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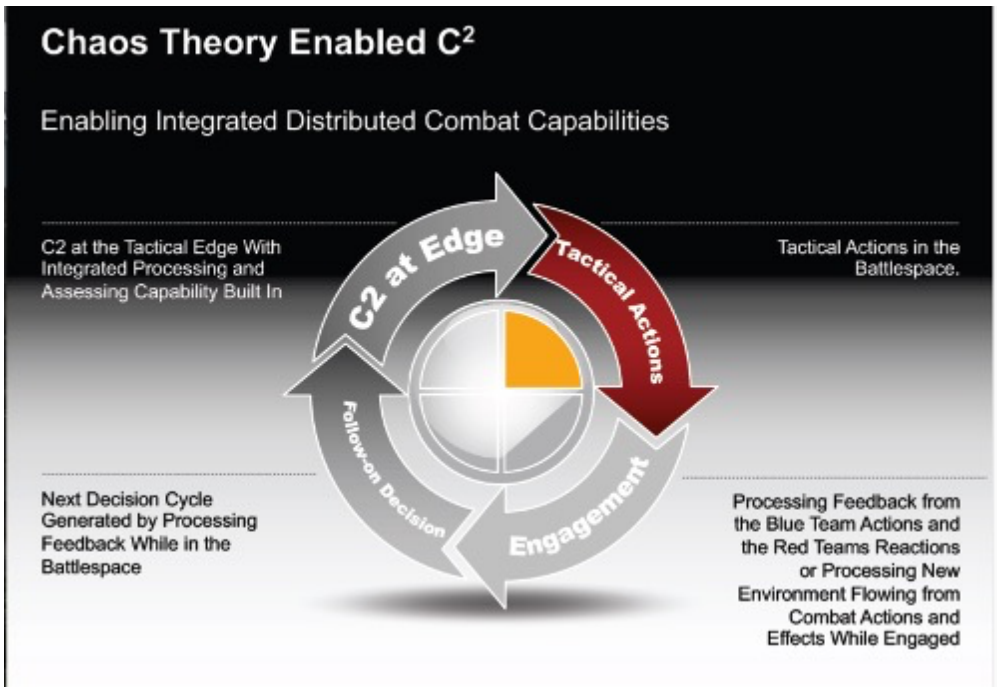
C2/ISR and the Integrated Distributed Force



August 12, 2020

The Way Ahead for C2 for a 21st Century Combat Force: Challenges and Opportunities

04/13/2020

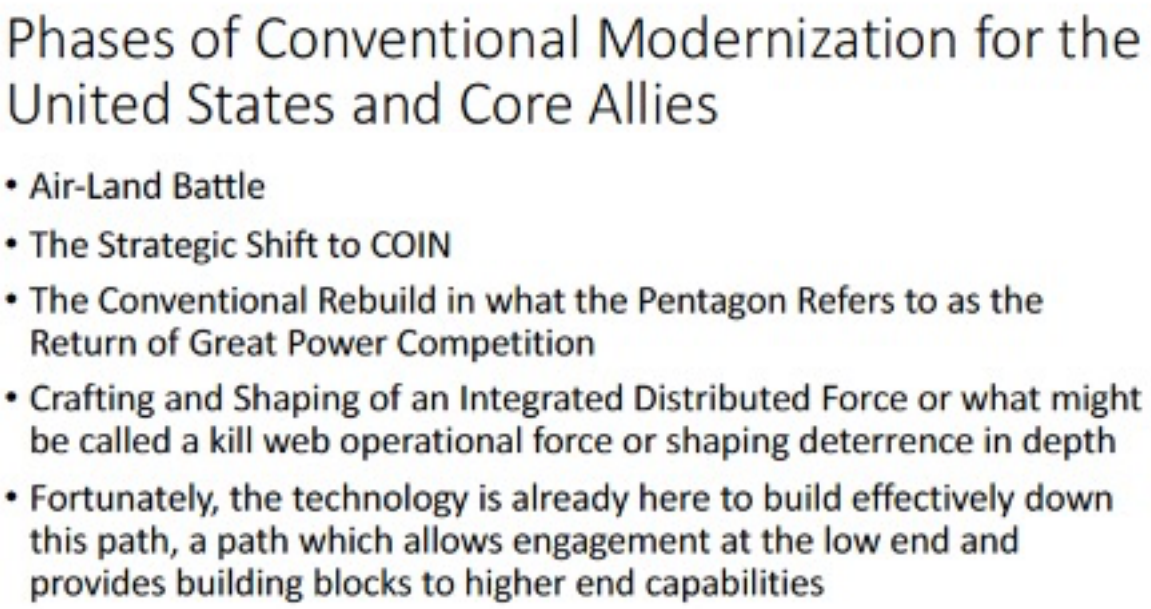
By Robbin Laird

Over the past thirty years, the United States and its core allies have gone through three phases of innovation with regard to conventional forces.

The first was air-land battle designed for the European theater and executed in the 1991 Iraqi War.

The second phase was the significant shift associated with the land wars and the joint force support for COIN operations.

The third which is unfolding now is designed to deal with 21st century high intensity operations which can be conducted by peer competitors.



And to be blunt about it – the capabilities and the infrastructure for such an approach with regard to C2 are radically different.

Yet the same acronym C2 is used.

How might we conceptualize the nature of the C2 required to empower the integrated distributed force?

Crafting an Integrated Distributed Force

This new phase might be called shaping, exercising and building an integrated distributed force.

This entails interactive technological, force structure and geographical deployment dynamics.

This is a key part of the effort to shape a full spectrum crisis management capability whose con-ops is shaped to deal with adversary operations within what some call the "gray zone" or within what has been labelled by some as the "hybrid warfare" engagement area.

The nature of the threat facing the liberal democracies was well put by the Finnish Ministry of Defence: "The timeline for early warning is shorter; the threshold for the use of force is lower."

What is unfolding is that capabilities traditionally associated with high end warfare are being drawn upon for lower threshold conflicts, ones that are designed to achieve political effect without firing a shot.

Higher end capabilities being developed by China and Russia are becoming tools to achieve political-military objectives throughout the diplomatic engagement spectrum.

This means that not only do the liberal democracies need to shape more effective higher end capabilities but they need to learn how to use force packages which are making up a higher end, higher tempo or higher intensity capability as part of a range of both military operations but proactive engagement to shape peer adversary behavior.

In today's world, full spectrum crisis management is not simply about escalation ladders; it is about the capability to operate tailored task forces within a crisis setting to dominate and prevail within that crisis. If that stops the level of escalation that is one way of looking at it.

But in today's world, it is also about the ability to operate and prevail within a diversity of crises which might not be located on what one might consider an escalation ladder.

This means that a core legacy from the land wars and COIN efforts needs to be jettisoned if we are to succeed – namely, the OODLA loop. The Observe-Orient-Decide-Lawyer-Act loop is to slow to make decisions at the tactical edge in the evolving world of combat.

The OODA loop is changing with the new technologies which allow distributed operators to become empowered to decide in the tactical decision-making situation.

But the legalistic approach to hierarchical approval to distributed decisions simply will take away the advantages of the new distributed approach and give the advantage to our authoritarian adversaries.

What changes with the integrated distributed ops approach is what a presence force can now mean.

Historically, the presence force has been about what organically can be included **within** that presence force; now we are looking at reach or scalability of a force operating in terms of its effects on an area of interest.

Economy of force is a key attribute of a scalable force as well.

The presence force, however small, needs to be well integrated but not just in terms of itself but its ability to operate via C2 or ISR connectors to an enhanced capability.

But that enhanced capability needs to be deployed in order to be tailorable to the presence force and to provide enhanced lethality and effectiveness appropriate to the political action needed to be taken.

This rests really on a significant rework of network accessibility for C2 in order for a distributed force to have the flexibility to operate not just within a limited geographical area but to expand its ability to operate by reaching beyond the geographical boundaries of what the organic presence force is capable of doing by itself.

This requires multi-domain situational awareness (SA) – this is not about the intelligence community running its precious space- based assets and hoarding material.

This is about looking for the coming confrontation which could trigger a crisis and the SA capabilities airborne, at sea and on the ground would provide the most usable SA monitoring.

This is not "actionable intelligence."

This is about shaping force domain knowledge to anticipate events.

What is required is tailored force packaging and an ability to take advantage of what the new military technologies and platforms can provide in terms of multi-domain delivery by a smaller force rather than a large air-sea enterprise which can only fully function if unleashed in sequential waves.

It is clear that connectivity for a distributed force is a foundational element; it is also clear that such connectivity must be secure and able to operate in peer-to-peer conflict and is capable of being multi-domain and operated by air, sea and ground elements in an interactive and distributed combat environment.

But it is equally clear that we are not talking about traditional C2 as understood in the world of legacy combat radios or as evidenced in the period of the land wars.

We are talking about being able to operate at the speed of light, and to make decisions at the tactical edge and to do so while engaged in operations and to generate responses while still engaged, rather than relying on reachback intelligence evaluators and decision makers.

C2 for the Integrated Distributed Force

There is a significant dynamic of change in the world of C2 systems which is reshaping capabilities which can allow decision makers within distributed task force elements to combine their capability into an integratable combat capability.

First, there is no single road in existence or being built down which the platforms can "drive" to reach the convergent point of operation.

There are multiple highways, some paved, some dirt roads, and some being considered by force planners for future development.

This means that various platforms tap into various networks to generate the information based upon which decisions are made.

But which networks deliver the best information, at the right time for the most effective actions?

Platforms operating across the battlespace leverage networks which provide their operators with the information they deem most accurate to make their decisions.

Second, this gets at a key aspect of C2 which is not about the networking systems themselves, but the operational experience and training of the operators in the integrated force about how best to work together.

Within a task force, operators on various platforms will shape combat experience and training which will determine how they are relied upon to make decisions for the broader integrated task force.

It is about **levels of confidence** in the data coming from various networks that decision makers will then proceed to act.

Third, there is a growing capability for machine-to-machine communication which handles data and generates data into information.

Artificial intelligence and machine to machine communication are clearly growing in importance, but the challenge is to manage information flows to ensure that information inputs do not slow down decision-making capabilities.

How then best to manage machine-to-machine communications into an effect C2 process?

And how to handle the spoofing which adversaries will work to inject into the machine-to-machine networking world?

Fourth, there is the clear challenge of communication and information security.

Cyber war and cyber operations are clearly part of the challenge, but another part of the equation is how to ensure that forces working to shape an integrated force capability have the ability to work with a diversity of forces with the appropriate security caveats.

This is especially significant when working across the spectrum of conflict to manage a crisis.

There may be a clear need to work with civilian organizations, higher end combat forces, to deliver sensitive political and combat decision making options through the networks which need to be funneled into a decision-making point, which could be at the tactical edge or in a C2 center.

Notably, on the new aircraft carriers, such as the USS Ford and HMS Queen Elizabeth there are a number of C2 rooms which can be stood up in a crisis, which can allow for different organizational outreach to be worked from the ships.

Fifth, new civilian systems are coming into play which dwarf the investments in military systems and will shape capabilities which will be more capable than strictly military systems and will access parts of the communications spectrum which impede their use by military systems.

Clearly, the coming of 5G, for example, will have a major impact on the networks which will be used for crisis management C2.

Characterizing the Challenge

At last Fall's Williams Foundation seminar which looked at C2 for an integrated distributed force, the noted Australian strategist, Michael Shoebridge characterized the challenge facing the ADF as it continued its force transformation.

The transitory, small 5th Generation bubble of force projection and force protection provided by platforms like the F-35, P-8s and Growlers are extremely valuable, but the bulk of the ADF, Defence organisation, defence industry and 'national support base' do not have these advantages and are vulnerable to the cyber, kinetic and information domain attacks that can disable and confuse the deployed force and its decision makers.

The problem is not encrypting or securing SATCOM between nodes and platforms, it's being able to operate without such nodes and connections. This requires a force design approach that can unite and disaggregate easily.

On this dispersal and disaggregation, I think Orwell's Animal Farm has a useful principle: "Some animals are more equal than others." Some platforms and people will be able to be – and need to be – 'super users' of data and analytic tools and skills. These will be the deployed 'disaggregated brains' of the forming and reforming temporary networks force design needs to create.

A super user may turn out to be a Wedgetail or P-8, which has a critical mass of sensors, people and processing hardware to cache large data sets and turn them into decisions and operational activities. But these large, vulnerable nodes won't be sufficient operational 'super users', because they won't be connected enough to at risk deployed people and systems deeper in the threat environment.

So, platforms like Growler and the F-35, which are 'super collectors' already, must become sup users, who carry wider data sets and who are enabled by more powerful artificial intelligence and processing than currently imagined, and who can themselves act on the results in ways probably not authorised now.

And autonomous systems need to be in this chain at higher or lower levels depending on their role. Maybe some are data and data analytic trucks who can connect to other force elements but be lost and replaced.

I hate the term, but a very different 'data and communications architecture' and 'command and control architecture' is needed in this world.

In my terms, what Shoebridge is calling for is shaping and empowering a C2 infrastructure to allow a scalable force with a diversity of force packages tailored to a crisis to form, operate and be able to reachback to additional combat capabilities as needed in a crisis.

This is the C2 "engine's" ability to shape a combat force something along the line of a configurable Lego block operational force.

It is the C2 infrastructure which is at the heart of forging a mixable force, tailored to a crisis but capable of reaching back to the kind of combat or crisis response management capabilities needed to achieve force equilibrium or dominance.

At the Chief of Navy Seapower Conference held in Sydney last October, the Chief of Navy's panel had two presentations which highlighted two different aspects of the Lego block challenge which can be enabled by an appropriate C2 infrastructure.

Vice Admiral Johnston, Deputy Chief of the ADF, argued that the ADF was seeking advantages over its adversaries in terms of knowledge of the environment, an ability to draw together different parts of a joint or coalition force to get the kind of combat effects desired, and to be able to operate more quickly and decisively than the adversaries.

In effect, what he identified was the need for the ADF to have a C2/ISR infrastructure which enabled the scalable force to operate effectively in a timely manner.

He then added: "With our small force we need to need to focus on how to generate the appropriate mass and scale for that force to achieve the combat effects we need."

That clearly rests on a C2 approach which allows both the ADF and the coalition partners to work together.

And that would rest on not just having something like a high-end F-35 CNI capability, but upon a distributed and diffused capability, and one which can leverage what the F-35 brings to the force,

The scalability aspect also highlights the importance of the ability to manage several levels of security on the fly, quite literally.

It is not just the case that the ADF or the U.S. will operate with the five eyes partners; coalitions will need to be organized lego block-like into a combat force led by either the coalition partner or the United States.

That is not going to happen without the right kind of C2/ISR infrastructure.

Put bluntly, C2 systems are no longer commodities added platform by platform; they are the operating infrastructure within which platforms find their role within a scalable, tailorable combat force.

This is a major reversal from both the first and second phases of conventional modernization in my lifetime.

C2, the Knowledge Base and the Kill Web

06/11/2020

By Robbin Laird and Ed Timperlake

We had the opportunity to work with and for Secretary Wynne when he was in the Defense Department. He was involved in many innovations which revolved around shaping an information force before the term became fashionable, which involved pushing information to the edge of the tactical force, shaping distributed decision making and ISR enablement for what can be called the integrated distributed force.

Part of this effort revolved around the coming of the fifth-generation aircraft, first F-22 and then F-35; and the realization that these platforms had battlefield management capabilities beyond their well-known platform capabilities.

Feedback enhanced this view, as when an F-22 expended all of its weapons during an exercise, and the force commander directed it to remain on station distributing targets to other platforms from prior generations.

Secretary Wynne was a key mover in the shaping of a coalition F-35 which, because of its multination and multidomain usage could provide for historically unparalleled shared ISR and theater level decision-making capabilities.

We lived through the critical comments about the Secretary and the COS of the USAF, General Mosely, for being too committed to future war with what President Obama came to refer to as a "Cold War" airplane.

And it is clear that for far too many defense analysts, the fifth-generation revolution, with its inherent platform capability to have deeper penetration for a prolonged period is still not viewed as a driver for transformation with regard to shaping the kill web force.

What the war game commander (referred to above with regard to the initial F-22 experience) had learned was that the aircraft could provide target acquisition for the force, and had the ability to share across multi generation platforms and potentially multi domain systems.

But this did not become ground truth for the Air Force and the joint force.

And the full impact of the coming of fifth generation aircraft, still remains too compartmentalized.

For example, at the International Fighter Conference 2019, held in Berlin last November, the entire discussion of the way ahead for the combat air force as a multi-domain force and the challenges and opportunities for shaping a way ahead really was conducted with a discussion of what the impact of fifth generation aircraft HAVE already delivered.

Notably, the presentation on F-35 given at the conference seemed more like a separate discussion related to its platform capabilities rather than being part of the challenges and dynamics of overall force transformation.

Fifth generation aircraft are not a cult; they are a force for the renorming of airpower and a driver for the creation of a kill web force.

The other driver for the Kill Web future which Wynne was associated with has been the Rover system.

Rover, which was first conceived as a means on a better, more direct transmission of information from unmanned Aircraft, ultimately became a communication device for all sorts of airborne platforms for use in battlefield elements and in first responder situations such as fire and flood.

We would note as well that the baseline Rover briefing included in our 2012 article on Rover has been downloaded thousands of times from our sister website where we provide for briefings. And it continues to be downloaded on a regular basis.

In the world of information-based warfare, this ability to transmit images and actually produce calls for fires led to the democratization of the battlefield, which the introduction of the AC-130 Gunships and helicopter support and integration operations first generated.

Rover has led to a dramatic shift in how C2 and ISR were becoming distributed.

In many ways, the coming of Rover is a key part of the legacy of the land wars which is being taken forward into a more sophisticated and complex kill web force development and concepts of operations efforts for the joint and coalition force.

In a recent discussion we had with Secretary Wynne, we went back over his time at the birth of the kill web and the integrated distributed force.

A key point which he highlighted was that a major challenge to hierarchical culture had to be addressed within the land wars as the introduction of JTACs into the Army.

This created dramatic change from the top down distribution of battlefield fire assets, as it led to small unit commanders controlling seemingly theater level assets.

According to Wynne, "the US Army had a difficult time adapting to how and where they would fit into their division, battalion, company or platoon units.

"Over time they were guided by the utility that the Special Forces got from what JTACs could bring to a distributed force. But, at the outset, the Army saw their main contribution as being part of reconnaissance patrols, surfacing information to senior commanders."

Over several years of innovation, the JTACS introduced a new way of war, information driven, with demand for fires and responses from air and ground support provided far more rapidly at the tactical level.

Wynne noted that he took a film on this new way of war to West Point to show "the next generation of officers that information warfare is where it was at, and that a new approach, namely, being able to operate with Tactical units on the Z axis was a key way ahead."

That presentation was in 2006.

He also sent small UAV's and experienced JTACs to both the Air Force Academy and West Point to summer camps to gain traction with the cadre of seniors enlisted assisting in the training.

The introduction of the JTAC and an ISR officer as part of the maneuver force was a foundation for change.

Now maneuver forces can operate with new technologies to aggregate in larger combat effects, through the revolutions in computational power, C2 wave forms, and cyber capabilities to distribute into the battlespace.

The Army now leads the way in integrating both large and small UAV's.

And with the impact of the F-35 on the joint and coalition force, a new axis of development, the Z axis is a key driver of change for the emergence of a kill web force.

Secretary Wynne argued that fifth generation aircraft would push forward a significant change whereby every shooter could become a sensor and some sensors as shooters in every domain.

It was about shaping a knowledge set in the battlespace that could inform targeting decisions, but as well to provide for a very different dynamic for battle damage assessment.

With the F-35s operating as a package, the force can deliver a strike or provide the information for a strike, can provide real time battle damage assessment, and continue target prosecution as required.

The emphasis here being to further minimize bombs on target that has been a hallmark of precision weaponry.

This Battle Damage cycle can be a major change for operating a sequential airpower operation with a C2 hierarchy informing the sequential aircraft coming into or operating in the area.

Whereas with the legacy approach, continued strikes would occur even without a need to do so, with a fifth generation enabled force, more effective use of assets can be generated.

There is a key tension built into the evolution of C2 for the kill web which was already evident in the work being conducted when Wynne was in the Department of Defense. The tension continues to ripen between strategic acquisition of information and tactical use of information. This extends a key tension between tactical decision making at the edge, and the need for strategic direction of the combat forces.

With the new technologies, tactical decision making at the edge is empowered by computing and wave form technologies.

At the same time, determining the impact of the distributed force on desired combat outcomes is crucial for crisis management.

How to best manage the inevitable tension between tactical decision making at the edge, and the right kind of strategic decision making to manage the force to get the desired combat effects?

Wynne described this as a tension between the process owners and the implementers of the process, whereby the later are gaining enhanced knowledge resources to shape the process, while the process owners have so much information available that they now need to step back and look at the strategic picture rather than delving into detailed management of the combat process at the tactical edge.

This is a very difficult situation for command authorities to ensure that they are acting on the most salient and trusted information.

In short, as we examine the way ahead for the kill web force, working how best to manage the distributed shooters and sensors is a core challenge.

That challenge can be understood in part as the ability to provide the most effective decision making at the edge but also guided by effective strategic process assessment.

That shift started with changes made in the land wars with JTACs, and Rover introductions, and is accelerating with the growing impact of the information made available for the entire Joint and Coalition Force by the fifth-generation aircraft.

But leveraging this past, and working the with a fifth generated enabled force, we are seeing a broad transformation of the joint and coalition force into an integrated distributed force able to operate as multiple interactive kill webs.

Standing C2 on Its Head: It is a Force Generator, Not Simply a Force Enabler

06/17/2020

By Robbin Laird

As we work through force structure change to deal with the new strategic environment, terms like C2, ISR and training are being changed significantly.

New concepts of operations are being shaped, with modifications of existing platforms to play new roles and responsibilities, and new platforms being designed to enable an integratable force.

With the crafting of an integrated distributed force able to operate through interactive kill webs, the ability and capability to shape task forces appropriate to crisis management challenge is enabled.

To do so effectively, rests upon how specific platforms can work together, which, in turn, depends in significant part on what wave forms they have onboard which enables them to work together in a crisis management environment.

In my discussion with the Navy Air Boss earlier this year, we focused on a better way to describe how the US Navy is reworking its fleet concepts. They are no longer simply doing training for a set piece carrier air wing, they are evolving it with regard to an integratable air wing.

In that discussion, we highlighted the rethink from operating and training an integrated air wing to an integratable air wing.

Vice Admiral Miller provided several examples of how this shift affects the thinking about new platforms coming onboard the carrier deck.

One such example is the new unmanned tanker, the MQ-25. The introduction of this new air asset will have an immediate effect in freeing up 4th gen fighters, currently being used for tanking, to return to their strike role.

Even more importantly from a transformation perspective, the MQ-25 will have operational effects as a platform which will extend the reach and range of the CVW.

But MQ-25 will be a stakeholder in the evolving C2/ISR capabilities empowering the entire combat force, part of what, in my view, is really 6th generation capabilities, namely enhancing the power to distribute and integrate a force as well as to operate more effectively at the tactical edge.

The MQ-25 will entail changes to the legacy air fleet, changes in the con-ops of the entire CVW, and trigger further changes with regard to how the C2/ISR dynamic shapes the evolution of the CVW and the joint force.

The systems to be put onto the MQ-25 will be driven by overall changes in the C2/ISR force.

These changes are driving significant improvements in size, capability, and integration, so much so that it is the nascent 6th gen.

This means that the USN can buy into "6th gen" by making sure that the MQ-25 can leverage the sensor fusion and CNI systems on the F-35 operating as an integrated force with significant outreach.

It is important to realize that a four-ship formation of an F-35 operating as an integrated man-machine based sensor fusion aircraft is can operate together as a four-ship pack fully integrated through the CNI system, and as such can provide a significant driver of change to the overall combat force.

This affects not only the future of training, but how operations, training, and development affect individual platforms once integrated into the CVW and larger joint force.

This is having a significant impact on Naval Air Warfare Development Center (NAWDC) based at Fallon.

I have conducted a wide range of interviews with NAWDC officers, and the change driven by the integratable air wing focus is dramatic.

Not only is the training of platforms being altered, but NAWDC has set up two weapons schools, one MISR or Maritime ISR, and the other focused on dynamic targeting, both of which are in turn based on the ability of the force to be integratable, which is rooted in available wave forms.

When I refer to standing C2 on its head, what I mean is simply, that C2 and wave form availability is becoming a foundational element for force generation in contested combat environments, rather than simply being ways to connect platforms operating in sequential operations.

A clear case in point is the changing nature of what an amphibious task force can deliver as integratability is shaped going forward with a USMC force which can operate common wave forms with the US Navy and the US Air Force.

For example, with common wave forms, the Viper attack helicopter can marry upon with the Seahawk Romeo to provide an entirely new flank defense and attack capability for the amphibious task force.

What is required are common wave forms, and common training to shape such a capability.

The key point is that without the common wave forms an entire force structure capability is currently absent which is crucial for sea control and sea denial activities which COULD be generated by the amphibious task force.

In a recent discussion with Marines at Aviation Headquarters at the Pentagon, the potential along these lines was highlighted.

By working integration of the MH-60 Romeo helicopter with Viper, the fleet would gain a significant defense at sea capability.

Integration of the two helicopters within the amphibious task force would allow them to provide an integrated capability to screen and defend the flanks of the afloat force.

The MH-60 crews are optimized to integrate into the Navy's command and control architecture, and with onboard sensors can help detect potential targets and direct Vipers to engage threats.

The integration of Link-16 will make this effort even more seemless.

My interviews with NAWDC have underscored how the Navy is working through the question of how the integratable air wing will change when the MQ-25 joins the fleet, and working ways for the Romeo to work with MQ-25 and Advanced Hawkeye will inform Romeo as part of its fleet defense function.

"The Romeo community is already looking at how having sensors onboard the MQ-25 can expand the reach and range of what the Romeo's onboard sensors can accomplish for the maritime distributed force.

"It is also the case that as sensor demands currently made on the Romeo can be shifted elsewhere.

"The Romeo can refocus its task priorities and enhance its contributions to broader mission sets such as ASW and to focus on contributing capabilities that other platforms within the strike group are not prioritized to perform."

Clearly, integrating Romeos which fly onboard the amphibious class ships with the Viper would provide a significant enhancement of the flank defense capabilities for the amphibious task force.

And working a Romeo/Viper package would affect as well the evolution of the Romeos that would fly off of the L class ships as well.

And all of this, frees up other surface elements to support other missions at sea, rather than having to focus on defending the amphibs as greyhound buses.

Another example of what the new generation of C2 can do is clearly the CNI system within the F-35, which enables the Marines to not just integrate their F-35s and to work a different approach to knowledge management to inform the maneuver force, but allows Marine Corps F-35s to be integratable with joint and coalition F-35s as well.

The integration of the F-35 into the Marine Corps and its ability to work with joint and coalition F-35s provides significant reach to F-35 empowered mobile bases afloat or ashore

In a recent interview which I conducted with Major Brian "Flubes" Hansell, MAWTS-1 F-35 Division Head, we discussed at length what the coming of the F-35 and its integratability capabilities meant for the evolution of the USMC and its role with joint and coalition partners.

The coming of the F-35 to the USMC has expanded their ability to operate within a broader kill web and to both empower their expeditionary bases as well as to contribute to the broader kill web approach.

The Marine's F-35s are part of the broader joint and coalition force of F-35s, and notably in the Pacific this extends the reach significantly of the Marine's F-35s and brings greater situational awareness as well as reach to other strike platforms to the force operating from an expeditionary base as well as enhancing the kill web reach for the joint or coalition force.

As Major Hansell put it: "By being an expeditionary, forward-based service, we're effectively extending the bounds of the kill web for the entire joint and coalition force."

The F-35 is not just another combat asset, but at the heart of empowering an expeditionary kill web-enabled and enabling force. On the one hand, the F-35 leads the wolfpack. As Major Hansell put it: "During every course, we are lucky to have one of the lead software design engineers for the F-35 come out as a guest lecturer to teach our students the intricacies of data fusion.

"During one of these lectures, a student asked the engineer to compare the design methodology of the F-35 Lightning II to that of the F-22 Raptor.

"I like this anecdote because it is really insightful into how the F-35 fights.

"To paraphrase, this engineer explained that "the F-22 was designed to be the most lethal single-ship air dominance fighter ever designed. Period.

"The F-35, however, was able to leverage that experience to create a multi-role fighter designed from its very inception to hunt as a pack."

Simply put, the F-35 does not tactically operate as a single aircraft.

It hunts as a network-enabled, cooperative four-ship fighting a fused picture, and was designed to do so from the very beginning.

"We hunt as a pack.

"Future upgrades may look to expand the size of the pack."

The hunt concept and the configuration of the wolfpack is important not just in terms of understanding how the wolfpack can empower the ground insertion force with a mobile kill web capability but also in terms of configuration of aircraft on the sea base working both sea control and support to what then becomes a land base insertion force.

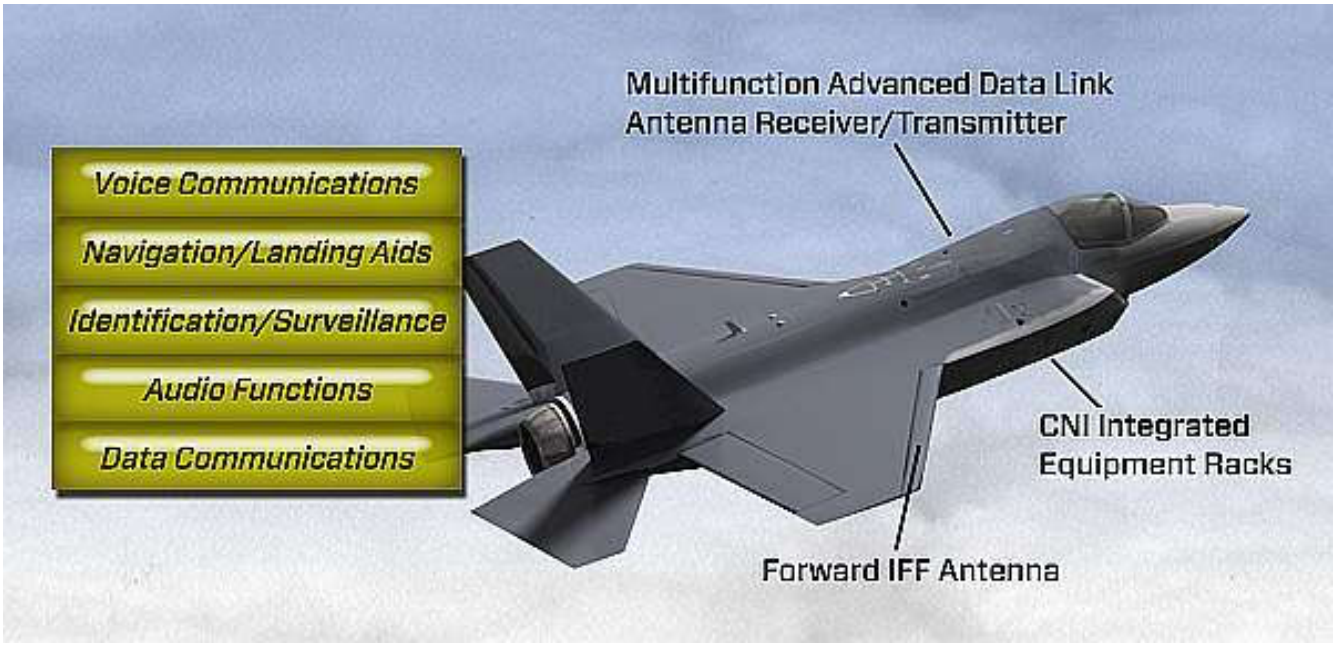
None of this would be possible without a revolutionary transformation of C2/ISR and data fusion integratability across the F-35 force.

Put bluntly, C2 systems are no longer commodities added platform by platform; they are the operating infrastructure within which platforms find their role within a scalable, tailorable combat force.

Crafting Effective C2/ISR in the Contested Battlespace: The Impact of the CNI System

07/26/2020

By Robbin Laird



In the previous article, I argued that C2 systems are no longer commodities added platform by platform; they are the operating infrastructure within which platforms find their role within a scalable, tailorable combat force.

But how best to build out such an operating infrastructure based on the force we have, rather than envisaging a new world in 2030?

A key building block in reshaping what C2/ISR can provide for the combat force is how the F-35 is reshaping the combat forces of which it is a part.

In that earlier article. I highlighted how the Marines are experiencing this impact.

“The communications, navigation and identification (CNI) system within the F-35 enables the Marines to not just integrate their F-35s and to work a different approach to knowledge management to inform the maneuver force, but allows Marine Corps F-35s to be integratable with joint and coalition F-35s as well.

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"The Marine's F-35s are part of the broader joint and coalition force of F-35s, and notably in the Pacific this extends the reach significantly of the Marine's F-35s and brings greater situational awareness as well as reach to other strike platforms to the force operating from an expeditionary base as well as enhancing the kill web reach for the joint or coalition force.

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"To paraphrase, this engineer explained that "the F-22 was designed to be the most lethal single-ship air dominance fighter ever designed. Period.

"The F-35, however, was able to leverage that experience to create a multi-role fighter designed from its very inception to hunt as a pack."

Simply put, the F-35 does not tactically operate as a single aircraft.

It hunts as a network-enabled, cooperative four-ship fighting a fused picture, and was designed to do so from the very beginning.

"We hunt as a pack.

"Future upgrades may look to expand the size of the pack."

The F-35 is a unique platform, and how the platform operates as well.

It has been designed from the ground up as a low observable platform to operate in contested air space means.

To maintain a low observable signature the aircraft is made from composites and its sensors must be embedded into the skin of the aircraft to ensure that it can operate as a low observable asset.

Anything the aircraft transmits must also be low observable.

This requires the use of low probability to intercept /low probability of detection (LPI/LPD) waveforms and technologies.

The F-35 has been designed from the ground up to be networked within the battlespace.

To do this, it needs low latency communications capabilities that are also low observable.

The F-35 is designed to operate as a networked pack that can then be networked to the rest of the battlespace with the right architecture.

The pack operates at the tactical edge and then enables the entire force throughout the battelspace.

These platform requirements provide the demand side for building the communications system onboard the aircraft.

And given the challenge of combing low latency with low observability, the opportunity to shape in effect a flying smart phone solution was required for the aircraft to fight as a pack.

Given the limited space on any combat aircraft, size, weight, and power (SWaP) must be managed and reduced to improve operational efficiency and logistics, increase mission life, and reduce the total cost of system ownership.

System upgrades are driving added functionality and increased performance, placing additional attention on SWaP.

The solution set worked by Northrop Grumman. the contractor responsible for developing, delivering, and upgrading the CNI system onboard the F-35, provides an ability to use the sensors embedded on the aircraft and to flow that data into a fused system.

In turn, this fused system enables the communication system writ large to both draw upon a network of sensors and to communicate the data fused from those sensors to trusted partners in the battle space.

The system entails an ability to manage the aircraft's skin and network of sensors through data fusion into a unique box carried onboard the aircraft.

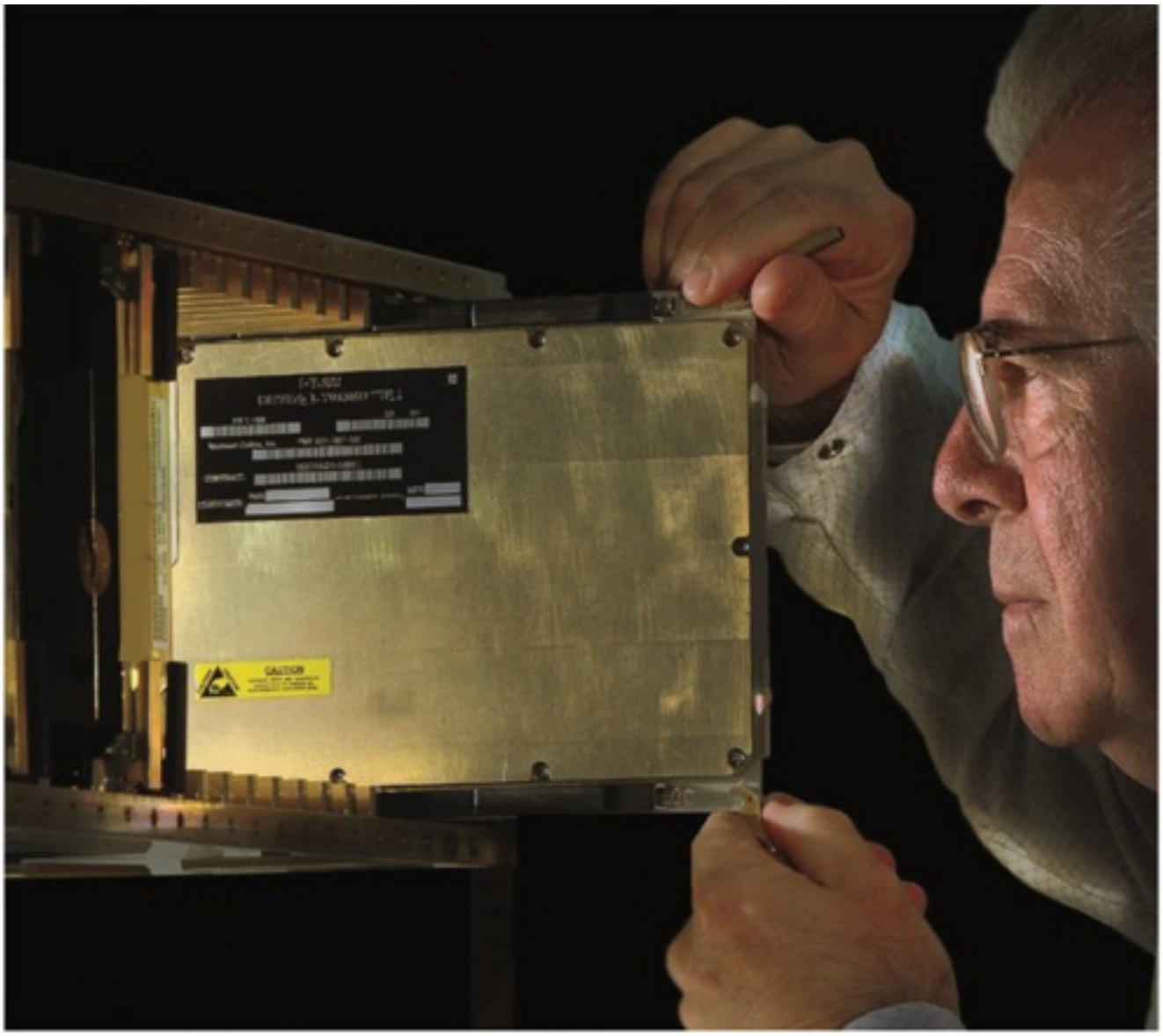
That box holds a series of cards, which enable three functionalities to be fused within the system, namely communications, navigation and identification and that is why it is called the CNI.

The three functions are managed and executed through the CNI system which draws upon the **same network of sensors** thus providing both low latency transfer of data from the aircraft and effective use of limited space onboard the aircraft.

The box required onboard the aircraft was designed to deal with the data fusion opportunities and the SWAP requirements.

How this box operates and evolves is a key part of the overall Northrop Grumman approach. Overtime, the box has shrunk in size, and the cards have become more capable as hardware capabilities to operate evolving software have been transformed. The interaction among what the cards can do provides the interactive capability which the CNI manages.

Cards can hold different wave forms to enable various ways to connect to combat assets in the battlespace.



F-35 CNI system.

The CNI system on an F-35 can manage 27 different waveforms, including the Multifunction Advanced Data Link (MADL) waveform.

MADL is the unique low latency wave form is used for other low latency assets.

MADL requires low latency to support machine to machine interactions between platforms as well.

In contrast, other wave forms, such as Link 16, for example, can be used to inform higher latency assets via that wave form of key information useful to those assets operating in the wider combat space.

The MADL wave form along with how F-35s process data and manage enables F-35s to operate as an integrated combat package able to collectively fuse data, and to do so within a specific force package which by being interactively fused provides higher levels of accuracy than any one combat aircraft operating by itself could provide.

The current F-35 software configuration allows for combined sensor fusion to be shared and able to work seamlessly through the CNI system, and with the MAD wave form they are able to communicate and share situational awareness and to operate in contested air space and make decisions at the tactical edge.

This capability sets the standards for what being able to operate in a contested environment is all about.

Contested airspace ultimately is the ability to operate within that battlespace and to shape effective decisions about how to disrupt the adversaries command and control and key nodes of combat capability to enable the entire force to be used effectively in shaping escalation dominance.

F-35 Pack Operations moving forward highlights and provides a case study of the importance of shaping a more integrated combat force one which can operate in distributed battlespace but be aggregated at the point of attack as the opportunity and need arrives.

It is about reshaping the combat force to become more integratable and when considering new platforms ensuring that integratability is built into these platforms.

It is also a leverage point into shaping a broader approach of C2/ISR capabilities necessary to enable the kind of combat force which can operate across the spectrum of conflict.

The F-35 is a unique platform, but its build out and operational experience sets a dynamic background against which a broader shift in understanding a way ahead to enhance the integratability of a multi-domain force.

Indeed, within Northrop Grumman, there are two interactive epicenters for shaping a way ahead.

The first epicenter is associated with the F-35 and crafting a way for F-35s to work together in the combat space and to share data across the extended combat space.

The second epicenter is associated with their new “radio” program, the most recent manifestation of which is the SPOC “radio,” or the Software Programmable Open Mission Systems (OMS) Compliant (SPOC) open-architecture networking terminal and will deal with this effort in the next article.

These capabilities are about ensuring combat dominance, not just about linking the lowest common denominator into a combat cloud an exposing the entire combat force to C2 disruptions, or worse, infiltration, masking and selective takeovers by adversaries.

The ability to share C2 decision making data across the F-35 global enterprise and make that data available other key elements of a task force operating in contested multi-domain operational area of interest is essential to its ability to work at the higher end of the fight.

Multi-Layer Security, SPOC and Shaping Way Ahead for Deploying C2 Hubs Empowering Integratability

08/04/2020

By Robbin Laird

C2 systems are no longer commodities added platform by platform; they are the operating infrastructure within which platforms find their role within a scalable, tailorable combat force.

But how best to build out such an operating infrastructure based on the force we have, rather than envisaging a new world in 2030?

Which networks deliver the best information, at the right time for the most effective actions?

This is associated with the challenge of providing access to a wider range of networks for crisis management across the spectrum of conflict, and which operate with a wide variety of security requirements, protocols and caveats.

In my previous article on C2/ISR enablement, I highlighted the impact of the F-35 and the CNI system in shaping a new way ahead.

In that article I underscored the solution set involved in CNI allowing the F-35 to fight as a Wolfpack.

But the technology involved with the F-35 solution set, although specific in many ways to that platform, has opened a way ahead to bring new C2/ISR enablement to the wider combat force.

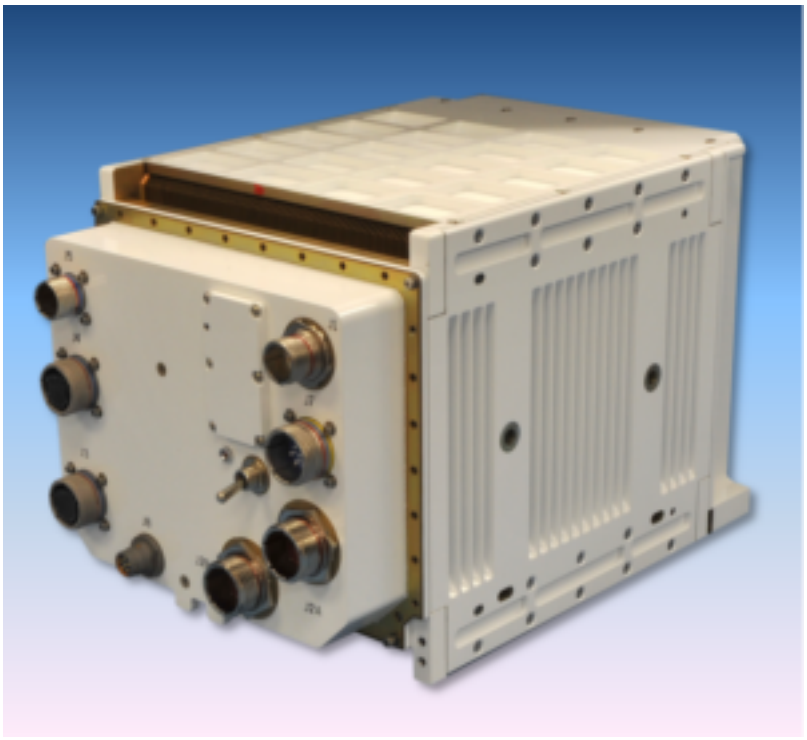
This approach leverages the unique security solution built into the F-35 approach, and leverages as well the SWaP learning curve evident in the F-35 global enterprise.

But while leveraging their experience with CNI, the Northrop Grumman approach to software upgradeable C2 hubs (radios if you wish) provides for a wider range of solution sets than are available if one was focused on the low latency requirements approach as the baseline requirement.

This approach functions as the second epicenter within Northrop Grumman to shaping a new way ahead to C2/ISR integratability for the distributed combat force.

This second epicenter of Northrop Grumman's approach to shaping C2/ISR solutions for the multi-domain force takes elements of the F-35 solution but sets in motion a different trajectory to shaping a solution set.

Theresa Hitchens of *Breaking Defense* provided her description of the Northrop Grumman approach to innovation in the radio domain in terms of their new Software Programmable Open Mission Systems (OMS) Compliant (known as SPOC) radio terminal.



She noted: "Northrop Grumman has won a $14.5 million chance to prove to the Air Force that its design for a new radio would allow operators to use multiple US and allied data links and help the service realize its plans for the Advanced Battle Management System (ABMS).

"Importantly, the new Software Programmable Open Mission Systems (OMS) Compliant (known as SPOC) radio terminal will allow the Air Force to rapidly develop and prototype upgrades or change or to third-party contractors to do so. In other words, the software code is not proprietary to Northrop Grumman….

"As Breaking Defense readers know, the Air Force — and DoD writ large — continues to struggle to allow myriad communications terminals designed for one platform to talk to other weapon systems….The Northrop Grumman radio will provide one-stop access to four types of radio frequency communications widely used by all services and some allies for air-to-air and air-to-ground communications:

"Link-16" CMN-4, an upgrade to the ubiquitous communications link used by military aircraft, ships, and ground forces to exchange tactical information in near-real time, developed by Naval Information Warfare Systems Command;

Common Data Link (CDL), one of the oldest (dating from the 1990s) secure military communications protocols that serves as a primary link for sharing imagery and signals intelligence;

Multifunction Advanced Data Link (MADL), which Breaking Defense readers know is the hard-to-detect waveform used by the stealthy F-35 Joint Strike Fighter, which can unfortunately only talk to other F-35s; and,

Multi User Objective System (MUOS), the narrowband, ultra-high frequency satellite communications network developed by the Navy, but used by all the services for mobile communications.

"The open architecture networking terminal offers numerous benefits" to the Air Force, according to Northrop Grumman, "including opening the F-35 communications, navigation and identification (CNI) system to third-party developers; ownership of Link 16 development; sharing of intelligence, surveillance and reconnaissance information over a common data link; and Mobile User Objective System beyond line of sight capability."

Hitchens has provided a good analysis of the Air Force contract win for Northrop Grumman.

But underlying this programmatic effort is what I am referring to as the second epicenter for Northrop Grumman in working C2/ISR connectivity for the combat force.

The underlying capability built into the F-35 is carried over into the SPOC networking hub approach.

The system operates on the basis of a multilevel security architecture.

Rather than having each card in the box working a separate network with its own logistics and hardware requirements to be met on the platform on which it is operating, the cards in the network hub box can leverage common logistics and hardware.

MLS, which is a government owned capability managed by Northrop Grumman, can work across the card infrastructure to shape common delivery processes which can differentiate among the data to allow for the maximum allowable for security policies in place to deliver data to an authorized user.

MLS is incorporated at the processor level which allows for a modular, scalable architecture to manage networks and the data which they provide.

What the MLS architecture allows is for the use of networks to provide information and to make C2 decisions across the joint force or a coalition.

What it allows is for the kind of force aggregation which is required for full spectrum management.

A force could go out and conduct its current mission and switch the next day to a new mission with different force components involved in that mission.

Ultimately, one would one to be able to be able, in real time, to reconfigure all of your hardware for the required set of security caveats.

With the MLS architecture because the caveats can all can run on the same processor, and they all use the same memory space, and are transported over the same buses in the network box, subject to a limitation of the processing throughput, one can put as many caveats as you want into that system.

This architecture is the foundation of the SPOC approach, and is morphed from the CNI approach.

But whereas the cards being inserted into the CNI hardware are optimized for low latency communication and low observable operations, the cards which can be inserted into the SPOC "box" can focus on a wide range of networks providing information for C2 decisions across the spectrum of conflict.

The SPOC "box" can accommodate a wide range of cards, and notably ones not built by Northrop Grumman itself or, for that matter, by only U.S. vendors.

With the MLS architecture, SWaP needs are highlighted and met.

Because each card in the networking box does not need its own subsystem of support from the platform, real estate needed to operate the SPOC networking capability is significantly reduced.

Rather than having to operate multiple physical buses and processors separated in a network box, Northrop's approach to MLS provides for separate applications and their data operating a multiple levels of security on a single processor.

And if one can work reconfiguration of communications across a spectrum of security, then one is able to deal more effectively with cyber war considerations as well.

As is already evident with regard to the F-35, the CNI allows for the F-35 global enterprise to work security caveats across the coalition. With SPOC, this is about working across the joint or coalition force, with similar adaptability built into the MLS architecture.

The MLS architecture is designed to achieve the maximum possible processing per watt which provides a foundation for shaping expanded capabilities as well.

Because this is a software governed system, there is a high potential for adaptability and code rewrite in response to the dynamics of change in the battlespace.

With a software-definable system, the capability to transition to a new radio type and a new frequency is facilitated, notably with the advent of broadband antennas, which allow for scalability and adaptability in the networking domain and it's empowering of more flexible C2 and C2 at the tactical edge.

In short, the two epicenters of effort drive change in networking flexibility, capabilities and viabilities in dealing with full spectrum crisis management.

With CNI, one is working the challenge of low latency communications for a low observable platform working within unique combat clusters of F-35s.

With SPOC, one is working across the spectrum of conflict, and working to ensure that there are no digital orphans in the battlespace, and that integratability is possible across the broad-spectrum force.

A clear advantage of SPOC is providing other platforms to be interoperable with F-35 and new platforms that might have new LO waveforms.

In other words, even though one can conceive of the NG approach as being driven by two epicenters, they clearly provided cross-cutting leveraging in terms of technology, wave forms and security management.

What this allows is the strategic shift towards the 6th generation world in which networked sensors allow for the flow of data through networked systems to inform decision making for a distributed force which can morph as needed into an integrated force scaled to the effect needed to dominate or manage a crisis.

Northrop Grumman Radio Terminal for the US Air Force

01/21/2020

By Northrop Grumman

According to a Northrop Grumman press release issued on January 10, 2020, Northrop Grumman has won a $14.5 million chance to prove to the Air Force that its design for a new radio would allow operators to use multiple U.S. and allied data links.

Northrop Grumman Corporation (NYSE: NOC) has been awarded a contract to develop and demonstrate a Software Programmable Open Mission Systems (OMS) Compliant (SPOC) radio terminal for the U.S. Air Force.

Northrop Grumman's SPOC solution will provide the Air Force Life Cycle Management Center with an air-to-ground and air-to-air communications capability across four radio frequency waveforms: Link-16 CMN-4, Common Data Link (CDL), Multifunction Advanced Data Link (MADL) and Multi User Objective System (MUOS).

This development defines the Air Force's next generation radio approach.

"Our solution for SPOC provides a mature hardware and software development kit that allows the Air Force to rapidly develop and prototype innovative communications solutions from any provider on an open architecture networking terminal that can be quickly taken into flight test and production," said Roshan Roeder, vice president, communications, airborne sensors and networks division, Northrop Grumman. "With the Air Force taking responsibility for developing the airborne communications network infrastructure for the Advanced Battle Management System, SPOC radio will allow the Air Force to rapidly develop, test, fly and iterate."

Northrop Grumman's SPOC open architecture networking terminal offers numerous benefits to the Air Force customer, including opening the F-35 communications, navigation and identification (CNI) system to third-party developers, ownership of Link 16 development, sharing of intelligence, surveillance and reconnaissance information over a common data link, and Mobile User Objective System beyond line of sight capability.

Northrop Grumman and Multi-Domain Radios

01/20/2020

By Theresa Hitchens

Northrop Grumman has won a $14.5 million chance to prove to the Air Force that its design for a new radio would allow operators to use multiple US and allied data links and help the service realize its plans for the Advanced Battle Management System (ABMS).

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“With the Air Force taking responsibility for developing the airborne communications network infrastructure for the Advanced Battle Management System, SPOC radio will allow the Air Force to rapidly develop, test, fly and iterate,” she added.

As *Breaking Defense* readers know, the Air Force — and DoD writ large — continues to struggle to allow myriad communications terminals designed for one platform (i.e., the F-35 Joint Strike Fighter) to talk to other weapon systems.

A major obstacle with most systems is that the software code is owned by the company that developed it. This is a particular problem for satellite communications terminals and ground stations because, while the Air Force is responsible for satellite acquisition and operating the networks, the other services — especially the Army — actually buy the terminals and antennas that allow troops on the ground and at sea to use the networks.

While already acute, this problem is looming even larger as the Air Force pushes development of ABMS as a key node in DoD’s effort to solidify plans for the development of a Joint All-Domain Command and Control (JADC2) system.

JADC2, if successful, will link all sensors and shooters at all levels of military operations (from troops in the field to four-stars at combatant command headquarters) to underpin multi-domain operations (MDO).

The Northrop Grumman radio will provide one-stop access to four types of radio frequency communications widely used by all services and some allies for air-to-air and air-to-ground communications:

Link-16 CMN-4, an upgrade to the ubiquitous communications link used by military aircraft, ships, and ground forces to exchange tactical information in near-real time, developed by Naval Information Warfare Systems Command;

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