Federal Scientific Agency Deploys High-Performance Network

NOAA's N-Wave advances science, and supports government research and education initiatives.

Executive Summary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

- **Industry:** Federal Government
- **Location:** Headquartered in Silver Spring, MD

CHALLENGE

- Increase collaboration and access to weather and climate data among scientists and researchers nationwide
- Accommodate massive amounts of bandwidth to support increasingly sophisticated climate models with higher resolution and more data
- Provide scalable platform to meet research demands and technologies of tomorrow

NETWORK SOLUTION

- Cisco Carrier Routing System to manage data traffic on Multiprotocol Label Switching (MPLS) backbone
- WAN based on 10-Gibabit Ethernet, with ability to scale to 100 Gigabit and beyond
- 10 GB per second wavelength-division multiplexing (WDM) fiber-optic links supplied by partners in national research and education network community

RESULTS

- Increased collaboration and access to data
- High-bandwidth availability of network, with capacity of up to 80 TB of data per day
- Emerging technologies easily incorporated without major network upgrade

Challenge

The mission of the National Oceanic and Atmospheric Administration (NOAA), a science-based federal agency within the U.S. Department of Commerce, is to understand and predict changes in climate, weather, oceans, and coasts; to share that knowledge and information with others; and to conserve and manage coastal and marine ecosystems and resources. NOAA's comprehensive system for acquiring observations, from satellites to ships to radar, provides the quality data and information critical for the safe conduct of daily life and the basic functioning of a modern economy.

NOAA's weather models support the accurate issuing of tornado, hurricane, and thunderstorm warnings, tracking of oil spills, marine commerce and coastal restoration, collection of space weather data, gathering of global warming statistics, and up-to-date weather forecasts. Key stakeholders constantly need to access and transfer data, conduct research, collaborate with one another, and improve upon the high-performance, computer-based climate models that operate over NOAA's network.

Some of the models that NOAA and its partners use are so bandwidth-intensive that, in the past, scientists had to ship hard drives to each other to share data. NOAA wanted to increase the ability of its researchers and scientists, and those of its partners, such as the U.S. Department of Energy, National Aeronautics and Space Administration (NASA), and major universities, to securely collaborate and have immediate access to critical data.

To meet growing demands for bandwidth and network applications used in analyzing everything from the ocean floor to the surface of the sun, and to advance science and collaboration among partners in the research communities, NOAA needed an underlying infrastructure that could provide efficient, ultra-high-speed network connectivity for collaboration on multiple levels. NOAA worked closely with its partners in the research and education communities, and with Cisco, to design a solution that would advance the science of climate modeling.

Network Solution

In close collaboration with the national research and education communities, local service provider partners, and Cisco, NOAA designed, engineered, and built N-Wave, a nationwide, high-capacity, data transfer network that is helping scientists, researchers, and other government agencies conduct advanced research without network constraints.

"We've created, for the very first time, a network platform for NOAA researchers that underpins much of the high-performance computing, data storage, archival, and data retrieval that is necessary for scientific research," says Jerry Janssen, who works in the NOAA Earth System Research Laboratory and manages NOAA's N-Wave Research Network.

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N-Wave Research Network Manager, NOAA

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Robert Sears
N-Wave Research Network Engineer, NOAA

N-Wave was developed to set a new, global standard for transparency and secure access to large volumes of complex, high-resolution climate and weather images and data. N-Wave consists of a WAN — based on a 10-Gigabit Ethernet and used exclusively for scientific research — that interconnects NOAA's high-performance computing sites, data archives, and researchers. As research demands increase and next-generation services are added to the network, N-Wave has the ability to scale to a 100-Gigabit Ethernet and beyond.

N-Wave is a highly scalable, stable, and secure network with 10 GB per second wavelength-division multiplexing (WDM) fiber-optic links supplied by partners in the national research and education network communities. N-Wave's creation and long-term success are directly related to and dependent on the long-term trust relationships and partnerships that NOAA has developed in this community.

The five core backbone sites are Denver, CO; Chicago, IL; Atlanta, GA; McLean, VA; and Seattle, WA. Partner sites are located around the country, from Washington, DC to Miami, FL, to Boulder, CO. The network even includes a remote research center in Hawaii and will soon include one in Alaska as well.

NOAA's N-Wave Network

The N-Wave network relies on a Cisco® Carrier Routing System (CRS) to manage data traffic on its Multiprotocol Label Switching (MPLS) backbone. It is a meshed system with redundant routers, so if one link goes down, traffic is quickly routed elsewhere. The Cisco CRS has a self-healing, distributed operating system and efficiently handles the multidirectional traffic of network and data center cloud interactions. "We chose the Cisco Carrier Routing System for N-Wave because of its performance, reliability, and scalability, which will meet our network needs well into the future," says Robert Sears, NOAA network engineer.

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Product List

ROUTING AND SWITCHING

- Cisco CRS 1 Carrier Routing System
- Cisco Catalyst® 4900 Series Switches
- Cisco Catalyst 2900 Series Switches

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Robert Sears
N-Wave Research Network Engineer, NOAA

For More Information

To find out more about Cisco Carrier Routing Systems, go to: http://www.cisco.com/go/crs

Results

N-Wave connects researchers, including climate scientists, physicists, meteorologists, and computer scientists, to the data and resources needed. This will lead to greater predictive models of weather, climate change, and the effect of environmental incidents. More accurate forecasting will have profound safety, economic, and environmental benefits for citizens and the global economy. The network ultimately supports NOAA's vision of an informed society that uses a comprehensive understanding of the role of the oceans, coasts, and atmosphere in the global ecosystem to make the best social and economic decisions possible.

With a capacity to manage up to 80 terabytes of data per day, N-Wave is NOAA's highest-performance network infrastructure. "In one month alone, 1.3 petabytes of data were transferred. That is the equivalent of streaming approximately 13 years of high-definition television," says Robert Sears, N-Wave Research Network engineer for NOAA. The high-bandwidth availability of the network helps ensure that researchers have access to important data when and where they need it. "Climate model data transfers that used to take a day now take minutes. This is critical to responding to events happening in real time," says Sears.

A critical component in NOAA's high-performance computing climate research program, N-Wave enables the agency's scientists and partners to conduct new research into complex climate systems. N-Wave facilitates analyses and predictions of climate variation in the short term, such as upcoming cold spells or periods of drought, as well as over the much longer term, to centuries ahead and beyond.

What used to be available in just one location is now available to the entire network because N-Wave promotes information-sharing and collaboration. Local research and academic communities are now connected to data that would otherwise be extremely difficult to access. And NOAA scientists and researchers now have access to the Energy Sciences Network (ESnet), a high-speed network, serving thousands of U.S. Department of Energy scientists at more than 40 institutions, as well as NASA's Research and Engineering Network (NREN).

N-Wave was designed to help ensure that the platform deployed today will be able to meet the industry standards of tomorrow, with nominal additional costs. For example, the network can easily incorporate emerging technologies, such as video, wireless, IP voice and more, without the need for a major network upgrade. N-Wave also lowers NOAA's current costs by consolidating network assets, helping enable instant provisioning, more efficient management of bandwidth, and reduced energy costs.