

Fully integrated COTS “IF to Ethernet” wideband spectral analysis solution integrating a software defined radio hardware environment with the software tools necessary to support the rapid development of systems for the intercept and channelization of communications signals.

### Benefits

- Simultaneous processing of wideband spectrum and narrowband signals identified as channels of interest
- Fully integrated system allows you to focus on application development to reduce time-to-market
- Highly customizable and modular architecture
- Modular hardware platform is configurable to meet application specific requirements
- Comes with system examples to enable rapid-prototyping and testing of spectral analysis and channelization algorithms
- Deterministic operation
- *quicComm*<sup>™</sup> software architecture accelerates application development, simplifies the programming model, and ensures code compatibility between other *flexComm*<sup>™</sup> products

### Applications

- Communications Intelligence applications including Wideband Spectral Analysis and Channelized Reception
- Waveform development

### Features

- Supports two IF inputs at industry standard 21.4 MHz IF with bandwidths in excess of 30 MHz
- Wideband operation enables simultaneous processing of multiple carriers
- High-speed recording of digitized IF input to mass storage at up to 200 MB/sec
- Incorporates Xilinx<sup>®</sup> Virtex-II<sup>™</sup> FPGA and Freescale<sup>™</sup> MPC7410 PowerPC processing, all interconnected through Solano~links
- Includes comprehensive system examples illustrating typical application data flow
- Comprehensive training and support available

### Description

The HCDR-1000 CRDP<sup>1</sup> is a fully integrated, commercial off-the-shelf (COTS) platform that enables development of algorithms and applications for a wideband analysis system with narrowband channelized receiver capabilities. It integrates a high-speed, high-capacity data mass storage subsystem with a signal processing platform that combines both FPGA and PowerPC processing devices. This integrated solution is designed specifically to de-risk customer COMINT programs by providing a fast route to developing a sophisticated wideband signal analysis and channelized receiver application.



Figure 1. HCDR-1000 CRDP

<sup>1</sup> Subject to U.S. export regulations

## Typical Application

The tactical application consists of two main functional blocks to which digitized signals flow simultaneously: wideband spectral analysis and channelization.

The purpose of the wideband spectral analysis block is to quickly detect the presence of signals in the radio frequency (RF) spectrum for tasks such as spectral analysis/spectral monitoring. This includes identifying the center frequency, received signal power and spectral shape of each detected signal. Signal types can include wideband and narrowband signals, complex signals incorporating frequency agility (frequency hopping) and direct sequence spread spectrum.

The channelization block performs narrowband channelization, baseband demodulation and/or other analysis functions on signals of interest identified by the spectral analysis stage. Before channelization, the signal is often delayed using a memory buffer in order to analyze signals that have occurred in the time taken to complete the spectral analysis stage.

Such systems often include the capability to record raw data from the ADC. The data is then played back through the system for offline spectral analysis or channelization.

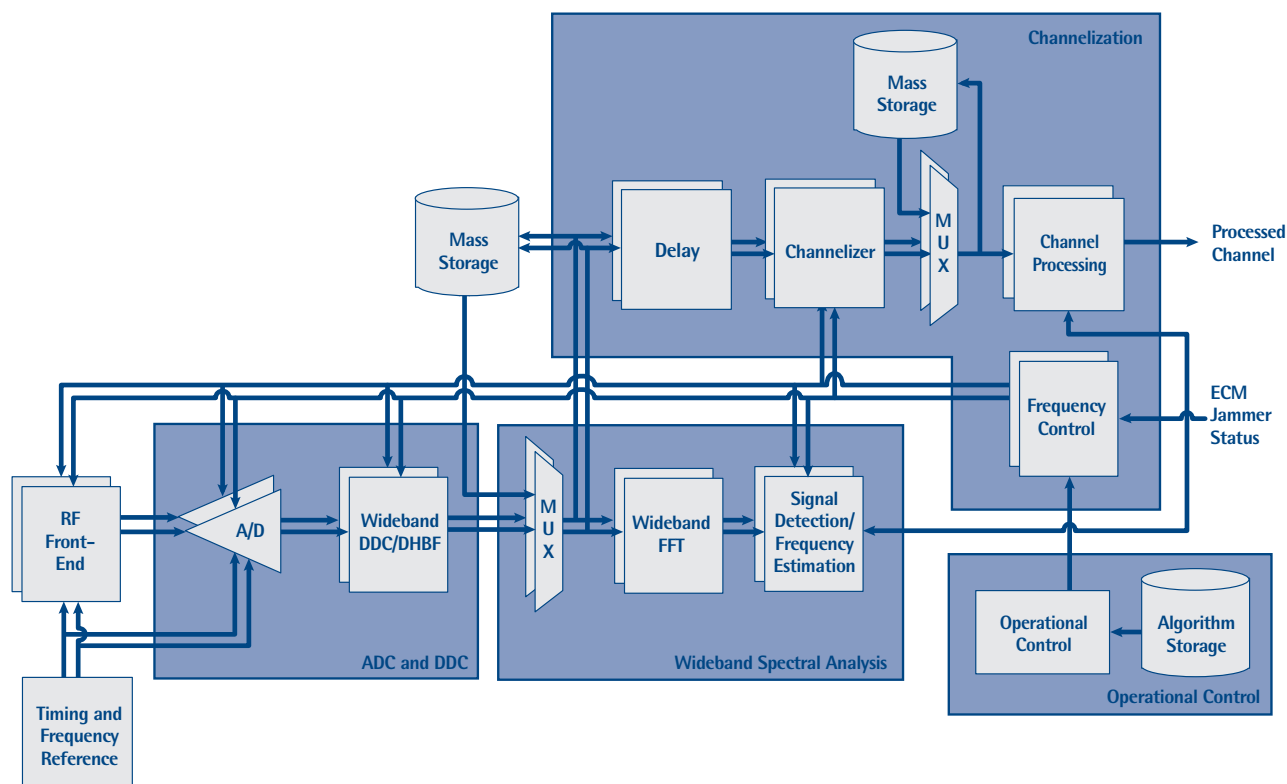


Figure 2. Typical Wideband Spectral Analysis System with Wideband Channelized Reception

## Architecture

The HCDR-1000 CRDP integrates a high-speed dual ADC module (ePMC-2ADC), a high-speed digital recording subsystem, Xilinx Virtex-II based FPGA modules (ePMC-8120), and dual Freescale G4 PowerPC MPC7410 processors (ePMC-PPC) on a VME-based carrier board (PRO-1900/1901) creating a highly reconfigurable and flexible platform for signal analysis and channelized reception applications.

On the input, the ePMC-2ADC digitizes up to two IF signals from the RF front-end at sampling rates up to 80 megasamples per second (MSPS). Raw ADC data is sent over the LinkIF (high-speed Low-Voltage Differential Signalling or LVDS) interface to two ePMC-8120 modules. Raw ADC data from one IF channel can be recorded by the digital mass storage subsystem in real-time at up to 160 MB/sec (assuming 80 MSPS sampling rate). The first ePMC-8120 can do wideband spectral analysis functions such as FFT processing and signal detection algorithms. Meanwhile, the second ePMC-8120 can process both IF inputs in real-time doing delay block and channelization functions before forwarding the baseband data to the PowerPC G4 processors for channel processing (demodulation, decoding, etc.).

Recorded raw ADC data can be played back into the signal processing hardware for offline processing.

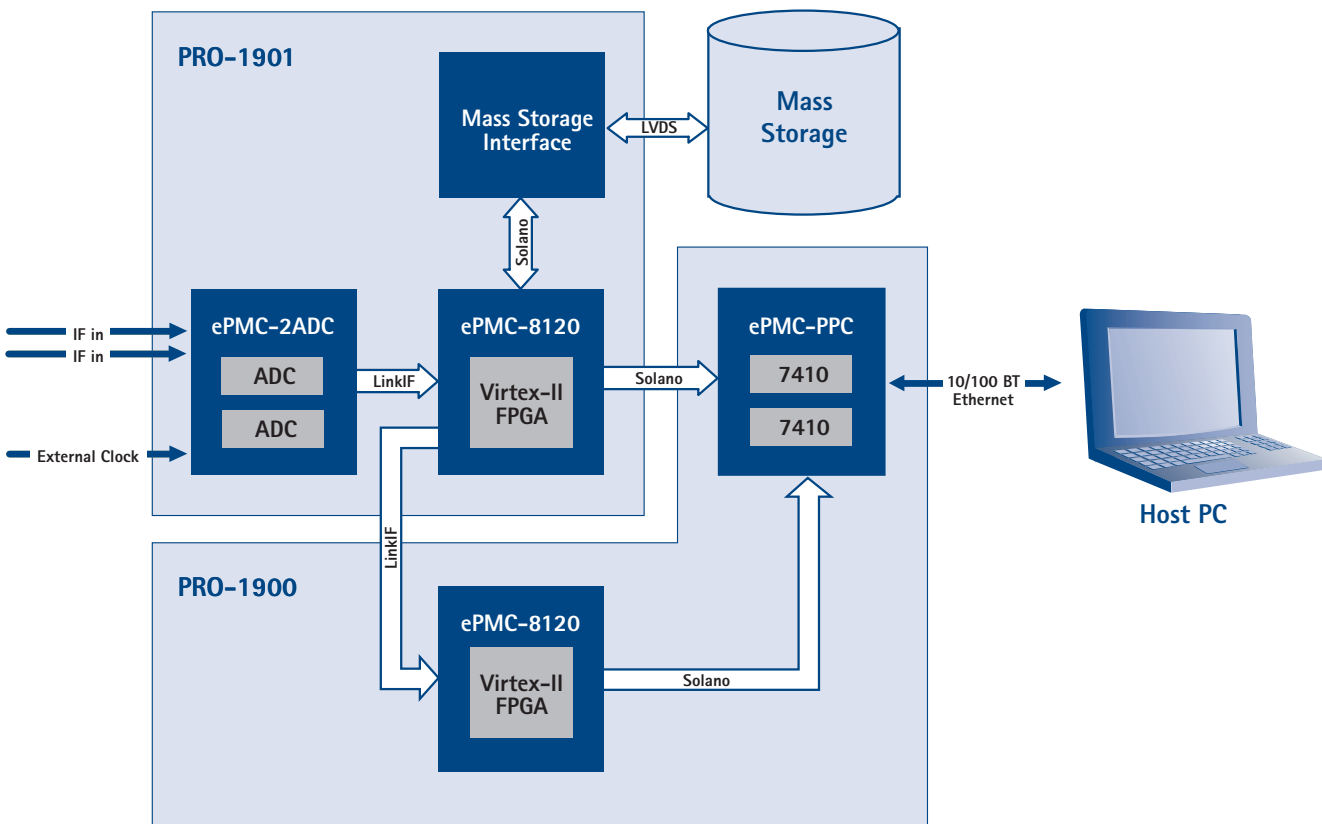


Figure 3. HCDR-1000 CRDP Block Diagram

## Hardware

### [ ePMC-2ADC ]

The ePMC-2ADC has dual input 14-bit A/D converters, each running at up to 80 MSPS in a single-width PMC form factor. The ePMC standard is fully compatible with the IEEE P1386.1 PMC standard, but has the additional benefit of dedicated rapid Solano~links between ePMC compliant carrier and mezzanine modules. Data can also be transferred out via the front-panel LinkIF connectors, a high-speed LVDS interface, to additional processing modules downstream. For more information, please see the ePMC-2ADC datasheet.

### [ Data Mass Storage Subsystem ]

The data mass storage subsystem consists of a Wideband Systems Digital Recording System (DRS3300) with Spectrum's LinkIF interface, and a fixed function interface built from Spectrum's ePMC-FPGA module, which connects the mass storage to the signal processing hardware. The DRS3300 is a disk storage unit capable of storing up to 324 Gbytes of data at a maximum sustained rate of 200 Mbytes per second. For more information, please see the DRS3300 datasheet. Please go to [www.wideband-sys.com](http://www.wideband-sys.com) for more details.

### [ ePMC-8120 ]

The ePMC-8120 is an IF processing engine using a single Xilinx XC2V6000 Virtex-II FPGA to provide up to 6 Million gates of FPGA processing capability. The module is configured with 512 MB of SDRAM for use as delay memory. It features front-panel LinkIF data interfaces and up to 8 Solano~links, each capable of up to 200 MB/sec of bandwidth. Data can also be transferred over PCI, which provides a control path. For more information, please see the ePMC-8120 datasheet.

### [ ePMC-PPC ]

The ePMC-PPC is a signal processing engine with dual G4 PowerPC 7410 nodes that provides up to 8 MFLOPs for demanding channel processing applications in an ePMC form factor. For more information, please see the ePMC-PPC datasheet

### [ PRO-1900/1901 ]

The PRO-1900 and PRO-1901 provide an intelligent VME-based carrier platform with four enhanced PMC (ePMC) sites and one PMC site. The PRO-1900 employs a 200 MHz MPC8240 PowerPC embedded controller with 16 MB of Flash and 64 MB of SDRAM to facilitate network communication and provide support for high-level control and protocol stack processing. For more information, please see the PRO-1900/1901 datasheet.

### [ Development Laptop ]

The system includes a development laptop running Microsoft Windows XP. This laptop is delivered with all the necessary cabling interfaces to the HCDR-1000 CRDP such as serial ports and Ethernet connection. Wind River Tornado IDE and all system software and examples are pre-loaded allowing development to begin immediately.

## Software

The HCDR-1000 CRDP comes fully integrated with the VxWorks operating system, Tornado Development Tools, Board Support Packages and Software Development Kits. The system is ready to use, right out of the box.

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

*quicComm* is a high-performance software development tool that provides an Application Programming Interface (API) for interprocessor and I/O-to-processor communications.

*quicComm* has been a standard on Spectrum's products since 2000 and therefore spans all of our processing technologies, including DSPs, general purpose processors (GPPs), interfaces to FPGAs and I/O. *quicComm* enables developers to rapidly create multiprocessing communication applications with a mixture of processing engines, communication fabrics and I/O devices. *quicComm* provides:

- Configuration and control of the Solano and RapidIO communication links between the processors and between mezzanine sites
- Initiation and management of data transfers
- Management of interrupts
- Dynamic loading on a processor without affecting other processors
- FPGA wrappers to abstract all board level interfaces on each FPGA, including the interfaces to the analog converters, communication fabrics and control. The wrapper is designed so users can expedite the integration of third party or custom FPGA IP cores.

Please see the *quicComm* datasheet for more details about the benefits and features of *quicComm*.

### [ System Examples ]

Comprehensive system examples illustrating a typical wideband spectral analysis and channelized receiver data flow are provided as a tool to accelerate design efforts. These examples include the source code to facilitate rapid customization. Spectrum's Application Engineering team can be engaged to modify or extend the existing example feature set to meet specific customer needs. The included system examples demonstrate how to set up the data flows representative of a typical application. The customer can then use the example as a framework for integrating their own algorithms and intellectual property.

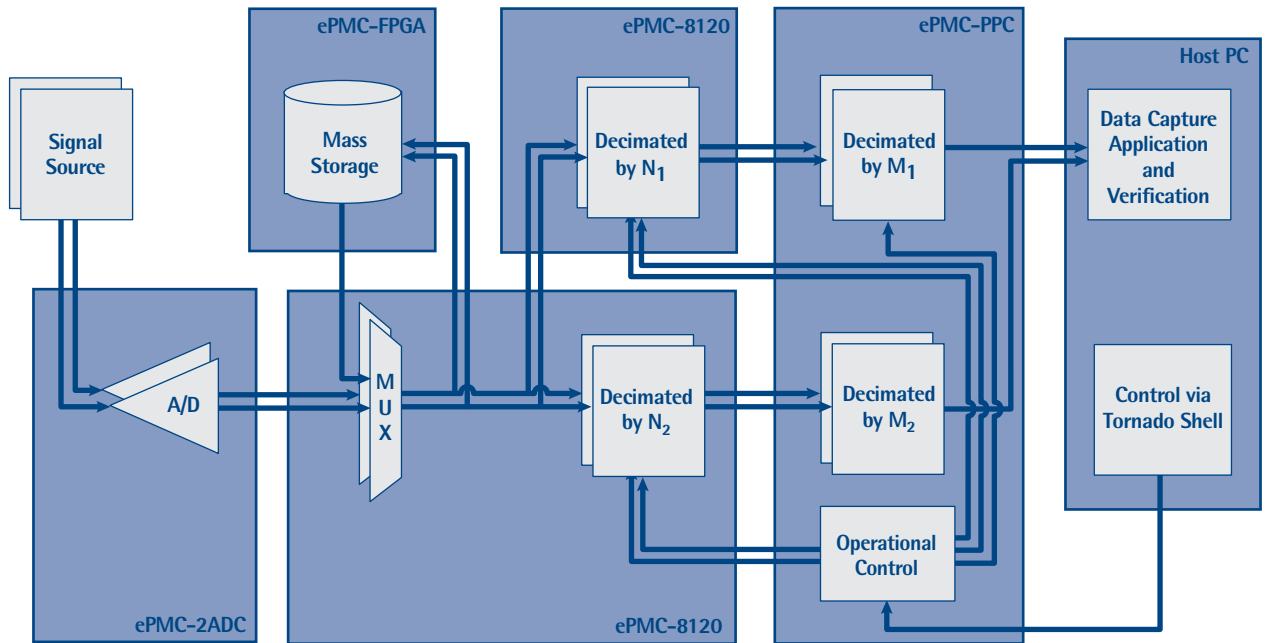


Figure 4. Sample System Example Data Flow

#### [ Operating System ]

VxWorks, from Wind River Systems, is the leading real-time operating system in the embedded marketplace. HCDR-1000 CRDP supports VxWorks on both the G4 processors as well as the on-board embedded controller (8240).

Features of the VxWorks RTOS include:

- Scalable, high-performance wind® microkernel
- Advanced networking support
- File system and I/O management

VxWorks is bundled with the Tornado II development toolset from Wind River Systems, also available from Spectrum. The package available from Spectrum includes:

- Windows XP development environment
- C/C++ compiler
- Editor, debugger, simulator, launcher, browser
- The VxWorks operating system
- A choice of the supplemental development tools, including WIND®VIEW, VxSim, StethoScope, TraceScope, MemScope, ProfileScope, Real-time Visualisation Pack, CoverageScope, CodeTEST and Visual SlickEdit.

#### [ FPGA Cores ]

To accelerate development, RF Engines Ltd ([www.rfel.com](http://www.rfel.com)) provides individual IP cores and integrated turnkey designs for digital RF signal processing in FPGAs and Application Specific Integrated Circuits (ASICs) as appropriate. RF Engines provides “off-the-shelf” IP cores that are highly optimized in terms of speed, power and size compared to cores available from the major FPGA vendors. RF Engines FPGA IP core offerings include: Pipelined FFT, Tunable PFT, Half-band Filters, Highly Optimized FIR Filters, Windowing and CORDICS. Spectrum routinely develops custom cores for clients when suitable cores are otherwise unavailable. Please contact Spectrum Sales for details.

#### [ Xilinx's ISE Foundation ]

ISE Foundation is an integrated programmable logic design environment. It includes schematic capture, power analysis tools, physical synthesis for FPGAs, advanced Place and Route Algorithms, HDL Advisors, and Timing Cross-Probing. ISE Foundation also contains COREgenerator, a graphical interactive design entry tool that is used to create high-level modules. COREgenerator gives access to a library of hundreds of FPGA IP cores, many of them free, from Xilinx and third-party vendors. This library includes DSP applications such as digital down converters (DDC), direct digital synthesizers (DDS), FIR filters, FFT, numerically controlled oscillator (NCO), memory controllers, and much more. This software option can be included with your development PC.

## Specifications

[ export regulations ]		The HCDR-1000 CRDP is subject to the export control laws of the United States including the United States International Traffic in Arms Regulations (ITAR).
[ analog I/O ]	Receiver IF Sample Rate Resolution IF Bandwidth	Up to 80 MSPS External Sampling Clock or 80 MSPS Internal Clock 14-bits up to 40 MHz
[ general ]	FPGA PowerPC Embedded System Controller	Two Xilinx Virtex-II XC2V6000 (-5 speed grade) Two Freescale G4 PowerPC MPC7410 @ 500 MHz Freescale MPC8240 @ 200 MHz
[ memory ]	SDRAM	up to 512 MB DDR SDRAM for each FPGA up to 512 MB DDR SDRAM shared between PowerPCs
[ external interfaces ]	Analog IF Inputs External Sampling Clock Serial Ports JTAG Connection	Two 50 Ohm Analog IF inputs, SMB connectors One clock input (50 Ohms) SMB RS-232 JTAG connection available on ePMC-8120
[ performance ]	Maximum Disk Recording Rate (sustained) FPGA to PowerPC	200 Mbytes/sec < 400 MB/sec for each ePMC-8120 module (over two Solano~links)
[ host requirements ]	Host Operating System	Laptop Windows XP
[ development software ]	General Purpose Processor Operating System Host Integrated Development Environment	VxWorks 5.5.1 Tornado 2.2.1
[ electrical ]	Supply Voltage (DC)	+5V $\pm$ 5% and +3.3 V $\pm$ 5%
[ environmental ]	Temperature  RoHS	Operating temperature range of 0 to 30 degrees C Storage temperature between -20 to 65 degrees C Please see component level datasheets for RoHS compliance or contact Spectrum Sales
[ ordering information ]	901-00019 901-00014	HCDR-1000 CRDP 1st Development System HCDR-1000 CRDP Recurring Production System