POWERING THE NATIONAL RESEARCH AND EDUCATION NETWORKS

Cisco Systems

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CISCO'S COMMITMENT TO THE NREN COMMUNITY

From the time that two professors at Stanford University got together to start Cisco Systems, the academic and research environment has provided a firm foundation for the business. Of course, since those pioneering days the company has been transformed into the global business that it is today. But innovation remains at the very heart of the organisation, and collaborating with others who are also shaping the technology landscape is important to help test and develop new ideas for information networks. Many of these pioneers are to be found in the National Research and Education Networks (NREN) community around the world.

OUR COMMITMENT TO EUROPE, MIDDLE EAST AND AFRICA

Cisco provides many leading NRENs with the tools and technologies to build and expand their own high-capacity, high-performance networks that are essential for the sharing of ideas, data and learning. To deepen our relationships with NRENs in Europe, Middle East and Africa (EMEA) we have a dedicated team of research and development (R&D) and technical experts supported by a sales team who focus solely on working with NRENs throughout the region.

Collaboration, information exchange and partnership are key to this relationship For example, we are an active member of the Trans-European Research and Education Networking Association (TERENA), providing technical and practical support to help it develop a high-quality international information and communications infrastructure to benefit research and education in Europe. Cisco employees are among past chairs of the Internet Engineering Task Force (IETF) and Cisco has long been involved in helping the IETF to pursue its aims across the full range of its activities.

As project coordinator of 6NET, Europe's largest Internet research project, Cisco Systems has been at the heart of the most advanced networking experiment in Europe. The 6NET project was formed by 31 partners from research and business organisations throughout the European Union. It is the first such initiative in Europe to pull together all European research networks in a focused collaborative environment. The project connects more countries at a higher capacity than any other native IPv6 network deployed to date and the benefits are already being realised by other users as IPv6 networks begin to shape the next generation of the Internet.

LEADERSHIP IN TECHNOLOGY – CRS-1

Technology innovations and leadership are central to Cisco System's strategy and these are also vital elements of our relationship with the NREN community. Developing new technologies that can respond to the challenges that the NREN community faces in delivering next generation networking technologies is a core element of our programmes for research and development. As a 'test-bed' for products that meet these demands, there is no more challenging environment.

For example, the release of the CRS-1 Carrier Routing System, heralds a significant breakthrough comprising a series of hardware and software innovations that are already helping NRENs around the world to push their capabilities further towards achieving their aims. The CRS-1 innovations include:

- Cisco IOS XR software designed for terabit-scale routing systems built on massively distributed multi-shelf architectures
- System capacity of up to 92 terabits per second
- The industry's first Optical Carrier 768c/STM-256c packet interface
- Cisco Silcon Packet Processor (SPP), the world's most sophisticated 40-Gbps application-specific integrated circuit

LEADERSHIP IN R&D

Cisco's technology development and innovation strategy is driven by our customers. And when it comes to NRENs, Cisco is committed to developing the technologies that will create the next generation of Internet and networking capabilities. And collaborating with the NREN community to test many of these technologies is crucial to retaining the leading edge. Our work on Internet Protocol (IP)/optical convergence involves working with NRENs around the globe. For example, we are involved in collaborative projects that will allow us to bring our new data centre technologies into an environment that would support large-scale GRID computing.

At Cisco, we recognise that the work we do at the cutting edge today with our NREN customers will be applicable tomorrow to the wider community: to enterprise and public sector customers who will be able to reap the benefits of the pioneering work in which Cisco and the NREN community are engaged in today.

NREN SUPPORT

Meeting NRENs demanding, specialised technology and network services requirements needs highly focused support. Hence Cisco Systems developed the NREN Advanced Services support program. The service provides named support engineers who comprehend the individual NREN's network, procedures and engineers who have specialisation knowledge of the technologies used by NRENs such as IPv6, multicast, MPLS, BGP, QoS, NetFlow, security, IP+optical, This provides NRENs with high quality support for both operational problem resolution, in addition to developing and deploying new services. Many NRENs in Europe utilize the service either directly or delivered in combination with a Cisco partner. Customers include; DFN (Germany), UKERNA (UK), CESNET (Czech Republic), BELNET (Belgium), SUNET (Sweden) and 6NET (pan-Europe)

COMMITMENT IN ACTION

The following case studies show our commitment in action in projects throughout Europe and the rest of the world.

OUR COMMITMENT TO THE NREN COMMUNITY

PITTSBURGH SUPERCOMPUTING CENTRE
UNITED STATES

Pittsburgh Supercomputing Centre (PSC) is a part of TeraGrid, a National Science Foundation program that uses advanced cyber infrastructure for scientific research. PSC uses Cisco's most advanced routing system to date, the CRS-1, to manage its connection to TeraGrid.

The CRS-1 system uses the latest and most innovative hardware and software to deliver the capabilities that allow research organisations to scale their network capacity to new levels in order to deliver next-generation data, voice and video services over a converged IP network. Gwendolyn Huntoon, PSC director of networking says that the CRS-1 provides a basis for meeting their needs today and in the future;

"Having installed the Cisco CRS-1 to manage PSC's TeraGrid connection, we're confident this platform is the best routing system to meet our requirements now and in the foreseeable future" she said.

PSC is also an associate of the National Lambda Rail (NLR) which provides advanced network services to a number of leading-edge research institutes and agencies across the United States. NLR also plans to deploy CRS-1 in its national backbone as the foundation of its ongoing ability to provide the advanced networking services across all member institutions and agencies.

UKERNA
UNITED KINGDOM

The United Kingdom's Education and Research Networking Association (UKERNA) was the first 10Gbps academic research network in Europe, powered by Cisco 12000 Internet Router technology.

UKERNA's IP core – called SuperJANET4, enables information sharing and communication among key European academic and research groups. The Cisco 12000 router is one of the next generation of Internet Routers offering industry leading efficiency, scalability and performance.

Using Cisco technology, the UKERNA's high-speed core has been extended to 10Gbps and enables the use of GRID applications, allowing high end computers, networks, databases and scientific instruments from a range of organisations and institutions to collaborate on research projects covering disciplines including metrology, human genome research and radio astronomy.

OUR COMMITMENT TO THE NREN COMMUNITY

TWAREN
TAIWAN

The Taiwan Advanced Research and Education Network (TWAREN) project was launched in 2003 by Taiwan's National Center for High-performance Computing (NCHC) and forms part of a project that will eventually provide the foundation for the connectivity of the whole Taiwanese economy. Initially, 60 academic and research institutions will be linked, but this number is set to expand rapidly.

Cisco's IP+optical network architecture has been selected for the network, with Cisco acting as the primary network designer. TWAREN aims to provide a future-proof, high performance network that can adapt as user demands and technology develop.

TWAREN comprises three networks, the Production Network, the Research Network and the underlying optical layer. The Production Network handles the present and future traffic of the tertiary education sector, the research network provides very high performance and bandwidth networking for scientific research projects, within and beyond Taiwan through collaboration, and the underlying network makes dark fibre available from the backbone to user organizations, enabling them to manage their own specific connectivity requirements.

TWAREN also incorporates Taiwan's supercomputing grid KING (Knowledge Innovation National Grid) that provides connectivity to researchers within Taiwan and in other countries to collaborate internationally on research projects.

The physical backbone of the network is based on four core nodes supported by Cisco ONS 15600 MultiService Switching Platforms (MSSP) and Cisco ONS 15454 Multiservice Transport Platforms (MSTP). Cisco 7600 Series and 12800 Series Routers simultaneously provide maximum performance and simplify design and support requirements, so lowering the total cost of ownership. Juang Zhe Nan, director of the NCHC commented on the selection of Cisco:

"I am confident that we have made the right choice on Cisco's well-proven IP and optical networking technology, and am looking forward to enjoying the ultra-high performance and reliability the company's products offer in this demanding field."

OUR COMMITMENT TO THE NREN COMMUNITY

GRNET
GREECE

Consisting of networks nodes in seven major Greek cities, the Greek Research and Technology Network (GRNET2) provides Internet services to the country's academic and research community. Its aim is to connect all university and research centers and to provide reliable connections with the R&D departments of other organisations, at high data transfer speeds.

Cisco Systems has played an integral role in creating this powerful gigabit Metropolitan Area Network (MAN) and national network, which deploys Cisco's next-generation 12000 routers, capable of speeds up to 10 Gbps to give the Greek academic community access to high-end technology applications such as e-learning and video on demand. The upgraded network also creates a test environment for new application and network capabilities and directly plugs Greek institutions into the pan-European research community GEANT.

The GRNET installation builds on Cisco's long track record of working with national research networks to deliver high-capacity IP networks that are essential for the sharing of ideas, information and learning.

ALICE
LATIN AMERICA

The ALICE (America Latina Interconectada con Europa) project is using Cisco technology to link Latin America's NRENs and, in turn, connect them with the GEANT pan-European network and Internet2 in the United States.

Cisco 12400 Series Routers were chosen to create a central regional network that connects academic and research institutes across the continent so that they can collaborate and share their findings and analysis.

The new network will link the NRENs of Argentina, Brazil, Chile, Panama and Mexico and as the network expands, further NRENs will be added. In addition, the new connections to Europe and the United States will allow researchers in Latin America to collaborate directly with their colleagues in those locations for the first time.

OUR COMMITMENT TO THE NREN COMMUNITY

NIIF
HUNGARY

NIIF the Hungarian NREN offers networking resources to all academic institutions throughout the country. Its contribution to building a knowledge economy through management of a high-speed network is widely seen as key to integrating Hungarian intellectual power into international projects.

Its former 2.5Gpbs network, implemented in 2001, allowed it to launch new services to the academic community such as Voice over IP, GRID computing, video conferencing and a national directory. Traffic has since multiplied quickly and by 2004, the Hungarian NREN decided it was time to expand the network.

The new network called HBONE is running on 10GE and the service is provided by MATÁV the Hungarian PTT. At the NREN side Cisco Catalyst 65xx series equipments are used, while in MATÁV's infrastructure Cisco's ONS 15454 MSTP platform was chosen to provide the upgrade to the backbone network. As the latest in multi-service optical platforms, Cisco's platform allows expansion to 10 Gbps within the pre-existing DWDM network. It also facilitates continued innovation in Hungary by enabling the introduction of several new protocols and services, including SAN, Digital Video, high-speed Ethernet and TDM-based services.

Cisco's participation extends to supporting MATÁV, the service provider and the Hungarian NREN directly, to provide a truly end-to-end Cisco network. The upgraded network will further provide reliable access to the pan-European GEANT2 computer research network for some 600,000 users in almost 700 Hungarian institutions. No wonder then that Miklós Nagy, director of the Hungarian NREN, is excited. "This improved infrastructure broadens opportunities to communicate access information nationwide and is of extreme importance for Hungary both with regard to achieving eEurope targets as well as connecting the European research region."

Attila Koós, R&D Director of MATÁV agrees.

"The expansion to 10 Gbps really reinforces Hungary's position in network-based cooperation within the field of research and education."

CESNET ASSOCIATION
CZECH REPUBLIC

The CESNET association was formed by Czech Universities and the Academy of Sciences of the Czech Republic. It operates the national CESNET2 gigabit network and cooperates with Canada, the Netherlands and the United States in building the Global Lamda Integrated Facility (GLIF) network.

Late in 2004, CESNET put the first 10Gbps fibre-optic using Dense Wavelength Division Multiplexing (DWPM) into operation, linking Prague and Brno in the CESNET2 network. The DWDM technology was created by Cisco Systems and allows for the operation of several optical channels on leased fibre. In future stages, the DWDM technology will offer integration with the current IP network and transition to an IP optical backbone network.

CESNET plans to extend the DWDM system to connect with other sites in the association, thereby completing the main backbone optical ring. This development also forms part of the preparatory work for interconnecting with GEANT 2, the European research network.

OUR COMMITMENT TO THE NREN COMMUNITY

SUNET
SWEDEN

The Swedish University Network (SUNET) provides all data communications for more than 30 Swedish universities across the country to everyone from teachers to students to researchers.

Due to growing university attendance and ever-increasing network usage, SUNET needed a major network upgrade to accommodate the demand for Internet and network access.

Cisco provided SUNET with an optimal solution using its Dynamic Packet Transport (DPT) technology, which combines intelligent IP routing with the bandwidth efficiencies of optical rings to provide scalable Internet service, reliable IP-aware optical transport and simplified network operations.

“We found the DPT metro technology for the universities is the best way for us to provide enough capacity and quality in our new network,” said Hans Wallberg, Manager of SUNET.

The DPT 10-Gbps backbone is supported by Cisco 12000 Series Internet routers, which provide SUNET with bandwidth-management capabilities and enhanced redundancy to key system components. Likewise, the Cisco 10720 Internet routers form the essential building blocks for SUNET’s metro access network, enabling it to deliver data, voice and video services over IP in a cost-efficient manner.

The upgraded network further allows for constant expansion of the capacity available to universities without service disruption. Expansion is also much easier – instead of the multiple connections and interfaces required for a point-to-point network, all that is needed is the installation of another node.

NATIONAL LAMBDARAIL
UNITED STATES

The National LambdaRail (NLR) project is a revolutionary networking initiative which provides a unique and rich set of facilities, capabilities and services that will support a set of multiple, distinct, experimental and production networks for the US research community.

NLR is capable of hosting both experimental and production networks simultaneously, allowing easy and broad-based access by researchers to the multitude of networks running over NLR. This facilitates migration of promising technologies from experimental to production networks, provides real-world production network data for study and enables research and development that transcends or interconnects different network layers.

Experts have called NLR the most ambitious networking initiative since the US Department of Defense commissioned the ARPAnet in 1969 and the National Science Foundation developed NSFnet in the late 1980s – projects which are widely considered to be the critical predecessors of modern-day Internet technology.

NLR also equips the academic community with full access to a research network and provides the chance to accelerate networking technology at an exciting pace. It represents a solution to the problem which has impeded researchers since the commercialisation of the Internet – that they do not own access to the basic infrastructure of networks and instead have to sign multi-year contracts with communications network carriers, meaning severe limitations to how researchers can experiment with basic networking infrastructure. As Tom West, CEO of NLR says, “The National LambdaRail is the next step in the natural evolution of research and education in data communications. For the first time, researchers will actually own underlying infrastructure, something that is crucial in developing advanced science applications and network research.”

Researchers are banking on the flexibility which NLR provides to access remote computing and data resources and to conduct cutting-edge experiments on the network itself. In particular, NLR’s ability to allow researchers to work across and on the potential interrelationships between traditionally defined network layers will enhance system-level integration of new technologies across those layers to enable critical applications such as human resource and security.

A PARTNERSHIP WITH CISCO

Cisco has formed an exclusive partnership with NLR to supply it with optical dense wave division multiplexing (DWDM) components (which form the backbone for NLR technology), Ethernet switches and IP routers. More significantly, Cisco’s involvement goes beyond simply providing equipment. The company is a strategic associate of NLR with two seats on the board that they have elected to name prominent US researchers to hold, thus ensuring that the networking research community is engaged in the overall development and direction of NLR. Cisco continues with the NLR members to drive this groundbreaking technology forward and to deliver it to researchers across the United States. It will also provide funding for individual projects that use NLR via its University Research Program.

As a long-standing pioneer in the use of state-of-the-art technologies, Cisco is truly committed to advancing the NLR project. As Javad Boroumand, a Senior Manager in Cisco’s Academic Research and Technology Group, says, “NLR can serve as the testbed for so many new projects involving networking. We want to help drive this innovation.”

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Printed in the UK

30492/pn/ecoutez/mar.05