Finnish national E2E performance survey 2009

Report

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Background

Funet [1] is involved in TERENA's [2] "Campus Best Practices" project, which is part of GEANT3 (GN3)[3]. Funet has traditionally been a data communications operator for Funet member organisations, and the operations have mainly involved the backbone network sector. The GN3 project allows Funet to be more active in the campus network sector and thereby to offer more extensive support for its members.

The objective of the GN3 project is to cooperate with both Funet members and other European NREN organisations (NREN, National Research and Education Network) in finding and documenting best practices benefiting users. Possible forms of cooperation include various seminars, workshops, courses and meetings. The results of the cooperation could be published on the Funet Wiki [4], for example.

It has been said that the campus network is often the weakest link between users and services [5]; campus networks are bottlenecks preventing or hindering users from obtaining high-speed connections to their workstations or using online services efficiently.

EARNEST (Education And Research Networking Evolution Study) [6] is one of the Terena Task Forces that have tackled the above-mentioned claim, and focuses on studying campus networks. Topics include network technologies, information security, network services and the performance of campus networks.

EARNEST has recommended that an annual survey be carried out regarding the performance of campus networks. The results of annual surveys enable the monitoring of campus network development and the spread of new technologies within the grasp of end users, such as user access to faster data transfer connections from the workstation.

Inspired by EARNEST's recommendation, a survey on campus networks was carried out among Funet member organisations. This report provides a summary of the results of the survey. Those replies to the survey that do not include identification data can be found in appendix [8] of the report. The other replies have been excluded from the appendix.

The survey and results

The survey was performed using the Webropol tool [7], which allowed respondents to reply using a web browser. This was done to make responding to the survey straightforward and attractive compared to printed forms, for example. Having the replies in electronic format also sped up the processing of the results.

The campus network survey was advertised in the monthly Funet newsletter, which is distributed to all Funet member organisations, in both November 2009 and January 2010. A link to the survey was also sent by e-mail to technical and administrative Funet contact persons in January 2010. The response rate was 34%. Half of the respondents came from universities and a third from universities of applied sciences.

The first questions charted the size of the campus networks of Funet membership (Figure 1). In terms of the number of users, the majority of campus networks have several thousand users.

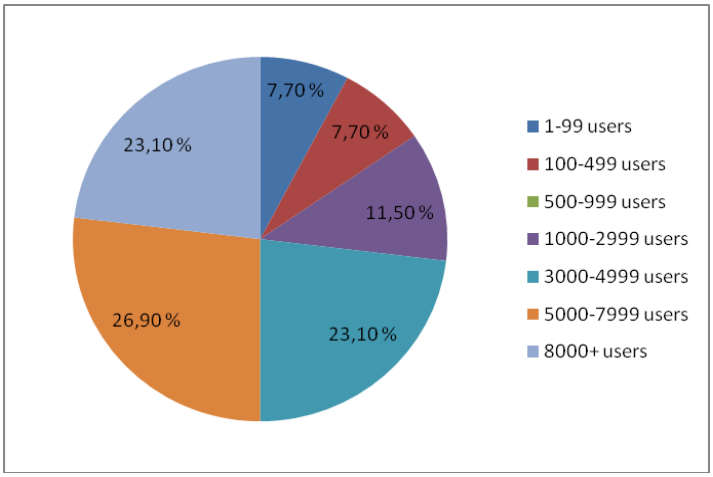

Figure 1. **Respondents' campus network size by number of users**

The following questions focused on the number of ports on campus networks and the connection speeds offered to end users (figures 2 and 3).

61.5% of respondents used ports with a speed of less than 100Mbit/s. The majority (81.3%) had fewer than one hundred such ports on their campus network.

88.5 % used 100Mbit/s ports. For the most part the number of ports remained below 10,000, but 13% of respondents had more than 10,000 ports.

Nearly all respondents had 1Gbit/s ports on their networks. In terms of number of ports, 44% had fewer than a thousand ports and another 44% fewer than 10,000 ports. The remaining respondents had fewer than one hundred ports.

50% of the respondents used 10Gbit/s ports. The number of ports was fewer than ten for 84.6% of the respondents, and fewer than one hundred for the remaining 15.4%. None of the respondents had more than one hundred 10Gbit/s ports.

Speed/number	<10	<100	<1,000	<10,000	10,000+
<100 Mbit/s	43.80%	37.50%	6.30%	12.50%	0.00%
100 Mbit/s	0.00%	4.30%	13.00%	69.90%	13.00%
1 Gbit/s	0.00%	12.00%	44.00%	44.00%	0.00%
10 Gbit/s	84.60%	15.40%	0.00%	0.00%	0.00%

Figure 2 Number of ports on campus network

The ports available to end users (figure 3) were in proportion to the total number of ports. The majority (92%) offered access to 100Mbit/s or below 100Mbit/s ports. 41.7% offered access to fewer than one hundred 1Gbit/s ports. The figure for over 10,000 ports with a speed of 10Gbit/s in figure 3 is erroneous, as figure 2 shows than none of the respondents offered networks of that size.

Speed/number	<10	<100	<1,000	<10,000	10,000+
<100 Mbit/s	42.90%	28.60%	7.10%	21.40%	0.00%
100 Mbit/s	0.00%	4.20%	20.80%	66.70%	8.30%
1 Gbit/s	8.30%	41.70%	29.20%	20.80%	0.00%
10 Gbit/s	90.00%	0.00%	0.00%	0.00%	10.00%

Figure 3. Ports available to end users

The next questions concerned the speed of the backbone network. All respondents had a backbone network speed of at least 1Gbit/s and 19.2% had a speed of at least 10Gbit/s.

This was followed by questions relating to the Funet connection: whether there are needs for updating or duplicating the connection and whether there are remote campuses. If the respondent reported that they had remote campuses, further questions were used to establish the status of their datacommunications connections.

80.7% of the respondents had a 1Gbit/s Funet connection, 3.8% a 10Gbit/s connection and the remaining 15.4% a 100Mbit/s or 155Mbit/s connection. 36% felt that the current connection would require updating during 2010, and 38% saw updating as becoming relevant in 2011–2012. 28% were satisfied with their current connection and did not see a need for updating in the foreseeable future or only saw one as becoming relevant after 2012.

Only 15.4% of the respondents had a duplicated Funet connection. This is likely to change, however, as many of the respondents indicated that they are updating their hardware. Updating plans included opportunities for both connection duplication and increases in connection speed. Some respondents indicated an immediate need for connection duplication.

Nearly all respondents (84.6%) have remote campuses. Out of these, 81.8% had between five and ten remote offices. 77.3% had connected remote offices to the main campus network. The most popular connection methods were based on Ethernet, xDSL or MPLS/VPN technology, but several other methods were also being used (figure 4).

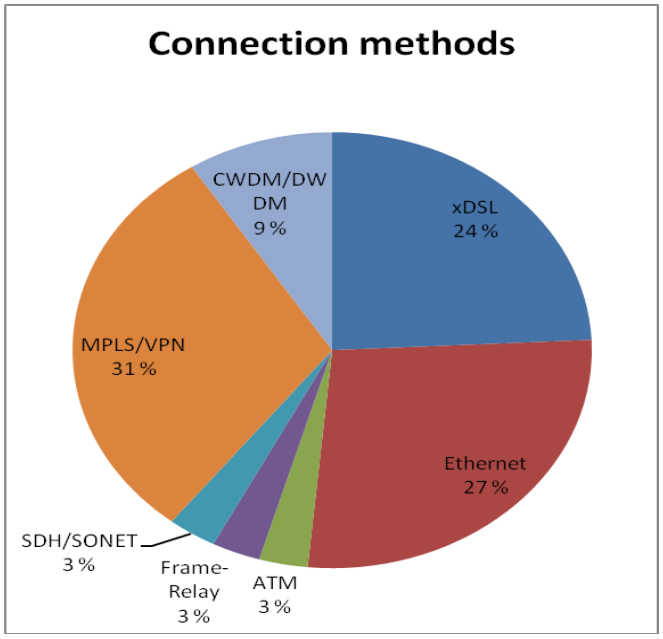

Figure 4. Connection methods

The most popular connection speed for remote offices was 100Mbit/s, followed by 1Gbit/s and 2Mbit/s. On the basis of the respondents' comments, several technologies and different speeds were being used.

45.5% of respondents estimated that there would be no need to update the connection speeds for remote offices until 2012, but 40.9% saw such a need becoming relevant during 2010. Only 18.2% saw a need for connection duplication.

Conclusions and remarks

The results of the survey indicate that both large and small organisations were among the respondents. The principal connection speeds offered to end users appear to be 100Mbit/s and 1Gbit/s. The speed of the backbone network is higher, i.e. 1Gbit/s or 10Gbit/s.

The number of 10Gbit/s ports is still small. There may be several reasons for this, such as actual need or price. There have been changes in device supply and prices, however: there are more alternatives to choose from and prices have decreased. For example, it may now be less expensive to purchase one 10Gbit/s port module than several 1Gbit/s ones. There are also new actors and products on the market. Moreover, many network services have developed and require more data transfer bandwidth. Bearing this in mind, it is likely that the need for 10Gbit/s speeds will increase for both campus network backbone connections and main servers.

It is also likely that 100Mbit/s ports will reduce in number and that more and more users will have access to a 1Gbit/s connection. Network cards enabling 1Gbit/s connections have been standard components on new workstations for several years now. The decrease in the prices of workgroup switches makes it possible to opt for gigabit class switches when updating hardware.

The Funet network has undergone a great deal of changes in the recent past. The basic backbone infrastructure has been built on DWDM fibre-optic technology. The solution enables a capacity of 40 x 10Gbit/s for individual backbone fibre-optics. All connections in the new Funet backbone network are 10Gbit/s connections. The default lightpath offered to users is a 1Gbit/s connection, but 10Gbit/s connections are also possible where necessary. Of course, if high-speed connections are offered all the way to the end users, sufficient fibre-optic infrastructure will also be necessary. That being said, campuses should already start preparing for the future by building fibre-optic connections to suitable sites.

There have also been changes in the Funet router network: new routers have been installed, with the basic configuration offering 1Gbit/s and 10Gbit/s ports. The new hardware enables the necessary connection capacity to be offered to users. There are fewer than twenty old routers, which will be taken offline in the near future.

Funet's ability to offer high-speed connections (1Gbit/s, 10Gbit/s) and the reduction in the number of Funet routers provide users with new opportunities. It will be possible to increase current connection speeds, and DWDM connection points will enable connection duplication without the need to have a router on site.

The DWDM fibre-optic network will make it possible to supply high-speed connections to remote offices, for example. Remote offices currently use various technologies, which causes challenges for both administrators and users. Small sites often use an asymmetrical connection, which means that the remote office has a greater download than upload capacity. This being the case, it may be difficult to arrange a functional backup solution from the main campus.

Site size may also be an advantage for small remote offices, if changes in infrastructure are required to make high-speed connections available. The amount of hardware or fibre and cabling required is low, which eliminates the need for major, time-consuming updates after making the necessary changes. For large campuses, however, it may take several years of updating to reach the same level. On the other hand, small units may find it much more difficult to cover the necessary costs than large units.

It will take time for some of the changes in the Funet network to be realised in campus networks. Once sufficient Internet access capacity is available and the price of 10Gbit/s ports for network hardware declines, it

will be possible to offer greater capacity. DWDM technology enables lightpaths on campus networks, provided that they have the required fibre network infrastructure. This would enable connections of up to 10Gbit/s all the way to the workstation. It remains to be seen when such a connection becomes reality.

Appendices

[1]: Funet: http://www.funet.fi

[2]: TERENA: http://www.terena.org/

[3]: Geant: http://www.geant.net/

[4]: Funet Wiki: https://info.funet.fi/wiki

[5]: EARNEST Report on Campus Issues, Jan 2008

[6]: EARNET: http://www.terena.org/activities/earnest/

[7]:Webropol: http://www.webprobol.com

[8]: Campus network survey responses, PDF