

Initial NORDUnet – the first multiprotocol network

Strategy, solutions, results

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NORDUNET – 25 years of successful nordic cooperation

- NORDUNET – a cooperation forum, a development program, a data communication network
 - * The NORDUNET conferences – important forum for nordic data networkers and users
 - * First NORDUNET conference in 1980 initiated by NORDFORSK
 - Key meeting place and laboratory to develop and exchange ideas and identify tasks to promote networking in the Nordic area during 25 years
 - Comprising networking enthusiasts and experts, key personell for nordic networking and network users
 - The first NORDUNET development program 1985 – 1990
 - The program proposal was written by a group established at the NORDUNET conference in Helsinki 1983, approved by the Nordic Council of Ministers in 1985
 - * Aim to establish a common nordic data network for academia and R&D, and to promote a common nordic framework for data communication pilots
 - 10 MSEK to be contributed by the Nordic Council of Ministers, in addition to contributions by the nordic national network projects
 - Several members of this group also continued in the NORDUNET steering committee appointed in 1985
 - The NORDUnet network – the legitimate child of the NORDUNET program – network inaugurated in 1989
 - Decisive support by the Nordic Council of Ministers both for the conferences, the development program and the network

Background at NORDUNET startup 1985

- Build up period of national academic networks in the Nordic countries and elsewhere in Europe
 - * Many national development programs for data communication resulting in "home made" protocols, pilot services and software prototypes, but *operational services* were few and not very stable.
 - Interconnection between machines and services was rare and very limited, both within the countries and even more so internationally.
 - * Real time data communication in the nordic countries was limited to hosts connected to the public (X.25) telecom services, used mainly for simple terminal access (the PAD service) and transfer of mail (X.400 EAN mail)
 - Lack of general connectivity and absence of standard network and application services enforced focus on networks based on "store and forward"-technology (EUNET and EARN). Also it created much work towards application gateways, especially mail gateways,
 - TCP/IP was not important for wide area data communication, but in LANs. Also important for some "privileged" users at some university institutes in Norway connected to the ARPA node at Kjeller near Oslo.
- Important european international network initiatives
 - EARN network established 1984, based on leased lines, nodes in all nordic countries. Lines paid by IBM, based on IBM protocols, IBM software and machines.
 - EUNET (USENET) based on UNIX UUCP and dial up connections, important for the mail services both in Scandinavia and elsewhere in Europe.
 - HEPnet, international data network for high energy physicists based on DECnet, organized by CERN.
 - RARE, no network, but umbrella for the european network organizations established at the same time as NORDUNET

Background – political battlefield

- Widely differing views on development strategies both in the nordic countries and elsewhere in Europe
 - * Widely recognized need for standardization of protocols and services based on OSI in almost all networks and user communities. But no OSI products available except for few, but important prototypes (EAN X.400 mail, later ISODE for FTAM, X.400 og X.500 directory services)
 - Key issue: Which interim solutions to choose, and how much emphasis?
 - * The "pragmatists" in HEPnet, EUnet, NORDUNET, and some national academic networks were open towards IP.
 - Large academic networks in Europe with little interest in interim services, rejecting IP
- Data communication as a political mine field – the protocol war
 - Data communication seen as a key area for industrial contention with US by the CEC Commision
 - Strong CEC support for OSI and the telecom network (X.25) services, i.e. ISO CONS.
 - CEC rejection of ISO IP service (ISO CLNS), and of TCP/IP as interim solution
 - Political pressure and limitations experienced by many national networks

The NORDUNET program 1985 - 1990

- NORDUNET original strategy to
 - * "establish an operational, stable nordic data network based on the nordic PTT services, and secondly establish connectivity to international data communication networks by supporting transition to accepted international standards"
 - * i.e. public X.25 and OSI, but also use of interim solutions
 - "build a common infrastructure and competence around this network based on local communities and resources"
 - i.e. emphasizing working groups and pilot projects promoting the various services, in close cooperation with the national academic network initiatives
- Phases of the NORDUNET project
 - 1985 - 1986: Surveys, investigations and pilot projects, both on OSI pilots and interim solutions
 - 1987: Moment of truth - the great reorientation
 - 1988: The NORDUnet implementation year
 - 1989: Opening of NORDUnet - the break through

Original NORDUNET working strategy

- Focus and emphasis on OSI
 - * Working group on X.400 mail and mail gateways
 - Organizing a nordic pilot X.400 mail service based on the EAN package developed by University of British Columbia
 - Also working groups on ISO FTAM file transfer services og X.500 directory services
 - E.g. organizing a pilot in 1988 comprising the ISODE FTAM prototype and Digitals first FTAM product.
 - Pilots on X.500 directory services based on the ISODE X.500 prototype
 - Close cooperation with RARE WGs
- Network services and interim application services
 - Initial view in NORDUNET that the network services of the academic communitis should be based on the PTT public X.25 services
 - Few real time user services, mainly terminal access via the simple, line-oriented CCITT PAD standards
 - Lack of good solutions for file transfer
 - Surveys and pilots directed towards the UNINETT file transfer proposal and the UK Blue Book protocol, but no operational service established
 - Initiatives towards CERN to acquire their file gateway software GIFT - to enable tile transfer between DECNET, Blue Book, ARPA ftp. EARN file transfer later added as a result of FUNET work, also ISO FTAM. But no gateway service established.
 - TCP/IP not considered initially...
 - ... because of the limitations of the ARPA network at that time
 - ... and because of our own illusions of fast transition to OSI

The great reorientation - status 1987

- NORDUNET project status spring 1987 – lack of progress concerning nordic operational network services
 - * Some progress in mail services due to the X.400 work on EAN, which also served as gateway toward DECnet mail, SMTP of Internet and the EARN mail service.
 - ... but small or negligible progress to promote terminal access, file transfer or other real time services
 - ... and very limited internordic traffic capacity via public X.25
- Reassessing time horizon for operational OSI services
 - Not possible to establish an operational OSI network with desired services, extent and connectivity within at least 10 - 15 years, ie not within the time frame of the running NORDUNET program
 - * Slow progress of ISO standardization work
 - Few (and simple) products from the industry
 - Many unsolved problems, e.g. concerning addressing and routing
- NORDUNET facing the need for a revised strategy – the two leg strategy
 - Continued work on OSI
 - ... but much more emphasis on building operational "interim" network services

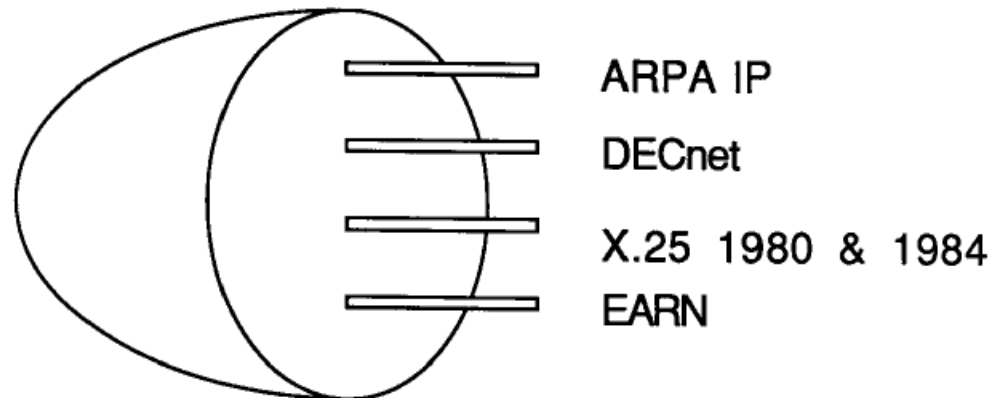
The great reorientation – birth of NORDUnet idea

- Three important conditions and a golden opportunity
 - The new conditions – the new possibilities
 - New products and progress in network technology, especially LAN technology and client server technology based on TCP/IP
 - * Proliferation of LAN "islands" with local interconnectivity based on TCP/IP, but with little or no national or international interconnection
 - Emergence of products to interconnect Ethernet segments over slow lines – first experience with the Vitalink TRANSLAN bridges
 - Because all desired protocols and services could run over Ethernet, this made it possible for the first time to run a multiprotocol wide area Ethernet
 - Closing down of the old restricted ARPA network, transforming the net into a closed, military part and the much more open NSFnet
 - Opened the possibility for a common nordic connection to the US Internet
 - NORDUNET had established close contact and close cooperation with the most important European user services, including EARN, HEPnet and EUnet
- The golden opportunity – common nordic use of EARN infrastructure – the X.EARN proposal
 - Funding of EARN international lines to be overtaken by the national academic networks by the national nordic networks represented in NORDUNET.
 - Hot discussions within the NORDUNET leadership on how to take full advantage of the EARN connections, not only for EARN traffic but also other desired network services, especially IP.
 - The goal to establish a common nordic backbone based on (upgraded) EARN lines was placed before a special task force, the X.EARN group, autumn 1987.
 - Beside internordic internetwork services the backbone should also offer common nordic connections to all important international network services, especially the US Internet
 - The X.EARN recommendations were approved by the NORDUNET steering committee january 1988

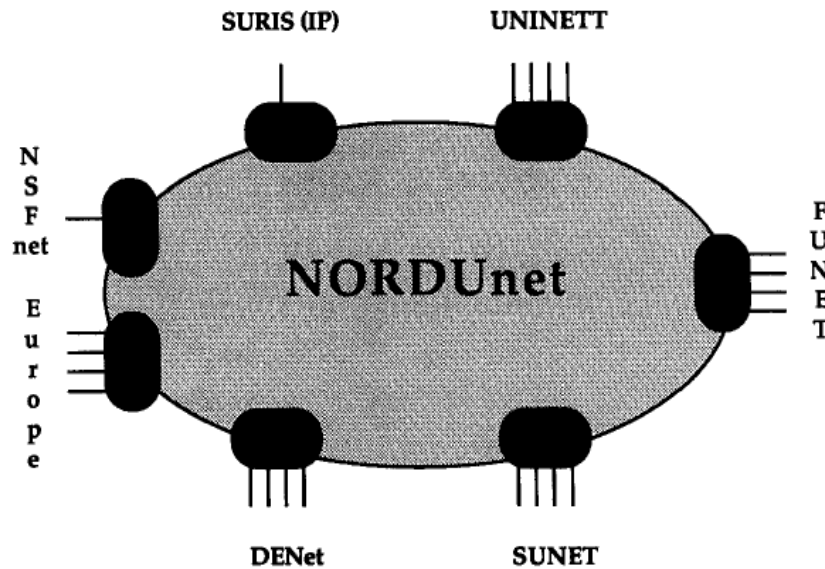
Realization of NORDUnet

- The NORDUnet plug as a metaphore of the services to be offered the nordic national networks:
 - * The TCP/IP pin: Access to a common nordic Internet sharing connections to the US Internet and other European IP services, e.g. EUNET
 - The DECnet pin: A nordic DECnet for high energy physicists and space researchers having access to the international HEPnet and SPAN DECnet
 - The X.25 pin: A nordic X.25 private network - after some time also connecting the COSINE IXI X.25 services.
 - The EARN pin: Sustaining the traditional nordic EARN services

The NORDUnet plug (or socket)



NORDUnet backbone - connections



US:

NSFnet, ARPA Internet IP

Europe:

- EARN
- SPAN/HEPnet
- EUnet
- X.25 IXI-pilot

NORDUnet realization

- Implementation of NORDUnet backbone 1988/89
 - Internal organization of NORDUnet as a wide area Ethernet
 - Ethernet segments - one in each country - connected via bridges using internordic 64 kbit connections
 - The "pins" were realized using standard router technology (Cisco for IP og DEC products for DECnet), plus X.25 switches able to communicate over Ethernet (Camtech switches). The EARN pin was first implemented using band splitting to interconnect the existing nordic EARN nodes, the idea being that this solution should be replaced by the so-called "G-boxes" (DEC VAX/VMS machines supporting the EARN IBM protocols).
 - The international connections operational during autumn 1988 - early in the winter 1989
- In parallell a vast construction period of the nordic national network services
 - Creating national backbones connected to the NORDUnet backbone, either copying the idea and technology of the NORDUnet backbone or using private X.25 as a national carrier service.
 - Implementation of national DECnet and IP services during 1989, especially extensive national IP networks

NORDUnet and Europe

- The revised NORDUNET strategy and the NORDUnet idea was very controversial in Europe
 - Support from important user communities, including the HEP community and CERN, EUnet, some "pragmatic" academic national network projects
 - Not very popular in RARE leading bodies, who relied on the strategy and goals of the CEC COSINE initiative
 - Focus on OSI services and a pan European X.25 backbone (IXI) for R&D
 - The new NORDUNET strategy and the NORDUnet plug was presented to the european academic networks at the RARE conference in Trieste may 1989:
 - TCP/IP should be recognized as European network service - not only a US phenomena, as it was already the most widely used data communication technology in Europe
 - OSI lacked solutions for routing and addressing. Also the absence of a distributed hierarchical naming- and addressing service like the DNS system (Domain Name Service) made it impossible to meet the demands of interconnectivity and scaleability of a rapidly growing communication network
 - OSI transport service not as functional and adaptable to varying network environments as TCP/IP
 - The challenge - develop European IP services in a planned and organized way, seek cooperation with Internet communities overseas on OSI pilots

NORDUnet results – the break through

- A vast and immediate success, establishing overnight a new and lasting platform for data communication services for the nordic countries
 - Bringing Internet out to academia and R&D throughout the Nordic countries
 - 5500 machines connected to the Nordic Internet already in May 1989, then a yearly growth rate of 150%.
- Giving the nordic countries a lead in Europe in Internet development and data communication services
 - October 1990: "NORDUnet traffic amount to more than 50% of NSFnet total with Europe, The NORDUnet connection being saturated more than 50% of the time" (Steve Goldstein, director NSFnet)
 - Gave the nordic countries an important position in European IP and in the international Internet bodies
 - Educated a new generation of nordic network experts, NORDUnet being a common reference promoting nordic cooperation in the field

NORDUNET afterthought

- The strongest asset of NORDUNET – the enthusiasm and dedication
- The vision of 25 years of NORDUNET data communication work
 - * seeing data communication as the runes of our time
 - also seeing data communication as the vehicle of our time to promote true human communication and understanding and human cooperation

*SKALAT MADR RUNAR RISTA , NEMA RÁDA VEL KUNNI
Egill Skalla-Grimsson*

*When man writes runes,
he should know their meaning*