

Update on Academic Networks in Europe

Structure, Capacity and Costs

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Abstract: EUNIS conducted in spring 2000 a survey on the scientific networking in the European universities in its member countries. The survey was updated in February 2001. 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 almost every country has a national network organization, the network 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 and government involvement.

The questions were sent to EUNIS representatives in its member countries, plus Austria and Latvia. The rate of answering was 75 % or 18 of 24.

Organization of Academic Networks

In 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 seven countries libraries are connected and in Sweden, UK and France museums are connected as well. Also Estonia mentions cultural establishments. In Norway private colleges are connected. Colleges and secondary schools are connected in Latvia and Lithuania and even primary schools in France, Estonia, Portugal and Slovenia. Germany and Poland mention both commercial and non-commercial customers.

The numbers of customers vary from 22 MANs in Poland to 4080 in Portugal. For more details see **Table 1**.

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. Several countries have upgraded at least a part of their backbone to the giga-

bit range. The speeds at which universities are connected are typically lower. For details see **Table 2**.

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 placed 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. In some countries universities are connection points for Metropolitan Area Networks (MANs). 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 **Table 3**.

The Role of Service Providers

Almost all national network organizations lease lines and bandwidth from national telecommunications service providers. In Germany the G-WiN is a special autonomous network provided by a national telecommunications provider. The majority buys SDH and ATM services but very few IP services from the national telecommunications provider. See **Table 4**.

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). **Table 5**.

Further Information

For more information on the European National Research Networks look up www.garr.it/garreuropa/nrn-engl.shtml

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	60	Universities, Research centers, University hospitals, Scientific libraries, Schools with research activities	
Denmark	Yes	Forsknings-nettet	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	Yes	G-WiN	700	Commercial and non-commercial.	-
Ireland	Yes	HEAnet	-	-	-
Latvia	No	LANET (65%) RTUnet (18%)	31	Universities, higher education, Scientific institutions, Libraries, Secondary schools	
Lithuania	Yes	LITNET	500	13 Universities and Academies, 36 Research Institutions, 300 Secondary schools, 12 Libraries, 140 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.	-

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Poland	Yes	POL-34/155	22 MANs	Only the MANs connect directly to POL-34/155. Each MAN has its own scientific and commercial customers.	-
Portugal	Yes	FCCN	4000 + 80	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 4	> 800	Universities. Research Councils. Museums. Libraries. Other research units with collaborative arrangements with universities	-

EUNIS SURVEY OF DATA ACADEMIC NETWORKS IN EUROPE (1) - FEBRUARY 2001 Table 1 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	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	34Mb/s - 155Mb/s - 1 Gb/s	Partly
	Denmark	34Mb/s	64Kb/s - Nx2Mb/s	34Mb/s	No (They are connected to Sektornet)
	Estonia	8Mb/s	2 Mb/s - 8 Mb/s (going to 155 Mb/s)	2Mb/s - 8Mb/s	Yes (64Kb/s for ordinary schools)
	Finland	2,5 Gb/s)	155 Mb/s - 622 Mb/s - 2,5 Gb/s	155 Mb/s - 622 Mb/s - 1 Gb/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	2Mb/s - 34Mb/s - 155Mb/s - 622Mb/s	2Mb/s - 34Mb/s - 155Mb/s - 622Mb/s	34Mb/s - 155Mb/s	Yes
	Ireland	34Mb/s	-	10Mb/s	Yes
	Latvia	155 Mb/s	128 kb/s - 2 Mb/s - 155 Mb/s	155 Mb/s (International 1 Mb/s + 256 kb/s)	Yes 4
	Lithuania	1Mb/s - 2Mb/s	448 Kb/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 - 2,5 Gb/s	2,5 Gb/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	-	Between 2 - 8 Mb/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	2,5 Gb/s	100Mb/s - 155Mb/s - 1 Gb/s - 2,5 Gb/s	4Mb/s - 155Mb/s	All polytechnics connected Schools being connected

EUNIS SURVEY OF DATA ACADEMIC NETWORKS IN EUROPE (2) - FEBRUARY 2001 Table 2 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	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.?
Country					
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	Yes	No	-	Yes (all but 6 "Super"-PoPs)
6 "Super"-PoPs owned by national org, operated by ISP	France	Not now - some in future	Yes - see note on left	Academic MAN	National backbone
Regional network	Germany	Yes	-	Yes	-
-	Ireland	PoPs at 4 universities	See note on left	Yes	-
-	Latvia	Yes	-	Yes, connected to LANET	-
Some	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	No, service is provided at Universities' premises	-	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	8 core PoPs, 18 Backbone Access Routers (BAR)	Mostly	BAR to MAN	-	Core backbone, BARs

EUNIS SURVEY OF DATA ACADEMIC NETWORKS IN EUROPE (3) - FEBRUARY 2001 Table 3 Question A: Structure of the academic network Sub-question A3: How do the universities connect?

Question Country	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.	Yes	Yes	No	No	Yes	By local agreement		-
Denmark	Yes	No	Yes	No	Yes If agreed	By local agreement		-
Estonia	Yes	Yes	Yes	No	Yes If agreed	By local agreement		-
Finland	-	Yes	No	-	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 G-WiN is a special network provided by a national telecommunications provider.
Ireland	Yes	Yes	Yes	No	-	-		-
Latvia	Yes	-	Lease dark fiber, use ATM	-				
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)	Yes	Yes (mainly)	Yes	Yes If agreed	Not for profit deal		-
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 Country	B1 Is the network subs'zed?	B1.1 How much does gov'ent pay?	B2 Do universities pay for network connec- tions?	Notes What do ex- tra university payments depend on?
Austria	Yes	80%	If they need more band- width than provided	Bandwidth
Czech Rep.	Yes	70 %	Yes	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 in- stitution.
Estonia	Yes	100% (under-funded)	Pay for leased lines to phone companies.	For historical reasons, some institutes of universi- ties (separate parts) pay fixed costs to commercial providers.
Finland	Yes	50% operating + d'ment costs	Yes	International traffic in- wards + fixed cost de- pending 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 in- stitution (in a few cases). Subsidies are partly na- tional and partly regional. Significant variation across the country.
Germany	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.
Latvia	Yes	Shrinking amount (see note ->)	Yes	Earlier 80 - 100% of In- ternational traffic. 2001 the same amount as Univ. of Latvia
Lithuania	Yes	All central costs	Yes	Pay for leased lines to nearest PoP of LITNET
Netherlands	Yes	-	Yes	Number of staff and stu- dents.
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 op- erators and connected in- stitutions. Institutions have to pay difference)

Portugal	Yes	About 50%	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.

EUNIS SURVEY OF DATA ACADEMIC NETWORKS IN EUROPE (5) - FEBRUARY 2001 Table 5 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?