UCORE AND NIEM: CREATING POTENT NEW CROSS-BOUNDARY NETWORKS

— From a Portfolio of NIEM Success Stories —

When I was the USAFE commander during the Kosovo war, I stood in the Air Operations Center in what they called the Real-Time Targeting Center. This was where the stovepipe feeds from the Rivet Joint, the Joint STARS, the AWACS, the U-2, and the Predator UAV all arrived, and I sat there and watched the stovepipe operators—each with a 'tribal' mind-set—working independently, even sitting beside each other and not putting their information together and correlating it. They were letting targets get away because they lacked the ability to fuse their data. Because no one had worked in anyone else's stovepipe, they had no idea how to act in a real-time environment.... We should be able to take advantage of what the imagery digits and the signals-intelligence digits can discuss with one another and let them go as far as they can toward putting a cursor over the target. I want the sum of the wisdom of the intelligence, surveillance, and reconnaissance that I do to end up with a cursor over the target, and I want the guy sitting behind the console looking at that cursor over the target to be completely indifferent to the technology or the platform that brought him the final result of that cursor."

— Former USAF Chief of Staff
General John J. Jumper

The Challenge of Collaboration

In today's cross-boundary, shared-mission environments, results depend on effective collaboration. And collaboration, in order to be effective, requires a *common operating picture* and dynamic, accurate, *verifiable* situational awareness among all involved parties. Yet achieving these things has proved elusive.

All those data streams flowing in, all those bits and bytes, and in the Real-Time Targeting Center, all anyone really needed to know was how to get "cursor over target."

Child welfare administrators seeking insight into the risk of harm to a child find that systems and people with information concerning the child—police, social workers, health officials— do not easily share information with each other. And they cannot easily align on the "same facts." But they all have the same goal—to protect a child at risk.

Ship captains and port directors need "maritime domain awareness," or MDA— knowledge of a vessel, its crew, and its cargo as it comes over the horizon or steams into port.

Emergency responders need a clear view of the path and trajectory of a forest fire, knowledge about which of the many agencies in the area are responding, where they are, who else is available, and when they might arrive.

Food safety agencies trying to anticipate the next outbreak of salmonella in a spinach patch halfway around the world find that regulatory issues block their collaboration with industry. Government and industry don't have access to each other's strategies or systems, and cannot easily collaborate when they most need to do so: at the outbreak of a food-borne disease.

Our military and intelligence organizations have encountered difficulties as well, as Gen. Jumper's frustration showed. Sophisticated and battle-tested as they are, significant issues in cross-boundary collaboration remain, many of them based on obstacles to quickly sharing information and making sense of it.

But there is progress.

Clearing the Underbrush

"*One approach to mitigating this problem is to adopt existing agreements on semantics and syntax for concepts that are universal (or at least broadly common), thus forming a 'Universal Core' of implementable objects that will be used in information systems wherever practicable...*"[1]

In the winter of 2007, the chief information officers of the Department of Defense (DoD) and the Office of the Director of National Intelligence (ODNI) received these recommendations from a task force investigating current obstacles and enablers to information sharing between the defense and intelligence communities. They chartered an expeditionary force of technologists to fix it—by September 2007.

As other standards communities had done, the interagency project team was instructed to find, demonstrate, and prove a *common core* of universal terms for its communities' messaging that everyone could agree to. The team was to specify it, code it, prove it, and assure that its design was extensible, scalable, and implementable.

With no additional funds; with no extra labor dedicated to the effort; unrelieved from the duties of their day jobs; but with strong executive sponsorship, a "fast and light" charter of tasks,

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1   Common Core Task Force, 2007. Criteria for Universality and Utility of Information Structures. Unpublished internal U.S. Department of Defense report. Page 8.

and a breakthrough opportunity, the co-leads—Dan Green of the U.S. Navy, representing DoD, and Jim Feagans, representing ODNI—set out to see what they could do.

A 2006 MITRE Corporation review of tactical message traffic reported that 80 percent of all DoD and Intelligence Community messaging contained primary data on *who*, *what*, *when*, and *where*. That was good news: it meant that those four factors comprised a *universal core* of data shared by 80 percent of all message traffic. It also meant that with proper development, any cross-agency message that had a *who*, a *what*, a *where*, and a *when* could be handled, at some level, entirely machine-to-machine.

Getting Started

But where to begin? To the project team, the *where* and *when* seemed easiest to tackle first. Both terms already had formal representation in markup languages. Clearly UCORE, as the universal core soon became known, would need to be an XML-based framework. As a "fast and light" development effort, any result would not be the *end* of information-sharing, but would rather serve as a starting point. That would be good, since with a volunteer technical force, time and effort would be limited.

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Where and *when*, then, looked like the easiest first fork in the road, and the project team followed it.

Needing to "go broad" to include a wide range of users, the team invited community-wide participation. But the quick march it envisioned soon brought the team into a thicket of cross-agency head-scratching, chest-thumping, and feather-ruffling—all on the supposedly "simple" technical tasks of defining a few common terms in XML, and documenting meaning and formatting ("semantics" and "syntax").

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The process nearly collapsed. But then 20 organizations sent 45 delegates to a face-to-face session in July 2007. Dodging gridlock, a sub-group broke off, formulated plans, and drove key agreements back out to the plenary. By September 30, as tasked, the project team produced Universal Core 1.0, and by October 2007 end-user organizations began testing the new artifacts in proofs of concept.

Early Adopters

The U.S. Strategic Command's (STRATCOM) Strategic Knowledge Integration Web (SKIWeb), for example, re-factored UCORE's *where* and *when* concepts into its existing products. Could data producers on the SKIWeb platform, Green later wrote, use UCORE 1.0 artifacts "to conform to a standardized way of depicting time and location so that SKIWeb sources could be combined on a map without mediation?"

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SKIWeb soon showed that they could—and even that they could bring the United Kingdom's equivalent of SKIWeb onto the platform for data exchange. In an important vote of confidence, STRATCOM mandated UCORE even in its primitive version 1.0 format for the SKIWeb platform. Shortly thereafter, Joint Forces Command (JFCOM), National Security Agency (NSA), and STRATCOM partnered with U.K. Ministry of Defence and Australia to evaluate and enable its UCORE solution for cross-domain use. Within a year SKIWeb's 28,000 users were pushing data around from multiple sources with time and location information mediated not by humans, but by UCORE-enabled machines, including those of our coalition partners.

Enter NIEM

What was the next step? Well, the other two terms—*what* and *who*—remained to be dealt with. The project team anticipated that a version 2.0 development effort would include them. However, it was soon tasked to do more: to reach out to the Department of Homeland Security (DHS) and the Department of Justice (DoJ) and to expand UCORE from its DoD and Intelligence Community base to include these new partners. This would be a great coup if it were possible—a formidable new user base, with key partners on critical missions.

Over on "the other side of the Potomac" DHS and DoJ had been busy developing broad-based information sharing using the National Information Exchange Model (NIEM). NIEM now had a large installed base of users. American law enforcement and criminal justice organizations especially, including State and local corrections, police, probation, and courts, had substantially embraced the forerunner to NIEM, the Global Justice XML model, and were now NIEM-conformant. But NIEM already had a digest—Logical Entity Exchange Specifications (LEXS), a law enforcement/terrorism-oriented, feature-rich digest. Why would it want to acquire a new one like UCORE, light as it was? And surely DoD and the Intelligence Community were not about to migrate *en masse* to NIEM, nor to adopt the law enforcement/terrorism-oriented LEXS.

But that was precisely the point. *Whether Justice did or did not give up LEXS, and whether DoD and the Intelligence Community did or did not migrate to NIEM*, UCORE might still permit all four communities' information systems to exchange essential messages around the four domains—wherever there was a *who*, *what*, *where*, and *when* component in their messages. Which there were, aplenty.

Think, for example, of the DoD's Northern Command's (NORTHCOM) force protection requirements in a H1N1 outbreak in the United States. Working with civilian agencies, corporations, State National Guards, other Federal organizations, and non-governmental partners, NORTHCOM would have to exchange health, law enforcement, counter-terrorism, media, environmental, and related data.

Some, but not all, such organizations might be NIEM-conformant. Yet, whether they are conformant or not, all need to share information. It would be important for NIEM and UCORE to demonstrate that they could complement each other, with UCORE adding a *who/what/where/*

when digest to NIEM messages so that DoD, for example, could still understand a NIEM-conformant message coming from their civilian counterparts.

In the late fall of 2007 and into the winter of 2008, as he had done before, Green, now working with Jeremy Warren, Chief Technology Officer at DoJ, took up the next wave of UCORE development—expanding UCORE's collaboration to include the NIEM-conformant world of law enforcement and counter-terrorism. They armed themselves with a fast-march "continuous" governance body of executive sponsors for the effort comprising the chief information officers from all four agencies (DoD, ODNI, DHS, and DoJ) and the Office of the Program Manager, Information Sharing Environment. A simple, clear, one-sentence statement of objective guided them: *"Build a sustainable, collaborative, technical relationship across the Federal Government."*

With strong support from the four-agency governance body of chief information officers, the UCORE effort drew more than 200 volunteers. Operating with an end-of-fiscal-year deadline (September 2008), the UCORE team created an agile, fast-track development process, with continuous and "massive" peer reviews. By April 2008 the team had completed UCORE Version 2.0, adding *who* and *what* to the *when* and *where* data elements already in the UCORE digest.

Next came the pilots. Upwards of 30 platform operators initiated a series of 90-day tests spanning use-cases ranging from position reporting to suspicious activity reporting, including those supporting DoD's JC3IEDM data exchange, as well as MIEM—the Maritime Information Exchange Model—which would soon become NIEM-Maritime, the maritime domain within the National Information Exchange Model.

DHS UICDS

The DHS Unified Incident Command and Decision Support (UICDS) System is another NIEM/UCORE enterprise. With the first phase completed in 2006, UICDS is coming out of a prototype proof of concept run in April 2009, and is headed to pilot—loaded up with UCORE—and NIEM, Common Alerting Protocol, Open Geospatial Consortium, and other standards.

UICDS enables incident commanders from different jurisdictions to share information about availability, requisitioning, and cost recovery for needed resources, based on a variety of messages coming into the platform in various configurations—maps, alerts, incident reports, sensor requests, and personnel lists, for example.

Using intelligent agents the UICDS "understands" which type of message is arriving—for example, an incident alert, a sensor observation, or a resource request. The message could be based on diverse standards, including NIEM. Depending on the message type, the agent "knows" what it should be expecting in terms of which metadata to use, which digest to look for, and which payload to display.

"That's all part of the service oriented architecture and the intelligent agent technology that we are using," Nabil Adam, DHS Technical Lead for UICDS, explains. And Larry Skelly, Program Manager for UICDS adds, "What we saw in UCORE was an emerging capability within the DoD environment that DoD was pushing out to its civilian partners, including those using NIEM. It was just a natural adoption process."

"We thought there were a few advantages we could achieve through the use of UCORE that we could not achieve otherwise," Adam says. "UCORE comes in very handy in terms of making situational awareness, but without sending a message all over the place with payload information. Instead, we could use the

metadata and digest, which include the '4 Ws.' It's obviously just a light piece of information, but it's enough to make the others aware of what's happening in an incident whether the original message is in NIEM or some other language, without consuming bandwidth unnecessarily."

Adam has also lauded UCORE's ability to turn data "atomic" using the *who/what/where/when* digest—so that UICDS's work products can be represented by standards such as NIEM and managed by implementing services. Others see this same value. At the Armed Forces Communications and Electronics Association (AFCEA) conference in February 2010, for example, Bill Stewart of Jeskell, Inc. saw great potential for analytics from UCORE's loosely coupled *who/what/when/where* data—as well as for data fusion, new mashups, and semantic search.

Maritime Domain Awareness (MDA)

In 2008, the Seahawk project in Charleston, South Carolina, operating under the umbrella of the Maritime Domain Awareness (MDA) initiative, began using a generated MIEM-based Vessel Activity Report (VAR) capability for any vessel inbound to the Port of Charleston. Using MIEM, the Department of Transportation, the Coast Guard, the Navy, and 30 other participating Federal, State, and local agencies could all exchange information about cargos, crews, and vessels. The Seahawk platform generated a VAR for each vessel, adding value with a risk assessment, vessel analyses, and related data.

Could UCORE take the *where/what/when/who* data in each MIEM-conformant VAR, digest it, and make that essential data available to any UCORE-conformant information exchange *beyond* the maritime community—even if that user group was not MIEM-*conformant*? The

Seahawk pilot demonstrated that it could. When the MDA community converted from MIEM to NIEM, as DHS soon mandated that the Coast Guard must do, the MDA community brought its UCORE-compatability with it over to the NIEM world.

Today, the MDA initiative is one of the most significant cross-domain information-sharing enterprises in the Federal Government, linking industry, the Navy, the Coast Guard, and the Department of Transportation around the world. It comprises a striking example of success, built on a foundation of UCORE and NIEM.

Looking Forward

"Which is the one standard that will rule them all?" Jeremy Warren asked. "That's the kind of approach that's unlikely to succeed in something as incredibly complicated as information sharing in and across government. There are too many different people out there with their own legacy systems installed," he continued, "investments in standards, in the way that they do semantics for data."

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"The biggest benefit that we're likely to see from UCORE," Warren continues, "is the fact that it's so agnostic to the way that you are doing your detailed data modeling in your community, whether NIEM or JC3IEDM, or whatever. It's very lightweight. So without a whole lot of

investment you're able to share the most important details of information."

"If I were to have an optimistic expectation for the outcome of this," he concludes, "it would be that UCORE and NIEM together is the triumph of interoperability over king-of-the-hill."

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