Future waveforms and software defined radio for dismounted soldier communications

Rob Garth, Product Director, Domo Tactical Communications (DTC) talks to Soldier Modernisation

Q: What do you mean when you talk about a "Waveform"?

A: That's an interesting question. Many people think of a communications waveform as simply the "air interface" of a radio - the way the radio launches the information to be transmitted into the ether. In the old days this might be achieved using Frequency Modulation (FM), Amplitude Modulation (AM) or Single Sideband (SSB) for example, whereas today it is more likely to be COFDM or spread spectrum.

But actually, a Communications Waveform really encompasses much more than this - in fact, every step between the information to be transmitted entering the communications system to it actually being transmitted on air. This might include audio or video encoding, encryption, frequency hopping algorithms, channel access mechanisms, traffic routing and a host of other things - including Cognitive Radio technology which adjusts the behaviour of the communications system based on the radio environment in which it finds itself.

Q: But I just want to communicate. Why should I care which waveform is used?

A: Essentially there is no such thing as a "one size fits all" Waveform - Waveforms are optimised for a particular use case or set of use cases and a particular deployment environment. Choose an unsuitable waveform and you might suffer from unreliable communications, poor LPI/LPD

(Low Probability of Intercept/Low Probability of Detection) performance and compromised security, insufficient data throughput or unnecessarily high power consumption. Your radio system might also be unnecessarily wasteful of scarce radio spectrum and disruptive to other radio spectrum users.

For example, many satellite communications systems utilise wideband "Single carrier" Quadrature Amplitude Modulation (QAM) transmissions which are spectrally efficient and can be generated and demodulated using relatively simple hardware. In a line of sight Satcom link, these waveforms perform very well, but try deploying the same waveform in a wideband ground to ground link - particularly in an urban environment with strong reflections - and it will likely be rendered completely unusable by multipath fading.

Q: How Does Software Defined Radio play into all this?

A: Traditional radio systems were "hardware-defined," meaning that their key waveform parameters - modulation type, channel bandwidth etc. were fixed at the time of manufacture by the electronic circuitry and components employed. Some radios could support more than one waveform - both AM and FM for example - but this was achieved by switching between different hardware circuitry.

In contrast, a Software Defined Radio such as Domo Tactical Communications' SOL8SDR has its behaviour and waveforms defined not primarily by the hardware employed but by the Software installed. Thus, the same radio hardware can potentially host multiple different waveforms and the user can choose between them depending on the mission and deployment environment. And a radio developed today might be field upgraded down the line to a waveform which hasn't even been developed yet - immensely powerful in staying ahead of an adversary's Electronic Warfare (EW) and capabilities.

Q: What Waveforms does DTC offer and what benefits do they bring?

A: DTC's flagship MeshUltra™ family of Tactical COFDM MANET IP Mesh waveforms supports up to 144 nodes and channel bandwidths from 1.25MHz to 20MHz, delivering a maximum throughput approaching 100Mbps. The MeshUltra™ family was developed from the ground up to perform well in challenging RF environments - in the presence of strong multipath reflections, interference and jamming and also for deployment on high-speed platforms. It also supports DTC's cutting edge "every radio a sensor" Cognitive Radio capability "Interference Avoidance System" (IAS).

We also support several other MANET waveforms primarily for compatibility with currently fielded systems as well as a unidirectional COFDM Video waveform which offers a DVB-T compatible mode and is ideally suited to "one to many" applications such as video downlink from a strategic UAV.

Q: Does the Dismounted Soldier environment impose limitations on a practical SDR?

A: To some extent yes. Compared with a rack-mounted base station or vehicle radio system, a Dismounted Soldier SDR has to deal with significant SWaP (size weight and power) constraints. Dismounted Soldier Radios are also typically deployed in very large numbers and therefore hardware cost also becomes a significant factor (SWaP-C). This typically leads to restrictions in the frequency range and instantaneous bandwidth which can be supported and also sometimes limits the complexity of the waveforms which can be hosted.

But low SWaP-C Software Defined Radio hardware has moved forward in leaps and bounds in the last couple of years as can be seen from DTC's latest single-board SDR - just two inches square and weighing less than 26 grammes but still capable of supporting all of DTC's waveforms, with plenty of room for growth. ■

Rob Garth is Product Director at Domo Tactical Communications (DTC). With a background in RF engineering, Rob has more than twenty years in the development and delivery of robust tactical and fixed wireless systems for both military and civil applications, from simple FM links to multi-Megabit COFDM MESH systems and data pipes on the ground, in the air and at sea. He is Chartered Engineer and Eur.Ing with a Masters Degree in Electronic Engineering from the University of Warwick.