INTERNATIONAL ATOMIC ENERGY AGENCY
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
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H4.SMR/585-22

FIRST INTERNATIONAL SCHOOL ON COMPUTER NETWORK ANALYSIS AND MANAGEMENT

(3 - 14 December 1990)

EARN
The European Academic and Research Network

C.A. HERITIER

IBM - SUISSE
Geneva
SWITZERLAND

EARN
The European Academic and Research Network

Trieste 3 - 14 December 1990

Prof. C.A. Héritier
Geneva

First International School
on
Computer Network Analysis and Management

AGENDA

- Introduction
- EARN Structure / organization
- EARN today
- Communications / MAILER
- LISTSERV
- NETSERV
- User Directory
- Data bases

European Academic and Research Network

- EARN was initiated by IBM as part of its contribution to the European Academic Community.
- EARN is managed and controlled by its users.
- EARN is open to all academic, education and research institutions.
- EARN is open to all types of computers.
- EARN is connected to an equivalent
  - North American network (BITNET)
  - Canadian network (NORTHNET)
  - Asian network (ASIANET)

Computer Networks Objectives

- To allow the convenient, fast and unrestricted exchange of data, information and messages between the users having access to a computer connected to the network.

- With such a computer network, these users will be able to work closely with one another, even if geographically separated.

Computer Networks Objectives

- To distribute experimental data for analysis and to collect results for further study and publishing.

- To have informal discussions and to seek advice from colleagues working in the same or related fields.

- To work together on preparation and execution of joint projects.

- To prepare reports and papers together and to rapidly circulate them for correction and comments.

EARN Applications

- Message exchange.
- Data exchange.
- Computer conferencing.
- Access to remote applications.
- Remote data bases inquiries/update.
- Remote access to libraries.

EARN - IBM participation

- IBM initiated EARN in the fall 1982.
  - European scale project.
  - In the field of communication, today the most important for scientists.
- IBM supports it :
  - Technically
  - Financially (end 1987)
    - Telecommunication equipment
    - Telecommunication lines

EARN Management

- EARN is managed by its users.
  - EARN association created (Feb. 85) and
  - EARN Board of Directors (BoD) :
    - One representative per country.
    - One representative from CERN.

    The BoD meets twice a year.
  - EARN technical committees
- IBM is NOT part of the Board of Directors.

Other IBM contributions to the European Academic community

- IBM has always supported the European Academic Community :
  - Equipment donations
  - Scientific Centers
  - Professor's tours
  - Sabbatical years
  - IBM Europe Institute
  - European networking Center
  - European Center for Scientific and Engineering Computing.

EARN today (November 1990)

- 27 countries connected :

- Austria
- Belgium
- Cyprus
- CERN
- Denmark
- Egypt
- Finland
- France
- Germany
- Greece
- Iceland
- India
- Ireland
- Israel
- Italy
- Ivory Coast
- Luxemburg
- Netherlands
- Norway
- Poland
- Portugal
- Spain
- Sweden
- Switzerland
- Turkey
- United Kingdom
- Yugoslavia

And connected to U.S.A., Canada and Asia.

- Access through "gateways" to preexisting national academic networks (U.K., Sweden, ...)

EARN Management

- EARN executive committee :
  - EARN officers
  - EARN technical committees chairmen

  The executive committee meets 4 times a year.

- EARN officers (1989-1990)
  - Chairman F. Greisen (U. of Copenhaguen)
  - Vice Chairman M. Hebgen (U. of Heidelberg)
  - Treasurer J.C. Ippolito (Montpellier)
  - Secretary P. Bryant (Rutherford Lab, U.K.)
  - Members A. Cohen (U. of Tel Aviv)
    D. Jennings (U. of Dublin)
    S. Trumpy (CNUCE, Italy)

EARN and OSI

- EARN has or will have access through "gateways" to several national academic networks :
  - In Germany : **DFN**
  - In Sweden : **SUNET**
  - In the U.K. : **JANET**
  - Etc...
  - IBM is helping EARN in its migration to OSI and its building of gateways, particularly in the IBM Networking Center.

EARN and OSI

- EARN started in February 1984 using RSCS protocols (simple, reliable, used by BITNET).
- The EARN BoD decided to move EARN to OSI
  - Perequisite are :
    - ► Internationally defined OSI protocols.
    - ► OSI protocols should be implemented in products by all involved manufacturers.
    - ► These protocols should be technically and economically sound.

EARN Today

EARN/BITNET/NORTHNET/GULFNET/ASIANET

Number of countries	:	45
Number of nodes	:	3055
EARN nodes	:	1084
BITNET nodes	:	1791
NORTHNET nodes	:	180

Some countries

U.S.A.	:	1791	nodes
Germany (F.R.)	:	238	nodes
France	:	164	nodes
. . . .			
Poland	:		nodes
Yugoslavia	:	3	nodes
Czechoslovakia	:	1	node
Hungary	:	1	node

EARN and OSI

- An experimental use of X.25 (for communication) and X.400 (for message handling) has been defined and tests conducted (1986).

- Other protocols are considered :
  - NJE/OSI (IXI Pilot Project)
  - TCP/IP

- One of the EARN Board's objective is to migrate to "standard" protocols.

Communications under VM/CMS

- Functions
  - Electronic mail
  - File transfer
  - Remote job submission
  - Exchange of short messages
- Network address

  nodeid userid
- NAMES File

  Contains "userid/nodeid" of correspondants

  nicknamereference

  NAMES (Panel)
- Commands

  TELL name "message text"

  NOTE name < cc: name ... > < options ... >

  SENDFILE < fn ft fm > to < name >

  RDRLIST

  RECEIVE

  NETLOG file

EARN load

Period March 90 to August 90

- Average traffic per month

  473 million records

Country	Records sent	Records received
Germany	197.10^6	394.10^6
U.S.	316.10^6	102.10^6
France	154.10^6	139.10^6
. . .		
. . .		
Poland	415	5639
Hungary	0	44
Yugoslavia	567.10^3	$8,2.10^6$

NETSERV / Network Server

- File Server of EARN
  - specialized virtual machine
  - one server per country
- Functions
  - File server
  - Administration/control of the network
  - Maintains User Directory
- Machine waits for message and sends replies

  TELL NETSERV AT xxx Netserv command
- NETSERV commands

  GET fn ft

  SENDME fn ft

  GET NODENTRY nodeid

  HELP

  QUERY CMD

  . . .
- TELL NETSERV AT FRMOP11 GET NETSERV FILELIST

MAILER

- Tool to simplifiy the communications
- Virtual machine accessed by end user
- Performs the communications functions
  - communicates with other MAILERS
  - communications accross networks (single interface)
  - handles multiple copies
- HELP MAIL

  MAIL (Panel + PF Keys)

  MAIL name < cc: name ... >

  MAILBOOK to handle NOTEBOOKS

LISTSERV

List server

- EARN server for distribution lists - one per country
- A LIST is a set of users with a common interest - using for sharing information
- A LIST is used by LISTSERV to :
  - receive information, comments, programs, etc. from members of the list.
  - automatic redistribution to all members of the list
- To get help on LISTSERV's

  TELL LISTSERV AT FRMOP11 HELP (commands)

  TELL LISTSERV AT FRMOP11 INFO (list of guides)

  (or INFO GEN, INFO FILE, LIST GLOBAL)
- To subscribe to a list

  TELL LISTSERV AT FRMOP11 SUB listname name firstname

NETNAMES

User Directory

- Maintained in each country by NETSERV
- User commands ADD, DEL, REP
- NETNAMES (will invoke a panel)
- Name, address, function

  Domains of specialisation/Interest

- SEARCH for other users
  - per country
  - all countries
- Search results sent on-line
  - displayed at terminal
  - filed in NOTEBOOK's
  - copied in NAMES' file

Data Bases in EARN

- Homogeneous set of documents
  - Distribution lists archives
  - Directories
  - Bibliographical references
  - Publications lists
  - etc.
- Maintained by LISTSERV
- Accessed through interactive interface LDBASE
  - Tell Listserv at FRMOP11 Get LDBASE EXEC
  - Tell Listserv at FRMOP11 Get LSVIUCV MODULE
- Te get connected to specific DB's
  - LDBASE nodeid
- To know which DB are available
  - Tell Listserv at nodeid DATABASE LIST

LISTSERV

- Information on a list

  TELL LISTSERV AT listnodeid REView listname

  TELL LISTSERV AT listnodeid Query listname

  TELL LISTSERV AT listnodeid SET lisname option

  REVIEW : attributes and distribution list

  Query : user options - modify with SET

  INDex : description of each file

- To get a file

  TELL LISTSERV AT listnodeid GET fn ft

  TELL LISTSERV AT listnodeid GIVE fn ft userid AT nodeid

- Set of Commands for list management

ASTRA

Application Software and Technical Reports for Academia

- Joint Project of IBM and CNR (Italian National Research Council)
- Started in January 1988 for 2 years
- Design/implement a free European service through EARN for the distribution of :
  - information
  - software in public domain
  - documentation about academic projects in E + R
- Available since January 1990 to EARN users
- Results to EARN or CNR
  - Databases
  - Software
  - Documentation

  who will decide on future use

Search examples

- LDBASE nodeid
  - search * in EARN-UG
    - ► Database EARN-UG, 368 hits
  - search university in EARN-UG
    - ► Database EARN-UG, xxx hits
  - search * in EARN-UG since October 90
    - ► Database EARN-UG, xxx hits
  - search earn89 in EARN-UG
    - ► Database EARN-UG, xxx hits
  - index
    - ► list of hits with detailed information
  - print all
  - sendback print all

- To get LDBASE user guide
  - Tell Listerv at FRMOP11 INFO DATABASE

Access to ASTRA

- TELL ASTRADB AT ICNUCEVM SUBSRIBE

  firstname name

- Software sent automatically to user (ASTRA EXEC) with general info

- To start : ASTRA

- Selection panels

- Define Search criteria

- Results
  - numeric : number of documents
  - documents : all satisfying query
  - for STAR : software and reports related to project selected.

ASTRA Services

- Allow users to retrieve documents located
  - in ASTRA DB (CNUCE)
  - in remote DB

  with same user interface
- Based on the IBM STAIRS/CMS product
  - powerful information retrieval system
- The STAR DB
  - central european DB on educational/research projects
  - maintained by the ASTRA staff
  - bibliographic documents contain :

    title, abstract, name of participants, institutions, project description, HW/SW used, starting date, duration.
- Other DB available in Pisa

EASI
EUROPEAN ACADEMIC SUPERCOMPUTING INITIATIVE

EASINET

Trieste 3 - 14 December 1990

Prof. C.A. Héritier
Geneva

First International School
on
Computer Network Analysis and Management

Conclusion

- **EARN is the most important network in Europe for Academic and Research institutions :**
  - All European conutries involved
  - Links to USA, Canada and Asia
  - Academic community is enthusiastic
  - Heavy load, increasing rapidly
- **Future of EARN :**
  - Migration to OSI
  - Extensions
- **Major problem :**
  - Telecommunication lines tariffs

EASInet

- Interconnection of the European supercomputing centers via high speed links.
- Interconnection with the American supercomputing centers in NSFnet, via transatlantic T1 line
- Communication and sharing of information.
- IBM Scientific Centers

  Work with the scientific and research community

  - ECSEC (European Center for Scientific and Rome.

    Competence Center for supercomputing in Europe.

  - ENC (European Networking Center), Heidelberg.

    cooperation with

  - GMD (Gesellshaft für Mathematik un Dataverarbeitung), Bonn.

    to design and operate EASInet

EASI

European Academic Supercomputing Initiative

- Launched by IBM in 1987
- Partnership with leading enropean academic and research institutions
- Goals
  - Support wide scale use of modern high performance computing.
  - Help build a high speed European backbone network.
- Means
  - Establish competence centers in various aspects of supercomputing.
  - Provide Europe-wide support for education in vector and parallel computing.
  - Promote development and exchange of state-of-the-art software tools and application programs for high performance computing.
  - Centers utilize IBM 3090 Model 600 multiprocessors with Vector Facilities.

EASInet GUIDELINES

- o TOPOLOGY DETERMINED BY
  - PARTNERS WISHES
  - TECHNICAL CONSIDERATIONS
- o SHARE LINES WHEREVER POSSIBLE / BUT ONLY TO INCREASE TOTAL BANDWIDTH
- o USE IDNX BOXES WHERE SENSIBLE
- o NO RELIGIOUS VIEWS ON PROTOCOLS
  - SATISFY NEEDS OF EUROPEANS PARTNERS

IBM Academic Initiative in Czechoslovakia

- Partnership with the Czech. University of Technology (CVUT)
- IBM 3090 installed
- Base of EASI in Central Europe

  Hungary, Yugoslavia, Poland, ...
- CVUT connected to :

  Charles University
  Masaryk University (Brno)
  Slovak School of Engineering (Bratislava)
- Link to EARN
- Help develop Information Technology skills
- Technical staff of 15 at CVUT (Jiri Navratil, Proj. Mgr)

  Fluid dynamics, laser simulation,
  Fusion systems simulation, Pattern recognition,
  PROLOG, Automatic translation from English.

EASInet

- IBM COMMITMENT / 3 YEARS
- CONNECT EASI SITES TOGETHER VIA 64 Kb LINES
- IBM CONTRACTS NETWORK OPERATION TO GMD

HIGH SPEED EUROPEAN BACKBONE

- INSTALL FIRST T1 LINE FROM CERN - CORNELL
  - MOSTLY FOR EASI SITES
  - TEST NEW APPLICATIONS
  - TRY SOME VIDEO EXPERIMENTS
- AD HOC USERS COMMITTEE
- SHARE BANDWIDTH WHEREVER POSSIBLE
  TO BUILD 2 Mb BACKBONE
- PREPARE FOR EXPERIMENTATION ON HIGHER SPEEDS
  - T3
  - GIGABIT NETWORKING

GMD is ...

- one of 13 national research centers,
- the national reseach center for computer science and communications,
- locations in St. Augustin, Bonn, Cologne, Karlsruhe, Berlin, Darmstadt, Washington, Tokyo, Berkeley.

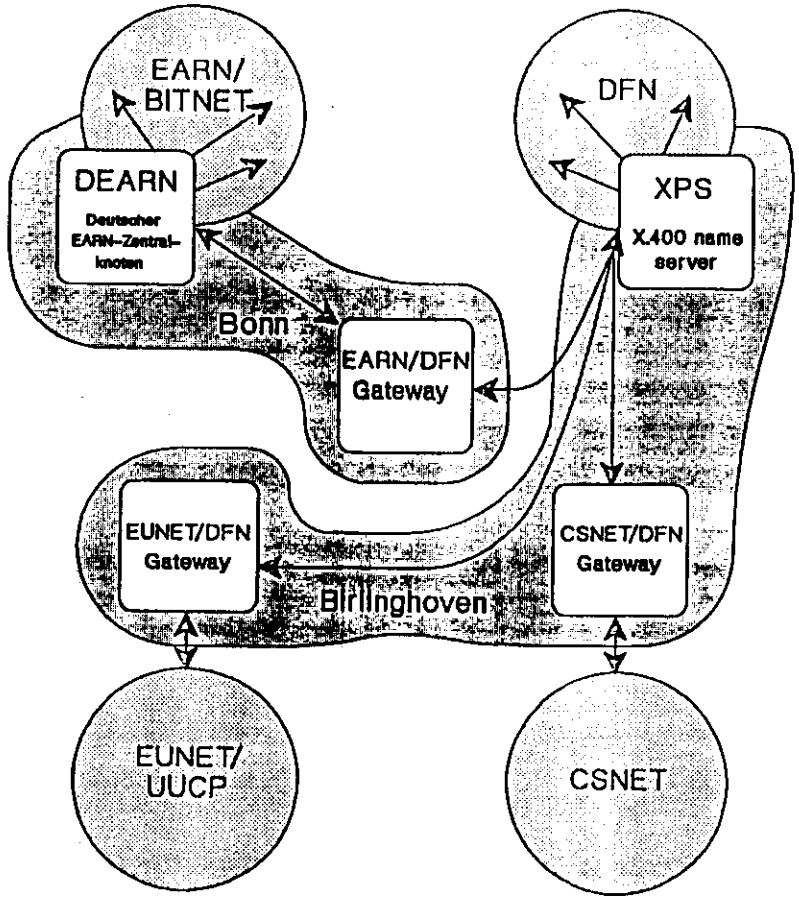
EASInet sites

1. RWTH Aachen, Germany
2. CINECA Bologna, Italy
3. CEA Paris, France
4. CERN Geneva, Switzerland
5. CNUSC Montpellier, France
6. IN2P3 Lyon, France
7. CIRCE Paris, France
8. KUL Leuven, Belgium
9. SDCN Skelleftea, Sweden
10. University of Vienna, Austria
11. University of Rome, Italy
12. GSI Darmstadt, Germany
13. ETH Zurich, Switzerland
14. SARA Amsterdam, The Netherlands
15. DESY Hamburg, Germany
16. University Braunschweig, Germany
17. KfK Karlsruhe, Germany
18. FCR Barcelona, Spain

Current networking activities at GMD ...

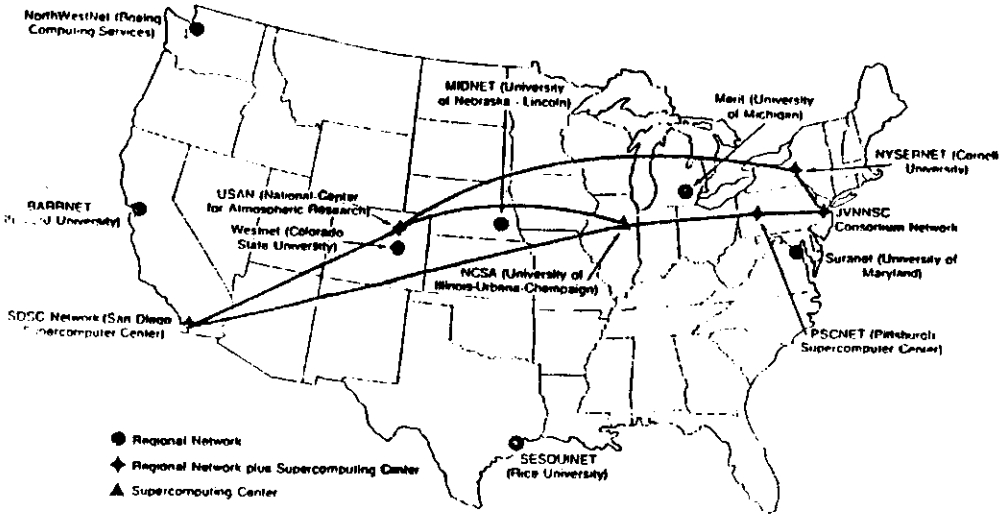
- building a national backbone (AGFnet) capable of OSI (DFN) EARN and SNA protocols,
- operation of the EARN national node,
- operation of central DFN-facilities,
- X.400 MHS / RFC 822 MHS and gateway development (together with SOFTLAB, sponsored by DFN),
- SNAPAD, X.29, VT100 and IBM 3270 emulation for MVS and VM (initially sponsored by DFN) via X.25,
- some cooperations with IBM on network management,
- EASInet - planning, management and operation,
- a lot of ongoing research work.

Scientific networking at GMD



BACKGROUND - NSFNET Motivation

National Science Foundation Objectives :



- Widen Access to NSF Funded Supercomputer Centers
- Advance Scientific Collaboration on a National Scale
- Speed Dissemination of Research Results
- Provide an Experimental Platform for Network Research
- Establish U.S. Leadership in Networking Technology

BACKGROUND

OPPORTUNITY - CONGRESSIONAL NETWORK STUDY

Office of Science and Technology Policy (OSTP) Establishes FCCSET

Federal Coordinating Council on Science, Engineering and Technology

FCCSET REPORT

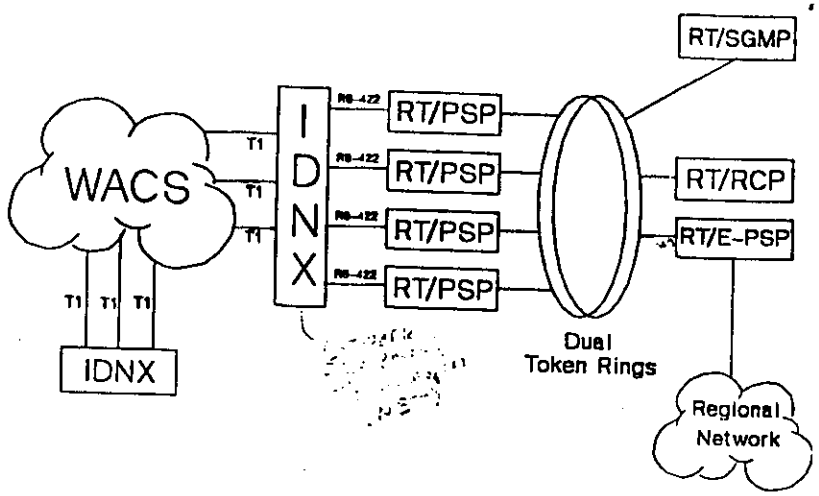
- Public Law 99-383 (1986) established study to evaluate/ recommend networking requirements for linking academic and federally supported research computers, including supercomputers

- Study Conducted by Interagency Group
  - Participants from Government, Universities, National Labs, Industry

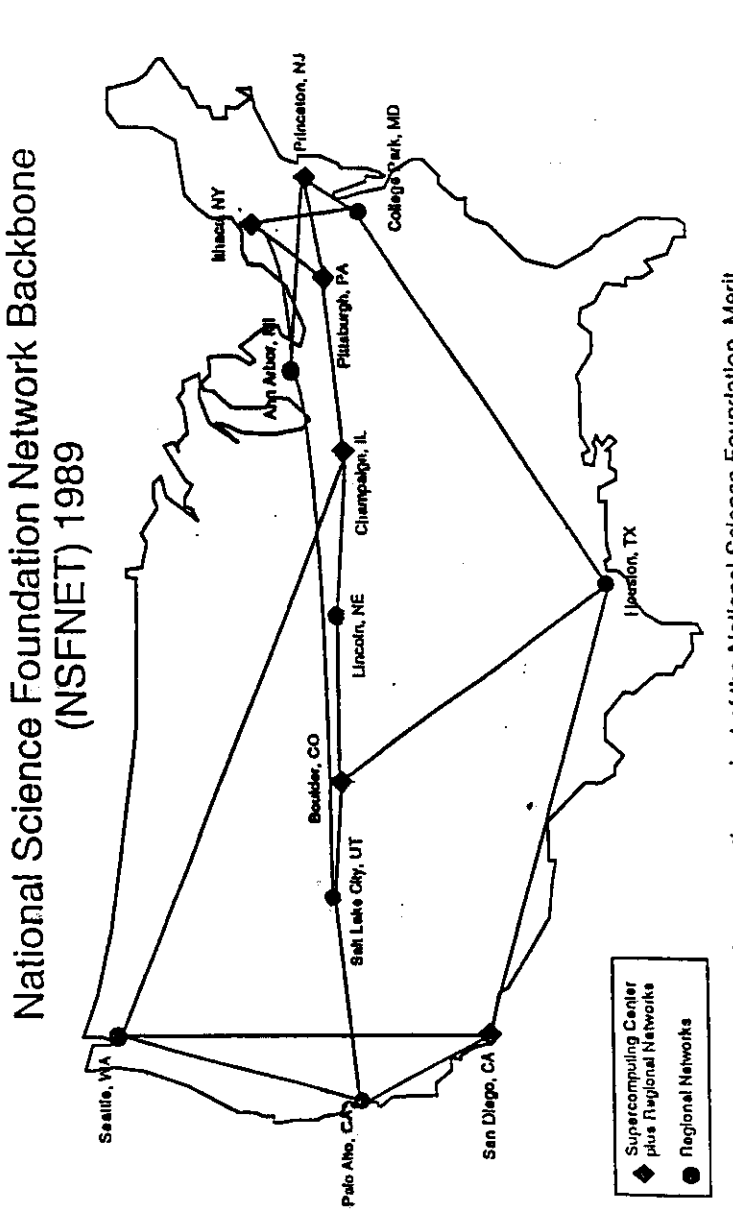
- Recommendations
  - NSF Be Designated as Lead Agency
  - $175 Million Over Next 5 Years to Upgrade Existing Networks
  - $200 Million Over Next 5 Years for R & D in National Networking
  - Advanced 3 Gb/s Network to be Deployed by 1997 - $300 Million/Year

NSFNET Work Products

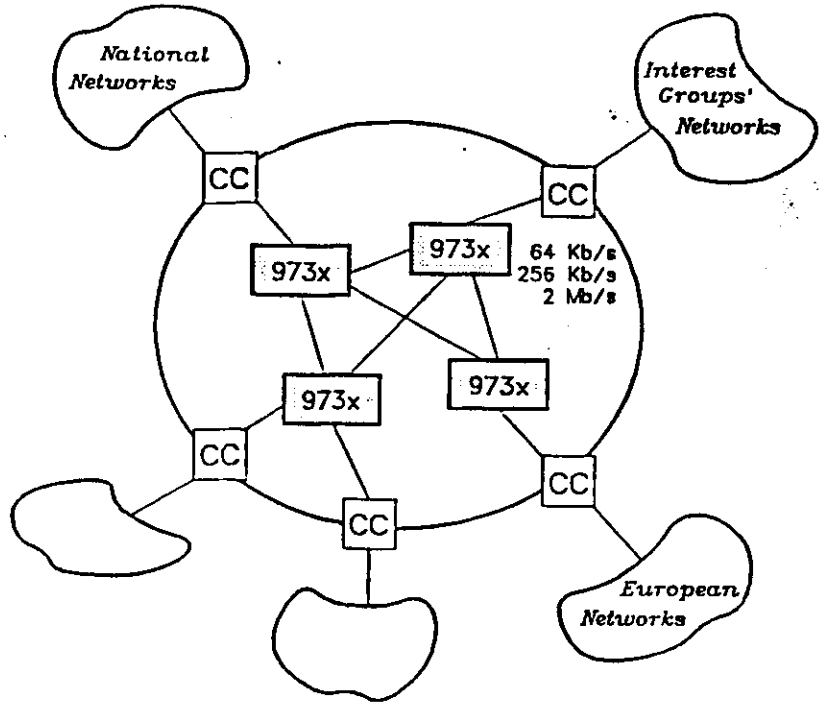
IBM Develops Nodal Switching Sub-system (NSS)



- IDNX Multiplexor Interfaces to T1 Circuits at Each Node
- RT/PC Packet Switching Processors (PSP)
  - RT/PC RS-422 Card Interfaces to IDNX @ 1/2 T1 Full Duplex
  - TCP/IP Protocols Running Under BSD 4.3
  - Aggregate Data Rate ≅ 2.8 Mbps With 4-RT/PC's
- Dual 4 Mb/s Token Ring LAN's
- RT/PC Routing Control Processor (RCP)
  - Computes Packet Routing Tables For PSP's
  - Based Upon Shortest Path First (SPF) Algorithm
- RT/PC Exterior Packet Switching Processor (E-PSP)
  - Routes Packets $\rightleftharpoons$ Regional/Local Networks
  - Based on Exterior Gateway Protocol (EGP)



Proposed Solution for Convergence



The Integrated European Academic Networking Backbone

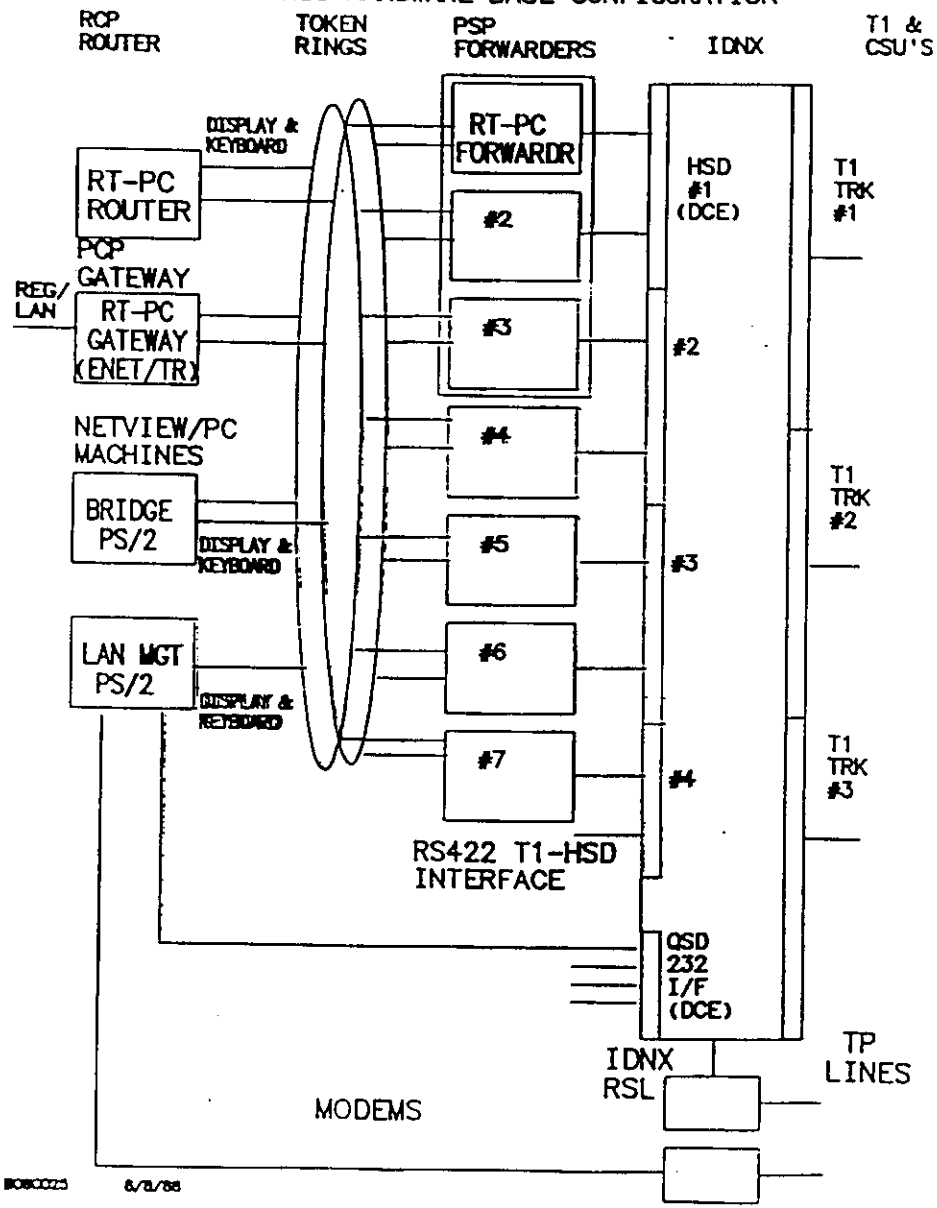
Different Protocols

Applications	Protocols		
	SNA	TCP/IP	ISO/OSI
Mail	BSMTP (NJE)	SMTP	X.400
File Transfer	NJE, BDT Netview/FTP	FTP	FTAM
Dialog	3270	TELNET	Triple-X
Directories	NETSERV		X.500

IBM TECHNICAL COMPUTING SYSTEMS
COMM. PRODUCT DEVELOPMENT

NSFNET
NSS CONFIGURATION

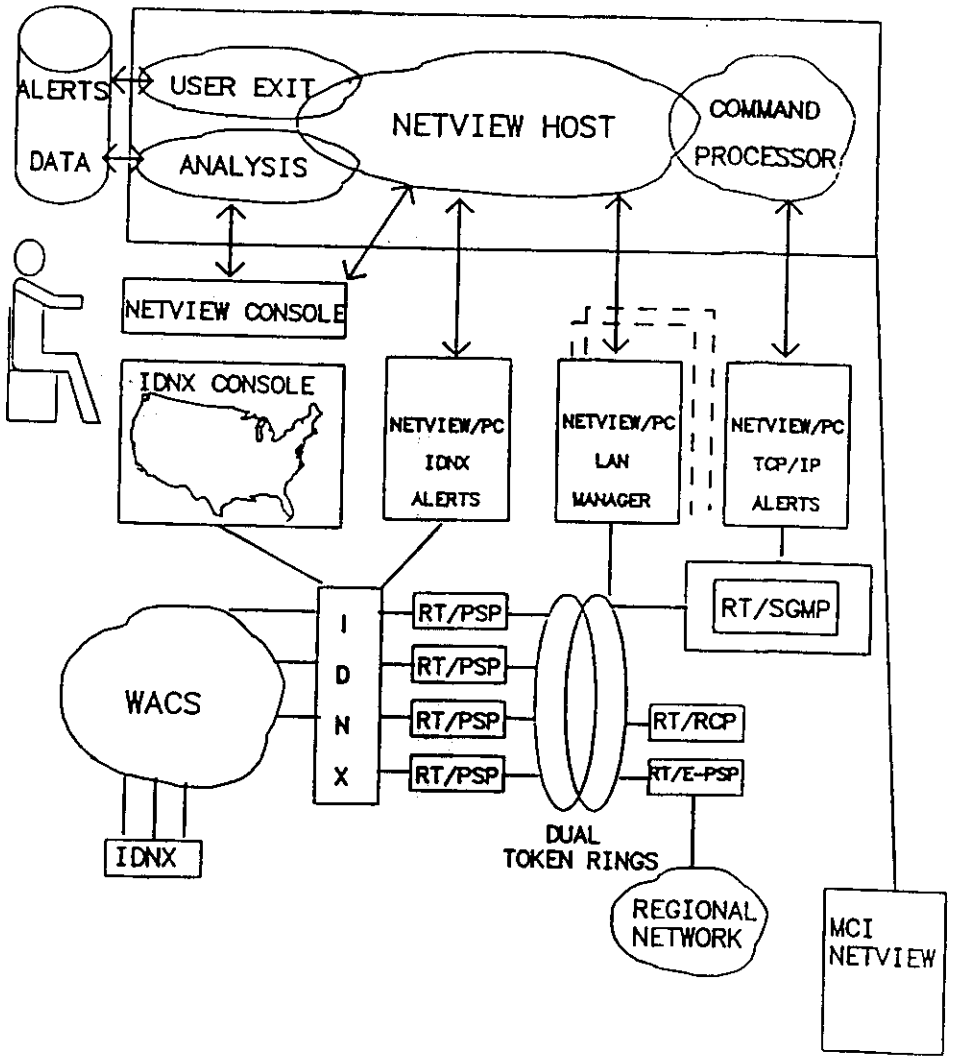
NSFNET NSS HARDWARE BASE CONFIGURATION



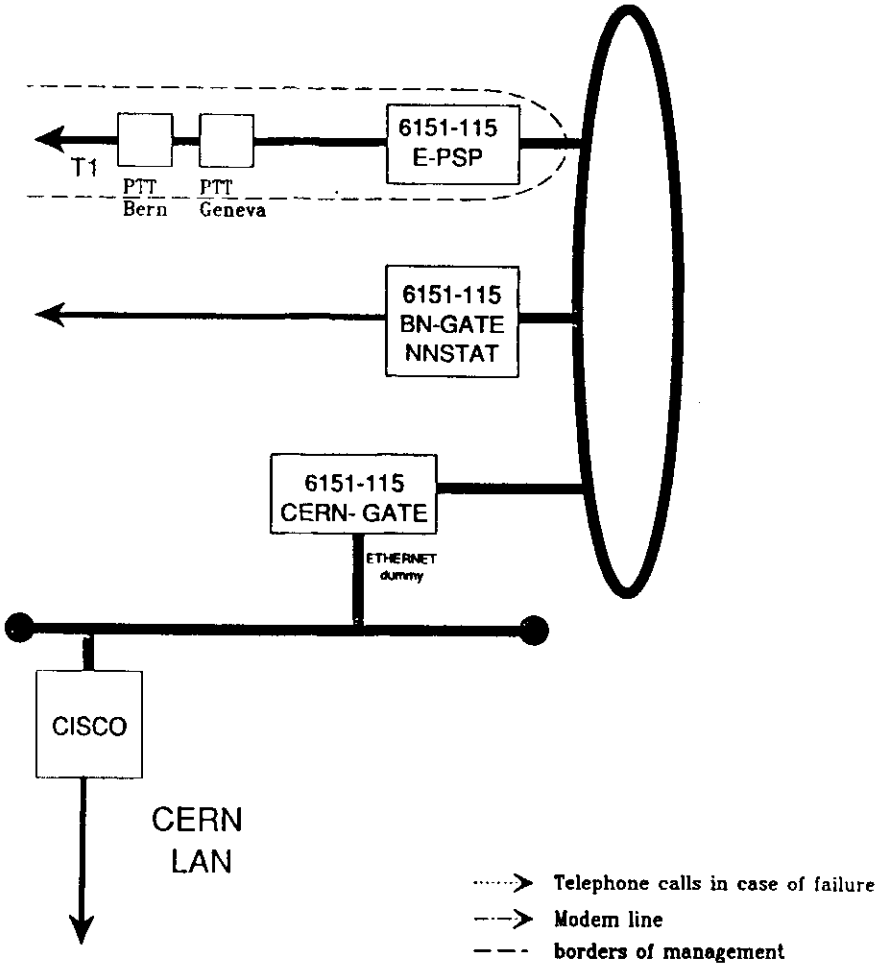
IBM TECHNICAL COMPUTING SYSTEMS
COMM. PROD. DEVELOPMENT

NSFNET
OVERVIEW

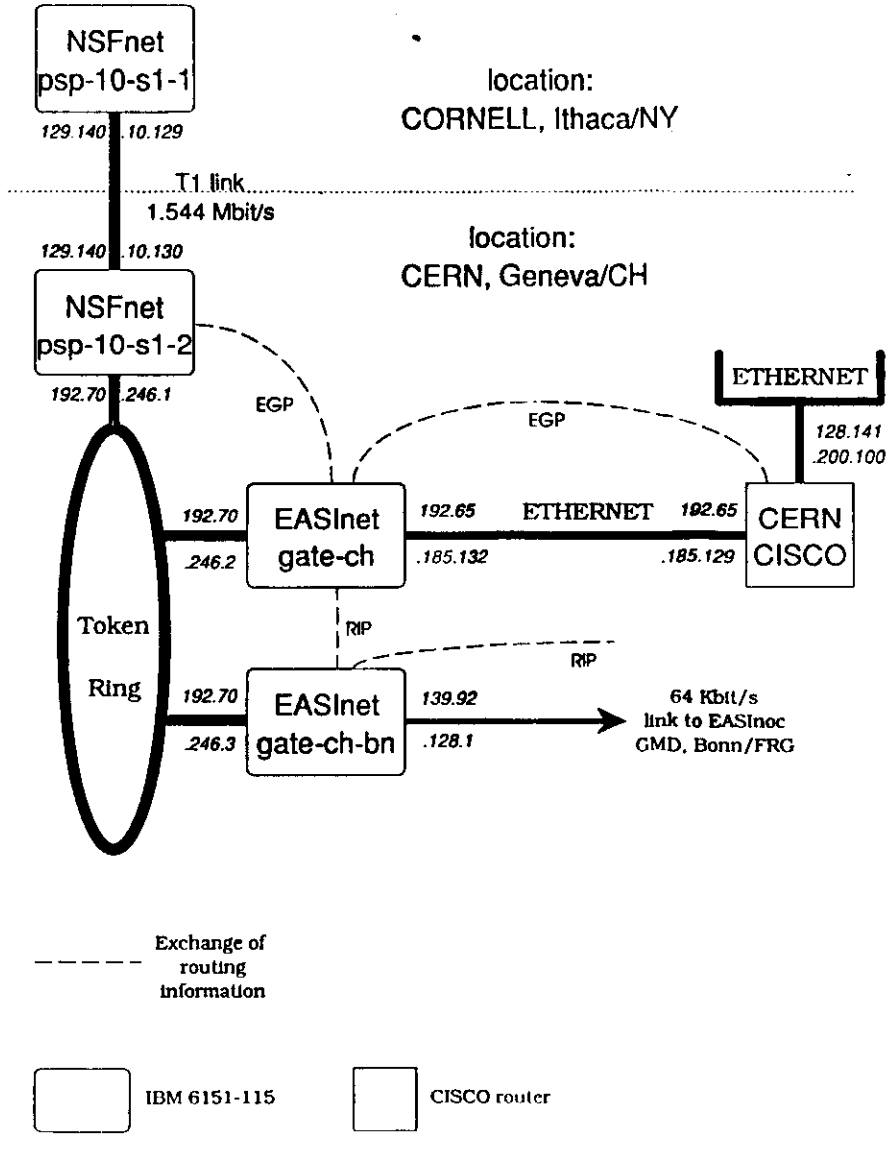
NMS ARCHITECTURE



EASInet CERN

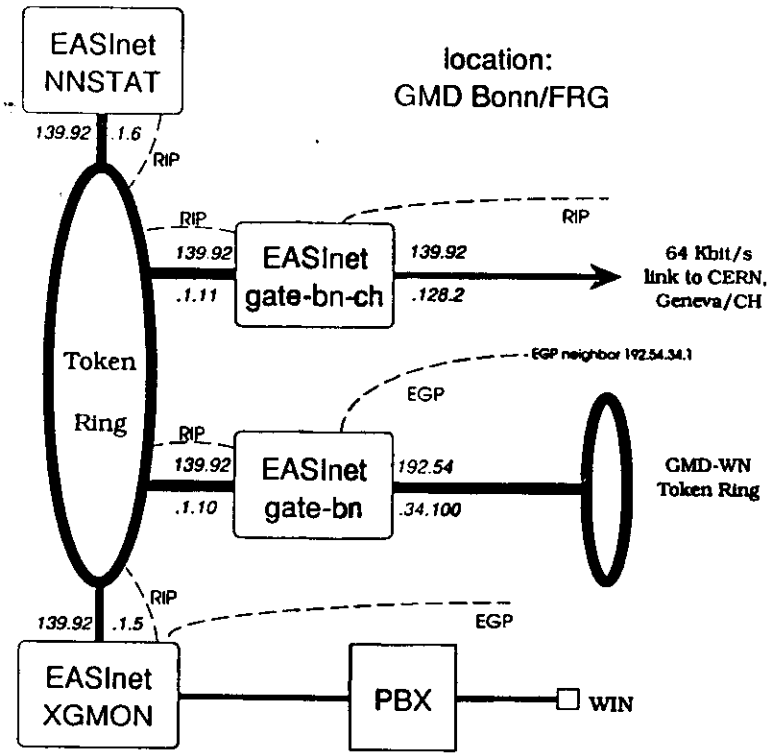


EASIgate configuration



EASInet GMD

configuration

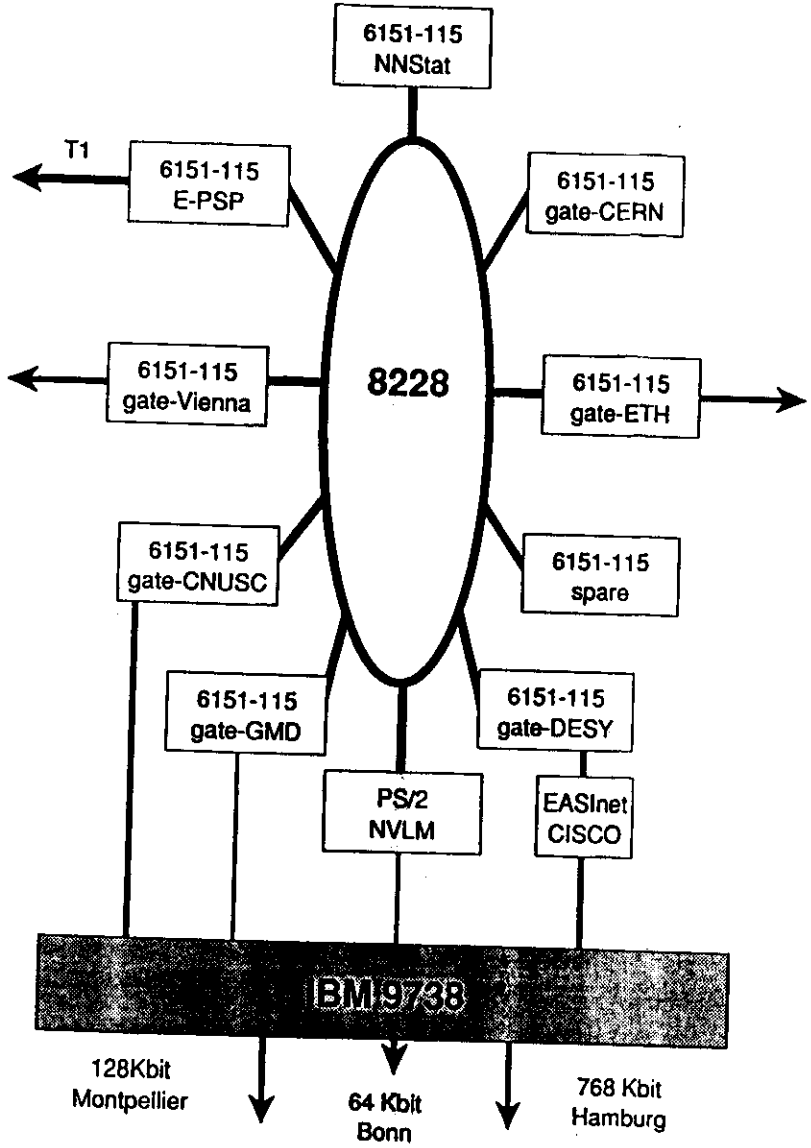


IBM 6150-125 or IBM 6151-115

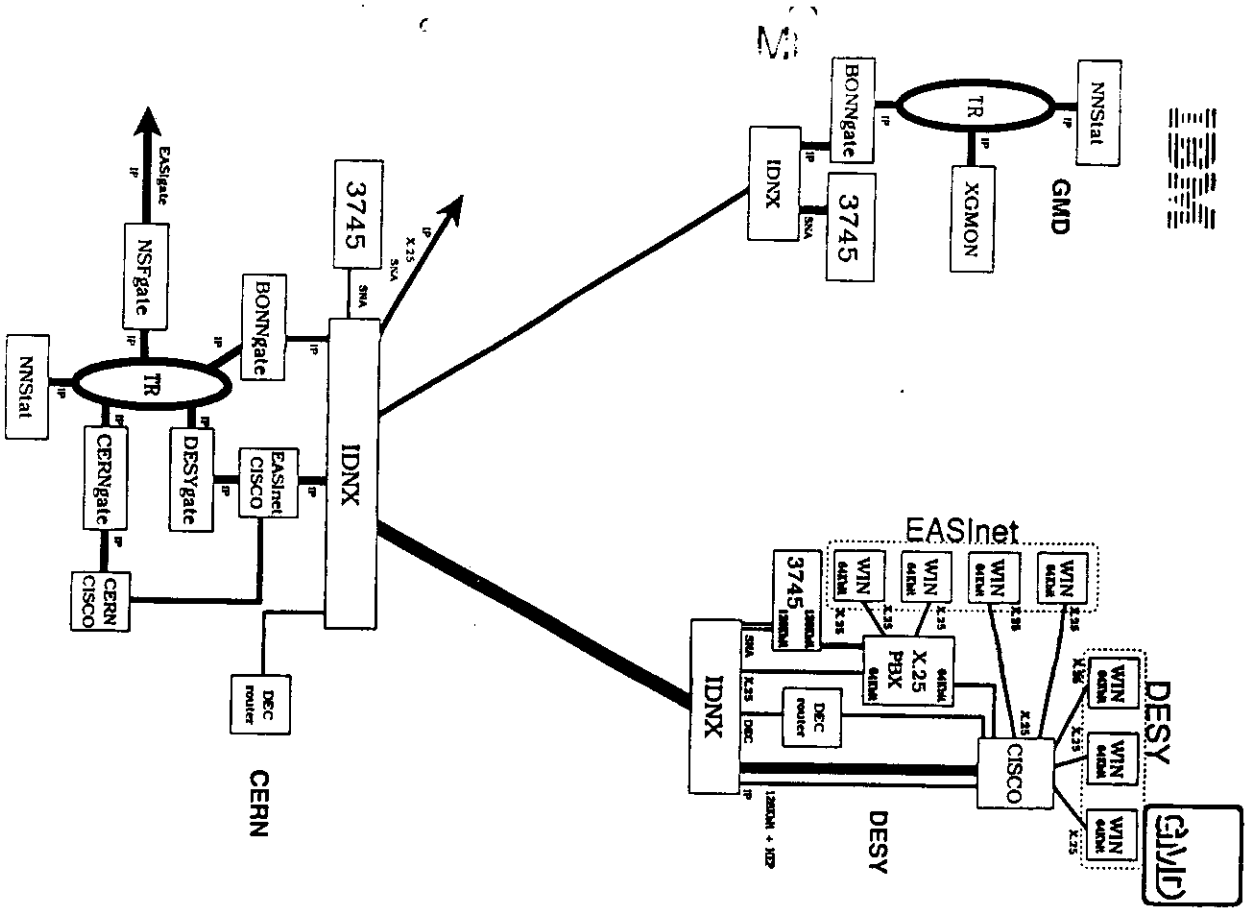
Exchange of routing information

WIP 05/11/90

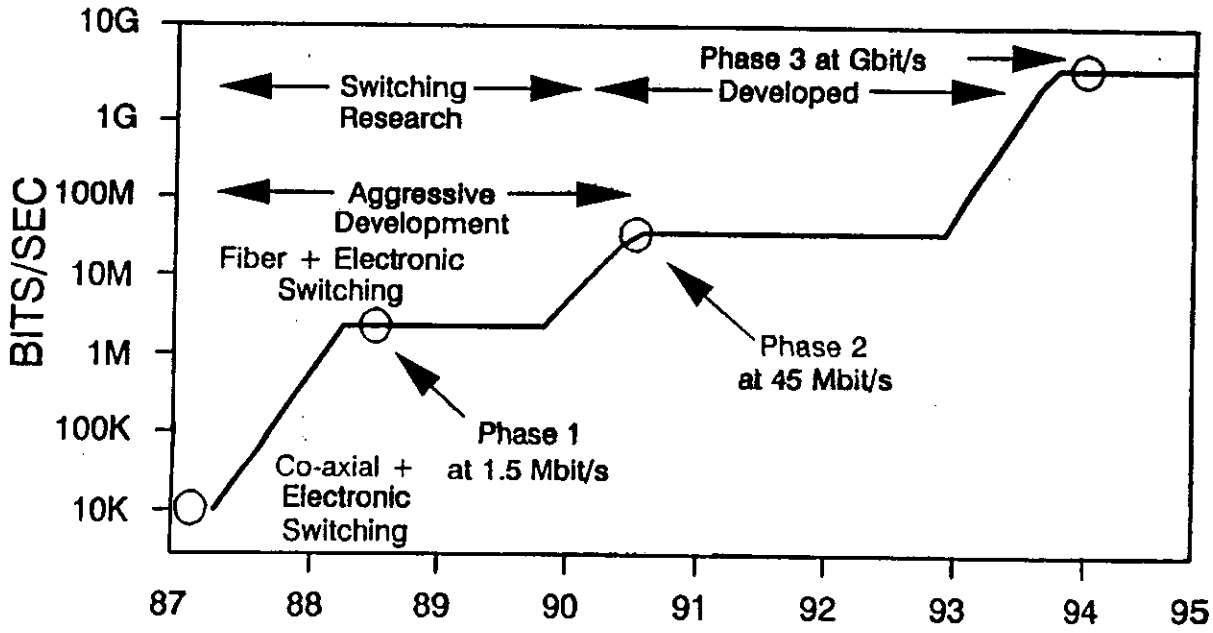
EASInet CERN



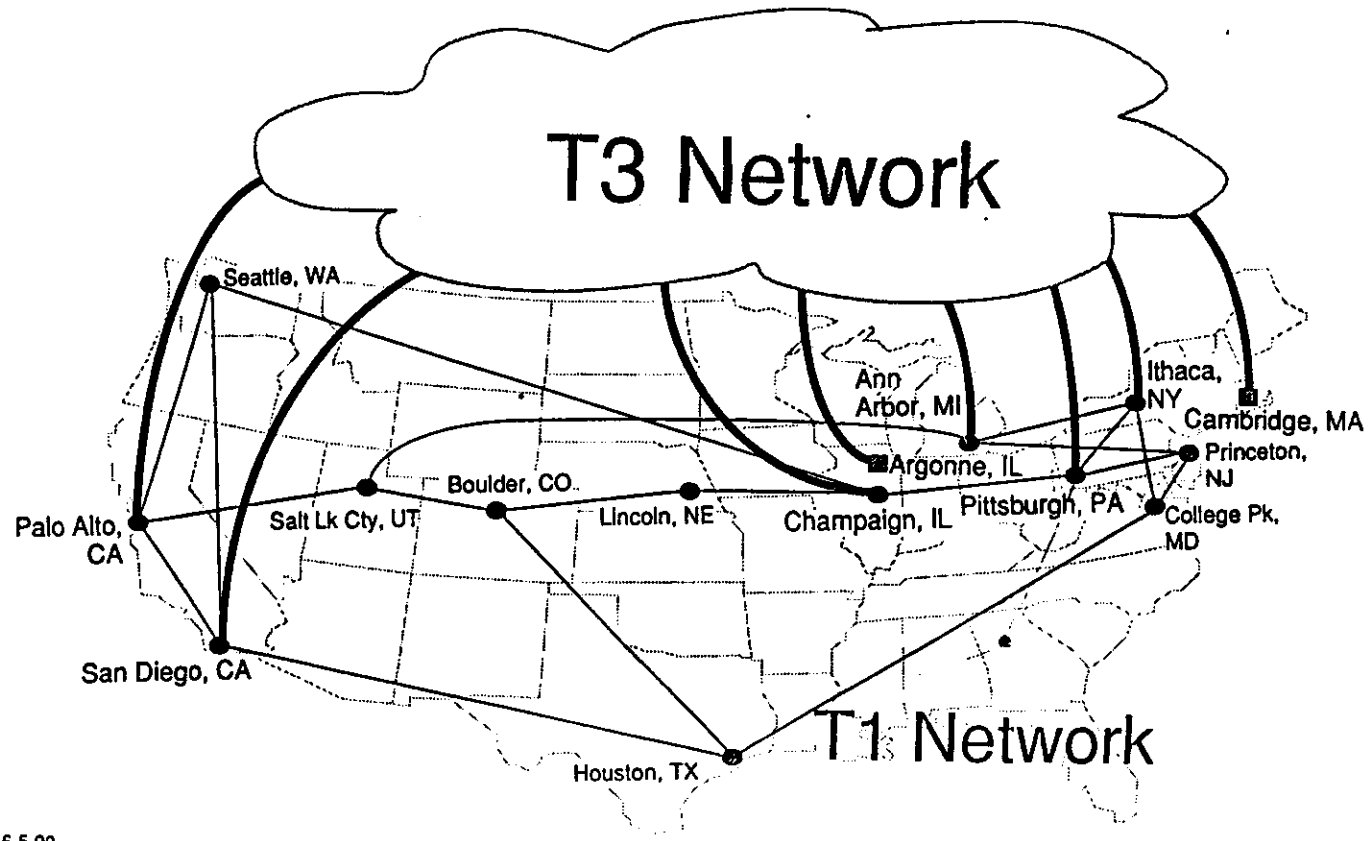
WIP/DST/08/05/1990



TIMETABLE FOR NATIONAL RESEARCH NETWORK



NSFNET T1 (1.54 . ops) / T3 (45 Mbps) Backbone Interconnection



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