GLOBAL INTERNET

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THE ROAD TO TEN-34

On May 20 of this year, the TEN-34 consortium launched a new Trans-European Network, linking national research networks in 14 countries at speeds of up to 34 Mbps.

TEN-34 is considered a major achievement because of the large number of public network operators (PNOs) involved, many of them operating in noncompetitive environments.

INTERCONNECTING A CONTINENT

The first major effort to interconnect European research networks was the establishment of the International X.25 Infrastructure (IXI) in the late 1980s. As the name suggests, one of IXI's principal purposes was to carry X.25 traffic between the 18 participating countries. The most widely used protocol at the time was IP, and when IXI was enlisted to carry IP encapsulated in X.25, it became a major plank in the development of the Pan-European Internet.

In 1992, IXI was superceded by EuropaNet, which offered a multiprotocol network at 2 Mbps. Initially the system was operated by PTT Telecom NL, which later became Unisource Business Networks. A call for tenders in December 1994 led to British Telecom taking over operation in October 1995.

At the time of the takeover, EuropaNet's most bandwidth-hungry customers were connected at a maximum speed of 6 Mbps. Compare this with the bandwidth provided by NSF-net, already operating at 45 Mbps when it was taken out of service some five months earlier.

GAINING SPEED

It was around this time that a project referred to as EuroCAIRN (European Cooperation for Academic and Industrial Research Networking) determined that 34-Mbps connectivity was needed immediately, and that planning for an upgrade to 155 Mbps must follow close behind. The only problem was on the bandwidth supply side. Although quite a few European PNOs could supply lines running at 34 Mbps, the cost advantage over the currently operating multiple parallel 2-Mbps circuits was not significant.

The TEN-34 consortium consisted of the participating national research networks with DANTE,* a not-for-profit company established by Europe's national research networking organizations, as the coordinating partner. Following consultations with the PNOs, two significant offers for providing connectivity were received. One came from the network operators of France, the United Kingdom, Germany, and Italy. Although the country mix has now changed, it is still referred to as the FUDI proposal (for France, the UK, Deutschland, and Italia).

The offer was to provide an ATM service that would link the four countries at a range of speeds from 6 to 34 Mbps. TEN-34 could set up virtual paths across this service to which routers could be connected.

The second offer came from Unisource and involved the provision of an IP service running across 34-Mbps leased lines connecting the countries in which it operated (the Netherlands, Switzerland, Sweden, and Spain). This service would eventually migrate to ATM; however, this transition would not be visible at the user (IP) level.

The TEN-34 consortium made plans to move forward with both of these proposals, establishing interconnects between the two sub-networks in three locations (the UK, Germany, and Switzerland). In May 1996, the European Commission awarded the consortium the contract to implement TEN-34.

The first TEN-34 link to become operational was a leased circuit between Germany and Switzerland on 6 March 1997. Most of the FUDI ATM network was operating later that month, with the Unisource leased-line network following in April along with the remaining ATM links. Thus the core network was completed.

Austria commissioned an access link on May 8. Since TEN-34's launch on May 20, the Czech Republic and Greece have connected to the network backbone, with Belgium, Slovenia, Luxembourg, and Portugal still to join.

Figure 1 shows the size of each national research network's connection to TEN-34 together with their principal intercontinental links.

BLAZING A TECHNOLOGICAL TRAIL

The European Commission provides partial funding of the ECU40-million (about US $43 million) annual cost of running the TEN-34 project. However, the current contract provides for a service period of just 18 months, so the future of the service is still in question. Technical plans continue, however, and a parallel project called the Task Force-TEN* (TF-TEN) is set to try out new network services as they become available and to make recommendations for changes and upgrades to the TEN-34 infrastructure.

The Advanced Communications Technologies and Services* (ACTS) research program, funded by the

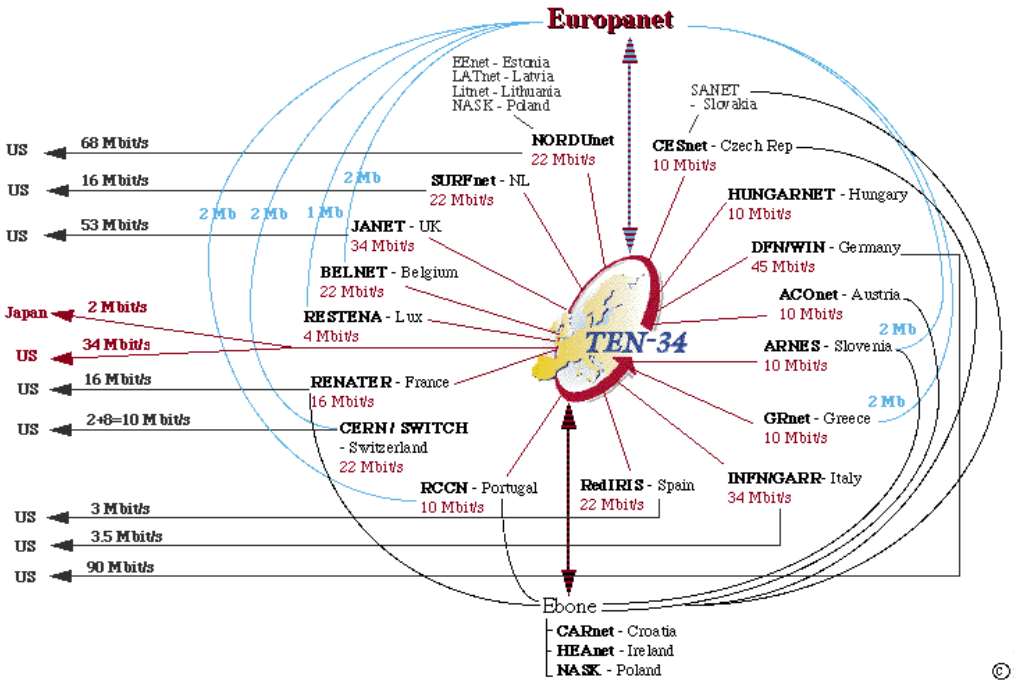

Figure 1. Intra-European and intercontinental connectivity of European national research networks, August 1997.

European Union, has sponsored a project to link the so-called national hosts (advanced wired and wireless communications platforms) located throughout Europe. This project, referred to as JAMES* (Joint ATM Experiments on European Services), is making the infrastructure available to other projects running within ACTS and other complementary programs. TF-TEN has initiated a series of experiments on the network, concentrating primarily on the network's ability to carry IP traffic over switched and permanent virtual circuits using a variety of different quality-of-service parameters.

Through technologies such as classical IP over AT or the Next Hop Routing Protocol (NHRP), it is hoped that more effective use can be made of the underlying ATM network infrastructure than is possible in the current system, which operates as a network of virtual leased lines.

Other experiments carried out by TF-TEN concern the management and security of ATM networks as well as the use of real-time protocols such as the Resource Reservation Protocol (RSVP). Initial indications are that the more advanced ATM network features in the JAMES network are not ready to serve as a platform for operational service, but the situation remains under review. A second round of experiments was initiated in May of this year.

The technological path to the future of European research networking is clear. What remains to be resolved is how the Pan-European network will provide the required services at a price users are willing to pay. The launching of TEN-34 and its continued development represents a significant step in the right direction. ■

URLs FOR THIS COLUMN

***DANTE Home Page** • www.dante.net

The Works of DANTE • www.dante.net/pubs/works/
A bimonthly electronic newsletter reporting on the activities of DANTE.

***European Union ACTS Programme** • www.infowin.org/ACTS/

Experiments for Advanced Backbone Services • www.dante.net/pubs/dip/29/29.html
An account of the Phase 1 experiments undertaken by TF-TEN, edited by Michael Behringer and presented at JENC8, the eighth annual Joint European Networking Conference held in Edinburgh, 12–15 May 1997.

"The Implementation of TEN-34" • www.dante.net/pubs/dip/28/28.html
A TEN-34 status report given by Michael Behringer at JENC8, the eighth annual Joint European Networking Conference held in Edinburgh, 12–15 May 1997.

***JAMES project** • www.labs.bt.com/profsoc/james/

***Terena TF-TEN Home Page** • www.dante.net/ten-34/tf-ten/