

N-Wave Engagement & Outreach Portfolio



CAPT Joseph Baczkowski,
*N-Wave's Engagement
& Outreach Portfolio
Manager*

Words have power. As the English author Edward Bulwer-Lytton in 1839 stated, *"The pen is mightier than the sword"*. More than that we need to both choose and order our words wisely and be clear about what those words mean. Engagement, (3b) emotional involvement or commitment, and Outreach, (1) the act of reaching out (3) the extending of services or assistance beyond current or usual limits. Engagement and Outreach, committing ourselves to reaching out beyond our preconceived limits.

What a somber tone to the introduction of N-Wave's newest portfolio, how about we lighten up a bit? My name is Joseph "Captain Joe" Baczkowski and I am N-Wave's newest team member and manager of the Engagement and Outreach

portfolio. My callsign has a comedic origin, which I can dive into at a later point if you care to know. But yes, I am an actual captain, a uniformed officer, a four striper, currently attached to N-Wave and assigned to NOAA since 2009, with a couple breaks thrown in between. I've worn several hats in my time at NOAA, but the first hat was, surprise surprise, as a network engineer. It is in fact my background way back in the day before dinosaurs roamed the earth. Shortly after the industrial revolution, I found myself the chief of what they called the "information office" or in the three letter acronym vernacular "CIO". Yes sir, they unknowingly put me in charge of NOAA's ships and aircraft - no one else wanted the job because aviators and mariners are a rather tough crowd to get along with, let alone try to lead.

You see back then, aircraft and ships both still used morse code and did not want to have anything to do with the high and fancy doodad called "information technology". I spent most of that time losing my hair, as I replaced the telegraph infrastructure with "I.T." Fast forward almost a decade and you see a still short but now completely bald man in a ruffled uniform. "Slightly" after we landed on the moon, I was asked to start a new office that would be in charge of something they call the "cloud". It's a fancy term that really means "do what I say and not what I do".

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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

(October 1, 2022 - March 31, 2023)

NOAA Line Offices

Office of the Chief Information Officer (OCIO)

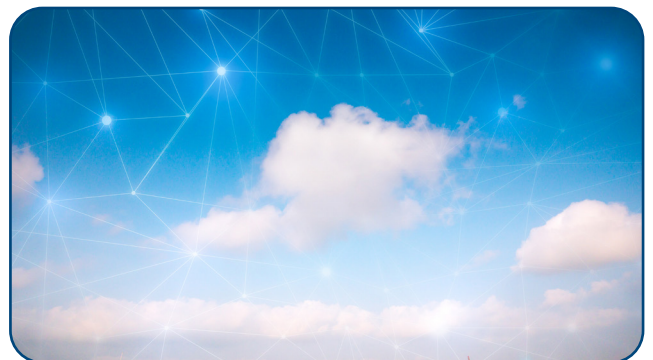
- **Virtual Private Network (VPN) Tunnel to ePaaS (enterprise Platform-as-a-Service) for Information Technology Center (ITC) Shared Services | ePaaS ITC Tunnel Migration** - N-Wave recently worked with engineers with the OCIO WOC (Web Operations Center) to expand the routing capabilities in ePaaS for the ITC tenant. Cloud Virtual Private Network (VPN) tunnels were provisioned to provide connectivity to the ITC Shared Services environment for bastian and Out-of-Band (OoB) management communication. N-Wave also coordinated with ePaaS engineers to migrate the Cloud VPN Tunnels for production ITC cloud services, from the ePaaS Unified Threat Management (UTM) Cloud firewalls, to the ePaaS Transit Gateway (TGW). This transition allowed for routing to peer directly with the cloud gateway responsible for transitive communication functions and to expand the potential for dynamic communications within the ePaaS environment.

Office of Oceanic and Atmospheric Research (OAR)

- **Expansion of Public IP Space and Provisioning of IPv6 Address Block for OAR Headquarters (HQ)** - N-Wave worked with the staff from OAR HQ to expand the IPv4 public IP space for the OAR HQ Cloud environment in Amazon Web Services (AWS). The allocation of this additional /23 public subnet, allowed for over 500 new public addresses to be provisioned for operational use across all of the OAR lab environments in AWS. Furthermore, N-Wave worked with the OAR HQ staff to provision a /40 IPv6 allocation for the OAR HQ environment in AWS Commercial for the Washington, DC, Trusted Internet Connection Access Point (TICAP) region. An initial /48 certificate of ownership has been generated by N-Wave for OAR HQ, and this certificate will be used as the artifact to prove address block ownership when the address space is imported into AWS.

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

- **Common Cloud Framework (NCCF) Development (Dev) Cloud Connectivity Expansion | NCCF Dev OoB/Management Services** - N-Wave worked with staff from both the NESDIS NCCF Production (Prod) and Dev programs to leverage the existing, dual NCCF Prod 10Gbps cloud circuits for NCCF Dev communication. This initiative allowed NCCF Dev to gain access to high capacity cloud circuits, maximized the potential for resource utilization between both programs, and implemented layer-2, sub-interface isolation to ensure independent network communications for both environments. After integrating the NCCF Dev environment into the 10G high capacity circuits for operational communication, N-Wave worked with NCCF Dev engineers to deploy Cloud VPN tunnels to the NCCF Dev cloud environment to establish OoB/Management access. This connectivity was provisioned to ensure management access to the cloud environment could exist separately and independently from the operational communication traffic.



N-Wave Cloud Services (Cont.)

National Weather Service (NWS)

- **DIS/IDP Multi-region, High-capacity Cloud Circuit Deployment | Cloud Enhancements - Meteorological Development Lab (MDL) | Cloud Network Address Block Expansion** - N-Wave worked directly with the NWS Office of Dissemination/Integrated Dissemination Program (DIS/IDP) staff to design, configure and deploy one of the most diverse/sophisticated N-Wave-connected cloud environments to date. This deployment consists of diverse, dedicated 10G Cloud circuits, landing in both AWS us-east-1 and us-east-2 regions, to provide resiliency and dual-region cloud connectivity to over 15 AWS cloud environments via a dual-region TGW topology. In addition, N-Wave worked with the NWS/MDL staff to enhance the cloud operating environments for MDL. The cloud circuit capacity for AWS us-east-1 was upgraded from 1 Gbps to 2 Gbps Direct Connects and new 2 Gbps Direct Connects were deployed to support the MDL cloud environment in AWS us-east-2. For more dynamic and transitive routing functionality, cloud environments in both regions were also upgraded from Virtual Gateway (VGW) architectures to TGW architectures. Finally, N-Wave worked to provision over 20 new public and private IPv4 address allocations and expanded BGP route peerings to support numerous cloud expansion initiatives across NWS, including Office of Water Prediction (OWP)/ Hydrologic Visualization and Inundation Services (HydroVIS), Geographic Information System (GIS) Viewer, NWSChat and MDL.

Infrastructure

- **New IPv4 Public Address Block for Cloud - Washington, D.C. Region** - Due to the high demand for public IPv4 blocks in cloud environments in this region, a new /22 public IPv4 subnet was allocated to support new customer cloud requests requiring public connectivity. IPv4 public address space is nearly 100% saturated across both NOAA and the Department of Commerce (DOC), but this allocation was made possible by successful efforts to deallocate multiple contiguous subnets from decommissioned legacy cloud systems. The next series of publicly routable address expansions will come via IPv6 adoption.
- **Enterprise AWS Landing Zone Proof of Concept (PoC)** - Extensive cloud engineering and design efforts produced a tangible AWS Landing Model (with Gateway Load Balancer (GWLB), clustered firewall and virtual Geneve interface components) to have a potential target enterprise architecture model in the event there is an enterprise-level appetite for adoption of an AWS Landing Zone.
- **Adoption of N-Wave Advanced Layer 2 Service (AL2S) Chicago Infrastructure** - The 100G N-Wave AL2S infrastructure in Chicago, IL, has paid tremendous dividends to N-Wave Cloud Operations. Since its adoption in the first quarter of Fiscal Year 2023, 32 cloud broker connections have been provisioned through Chicago, totaling 43 Gbps of cloud circuit capacity. Having established an anchor in Chicago for cloud on-ramp capabilities, east-region cloud environments now have a secondary path for redundancy, without incurring noticeable traffic latency.
- **N-Wave Cloud ICD Format Enhancements** - The ICD format for cloud network diagrams was enhanced to focus on the information regarding security elements related to the system interconnections (demarcation points, circuit connectivity, customer/provider components, etc.). This documentation enhancement improved the illustration of relational components between interconnected systems and provided customers better clarity into cloud connection topologies.

Internet Protocol Version Six (IPv6) Developments

- **Collaborative Beta Testing Initiative with Google** - The N-Wave cloud team established a collaborative beta testing initiative with engineers from Google to explore architecture options for expanding IPv6 feature support in the Google Cloud Platform (GCP) - for routing services not currently included in general availability. Progress with expanding IPv6 feature support in GCP will positively benefit agencies across the federal sector aiming to align their IPv6 adoption progress in GCP with the Office of Management and Budget (OMB) Memorandum ([OMB M-21-07](#)).

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N-Wave's IPv6 Transition Progress

Federal agencies are making progress toward meeting this fiscal year's milestone of having at least 20% IP-enabled assets on Federal networks operating in an IPv6-only environment. 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.

N-Wave's Progress

N-Wave has taken numerous actions over the last several months to provide information and assistance to the Department of Commerce's Bureaus and National Oceanic and Atmospheric Administration's (NOAA) Line Offices. These efforts include preparing an internal IPv6 Addressing Plan for new /20 recently assigned to NOAA by the [American Registry for Internet Numbers \(ARIN\)](#), allocating IPv6 address space to customers upon request and developing a plan to centralize DNS64/NAT64 technology for customer use. N-Wave network engineers continue to work toward finding solutions and offering assistance to N-Wave customers during this transition. N-Wave's made significant progress in the last six months with its internal network management migration - all network infrastructure servers are now able to support both IPv4 and IPv6 (dual stacked), which allows for the next phase of finalizing the development, testing and documentation to start migrating network management (all network device management interfaces) over IPv6-only. In parallel, the support, testing and documentation for applications is occurring.

Robert Sears, N-Wave's Director and Chair of the Federal IPv6 Task Force, has been leading multiple efforts to ramp up agency engagement efforts through one-on-one meetings, feedback surveys and training opportunities. The General Services Administration (GSA), which is the managing partner of the IPv6 initiative, has been reaching out to federal agency IPv6 transition managers and Chief Information Officers (CIO) to ascertain and document any challenges, assist with identifying solutions and to gather additional best practices and lessons learned in this initial transition phase. An IPv6 survey was also released to members for gathering information related to progress with respect to IPv6, specifically looking at assets (those transitioning to IPv6-only and those that are not), their understanding of the

IPv6 mandate (expectations, instructions, support provided and access to help) and whether the tools and resources available to federal agencies are sufficient for a successful IPv6 adoption. The culmination of this information will provide valuable feedback in assisting agencies meet this year's milestone and the remaining milestones until September, 30, 2025. Plans are also underway for the Federal IPv6 Task Force to host another IPv6 Summit this summer. N-Wave continues to lead efforts associated with the DOC/NOAA IPv6 Transition Coordination Team. The team meets monthly to discuss any additional guidance to the OMB mandate, socialize issues and concerns, and actively shares information and resources to help with the transition effort. Along with various IPv6-related presentations, an IPv6 technical training survey was recently sent to team members requesting their input on different levels of training that could be offered to assist in the IPv6 transition process. This included training on topics such as DHCPv6, address planning, security, routing and Stateless Address AutoConfiguration (SLAAC). N-Wave is making plans to offer this training in conjunction with its Joint Engineering and Technical Interchange (JETI) annual meeting scheduled for this summer (tentatively in July).

Reporting

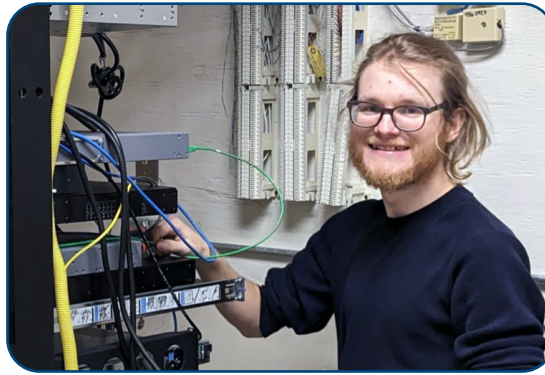
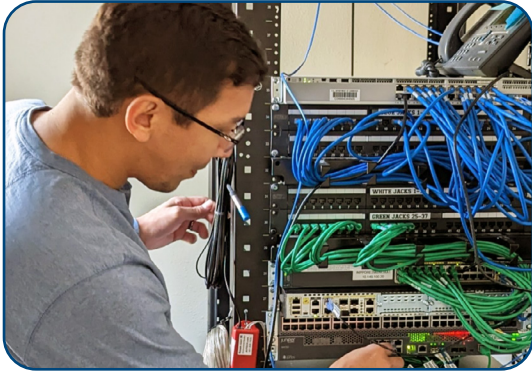
Federal Information Security Modernization Act (FISMA) systems must report their IPv6 status via the quarterly Department of Homeland Security (DHS), Cybersecurity and Infrastructure Security Agency (CISA) [FISMA reporting mechanism](#). These metrics also provided an opportunity to highlight the percentage of agency endpoints, networking devices, and input/output devices operating in IPv4 and IPv6-only environments.

Milestones

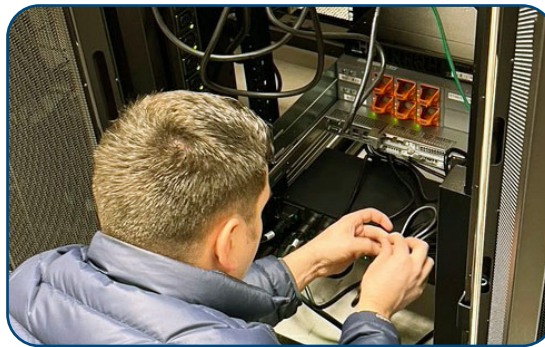
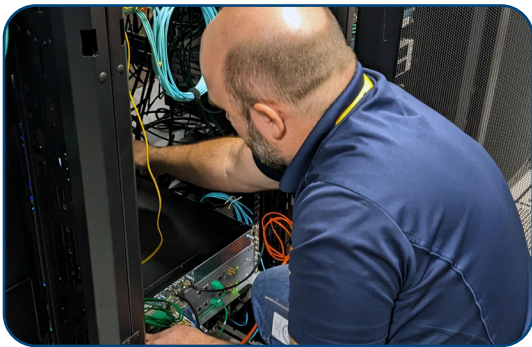
By the end of FY 2025, 80% of all NOAA IT assets must transition from IPv4 to an IPv6-only environment. NOAA's scientific mission includes sharing information globally with other stakeholders, agencies and partners. This transition is necessary to ensure the collaboration and research along these internet communication pathways can continue without interruption. N-Wave is providing leadership for transition efforts and will continue to share guidance and resources to offer best practices and assistance to NOAA Line Offices.

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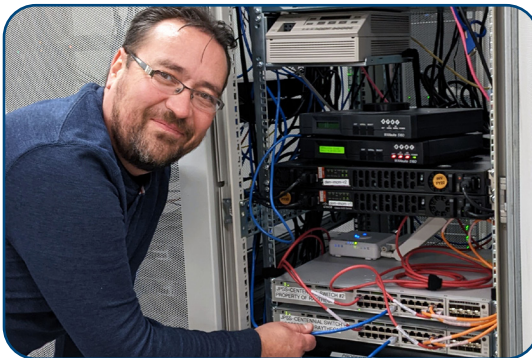
N-Wave In the Field or On the Campus



Josh Brooks (left) and Daniel Hurley (right) working on installs and upgrades on their multi-hop California trip covering Point Reyes, Oakland and San Francisco.



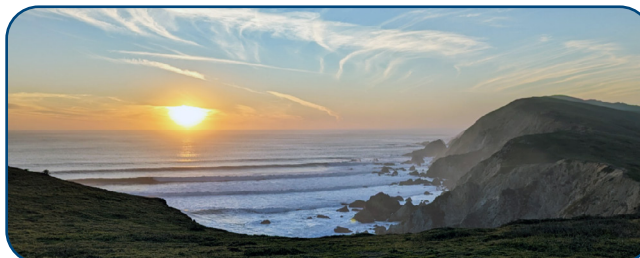
Anthony Winkler (left) and Jared Schlemmer (right) performing the physical installation for the Department of Commerce's Bureau of Economic Analysis location in Bowie, MD.



Jared Schlemmer (not pictured) and Eldar Urumbaev (pictured) performed the Centennial, CO, installation connecting the Joint Polar Satellite System (JPSS).

Josh Brooks performed this install in Phoenix, AZ, bringing the National Weather Service's supercomputer site onto N-Wave's network.

View from Point Reyes in California. Engineers get to enjoy the views after they've finished up their work. Installs are hard work but sometimes the view helps you recover!



Security Updates & New Initiatives

IPv6 Asset Discovery

It is often said the first step towards enterprise security is to know what you have. In other words, you should inventory and track all network-connected devices to ensure all devices are accounted for, authorized and subject to standard management tools and procedures. An important element of this concept is asset discovery: leveraging tools to discover which devices are connected to the network at any given time.

With IPv4, it is feasible for most enterprises to routinely scan their address space to discover network-connected devices. Due to the vastness of the IPv6 address space, for most enterprises, it is not. The N-Wave Security team leveraged its strong partnership with the N-Wave Network Operations Center (NOC) Systems team to collaborate in solving this problem. The winning solution involved the Neighbor Discovery Protocol (NDP). This component of the Internet Protocol (IP) suite can perform functions for IPv6-connected devices similar to Address Resolution Protocol (ARP) for IPv4, resulting in a mapping between physical and logical addresses. The proposed idea was to routinely poll the NDP tables of key routers across the network to obtain a near real-time list of all network-connected devices with IPv6 addresses.



We are pleased to announce the new IPv6-compatible 'asset discovery' tool is now live. It frequently polls neighbor discovery tables via Simple Network Management Protocol (SNMP) and compares all addresses observed against an authorized inventory database. Any IPv6 address not properly associated with a documented node in the inventory will generate an alarm in the N-Wave monitoring system which is then disseminated to the appropriate team for investigation and resolution. This tool ultimately provides a more accurate accounting of devices connected to the N-Wave network infrastructure, yielding a higher assurance of a stable and secure network for N-Wave customers.

Enterprise Boundary Protection (eBP) Update

For the past couple years, N-Wave and NOAA's Cyber Security Center (NCSC) have been collaborating on a joint project known as enterprise Boundary Protection (eBP). Through this project, a series of firewall policies were implemented at the network boundary, systematically ratcheting down the ports and protocols which are exposed to the internet for NOAA IP address space. Each implementation phase requires registration of legitimate needs for inbound access to specific port/protocol ranges.

Currently, with eBP phase three complete, all NOAA assets requiring inbound connections to TCP/UDP ports above 1024 must be registered and allowed through the Trusted Internet Connection Access Points (TICAP) firewalls. Phase four will expand that range to ports below 1024, with the exception of some very common ports such as HTTP/HTTPS. Compared to the completely open network perimeter just a couple of years ago, this represents a dramatic reduction in NOAA's attack surface and significantly reduces the success of post exploitation activities such as command and control for malware.

Perhaps more important than the technical milestone is the cultural one. NOAA's mission is a challenging one and this is reflected in the plethora of individual systems comprising NOAA's cyber architecture. Less than two years ago, attempts to require registration of inbound services to specific destination IPs met with limited success. Through effective and frequent communication, collaborative meetings and prompt response to reports of issues during each phase of eBP implementation, the NOAA NCSC and N-Wave have moved NOAA one step closer to a more comprehensive enterprise security posture.

N-Wave Engagement & Outreach Portfolio (Cont.)

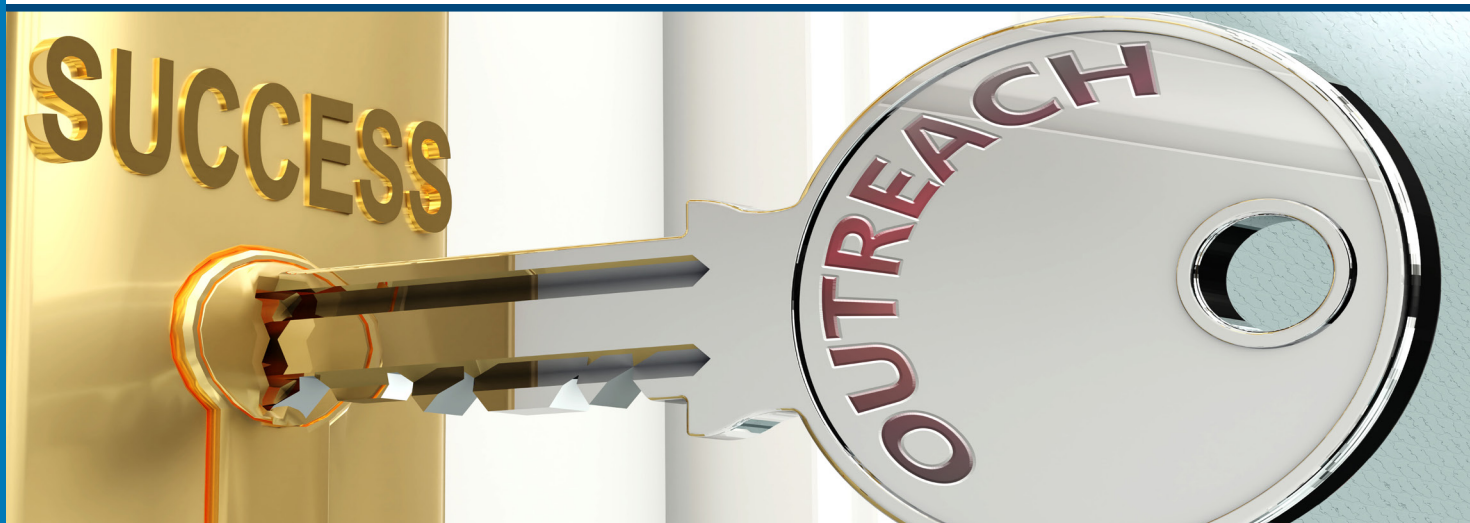
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I had no real office so to speak, I was invited to meetings but no one knew my name, I was the Man in Black (or usually in blue), a shadowy figure standing just out of view, visible only by looking out of the corner of your eye. That is where Robert Sears, N-Wave's Directory, discovered me. Did you like that fictional work? I'm starting an Amazon book store and I plan to publish the first of a multi-part series soon. Really I mean it.

In reality, I have known Robert and the N-Wave program for many years. We migrated the majority of the ship and aircraft network infrastructure over to N-Wave while I was at OMAO. There were two significant N-Wave projects in my mind that stand out, the pier in San Diego where the NOAA ship Ruben Lasker tied up and the move of the NOAA aircraft hanger from MacDill Air Force Base to the Lakeland Regional Airport in Florida. I can write volumes on how instrumental N-Wave was to those projects and continuing NOAA's mission.

N-Wave's Engagement and Outreach portfolio is really the culmination of a Series of Unfortunate Events. Oops! I had NetFlix running in the background there, sorry about that. It's the result of years of individual efforts and ad hoc outreach as well as through events like the annual N-Wave Stakeholders and Science Engagement Summit. N-Wave's stakeholder audience has grown as much through word of mouth as through direct engagement. While N-Wave has a great team willing to help in a variety of ways, the increasing scale and number of N-Wave led events, such as the Joint Engineering and Technical Interchange (JETI) events, including the monthly technical crosstalks, an annual meeting and ad hoc one-day workshops along with the new Alaska Region Technology Interchange Consortium (ARTIC) working group, has accumulated to the point where more dedicated resources and full-time leadership were needed. Thus, the creation of N-Wave's Engagement and Outreach portfolio (E&O for short).

Now that I have a couple of N-Wave Stakeholder Summits under my belt (I was a Stakeholder attendee at the first one in 2019) along with a handful of JETI meetings, I can absolutely say this is hard work! By the time this newsletter is released, we'll be knee deep in planning N-Wave's ARTIC meeting along with the annual JETI virtual conference. See what I mean? It's like dealing with your OWLs (Ordinary Wizarding Level for you muggles) while learning to play quidditch. I'm excited to work with such a fantastic organization, there are very few programs within NOAA that have such a stellar reputation across the agency and beyond. Stay tuned for more information and comedy relief as the E&O infection, err, I mean as we continue to organize and define our place within the N-Wave family.



N-Wave Cloud Services (Cont.)

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Department of Commerce (DOC) Bureaus & Offices

Bureau of Industry and Security (BIS)

- **Dedicated Circuit/Cloud Environment** - N-Wave worked with BIS staff to deploy a dedicated circuit to the BIS facility in Manassas, VA, and provision two ExpressRoutes (ERs) into the BIS cloud environment in Azure to support large dataset transfers from on-premise to cloud.

National Institute of Standards and Technology (NIST)

- **Cloud Connection Capacity Expansion for NIST in Amazon Web Services (AWS)** - To stay out in front of the growing circuit capacity needs for the NIST cloud environments, N-Wave worked directly with NIST to expand the cloud connection capacity for each of the (4) primary cloud environments. The capacity for the AWS East Com connection was expanded to 5 Gbps, where capacity for the East Gov and West Com/Gov connections were each expanded to 2 Gbps.
- **Cloud Connectivity Expansion for multiple NIST Environments** - Extended coordination between N-Wave and NIST staff resulted in the deployment of cloud connect circuits for multiple NIST environments, including for Enterprise Cybersecurity Monitoring & Operations (ECMO), Enterprise Cybersecurity Continuing Diagnostics (CDM) and Mitigation (ECDM) and the National Cybersecurity Center of Excellence (NCCoE). The cloud connect circuits encompassed (2) for NIST ECD using 1Gbps circuits for AWS and (6) for NIST NCCoE - 2Gbps circuits for AWS and 1Gbps circuits for Azure/GCP.

United States Patent and Trademark Office (USPTO)

- **Increased Cloud Connection Capacity and Infrastructure Enhancements for USPTO Cloud Environments** - Extensive coordination between N-Wave and USPTO resulted in a number of substantial cloud infrastructure advancements. The cloud connect circuits for the USPTO AWS cloud environment were upgraded from two 1G AWS Direct Connects to two 2G AWS Direct Connects, to keep pace with the rapidly growing cloud circuit capacity needs for USPTO. N-Wave also coordinated a sizable effort to migrate all of the secondary-region cloud connections for USPTO in AWS, Azure and GCP from Denver to Chicago. The swing of these secondary-region cloud connections shaved approximately 50 milliseconds off of response times for data communication and established an alternative region for diversity and high availability with a negligible increase in response times.
- **Consolidation Into Cloud Hub Environments** - Through collaborative coordination between N-Wave's cloud engineers and USPTO staff, USPTO successfully integrated multiple environments into consolidated cloud environments leveraging hub topologies and consolidated connections. This consolidation reduced the number of cloud connections USPTO required to support operations.

Office of Financial Management (OFM) | Business Applications Solution (BAS)

- **Cloud VPN Tunnels** - N-Wave staff worked with BAS engineers to provision cloud VPN tunnels to provide connectivity to BAS cloud environments in AWS Government-East and Oracle Cloud Infrastructure (OCI) Gov-East for both production and development systems. Advanced coordination occurred between engineers from N-Wave, BAS and the National Institutes of Health (NIH) to establish N-Wave and the network translation and routing infrastructure to support bi-directional communication flows between NIH and BAS cloud systems.



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

N-Wave, NOAA's network service provider, hosts a series of regular JETI meetings throughout the year geared toward fostering collaboration and the sharing of ideas within the Department of Commerce and other federal agency network engineering communities. These meetings are described in more detail below:

JETI Annual Meeting (tentatively scheduled for July 2023)

The annual N-Wave JETI meeting will be held virtually this summer (tentatively in July). More information and details will be forthcoming, but we anticipate opportunities for training on a variety of IPv6-related topics and sessions focused on cloud services, N-Wave updates and other networking subject matter as requested from feedback received by attendees at previous JETI meetings.

JETI Technical Crosstalk Sessions (monthly)

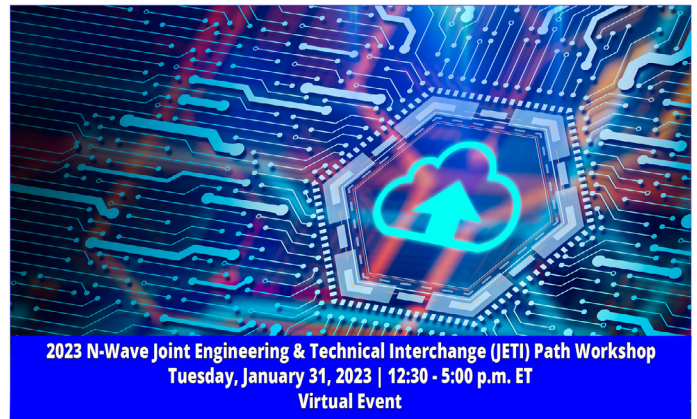
N-Wave hosts a one-hour JETI Technical Crosstalk session each month. These Google Meet virtual sessions provide a forum for all who use N-Wave to raise issues and concerns, discuss questions and problems and generally share ideas in a collaborative manner with other participants on the call. Technical Crosstalk is held on the second Wednesday of every month from 2:30-3:30 p.m. Eastern Time. In addition to the monthly meeting, a Google Space was created to foster ad hoc conversation outside of the monthly Google Meet session. If you would like to be invited and receive the calendar and Google Space invitation, please send an email to nwave-jeti@noaa.gov.

JETI Path Meeting (ad hoc)

The 2023 N-Wave JETI Path Workshop was held virtually on Tuesday, January 31, 2023. More than 100 attendees registered for this event to hear from informative speakers imparting their knowledge about a variety of cloud-related and other networking topics, including presentations on "AWS Control Tower Onboarding - A Technical Explanation"; "Leveraging Cloud PaaS over IaaS"; "Understanding Cloud Accreditation Status"; "FedRAMP and the SCRA"; "AWS Landing Theory of Operation"; and, "N-Wave's IPv6 /20 Addressing Plan". You can access information about a variety of JETI events by visiting the following sites:

- [NOAA JETI Meetings public webpage](#)
- [N-Wave JETI internal site](#) (NOAA Google account required)

JETI is intended to be community-driven both, in areas of interest, and contribution of content. The survival of future JETI events relies on active participation among its members. If you have an interest in leading any sessions at a future ad hoc JETI Path event or would like to become a JETI member and be added to the invite list for information about upcoming events, send an email to nwave-jeti@noaa.gov.



Notification Subscription Portal Update

With a year's worth of experience on the new notification subscription portal, N-Wave is working on enhanced updates to make selections easier for the customer.

"Location" Drop-Down Box Adjustment

The most notable update anticipated to happen in the coming summer months is to the information included within the "Location" drop-down listing, one of the three primary drop-down listings a customer can select when creating a new notification rule alert. The other two choices are "FISMA ID" and "Service".

The "Location" drop-down box will still be labeled the same, but the enhancement includes grouping individual locations into localities. For instance, the current version of the notification subscription portal provides several choices from the drop-down listing for the same city, which can be confusing when a customer is trying to identify the correct site within that city.

The locality change would make that appear as one choice. Along with the other two available choices - "FISMA ID" and "Service" - we believe the change to the "Location" listing will assist customers with narrowing down the best information for their notification rule selection.

When the change is implemented, customers will not be asked to take any action - all previously created notification subscriptions will automatically be updated with the new locality information.

Currently there are 294 notification subscribers, including individuals and distribution lists. To access or register for the Notification Subscription Portal, visit notifications.nwave.noaa.gov.



N-Wave Lab Update

The N-Wave lab has deployed a network to mimic N-Wave's production network as closely as possible. This includes everything from the 400G Ethernet core routers all the way to the edge routers and switches N-Wave installs at customer facilities.

One of the key uses of the lab is to test changes before they are applied to the production network. The most consistent change occurring on network devices is software upgrades. N-Wave regularly performs software upgrade maintenance as vendors release updates, primarily related to security, stability or new features.



N-Wave recently established a system in the lab to help automate a portion of the testing process. N-Wave uses this automation in pre-and post-upgrade simulations to verify system upgrades. Comparison operators are then used to confirm operational parameters performed as expected.

Overall, this testing framework saves engineers time while also improving accuracy. Previously, network engineers would have a checklist and manually check all of these items to confirm the upgrade completed as expected. As N-Wave looks to the future and the anticipated growth of its network, additional actions performed often in the lab by network engineers are being evaluated to determine if automation is a tool that can be used to reduce manual processes for testing and improve the efficiency of the lab.

SC22 Birds of a Feather (BoF) Session

The Association for Computing Machinery (ACM) and Institute of Electrical and Electronics Engineers (IEEE) organized the **SC22 Conference** (formerly known as the Supercomputing conference), held from November 13-18, 2022, in Dallas, TX. Along with a wide variety of technical sessions, workshops, panels, exhibits and the building of SCinet (the SC's high-capacity network and one of the largest in the world for the conference week only and with just over 5 Tbps capacity), the conference included two days of interactive Birds of a Feather (BoF) sessions on topics such as the Department of Defense's High Performance Computing (HPC) Modernization Program, the European HPC Ecosystem, and the ethical concerns of coupling Artificial Intelligence (AI) with HPC systems, among other relevant topics from around the world.



Robert Sears, N-Wave's Director and Chair of the Federal IPv6 Task Force, co-hosted a BoF entitled "Global Migration to IPv6 and Real World Applications" for an estimated 35 participants on Tuesday, November 15, 2022. Ron Bewtra, former Chief Technology Officer for the Department of Justice and now the Vertical Director for Leadership Computing at Hewlett-Packard Enterprise (HPE) joined Mr. Sears as a session leader. The BoF was provided for SC22 attendees who wanted to learn more about IPv6 and IPv6-only networking.

With the world transitioning to IPv6 - many Internet Service Providers (ISPs) are now seeing over 50% of their traffic via IPv6 - this BoF provided a brief summary of the transition to, and exploration of, the current state of IPv6-only networks. At SC22, SCinet turned on IPv6 over its WiFi and saw 35-55% of the traffic move to IPv6. Going forward, HPC, other systems and networks of all sizes will see the implications and impact of the movement toward an IPv6-only environment. During this BoF, dynamic quick talks on IPv6 themes surrounding global impacts, real world applications, best practices, and lessons learned guided a robust and interactive discussion with the audience.



Network Changes and New Participants

(October 1, 2022 - March 31, 2023)

N-Wave Upgrades

- **NOAA Daniel K. Inouye Regional Center (IRC) - Honolulu, HI** - N-Wave updated the network infrastructure at the IRC, which supports the Hawaii region for all of NOAA, and provided an increase to the region's capabilities.
- **NOAA Environmental Security Computing Center (NESCC) - Fairmont, WV** - N-Wave removed the legacy GuestLAN and Voice over Internet Protocol (VoIP) systems in NESCC.

National Marine Fisheries Service (NMFS) - Silver Spring, MD

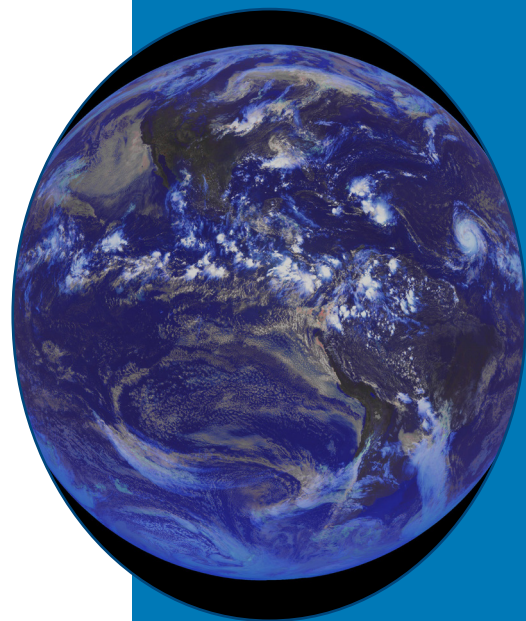
- **NMFS Data Center** - NMFS relocated their data center from the 12th floor to the fifth and seventh floors in the Silver Spring Metro Campus (SSMC). N-Wave helped facilitate this move and patched connections to ensure NMFS could remain operational in their new space.

Office of Marine and Aviation Operations (OMAO)

- **University of New Hampshire Judd Gregg Marine Research Pier - New Castle, NH** - N-Wave provided Wide Area Network (WAN) and Managed Local Area Network (LAN) solutions for OMAO at the shared pier.
- **SSMC - Silver Spring, MD** - As part of the NOAA restack effort at the SSMC, OMAO relinquished space in their former office building and moved into the SSMC. N-Wave turned down the wireless service and removed all equipment from the previous OMAO office space and worked with OMAO to develop the networking to facilitate its move into the SSMC.
- **New England Marine Support Facility - Middletown, RI** - N-Wave provided WAN and Managed LAN solutions for OMAO's Middletown site.
- **Marine Operations Center - Atlantic (MOC-A) - Norfolk, VA** - OMAO was able to complete the cabling required for the N-Wave enterprise wireless to be installed in MOC-A. N-Wave completed the enterprise wireless install and the service is now offered throughout this facility.

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

- **Space Weather Prediction Center - Boulder, CO and Ashburn, VA** - N-Wave facilitated connectivity between GOES-R and the SWPC at these two locations.
- **NASA John C. Stennis Space Center - Stennis, MS** - N-Wave installed its enterprise wireless solution inside the Mississippi State University building on NASA's campus for use by NOAA customers at this location.
- **NASA's Goddard Space Flight Center (GSFC) - Greenbelt, MD** - N-Wave created an aggregation site at GSFC to support the Deep Space Climate Observatory (DSCOVR) program and the Joint Polar Satellite System (JPSS).



Continued on p. 21

N-Wave NOC Metrics & Updates

(October 1, 2022 - March 31, 2023)

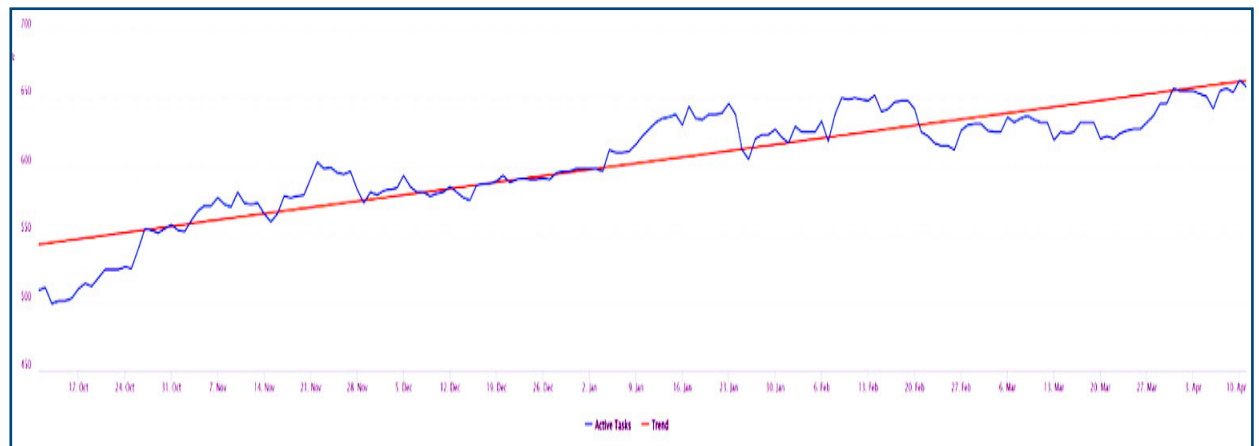
N-Wave partners with the Global Network Operations Center (NOC) at Indiana University to provide advanced network operations, offering support 24 hours a day, 365 days a year and is integrated within the N-Wave Federal Information Security Modernization Act (FISMA) high system controls. N-Wave NOC support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

Support metrics gathered from October 2022 through March 2023 indicate the N-Wave NOC opened 16,695 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 (35%) and communication records (46%) make up the bulk of those tickets, while incidents and changes together account for the remaining 19% of tickets.

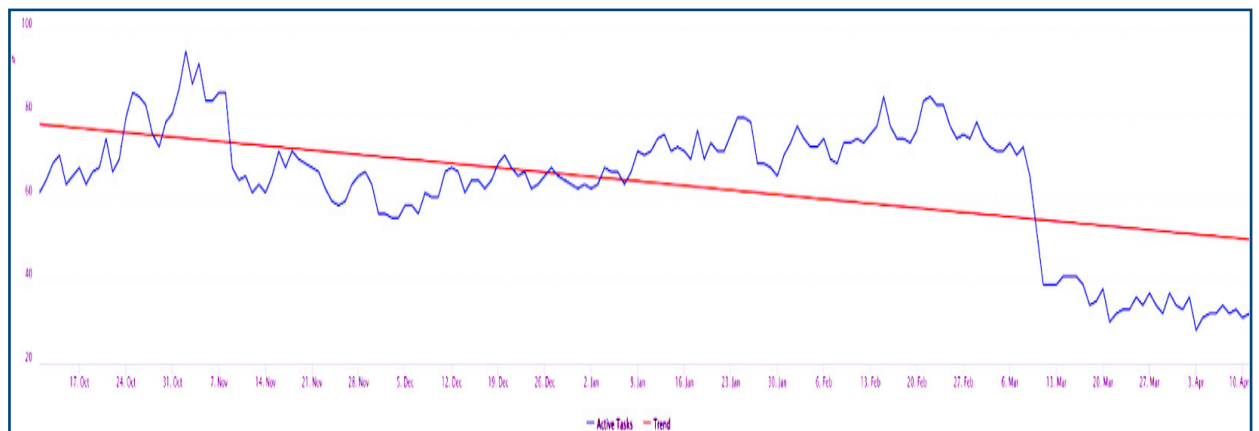
Trends in Requests and Incidents

The trend lines for customer requests and for incidents is slightly increasing, reflecting the growth of the network; however, a recent initiative to resolve issues related to long-standing non-service impacting incidents is reflected towards the end of the incidents chart for this period in a large drop in overall active tickets. This was the result of a recent ticketing process update meant to assist with ticket engagement. This resulted in a sudden decrease in overall open tickets, but we expect the overall trend to increase in the future. (In the two graphs below the value of vertical axes are incident counts).

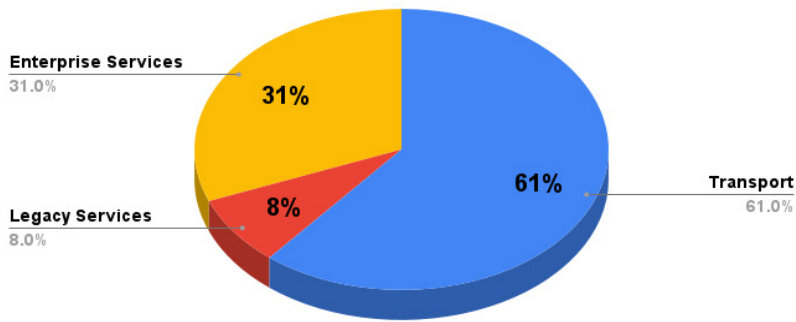
The Active Requests metric below shows the trend of all catalog tasks active on any given day.



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



N-Wave NOC Metrics & Updates (Cont.)

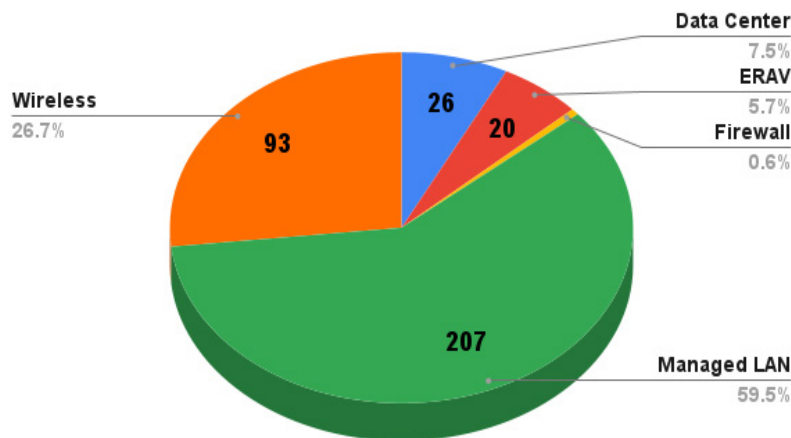
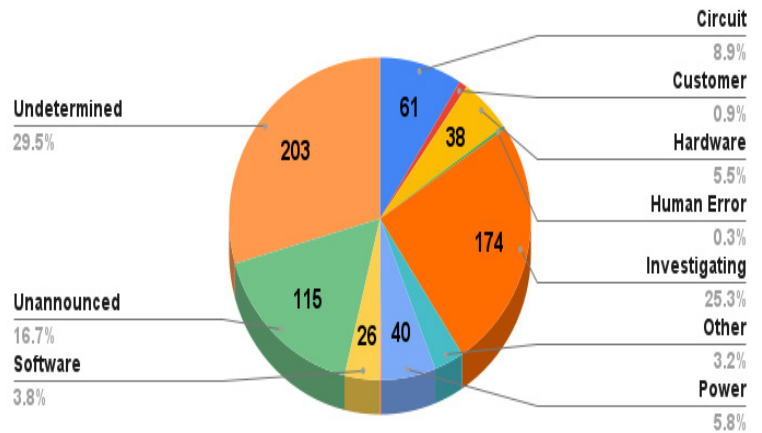


Incidents by Service Portfolio

This graph represents 1,132 total incidents, broken down by service portfolio: N-Wave Transport, N-Wave Enterprise Services and NOAA Silver Spring Legacy Services. The Legacy Services' pie chart wedge continues to shrink.

Transport Incidents by Category

This graph shows 688 total Transport incidents, broken down by category. 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.

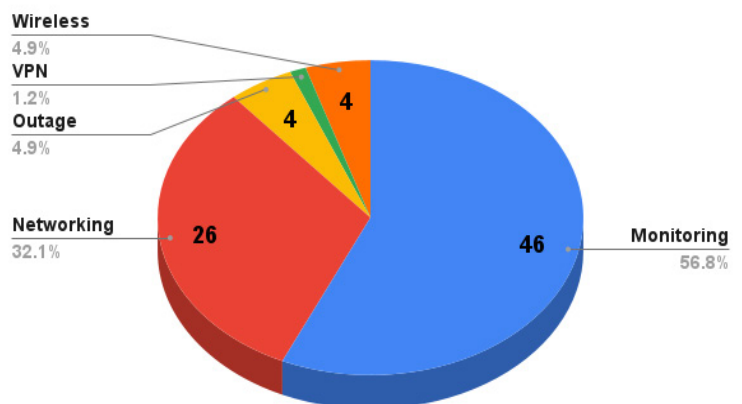


Enterprise Service Incidents

This graph shows the 355 total incidents related to N-Wave Enterprise Services, an increase from last period, broken down by specific service: Data Center, Enterprise Remote Access VPN (ERAV), Enterprise Wireless, Managed LAN and Firewall.

Legacy NOC Incidents by Category

This graph shows 89 total incidents related to NOAA Silver Spring Legacy NOC, broken down by category: Outage, Networking, Wireless, VPN and Monitoring. This is down from 146 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 Enterprise Services Updates

(October 1, 2022 - March 31, 2023)

N-Wave Services Team

The N-Wave Services team consists of engineers across multiple disciplines, including switching, routing, firewalls, network architecture and design, wireless, cabling infrastructure and associated support across the portfolio. The N-Wave Services team, as with all N-Wave portfolios, consists of highly skilled professionals with a rich diversity of backgrounds, experiences and approaches. These bring great influence to the value of N-Wave services. Each member of the team brings a unique set of skills, knowledge and perspective to every project. Cross training and information sharing is critical to the success and growth of the team. Engineers are always looking for ways to improve implementations and deployments as well as staying up to date with technology and industry trends. The team is spread out across multiple locations - Colorado, Maryland, Seattle, South Carolina, Virginia and West Virginia - giving extensive coverage at major campuses to provide quick responses.

Enterprise Remote Access Virtual Private Network (VPN) - (ERAV)

N-Wave is excited to announce ERAV supports Internet Protocol Version 6 (IPv6) tunnel termination with dual stack, Internet Protocol Version 4 (IPv4)-only or IPv6-only VPN IP assignment. VPN tunnel termination refers to the connection made from the user to ERAV. This establishes the actual VPN connection. VPN IP address refers to the address assigned to the client while connected to ERAV.

N-Wave now offers the ability for VPN tunnel termination to operate over IPv4 or IPv6 based on the IP address the user is assigned before they attempt to connect to VPN. For instance, if a user is connecting to ERAV from a home network and the user's ISP has assigned an IPv6 address, the VPN tunnel can establish over IPv6. The default behavior is to prefer using IPv4. Users can find out details about updating their preferences so IPv6 is preferred with IPv4 as the fallback by using the email address provided. This has no impact on the VPN IP users are assigned.



For more information, contact the N-Wave Network Operations Center (NOC) via email at nwave-noc@noaa.gov. In order to get dual stack or IPv6-only VPN IPs, a service ticket needs to be opened with the N-Wave NOC ([complete the Request for Service Form here](#)) and VPN engineers will update the settings.

For the N-Wave engineering VPN group, an IPv6-only group was created allowing testing from a client that only has an IPv6 address. When N-Wave is planning to implement new capabilities, like IPv6-only management of network devices, this VPN group can be used to test the experience from an IPv6-only client.

Posture Control

N-Wave continues to move groups to posture control, which is technology that verifies whether a user is on a Government Furnished Equipment (GFE) computer. Using a method of monitor-only mode in the beginning ensures the majority of issues can be resolved prior to enforcing posture control for the group. N-Wave appreciates the teamwork with customer VPN administrators during the roll-out with respect to troubleshooting any issues. This has greatly contributed to the success of this project.

Hawaii ERAV Node

The ERAV node in Hawaii is in final testing mode and N-Wave plans to turn up production in the near future. When the ERAV in Hawaii is cleared for production, N-Wave will notify all VPN administrators via email with details about how to use the new node. N-Wave appreciates the groups currently working with us on testing.

N-Wave Enterprise Services Updates (Cont.)

Managed Local Area Network (LAN)

IPv6 Testing - Management Plane

The N-Wave Services team is actively testing and adopting IPv6-only for the Managed LAN switches. As part of these testing efforts, a test switch has been set up with an IPv6 management address. The purpose of this test is to identify and resolve issues that may arise when the switch management traffic is migrated to IPv6-only.

N-Wave's Transport and Service teams worked closely together to establish IPv6 routing on the N-Wave backbone network specifically for VRF management. Collaborative efforts included coordinating with the System team to ensure RADIUS, SNMP and SSH servers were supporting IPv6. With these efforts, N-Wave has successfully been able to manage the test switch with IPv6.

Currently, all of N-Wave's Managed LAN switches are IPv4. As we move forward, the plan is to configure them to be dual stack before they become IPv6-only. The next phase of testing involves configuring a switch with both IPv4 and IPv6 management addresses. N-Wave will conduct the test and gather results to ensure its adoption of dual stack will be effective.

Look for updates in the next edition of the "N-Wave News" newsletter.

ERAV

65 VPN groups

6 NOAA Line Offices use ERAV

2 Other Federal entities use ERAV

10,000 + registered users

Firewall

7 Service locations spanning the U.S.

17 Firewalls including cloud firewalls

29 Virtual firewall instances

Managed LAN

48 Service locations spanning the U.S.

5 NOAA Line Offices use Managed LAN

375+ Switches

Wireless

35 Service locations spanning the U.S.

17 States with service locations

1,050+ Wireless access points



N-Wave Stakeholders Summit Recap

N-Wave's Stakeholders and Science Engagement Summit was held March 28-30, 2023, in Silver Spring, MD. This hybrid (both in-person and virtual) three-day event provided more than 200 participants with opportunities to learn, collaborate and share ideas about a variety of networking topics. The Stakeholders Summit is part of N-Wave's continuing efforts to engage network stakeholders in strategic discussions, including capacity planning for shared network resources, and to look at challenges and opportunities for future network-related growth.

With an exceptional opening keynote presentation by Dr. Michael Morgan (NOAA Assistant Secretary of Commerce for Environmental Observation and Prediction) and subsequent guest speaker presentations over the three days by Zachary Goldstein (NOAA CIO), Doug Perry (NOAA Deputy CIO), Zachary Schwartz (DOC Deputy CIO, Office of the Secretary), André Mendes (DOC CIO) and Ryan Higgins (DOC Deputy CIO/CISO), attendees were regaled with lots of great information about the direction of federal government initiatives and the importance of networking security to protecting our national interests and the program-specific missions of each federal agency.



N-Wave Team

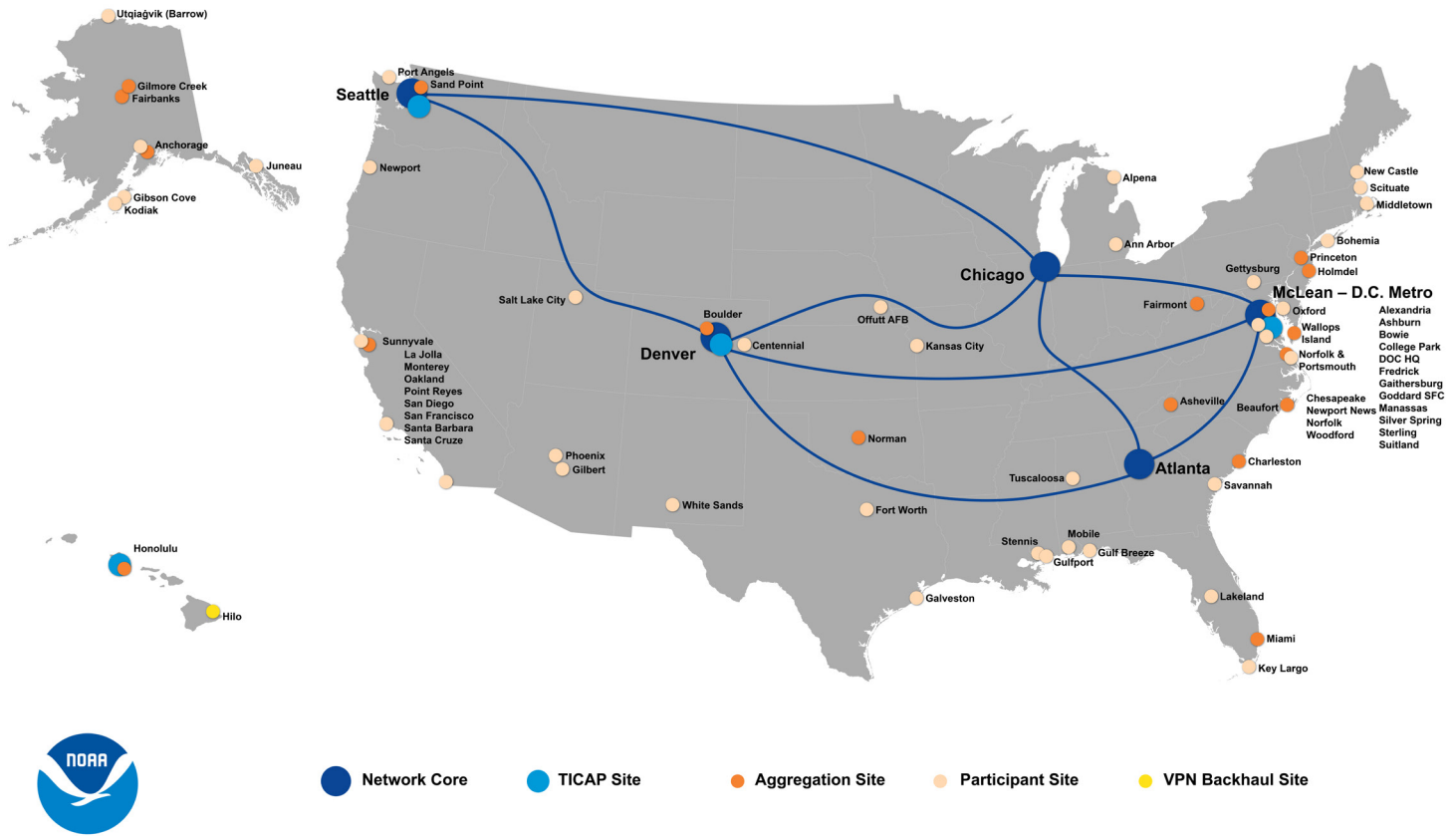
Additional speakers from across NOAA Line Offices and Department of Commerce Bureaus gave insights into future projects for network services and the strategies aligning with each program's mission. Two informative panel discussions with speakers from a variety of backgrounds and experiences were also held - one on low earth orbit (LEO) satellites and their roles in support of NOAA's mission and another on cloud services and its potential. Attendees also heard from other speakers about the annual conference on supercomputing (SC23), and how it builds the world's largest computer network (SCinet) every year, along with the challenges for broadband access in many parts of Alaska, to include the innovative work being done in the Yukon Kuskokwim Delta by tribal citizens connecting to new technology.

Attendees this year were also treated to several live mission spotlights from Hawaii to the northernmost Alaskan city in the U.S. and several places in between. These mission spotlights showcased a weather forecast office; atmospheric baseline observatory; the Inouye Regional Center on Ford Island in Joint Base Pearl Harbor-Hickam, a national historic landmark site; an aircraft operations center; a national geodetic survey field site; NOAA's enterprise data center and N-Wave's own network operations center. We thank all of those who attended or spoke at this year's event and are looking forward to next year's summit, where we'll have another schedule full of great speakers and interesting topics.

Stakeholder Summit Speakers, Panelists and Attendees Learning, Collaborating and Sharing Information



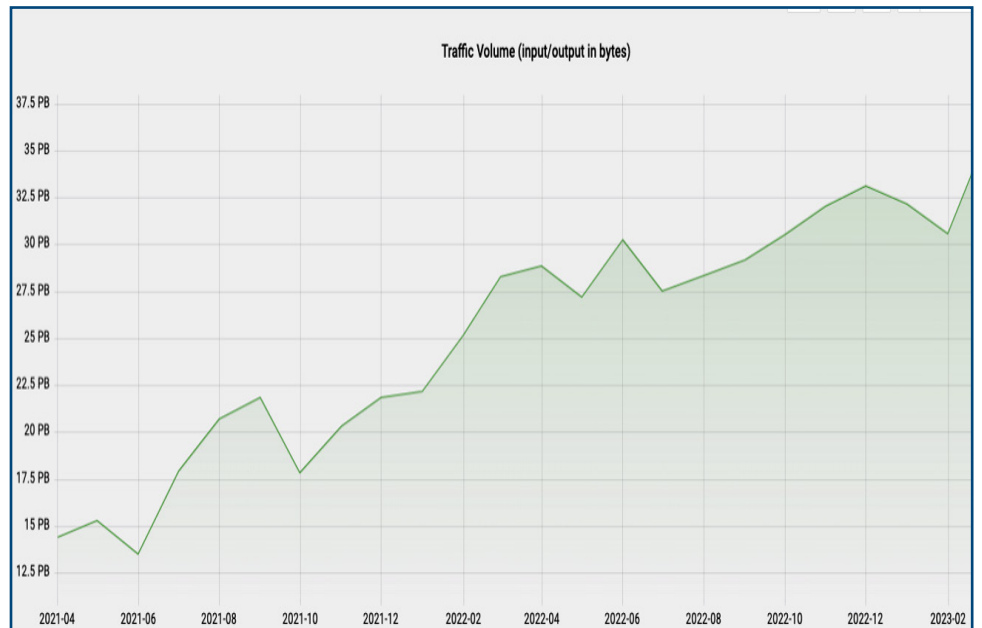
N-Wave Map



N-Wave Network Performance Metrics

As mentioned in past newsletters, N-Wave will be updating the “Traffic Volume” graph for each newsletter with the start date remaining in April 2021. This provides a cumulative timeline for network traffic information. For reference, the cumulative total from N-Wave’s inception through March 2021 can be found on [page 15 of the spring 2021 newsletter](#).

Please note from October 17, 2021 - November 8, 2021, there was an issue with data collection - it’s the reason for a slight decrease during that specific time period. Traffic continues to grow.



In the graph above, N-Wave traffic has more than doubled from April 2021.

Network Changes and New Participants (Cont.)

Continued from p. 13

- **Defense Meteorological Satellite Program (DMSP) - Fairbanks, AK, Suitland, MD and Denver, CO** - N-Wave worked with NESDIS to develop peerings at the three locations to support the DMSP Ground System Comms Refresh project.
- **Joint Polar Satellite System (JPSS) WAN Migration** - JPSS migrated all the CONUS 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: NSF Antarctic Program - Centennial, CO; NASA White Sands Complex (WSC) - White Sands, NM; and, the 557th Weather Wing, Offutt Air Force Base (AFB) - Bellevue, NE.

National Ocean Service (NOS)

- **National Centers for Coastal Ocean Science (NCCOS) - Beaufort, NC, Charleston, SC and Oxford, MD** - N-Wave increased the area covered by the enterprise wireless footprint within the three NCCOS laboratory locations.
- **Office for Coastal Management (OCM) - Charleston, SC** - N-Wave provided Managed LAN and N-Wave enterprise wireless services for the OCM offices.
- **Office of National Marine Sanctuaries (ONMS) - Point Reyes, CA and Savannah, GA** - N-Wave removed NOS and N-Wave equipment from the existing location in the National Park Service building and extended the WAN circuit into ONMS' building. While conducting this operation, N-Wave installed enterprise wireless at the site. N-Wave also installed WAN at ONMS' Savannah site which is co-located at the University of Georgia.



National Weather Service (NWS)

- **Weather and Climate Operational Supercomputing System (WCOSS) - Phoenix, AZ and Manassas, VA** - N-Wave established redundant connections to each of the two NWS operations supercomputers.

NOAA Western Regional Center (WRC) - Seattle, WA

- The N-Wave team replaced the existing wireless access points at WRC with new Aruba access points.

Department of Commerce Bureau of Economic Analysis (BEA) - Bowie, MD

- N-Wave brought up redundant connections to this BEA site.

N-Wave's IPv6 Transition Progress (Cont.)

Continued from p. 4

IPv6 Transition Resources

Federal IPv6 Task Force

For federal staff, additional resources, including templates, tools, and training resources are available on the [IPv6 Federal Task Force OMB MAX webpage](#).

These materials are available to those with .gov or .mil email addresses. Information about the Task Force is maintained through both the Fedv6 Deploy listserv and the CIO Council's Cloud & Infrastructure Community of Practice (C&I CoP). To contact the Task Force directly, send an email to dccoi@gsa.gov.

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

- [NOAA JETI Meeting Public Website](#)
- [N-Wave Internal Google Drive](#) (NOAA Google account required)

N-Wave's Internal Management & Monitoring Systems Now Support IPv6

Over the last year, software developers, system administrators and network administrators have been transitioning management and monitoring systems to support and use IPv6 on the N-Wave network, in furtherance of following best practices, and with the mandate established by [OMB M-21-07](#).

The management and monitoring systems are now viable over IPv6 and IPv4, and the N-Wave Network Operations Center (NOC) has started transitioning network equipment to IPv6-only management. N-Wave's network engineering groups are developing deployment and transition processes to take full advantage of native IPv6 management capabilities. An example is doing asset discovery using IPv6's Network Discovery Protocol.

Even before we began this effort, the N-Wave management network was able to provide IPv6 routing to supporting tools and systems. Much of the underlying software already supported IPv6, but network management was over IPv4. IPv6 was intentionally disabled, in part to simplify management configuration and reduce potential attack surfaces. Integrations between the internal network management database and various systems such as authentication, alerting and statistics collection have been expanded to include the existing IPv4 support, IPv6 support, and as a transition mechanism, mixed IPv4 and IPv6 support.

Planned investment in IPv6 support for network management tools and infrastructure is enabling N-Wave to stay ahead of targets set by OMB M-21-07, and help define best practices for the wider networking community.

N-Wave In The 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:

- **Robert Sears**, N-Wave’s Director, was named chair of the [Federal IPv6 Task Force](#) in early 2022. This complements his leadership of the NOAA/Department of Commerce IPv6 Transition Coordination Team.
- **Jeffery Bowmar**, N-Wave’s Federal Cloud Services Manager, participates on the General Service Administration’s (GSA) Cloud & Infrastructure Community of Practice Committee.
- **Robert Sears** is also [Co-Chair of the Cloud & Infrastructure Community of Practice \(CoP\) Executive Committee](#) with the U.S. Chief Information Officers Council. This committee provides leadership to the CoP by directing topics of discussion, providing resources to support CoP efforts and promoting the CoP to the wider federal community.
- **Jeffery Bowmar** was a featured speaker on a *FedInsider* webinar entitled [“Supporting IPv6 in a Cloud Environment”](#) on April 20, 2023. The webinar brought together thought leaders from the government and private industry to discuss the role of IPv6 in a cloud environment and how to maximize its benefits.
- **Several N-Wave team members** are participating in this year’s SCinet - the group that builds the network for the annual [International Conference for High Performance Computing, Networking, Storage and Analysis \(SC23\)](#). This year’s conference is scheduled from November 12-17, 2023, in Denver, CO.
- **Robert Sears and Paul Love**, N-Wave Special Projects Consultant, helped with the planning for [GSA’s High-Performance Computing Summit](#) held on April 20, 2023. The summit featured panels of experts discussing how HPC is being used and how it can help to drive innovation. Robert Sears moderated the Military/Defense panel showcasing the Department of Defense’s HPC program and discussing how defense priorities and readiness are actively affected by HPC technologies and capabilities.



Alaska Progress

N-Wave is working with various NOAA Line Offices to support their activities in Alaska. N-Wave is also working with various indigenous tribal nations along with the State of Alaska Broadband Office to identify locations where a NOAA mission, say to support a facility in the city of McGrath or Bethel, could also assist with broadband needs of the local community (many of Alaska's small communities, say of a few hundred residents, have no connection to the rest of the state other than planes, dog sleds or ATVs with microwave, if that, for phones).

These efforts and more are part of the newly-created Arctic Region Technology Interchange Consortium (ARTIC), which N-Wave has organized with partners in the State of Alaska, other federal agencies, tribal nation partners, the science, research and education community and other non-profit partners. ARTIC grew out of last fall's Alaska Federal Networking Coordination meeting. 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 N-Wave Outreach & Events article on p. 27 for a description of ARTIC upcoming activities.)

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 Gbps to 2 Gbps on each leg.

At the other extreme is the NOAA Office of Marine and Aviation Operations (OMAO) small site in Ketchikan, AK. 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

NWS recently approved six Alaska sites for migration to N-Wave; three in Anchorage and one each in Fairbanks, Juneau and Palmer. These sites include 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

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.

NOAA National Marine Fisheries Service (NMFS) & NWS Projects - Anchorage, AK

N-Wave is currently engaged with the NWS and NMFS regarding connectivity efforts in the Anchorage Federal Building. NWS is a new customer, while NMFS is an existing customer who requires connectivity changes within the building. NMFS needs to vacate their current data center in the building. Since NWS has a data center in the same building, NMFS is moving there with N-Wave's support to migrate all connectivity into this one data center. This solution reduces the time needed for N-Wave to bring up the new connectivity for NWS in the Anchorage Federal Building and provides redundancy and economies of scale for both of the NOAA Line Offices. The deadline for this project is July 2023. In addition, NMFS is considering adding N-Wave wireless to their current list of the N-Wave services it uses in the Anchorage Federal Building.

Alaska Progress (Cont.)

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

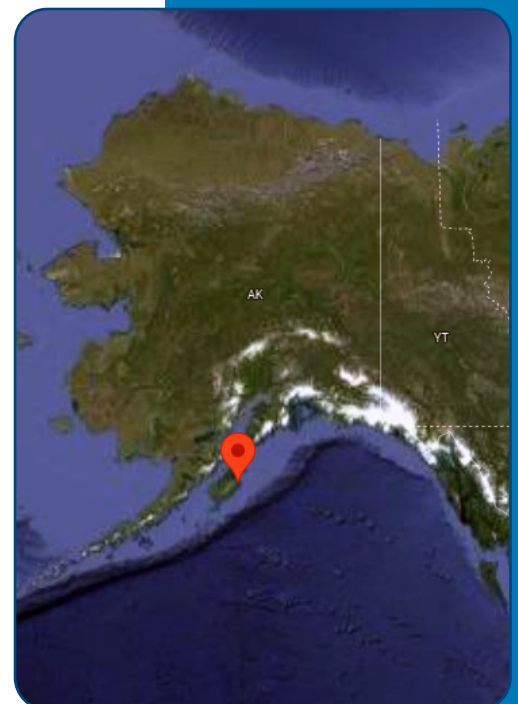
Satellite communications offer many advantages not available with other technologies. Satellite communications are independent from local infrastructure, and therefore suitable for many remote and back-up applications. Satellite communications are usually quite relocatable and can be moved and reconfigured more easily than terrestrially-based systems. There are, however, many drawbacks to using satellite communications, notably long delay times, signal attenuation and interference issues and sometimes low capacity.

Low earth orbit satellite (LEO) technology is becoming more available in the commercial marketplace. LEO promises much higher capacities and much lower delay times by using a large number of satellites in lower orbits, much closer to earth. OneWeb and SpaceX's Starlink are two commercial vendors available now, and others, such as Amazon's Project Kuiper, are expected to be available sometime in late 2024.

To determine the feasibility of using LEO-based systems for operational use, NWS was offered by the Department of Energy via N-Wave the opportunity to set up a Starlink test system. An NWS facility near Kodiak, AK, was chosen, approximately 230 miles south and west of Anchorage, AK. The system was installed and configured in late January of 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.

System performance during the test period was highly variable. There were regular outages lasting from a few seconds to a few minutes (these may have been caused by Starlink not yet having deployed its full constellation). While peak download speeds were well in excess of 200 Mbps, the average was around 75 Mbps and speeds as low as 0.7 Mbps were observed. As expected for asymmetrical capacity systems like Starlink, upload speeds were much slower, with the measured peak speed at 42 Mbps, an average of 14 Mbps and the lowest being 0.6 Mbps. Latency was similarly variable, ranging from 64 milliseconds (ms) to 698 ms, with an average of 170 ms. While these results are encouraging in some ways, the variability would make this a difficult system to use for operational requirements. This test was not fully successful, but allowed engineers to gather a wide range of performance data to take into consideration for future use cases.

With the great promise of LEO's for supporting many of the very remote sites in Alaska (and elsewhere) it is to be hoped that this test can be rerun after Starlink has more fully populated its constellation for coverage in the high latitudes. Many thanks to those in the Alaska region for their assistance and for making this project possible.



N-Wave New Staff



**CAPT
Joseph Baczkowski**

Captain Joseph “Capt Joe” Baczkowski, USPHS, detailed to NOAA off and on since 2009, transferred to the N-Wave team in January 2023 as the Engagement and Outreach portfolio manager. His primary mission is to formally stand up and operationalize the Engagement and Outreach services which include managing N-Wave events, conferences and anywhere N-Wave engages its stakeholders and customers. Capt Joe is based in La Jolla, CA. Prior to joining N-Wave, he was the Acting Director for NOAA’s Cloud Program Office (PMO), tasked with establishing the new division within the Office of the Chief Information Officer (OCIO). Before the OCIO, Capt Joe was the Chief Information Officer for NOAA’s fleet of ships and aircrafts, where he also created the Marine and Aviation Cyber Center.



Frank DiCaprio

Frank DiCaprio has been hired as a Technical Project Coordinator with the N-Wave Services team. His primary duties include facilitating communication between team members and stakeholders, ensuring stakeholders are informed of project updates, milestones and any changes in scope or timeline. In addition, Frank is working towards establishing more robust workflows and procedures with network engineers. He joined N-Wave in February 2023 and is based in Seattle, WA. Prior to joining N-Wave he worked with a small IT consulting team as a Project Manager and Systems Administrator in the healthcare, aerospace and technology industries.



Rachel Mark

Rachel Mark joined the N-Wave Business team in October 2022. Her primary role is to serve as the team’s Invoicing Specialist. Prior to joining N-Wave, Rachel worked for the National Park Service for 18 years, as a Budget Analyst in the Environmental Clean-up and Compliance Division. Rachel lives in Longmont, CO, and is based in the Boulder office. Aside from work, Rachel describes herself as a community activist and mom. In her spare time, she enjoys hiking, gardening and spending time with family.



N-Wave Outreach and Events

Joint Engineering & Technical Interchange (JETI) Events

- **JETI Technical Crosstalk monthly sessions** (virtual) - Second Wednesday of each month from 2:30 - 3:30 p.m. ET.
- **JETI Annual Meeting** (virtual) - Tentatively scheduled for July 2023. The annual meeting is a multi-day and fully virtual event. This year's meeting is anticipated to have both training sessions and presentations. The focus of this meeting will be centered around IPv6 related topics.

See p. 9 for more specific details about JETI events.

Arctic Region Technology Interchange Consortium (ARTIC) Annual Meeting

At the end of February 2018, the NOAA Networking Committee held an offsite meeting in Anchorage (with nice, crunchy snow underfoot). In 2019 and 2022, the "Alaska Federal Networking Coordination" meetings were held to discuss networking and broadband access efforts in Alaska. These annual meetings give NOAA Line Offices, the Department of Commerce, other federal agencies and state and tribal participants a forum for the exchange of ideas and lessons learned for networking. With the newly-established ARTIC group ready to continue these efforts, it will also be a place where the possible sharing of resources inside Alaska and/or to the Lower 48 can be examined. ARTIC's annual hybrid meeting is one portion of the consortium. Another is a monthly call with both planned and ad hoc topics. This year's ARTIC annual meeting is tentatively scheduled for mid-September in Anchorage.

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



Robert Sears, N-Wave Director, and Adam Nemethy, N-Wave Deputy Director, attend the NOAA National Weather Service (NWS) summit to discuss N-Wave's network services.



Robert Sears, N-Wave Director, presented on a panel of thought leaders about the government's journey to IPv6 and what it means for IPv6 during a *FedInsider* Digital Training event.



An N-Wave customer visit to the National Water Center in Tuscaloosa, AL. Pictured from left to right is Jason Letkiewicz, Matthew Crisafulli, Ron Stringer and Adam Nemethy.

Partner Spotlight - Internet2

2023 Internet2 Community Exchange

From May 8-11, 2023, Internet2 is holding its annual member's meeting, called [Community Exchange \(CommEX\)](#), in Atlanta, GA. This will be the meeting's first in-person gathering since 2019 (when it was called the Global Summit) and will give those attending an opportunity to attend a variety of technical and policy sessions, meetings of related organizations and to hold networking meetings with partners and collaborators. In N-Wave's case, the ability to have both planned and ad hoc meetings with its partners from the academic research and education community is very important, since much of N-Wave's success is built on these partnerships. Attending from N-Wave will be CAPT Joseph Baczkowski, Amy Bogner, Alex Hsia, Paul Love, Adam Nemethy and Robert Sears.



N-Wave Director Highlights New Milestones Reached in Internet2 Article

In February 2023, Robert Sears, N-Wave's Director, was interviewed by Internet2 for an article discussing N-Wave's history, progress over the years, partnerships with the Research and Education (R&E) community and the importance of reaching specific milestones recently.

For instance, Robert Sears was asked about the high-level geographic reach of N-Wave. He stated, "Through N-Wave's national network backbone, we provide connectivity at sites all across the contiguous U.S., and in Alaska and Hawaii. We are as far-reaching as Utqiagvik, which is the northernmost city in Alaska, all the way down to the Florida Keys, and from Hawaii to New Hampshire. In total, we serve more than 100 stakeholder locations in cities across the U.S."

To read more from this interview, click on the full article entitled, "[N-Wave Reaches New Milestones as an Innovative Mission Enabler in the Science Community](#)." We encourage you to take a look and learn more about N-Wave's growth and future outlook.

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- NOAA N-Wave Program
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