



TELEDYNE PARADISE DATACOM, Ltd.
A Teledyne Technologies Company

PARADISE DATACOM APPLICATION NOTE

Optimising Satellite Link Performance for Military, Government and Civil Defence Communications

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INTRODUCTION

Teledyne Paradise Datacom has a strong track record in supplying both MIL-STD and Commercial Off The Shelf (COTS) equipment for use in Government, Military and Disaster Recovery programs. Recent developments provide the user with improved link efficiencies, higher guaranteed throughput and greater link availability, improving on both the operational and capital expenditures of the link.

SATELLITE MODEM OVERVIEW

Paradise offers a wide range of COTS and MIL-STD satellite modems. The modems are hardware and software configurable for a wide variety of different services, allowing:

- IF, L-band or combined IF/L operation.
- An extensive range of modulations including 32APSK and 64QAM.
- Advanced FEC schemes including DVB-S2 and Fastlink low-latency LDPC.
- Support for a large number of terrestrial interfaces including IP with operation from 4.8kbps to 155Mbps.
- *Paired Carrier*, allowing transponder bandwidth to be re-used by overlaying carriers on top of each other, thereby potentially doubling the data throughput with minimal link performance degradation.
- Market-leading web-based M&C with built-in Spectrum Analyser, Constellation Monitor, data test set and Linkguard™, our patent-pending signal-under-carrier interference detection system.

Modulation and FEC Coding Schemes

Paradise modems support:

Modulations: BPSK, Q/OPSK, 8PSK, 8QAM, 16QAM, 16APSK, 32APSK and 64QAM.

FEC: Viterbi, Sequential, Reed-Solomon, Turbo Product Coding (TPC), FastLink LDPC, DVB-S2.

In addition, SmartLink™, is a proprietary extension to DVB-S2 that allows the use of serial interfaces that produce continuous data (as opposed to packetized). SmartLink™ also allows traditional link features such as Drop and Insert, ESC channel, Automatic Up-link Power control, etc. to be overlaid onto DVB-S2 services,

Paradise's DVB-S2 ACM service is the simplest to configure on the market, requiring you only to switch it on! It maximises throughput at all times by dynamically responding to the link atmospheric conditions to provide only the level of error protection required at the receiver, converting any link margin into useful throughput. ACM increases link availability even during severe rain-fades beyond what has been previously possible – the link modulation and FEC rate drop back to provide stronger error protection, ensuring that the link continues to function even under the worst case conditions.

DVB-S2 also has other useful benefits – the use of Pilot tones provides the link with inbuilt interference suppression. Pilot tones are used to help the receiver lock onto the carrier with certain modulation scheme. A small part of the DVB-S2 satellite frame is transmitted as BPSK, which helps the receivers to lock onto the rest of the signal in a noisy environment.

This allows the receiver to hold on to the signal lower into the noise or even in the presence of an interfering signal such as WiMax, particularly when using higher order modulations for the main signal.

Fastlink low-latency LDPC, as the name suggests, combines the efficiencies of LDPC coding with higher order modulations and low latency. This allows spectrally efficient links that are also suitable for applications such as voice traffic that require lower latencies to operate.

Paired Carrier

Paradise has incorporated ViaSat's patented PCMA technology to quite literally re-use satellite bandwidth with little degradation in link performance. Coupled with advanced modulation and FEC technology this gives the user unprecedented ability to reduce operational costs while maintaining high-performance links.

IP

Paradise provides an extensive IP feature set, all contained within the modem, saving on rack space and cost when compared to modems that require supplemental external equipment. Features fall into two categories: those, such as compression and acceleration that increase bandwidth efficiency, and those, such as traffic shaping, VLAN tagging and routing, that directly control the quality of service being provided.

Diagnostics, Monitor and Control

All Paradise modems are equipped with a wide range of diagnostic tools and remote control options. Paradise pioneered the use of web-based modem test equipment and continues to innovate in this field. Included in every modem is a Spectrum Analyser and Constellation Monitor and a Bit Error Rate Tester. These allow rapid detection and diagnosis of system problems, minimizing down time and periods when link performance is degraded.

The Spectrum Analyser provides a view of the receive signal. The resolution is configurable from a narrow view of the carrier to a wideband mode that includes adjacent carriers. This feature works even when the carrier is not present or the demodulator is unlocked allowing the user to align and monitor the terminal using only the built-in tools.

A great new feature is our patent-pending Linkguard™ signal-under-carrier interference detection system. This allows the user, while still on traffic, to see any interference that is present under the wanted modulated carrier. Linkguard™ detects a wide range of types of interference such as Wi-MAX, tonal interferers (e.g. CW) or other modulated carriers (caused by other users on the transponder through cross-polar interference or unintentional transmission at the wrong frequency). Switching on the persistence mode of the spectrum analyser allows the detection of even transient interferers. Best of all, no operator monitoring or intervention is required as the modem can automatically generate an alarm to a remote control center when the interference reaches a user-set threshold level, thereby giving 24x7 policing of each individual carrier.

Remote control is provided via an easy-to-use web user interface. SNMP (all versions) can also be used.

Modem Redundancy Products

All Paradise modems are fitted with an internal 1:1 redundancy controller. With the addition of a simple cable and RF splitter/combiners, the user has a fully-featured 1:1 redundant system. For systems that require higher levels of protection, a 1:N redundancy switch system is available (with N configurable up to 16). Uniquely, the modem is used as the controller, reducing the cost compared to a traditional system. Two flavours of redundancy switch are available – one where the backup modem is built into the switch and one where the backup modem is standalone.

RF PRODUCT OVERVIEW

Paradise offers a diverse and extensive line of RF products that provides the system integrator with an RF Amplifier, Block Up Converter (BUC) or Converter product for every possible system configuration. Gallium Nitride (GaN) technology is used to provide the highest output power possible in the smallest package size.

The common interface between modem and RF products allows for a 'plug and play' approach to modem and RF integration, greatly simplifying the system designer's task.

RF products range from the μ BUC (a brick style BUC) to the PowerMax systems - a modular phase-combined amplifier system providing up to a remarkable 6kW at X band.

μ BUC and vBUC

The Paradise μ BUC transceiver is designed for highly mobile applications where form factor and power density are an issue. The μ BUC products operate in X and Ku Band at up to 25W, P1dB output power. The small package makes this an attractive as an integral part of a manpack or flyaway product.

The vBUC range increases output power and frequency but still keeps to a small package size. The vBUC can provide 70W at P1dB in C and X band, 40W at Ku band and 10W in Ka band, providing an impressive power density ratio across the range. All vBUC products have an internal web server and communicate with the modems using Ethernet, FSK or serial interfaces to allow system power, frequency and BUC alarms to be displayed on the modem menus. An SNMP Management Information Base (MIB) allows integration with OEM Network Monitor and Control Software.

The L-band modem can supply 24 or 48V DC plus 10 MHz on the cross-site cables to power the vBUC and provide the services necessary to offer a self contained system. Add in the FSK interface and the user has full monitoring of the complete system. All the user then has to do is supply the antenna for a simple terminal solution.

Compact Outdoor

The Compact Outdoor range increases the power capacity, providing up to 400W in C and X band, 300W in Ku and 40W in Ka band. The Compact Outdoor extends the M&C capabilities, providing both fibre and BlueTooth interfaces. As the Compact Outdoor SSPA/BUC is a fully weatherproofed product it is ideal when used in hub or boom mounted antenna systems, reducing the system output losses by getting the amplifier as close to the feed as possible. The internal zBUC and 10MHz reference ensure simple integration with L-band modems.

Rack Mount

The rack mount range of amplifiers vary in size from 3 to 7U and push the RF output powers up to 500W in C and X and 300W in Ku band. They are ideal for high MTBF requirements with a truly modular design, providing front panel swap out of fans, power supply and RF module to ensure that the minimum down time is achieved and a high level of repair is possible with Line Replaceable Units.

Power Max

The PowerMax product is a modular phase combined SSPA system providing parallel system reliability and extremely high output power capability; up to 6kW at C and X band, 5kW at Ku and 3 kW at Ka band. The modular approach provides a system that has a soft fail capability; loss of one module in an 8 module system gives a drop in output power of just 1.2 dB. At the same time, the modular approach provides a solution to problems of operational system power saving. Modules may be powered down in normal operation, to reduce the AC power consumption, whilst providing the normal running RF output power. The user then has the ability to quickly switch in the extra modules to achieve full RF output power.

LNAs

Paradise supply a range of Low Noise Amplifiers with noise temperatures optimised for the satellite frequency sub-bands. They can be integrated into plate assemblies, allowing the supply of 1:1 and 1:2 redundant assemblies specific to your system requirements. The supported frequency range is 3.4GHz to 21.0GHz in 9 separate frequency sub-bands.

Frequency Converters

Paradise Up/Down Frequency Converters offer the maximum performance and high reliability. The rack-mounted converter chassis is designed to accommodate two up or down converter modules covering C, X and Ku band - allowing maximum flexibility when specifying the product. The converter chassis can therefore be configured as a single, dual or fully redundant system in a 1U chassis. The MTBF and reliability of the product is enhanced by a "hot swap" capability – converter modules may be removed and replaced while the unit is powered up. The RF converter "trays" become a line replaceable unit, greatly simplifying sparing and reducing repair times.

CONCLUSION

Paradise modems and RF equipment allow the user to

- Reduce the operational cost of satellite bandwidth with efficient technologies including DVB-S2, Fastlink Low-latency LDPC and Paired Carrier.
- Improve link spectral efficiency with advanced modulation techniques.
- Enhance system monitoring and control with a wide range of web-based tools.
- Add an extensive array of web diagnostic tools for the site integrator.
- Obtain the best power spectral density in their class for the μ BUC and vBUC products.
- Reduce capital and operational expenditure when using the PowerMax system by taking advantage of its highly modular design, allowing you to purchase only the modules you need, while allowing more to be added in the future.

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