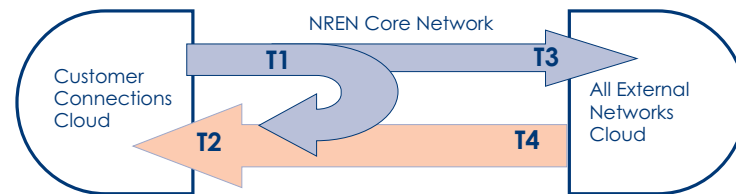


## 4 Traffic

In this section, a distinction is made between internal and external networking and network traffic. These terms are not immediately clear to all NRENs. The figure below illustrates how these terms are being used for the purpose of the Compendium.

External traffic is all traffic to GÉANT, the Commercial Internet, Internet exchanges, etc. (made up of T3 and T4 in the diagram).



*T1 - all outbound traffic from customer sites*

*T2 - all inbound traffic to customer sites*

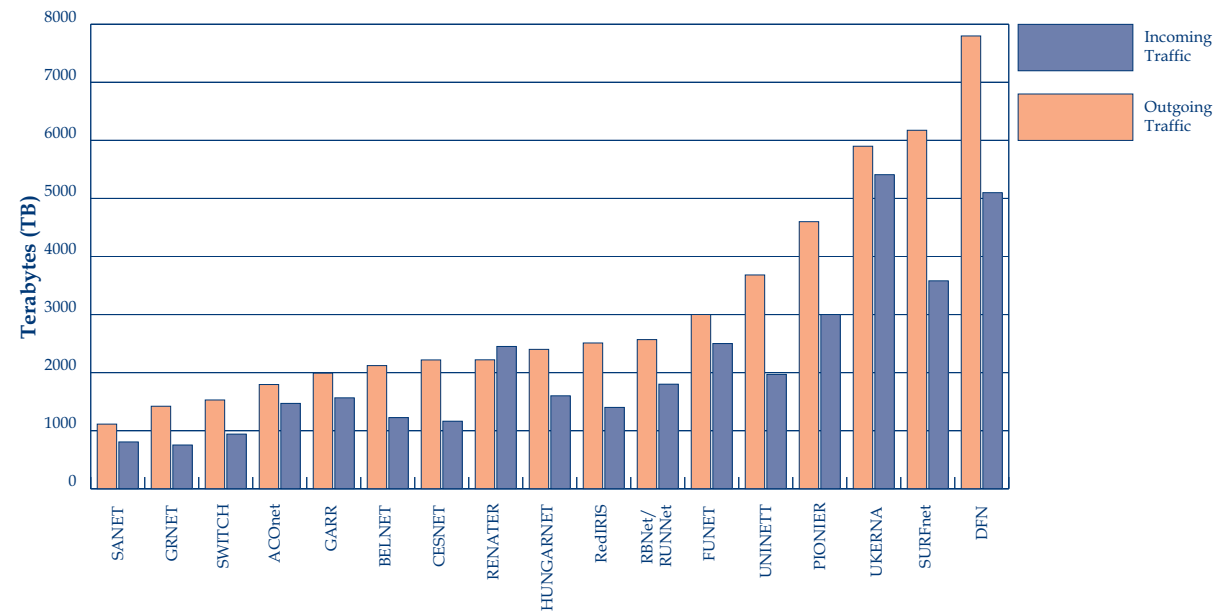
*T3 - all outbound traffic to external network clouds*

*T4 - all inbound traffic to the NREN backbone.*

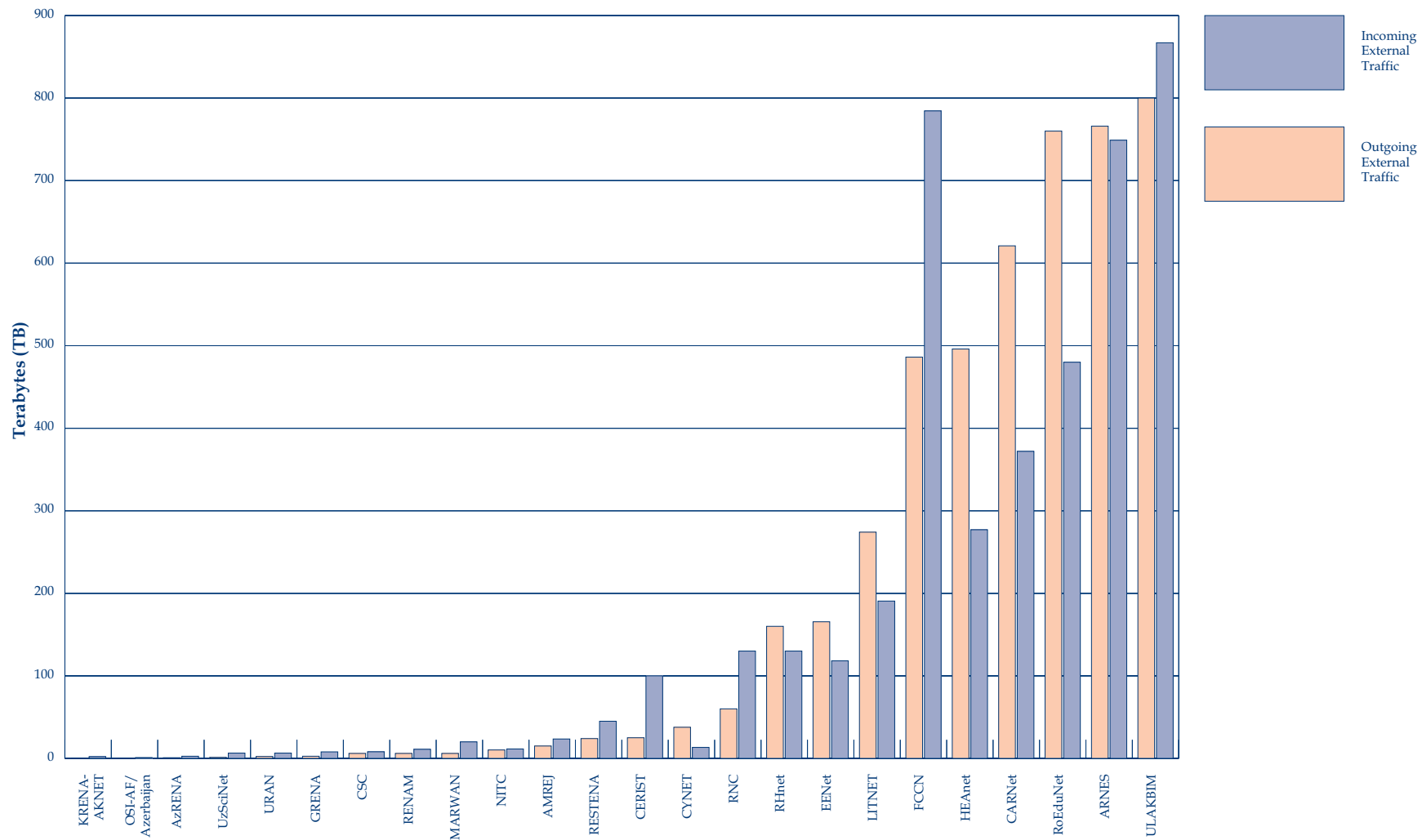
### 4.1 Incoming and outgoing external traffic, 2002 and 2003

For presentation purposes, two graphs are presented: graph 4.1.1 shows the information for those NRENs with total external traffic above 1000 Terabytes; graph 4.1.2 gives the same information for NRENs with total external traffic below 1000 Terabytes.

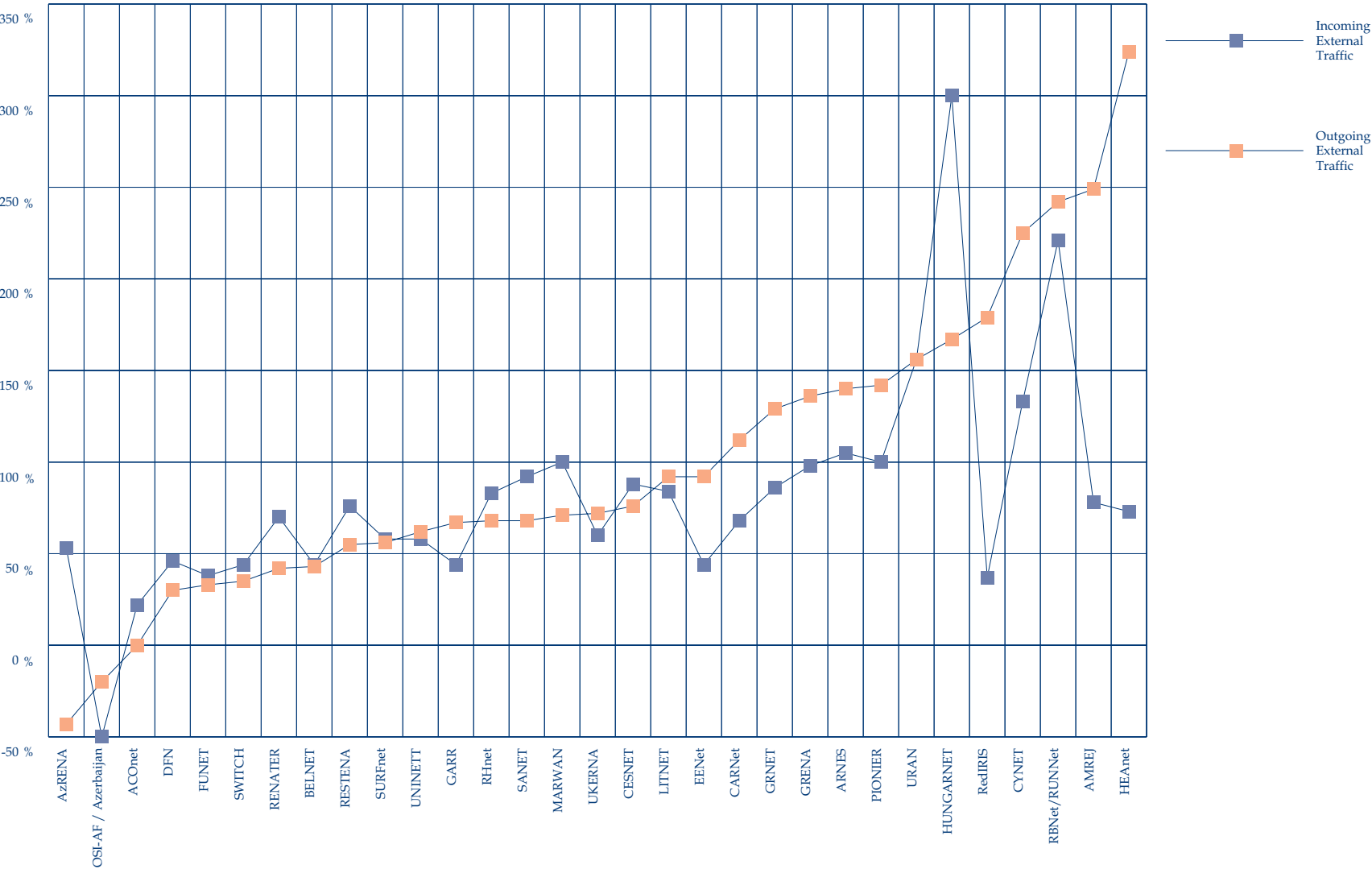
Graph 4.1.1 Incoming and outgoing external traffic 2003, > 1000 Terabytes (TB)



Graph 4.1.2 Incoming and outgoing external traffic 2003, < 1000 Terabytes (TB)



Graph 4.1.3 External traffic growth pattern, 2002 - 2003



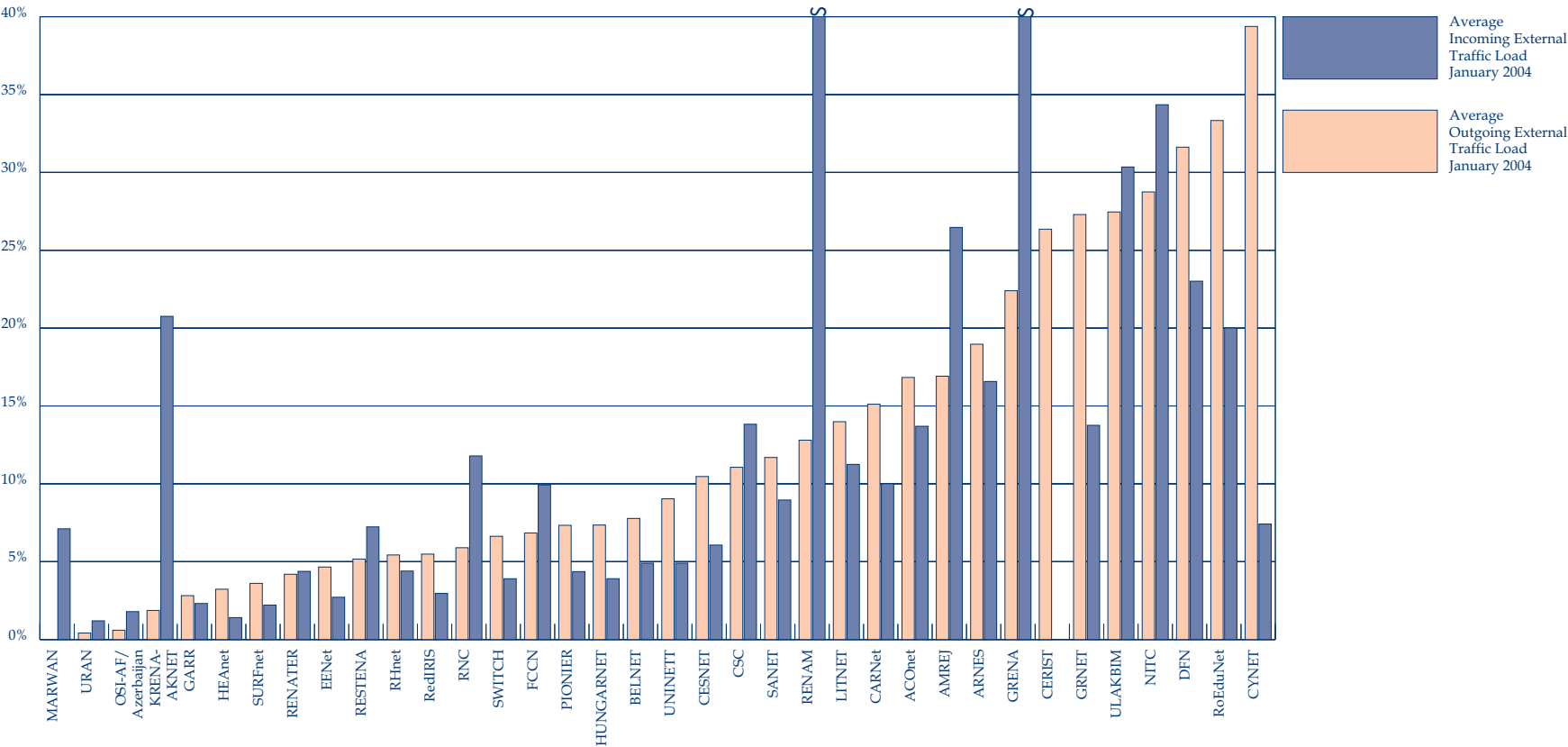
## 4.2 Average traffic load

Traffic load on the network is one potential way of measuring congestion and thus also of measuring customer demand.

RENAM of Moldova and GRENA of Georgia are outside of the range of the graph, with incoming external traffic loads of respectively 64% and 60%.

The graph below shows the average incoming and outgoing external traffic loads for January, 2004. For an indication of sustained peak usage, these figures should be multiplied by 3.

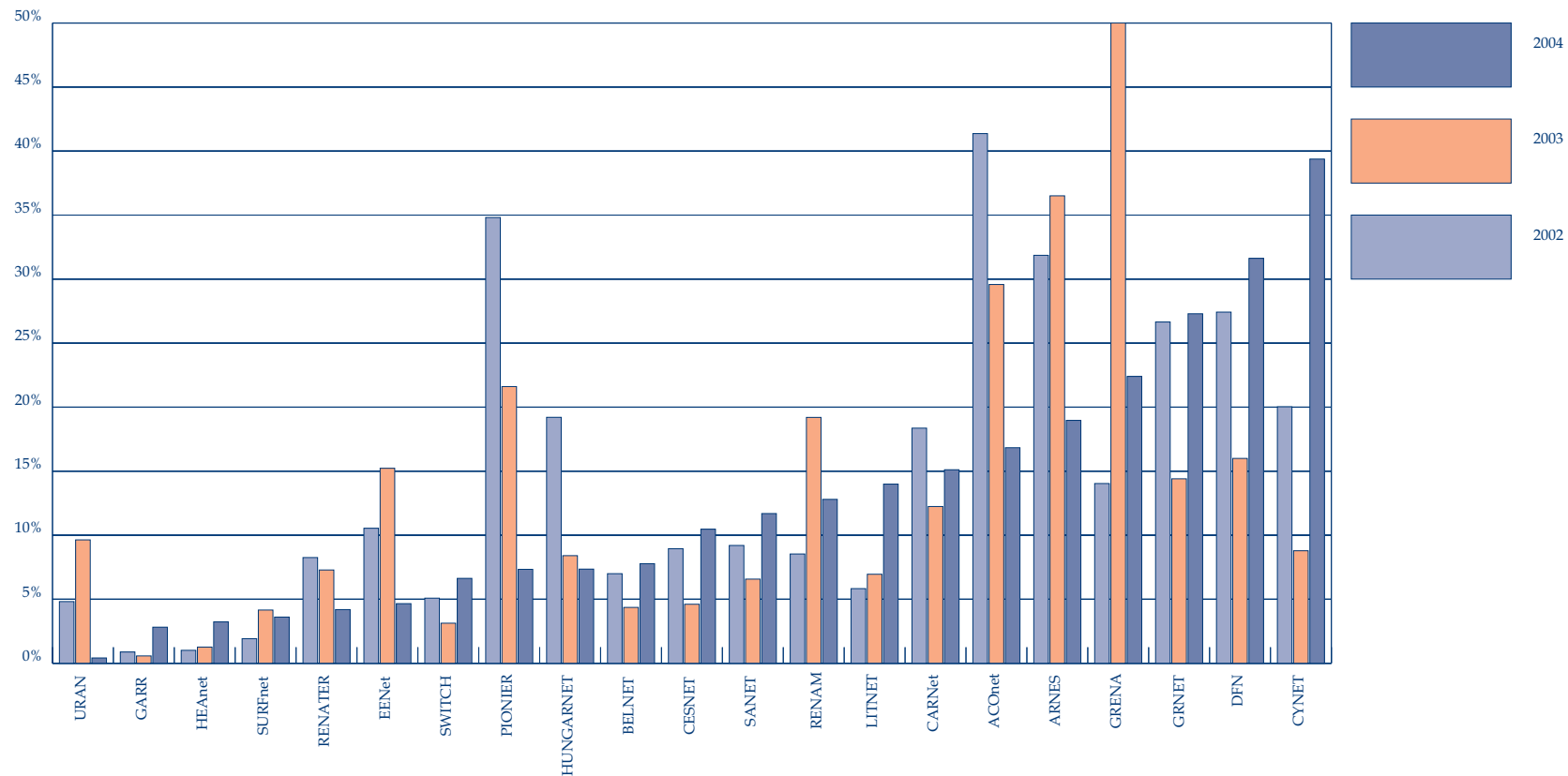
Graph 4.2.1 Average traffic load, January 2004



The next graph compares the average outgoing external traffic load in January, 2004 with that of 2002 and 2003, for those countries that provided the relevant data in all three years.

This graph, in combination with the information about traffic growth (section 4.1) and external links (section 3.5) shows how NRENs need to keep extending their external links from time to time in order to keep up with increasing demand.

**Graph 4.2.2 Average outgoing external traffic load, January 2002, 2003 and 2004**



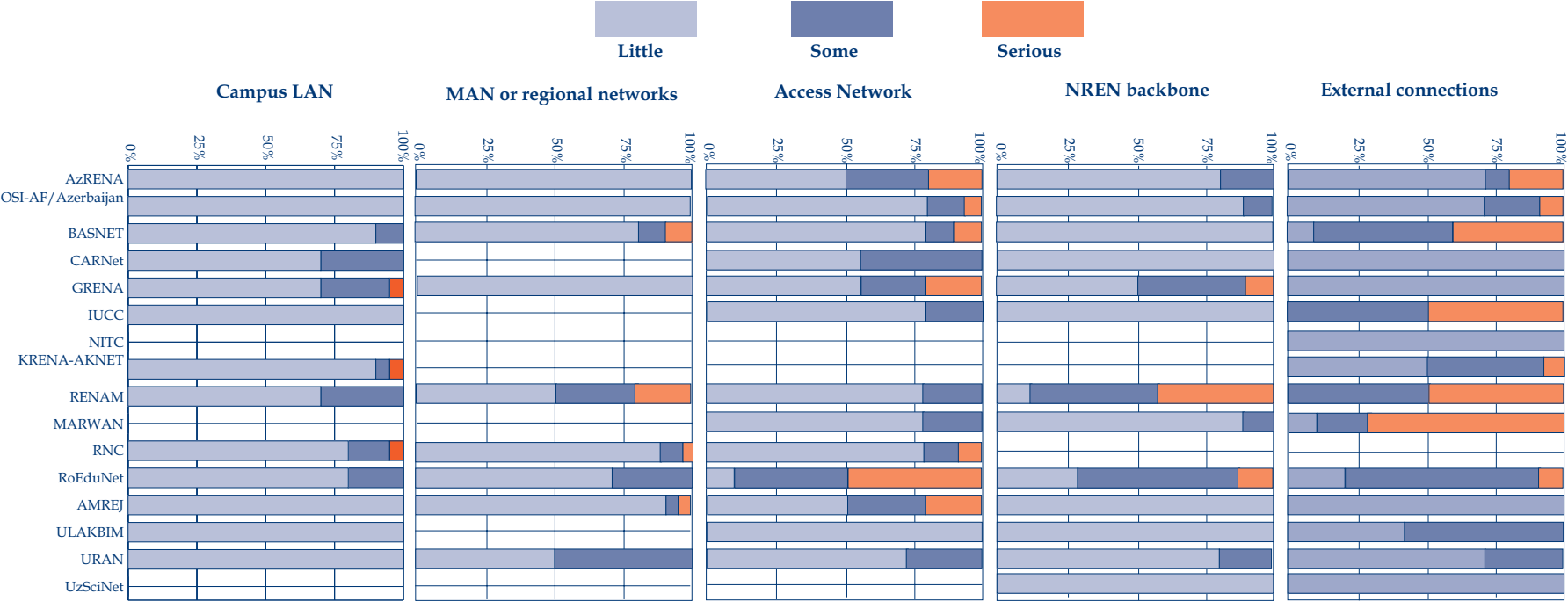
4.3 Congestion

NRENs were asked to give an estimate of where there is congestion (if any) in their networks and of the percentage of client institutions that are affected by congestion at that level. Note that not all NRENs gave an answer for all of the network levels and note also

that not all levels exist in all networks (see also the “Focus Study on Funding, Management and Operation of European Research Networks analysed by network hierarchy” by John Martin and Baiba Kaskina, TERENA, May 2004).

These graphs show that in the EU countries, congestion, if any, occurs mainly at the levels of the Campus LAN and of the access networks. For the other countries, congestion occurs at all levels except the Campus LANs.





## 4.4 Important applications in IPv6 development

Many NRENs are planning to, or have already started to implement IPv6 on their networks. We have asked NRENs what they think will be the most important application(s) for IPv6 development. Not many NRENs have answered this question, but the answers obtained are given below.

**Table 4.4 Important applications for IPv6**

Country	NREN	Important applications for IPv6
Croatia	CARNet	DNS, FTP, HTTP, e-mail, IRC, DHCP
Greece	GRNET	Peer-to-peer and telematics applications
Hungary	HUNGARNET	Applications requiring real end-to-end connections: Voice over IP, Instant Messaging, peer-to-peer applications
Ireland	HEAnet	3G applications, use by new user communities
Italy	GARR	Peer-to-peer, on-line gaming
Netherlands	SURFnet	The most important stimulus for the development of IPv6 will be the growth of the number of clients (i.e. appliances) with an IP-connection.
Norway	UNINETT	Peer-2-peer
Poland	PIONIER	Mobility
Romania	RoEduNet	Applications with mobility support.
Turkey	Ulakbim	DNS, WWW

## 4.5 Percentage of Institutions connected via IPv6

Now that many NRENs are starting to, or have started to implement IPv6, it is interesting to know how many institutions are actually being connected to them via IPv6. We have asked what percentage of the Universities and Research Institutions are connected to the NREN via IPv6, either via native IPv6 or via tunnelled IPv6.

The following table shows that the Czech Republic is the clear leader in this field, with 80% of the Universities and Research Institutions connected to them via native IPv6. Note, though, that a number of NRENs did not answer this question. For technical reasons, CESNET does not know how much of the traffic on its backbone is actually IPv6 traffic. However, for PIONIER from Poland, with 20% of the Universities and Research Institutions connected to it via native IPv6, the IPv6 traffic percentage in December 2003 was only 0.1%. For FCCN from Portugal, with the same percentage of connected Universities and Research Institutions, the percentage of IPv6 traffic was 1%.

More information about this and about other aspects of IPv6 adoption can be found in the individual country entries on the Compendium website.

**Table 4.5 Percentage of institutions connected via IPv6**

Country	NREN	Native	Tunnelled
Belgium	BELNET	5.0	0.0
Croatia	CARNet	2.0	0.0
Czech Republic	CESNET	80.0	20.0
Estonia	EENet	5.4	8.0
Finland	FUNET	5.0	5.0
Greece	GRNET	4.0	2.6
Hungary	HUNGARNET	10.0	0.0
Iceland	RHnet	0.0	10.0
Ireland	HEAnet	6.0	9.0
Italy	GARR	3.0	3.0
Lithuania	LITNET	0.4	0.6

Country	NREN	Native	Tunnelled
Netherlands	SURFnet	5.0	5.0
Norway	UNINETT	6.0	3.0
Poland	PIONIER	20.0	0.0
Portugal	FCCN	20.0	0.0
Romania	RoEduNet	4.0	2.0
Russia	RBNet/RUNNet	0.0	100.0
Slovenia	ARNES	0.0	1.0
Spain	RedIRIS	5.0	20.0
Sweden	SUNET	10.0	40.0
Switzerland	SWITCH	10.0	11.0
Turkey	ULAKBIM	3.0	0.0