

**Yearly Report and
Accounts 1999**

NORDUnet



NORDUnet A/S

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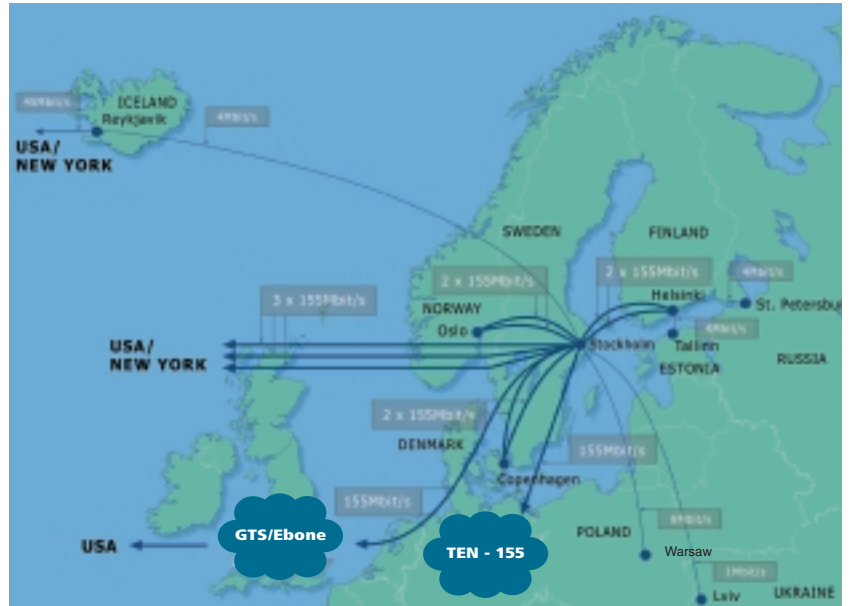
NORDUnet A/S

NORDUnet A/S is the common international IP service provider for the Nordic national networks for research and education. NORDUnet interconnects these networks and connects them with the rest of the Internet.

NORDUnet represents the Nordic networks in international research network collaborations in Europe, America and the Far East. The shareholders of NORDUnet A/S are government institutions in the Nordic countries.

Shareholders of NORDUnet A/S are:

- UNI-C, Denmark**
- Ministry of Education, Finland**
- University of Iceland**
- UNINETT A/S, Norway**
- National Agency for Higher Education, Sweden**



The topology of the NORDUnet network. Lines signify point-to-point circuits and clouds are connections to Internet services by other operators.

The Nordic networks for research and education

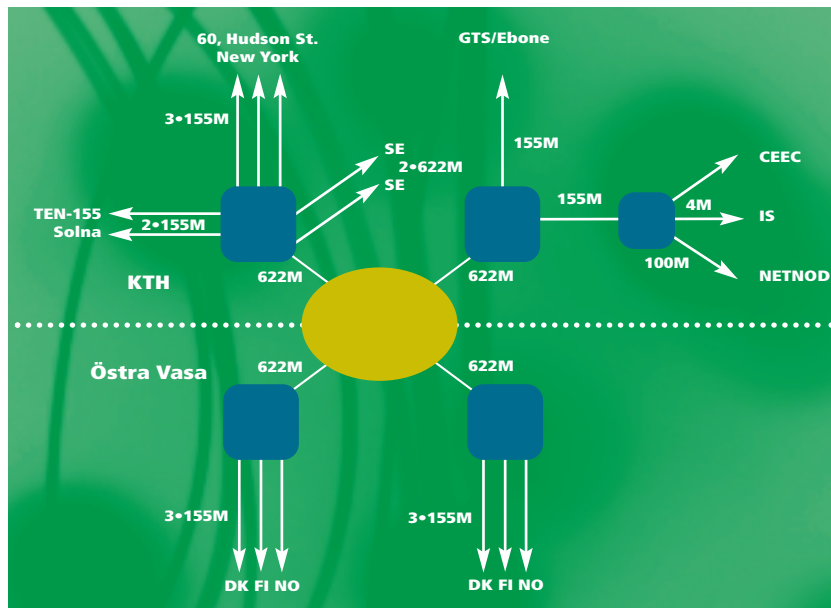
The Nordic networks for research and education serve publicly funded research and education in the Nordic countries. They are:

- Forskningsnet and Sektornet in Denmark**
- FUNET in Finland**
- INTIS in Iceland**
- UNINETT in Norway**
- SUNET in Sweden**

The Board of NORDUnet

-  **Markus Sadeniemi - Finland**
-  **Tor Bloch - Denmark**
-  **Hans Wallberg - Sweden**
-  **Helgi Jónsson - Iceland**
-  **Petter Kongshaug - Norway**





Schematic layout of NORDUnet's node in Stockholm. The white arrows are lines, the square boxes signify routers and the ellipsis is a dark fibre network.

Network connections

General

The NORDUnet network is designed to carry the IP traffic between the Nordic countries and the rest of the World with minimum delay. It is dimensioned so that the peak load normally does not exceed the network capacity.

The most economical way to do this is by having a star topology centred in Stockholm, as it corresponds to the traffic pattern.

However, if a branch of the star is cut, the country served by that branch will lose all service from it. In light of the increasing dependence of research and education on network services, a full cut-off has become unacceptable, so resilience against circuit and equipment

outage was added to the network during the year. The major routers were duplicated, and the capacity upgrade of the circuits was done by duplicating circuits instead of replacing them by ones of the next level of capacity, so the effect of a single circuit interruption is limited to a service level reduction instead of a full cut-off.

The Nordic system

The Nordic system interconnects the Nordic national networks for research and education in a star centred at Kungliga Tekniska Högskolan (KTH) in Stockholm.

At the start of 1999, the capacity was 155 Mbit/s to Copenhagen, Helsinki and Oslo, and 4 Mbit/s to Reykjavik. The 155 Mbit/s connections were established individually during 1998 as the technical and economical possibilities permitted.

The resulting central Nordic system consisted of the following circuits from KTH:

Copenhagen: A microwave link across Øresund with terrestrial circuit to Stockholm

Helsinki: A protected STM-1 circuit to Stockholm

Oslo: A non protected STM-1 circuit with a 34 Mbit/s link for emergency backup

Stockholm: A local interconnection at KTH



The microwave link to Denmark was supplemented by an unprotected 155 Mbit/s backup circuit in 1999 to prevent long outages in case of physical damage to the microwave installation.

Although there were no interruptions of the microwave link proper, the backup circuit gave a significant improvement of the reliability of the over all connection.

To consolidate the Nordic system and to cater to future capacity upgrades, a public call for tenders for the entire central Nordic system was issued in 1999. The call envisioned an upgrade to 622 Mbit/s and beyond over the next 3 years. The result was a new system of initially 310 Mbit/s made up of 2 unprotected STM-1 circuits each to Copenhagen, Helsinki and Oslo.

The circuits for Oslo and Helsinki were installed in September and those for Copenhagen in December, so by the end of the year the previous 155 Mbit/s system had been completely replaced.

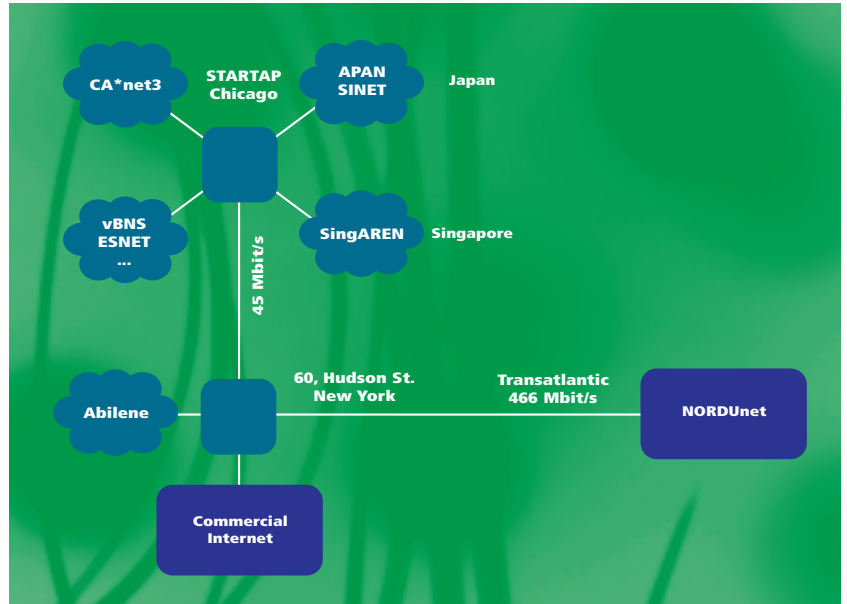
The new system was cheaper than its predecessor, and it was the best economical compromise between capacity and reliability. To increase the resilience in case of a major disaster at KTH, the new system is centred on the premises of the provider, where dual terminating routers are placed. They are in turn connected to KTH via duplicated dark fibre circuits. In this way all circuits, international as well as local, are duplicated and carried along geographically diverse paths. The duplication was achieved without large amounts of unused capacity that would have been the case in a protected system.

The direct 155 Mbit/s microwave link set up in 1997 between the universities in Lund and Copenhagen was terminated at the end of 1999. In the future, the universities will communicate via the national networks and NORDUnet.

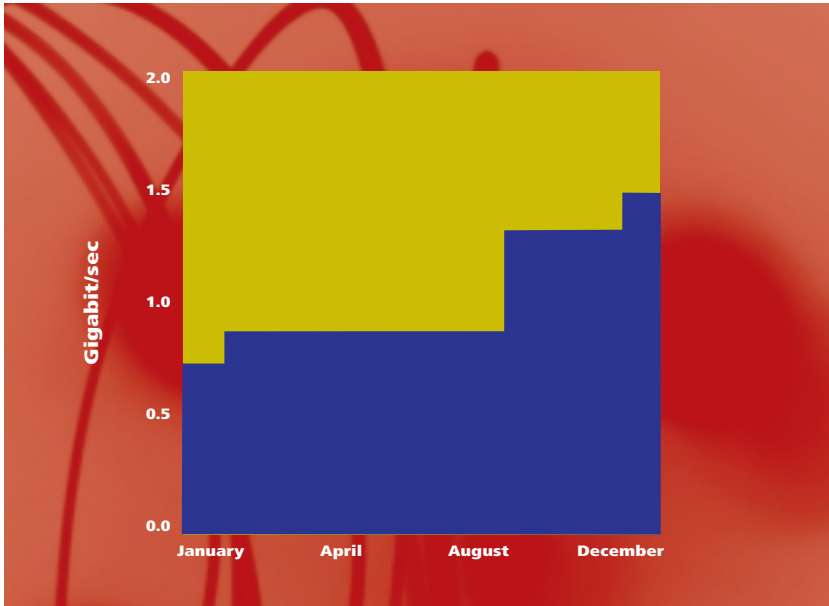
Europe

NORDUnet is connected to the other European networks for research and education through a port to the European backbone network TEN-155 in Stockholm. The port capacity is 155 Mbit/s and is connected to NORDUnet at KTH via two dark fibres.

The port is connected to the rest of TEN-155 via two 155 Mbit/s circuits to Amsterdam and Frankfurt. The research networks in all the



Structure of NORDUnet's system in the USA. The blue clouds are research networks.



Change during 1999 of the total connected international capacity at the Stockholm node. It increased from 0.8 Gbit/s in January to 1.6 Gbit/s at the end of the year.

Western European countries and Hungary, the Czech Republic, Slovenia, and Israel are connected to the TEN-155 backbone.

The connection to TEN-155 became operational in December 1998, when it replaced the previous TEN-34 structure. The transition did not carry over the peerings with important pan-European commercial networks with the result that this traffic was exchanged via the USA.

As an interim measure to avoid this detour, NORDUnet provided a connection between TEN-155 and the Ebone network in the period February to December, until the situation was normalised in TEN-155. It was just possible to accommodate the extra traffic within NORDUnet's 155 Mbit/s subscription.

In 2000, IP access to TEN-155 will be supplemented by the possibility for the Nordic national networks to have direct access to the TEN-155 ATM based Managed Bandwidth Service. It will be implemented over dedicated 2 Mbit/s circuits between Stockholm and the national networks in parallel with the main circuits.

USA

The largest volume of NORDUnet's traffic is with destinations in the USA. The USA destinations are research and education institutions as well as other sites on the Internet. Research networking is organised differently in the USA than in Europe in that the majority of American universities are connected solely to the commercial Internet, whilst only a few major universities and research organisations have access to high performance research networks. NORDUnet is therefore connected to the American commercial networks as well as to the research networks.

The capacity to the USA was 155 Mbit/s at the beginning of the year. It was supplemented by another 155 Mbit/s circuit in February and again in September giving a total capacity of 465 Mbit/s at year's end.

The circuits terminate at NORDUnet routers in New York, where the traffic with the commercial Internet is channelled off. In May, a connection to the Internet2 network Abilene was set up in New York, and in June a 45 Mbit/s circuit to Chicago was connected to the STARTAP via a NORDUnet router in Chicago. The STARTAP is a global interconnection facility for research networks, where NORDUnet peers with a number of American research networks and similar networks in Canada, Japan, and Singapore. The dimensioning of the capacity was made so that there are



no bottlenecks between the research networks, to facilitate Nordic participation in advanced network applications and developments.

At the end of the year a contract was entered into for up to three ports for the commercial Internet in Stockholm, to be connected during 2000. Each port has a capacity of 155 Mbit/s and will carry traffic with the American commercial Internet. This will allow one of the existing circuits to the USA to be reserved solely for the use of research traffic with Abilene and the STARTAP.

CEE Countries

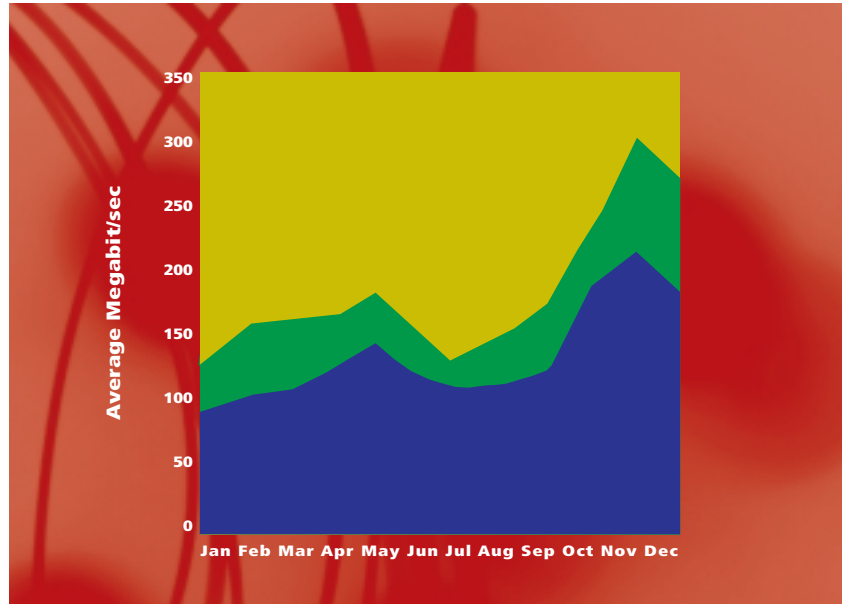
NORDUnet provides IP transit services to the research networks EENet in Estonia, NASK in Poland, RUNNet in Russia and UARnet in Ukraine. The transit traffic is charged at a rate that directly reflects NORDUnet's cost of the capacity occupied by the transit traffic. EENet upgraded its connection Tallinn-Helsinki from 2 to 4 Mbit/s in March, NASK decreased its connection Warsaw-Stockholm from 12 to 4 Mbit/s in February when Poland got its own link to TEN-155 in Frankfurt, and UARnet upgraded its satellite connection Lviv-Stockholm from 0.8 to 1.0 Mbit/s in August. RUNNet maintained its connection St. Petersburg-Helsinki at 4 Mbit/s. Most of the connections are heavily overloaded because of a lack of upgrading resources.

Commercial networks

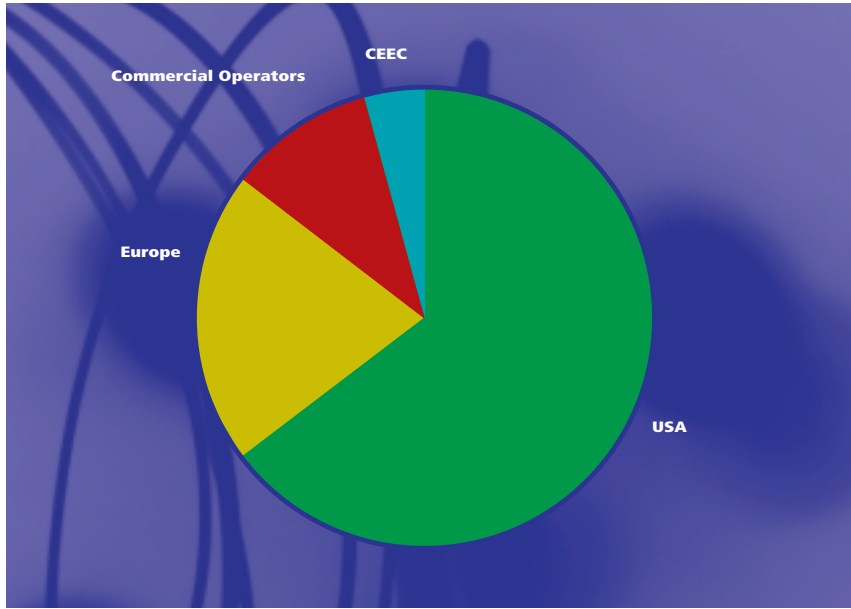
A significant fraction of the traffic on NORDUnet is with sites on the commercial Internet. NORDUnet does not pay the European commercial networks for access, but it has a no-cost-exchange peering with them. Nearly all the peering connections are in Stockholm at the D-GIX.

When the D-GIX was distributed over more sites, which was realised by Netnod AB, NORDUnet entered into a subscription to Netnod via KTH, and was subsequently connected to two Netnod sites in Stockholm. For capacity reasons these connections were supplemented by a direct connection at KTH with a major provider.

The number of peerings was 23 at the end of the year. The peering traffic is about 100 Mbit/s during daytime hours, and it is rather symmetrical in the two directions.



Growth during 1999 of traffic into and out from the Nordic research networks. Green is traffic sent into the Nordic networks and blue is traffic received from them.



Distribution between external networks of the traffic to and from the Nordic research networks. The major fraction of the traffic is with networks in the USA.

Research network collaborations

Outside Europe

NORDUnet has entered into collaboration agreements with a number of research networks all over the World.

The agreements are the basis for interconnection, they define the interconnection points, cost sharing, and acceptable use.

The form varies from merely the exchange of e-mails to full Memoranda of Understanding. NORDUnet has MoU's with the Internet2 organisation UCAID for the Abilene connection, with Canarie in Canada for the connection with CA*net 3,

and with SingAREN in Singapore. Most of the agreements were made during the year as NORDUnet was connected to the STARTAP.

The connection to the STARTAP in Chicago is realised via dedicated circuits between Stockholm, New York and Chicago, paid by NORDUnet. However, the National Science Foundation in the USA supports the connection with an amount that roughly corresponds to the cost of the path from New York to the STARTAP in Chicago. The support is given in the framework of NSF's Euro-Link programme.

Europe

The research networks in Europe are interconnected via the TEN-155 backbone network. The TEN-155 network is managed by the Quantum Consortium of European national research networks with the European Commission contributing about 30% of the cost.

The Quantum Consortium is governed by its Policy Group which is constituted by representatives from the member networks. NORDUnet represents the Nordic networks in the Policy Group. The actual implementation and operation of the TEN-155 network is carried out by DANTE, which is a European-level body similar to NORDUnet. DANTE's shareholders are the European networks, with NORDUnet representing the Nordic networks.

The main activities of the Policy Group during the year have been the final commissioning of the TEN-155 network, organising its peer connections to the commercial Internet, and planning for its continuation under the European Commission's 5th framework programme. NORDUnet participated in a Commission advisory group that produced the general

specifications of the backbone network to be supported by the 5th programme.

Nordunet2

NORDUnet is represented in the steering group of the Nordunet2 programme. The programme was organised during the year, and it issued a call for proposals in autumn 1999. It expects the first projects to begin during 2000.

CEE countries

The transit services to the Russian research network RUNNet was supported by a grant to NORDUnet from the Nordic Council of Ministers. The grant allowed the provision of the service to RUNNet at 50% cost.

NORDUnet was represented on the advisory board for the Nordic Council of Minister's programme for training teachers in the Baltic States in the use of networks.



Participants in the Global Observation Information Network demonstration in Stockholm

Projects

Multicast

The experimental server-based multicast service (MBONE) was replaced by a native multicast service in NORDUnet during the summer.

The service is connected to similar services on TEN-155 and the American networks. It was used for a.o. transmission of an IETF meeting in Oslo in June to the world, and for the transmission of seminars at Telecom 99 in Geneva to the Nordic networks.

NORDUnet CERT

The NORDUnet CERT (Computer Emergency Response Team) coordinates the CERTs of the Nordic networks. It also assists the CERTs of the Nordic networks to attain membership status in FIRST (Forum of Incident Response and Security Teams). The FUNET CERT was accepted during the year, while the UNINETT CERT application was still pending at the end of the year.

Information services

The information service on NORDUnet's Web server was reorganised to ease navigation, and a trouble ticket system was added. The hardware platform was replaced by a more resilient system.

Terena NORDUnet Networking Conference

The annual Terena Networking Conference and the NORDUnet conference were combined into one and held at Lund University in June. NORDUnet's recent connection to the Abilene network in the USA was used for an on-line session between Lund and Washington D.C. with high quality video and sound.

GOIN

In cooperation with the NASA Research and Education Network (NREN) and the Asia-Pacific Advanced Network (APAN), NORDUnet and SUNET supported live demonstrations of the Global Observation Information Network (GOIN) in Stockholm. The demonstrations included on-line activities in the USA, Japan, Korea, and Europe.

Year 2000 preparations

NORDUnet released a Y2K statement in 1999. Only minor adjustments to the system were needed, and they were implemented in due time. Normal service status was maintained during the millennium shift and none of the services were affected by Y2K related problems.



Annual Report and Accounts for the year ended 31 December 1999

Profit and loss account for the year ended 31 December 1999

	Note	1999 DKK	1998 DKK'000
Turnover		134.510.128	138.013
Network operation expenses		<u>-131.449.756</u>	<u>-132.410</u>
		3.060.372	5.603
Other operating expenses		542.795	2.443
Staff costs	1	<u>928.899</u>	<u>1.072</u>
		1.588.678	2.088
Depreciation and write-downs of tangible fixed assets	2	<u>1.932.922</u>	<u>1.264</u>
Operating profit/loss		-344.244	824
Interest receivable and similar income		980.209	806
Interest payable and similar charges		<u>2.406</u>	<u>0</u>
Profit before tax	3	633.559	1.630
Tax for the year		<u>353.974</u>	<u>489</u>
Profit for the year		279.585	1.141

AUDITORS' REPORT

We have audited the Annual Accounts, presented by the Board of Directors and the Management of NORDUNET A/S for the year ended 31 December 1999.

Basis of Opinion

We planned and conducted our audit in accordance with auditing standards generally accepted in Denmark to obtain reasonable assurance that the Annual Accounts are free from material misstatement. Based on an evaluation of materiality and risk, we have tested the basis and documentation for the amounts and disclosures in the Annual Accounts. Our audit includes an assessment of the accounting policies applied and the accounting estimates made by the Board of Directors and the Management. In addition we have evaluated the overall adequacy of the presentation in the Annual Accounts.

Our audit has not resulted in any qualification.

Opinion

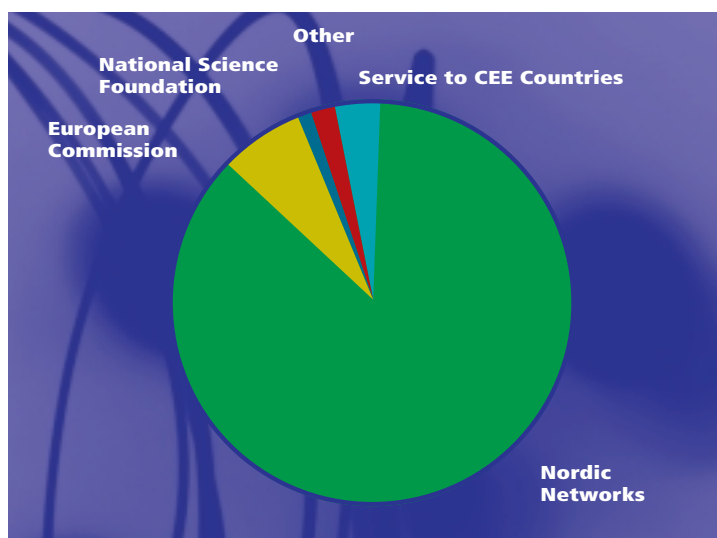
In our opinion, the Annual Accounts have been presented in accordance with the accounting provisions of Danish legislation and give a true and fair view of the Company's assets and liabilities, financial position and profit for the year.

Copenhagen, 21 January - Ernst & Young - Statsautoriseret Revisionselskab

Mogens Lundin Tommy Nørskov
State Authorised Public Accountants

Balance sheet at 31 December 1999

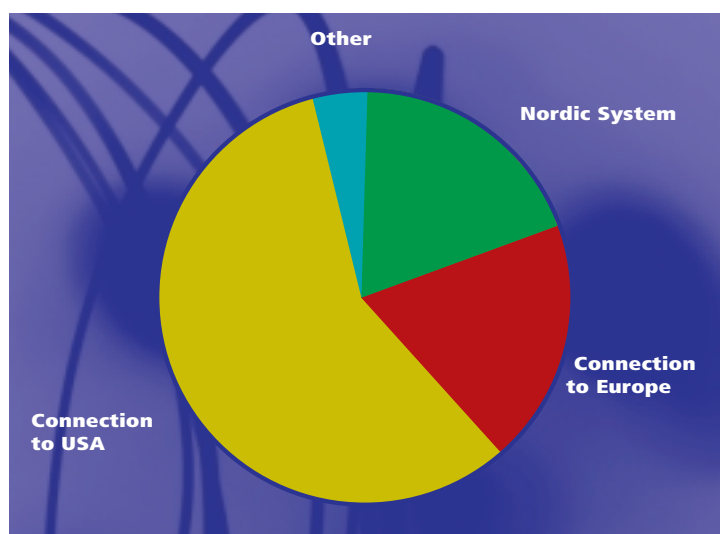
ASSETS - FIXED ASSETS	Note	1999 DKK	1998 DKK'000
Tangible fixed assets			
Other fixtures and fittings, tools and equipment		<u>4.488.345</u>	<u>3.855</u>
Total tangible fixed assets	4	<u>4.488.345</u>	<u>3.855</u>
Fixed asset investments			
Deposit	5	<u>4.109</u>	4
Total fixed asset investments		<u>4.109</u>	4
Total fixed assets		<u>4.492.454</u>	<u>3.859</u>
Debtors			
Trade debtors		1.683.342	34.677
Other debtors		58.306	407
Prepayments		<u>10.915.256</u>	<u>16.586</u>
Total debtors		<u>12.656.904</u>	<u>51.670</u>
Cash at bank and in hand		<u>4.918.831</u>	<u>3.062</u>
Total current assets		<u>17.575.735</u>	<u>54.732</u>
Total assets		22.068.189	58.591



Balance sheet at 31 December 1999

LIABILITIES

	Note	1999 DKK	1998 DKK'000
Capital and reserves			
Share capital		11.150.000	11.150
Profit and loss account		<u>938.288</u>	<u>659</u>
Total capital and reserves	6	<u>12.088.288</u>	<u>11.809</u>
Provisions			
Deferred tax provisions		<u>0</u>	<u>11</u>
Total provisions	7	<u>0</u>	<u>11</u>
Current liabilities			
Prepayment from customers		0	4.476
Trade creditors		8.128.964	7.534
Corporation tax payable		0	477
Other creditors		186.840	2.559
Deferred income		<u>1.664.097</u>	<u>31.725</u>
Total current liabilities		<u>9.979.901</u>	<u>46.771</u>
Total liabilities		22.068.189	58.591
Contingent liabilities	8		



Distribution of NORDUnet's expenditure. The largest part is used for connections to the USA.

Notes	1999 DKK	1998 DKK'000	
Note 1: Staff costs (by type)			
Analysis of staff costs	852.899	987	
Wages and salaries	70.732	77	
Pension costs	5.268	8	
Other social security costs	928.899	1.072	
Average number of employees	2	3	
Note 2: Depreciation and write-downs of tangible fixed assets			
Other fixtures and fittings, tools and equipment	1.932.922	1.264	
	1.932.922	1.264	
Note 3: Tax for the year			
Estimated corporation tax charge, exclusive of surcharges/allowances	0	477	
Charge in deferred tax provision	-11.500	12	
	-11.500	489	
Prior year adjustments	365.474	0	
	353.974	489	
Other fixtures and fittings, tools and equipment			
Note 4: Tangible fixed assets			
Balance at 010199		7.365.541	
Additions in the year		<u>2.566.238</u>	
Cost at 311299		<u>9.931.779</u>	
Depreciation and write-downs			
Balance at 010199		3.510.512	
Depreciation in the year		<u>1.932.922</u>	
Balance at 311299		<u>5.443.434</u>	
Net book value at 311299		4.488.345	
Note 5: Fixed asset investments			
	Deposit	Securities	Total
Cost			
Balance at 010199	<u>4.109</u>	<u>414.545</u>	<u>418.654</u>
Cost at 311299	<u>4.109</u>	<u>414.545</u>	<u>418.654</u>
Write-downs			
Balance at 010199	<u>0</u>	<u>414.545</u>	<u>414.545</u>
Write-downs at 010199	<u>0</u>	<u>414.545</u>	<u>414.545</u>
Net book value at 311299	4.109	0	4.109
Note 6: Capital and reserves			
	Balance at 010199	Appropriation of profit	Balance at 311299
Movements on the Company's capital and reserves			
Share capital	11.150.000	0	11.150.000
Profit and loss accounts	<u>658.703</u>	<u>279.585</u>	<u>938.288</u>
Total capital and reserves	11.808.703	279.585	12.088.288
Note 7: Deferred tax provisions			
Balance at 010199		1999 DKK	1998 DKK'000
Provisions in the year		11.500	0
		<u>-11.500</u>	<u>11</u>
Balance at 311299		0	11
Note 8: Contingent liabilities: The company has no contingent liabilities other than what appears from the Annual Accounts.			





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