEARN.

1. The networking project must be regarded as an exercise in which leading edge technologies so vital to the economic development of the country are tried and tested. In addition to providing the network services, the experience and confidence gained in setting up and maintaining the network will become a useful asset in the future networking projects to be undertaken in Sri Lanka.

2. It is recommended that the project be completed in two phases as follows.

    a. Setting up of an experimental network as indicated in Figure 1.

    b. Expanding the network to connect all the Universities and Research Centres as in Figure 2.

3. The Government, through the relevant Ministries, *eg. Ministry of Higher Education, Science & Technology, Ministry of Post & Telecommunications, etc,* is expected to provide necessary capital and recurrent expenditure of the networking project.

4. A Network Management Committee (NMC) to coordinate the implementation.

5. A Network Control Centre (NCC) should be set up at the University of Moratuwa to undertake all aspects of the network operation (reporting, locating and clearing of faults, software development, monitoring, planning, etc).

6. The Universities must agree to accept network technologies recommended by the NMC, if they wish to be integrated into the national network.

7. The Government, through proclaimed policy, should insist that the equipment either purchased with funding made available by the Government or received under aid or grant agreements, should conform to standards recommended by the NMC.

Acknowledgements

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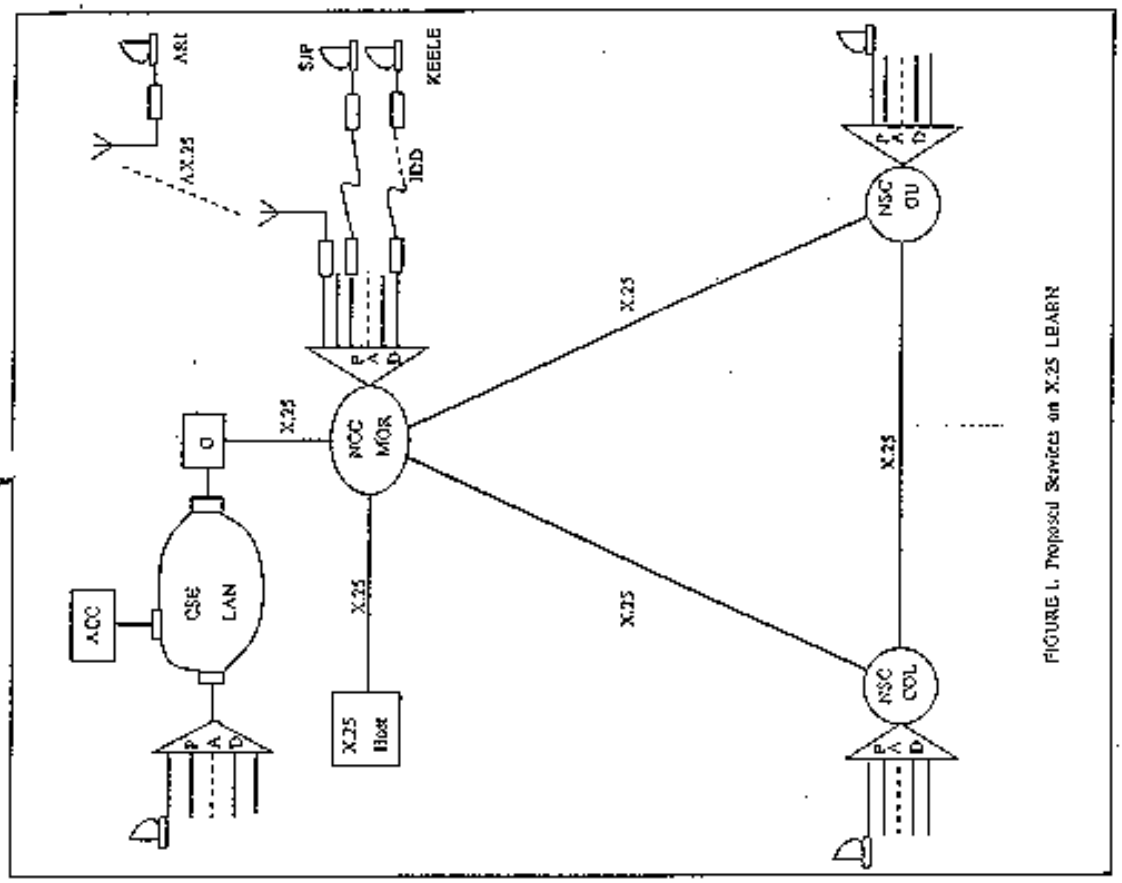

FIGURE 1. Proposed Services on X.25 LEARN

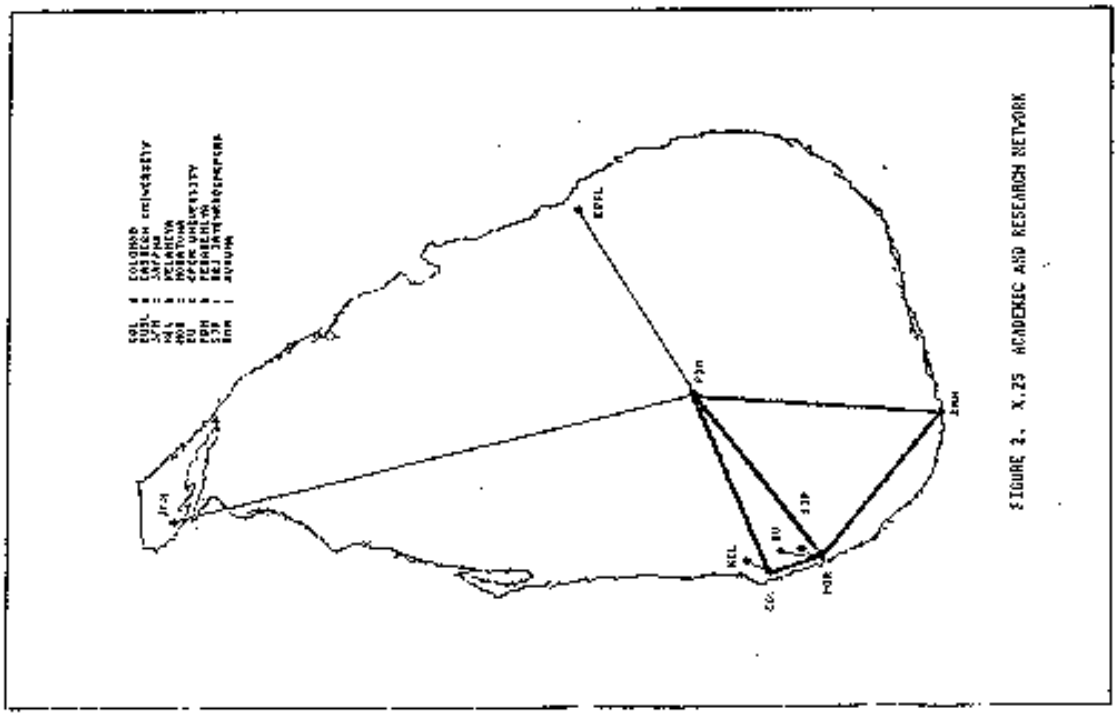

FIGURE 2. X.25 ACADEMIC AND RESEARCH NETWORK