

Comparison of the Costs and Structure of Scientific Networking in European Countries

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ABSTRACT

EUNIS (the European University Information Systems organization) conducted in spring 2000 a survey on the scientific networking in the European universities in its member countries. The main aim was to be able to compare the costs involved in networking from the universities' perspective. Another goal was to get a general picture of the network structure and speed and the principles of subsidies and cost recovery. It turned out that although every country has a national network organization, it is run in a diversity of ways and the government involvement in subsidizing the costs of networking is so different in different countries that it is virtually impossible to make any exact comparisons. Therefore this paper is concentrating on comparing overall structures, connections speeds, principles of operation, government involvement and less on what networking actually costs a university.

The questions (**Appendix 1**) were sent to EUNIS representatives in its member countries, plus Austria. The rate of answering was 74% or 17 of 23.

ORGANIZATION OF ACADEMIC NETWORKS

In all 17 countries the academic networking is organized as a national network organization. The big difference is which types of customers are part of this network organization. The primary customers are of course universities and research organizations. In Denmark these are the only customers mentioned. In most countries the polytechnics are also connected to the backbone. In Finland most of the polytechnics have joined the network recently. In Sweden and UK museums and libraries are connected as well. Also France and Estonia mention cultural establishments. In Norway private colleges are connected. Colleges and secondary schools are connected in Lithuania and even primary schools in France, Estonia, Portugal and Slovenia. Germany and Poland mention commercial and non-commercial customers.

The numbers of customers vary from 22 (Poland) to 9000 (Portugal). For more details see **Appendix 2**.

CAPACITIES OF BACKBONES AND CONNECTION SPEEDS

The backbone capacities vary very much (1 Mb/s – 2.5 Gb/s) from country to country and also between different parts of the same country. The most frequently used backbone capacity is 155 Mb/s, in eleven countries, and 34 Mb/s is used in seven countries. The speeds at which universities are connected are typically lower. For details see **Appendix 3** and for an overview see **Appendix 4**.

WAYS OF CONNECTION TO AND OPERATION OF THE NETWORKS

It is typical that the nodes or Points of Presence (PoP) of the national network are situated in at least the bigger universities, which are then connection points to other organizations. In about half of the countries the switches and routers are at the moment owned and operated by the national network

organization but there seems to be some trend towards shifting the operation to some of the universities. The commercial ISPs do not seem to have any major role in operating the academic networks. A compilation of the answers to these questions can be found in **Appendix 5**.

THE ROLE OF SERVICE PROVIDERS

Almost all national network organizations lease lines and bandwidth from national telecommunications service providers. In Germany the B-WiN and G-WiN are special autonomous networks provided by a national telecommunications provider. The majority buys SDH and ATM services but very few IP services from the national telecommunications provider. See **Appendix 6**.

SUBSIDIES AND PRINCIPLES OF PAYMENT

The academic and research networks are subsidized in all countries but there is a very great variety in the amount of subsidy. There are also very different ways of defining how the universities are charged for their share of the costs. The most commonly used factor (in 8 cases) is bandwidth, next comes the dependence on the amount of traffic, either incoming or all international traffic (in 6 cases), number of students and staff (in 4 cases), turnover (in 3 cases) and some other factor (in 2 cases). **Appendix 7**

FURTHER INFORMATION

For more information on the European National Research Networks refer to the following table or look up www.garr.it/garreuropa/nrn-engl.shtml . In addition to EUNIS member countries also Austria, Belgium, Italy, Spain, Switzerland and NORDUnet are included in the table.

Country	Network	URL
Austria	ACOnet	www.aconet.at/
Czech Rep.	CESNET	www.ten.cz/english/
Denmark	Forskningsnettet	www.darenet.dk , www.it.dtu.dk/netsek , www.sektornet.dk (other educ. inst.)
Estonia	EENet	www.eenet.ee/englishEENet/index.html
Finland	FUNET	www.nordu.net
France	GIP Renater	www.renater.fr
Germany	G-WiN	www.dnf.de/
Ireland	HEAnet	www.hea.ie/
Lithuania	LITNET	www.litnet.lt
Netherlands	SURFnet	www.surfnet.nl
Norway	UNINETT	www.uninett.no/index.en.html
Poland	POL-34/155	www.pol34.pl/aindex.html
Portugal	FCCN	www.dns.pt/dnsestat.htm
Slovakia	SANET	www.sanet.sk/english.html
Slovenia	ARNES	www.arnes.si/
Sweden	SUNET	http://basun.sunet.se/
UK	JANET	www.ja.net/ , www.ukerna.ac.uk/
Belgium	BELNET	www.belnet.be/main_uk.html
Italy	GARR	www.garr.net
Spain	RedIRIS	www.rediris.es/index.en.html
Switzerland	SWITCH	www.switch.ch/
The Nordic net	NORDUnet	www.nordu.net

Questions

Survey on Internet Connection Structure and Costs

This survey covers both the structure and costs of Internet connections in the Academic world in the various European Countries and the expenditure for individual universities in Europe due to telecommunications connectivity.

A Structure of the academic network

- A1 How is the national backbone of the academic network in your country organized?
- A1.1 do you have a national network organization?
 - A1.2 what name does it have?
 - A1.3 how many customers does the network organisation have?
 - A1.4 are there different types of customers, which kinds?
 - A1.5 is it organized in another way, how?
- A2 The capacity of the backbone network
- A2.1 typical speed
 - A2.2 if it varies from place to place, which speeds are used?
 - A2.3 at which speeds do universities typically connect?
- A3 How do the universities connect?
- A3.1 to a Point of Presence (PoP) at every University or
 - A3.2 the university has to make its own connection to a PoP somewhere else
 - A3.3 the connection switches/routers are owned and operated by
 - A3.3.1 the university
 - A3.3.2 national network organization or
 - A3.3.3 commercial ISP
- A4 Are the polytechnics (meaning schools with less than university status) also connected to the backbone?
- A5 Does the network organization
- A5.1 lease lines/bandwidth
 - A5.2 buy SDH-services
 - A5.3 buy ATM-services
 - A5.4 buy IP-services from a national telecommunications service provider?
- A6 Is it possible to cascade other institutions, meaning can you connect other institutions through a primary connected institution?
- A6.1 if yes, how are expenses shared?

If the above questions do not apply: how is the network organized?

B WHO PAYS FOR WHAT?

- B1 Is the academic network subsidized by your government, i.e. the ministry of education/science or another local institution?
B1.1 If yes, how big is the part it pays?
- B2 Do the individual universities pay for network connectivity?
If they do, what do the fees depend on:
B2.1 connection capacity, meaning bandwidth
B2.2 amount of traffic, defined as:
B2.2.1 national traffic inwards
B2.2.2 national traffic outwards
B2.2.3 international traffic inwards
B2.2.4 international traffic outwards
B2.2.5 some other criteria, which?
B2.3 fixed price according to size of the institution in terms of
B2.3.1 amount of people
B2.3.2 revenue
B2.3.3 distance to backbone
B2.3.4 other definition, how?

If the above questions do not apply, how is the network connectivity paid for?

C Actual costs

- C1 The total annual budget in EUROs for
C1.1 operating the national backbone network
C1.2 development projects
C1.3 (both together if this is the only figure available)
- C2 Some examples of what different size universities actually pay for their network connection (for instance in a table with columns 1),2),3),4) and 5)):
- 1) Number of students of the university,
 - 2) part of yearly payment depending on number of network users,
 - 3) part depending on institute turnover,
 - 4) part depending on traffic,
 - 5) part depending on bandwidth

Question A Structure of the academic network

Sub-question A1 How is the national backbone of the academic network in your country organized?

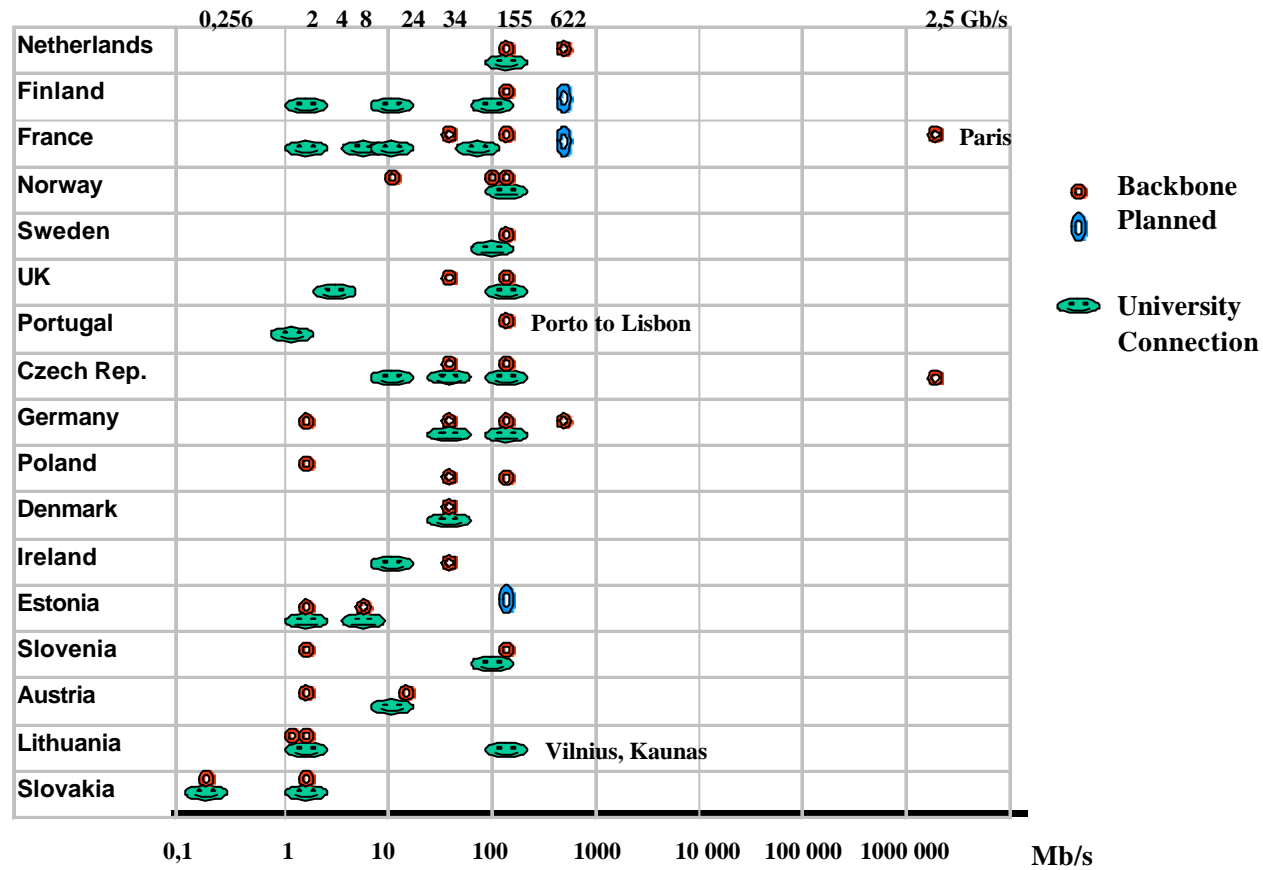
Question Country	A1.1 Do you have a national network organization?	A1.2 What name does it have?	A1.3 How many customers?	A1.4 Are there different types of customer?	A1.5 Is it organized in another way?
Austria	Yes	ACOnet	100	No ?	-
Czech Rep.	Yes	CESNET	-	-	-
Denmark	Yes	Forskningsnettet	110	Universities. Academic research units and private units with research collaboration agreements. Only research related traffic allowed.	-
Estonia	Yes	EENet	450	Scientific, educational and cultural establishments.	-
Finland	Yes	FUNET	85	Universities. Polytechnics. Research and Government organizations.	-
France	Yes	GIP Renater	600	University research. Teaching – university to elementary school. Public/private research + development units. Libraries. Museums.	-
Germany (1)	Yes	B-WiN	700	Commercial and non-commercial.	-
Germany (2)	Yes	G-WiN	700	As above	-
Ireland	Yes	HEAnet	-	-	-
Lithuania	Yes	LITNET	117	Universities and Academies. Research Institutions. Colleges and secondary schools. Other non-profit institutions.	-
Netherlands	Yes	SURFnet	230	Universities, colleges, research centres, academic hospitals, and scientific libraries.	-
Norway	Yes	UNINETT	96	Universities. Other government-financed higher education institutions. Private colleges. Research institutions.	-
Poland	Yes	POL-34/155	22	Only the MANs connect directly to POL-34/155. Each MAN has its own scientific and commercial customers.	-
Portugal	Yes	FCCN	9000	Universities. Research institutes. Secondary schools. Primary schools are being connected. Other non-commercial organizations.	-
Slovakia	Yes	SANET	-	-	-
Slovenia	Yes	ARNES	227	Institutes. Research departments in industry. Universities. Secondary schools. Primary schools. Other education.	-
Sweden	Yes	SUNET	64	Universities. Research Councils. Museums. Libraries.	-
UK	Yes	JANET	600	Universities. Research Councils. Museums. Libraries. Other research units with collaborative arrangements with universities	-

Question A Structure of the academic network

Sub-question A2 The capacity of the backbone network Sub-question A4 Are polytechnics also connected to the backbone

Question Country	A2.1 What is the typical speed of the backbone?	A2.2 If it varies, what speeds are used?	A2.3 At what speeds do universities typically connect?	A4 Are the polytechnics also connected to the backbone?
Austria	2Mb/s	0.5Mb/s – 24Mb/s	10Mb/s	Yes
Czech Rep.	34Mb/s – 155Mb/s – 2.5Gb/s	34Mb/s – 155Mb/s – 2.5Gb/s	10Mb/s – 34Mb/s – 155Mb/s	Not generally
Denmark	34Mb/s	64Kb/s – Nx2Mb/s	34Mb/s	No (They are connected to Sektornet)
Estonia	8Mb/s	2Mb/s – 8Mb/s (going to 155 Mb/s)	2Mb/s – 8Mb/s	Yes (64Kb/s for ordinary schools)
Finland	155Mb/s (going to 622Mb/s)	-	2Mb/s – 10Mb/s – 100Mb/s	Yes (most of them)
France	155Mb/s (going to 622Mb/s) 2.5Gb/s rings in Paris	34Mb/s – 155Mb/s – 622Mb/s – 2.5Gb/s	2Mb/s – 6Mb/s some have 10Mb/s – 45Mb/s	Yes
Germany (1)	2Mb/s – 34Mb/s – 155Mb/s	2Mb/s – 34Mb/s – 155Mb/s	34Mb/s – 155Mb/s	Yes
Germany (2)	As above + 622Mb/s	As above + 622Mb/s	34Mb/s – 155Mb/s	Yes
Ireland	34Mb/s	-	10Mb/s	Yes
Lithuania	1Mb/s – 2Mb/s	128Kb/s – 100Mb/s	2Mb/s – 100Mb/s in Vilnius and Kaunas	Yes
Netherlands	155Mb/s – 622Mb/s going to 80Gb/s by 2002	As on left	155Mb/s (max) going to 20 Gb/s by 2002	Yes (HE schools only)
Norway	155Mb/s	10Mb/s – 100Mb/s – 155Mb/s	155Mb/s	Yes
Poland	2Mb/s - 34Mb/s – 155Mb/s	2Mb/s - 34Mb/s – 155Mb/s	Universities are connected to MANs - see A1.4	Yes - to MANs
Portugal	155Mb/s between Porto and Lisbon	(data coming later)	1.44Mb/s ?	Yes
Slovakia	256Kb/s – 2Mb/s in cities	256Kb/s – 2Mb/s in cities	256Kb/s – 2Mb/s in cities	Partly ~33%
Slovenia	2Mb/s – 155Mb/s	2Mb/s – 155Mb/s	100Mb/s	Yes
Sweden	155Mb/s	155Mb/s	Fast Ethernet	No
UK	155Mb/s	34Mb/s – 155Mb/s	4Mb/s – 155Mb/s (managed by bandwidth limiting)	All polytechnics connected Schools being connected

Typical Speeds



Question A Structure of the academic network
 Sub-question A3 How do the universities connect?

Question Country	A3.1 To a PoP at every university?	A3.2 Universities have to make connections to PoP elsewhere?	A3.3 The switches and routers are owned and operated by:		
			A3.3.1 The universities?	A3.3.2 The national network org.?	A3.3.3 Commercial ISPs
Austria	Yes	-	-	Yes	-
Czech Rep.	PoPs at 11 universities	Connection to PoP done via academic MAN	Academic MAN	Backbone and PoP	-
Denmark	Yes	-	Maybe in future for some universities	Yes – but see note on left	-
Estonia	Some	Some	-	Some	Some
Finland	PoPs at 21 sites	Small universities connect to bigger ones.	-	Yes	-
France	Not now – some in future	Yes – see note on left	Academic MAN	National backbone	Regional network
Germany (1)	Yes (soon)	Yes (now)	Yes (soon)-	Yes (now)	-
Ireland	PoPs at 4 universities	See note on left	Yes	-	-
Lithuania	Some	Some	Some	Some	Not usually
Netherlands	Mostly	Some	-	Yes	-
Norway	Yes	-	Owned – No Operated – Yes	Owned – Yes Operated – Yes for colleges	-
Poland	No	PoPs are where MANs join backbone	Routers owned by universities are connected to..	..routers owned and operated by MANs.	-
Portugal	No	PoPs in Porto and Lisbon (possibly more)	-	Yes	-
Slovakia	Yes	-	Owned – No Operated – Yes	Owned – Yes Operated – No	-
Slovenia	Mostly	Some	Owned – Yes Operated – No	Owned – No Operated – Yes	-
Sweden	PoPs at 4 universities	PoPs at 4 universities	-	Yes	-
UK	Mostly	Mostly	-	Yes	-

Question A

Structure of the academic network

Sub-question A5

Does the network organization from a national telecommunications service provider?

Sub-question A6

Can you cascade services to others?

Question	A5.1 Lease lines and bandwidth?	A5.2 Buy SDH services ?	A5.3 Buy ATM services?	A5.4 Buy IP services ?	A6 Can you cascade to others?	A6.1 How are costs shared?	Other network organizations
Austria	Yes	No	Yes	No	Yes If agreed	By local agreement	-
Czech Rep.	No/Yes	Yes	No	No	-	-	-
Denmark	Yes	No	Yes	No	Yes If agreed	By local agreement	-
Estonia	Yes	Yes	Yes	No	Yes If agreed	By local agreement	-
Finland	Yes	-	Yes	-	Yes	By international inward traffic	-
France	Yes	Yes	Yes	No	Yes If agreed	By mathematical formula	-
Germany	-	-	-	-	Yes If agreed	By local and nat'l agreement	The B-WiN and G-WiN are special networks provided by a national telecommunications provider. They are autonomous systems within the internet.
Ireland	Yes	Yes	Yes	No	-	-	-
Lithuania	Yes	Yes	Yes	Yes	Yes	Free for non-profit institutions	-
Netherlands	Yes	Yes	Yes	No	No	-	-
Norway	Yes	Yes	Yes	Yes	No	-	-
Poland	Yes	Yes	No	No	Yes	Shared by agreement	-
Portugal	Yes (mainly)	No	Yes (mainly)	No	Yes If agreed	Bandwidth shared independently	-
Slovakia	Yes	Yes	No	No	-	-	-
Slovenia	Yes	Yes	Yes	No	Difficult technically	-	The national network pays for the backbone and PoPs. Units pay for local PoP connection.
Sweden	Yes	Yes	No	No	Yes	By local agreement	-
UK	Yes	Yes	Yes	No	Yes	By local agreement	-

Question B

Who pays for what?

Sub-question B1

Is the academic network subsidized by your government?

Sub-question B2

Do individual universities pay for network connectivity?

Question Country	B1 Is the network subs'zed?	B1.1 How much does gov'ent pay?	B2 Do universities pay for network connections?	Notes What do extra university payments depend on?
Austria	Yes	80%	If they need more bandwidth than provided	Bandwidth
Czech Rep.	Yes	-	Partly	Bandwidth > 155Mb/s. International traffic in. Size of institution. Also, last year's service fee.
Denmark	Yes	In 1999 – 62% In 2000 – 50%	Yes	The sum of all incoming and outgoing traffic and fixed cost (in the future) according to revenue of institution.
Estonia	Yes	100% (under-funded)	Pay for leased lines to phone companies.	For historical reasons, some institutes of universities (separate parts) pay fixed costs to commercial providers.
Finland	Yes	50% operating + d'ment costs	Yes	International traffic inwards + fixed cost depending on number of staff and students and type of university. There are 11 fixed price groups.
France	Yes	50% see detail	Yes	Bandwidth + size of institution (in a few cases). Subsidies are partly national and partly regional. Significant variation across the country.
Germany (1)	-	-	Yes	Bandwidth. No detail in reply. Told to look at http://www.dfn.de
Germany (2)	Yes	100M DM for the start!	Yes	Bandwidth + amount of incoming traffic. See http://www.dfn.de
Ireland	Yes	A small amount	Yes	Bandwidth + amount of traffic.
Lithuania	Yes	All central costs	Yes	Pay for leased lines to nearest PoP of LITNET
Netherlands	Yes	-	Yes	Number of staff and students.
Norway	Yes	35%	Yes	Bandwidth + small fixed amount + large amount proportional to revenue.
Poland	Yes	A fixed amount (see note ->)	Yes	Bandwidth (Note from left: fixed amount is split equally between MAN operators and connected institutions. Institutions have to pay difference)
Portugal	Yes	About 50% see e-mail for detail	Yes	Bandwidth
Slovakia	Yes	-	Yes	Fixed membership fee ~ \$20 per year (I assume per user or connection) Also pay for leased lines to SDH provider and intranet leased lines.
Slovenia	Yes	95%	No	Only research departments in industry pay for service. Fee depends on incoming traffic.
Sweden	Yes	50%	Yes	Fee depends on institute turnover.
UK	Yes	85%	Yes	Proportion of total International traffic into JANET.