N-Wave News

NOAA ENTERPRISE NETWORK

NOAA N-Wave

The N-Wave Enterprise Network Services Branch, under the NOAA Office of the Chief Information Officer, Service Delivery Division, supports both operations and research, enabling NOAA's mission of science, service and stewardship through highly available, secure, high-speed network transport and services.

Mission

N-Wave is committed to providing innovative networking capabilities with integrity, transparency and flexibility, to enable NOAA's missions through the implementation of:

- Quality, advanced high-speed connectivity both internally and externally to NOAA
- Portfolio of secure, flexible, available, high-bandwidth network services
- Retention and recruitment of exceptional operations and engineering staff.

Our Vision

To provide reliable, secure and sustainable enterprise network services for NOAA, which enables NOAA's mission of science, service and stewardship.

From the N-Wave Program Manager

Robert Sears

Among the many projects, service developments and infrastructure expansions that you will read about in this edition of the N-Wave newsletter, I want to highlight the N-Wave team's concerted efforts to establish a more formal, direct engagement with our stakeholder community.

This community encompasses the entirety of NOAA, along with a growing family of other Department of Commerce bureaus. Our customer relationships range from direct services provided to a line office or program in support of a specific mission, to indirect services provided to multiple line offices and programs colocated on a campus. If you are accessing the internet at a NOAA facility, that resource is provided by your N-Wave team.

As N-Wave provides network connectivity to all major NOAA campuses, data centers and multiple line office locations, we have a great need to engage in proactive planning with all customers to better understand their growing data needs. *From the campus to the cloud*, the theme of the first annual N-Wave Stakeholders and Science Engagement Summit meeting held this past July, targeted the need to engage with our expanding stakeholders community and place visibility on the common, shared resources of the N-Wave national infrastructure.

These annual stakeholders events are centered on:

1. Gaining insight into the multiple NOAA and partner network infrastructures that enable data exchange among NOAA, the scientific community and the world,
2. Sharing about line office and program initiatives that may present new challenges and opportunities in leveraging shared network resources, and
3. Exploring topics ranging from data transfer optimization and process flow to N-Wave's latest capabilities and services.

We encourage NOAA leaders, campus technology coordinators, data producers, data managers, information security officers, network engineers, researchers, scientists, system administrators, and N-Wave's partners from the scientific, research and education networking community to attend the 2020 N-Wave Stakeholders meeting. The meeting is currently in the planning stage and will be held the week of May 4 in College Park, MD.

On a personal note, N-Wave is an exciting and rewarding program to be part of as it supports NOAA science and operations, enables the missions of all our customers and provides a direct impact to our nation. Even more rewarding is when I have the chance to convey to others the great talents, efforts and ambition of the N-Wave team.

I never shy away from the opportunity to tell our story and brief others on the unique capabilities and program offerings of N-Wave— from acquisition to security, and from network engineering and operations to our provider partnerships.

This summer I had the great privilege to meet with the most senior appointed IT official in the U.S. Government, Federal Chief Information Officer Suzette Kent, and once again share with a wider audience the vast talents of every member of our program. On August 8, Suzette Kent, Federal CIO, Joseph Klimavicz, Department of Justice CIO and former NOAA CIO, Ron Bewtra, DOJ CTO and former NOAA program office CTO, David Shive, General Services Administration CIO, Joseph Harris, Department of Homeland Security acting deputy CIO, Mark Kneidinger, Department of Energy principal deputy CIO, Sarah Lynn, DOJ senior advisor, and Bob DeLuca, GSA executive director of IT Modernization Centers of Excellence, toured the NOAA David Skaggs Research Center in Boulder, CO.

The tour included program briefs from N-Wave, the National Centers for Environmental Information, the Earth System Research Laboratory's Physical Sciences Division and Global Systems Division, the National Weather Service and the Space Weather Prediction Center. It was an honor to share N-Wave's successes and strategic plans for the future.

During U.S. Federal CIO Suzette Kent's visit to NOAA's David Skaggs Research Center in Boulder, CO, Robert Sears provides an introduction to the N-Wave network.

N-Wave Completes 100 Gbps Backbone Upgrade

One of the most exciting upgrades to the N-Wave network since its inception 10 years ago is now complete. The latest generation of the N-Wave network has up to 10 times the potential capacity of the previous version, jumping from a 10 gigabits per second (gbps) based network to a 100 gbps network.

Core backbone circuits between Denver, CO, Chicago, IL, Atlanta, GA, and McLean, VA, are now operational at 100 gbps. The two backbone circuits connecting to N-Wave's other core location in Seattle, WA, will each remain 10 gbps until increased capacity is needed.

800 gbps delivered to D.C. metro

The N-Wave network in the Washington, D.C., area consisting of the McLean core location, Mid-Atlantic Crossroads (MAX) facility at College Park, MD, NOAA Satellite Operations Facility (NSOF) in Suitland, MD, and NOAA Center for Weather and Climate Prediction (NCWCP) in College Park, was upgraded to 100 gbps. This growth was facilitated by a preceding upgrade to the N-Wave D.C. Metro

Dense Wavelength Division Multiplexing (DWDM) ring. In total, N-Wave now delivers more than 800 gbps of capacity around the ring, providing ample room for future growth.

More capacity for NOAA big data sites

Following the backbone and D.C. area upgrades, N-Wave is now working to increase the capacity of connections between NOAA's big data generating sites and the network core. This includes the NOAA Environmental Security Computing Center (NESCC) in Fairmont, WV, and the Department of Commerce campus in Boulder, CO. The link from NESCC to McLean is complete, increasing from 3x10 gbps to 100 gbps, and work is nearly finished on the link to Chicago, which will increase from 2x10 gbps to 100 gbps. Upgrades to the links between the Denver core location and the DOC campus in Boulder are in process. N-Wave anticipates having this span of the network upgraded from 3x10 gbps to 100 gbps by early January 2020. Equipment is on order through N-Wave's local regional network partner, the Front Range GigaPop.
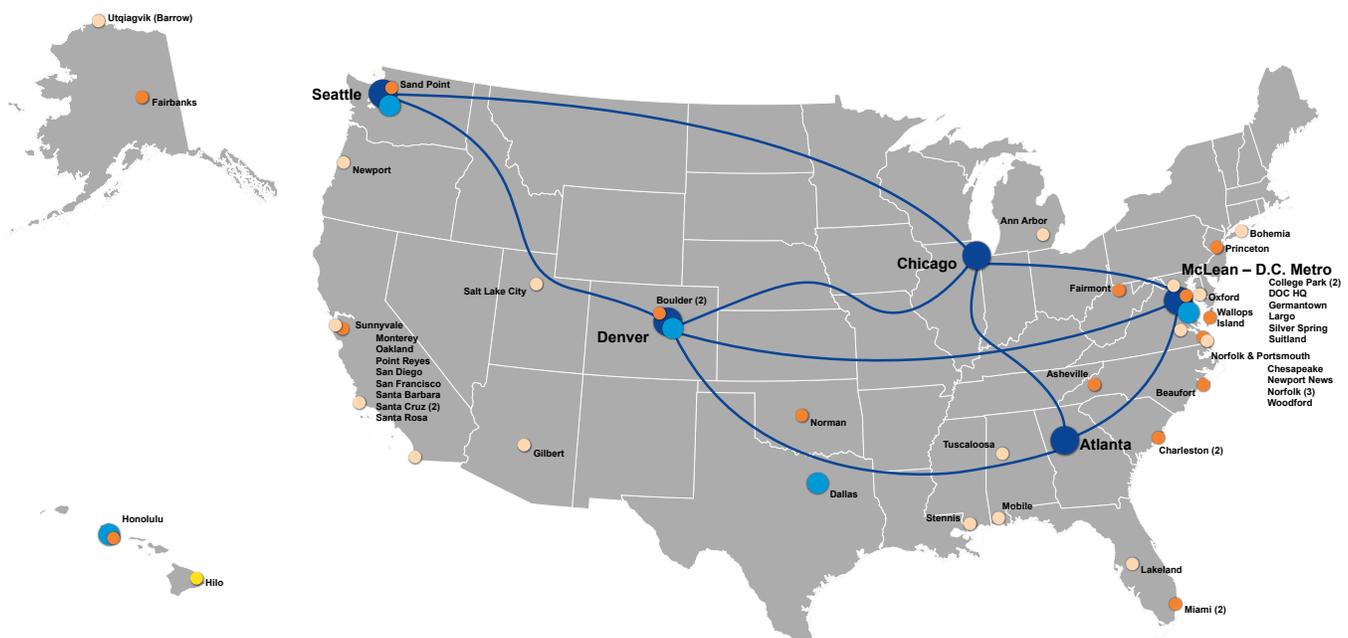
First N-Wave Stakeholders Summit – Collaborative, Engaging and Educational

More than 80 attendees joined in person and remotely for the 2019 N-Wave Stakeholders and Science Engagement Summit, making this first annual event a collaborative, engaging and educational success. The summit was held July 9-11 at the David Skaggs Research Center in Boulder, CO.

With 27 unique sessions, the agenda was akin to a three-day lightning round of NOAA program briefings, collaborative project overviews and technical talks. The lineup included 30 speakers representing NOAA's line and staff offices and external partner organizations, including the Department of Defense, Department of Energy, National Institute of Standards and Technology, and University Corporation for Atmospheric Research. Each presenter offered valuable insight into program initiatives and the latest technologies that may present new challenges and opportunities in leveraging shared network resources.

N-Wave and the future of NOAA's environmental information

Dr. Neil Jacobs, assistant secretary of commerce for environmental observation and prediction performing the duties of under secretary of commerce for oceans and atmosphere, kicked off the event with a keynote on "NOAA's Environmental Information: Why It Matters and Future Direction." Looking toward the future of NOAA's IT capacity, Dr. Jacobs highlighted N-Wave as an important platform for facilitating NOAA's ability to ingest and assimilate large amounts of data. That data will allow for the development of new tools and better collaboration across weather, water, climate and ecological systems.

In the air and at sea, bandwidth is a challenge

Rear Admiral (Lower Half) Nancy Hann of the Office of Marine and Aviation Operations (OMAO), provided insight into NOAA's fleet and aircraft missions and challenges. The major challenge? Growing demand for network bandwidth. OMAO

expects its Aircraft Operations Center's average mission dataset to increase by approximately 18 gigabytes in the next year. This is largely due to new sensors and instrumentation, including the tail Doppler radar used for forecasting by the National Hurricane Center.
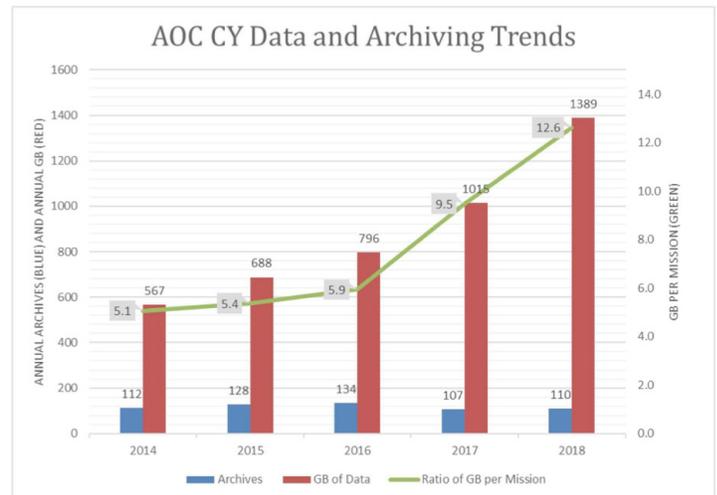
In the air and at sea, growing demand for bandwidth is a challenge for OMAO's aircraft and fleet. OMAO expects the Aircraft Operations Center's average mission dataset to increase by approximately 18 gigabytes in the next year. Graph is courtesy of OMAO.

Admiral Hann offered five key takeaways regarding how N-Wave can help OMAO achieve its vision for the future:

1. Ensure OMAO's fleet and aircraft have a reliable network with adequate bandwidth in the air and at sea.
2. Provide and manage high-speed internet across all of OMAO's centers and port offices.
3. Make sure OMAO's networks are secure.
4. Help harness and use the data OMAO is collecting by leveraging the cloud.
5. Explore innovative ways to move data from OMAO platforms to the programs OMAO supports.

This engagement has spurred multiple direct meetings among N-Wave engineers and OMAO program and technical leads, as they look toward

the next generation of networks for the new fleet of NOAA ships to be built by early 2023. This team is working to ensure the networks take advantage of the latest wired and wireless technologies, address current issues and allow room for future growth. Planned enhancements include Network Access Control (NAC) and a fully converged wired and wireless network that is capable of segmenting users' access to networks and resources based on their affiliation—regardless of how they connect. These features will enable the crew and on-board scientists to work securely and efficiently, without being tied to a physical location. Collaborating on these requirements now will ensure the proper cabling and infrastructure are built into each ship and allow room for growth.

Exploring downstream effects on shared infrastructure

One of the key objectives of the Stakeholders Summits is to gain visibility into campus-level science and other activities that generate traffic across shared network infrastructures. Ultimately, this insight helps N-Wave—and its stakeholders—better understand the downstream effects of those activities and identify challenges and opportunities for improvement.

During a session on the Center for Satellite Applications and Research (STAR), presenter Matt Jochum and N-Wave's transport operations manager, Mark Mutz, described a network bottleneck affecting STAR, which is based at the NOAA Center for Weather and Climate Prediction (NCWCP) in College Park, MD. The two discussed an opportunity to create a direct path for STAR to the N-Wave network core, separating STAR's traffic from the current shared path out of NCWCP.

N-Wave and STAR are now working on establishing that direct path to N-Wave's new 100 gigabits per second infrastructure in the Washington, D.C. area. Expected results include better support for STAR's mission and operations. The change will also give N-Wave more detailed insight into customer traffic patterns and capacity planning needs in that area.
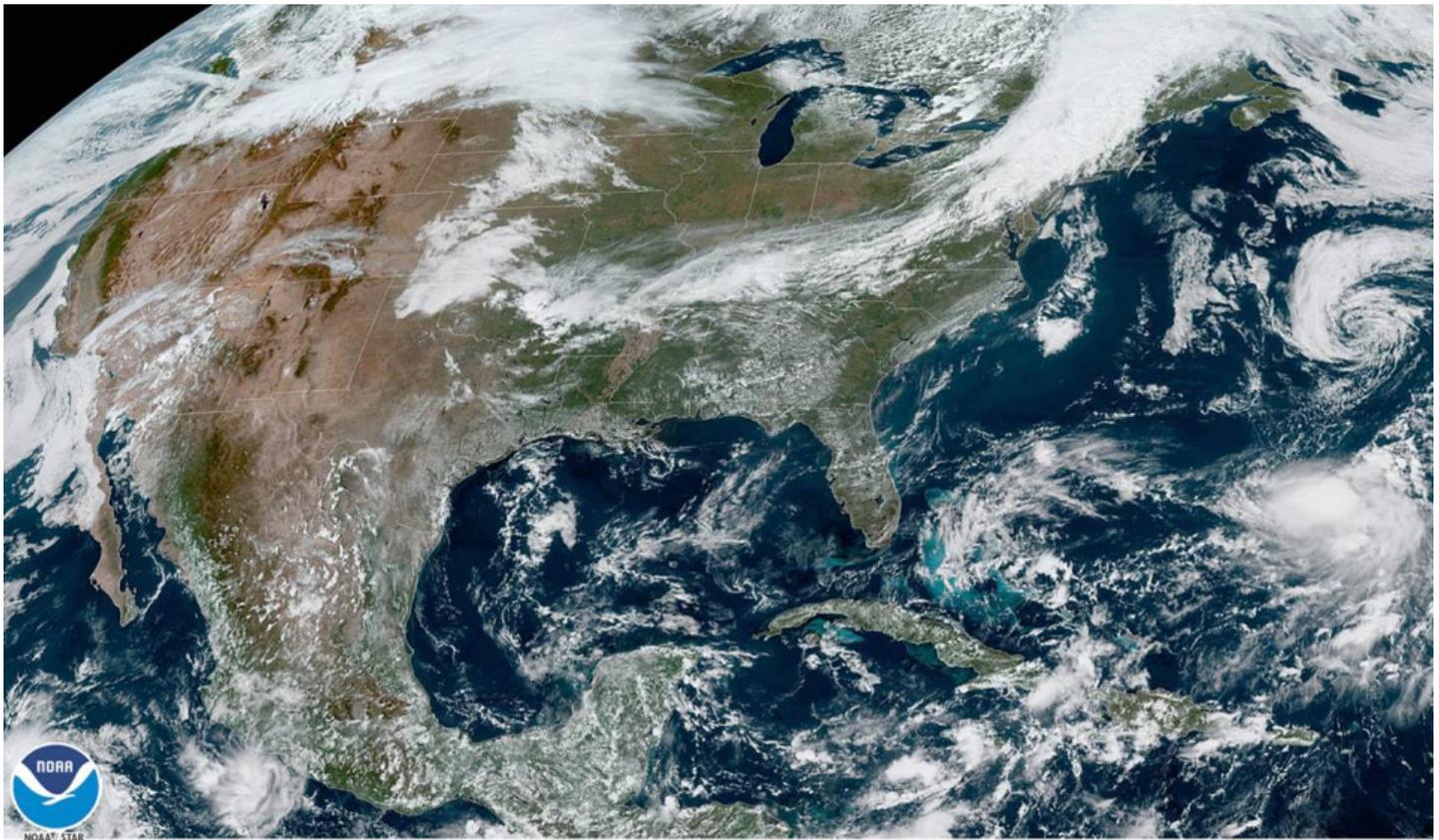
The Geocolor product was developed at the Cooperative Institute for Research in the Atmosphere (CIRA) and STAR's Regional and Mesoscale Meteorology Branch (RAMMB). Daytime imagery looks approximately as it would appear when viewed with human eyes from space. Credit: CIRA/NOAA

NIST's plans to leverage N-Wave

Robert Densock, network operations manager for NIST, presented a briefing on the 5-8 year roadmap his team developed for network updates required to meet the NIST science community's needs. One milestone on the roadmap is a high-speed science network that includes 100 gbps campus backbones at NIST's two main locations in Gaithersburg, MD, and Boulder, CO, along with increased capacity to share resources between the two sites.

In 2017, NIST transitioned from two commercial T3 circuits to two one-gigabit N-Wave circuits between Gaithersburg and Boulder. As a result, NIST saw a significant increase in bandwidth at a decreased cost. Densock said NIST's long-term vision is to realize additional cost savings and higher speeds by converging all its traffic onto N-Wave, using separate virtual routing and forwarding instances and virtual LANs to transport traffic to the wide area network.

Since the summit, N-Wave has continued to work with NIST on plans to upgrade the two circuits between Gaithersburg and Boulder from one to 10 gbps each, with a longer-term goal to deploy 40 gbps connections. N-Wave now also provides internet service for NIST's Boulder site.

NIST saw a significant increase in bandwidth at a decreased cost after switching from commercial T3 circuits to N-Wave for connectivity between its two main locations: Gaithersburg, MD, and Boulder, CO.

NOAA CIO and assistant CIOs frame strategies for broader IT success

NOAA's chief information officer Zachary Goldstein and assistant CIOs Irene Parker of the National Environmental Satellite, Data and Information Service (NESDIS) and Roy Varghese of the National Marine Fisheries Service (NMFS) were among others who presented at the Stakeholders Summit. The briefs included updates on key technology initiatives within their offices, including cloud services, and their visions for broader NOAA IT success.

Continuing the conversation

The operational success of any enterprise service is founded on frequent customer collaboration that occurs in many forms. Each annual Stakeholders and Science Engagement Summit is just one of N-Wave's efforts to develop a deeper understanding of stakeholder activities that drive science and associated network requirements. Combined with direct customer interactions that take place on a regular basis, these collaborations play a vital role in strategic planning and network capacity planning.

More information about the N-Wave Stakeholders Summit is available at https://noc.nwave.noaa.gov/nwave/public/events.html. To sign up for announcements regarding the 2020 N-Wave Stakeholders Summit, please email nwave-summit@noaa.gov.

2019 N-Wave Stakeholders Summit Program

Tuesday, July 9

- NOAA's Environmental Information: Why It Matters and Future Direction
  Dr. Neil Jacobs, National Oceanic and Atmospheric Administration

- Shared Network Infrastructures – Enabling NOAA Science and Operations
  Robert Sears, N-Wave

- Unidata's Internet Data Distribution: A Community Driven Virtual Network
  Jeff Weber, University Corporation for Atmospheric Research

- Radar Operations Center and NEXRAD 2020-2040
  Christina Horvat, National Weather Service

- NESDIS International Satellite Data and Cloud Strategies
  Irene Parker, National Environmental Satellite, Data and Information Service

- OMAO's Mission in the Air and at Sea
  RDML Nancy Hann, Office of Marine and Aviation Operations

- NOAA OCIO Brief
  Zachary Goldstein, NOAA Office of the CIO

- Network Virtualization - Unleashing Innovation in Advanced Networks
  Jerry Sobieski, NORDUnet

- Transporting NOAA to the Cloud: N-Wave Enterprise Cloud Transport
  Dave Mauro, N-Wave

- TIC 3.0 Security Capability Update and Scoring Model
  Chi Kang, NOAA Cyber Security Division

- Navigating the Path to IPv6 Only
  Ron Broersma, DOD Defense Research and Engineering Network (DREN)

Wednesday, July 10

- NOAA Fisheries Office of the Chief Information Officer
  Roy Varghese and Frank Amankwah, NOAA National Marine Fisheries Service

- ESRL/GSD: Research Today for Better Forecasts Tomorrow
  Jennifer Mahoney, Earth System Research Laboratory / Global Systems Division

- Engagement and Performance Operations Center (EPOC) and NetSage
  Dr. Jennifer Schopf, Indiana University

- N-Wave Infrastructure Upgrades
  Mark Mutz, N-Wave

- NCEI Data Science and Stewardship — Preparing for the Exponential Growth of Environmental Data
  Dr. Stephanie Herring, NOAA's National Centers for Environmental Information

- WAN and Workflows - Enabling Science
  Matthew Link, Indiana University

- HPC / GFDL Brief
  Zachary Goldstein, NOAA Office of the CIO

- Globus Secure Data Transfer
  Scott Ruffner, University of Virginia

- Integrated Dissemination Program
  Bernie Werwinski, National Weather Service

- Alaska Federal Agencies Networking Consortium
  Per A. Pedersen, National Weather Service Alaska Region

Thursday, July 11

- Demystifying the Science Requirements Review Process for Network Design and Use
  Jason Zurawski, ESnet

- Panel Discussion: NOAA Campus IT Coordinators
  Jason Zurawski, ESnet (Moderator); Ian Chun, NOAA Inouye Regional Center; Alex Hsia, NOAA Boulder Network Operations Center; Steve Martin, NOAA Western Regional Center; Todd Schira, NESDIS / Office of Satellite and Product Operations

- Update on Internet2's Next Generation Infrastructure
  Christian Todorov, Internet2

- NIST's Plans to Leverage N-Wave
  Rob Densock, NIST

- The Center for Satellite Applications and Research (STAR)
  Matthew Jochum, NESDIS / Center for Satellite Applications and Research

- ESnet Capacity Planning Techniques
  David Mitchell, ESnet

Photo highlights – 2019 N-Wave Stakeholders and Science Engagement Summit

NOAA Secure Ingest Gateway Project Awarded Commerce Gold Medal for Scientific and Engineering Achievement

The team behind NOAA's Secure Ingest Gateway Project (SIGP) recently was awarded a Department of Commerce Gold Medal for scientific and engineering achievement. Staff from the National Environmental Satellite, Data and Information Service (NESDIS), National Weather Service (NWS) and the NOAA OCIO's Service Delivery Division, Cyber Security Division and N-Wave were recognized for the SIGP project:

- Kate Becker, NESDIS
- Michelle Detommaso, NESDIS
- Matthew Jochum, NESDIS
- Chi Kang, OCIO
- Joseph Mangin, NESDIS
- Irene Parker, NESDIS
- Robert Sears, OCIO
- Cameron Shelton, OCIO
- Doug Whiteley, NESDIS
- James Yoe, NWS

SIGP was a pilot project launched in 2017 to establish a standard, enterprise and secure method for receiving data – including satellite weather data – from NOAA external sources, including foreign government agencies, commercial providers and strategic partners. The project leverages N-Wave and X-Wave for data transport, including high-capacity circuits directly connected to cloud infrastructure, along with NOAA's Trusted Internet Connections. The pilot project is in the process of transitioning to the Operational Secure Ingest Service (OSIS).

The Gold Medal, the highest honorary award given by the Department of Commerce, recognizes distinguished performance characterized by extraordinary, notable or prestigious contributions that impact the mission of the Department of Commerce and/or one or more of its operating units. To warrant a Gold Medal, a contribution must focus on qualitative and quantitative performance measures reflected in the DOC's Strategic Plan. Awards are given in the areas of leadership, personal and professional excellence, scientific and engineering achievement, organizational development, customer service, administrative and technical support, and heroism.

The Secretary of Commerce Annual Honor Awards Ceremony took place October 16, 2019, at the Herbert C. Hoover Building in Washington, D.C.

From left to right: Commerce Deputy Secretary Karen Dunn Kelley; SIGP team members Chi Kang, Cameron Shelton, Robert Sears, James Yoe, Kate Becker, Doug Whiteley, Irene Parker, Matthew Jochum, Joseph Mangin and Michelle Detommaso; Commerce Secretary Wilbur Ross and NOAA administrator Neil Jacobs.

Enterprise Wireless Sees Continuous Improvement Year One of Operation

September 2019 marked one year since N-Wave's first production deployment of the NOAA Enterprise Wireless Service. Over the year, 17 new sites were provisioned, yielding substantial growth in user devices and traffic.

Single solution creates a better user experience

As the number of NOAA Enterprise Wireless user sites and spaces continue to increase, the value of the service also grows. As evidence, sites that start with limited coverage in select spaces quickly request full coverage to give their users greater mobility. Across the country, user mobility also improves as the service is deployed at more campuses and line office sites. After users onboard in any one location, they automatically have access at any other deployed site.

This can drastically decrease the load on local IT staff who support user onboarding during large NOAA events and conferences. When combined with the ease of self-registration offered by wireless conference accounts, customers have reported positive wireless access experiences for large gatherings.

Full wireless coverage at NOAA headquarters

NOAA's headquarters at the Silver Spring Metro Center (SSMC) in Maryland is another example of how a single solution with widespread coverage creates a better user experience. The Enterprise Wireless service is now available across most of SSMC, including SSMC Buildings 1 and 4, along with parts of Buildings 2 and 3. Full coverage in Buildings 2 and 3 will be completed by the second quarter of 2020. That means one wireless solution will serve thousands of NOAA employees and guests at SSMC, enabling seamless connectivity throughout the campus.

Furthermore, in the majority of SSMC conference rooms, wireless access points are completely replacing wired network ports. This conference room standardization, which is part of a larger campus renovation and restacking project,

facilitates consistent user experiences and greater collaboration between employees and guests. Costs for cabling and engineering support for swing spaces are also reduced.

Customer feedback is key

Customer feedback plays a big role in N-Wave's efforts to fine-tune the Enterprise Wireless service and the instructions users rely on to connect to the service. Combining this input with service and support metrics, N-Wave meets weekly with the equipment vendor to discuss the current setup and plans for future enhancements.

One example is expanding support for devices that cannot onboard via the standard, certificate-based process. Those devices include Apple TVs and Chromeboxes. By customer request, N-Wave recently enabled wireless streaming to Apple TVs in two conference rooms.

Customer feedback has also shed light on the benefits of using guest wireless to more easily test new technologies. This is particularly valuable when testing devices that only need internet access to connect to cloud resources, whether it be for a proof of concept or vendor demonstrations.

N-Wave encourages customers to continue providing feedback and feature requests. The team evaluates every request with the goal of making the service better for all.

On the horizon

Engineers soon will begin testing the latest Aruba controller operating system, ArubaOS 8, in the N-Wave test lab. This latest version uses Mobility Master, a software-defined master controller that centralizes and simplifies the management of multiple wireless controllers in the enterprise environment. ArubaOS 8 also offers benefits to hitless failover and granularity of control for better system performance.

N-Wave engineers are also working with Office of Marine and Aviation Operations program and technical leads, as they look toward the next generation of networks for the new fleet of NOAA ships to be built by early 2023. This vision includes a fully converged wired and wireless network. Engineers are leveraging lessons learned from the NOAA Enterprise Wireless service to provide expert recommendations and services in support of OMAO's new fleet of ships.

Enterprise Wireless metrics
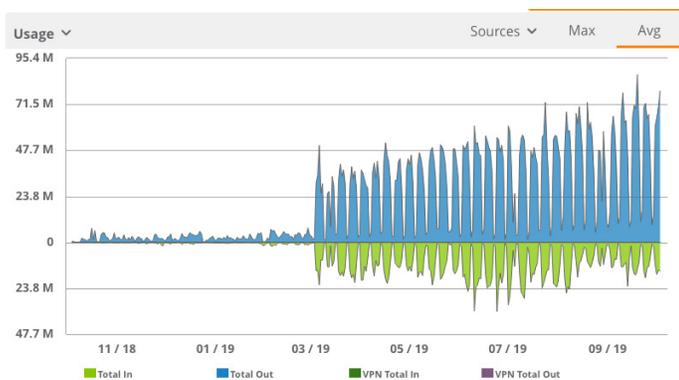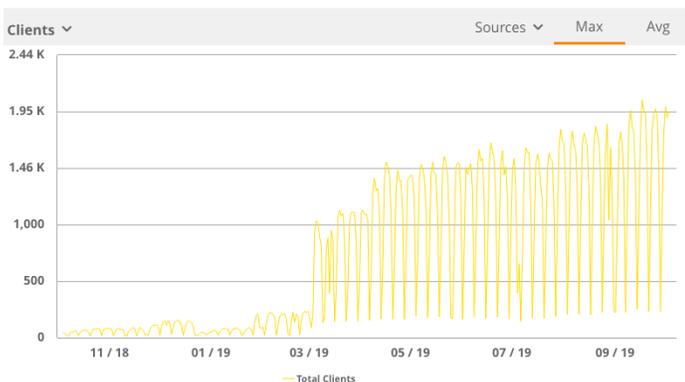
One year in review: Average usage and the number of devices concurrently connected to the NOAA Enterprise Wireless service continue to grow as the service is deployed to new sites.

Enterprise Wireless for new customers

N-Wave customers who are interested in the NOAA Enterprise Wireless service can submit a new service request. The service inquiry form is available at: https://sn-tools.grnoc.iu.edu/nwave-service-inquiry-request/

Current service locations

- Aircraft Operations Center – Lakeland, FL
- David Skaggs Research Center, Building 22 and NTIA in Building 1 – Boulder, CO
- Fairbanks Command and Data Acquisition Station – Fairbanks, AK
- NOAA Finance Office – Germantown, MD
- Information Technology Center – Largo, MD
- Oxford Cooperative Laboratory – Oxford, MD
- Hollings Marine Lab – Charleston, SC
- Monterey Bay National Marine Sanctuary Exploration Center – Santa Cruz, CA
- NOAA Beaufort Laboratory – Beaufort, NC
- NOAA Environmental Security Computing Center – Fairmont, WV
- NOAA Norfolk Regional IT Support Office – Norfolk, VA
- NOAA Satellite Operations Facility – Suitland, MD
- Wallops Command and Data Acquisition Station – Wallops Island, VA
- Office for Coastal Management – Charleston, SC
- Office for Coastal Management – Oakland, CA
- Silver Spring Metro Center Buildings 1, 2*, 3* and 4 – Silver Spring, MD
- Western Regional Center – Seattle, WA

Current coverage in SSMC Buildings 2 and 3 is only in some spaces. Coverage in remaining spaces is coming soon.

Coming soon

- Inouye Regional Center (IRC) – Honolulu, HI
- Marine and Aviation Operations-Atlantic – Norfolk, VA
- Marine and Aviation Operations-Pacific – Newport, OR
- National Geodetic Survey Testing and Training Center – Woodford, VA
- Office of Response and Restoration – Sand Point, WA
- Silver Spring Metro Center, Remaining Spaces in Buildings 2 and 3 – Silver Spring, MD
- Thunder Bay National Marine Sanctuary – Alpena, MI

N-Wave Expands Services in Alaska

Bandwidth doubles from Utqiagvik (Barrow) to Fairbanks

Throughout fiscal year 2019, N-Wave and its partner Internet2 worked to establish new provider relationships throughout the Alaska region. One such partnership finalized in Q4 of FY19, has resulted in the doubling of capacity along the Utqiagvik-to-Fairbanks data path with no increase in cost. The additional capacity will allow the circuit to be shared among NOAA entities located in Utqiagvik.

As the primary user, the NOAA Polar Operational Environmental Satellites (POES) Ground System has been using this circuit operationally since November 2018 to receive Joint Altimetry Satellite Oceanography Network (JASON) satellites' passes. Compared to their previous satellite-based 1.5 mbps connection, the recently upgraded 20 mbps over fiber, with its significantly lower latency, has opened the door to new possibilities for POES.

Previously, the satellite connection permitted only command and control of the spacecraft and receipt of health and safety telemetry from the JASON satellites. Now, the ground station will also be able to receive instrument and science data, making the most of its strategic location well above the Arctic Circle (which enables the spacecraft to be "seen" on a larger number of orbits). Additional benefits include more efficient system management functions, such as maintenance, system scans and software upgrades. It also facilitates better performance for the remotely monitored camera at the unmanned location, which, among other things, permits remote operators to read local instruments for positioning the dish during a satellite pass.

Other NOAA entities in Utqiagvik – the Earth System Research Laboratory (ESRL) Barrow Atmospheric Baseline Observatory and National Weather Service's Weather Service Office – are also looking to take advantage of this new N-Wave connection.

Fiber build in Utqiagvik

N-Wave is working with a local Alaska network vendor to build a new fiber path to replace the current link between Quintillion's facility and ESRL's Barrow Observatory. The existing path is a combination of fiber optic and microwave-switched networking. The new path consists entirely of fiber and follows a more inland route that offers protection from beach erosion. The fiber connection will further enhance NOAA's science at ESRL's new facility currently under construction in Utqiagvik. It will also enable the polar satellite missions to operate effectively in this unique location on Alaska's North Slope where NOAA owns approximately 100 acres of land. The fiber build is expected to be completed in early 2020.

Redundant path for Gilmore Creek – Fairbanks Command and Data Acquisition Station (FCDAS)

To continue to improve the overall availability, continuity of operations and robustness of the network connectivity for the FCDAS, N-Wave is working with a local carrier to establish a 1 gigabit per second backup path from Gilmore Creek (outside of Fairbanks) to downtown Fairbanks, where the current circuit connects to the fully redundant MPLS network to Seattle, WA. The backup circuit will be on a completely diverse path to the existing fiber optic path. The new 1 gbps circuit will consist of a combination of both an FCC licensed spectrum microwave running from Gilmore Creek to the West Coll tower, Birch Hill repeater and then down to the AlasConnect Wilson Central Office, which then passes via a fiber interconnect to the Alaska Communications Systems (ACS) MPLS backbone.

Work on the project is expected to begin in the heart of Alaskan winter: January/February 2020. To facilitate the installation of the microwave equipment, the FCDAS is offering to use its snowcat to help plow the road up to the West Coll tower and, in the future, if AlasConnect needs access to the tower for any maintenance, troubleshooting or restoration of service activities.

Fairbanks Command and Data Acquisition Station (FCDAS) diverse path
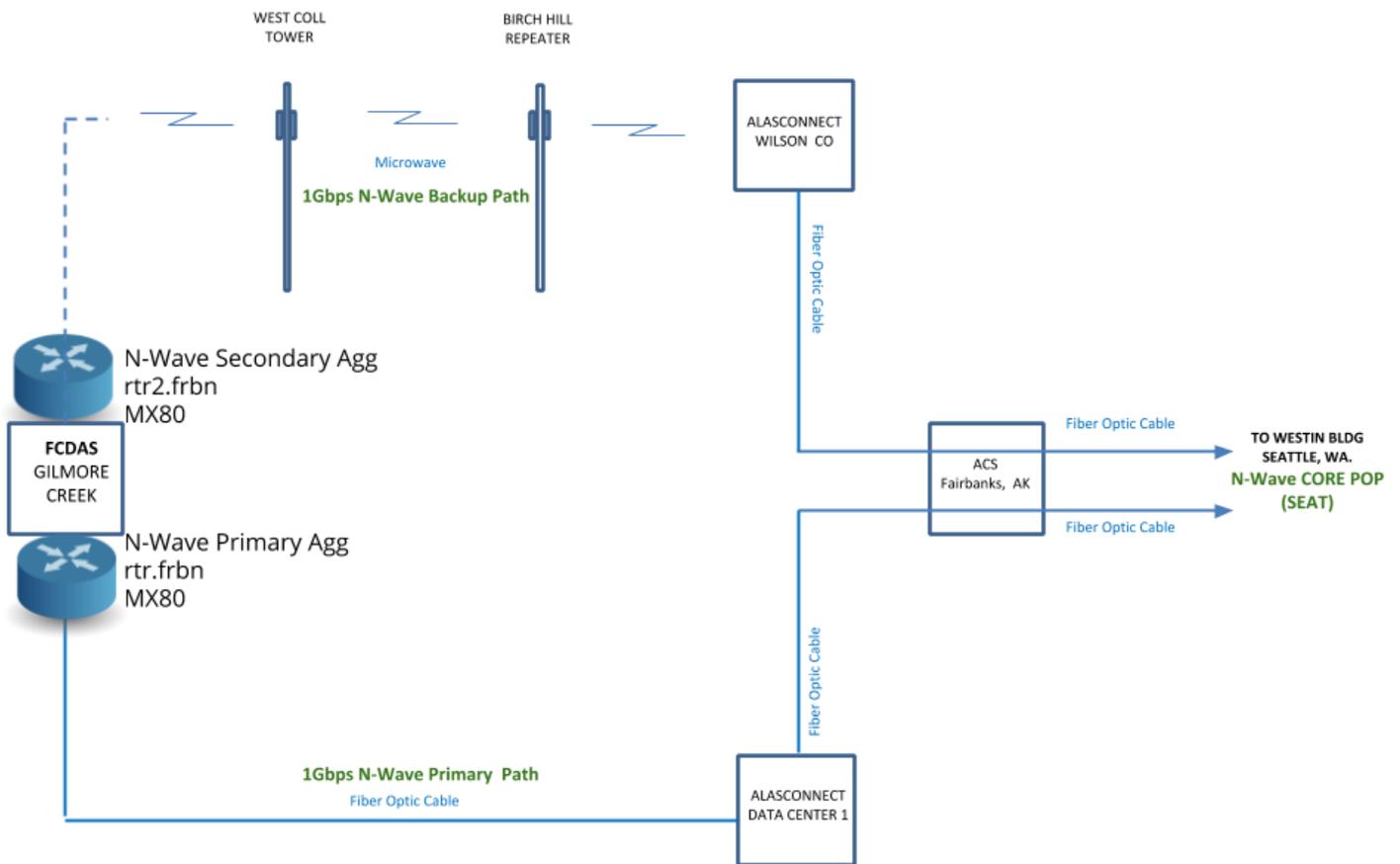
To continue to improve the overall availability, continuity of operations and robustness of the network connectivity for the FCDAS, N-Wave is working with a local carrier to establish a 1 gbps backup path from Gilmore Creek to downtown Fairbanks.

Credit: NOAA/OER

Vision for an Alaska Federal Agencies Consortium

Historically, Alaska has been a challenging environment in which to operate telecommunications. High costs combined with poorly built-out infrastructure and few vendors makes for a trying setting.

Alaska is a long way from the "lower 48" states, and its intrastate distances are immense and road systems are limited. With very little economies of scale, Alaska continues to be an expensive place for many things, including telecommunications. For these reasons, federal agencies that have a presence in Alaska are spending disproportionate resources on telecommunications to support their Alaska operations compared to the rest of the U.S.

At the initiative of the National Weather Service in Alaska, NOAA convened a meeting May 7-9, 2019, in Anchorage to discuss options for federal agencies with a presence in Alaska to join forces. The goal? To gain economies of scale and reduce costs by using shared high-capacity communications circuits wherever possible. A similar initiative known as the Hawaii Intranet Consortium (HIC) continues to be very successful in accomplishing comparable goals in Hawaii.

The Alaska meeting was well attended with participants from the Department of Commerce (NOAA's N-Wave; National Environmental Satellite, Data and Information Service; National Marine Fisheries Service; and National Weather Service), Department of Transportation (Federal Aviation Administration), Department of the Interior (Bureau of Land Management, U.S. Geological Survey) and Department of Defense (Defense Research and Engineering Network). Participants agreed that this is a feasible option worth exploring with a team of representatives from Federal agencies. A recurring teleconference will commence later this fall to gather support and explore opportunities for partnerships.

NOAA Sites in Alaska
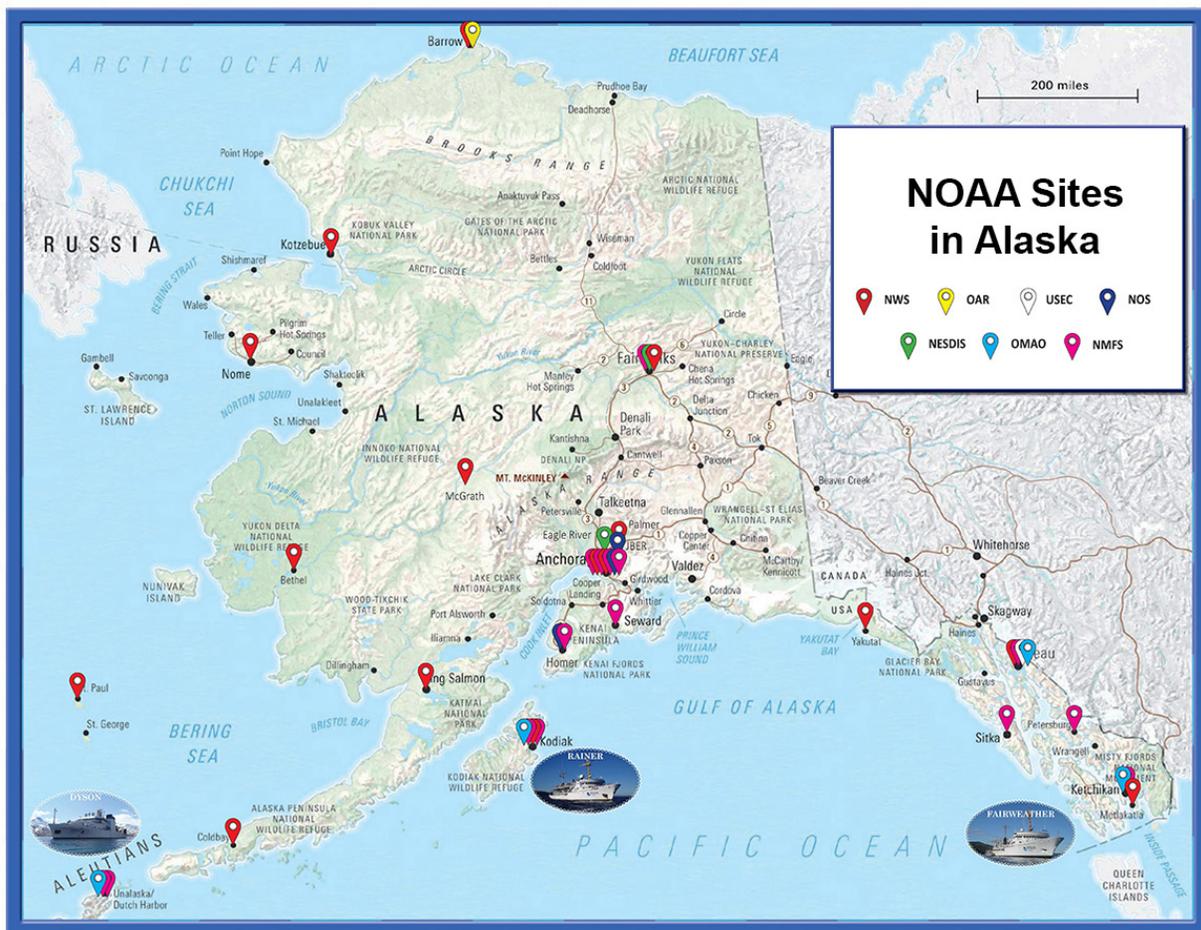
N-Wave Launches Enterprise VPN Service

N-Wave recently launched a new enterprise service that offers a scalable and highly available high-performance VPN solution to NOAA line office users. To deliver these capabilities, the Enterprise Remote Access VPN (ERAV) service terminates VPN connections at geographically separate locations: currently College Park, MD, and Denver, CO, with a third ERAV node planned for future deployment at Seattle, WA.

Each location offers two firewalls in active/standby configuration and is colocated with N-Wave Trusted Internet Connection (TIC) infrastructure. Users can connect to any one of the VPN service nodes and experience the same level of access to their internal network resources.

ERAV service benefits

N-Wave developed the ERAV service to replace the end-of-life legacy NOC VPN. N-Wave engineers pooled resources and leveraged existing equipment to create an enterprise solution that offers significant enhancements over the legacy VPN:

- Service is redundant locally and geographically with clusters in College Park, Denver and soon in Seattle
- Client use is spread across multiple clusters

- VPN groups can be sized based on customer needs
- Unique NAT address per VPN group
- Ability to use a customer's Active Directory for authorization, allowing customers to self-manage user membership in VPN groups
- Routing across N-Wave backbone directly to destination using ERAV virtual routing and forwarding (VRF)
- Unique URL for each group, allowing users to be members of multiple groups
- Access rules are configured per group

Migration timeline

N-Wave is working with existing customers to migrate from the legacy VPN solution to the ERAV solution by the end of the 2019 calendar year. The project will involve approximately 70 VPN groups, encompassing more than 6,000 users across 11 NOAA line and staff offices.

ERAV service for new customers

N-Wave customers who are interested in the ERAV service can submit a new service request. The service inquiry form is available at: https://sn-tools.grnoc.iu.edu/nwave-service-inquiry-request/
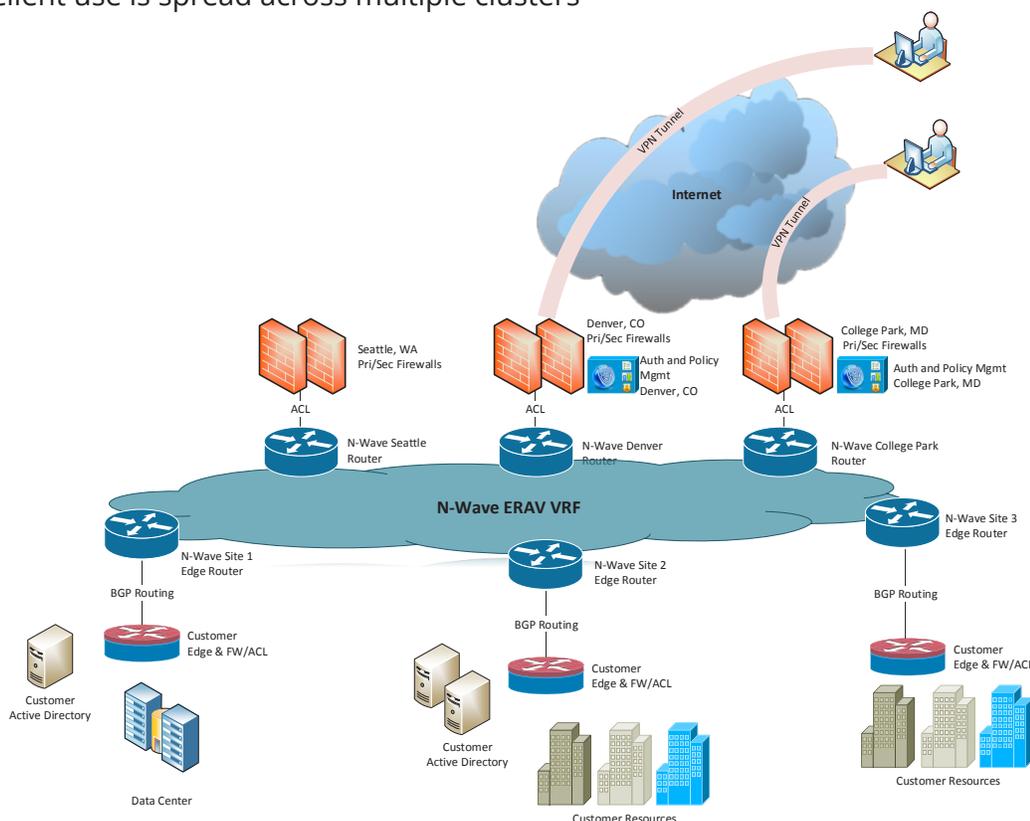
This high-level ERAV design diagram includes the current ERAV sites at College Park and Denver, along with the future site at Seattle.

NOAA Information Systems Can Now Inherit Security Safeguards for N-Wave Services

Security protections have always been built into N-Wave services. As an added value, N-Wave now also offers security controls for inheritance to its NOAA customers.

The Federal Information Security Modernization Act (FISMA) of 2014 requires federal information systems to establish strategies for implementing required security controls within their system boundaries. When common service providers like N-Wave build controls into their services and then officially offer those controls for inheritance, customers can save time and expenses associated with establishing and documenting those safeguards on their own.

The security controls listed in the table below are now available for inheritance. These add new value to N-Wave's Transport, Trusted Internet Connection Access Provider (TICAP), Enterprise Remote Access VPN (ERAV) and Enterprise Wireless services.

More details about each control is available through the NOAA Cyber Security Assessment and Management (CSAM) system. Questions about how to select these controls for inheritance can be directed to the NOAA CSAM support team (csam@noaa.gov), and questions about N-Wave's implementation of these controls can be directed to the N-Wave NOC (nwave-noc@noaa.gov).

N-Wave Service	Security Control	Description
Transport	Information Flow Enforcement AC-4	Hybrid inheritance for NOAA systems that have N-Wave provided Transport services, as N-Wave enforces information flow between N-Wave managed devices only. The inheriting system is responsible for AC-4 within its own boundary.
Transport	Telecommunications Services CP-8 (1) (2) (3) (4)	Full inheritance for systems that have redundant connections via N-Wave's Transport service.
Internet / Trusted Internet Connection Access Provider (TICAP)	Boundary Protection SC-7 (3) (4) (8) (21)	Full inheritance for systems that use N-Wave provided Internet / TICAP services.
Enterprise Remote Access VPN (ERAV)	Remote Access AC-17 (1) (2) (3)	Full inheritance for systems that use ERAV.
Enterprise Remote Access VPN (ERAV)	Prevent Split Tunneling For Remote Devices SC-7(7)	Full inheritance for systems that use ERAV.
Enterprise Wireless	Wireless Access AC-18 (1) (4) (5)	Full inheritance for systems that use the Enterprise Wireless service.

Update on IPv6

Building on previous initiatives and the federal government's commitment to IPv6, the Office of Management and Budget (OMB) and the Federal CIO Council are working to release new federal IPv6 requirements based on the current technology and global IP utilization.

OMB is anticipated to release a memo on the updated IPv6 mandate by early 2020. The expectations of the revised mandate are:
- Agencies will need to fully deploy IPv6-only across all back-end systems and clients.
- Public-facing application services and clients will run IPv6 while supporting the legacy IPv4 during a transition period.
- At the end of the transition period, federal networks are expected to be IPv6-only. Dual stack (i.e., supporting both IPv4 and IPv6) will be eliminated to simplify network operations and maintenance.

DOD is paving the way

The Department of Defense and its Defense Research and Engineering Network (DREN) have been pioneers in deploying IPv6. DREN engineers have worked extensively on testing and vetting network vendors' IPv6 features and capabilities. As a result of their efforts, the current version of DREN is 100% operated by software using IPv6.

Looking to the DOD for insight on successful IPv6 deployment, NOAA recently invited Ron Broersma, DREN's chief engineer, to present at two networking meetings. Broersma presented on navigating the path to IPv6 at the Alaska Federal Agencies Networking meeting in May and at the N-Wave Stakeholders and Science Engagement Summit in July. Lessons learned by the DOD may well play a key role in NOAA's plans for meeting new federal IPv6 requirements.
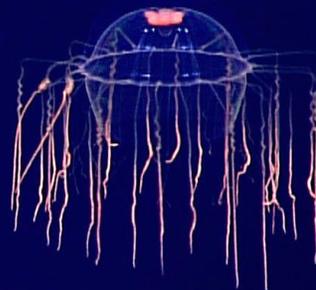
Credit: NOAA Okeanos Explorer Program

Network Changes and New Participants (April 1 - September 30, 2019)

NESDIS Admin LAN extended to Wallops Island, VA, and Fairbanks, AK

N-Wave extended the NESDIS Admin LAN private virtual routing and forwarding (VRF) and Trusted Internet Connection VRF to both the Wallops and Fairbanks Command and Data Acquisition Stations.

NOAA JASON Ground System (NJGS) Refresh Project – Suitland, MD, Wallops Island, VA, and Fairbanks, AK

N-Wave extended a new NJGS private VRF to Suitland, Wallops Island and Fairbanks for the new ground system refresh project. This is in preparation for the Joint Altimetry Satellite Oceanography Network - 3 (JASON-3) satellite, as the JASON-2 ground system is being decommissioned.

Environmental Satellite Processing Center (ESPC) at the NOAA Center for Weather and Climate Prediction (NCWCP) – College Park, MD

N-Wave provisioned ESPC with 2x10 gbps interfaces to tie into its existing Layer 2 Virtual Private LAN Service (VPLS) WAN instance at NCWCP in College Park. These new interfaces replace the legacy point-to-point ESPC passive optical network circuit, which was a 10 gbps circuit lit over dark fiber between the NOAA Satellite Operations Facility in Suitland and NCWCP.

NOAA Center for Weather and Climate Prediction (NCWCP) – College Park, MD

N-Wave completed the installation of 100 gbps network services into NCWCP in College Park. This connectivity will support the National Weather Service's mission of providing weather, water and climate data, forecasts and warnings for the protection of life and property and the enhancement of the national economy.

National Weather Service (NWS) Eastern Region Headquarters – Bohemia, NY

N-Wave completed an upgrade to increase the bandwidth from 1 to 10 gbps on one of the circuits to the NWS Eastern Region Headquarters in Bohemia.

Department of Commerce (DOC) Herbert C. Hoover Building (HCHB) – Washington, D.C.

N-Wave recently expanded to deliver services to the DOC headquarters at the Herbert C. Hoover Building in Washington, D.C. N-Wave will provide internet and Trusted Internet Connection services, along with NOAA-to-DOC connectivity at HCHB. It will also be the transport provider for the DOC's connectivity to the Microsoft Azure cloud service where DOC shared applications and web services are provided.


Credit: NOAA/OER

N-Wave Network Performance Metrics

## Network Traffic (December 2011 - September 2019)
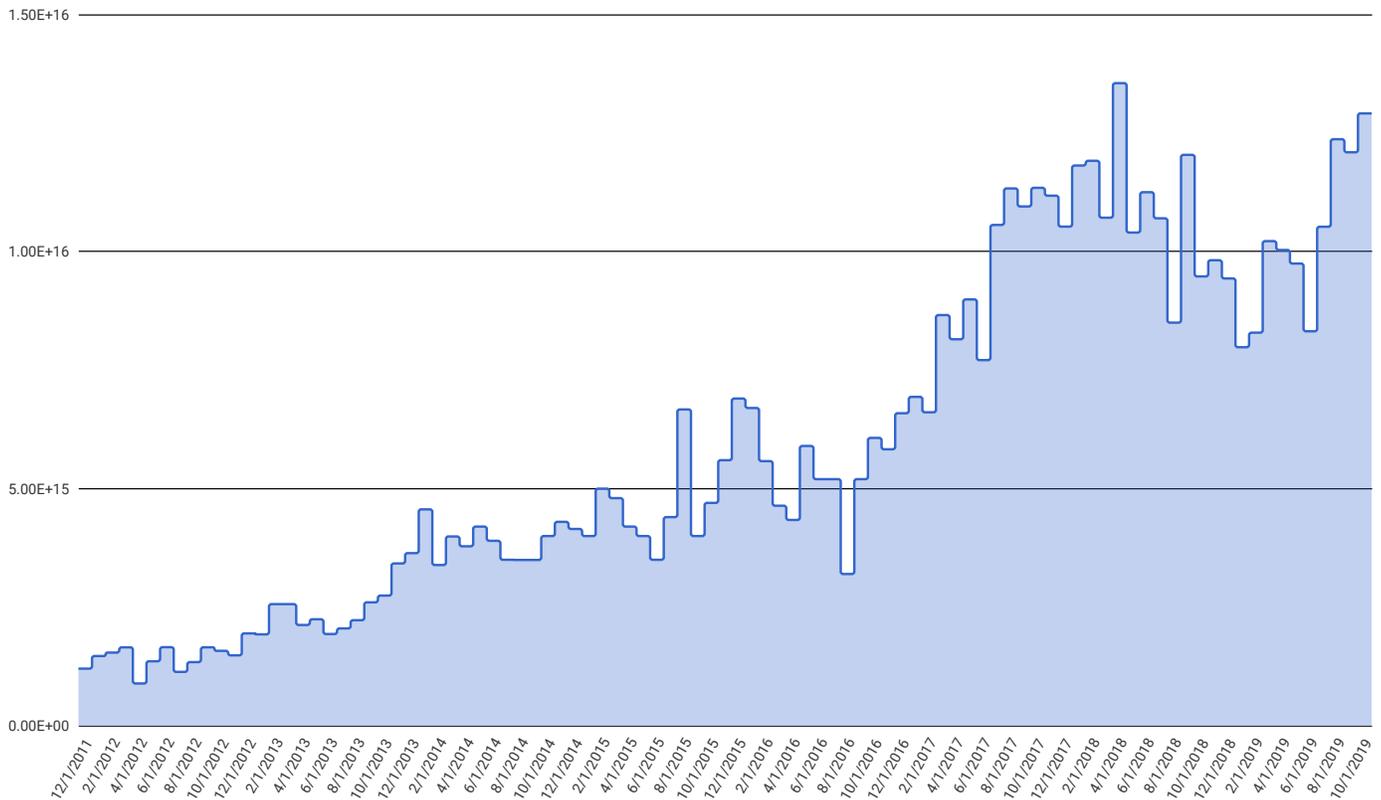
Network Operations Center
Metrics and Updates

The N-Wave Network Operations Center (NOC) provides support 24 hours a day, 365 days a year. Support metrics gathered from April through September 2019 indicate that the N-Wave NOC opened 17,764 tickets. That number encompasses all incidents, service requests, change and maintenance events, and customer communication records, such as individual phone calls and incoming and outgoing email correspondence of the NOC. Service requests (25%) and communication records (51%) make up the bulk of those tickets, while incidents account for only 4% of tickets.

Incidents by Service

Other
2.3%
Enterprise Services
16.6%

Silver Spring
(Legacy Services)
32.7%

16

117

230

340
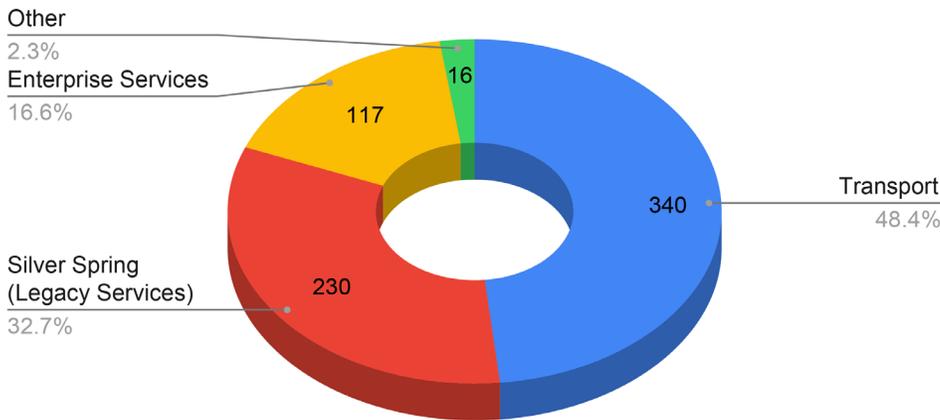
Transport
48.4%

This shows the high-level breakdown of incidents by service, namely Transport, Enterprise Services and Silver Spring legacy services. As Silver Spring legacy services continue to migrate into N-Wave's Enterprise Services portfolio, the NOC expects the number of Silver Spring incidents will decrease while the portion of Enterprise Services incidents will grow.

Transport Incidents by Category

Security
0.6%
Customer
3.0%
Other
6.5%
Power
11.9%

Hardware
12.2%

Circuit
14.6%

Human Error
0.3%

Investigating
0.3%

Software
0.3%

Undetermined
35.1%

Unannounced
Maintenance
15.2%

10

22

40

41

49

51

118
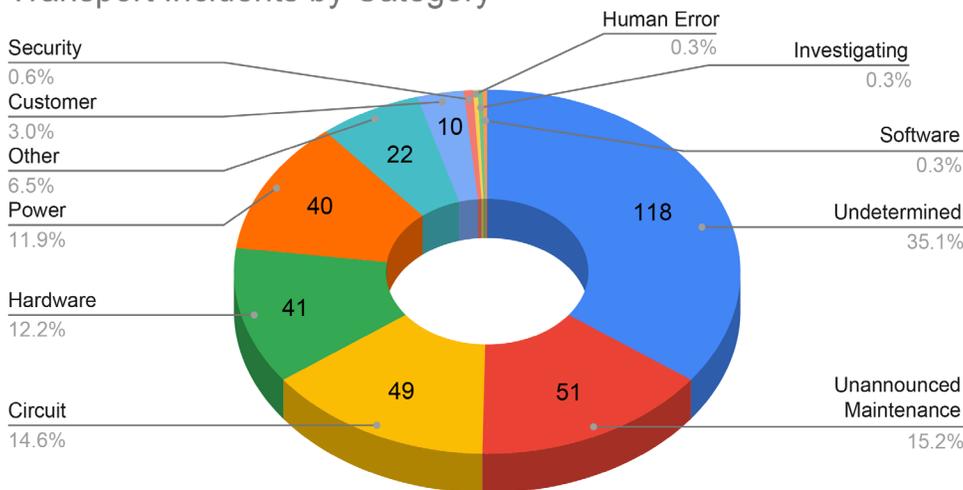
This is a high level breakdown of Transport incidents. Undetermined incidents, which typically account for a large portion of Transport incidents, mostly comprise very brief observed outages for which a vendor is not able to determine the cause. Unannounced maintenances are usually events where customers or providers do not announce the maintenance to N-Wave. As a result, the NOC is unable to notify the community and instead has to treat the event as an incident separate from standard maintenance events. For circuit incidents, the N-Wave NOC tracks additional granular data regarding the cause of the outage, including fiber damage, bumped fiber, vandalism or cut fiber.

Enterprise Services Incidents by Category

ERAV
2.6%

Managed LAN
42.7%

3

50

64
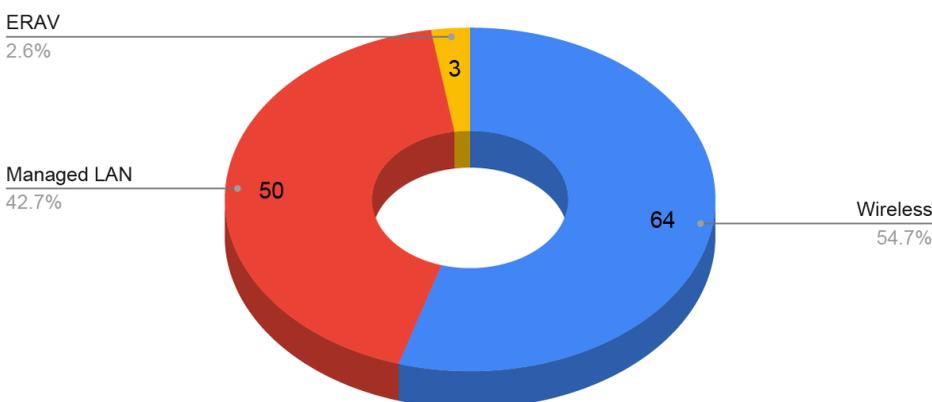
Wireless
54.7%

This represents 117 incidents related to N-Wave Enterprise Services. NOAA Enterprise Wireless and Managed Local Area Networks (LAN) are the most widely deployed services, accounting for more than 97% of Enterprise Services incidents. Since the recent launch of the Enterprise Remote Access VPN (ERAV) service, few incidents have been reported. N-Wave anticipates ERAV will have a larger portion of the overall incidents as adoption and use of the service increases.

Active Incidents
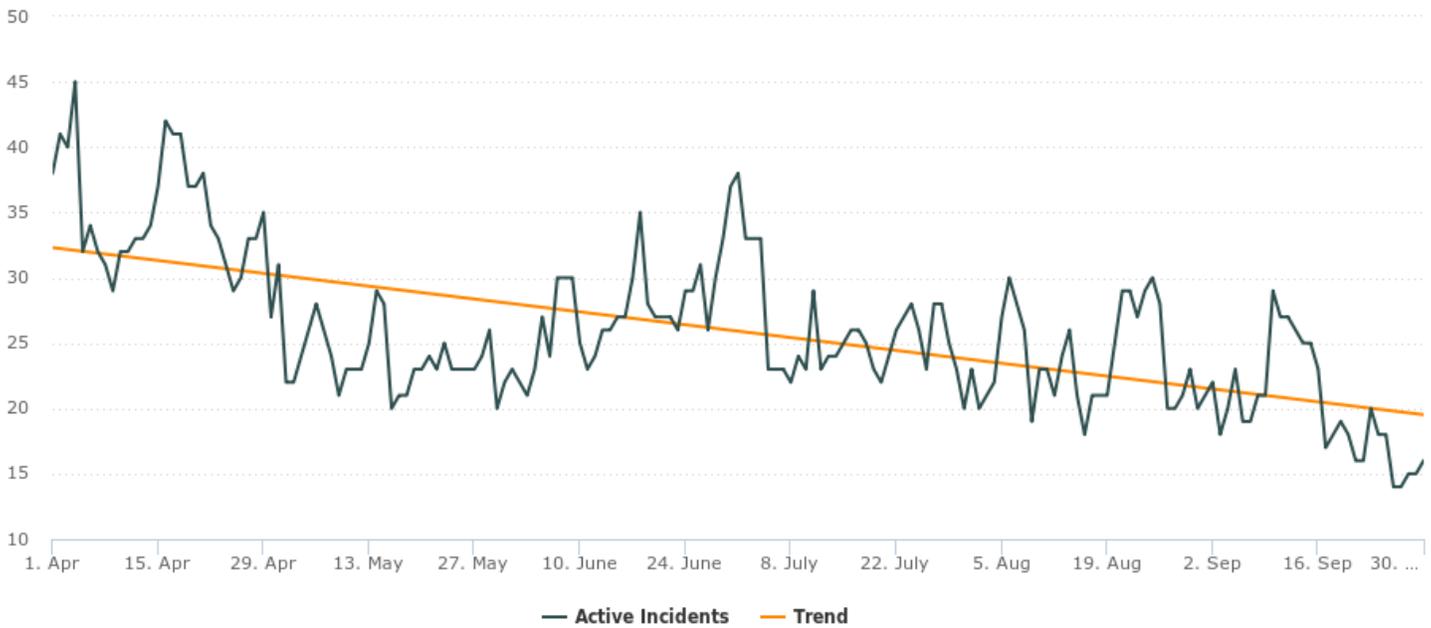
Trend data show a steady decline in incidents as N-Wave's network and services become more and more stable.

Active Requests
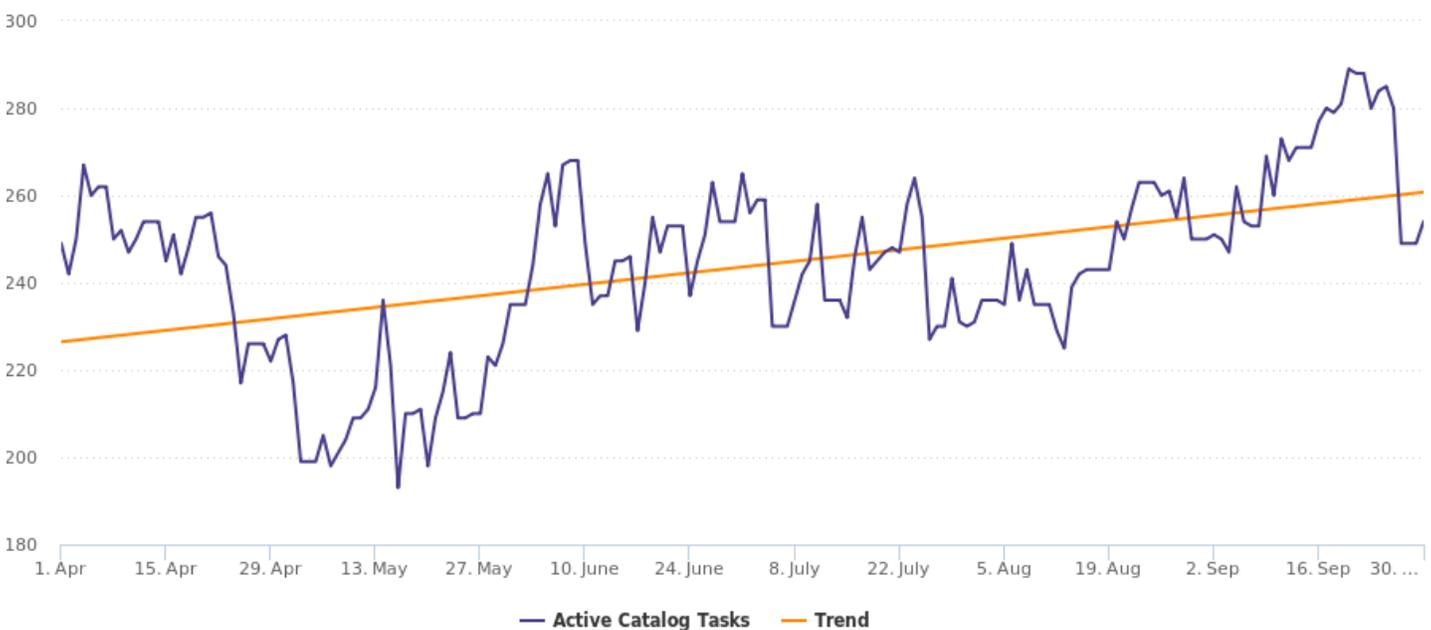
The trend line indicates the overall rate of growth in requests as N-Wave expands its service catalog and delivers services to new sites and customers.

N-Wave Welcomes New Staff

Alex Hsia has joined N-Wave as the technology development and innovation manager. In this role, Alex will explore and test new network technologies, practices and services to enhance future versions of N-Wave and further enable NOAA's mission. He will also provide guidance for the transfer of technology from a test/prototype phase to operational development within N-Wave. Alex is based in Boulder, CO, and he transitioned to N-Wave in October 2019. He has served as a federal employee with NOAA since 1998, most recently as the lead network engineer for the NOAA Boulder Network Operations Center. He has a bachelor's degree in mechanical engineering from Cornell University and a master's degree in aeronautics and astronautics from Stanford University.

Chris Konger has been hired as N-Wave's cloud network engineer. He is responsible for designing and deploying cloud connectivity for N-Wave customers, working with public clouds and cloud brokers. He also assists with troubleshooting cloud reachability and performance issues. Chris joined N-Wave in September 2019 and is based in Boulder. He has a wide range of networking experience, working with research and education institutions, cloud and internet service providers, and migrations associated with corporate mergers and acquisitions. Most recently, he worked for a publishing and advertising technology company based in Boulder. Chris has a bachelor's degree with a double major in biomedical and electrical engineering from Duke University and a master's degree in electrical engineering from the University of Florida.

Adam Nemethy has transitioned to the role of N-Wave federal network services team manager, after serving as a network engineer with N-Wave since March 2018. In the new role, he is responsible for managing all N-Wave campus services, including Enterprise Wireless, Enterprise Remote Access VPN (ERAV), Managed LAN and Campus Core network services. Adam is currently based out of Jacksonville, NC, but will relocate to Silver Spring, MD, in fall 2020. He has a bachelor's degree from the University of Phoenix in information technology and served in the Marine Corps for over 12 years, stationed in Japan, Maryland and North Carolina and deployed to Iraq and Afghanistan. His duties included serving as a local area network manager while deployed to Iraq and as an IT manager overseeing the help desk, LAN and server teams while deployed to Afghanistan.

Andrew Prince has been hired as a project manager for N-Wave. His current focus includes projects to migrate legacy VPN customers to N-Wave's Enterprise Remote Access VPN service and deploy Enterprise Wireless throughout remaining spaces at the NOAA Silver Spring campus in Maryland. Andrew joined N-Wave in April 2019 and is based in Indianapolis, IN. Prior to that, he served as a program manager for a network management services company. He has a bachelor's degree in information systems from Ball State University.

N-Wave Participants

Through a shared national network infrastructure, N-Wave supports both operations and research for NOAA and other government agencies. N-Wave's reach extends across multiple Department of Commerce bureaus. Within NOAA, N-Wave serves all six Line Offices, Staff Offices and Corporate Services.

Department of Commerce

- Commerce Headquarters
- National Institute of Standards and Technology (NIST)
- National Oceanic and Atmospheric Administration (NOAA)
- National Telecommunications and Information Administration (NTIA)

NOAA

- National Environmental Satellite, Data and Information Service (NESDIS)
- National Marine Fisheries Service (NMFS)
- National Ocean Service (NOS)
- National Weather Service (NWS)
- Office of Marine and Aviation Operations (OMAO)
- Office of Oceanic and Atmospheric Research (OAR)
- Staff Offices
- Corporate Services

62 Facilities

128 Active circuits

99.99% Availability experienced by dual-connected customers

99.999% Availability for Trusted Internet Connection services

100% Availability on the N-Wave backbone network since 1/1/2011

Credit: NOAA/NMFS/PIFSC

The theme for this year's SC conference is "HPC is Now." Leading scientists, researchers and engineers from the HPC community, federal agency staff, and students and educators from around the world will convene at the Colorado Convention Center in downtown Denver. The conference kicks off on November 17, and the accompanying exhibits open the evening of November 18. Formerly called Supercomputing but now expanded to the "International Conference for High Performance Computing, Networking, Storage and Analysis," SC is jointly sponsored by ACM and IEEE.

Each year attendees discover a conference chock full with peer reviewed technical papers, research posters, tutorials and cutting-edge technology exhibits. Underlying all of this is SCinet, the world's most advanced and powerful network built each year from the ground up and operated for the week of the conference. To develop SCinet this year, 33 contributors donated a total of $80 million in hardware, software and services. The network is predicted to deliver up to 4.7 terabits per second of wide area capacity to the convention center for SC19.

Steven Squyres, principal scientist for the Mars Exploration Rover Project, will deliver the conference's keynote, "Exploring the Solar System with the Power of Technology." More details on this year's event can be found at: sc19.supercomputing.org.

Members of the N-Wave team attending SC19 include: Alex Hsia, Ann Keane, Paul Love, Amber Rasche and Robert Sears. Members of NOAA's High Performance Computing and Communications team will also be in attendance.