

# SDR-4000 SATCOM Wireless Modem (SWM)

## IF-to-Ethernet Modem for Wideband SATCOM Applications

3U cPCI



A deployable wireless modem for wideband satellite communications (SATCOM) waveforms.

### Your Challenges

Do you face any of the following challenges deploying your wideband SATCOM communications system:

- Support one or more of the following waveforms: DVB-S/DVB-S2, DVB-RCS, MUOS, INTELSAT Business Services (IBS), INMARSAT BGAN
- Minimize the physical footprint of the communication packages
- Require simultaneous multiple carriers within the same transponder bandwidth, and must handle wideband analog IF signals (above 36 MHz)
- Support a complex waveform with time critical functionality
- Short time to train your development team
- Support a standards-based Software Radio Application Frameworks

### Spectrum's Solution

Spectrum's SDR-4000 SWM can help you overcome your challenges:

- The SDR-4000 SATCOM Wireless Modem is designed to support the DVB-S/ DVB-S2, DVB-RCS, and Mobile User Objective System (MUOS) waveforms. It is also designed to support INTELSAT Business Services Waveforms (IESS-309 and IESS-315), and INMARSAT BGAN.
- The SATCOM wireless modem transceiver uses 3U CompactPCI form factor.
- The SDR-4000 SWM I/O has dual input 12-bit A/D converters and a single output 14-bit D/A converter, each running at up to 213.33 MSPS. Capturing standard IF frequencies such as 70 MHz, 140 MHz and 160 MHz IF, with up to 100 MHz of analog IF bandwidth is supported.
- The SDR-4000 SWM provides high-speed, low latency deterministic data paths between the various processing elements
- The SDR-4000 SWM comes with data flow examples, source code, hands-on training and your choice of support packages.
- The SDR-4000 SATCOM supports the CRC SCARI implementation of the Software Communications Architecture (SCA) Core Framework

### Description

The SDR-4000 SATCOM Wireless Modem (SWM) supports black-side "IF-to-Ethernet" digitization and processing of complex waveforms. The SDR-4000 SWM forms a key element of a network-centric IP-based satellite communications system, providing modem, link and network layer processing (see Figure 1). The SDR-4000 SWM has been architected to support the latest in satellite communications waveforms including Digital Video Broadcast (DVB/DVB-S2, DVB-RCS), MUOS and traditional legacy satellite waveforms including INTELSAT Business Services (IBS) and INMARSAT BGAN.

The SDR-4000 SWM is 3U CompactPCI in size and is available in air-cooled configuration. It supports two IF input channels, and one IF output channel that can be directly interfaced to off-the-shelf or custom designed satellite RF front end equipment. External interfaces include Gigabit Ethernet, RS232 and JTAG and a high speed sample clock input. The SDR-4000 SWM employs a combination of two Xilinx® Virtex-4™ FPGAs, a TMS320C6416T DSP and an MPC8541E general purpose processor to provide the processing resources required to support the target waveforms.

The SDR-4000 SWM consists of an XMC-3311 transceiver module mounted onto a 3U cPCI PRO-4600 carrier card. Through Spectrum's Modified COTS (MCOTS) process, the SDR-4000 SWM can be customized (if necessary) to meet program specific digital and analog I/O, mechanical, processing and environmental requirements. This may include custom software, FPGA code or hardware.

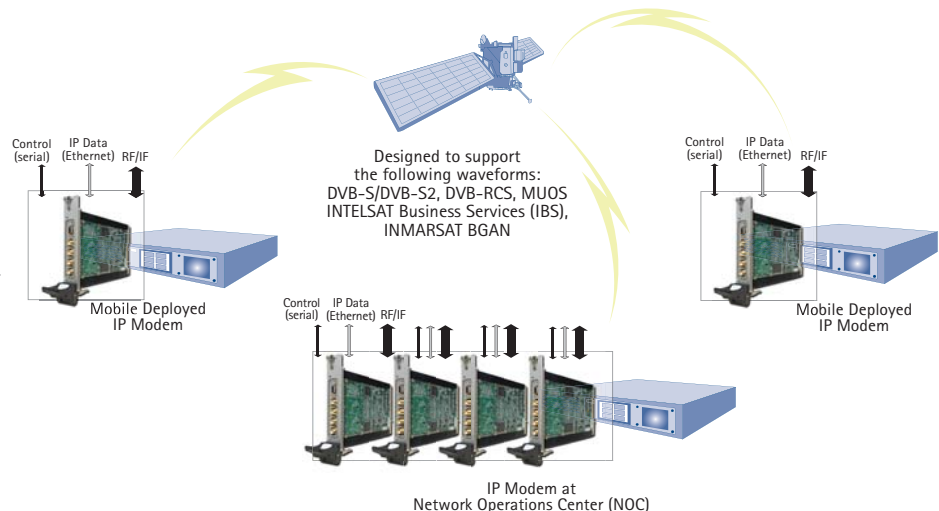


Figure 1. SDR-4000 SWM in a typical IP-based satellite network system

## Block Diagram

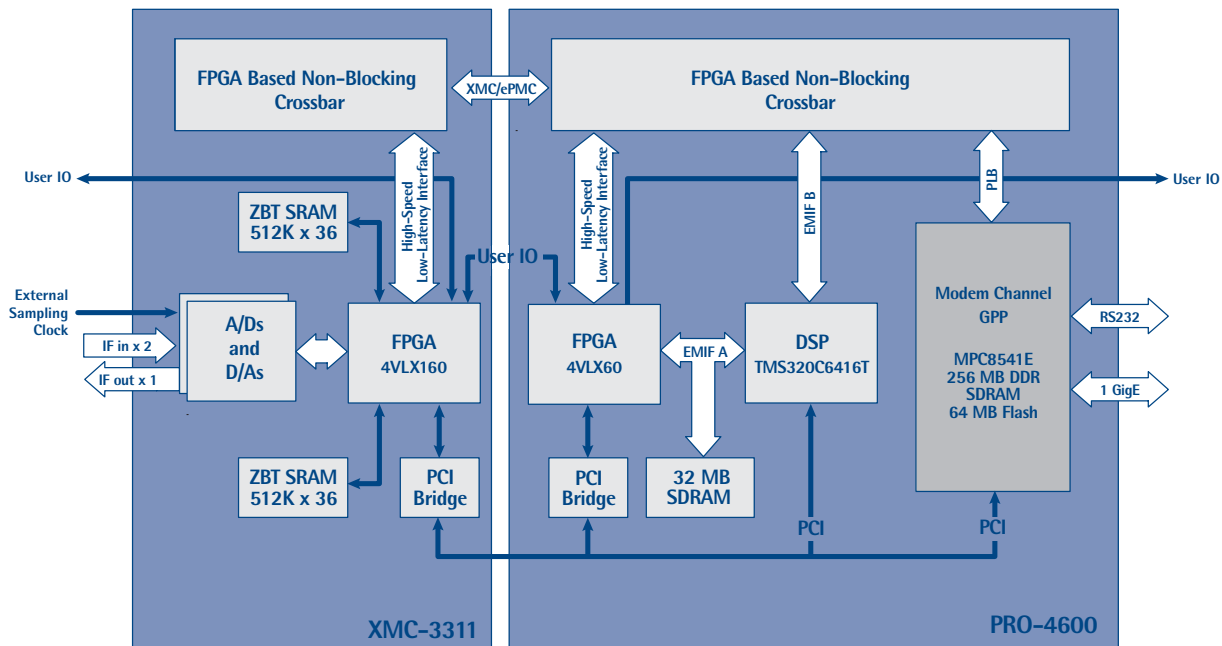


Figure 2. SDR-4000 SATCOM Wireless Modem block diagram

## SATCOM Waveform Support

The SDR-4000 SWM is architected to meet the processing and I/O requirements of both wideband next-generation SATCOM waveforms and legacy waveforms, from INTELSAT Business Services (IBS) to Digital Video Broadcasting (DVB-S and DVB-S2) to the Mobile User Objective System (MUOS). Table 1 describes typical partitioning of waveform processing on an SDR-4000 SWM.

Contact Spectrum for further details on a specific waveform implementation.

	FPGA Xilinx LX160 & LX60	DSP TI C6416T	GPP Freescale MPC8541E
DVB-S2	Yes	Not Required	Yes
DVB-RCS	Yes	Yes	Yes
MUOS	Yes	Yes	Yes
INTELSAT Business Services (IESS-309 and IESS-315)	Yes	Not Required	Yes
INMARSAT BGAN	Yes	Yes	Yes

Table 1. Typical waveform processing partition on an SDR-4000 SWM

## Architecture

### [ PRO-4600 SDR Processing Engine ]

The PRO-4600 is a 3U CompactPCI heterogeneous processing engine that employs a combination of a Xilinx Virtex-4 LX60 user FPGA, a TMS320C6416T DSP and an MPC8541E general purpose processor to support the processing requirements of size, weight and power-limited SDR applications. The PRO-4600 is equipped with a single-width XMC site, capable of hosting Spectrum's ePMC (Solano) modules and industry-standard PMC and XMC modules. For more information on the PRO-4600, refer to the PRO-4600 datasheet at [www.spectrumsignal.com](http://www.spectrumsignal.com).

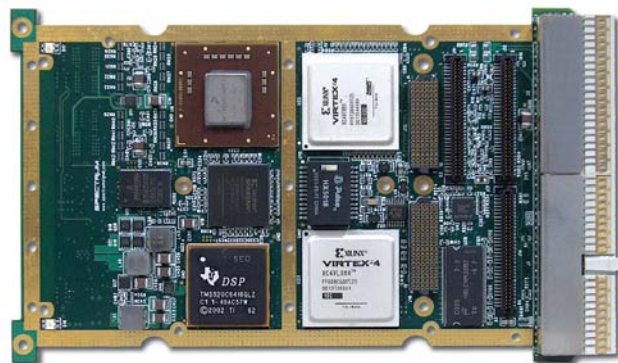


Figure 3. PRO-4600 SDR processing engine

### [ XMC-3311 High Speed Transceiver XMC Module ]

The XMC-3311 has dual input 12-bit A/D converters and a single output 14-bit D/A converter, each running at up to 213.33 MSPS in a single-width VITA 42.0 XMC form factor. The A/D converters and D/A converter are integrated with a single user programmable Xilinx Virtex-4 LX100, LX160, or SX55 FPGA device for wide bandwidth signal processing and filtering in the digital domain. The module can also be used as an Enhanced PMC (ePMC) module. The ePMC standard is fully compatible with IEEE P1386.1 PMC standard but offers the additional benefit of dedicated Solano~links between ePMC compliant carrier and mezzanine modules. Data can also be transferred over PCI, which provides the control path.

The XMC-3311 uses two AD9430 12-bit A/D converters, sampling at rates from 110 to 213.33 MHz. The input includes a transformer coupling circuit, which has a passband of 0.5 MHz to 213.33 MHz. The XMC-3311 uses an AD9755 14-bit D/A converter, sampling at rates from 110 to 213.33 MHz.



Figure 4. XMC-3311 high-speed transceiver

## Software

### [ *quicComm* Software Development Kit (SDK) ]

The SDR-4000 SWM software interface is via the *quicComm*™ SDK that is available on all *quicComm*-supported platforms. *quicComm* software abstracts the underlying hardware providing users with basic transport level access and control of Spectrum's *flexComm*™ products. This significantly accelerates user application development. *quicComm* is standard across all *flexComm* products, allowing code portability. This software includes a board support package for control and data handling which allows configuration and control of the data links between processors and mezzanine cards, initiates and manages data transfers, manages interrupts, and is used to load applications onto the DSP and user-programmable FPGAs.

### [ Software Communications Architecture (SCA) ]

The SCA option provides a complete SCA-compliant software operating environment including the Communications Research Centre (CRC) Canada's implementation of the SCA Core Framework, associated tools and Object Request Broker (ORB). Please contact Spectrum Sales for more information.

## Services

### [ Modified COTS Optimization ]

The SDR-4000 SWM hardware and software architecture is based on Spectrum's SATCOM reference designs resulting in a quick turn-around to optimize the product to meet the size, weight, power, cost and/or ruggedization characteristics of fielded applications. The SDR-4000 SWM's independent hard and soft real-time communications fabrics allow the use of custom data-routing techniques. Using the Modified COTS (MCOTS) process, Spectrum works with its customers to provide an MCOTS solution while substantially reducing the time-to-deployment. For more information on the benefits of Spectrum's MCOTS process, please contact Spectrum Sales.

### [ Customer Training ]

Spectrum's training workshops are designed to get your team up and running in the shortest time possible by using a combination of lectures and at least 60% hands-on experience with your system. This service is an invaluable tool that generates significant cost savings and reduces risk for Spectrum customers. The standard SDR-4000 training consists of two days instruction by a Spectrum Applications Engineer.

### [ Custom Waveform or Application Development ]

Spectrum's Application Engineering Services (AES) can assist with the development of your custom waveform or application software, including U.S. Department of Defense and ITAR-controlled projects. The scope of these services is tailored to customers' needs, ranging from complete subsystem development to support for SCA operating environment and waveforms. Spectrum's AES team partners with customers' internal application development engineers to augment their development resources. For more information, please see the Application Engineering Services datasheet.

## Specifications

[ general ]	FPGA User Devices DSP Processor General Purpose Processor	Xilinx Virtex-4 LX160 and Xilinx Virtex-4 LX60 Texas Instruments 600 MHz TMS320C6416T processor with 32 MB SDRAM 666 MHz Freescale MPC8541E with 256 MB of 266 MHz DDR SDRAM and 64 MB flash
[ buses ]	Host	3U Compact PCI bus 32-bit/33 MHz
[ analog I/O ]	High-Speed ADC ADC Input  High-Speed DAC DAC Output	Two Analog Devices AD9430 12-bit @ 213.33 MHz AC coupled, full scale 1.72 Vpp into a 50 ohm load, single ended 3dB input bandwidth: 500 kHz - 213.33 MHz  One Analog Devices AD9755 14-bit @ 213.33 MHz AC coupled, max of 0.61 Vpp into a 50 ohm load when driven at +/- full scale 3dB output bandwidth: 500 kHz - 213.33 MHz
[ external interfaces ]	Ethernet Low Speed Serial Analog IF Input Analog IF Output External sampling clock/ reference User I/O	Gigabit Ethernet (10/100/1000 BaseT) RS232 data 2 channels, SMA connector, 50 ohm (75 ohm optional) 1 channel, SMA connector, 50 ohm (75 ohm optional) 1 input, SMA connector. 110 to 213.33 MHz, 0.5-0.9 VPP (-2 to +3 dBm)  GPIO lines via front-panel connector (up to six differential input/output LVDS pairs and one TTL input)
[ performance ]	High-Speed Data Transfer Rates	<ul style="list-style-type: none"> <li>• Between FPGA (LX160) on XMC-3321 and FPGA (LX60) on PRO-4600: up to 400MB/sec full-duplex via crossbar</li> <li>• Between the crossbar and GPP: 120 MB/s read, 180 MB/s write half-duplex</li> <li>• Between the crossbar and DSP: 60 MB/s interrupt, 240 MB/s polling half-duplex</li> <li>• From the GPP to memory: 1064 MB/s</li> <li>• Between the crossbar and LX60 FPGA: 400 MB/s</li> <li>• From the DSP to memory via EMIF-A: 532 MB/s at 133 MHz</li> </ul>
[ software ]	Application Libraries SCA	quicComm Software Development Kit Communications Research Centre (CRC) Canada SCARI++ SCA Core Framework
[ electrical ]	Supply Voltage (DC)	+3.3V and +5.0 V
[ mechanical ]	Size	100 mm (height) x 160 mm (length) x 2 slots
[ environmental ]	Temperature RoHS	Air-cooling operating temperature range of 0 to 50 degrees C, forced air @ 600 LFM 5 of 6 compliant. For other RoHS options, please contact Spectrum Sales.
[ ordering information ]		OS configuration indicated in brackets 650-00575 SDR-4000 SWM-BLADE-CAC-VXW ; PRO-4600-CAC with XMC-3311-LX160; (VxWorks) 650-00576 SDR-4000 SWM-BLADE-CAC-INT ; PRO-4600-CAC with XMC-3311-LX160; (Integrity)
[ custom configurations ]		For Integrated Development System Packages or custom configurations, please contact Spectrum Sales
[ future options ]	Analog IF Input/Output Bus Low Speed Serial Waveforms	Future options may be implemented at the discretion of Vecima Networks Inc. or its subsidiaries based on market demand.* 75 Ohms 3U cPCI bus at 32 bit/66 MHz RS422/485 Physical layer implementations for the following waveforms: <ul style="list-style-type: none"> <li>• DVB-S/DVB-S2, DVB-RCS</li> <li>• MUOS (Multiple User Objective System)</li> <li>• IBS (INTELSAT Business Services)</li> <li>• INMARSAT BGAN</li> <li>• MIL-STD-188-181B Ultra High Frequency (UHF) SATCOM</li> </ul>