Special Feature

SIGINT System Architectures

Scalable, Flexible PC Platforms Achieve SIGINT Spectrum Dominance

Especially for stationary and low-g airborne systems, PC-based, high-performance SIGINT systems can be built that are highly scalable and flexible.

Anthony Hunt, Chief Technology Officer, Signatec
Tom Wagner, Director of Marketing, Signatec
Boris Molochny, Director of Marketing, Militram

Since electronic warfare applications are highly specialized, it can be difficult to source commercial, off-the-shelf solutions for them. Each field in electronic warfare (EW)—electronic attack, electronic protection or electronic warfare support—commands its own unique requirements. Often, this ensures that common system architectures won't satisfy all EW solutions for an increasingly complex electromagnetic environment.

Using electronic warfare support as an example, data consisting of oscillating electrical and magnetic fields propagated at or near the speed of light can be exploited by advanced systems to produce signals intelligence (SIGINT), provide targeting for electronic or destructive attack and produce measurement and signature intelligence. SIGINT also provides battle damage assessment and feedback on the effect of the overall operational plan, whether in the air, on land or at sea.

However, with the current objective of creating integrated Joint solutions, the challenges of developing a common system architecture are further exacerbated by new projects requiring state-of-the-art equipment. Typically, a common solution seldom performs nearly as well as a product specifically designed for a particular SIGINT application that requires advanced signal performance, spectral purity, wideband capabilities, high dynamic range, processing or other specialized features.

Fortunately, by developing with a modular approach for an appropriate PC platform, current solutions provide the flexibility and performance required to quickly reconfigure and upgrade systems for real-time, multi-mission SIGINT applications. To illustrate the point, today's commercial systems—for everything behind the antenna and RF front end—deliver affordable, high-performance data acquisition, processing, recording and playback solutions to support the SIGINT community in achieving spectrum dominance (Figure 1).

SIGINT PC System Architecture Overview

Clearly, not all SIGINT applications can be built upon the latest PC-based technology as a host platform. However, whenever possible, PCs should be carefully considered as a first option for any stationary and low-g airborne system, since commercial server-class motherboards offer considerable performance for both I/O and processing. Additionally, the chassis housing these servers have excellent ergonomics for cooling and easy access which, when coupled with an integrated disk system, enable developers to create industry-leading data recording and playback applications at an unbeatable price.

Furthermore, by integrating board-level products into server-class PCs, system developers can leverage affordable, high-performance signal technologies to deliver advanced, scalable SIGINT capabilities. In fact, when considering the myriad combinations of boards that can be plugged into server-class systems, it becomes clear that PC-based systems offer considerable flexibility and scalability.

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Project managers can now leverage the COTS paradigm to successfully deliver advanced SIGINT solutions on time and on budget.

High-Speed Waveform Recording Systems

Since most contemporary operating systems such as Windows or Linux are not real-time environments, PCs are often overlooked as an option for real-time applications. Yet, properly engineered subcomponent hardware and software can transform PC systems effectively into a real-time SIGINT platform.

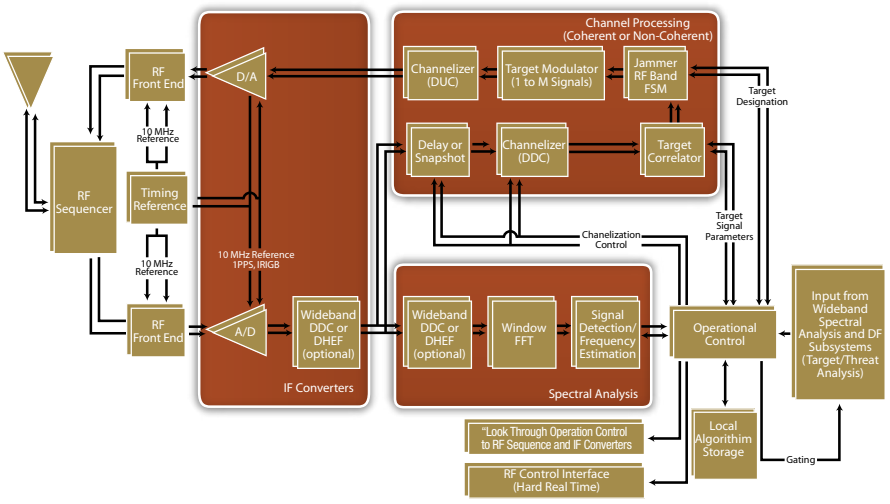

Figure 1

Commercial off-the-shelf solutions can form the backbone of system architectures for advanced SIGINT acquisition, processing and playback.

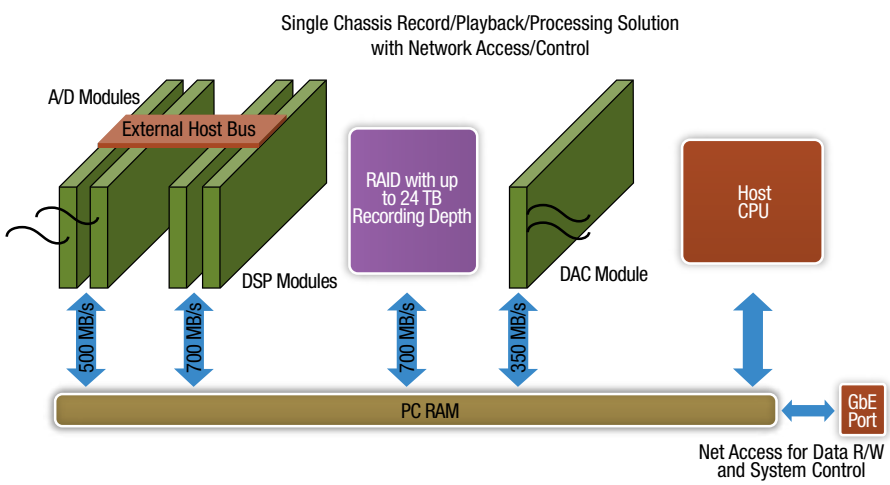

Figure 2

A multichannel signal recorder system based on PC technology can continuously record up to 700 Msamples/s of data through the PC to disk storage without any break in the analog record.

For example, to develop a wideband signal recording solution for spectrum monitoring, properly designed digitizers can stream continuous signal data without interruption direct to disk storage at rates of 700 Mbytes/s (Figure 2). In this data exchange, the server motherboard acts as the arbiter. However, the key lies in engineering proper buffering techniques.

Engineering waveform recording boards, designed with large memory buffers to withstand the non-real-time nature of PC systems, is essential to account for the periods when a PC system is busy handling other tasks. Additionally, a high-speed bus interface should be incorporated to offload buffered data. With these design features, data acquisition boards will simultaneously acquire, buffer and transfer data to prevent a break in the analog record.

Considerable thought needs to go into buffering techniques since, for many advanced SIGINT applications, overflow conditions are disastrous. Fortunately, high-speed turnkey recording systems are commercially available today with the appropriate combination of motherboard, RAID components, high-resolution waveform digitizers with sufficient RAM configured as a FIFO and software solutions.

High-Speed Waveform Recording, Real-Time Processing and Playback Systems

Multiple channels can be integrated within PC systems by utilizing waveform digitizer products in a master-slave configuration to create a synchronized, multichannel acquisition system. SIGINT system developers have the flexibility of using the non-real-time CPU for processing the buffered real-time stream of signal data. Additionally, if the CPU is insufficient for the processing requirement, real-time parallel processing boards—provided they are compatible with the digitizers—can be added to appropriately accelerate the processing capability.

For even more advanced SIGINT applications, new off-the-shelf subcomponents can provide numerous

combinations of high-speed acquisitions, with accommodation for large-bandwidth and high-resolution applications, along with an extremely large memory capacity and onboard FPGA processing. For example, a subcomponent board with two 150 MHz, 16-bit channels for a total data rate of 600 Mbytes/s, as well as an onboard FPGA, creates an extremely high-speed, high-resolution real-time processing and recording solution.

Furthermore, playing back collected data for analysis can employ the same recording platform populated with playback modules to create a continuous signal playback solution based upon the same signal recording model. By adding D/A conversion modules with buffering techniques similar to those engineered on the A/D modules, digital data can be streamed direct from disk storage at the same high rates for playback as for recording.

Integrated SIGINT Recording and Playback Systems

Signatec develops platforms specifically for high-performance, flexible and scalable SIGINT applications, either for rugged, lightweight, low-power and networkable applications or fixed rackmount systems. For example, a current system development is a multichannel record and playback solution for airborne SIGINT missions.

Comprising six total channels, five high dynamic range synchronized channels digitize analog signals at up to 160 Msamples/s per channel with 16-bit resolution. The digitizers offer onboard FPGA processing, which allows for digital filtering and digital down-conversion (DDC) to prolong the system's total storage capability.

Within the same system, a sixth digitizer provides a 1 Gsample/s acquisition rate with 8-bit data and 512 Mbytes of onboard memory for much wider instantaneous bandwidth surveillance, although at a lower dynamic range. Data from this high-speed channel won't stream continuously to disk. Rather, it records continuously to onboard memory and copies data to disk memory as time allows (Figure 3).

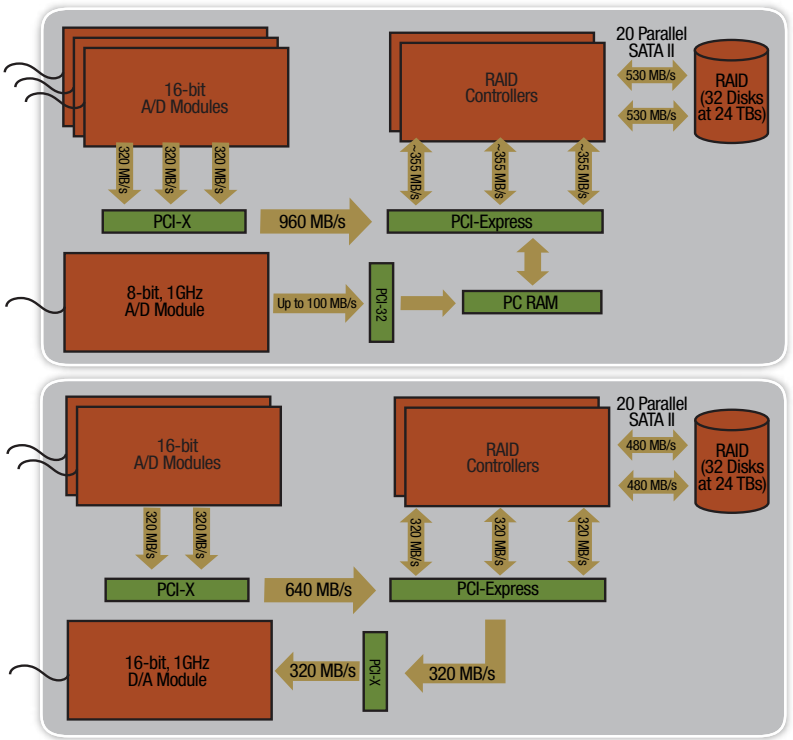

Figure 3

Signatec's fully integrated, six-channel, high-speed, high-resolution acquisition and recording system with a high-speed, 16-bit playback channel uses affordable PC-based solutions for airborne SIGINT applications.

To complete the development, a 16-bit playback channel offers at least 125 MHz bandwidth and is completely compatible with the high-resolution A/D channels to play back previously recorded data.

The complete system spans two chassis and delivers a combined 1,920 Mbytes/s of sustainable peak data throughput passing to/from the various modules to/from the disk storage system via the server motherboard's I/O resources. These rackmount systems are network controllable, with dedicated Ethernet ports available for easy user control during mission deployment.

Affordable, PC-based, high-performance SIGINT systems are highly scalable and flexible, possessing too many variables to encapsulate with one example. However, one thing is clear: with the numerous off-the-shelf solutions available to system developers, PC systems can now sustain very high-speed waveform recordings, real-time processing and high-speed signal playback capabilities. Additionally, network control options can be easily integrated into a single host system. Essentially, there has never been a better time to strongly consider PCs—and their associated advanced peripheral boards—as the ideal platform for bringing to market the fastest, most flexible, scalable and affordable SIGINT technology solutions. ▮▮

Signatec
Newport Beach, CA.
(949) 729-1084.
[www.signatec.com].

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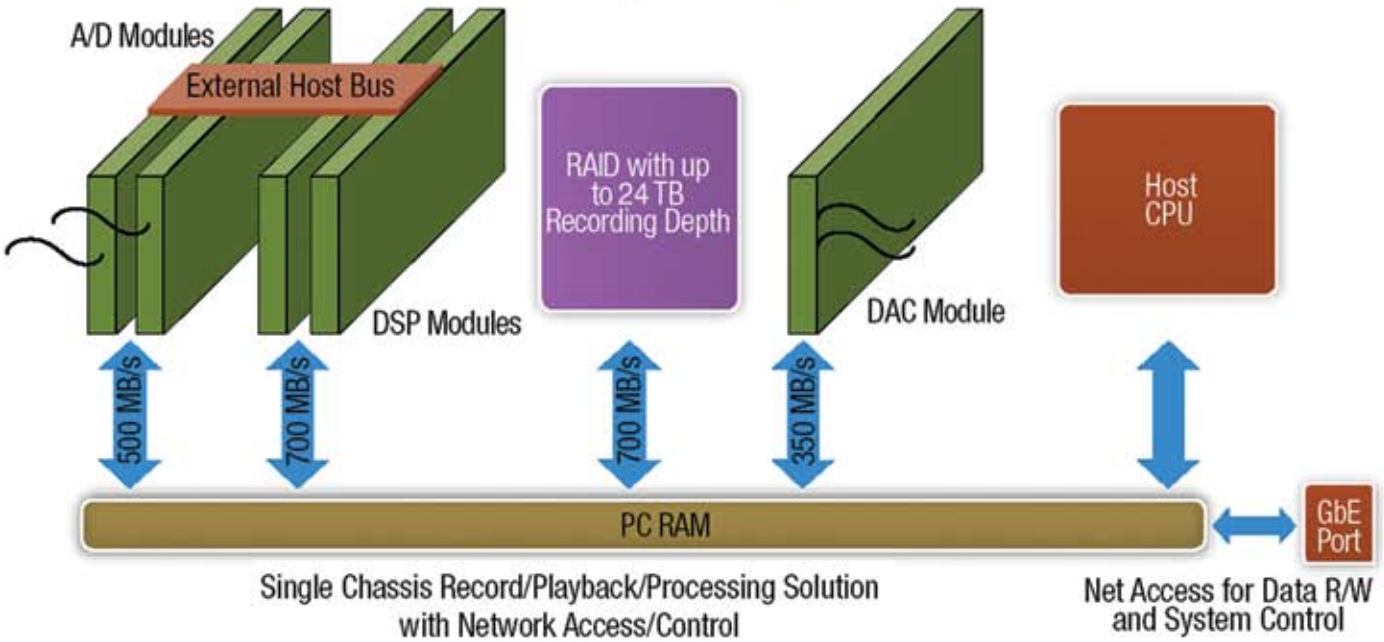
Advanced Signal Technololgy Systems

Continuous Acquisition and Simultaneous Recording Ensures Nothing Escapes Detection.



Signatec's 700 MB/s SIGINT Recording Systems

- 1-6 Channels, 8-bit Resolution, 1 GHz Sampling Per Channel
- 1-6 Channels, 14-bit Resolution, 200 MHz Sampling Per Channel
- 2-12 Channels, 14-bit Resolution, 100 MHz Sampling Per Channel
- 700 MB/s Continuous Recording and Disc Storage
- Up to 24 TB of RAID Storage Integrated within a Single Chassis
- Integrated Real-Time Processing and Continuous Waveform Playback Options

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