VPX for Systems Development

The VPX standard (VITA 46) makes possible open architectures that lead to innovative new designs of high-performance embedded computing platforms. VPX systems are building on more than 20 years of VME development and are capable of delivering high performance while meeting stringent shock and vibration constraints. Rugged COTS computing applications are relying more and more on VPX, and the standard has already been deployed extensively in data-intensive defense and military programs, particularly for applications dealing with high frequency signals. 3U VPX is poised to serve as the ideal modular format for the coming decades of embedded computing development.

Designing a complete system based on OpenVPX (VITA 65)-compatible products offers advantages in terms of performance and specialized functionality. The increased flexibility provided by the standard expands the number of options to be considered, however, and requires diligent effort during the planning stages to choose the best technology and ensure compatibility between modules and backplanes.

Let's consider some of the main characteristics and advantages of OpenVPX that should inform the planning of a VPX system.

- More power in 3U and 6U form factors than VME and cPCI
- Convection or conduction-cooled environments are possible
- High bandwidth interconnects with 10 Gbps lanes
- Fabric protocols supported include PCIe, Ethernet, Serial RapidIO
- System topologies supported: Mesh, Single Star, and Dual Star
- Hybrid topology enables legacy support for parallel VME
- Multi-plane architecture for design flexibility and reliability

Backplane Profiles and Slot Definitions

Standards such as VME have been in use for decades and have enabled pluggable modules with a wide variety of functions to be used with standard backplanes. The serial fabrics such as 10-Gigabit Ethernet, PCIe, and SATA now used in OpenVPX make board-to-board I/O uniquely point-to-point and highly interoperable.

OpenVPX defines the interconnects required to implement specific system topologies, and profiles identify specific topologies for interconnecting modules. The backplane profile defines the interconnect between backplane slots. Backplane profiles reference slot profiles, so system designers need to identify the profiles associated with the boards used in the system. Board manufacturers, therefore, specify the physical interfaces of their modules by defining the module profile descriptions of OpenVPX boards. These profiles must be considered by system designers when selecting modules for use in an OpenVPX topology. The system topology required by the modules or boards in the system must also be taken into consideration.

The process of defining the architecture requirements for an off-the-shelf, OpenVPX-based solution may require multiple iterations to identify the best backplanes and modules for the application. When planning the implementation of a VPX system, the types of profiles defined by OpenVPX must be taken into account to match modules with compatible slots and ensure the correct mapping of I/O to backplane connectors. A module profile indicates the protocol (such as PCIe) and a slot profile maps I/O onto a connector independent of a specific protocol.

Backplane Topologies

- Central or Star (CEN)
- Distributed or Mesh (DIS)
- Hybrid - VME & VPX (HYB)

Slot Definitions

- Payload (PAY)
- Peripheral (PER)
- Switch (SWH)
- Storage (STO)
- Bridge (BRG)

Planning a VPX System

Systems designers may start with the architecture, where board selections flow from the chosen topology, or with a board that features a desired function and informs the topology choice. Either way, it is crucial to first develop a good understanding of the best topology

options for a particular application. A deep understanding of the OpenVPX ecosystem will lead to the best decisions about how to deal with such issues as cooling and board configuration. A supplier with experience in designing key system components such as FPGA cards, FMCs, and backplanes is in the best position to integrate them into a complete system that exploits the potential of each element to deliver maximum performance and reliability. This helps to minimize the effort and expense required to complete a project.

Let's take a look at the steps in planning a VPX System.

- Select a backplane topology for the application and its data flow requirements.
- Use a standard backplane profile if available.
- Select the slot profiles (bridge, payload, peripheral, storage, switch) based on boards and I/O.
- Identify the best board to base a system around.
- Select supporting boards based on functionality and profiles.
- Select an OpenVPX chassis profile to suit either development or deployment.

Whichever path is chosen, 4DSP can help educate system designers about the best choices for creating a complete system from the ground up to suit a specific application. We can also potentially design the ideal module or simply supply or adapt boards from our extensive family of FMCs and FPGA carrier cards.

What 4DSP Offers

A simple plug and play design scenario is not a given with VPX. As a leading supplier of FPGA carrier cards, FPGA Mezzanine Cards (FMCs), and backplanes, 4DSP is especially well suited to plan the correct high-performance system architecture for any application. This expertise ensures that expensive design changes late in the development phase are avoided while keeping projects on schedule. A benefit of purchasing a complete system from 4DSP is that many key decisions are made by a vendor who can carefully match, customize or design modules, boards, and backplanes to deliver the best performance for a specific use case. This removes the risk, for instance, of selecting FPGA-based boards from one manufacturer for system expansion slots that may be incompatible with a backplane from another manufacturer.

A 3U, 6-slot VPX system such as 4DSP's desktop-format VPX360 can be tailored for high-speed signal processing and computing applications and offers a combination of flexibility and high performance in a small footprint. With the system slot populated by a dual-core i7 Intel single board computer (SBC), the remaining five expansion slots are available for user-defined, high-end OpenVPX-compliant cards that communicate with the host via PCIe bus. The backplane is optimized for fast inter-slot communication in excess of 6 Gbps between any two adjacent system slots via independent links.

Figure 1: 4DSP VPX360 desktop VPX system

Any of 4DSP's 3U VPX products can be used in the VPX360 enclosure. The VP780 with a Xilinx Virtex-7 FPGA, for example, provides ample processing power. An FMC site on the carrier card offers I/O versatility, making the system suitable for any application. 4DSP's extensive selection of FMCs enables a wide range of multi-channel A/D and D/A functionality. Rackmount (VPX361) and rug-gedized (VPX362) chassis configurations are also available to ensure maximum flexibility when designing a system for demanding applica-tions in lab settings or field deployments. All systems are compatible with 0.8-inch, 0.85-inch, and 1.0-inch modules and feature Rear Transition Module (RTM) support for additional storage or I/O.

4DSP's compact FlexVPX backplanes are also available for integra-ted solutions development. These two and three-slot backplanes adhere to the OpenVPX standard and provide excellent options for building SONAR/RADAR, satellite communications, and Software Defined Radio (SDR) systems when used with our 3U VPX FPGA car-rier cards. FlexVPX backplanes have PCI Express bridges that deliver fast and high throughput, enabling point-to-point communications between elements in the system.

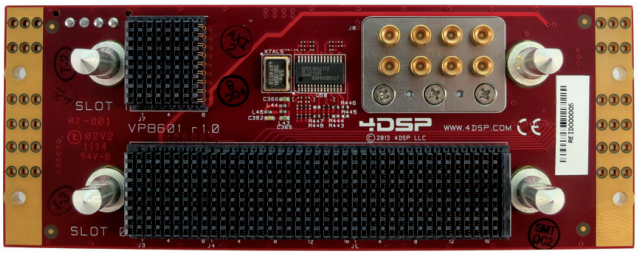

Figure 2: 4DSP FlexVPX VPB601 backplane

FlexVPX products also feature RTMs that enable interconnection within a VPX system via high-speed cables. This is powerful because it allows for the use of multiple backplanes that may not be positi-oned adjacently due to demanding space constraints such as those required in aerospace applications. By providing the capability to build a VPX system with any number of slots, FlexVPX makes pos-sible a wide range of designs characterized by compact hardware footprints, a high level of ruggedization, and unmatched perfor-mance. This commitment to delivering extremely capable and flexible products for systems designers is a guiding principle of 4DSP's product philosophy.

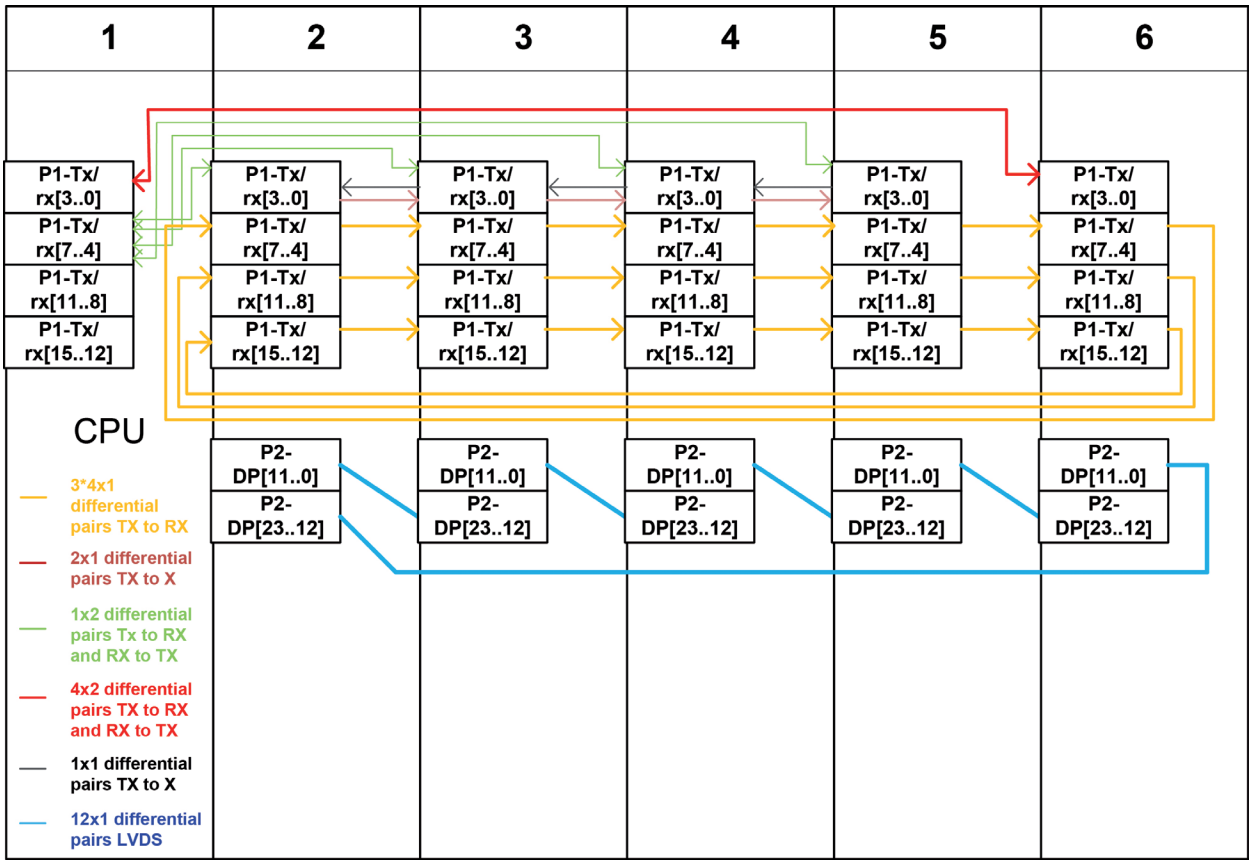

Figure 3: VPX360 Slot Diagram