Cisco Systems

Customer Profile

Cisco Delivers High-Performance Broadband Network Solution—**Long-Reach Ethernet**—for Historic Building

The Norwegian Nobel Institute (NNI), located in Oslo, Norway, is charged with the important task of assisting the Norwegian Nobel Committee in selecting laureate(s) for the annual Nobel Peace Prize and organizing the awards ceremonies. Former United States President Jimmy Carter Jr. was selected for the 2002 Prize for his efforts to "find peaceful solutions to international conflicts, to advance democracy and human rights, and to promote economic and social development," according to the Committee.

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—NNI Director Geir Lundestad, PhD.

In order to serve as a center of knowledge on peace and international affairs, the NNI opened its library to the public in 1905. Today it is a 187,000-volume library that grows by 3000 to 4000 volumes annually. However, an increasingly inefficient data network was hampering the library's important work—conducting research projects and supporting the research needs of Nobel Committee members, visiting scholars, university professors, and others.

"Technologically, the NNI must be at the top level for users to access the library's inestimably valuable content," said NNI Director Geir Lundestad, PhD. "But increasing the technological capabilities without changing the walls of the historically protected building presented a very delicate challenge," he noted.

As the official Internet Infrastructure Partner of the Nobel Foundation, Cisco provided network infrastructure and technology to help the Nobel e-Museum in Stockholm, Sweden upgrade its networking capabilities. This network infrastructure has optimized the Nobel e-Museum to deliver its vast archives and multimedia educational content to millions worldwide. The Norwegian Nobel Institute, also facing the challenge of a network upgrade, chose Cisco to help solve its need to boost network performance.

Cisco High-Performance Broadband Technology Eliminates Need for Costly Infrastructure Upgrades

Long-reach Ethernet offers high-performance, cost-effective, and easy-to-deploy high-speed Internet access in many types of buildings ranging from historic structures to multiunit and multi-tenant buildings and enterprise campus environments.

- **Hotels and motels**—The Crowne Plaza Hotel Promenade in The Hague, Netherlands, uses Cisco LRE to provide high-speed broadband connectivity for its guests. Services include laptop connection and e-mail, printing, and Microsoft applications. In the United States, Starwood Hotels & Resorts adopted Cisco LRE to deliver high-speed Internet access and other broadband services to its guests nationwide.
- **Factories and plants**—The Saudi Aramco Shell Refinery Company uses LRE, a cost-effective alternative to fiber deployment, to connect buildings within its refinery to extend the LAN network.
- **Public institutions**—As part of its compliance with European Union regulations for securing the Polish border, the Polish Border Guard used LRE to upgrade its 300-border-guardstation network for high-speed Voice over IP (VoIP).
- **Colleges and universities**—New Mexico University uses LRE to provide broadband services to residents in its student housing complexes. Portland State University's engineering program influenced the institution to use LRE to enable a broadband student residential network.
- **Financial and insurance corporations**—Lloyd's of London used LRE to upgrade the data network at its two London locations and to provide high-speed IP phones to every point where it had previously used traditional PBX service.

An Historic Challenge

The NNI has occupied its present building for almost a century. Its data network has grown over the years in a progression of installations, filling up existing conduits with wires and cables that are no longer in use. With cabling so tightly packed in the historic building's walls, plans to add fiber were quickly abandoned. Much of the previous network relied on aging coaxial cabling, which was rapidly decaying. With no more room in the conduits, cable in some offices was simply laid on the floor. Frequent movement of NNI staff and visitors was causing damage, reducing data transmission efficiency.

"The network was so unstable that on occasion users could not access it until it had been restarted a couple of times," said Bjorn Feen, NNI Technology Manager. Bandwidth, too, was insufficient to support many of the critical applications. "Since it was a flat, un-switched network, we were all sitting in a ring, and if one client in the ring was using a lot of bandwidth for a database search, clients farther out in the ring couldn't access the server," explained Bjorn.

A lot of the network's traffic was related to searching and cataloging and included office applications as well as streaming audio, according to Bjorn. "The amount of data going through our network is only likely to increase in the future with sheer growth of archive research data and streaming media content," he said.

As part of its Nobel Cisco Internet Initiative, Cisco conducted a full network analysis of the NNI's existing infrastructure to determine current and future needs, as it did with the Nobel e-Museum. The NNI analysis revealed that usable bandwidth from its coax, half-duplex, shared service was so congested that it was delivering a fraction of what the network should have been providing—and far below what was needed. Usable bandwidth was just 2.78 Mbps—a mere 27.8 percent of the potential bandwidth. In addition, no wiring documentation was available to sort out and identify the tangle of cables packed in the walls.

Upgrading the network was urgent. "The old coax was getting brittle and I was getting really concerned about the quality of the cables and connection points," said Bjorn. "We were trying to make do with 10-Mbps shared service, which was shared among as many as 18 simultaneous users. What we really needed was perhaps 10 Mbps for each user," he added.

The historical classification of the Nobel Institute building, built in 1867, meant no penetration of the walls or modification to the structure was possible, eliminating the alternative of installing new cabling within the walls. Another alternative, running cable on the surface of walls, was determined to be prohibitive in cost, time, and effort. The sheer thickness of the walls (60 centimeters, or about two feet) prevented initiating wireless technology on a building-wide basis. "It appeared that there was no practical solution to our cabling and bandwidth problem until Cisco suggested a new approach," Bjorn said.

The Norwegian Nobel Institute Chooses Long Reach Ethernet Solution

To resolve the NNI's dilemma and provide sufficient bandwidth for current and future needs, Cisco proposed long-reach Ethernet (LRE) in-building technology, part of the Cisco Internet Mobile Office solution. This innovative solution—Digital Subscriber Line (DSL)-based, Ethernet-speed connectivity over standard, existing phone lines—would reduce the need to add or replace wiring infrastructure.

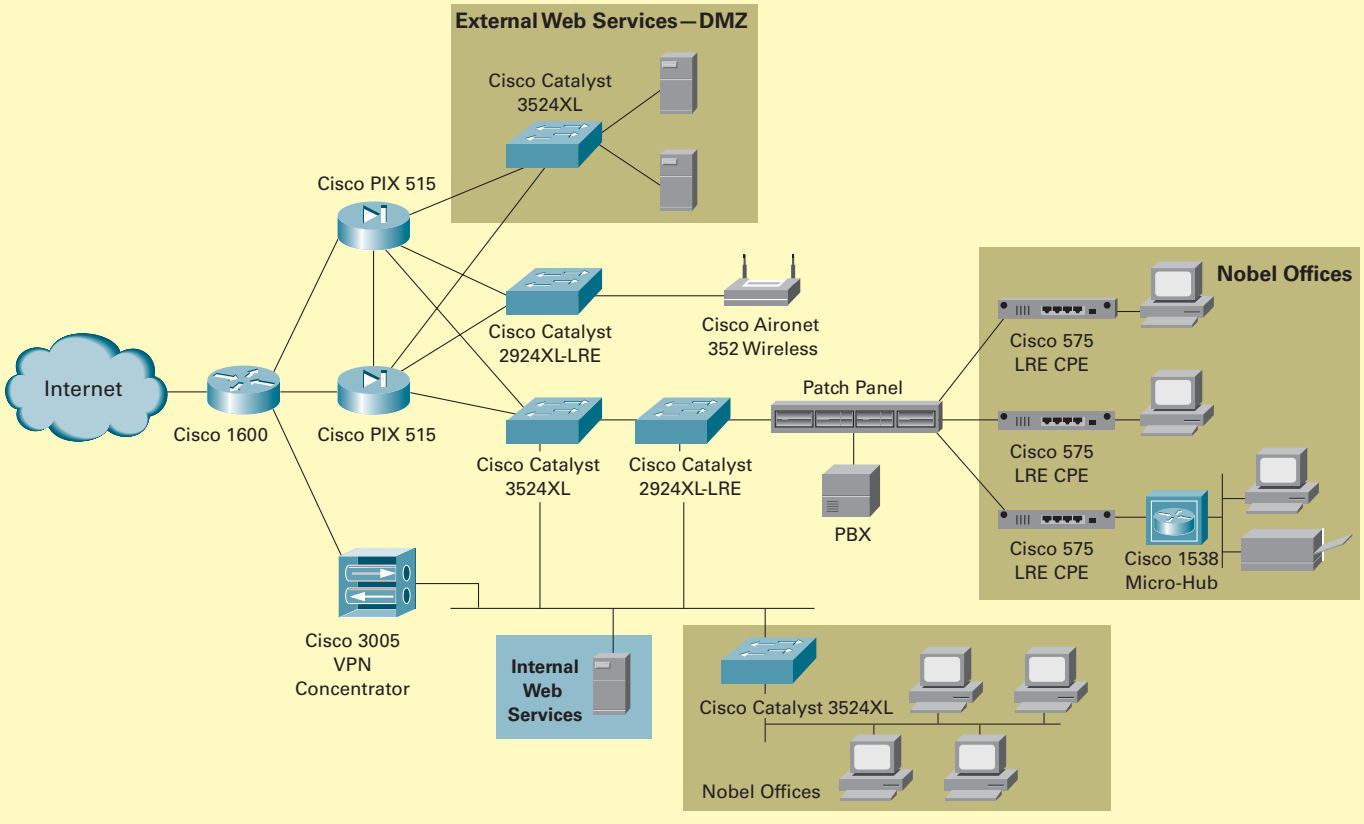
In areas where LRE could not be installed, such as in the Great Hall where presentations are made and in the library reading room, a wireless local-area network (WLAN) was deployed using Cisco Aironet® 350 Series wireless adaptors. This eliminated the need for hard-wired connections in these areas and provided easy mobile Internet access.

LRE combines two technologies—Ethernet and DSL—into a single, powerful solution that delivers broadband speeds over Category 1, 2, or 3 phone cabling. LRE can cost-effectively deliver up to 15 Mbps to users at distances more than 3,500 feet (1066.8 Meters) farther than conventional Ethernet can offer. Ethernet is a well-established, standards-based technology used by most of today's organizations. Because LRE is based on this familiar technology, end users and network administrators can adopt it quickly, with minimal training and no administrative hassle.

Implementing LRE allowed the Norwegian Nobel Institute to use the same copper wiring that had been serving its existing PBX system for the past several years. Very little new wiring was required. Deployment was completed in just a week. The upgraded network consists of a Cisco 1600 Series Router, Cisco Catalyst® 2900 Series LRE-XL switches, Cisco Catalyst 3500 XL Series switches, and a Cisco 575 LRE CPE device at each desktop (Figure 1). Also included were a Cisco Aironet 350 Series Wireless Access Point, a Cisco 3005 VPN Concentrator, and integration of existing Cisco PIX® 515 firewalls.

The Cisco 1600 Series Router is the edge device of the network, connecting the NNI network to the Internet. Each office is equipped with at least one Cisco 575 LRE CPE connected to the Cisco Catalyst 2900 LRE-XL switches. The Cisco Catalyst 2900 switches segment traffic and provide dedicated performance and bandwidth over existing Category 3 wiring. The customer premise equipment (CPE) device includes a standard RJ-11 port that connects to the existing telephone wire infrastructure and

Figure 1 Norwegian Nobel Institute Network



standard ports RJ-45 and RJ-11 that serve the Ethernet equipment and telephones, respectively. The Cisco Catalyst 3500 Series Switch is configured with multiple Virtual LANs (VLANs) handling both external traffic (between the Internet and firewall cluster) and demilitarized zone (DMZ) traffic. The DMZ creates a secure zone behind the firewall that hosts public services such as email, Web servers. However, these services have no direct connection to the internal LAN without going through the firewall. This configuration separates the LANs in a single box without compromising security.

Central to the network is the integration of two Cisco PIX 515 firewalls. They provide redundancy, filtering options, and security to the internal, DMZ, and external networks. To provide easy Internet access for mobile users, such as visiting scholars, a WLAN was deployed using Cisco Aironet 350 wireless access points. This eliminated the need for hard-wired connections in the Great Hall and the reading room of the library. The Cisco Aironet solution uses Service Set Identifiers and Wired Equivalent Privacy keys to authenticate and connect to the network via Cisco PIX firewalls. This configuration isolates the wireless segment from the internal Nobel network. A Cisco 3005 VPN Concentrator was installed for secure remote access. The Cisco VPN solution allows users to access the internal network remotely in a secure fashion. Whether users are in their home office or on the wireless LAN, the Cisco VPN solution allows them to reach internal resources without sending information in plain text outside the internal LAN.

In a traditional installation, the Cisco Catalyst 2900 LRE-XL switch segments traffic and provides dedicated performance and bandwidth. The CPE device includes a standard RJ-11 port that connects to the existing telephone wire infrastructure and standard ports RJ-45 and RJ-11 that serve, respectively, the Ethernet equipment and telephones. The Cisco LRE 48 POTS Splitter delivers Ethernet to individual end users over existing telephone wiring. The Cisco Building Broadband Service Module (BBSM) software platform functions as a tollgate or central manager for capabilities, including end-user provisioning, "plug-and-play," authentication, and tiered bandwidth configuration.

Results

A comparison of system elements for the preexisting system and the new NNI network demonstrates the results of the Cisco LRE installation (Table 1).

Table 1 Comparison of Previous and New NNI Network

Network Comparison	Old Network	LRE Network
Description	Outdated coax, half-duplex 10 Mbps shared service • Unswitched, flat network with aging and rapidly decaying coax cabling	Cisco LRE broadband networking solution—the industry's first end-to-end product line for delivering: • Up to 15 Mbps performance over existing Category 1/2/3 wiring • Ethernet-like performance that reaches up to 5,000 feet • Simultaneous voice, video, and data applications
Performance	Inefficient and congested: • Usable shared bandwidth 2.78 Mbps or 27.8% of potential bandwidth • Single-user library database search drained 98% of total bandwidth	5x performance boost • Usable bandwidth increased to 14.84 Mbps or 98.93% • 500% increase in usable bandwidth
Reliability	Unstable • If one client in the flat, ringed network was closer to the servers and using a lot of bandwidth, other clients had trouble accessing the server, andtypically had to reboot several times before making server contact	99.99% availability
Security	Limited by security shortcomings of a flat, unswitched network	• Cisco Secure PIX 515 Firewall • Higher security of the LRE switched network • VPN
Deployment	Much of old network relied on aging coaxial cabling. Replacement was cost prohibitive and would have taken too long to implement even if the historic building could have been retrofitted	One week for end-to-end provisioning LAN building-wide, as well as WLAN in areas where LRE was impossible
Scalability	Old coax made any additional clients or changes difficult	LRE combined with eight ports enables easy expansion for new clients

Summary

The Cisco LRE solution delivers high-speed bandwidth capability that meets the NNI's current needs and offers scalability for future growth. The NNI now has a secure, reliable network that uses its existing communications infrastructure and preserves the historic building's structure. Additional users also can be added easily.

"I feel much more confident that the network is stable and is going to stay so," commented Feen. "As our needs require, we can now deploy small hubs at each CPE and thereby connect more users to the network without much work," he said.

Lundestad, Feen, and the library staff all commented on the installation Cisco provided. Cisco engineers were "extremely clever in the implementation of the LRE network and as a result saved a great deal of time and work," said Office Manager Grete Haram. "It worked from day one. And now we have complete documentation on our network," she said. As to the service of the technicians doing the actual job, Feen said "it was just plain excellent!"

"We are very pleased with what Cisco has done," Lundestad stated. The Cisco upgrade has "helped us tremendously in advancing our technology network. Visiting scholars are very pleased," he said, noting scholars visiting from other countries were surprised by the new advances that in some ways seemed ahead of the United States.

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Printed in the USA

BW8604/10.02