Cobham intros AXIe, but the software is the real surprise

Larry Desjardin - March 22, 2016

Cobham officially unveiled their AXIe offering last week at WinnComm, the premier SDR (software defined radio) conference. As a reminder, Cobham is the new name of the company previously known as Aeroflex, having purchased Aeroflex in 2014. Frequent readers of EDN’s Test Cafe column will recall our exclusive sneak preview of Cobham’s AXIe products in an October column entitled Cobham leaps into AXIe. There, we highlighted that Cobham’s upcoming transceiver density was double that of those available in PXI, entirely due to the density advantage offered by AXIe. We also highlighted Cobham’s deployment of Wide PCI Express (16 lanes in each direction), allowing nearly 16GByte/sec of streaming bandwidth per slot each direction, 32 GByte/sec total.

Cobham made their AXIe introduction official last week at WinnComm, but it was the software that was the real surprise. In a press release entitled Cobham and NordiaSoft announce world’s first integrated SCA development and test system, the two companies announced that they were joining forces to offer SCA (Software Communications Architecture) developers an integrated development platform for software defined radio development, emulation, and test.

On the left is a block diagram of an SDR (software defined radio), empowered by SCA (Software Communications Architecture). To the right is Cobham’s next generation instrument architecture. Noting the similarities, Cobham adopted SCA as their internal software architecture. Image courtesy of Cobham.

That’s a mouthful. But, having once seen a NordiaSoft presentation, I knew that adopting SCA had implications well beyond the SDR community. This column prides itself in giving architectural insight unmatched from other outlets. With that as our mission, I tracked down Marv Rozner, VP of Strategic Development at Cobham AvComm, for an interview and added insight. In an EDN Test Cafe exclusive, I will discuss the real story behind Cobham’s architectural choices. Here are some
highlights:

• Adopting SCA allows Cobham and users to mix and match software components similarly to how a backplane allows users to mix and match hardware modules.

• SCA, though general purpose, was specifically designed to handle SDR applications, making it “battle tested” for demanding RF and microwave instrumentation applications.

• Cobham’s AXIe transceivers represent the industry’s first instrument grade SDR, including calibration.

• Cobham’s adoption of AXIe allows them to offer “tons” of backplane performance, digital signal processing, FPGA, GPU, and prototyping capability in an industry-standard format, and all programmable in the SCA architecture.

• Cobham’s adoption of SCA has led to massive productivity breakthroughs from their own engineers, a precursor of what users will see.

With that as a summary, let’s take a specific look at Cobham’s software, hardware, and system level functionality. First stop, software...

The SCA architecture

The SCA architecture

The SCA architecture is an open architecture framework that allows hardware and software elements to operate synergistically within a software defined radio. It was originally designed to support the JTRS (Joint Tactical Radio System) program of the US Department of Defense.

SCA (Software Communications Architecture) is an open system architecture allowing software components to be quickly ported to other processors and RF hardware. Image
SCA uses a component based software framework that is not specific to radios. In fact, SCA builds on top of CORBA (Common Object Request Broker Architecture), which acts as a “Logical Software Bus” for the system. Think of CORBA as a software backplane bus that interconnects processes running on different processors, including CPUs, GPUs, and FPGAs. In SCA, radio functionality is provided by software, not hardware. This includes waveform generation and processing, encryption, signal processing, and other communication-related functions. The SCA tells communication system designers how elements of hardware and software work together, so these functions can be mixed and matched. Remarkably enough, the goals of SCA, though focused on radios, are equally applicable for test and measurement equipment. Thus, Cobham’s initial interest in the standard.

Software defined radios need not only a standard, such as SCA, but they also need a development suite. The CRC (Communication Research Centre Canada) developed such a software suite called SCARI (pronounced “scary”, short for SCA Reference Implementation). In 2013, the SCARI software suite was spun off to NordiaSoft, along with the team of engineers that developed it. NordiaSoft positions SCARI as a development environment not just for SDRs, but for nearly any embedded application, including robotics and transportation. Nevertheless, the major applications so far revolve around communications, radar, and electronic warfare.

**SDR platforms can provide three types of Computational Elements (CEs):**
- General Purpose Processor (GPP)
- Digital Signal Processor (DSP)
- Field-Programmable Gate Array (FPGA)

While the above graphic shows the variety of computing elements in a software defined radio, the diagram also matches that of an instrumentation system. Image courtesy of NordiaSoft.

Marv told me that Cobham had been exploring new architectures to address next generation radio and avionics challenges. They needed reusable software components that were plug-and-play and configurable at run time. They also needed to support massively scalable processing with distributed CPUs, GPUs, and FPGAs, often deployed on different operating systems. All of this had to be deployed on a generic system architecture with high scalability and flexibility. For hardware,
Cobham chose AXIe combined with embedded sub-modules. For software, they were surprised to discover that the SCARI software suite from NordiaSoft met all their needs, and was commercially available.

It was a great match, and the two companies agreed to collaborate. Having the instrumentation structured similarly to the DUT (device under test) brings extra benefits during the prototyping stage, which I will cover in the summary. Now, let’s look at the hardware...

**Cobham’s AXIe hardware**

While this column gave a preview of the Cobham AXIe products last October, Cobham has added significant product details with their introduction. The key products are:

- mA-1305 5-slot AXIe Chassis
- mA-6806 Dual Vector Signal Transceiver
- mA-3011 Embedded Host

As mentioned earlier, Cobham’s AXIe chassis supports the new Wide PCIe (Wide PCI Express) standard from AXIe. At Gen3 PCIe rates, 16 lanes in each direction leads to an industry-best 16 GByte/sec in each direction. Cobham claims it is the highest performance modular instrument chassis on the market. This is likely true.

The dual VST (vector signal transceiver) is a single slot AXIe module that delivers 200MHz of bandwidth for frequencies up to 6 GHz. A total of 10 VSTs can be integrated into a single 4U chassis, making it the densest modular transceiver design on the market. The VSTs can record or play back up to 4GBytes of IQ data stored in onboard memory, or real-time stream the data over AXIe’s PCIe interface. Cobham deployed the VST with rugged Type-N connectors, enabled by AXIe’s wider slot width. Cobham’s slides from WinnComm hint of microwave and higher bandwidth functionality to come. The dual VST is built as four sub-modules.

The embedded host is a 2.4 GHz Quad Core Intel i7 processor with 8GB or RAM. This is a nice
embedded solution for those who prefer an embedded controller to an external one. A unique attribute of the mA-3011 is its ability to accept standard ¾ length PCIe cards. These could be GPU accelerators, networking interfaces, or even many of the instrumentation cards now on the market.

The embedded host design is based on a processor carrier module that includes two COMe slots and a ¾ length PCIe slot. The i7 is mounted in one COMe slot, leaving the other for a second i7 or some other COMe module. This might include other types of CPU, FPGAs, DSPs, memory, and more. The concept here is to add processing power as needed, much of it commercially available.

I was able to see prototypes first hand at an AXIe Consortium meeting in September. The internal modularity of the VST, along with that of the processor carrier module, gives Cobham remarkable flexibility and productivity in creating new instrument and processing combinations.

Marv described the totality of the platform as the industry’s first instrument grade software defined radio. In the final section of this column, I will summarize some of the key applications this enables.

Applications

Marv described two key use models for these AXIe products. One model hides the software defined radio concepts from the user, and the products are treated as conventional test and measurement modular products. In this latter case, the products appear as standard AXIe devices (similar to PXI devices), controlled by an external or embedded controller executing standard IVI drivers. Even in this case, Marv espoused the benefits of SCA. The SCARI tools from NordiaSoft enabled the Cobham team to develop the software platform in a fraction of the expected time. As an example, Cobham was able to move from a low level transceiver driver to emulating an SCA radio including AM, FM, and P25, in less than one week.

The second model exposes the SCA radio interfaces and SCARI development environment to the end user, and is focused on SDR developers.
The Cobham/NordiaSoft SCA platform supports the entire SDR lifecycle, from simulation through development, then into production and field test. Image courtesy of Cobham.

There are four stages to a user developing a software defined radio: simulation, design, emulation, and test.

**Simulation.** With the AXIe products acting as an instrument grade software defined radio, the system essentially becomes a real-time simulation system. Users can experiment with different SCA waveforms and measure the performance and robustness of each. Embedded tools give key internal performance parameters, such as BER (Bit Error Rate) and spectrum analysis.

**Design.** The simulation will also determine the processing power (e.g. how many MIPS) needed in the radio. Enabled by the SCA architecture, portions of the user’s design can be combined with portions of the AXIe products to design and test individual functional blocks of the radio. Marv mentioned that the Cobham AXIe products were able to act as the RF front end for an SCA-based Android phone running AM, FM and P25 waveforms in under one day.

**Emulation.** During emulation, the Cobham products can emulate a real environment for the radios, including impairments. The scalability of the solution allows hundreds or thousands of waveforms to be added, all with appropriate channel impairments.

**Test.** At the end of the SCA development cycle, a tester is a natural output of the process. After all, the simulation and emulation has led to an instrument grade golden device. Production or field service oriented impairments can be added to create the final test system. While cellular phones use custom procedures for production test, military and public safety radios typically do not.

The SCA is not limited to radio communications. Radar and electronic warfare applications are equally addressed. I noted in a previous column that 5G communications, radar, and electronic warfare applications are all trending in a similar direction- massive numbers of channels coordinated by fast real-time processors. To address these applications, the testers must also be massively scalable.

Cobham is betting on AXIe plus SCA to be the architecture that delivers it.

**See also:**

- Cobham leaps into AXIe
- 5G to disrupt the test equipment market
- AXIe nears the tipping point