Considerations when Selecting COTS WLAN Products for Military Systems

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Introduction

Commercial off-the-Shelf (COTS) Wireless Networking products and protocols have recently experienced increased usage in some military end-use RF systems. Their utilization spans a number of applications which include wireless networking and point-to-point data transmission in UAVs, UGVs, and various other products.

System designers are finding radios based on 802.11 and similar standards good candidates for projects that require a quickly available, high performance solution for prototype and/or production radio link designs. Many factors contribute to their appeal. The widespread availability of 802.11 radio cards from a variety of vendors has promoted their low cost and a variety of available features, and many offer them at different levels of integration. Chipsets with baseband outputs enable the use of 802.11 radios at non-ISM frequency bands once the appropriate ancillary hardware is integrated, and a card with all the RF components built in facilitates getting a link up and running as quickly as possible. In addition, the data-rate performance of most 802.11 products is sufficient for most throughput-intensive applications, provides an adequate level of interference resistance (more apparent in 802.11a/g) and in some cases, is comparable in both of these categories to legacy tactical digital information links now in use.

Our aim is to provide the RF system integrator a few things to consider when it comes to COTS WLAN radio and RF SSPA selection. In particular, we will focus on what needs to be addressed when an off-the-shelf radio product with an RF output is paired with a bi-directional SSPA designed for 802.11 applications for a long range link. The information provided has been drawn from our customers' experience in this area and various projects where we've been tasked to provide a bi-directional SSPA to meet their needs.

The SMTR2425-11B40 is an SSPA intended for systems designed for military use based on 802.11b radio systems.

Performance Measurements - 10 Watt Bi-Directional SMTR2425-11B40 vs. competitive WLAN SSPA 10W product claimed to be suitable for military use.

Specifications	Other 10W SSPA	SMTR2425
802.11b Mean Power Out (11Mbps, Claimed / Measured)	40 dBm / 38.6 dBm	40 dBm / 40.8 dBm
Burst EVM @ Measured Power	9.6%	5.9%
Capable of CW operation if necessary?	No	Yes

Radio Selection

Many of the specifications outlined by a radio card's data sheet provide adequate insight as to whether or not the product is acceptable for use based on the general requirements of the system. However, when it comes to the maximum range spec of the radio some caution needs to be observed. Most commercial grade 802.11 products are designed for a maximum range of a few hundred meters. Some assume that this is a limitation of the RF output power of the card itself and that the solution is to amplify the card's output to a level that will satisfy their link budget calculations. In most instances this is not the case. A number of default timing parameter settings in commercial 802.11 hardware impose a range limit of only a few miles no matter how much amplification is present. A paper containing information concerning this topic is available at the following location: "http://c3lab.poliba.it/images/7/71/Optimization.pdf". As a result, it is important to find a radio card vendor that can carry out the specific modifications needed to make long range operation possible. As these changes deviate from how IEEE 802.11 standards have been defined, compatibility with IEEE 802.11 compliant cards may be affected. Therefore, any radios used in the system should be configured identically.

SSPA Selection

Once a radio manufacturer has been selected and a link budget calculated, a minimum set of RF requirements will have been identified in terms of average power output, gain, noise figure, EVM, and spectral mask performance, among others. A bi-directional SSPA that conforms to these specs is now required. Searching Google for "802.11 amplifiers" will lead you to a large number of manufacturers that claim to design and manufacture high power WLAN amplifiers that can be used in military applications. Out of this group, only a select few can actually demonstrate the performance indicated on their spec sheets. Many manufacturers' products fail to meet even basic power output claims, which as a result cause the systems they are used in to under-perform. It is absolutely necessary that the performance numbers of the amplifier be checked by either obtaining verifiable test data from the manufacturer or via in-house testing. Thoughtful evaluation of potential suppliers and products at this point will save a lot of difficulty in the long run.

Conclusion

Using 802.11 WLAN technology is a low cost, effective means of providing robust, relatively high bandwidth data transmission for some military applications. However, a careful evaluation of the components being considered for use is needed to mitigate system performance risks, as gray areas or falsities exist in some product specifications. In most cases, this occurs because the manufacturer serves the commercial sector and does not understand or has the means to test for certain specs. With regard to the SSPA, we have independently tested a number of bi-directional WLAN SSPA products and have found that measured performance did not match specified performance in some cases. It has prompted us, as a manufacturer of WLAN bi-directional amplifiers, to ensure that our products meet or exceed the requirements of the military wireless system designer.

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