

## 2 Users/Clients

This section starts with information about the connection policies of NRENs (i.e. who is allowed to connect) (2.2) and about what is allowed on the connection, or the Acceptable Use Policies (2.3).

Section 2.4 looks at IPv6. The last sections look more closely at bandwidth of Universities, secondary schools and primary schools. Note that Appendix 1 contains additional information for other user categories.

The overview section (2.1) gives aggregate data and tries to identify trends in all of these areas.

### 2.1 Overview

#### Connection Policies

Table 2.2 gives an overview of which types of institutions can be connected to the NREN (the Connection Policies).

For more details on individual NRENs, please consult the country entries on the website or the NREN websites themselves.

As is clear from Table 2.2, all NRENs can connect Universities. For other institutions, there are great differences in policy between NRENs. Note that sometimes there are further restrictions, not included in the table. For example, some NRENs only connect government departments that have a relation to research and education, etc.

#### Acceptable Use Policies

Some NRENs have sent us summaries of their Acceptable Use Policies (AUPs) or have given us the URLs to the Acceptable Use Policies as published on their websites. This information is now available on-line at <http://www.terena.nl/compendium/2005/aup.php>.

Table 2.3 gives an overview of some key characteristics of the AUPs of NRENs.

#### Connection methods

NRENs are quite diverse when it comes to methods of connecting institutions. Reference to previous Compendia show that this has changed very little in recent years.

Most NRENs provide for institutions to connect directly either to one of their Points of Presence (PoP) or in some cases to a Metropolitan Area Network or regional network run by the NREN. There are some exceptions with separate Metropolitan Area Network/ Access Network (MAN/AN) layers run by third parties. This is the case, for example, with UKERNA (UK), RENATER (France) and PIONIER (Poland).

Table 2.1.1 provides aggregated data on connection methods. Here the aggregation has been done from the perspective of NRENs, not from that of the institutions. Thus, the figures below show the connection method for the different types of institutions for the ‘average’ NREN. These are averages across NRENs, not weighted by their size or the number of institutions they connect.

Table 2.1.1 Connection methods

Type of institution	PoP or MAN run by NREN	MAN or regional network run by 3rd party	Via another institution	Some other way
University	87%	10%	0%	3%
University site	60%	4%	32%	4%
Institute of higher education	72%	18%	10%	0%
Research institute	82%	10%	8%	0%
Secondary school	58%	26%	7%	9%
Primary school	56%	21%	0%	13%
Other	74%	19%	7%	0%

There are some distinctions between the different types of institutions here. Note, for example, that the highest proportion of reported connections via another institution (32%) is by university sites. It seems that many such sites connect through their parent university rather than directly to the NREN PoP or MAN.

For reasons of space, the full tables are not made available in printed form but they can be consulted on the web by NRENs who have participated in the survey; they are available for others upon request.

### Bandwidth of Universities

As part of the survey, NRENs have given the percentage of connections for each type of institution (university, research institute, secondary school, etc) to the network at each of a set of bandwidths.

These were given as ranges, such as “greater than 100Mbps and less than 1000Mbps”. We have examined the bandwidth of university institutions a bit more in-depth, for two reasons. First, an NREN generally connects (almost) all Universities in its country; in most countries where the NRENs are well established, the numbers of connected universities is not going to vary much over time. Second, Universities tend to be the leaders in new and faster connectivity to NRENs, and we are interested in the trend of such connections in recent years.

For each access range, we have identified an average or typical bandwidth. Thus, for the example given above (>100Mbps and <1000Mbps) we select 155Mbps (STM-1) as being indicative of the type of connection. For each NREN, we have summed the product of the percentage of universities connected in that access range by the typical bandwidth for that range. This gives us an indicative weighted mean of university access bandwidth for the NREN.

**Table 2.1.2 Access capacity increase for Universities in different groups of NRENs**

Group of NRENs	Number of NRENs	Mean annual increase in University access capacity, 2003-2005 <sup>1</sup>
EU-15/EFTA	18	41%
New member states	10	116%

<sup>1</sup>See also the country-by-country data in section 2.5

In the EU-15/EFTA countries, the largest increases were achieved in Switzerland (200%/year) and in Italy (114%/year). In Switzerland, there was a large increase in Gb/s connections and a decrease in connections of below 10 Mb/s. A similar, though less pronounced shift took place in Italy. Average bandwidth stayed at more or less the same level in Belgium, Portugal, Sweden and the U.K. Belgium and Sweden already had a significant proportion of Gb/s connections in 2003.

In the new member states, the largest increases were achieved in Estonia and Hungary (more than 300%/year). In both countries, there was a

large increase in 1 Gb/s connections (and some 10 Gb/s connections were introduced in Hungary), with a corresponding decrease in connections of below 10 Mb/s. Average bandwidth stayed at more or less the same level in the Czech Republic and in Lithuania. Both of these countries already had a significant proportion of Gb/s connections in 2003.

In the other countries, the diversity was even greater. Therefore, these countries are not presented in the aggregated table. The largest increases were achieved in Moldova and no increases were reported in Algeria, Azerbaijan, Belarus, Turkey and Uzbekistan. In Moldova, the increase was

due to the fact that two universities jumped from connections of up to 10 Mb/s to Gb/s connections.

It should be noted that increases are usually not gradual, but occur step-wise, with the introduction of new technologies.

We have looked at this also from the point of view of the average University (rather than of average NREN as in section 2.1.3). This gives a complementary picture:

**Table 2.1.3 Average access capacity for Universities and average increases<sup>2</sup>**

	2003		2005		
Group of NRENs	Number of connected Universities	Average bandwidth (Mb/s)	Number of connected Universities	Average bandwidth (Mb/s)	Mean annual increase in University access capacity, 2003 - 2005
EU-15/EFTA	637	254	639	410	27%
New member states	394	214	391	546	60%

Note that the figures in Table 2.1.3 and 2.1.4 don't take into account the data from France. RENATER has provided data about connections to individual university sites, including both campuses with larger access capacities and a large number of sites with relatively limited access capacities. This is partly due to capacity-based charging policies in RENATER. The situation may be similar in other NRENs.

Calculating a mean for the other countries would not yield a meaningful figure because of the more extreme diversity and the uneven availability of data<sup>2</sup>.

A third way of looking at the trend in access speeds is to consider the change in Gigabit or higher links to universities over the period 2003 to 2005. This gives the following results:

**Table 2.1.4 Gb connections of Universities**

Group of NRENs	Percentage of Universities connected at >= 1Gb/s <sup>3</sup>	
	in 2003	in 2005
EU-15/EFTA	13%	18%
New member states	17%	42%
EU/EFTA	15%	24%

NRENs in the new member states have shown a remarkable increase in the number of universities connected at Gigabit speeds. From a position close to parity with the other EU members, they have taken the lead with more than twice the proportion of high bandwidth connections. This also helps to explain the increases in average bandwidth that are apparent from table 2.1.3. The SERENATE study<sup>4</sup> recommended the promotion of Gigabit networking services. Gigabit connections can be seen as a necessary, though not necessarily sufficient, condition for a university to engage in high-end research and learning programmes.

<sup>2</sup> See section 2.5 for more information

<sup>3</sup> Taken as a percentage of all connected Universities

<sup>4</sup> SERENATE Summary Report, p.6

The Compendium data suggest that the SERENATE recommendations on Gigabit networking are being implemented in many countries now. It seems that fibre optic technology is allowing NRENs to leapfrog immediately to much higher capacities. Gigabit Ethernet is being introduced by many hitherto less developed NRENs (such as AMREJ, MARNET and RENAM) and thus seems to make it possible, for the first time, to quickly address an important aspect of what was termed the 'digital divide' in Europe in the SERENATE study.

### Bandwidth of secondary and primary schools

There is clear evidence from many sources that the connection of secondary and primary schools to the Internet via NRENs and also the provision of support and application services to schools features high on the agenda in many countries in very recent years. The commitment by EU heads of government in Lisbon in 2000 to making Europe "the most dynamic and competitive knowledge-based economy in the world" by 2010 is a common factor underlying this activity. Secure access by schools to the Internet is seen as key to the development of the Information Society.

The following table summarises the policy position of NRENs with regard to the connection of schools, both primary and secondary:

**Table 2.1.5 Connection policies: secondary and primary schools**

Group of NRENs	Allowed to serve secondary schools?		Allowed to serve primary schools	
	Yes	No	Yes	No
EU/EFTA	21	4	20	5
Other	17	4	10	11

For EU/EFTA countries, there is only one NREN which distinguishes between primary and secondary schools when it comes to permission to connect. In other countries, this distinction seems to be more widespread.

On the level of connection policies, not much has changed since 2003. However, there were significant changes in the actual connections. In the new EU member states, only Cyprus and Malta do not connect secondary schools. The total number of secondary schools connected in these countries has risen from 767 in 2003 to 1,187 in 2005. There has not been a similar increase in the 'old' member states yet, although several NRENs from these countries have reported that they have started with programmes to connect secondary schools<sup>5</sup>.

<sup>5</sup> See Country-by country information in section 2.6

No conclusions can be drawn about the situation in countries not included in the tables. Various cases may apply:

applications. Secondary and primary schools are an emerging and potentially important new area for NRENs and therefore it seemed appropriate to feature them in this edition of the Compendium.

- \* The NREN may connect the relevant institutions, but may not have been able to answer these questions in the survey (see also the information in table 2.2);
- \* The Institutions may be connected through a different organisation. For example, secondary schools in many countries are connected to the Internet through separate organisations.
- \* Institutions may be connected through commercial ISPs;
- \* Institutions may not be connected to the Internet at all.

A similar analysis has not been carried out for other categories of connected institutions (research institutes, institutions of higher/further education, other bodies). We have decided to focus on Universities because all NRENs provide connections to them and because by their nature, Universities contain good samples of users from all disciplines. Looking at Universities can thus indicate overall trends as well as important advances in networking technologies and

## 2.2 Connection Policies

Legend	
	100% connected
	≥ 75% connected
	≥ 50%, < 75% connected
	≥ 25%, < 50% connected
	≥ 1%, < 25% connected

Note that the percentages here show the percentage of all institutions that is connected to the NREN. Institutions connected by other service providers are not taken into account

Table 2.2 Connection policies – categories of institutions for which connection to the NREN is allowed and % connected to the NREN.

Country	NREN	Universities	Institutes of higher/ further education	Research institutes	Secondary schools	Primary schools	Libraries, museums, national archives	Hospitals (other than University hospitals)	Government departments (national, regional, local)	Others
EU & EFTA countries										
Belgium	BELNET	yes	yes	yes	yes	yes	yes	yes	yes	yes
Cyprus	CYNET	yes	yes	yes	no	no	no	no	no	yes
Czech Republic	CESNET	yes	yes	yes	yes	yes	yes	yes	yes	yes
Denmark	UNI•C	yes	yes	yes	no	no	yes	no	no	yes
Estonia	EENet	yes	yes	yes	yes	yes	yes	yes	yes	no
Finland	FUNET	yes	no	yes	no	no	yes	no	yes	yes
France	RENATER	yes	yes	yes	yes	yes	yes	yes	yes	no
Germany	DFN	yes	yes	yes	yes	yes	yes	yes	yes	yes
Greece	GRNET	yes	yes	yes	yes	yes	yes	no	yes	yes
Hungary	NIIF/HUNGARNET	yes	yes	yes	yes	yes	yes	no	yes	yes
Iceland	RHnet	yes	yes	yes	yes	no	yes	no	no	no
Ireland	HEAnet	yes	yes	yes	yes	yes	yes	no	yes	yes
Italy	GARR	yes	yes	yes	yes	yes	yes	yes	yes	yes
Latvia	LANET	yes	yes	yes	yes	no	yes	yes	yes	
Latvia	LATNET	yes	yes	yes	yes	yes	yes	yes	yes	yes
Lithuania	LITNET	yes	yes	yes	yes	yes	yes	yes	yes	yes

Table 2.2 Connection policies (continued)

Legend										
	100% connected									
	≥ 75% connected									
	≥ 50%, < 75% connected									
	≥ 25%, < 50% connected									
	≥ 1%, < 25% connected									
Country	NREN	Universities	Institutes of higher/ further education	Research institutes	Secondary schools	Primary schools	Libraries, museums, national archives	Hospitals (other than University hospitals)	Government departments (national, regional, local)	Others
Luxembourg	RESTENA	yes	yes	yes	yes	yes	yes	no	yes	no
Malta	CSC	yes	yes	yes	yes	yes	yes			
Netherlands	SURFnet	yes	yes	yes	yes	yes	yes	yes	no	yes
Norway	UNINETT	yes	yes	yes	yes	yes	yes	no	no	yes
Poland	PIONIER	yes	yes	yes	yes	yes	yes	yes	yes	no
Portugal	FCCN	yes	yes	yes	yes	yes	no	no	yes	no
Slovakia	SANET	yes	yes	yes	yes	yes	yes	no	yes	no
Slovenia	ARNES	yes	yes	yes	yes	yes	yes	no	yes	yes
Spain	RedIRIS	yes	no	yes	no	no	yes	yes	yes	yes
Sweden	SUNET	yes	yes	yes	no	no	yes	no	yes	yes
Switzerland	SWITCH	yes	yes	yes	yes	yes	yes	yes	yes	no
United Kingdom	UKERNA	yes	yes	yes	yes	yes	yes	yes	yes	yes
Other countries										
Algeria	CERIST	yes	yes	yes	yes	no	yes	yes	yes	
Azerbaijan	AzNET	yes	no	no	yes	no	yes	no	no	yes
Azerbaijan	AzRENA	yes	no	yes	no	no	yes	no	yes	
Belarus	BASNET	yes	no	yes	yes	no	yes	yes	yes	no
Bulgaria	IST Foundation	yes	yes	yes	yes	yes	yes	no	no	no
Croatia	CARNet	yes	yes	yes	yes	yes	yes	yes	yes	yes
Georgia	GRENA	yes	yes	yes	yes	no	yes	yes	yes	no

Table 2.2 Connection policies (continued)

Country	NREN	Universities	Institutes of higher/ further education	Research institutes	Secondary schools	Primary schools	Libraries, museums, national archives	Hospitals (other than University hospitals)	Government departments (national, regional, local)	Others
Israel	IUCC	yes	yes	yes	no	no	yes	yes	no	no
Kazakhstan	KazRENA	yes	yes	yes	yes	yes	yes	yes	yes	yes
Kyrgyzstan	KRENA-AKNET	yes	yes	yes	yes	yes	yes	yes	no	yes
Macedonia, FYRo	MARNet	yes	yes	yes	yes	yes	yes	yes	yes	yes
Moldova	RENAM	yes	yes	yes	yes	yes	yes	yes	yes	yes
Morocco	MARWAN	yes	yes	yes	yes	yes	yes	yes	yes	no
Romania	RoEduNet	yes	yes	yes	yes	yes	yes	no	yes	no
Russian Federation	RBNet/RUNNet	yes	yes	yes	yes	no	yes	no	yes	no
Serbia / Montenegro	AMREJ	yes	yes	yes	yes	no	yes	yes	yes	yes
Syria	SHERN	yes	yes	yes	no	no	no	no	no	no
Turkey	ULAKBIM	yes	yes	yes	no	no	yes	no	yes	no
Ukraine	URAN	yes	yes	yes	yes	yes	no	no	yes	yes
Uzbekistan	UzSciNet	yes	yes	yes	yes	yes	yes	yes	yes	yes

## 2.3 Acceptable Use Policies

The following table summarises a number of key elements of the AUPs of NRENs:

- \* Does the NREN have an AUP?
- \* Does it describe what use of the network is allowed?
- \* Does it describe what use of the network is forbidden?
- \* Should it be signed by each institution that is connected to the network?
- \* Does it require institutions to designate a person in charge of security?
- \* Does it recommend or require connected institutions to develop their own AUPs?

Legend	
	100% connected
	≥ 75% connected
	≥ 50%, < 75% connected
	≥ 25%, < 50% connected
	≥ 1%, < 25% connected

Table 2.3 Acceptable use policies

	NREN	AUP?	Describes what is allowed?	Describes what is forbidden?	Signed?	Security person?	Own AUPs?
EU/EFTA countries							
Belgium	BELNET	yes	yes	yes	yes	no	no
Cyprus	CYNET	yes	yes	yes	no	no	no
Czech Republic	CESNET	yes	no	yes	yes	no	no
Denmark	UNI•C	yes	yes	yes	no	no	no
Estonia	EENet	yes	yes	yes	no	no	no
Finland	FUNET	yes	yes	yes	no	no	
France	RENATER	yes	yes	yes	yes	yes	yes
Germany	DFN	yes	yes	yes	yes	no	yes
Greece	GRNET	yes	yes	yes	yes	no	no
Hungary	NIIF/HUNGARNET	yes	yes	yes	yes	yes	yes
Iceland	RHnet	yes	yes	yes	no	no	no
Ireland	HEAnet	yes	yes	yes	yes	no	no
Italy	GARR	yes	yes	yes	yes	yes	no
Latvia	LANET	yes		yes			
Latvia	LATNET	yes	no	yes	yes	no	no
Lithuania	LITNET	yes	no	yes	yes	yes	no
Luxembourg	RESTENA	yes	yes	yes	no	no	no
Malta	CSC	yes	yes	yes	yes	yes	no
Netherlands	SURFnet	yes	no	no	yes	yes	yes
Norway	UNINETT	yes	yes	yes	no	no	no
Poland	PIONIER	yes	yes				
Portugal	FCCN	yes	yes	yes	yes	yes	no
Slovakia	SANET	yes	yes	yes	no	no	
Slovenia	ARNES	yes	no	yes	no	no	no
Spain	RedIRIS	yes	yes	yes	yes	yes	yes
Sweden	SUNET	yes	yes	yes	no	no	no
Switzerland	SWITCH	yes	yes	yes	no	no	yes
United Kingdom	UKERNA	yes	yes	yes	yes	no	yes

Table 2.3 Acceptable use policies (continued)

	NREN	AUP?	Describes what is allowed?	Describes what is forbidden?	Signed?	Security person?	Own AUPs?
<b>Other countries</b>							
<b>Algeria</b>	CERIST	yes	yes	yes	yes	no	no
<b>Azerbaijan</b>	AzNET	yes	no	yes	no	no	no
<b>Azerbaijan</b>	AzRENA	yes	no	yes	no	no	no
<b>Belarus</b>	BASNET	no					
<b>Bulgaria</b>	IST Foundation	yes	yes	yes	yes	no	yes
<b>Croatia</b>	CARNet	yes	yes	yes	no	no	yes
<b>Georgia</b>	GRENA	yes	no	no	no	yes	no
<b>Israel</b>	IUCC	yes	yes	yes	no	no	no
<b>Kazakhstan</b>	KazRENA	no	no	no	no	no	no
<b>Kyrgyzstan</b>	KRENA-AKNET	no	no	no	no	no	no
<b>Macedonia, FYRo</b>	MARNet	no					
<b>Moldova</b>	RENAM	yes	yes	yes	yes	no	no
<b>Morocco</b>	MARWAN	yes	yes	yes	yes	yes	no
<b>Romania</b>	RoEduNet	yes	yes	yes	no	yes	yes
<b>Russian Federation</b>	RBNet/RUNNet	yes	yes	yes	yes	no	no
<b>Serbia / Montenegro</b>	AMREJ	yes	yes	yes	no	no	no
<b>Turkey</b>	ULAKBIM	yes	yes	yes	yes	no	yes
<b>Ukraine</b>	URAN	no					
<b>Uzbekistan</b>	UzSciNet	yes	no	no	yes	yes	no

## 2.4 IPv6 uptake

The table 2.4 gives information about the IPv6 uptake in NRENs.

The uptake of IPv6 is greater within EU/EFTA NRENs than in those of other countries. The overall mean figures are that 10% and 2% of connected institutions, respectively, are also connected via IPv6.

These figures are probably understated, because not all NRENs that offer IPv6 connections have answered this question, partly because some NRENs do not have separate figures for IPv6 and IPv4 traffic.

There are wide variations within these averages, though. Within NRENs of all types, the lead in IPv6 seems to be taken by the universities rather than research institutes. In the EU/EFTA NRENs, the respective figures are 15% and 5% take-up. In other NRENs, the mean figures are 3% and 1%, respectively.

One cause of this disparity could be the relative size of universities and research institutes. By their very nature, universities encompass large numbers of students, teachers and researchers, from a range of disciplines and interests. It would not be unusual for at least some departments in a university to have a professional interest in a new Internet protocol.

There are other indicators of the uptake of IPv6. The GÉANT monthly reports give the volume of IPv6 traffic for each NREN access (or group of NRENs, as in the case of NORDUnet). Over time, there has been an increase in the overall level of IPv6 traffic within GÉANT.

Usage varies considerably from one NREN to another. While the usage by most NRENs is still less than 1% of total IP traffic, there are a few leaders, with levels of usage between 10% and 20%. Moreover, the growth in IPv6 traffic has been considerable, increasing by a factor of 14 between December 2003 and May 2005.

As a proportion of total IP traffic, the growth in IP traffic has been from 0.3% to 2.7% of the total traffic.

The following table provides information on IPv6 connections for Universities and for Research Institutes. The first two columns give the total number of connected institutions in each category and the number that has an IPv6 connection. The other columns give information on which percentage of all the institutions that have an IPv6 connection are connected, respectively, via native

IPv6, via tunneled IPv6, connected using 6to4 or via tunnel brokers. Note that unfortunately, because of the way the data was gathered, a zero can mean either a true zero or no reply.

Table 2.4 IPv6 uptake

	NREN	Total Universities connected to the NREN	Number connected via IPv6	% native	% tunnelled	% 6to4	% brokers	Total Research Institutes connected to the NREN	Number connected via IPv6	% native	% tunnelled	% 6to4	% brokers
EU/EFTA countries													
Belgium	BELNET	18	3	100	0	0	0	34	1	100	0	0	0
Cyprus	CYNET	1						3					
Czech Republic	CESNET	37	11	100	0	0	0	21	1	100	0	0	0
Denmark	UNI•C	12						25					
Estonia	EENet	11	2	100	0	0	0	15	5	40	60	0	0
Finland	FUNET	49	10	50	50	0	0	15	1	0	100	0	0
France	RENATER	406						244					
Germany	DFN	70	18	11	89	0	0	127	18	0	100	0	0
Greece	GRNET	20	7	57	29	14	0	20	1	0	100	0	0
Hungary	NIIF/ HUNGAR- NET	24	12	100	0	0	0	66	1	100	0	0	0
Iceland	RHnet	8	1	0	100	0	0	7	0	0	0	0	0
Ireland	HEAnet	7	2	50	0	0	50	10	1	100	0	0	0
Italy	GARR	85	13	70	30	0	0	106	5	60	40	0	0
Latvia	LANET	27						36					
Latvia	LATNET	22						18					
Lithuania	LITNET	20	5	40	60	0	0	54	1	100	0	0	0
Luxembourg	RESTENA	6						16					
Malta	CSC	5	1	0	100	0	0	1	0	0	0	0	0
Netherlands	SURFnet	60	60	83	17	0	0	65	50	33	17	0	0
Norway	UNINETT	4	4	100	0	0	0	83	10	50	50	0	0
Poland	PIONIER	95						160					
Portugal	FCCN	22	7	57	43	0	0	12	1	0	100	0	0
Slovakia	SANET	52	3	100	0	0	0	25	0	0	0	0	0

Table2.4 IPv6 uptake (continued)

	NREN	Total Universities connected to the NREN	Number connected via IPv6	% native	% tunnelled	% 6to4	% brokers	Total Research Institutes connected to the NREN	Number connected via IPv6	% native	% tunnelled	% 6to4	% brokers
Slovenia	ARNES	10	1	0	100	0	0	57	1	0	100	0	0
Spain	RedIRIS	66	11	36	64	0	0	150	0	0	0	0	0
Sweden	SUNET	40						5					
Switzerland	SWITCH	31	4	100	0	0	0	2	1	100	0	0	0
United Kingdom	UKERNA	120	30	10	90	0	0	50	0	0	0	0	0
	<b>Total</b>	<b>1,328</b>	<b>205</b>					<b>1,427</b>	<b>78</b>				
			<b>15.4%</b>						<b>5.5%</b>				
<b>Other countries</b>													
Azerbaijan	AzNET	4											
Azerbaijan	AzRENA	16						24					
Belarus	BASNET	10						180					
Bulgaria	IST Foundation	20						72	1	100	0	0	0
Croatia	CARNet	190	3					50					
Georgia	GRENA	10	0	100	0	0	0	30	0	0	0	0	0
Israel	IUCC	8	2					5	0	0	0	0	0
Kazakhstan	KazRENA	6	0	0	100	0	0	21	0	0	0	0	0
Kyrgyzstan	KRENA-AKNET	16						2					
Macedonia, FYRo	MARNet	10						5					
Moldova	RENAM	6						35					
Morocco	MARWAN	13						2					
Romania	RoEduNet	50	10					35	6	85	15	0	0
Russian Federation	RBNNet/RUNNet	168	0	80	20	0	0	270	0	0	0	0	0

	NREN	Total Universities connected to the NREN	Number connected via IPv6	% native	% tunnelled	% 6to4	% brokers	Total Research Institutes connected to the NREN	Number connected via IPv6	% native	% tunnelled	% 6to4	% brokers
Serbia/Montenegro	AMREJ	5	1					22	0	0	0	0	0
Syria	SHERN	5	0	100	0	0	0	3	0	0	0	0	0
Turkey	ULAKBIM	80	5	100	0	0	0	14	1	100	0	0	0
Ukraine	URAN	25	0	100	0	0	0	6	0	0	0	0	0
Uzbekistan	UzSciNet	80						24					
	<b>Total</b>	<b>758</b>	<b>21</b>					<b>811</b>	<b>8</b>				
			<b>2.8%</b>						<b>1.0%</b>				

## 2.5 Number of connected Universities and bandwidth

The organisational setup of Universities and other institutes can be very different from country to country. For example, in some countries Research Institutes are part of Universities; in other countries, they are not.

Some countries have relatively few but large Universities, others have relatively many, but smaller ones.

Also, some NRENs have listed entire Universities as one institution, others have counted faculties or schools that form part of a University but are geographically at different locations as different institutions.

In this section, information is provided for 2003 and 2005, showing the evolution over the past years. The 2005 information is also provided in table format in Appendix 1.

Note that the Polish information from 2005 was extrapolated from data gathered from 13 out of the 20 MANs that together form the PIONIER network.

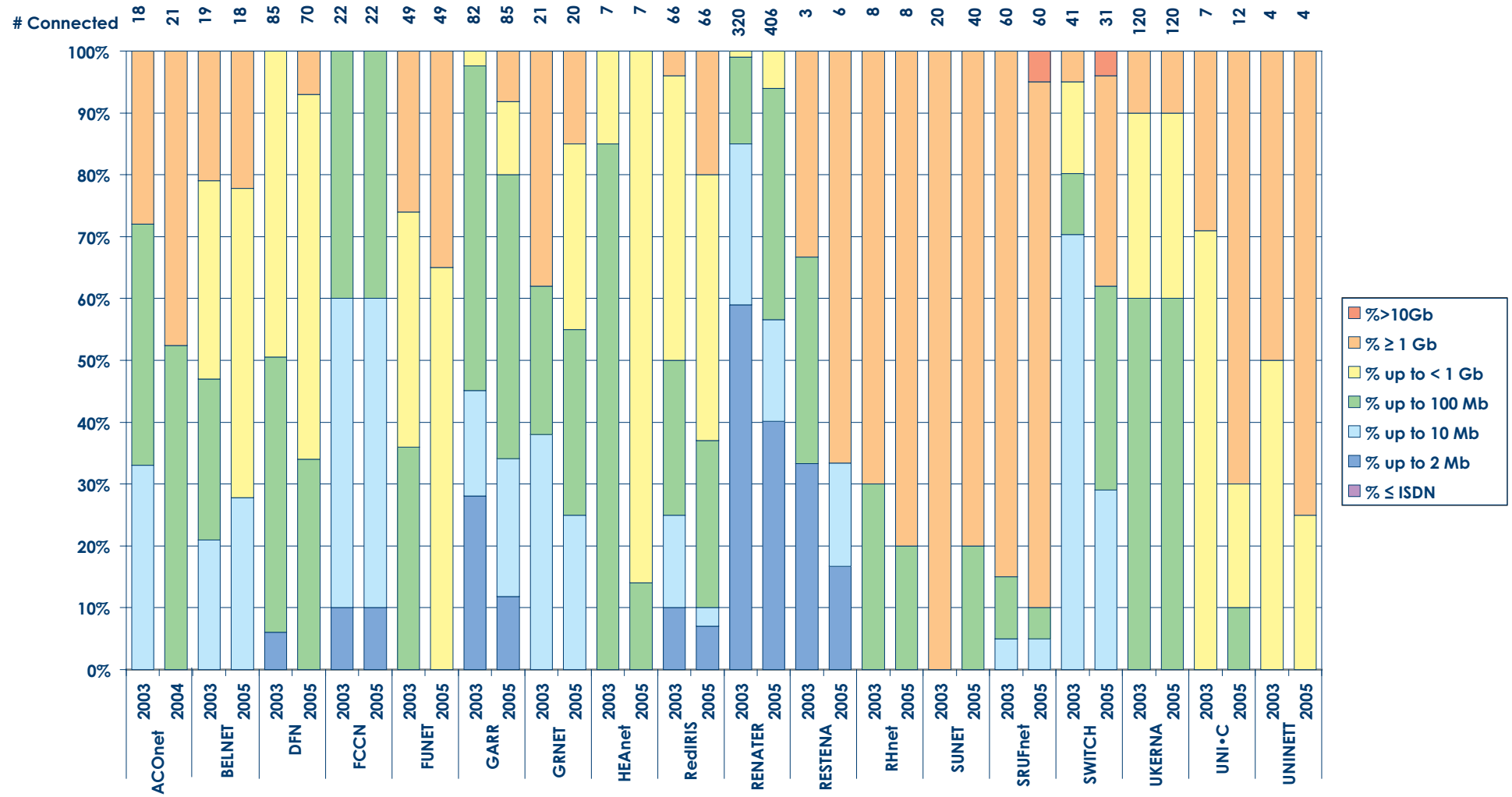
RENATER (France) has given the information on the number of separate institutions that are connected. DFN (Germany) has instead given information about the number of connected Universities. France does not have four times the number of Universities that Germany has.

The information of some NRENs in 2003 (e.g., AMREJ, HUNGARNET, SWITCH) concerns the number of connected institutions, whereas in 2005 it concerns the number of connected Universities.

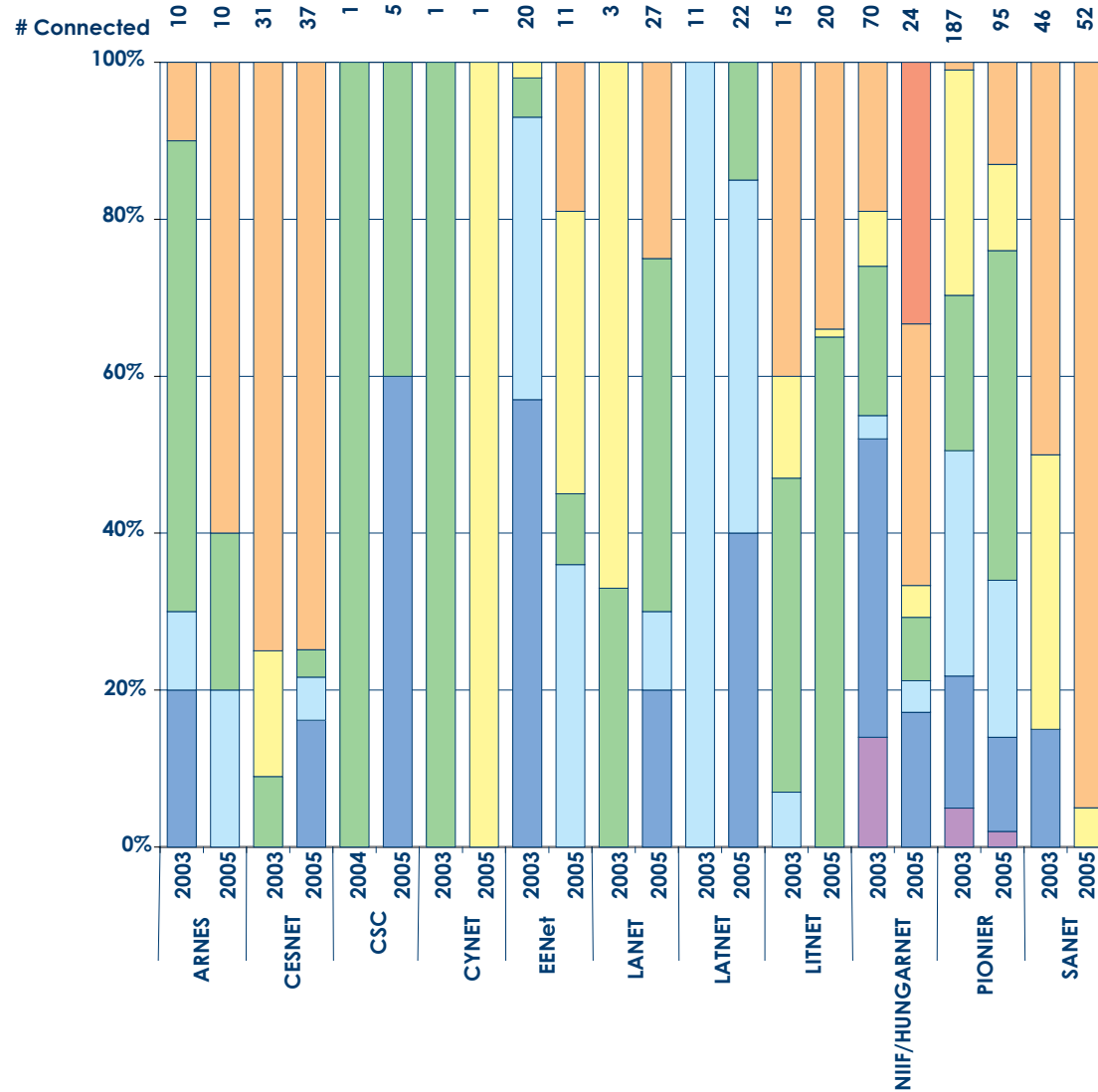
In some cases (e.g., CARNet) the reverse applies: the information from 2003 concerns the number of connected Universities as such, the information from 2005 concerns rather the connections to the separate institutions that are part of those Universities.

It may not be possible to normalize this completely, because not all NRENs are able to supply the data in both ways.

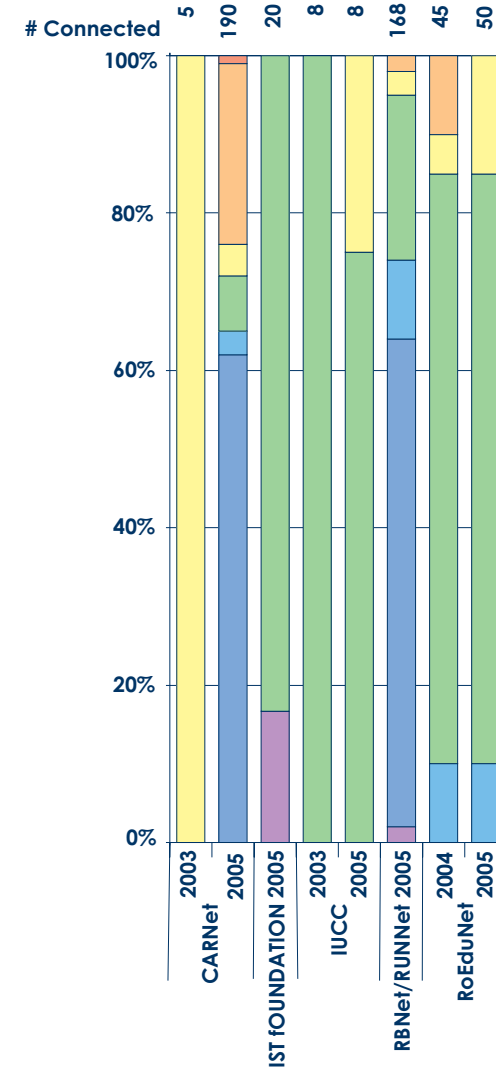
Graph 2.5.1 University bandwidth, EU-15/EFTA countries, 2003 and 2005



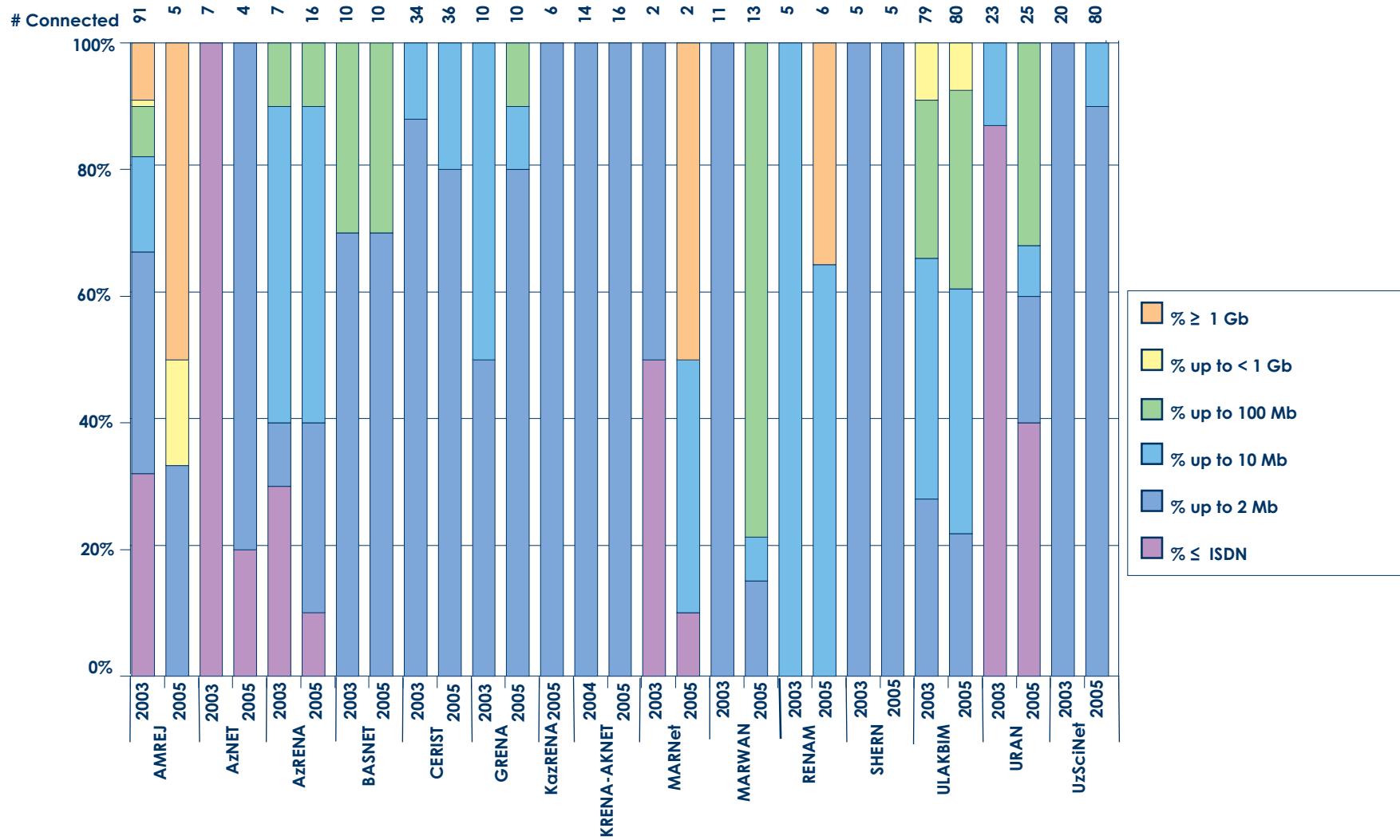
Graph 2.5.2 University bandwidth, new EU member states



Graph 2.5.3 University bandwidth, non-EU/EFTA GN2 partners



Graph 2.5.4 University bandwidth, other countries

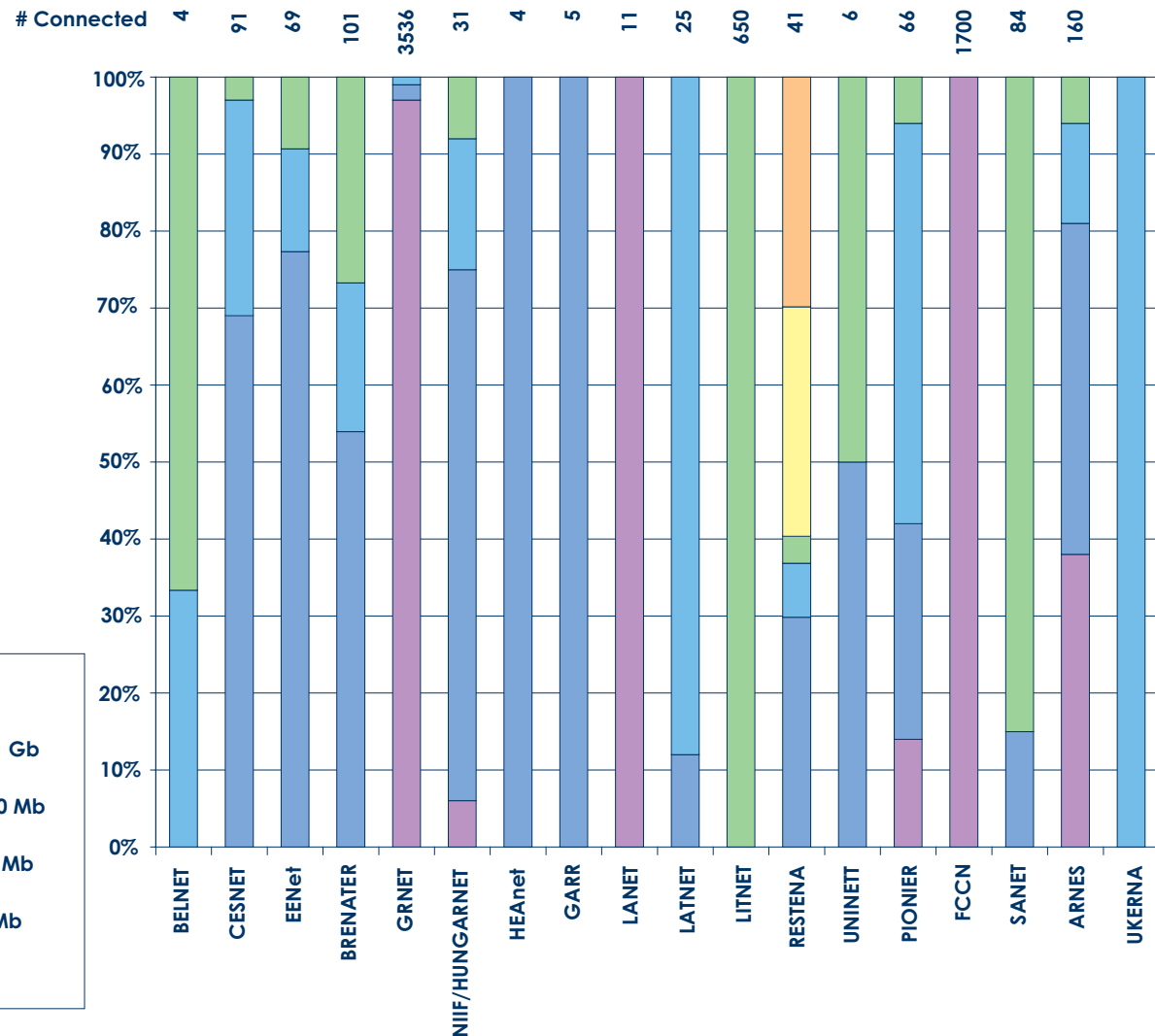
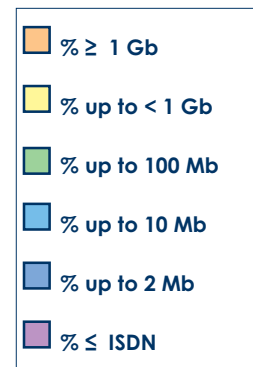


## 2.6. Number of connected secondary schools and bandwidth

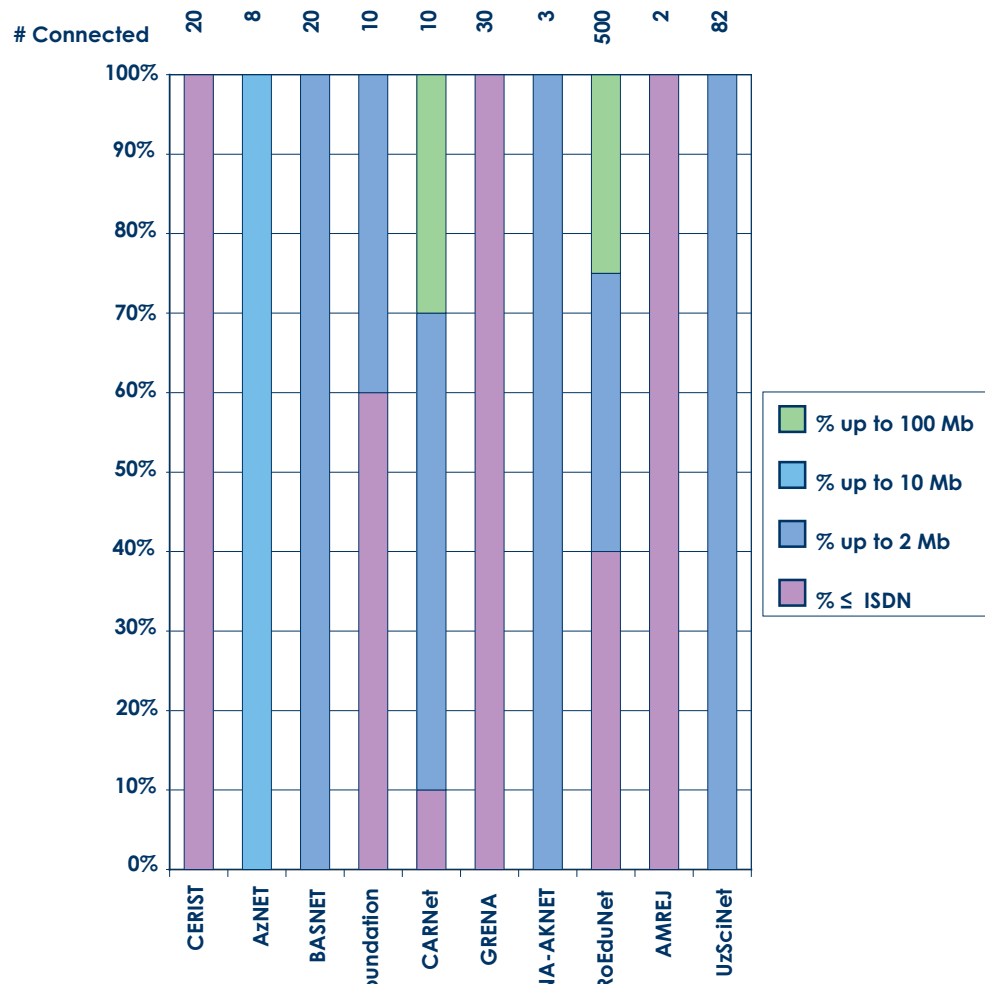
Graph 2.6.1 Secondary school bandwidth, EU/EFTA countries

Note that in Denmark, two networks are operated by UNI•C: Forskningsnettet (the Danish Research Network), that does not connect secondary and primary schools, and Sektornet, that does. The information in this Compendium provides only the information from Forskningsnettet. See <http://www.uni-c.dk/generelt/english/education/sektornet.html> for more information.

More information can also be found in the SERENATE deliverable 15, 'Report on examples of extension of research networks to education and other user communities', TERENA, Amsterdam, October 2003, ISBN 90-77559-05-1



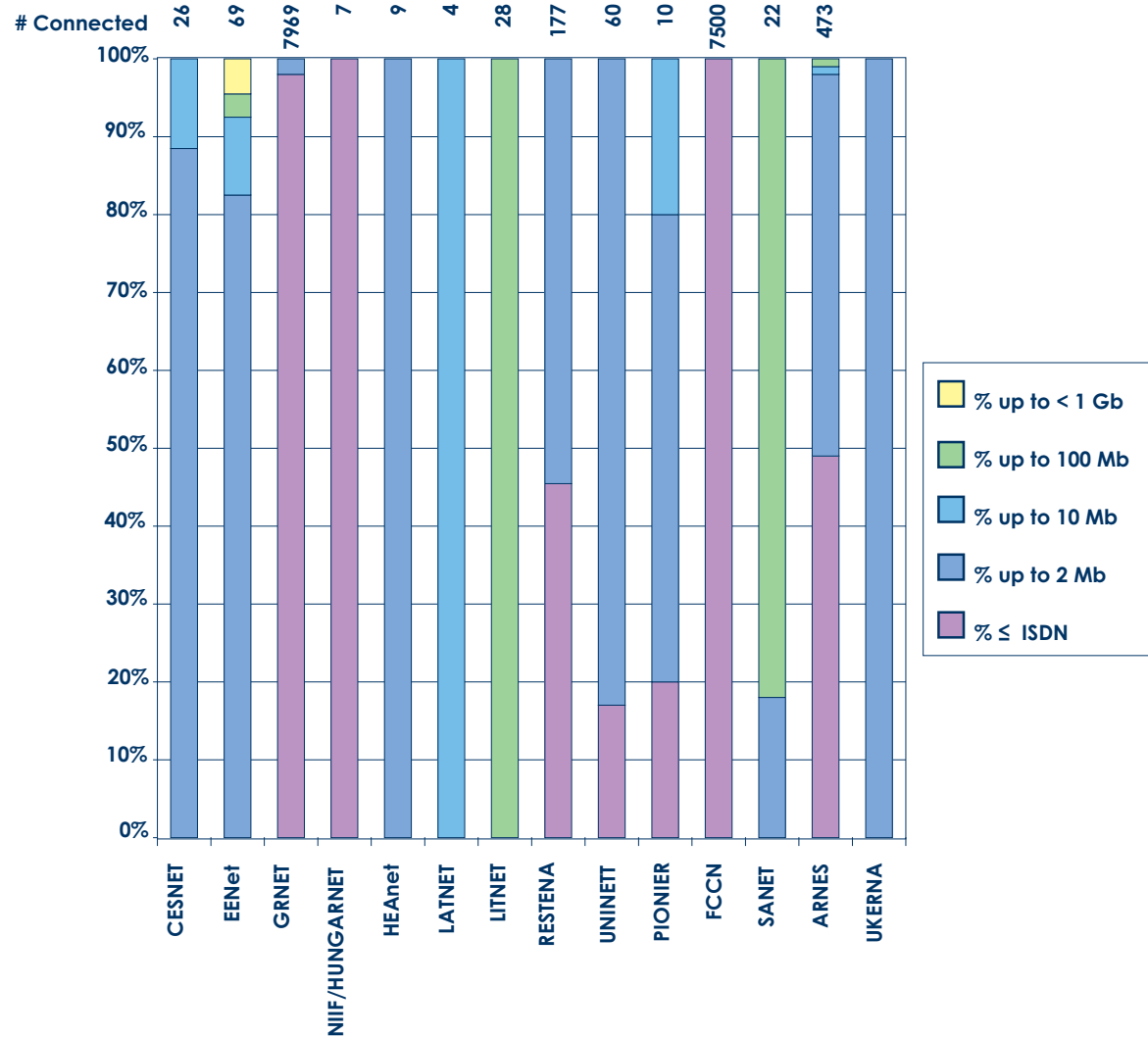
Graph 2.6.2 Secondary school bandwidth, other countries



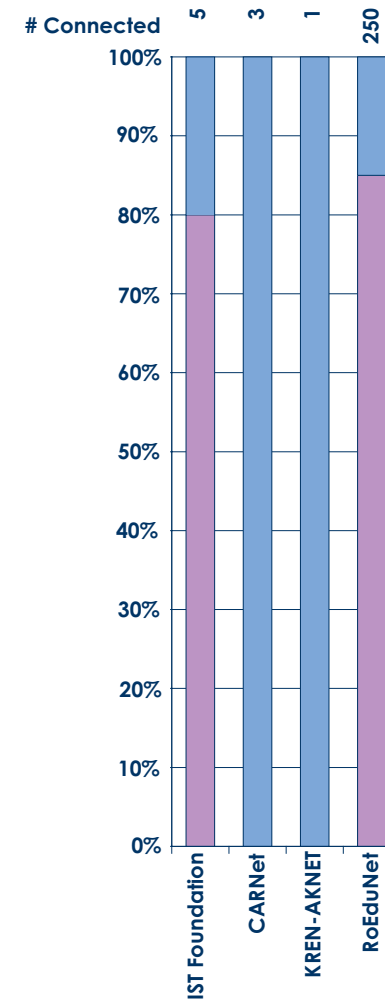
Note that RBNNet/RUNNet (Russia) is not included in this graph because it did not provide information about the division of the bandwidth over secondary schools. However, it connects 5,000 secondary schools.

## 2.7 Number of connected primary schools and bandwidth

Graph 2.7.1 Primary schools bandwidth, EU/EFTA countries. (See the remark in section 2.6 about UNI•C, Denmark.)



Graph 2.7.2 Primary schools bandwidth, other countries

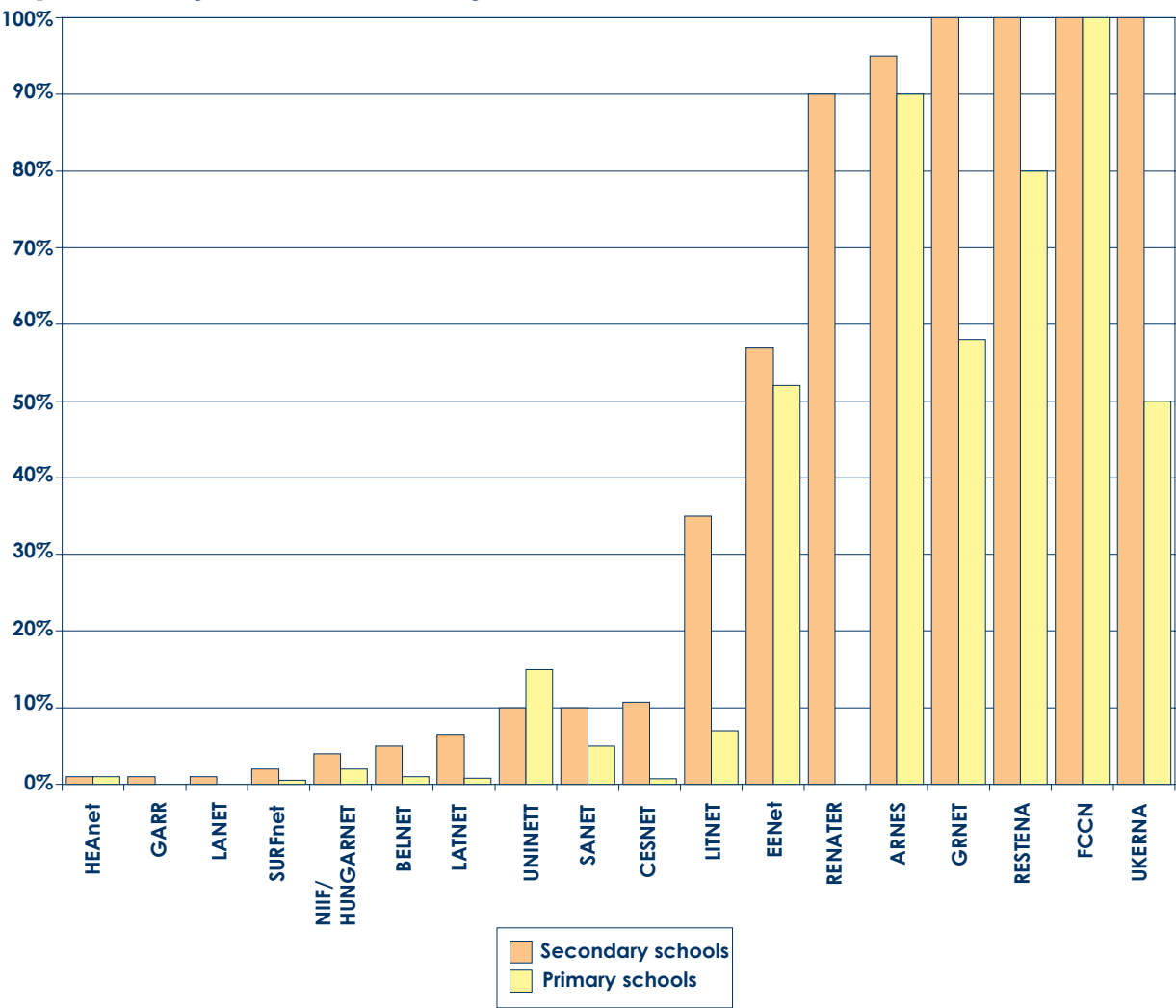


## 2.8 Percentage of schools connected to the NREN

The following graphs provide information about the percentage of all secondary and primary schools that is connected to the NREN, according to estimates supplied by the NRENs.

Note that aside from the connection itself, also the connection method and the type of services offered are important. Thus, in the UK schools are not connected directly to the NREN but via the regional broadband consortia or local authorities who use the NREN as their backbone. Schools receive a reduced set of services. In other countries, schools may be connected directly to the NREN backbone and may receive an extended set of services, tailored to the needs of schools.

Graph 2.8.1 Percentage of schools connected through the NREN, EU/EFTA countries



Graph 2.8.2 Percentage of schools connected through the NREN, other countries

