SDR and JTRS: Lessons learned

An interview with Col. Steven MacLaird, USAF (ret.) and former Program Executive Director of the Joint Tactical Radio System JPO

EDITOR'S FOREWORD

Col. Steven MacLaird managed the Joint Tactical Radio System (JTRS) Joint Program Office (JPO) from 2000 until his retirement from the U.S. Air Force in 2005. JTRS is one of the DoD's largest programs, which I include with the "big three" of the Joint Strike Fighter F-35 and Future Combat Systems. Last year, I estimated that over the program's life, somewhere between $12-$15 billion would be spent on JTRS radios and infrastructure (download available at http://meecc.com/presentations/CIUFO.pdf).

Steven successfully navigated a challenging program, rife with technical, financial, and programmatic obstacles. Today, the JTRS clusters have been renamed and shuffled around, and the program is realigning its timetable for initial deployment over the next 12 months. He has been selected to sit on the board of directors of PrismTech, a COTS supplier of the Software Communications Architecture (SCA) that's essential to JTRS. I had the privilege of speaking with him last April. Edited excerpts from that conversation follow. – Chris Ciufo

MIL EMBEDDED: ***Please provide a brief overview of the current JTRS radios and explain how they relate to the previous clusters.***

MACLAIRD: In March of last year a hand off was initiated between the old [Joint Program Office] organization and the new, and I went in and briefed Dennis Bauman on the program. And we provided to him a way ahead on the organizational structure. He's adopted a large set of that, which you have undoubtedly seen in the press.

The ground domain consists of Ground Mobile Vehicles (GMV) radios and the Handheld/Manpack/Small form fit (HMS) radios, i.e., *Cluster 1 and Cluster 2.* Special radios used to be *Cluster 2,* also known as JTRS Enhanced MBTR (JEM). The airborne maritime fixed site domain is made up by the AMF program, which previously, probably about November 2004 was to be the airborne fixed site program, known as *Cluster 3* and *Cluster 4*, and the Air Force and Navy came together and consolidated them into the AMF. Finally, the waveform and crypto program was transitioned into the Network Enterprise Domain (NED).

MIL EMBEDDED: ***Why did you recommend changing the clusters around?***

MACLAIRD: There was a strong service equity issue within the program when I took it over in June of 2001, which led to some dysfunctional approaches to delivering capabability to the joint force. Also, when you looked at the history of the original intent of the program organization, the organization that I inherited did not reflect the intent of the program.

MIL EMBEDDED: ***Can you define the term*** **service equity?**

MACLAIRD: The way the money was laid out – actually, the way the program was laid out – was the funds for the particular programs resided in the service's top line [budget]. So if you talk about what used to be Cluster 1, that was predominately Army funded. The Army ran that program. And although the JPO director had oversight authority over the program, the actual funding went through the Army, then through the JPO and separately through the Army CECOM for Cluster 1. And the leadership of the organization reported through another organizational structure up at [U.S. Army] CECOM.

MIL EMBEDDED: ***Let's talk about some of the technologies. Can you comment on COTS technology and this program … where it's come from to where it is today?***

MACLAIRD: *Proprietary* is a pretty good summation of the program. What's really important to understand is that you took a program that started in 2000 that not only was trying to build hardware but software operating systems and waveforms, *and* build new standards *and* try to deliver new capability all at once.

What we can do today on FPGAs, GPPs, and DSPs and what people thought we could do back in 2001 when I took over the program has greatly expanded. Spectrum Signal [Processing], Harris Corporation, and General Dynamics are out there running

with the capability. So if you look at that and what technologies are out there, you know that open architectures with POSIX corporate middleware are critical.

Also, in February 2004 I spoke with NASA and they're now adopting the SCA. They actually had been looking at building their own standards and looked at ours and did a 168-page summary that said, bottom line: It's already here; we just have to adapt it for a space-based environment. They told me in 2003/2004 that they had four satellites waiting for proprietary software to show up so they could go launch the systems.

MIL EMBEDDED: ***What sort of technologies do we need going forward to actually bring JTRS into deployable fruition?***

MACLAIRD: Our biggest challenge is in the processing because of heat and the issues of quickly and efficiently dissipating that heat. In the past, we've done that with size and with fans, which is not the best way to operate radios in desert environments. Balancing environmental factors plays a big part in how you design and deliver capability to the war fighter. But that's not the only place where JTRS technology needs to be focused.

Other system needs include focusing on new battery and antenna technology, smaller, lighter, more capable, and relying on easy access to commercial markets. I've seen needs in the Special Operation Forces where they desire more batteries that are easily accessible (AA batteries, for example), and how do you do that – by going into a local Iraqi CVS or grocery store? War fighters are asking, "Why can't you build me a military radio capable of accepting commercial battery sources? And by the way, I want it to operate for 8 to 10 hours without taking out the batteries."

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Also, JTRS radios have to talk to satellites, so we need transmit power and some proprietary [military] technology, but the radios still need to be reduced in size and weight. And we also need faster [red/black] encryption security chips – the ability to encode and decode and process information factors into the heat and battery issue, too.

MIL EMBEDDED: ***So what do you think the software impediment is in JTRS?***

MACLAIRD: From my perspective of watching how we do things in government, the issue has to do with the program pace. You go in, you buy a capability, and you want to build it in 36-42 months. By the time you get there, things have changed.

We're talking about SDR, with the emphasis on *software-defined* and yet every conversation we have in the marketplace is about the hardware. A lot of people don't get the fact that the value content in the future of these radios is going to be all software. Software needs to be produced very efficiently and, until now, that has been very difficult to do because open standards such as the SCA have been evolving.

MIL EMBEDDED: ***Let's go down that path for a moment. So what's the current state of the SCA?***

MACLAIRD: I understand that they recently released version 2.2.2, which is basically a debugged version of the SCA. Just prior to my departure, we had pulled a team of experts together from government and industry, people to attack current and future concerns. People like: Vanu's John Chapin and PrismTech's Dom Paniscotti and Jerry Bickle, Spacecoast Communications President John Bard, and Lee Pucker of Spectrum Signal along with some others. We had laid out a road map with what we called *SCA 3.x* that would allow fixing of some of the problems of SCA 2.2 and migrate to a capability for above 2 GHz [RF]. And it also addressed a high-order language that some call *Modem HW Abstraction Layer* (MHAL). It created a similar higher order language or higher order abstract language capability that would allow the migration and maturation of the program.

MIL EMBEDDED: ***I would argue that the idea behind the SCA core framework was a good one, but here we are four years later and we're still not actually shipping JTRS. Are we going down the right path with SCA?***

MACLAIRD: As you go through any process, the issue is getting it to be socialized with the right people and adopted. There are a lot of people who have problems with opening up the architecture because they have proprietary solutions. PrismTech's view is that there is nothing fundamentally wrong with SCA. The 2.2 version does the job for which it was designed: The JTRS program provides radios, a common standard that has been reviewed and endorsed by the 130+ member Software Defined Radio Forum (SDRF) and the 880+ member Object Management Group (OMG). Both of these are well known standards bodies.

MIL EMBEDDED: ***If the military had to do this all over again, what do you think that this program should do differently, knowing what you now know?***

MACLAIRD: Organization and financial structure were, in my mind, the biggest obstacles. Technology was there or would have evolved to get us to where we needed to be.

MIL EMBEDDED: ***Are there any technology issues that, if done differently, might have achieved more success sooner?***

MACLAIRD: I would not have put the majority of the waveforms on a single contract. We put 20 or 21 Waveforms (Wf) on the contract with Cluster 1, and it became a big output to manage

when the contract focus and difficulties seemed to be more on the hardware. I think if the organizational and financial structure and political structure had been set up right, more along the lines of what it is today, we could've been more successful than we were.

Col. Steven MacLaird *(USAF ret.) served as Program Director of the U.S. Department of Defense's JTRS Program Office. His responsibilities included: development and acquisition of a new family of SDRs for joint use throughout the armed services with the goal of replacing 750,000 radios in the 2 Mhz to 2 GHz radio spectrum; coordinating the development of the radio SCA into commercial and international standards; the development of JTRS radio families to serve domestic and international uses as well as encouraging their commercial use; overseeing five Service cluster acquisition programs valued at more than $9 billion. Steven is a 1978 distinguished graduate of Kansas State University's Reserve Officer Training Corps program.*

For more information, contact:

PrismTech
6 Lincoln Knoll Lane, Suite 100
Burlington, MA, 01803
Tel: 781-270-1177
Fax: 781-238-1700
Website: www.prismtechnologies.com