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NOAA N-Wave

N-Wave is NOAA's science network. N-Wave is built on partnerships and relationships among NOAA and the Academic and State research network communities, connecting researchers to the data and resources needed to advance environmental science.

Mission

N-Wave is committed to provide innovative networking capabilities with integrity, excellence, value, and flexibility, to enable NOAA's science and research through reliable high-performance networking.

Our Vision

A consolidated, agency-wide network resource that meets NOAA's research connectivity requirements and where appropriate, supplements NOAA's operational connectivity requirements.

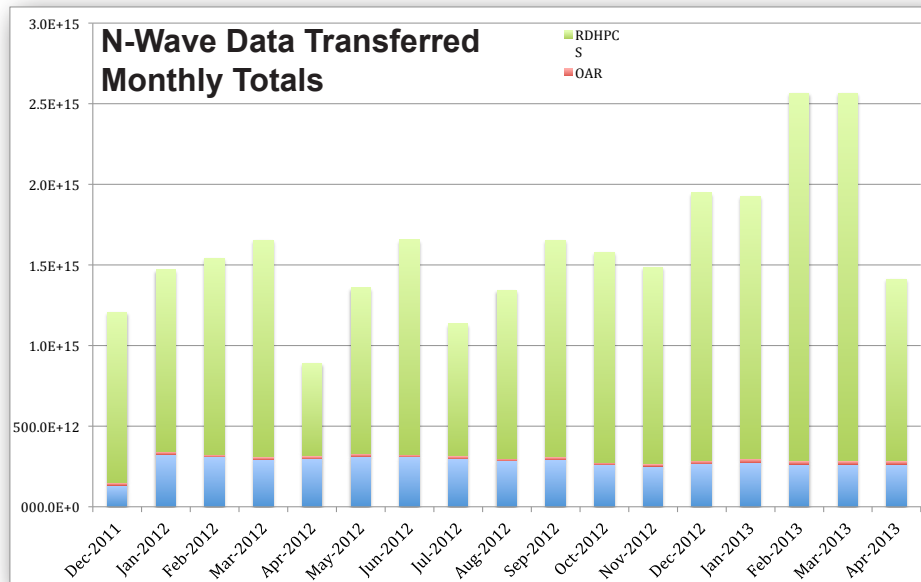
From the N-Wave Science Network Manager



As leader of the N-Wave team, I would like to thank all the individuals, in and outside of the National Oceanic and Atmospheric Administration (NOAA), that have worked to make this network a reality. Your dedication and commitment have made N-Wave a success. I am proud of what you have accomplished over the past few years and I am indeed privileged to work with all of you.

The N-Wave team has engineered and deployed an entirely new advanced communications capability for NOAA, a nationwide 10-Gigabit Multiprotocol Label Switching (MPLS) mesh that enables NOAA's scientific research and mission from the top of the atmosphere to the bottom of the ocean. N-Wave moves massive data loads from remote High-Performance Computing sites as well as increases collaboration and access to weather and climate data across the scientific community. Currently N-Wave moves up to 80 terabytes of data per day and our backbone operates at or above 99.999%.

As we move forward, communicating with our customers, stakeholders, and partners is key to our continued success. In the coming months we will be working on several ways to open communication channels. So here is our first "NOAA N-Wave News." We hope to make this newsletter a regular publication. We welcome your input, ideas, and other feedback as we move forth with our communications.



N-Wave Network and Performance Metrics

Numbers for N-Wave network performance in 2013 came in at high levels and continue on a rising trend.

The N-Wave network was built to support NOAA's science mission and its researchers. It consists of a private carrier class network backbone that provides high-speed, segregated, networking services to NOAA customer sites, programs, line offices, and research facilities. Above is a breakdown of statistics provided by the Quarter Quad Chart as of January 31, 2013:

- N-Wave backbone (core node) availability: 99.999%
- Total N-Wave Volume Transported: 1.2 - 1.9 Petabytes (PB) a month
- Traffic breakdown per program:
 - NOAA's Research & Development High Performance Computing Program (R&D HPCS), which includes three labs: the Geophysical Fluid Dynamics Laboratory (GFDL); National Center for Environmental Prediction (NCEP), Earth System Research Laboratory (ESRL): 80%
 - NOAA's Comprehensive Large Array-Data Stewardship System (CLASS): 18%
 - Oceanic and Atmospheric Research: 2%.

Global Research Network Operations Center (GlobalNOC)

Providing around-the-clock support to N-Wave

In the spring of 2010, the Global Research Network Operations Center at Indiana University (GlobalNOC) began supporting the NOAA's High-Performance Optical Research Network, N-Wave. As an operational provider for N-Wave, the GlobalNOC is specifically referred to as the N-Wave NOC.

The N-Wave NOC has various roles and is comprised of several groups and tiers of support:

GLOBAL Research Network Operations Center (GlobalNOC) Providing expert round-the-clock support to N-Wave. The N-Wave NOC Service Desk operates on a 24x7x365 basis out of redundant NOC control facilities in Indianapolis and Bloomington, IN providing Tier1 support for partners' networks. The N-Wave NOC Service Desk serves as the primary hub for proactive monitoring and communications among N-Wave engineers, network users, network owners, vendors, and related support organizations. The Service Desk also serves as the first stop and the final stop for all trouble tickets associated with the N-Wave network and services.

The N-Wave NOC Engineering organization is made up of three teams: the Network Engineering Team, the Network Planning Team, and the Tool Development and Systems Support Team:

- **The Network Engineering Team** provides N-Wave with Tier2 network engineering services on a 24x7 basis. This team has expertise in a broad range of networking technologies, most specifically including Dense Wave Division Multiplexing (DWDM), Ethernet, and IP on a broad range of vendor platforms. They also have familiarity and excellent contacts with other research and education networks, including Regional Optical Networks (RONs) and federal research and engineering networks such as Internet2, National LambdaRail (NLR), Mid-Atlantic Crossroads (MAX), and Energy Sciences Network (ESnet). A member of the GlobalNOC Network Planning Team (NPT) is assigned to N-Wave as a senior engineer who is focused on N-Wave to provide or assist with overall planning and design for the network. This expert will also serve as the Tier3+ operational escalation point for that network and liaison with N-Wave customers and N-Wave engineering team.
- **The Tool Development and Systems Support Team** develops and provides N-Wave with a suite of tools that is customized for N-Wave support operations. This team provides system administration and programming expertise for the tools used by the N-Wave NOC operations. This includes a dynamic network database, trouble ticket system, the login hosts, syslog servers, email servers, and internal and external web hosts. Finally, this team deploys and supports research and measurement platforms, including specialized tool development as needed.
- **The Project Management Team** provides project management tools and resources for the N-Wave project. The Project Manager will lead project meetings, document and prepare meeting minutes, agendas and provide a plan schedule for the N-Wave project. They track and follow up on key action items and tasks, providing oversight of the N-Wave GlobalNOC project team and help to ensure timelines and key dates are hit.

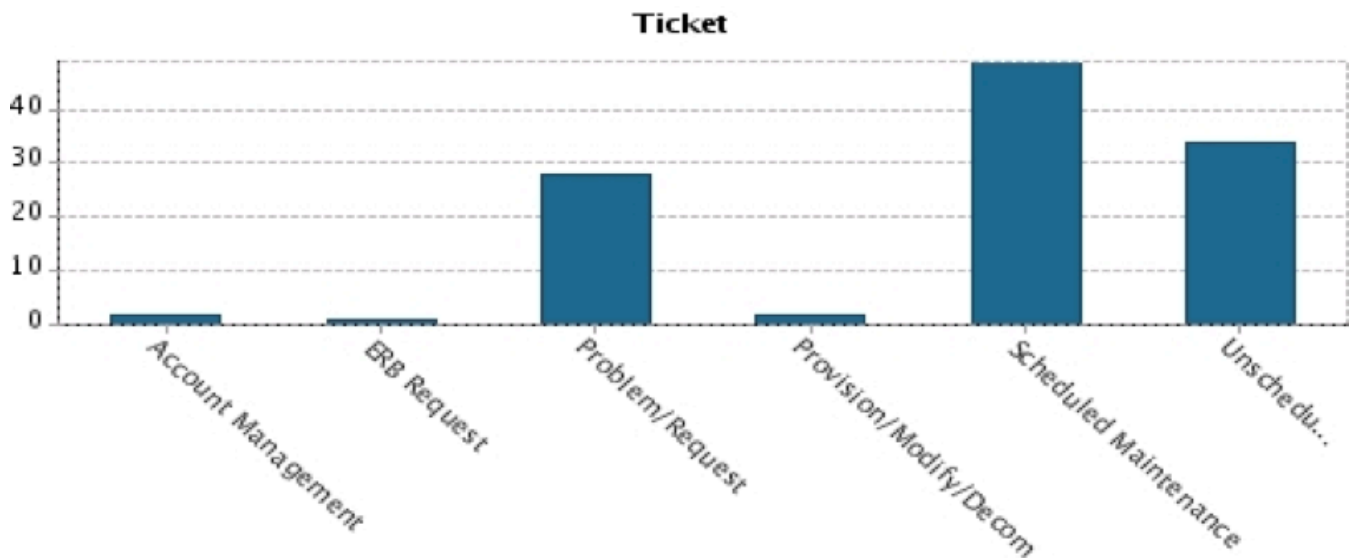


The GlobalNOC's organization's expertise and community participation is brought to bear on consulting on the design and the operations of the N-Wave Network. From the beginning of the partnership, the GlobalNOC has been working closely with NOAA staff to clearly understand the requirements of N-Wave, as well as leveraging its connection to the fabric of Regional Optical Networks (RONs) and national Research

and Education (R&E) network resource providers (Internet2 and NLR). The GlobalNOC's related expertise in high performance, nationwide networking serves the N-Wave project well, not only from the excellent customer-support perspective, but also as a well-known and respected member of the R&E community.

N-Wave NOC Tickets Report 1st Quarter 2013

This report contains data from 130 Tickets



This N-Wave tickets report tracks various ticket types that are used to support the N-Wave Network. In future issues, we will feature and discuss each of these ticket types and respective associated workflows. In this issue, we will briefly introduce the Account Management ticket type.

Account Management ticket type is used to track all N-Wave Account creation requests for access into the N-Wave systems. The N-Wave Account Creation Request Procedure is used to assure proper turn-up and tear-down of N-Wave system accounts at appropriate levels of access. The Account Creation Procedure starts with submitting a request to the N-Wave NOC (nwave-noc@noaa.gov) and an Account Management ticket is created to track the following items:

- Proper Background Investigations (BI) or National Agency Check with Inquiries (NACI) background checks,
- NOAA Security Awareness Training course completion,
- Completion and approval by Information Systems Security Officer (ISSO) of “N-Wave Information System Access Request” form,
- Actual account creation and 2-factor authentication token assignment by the N-Wave Systems Engineers,
- Annual review and completion of the NOAA Security Awareness Training course,
- Account modification and tear-down

N-Wave was envisioned and engineered to be a robust and high-availability network. N-Wave tracks outages and maintenances for each network event whether it affects service or not. The N-Wave Backbone is completely redundant and no single event affects traffic in the Backbone, however each is tracked and reported on. Most NOAA sites (N-Wave Participants) are multi-homed and are normally not affected by single outages/maintenances that are reflected in ticket numbers in this report. For instance, out of 35 Unscheduled Outage tickets on this report, only two events were service impacting and both were due to each N-Wave participant having a single connection into the N-Wave Backbone. NOAA-Fairmont site had a brief service impacting outage during this period, however, now that Fairmont is dual-homed with a new circuit that connects NOAA-Fairmont into the N-Wave Backbone in Chicago, no service impacting events have been observed. We encourage you to work closely with the N-Wave NOC or the N-Wave Project management to make sure you have best possible architectural design on your services that run across the N-Wave Network that meets your particular needs and expectations.

N-Wave Updates

Fairmont to Chicago Connection

N-Wave engineers worked closely with their partners to provide a second connection to Fairmont – this time from Chicago. What sounds like a somewhat simple task in connecting point A to point B is much more involved than what meets the eye.

Completed in mid-February, the connectivity path traverses several partners provided by Three Rivers Optical Exchange (3ROX) and Internet2. The Fairmont facility to Charleston, West Virginia path is extended via a contract with West Virginia Net (WVNET – West Virginia’s statewide R&E network) and local provider Lumos. In Charleston, West Virginia, the connection is made with OARnet (the Ohio Academic Resources Network), which takes the circuit to Cleveland, Ohio.

This entire Fairmont to Charleston to Cleveland path and partners, include WVnet, Lumos, and OARnet, and is made possible through the 3ROX contract. From Cleveland to Chicago, the connection is made possible under N-Wave’s Internet2 contract.

To meet the growing demands for higher resolution models, high-capacity data, and more computing power, the circuit provides improved site availability for all of NOAA’s activities that make use of the Fairmont location. The largest user of Fairmont, in terms of network requirements, is NOAA’s R&D HPCS program, which is heavily dependent on the quality of the network. N-Wave has been and continues to be successful in meeting and exceeding all R&D HPCS’ needs.

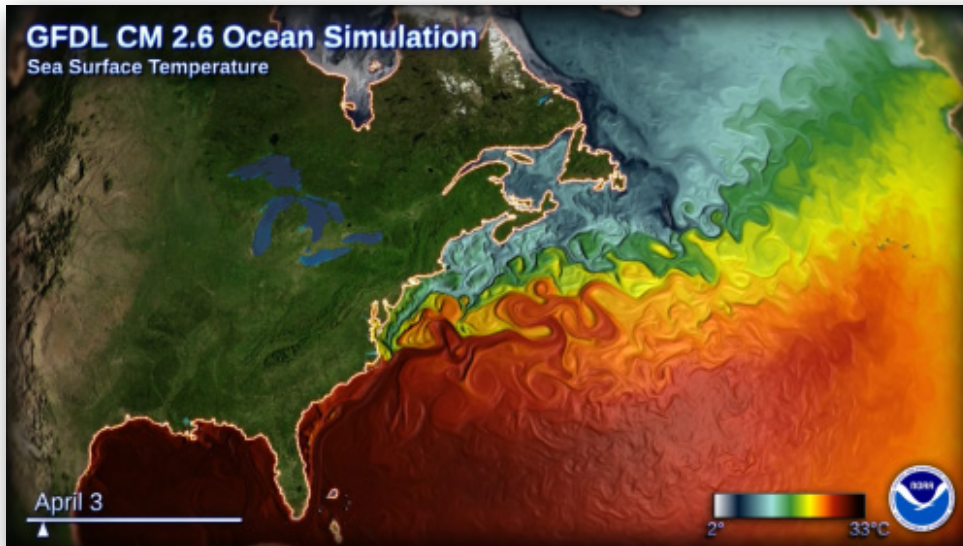
High-Performance Computing and Communications (HPCC)

N-Wave network supports NOAA’s data computing advances

In order to get better weather forecasts and climate predictions, you need better models.

To get better models, requires a whole lot of dependable data and a whole lot of computing power to deal with the data. A third crucial element to all that data is a powerful reliable network that connects the modeling researchers with their data and research centers. To make that possible, NOAA deployed the N-Wave Science Network, which supports NOAA’s Research and Development High Performance Computing Program (R&D HPCS). In turn, this program supports NOAA’s research in climate and weather modeling.

This program is comprised of computing resources supported by NOAA and Oak Ridge National Laboratory’s National Climate Computer Research Center, (NCRC). The NCRC hosts Gaea, a leadership class petascale system dedicated for NOAA’s science. In addition, NOAA has an HPC system at their new NOAA Environmental Security Computing Center (NESCC) in Fairmont, WV; a climate post-processing and archive solution in Princeton, NJ; and a system to support Hurricane Forecast Improvement Program (HFIP) in Boulder, CO. NOAA’s high-performance network, N-Wave, connects all of these sites to support data movement, and centralized scheduling and accounting of shared resources that are geographically separated from their user bases. NOAA is moving more than 80 TB of model data per day between NCRC, NESCC and NOAA’s R&D HPC user base located across three laboratories: the Geophysical Fluid Dynamics Laboratory (GFDL) in Princeton, NJ; the National Center for Environmental Prediction (NCEP) in Camp Springs, MD; and the Earth Systems Research Laboratory (ESRL) in Boulder, CO. The R&D HPCS program and NOAA’s N-Wave Science Network increase collaboration and access to weather and climate data among scientists and researchers nationwide. N-Wave is currently a 10-gigabit Ethernet wide-area network and has the ability to scale to a



To build prototype high-resolution models to study climate change, variability and predictions, we need increased computational resources. N-Wave is the transport for big data used in this type of modeling.

100-gigabit Ethernet as research demands increase and next-generation services are added to the network. N-Wave has already supported a single month transfer for just the R&D HPCS program of over one petabyte of data moved between the sites and has maintained 100% availability since the R&D HPCS program joined N-Wave in December 2010.

N-Wave has been and continues to be successful in meeting and exceeding all requirements. The Indiana University Global Research Network Operation Center's

(GlobalNOC) role in operating N-Wave has assured the R&D HPCS Program's ability to maintain access and have the highest quality path to move the vast quantities of scientific data between the computing resources and the analysis and archive resources. The expanded scientific capability of these computing resources, in combination with N-Wave, will ensure NOAA's leadership in weather and climate research in solving large complex challenges.

Reaching out from CONUS

Seattle to Hawaii and Alaska

Even before the N-Wave core node was "turned up" in Seattle, the project was exploring how to reach the NOAA offices in Hawaii and Alaska. Both present unique challenges, but both have two major points in common; being a long way from the continental US and only having network connections via submarine cables or satellite.

N-Wave has contracted with the University of Hawaii to use an OC-3 from Seattle to Hawaii that the university owns but no longer uses. From nodes at NOAA's new Inouye Research Center on Ford Island and at the university's Manoa (Honolulu) campus, all NOAA sites in the state are being connected via metroEthernet. With these two steps, traffic to and from the mainland can bridge the Pacific. Individual NOAA Line Offices are able to connect to N-Wave in Seattle, Silver Spring, and other locations to complete the connection.

Similarly N-Wave is working with the University of Alaska. Currently a proof-of-principal link is in place to their Fairbanks campus with testing underway. This effort engages staff from the university's telecommunication office, their Geographic Information Network of Alaska, NWS's Alaska Regional Office, and N-Wave engineers. As with the link to Hawaii, the Alaska traffic will flow through the Seattle core node.

NOAA Network Operations Centers and N-Wave Improving Computer Security

NOAA has four established Network Operations Centers (NOCs) located in Sand Point, WA near Seattle, Boulder, CO, and Ft Worth, TX. Efforts to coordinate these centers with a single overseeing group and implement the plans for NOAA's Trusted Internet Connections (TICs) is moving full steam ahead. NOAA is also exploring the possibility of establishing a community TICAP in Hawaii in collaboration with other federal agencies.

A presidential mandate that requires NOAA to route all external network traffic through an established TIC Access Provider (TICAP) by the end of FY13, or have plans and milestones in place for meeting this requirement, is the driving force behind this undertaking. NOAA has designated four TICAPs geographically distributed throughout the continental US: Silver Spring, Boulder, Sand Point, and Fort Worth.

The requirement for NOAA to route all external traffic via a designated TICAP by the end of FY13 is a huge undertaking; especially so for those NOAA sites not collocated with or near one of the four TICAPs. The N-Wave team has been leading the effort to design and engineer the TICAP solution along with the needed management policies and procedures. Their work will aid NOAA sites in the overall TIC process designating N-Wave as the program responsible for the TIC networking initiative across NOAA.

The end result will be a unified treatment of NOAA's "public face" by a TIC—be it for a website, e-mail, or data exchange.

Working closely with the Silver Spring NOC team to ensure unity, the N-Wave team will manage the network responsibilities surrounding NOAA's TICAPs.

The Newest Piece of N-Wave's Backbone

Culminating in nearly two years of work, the newest circuit in N-Wave's backbone came on-line the week of April 15. The fifth and most recent core node for N-Wave is located in Seattle. Until now it has been connected by just a single 10-GE wave to the N-Wave core node in Denver. As a result of a partnership with the Northern Tier Network Consortium, N-Wave now has a backup connection between the core nodes in Seattle and Chicago. This backup path is over the Northern Tier's layer 2 service, Northern Wave, and removes a potential single point of failure. This in turn permits all sites connected to Seattle to remain available in the event of any issues with the primary Seattle<->Denver circuit.

The Northern Tier Network Consortium is an imaginative effort by schools across the northern border that brought high-speed R&E connectivity to the area. Member schools and organizations are from Alaska, Colorado, Idaho, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, South Dakota, Washington, Wisconsin, and Wyoming.



N-Wave Conducting Network Assessments

N-Wave recently conducted a network assessment for the National Environmental Satellite, Data, and Information Service (NESDIS). Another is underway for the National Ocean Service (NOS). The completed assessment for NESDIS has recently been subjected to a peer review by a team from outside NOAA.

Network assessments such as these are instrumental in identifying improvements in network performance, bandwidth, resiliency, and identifying where different networking technologies or services can provide significant cost savings. These recommendations also facilitate the support of NOAA's implementation of the OMB-directed Trusted Internet Connections.

The recent NESDIS-wide study completed in December resulted in the decision for the development of the DC DWDM network. With this, the GOES-R program and NESDIS in general can achieve significant savings for their Wide-Area Network (WAN) costs. Through the recommendation and implementation of these assessments, N-Wave is enabling NESDIS, NOS, and NOAA to establish enterprise-level network services which are reliable, secure, and cost effective.

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NOAA SCIENCE NETWORK

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