Asia Net

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ABSTRACT

Starting from Arpanet in the late 1960's, computer networks for research and education have been developed in many countries. In 1980's, the computer networks for research and education were established in several countries of the Asian and Pacific region. At the same time, international computer networks are being developed to connect various organizations and computer networks. One of them is Asia Net, which is under development and partially operational now.

1. INTRODUCTION

Arpanet, the first computer network was developed in the late 1960's.[22] Arpanet connects various universities and research laboratories in USA with extensions to UK and Norway. Several European countries developed similar computer networks for research and development.[1,9,12,20,22] Many of these experimental networks helped to develop commercial data communication networks such as Telenet and Tymnet in USA. Transpac in France, PSS in UK, and Datapac in Canada among others.[22] As computers became more common and data communication technologies improved, various computer networks were developed among the developed countries. Several computer networks developed in USA lately are Mailnet Bitnet CSNET, and UUCP Net/USENET.

Mailnet is the computer network for electronic mail among major universities.[12] Some European universities joined later. Mailnet supports various mainframe and supermini computers. See Figure 1 for the current configuration.

Bitnet is started at City University of New York to interconnect IBM mainframe computers with the IBM support.[12] See Figure 2 for the current configuration. Similar networks are installed in Canada and Europe. The former is called Bitnet North, and the latter is called European Academic Research Network(EARN). Bitnet may be extended to Asia soon.[6]

Computer Science NET(CSNET) is a logical network spanning Arpanet, Telenet, and Phone Net.[7] It is being extended to Europe and Asia. See Figure 3 for the current configuration.

UUCP Net/USENET started at Bell Laboratories in USA to interconnect UNIX machines.[14] UUCP Net is primarily for electronic mail and file transfer, and USENET is for electronic news. They are, by far the largest network with over 3000 computers in USA, Europe, and Pacific. It is growing very rapidly. See Figure 4 for the current configuration.

There are several regional networks for Europe and Asia. In Europe, there are European UNIX Net(EUNET) which is connected to UUCP Net/USENET, European Academic Research Network(EARN) which is under development and is compatible to Bitnet, and ESPRIT NET which is under development as a part of ESPRIT Programme of EEC.[12,13,16]. In addition, there is the satellite-based network, STELLA to interconnect local area networks in Europe.[3] Asia Net, which is the main theme of this paper, is being formulated among Korea, Japan, and Singapore with more countries to follow.[4,5]

Most of the above networks are being interconnected for the electronic mail services following Open System Interconnection of International Standard Organization and the domain name of Arpanet.[17,21]

Purposes of these networking activities are information exchanges including the electronic mail and electronic news, and resource sharing. Computer networking is vital to build up high technologies, in particular, information technology.

Explosion of personal computers is rapidly changing computer networking from the one based on mainframe and supermini computers to the one based on personal computers and workstations.

2. OPEN SYSTEM INTERCONNECTION

In the late 1970's. it was realized that the standards for networks of heterogeneous systems were urgently required. Thus, Internation Standard Organization(ISO) started the standardization activity, so called Open System Interconnection(OSI).[17,22] It is expected to be completed by the end of 1980's. The Arpanet protocols, which is not compatible to that of OSI, are also commonly used among wide and local area networks.[21,22] UK has its own protocols.[11] Recently. UK established Intercept Strategy which gradually transfer the protocols to the ISO standards.

Open System Interconnection(OSI) consists of the seven layers.[17] See Figure 5 for the seven layer architecture. They can be subdivided to the communication subnet(Layers 1,2,3), and the hosts. It is applicable to both wide and local area networks. Layers 1 through 5 are well standardized by now. Currently, ISO/TC97/SC21 Committee are working on the upper layers.[19] Many organizations throughout the world are developing the prototype implementation of the upper layers. Among the application layer, to which users interface, there are the message handling system, the virtual terminal service, the file transfer service, and the job transfer service as well as the Common Application Service Element.[17,19] The message handling system was standardized at CCITT, called X.400. The R&D implementation has been done in Canada.[15] It is going through the beta-site testing in Norway, Germany and Korea now. Other services will take a few more years to be standardized with additional years for the implementations.

The Arpanet protocols are more complete due to its long operational status. They have gone through evolution to reach the current status. The Berkeley Software Distribution of UNIX, called 4.2 BSD has fairly complete implementation of the protocols for the wide and local area networks.[24] The mid-layers(Layers 3,4,5) are called Internet Protocols(IP) and Transmission Control Protocol(TCP).[22] They support both connection and connectionless data transmissions. Available application protocols are the file transfer service, the mail transfer service, and the virtual terminal service among others. Many of the above protocols and specifications are available as Request For Comments(RFC) from SRI-NIC.[21] The domain name is another important specification to define networks, and mailing addresses. Many networks are being converted to comply the domain name scheme of Arpanet.[21] By complying the domain name, the internetworking among many computer networks can be accomplished easily.

3. INTERNATIONAL AND NATIONAL COMPUTER NETWORKS

There are international, regional, and national computer networks as the wide area networks for research and education. Many of the international networks are based in USA. CSNET, Bitnet, Mailnet, and UUCP Net/USENET are such networks. All cover USA and Canada, portion of Europe, and portion of Asia/Pacific. Some are only for electronic mail(Mailnet and Bitnet). UUCP Net/USENET offers electronic news in addition to the electronic mail. CSNET can offer the virtual terminal service in addition to the above services.

The regional networks can be found only in Europe except the newly formed Asia Net. UUCP Net/USENET has the compatible network in Europe, called European UNIX Network(EUNET) [16] Over 10 countries joined the network. European Academic Research Network(EARN) is being formulated now with the IBM support. ESPRIT Net is a part of ESPRIT Programme of EEC for research and development on information technology.[13]

Many countries have national computer networks for research and education. The followings are some of them.

A. UK[1,20]
   SERCNET
   Alvey Net
   UNIVERSE(Satellite-based Network)

B. Sweden[12]
   SUNET

C. West Germany[9]
   DFN

D. France[17,22]
   CYCLADES

E. Canada[12,15]
   CDNNET
   Bitnet North

F. Australia[8,10]
   ACSNET
   CSIRONET

G. Japan[2,18]
   N-1 Net

H. Korea[4.5]
   SDN

4. SYSTEM DEVELOPMENT NETWORK

There are many national networks for research and education throughout the world. System Development Network(SDN) is one of them, and started its operation in Korea in 1982.[4,5] There are 15 organizations in the network with increase of three to five organizations each year. Several organizations have their own local area networks which are connected to SDN. It has several internation connections such as UUCP Net/USENET, CSNET, and Asia Net. Many major international and national networks throughout the world can be accessed through CSNET and/or UUCP Net. See Figure 6 and 7 for the SDN configurations.

The communication media for SDN are leased lines, dialup lines, and X.25 networks. Currently, many connections are converted to the X.25 networks due to their much lower costs. Available application layer protocols are the electronic mail including the Korean language mail, the file transfer service, the virtual terminal service, and the electronic news. See Figure 8 for the seven layer architecture of SDN.

Currently, most of computers in SDN are UNIX machines since majority of research activities in Korea are carried out under the UNIX environment. We are adding VAX/VMS, IBM/VM, and others now. But, available protocols for these computers are very limited compared with those of UNIX machines.

5. ASIA NET

In the Pacific region, Australia, Korea and Japan have their own national computer networks for research and education. In addition to the above countries, several more countries such as Hong Kong, Singapore and Indonesia have or plan to connect to the international networks such as CSNET, UUCP Net/USENET, and Mailnet as well as Asia Net.

In early 1983, The Asia Computer Network Committee was formed during the UNESCO Workshop in Singapore. Since then, the computer networking among Korea, Japan, Hong Kong, and Singapore went under development.[5] Currently, Japan and Singapore have the connection to SDN. Hong Kong plans to have the connection to SDN soon. A few more countries would follow as they become ready. See Figure 9 for the current configuration.

Services being offered in Asia Net are the electronic mail, the file transfer service, and the electronic news. All services are based on the protocols of UUCP Net/USENET so far. For the news service, we followed the USENET convention on newsgroups with net.xxxx for the world-wide newsgroups, asia.xxxx for Asia Net, sdn.xxxx for Korea, and kaist.xxxx for KAIST. Other regions and countries have similar arrangement. See Figure 10 for the current newsgroups. The domain names also follow the similar convention as they are enforced in 1985.

The network protocols for Asia Net is the subset of SDN initially. The network management center was tentatively set up at SDN. AS the requirement on Asia Net will be more specified with more activities, the network protocols will be developed accordingly. The first Asia Net meeting may be held during Pacific Computer Communication Symposium at Seoul in 1985.

6. REMARK

While developing Asia Net, several questions came up. Is Asia ready for a regional computer network? Is the network topology a ring or a star? Do we have enough traffic in the region to justify the effort? Europe and the North America are the only regions in the world with the regional computer networks. Inter-country communication costs in Asia is much more expensive than those of Europe and the North America. There are a lot of information traffic in Europe compared with Asia. This is particularly true for research and development in high technologies such as information technology.

First of all, many Asian countries do not have the proper infrastructure to support computer networks such as research manpower, computing facilities, and research funds. Secondly the communication costs are very high or rather flat in Asia. For example, the dialup cost from Korea to countries in Asia is the same as that to USA or Europe. For X.25 networks, there are two rates in Korea, to USA and to others. The former is cheaper than the latter, i.e., the communication cost based on X.25 is cheaper to USA than to Japan! Then, why do we have the regional computer network instead of the direct connection to USA?

Since the communication costs are not proportional to geographical distance, the network topology would be different from the networks of airlines or shipping. It is more of star-shape following information traffic density. As we share many problems in the region, we expect the need for more information exchanges in the region. Moreover, we need to form the third group after the North America and Europe to be competitive as a group in the information technology. The European countries did not cooperate in research and development. They realized that they have to cooperate in high technologies, in particular, in the information technology, and they formulated ESPRIT Programme for research in the information technology. The computer network is one of the important tools to pursue the cooperation as well as to provide the necessary infrastructure. As we are heading for the Pacific Age, the first step is to provide information exchanges in the region. Asia Net and other computer networks would offer the necessary infrastructure. So are regional conferences and manpower exchanges. As we face similar problems in the region, Asia Net could offer a necessary vehicle for information exchanges to solve the problem. It could also help to develop a more coherent research community in the Asia and Pacific region. Of course, the development of a regional computer network like Asia Net is one of the key information technologies on its own right.

Personal computers are exploding. The computer networks like many other technologies feel the impact. The computer networks were centered around the mainframe computers in 1970's. Currently, many computer networks are based on mainframe and supermini computers. Many computer networks based on personal computers are appearing such as the computer bulletin boards. The personal computers and workstations are becoming the basic man-machine interface unit instead of CRT terminals. Future computer networks must incorporate the personal computers and workstations in their architecture.

Satellite-based computer networks may also be important, in particular for the Pacific/Asia region. The satellite can offer broadcasting, which is important to the information exchange based on mass communications such as news. Another attraction of the satellite is that it can offer a computer network with the star topology regardless of the countries in the region being land-connected or not. The Pacific/Asia region is such a region.

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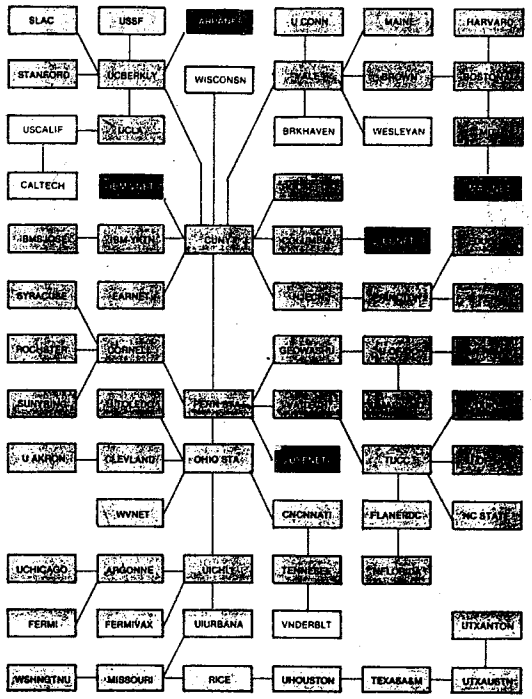

In the above BITNET topology, gray-screened blocks depict existing BITNET members, white blocks show pending sites, and black blocks represent gateways to other networks. For a full name listing of all BITNET sites as of April, see *EDUCOM Bulletin*, Spring 1984, p. 29. EDUCOM's connection to BITNET is a leased line to Princeton University, while MIT acts as the gateway between the 21 MAILNET member institutions and BITNET.

Fig. 2. Bitnet Configuration (from Edunet News, Spring 1984 [12])

MAILNET Sites	Machine	Operating System	Mail System	Sitename	MAILNET Liaison	Liaison Address	Postmaster Address
Carnegie-Mellon University	DEC 20	TOPS 20	MS	CARNEGIE.MAILNET	Charles Augustine	CA11%CMCCTE@CARNEGIE.MAILNET	POSTMASTER%CMCCTE@CARNEGIE.MAILNET
University of Chicago	DEC 20	TOPS 20	MailManager	UCHICAGO.MAILNET	Martha Ash	STAFF.MARTHA@UCHICAGO.MAILNET	POSTMASTER@UCHICAGO.MAILNET
Dickinson College	PDP 11/70	RSTS	DREAMS	DICKINSON.MAILNET	Tom Burtnett	BURTNETT__TOM@DICKINSON.MAILNET	POSTMASTER@DICKINSON.MAILNET
University of Durham (UK)	IBM 4341	MTS	$MESSAGE	DURHAM.MAILNET	Nigel Hall	NIGEL__HALL@DURHAM.MAILNET	POSTMASTER@DURHAM.MAILNET
EDUCOM	DEC VAX 11/750	VMS	DEC VAX 11/750	EDUCOM.MAILNET	Candice Willut	WILLUT@EDUCOM.MAILNET	POSTMASTER@EDUCOM.MAILNET
Grinnell College	PDP 11/70	RSTS	DREAMS	GRINNELL.MAILNET	Michael Strait	STRAIT__MICHAEL@GRINNELL.MAILNET	POSTMASTER@GRINNELL.MAILNET
Harvard University	IBM 370	VM/CMS	VM SP2 Mail	HARVARD.MAILNET	Peter Hefferman	PETEH@HARVARD.MAILNET	POSTMASTER@HARVARD.MAILNET
Iowa State University	NAS AS/6	MVS/Wylbur	CONTACT/EMS	IOWA-STATE.MAILNET	William Frazer	GG.WSF@IOWA-STATE.MAILNET	POSTMASTER@IOWA-STATE.MAILNET
University College of London	PDP 11/44 DEC VAX 11/780	UNIX	JNT-Mail	UCL-CS-MAILNET.MAILNET	Irene Hassell	IRENE@UCL-CS-MAILNET.MAILNET	POSTMASTER@UCL-CS-MAILNET.MAILNET
MIT	Honeywell 6180	Multics	MulticsMail	MIT-MULTICS.ARPA	Peter Kelley	Kelley.SysMaint@MIT-MULTICS.ARPA	POSTMASTER@MIT-MULTICS.ARPA
University of Michigan	Amdahl 5860	MTS	$MESSAGE	UMICH-MTS.MAILNET	Steve Rothwell	STEVE__ROTHWELL@UMICH-MTS.MAILNET	POSTMASTER@UMICH-MTS.MAILNET
University of Newcastle upon Tyne (UK)	IBM 370	MTS	$MESSAGE	NEWCASTLE.MAILNET	Alan Hunter	ALAN__HUNTER@NEWCASTLE.MAILNET	POSTMASTER@NEWCASTLE.MAILNET
New Jersey Institute of Technology	Perkin-Elmer 3220	OS32MT-RO6.2	EIES	NJIT-EIES.MAILNET	Alan Leurck	AL@NJIT-EIES.MAILNET	POSTMASTER@NJIT-EIES.MAILNET
Northwestern University	DEC VAX 11/780	VMS	VAXMail	NORTHWESTERN.MAILNET	User:Cedric Hampton Tech.: Jack Pressman	HAM1982@NORTHWESTERN.MAILNET JACK@NORTHWESTERN.MAILNET	POSTMASTER@ NORTHWESTERN.MAILNET
Queens University (Kingston, Ontario)	IBM 4341	VM/SP2[9]	PROFS	QUCDN.MAILNET	Jim Lesslie	LESSLIE@QUCDN.MAILNET	POSTMASTER@QUDCN.MAILNET
Rensselaer Polytechnic Institute	IBM 3081D	MTS	$MESSAGE	RPI-MTS.MAILNET	Gary Schwartz	GARY__SCHWARTZ@RPI-MTS.MAILNET	POSTMASTER@RPI-MTS.MAILNET
University of Southern California	DEC-10	TOPS 20	MM	USC-MAILNET.MAILNET	Skip Eastman	SEASTMAN@USC-MAILNET.MAILNET	POSTMASTER@USC-MAILNET.MAILNET
Stanford University	IBM 3081	MVS/Wylbur	CONTACT/EMS	STANFORD.MAILNET	Jon Sandelin	GDJCS@STANFORD.MAILNET	POSTMASTER@STANFORD.MAILNET
University of Stockholm	DEC 10/20	TOPS 10	COM	QZCOM.MAILNET	Jacob Palme	JACOB__PALME__QZ@QZCOM.MAILNET	POSTMASTER@QZCOM.MAILNET
Union College	DEC VAX 11/780	VMS	VAXMail	UNION.MAILNET	Wayne Holt	HOLTW@UNION.MAILNET	POSTMASTER@UNION.MAILNET
University of Wisconsin-Madison	Sperry 1100/82	EXEC	MACC	MACCWISC.MAILNET	Michael Dorl	MICHAEL=DORL@MACCWISC.MAILNET	POSTMASTER@MACCWISC.MAILNET

Fig. 1. Mailnet Configuration (from Edunet News, Summer 1984 [12])

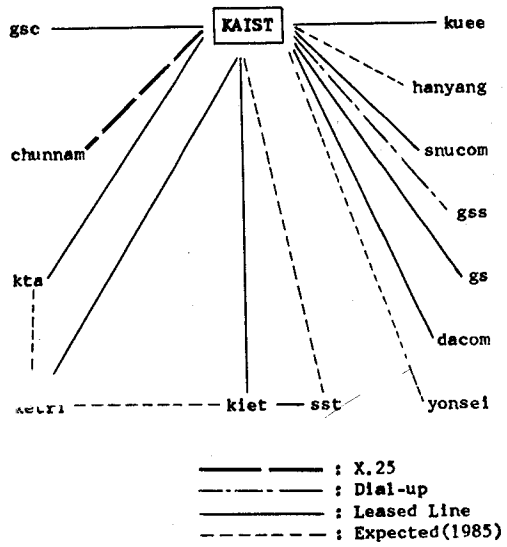

Fig. 6. Network Configuration of SDN

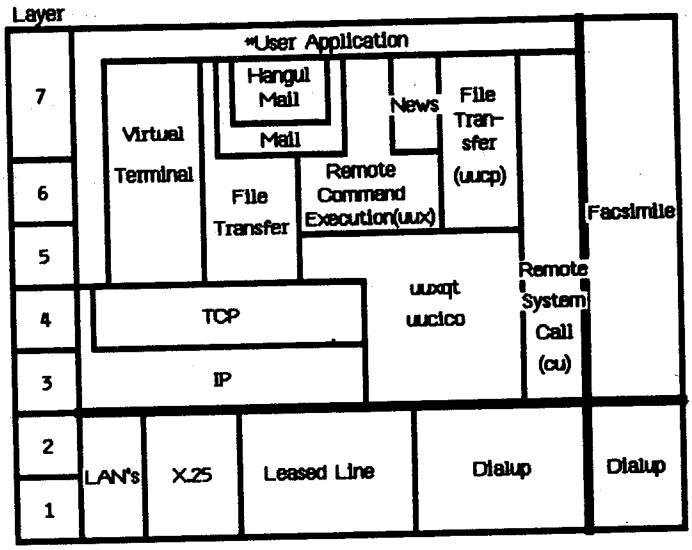

Fig. 8. SDN Seven Layer Architecture

Remark: User applications are optional.

cu: call UNIX
IP: Internet Protocol
LAN: Local Area Network
TCP: Transmission Control Protocol
uucico: unix to unix copy in copy out
uucp: unix to unix copy
uux: unix to unix command execution
uuxqt: unix to unix execution

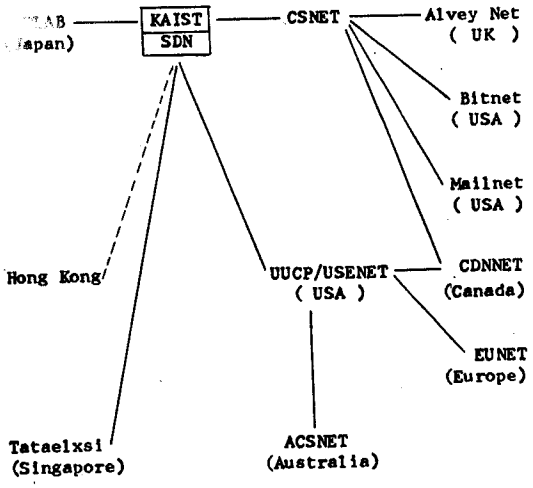

Fig. 7. International Connection of SDN

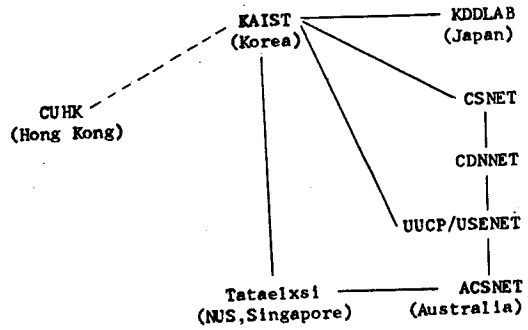

Fig. 9. Asia Net

net (partial list)	ai, announce, arch, bugs, bugs.2bsd, bugs.4bsd, bugs.usg, bugs.uucp, bugs.v7, columbia, dcom, flame, followup, general, graphics, lan, lang, lang.ada, lang.apl, lang.c, lang.f77, lang forth, lang lisp, lang.mod2, lang.pascal, lang.prolog, lang.st80. mail, mail.headers. math, micro.68k, micro.cpm, micro.pc, misc, news, news.b, news.config, news.directory, news.group, news.map, news.newsite, periphs, sources, sources, unix-wizards, usenix, wanted, works
asia	general, news, test
sdn	adm, ai, bugs, general, hangul, news, news.map, sources, test, unix-wizards
kaist	cs, games, general, test

Fig. 10. Current Newsgroups

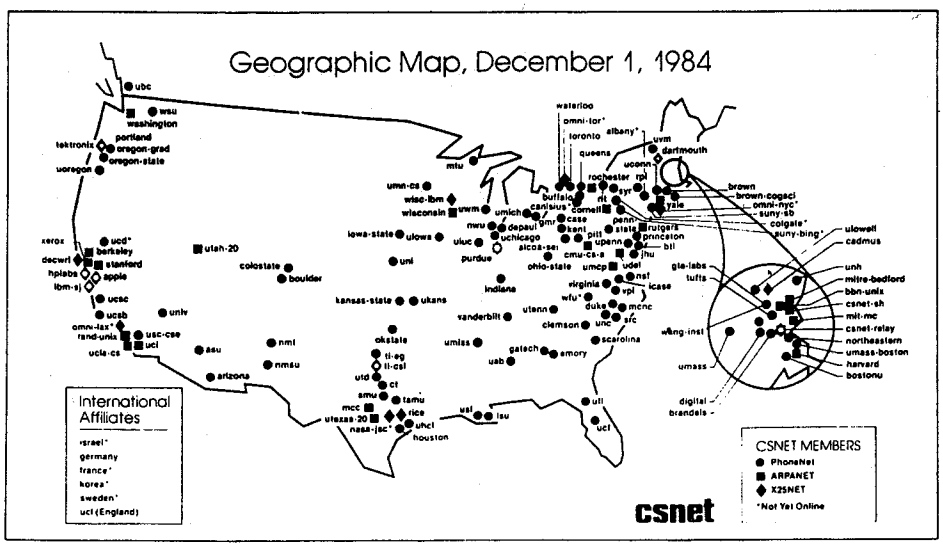

Fig. 3. CSNET Configuration
(from CSNET News, Dec 1984 [9])

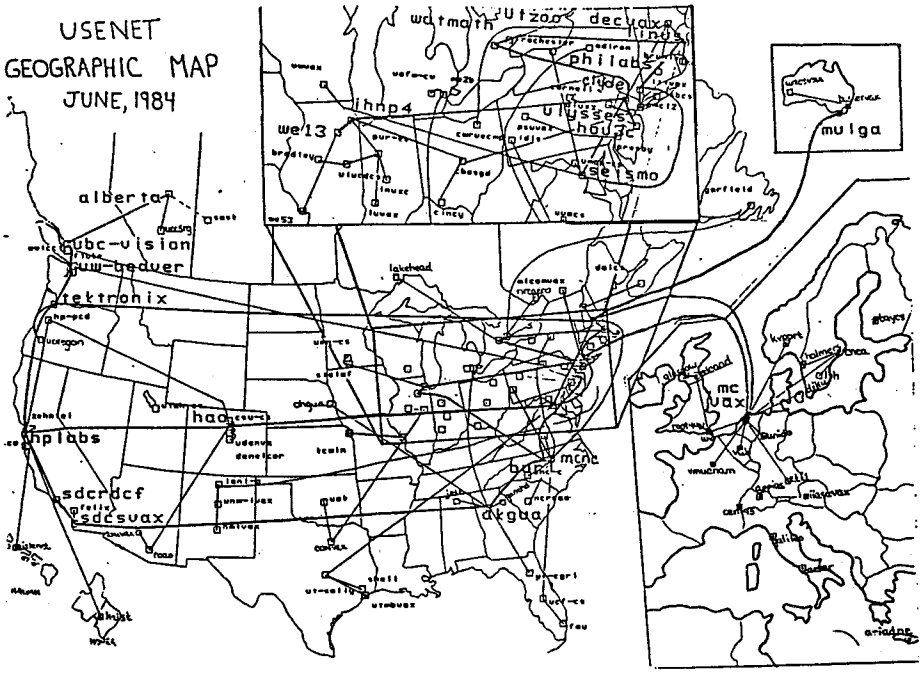

Fig. 4. USENET Configuration
(from Usenet Maps [23])

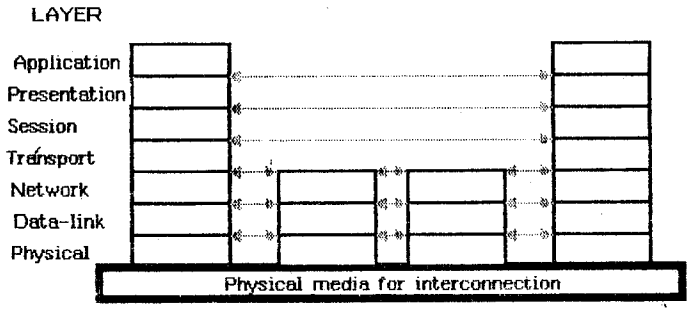

Fig. 5. The seven-layer OSI architecture
(from Special issue on OSI [17])