# The JTRS Revolution

By Capt. Todd G. White, USAF

Have you ever imagined the Radio Frequency (RF) spectrum as a weapon system? Software defined radios in the form of the Joint Tactical Radio System, referred to universally as JTRS (pronounced jitters), have led warfighters throughout the Department of Defense (DoD) to join forces and look at the RF spectrum from a completely new perspective.

"JTRS is much more than just another radio ... it's a revolution in the way warfighters will access and employ the RF spectrum in DoD in the future. The JTRS revolution ranks among the most significant transformation events within the world of communications taking place in the RF spectrum domain today, delivering virtually the entire RF spectrum to the warfighter in a single family of radios. JTRS cuts across all operational platforms, all Services, all frequencies, throughout the tactical, operational and strategic levels of warfare," said Col. Charles "Whitey" Whitehurst, Director of the Global Communications & Information Directorate (SC) of the Air Force Command and Control and Intelligence, Surveillance & Reconnaissance Center, Langley AFB, Va.

As the military moves toward a network-centric communications environment, it is imperative that we move from legacy equipment that performed one function (HF, UHF, VHF, SATCOM) to a family of radios that provides the means for digital information exchange. JTRS supports joint operations by providing the capability to transmit, receive, bridge and gateway among similar and diverse waveforms and network protocols within the RF spectrum. Connectivity to civil and national authorities is possible as well as connectivity to vertical, horizontal, and joint and coalition warfighting elements.

Advances in areas such as embedded processor technology, digital converter performance, and object-oriented programming have enabled a shift from hardware-intensive radios to flexible, multi-band, multi-mode software radios, in which functionality is provided through software rather than hardware. A software-defined radio permits operators to tailor the radio to meet specific operational needs by using relatively generic hardware and loading multiple software waveform applications that meet identified requirements. The flexibility of a programmable software radio allows the warfighter to accommodate various physical layer formats and protocols. This allows the Services to host the entire RF spectrum, HF, UHF, VHF, SHF, etc., on a software format and install those waveforms inside the JTRS radio system. JTRS is a family of radios that is "platform-agnostic" yet "mission-specific" for each platform, and represents the OSD solution for spectrum dominance.

On Oct. 14, 2002, the Assistant Secretary of the Air Force for Acquisition (SAF/AQ) tasked the AFC2ISRC to develop the Air Force JTRS migration plan, utilizing the current 32 different primary waveforms currently being developed by the JTRS Joint Program Office. "Six months ago, we were talking in terms of 2 MHz to 2 GHz," said Whitehurst. "We looked at the JTRS airborne radio only in terms of the channels on the radio, a power amplifier and additional RF frequencies. That way of thinking was fine to meet current operational requirements, but it didn't address future requirements which we anticipate will reach 54GHz. JTRS is far more than a radio replacement program ... it's a totally new way of thinking about communications," Whitehurst added.

A major tenet for JTRS is the easy insertion of advanced technology. Since the radio is software driven, any inherent change in the software capabilities has minimal (if any) impact on the resident hardware. In the first iteration of the JTRS system, it was possible to install a variety of different frequencies on available ports, but the number of ports was limited. While this equated to a major leap forward from previous technical solutions, it did not fully exploit the capability of JTRS since it did not fully exploit the processing capacity of the radio. The latest JTRS system will migrate away from this type of thinking entirely and incorporate all programmable components within one relatively small unit.

When we think of multi-mission platforms, an airborne platform that can perform more than one mission, we usually think in terms of large wide-body platforms. We are driven to this due to the space required to host electronic, communications and support equipment. One example of this is employment of the Roll On/Off Beyond Line of Sight Equipment (ROBE) on the KC-135, which allows the aircraft to perform both the air-refueling mission and Line of Sight/Beyond Line of Sight extension of Link 16. The scalability of JTRS allows it to be easily installed in virtually any platform within the Air Force inventory, including hosting waveforms on missiles and smart bombs.

Imagine a flight of F-15s en route to a theater of operations. On their ingress/egress, equipped with JTRS radios, they perform a variety of missions currently being conducted by large, wide-body platforms. They transmit and receive RF signals over the entire frequency spectrum, functioning as both fighter aircraft as well as communications and gate-

*Col. Charles "Whitey" Whitehurst demonstrates a current JTRS Cluster-1 radio (left) and a two-channel Cluster-4 prototype radio. Photo by Capt. Todd G. White.*

way nodes to perform such missions as signal intelligence collection and radio jamming — performing whatever RF mission is required to deny enemy access to the RF spectrum.

JTRS will eventually be integrated into 64 different types of aircraft in the Air Force inventory, as well as a myriad of ground-based platforms, during scheduled depot level maintenance. JTRS is programmed to replace 750,000 radios within the inventory covering operations such as navigation, positioning, location, identification, Air-to-Ground, Air-to-Air, Ground-to-Ground and satellite communications. Capitalization of integration costs will be realized by reducing 124 different radio sets to approximately 10 to 20 form-fit radio sets.

There are several challenges yet to be resolved to fully exploit the inherent capabilities that JTRS will bring to the battlefield. Two of these include antenna research and legal constraints affecting all radio systems, especially those designed to access the entire RF spectrum, due to potential conflicts with non-U.S. authorized frequencies and non-military systems. While several challenges have yet to be resolved to fully exploit the capabilities that JTRS will bring to the battlefield, JTRS is a revolutionary way of doing business. Once fielded, warfighters will no longer think of the RF spectrum in terms of hardware but as capabilities. Multiple software modules will allow implementation of different standards in the same radio system (including the capability to employ multiple waveforms resident on the same set). Radio receivers will be reconfigured over-the-air, thereby reducing maintenance requirements.

"In the past, if you were equipped with an HF radio, you were limited to communicate with HF waveform subscribers. Once JTRS has been fielded, a warfighter will be able to talk to another warfighter on multiple waveforms, and it will be totally transparent to him that this is what he is doing. We are only beginning to appreciate the realm of the possible that JTRS brings to the battlefield," concluded Col. Whitehurst.

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*Capt. Todd White is the Chief of Public Affairs for the Air Force Command and Control and Intelligence, Surveillance & Reconnaissance Center at Langley Air Force Base, Va. Commanded by Maj. Gen. Robert F. Behler, the AFC2ISRC is the lead organization to integrate and influence command and control, intelligence, surveillance and reconnaissance strategies, roadmaps, and investment plans for the Air Force. The center also oversees the Air Force Experimentation Office (AFEO) in Hampton, Va.; and the Command and Control (C2) Battlelab, located at Hurlburt Field, Fla. In addition, the center has Officer Liaisons (OL's) assigned to 16 additional agencies.*