

# C4ISR

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# Inverting the information pyramid

When the Army's Future Combat System (FCS) was canceled in 2009, so was the vision of the U.S. military fighting conventional wars against states such as China and Russia. FCS' replacement, Brigade Combat Team Modernization (BCTM), instead focuses on a versatile mix of brigade combat teams that can be assembled in whatever configurations are needed to fit the need.

Along with that also comes a change in how Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) is implemented. Although FCS was to be anchored by a comprehensive battlefield network that would provide information and data to the fighting brigades, BCTM instead shines the spotlight on the individual soldier.

The network is still the centerpiece of the Army's modernization, but the direction in which information needs to flow has changed. The old model, in which the senior commanders handled the collection and analysis of the information and then pushed that down to their subordinates as they felt was needed, has been stood on its head.

"The pyramid has been inverted," said Gen. Peter Chiarelli, the Army's vice chief of staff. "The majority of information is collected by soldiers at the unit level, the same guys and gals making the majority of the 'game-changing' decisions [and] we've had to figure out how to accommodate this change."

Speaking in early 2011 to a meeting of the Association of the United States Army's Institute of Land Warfare, Chiarelli said the future success of the Army rests with the ability to empower leaders and soldiers at the small unit level. The squad or the platoon "has become the decisive element of our formation," Chiarelli said.

Ultimately, the intent is for soldiers, sailors, airmen and marines at all levels, at every echelon of command, to be provided with the right information quickly and seamlessly. But a major focus now is on the tip of the spear, and how to get information to and from the dismounted soldier.

The goal is to develop the ability for individual soldiers to acquire, tailor and prioritize information they need to complete their mission, and for them to be able to relay information they collect on the ground back to the network so that others can take advantage of it.

And that's not the same as simply providing as wide a communications pipe as possible to the dismounted soldier, which was the prevailing concern for the old top down approach where the intent was to push information to the warfighters.

"If all you do is get a pipe to the soldier and it can't carry information that can be harvested from the broader tactical command network in a way that's usable to that soldier, or what the soldier is doing can't be exploited back onto that network, then you really haven't accomplished much," said Joe Taylor, vice president, ground combat systems at Northrop Grumman Corp.

Providing a mobile phone or other device to soldiers and pushing a photograph or other piece of data down to them is not the same as them being connected to the tactical battle command network, he said.

Meanwhile, elements of the broader network are coming together. The Army approved the fielding of the next generation Force XXI Battle Command Brigade and Below (FBCB2) system, named Joint Capabilities Release (JCR), early in 2011. And Warfighter Information Network-Tactical (WIN-T) increment 2, which for the first time will take mobile communications down to the company level warfighter, is expected to be operational with the first unit by the end of 2012.

FBCB2 is a fully digital command and control system that provides both battle command and situational awareness from the brigade level down to the individual soldier. It includes Blue Force Tracking, a network used to identify friendly forces on the battlefield. The upgrades included in JCR provide for a substantial increase in network bandwidth that can update information to a much greater number of people in seconds rather than minutes.

The next iteration of FBCB2, the Joint Battle Command-Platform, will introduce at the individual user level capabilities that commercial smart phones and tablets are bringing to the consumer market, such as a Google Earth-like interface for searching pictures and texts, drag-and-drop icons, touch-and-zoom maps, and the ability to collaborate with each other through chat and text.

The question is how to deliver connectivity to the dismounted soldier that will provide for all that. Although JCR and WIN-T provide the broad capabilities and backbone connectivity, the last mile connection to the edge, where the dismounted soldier lives, is not so clear.

Complicating things is a recent turn by the Army to a lower-cost and more agile acquisition process that emphasizes commercial off-the-shelf technology development over the long-term and far more costly process that's been used in the past. That, plus some very negative feedback from soldiers during several field tests last year, was the reason the Army last October canceled its effort to produce a software-definable Ground Mobile Radio as part of the Joint Tactical Radio Systems program.

"We want to increase competition because that encourages innovation and brings lower costs," Heidi Shyu, acting Assistant Secretary of the Army — Acquisition, Logistics and Technology, explained at the time. "Our adversaries are very adaptive, so our acquisition process has to be agile. We understand that in order to attain this agility we need mature technologies."

That's produced some innovative takes on what can be used to provide this edge connectivity, and which were on display during several Network Integration Evaluation (NIE) exercises run by the Army in 2011 to

subject a range of technologies to testing under combat conditions.

For example, Northrop Grumman's Advanced Meshnet Technology (AMT) was one of those selected. It works in concert with FBCB2, and can use any piece of equipment or platform on the meshnet to serve as a node that soldiers can access to get information by using, in the case of the NIE demonstration, Android smart phones.

When connected in this mobile ad hoc network, every soldier, vehicle and command post becomes essentially a high-bandwidth node.

"So you get that handheld and all of the bandwidth that the meshnet gives you, and you get the ability to put a number of people on a common network that's also fully integrated with the rest of the tactical environment using software we developed for the handheld that exploits the FBCB2 JCR," Taylor said.

AMT is based on meshnet technology Northrop Grumman found in the mining industry, which has the same elements of compartmented terrain, the need for situational awareness as well as the need to distribute commands to various people the Army contends with.

The military application of these technologies is somewhat different, Taylor said, "but with some thought and energy we can probably make them applicable to the battlefield, and make them durable enough to last so they come in a lot cheaper than through that older, methodical and more deliberative process."

NIE 12.2, scheduled for April and May of 2012, will include a more formal test of the capabilities of WIN-T Increment 2, along with a closer evaluation of technologies such as AMT to deliver tactical command network connectivity to the dismounted soldier. ▲



# Smart phones — and their apps — go to war

The Network Integration Evaluation (NIE) exercise held in the fall of 2011 showed the potential that smart phones hold for the dismounted soldier, both for the situational awareness capabilities they can provide, and because using them would help to lighten the load soldiers now carry.

Their experience in exercises such as the NIEs and the three-week Army Expeditionary Warrior Experiment held at Fort Benning, Ga., last October and November showed soldiers on the ground what smart phones could do for them. They were able to receive alerts from platoon leaders and adjust points of attack, send and receive intelligence, monitor the positions of friendly and opposition forces, and call for such things as artillery support at the touch of an icon.

Ongoing evaluations under a program named Connecting Soldiers to Digital Apps (CSDA), started in late 2009, have shown as much as a 40 percent increase in spot reports that soldiers in the field make when using smart phones, including taking photographs and sharing that data to others in their formations. And Army officials are quickly learning that sharing data, images and even video provide a major tactical advantage.

Last October, the Army decided that the redesign of its Nett Warrior situational awareness system, the latest iteration to outfit soldiers with a wearable computer/communications system, would use smart phone technology. And in December, Mike McCarthy, operations director of the Army Brigade Modernization Command's Mission Command Complex and co-lead for CSDA, told the Army Times that secure smart phones could be in the hands of soldiers heading to the battlefield by mid-to-late 2012.

The result of NIE 12.2, which will evaluate technologies for connecting tactical networks to devices such as smart phones and tablets, will show how close is the broad

use of smart phones by dismounted soldiers on the battlefield, he said.

Lt. Gen. Michael Vane, director of the Army Capabilities Integration Center, believes smart phones, already familiar devices for many younger soldiers, are a key element in the Army's future. If a cost-effective way could be found to do it, Vane has said, "it probably makes sense in the long run to provide a smart phone to every soldier."

The CSDA has already developed a set of more than 80 smart phone apps specifically for Army needs, and has involved soldiers in writing apps.

Various companies have been writing military apps for some time. One app that's been highly touted and already evaluated in tests is SoldierEyes, which uses the phone, GPS and other capabilities of the smart phone to enable soldiers to receive and gather information about a specific mission in real time, greatly improving tactical response.

Another is Northrop Grumman's Joint Tactical Handheld (JTACH), which provides text messaging, email and a full-color blue force tracking display. It's a version of the JBCB2 Joint Capabilities Release (JCR), which the company developed for the Army, and which is interoperable with the JCR as fielded.

"It's been tailored to what the dismounted soldier would need to exploit in any contact situation," said Joe Taylor, Northrop Grumman's vice president of ground combat systems. "We've taken out some of the more obscure message presets that deal with the operational and higher levels of command, so it's a slimmer version of the software and yet it's still completely integratable with the fuller software running on other platforms."

That's an important point when designing software that

is immediately useful to the dismounted soldier, he said. What's needed at the dismounted edge of the tactical network is not the full data or imagery that a brigade commander might want. Instead, all platoon leaders need to see on their smart phone or tablet is what's on the other side of a compound wall, or the high ground that's beyond the bridge they have to cross.

Other apps could be simpler, such as one that allows dismounted soldiers to mark improvised explosive

devices in their areas with icons that show up on the smart phone display. The idea is to provide soldiers with a list of usable apps they can mix and match according to relevant mission needs.

The Army was expected to open its own app store some time early in 2012, to be called the Army Market Place. Companies such as Raytheon, with its Appsmart portal, are also providing secure defense and intelligence apps for smart phones. ▲



# Powering the dismounted soldier

**A**lthough more capable equipment and communications will provide a substantial tactical edge for the dismounted soldier, the inescapable fact is that all of this equipment must be powered. And the more you want to do with that equipment, and the more images and data you want to deliver through it, the greater the need for power.

The goal is not to have that situation add to the heavy load soldiers already carry. The decade-old Land Warrior kit that is being replaced by Nett Warrior required more than 13 watts per hour to power it, which meant that every soldier must carry three 2.2 pound batteries each day. The total weight of the entire Land Warrior ensemble is 18 pounds.

The goal for Nett Warrior is to reduce battery needs to just two a day, and to have the total weight come in at no more than 12 pounds. The use of technology such as smart phones will help with that, but squeezing more out of battery technology will be crucial to meeting the kind of power-to-weight trade off goals the new gear requires.

It's a constant grind for power technology companies in trying to meet the criteria for this, said Jeffrey VanZwol, vice president of marketing for Micro Power Electronics, Inc., which provides custom battery systems for military OEMs and other markets.

"There is always the push with every customer for handheld devices to use more power in a smaller footprint, and that is even more exaggerated in the case of the dismounted soldier because he is already carrying so many devices with batteries integrated with them, as well as replacement batteries," he said.

The standard military battery in the past provided a continuous supply of 2.6Ah (amp hours), he pointed out, but the typical military OEM now uses higher capacity batteries that run at 3Ah, and battery cells that can run at 4Ah are already on the drawing board.

There are several ways to get around the power-to-weight

conundrum. One is to lighten the packaging of the battery. The typical military battery uses a metal can enclosure, but new battery packs using much lighter lithium polymer materials are now being pushed into the field after achieving a mil standard rating during the past year.

In this battery, the cell itself is made out of a coffee-bag type of material, VanZwol said, which is flexible so you can get the shape of the cells to be custom fitted to the battery package. That means you can maximize the amount of active material in the battery, which in turn makes for more battery runtime.

Another option is to use a different material with better performance characteristics for the battery cells. The predominant chemistry in both notebook and cell phone batteries now is lithium cobalt dioxide, more commonly referred to as lithium ion. A newer technology that's being introduced in military batteries uses lithium iron phosphate, which is based on the same chemistry as lithium ion, but which has a somewhat greater discharge current and longer life.

But its greatest advantage for the dismounted soldier is a much faster recharge rate. A lithium ion battery typically takes two to three hours to fully recharge, whereas you can drop a lithium iron phosphate battery into a charger and have it recharged in as little as 15 to 30 minutes, VanZwol said.

However, finding a way to recharge batteries is a constant headache for soldiers in battle, and it's another area that's seeing potentially big advances.

"Short of coming up with a nano cold fusion reactor that's cheap enough to put onto every soldier, finding a better way to recharge batteries is crucial" to enable the vision of the connected dismounted soldier, said Joe Taylor, vice president of ground combat systems at Northrop Grumman. "You can't carry enough batteries into combat for multiple day operations without the ability to recharge them."



One answer could be the kind of development Northrop Grumman is partnering with BAE Systems on to turn the future Ground Combat Vehicle (GCV), which will carry the dismounted soldier into battle, into what Taylor described as a “power export capable node” on the battlefield.

Under their proposal, the vehicle will use a hybrid electric drive propulsion system that will have huge reserves of power left over after its primary use that can then be stored in large batteries which would be an integral part of the GCV design. Dismounted soldiers would then simply drop their smart phones and radio batteries into recharge jacks built into the GCV.

Another possibility is to use battlefield robots such as Northrop’s Carry-All Mechanized Equipment Landrover, which is also in development. That’s slated as a an overall squad support robot, but one of its responsibilities could be to act as a charging device for batteries. Other companies have similar robot platforms in development.

These kinds of solutions could be available relatively soon, Taylor said. The GCV is a seven-year program from initial development to production, though that’s still fast compared to previous technology development cycles. The squad support robot could be on the battlefield much sooner, depending on requirements and budgets, Taylor said. ▲



# Unmanned eyes in the sky

By now, many people have heard of the Predator and other large unmanned aircraft systems (UAS) that prowl the skies over Afghanistan, collecting intelligence or delivering precise missile strikes on enemy locations. In the past decade they have become a prime strategic asset and one that, even in a time of severe budget constrains, the Defense Department still expects to invest in heavily.

Less known is the importance large and small UAS will play in battlefield communications and in delivering intelligence to, and getting data back from, combat forces. The ability of dismounted soldiers to effectively use radios, smart phones and other devices to press their mission will depend on how well a mix of these airborne assets work with those on the ground.

In September 2011, the Army's Program Executive Office for Aviation sponsored the first Manned-Unmanned Systems Integration Capability (MUSIC) exercise to test the advancements made in interoperability in the Army's UAS Project Office and the Manned-Unmanned Teaming community. Many of the features tested in the exercise are what the UAS program manager intends to field to soldiers as a part of the Army's network capability set 13-14.

That capability set, which will begin fielding in fiscal 2013, is expected to produce an overall five-fold increase in network capability.

A critical element for the dismounted soldier that was tested as part of the MUSIC exercise was the One System Remote Video Terminal (OSRVT), a modular video and data system that enables warfighters to downlink surveillance images and geospatial data directly from both UAS and manned platforms.

The Project Manager's Office UAS (PM-UAS) provided three systems tested in MUSIC – the OSRVT, the Shadow Tactical UAS and the Raven small UAS – in support of both the Network Integration Evaluation 11.2 and 12.1 exercises. OSRVT could potentially allow anyone with

a wearable Joint Tactical Radio System radio to receive streaming video from manned and unmanned assets to provide an overhead picture of a unit's battlespace.

“OSRVT is the ‘gateway’ for video into the tactical network,” according to Michelle Vigo, interoperability systems engineer, PM-UAS. “It allows for the dismounted soldier on the ground to receive streaming video thus providing for better situational awareness.”

The Raven UAS was fitted with customized JTRS Handheld, Manpack and Small Form Fit (HMS) communications packages, which the UAS project office said was made possible due to the small size of the HMS radio and the major advances in wireless network communications enabled by the Soldier Radio Waveform (SRW) used with the software-defined JTRS radios.

The Shadow UAS was used as the communications relay node, using components capable of relaying and routing SRW signals to extend the range of the terrestrial network and to provide command and control messaging between units on the ground and the UAS operators.

The teaming of manned and unmanned aircraft is increasingly driving the way the Army fights, and the demand for UAS continues to increase for both ISR and attack missions. In the middle of 2011, the Army announced a surge of 180 additional Raven systems to Afghanistan, taking the number per combat brigade teams from 15 to 35. It also said it would send another 129 Puma UAS, which would be deployed down to the company level.

However, Northrop Grumman's Joe Taylor believes the key to providing the dismounted soldier with video and data doesn't reside so much with the UAS providing a video and data stream but with how the soldier can exploit it.

“The packable UAS are out there, and I think the Army is getting its arms around what the brigade group systems should look like, but all of them are pretty much



stovepiped right now,” he said. “Each UAS comes with a screen and it reports just to that screen. The key is to bring the data and video that the UAS is collecting to the network so that it’s widely exploitable over the network.”

The burden should not be put on the dismounted soldier

to figure this out, he said. Solutions have to be provided by others to integrate all of the data onto the common network. That’s where the real opportunity lies, he feels, and why Northrop with its JTacH smart phone app focused on exploiting Battle Command Brigade and Below Blue Force tracking, “because it was an already existing network at the tactical level.” ▲



# Shifting the acquisition focus

It's an ill wind that blows no one any good, according to the old saying, and that's certainly true of the changes being called for because of tightening defense budgets. Combined with the increasing need to meet modern asymmetrical threats and an agile enemy, the push to overhaul the military's ancient acquisition process has become critical.

That should bring good results to warfighters, who have had to struggle in the past with technology that has been slow to arrive as the results of years, sometimes decades, of long development processes. Particularly in the last decade, this has resulted in soldiers being saddled with IT and other technology that has been generations behind what they could buy commercially.

So, instead of the military-specific requirements that drove the acquisition process, and also resulted in hugely expensive development programs and technology that often didn't work well, the new approach is to depend more on commercial-off-the-shelf (COTS) products and the kind of "it just works" maturity that brings with it.

Heidi Shyu, Acting Assistant Secretary of the Army — Acquisition, Logistics and Technology, told the 2011 Association of the U.S. Army Annual Meeting and Exposition held last October that things really changed after the terrorist attacks in 2001, and the threat the U.S. faced also veered dramatically away from the historical large, nation versus nation war.

"In order to be more agile, we know we need to emphasize mature technology and less cost," Shyu said. "Our focus is to allow industry to help us determine what the requirements need to be."

The Network Integration Evaluation (NIE) exercises are a prime example of that approach. By putting a mix of technologies into the hands of combat soldiers, who test them under realistic combat situations, the goal is to sort out more quickly what works and what doesn't and to come up with a set of system needs that industry can work with on an ongoing basis.

"If you look at the value of the NIE for the Army, it's really about us getting our hands around the requirements, how to resource them, and then how to make it work in an operationally relevant environment," to provide better field systems that soldiers use on the battlefield, Lt. Gen. William Phillips, principal military deputy for the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology, said at the conference.

The goal is to spiral new technologies down to soldiers no less than every two years, and to make sure that whatever systems are introduced work with what has gone before.

The question for the Army is to find a better way to exploit COTS capabilities and integrate them with whatever else is happening on the battlefield as opposed to creating them out of whole cloth and, in the process, move them through much shorter development loops as those capabilities are created.

If the focus is on the dismounted soldier, you can get an initial capability out in 18 months to 24 months and start fielding it to the first six brigades, said Northrop Grumman's Joe Taylor.

"At the same time, whatever NIE you are in then would be looking at the next level of software, handhelds or meshnets," he said. "As long as you ensure backwards compatibility, there's no reason at Brigade 7 that you can't start fielding the next generation of technologies that would fight alongside what's already out there."

That will force defense suppliers such as Northrop Grumman to deal with a more volatile business case, he said, and it does complicate budget planning compared with the old acquisition process. But it will free companies to exploit developments taking place now in ways that weren't open to them in the past, he said.

"We won't have that 10-year certainty but, on the other hand, if you didn't have that long-term contract then opportunities were closed off to you," Taylor said. "This way, it may actually open up the opportunity space."



And that will make the entire process more competitive. It's that competition that the Army intends will provide a regular supply of innovative, COTS-based solutions that the dismounted soldier – so often an afterthought in the past – will be able to use as the new focus of networked warfighting. ▲



**THE VALUE OF  
BEING ABLE  
TO SEE THE  
BIG PICTURE  
IN THE  
SMALLEST  
DETAILS.**

Designed for maximum effectiveness and affordability, Northrop Grumman C4ISR systems are uniquely ready for the real world. We developed the MOSA-C™ business and open architecture strategy that makes it easier to add new technology and capabilities over the life cycle—avoiding vendor lock-in and reducing costs. And our user-centric design philosophy continuously meets the warfighters' ever-changing operational needs. *That's why we're a leader in responsive, flexible C4ISR solutions.*

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