



Interview With the N-Wave Director

In September, N-Wave’s Engagement and Outreach team interviewed Robert Sears, one of the founders and current Director of N-Wave, at the N-Wave Alaska Region Technology Interchange Consortium (ARTIC) Annual Meeting in Anchorage, Alaska. In this exclusive interview, Robert shares his thoughts on ARTIC, the past year and the path forward for N-Wave. *(Content has been edited slightly, but what you read is the raw dialogue).*

“Hi Rob, it’s such an honor to be sitting down talking to you today.”

“Well thank you. It’s nice to talk to you. It’s good to see you again in person. Well in person, not avatars on our screen. So that’s good.”

“Exactly. We’re about to gather here in Alaska. Tell us about the meeting.”

“Yes. Our annual gathering will be our second gathering here. It’ll be under the new banner of the Alaska Region Technology Interchange Consortium - not the proper spelling of “ARCTIC” but “ARTIC”. It actually takes some history and cues from colleagues that have done this in Hawaii - called the Hawaiian Intranet Consortium (HIC) - many, many years ago. I think maybe 20 years ago. Same kind of concept - folks coming together to really work on a region without great connectivity and/or look at options for collaboration and where different entities could come together.

I think in this case we’re broadening the participation to include the state, tribal, federal and university representatives, because of NOAA and N-Wave’s history within these communities. It also includes lots of involvement with the science, research and education community. We’re opening that up at least from a collaboration perspective to get more folks involved, more folks that actually use local resources, internet broadband, co-location, all that type of stuff. The goal is to get as many folks as possible who are consumers of technology in the state to share ideas and collaborate.”



Robert Sears and Lauren Hines Discuss N-Wave Projects

Continued on p.4

About N-Wave

N-Wave delivers stable, secure, high-speed network services to enable the vast missions of its stakeholder community within the federal government. Our national network infrastructure extends across the contiguous U.S., Alaska and Hawaii — reaching remote field sites, major campuses, data centers and supercomputing facilities. Combined with our scalable cloud solutions, robust catalog of enterprise managed services and advanced network operations.

N-Wave supports all stakeholder missions with integrity, transparency and flexibility and employs a unique partnership approach to provide the best customer experience. The N-Wave Program Office operates under the Office of the Chief Information Officer within the National Oceanic and Atmospheric Administration.

N-Wave is NOAA’s network service provider and has expanded to serve other federal government agencies.

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N-Wave Cloud Services

(April 1 - September 30, 2023)

Infrastructure

- **Provisioned additional Internet2 Cloud Connect (I2CC) Service Through Chicago, Illinois, for Amazon Web Service (AWS)** - N-Wave cloud engineers recently worked with Internet2 engineers to provision a new 10 Gbps I2CC connection to provide additional cloud on-ramp capacity for AWS through the Chicago region.
- **Cloud Broker Bandwidth Utilization Doubles** - Over the last six months, utilization of the N-Wave cloud broker (provided in partnership with Internet2) has seen bandwidth utilization double. This significant growth in bandwidth utilization is a direct result of the expansion of networks and cloud environments receiving transport service from the 140+ cloud broker connections.
- **Continued Adoption of the N-Wave Advanced Layer 2 Service (AL2S) through Chicago, Illinois** - The 100 Gbps N-Wave AL2S infrastructure in Chicago, has continued to provide tremendous dividends to N-Wave cloud operations. Since its adoption in FY23Q1, 26 cloud broker connections have been provisioned through Chicago, totaling 42G of cloud circuit capacity. Multiple cloud environments have migrated secondary, east-region cloud paths from Denver, Colorado, to Chicago, which has significantly reduced response times for secondary connections.
- **Customer Expansion in N-Wave Microsoft Azure Landing Zone Environments** - The National Weather Service (NWS) Aviation Weather Center (AWC) Azure cloud environment was successfully migrated into the N-Wave Azure Landing Zone commercial environment for consolidated cloud utility and management efficiencies. Five other cloud tenants are currently in the design and planning phases for upcoming migrations to N-Wave Azure Landing Zones in both the government and commercial environments.

NOAA Line Offices

Office of the Chief Information Officer (OCIO)

- **Capacity Upgrade on OCIO Web Operations Center (WOC) AWS Direct Connect Cloud Connections** - As part of the cloud broker upgrade from the legacy Megaport architecture to the next-generation Internet2 architecture, the AWS Direct Connect cloud connections for the OCIO WOC were upgraded from 1 to 2 Gbps. The existing connections were experiencing periods of near capacity saturation. With the increase in connection capacity, the OCIO WOC cloud environment now has sufficient circuit capacity to support additional cloud initiatives.

National Environmental Satellite, Data, and Information Service (NESDIS)

- **Expansion of Cloud Connections for Multiple NESDIS Environments** - N-Wave and NESDIS cloud engineers collaborated on multiple efforts to expand and relocate cloud connections for the NCS (NESDIS Cloud System)/NCCF (NESDIS Common Cloud Framework) production, NCCF Development and GOES-R GeoCloud environments.

National Marine Fisheries Service (NMFS)

- **Deployment of NMFS Science & Technology (S&T) SaaS (System as a Service) Environment** - In coordination with engineers from the OCIO WOC and NMFS, N-Wave cloud engineers successfully deployed redundant direct connections into the AWS WOC environment in direct support of the Fisheries' Science & Technology SaaS environment.

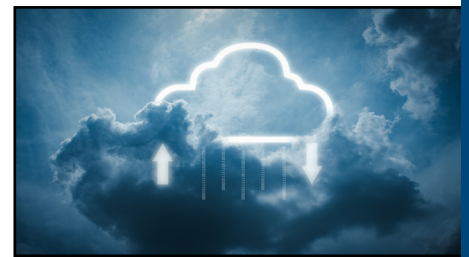
N-Wave Cloud Services (Cont.)

National Ocean Service (NOS)

- **Redesign of Cloud Transport Topology for NOS CO-OPS (Center for Operational Oceanographic Products and Services)** - To eliminate the dependency on shared legacy VPN tunnels for secondary cloud connectivity, N-Wave cloud engineers worked with staff from NOS CO-OPS to redesign the topology for cloud connectivity and provision dedicated cloud broker connections to each environment. This redesign has improved availability and performance for the secondary connections into both AWS cloud regions.

National Weather Service (NWS)

- **NWS Office of Dissemination/Integrated Dissemination Program (DIS/IDP) Multi-Region, High-Capacity Cloud Circuit Deployment** - N-Wave cloud and transport engineers worked directly with the NWS DIS/IDP staff to enhance one of the most diverse and sophisticated N-Wave-connected cloud environments to date. This effort included a migration of the 10 Gbps cloud circuit for AWS us-east1 to native cloud on-ramp capability through the N-Wave aggregation site in the Ashburn, Virginia, Equinix Datacenter.
- **Cloud Capacity Upgrade and Region Expansion for NWS MDL (Meteorological Development Lab)** - Engineers from the N-Wave cloud unit and the NWS MDL program collaborated to expand the circuit capacity of the cloud connections for the MDL AWS cloud environment from 1 to 2 Gbps. In addition to the expanded circuit capacity, connectivity for the MDL cloud environment was extended into AWS us-east-2 (previously only in us-east-1).
- **AWS Direct Connect Circuits Provisioned for NWS Advanced Weather Interactive Processing System/Incident Meteorologists System) (AWIPS/IMETS)** - N-Wave cloud engineers worked directly with staff from NWS AWIPS/IMETS to deploy redundant Direct Connect cloud circuits into the AWIPS/IMETS AWS environment to support the transition of operations to the cloud.



Department of Commerce (DOC) Bureaus and Offices

DOC Herbert C. Hoover Building Network

- **Capacity Upgrade on DOC Azure ExpressRoute Cloud Connections** - As part of the cloud broker upgrade from the legacy Megaport architecture to the next-generation Internet2 architecture, the Azure ExpressRoute cloud connections for DOC were upgraded from 200 to 500 Mbps. The existing connections for both private and public communication were experiencing periods of near capacity saturation. With the increase in connection capacity, the DOC Azure cloud environment now has sufficient circuit capacity to focus towards new cloud initiatives.

National Institute of Standards and Technology (NIST)

- **AWS Cloud Connection Capacity Expansion for NIST** - N-Wave cloud engineers continued to broaden the cloud communication infrastructure for NIST in AWS. NIST cloud environments in AWS east and west regions, as well as government and commercial cloud partitions, received circuit capacity upgrades from 17 to 23 Gbps to support the growing number of networks and environments in the NIST cloud ecosystem.

United States Patent and Trade Office (USPTO)

- **Multiple Cloud Connectivity Expansions for USPTO** - Collaboration between N-Wave and USPTO cloud engineers continued with the capacity increase of multiple USPTO cloud connections. Circuit capacity for USPTO cloud connections increased from 12 to 17 Gbps. In addition to the expansion in circuit capacity, the secondary cloud connections were migrated from Denver, Colorado, to Chicago, Illinois, for improved response times on resilient cloud connection paths.

Interview With the N-Wave Director (Cont.)



**Robert Sears,
N-Wave Director**

“If you had to pick one highlight you’re looking forward to or something you’re going to come out of the next few days with, what are you excited about?”

“...Outside of what I’m presenting on? No ... just kidding! Actually I mean there’s a lot of great content with some of the commercial projects we have coming, including the Low Earth Orbit (LEO) satellite folks. That’s always really good to see because in this region, satellite internet is actually one of the major players and components in getting into the hard to reach places, so that would really be good to see where they’re going. I look forward to hearing what the National Telecommunications and Information Administration (NTIA) has to say about the Broadband, Equity, Access and Deployment (BEAD) program. It’s getting money into the state of Alaska. Also, hearing from the state broadband office. And then we have a concept we’re trying to really push here with a peering

exchange and actually having folks start to exchange communication within the state and not only in Seattle, Washington. And it’s a big thing. There is no internet peering exchange in this state. However, we’re part of a federal agency in the federal building not too far from here. NOAA’s located there and the U.S. Geological Survey (USGS) is also there. We communicate all the way down in Seattle and then come back up. There’s an opportunity to do some local peering and build infrastructure and I think the state could be on board and some of our partners like Internet2. It’s going to be an evolving conversation. There could be some monumental achievements coming out of this meeting, but at the very least, some seeds are definitely going to get planted and we should be able to see possible growth and maybe new infrastructure here.”

“So you talked a little bit about where N-Wave came from and we’ll talk in a minute about what you see on the horizon for the future. What do you think are some of the biggest achievements of the program? What are the milestones in the latest year for N-Wave?”

“The Under Secretary of Commerce for Oceans and Atmosphere and the 11th NOAA Administrator, Dr Richard Spinrad, and the Assistant Secretary of Commerce for Environmental Observation and Prediction, Dr Michael C. Morgan visited the N-Wave Boulder Campus in June and had about 25 minutes to meet with us and learn more about N-Wave. I know they’re aware of it, but it was really good to go into a few more details. We touched a lot on the program itself and how we fully self-fund the entity or program through Service Level Agreements (SLA). And then really dove into a lot of the projects we were doing with the National Weather Service (NWS) and the National Environmental, Satellite, Data and Information Service (NESDIS) on the operational front. It was great to have the time with them and then also join the lab director’s, Dr Spinrad and Dr Morgan for dinner. So, it was a pretty good meeting all around.



Dr. Michael C. Morgan, Robert Sears and Dr. Richard Spinrad at the NOAA Campus in Boulder, Colorado

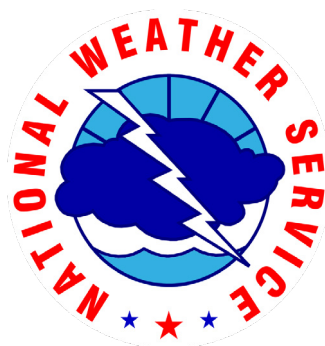
Interview with the N-Wave Director (Cont.)



The new [N-Wave website](#) has been a long time coming and it's very, very good. The new format of course, being on the NOAA standardized web infrastructure. The layout and the navigation are really great and there are links for stakeholders where they can see the service catalog and some of the readily available resources. I think it needed this

refresh for at least seven or eight years. It's always had a kind of a static presence and we didn't update it too much and there was some older information on there. This is a much needed facelift and I think it looks a lot more professional. It's timely as we continue to work outside of NOAA for customers. It's a great resource reflecting visually and operationally, about the kind of work we do. You know that first entrance, that web presence can say a lot about a program or a product, whatever it may be. And this puts a professional touch reflecting the quality of work N-Wave does by having a great visual entrance point for providing somebody a link to. And if they don't know about N-Wave, you can really get those details. I'm really happy it's come around and our Engagement and Outreach team pushed it through.

Our new partner, NJ Edge, is a big regional technology services provider and they have a great business model. The partnership there allows us to be a consumer and a tenant on their infrastructure and take advantage of their continuous capacity upgrades and modernization. We're basically going to them with our requirements, they're meeting them and we can buy 100G waves as needed to defined locations and not be so much, I guess in the weeds with it - it's a service we buy from them directly. They are a great N-Wave partner. They're like a lot of other regionals with multiple programs and users, such as universities. So they not only have a strong infrastructure and technical capability, but they have strong business backing, which is another thing we need to look at as we are optimizing and modernizing the N-Wave network. I would say it's a business and a technical decision.



And then I think the crowning achievement this year has been partnering with the National Weather Service (NWS) for network modernization of 30 sites to include two phases for their Weather and Climate Operational Supercomputing System (WCOSS). It's a huge undertaking helping to modernize and move all of the NWS centers - i.e. the National Tsunami Center, National Hurricane Center - moving those groups over to N-Wave transport along with the regional headquarters, like Eastern Region, Western Region and the NWS Headquarters. It's a big

undertaking and we're starting to migrate those sites with a deadline of turning most of them up by March 2024. We're also standing up service beyond NOAA and even inside of NOAA with the NWS."

Look forward to more interview dialogue from Rob and your Engagement & Outreach Team in the next issue of the N-Wave newsletter.

Security Updates & New Initiatives

Internet Protocol Address Management (IPAM) - Final Transition

For some time, N-Wave has been working to implement, enhance and transition its customers to a new IP Address Management (IPAM) tool - a custom web application developed by N-Wave's Network Operations Center (% GlobalNOC), which ties into operational network data to ensure a high degree of accuracy.

At long last, we are ready for the final stage of the transition which involves the sunsetting of the legacy IPAM database managed by NOAA's Cyber Security Division. As part of this final transition, we are asking all Federal Information System Management Act (FISMA) system stakeholders to log into the N-Wave IPAM web app and verify the contacts and netblocks listed for their FISMA system via: ipam.nwave.noaa.gov (NOAA authentication required).

Updates to contacts can be made directly in the Cyber Security Assessment and Management (CSAM) system (NOAA authentication required). Updates to netblocks can be made by submitting a ticket to the N-Wave IPAM team, either directly through the IPAM web app, or by email to nwave-noc@noaa.gov. The accuracy of the IPAM data is essential for timely and effective security incident response.



Network State Awareness

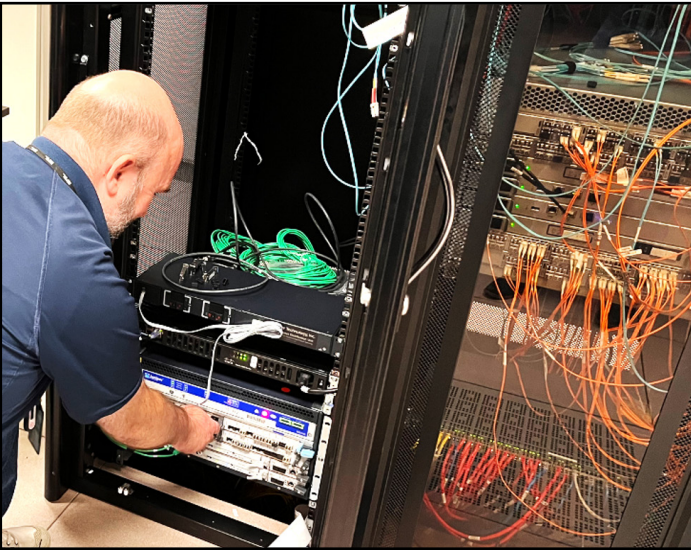
A network service provider such as N-Wave advertises a large number of routes for customer traffic through its upstream providers to the internet. Changes are happening constantly - new routes being advertised, old routes being withdrawn, routes changing temporarily due to network outages, etc. Keeping apprised of the state of upstream route advertisements on a large operational network is essential, but difficult.

N-Wave has recently developed tools which continuously monitor the state of upstream route advertisements and alerts when there are discrepancies between the observed and expected states of such advertisements. This results in a better awareness of the state of the network, enabling more proactive response to security incidents (e.g. Border Gateway Protocol (BGP) hijack attempts), misconfigurations, or unplanned/uncommunicated/unexpected changes. Ultimately, this enables N-Wave to better serve its customers by ensuring the network state is aligned with their expectations and mission needs.

N-Wave on the Campus Or in the Field



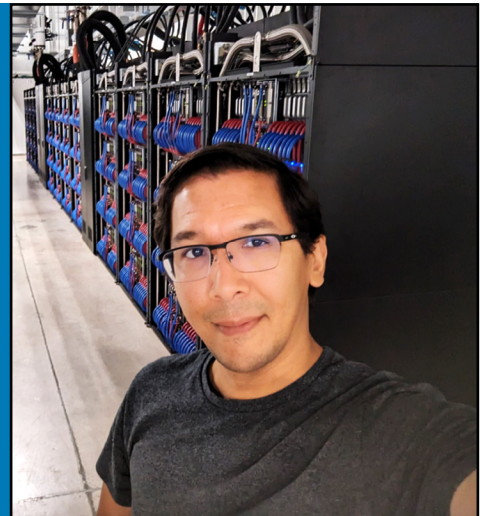
Onsite for an N-Wave installation, Jared Schlemmer (pictured left in both photos) and Eldar Urumbaev (pictured right in both photos), N-Wave engineers, stand in front of the Flight Test Squadron sign and rockets at Schriever Air Force Base in Colorado Springs, Colorado.



Tony Winkler, N-Wave engineer, assisted in the migration and installation of new equipment at the NOAA office in Asheville, North Carolina.



N-Wave engineer, Josh Brooks, has been busy moving two National Weather Service (NWS) Weather and Climate Operational Supercomputing System (WCOSS) locations onto N-Wave's network. They are located in Phoenix, Arizona and Manassas, Virginia.



N-Wave Cloud Services (Cont.)

Connected Cloud Environments

8 NOAA Staff & Line Offices

7 DOC Bureaus/ Offices

7 Cloud Service Providers -
Microsoft Azure Gov/Com, Amazon Web Service (AWS) Gov/Com, Google Cloud Platform (GCP), Oracle Cloud Infrastructure (OCI)

Multiple DOC Bureaus

- **N-Wave Cloud Transport Continues to Reach New DOC Bureaus** - N-Wave cloud engineers coordinated with staff from multiple DOC bureaus to provide high-capacity, redundant cloud connections for the International Trade Administration (ITA) environment in AWS and both the Bureau of Economic Analysis (BEA) and National Telecommunications and Information Administration (NTIA) environments in Azure.

Internet Protocol Version Six (IPv6) Developments

- **Expansion of IPv6 Address Block Assignments** - N-Wave worked with multiple cloud programs across NWS, NOS, Office of Atmospheric Research (OAR), OCIO, OMAO, DOC and ITA to provision /40 and /48 IPv6 address block assignments across a number of AWS and Azure cloud environments. N-Wave cloud engineers worked directly with cloud engineers from multiple programs to successfully execute the /48 IPv6 address pool authorizations required by AWS to complete the address ownership certification process.
- **Collaborative IPv6 Beta Testing Initiative with Google** - The N-Wave cloud team is currently engaged in an collaborative beta testing initiative with engineers from Google to explore architecture options for expanding IPv6 feature support included in General Availability for the Google Cloud Platform (GCP). This expansion would positively benefit agencies across the federal sector as efforts continue to align IPv6 adoption progress in GCP with the Office of Management and Budget's (OMB) Memorandum M-21-07.

Outreach

- **Rollout of N-Wave Cloud Connection Utilization Dashboard** - Staff from the N-Wave cloud and systems teams worked in tandem to develop a telemetry dashboard for providing near real-time circuit utilization monitoring. This dynamic visibility into cloud circuits and communication allows engineers to rapidly identify cloud circuits approaching capacity saturation, observe traffic trends for growth projections and detect traffic anomalies resulting in misconfiguration and/or malicious activity investigations.
- **Development of AWS Landing Zone Pilot and Proof of Concept (PoC)** - N-Wave cloud staff worked directly with product and architecture specialists from AWS and cloud program representatives to digest customer requirements and develop an AWS Landing Zone Pilot and PoC model to evaluate the operational capabilities within the AWS platform, identify any constraints and/or limitations and explore the appetite of the constituency for a landing zone architecture within AWS.
- **IPv6 Community Outreach Events** - Multiple representatives from the N-Wave cloud unit participated in community outreach events and working groups to spread awareness and provide guidance on IPv6 implementations in the cloud. These community engagements have included the N-Wave JETI Annual Meeting and the Stakeholders and Science Engagement Summit, external vendor conferences (including SC23 and FedInsider), Federal IPv6 Task Force, and General Services Administration (GSA) focused working groups.
- **N-Wave Partners with U.S. Air Force (USAF) for Cloud Transport Architecture** - N-Wave staff engaged with personnel from USAF to design and implement a cloud transport topology that will provide bi-directional communication between the NWS National Centers for Environmental Prediction/Central Operations (NCEP/NCO) and the Air Force Weather system hosted in the USAF cloud environment. This will enable native cloud communication and eliminate the dependency on commercially-provided on-premise data circuits and networks. N-Wave cloud technical designs have been drafted, proposed and accepted by USAF and interagency coordinations are currently underway to support execution.

N-Wave Joint Engineering & Technical Interchange (JETI) Meetings

N-Wave's Joint Engineering and Technical Interchange (JETI) has had a busy 2023. First we witnessed the passing of the torch from Alex Hsia to CAPT Joe Backzkowski as the master of ceremonies and general moderator for JETI events. This was followed by the JETI's two-day annual meeting, held in July and focused on IPv6.



PANEL DISCUSSION:
IPv6 & Its Cyber Security Ramifications

MODERATOR: CAPT Joseph Backzkowski, N-Wave Engagement & Outreach Manager

PANELISTS:

- Jeffery Bowmar, N-Wave Cloud Services Federal Manager
- Eric Estes, N-Wave IT Security Program Manager & Information Systems Security Officer
- Justin May, Corporate & Staff Office IT Security Officer, NOAA Cyber Security Division



The JETI team further expanded its offerings by hosting the Department of Commerce (DOC) and NOAA IPv6 transition coordination team meetings. In true JETI fashion, the existing name was deemed too long and subsequently changed to JETI IPv6 and CAPT Joe became the moderator.

The first JETI IPv6 event occurred in October. Not content to sit back, JETI also moved away from Google Meet and switched to WebEx webinar, which had some interesting side effects and lessons learned for future meetings, as those who attended the first meeting can attest.



N-Wave's Alex Hsia Retires

Finally, we come to one of the biggest changes for JETI and N-Wave - saying goodbye to the founding member of the JETI team and a long-standing pillar of strength and support for N-Wave, Alex Hsia. Alex announced his retirement after 32 years of federal service and with the last four years serving at N-Wave.

We will miss his wealth of knowledge and expertise, but more importantly, we will miss his steadfastness and deep friendship. We wish him all the best in the next stage of his life. He deserves it! Fair Winds and Following Seas Alex!

See p.30 for the particulars of JETI's recurring meetings.

N-Wave Lab Update

In the ever-evolving landscape of the internet, Internet Protocol version 6 (IPv6) is emerging as a critical technology to address the impending exhaustion of Internet Protocol version 4 (IPv4) addresses. As the federal government continues the transition to IPv6, one topic gaining prominence is the management and operation of IPv6-only networks. While IPv6 brings numerous benefits, running an IPv6-only network presents its own set of unique challenges.

The IPv6 Transition: A Necessity

IPv4 has been the backbone of the internet for decades. However, its 32-bit address space can only support approximately 4.3 billion unique Internet Protocol (IP) addresses. Given the rapid proliferation of devices and the growing demand for connectivity, IPv4 addresses have become a finite and exhaustible resource. IPv6 offers a vast address space with 128-bit addresses, allowing for an almost infinite number of unique IP addresses. Transitioning to IPv6 is not just an option; it's a necessity to ensure the continued growth and stability of the internet.

The Challenges of IPv6-Only Networks

- **Legacy Systems and Dual-Stack Complexity:** One of the most significant challenges when moving to an IPv6-only network is dealing with legacy systems that rely on IPv4. Many older devices and applications are not IPv6-compatible, requiring the network to support both IPv4 and IPv6, a configuration known as "dual stack." Managing dual stack networks is more complex and resource-intensive than supporting just one protocol.
- **Application Compatibility:** Even if your network infrastructure is IPv6-ready, you may encounter applications struggling with IPv6-only environments. Some applications may not fully support IPv6 or may require modifications to work seamlessly. This can lead to compatibility issues and potential service disruptions.
- **Security Concerns:** IPv6 introduces its own set of security challenges. Network administrators need to adapt their security practices to IPv6, which includes understanding new attack vectors and implementing security measures specifically designed for IPv6.
- **Address Management:** IPv6's extensive address space can make address management seem daunting. Assigning and tracking IPv6 addresses efficiently and securely is crucial to network operations. Automation tools and robust address planning become vital.
- **Routing Complexity:** IPv6 introduces deeper hierarchical addressing and route aggregation, which can be more challenging to configure and manage compared to IPv4. Ensuring proper routing and avoiding routing table bloat is essential in large IPv6-only networks.
- **Provider and Content Accessibility:** Some internet service and content providers may still rely heavily on IPv4. In an IPv6-only network, ensuring accessibility to IPv4-only resources can be tricky and may require various translation mechanisms such as Network Address Translation 6 to 4 (NAT64) or Domain Name System 6 to 4 (DNS64).
- **Lack of Expertise:** IPv6 expertise is not as widespread as IPv4 knowledge, leading to a shortage of professionals with IPv6 skills. This can hinder the deployment and maintenance of IPv6-only networks.

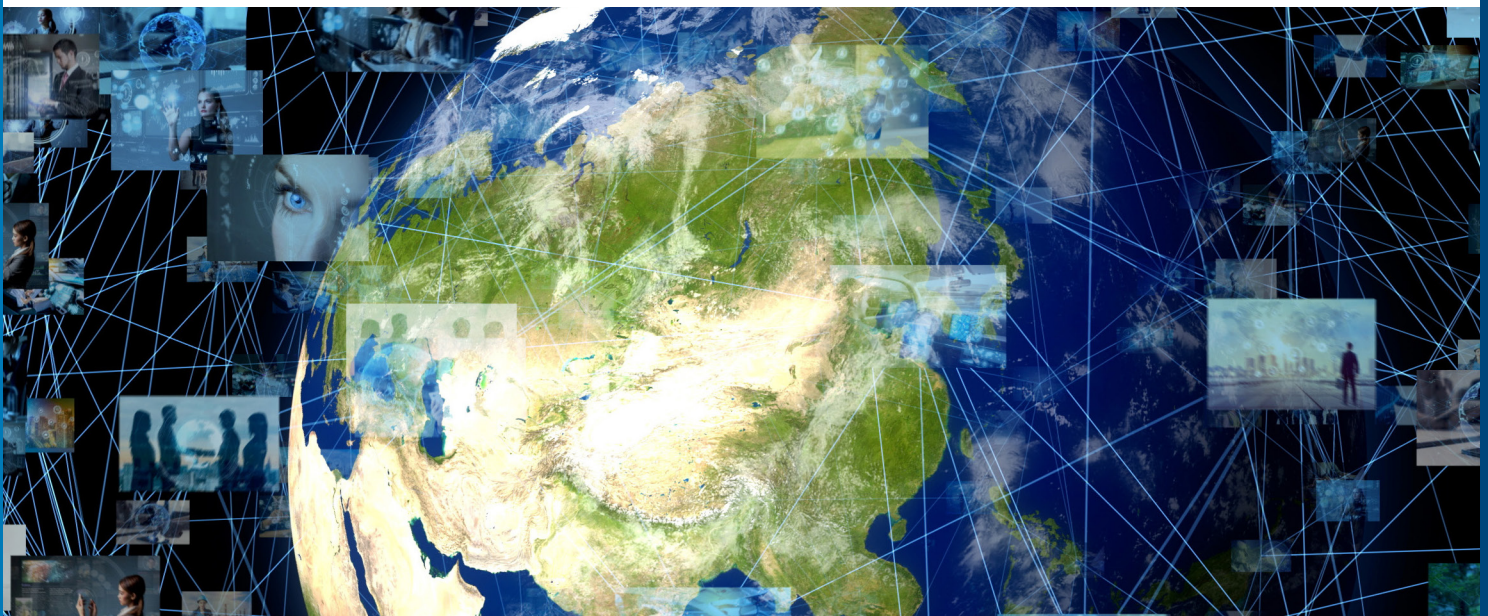
N-Wave Lab Update (Cont.)

Solutions and Best Practices

While the challenges of IPv6-only networks are real, they are not insurmountable. Here are some solutions and best practices to address these challenges:

- **Gradual Transition:** Consider a phased approach to transition from IPv4 to IPv6. Start with dual stack, allowing both protocols to coexist, and gradually move towards IPv6-only as the ecosystem matures.
- **Application Testing and Updates:** Test all critical applications for IPv6 compatibility and work closely with vendors to ensure their products are IPv6-ready. If necessary, explore application layer gateways (ALGs) or proxies to bridge the gap.
- **Security First:** Prioritize security by implementing IPv6-specific security measures, such as intrusion detection and prevention systems tailored for IPv6 traffic.
- **Address Management Tools:** Invest in IPv6 address management tools to streamline address allocation and tracking. Develop a comprehensive address plan to ensure efficient utilization.
- **Routing Optimization:** Work on optimizing routing in your IPv6 network. Employ route aggregation and ensure your routers are configured to handle IPv6 efficiently.
- **Translation Mechanisms:** Use transition mechanisms such as NAT64 and DNS64 to facilitate access to IPv4 resources. These mechanisms should be considered as temporary solutions while encouraging the adoption of IPv6. N-Wave and the NOAA Cyber Security Center operate NAT64 and DNS64 resources available to assist members transitioning to IPv6-only systems. Both services are deployed with Anycast prefixes for failover and ease of configuration/management. N-Wave members can point their IPv6-only clients, or DNS infrastructure supporting their IPv6-only hosts, to the DNS64 Anycast addresses: 2610:20:9140:feed::1 and 2610:20:9140:feed::2. These DNS servers will return specially formatted IPv6 addresses directing traffic to the N-Wave NAT64 gateways using the NAT64 Well Known Prefix (64:ff9b::/96). Using this combination of NAT64 and DNS64, IPv6-only clients will be able to reach IPv4-only resources.
- **Training and Certification:** Invest in training and certification for your IT staff to build IPv6 expertise. Encourage your team to stay updated with IPv6 developments and best practices.
- **Join N-Wave's IPv6 Monthly Discussions:** N-Wave offers a "Joint Engineering and Technical Interchange (JETI) IPv6" monthly meeting to its stakeholders and federal agency partners (see p.30 for more information about N-Wave's JETI meetings). If you are interested in joining these discussions, reach out to nwave-communications@noaa.gov to request a registration link.

Running an IPv6-only network may present unique challenges, but it is a necessary step in the evolution of the internet. By understanding these challenges and adopting best practices and solutions, organizations can navigate the IPv6 transition successfully.



Network Changes and New Participants

(April 1 - September 30, 2023)

N-Wave Upgrades

- **NOAA Daniel K. Inouye Regional Center (IRC) - Honolulu, Hawaii** - N-Wave added Virtual Private Network (VPN) infrastructure at the IRC. The IRC supports the Hawaii region for all of NOAA. This update provides better VPN performance to the Hawaii region.
- **NOAA David Skaggs Research Center (DSRC) - Boulder, Colorado** - N-Wave replaced the existing wireless access points at DSRC with newer models to enhance the wireless experience for the users at the Boulder campus.
- **Barrow Circuit Migration - Utqiagvik, Alaska** - N-Wave migrated to a new circuit at this remote location in Alaska.
- **NOAA Environmental Security Computing Center (NESCC) - Fairmont, West Virginia** - N-Wave added additional wireless access points at the NESCC to provide better coverage across the building.

National Environmental Satellite, Data, and Information Service (NESDIS)

- **Joint Polar Satellite System (JPSS) Wide Area Network (WAN) Migration | Multiple Locations** - JPSS migrated all the contiguous U.S. JPSS Ground System sites to N-Wave from the previous network provider. As part of this migration N-Wave established new Points of Presence (PoPs) at the following locations:
 - **Monterey, California** - Fleet Numerical Meteorology and Oceanography Center (JPSS, Defense Meteorological Satellite Program (DMSP))
 - **Sarpy County, Nebraska** - Offutt Air Force Base, 557th Weather Wing
 - **Centennial, Colorado** - National Science Foundation (NSF) Antarctic Program
 - **White Sands, New Mexico** - NASA White Sands Complex
- **DMSP Communications Refresh** - DMSP is in the process of moving away from the legacy geosynchronous satellite service to N-Wave at the following locations:
 - **Colorado Springs, Colorado** - Schriever Space Force Base
 - **Santa Barbara County, California** - Vandenberg Space Force Base
 - **Suitland, Maryland** - NOAA Satellite Operations Facility (NSOF)
 - **Fairbanks, Alaska** - Fairbanks Command and Data Acquisition System (FCDAS)
 - **Monterey, California** - Fleet Numerical Meteorology and Oceanography Center (FNMOOC) (JPSS, DMSP)
 - **Sarpy County, Nebraska** - Offutt Air Force Base, (JPSS, DMSP) & 557th Weather Wing
 - **Bellevue, Nebraska** - (Peraton)
- **NOAA Center for Weather and Climate Prediction (NCWCP) - College Park, Maryland** - N-Wave installed wireless at the NCWCP facility for its users.

National Marine Fisheries Service (NMFS)

- **NMFS Northwest Fisheries Science Center (NWFSC) - Newport, Oregon** - N-Wave turned up wireless at this location.
- **NMFS Ted Stevens Marine Research Institute (TSMRI) - Juneau, Alaska** - N-Wave turned up new connectivity to this facility.

Office of Marine and Aviation Operations (OMAO)

- **OMAO Gulf Marine Support Facility - Pascagoula, Mississippi** - N-Wave migrated the OMAO site from legacy WAN services and provided WAN, managed LAN and wireless connectivity at the facility. N-Wave installed equipment in the new network closet, which provides better environmental and stability for the network hardware.

Network Changes and New Participants (*Cont.*)

National Ocean Service (NOS)

- **Office of National Marine Sanctuaries | Savannah Visitor Center - Savannah, Georgia** - N-Wave installed a wireless solution at the new ONMS Savannah Visitor Center. This site is an all wireless office, relying solely on wireless for operational needs. The office will connect all devices to wireless. For access to internet-facing services, like Google Suite, they use wireless connection only. To access internal NOS resources, they connect to wireless and then to N-Wave Enterprise Remote Access VPN (ERAV).

National Weather Service (NWS)

- **NOAA Western Regional Center (WRC) - Seattle, Washington** - The N-Wave team replaced the existing wireless access points at WRC with new Aruba access points.
- **Weather and Climate Operational Supercomputing System (WCOSS) - Phoenix, Arizona and Manassas, Virginia** - N-Wave installed new connectivity at both of these locations.

Department of Commerce

- **Bureau of Economic Analysis (BEA) - Bowie, Maryland** - N-Wave brought up redundant connections to this BEA site.



Explore N-Wave's New Website

N-Wave is excited to announce the launch of its new public-facing website available under the "OCIO" section of the main NOAA website found here:

nwave.noaa.gov

The new website was developed to provide a user-friendly experience with easy navigation to quickly access information about N-Wave for both the general public and its federal agency and science, research and education partners. With five menu tabs and corresponding drop-down listings, users can select resources and information about the program. An overview of each is provided below:

- **N-Wave Home/About N-Wave** - Visit these sections to learn more about N-Wave's national network infrastructure and program, its leadership and the various partners and stakeholders working with N-Wave.
- **Stakeholder Resources** - N-Wave partners and stakeholders will find links and resources to dashboards/programs, the three ways to reach the N-Wave Network Operations Center (NOC) for questions about service inquiries or issues, and a downloadable version of the comprehensive N-Wave service catalog with separate links to information sheets detailing N-Wave portfolios and services (*authentication and login may be required for some of these resources*).
- **Outreach and Events** - Check out this section to read the latest edition of the "N-Wave News" newsletter and stay up-to-date on N-Wave events, such as the Stakeholders Science and Engagement Summit, Alaska Region Technology Interchange Consortium (ARTIC) and Joint Engineering & Technology Interchange (JETI) meetings.
- **Contact Information** - This section provides direct methods for communicating with N-Wave - both for general information about the program or events and for partners/ stakeholders with a specific ticket or issue for the N-Wave NOC.

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

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N-Wave

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About N-Wave

N-Wave is the National Oceanic and Atmospheric Administration's (NOAA) network service provider and has been in operation since 2009. N-Wave's foundation relies on an extensive array of partnerships and relationships among NOAA, the Department of Commerce, other federal agencies and the academic and state research network communities. N-Wave's national network infrastructure extends across the contiguous U.S. to Alaska and Hawaii — reaching remote field sites, major campuses, data centers and supercomputing facilities.

Combined with its scalable cloud solutions, robust catalog of enterprise managed services and advanced network operations, N-Wave supports all stakeholder missions with integrity, transparency and flexibility, and employs a unique partnership approach to provide the best customer experience.

N-Wave will continue to look for ways to enhance the features and tools available on the website for the best possible user experience. We encourage you to go in and take a look around to learn more about the N-Wave program.

N-Wave NOC Metrics & Updates

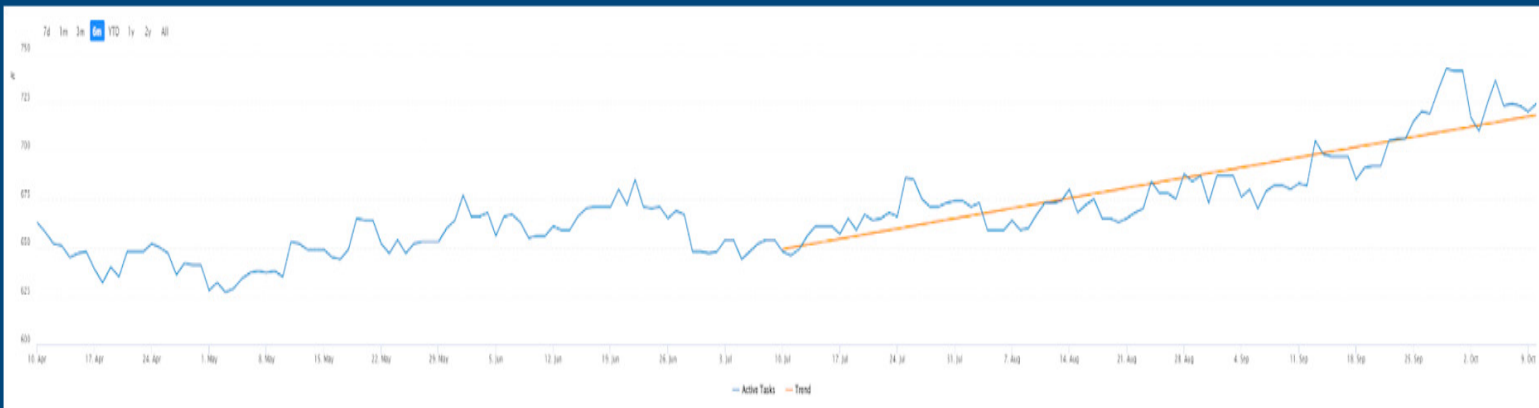
N-Wave partners with GlobalNOC at Indiana University to provide advanced network operations, offering support 24 hours a day, 365 days a year, which is integrated within the N-Wave Federal Information Security Modernization Act (FISMA) high system controls. N-Wave NOC support includes tier I, II and III engineering, along with monitoring, measurement and analysis.

Support metrics gathered from April - September 2023 indicate the N-Wave NOC opened 18,827 tickets. These tickets encompass 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 (12%) and communication records (70.3%) make up the bulk of those tickets, while incidents and changes together account for the remaining 17.7% of tickets.

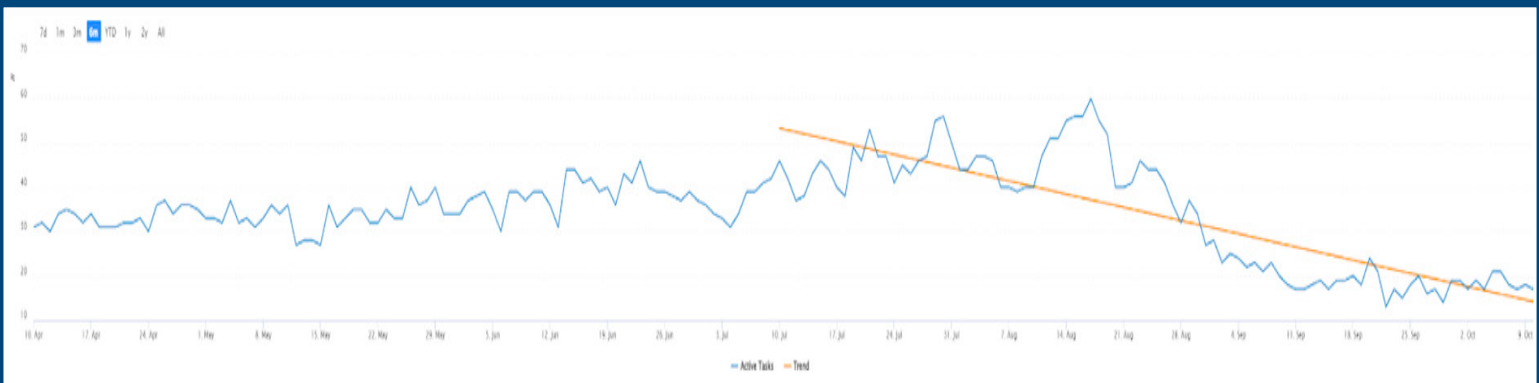
Trends in Requests and Incidents

The trend line for customer requests increased slightly, reflecting the growth of the N-Wave network. The trend line for incidents was steady through the first half of the metrics period with a decrease in the overall active incidents trend towards the end of the period. This represents a continued effort to resolve and close outage events in a timely manner. (In the two graphs below the value of vertical axes are incident counts).

Active Requests metric shows the trend of all catalog tasks active on a given day.



Active Incidents metric shows the trend of all incidents active on a given day.



N-Wave Enterprise Services Updates

(April 1 - September 30, 2023)

N-Wave Services Team

The N-Wave services team continues to meet current customer needs while rapidly expanding service to new sites. The specific service updates follow.

Enterprise Firewall Service

N-Wave engineers have been busy this summer migrating new customers and working through some challenges to address customer requirements. One such challenge was assisting a customer working on a migration with the requirement to route a single subnet to multiple Virtual Routing and Forwarding (VRFs) based on a few source addresses. N-Wave used policy-based routing, creating rules to allow the majority of traffic to Network Address Translation (NAT) and routing towards the internet with others routing into a private VRF. Since N-Wave utilizes Fortigate Virtual Domains (VDOM) acting as logically separate firewalls by customer, these policies are customer-specific.

N-Wave is working toward allowing customers to have a real-time view of their firewall policies to aid in clean up, troubleshooting and peace of mind that the correct rules are set. This effort was stymied by a Public Key Infrastructure (PKI) authentication bug in the FortiManager code. The bug issue was resolved and N-Wave has resumed testing with plans to roll out the feature once testing is complete and any remaining issues are resolved.

The enterprise firewall service supports routing and policy for a customer's Internet Protocol version 6 (IPv6) - while not a new update, we continue to raise awareness of it. Check back for more updates in the next newsletter edition!

Enterprise Virtual Private Network (ERAV)

N-Wave engineers planned, tested and began supporting IPv6 on the ERAV solution. As stated in the last newsletter, users can connect via an Internet Protocol version 4 (IPv4) or IPv6 address to build the Virtual Private Network (VPN) tunnel. The new options include being able to issue an IPv4, IPv6 or dual stack configuration for their VPN Internet Protocols (IP). Since VPN policy is to "deny by default" as VPN administrators

request their groups to be IPv6-only or dual stack, IPv6 rules will need to be established allowing for traffic to those destinations. This feature will assist other Federal Information Security Modernization Act (FISMA) systems to meet their IPv6 migration requirements and goals.

In other related news, the Hawaii node for ERAV was set up by N-Wave engineers and is now fully operational. Hawaiian users can now connect to the Hawaii node providing less latency than backhauling all traffic to Denver, Colorado, or College Park, Maryland. Users will be able to egress from the Hawaii Trusted Internet Connection Access Point (TICAP) to the internet and have overall better performance. Users can work with their VPN administrators to ensure they are using the best node based on their location. N-Wave continues to work with VPN administrators to enable posture control for their VPN groups. When enabling posture control, N-Wave first places the group in monitoring mode so N-Wave can work directly with the VPN administrators to identify any issues and get those resolved. Once the VPN administrators and N-Wave engineers are confident issues are resolved, then enforcement is applied. N-Wave will continue to work with VPN administrators until all groups are enabled for posture control.

Enterprise WiFi

The Enterprise Wireless team has been hard at work replacing older access points (AP) with newer variants. The new standard AP is the Aruba 635, which supports WiFi-6e allowing newer compatible devices to connect with much higher throughput. The service continues to grow rapidly with 33 new sites deployed in FY23 and over 14 new sites already planned for FY24. Wireless core nodes were deployed in Hawaii to support enterprise wireless in the state. This allows traffic to egress the Hawaii TICAP instead of backhauling to Denver, Colorado, greatly improving the performance of enterprise wireless in Hawaii.

N-Wave is exploring cloud-based solutions to assist with troubleshooting and management of the wireless service. Currently, N-Wave is working on an authorization to test and an update will be provided in the next newsletter based on

N-Wave Enterprise Services Updates (Cont.)

the outcome of the testing results. We plan to address several items in the test including IPv6 support.

Managed Local Area Network (LAN)

With respect to the federal mandate (OMB M-21-07) requiring agencies to have 20% of their IP-enabled assets as IPv6-only by the end of FY23, N-Wave met and exceeded this goal by reaching 30% before the end of the FY. N-Wave focused on Managed Local Area Networks (LAN) to meet the requirements of the mandate and is proud to report the Managed LAN is fully IPv6-only in the management plane (see the IPv6 article on p.26 for more information). N-Wave Managed LAN service has full support for customer IPv6 requirements.

N-Wave onboarded over 11 new Managed LAN sites in FY23 and already has over 17 planned sites for FY24. N-Wave is early in the process of evaluating current deployments alongside customer requirements to determine if any changes to design or baselines are needed. The service is growing steadily and a large amount of real data has been collected based on current deployments. N-Wave is looking into new technologies, changes in networking trends, different hardware platforms and overall optimizations. N-Wave engineers have taken advantage of the N-Wave lab environment to test new features and devices. Updates will be provided as significant progress is made.

ERAV

67 VPN groups

6 NOAA Line Offices use ERAV

2 Other Federal entities use ERAV

10,000 + registered users

Firewall

8 Service locations spanning the U.S.

24 Firewalls including cloud firewalls

38 Virtual firewall instances

Managed LAN

50 Service locations spanning the U.S.

5 NOAA Line Offices use Managed LAN

395+ Switches

Wireless

58 Service locations spanning the U.S.

21 States with service locations

1,300+ Wireless access points

N-Wave Hosts Inaugural ARTIC Annual Meeting

N-Wave hosted the inaugural Alaska Region Technology Interchange Consortium (ARTIC) Annual Meeting from September 12-14, 2023, in Anchorage, Alaska – three days, 38 unique presentations, speakers from 10 federal agencies, five state offices and the science, education and research community, along with several tribal programs and other organizations.

In total over 100 participants attended with the majority attending in-person. The event had a remote presentations, including from a speaker in Kastrup, Denmark.

Two key efforts led by N-Wave were showcased: a Google Earth map listing active fiber lines by organization and a dedicated vendor neutral peering exchange in Alaska, the first of its kind for the state. ARTIC is an informal and voluntary consortium of members created in late 2022. (See the “Alaska Progress” article on p.25 for background on ARTIC.)

In the words of Robert Sears, N-Wave’s Director (pictured right), “...*this is where our N-Wave came from. We started in that realm of building something from the ground up and learning from partners 12 years ago. So we’re kind of building on 12 years of collaboration and really taking it out here at the state (level).*”

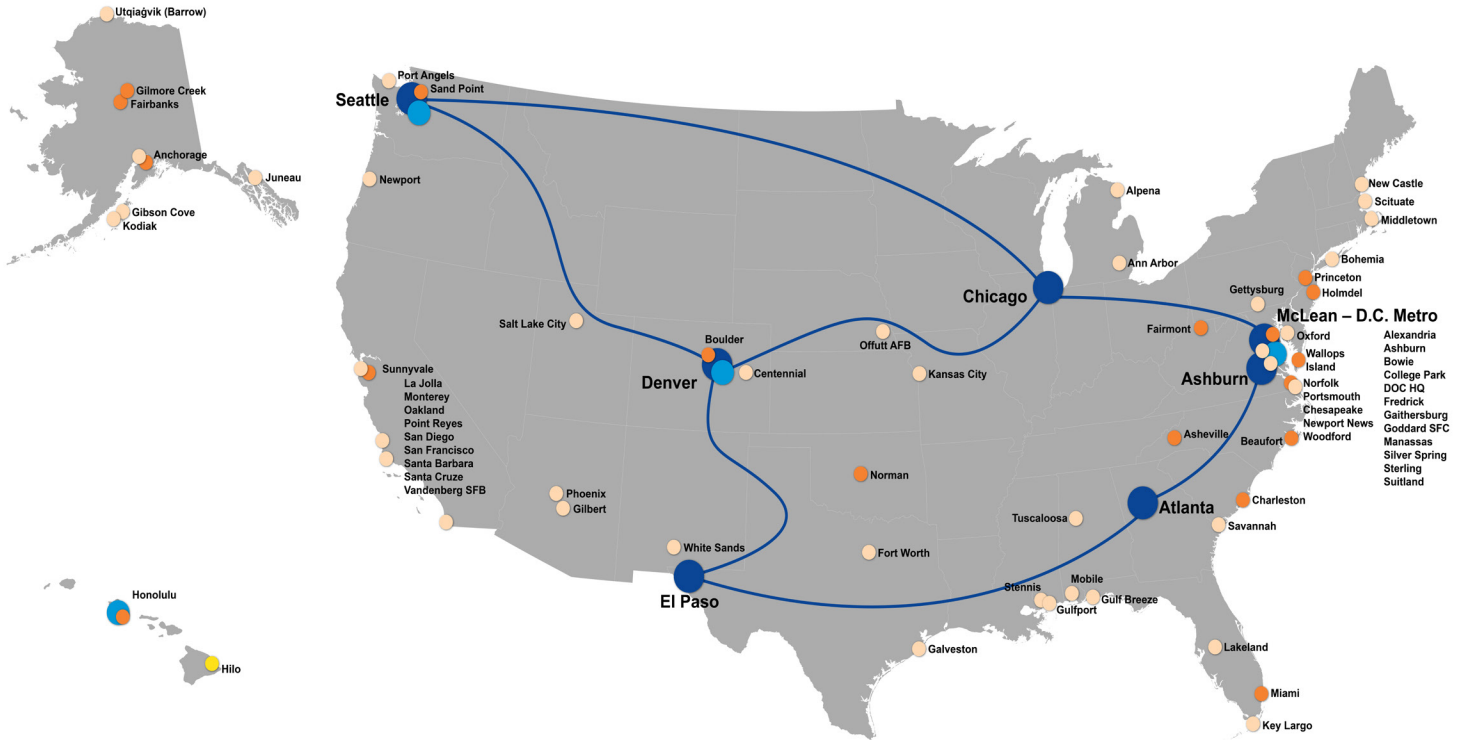
This grassroots community-led effort is what helped form the nucleus of N-Wave as it’s seen today.



Organizational executives, such as Bill Smith, State of Alaska Chief Information Officer (pictured left), and Douglas Perry, NOAA’s Deputy Chief Information Officer (pictured right), attended the open forum to listen and discuss opportunities and challenges with other Alaskan leaders and representatives.



N-Wave Network Map

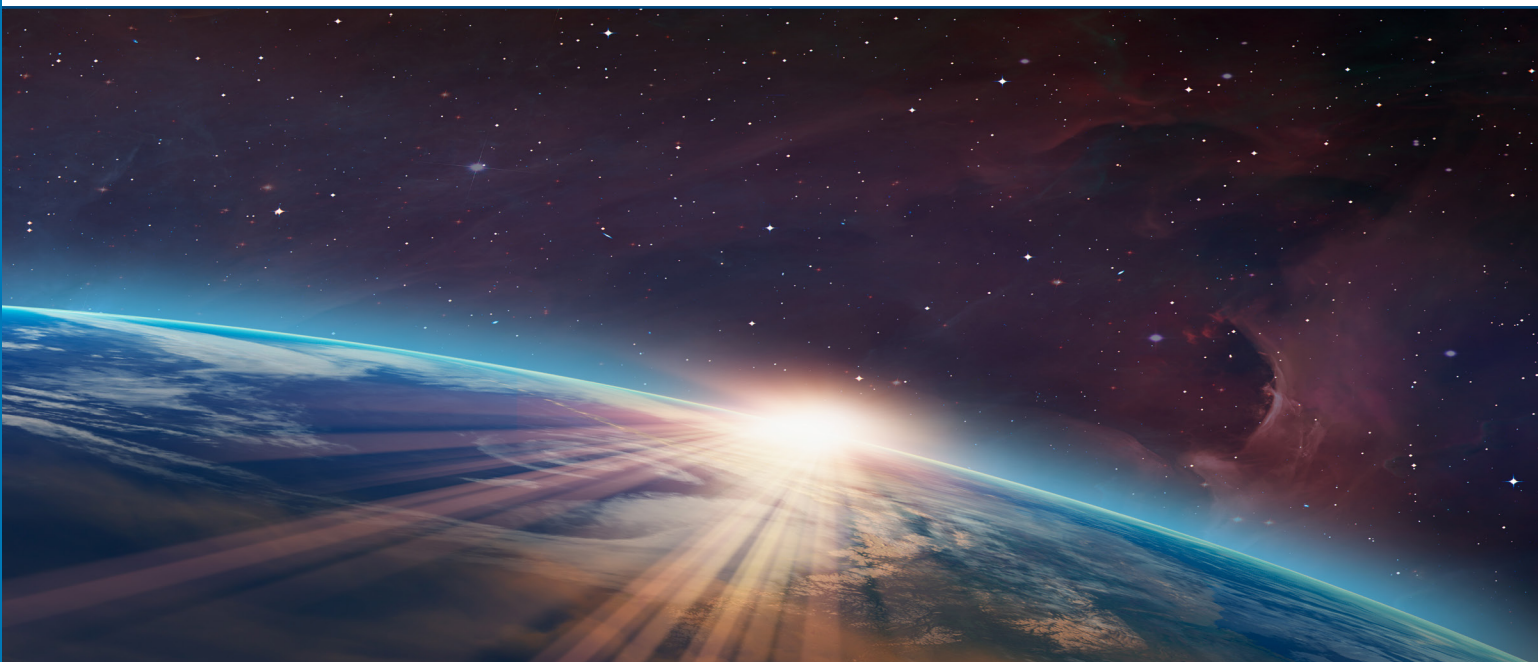


- Network Core
- TICAP Site
- Aggregation Site
- Participant Site
- VPN Backhaul Site

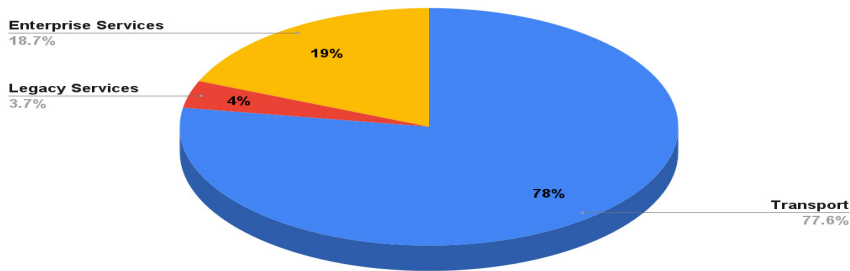
N-Wave Notification Subscription Portal

In the [spring edition of the newsletter](#), N-Wave discussed a modification in the location field of the Notification Subscription Portal to represent locality instead of specific location. This change aims to alleviate challenges when multiple sites in the same city/state are listed and which ultimately ends up confusing users on which selection is the correct choice for their search. While our intention was to roll it out this past summer, this alteration is now being included within a larger update planned for this winter or early next year. The larger update will encompass the ability to detect redundancy as part of these notifications. Currently, this is performed manually by N-Wave's service desk technicians. Automating this process requires collaborative work by N-Wave's systems, network engineering, service desk, and portfolio leadership teams. We will continue to look at ways to enhance the notification process and provide additional updates in the 2024 spring edition of the N-Wave newsletter.

The user base for the notification subscription portal is growing! With 294 notification subscribers reported in the previous edition of the newsletter, we are happy to announce the number has climbed to 367, which includes both individuals and distribution lists. To access or register for the N-Wave Notification Subscription Portal, visit notifications.nwave.noaa.gov.



NOC Metrics and Updates (Cont.)

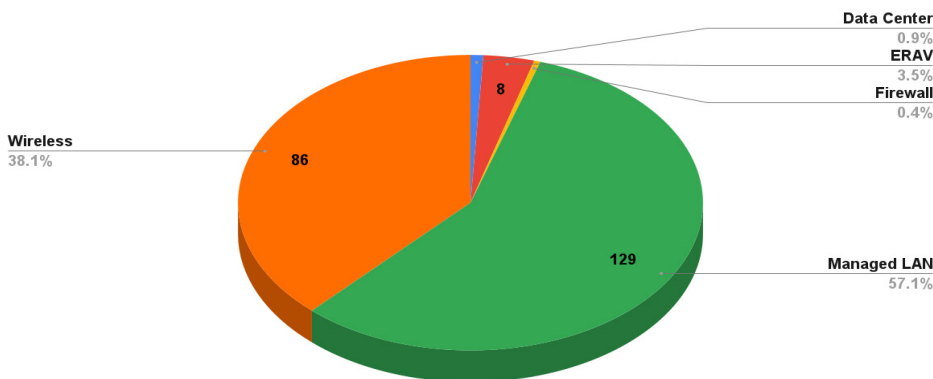
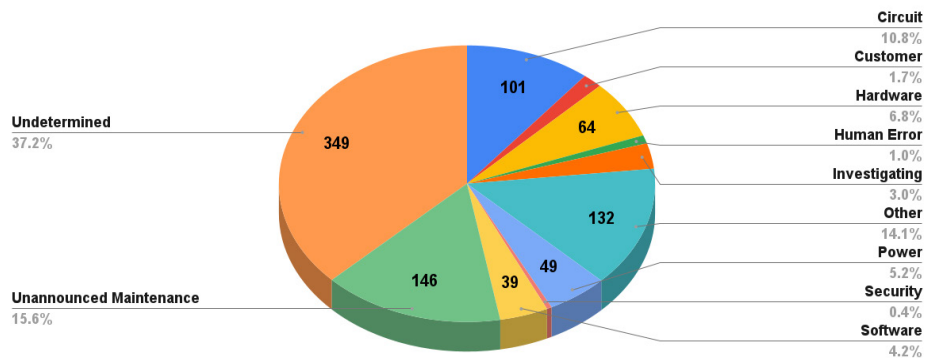


Incidents by Service Portfolio

This graph represents 1,208 total incidents, broken down by service portfolio: N-Wave Transport, N-Wave Enterprise Services and NOAA Silver Spring Legacy Services. Legacy Services continue to decline with Transport making up the large majority of outage events in this period.

Transport Incidents by Category

This graph shows 937 total Transport incidents, broken down by category, a substantial increase from last period, due to an influx of new sites connected to the Transport network as well as creating new connections for increased redundancy to existing sites. Undetermined incidents mostly comprise very brief, mainly non customer-impacting observed outages for which a vendor is not able to determine the cause. Unannounced maintenance events typically occur when customers or providers do not announce the maintenance to N-Wave. Investigating indicates an incident is still open for investigation. Circuit incidents are outages caused by fiber damage, bumped fiber, vandalism or cut fiber.

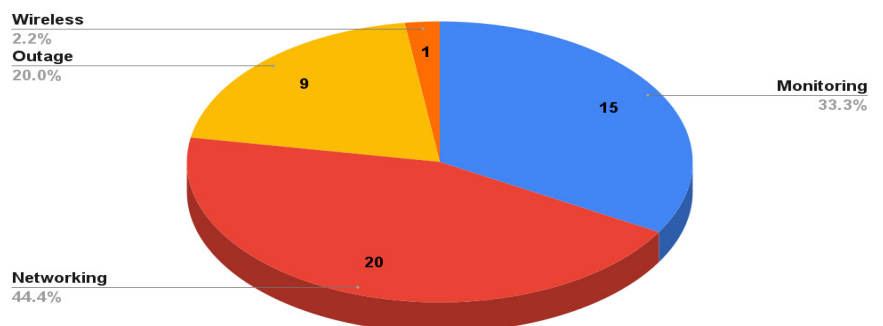


Enterprise Service Incidents

This graph shows the 226 total incidents related to N-Wave Enterprise Services, a decrease, in part due to the root cause for many Enterprise impacting events being Transport connections, broken down by specific service: Data Center, Enterprise Remote Access VPN (ERAV), Enterprise Wireless, Managed LAN and Firewall with one event.

Legacy NOC Incidents by Category

This graph shows 45 total incidents related to NOAA Silver Spring Legacy NOC, broken down by category: Outage, Networking, Wireless, VPN and Monitoring. This is down from 89 in last fall's report. Monitoring are incidents where N-Wave's monitoring system has triggered an investigation into an event that didn't necessarily cause an impact on the network.



N-Wave in the Networking Community

Besides building a network and providing services for its customers, N-Wave participates in and helps with some “outside” activities in the federal high performance computing and networking space along with related activities. An example of these efforts are described below:

SC23 (The International Conference for High Performance Computing, Networking, Storage, and Analysis) | Nov 12-17, 2023 - Denver, Colorado

The annual conference on supercomputing, SC23, will be held at the Colorado Convention Center in Denver from November 12-17. Several members of the N-Wave team (Eric Estes (pictured below), Lucianna Gallegos, Andrew Lee, Paul Love, Tran Nguyen and Glenn Roderick) are part of the group building the network, known as, SCinet, supporting the conference this year. SCinet, which takes roughly a year to design, a month to build and then runs only for a week, is expecting just over 6 TBps capacity at this year’s conference. Last year, over 10,000 attended the conference formerly known as Supercomputing in Dallas, with a larger number expected this year. Of particular interest this year to NOAA, the Department of Commerce and the rest of the federal government, is a Birds of a Feather (BoF) on IPv6 co-hosted by N-Wave entitled “[Less Worrying, Less Worrying, More Learning, More Sharing - Ways to Embrace IPv6](#)”. This BoF continues the engagement from SC22 with discussions



centered on international migration efforts, cyber security, High-Performance Computing (HPC), Internet Protocol Address Management (IPAM) and real-time IPv6 usage by SCinet23. We encourage anyone with a registration that allows attendance at SC23 BoF sessions to attend in-person or watch via the virtual experience offered for specific registration categories. This BoF session is scheduled for Tuesday, November 14, 2023, from 5:15 - 6:45 p.m. at the Colorado Convention Center (Rm. 704-706) in Denver, Colorado.



Internet2 Community Exchange | May 8 - 12, 2023 - Atlanta, Georgia - N-Wave team members attended the Internet2 Community Exchange and, in addition to attending sessions, met with several N-Wave stakeholders, such as Inder Monga and Jason Zurawski from the Department of Energy’s Energy Science Network (ESnet), Jennifer Schopf with the Texas Advanced Computing Center (TACC), Steve Corbato with Link Oregon (third from left in the second picture below with N-Wave staff), Mark Wolff from the Canadian Network for the Advancement of Research, Industry and Education (CANARIE), and Rick Lovelace and Miguel Ramlatchan from Old Dominion University (second and third from left in the first picture below).



N-Wave in the Networking Community (Cont.)



HPE Aruba Conference and Events | Multiple locations - Several N-Wave team members visited the HPE Aruba Executive Briefing Center in San Jose, California, to learn more about their services and capabilities. In attendance from N-Wave were Ronette Pratt, Sean Gambarini, Adam Nemethy, Robert Sears and Robert Webb (in order l - r in first picture above). In late April, N-Wave Enterprise Transport team members, Adam Nemethy and Tran Nguyen, attended the Aruba Atmosphere 2023 Conference in Las Vegas, Nevada (second picture above). Adam Nemethy, N-Wave Deputy Director, spoke at the 2023 HPE Aruba Networking Federal Symposium in Washington, D.C., on October 3, 2023, with a presentation entitled "Mission, Mandates and Partnerships" (third picture above).

CISCO Live Conference | Las Vegas, Nevada - Robert Sears, N-Wave's Director, co-presented with Kevin Hanahan and David Prall, both with Cisco, at an interactive break-out session entitled "What Should We Do About the IPv6-Only Mandate by Governments?" (first picture below and to the left). It featured discussions surrounding the progress being made at the federal level, what work is being done with private industry and the types of hurdles and/or challenges experienced in the migration process. Adam Nemethy, N-Wave Deputy Director, and Tran Nguyen, N-Wave network engineer, also attended and used the opportunity for networking and to attend technical sessions on topics such as automation, hybrid cloud, networking and more (second and third pictures).



FedInsider Training (Virtual) - In late April, Jeffery Bowmar, N-Wave Cloud Services Federal Manager, presented with other thought leaders from the industry and government on a virtual FedInsider training entitled "Supporting IPv6 in a Cloud Environment" (pictured right).



Alaska Progress

N-Wave is working with various NOAA Line Offices to support their activities in Alaska. As NOAA seeks to better network connectivity services for its offices throughout the state, including remote locations like McGrath or Bethel, collaboration with local tribal nations and the State of Alaska Broadband Office can help identify if there are opportunities to influence wider broadband improvements in a given region. Many of Alaska's small rural communities, with an estimated population of 100-300 residents, typically may have no connection to the rest of the state other than through the use of planes, dog sleds or off-road vehicles. Phones, if they have them, are over terrestrial microwave systems. Low Earth Orbit (LEO) satellites are just starting to change the calculus for internet services. These activities and more are part of the discussions occurring with the Alaska Region Technology Interchange Consortium (ARTIC), which N-Wave has organized with state and federal agencies, tribal nations, the science, research and education community, and other non-profit partners. ARTIC grew out of the Alaska Federal Networking Coordination meeting held in Anchorage in September 2022. It provides a forum for groups working in Alaska to discuss regional issues, needs and share lessons learned from the state's unusual networking demands - vast distances, sparse population, harsh climate. It may also furnish the mechanism for the sharing of resources within the state or between the state and the rest of the country. (See the article on p.18 about the ARTIC Annual Meeting.)

Alaskan Core Network and a Pilot for a Possible Small Site Solution

As part of adding support for National Weather Service (NWS) sites in Alaska, the core network supporting N-Wave in Alaska (Seattle<->Anchorage<->Fairbanks<->Seattle) is being doubled in capacity - from 1 to 2 Gbps on each leg. N-Wave's planning and development of an aggregation point in Alaska has been completed with the first upgrade already underway. N-Wave soon will have 2 Gbps of redundant connectivity from Seattle: the current path extends from Seattle, Washington ~ Anchorage, Alaska ~ Fairbanks, Alaska and back to Seattle. This will double the bandwidth of the current 1 Gbps Alaska aggregation iteration. The initial sites are online and moving traffic - these include the following:

Utqiagvik, Alaska - 20 Mbps | Gilmore Creek, Alaska - Dual 1 Gbps | Ted Stevens Marine Research Institute - Juneau, Alaska - 500 Mbps | National Marine Fisheries Service (NMFS) West 9th, Juneau, Alaska - 500 Mbps | NMFS Anchorage Federal Building - Anchorage, Alaska - 100 Mbps | NMFS Gibson Cove - Gibson Cove, Alaska - 10 Mbps

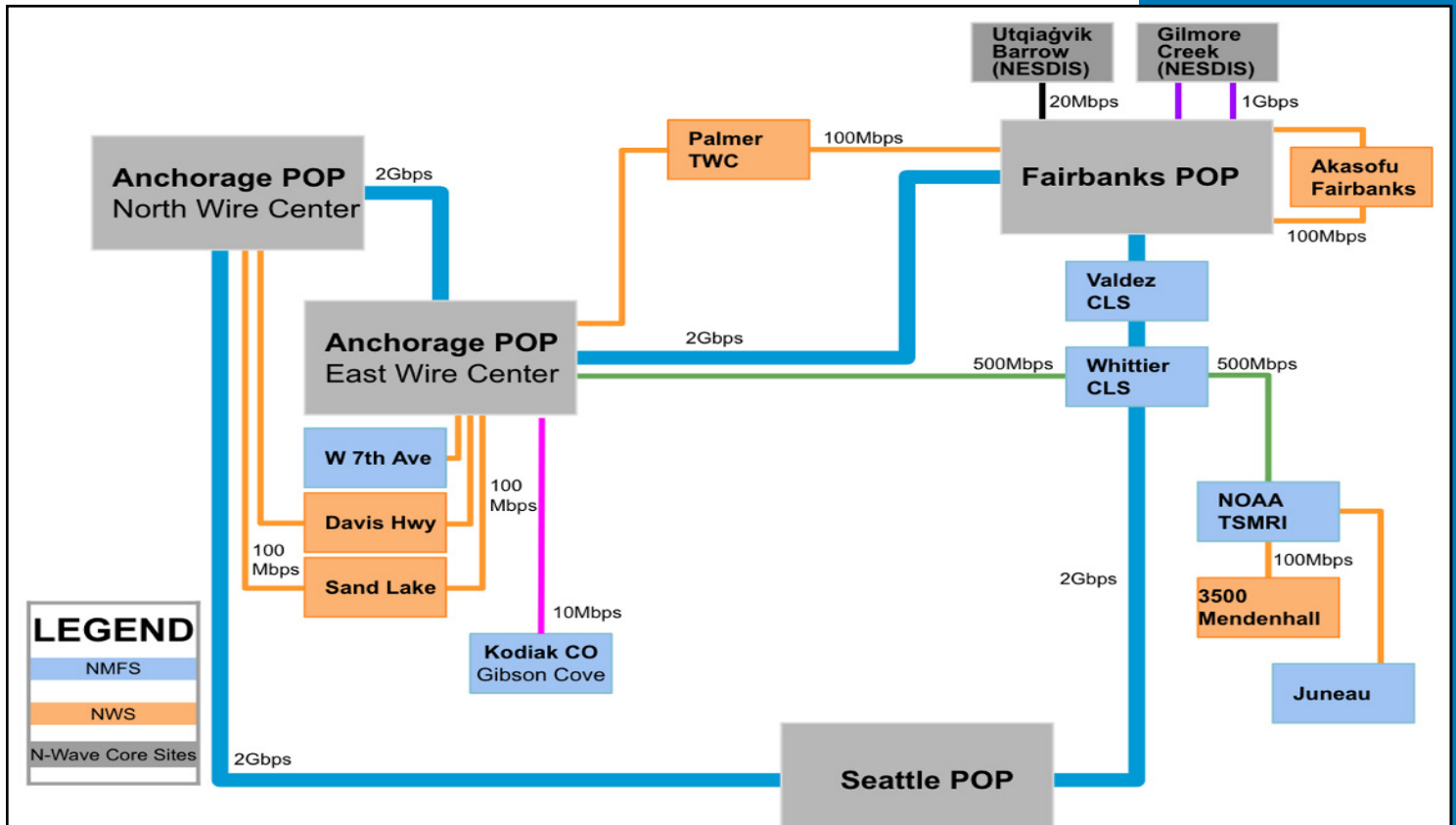
All sites but the NMFS Gibson Cove location in the list above have opted for N-Wave wireless services to be added to their sites. Not only is N-Wave helping by providing Wide Area Network (WAN) services to the region, but also additional managed services like wireless and/or Managed Local Area Networks (LAN). At the other extreme is the NOAA Office of Marine and Aviation Operations (OMAO) small site in Ketchikan, Alaska. It is being brought up using an Internet Service Provider (ISP) connection. This could become the model for other small/remote sites in Alaska and elsewhere.

NOAA National Weather Service (NWS) Sites

Planning has started for the following NWS Alaska sites to migrate to N-Wave, with installs beginning this coming fiscal year. N-Wave received the required hardware and is awaiting the new circuits to schedule the installations at these locations soon. The footprint of N-Wave's presence is continuing to grow. The expansion described above includes N-Wave adding a new Point of Presence (PoP) in Anchorage, at the Alaska Communications (ACS) North Wire Center.

Alaska Regional Office in the Anchorage Federal Building - Anchorage | Aviation Center Weather Service Unit - Anchorage | National Tsunami Warning Center - Palmer | Weather Forecast Office (Akasofu Building, University of Alaska) - Fairbanks | Weather Forecast Office - Anchorage | Weather Forecast Office - Juneau

Alaska Progress (Cont.)



The illustration above shows the augmentation to N-Wave in support of some National Weather Service (NWS) sites in Alaska

N-Wave is in the early planning stages for this project and taking steps to procure hardware for these sites. NWS has also asked N-Wave to investigate adding some of its Alaskan Weather Service Offices as well.

NWS - Low Earth Orbit (LEO) Satellite Proof of Concept Project

Satellite communications offer many advantages not available with other technologies. Satellite communications are independent from local infrastructure and; therefore, suitable for many remote and back-up applications. Satellite communications are also usually portable and can be moved and reconfigured more easily than terrestrial-based systems. However, there are many drawbacks to using conventional geosynchronous satellite communications, notably due to longer delay times, signal attenuation, interference issues and sometimes low capacity.

Recently, LEO satellite technology has become more widely available in the commercial marketplace. LEO promises much higher capacities and lower delay times by using a larger number of satellites geographically located much closer to earth than the older geosynchronous satellites. OneWeb and SpaceX's Starlink satellites are two commercial vendors with LEO networks available now, and others, such as Amazon's Project Kuiper and Telesat, are expected to be available in the near future. To determine the feasibility of using LEO-based systems for operational use, the Department of Energy, using N-Wave as a liaison, offered NWS the opportunity to construct a Starlink test system at their Automated Weather Balloon

IPv6 Metrics, Milestones & Outreach Progress

As noted in previous newsletter editions, all federal agencies must comply with the Office of Management and Budget (OMB) Memorandum ([M-21-07](#)) to complete a multi-year transitional timeline to IPv6-only networks. The migration to IPv6 is not only a federal government activity, it also impacts private industry, such as vendor providers and businesses who work with the federal government on contracts for services. Through these types of business partnerships and working with industry partners, we can more easily accomplish the milestones set by the federal government mandate requiring 80% of IP-enabled assets on federal networks to be IPv6-only by the end of FY25. In addition, it will be important for federal agencies to identify and justify federal information systems that cannot be converted to use IPv6 and provide a schedule for replacing or retiring these systems. Now that the first 20% milestone in this journey has passed at the close of FY23, next up is a 50% milestone by the end of FY24. There is a broad availability of information and resources to assist federal agencies, along with N-Wave's hosted monthly meetings bringing together the networking community to share ideas, experiences, lessons learned and to assist each other with troubleshooting tips. Robert Sears, N-Wave's Director and Chair of the Federal IPv6 Task Force, continues to lead efforts in support of the IPv6 federal government mandate. With FY23 officially at an end, the Federal IPv6 Task Force, in coordination with the General Services Administration (GSA) (the managing partner of the IPv6 initiative), has been able to accomplish progress toward several of its key goals, namely:

Hosting bi-monthly interagency meetings to share information about OMB M-21-07 | Updating the Federal Information Security Management Act (FISMA) IPv6-metric language | Hosting a Federal IPv6 summit | Continuing efforts to include more outside vendors and coalition groups | Collaborating more regularly with IPv6 transition managers | Releasing additional technical documentation and instructions for IPv6 sub-categories

The Federal IPv6 Summit was held on June 15, 2023, and showcased a wide range of IPv6-focused topics and panel discussions directed at federal agency and industry partners, including the "Federal Government IPv6 Measuring", "Zero Trust Architecture and IPv6 Technologies Panel", "IPv6 Private Sector Discussion", "Federal Agency Stories and Real-World Deployment Stories" and "IPv6 Enabling IT Modernization".

N-Wave team members, including Robert Sears, N-Wave's Director (pictured first), and both Chris Konger (pictured second) and Richard Obrien (pictured third) from N-Wave's Cloud Services team, either moderated or participated in the summit's panel discussions.

N-Wave has been busy attending conferences and meetings to raise awareness about IPv6 efforts, along with hosting its own monthly meetings and events to focus on training and resources available to federal agencies working to meet the IPv6 mandate requirements. N-Wave team members have also provided guidance and information at a meeting of the Office and Science Technology Policy's Networking Information Technology Research and Development (NITRD) program, a Department of Defense workshop, and at Cisco, Arista, Aruba



IPv6 Metrics, Milestones & Outreach Progress (Cont.)

and Carahsoft industry events. N-Wave is excited to once again be co-hosting a Birds of a Feather (BoF) session at the upcoming SC23 Conference in Denver, Colorado, on November 14, 2023. This session entitled "[Less Worrying, More Learning, More Sharing - Ways to Embrace IPv6](#)" continues the engagement from the SC22 Conference. The incorporation of IPv6 has taken on a larger role and function in the building of this year's SCinet. SCinet's IPv6 team published an article entitled "[SCinet Brings IPv6 to the Blue Bear and SC23](#)" providing more information about this objective. See p.22 for more information about SC23 and SCinet.

The N-Wave team not only met, but exceeded, the 20% IP-enabled assets milestone requirement mandated by the OMB's M-21-07 and due by the close of FY23. N-Wave ended at over 30%, which puts us in a great position to meet the 50% milestone required by the end of FY24. N-Wave's approach to meeting the 20% milestone was to first inventory everything already in place. This was relatively easy since all the devices are added to management and monitoring systems. The next step was getting the supporting systems identified and dual stacked. We identified this as being the longer step and once all included devices were dual stacked, we could begin testing the N-Wave managed devices. Since N-Wave is a network service provider, we have two aspects to consider – customer connections and our management plane. N-Wave has been able to support IPv6 routing for customer connections for a long time and customers are connected to N-Wave at either IPv6 or IPv4 based on their requirements. For N-Wave to meet the mandate, it needed to have 100% of the management plane running as IPv6-only. N-Wave elected to focus on the Enterprise Wireless Service and move its management to 100% IPv6-only. On a parallel track, we also tested migrating the Managed Local Area Network (LAN) switches as a backup plan. There were technical issues with migrating wireless which will require an architecture change to get the service on IPv6-only, so N-Wave pivoted to the Managed LAN. We ended up with a single device from each node role on IPv6-only, then tested moving from IPv4 to dual stack and then to IPv6-only. N-Wave used automation to push it to a couple of test sites, then to all sites. There were middle steps involved, including cutting up internet Protocol (IP) addressing, scraping data from the database for all connections requiring an update, using automation to push out configurations, removing old configurations, etc.

Key Drivers to N-Wave's Success

N-Wave identified a few key drivers enabling its success and these could be helpful tips for others working toward the federally-mandated IPv6-only migration.

- **When creating milestones, there should be early wins to build momentum for the teams participating in the process.** *A big shift in how engineers perceived their ability to meet the dates was noticed when N-Wave moved from an overall 20% milestone by the end of the fiscal year to focusing on a single device by a specific date. This kept everything manageable. N-Wave created milestones for getting a single device from a node role. This was a much easier target and helped engineers stay laser-focused on an individual project. When we had one device per node group, it became a scaling exercise, which is often performed with patches.*
- **Have a plan and a backup plan with clear milestones and expectations for each along with decisions on when to pivot and make a course correction.** *N-Wave initially targeted the wifi service. After running up against the originally planned decision date, we moved to the Managed LAN backup plan. If there wasn't a working test device on wireless, we quickly made the decision to pivot. Luckily, because we already had a backup plan in place, we were able to continue advancing the project. N-Wave also made plans to address automation versus manual migration. A date was established leaving enough time to test and revert if any challenges were encountered with automation. By pursuing this method, N-Wave would have enough time to manually configure changes if automation failed. Fortunately, automation worked and was used.*

N-Wave New Staff

Lauren Juanita Hines joined the N-Wave Engagement and Outreach team as a Strategic Planner Subject Matter Expert (SME) in August 2023, and previously supported NOAA's Office of the Chief Information Officer (OCIO) from 2018-2021. From 2021-2023, she served an office in the National Institutes of Health (NIH), with her team from Deloitte, in designing a new information technology strategy and establishing a Program Management Office (PMO). She brings expertise in project management, strategy development, facilitation and strategic communications. Lauren has supported federal clients, including NOAA, the Federal Emergency Management Agency (FEMA), and NIH, since 2018.

In addition, she moonlights as an adjunct instructor at Johns Hopkins Carey Business School where she teaches a graduate course in project management – and where some of the NOAA IT community's superstar program managers have visited as guest speakers. Lauren lives in Washington, DC, and spends her free time practicing yoga, dancing tango and cat sitting.



Lauren Juanita Hines

Alaska Update (Cont.)

Launch facility in Kodiak, Alaska. The system was installed and configured in January 2023 and ran for approximately 30 days. While the system was not operationally used, extensive testing and monitoring was conducted during the entire test period. The actual physical equipment installation was simple and could be done with a single technician. This began in the early days of Starlink expanding its coverage to include high latitudes, and the results reflected that with highly variable results ranging from good bandwidth to periods of no coverage.

With the great promise of LEO's for supporting many of the very remote sites in Alaska (and elsewhere) it is hoped this test can be repeated after Starlink has more fully populated its constellation for coverage in the high latitudes. Anecdotal reports of more recent uses of Starlink in Alaska describe much better results.

Alaskan Internet Exchange Point (IXP)

At the ARTIC meeting in September, N-Wave announced planning would begin for an IXP in Anchorage. Many architectural and operational details still need to be resolved, but discussions are already underway internally and with the partners involved. Having an IXP located in the state would be an advantage to all in Alaska. In addition, the placement of a Trusted Internet Connection Access Point (TICAP) in Anchorage would be a valuable asset to every federal network utilizing it in Alaska. The TICAP is in the very early discussion stage.

These regional improvements would allow Alaska internet traffic bound for the state to remain there and not have to traverse from Alaska to CONUS (Contiguous U.S.) and back to Alaska. Keeping internet traffic within the state, wherever possible, allows the traffic to move directly across the state and helps alleviate congestion on the expensive links to CONUS, while also reducing latency for all Alaska N-Wave network participants. If there is any interest in joining the N-Wave Alaska IXP project, reach out to nwave-communications@noaa.gov.

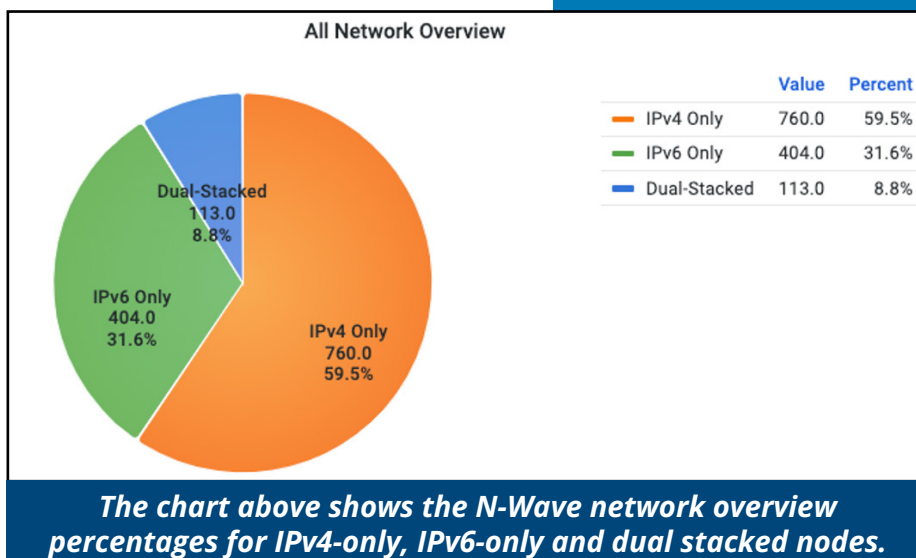
IPv6 Metrics, Milestones & Outreach Progress (Cont.)

- Leadership needs to be up-to-speed through the project to quickly make decisions to keep the project's momentum moving and to empower engineers. Leadership has to be involved throughout and deeply aware of all progress and milestones. As roadblocks or potential roadblocks were identified, they were brought to leadership for guidance and decision-making. With this type of collaboration and leadership being in sync with the project, quick maneuvering kept the project on track and its momentum uninterrupted. Leadership's involvement empowers engineers to proactively solve problems and derive creative solutions, which is key to forward progress.

IPv6 Lessons Learned

- Early on, N-Wave wanted all supporting systems, like monitoring and management systems, to be dual stacked first. An opportunity was missed for parallel tracks during this phase as we didn't plan what to do after the systems were dual stacked. N-Wave's system's team identified the system's readiness, then we were caught in a moment of "What's Next?". The key was N-Wave had a block of systems required to be ready. This enabled excuses directed at "waiting on the system's team" before moving ahead. There were many other tasks we could have initiated during this time; thereby, keeping the project's momentum and speeding up the project overall. Luckily, we had enough time in our plan to prevent any major disruptions to the project, but it was noted for future planning.
- Hidden steps always pop up - accounting for varying amounts of added time. Being prepared by knowing the key milestones and encouraging frequent check-ins during the process reduces the risk of any impact or disruption to the project. The best option here is to note these hidden steps for better planning going forward.

Following the above steps through trial-and-error and lots of lessons learned, N-Wave set an example and exceeded the FY23 mandate requirement. N-Wave provides numerous training and outreach opportunities and it is imperative we lead by example. As we moved along in this process, there were key takeaways we've shared widely with the larger federal networking and technical community. N-Wave is excited by its progress to date and is looking forward to exceeding this FY's milestone of 50%. The key to meeting a milestone is to just start the process. We've worked with many groups undecided about how and where to start, which prevents them from making any progress. Make a plan, start, adjust and move forward. Repeat as needed. When asked how N-Wave plans to finish this marathon in less than two years, the answer is to take the first step, which turns into completing thousands of steps, and finally, finishing the marathon. Just take the next step!



N-Wave Engagement & Outreach Meetings/Events

Alaska Region Technology Interchange Consortium (ARTIC) - April/May - TBD

N-Wave organized and hosted the first ARTIC meeting in Anchorage, Alaska, from September 12-14, 2023. The next meeting in 2024 will be held earlier in the year, most likely in late April or early May.

N-Wave Joint Engineering and Technical Interchange (JETI) Meetings

- JETI Technical Crosstalk monthly meetings (virtual) - Second Wednesday of each month from 2:30 - 3:30 p.m. ET.
- JETI IPv6 monthly meetings (virtual) - First Monday of each month from 3:30 - 4:15 p.m. ET.
- JETI Path Workshop (ad hoc) - TBD
- JETI Annual Meeting (virtual) - TBD

See p.27 for more specific details about JETI events.

N-Wave Stakeholders and Science Engagement Summit - May TBD

With ARTIC moving to the spring, the annual N-Wave Stakeholders and Science Engagement Summit gathering will be shifted to mid-May.

SC23 Conference - November 12-17, 2023 - Colorado Convention Center in Denver, Colorado. See p.22 for more information.

Send an email to nwave-communications@noaa.gov to be added to the invite list for information about N-Wave Engagement and Outreach events.

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