6 Local/Regional/National Networking in Greece

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6.0 ABSTRACT

In this article, information is given on the current telecommunications/networking infrastructure at the local/regional/national level, in Greece, as well as on the expected developments in the near future. Emphasis is placed on the capabilities this infrastructure offers to libraries, towards the new and constantly emerging era of the ‘virtual library’ or ‘library without walls’, where ‘access’ to shared online information resources available is the watchword.

6.1 INTRODUCTION-OVERVIEW

John Quartermen, in his book ‘The Matrix: Computer Networks and Conferencing Systems Worldwide’ (1990, Digital Press) writes that ‘Isolated computers are useful. Connected computers are more useful and in new ways’. Today, the following paraphrase is just as true: ‘Isolated libraries are useful. Connected libraries and patrons are more useful and in new ways’. We are in a period of constant transition from the era of isolated, but automated, libraries into a new era, where libraries are connected with each other and with their patrons, through emerging computer telecommunications/networking infrastructures. The challenge for librarians is to explore the future, this new emerging era of the so called ‘virtual library’ or ‘library without walls’, where ‘access’ to shared online information resources available is the watchword.

The main goals of this article are:

- to inform librarians about the capabilities currently offered (or planned for) by the telecommunications/networking infrastructure at the local/regional/national level, in Greece, and
- to show librarians how these networking capabilities can be exploited to the fullest, in order to lead to success in any kind of (local/regional/national) ‘virtual library’ initiative.
Everything that is covered in the following sections is given in the framework of the simple 'Network of Libraries' model of Figure 1.

Figure 1

[Diagram showing network levels and connectivity]
According to this model (just Network from now on):

- the Network interconnects only (partially or fully) automated libraries;
- an automated library, previously isolated but now connected to the Network is considered:
  - in small sized libraries: as a single user computer system (i.e. PC or Macintosh);
  - in small to medium sized libraries: as a multi user computer system (i.e. 'running' Unix or VAX/VMS) which is accessed by library users via dump terminals (i.e. DEC's VT2xx/VT3xx) or PCs running some terminal emulation software (as Procomm, Crosstalk or MS/Kermit), which enable them to act as 'smart' terminals, providing library users with local processing capabilities as well;
- in medium to large sized libraries: as a Local Area Network (LAN), which interconnects single user and/or multi user computer systems;
- the libraries, nodes/members of the Network, are connected to each other either at the regional level only (via a Metropolitan Area Network - MAN) or both at the regional and national levels (via a Wide Area Network - WAN);
- connectivity to international networks of libraries (easily described by the same model) is granted to all libraries, nodes/members of the Network, via international network links;
- all library nodes/members of the Network act as 'virtual libraries' or 'libraries without walls' since they provide their users access to online information resources available anywhere in the Network or other international networks;
- the degree of integration of the Network determines the degree of ease, transparency and efficiency that library users access online information resources and consequently the user's view concerning the quality of services provided by a 'virtual library' as well as the answer to the question 'WHERE these resources are actually available?' i.e. in the local library, in another library inside the country or somewhere in the outside world.

Thanks to the Telephassa seminars, nearly all topics involved in library automation (including networking and related integration issues), have been covered in sufficient depth. Thus, in this article we will focus our attention on the telecommunications/networking infrastructure currently available in Greece, at the local/regional/national level, along with its capabilities, strengths and limitations. The first part of the article deals strictly with technical information on the current Greek infrastructure and expected developments in the near future, while the second part covers the opportunities for libraries in the implementation of a Greek Network of Libraries and other successful 'virtual library' initiatives. Last, but not least, taking into account the Greek reality, where libraries (even the automated ones) are completely isolated (except one or two cases), a realistic proposal is made towards the implementation of GOAL (Greek Openly Accessed Libraries), the first Greek Network of Libraries.
6.2 THE GREEK TELECOMMUNICATIONS/ NETWORKING INFRASTRUCTURE

In Greece, over the last 7 years, we have witnessed major progress and developments in the area of Computer Networking. The speedy evolution of Local Area Networks (LANs), in the late 80's and early 90's, along with the evolution and adoption of international and de facto standards, forced many Greek Academic and Research Institutes to establish LANs and acquire technical know-how in LAN operations, which involve major (sometimes difficult to solve) connectivity interoperability, integration and management issues. Academic R&D Institutes and Universities (especially Computer Science Departments), became the pioneers in the Computer Networking field and their efforts to keep up with the trends in technology, besides being successful, resulted in the maturity of the Greek market. Last, but not least, those LANs which were developed in order to fulfil (mainly) local needs, got connected to national and international computer networks, and enabled the academic community to share data and information worldwide. Services like virtual terminal or remote login, file transfer, electronic mail and electronic conferencing (news) were introduced in Greek academic networks before 1985-86. Thus, the Academic R&D community, soon became opinion leaders and invaluable consultants (in most cases free of charge) to the Greek public and private sector, for computer networking issues.

Today, a large number of public and private companies use LANs in their office automation facilities. These facilities can be easily extended to the whole country as well as to the whole world, via national and/or international network links, depending on the company's size and needs. The Greek market is mature and able to provide customers with off-the-shelf products and technical support of high quality to their networking projects. Of course, the Greek academic community continues to play a very important role, provided its commitment to experiment and keep up with the advances in this continuously evolving and promising field of computer networking.

Everything sounds wonderful, as far as local area networking issues are concerned. LANs are installed in the owner's premises, usually taking into account only local needs and cost/performance requirements. Unfortunately, interconnection of LANs through wide area networks (WANs), in Greece, is not so easy. Actually, WANs is a 'real headache' and in most cases an expensive one. The interconnection issue of LANs, at the international level would pose even more problems. The main causes of this 'headache', appear to be:

- the weak telecommunications infrastructure of Greece, which is subject to the rules of the Greek monopoly. According to the current legislation, it is exclusively controlled by the Greek PTT company, the public organization 'OTE S.A.';
the lack of central (government) policy in the establishment and administration of Wide Area Networks (WANs): the Greek Map of WANs, is a result of several, ad hoc, academic R&D initiatives. These initiatives, although proven successful and invaluable in the short term, run into difficulties in the long term (mainly due to funding and administrative issues), which nowadays threaten their existence more than ever.

In the following (two) subsections, we present in (some technical) detail the most outstanding computer networking initiatives, at the local/regional level, the way they fulfil connectivity requirements to national and international computer networks as well as the services currently provided. Then, we focus upon the current telecommunications infrastructure and the most outstanding computer networking initiatives at the national level (WANs). Expected developments in the near future are also presented.

6.2.1 The Local/Regional Level
The most outstanding initiatives in the area of local/regional computer networking can be found in the regions of Patras/Peloponnese, Iraklion/Crete, Athens, Thessaloniki/Macedonia, Chios/Aegean Sea and Xanthi/Thrace. The characteristics of LANs are usually common in all these regions, but ... although the ingredients are the same, the cake is different'. So, we present in (some technical) detail the situation in Patras, as an example of a not very complicated but common LAN and then, when we refer to the other regions, we will focus only on the characteristics specific to those sites.

6.2.1.1 The Region of Patras/Peloponnese
In the region of Patras, the Computer Technology Institute (CTI) has played a key role, during the last 6 years, both from the scientific and technical point of view. CTI established in 1985, is a non-profit academic and research organization, devoted to R&D in the field of computer science and informatics. It is supervised by the Ministry of National Education and Cults and is closely associated with the Computer Engineering and Informatics Department of the University of Patras.
In order to fulfil the high demands of users for networking facilities, CTI has established a highly heterogeneous Ethernet based local area network (CTInet), which -for the time being- consists of about 150 nodes. This large variety of multivendor (DEC, Sun, CDC, IBM, Apple and others) computer systems (PCs, MacIntosh, powerful workstations and mini computers) is running the majority of synchronous operating systems (VAX/VMS, Unix, MS-DOS, Novell's Netware and MacOS). They are spread over 12 ethernet segments (IEEE 10base5/10base2) in two buildings (one in the University Campus in Rio and the other in the centre of Patras), over a distance of 10 km. The physical interconnection of these segments is achieved via multiport/multiprotocol/multimedia bridge/routers.
In detail:
- in the building in the University Campus (Computer Centre):
  - 1 Cisco AGS+ (including C-bus controller, 533Mbps) with 12 Ethernet (10base5) ports and 4 high speed (up to 7Mbps) serial ports;
  - 1 Cabletron 1RBM/MMAC5 multiport bridge with 12 ethernet (10base2) ports;
- in the building in Patras:
  - 1 Cisco IGS/R with 1 high speed serial port and 1 ethernet 10base5 port.

The interconnection between the two buildings is achieved via the 2 Cisco routers (serial ports), one 4w leased line and two V.33/V.32bis modems (14.4Kbps). The routers are configured to bridge the LAT protocol and to route the DECert and IP protocols. All CTInet nodes are logically interconnected using the TCP/IP protocol suite as the main internetworking solution. Other protocol families i.e. DECert, AppleTalk and Novell's IPX/SPX are also used to fulfill project oriented needs.

CTInet is also connected to:
- International Academic and Research Networks:
  - Internet: connection to this network is accomplished via the AGS+ (one serial port), a 4w leased line from Rio/University of Patras to Iraklion/University of Crete, and a pair of V.29 (9.6Kbps) modems. Standard Internet services are provided (see Subsection 6.2.2.2);
  - EARN/BITNET: connection to this network is accomplished via a MicroVAX 3600 running VAX/VMS (node GRPAT VX1) and an NJE over TCP/IP (Internet) network link to node GRENAR at Iraklion/University of Crete. Standard EARN/BITNET services are provided (see Subsection 6.2.2.2);
  - EUnet (UUCP): connection to this network is accomplished via a MicroVAX II running Ultrie (node 'ermsb') and a dial-up (2.4 Kbps) UUCP link to node 'ariadne' at Iraklion/Computer Science Institute. Standard EUnet services are provided (see Subsection 6.2.2.2);
- X.25 networks:
  - the public Hellaspace: connection to this network is accomplished via a MicroVAX 3600 running VAX/VMS and VAX/PSI software, a 4w leased line to the Hellaspace centre in Patras, and a V.29 (9.6Kbps) modem. Standard X.25 services are provided (see Subsection 6.2.2.2);
  - ARIADNET (the Greek part of the IXI/COSINE network): connection to this network is accomplished via a Sun 3/280 running SunOS and Sunlink X.25 software, a 4w leased line to the central ARIADNET X.25 switch in NRCP 'DEMOKRITOS' in Athens, and a V.29 (9.6Kbps) modem. Standard X.25 services are provided. Also standard OSI services: X.400, X.500, FTAM, VT but they are still in the experimental phase. Finally,
X.400 connections to Y-NET and COSINE/MHS networks are operational (see also Subsection 6.2.2.2).

Thus, CTInet serves as the communications service centre for about 10 local area networks (over 500 nodes) on the campus of the University of Patras as well as in the region of Patras.

In detail:
- departments of Polytechnic School, University of Patras:
  - Electrical Engineering
  - Mechanical Engineering
  - Civil Engineering
  - Chemical Engineering
  - General Department
- ICEHTnet: the LAN of the Institute of Chemical Engineering and High Temperatures (ICEHT);
- TEInet: the LAN of TEI of Patras.

CTInet and the above regional LANs are experimentally connected via 4w leased lines at 9.6Kbps, using DECnet, TCP/IP and NJE protocols, forming the experimental internetwork PATRASnet. The main network services that PATRASnet currently provides are: virtual terminal or remote logon, file transfer, remote printing, electronic mail and news. Needless to say, a great effort has been made to integrate these services as well as to modify (where possible) other services in order for local needs (mainly problems that arise from the different Greek character sets) to be satisfied.

Expected developments: the introduction of FDDI and/or B-ISDN technologies for Local Area Networking on the Campus of the University of Patras.

6.2.1.2 The Region of Iraklion/Crete

In Iraklion, the Computer Science Institute (CSI) of the Foundation of Research and Technology - Hellas (FORTH), plays a key role concerning the academic and research networking in the local/regional/national level. FORTH is a foundation for research and development supervised by the Ministry of Industry, Research and Energy (General Secretariat of Research and Technology). FORTH was formed in November 1987, when the Research Centre of Crete (founded in 1983) was merged with other Institutes from Patras and Thessaloniki. CSI is conducting applied research in Informatics with as its chief concerns, 'the research, study and implementation of Computer Information Systems for the benefit of the National Economy and the Public Administration'.

The major problem facing FORTH's large academic and research community was the proliferation of the high performance personal workstations and the increase in the needs for communications both internally in Crete as well as among the
Institutes in Patras and Thessaloniki and international networks. Living and working in Crete, an island 500 km away from the capital, they have long ago recognized the value of good telecommunications in overcoming the disadvantages of its geographical isolation. Thus, FORTHnet, FORTH’s large scale Local Area Network has been established in order to fulfil the above user networking needs. FORTHnet spans many buildings in the region of Iraklion and it is also connected to other LANs in Rethimnon and Chania as well as to ARIADNET and Hellaspace networks. Demands for high speed networking are satisfied via either FDDI rings or high speed point-to-point links (up to 2Mbps), where this is permitted by the capabilities of the local PTT’s telecommunications infrastructure. Finally, FORTHnet provides the national gateways to international academic and research networks RIPE/Internet, EARN/BITNET and EUnet, via two international network links (14.4 and 9.6 Kbps) to France and use of Cisco AGS+ routers and data compressors.

6.2.1.3 The Region of Athens
In the region of Athens, academic R&D institutes and University Departments have established their own LANs in order to fulfil local networking needs. Among them are: NRCPs 'DEMOKRITOS', University of Athens, National Technical University of Athens (NTUA), University of Economics and others. Nearly all of them provide connections to national (Hellaspace and ARIADNET) and international networks (Internet, EUnet, EARN/BITNET). In particular NRCPs 'DEMOKRITOS' has established and maintains the ARIADNET wide area network, the Greek part of the COSINE/IXI project (see Section 6.2.2.2).

Finally, a lot of private companies with R&D activities (such as Intracom, Algosystems, CDC Hellas, DEC Hellas, IBM Hellas among others) have established and maintain their own LANs, which in turn are connected to the national and international networks mentioned above.

6.2.1.4 The Region of Thessaloniki/Macedonia
Major developments are taking place at the University of Thessaloniki, in the area of Computer Networking, which initiated the development of the University's LAN based on FDDI and ISDN technologies. The installation of this network is still in progress. Connections to ARIADNET, EARN/BITNET and Internet networks are maintained.
Known problems: lack of adequate and qualified technical staff.

6.2.1.5 The Region of Chios/ Aegean Sea
The Department of Business Administration (BA) of the University of the Aegean Sea (UA), in Chios, has installed a small ethernet LAN, which is connected to ARIADNET network. Connection to Internet (IP over X.25) is still in progress.
Known problems: lack of adequate and qualified technical staff.
One computer networking initiative worth mentioning in the region of the Aegean Sea, is the installation of a Tourist Information System, known as the AEGIS System, which was completed in August 1992, by CTI and BA/UA and financed by the EC STAR project. This system is based on a central database application, a Tourist Information System (TIS), running on a VAX/VMS machine, under the Oracle DBMS. This central system is located at the University of the Aegean Sea, in Chios, and is accessed by remote nodes (smart terminals) located in the city of Chios (hotels and tourist offices), in Piraeus (tourist office), in Rhodes (hotel) and on a ship travelling in the Aegean Sea. The terminals and the central system are connected through the AEGIS network, via TCP/IP (point-to-point), X.25 (Hellaspace) or wireless (packet radio - AX.25) connections. A user of the AEGIS System, can easily access the TIS, in the central system from any terminal, in a user friendly and completely transparent way. The AEGIS network is also connected to CTINet.

6.2.1.6 The Region of Xanthi/Thrace
The Democritus University of Thrace, in Xanthi, has also installed a LAN with connections to ARIADNEt, Hellaspace and Internet networks.
Known problems: lack of adequate and qualified technical staff.

6.2.2 The National Level
While major developments are taking place at the local/regional level, the situation on the national level is not so promising because of the weak telecommunications infrastructure.

6.2.2.1 The Greek PTT Telecommunications infrastructure
The Greek PTT (OTE S.A.) public telecommunications infrastructure has long been regarded as one of the weakest in Europe. It is characterized mostly by analog technology, and is oriented to voice communications. The cabling infrastructure is also of bad quality resulting in data communications services of patchy overall quality. Last, but not least, the near absence of high speed data lines and lead times of up to six months for medium speed lines, while tarrifs are too high, are still major problems.

Although during the last 5 years considerable effort has been devoted to its digitization, according to the Greek PTT's plan, only 60% of the infrastructure is expected to convert to digital technology, by the end of 1995. OTE S.A., through its participation in the EC STAR program, will attempt to work out the digitization plans, by the end of 1992. But, since little effort is going into the improvement of the cabling infrastructure the quality of services will not be optimal, even after the successful completion of the digitization process. Keeping all the above in mind and taking into account the pressing needs of users for data communications at the national and international level, OTE decided on the development of
independent data networks, using the current infrastructure. As the digitization process continues, the quality of services offered by these networks will be improved. Today, only the public X.25 network, known as HELLESPAC, is operational. Of course, traditional data communication facilities via dialup or leased data lines are offered, but at a high cost.

The status of the telecommunications infrastructure for data communications and computer networking at the national/international level is as follows:

**Dialup data lines communications services**
These are conventional telephone lines of the Public Switch Telephone Network (PSTN). The bad quality of Greek PSTN along with its analog nature, push data communication speeds below 2.4Kbps using either CCITT V.21/V.22/V.22bis modems or even CCITT V.32/V.32bis, which are able to transmit/receive data at speeds up to 14.4Kbps. Also dialup lines are very sensitive to noise. OTE's charge policy for the use of dialup lines as data lines is the same as that of conventional voice telephone lines (based on the duration of the call).

**Leased data lines communications services**
These are 2 or 4 wire (CCITT M.1020) leased lines. Data transmission speeds range from 9.6Kbps (using V.29 modems) to 14.4Kbps (using V.33/V.32bis modems). OTE's charge policy for the use of these lines for data communications vary with the distance they span. Examples:
- a 4w leased line between the two buildings of CTI in Rio and the centre of Patras (about 10km) costs 50,000 drachmas per month, while a 2w leased line costs just half of that (25,000 drachmas per month);
- a 4w leased line from Rio/University of Patras to Iraklion/University of Crete (connection of CTInet to EARN) costs about 270,000 drachmas per month;
- a 4w leased line from Rio/University of Patras to Athens/NRCPS 'DEMOKRITOS' (connection of CTInet to ARIADNE) costs about 200,000 drachmas per month;
- a 4w leased line from Iraklion to France costs about 1,000,000 drachmas per month. Because of the bad quality of the cabling infrastructure, leased lines are very sensitive to noise. It is very common for a leased line to cease operating because of bad weather conditions (i.e. rain). But the real bad news, is that it takes a long time for OTE technical services, responsible for the repair of leased data lines, to respond.

**HELLESPAC**

This is the national public X.25 data network. It became operational in early 1988 and entered its experimental phase immediately, which lasted 2 years. During this experimental phase, HELLESPAC was free of charge to selected users only (mainly
academic institutions and private companies). Hellaspace entered its commercial phase in January 1990. Today, X.25 Hellaspace centres are located in many big cities. Users access Hellaspace services, after they become connected to the closest Hellaspace centre (X.25 DCE or X.3 PAD) via either dialup lines (X.28 asynchronous terminals/DTEs) or 2w/4w leased lines (X.28 asynchronous or X.25 synchronous terminals/DTEs) and proper modems depending on the required data transmission speed (up to 9.6 Kbps with CCITT V series modems or greater with baseband modems).

As far as OTE's charging policy for the use of Hellaspace services is concerned, it depends on the duration of a call and the volume of data transferred during that call. According to the latest price list:

- for calls inside the country:
  - time duration cost: 3.3 drachmas (dialup) or 0.8 drachmas (leased line) per minute;
  - data volume cost: 0.16-0.24 drachmas (depending on date and time) for every data segment (up to 64 bytes).

- for calls outside the country:
  - time duration cost: 10.50 drachmas for calls inside Europe and 31.50 for calls outside Europe, per minute.
  - data volume cost: 7 drachmas for calls inside Europe and 14 drachmas for calls outside Europe, for every data segment (up to 64 bytes).

Of course there are also:

- regular fees that must be paid once a user becomes connected to Hellaspace: 25,000/45,000/3,000 drachmas if a 2w/4w leased line or dialup line is used.
- regular fees per month, which depend on the data transmission speed used: 1,500 drachmas for a X.28 dialup line at 0.3/1.2 Kbps, 6,000 drachmas for a X.28 2w leased line at 1.2Kbps and 9,000/15,000/30,000/45,000/75,000 drachmas for a X.25 4w leased line at 2.4/4.8/9.6/19.2/64 Kbps. Needless to say speeds over 19.2 Kbps are usually never provided.

- regular fees for more X.25 facilities, logical channels and so on.

Of course, the above prices are subject to 18% VAT.

Finally, OTE has improved the quality of Hellaspace and the open dialog between users and the operator's personnel has been recognized as one of its major strengths.

Expected developments:

- HELLASCOM: the national public high speed (up to 2Mbps) digital data network;
- HELLASTEL: videotex services over Hellaspace;
- Integration of Telex and Telefax services with the new advanced Telematic services.
Although these new services have been announced by OTE, it is believed they will be delayed (not available before 1994), mainly because of substantial changes in the legislation concerning the operation of the Greek PTT. The new legislation puts an end to the monopoly status of OTE.

Known obstacles towards the improvement of the national telecommunications infrastructure:
- lack of sufficient technical expertise, flexible organization and legislation status as far as the Greek PTT company is concerned;
- lack of central (government) policy concerning the development, expansion, and exploitation of the national telecommunications infrastructure.

6.2.2.2 Known Wide Area Networks (WANs)
Regardless of the capabilities, strengths and limitations of the current telecommunications infrastructure, the pressing needs of users for computer networking at the national/international level, has lead to an ad hoc development of Wide Area Networks, which somehow stretch the current infrastructure to its limits. Today, the following two general categories of WANs exist, in Greece:
- Academic and Research Networks such as the Greek parts of EARN/BITNET, EUnet/InterEUnet, RIPE/Internet, IXI/COSINE (ARIADNET) and Y-NET, which also provide links to computer networks worldwide. In some cases, the infrastructure of these networks, enables big, geographically distributed R&D foundations/institutes (i.e. FORTH), to have their LANs interconnected through a suitable communication platform (in addition to their private HELLASPAC or leased data lines), in order to fulfil their own communication needs;
- Private Data Networks (i.e. banks, private companies, etc.) and Commercial Network Service Providers, such as KAPPA-TEL, which maintain and provide their users with access to various database and videotex services, on a subscription basis. These services are usually accessed either via Hellaspac or dialup lines.

Since the second category of WANs, in Greece, is of little concern (if any) to libraries, no further information is given. We will focus our attention on the first category and later (see Section 6.3) we will give detailed information on the opportunities for libraries.

EARN
The European Academic and Research Network is a general purpose computer network dedicated to Universities and research institutions throughout Europe, with extension to the Middle East and Africa. EARN maintains interconnections with other networks, mainly BITNET in the US and NORTHnet in Canada, Internet, Janet, EUnet, NORDUnet and others. It started operation in 1984 and
now connects more than 450 institutions in 27 countries and about 70,000 users. The communications are based in BSC, NJE, SNA, TCP/IP and OSI protocols. Services of EARN are electronic mail, file transfer, RJE, conferencing and archiving services.

As far as the Greek part of EARN is concerned, the national backbone is node GREARN, an IBM machine running VM, located at Iraklion/University of Crete and connected to EARN via a 4w leased line to Montpellier/France. There are 11 Greek nodes all connected to GREARN, except node GRPATEI (TEI of Patras) which is connected to GRPATVX1.

EUnet
The European Unix Network is a pan-European computer network. It started operation in 1982 and now connects more than 1300 organizations in 19 European countries and about 100,000 users. EUnet maintains interconnections with many other computer networks ACSnet, CSnet, Internet, Janet, EARN, BITNET, NORDUnet, etc. The communications are based on UUCP protocol. InterEUnet is the newest service of EUnet, which is based on TCP/IP protocol. Another service of EUnet, besides electronic mail and file transfer, is the EUnet news.

As far as the Greek part of EUnet (GRUnet) is concerned, the national backbone is node 'ariadne', a Sun 4 server running SunOS, located in Iraklion/CSI-FORTH and connected via the InterEUnet service to 'mcun' (EUnet's central backbone), in Amsterdam. There are over 28 Greek nodes all connected to 'ariadne' via UUCP dialup lines.

RIPE/Internet
Internet is a worldwide computer network. It started operation in 1975 and now connects more than 5000 organisations all over the world. Internet maintains interconnections with all existing networks. RIPE is the coordinating body of IP networking in Europe. The communications are based on the TCP/IP protocol. Actually, Internet is a big research project and not a commercial service network. The technical reports of the conducted research are known as Request For Comments (RFCs). Standard services of Internet are fast electronic mail delivery, file transfer, archive servers, and remote login.

As far as the Greek part of RIPE/Internet is concerned there is no national backbone. International connections to RIPE/Internet are maintained by CSI-FORTH in Iraklion (FORTHnet) and NRCPS 'DEMOKRITOS' in Athens (ARIADNEt). Any site able to maintain an IP network connection to either FORTHnet or ARIADNEt can be connected to RIPE/Internet. Unfortunately the slow (9.6 Kbps) transmission speeds of the international links severely limit and restrict their availability to a large community of users.
IXI/COSINE (ARIADNE)
IXI stands for International X.25 Infrastructure. It is a European Academic & Research Network backbone, based on X.25 technology, implemented by RARE (the coordinating body of academic and research networking activities in Europe) in the framework of the COSINE project. The main goal of the COSINE project was to encourage the development of open architecture networks, based on OSI protocols, for the benefit of the European academic and research community.

The Greek part of the IXI/COSINE project, known as ARIADNE, started operation in 1989. It is administered by the NRCPS 'DEMOKRITOS', in Athens, where the central X.25 switch is located and it serves more than 1000 users, in about 90 academic institutions and private companies with R&D activities. The communications are based on X.25, TCP/IP and OSI protocols. Apart from IXI, it is connected to Hellaspace, RIPE/Internet and EARN. ARIADNE offers standard X.25 and Internet services as well as X.400 electronic mail through COSINE/-MHS network.

Access to ARIADNE services is granted to connected users via:
- 4w leased lines (9.6 Kbps) to the central X.25 switch (22 sites)
- Hellaspace (8 sites)
- dialup facilities (60 sites).

Y-NET
This is an ESPRIT pan-European OSI infrastructure providing enhanced communication facilities, based on OSI protocols, to all the researchers involved in EC R&D programmes. It is an initiative of the European Commission and European IT manufacturers (Bull, Olivetti Systems & Networks and Siemens Nixdorf Informationssysteme). The aim of Y-NET is to promote the use of OSI services, especially in small and medium-sized enterprises (SMEs) who do not have access to communication networks, in order to improve their cooperation and liaison in R&D activities. Y-NET aims to offer:
- an OSI infrastructure providing the gradual introduction of a number of telematic services such as electronic mail, file transfer, directory services, and electronic data interchange (EDI);
- a reliable and dependable service offered via the Y-NET Service Points operating in each Member State. With a minimum of equipment such as a PC or a workstation, researchers will be able to access the local Service Point managed by the National Operational Unit providing the Y-NET service;
- an interconnection platform with other OSI services provided by the EUREKA COSINE and non-OSI services such as EUnet and EuroKom.

All participants in EC R&D programmes can use Y-NET to communicate with each other either:
- directly: via accessing their national Y-NET Service Point; or
- indirectly: via linking their in-house OSI systems to Y-NET.
The service Y-NET currently provides, is X.400 electronic mail, which can be used to exchange any kind of file (i.e. formatted documents, spreadsheets, source files, compiled programs, etc.). Interconnection with other scientific European e-mail networks, namely COSINE, EUnet and Eurokom, is also provided. The Y-NET service is provided in each Member State via organizations acting as National Operational Unit (NOUs) under the coordination of the Y-NET Management Unit (YMU) located in Brussels. The Y-NET Service Points are available 24 hours a day, 365 days a year to researchers engaged in EC R&D programmes. Subscription is free for the duration of the pilot phase. The NOU provides the following in the appropriate Member State language:

- Documentation
- User Support and Help Desk
- User Administration.

The Greek NOU is located at Hellenic ESPrIT Club, in Athens, and a large R&D community, in Greece, uses Y-NET services. Services of Y-NET are accessed by authorized users only, via either dialup facilities of the central node or X.25 networks (Hellaspac/ARIADNE). Y-NET services are free of charge during the pilot phase.

6.2.2.3 GRAN: The Greek Academic and Research Network initiative

The operation and prosperity of the above WANs is threatened, nowadays, mainly because of funding and administrative problems. EC and/or government funding of initiatives like EARN and ARIADNE, which also provide the gateways to international networks such as IXI and Internet, is running out. Last, but not least, recent developments and changes in the European networking scene, where users have to pay for the services they get, being connected to pan-European network backbones (i.e. E-BONE, EMPB, OU, etc.), had a great impact on the perspective of Greek Academic R&D WANs. Soon, it became clear that it was time for GRAN.

GRAN, stands for Greek Research and Academic Network, and is an initiative of the Ministry of Industry, Research and Energy (General Secretariat of Research and Technology). Mr. Penelis, the General Secretary, announced the GRAN initiative to representatives of Greek academic R&D institutions, on July 15th 1992.

The main idea of GRAN is that it could be easily established by the efficient merging of existing WAN infrastructures and services, for the benefit of the Greek R&D community. A technical committee was formed to handle the details and (most important) the conversion process from the current situation to that specified by the GRAN framework. Network Operations Centres (NOCs) will be established in Athens, Iraklion, Patras and Thessaloniki which will act as 'sockets' to GRAN services. The interconnection of these NOCs will form the GRAN backbone. NOCs in Athens and Iraklion will also provide the network links to
international computer networks. Users interested in getting network services on the regional/national/international level, will have to be connected to the nearest GRAN 'socket' (NOC) and they will have to pay for any services they get. ARIADNEt and the Greek parts of EARN and Internet have been invited to play a major role in the establishment of GRAN.

The author, being a member of the GRAN committee, believes that GRAN is the only way in which the Greek Academic R&D community can derive continuous benefit from state-of-the-art computer networking services, at the regional/national/international level.

The GRAN committee is expected to submit its conclusions by the end of October 1992. The complete proposal for the GRAN framework is expected to be approved by the General Secretariat of Research and Technology by the end of 1992. GRAN will enter its experimental phase in January 1993, but it is not expected to enter its full operation phase before January 1994.

6.3 OPPORTUNITIES FOR LIBRARIES

No doubt, the opportunities for Greek libraries regarding the information presented in Section 6.2, are many and of great importance, especially inside the GRAN framework. Libraries are welcomed as GRAN users. Once a library becomes (somehow) connected to the nearest GRAN NOC, automatically access to all/some GRAN services is granted. Of great importance to libraries are:

- remote login to OPACs and other online available information resources on the national/international level;
- electronic mail and conferencing (news). There are a lot of electronic forums, such as PACS-L, concerned with library automation issues.

Participants in the third Telephassa seminar, had the opportunity to experience the above services at the local/national/international level, during the hands-on sessions, through the networking environment/services of CT1net, the Local Area Network (LAN) of Computer Technology Institute (CTI).

6.3.1 A Greek 'Network of Libraries': Is it possible?

It should be evident, that inside the GRAN framework, Greek librarians have a unique opportunity to build their own 'virtual' network, proposed as the GOAL (Greek Openly Accessed Libraries) Network. Of course, this is not an easy task, even if we had GRAN fully operational. Fortunately, GOAL can take the form of an interesting joint project between Greek libraries and GRAN. I presume that GRAN will be glad to undertake such a project. So, the ball is in the Greek librarians' court.
The GOAL network, could be easily described according to the Network model of Figure 1. Greek libraries are just sites, equipped appropriately, in order to become connected to GRAN. GOAL, after its implementation, will provide a suitable networking platform for advanced 'virtual library' initiatives, at the regional/national/international level. Since, GRAN is committed to keeping up with technical advances in the area of computer networking and to provide state-of-the-art network services, GOAL is looking more promising than ever to libraries. So, from the technical point of view, the author believes that the implementation of the GOAL network is possible, but only inside the GRAN framework.

6.4 CONCLUSIONS

The detailed information presented in previous sections, concerning the telecommunications/networking infrastructure currently available in Greece, as well as the expected developments in the near future, made clear that ad hoc WAN initiatives (especially those for the benefit of the Greek academic/research community and libraries) will have difficulty surviving, if they continue to operate outside the GRAN framework. This framework is currently under development and will be glad to fulfil the networking needs of Greek libraries, inside the GOAL (Greek Openly Accessed Libraries) framework.

GRAN will soon (early 1993), be a reality. The Greek academic and research community has no alternatives. The opportunities will be many and of great importance. Greek librarians have to be more informed on the opportunities that GRAN will finally offer them, especially on the implementation of the GOAL network. GOAL will be the first Greek Network of Libraries, only after you, the Greek Librarians, decide to cooperate towards this goal. Find the way and take up the challenge. The author would be glad to provide technical (related to GRAN or other) information upon request. Please, feel free to contact him in any (electronic or other) way. He usually likes responding via e-mail, but he will also manage to respond on time via the public postal service, unless it is on strike!

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6.6 REFERENCES

1. O91] 'NETWORK', FORTH's network support team newsletter, Issue Number 1, Summer 1991
2. a91] Ioannis Gaviotis. 'An Overview of Library Automation in Greece: Present and Future Prospects', Proceeding of 1st Telephassa seminar on innovative information services and information handling, 1991