



**INFORMATION RELEVANT TO *e*EUROPE  
BENCHMARK INDICATOR 4,  
SPEEDS OF INTERCONNECTIONS AND SERVICES AVAILABLE  
BETWEEN AND WITHIN NATIONAL RESEARCH AND EDUCATION  
NETWORKS (NRENs) WITHIN EU AND WORLDWIDE**

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January, 2002

**INFORMATION RELEVANT TO eEUROPE BENCHMARK INDICATOR 4, SPEEDS OF  
INTERCONNECTIONS AND SERVICES AVAILABLE BETWEEN AND WITHIN NATIONAL  
RESEARCH AND EDUCATION NETWORKS (NRENs) WITHIN EU AND WORLDWIDE**

Commission order number 27639, contract signed 3 December 2001

TSec(02)001

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## Introduction

The aims of the *e*Europe Action Plan are to make sure that citizens and businesses across Europe fully benefit from the Information Society by accelerating the uptake of digital technologies across Europe and ensuring that all Europeans have the necessary skills to use them. To monitor progress in realising the objectives of *e*Europe, the Single Market Council agreed on a list of 23 benchmarking indicators each of which has a number of supplementary indicators. The Council asked that most of the indicators be measured annually. The objective of benchmarking *e*Europe is to give an overview of the state of play of implementation of the *e*Europe Action Plan and to enable Member States to compare performance, identify best practice and promote remedial action.

Indicator 4 of the benchmarking indicators concerns the “Speed of interconnections and services available between and within national research and education networks (NRENs) within EU and world-wide”. Given the experience that TERENA has in collecting information of this type from NRENs, among others through the “TERENA Compendium of National Research and Education Networks in Europe”, the Information Society Directorate-General of the European Commission requested TERENA to gather data that is relevant for this indicator.

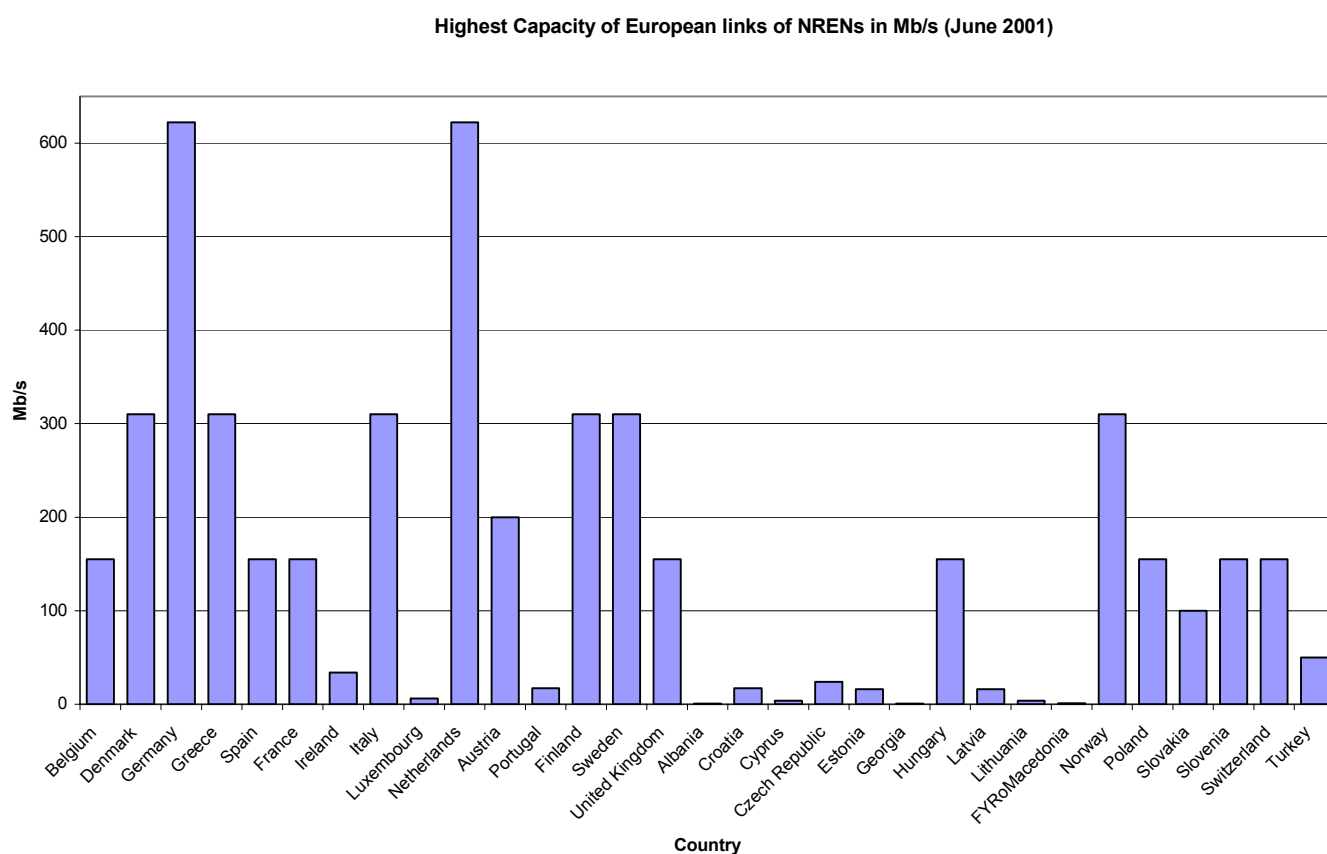
As a result of this request, a survey was designed and carried out of NRENs in the European Union and elsewhere in Europe in December of 2001. The answers to the questionnaire were compiled and checked for consistency by Licia Florio and Bert van Pinxteren of TERENA.

## 1. Speed of interconnections between NRENs

### a. Situation in June 2001

#### Capacity of the highest European link of NRENs

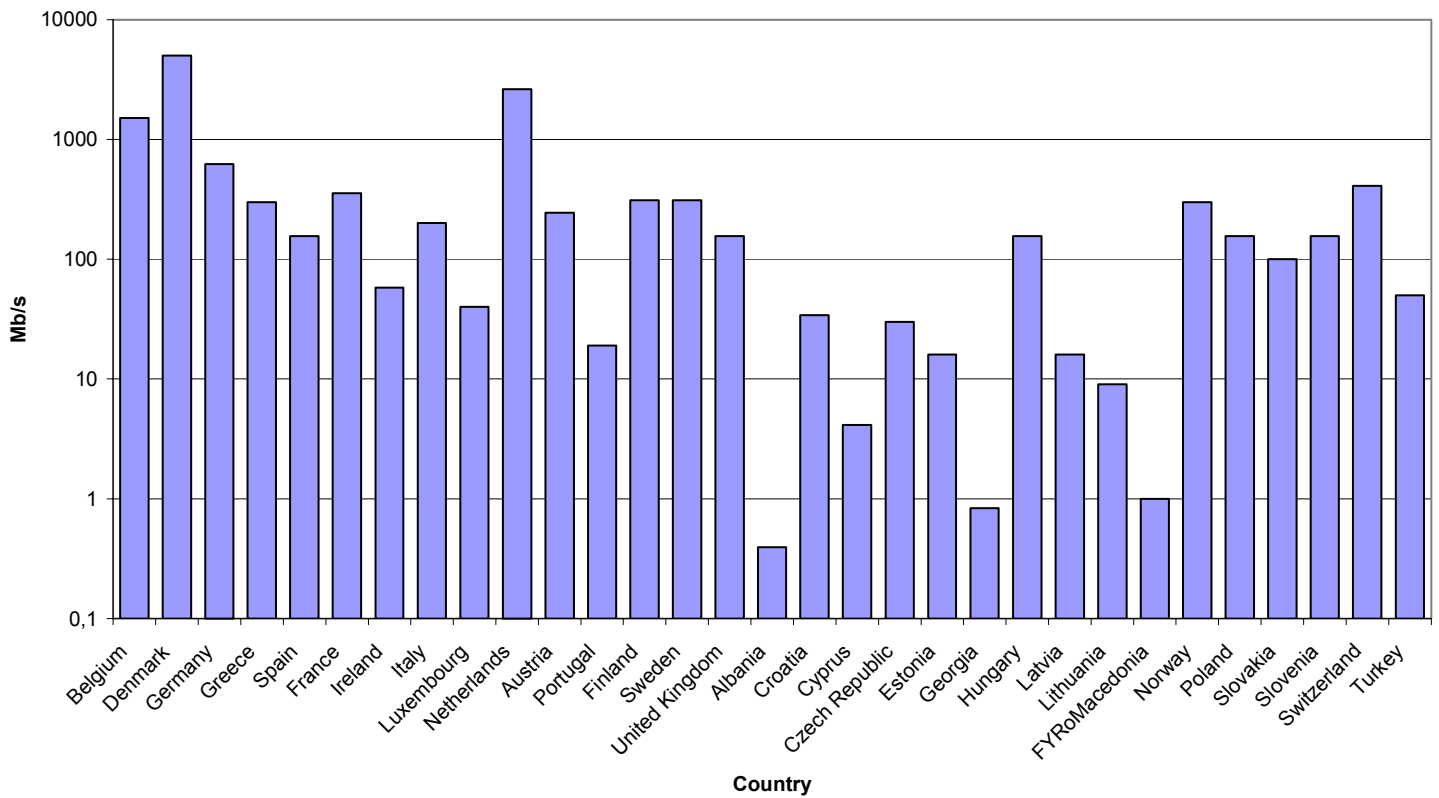
The graph below shows the capacity of the highest European link of NRENs (in most cases: the connection to the TEN-155 backbone) as of June, 2001.



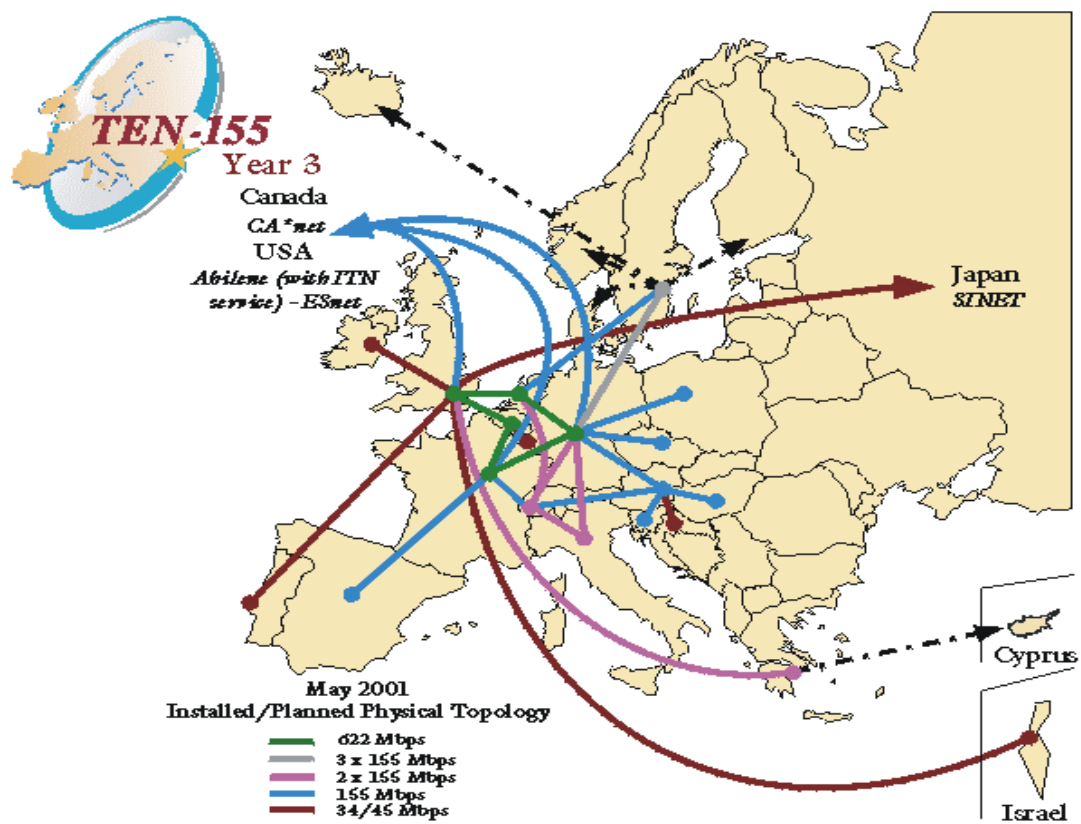
### Aggregate capacity of all direct European links

The table below shows the aggregate capacity of all direct links from the NRENs mentioned to TEN-155 or to other European NRENs as of June 2001. Note that the scale used is a **logarithmic** scale.

**Aggregate capacity of European Links of NRENs, June 2001**



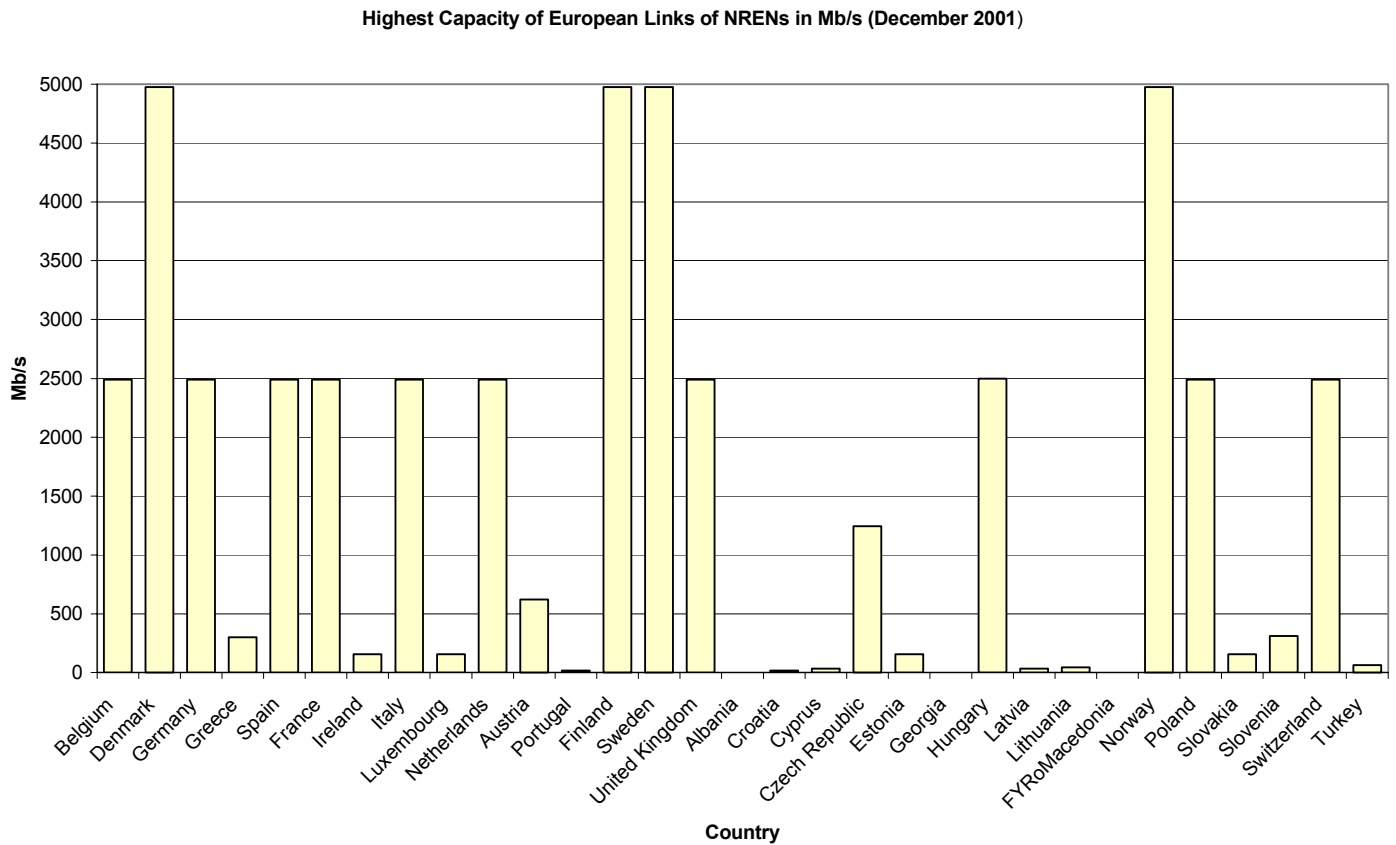
Logical map of interconnections of the TEN-155 network, June 2001



This map has been provided by DANTE. Data for June are identical to those of May.

**b. Situation in December 2001**

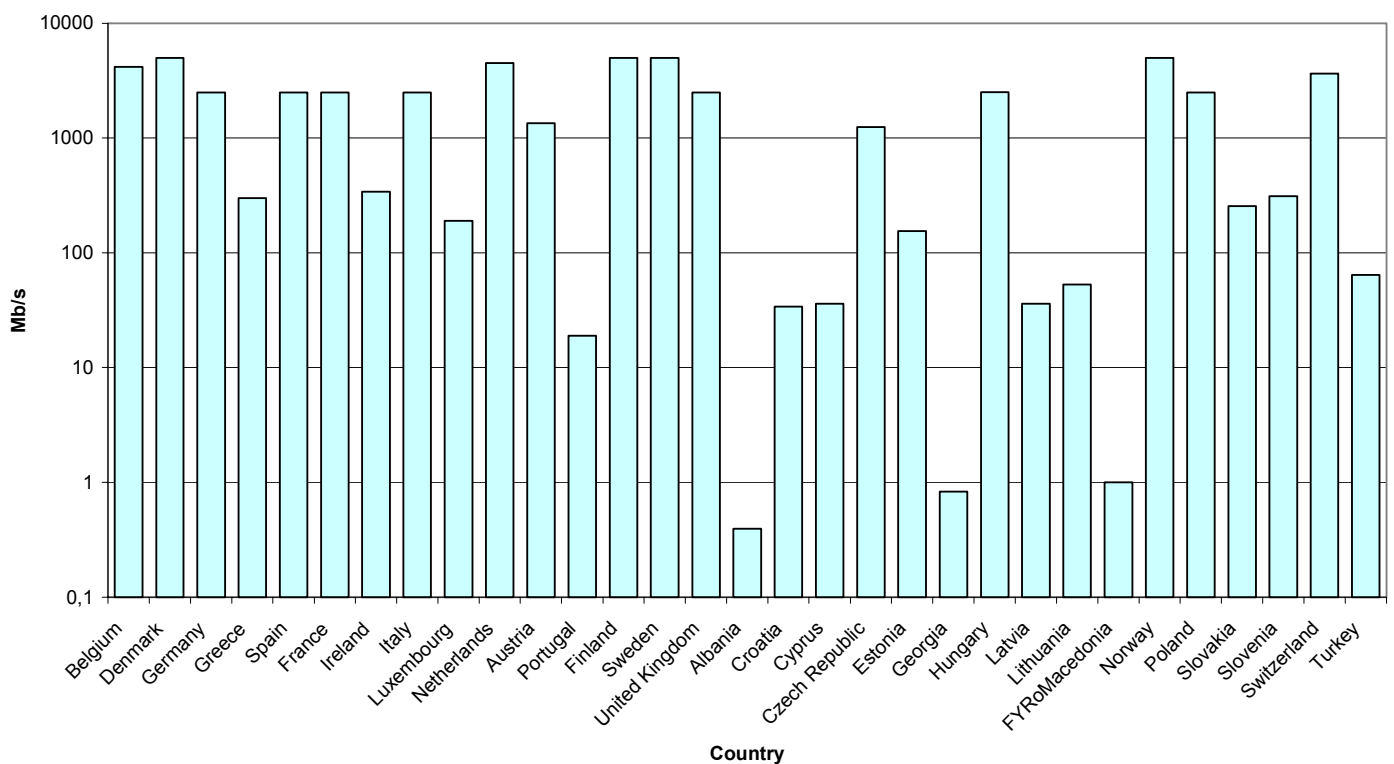
The graph below shows the capacity of the highest European link of NRENs (in most cases: the connection to the GÉANT backbone) as of December 2001.



### Aggregate capacity of all direct European links

The table below shows the aggregate capacity of all direct links from the NRENs to GÉANT or to other European NRENs as of December 2001. Note that the scale used is a **logarithmic** scale. Note that the Greek and Portuguese connections are due to be upgraded to 2 x 622 and 1 x 622 Mb/s respectively in January 2002.

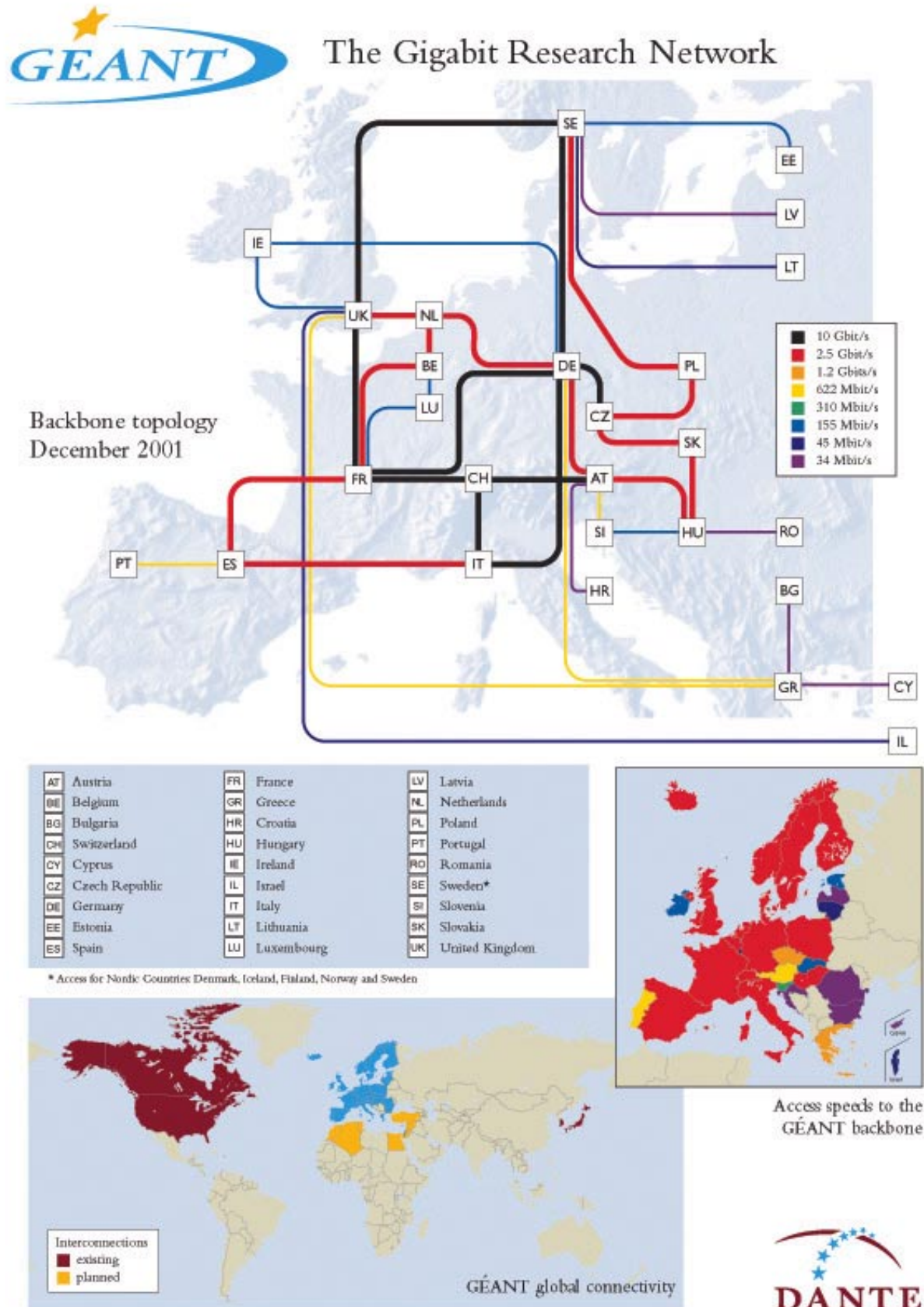
Aggregate capacity of European Links of NRENs, December 2001





## Logical map of interconnections of the GÉANT network, December 2001

This map has been provided by DANTE.

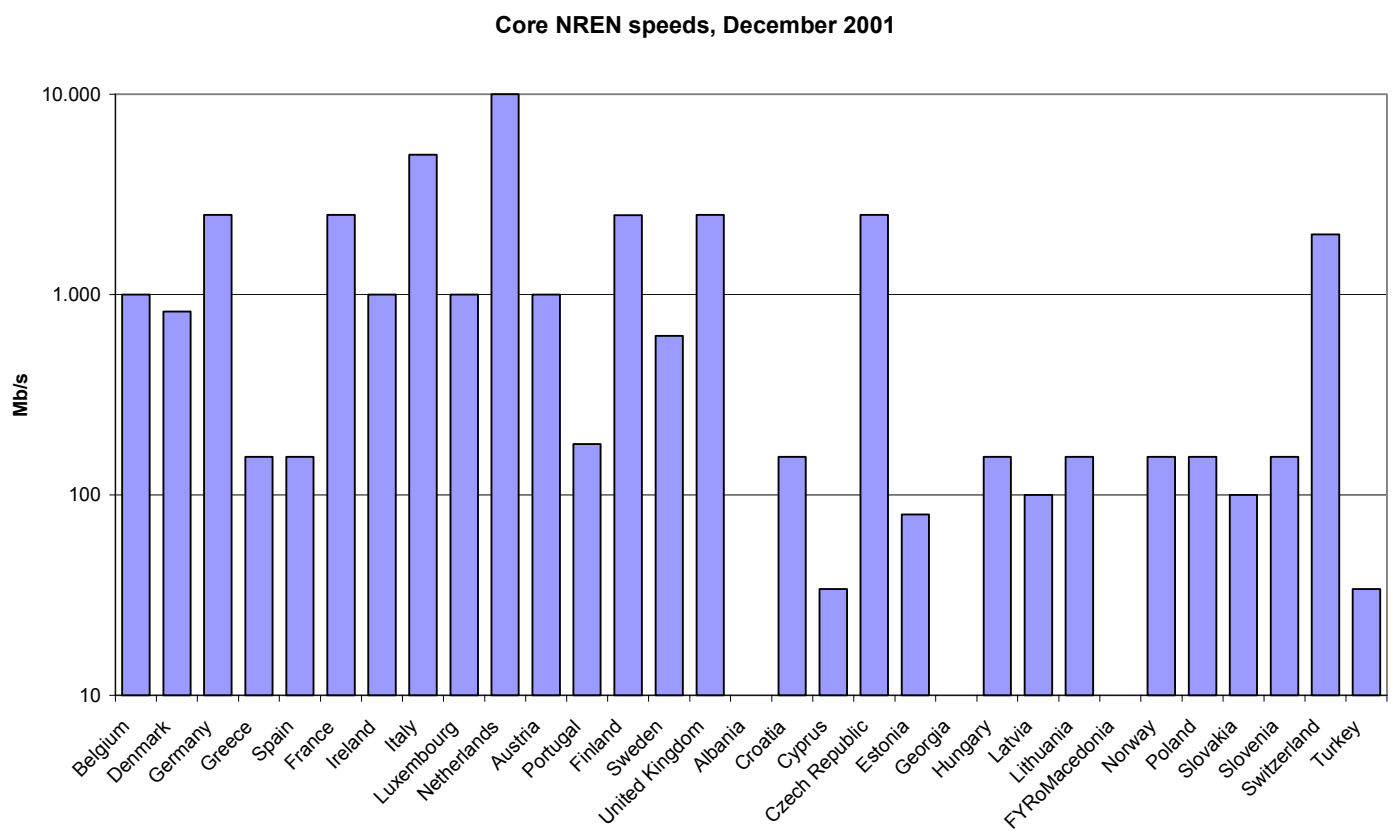


## 2. Core speeds on the national networks

Most NRENs have a limited number of central nodes that are connected to each other at high speeds. The speed of those connections is given in the table below. Other NRENs have a star topology, with only one central node. The highest capacity into that node is given in the table below for the NRENs to which this applies.

Country	Core Capacity in Mb/s	Notes
Belgium	1,000	from 155-622 in June to 155/622/1000 in December 2001
Denmark	822	
Germany	2,500	
Greece	155	Mid January 2002 these connections will be upgraded to 2.5 Gb/s
Spain	155	The net has a star topology with 17 nodes connected at different access capacities
France	2,500	The loop in the Paris area is 80 Gb/s
Ireland	1,000	One core link is 1Gbps, all others are 155 Mbps
Italy	5,000	
Luxembourg	1,000	
Netherlands	10,000	
Austria	1,000	
Portugal	180	
Finland	2,500	
Sweden	622	However, the core capacity will very soon be 10 Gigabit/s (from January 2002)
United Kingdom	2,500	
Albania	1	
Croatia	155	
Cyprus	34	Star Topology
Czech Republic	2,500	
Estonia	80	
Georgia	1	
Hungary	155	Upgrade core capacity is underway. By the end of December 2001 it was due to be 2.5 Gb/s
Latvia	100	
Lithuania	155	
FYRoMacedonia	10	The network implementation is a typical star topology with bandwidth ranging from 56Kb/s to 10Mb/s
Norway	2,500	Capacity still 155 Mb/s for some parts of the core.
Poland	155	Planning to 622 Mb/s rings in the first quarter of 2002.
Slovakia	100	
Slovenia	155	ARNES has a star topology. The maximum capacity into the central node is 155 Mbps. In the other nodes the capacity are 10 Mbps and 100Mbps.
Switzerland	2,000	SWITCH has its own fibre crossing Switzerland (Project SWITCHlambda). Currently two Gigabit Ethernet connections over this link are operational
Turkey	34	

The same information is also contained in the table below, which has a logarithmic scale.

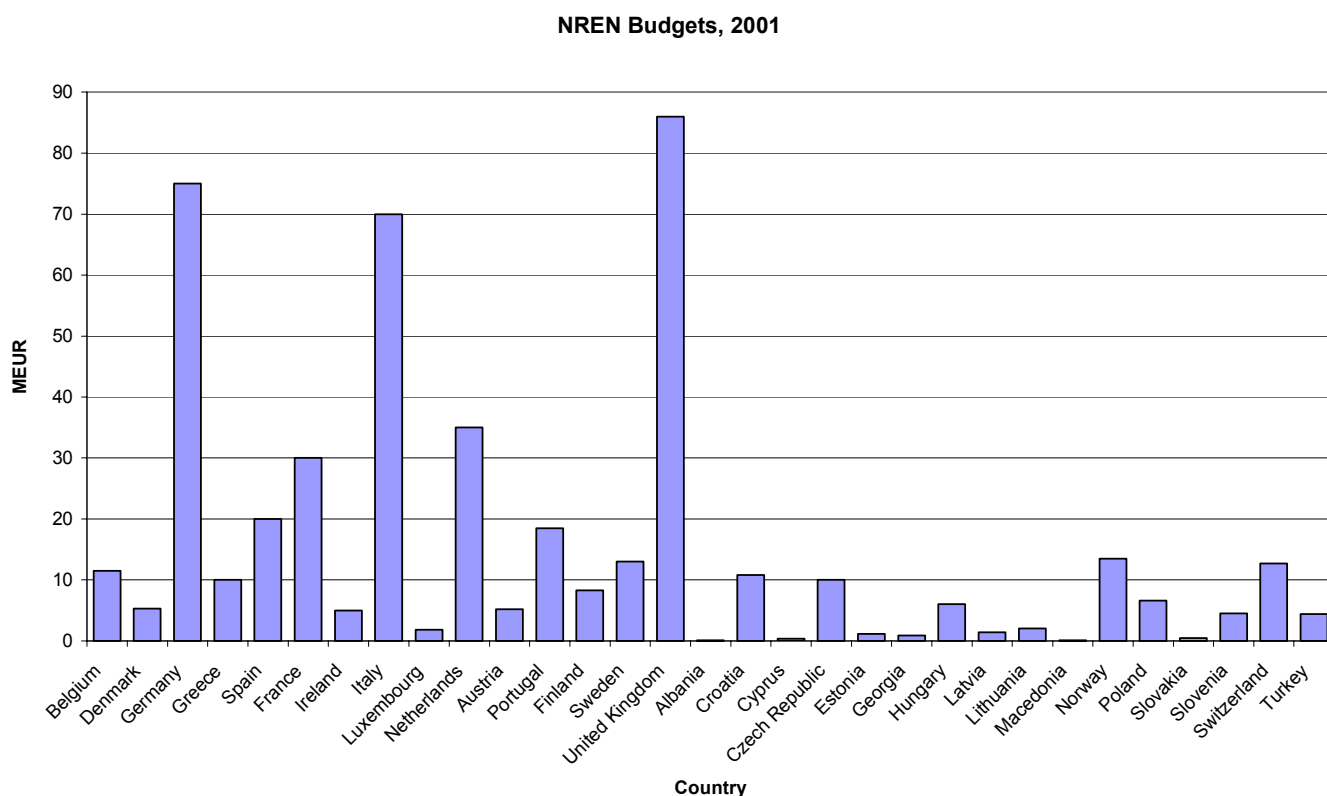


### 3. NREN budgets

Country	2001 Budget in MEUR	Notes
Belgium	11.5	
Denmark	5.3	
Germany	75	
Greece	10	
Spain	20	In 2001, RedIRIS spent 4 MEUR on network equipment (included in this figure). Secondary schools are not connected to RedIRIS
France	30	Including 1 MEUR in 2002 for connecting secondary schools
Ireland	5	
Italy	70	
Luxembourg	1.8	Around 30% of the budget used to connect secondary and primary schools to the national infrastructure
Netherlands	35	
Austria	5.2	
Portugal	18.5	During 2001 the main effort has been dedicated to the two following areas: · Introduction of differentiated bandwidth services in the backbone of RCTS · Connection of all Portuguese schools (primary, secondary schools were already being connected since 1997) (by the end of 2001 all schools – approx. 11.000 – will be integrated into RCTS)
Finland	8.3	The FUNET backbone was upgraded in 2001.
Sweden	13	Investments that were planned during 2001 have been postponed.
United Kingdom	86	Budget year from 1 August to 31 July. This is the 2000/2001 figure.
Albania	0.09	This is the budget used for the Soros Foundation Internet project (international link, running costs, training etc.)
Croatia	10.8	One of the priorities of the current government is the development of the Information Society and the preparation of Croatia for European integration. As a consequence the budget of CARNET was recently increased to the figure given here. 70% of CARNET's budget goes into telecommunication costs, due to the fact that the telecommunications market in Croatia has not been deregulated yet.
Cyprus	0.35	
Czech Republic	10	
Estonia	1.160	
Georgia	0.404	
Hungary	6	Actual annual income/expenditure figure is expected to be about 40 % higher than budgeted.
Latvia	1.4	
Lithuania	2.056	LITNET ordinary exploitation- 873,000 EUR, LITNET integration to GEANT related (directly and additional-core capacity upgrade, equipment)-1,183,000 EUR
FYRoMacedonia	0.07	
Norway	13.5	UNINETT might receive additional funds to build more Gigabit capacities into the national network. This is to be decided early 2002.
Poland	6.6	

<b>Slovakia</b>	0.5	A new project, SANETII, comprises building up the new optical infrastructure. The budget for this project will be approximately 5.5 MEUR
<b>Slovenia</b>	4.5	ARNES is connecting also all primary and secondary schools, museums and libraries in Slovenia. Universities represent a minority of the users. The liberalisation in telecommunications is at the beginning and therefore the price for the infrastructure is still rather high
<b>Switzerland</b>	12.7	The total budget of SWITCH is higher, because it includes the domain registration services. For this questionnaire, the network related budget figure has been used.
<b>Turkey</b>	4.4	

The same information is summarized in the graph below:



#### 4. Numbers and types of institutions permanently connected to NRENs

The NRENs have been asked to classify institutions offering education up to ISCED levels 5 and 6 as ‘universities’ and institutions offering education up to ISCED level 4 as institutes of higher and/or further education. It should be noted that the distinctions between Universities and other institutions of higher learning are fairly different from country to country; it could be that some respondents have not given the data precisely in conformity with the ISCED classification. This may have distorted the picture somewhat for a minority of the responding countries.

Country	Total number of connections	Universities	Higher/further education institutes	Notes
Belgium	130	13	30	
Denmark	120	7	40	
Germany	4600	80		Over 4000 schools are connected to DFN; this is about 10% of all German schools. The other 90% are connected to T-Online.
Greece	60	65	14	
Spain	270	66		
France	600	80	150	
Ireland	40	7	20	There is probably only one public-funded HE/FE institution not connected to HEAnet.
Italy	300	80		GARR connect s only universities or equivalent institutions in the education area. The other institutions connected are research institutions, and institutions with an important cultural role: museums, libraries, etc...
Luxembourg	350	2	4	Other institutions are research centres, secondary schools, primary schools, cultural institutions like museums etc.
Netherlands	200	60	15	
Austria	72	18	6	
Portugal	76	20	24	
Finland	85	48	2	
Sweden	80	40	0	There is no strict definition of what constitutes a university. Some universities are sometimes called "university colleges" - the difference being that they have fewer levels in the academic program or are more specialized than the more established universities. Using a strict definition, there are only 14 universities, all of them connected, and 26 "institutes providing higher or further education".
United Kingdom	730	120	550	
Albania	20	2		There are two main universities in Tirana (University of Tirana and Polytechnic University), part of their faculties are connected permanently.
Croatia	166	4	41	Most of the 166 connected institutions are separate faculties that belong to one of the four universities.
Cyprus	7	1		
Czech Republic	161	29	10	
Estonia	562	23	37	
Georgia	350	8	100	

<b>Hungary</b>	900	122	65	These numbers of connected universities and higher/further education institutes refer in some cases to independent faculties.
<b>Latvia</b>	2200	4	18	
<b>Lithuania</b>	292	15	20	
<b>FYRoMacedonia</b>	40	2		
<b>Norway</b>	300	4	35	
<b>Poland</b>				The Polish NREN, POL-34/155, consists of 21 Metropolitan Area Networks. Each of them provides connectivity for institutions within their area. There are no detailed data on the number of universities and institutes connected.
<b>Slovakia</b>	308	26	210	
<b>Slovenia</b>	274	9	all	
<b>Switzerland</b>	82	77	very few	
<b>Turkey</b>	93	75	Not known	The higher and further education institutions are organized as sub institutions of the universities. Most of them are connected

The table below provides further information about the (estimated) ‘market share’ of the NRENs:

<b>Country</b>	<b>% of universities connected through NREN</b>	<b>% of higher/further education institutes connected through NREN</b>
<b>Belgium</b>	100%	30%
<b>Denmark</b>	100%	90%
<b>Germany</b>	97%	
<b>Greece</b>	100%	100%
<b>Spain</b>	100%	
<b>France</b>	100%	90%
<b>Ireland</b>	100%	95%
<b>Italy</b>	100%	
<b>Luxembourg</b>	100%	100%
<b>Netherlands</b>	100%	25%
<b>Austria</b>	100%	60%
<b>Portugal</b>	100%	100%
<b>Finland</b>	98%	<1%
<b>Sweden</b>	100%	0
<b>United Kingdom</b>	100%	99,8%
<b>Albania</b>	15%	
<b>Croatia</b>	100%	100%
<b>Cyprus</b>	100%	
<b>Czech Republic</b>	57%	0.6%
<b>Estonia</b>	5%	7.6%
<b>Georgia</b>	80%	85%
<b>Hungary</b>	100%	100%
<b>Latvia</b>	100%	80%
<b>Lithuania</b>	100%	50%
<b>FYRoMacedonia</b>	66%	
<b>Norway</b>	100%	100%
<b>Poland</b>		
<b>Slovakia</b>	100%	90%
<b>Slovenia</b>	100%	100%
<b>Switzerland</b>	95%	10%
<b>Turkey</b>	100%	