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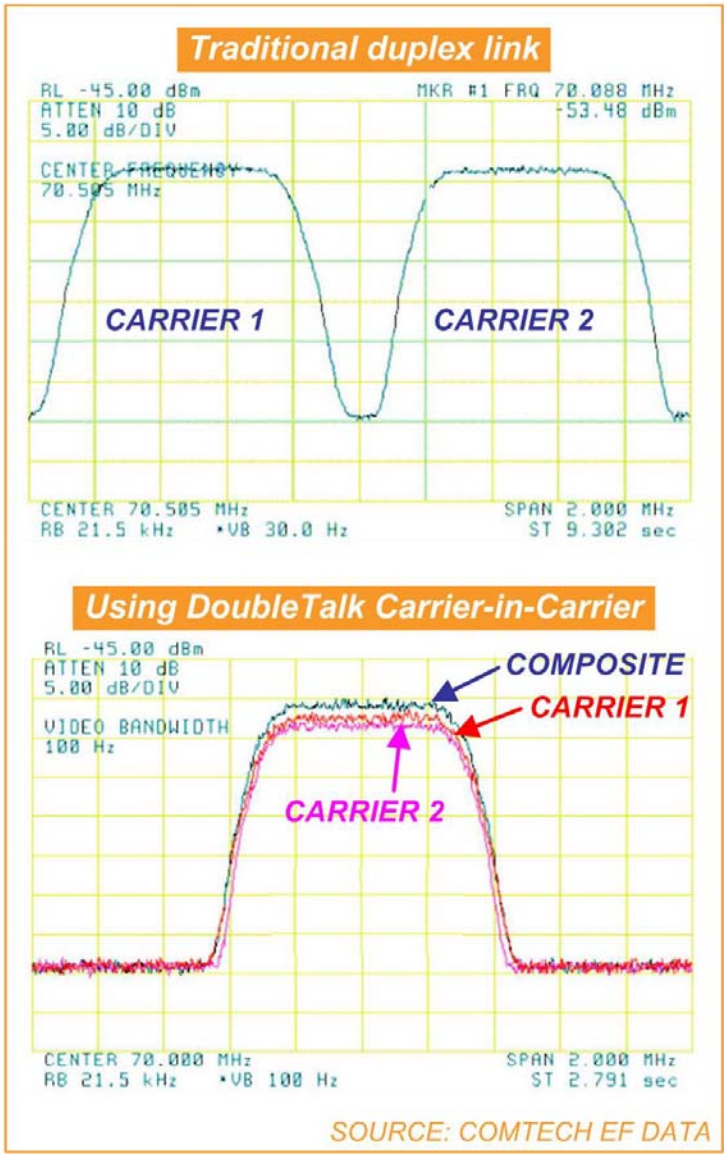
Advanced Technology Enables Spectrum Sharing in Satellite Links

Broadcasters utilize satellite links for a number of applications with the most typical being program distribution and news gathering (SNG or satellite news gathering). Over the years, improvements in satellite transmission technology such as higher level modulation techniques and advanced error-correcting codes have made supporting these applications easier and less expensive. For applications requiring two-way (i.e. duplex) communication, the latest generation of satellite transmission products make use of yet another technique which can reduce the required bandwidth needed by 50%.

This latest advance, which some refer to as "layered modulation" allows duplex satellite links to transmit concurrently in the same segment of transponder bandwidth. A number of different implementations of this technology exist, relying upon different patents. Comtech EF Data Corporation (Tempe, AZ, www.comtechefdata.com) utilizes "DoubleTalk Carrier-in-Carrier" patented by Applied Signal Technology, Inc. (Sunnyvale, CA, www.appsig.com), while ViaSat, Inc. (Carlsbad, CA, www.viasat.com) and Paradise Datacom (www.paradisedata.com) utilize "Paired Carrier Multiple Access" (PCMA) patented by ViaSat. All of these technologies rely on some form of adaptive cancellation technique to enable the sharing of spectrum by different carriers.



As an example, consider an SNG satellite circuit where "CARRIER 1" is the signal from the SNG truck to the studio, and "CARRIER 2" is the signal from the studio back to the SNG truck. In a traditional configuration, these two carriers would exist side-by-side as shown in the upper plot of the figure. With the bandwidth sharing technology applied to this example, these carriers now utilize one-half of the original required spectrum as illustrated by the lower plot. Note that this lower plot is a composite of three separate plots made by transmitting each carrier separately (in the shared spectral location), then by transmitting the composite carrier, and then superimposing the results from all three cases.

Here's how it works: at each end of the link, the composite RF signal consists of two components—the signal being transmitted (which originates locally), and the signal being received (which originates from the other end of the link). Since the locally-generated portion of this signal is known, by using sophisticated digital signal processing techniques, it is possible to estimate and remove the

contribution of the local signal from the composite signal, leaving just the received signal which can then be demodulated in the usual fashion.

According to a Comtech EF Data white paper (available on the Applied Signal Technology Web site at www.appsig.com/images/products/dt_cnc_bandwidth.pdf) the cancellation process includes delay and frequency estimation and tracking, adaptive filtering, and coherent combining. It continually estimates and tracks all parametric differences between the local uplink signal and its image within the downlink. Through proprietary adaptive filtering and phase locked loop implementations, it dynamically compensates for these differences by appropriately adjusting the delay, frequency, phase and amplitude of the sampled uplink signal, resulting in excellent cancellation performance of about 30 dB.

Some of the transmission products now available with this technology include the following:

- **Comtech EF Data** has the CDM-625, CDM-Qx and CDM-Qxl Satellite Modems, as well as the CLO-10 Link Optimizer, which is a “modem agnostic” implementation and can be added to existing installations where modems are already operating;
- **Paradise Datacom** has the Quantum Series PD20 and PD20L Satellite Modems and the PCMA-70 Bandwidth Saving Satellite Signal Canceller (also available from ViaSat as the VPCMA-70) which is another “modem agnostic” device designed to be added to existing satellite facilities.

For additional information about this topic, Sidney Skjei, Skjei Telecom will be presenting a paper on "New Techniques for Re-Using Satellite Bandwidth" in the Television Infrastructure Part I session at the 2009 NAB Broadcast Engineering Conference on Thursday, April 23 in Las Vegas.