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# Cursor on Target and the Air Defense Environment

**CDR Dave Markert USN**
NAVAIR Liaison
686 Cushing Rd, Sims Hall
Newport, RI 02871
USA

"'Magic 88', a NATO AWACS, came left to start its third turn in orbit over northern Germany. Sergeant Manny Diwo RDAF, looked closer at his display. As he studied the 'dots' representing hundreds of commercial airliner transiting European airspace, he recognized a non-squawking aircraft entering Polish air space from the northeast at flight level 370. SGT. Diwo dutifully 'tagged' the track as a 'special interest' and gave a heads up to the Surveillance Controller, LT. Samantha Jones USN, who in turn reported it to Magic 88's Tactical Director, CDR Andreas Kernchen GN. "Stupid Russian, why can't keep they keep their equipment working…"thought Kernchen. He keyed the UHF to tell the Control and Reporting Center (CRC).

Major Thordsen Toast Heinrichsen GAF was the CRC duty officer and designated local Area Air Defense Commander. As he reached for his coffee cup, the "special" track caught his eye. Instantly he realized that this non-squawker could be a possible hijacked airliner inbound into the crowded western European airspace. After the recent bombing of two Russian airliners by Chechen terrorists, Toast was spring-loaded to take action. As he scanned the Recognized Air Picture (RAP), he saw what appeared to be two friendly fighters airborne near the contact. While the fighters were not in his sector and certainly not under his control, these Polish MiG 29s might be the one hope that Toast had to make an intercept, escort and identify the suspect track. Major Heinrichsen tried to determine who was controlling the MiGs. He frantically called several CRCs and fighter control stations to determine who, if anyone, was talking to the friendly fighters. Toast realized that whoever had the fighters under control was certainly not part of the NATO Air Defense Ground Environment (NADGE) and thus not receiving the RAP via Link-1. He called local ATC as an attempt to verify the identity of the non-squawker while he keyed the mike to talk to Magic 88.

Toast advised Kernchen of the situation and told him of the two Polish MiGs. Kernchen immediately started calling the Fulcrums on 'guard'. Kernchen then radioed 'in the blind'. "Polish MiGs in the vicinity of Sokolk, please contact Magic 88 on 'Blue 2' immediately for real world tasking." Kernchen knew that this call would likely go unanswered due to range. He sighed in frustration; if only he had some way to vector the MiGs besides voice. Kernchen advised the crew that 'Magic 88' was heading eastbound. Kernchen would try to reduce the range between the AWACS and the MiGs.

Toast was growing increasingly desperate. The sector air defense was his responsibility; while many believed these CRCs were a residue of the cold war, Toast thought differently. He had always trained to expect the unexpected and react with thoughtfulness and professionalism. Now his training was being put to the test. Toast had seen the ruins of the World Trade Center while assigned to NATO AWACS and deployed to the US during the frantic days after the 11th of September 2001. He was well aware of what airliners could do when used as weapons of terror. He knew what desperate attempts had been made to intercept and ultimately shoot

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down the last renegade airliner on that fateful day. Toast suspected that it would only be a matter of time before the same tactics were tried over Europe.

If only he could raise the MiGs…

Major Nowaki was the flight lead of 'Zapper' flight, the flight of two Polish Fulcrum 'A's based at Minsk Mazowieski Airbase. They were conducting Air Combat Maneuvering (ACM) training in a local Military Operating Area (MOA) in northeast Poland. The 'Zappers' completed their second ACM engagement and Nowaki directed the section to proceed as briefed to a USAF KC-135 tanker, (callsign 'Trout 44'), to practice aerial refueling. Major Nowaki had no idea that Toast was attempting to assign to him a real world mission and was oblivious to the drama that was unfolding in the sky 60 miles north of his position.

The boom operator of 'Trout44", Sergeant "Brick" Smith saw the MiGs approach and checked them in on the 'boom frequency'. Brick planned on offering the 'Zappers' each five thousand pounds of offload. Brick knew that the big tanker would be airborne for another hour to 'burn down' if the he couldn't get rid of some of his gas. The Boeing refueler would be too heavy to land.

Major Nowaki declined the fuel and turned his section of fighters toward home. His radio (modified for full UHF usage) was set to his preassigned control frequency. He was not monitoring guard.

Toast was frantic. The guard calls had been unsuccessful and he had finally contacted the fighter control station controlling 'Zapper' flight. He was informed that they were low in fuel and returning to base. Toast could only watch as the non-squawking aircraft at flight level 370 started a slow decent into the heart of Central Europe.

While this scenario is fictitious, the problems depicted here are very real. Incompatible systems limit war fighting options and force lengthy and cumbersome, stove-piped 'human in the loop' interface, in this case to no good effect. While tactics, techniques, and procedures (TTPs) play a role, there is no machine-to-machine (M2M) integration of these legacy, stove-piped, and non-interoperable systems. The MiGs don't 'speak" link 16; they have their own Soviet-era datalink, and thus have no ability to receive the AWACS picture via link. The CRC has no way to pass the RAP to a fighter control station over 600 miles away. While the two ground stations are linked via land telephone line, this is of little use in this unfolding crisis.

The challenge is providing and the seamlessly availability of information on targets and tracks across disparate, tightly coupled systems that were never intended to communicate with dissimilar systems. While the information age has revolutionized telecommunications and computing, much of this revolution is lost to the warfighter when legacy hardware is incorporated.

The sad fact is that today, across the US and the NATO alliance, there are islands of stove-piped systems and communications that can only pass information between the same types of equipment and fail when dissimilar systems need to exchange critical information. Far too often each system has its own data format that is complex and non-interoperable with other systems. The most common 'work around' is the human in the loop; slow and error prone and often (as in this scenario) ineffective.

To solve this problem using conventional engineering and acquisition approaches would require designing tightly coupled systems of systems with 'translators' defining interfaces between two systems. In this case that would mean integrating the link 16 picture with the RAP and quickly converting what is germane to the MiGs datalink. This task alone would cost millions; impossible on today's budgets. As we continue down the path of further NATO expansion, the problem is further exacerbated by the requirement to integrate additional

legacy systems and hardware. Overhauling the C2 architecture of the NATO alliance to seamlessly pass information will cost millions and take decades and the resultant total system complexity would be overwhelming.

However, a more attainable solution to this vexing problem may lie in a revolutionary approach to data management conceived of by the MITRE Corporation for use by the US Department of Defense. This approach is based on the idea that full integration of complex systems is a failed paradigm. The level of complexity is far too great. In just one message set from the US Army's preferred Joint Variable Message Format (JVMF), there are over 18 quadrillion legal permutations that exist in the K5.19 message of the JVMF message standard. In one message set! Clearly, this problem is too vast for an 'apples to apples' integration. Something else is needed.

The approach is called 'Cursor on Target' (CoT), named so after a speech given by USAF Chief of Staff General Jumper who stated that the focus of net-centric warfare "…the sum of all wisdom is the cursor over the target." CoT is founded on the ideal that essential system integration can be achieved by focusing on only the minimum data required. CoT then is a data strategy that applies a common 'what', 'where', and 'when' standard to the systems to which it is applied. This 'what, where, when' standard is in the eXtensible Markup Language (XML), format so coding is a relatively simple process. When this data management strategy is applied, it enables systems to 'talk' using these common elements of data. Writing XML code to enable these conversations is relatively simple, varying between a few hundred to a few thousand lines of code, depending on the level of pedigree, trust and additional information required or desired. System integration is typically less that $100,000. CoT has proven itself very flexible and adaptable to virtually all fielded systems. New systems are coming on-line 'speaking' CoT natively. Cursor on Target has also proven that it is blind to the transport mechanism. It can run across UHF or VHF radios or be broadcast across the Global Broadcast System.

How did 'what, where, when' become the words of the net-centric battlefield? After an initial study of what goes on in modern battles, analysts have determined that 'what', 'where', and 'when' constitute the most valuable information for a large percentage of the most critical missions areas, and may constitute the minimum required data. 'What' tells us if this is a friendly or hostile track or force; a time sensitive target to be killed or a survivor to be rescued. 'Where' is clearly the location. This has become synonymous with military GPS accuracy of precision coordinates that can closely cue a weapons system, hit targets within one foot of intended impact point or point and image post strike 'hits' for Bomb Damage Assessment (BDA). As we need to pass near real-time information on tracks and targets of interest, 'when' is becoming increasingly important. As we shrink the sensor-to-shooter timeline for "time-sensitive-targeting" missions the precise location of the target, *and when the is there* become critical.

So Cursor on Target can 'speak' 'what, where, when' but how can this be used? First, Cursor on Target acts as an integrator and translator. Track information, (defined as 'what, where, and when') can now be passed across systems boundaries using the XML wrapper. Secondly, CoT can be used to send critical information where it did not exist before. In one instantiation of CoT, The AC-130 Gunship now has the Link-16 picture over the ARC-231 radio where this did not exist before. To get true link 16 capability (a MIDS or JTIDS terminal in the aircraft) would have cost over $1 million per cockpit. CoT provided this capability for less than $100,000 (integration costs) Third, Cursor on Target can build revolutionary new warfighting capability using this simple XML schema. The USAF and USN experimented with sending 'Blue Force' information to fighter cockpit via link-16 tracks and JVMF messages decoded in Navy F/A-18s. The capability of, for the first time, having Blue Force Situational Awareness (BFSA) in the cockpit will dramatically change the way we think and fight. We will go from a procedural 'close in' battlespace to an integrated networked

one…thanks to Cursor on Target. Clearly the employment possibilities are endless and the ramifications are war fighting will be vast.

The Cursor on Target approach has been like a small brush fire burning throughout the US Department of Defense (DOD). Currently over 50 systems are integrated using this XML schema and the demand continues to grow. The USAF has CoT enabled Combined Air Operations Centers (CAOCs) throughout the world thus integrating disparate systems using the 'what, where, when' machine to machine (M2M) data strategy. In the US Navy's recent experimentation (at the Joint Expeditionary Force Experiment (JEFX) at Nellis AFB, Nevada) using this M2M data strategy, precise target coordinates and detailed blue force information were successfully transmitted – battlefield, through the Combined Air operations Center (CAOC), to an airborne F/A-18, and into a Joint Direct Attack Munition (JDAM), all machine to machine. *Battlefield to bomb*; machine-to-machine, enabled by the CoT data strategy.

Let's review our opening scenario and apply Cursor on Target.

'Magic 88' reports the non-squawker tagged a 'special' to the CRC via link 16. A CoT XML interface at the CRC 'speaks' link 16 and culls the 'what'; (special, non squawker) the 'where', (FL370 over northeast Poland in GPS accurate coordinates) and the 'when', (1540 GMT updated as often as link 16 and Magic can accomplish). This information is then routed (as CoT can contain business rules) to all CRCs and fighter control stations via land line, in some cases using the plain old telephone modem. In our scenario, once the information is routed and received in the control station, a CoT interface converts the 'what, where, when' into the MiGs native Turkus datalink. Business rules (based on TTPs) state that any 'non-squawking special' immediately get sent to any fighter airborne within 100 km of the track.

As the 'Zapper 1" completes his second ACM engagement, Major Nowaki receives a datalink steer from his Turkus datalink. Major Nowaki knows that this is a real world mission based on his training. He immediately directs 'Zapper 2" to join and proceeds north for the intercept. Nowaki has worked with AWACS in the past and, on the off chance that AWACS is airborne, he attempts voice contact on one of the reserved air control frequencies.

Kernchen directs the AWACS northeast, He has directed his FA to attempt contact. As the 'guard' call is answered by 'Zapper' the AWACS picks up voice control on 'Blue 2' 'Magic 88's' FA provides additional information on the inbound track to 'Zapper1'. Kernchen advises the CRC that 'Magic 88' is controlling Zapper on the preassigned fighter control frequency. "Zapper flight under our control…they are on a vector of 360 to intercept and ID the 'special' at 370."

Toast recognizes the 'Zapper' callsign and knows which base the MiGs have originated from. He dials the MiGs' home fighter control station to advise them of the new tasking and is informed that there is gas airborne in 'Trout 44'. 'Trout 44' has received modified tasking via the automated commercial aircraft routing system (ACARS – Cursor on Target enabled) and had already begun heading north from their refueling track. While 'Trout' is coordinating with ATC, AWACS advises the 'Zappers' that fuel is available post intercept.

As the 'Zappers' now close on the commercial airliner in a slight decent over northwest Poland, Nowaki 'pushes' his wingman into a combat spread. He will join near the cockpit while having 'Zapper 2' in a position to fire if, God forbid, that becomes necessary.

Compare the first scenario with the second. Situational Awareness (SA) is greatly enhanced using a simple XML schema and 'what, where and when.' No legacy systems have been modified, TTPs have changed and

those are defined a business rules for Cursor on Target. These business rules determine who gets what track information. In this example link 16 is translated to the MiGs native Turkus datalink via CoT. CoT is interfaced with ACARS and allows the tanker crew to have SA on the unfolding situation. The fighter control station can receive the AWACS link 16 picture over the telephone line and it is 'deciphered' via CoT at the receiving end.

All this (mostly machine to machine using CoT) has occurred in a shorter period that it takes to tell about it. Clearly business rules need to be established and tactics, techniques and procedures (TTPs) developed, but now, in a CoT M2M environment, the Air Defense Commander has options (escort, force to land, *shoot down?)* In the former scenario, Toast had none.

By adopting a *small common data* set of the *most important* information across the battlespace, systems can be connected as never before at a fraction of the cost of traditional approaches. 'What, where, when' provides a huge warfighting benefit with little to no impact on existing systems…except to make them germane, not obsolete. CoT makes data compatible. This is where it shines. But it can also be used as a integrator/translator to allow systems to communicate independent of voltage issues, repetition frequencies, signal processing schemes or message sets. CoT is blind to the transport mechanism of the data. It can be used over UHF radios or the Global Broadcast System. CoT has been used on diverse and complex message sets from USMTF to JVMF as well as link 16. This light data management approach works!

But Cursor on Target isn't the total solution. In our scenario, CoT provides cueing for the MiGs weapons system via datalink. Due to systems latencies, CoT is not currently providing weapons quality tracks across disparate systems. Longer-term activity will be required to realize the full potential of machine-to-machine and the promise of net-centric warfare. Robustness, information management, and information assurance are examples of areas needing more attention. Nevertheless, the NATO should seize the opportunity today to rapidly tie systems together using the 'what, where, and when' approach.

Cursor on Target provides a light data management schema that is ideal for operational experimentation (as the US Navy has learned) or it is ideal for quickly integrating disparate systems to examine complex systems interfaces at a fraction of the cost of traditional system integration approaches. CoT integration and help the services learn about and shape the future of net-centric warfare within the resources available today. For these reasons alone CoT may bear scrutiny.

As Major Nowaki joined, he saw that the contact was an Aeroflot Ilyushin IL-96. As he neared white and blue airliner, he saw the pilot signaling with his thumb closing onto four extended fingers - like a lobster claw closing – and shaking his head from side to side. Nowaki recognized the signal as in-operative squawk. He radioed 'Magic 88'.

"Magic, it looks like it is an Aeroflot IL 96 with an inoperative squawk, breaking off the intercept. Zappers are proceeding 'Trout 44' for tank. 'Zapper 2' come aboard left side, Magic, Zappers are switching tank frequency."

Kernchen passed the information to Major Heinrichsen but Toast had monitored the transmission. "Good" thought Toast, "only a malfunctioning transponder and a somewhat befuddled airline pilot, it could have been a lot worse." Toast reflected on the recent events. Things went smoothly today, most were enabled by software (Cursor on Target) and communications links that Toast could not see…but today he sure appreciated that they were in place.