Atrenne
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OpenVPX™ Interoperability and Rugged Signal Processing

DESIGN > DEVELOP > DEPLOY

50 Years
1972-2022

THE PROBLEM FOR CHASSIS & BACKPLANES

Open-standards based COTS systems for signal processing applications are among some of the most demanding in terms of backplane complexity, heterogeneous module usage, and thermal management. Part of the challenge confronting designers of rugged signal processing systems is the need for modules and backplanes that can support multiple fabric planes. When it first emerged, the VPX™ system and board architecture immediately provided a superior form factor for signal processing than was available with VME. VPX's significantly greater bandwidth, support for distributed architectures and vastly improved ruggedization made it an ideal choice for modern compute-intensive signal processing applications.

Unfortunately, one of VPX's great strengths, its flexibility, also led to tremendous variation between different VPX module signal types and proprietary pin-outs. This hindered interoperability when attempting to design a multi-board signal processing system using a variety of VPX modules from multiple vendors. As a result, a high percentage of these applications required custom backplane connectivity for interoperability between specific modules. There were many types of incompatible pin-outs prevalent with early VPX modules *(Figure 1)*. In addition, the power and cooling requirements of those early VPX modules varied widely.

To address the critical interoperability issues common to early VPX systems, an industry-wide consortium worked together, beginning in early 2009, to define OpenVPX™, a new approach that provided, for the first time, a system level framework for VPX interoperability. This successful initiative culminated in ratification of the ANSI/VITA 65 standard in mid-2010.

OpenVPX and Signal Processing Systems

The VITA 65 OpenVPX standard promotes interoperability among COTS products and eases and simplifies the integration of rugged signal processing systems. System designers undertaking the design of an OpenVPX-based signal processing system should understand the module profiles that are typically used by COTS signal processing modules, the appropriate backplane topologies and fabric types to use, and be familiar with the OpenVPX compatible COTS backplanes that are available today to speed their development efforts for signal processing applications. Signal processing systems typically have specific requirements including the use of COTS signal processing modules designed to meet OpenVPX module profiles that support multiple fabric planes. These modules also require very high bandwidth data transfer.

The ANSI/VITA 65 OpenVPX Framework for Interoperability

The ANSI/VITA 65 OpenVPX provides a system framework that drives interoperability for OpenVPX modules. It enables integrators to match up OpenVPX modules with compatible backplanes and chassis

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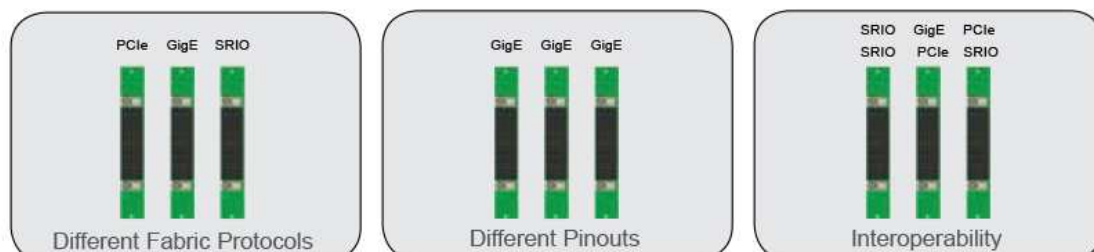

Figure 1: VPX Interoperability

The ANSI/VITA 65 OpenVPX Framework for Interoperability

The ANSI/VITA 65 OpenVPX provides a system framework that drives interoperability for OpenVPX modules. It enables integrators to match up OpenVPX modules with compatible backplanes and chassis *(Figure 2)*.

The OpenVPX system framework comprises:
- Module Profiles
- Slot Profiles
- Backplane Profiles
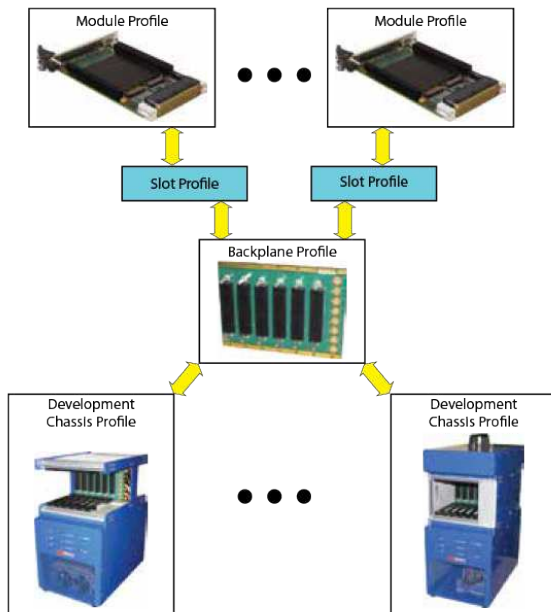- Development Chassis Profiles
- 5V-centric and 12V-centric Power Profiles

Figure 2: OpenVPX Profile Framework

Development Chassis

To address significant issues related to power and cooling for OpenVPX, the system framework defines requirements for a Standard OpenVPX Development Chassis. Specifications for both air- and conduction-cooled development chassis are included in the framework. Compliant OpenVPX Air-cooled Development Chassis are designed to provide an air flow rate of 18 CFM/slot at 0.24" H2O and 5000 ft. This is a very high flow rate and pressure drop; most pre-existing development chassis are unable to provide this level of cooling. Standard OpenVPX Development Chassis are designed to handle the power and cooling required for most available VPX modules.

Compliant OpenVPX Conduction-cooled Development Chassis are designed to maintain 55°C chassis rail temperature at 150W/slot (6U) & 75W/slot (3U) with 30°C ambient. These development chassis are also designed to handle power and cooling for most available VPX modules.

Because most pre-existing development chassis are not able to provide the power required for OpenVPX modules, the system framework defines both 5V-centric and 12V-centric Power Profiles for OpenVPX modules and Development Chassis, with >200W/slot for 6U and >100W/slot for 3U.

Compliant OpenVPX backplanes are available as well, supporting different types of OpenVPX topologies, including Central and Distribute topologies.

Improved Interoperability

A wide selection of COTS OpenVPX modules is now available from multiple vendors. Multiple vendors also offer a selection of COTS OpenVPX Backplanes, and many are available in COTS OpenVPX Development Chassis configurations in order to speed development activities *(Figure 3)*.

Previously, COTS interoperability was only possible for the simplest backplane architectures. Today, with the defined framework from ANSI/VITA 65 OpenVPX, It is much easier for an integrator to configure an interoperable system based on matching up the module profiles with compatible backplanes.

Air-cooled 3U OpenVPX

Forced Air Conduction-cooled 3U & 6U OpenVPX

Air-cooled 6U OpenVPX

Figure 3: OpenVPX Development Chassis

The data plane is a key for signal processing applications, which typically require very high bandwidth data transfer. The idea behind the additional planes is to offload the data plane to allow maximum performance. The expansion plane provides local slot-slot data transfer, offloading this from the data plane. In signal processing applications this could be local connectivity from data converters or signal processing front-end modules (e.g., FPGAs). It could also be used for local connectivity to a storage or recorder module.

OpenVPX Module Profiles for COTS Signal Processing Modules

COTS OpenVPX signal processing modules tend to use OpenVPX module profiles that support multiple fabric planes. For these modules, Serial RapidIO® (SRIO) and PCI Express® (PCIe) are the most commonly used fabric protocols for the data plane. The newest 3U OpenVPX signal processing modules tend to use the MOD3-PAY-1F2F2U-16.2.2-x, MOD3-PAY-2F2U-16.2.3-x, and MOD3-PAY-1F1F2U-16.2.4-n module profiles.

The newer 6U form factor signal processing OpenVPX payload modules tend to use the MOD6-PAY-4F1Q2U2T- 12.2.1-x module profile. For these boards, SRIO is the most commonly used fabric protocol for the data plane, with emerging products now moving to Ethernet and InfiniBand™ for Gen-3 speeds.

Appropriate Backplane Topologies and Fabric Types for Signal Processing Applications

COTS signal processing systems also typically use backplane profiles that support multiple fabric planes.

For 3U systems, newer signal processing payload modules tend to use module profiles such as MOD3- PAY-1F2F2U-16.2.2-x and MOD3-PAY-2F2U-16.2.3-x, and MOD3-PAY-1F1F2U-16.2.4-n. SRIO and PCIe are the most commonly used fabric protocols for the data plane. These module profiles are compatible with Backplane Profiles such as BKP3-CEN06-15.2.2-n, BKP3-CEN10-15.2.4 and BKP3-CEN12-15.2.6-n.

For 6U systems, newer signal processing payload modules tend to use module profiles such as MOD6-PAY-4F1Q2U2T-12.2.1-x, and SRIO is the most commonly used fabric protocol for the data plane. These module profiles are compatible with Backplane Profiles such as BKP6-CEN16-11.2.2-n, BKP6-CEN10-11.2.4-n, BKP6-CEN10-11.2.6-n, and BKP6-CEN05-11.2.5-n.

Standard OpenVPX Backplane Profiles for Signal Processing Applications profiles typically have in common the use of one or more switch slots, separate data plane and control plane fabrics. In most cases, these profiles also feature the same expansion plane fabric connectivity. *(Figure 4)* Shows a sample of Standard OpenVPX Backplane Profiles for Signal Processing Applications.

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Compatible COTS backplanes to speed development efforts for signal processing applications

OpenVPX backplane suppliers now offer compliant COTS 3U & 6U OpenVPX backplanes for Gen-1 as well as fabric baud rates (up to 6.25 Gbaud standard). Advanced Gen-3 backplanes are now becoming available as well (up to 10.3 Gbaud standard, supporting fabrics such as 40GbE, InfiniBand QDR and PCIe Gen-3). For more information and details on Signal Integrity management for interoperability using these high speed fabrics, please see our White Paper: The Importance of Signal Integrity: Achieving Robust Gen-3 >10 Gbaud Signaling in OpenVPX™ Systems.

The availability of these COTS OpenVPX backplanes enables system integrators to quickly configure an OpenVPX system from COTS chassis, backplanes, and modules.
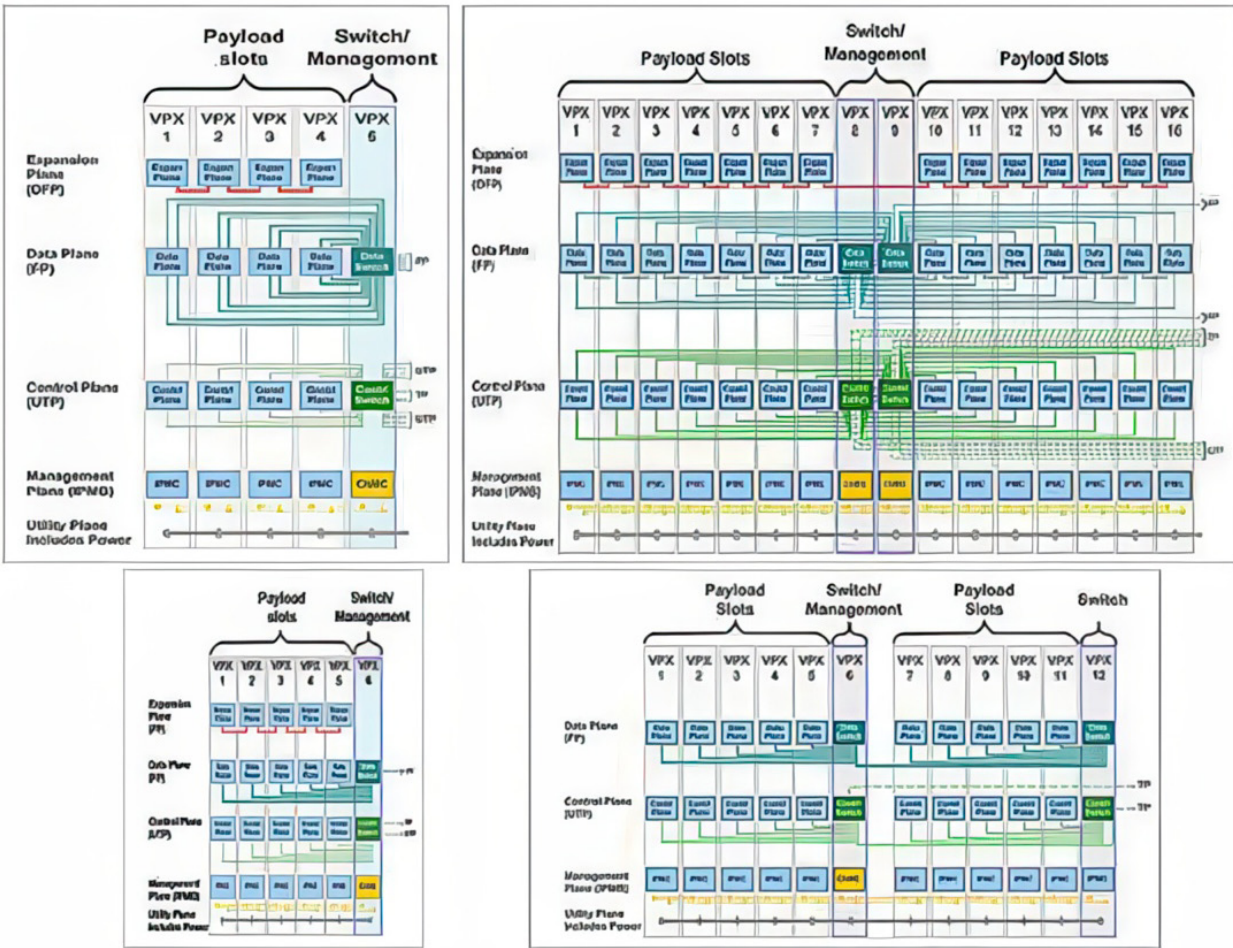
Figure 4: Sample of Standard OpenVPX Backplane Profiles for Signal Processing Applications

Solving the Signal Processing OpenVPX Interoperability Challenge

COTS OpenVPX modules, development chassis, and backplanes are now available off-the-shelf. Several of these module and backplane profiles are specifically targeted at signal processing applications. To support signal processing these profiles support 6.25 Gbaud data plane and expansion plane fabrics which provides support for Gen-2 fabric rates and increased performance, with Gen-3 products just around the corner. Today, there is a widely available interoperable ecosystem of OpenVPX-compliant COTS products that system integrators can leverage for rapid prototyping and deployment. COTS OpenVPX development chassis support a wide range of slot counts, both large and small, and are available in both air cooled and conduction cooled payload types. COTS Deployable OpenVPX chassis that leverage the standard OpenVPX backplanes are also available.

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Conclusion

Atrenne is an ideal supply chain partner with design and manufacturing capabilities that complement your application expertise. We take an open and collaborative approach and can apply our manufacturing and electronic assembly capabilities to your custom requirements. Our defense and industrial customers choose to partner with Atrenne to lower financial, program and technical risk, and to free up resources to focus on their own core competencies all through the help of our vertical integration.

About Atrenne

Atrenne, a Celestica company, is a vertically-integrated, component and system provider serving aerospace, defense, computing, communications, and other technology-driven industries. Atrenne delivers integrated components, electronic packaging, fabricated metal, electronic assemblies and value-add build-to-print manufacturing services to industrial markets across the globe. With more than 40 years of experience, Atrenne provides innovatively engineered products and services throughout the program lifecycle, from concept to manufacturing to obsolescence management. Atrenne is proud to provide customers with fully-tested, reliable, electromechanical solutions on-time and with world-class quality.

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