

BREAKING  
**DEFENSE**

**E-BOOK:**

**Forward Observer:  
Essential Issues in  
National Security**

SPONSORED BY

**NORTHROP  
GRUMMAN**





**Advancing the future of  
technology, today.**

**That's Defining Possible.**

**NG7**

**NORTHROP GRUMMAN**

[ngc.com](http://ngc.com)

# Table of Contents

Army network plan will offset contested comms with multi-path transport-agnostic capabilities	4
Bringing powerful battlespace capabilities to bear through the unified C2 of IBCS	7
Here's how the soldiers assigned to shoot down ballistic missiles from North Korea stay sharp	11
Operations in contested environments demand collaborative autonomy between crewed and uncrewed aircraft	14
Sentinel and Raider: Where these two legs of the nuclear triad stand today	19
Dissecting the DNA of JADC2 reveals what makes communications tick	23



# Army network plan will offset contested comms with multi-path transport-agnostic capabilities

“You have to be able to operate with challenges to comms at times, whether it’s jamming, lack of available fiber, geography impacting your line of sight, or host-nation spectrum restrictions.”



The ultimate goal of the Army’s Unified Network is to give soldiers the same network capabilities while deployed as they have at posts, camps, and stations. (US Army.)

By BARRY ROSENBERG - December 20, 2022

To discuss the US Army’s progress in developing a layered terrestrial- and space-based tactical network that will be a main building block for Joint All Domain Command and Control, Breaking Defense talked with Col. Shane Taylor, project manager, Tactical Network, Program Executive Office Command Control Communications-Tactical (PEO C3T), and John Anglin, technical management division chief for PM TN.

**Breaking Defense:** A recent Army article quoted US Army Deputy Chief of Staff Lt. Gen. John Morrison as saying: “The Army’s Unified Network is the Army’s contribution to JADC2, and at the core of the unified network is space.” The unified network almost sounds like a concept of operations like Joint All Domain Command and Control. But it’s more than that. Describe what is meant by the “unified network.”

**Anglin:** The two main components of the Unified Network are the Integrated Tactical Network and the Integrated Enterprise Network, ITN and IEN. For ITN, we’re fielding kit from the company up through the battalion and brigade to division, with other maneuver type elements sprinkled in.

That’s supporting everything from the base band perspective for each of the enclaves that they need to support. We have our own transport network called the Unified Transport Network that is, essentially, colorless. That is what we’re using to interconnect all of the DoD teleports, the regional hub nodes. It’s the fabric that’s stitching all this together. Then there’s user enclaves that connect into that transport network.



The flexibility there is to drive toward [being] transport agnostic, where you can take a unit's base band component and plug it into commercial internet, a commercially provided terminal, or one of the program-of-record terminals that we field. It gives them flexibility to reach into tactical and strategic.

**Taylor:** From an Army perspective, there are deliberate gaps from where we came from between those formation types. That puts a lot of complexity down at the user level.

It also causes impacts when a unit goes from point A to point B. Depending on where point B is, it could result in them quite frankly having to sometimes even re-image their systems to be able to access the DODIN in that new location.

Where the Army is going is an attempt to converge those networks, both from a technical and policy perspective, so that a soldier using the system at post, camp, and station can also use that same system in a deployed environment.

That is the impetus behind the Unified Network approach — common standards and policy. From a hardware perspective, it's routers, switches, encryptors.

To your point, this is not just a concept. There's definitely material solutions behind all of it. It's a unifying effort to get us all rowing in the same direction in some of those solutions and how we implement them.



Col. Shane Taylor, program manager, Tactical Network, US Army PEO C3T.

### **Breaking Defense: And what about the importance of space in the Unified Network?**

**Taylor:** As a signaleer, one of your responsibilities is to develop what we call a PACE plan [primary, alternate, contingency, and emergency plans for resilient communications]. A signaleer is going to attempt to maximize all the options available to them, so space and terrestrial are key players.

I wouldn't necessarily prioritize one over the other in the aggregate; you probably would on specific missions where SATCOM would be your primary depending on where you're at. There are other missions where line of sight may be your primary. Other missions where fiber may be your primary. They're all key. Every one of those pathways — whether it be line of sight, beyond line of sight, fiber, host nation, 5G, SATCOM, and LEO, MEO, GEO — are part of this Unified Network approach.

The challenge for us is how we bring all that capacity and capability to the edge, seamlessly and simply. That's the impetus behind where we're going from a Unified Network approach.

The challenge for us is how we bring all that capacity and capability to the edge, seamlessly and simply. That's the impetus behind where we're going from a Unified Network approach.



The Army's Unified Network strives for transport agnostic links so a component can plug it into commercial internet and various terminals. Photo courtesy of the US Army.



**Breaking Defense:** Much of the emphasis of JADC2 is on the kill chain and precision fires, with less attention paid to the command and control aspect. How will the Unified Network let leadership not only command but also have control through communications — even in a contested environment?

**Taylor:** One of the challenges historically and why there's been this bit of divide, whether artificial or not, between the strategic and the tactical, is the unique use case from a tactical environment that we used to call a DDIL [denied, degraded, intermittent, or limited] or DIL [disconnected, intermittent, limited] environment. You have to be able to operate with challenges to comms at times, whether it's jamming, lack of available fiber, geography impacting your line of sight, or host-nation spectrum restrictions. There are a lot of challenges in the tactical space. You have to create an architecture and a configuration that could mitigate the issues associated with that DIL environment.

As we move forward and start enabling things like cloud capabilities and get after the demand signal for constant transport, it harkens back to our previous discussion about not putting all of our eggs in one basket. We're going to need all these different pathways.

We talk about PACE, but we need to add some letters at the end of that at some point because of the added links that we're trying to get in there. There's less of an acceptance of having a DIL environment in a tactical space. We have to up our game to enable assured, resilient transport in the tactical space.

**Breaking Defense:** You mentioned that DDIL and DIL were not terms you used anymore. Is there a new term for denied and contested environments?

**Taylor:** We still use the term. It's a term that at some point we need to try to work our way out of. What I mean by that is, the more options, the more links that we can provide, the more tools like auto-PACE that enable us to do cross loading, [and other] efforts that are underway, our goal should be to work our way away from that term.

It's still a term that's out there. You can have the best SATCOM system in the world but if an adversary puts up a certain type of jammer, you're not getting out. If the fiber gets cut or you've got geography limitations, you're not going to be able to use it.

There are unique challenges in the tactical space that we don't see on the enterprise side with posts, camps, and stations, and unique implementations that we have to pay attention to. Our goal is to give them enough options moving forward from the perspective of capability capacity and link aggregation perspective that we work our way away from that term.

**Anglin:** We want to make it so that the soldiers can fight with the network versus fighting the network. They have other things they have to soldier and do. Working around DDIL or other scenarios shouldn't be something they have to worry about.

**Taylor:** The challenge that we've given our engineering teams and industry partners is that we want to add all this capability and capacity, but we want you to do it with less kit and keep it simple. That's because you've got general-purpose users having to employ these systems. The signal fleet has been adjusted and a lot of them have been put in different formations for various reasons. The result is you could have a general-purpose user having to implement.

Again, it's an opportunity for us to focus our limited resources on capabilities that add to everything that we've been talking about. But it doesn't do us any good if it comes with an extensive amount of training and complexity that soldiers won't be able to install, operate, and maintain.



John Anglin, chief engineer, PM Tactical Network, PEO C3T, US Army.



# Bringing powerful battlespace capabilities to bear through the unified C2 of IBCS

presented by **NORTHROP GRUMMAN**

The Integrated Battle Command System (IBCS) allows commanders to jointly plan, coordinate and synchronize operations across air, land, sea and space assets.



At its core, IBCS is a command and control system for integrated air and missile defense that fuses sensor data for a single, actionable picture of the full battlespace. Photo courtesy of Northrop Grumman.

April 03, 2023

In this Q&A with Ian Reynolds, vice president, Command, Control, Communication, and Computers (C4) Missile Defense, Combat Systems and Mission Readiness, Northrop Grumman Defense Systems, we discuss: the revolutionary paradigm that IBCS brings to the battlefield, the importance of disaggregating the sensor from the weapon from the C2 system, and how IBCS enables the warfighter to make better informed decisions through a single and integrated air picture of fused sensor data.

**Breaking Defense: Let's frame the threat space and how it's evolving, and then transition into some of the characteristics of IBCS as it exists today, especially how it's been demonstrated to stay ahead of those threats.**

Reynolds: One of the major challenges for U.S. forces and our Allies across the globe is that the battlespace is becoming increasingly more complex as the threats evolve across multiple domains. This complexity means we must transform decision making so warfighters can quickly deny, disrupt, and defeat threats. And that transformation requires integrating sensors, weapons, and C2 across land, air, sea, space, and cyber. What's unique and innovative about IBCS is it integrates across the domains. Because it creates a single C2 system, IBCS brings all the sensors and weapons more powerfully to bear in that new threat environment. Beyond integrating across domains, IBCS enables joint operations across services and with our allies and coalition partners.



I like to compare IBCS' integration of these new systems to how you add an app to your phone. The phone is the base system that powers your delivery of information and ability to act. IBCS serves in a similar manner. It serves as the backbone of responding to a threat. It takes in data from the various systems and delivers actionable decisions for the warfighter. The reason this is so important is that it allows IBCS to remove the data analysis burden so the warfighter can focus on real-time decision making to defeat threats.

For the U.S. Army, IBCS is a transformational capability which will enable the service to replace the current, multiple air and missile defense C2 systems with a single, integrated fire control network. IBCS is the cornerstone of the U.S. Army's air and missile defense modernization strategy. This isn't just an important advancement on the battlefield, it also offers a cost saving to the government by reducing total life cycle costs.

IBCS is also fundamental to achieving the DoD's larger JADC2 vision for joint and coalition network integration. Its architecture is a core foundational element for JADC2 and allows the U.S. and its allies to integrate air and missile defense systems.



Ian Reynolds, vice president, C4 Missile Defense, Combat Systems and Mission Readiness, Northrop Grumman Defense Systems.

### **Breaking Defense: How would you describe the elements of IBCS and the role they play in the kill chain? What plugs into IBCS?**

**Reynolds:** IBCS' Integrated Fire Control Network (IFCN) is central to enabling the kill chain for defeating the range of threats operating today across the various domains. The IFCN allows data exchange over various communications networks — radios, satellite, fiber and 4G/5G cellular — and most importantly that data exchange creates fire control quality information. So we're not just sharing data, we're creating actionable information that empowers commanders to confidently defeat threats.

The baseline system that recently completed Initial Operational Test and Evaluation (IOTE) encompasses the integration of the Patriot radar and family of missiles, and the Sentinel short range surveillance radar. IBCS will modernize these systems, and by that I mean IBCS will network them to create a broader, more complete view of the battlespace than the current standalone systems provide.

We are also working to integrate the new LTAMDS radar that is still in development. And in the future, we will integrate the Army's Indirect Fire Protection Capability (IFPC-2) system, which adds a capability for defeating cruise missile threats. Together these currently stovepiped systems will be integrated to provide a single, multi-domain view of the battlespace to provide that fire control quality for warfighters to take action.

In addition, we are investing in the system to ensure IBCS is extensible, meaning it's ready to integrate new nodes, other C2 systems and international capabilities. We have pursued engineering development, test and demonstration for integrating multi-service sensors and C2.

Integration of Joint Strike Fighter, or F-35, has been successfully demonstrated in two developmental flight tests. This is a critical integration given the importance of that platform for the U.S. and our allies and coalition partners.

We have also successfully demonstrated and tested the integration of the U.S. Marine Corp's G/ATOR radar via a developing technology called the Joint Track Management Capability (JTMC) bridge. The JTMC enables the fire control network quality data to be exchanged with the U.S. Navy's Cooperative Engagement Capability (CEC) on which G/ATOR is a participating sensor.

From an international perspective, we have completed proof of concept engineering development and test for integrated Sweden's GIRAFFE radar and the United Kingdom's CAMM interceptor. These initiatives were pursued with the manufacturers of both systems, Saab and MBDA respectively. They are also a part of our commitment to working to incorporate sovereign capabilities for our allies.

These are all examples of how IBCS quickly integrates and leverages additional sensors and weapons as they're developed by U.S. forces and allies. And it shows how we're able to integrate the capabilities of a particular country into the system to meet their nation's IAMD requirements, while still remaining interoperable with the U.S.

**Breaking Defense: What does IBCS' MOSA architecture let the system do?**

**Reynolds:** Modular Open System Approach, or MOSA, designed architectures are really powerful and through implementation in the IBCS' architecture, it enables the capability to componentize existing air and missile defense systems like Patriot, by disaggregating the sensor from the weapon from the C2 system. The open-architecture design allows developers of future sensors and weapons to integrate with IBCS and create a Single Integrated Air Picture to optimally engage hostile threats.

We are agnostic to what the sensor or weapon is. We're providing a secure, robust, resilient fire control network the warfighter can connect to and take advantage of all the information in the battlespace. I'll go back to my app analogy, it's our MOSA architecture that allows IBCS to serve as the brains to integrate all that information.

**Breaking Defense: Building on that, it makes sense that LTAMDS and newer systems would be integrated into IBCS because of its agnostic nature as you just mentioned. But how does a legacy system like Patriot connect into IBCS?**

**Reynolds:** The power of IBCS is that it connects systems that were never designed to be integrated. When we do that, it expands our view of the battlespace.

There are multiple ways we can connect IBCS to both legacy air and missile defense systems, as well as new, leading-edge sensors, weapons, and platforms. In addition to directly connecting to IBCS on the fire control network via what we call a "plug and fight" kit, IBCS is capable of communicating through message data protocols like LINK-16 and MADL. We are also working to develop data bridges which enable network and joint service integration like the JTMC bridge for integrating with the Navy's CEC command and control.

What is particularly powerful about this technology is it enables a high level of network integration without having to make major software changes in the C2 systems and networks that are being integrated. Think back to how I described the similarities to apps on your phone. Your phone isn't creating those apps, rather they have created the mechanism by which you're easily able to access data from another company. IBCS uses a similar approach.

**Breaking Defense: Once you get the full rate production decision, how are you preparing to ramp up production capability for IBCS? What exactly is being ramped up when you get that decision?**

**Reynolds:** Having recently completed IOTE, the program is on track for a U.S. Army and Department of Defense decision on Full Rate Production later in 2023. We are ready and working with the U.S. Army toward ensuring we are positioned for the decision and have ramped production to meet fielding demand for the U.S. Army and future international acquirers of the system.

Northrop Grumman has tremendous state of the art manufacturing capabilities across our corporation, and we're bringing all those capabilities to bear to make sure we are prepared for the full-rate production manufacturing decision.

As an example of what we're doing, one of the key benefits we have at our Huntsville manufacturing center is an active production line that has been producing IBCS hardware for our Foreign Military Sales IBCS case with Poland.

Poland is pursuing an air and missile modernization program that aligns very closely with the U.S. Army in that they are acquiring IBCS to be the single C2 system for both its WISLA Medium Range and NAREW Short Range Air Defense programs. [Editor's note: In July, Northrop Grumman delivered the first of six production IBCS Engagement Operations Centers (EOC) to the US government under an FMS contract for Poland's WISLA program for medium-range air and missile defense. It marked the first foreign military sale of IBCS.]

We already have in place the necessary infrastructure, tooling, manufacturing process disciplines and a skilled and experienced labor force to produce both the low rate initial production (LRIP) quantities we're on contract for now and then to quickly ramp for higher volume.

**Breaking Defense: For INDOPACOM's Valiant Shield, Northrop Grumman systems fused sensor information from multiple services to create a fire-control-quality composite track on a multi-service network, enabling an extended battlespace and allowing better and quicker decisions. Please break that down with some details.**



**Reynolds:** Valiant Shield was an important and powerful exercise, proving that IBCS provides the necessary joint connectivity that the customer's mission requires.

We demonstrated at Valiant Shield that IBCS was able to network any sensor and weapon across every domain in that real-world exercise. Our system was deployed at Joint Base Lewis-McChord in Washington State where we were a core part of the overall network even far away from the rest of the demonstration. It proved that our adaptable, distributed architecture was still able to utilize the network and all the information coming out of the Pacific to provide the warfighter with a single, integrated air picture connecting multiple service assets despite the large geographical separation.

By having that integrated air picture, the warfighter can focus on executing the best courses of action, confident in their target data. It reduces the amount of data analysis they must do, and instead gives them a game-changing capability to decide and act inside their adversary's decision loop.



IBCS is the centerpiece of the Army's modernization strategy for air and missile defense, and will replace all Army air and missile defense C2 systems with the one single IBCS system. Photo courtesy of Northrop Grumman.

**Breaking Defense:** IBCS has an open, modular and scalable architecture that is foundational to integrating all available assets in the battlespace, regardless of source, service or domain, as you've said. In what ways is it "foundational?"

**Reynolds:** I think of IBCS as foundational in several ways. First, IBCS is the centerpiece of the U.S. Army's modernization strategy for air and missile defense. It will replace all U.S. Army air and missile defense command and control systems with the one single IBCS system. No longer will each sensor and weapon have a separate C2 system like it exists today. So it's clearly foundational from that perspective.

The second is the architecture that we've been talking about. What's foundational about it is that it disaggregates air and missile defense systems like Patriot by removing the C2 and placing the sensors and weapons onto an integrated fire-control network. This allows them to be placed where they will be most effective and lets the C2 system take advantage of all the data available from them. What that does is remove complexity from the battlespace, creating one resilient force and one combined picture.

Another foundational element is the MOSA design that allows us to quickly integrate new systems and take advantage of them as they become available. Then there's the distribution and exchange of fire-control data across the network that improves the lethality of weapons deployed.

Lastly, separating the C2 from the sensors and weapons improves your survivability because you have no single target for the enemy to focus on.

Ultimately the most foundational element of IBCS is its ability to unify all that data into one view of the battlespace, which creates the decision advantage to select the best weapon to take out the threat.

# Here's how the soldiers assigned to shoot down ballistic missiles from North Korea stay sharp

The 100th Missile Defense Brigade and the 49th Missile Defense Battalion at Fort Greely train on and operate the Ground-Based Midcourse Defense system for exoatmospheric intercepts against ballistic missiles.



A Ground Based Interceptor missile is emplaced at Fort Greely, Alaska. Photo courtesy of the US Army.

By BARRY ROSENBERG - November 29, 2022

The 100th Missile Defense Brigade is the only US military unit assigned to shoot down long-range ballistic missiles from North Korea. The brigade operates the Ground-Based Midcourse Defense (GBMD) system — an array of sensors supporting a fire-control system for missile-launched exoatmospheric kill vehicles to track, intercept, and destroy enemy warheads in their midcourse phase of flight, outside the earth's atmosphere.

A component of US Army Space and Missile Defense Command, the 100th Missile Defense Brigade is based in Colorado Springs, Colo., and Fort Greely, Alaska. In the coming years, the GBMD mission will evolve as part of the Missile Defense Agency's recently awarded and similarly named \$3.3 billion Ground-based Midcourse Defense program where the current exoatmospheric interceptor will be replaced by the Next-Generation Interceptor.

In this Q&A with Col. Joseph Paladino — commander of the 100th Missile Defense Brigade, US Army Space & Missile Defense Command — and Lt. Col. Christopher Stutz, commander of the 49th Missile Defense Battalion — Breaking Defense discusses their mission and how they train for it and stay sharp.



**Breaking Defense: What is the structure of the 100th Missile Defense Brigade and how do you execute the GBMD mission?**

**Paladino:** The 100th and the 49th Missile Defense Battalion soldiers operate the Ground-Based Midcourse Defense, or GMD. The GMD fire control system, the GFC, is what connects everything from the sensors to the shooter, and it is called the GFC or the GMD fire control system.

There are two nodes, one at Schriever Space Force Base in Colorado and one at Fort Greely, Alaska. The 100th Brigade in Colorado operates five-soldier crews within that node, which we call the missile defense element. These soldiers work in conjunction with the crews at Fort Greely, and also receive directions from USNORTHCOM to conduct the mission.

The soldiers at the 49th also work in five-soldier crews. They operate the GFC in what we refer to as the fire direction center or the FDC. I'll let Chris talk a little bit more about that. They work in conjunction with the brigade in Colorado to perform tasks at the tactical level.

Nominally, under normal conditions, both crews work together during operations: one at the operational level, one at the tactical level. They're trained to specifically take over the mission and operate independently, so if **one of those** two nodes were to go down for any reason each node can take over the roles and responsibility for the other and execute their mission in response to any threat to our homeland. We refer to that as failover operations.



Col. Joseph Paladino, commander of the 100th Missile Defense Brigade, US Army Space & Missile Defense Command.



Lt. Col. Christopher Stutz, commander of the 49th Missile Defense Battalion.

**Stutz:** Although our nodes are slightly different, each crew has a director and a deputy director, responsible for analyzing the current situation, making decisions, and communicating with our weapons release authority to prosecute missile defense operations if we have anything that comes our way.

The brigade node looks at the future fight and the operational fight; at our node up here at the 49th, we look at the tactical fight. As Col. Paladino said, both nodes work in conjunction with each other, but they are very comfortable working separately if something happens. It's how we build redundancy into our system.

Working along with these soldiers are sensor operators. Despite that name, they actually don't operate the sensors. We have great mission partners across the world to take care of sensors for us. What they do is monitor and analyze the data from space, land, and sea-based GMD network sensors that provide the input to the GFC. They also work directly with the directors and the deputies and give them data and courses of action to prosecute the missile defense operations as they happen.

The remaining crew members are chiefly responsible for various secure communication systems and are responsible for the actions necessary to launch our GBIs [ground-based interceptors]. They monitor the overall health of the system and make tactical recommendations to the director and deputy based on available assets. At any given time, 24/7, both crews, 10 soldiers in two different locations, are ready to defend the nation.



A crew working at the 49th battalion In the Fire Direction Center at Fort Greely, Alaska. Photo courtesy of the US Army.

**Breaking Defense: Describe your training regimen.**

**Stutz:** The GMD system trainer, or GST, provides us real-world high-fidelity scenarios that we train on day-to-day to ensure our crews are at the point of the spear and ready to defend the nation at any given time.

These systems are at both Schriever and Fort Greely. Originally they were housed in separate parts of the facilities. We had to bring in additional soldiers to maintain the system while our crews actually trained on the GST, or the crews came in before their shift to train on the GST to make sure that they were warmed up and ready for their shift.

About 10 years ago, MDA provided the ability for the crews to conduct training within the operational nodes themselves. They now have the ability to actually stand watch, and while they're standing watch they can train on these scenarios that we have on the GST. They're able to switch to the operational configuration within seconds of any type of missile event happening that they need to take care of in the real world.

The system is also programmable so we can adjust the scenarios we train on every day. As things change in the real world our system keeps pace with it, and our directors and deputies are able to focus the type of training they want their crews to work on.

Paladino: All of our crew members go through a very rigorous training program that starts off with a seven-week course with very high standards. It requires a 90 percent in all written exams, as well as many different practical evaluations.

Once the soldier graduates from that course, they go through a certification program on their individual duty positions based on where they're assigned on the crew. They train collectively as a crew on training scenarios that are extremely challenging, complex, and dynamic. Certifying the entire crew requires them to rapidly process the threat, make recommendations to the deputy and the crew director, and execute the actions based off of the current USNORTHCOM shot doctrine.

Our crews are certified externally by SMDC every six months. They train on multiple conflict scenarios. As Chris described, the ability to train in the operational node within those 12-hour shifts that each crew sits, probably the first four or five hours of that shift they are doing nothing but training runs and building and maintaining proficiency [while maintaining] the ability to switch over to the operational environment within seconds.



# Operations in contested environments demand collaborative autonomy between crewed and uncrewed aircraft

presented by **NORTHROP GRUMMAN**

To remove the human from the loop in uncrewed operations, the AI must be trusted to take specific actions every time certain scenarios happen based on its programming.



The M437 is Northrop Grumman's concept for a low-cost uncrewed, attritable aircraft designed for U.S. and allied militaries. Image courtesy of Northrop Grumman.

March 20, 2023

In this Q&A with Richard Sullivan, vice president for future programs at Northrop Grumman, we discuss how autonomous systems such as Triton and Fire Scout can reduce crew workload for US Navy anti-surface warfare helicopter crews, and autonomous operations can be conducted in contested environments.

**Breaking Defense: How does Northrop Grumman view autonomy and uncrewed-crewed operations going forward in a near-peer competition, based on what we've seen with Russia in Ukraine and what is expected for multi-domain operations in the Indo-Pacific.**

**Sullivan:** Northrop Grumman's family of autonomous systems, including the MQ-4C Triton, MQ-8C Fire Scout and differing variants of the RQ-4 are critical components of networked, global ISR collection for the United States and allied nations. Today, RQ-4 is supporting operations in Eastern Europe on behalf of NATO and the United States Air Force, as well as in the Pacific with our international customers.

The situational awareness that the RQ-4 provides in theater helps ensure operational commanders make informed decisions. Fire Scout, which is capable of deploying off a range of surface vessels, is making a tremendous impact in organic ISR and targeting information collection for the surface fleet.

We also expect the U.S. Navy and allied nations such as Australia to continue to also use Triton to deter conflict in the Indo-Pacific, especially when the multi-intelligence configuration reaches initial operating capability later this year.

We are using our expertise in autonomy and crewed aircraft to not only support all three systems in today's environment, but also enable future uncrewed-crewed operations.

How our BQM-34 and BQM-74 target drones were deployed during the Vietnam War era is similar to how Ukraine is using drones. We put sensors and systems on our target drones and flew them in advance of other systems. This concept of employing unmanned systems to help the crewed systems be more effective is something that we have gained expertise in over the decades.

Today, [Northrop Grumman](#) is an industry leader on the forefront of the design, development and deployment of some of the world's most cutting-edge sensors and multi-function systems. Our hardware-defined, software-enabled sensors enable us to quickly field advanced software and capability updates to stay ahead of modern and future threats.

We have developed advanced multi-function systems that seamlessly integrate core functions like resilient/secure communications, jam-resistant radar, electronic attack and high gain passive sensing that are necessary for the successful operation of future platforms.

When we discuss "autonomous systems," I'm not talking about remotely piloted systems. I'm talking about ones that fly a planned mission with crewed-uncrewed teaming so that they can execute the mission and adapt as needed based on data from onboard sensors.

When you think about crew workload and what pilots and weapon system operators face, along with dynamic changes in the environment and sophistication of the adversary, having autonomy to help make decisions reduces crew workload drastically.

Taking the autonomous functions that we develop and optimize in crewed systems and then make them the baseline software configuration for uncrewed systems is easier for us because the tactics, techniques, and procedures are proven in the crewed vehicles.

We can also do a lot of mission management before flight because we can analyze and simulate different situations in our digital environment. We've proven many of these capabilities through use of digital engineering capabilities, like digital twins, that help keep programs on track.

**Breaking Defense: When we talk about collaborative autonomy, are we talking about uncrewed-crewed, uncrewed-uncrewed as in a swarm, or both?**

**Sullivan:** The definition of collaborative autonomy is having access to information and taking action on it immediately if it is actionable, such as the detection of a surface-to-air missile site that has been activated. Our current uncrewed systems are very specific in how they operate and how data is disseminated. We foresee a future where autonomous scout vehicles provide information to be immediately acted upon by other teaming systems.

So what are the actions that an uncrewed system can take without human intervention? As we go forward in this complex environment, there will be discussions about how much we trust autonomous systems and how much we trust the algorithms.



Richard Sullivan, vice president for future programs at Northrop Grumman.



The results of those discussions are core to what we see as the discriminators to being able to develop systems that have certifiable, trusted algorithms that make it possible for us to have higher mission effectiveness. Trusting that our systems will take action every time a specific scenario happens based on their programming enables uncrewed systems to take action while a human can monitor progress.

We're looking at this family of systems approach in our advanced modeling and simulations of autonomous vehicles and crewed systems to determine how to utilize the strengths and weaknesses of different systems so that we can more effectively act in contested environments without putting greater risk on service members. That's key and what collaborative autonomy is.

**Breaking Defense: What does it mean to retain autonomy in contested environments where communications and GPS is jammed?**

**Sullivan:** When we look at contested environments, there are many dimensions to being able to operate in that environment. One of those dimensions was implementing reduced observability features on future manned aircraft that will operate in this environment. These aircraft will enable operations for a variety of other systems.

Our breadth of systems, digital approach and operational knowledge is what is driving our complex autonomous systems designs for the 2030 battlespace.

Take, for example, our history on the X-47B — the first unmanned system to autonomously takeoff and land on a naval aircraft carrier, and to also refuel in flight. Through our company Scaled Composites, we've developed the Model 401 and 437 technology demonstrators using low-cost manufacturing techniques that bring mass to the fight. I call these 'attrition tolerant' — smaller, lower-cost vehicles in the 8,000-10,000 pound max takeoff weight vehicles.



Northrop Grumman's X-47B, a tailless, strike fighter-sized unmanned aircraft, pioneered unmanned carrier aviation as the first platform to ever land on and take off from an aircraft carrier. Image courtesy of Northrop Grumman.

These are our future for low-cost aircraft. The Model 401 and derivative autonomous systems concepts are examples of the power of how Scaled designs, builds and tests new aircraft. They showcase our rapid prototyping capabilities that allow us to demonstrate new air vehicles and validate digital engineering tools and processes under accelerated schedules, yet at a low cost, reducing risk for production programs.

As with the tools gained from the Model 401, the lessons learned from that technology demonstrator are now supporting the successful development for new concepts such as a low-cost attritable platform like the Model 437.

We are all-in on transitioning toward a new methodology of rapid design through our next-generation capabilities and our collaboration with global partners that demonstrate our leadership in developing advanced aircraft on a global scale to deter future adversarial threats.

Having systems and payloads resilient enough to operate in a GPS- or communications-jammed environment is another dimension. Programs like our MQ-4C Triton uncrewed ISR vehicle understand how well their systems work in a variety of naval scenarios from the perspective of autonomy.

As we speak, the U.S. Navy and Northrop Grumman are fully immersed in the testing phase of the multi-intelligence configuration of Triton, which will provide commanders an unprecedented amount of information to support critical decision making. For both the Royal Australian Air Force and U.S. Navy, Triton is critical today and indispensable tomorrow. Our across-the-board digital approach and operational knowledge is what's driving our autonomous systems designed for the 2030 battlespace.



Built for the U.S. Navy, Northrop Grumman's Triton can fly over 24 hours at a time, at altitudes higher than 10 miles, with an operational range of 8,200 nautical miles. Image courtesy of Northrop Grumman.

Other dimensions include our history on the X-47B — the first unmanned system to autonomously takeoff and land on a naval aircraft carrier, and to also refuel in flight. Through our company Scaled Composites, we've developed the Model 401 and 437 technology demonstrators using low-cost manufacturing techniques that bring mass to the fight. I call these “attrition tolerant” — smaller, lower-cost vehicles in the 8,000-10,000 pound max takeoff weight vehicles.

These accomplishments enable us to show different capabilities that are relevant and effective in complex, contested environments. It also demonstrates our ability to rapidly design and field new capabilities.

The contested environments we're talking about are on the doorsteps of many of our key allies. The US has the unique advantage of having a huge ocean in nearly every direction to protect us from near-peer threats. Having partnerships with allies and being able to develop autonomous systems that are relevant in contested environments is key for them and for us.

We are collaborating with international partners and some of our key allies on developing unmanned systems on a global scale and making it possible for these international partners to provide their organic in-country content.





Combined with the maturity of Northrop Grumman's autonomous systems architecture, the MQ-8C Fire Scout meets customer requirements for ship-based and land-based autonomous systems. Image courtesy of Northrop Grumman.

**Breaking Defense: What is the relevancy of MQ-8C Fire Scout and Triton to potential uncrewed-crewed teaming with Future Vertical Lift and other aircraft for maritime strike?**

**Sullivan:** As I mentioned earlier, Fire Scout and Triton are already teaming with crewed platforms. Capable of deploying off the deck of a different U.S. and allied nation surface ships, Fire Scout is the vertical takeoff UAV capability that the US Navy uses today. They're looking at how uncrewed VTUAVs can better augment the current crewed helicopters, the MH-60 Romeo and Sierra, in the roles that they perform for the fleet.

For example, if the MH-60 Romeo/Sierra is spending a lot of its time doing surveillance, let's let the 10-plus-hour-endurance Fire Scout do the surveillance mission instead. Fire Scout can take that burden away from the MH-60 so that it can do the things that only it can do such as combat search and rescue, and medivac. That's today's mission set, but we are also focused on crewed/uncrewed concepts for future vertical lift

When we talk about crewed/uncrewed teaming, the first step is looking at the missions that the crewed systems are doing and determining which of those can be taken over by autonomous, uncrewed systems. It's like having a two-car family with an electric car and a pickup truck. You don't drive the pickup truck for everything; you drive it when you need the truck bed. You drive the electric car for everything else, which gives you a good balance of your missions across the two vehicles.

For the missions that the uncrewed system can do best, because it has the same or better sensors and the endurance is usually two to three times more than crewed helicopters, how do we take best advantage of the asset? That's one of the things we continue to explore with the MQ-8C, as well as Triton for the maritime surveillance mission.

We're working with the Navy to leverage all the crewed-uncrewed systems available and optimize the usage model for all of them in a way that drives affordability and mission effectiveness. Further, Northrop Grumman is leveraging our experience to partner with other organizations to meet our customer's operational needs.

# Sentinel and Raider: Where these two legs of the nuclear triad stand today

The new ICBM and B-21 bomber will be a “stabilizing force” for strategic deterrence that is born digital to meet evolving threats.



US Air Force artist's rendering of the Sentinel in flight. (Credit: US Air Force)

September 21, 2022

Modernization of America's strategic deterrence capability is continuing apace for two legs of the nuclear triad — land-based intercontinental ballistic missiles and strategic bombers. Air Force Maj. Gen. Jason Armagost is responsible for strategic planning and requirements for both: the Ground Based Strategic Deterrent (GBSD), now known as Sentinel, that will replace the Minuteman III ICBM; and the B-21 Raider that will join the B-2 and B-52 for long-range bomber strike.

In this Q&A with Armagost, director of Strategic Plans, Programs, and Requirements, Headquarters Air Force Global Strike Command, Barksdale AFB, LA, we discuss the latest developments on the Sentinel program, how strategic deterrence can work complementary with tactical architectures like JADC2, and the importance of “nukesurity.”

**Breaking Defense:** With Sentinel awarded, what are the major improvements that the DoD should expect in its strategic deterrence capability?

**Armagost:** Sentinel is going to be highly resilient and flexible. It's not just for our own security, but it's also to assure our partners and allies around the world. It's an evolutionary capability and there's deliberate decisions that have been made about how we make it efficient with the infrastructure we have, and can modernize the capability to remain flexible with open mission systems and a digital architecture to evolve with changing threat environments.



The key part for the ICBMs, obviously, is to hold at a high ready rate and in a dispersed fashion. In that way, it's a continuity as much as it is an evolution of capability [and] will be responsive to the president's direction in new ways.

**Breaking Defense:** What are the challenges associated with maintaining the existing Minuteman III system while executing on Sentinel?

**Armagost:** Minuteman III was in place in the '60s with a 10-year design life initially. By the time we are complete with the deployment Sentinel, it will have been in service for over 60 years. It was never designed to be sustained in the way that we've had to sustain it.

Because we've learned those lessons, we've also learned how to design what we think Sentinel needs to be going into the future to make it viable from a modern sustainment perspective for decades. Because we fully understand the issues, we understand the transition, as well.

That's not to say we're not surprised by a part that suddenly becomes obsolete, or material that fails in a way that wasn't anticipated. But with our team of experts we're able to capture that quickly, mitigate it, and then find solutions to make sure the transition plan stays healthy.



Maj. Gen. Jason Armagost, director of Strategic Plans, Programs, and Requirements, Headquarters Air Force Global Strike Command, Barksdale AFB, LA.



Shown is an illustration of the LGM-35A Sentinel launch silo. Replacing the 1970s-era missile modernizes the ground-based leg of the nuclear triad and brings the Minuteman's more than 50 years of service to a close. (U.S. Air Force illustration).

**Breaking Defense:** You also have responsibility for the B-52 requirements. The bomber's service life is being extended under the B-52 Commercial Engine Replacement Program (CERP). For Minuteman III, was it no longer possible to, in essence, do the equivalent of a re-engineering on the missile like you did for B-52?

**Armagost:** In the case of a rocket, it's more than re-engineering. It's a weapon system approach. You may find a part from the launch facility or some other critical component that is no longer manufactured. The company that built it doesn't exist anymore. Going out and trying to find a company to produce an item is not cost effective for the Air Force, and it's not cost effective for a company.

There's not a lot of companies interested in producing boutique products with old manufacturing techniques, or materials that don't exist anymore. So the business case for sustaining the Minuteman III truly doesn't even exist anymore. That's not to say we don't find ways to, again, mitigate and plan for the health of the system. But it's not something we can do forever, and it's certainly not a business model that anyone would design.

**Breaking Defense: GBSD was conceived long before we started talking about the Great Power competition with China and Russia. How has your thinking about GBSD possibly evolved in that respect, and because of the pivot to the Pacific?**

**Armagost:** Adm. Charles Richard [commander of US Strategic Command] has been very outspoken on what China's doing with their ICBM fields. It's not so much that our thinking has evolved, but it's energized the discussion that was behind the scenes in a lot of ways — in academic circles, in global strike, in STRATCOM — and it's brought those more into the public view. So I wouldn't say that it's evolved our thinking, but it's brought more attention and clear thinking from others who may not have been involved in the past. That's been good.

What I will say about the triad and the ICBM leg in particular in this case is that it's a stabilizing and a risk-reducing function for our country, partners, and allies. The National Defense Strategy is clear about what we do with our nuclear strategy. The ICBM leg of that, currently Minuteman III but Sentinel going into the future, is that stabilizing force so that we can hedge against breakout with new adversaries.

**Breaking Defense: JADC2 and All Domain operations are tactical concepts of operation specifically related to improving the kill chain and OODA loop. Is there a connection between that sort of tactical deterrence and strategic deterrence?**

**Armagost:** There absolutely is. I remember that Gen. David Goldfein [former Air Force chief of staff] used to talk about there being no JADC2 without NC3 [Nuclear Command, Control, and Communications, which is also part of Armagost's portfolio], and there's no NC3 without JADC2 going into the future.

Command and control is and will remain a military principle regardless of the technology that is fielded and the capabilities we have. To have that credible and viable force going into the future, we have to be able to command and control it.

There's an opportunity that exists inside of JADC2 to connect conventional capabilities all the way on the spectrum up through nuclear options. The ability of the president to decide on a range of options is actually increased through that command and control architecture if we get it right. So they're absolutely interconnected.

[Air Force Secretary Frank Kendall] talks about how everything is connected. For the JADC2 question, how the tactical connects to the strategic is becoming more important because of the speed of technology, because of how technology is being used by our adversaries, and the rapidity of the environment.

When we talk about a system, whether it's B-21 or Sentinel, it is important to understand how they connect to the other capabilities, and how they're commanded and controlled in an integrated fashion.

**Breaking Defense: GBSD is being designed with a modular and open approach, which is something usually associated with tactical systems such as cybersecurity improvements related to evolving threats. What's modularity for strategic systems?**

**Armagost:** I hear Northrop Grumman say fairly routinely that Sentinel was born digital. Because of that, it's helping us think clearly about how to confront the challenges for a digital system at the inception of design so that nukesurity is baked into the program.

**Breaking Defense: You've coined a new word: nukesurity.**

**Armagost:** It's a safe-and-secure enterprise approach to nuclear capability. It's very deliberate, coordinated, and transparent to oversight. The ability to be safe, secure, and reliable from stockpile to weapon system back to stockpile is a huge effort by a lot of different agencies, senior leaders, and within the force. It's an approach to enterprise management that, again, provides safe, secure, reliable, predictable capability on call for the president.



**Breaking Defense: What's the near-term roadmap for Sentinel?**

**Armagost:** You're familiar with some of the acquisition gates we have to cross through, and the near-term one that would be of interest is the Critical Design Review [scheduled] for the fourth quarter of fiscal year 2023. First flight is currently scheduled for no later than the third quarter of FY24.

The next major milestone on that acquisition path is Milestone C, which is the production decision. That's scheduled for the third quarter of FY26.

**Breaking Defense: How confident are you in meeting those milestones and gates?**

**Armagost:** Across our portfolio and Global Strike Command, we have a great relationship with the acquisition side of the Air Force and with the companies that are under contract — whether it's for Sentinel, B-21, Long Range Stand Off Weapon, or B-52 CERP.

That transparency and close relationship allows us to adapt and adjust to whatever comes at us from a supply chain perspective, scheduling perspective, or fiscal perspective, whether it's inflation or other cost drivers. Supply chain right now is on a lot of people's minds. We're watching that closely, and the close relationship we maintain with the contractors allows us to adapt to whatever arises in that environment. We don't get surprised by a lot.

**Breaking Defense: On another subject, what's the latest on the B-21 program and its upcoming milestones?**

**Armagost:** The B-21 is slightly further along, obviously, than Sentinel. The interesting thing is that those programs do a good job of learning from each other, especially in the digital environment. The lessons learned we take from one, we build in and bake into the other in various ways — particularly in the digital engineering, manufacturing, and software side of things where we're learning a lot and allowing the programs to get better as a result of that. Between the B-21 and GBSD, they're on cost, on schedule, and the acquisition program baseline is being met.

In March, Sec.Kendall said that there are six aircraft in flow at Air Force Plant 42. From an organize-train-equip perspective for our MAJCOM here in global strike, we're building out military construction at Ellsworth Air Force Base, which is where the first operational aircraft will go in the mid-2020s.

It's starting to become real. In other words, we have some good plans for how we're going to equip and man the test apparatus and then the operational apparatus to make sure that the transition happens as smoothly, efficiently, and quickly as possible.

# Dissecting the DNA of JADC2 reveals what makes communications tick

presented by **NORTHROP GRUMMAN**

There's connective tissue among gateways, 5G, edge computing, and AI/ML that can be built to develop the advanced network capabilities needed for JADC2.



Northrop Grumman presents its vision for what it calls the “digital battle network” and architecture in this graphic. Photo courtesy of Northrop Grumman.

October 26, 2022

In this Q&A with Jenna Paukstis, vice president, communications solutions business unit, Northrop Grumman, she discusses: how the enabling technologies of JADC2 can be brought together in a “digital battle network”; the company’s 5G partnership with AT&T; and the company’s portfolio of open-architecture, platform-agnostic solutions that are designed to help the Department of Defense connect communications nodes, shooters, and platforms across all domains and branches.

**Breaking Defense:** [Northrop Grumman](#) has many of the enabling technologies to connect the joint force, including gateways, 5G commercial partnerships, edge processing, AI/ML, space, and command and control systems. What’s the thread and connective tissue between those enabling technologies, and how specifically does the combination create the JADC2 capabilities DoD needs?

**Paukstis:** The key to the future of defense is connecting those enabling technologies into what we call the “digital battle network” and architecture that leverages the latest commercial and defense technology along with Northrop Grumman’s mission expertise across all domains to enable real-time decision making. That’s the game changer that the United States Air Force and other services are looking for.



When you think about JADC2 connecting communications nodes and platforms across all domains and branches, advanced networking capabilities become a critical enabler. You need both an enterprise-level and a theater-level network of networks that can provide a dynamic mission architecture in real time across disparate domains.

That's important in developing a multi-mission focus because in any given theater you'll need to converge networks to seamlessly appear as a single network to the user to ensure the right data gets to the right user at the right time.

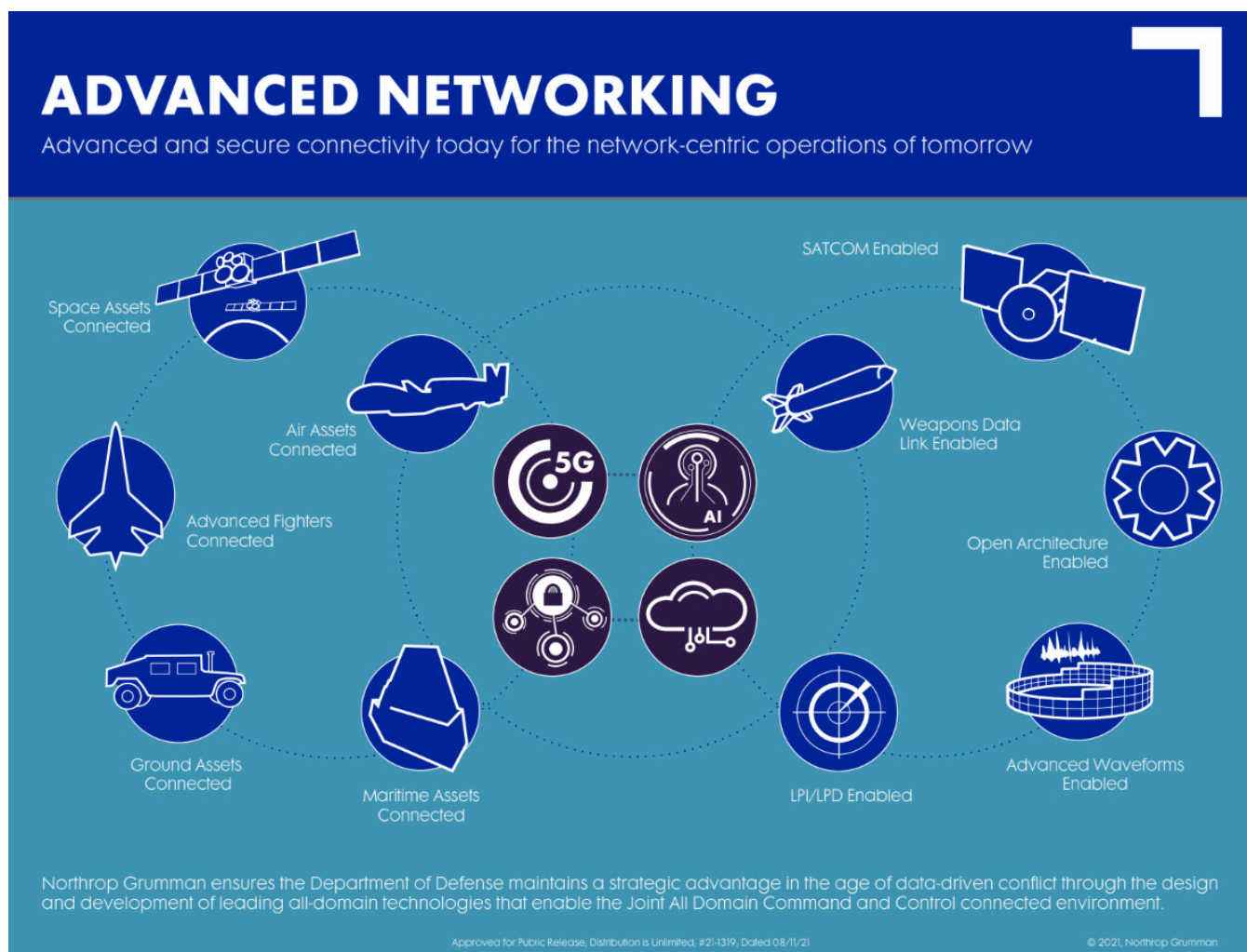
With those focus areas in mind, we're pushing technology to the edge so we can define what's possible in terms of the mission. Our customers look to us to deliver the next generation of innovative capabilities that will continue to provide strategic advantages to enable deterrence in this new age of information-driven warfare and rapidly advancing threats.

In response, we're accelerating our focus on the key technology areas that you named with a focus on integrating connectivity, processing, and intelligence so we can enable our customers to achieve information overmatch, particularly in contested environments.

For that, our customers need what I call the "mission-aware network" that can morph as needed. We can provide almost any-to-any connectivity depending on the demands of the mission, and how those demands change in theater.



Jenna Paukstis, vice president, communications solutions business unit, Northrop Grumman.



Northrop Grumman's advanced networking will result in a "mission-aware network" that can morph as needed, as illustrated in this graphic. Graphic courtesy of Northrop Grumman.

**Breaking Defense: Tell me about your partnership with AT&T to research and develop a 5G digital battle network to support the DoD. How does this network create the high speeds, low latency, cybersecurity protections, and scalability needed for JADC2?**

**Paukstis:** Northrop Grumman is investing broadly in commercial 5G partnerships such as the one with AT&T to create a digital battle network. That's important because it creates the dynamic, scalable, and resilient architectures that leverage the power of 5G and commercial technology with the security, mission awareness, and range that we need in a JADC2 environment.

The key is enabling the architectural building blocks that we can get from commercial industry to fit into our warfighting ecosystem. That lets us take advantage of both the scale and the technology that comes from commercial industry while still giving our customers the ability to own, compete, and protect the architecture through security protocols.

This makes it possible to redefine the mission so customers can reconstruct the network on the fly to support various missions as they move to intelligent mission-aware networks. This is one of the key steps toward achieving a next-generation battle network. These networks require AI and resource management that uses both tactical and commercial network solutions. They also enable the use of legacy platforms in new ways, such as a gateway or communications relay.

The digital battle network provides the network, resilience, and security management and controls with additional compute power for real-time processing at the edge. This will bring support for low-latency operations and data reduction. Open architecture enables the rapid deployment of those new capabilities on a global scale to ensure we can get the right data to the right shooter at the right time in order to shorten sensor-to-shooter engagement timelines in the multi-domain environment.

We're leveraging partnerships with AT&T and commercial industry as a whole, in several different use-case areas — JADC2 to include things like: networked platforms, sensors, and weapons; space-to-air and space-to-ground; as well as a set of use cases that are enabling efficiencies, digital transformation, and zero trust architectures for the "Factory and Flightline of the Future." The possibilities are endless and very exciting.

**Breaking Defense: Moving on to open architecture and platform agnostic solutions, tell me about the latest developments in your Software Programmable Open Mission System Compliant (SPOC) solution, including the recent demonstration with Kratos that validated third-party integrations. What's the connection to JADC2?**

**Paukstis:** SPOC is part of our portfolio of open architecture, platform-agnostic solutions that are designed to connect communications nodes, shooters, and platforms across all domains and branches, as well as supporting the future of network or data-centric operations.

The demonstration of our SPOC radio terminal successfully showed that we could connect third-party industry providers and securely share information over the air in a platform-agnostic all-domain environment.

We were able to do that with our Open Software Development Kit which drastically reduces development and integration lead time, a critical component going forward to rapidly deploy new capabilities.

In terms of our SPOC offering, the open architecture provides numerous benefits to our customers, including: integrated communications, navigation, and identification capabilities; allowing third-party developers to incorporate their capabilities; ownership of Link 16; and sharing intelligence, surveillance, and reconnaissance information over a common data link.

Our family of radios improves situational awareness and enhances overall mission effectiveness by enabling multi-level, secure 5th-to-5th and 5th-to-4th generation, and next-generation networked data sharing that provides interoperability across joint and coalition forces.

**Breaking Defense: Your Integrated Communications, Navigation, and Identification (iCNI) system provides more than 27 functions. Tell me about that and the recent demonstration of a smaller version (Mini-CNI) of the platform to help with the Army's aviation ecosystem modernization efforts. Connect that back to capabilities for JADC2?**

**Paukstis:** Our iCNI system is part of our family of platform-agnostic, open architecture offerings. We've been providing integrated communications, navigation, and identification for decades, right up to the F-35.



Recently, we built the Mini-CNI system by leveraging radio offerings that we talked about from the SPOC product line with our multi-level security technology to deliver a number of capabilities that can operate simultaneously and securely. The development of this system helps greatly reduce the size, weight, and power demand, which is important, especially when you're talking about Army platforms.

The recent demonstration proved our ability to provide an open architecture, in-flight connectivity, interoperability, and network management capability for vertical-lift platforms. During a series of demos, we were able to progressively add additional capability in a matter of weeks and months, not years, which again, speaks to the value of open architecture in being able to rapidly deploy new capabilities in drastically reduced lead time.

This proven technology enhances overall mission effectiveness for a variety of platforms for the Army and other services and extends the operational reach of joint and coalition partners – improving lethality, survivability, and targeting against any threat by enabling decision dominance at speed across multi-domain operating environments.

**Breaking Defense: You're also investing in development of low SWaP gateway systems that are designed to enable communications and cross-domain translations between multiple beyond line-of-sight and line-of-sight networks and datalinks. Tell me about that.**

**Paukstis:** Similar to our earlier discussion around intelligent mission-aware networks that lead to next-generation digital battle networks, our next-generation of platform-agnostic gateways provide intelligent and mission-aware, cyber-secure routing and data translation through integrated functions like cloud computing, machine learning, and artificial intelligence.

Effectively translating data between previously siloed legacy platforms and next-generation systems, while also providing all-domain, interconnected, near-real time communication links in a resilient and secure manner, are outcomes that our warfighters and government customers need to continue their strategic advantage. It shouldn't matter where the data comes from as long as we can securely access it exactly where and when it's needed.

**Breaking Defense: Northrop Grumman was recently selected to build a secure connective networking layer in space with Aeronix. Northrop Grumman will develop a [Space End Crypto Unit \(ECU\)](#) prototype that will connect platforms and weapons in low-Earth orbit across common architecture, providing added network security to critical missions for the Space Force. Bring us up to date on that.**

**Paukstis:** That's another good example of how we're able to leverage this technology across multiple domains. The Space End Crypto Unit is also part of our portfolio of platform-agnostic solutions. By leveraging what we call our Crypto Development Kit, we proved that third-party developers can further contribute to the rich library of cryptographic algorithms.

Northrop Grumman's investment into a crypto-based product line utilizes a flexible, high throughput design based on a single-chip reprogrammable solution. The Space End Crypto Unit will provide a connected network solution that helps warfighters make decisions faster across a full range of platforms.

The prototype will be built to survive in the space environment and deployed on satellites. It can also be deployed in multiple other environments, including ground stations and on aircraft.

**Breaking Defense: Late last year, Breaking Defense wrote that Northrop Grumman will flight test its software-defined satellite communications radio. What's new with that?**

**Paukstis:** We recently completed a lab demonstration that integrated a low-Earth orbit, commercial satellite Internet communications capability into the existing product line, utilizing the software-defined nature of our radio product line.

The demo further displayed our ability to evolve to meet future mission demands and to provide functionality needed to enable multi-level secure network data sharing in order to connect the fleet aviation ecosystem with ground, joint and coalition forces. We have a flight demonstration scheduled for later this year.

**Thanks For Reading!**  
View news articles daily at  
[BreakingDefense.com](https://BreakingDefense.com) or  
Connect with all our news channels

