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Antennas point to effective man portable communications

Man portable communications play a key role in governmental and military operations worldwide to ensure safe, reliable, and secure communications. Requiring extremely complex technology to achieve all of the above, there are many things to consider, with the size, weight, and power (SWaP) attributes of the highest import.

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Man portable antennas are ineffective without the integration of suitable radio frequency (RF) equipment. Such RF devices include a modem, block up converter (BUC), low noise block (LNB) and other tools that enable effective antenna operation and thus reliable satellite communications.

These tools, obviously, require power to function. A means to point the antenna easily is needed, as well. Additionally, making the communications setup and use trouble-free for military, homeland security, first responder and other operators is equally important.

Systems integrators are enlisted in the design and compilation process to deliver all of these distinct components into a highly functional, rugged, and complete package. Virtually all antenna, modem and RF terminal manufacturers have strong working relationships with their integrator partners. These vendors have formed a symbiotic ecosystem for decades that has become an essential part of the satellite industry.

The systems integrator work is demanding. Although designing and ordering custom-made components for man portables is often a possibility, quite frequently, the integrator must use off-the-shelf components and work within the physical and operational parameters of the modules.

Flat panel antennas

The components' unique characteristics significantly diminish the flexibility that the SATCOM integrator has to reduce the terminal's size, weight, and power (SWaP) impact. These design challenges are exceedingly amplified when integrating with flat panel, electronically steerable antennas (ESAs).

A highly valued feature of ESAs includes the inherent SWaP in their design. When the supporting components in the integrated terminal are not designed specifically to integrate with flat panel antennas, the SWaP attributes of the solution will be seriously undermined.

Another growing trend that affects flat panel integration in the satellite industry is the proliferation of waveforms and the desire of end users to have man portables that support various waveforms. The straightforward means to support multiple waveforms incorporates the implementation of multiple modems. Employing multiple modems is not a sophisticated method, and of course, implementing this RF design solution is not conducive to SWaP.

The propagation of waveforms is led by several factors but fundamentally is based on satellite technology enhancements. The move from bent pipe, geosynchronous satellites to high throughput satellite (HTS) architectures brought about an increase in new waveforms. The debut of low Earth orbit (LEO) and medium Earth orbit (MEO) satellites is driving another upsurge in waveforms.

One contention on the genesis of myriad waveforms centres around the idea of a lack of accepted industry standards and, therefore, satellite modem vendors are protecting their own proprietary RF signals. Although there is some truth to the argument, emerging satellite technologies do dictate changes to waveforms.

Software-defined radios

To satisfy the requirements of the MILSATCOM end-user, both the convenience and SWaP of flat panel antennas and the incorporation of multiple waveforms in a single, compact modem are essential. The preeminent solution to the multi-waveform obstacle is the development of a software-defined radio (SDR).

Available in the MILSATCOM market for a number of years, not all software-defined radios (SDRs) can accommodate all waveforms. With a thorough understanding of modem hardware and firmware design, it can be seen that there exist underlying system elements which are waveform dependent.

As an example, automatic gain control (AGC) algorithms can be quite different on single channel per carrier (SCPC) modems when compared to AGCs on time division multiple access (TDMA) modems. The waveform timing mechanism often determines which clocks within the hardware are free running versus those that are slaved.

The tradeoff between the physical dimensions of the SDR modem's analog portion versus the range of modulation orders supported must be carefully considered. All these design and integration challenges can be overcome. However, it leads to the integration work of a waveform on an SDR modem to be more complex than it is often imagined.

Flexibility is integral in designing components for next-generation flat panel antennas. Different flat panel antenna manufacturers will have specialized architectures for their integrated antenna control units (ACUs) and other components essential to the antenna design.

For SWaP requirements, flat panel antenna manufacturers and terminal integrators cannot be plagued by such problems as cable bend radius to realize a design. Therefore, the outmoded paradigm of simply integrating off-the-shelf components where the intermediate frequency (IF), Ethernet, power and other interfaces are predetermined no longer will suffice.

A new physical architecture for modems must be adopted to meet SWaP and industry requirements. This means incorporating an architecture which allows for design freedom.

A freedom of design architecture would mean that the analog section and the digital section of the modem are no longer rigidly coupled, but rather they use standardized interfaces and have internal loopback self-checks. This allows an antenna manufacturer or an integrator to design their own carrier boards complete with all the components necessary to deliver a comprehensive solution.

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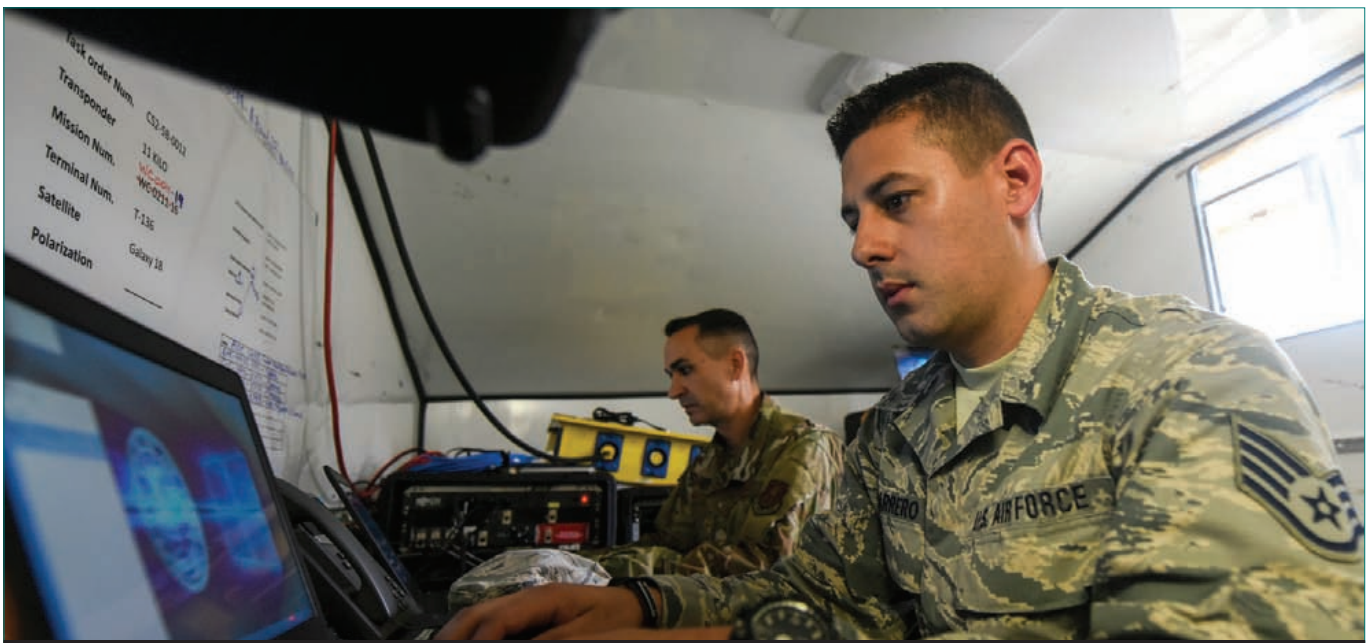
By decoupling the analog and digital portions of a software-defined radio and enabling flat panel antenna manufacturers and integrators to have the flexibility to directly integrate the components on the control board instead of using interfacility link (IFL) and Ethernet cable, the delivery of a truly integrated system can be accomplished realistically and successfully.

This design methodology serves as a means to the next stepping stone in terminal design, which is the migration toward digital IF. With digital IF, the interface to the SDR is no longer L-band, but rather digitized RF known as in-phase quadrature, or more commonly referred to as I/Q. The antenna design transformation, which is prompted by radical changes in satellite technologies and multi-orbit topologies, is likewise driving a revolution in modem and RF transmission equipment. To promote technological innovation in man portables, manufacturers of all components - whether antenna, SDR or transmission - must be in synch as technology advances to ensure the best modern solutions reach the end-users and bring more advanced features and functionality to man portables. **GMC**



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