

VXS – A Novel and Emerging Architecture for Embedded Computing -

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Abstract

Bused embedded compute platforms like VMEbus and CompactPCI® have served the embedded computing industry well, and over their respective lives have built up extensive ecosystems of complementary and competing products. While the bus interconnects on these platforms will continue to be employed in non-demanding applications, new high speed switched serial interconnects have emerged that hold the promise of performance beyond the limits of the current parallel multi-drop buses all the way to the upper edge of copper physics. One way of protecting the investments made in the current bused interconnects yet allowing growth into switched serial interconnects is through hybrid architectures. Hybrid architectures can simultaneously accommodate both a traditional parallel multi-drop bus and a switched serial interconnect, providing a seamless bridge from today to the future. This article discusses one such emerging hybrid architecture, VMEbus Switched Serial (VXS), which is currently under definition by the VITA 41 working group.

The elements of VXS

VXS is an emerging standard that extends the capabilities of the VMEbus traditional 6U high by 160 mm deep Eurocard form factor with a high-speed switched serial fabric. Diagram 1 depicts the physical elements of VXS: a payload card, a switch card, and a backplane. VXS adds new capabilities to VMEbus by adding a high-speed P0 connector to VMEbus cards (now called “payload cards”) in-between the existing P1 and P2 connectors. This new high-speed connector will allow payload cards to communicate at uni-directional speeds approaching 10 gigabits per second per serial pair, or bi-directional speeds of 20 gigabits per second per serial pair, which is believed to be the upper limit of copper interconnect. The VXS specification allows for four differential serial pairs per direction per port, and supports up to two such ports on each VMEbus card. Initially VXS has sub-specifications for InfiniBand™ 4X links, and Serial RapidIO™ 4X links. The VXS documents are structured such that a new link technology can be added without changing the base specification, which is where all the mechanicals are defined.

The VXS switch card, also depicted in diagram 1, is the hub of the switched interconnect. Notice that the VXS switch card does not have the traditional P1 and P2 connectors found on a VXS payload card. This is because the VXS switch card does not have to maintain backward compatibility with the existing VMEbus ecosystem.

An example VXS backplane is also depicted in diagram 1. Note that VXS will require a new backplane to implement the high-speed switched serial interconnect. While the VXS specification details the full characteristics of a VXS payload card and a VXS switch card, with regards to the backplane the specification only describes a “payload slot” and a “switch slot”. This is so that backplanes of various slot capacities and topologies can be constructed while still being compliant with the standard.

While VXS requires a new backplane, the framers of VXS strived to achieve the maximum compatibility with existing VMEbus products. For example, existing VMEbus cards should plug into a VXS payload slot if the card does not have an existing P0 connector or some other

obstruction in the P0 area. As well, VXS payload cards should plug into a traditional backplane slot if the backplane does not have a P0 connector or some other obstruction in the P0 area. Note that in this scenario the payload card will not be able to make use of the switched serial interconnect, nor should it attempt to draw more power than can be supplied by the backplane.

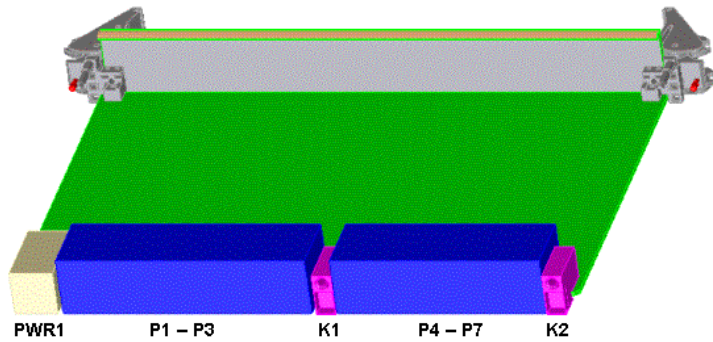
The VXS approach of building on an existing embedded compute platform is different from the approach of other efforts to introduce high-speed switched serial fabrics. For example, an effort in VITA (VMEbus International Trade Association, the body that controls the VMEbus specification) called VITA 34 or Advanced Packing System (APS) introduces switched fabrics but utilizes a completely new form factor that is incompatible with existing deployments. As well, an effort in PICMG (PCI Industrial Computer Manufacturer's Group, the body that controls the CompactPCI specification) called PICMG 3.x or Advanced Telecommunications Compute Architecture (ATCA) introduces switched fabrics but also utilizes a completely new form factor also incompatible with existing deployments. VXS is the only embedded compute platform announced to date that provides serial switched links up to 10 gigabits per second per link while maintaining compatibility with existing deployments.

How its wired together

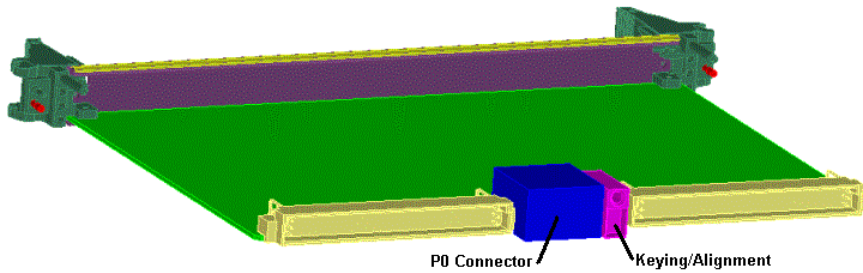
The VXS switched serial interconnect is an optional interconnect over and above the always-present VME parallel bus. Applications that do not need VXS speeds do not have to connect to the fabric, they can confine their references to the traditional VME parallel bus. Diagram 2 gives an example of how a VXS backplane could be wired. While most VXS implementations are expected to have two switch slots for redundancy, this example only uses one. Both scenarios would be compliant with the standard. Notice that the P0 connector of every payload slot is wired to the switch slot. Also notice that the VME parallel bus (represented by the upside down "U") is also wired to every slot, with the exception of the switch slot. There are eight payload cards depicted in this example, and they illustrate the three different ways that a payload card may interact with the backplane. Payload cards 1,2,3,5, and 6 attach to both the VME parallel bus and the high-speed switched fabric. Such a payload card is making use of both the VME parallel bus and the high-speed switched serial fabric. Payload card 4 references only the VME parallel bus. This scenario would be used for an existing VMEbus card plugging into a VXS backplane. Payload cards 7 and 8 attach to only the high-speed switched fabric. This scenario is called "pure VXS", meaning that the cards do not reference the parallel bus. Note that cards 7 and 8 would still have to have the traditional P1 and P2 connectors on them because this is how power and other non-interconnect services are delivered to payload slots. Each of the various payload slots on the backplane are wired in exactly the same way – the payload cards discussed in this example could be shuffled into different payload slots without consequence. So the interconnect that a payload card chooses to use, parallel or serial or both, is a function of the card, not of the backplane.

VXS is a platform where implementers can utilize both a VME parallel bus and a high-speed switched serial fabric at the same time. The VXS approach of profound innovation coupled with compatibility with existing VMEbus products protects existing investments while providing a platform for growth well into the future. VXS will allow users to experiment with switched serial fabrics and at the same time enjoy the stability and legacy ecosystem of the parallel bus. It means that customers can transition their hardware and their software at their own pace from the parallel bus to switched serial fabrics.

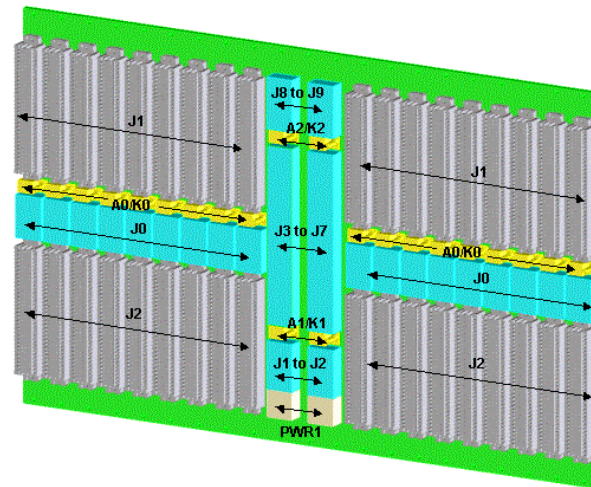
Diagram One –VXS Elements



VXS Switch Board



VXS Payload Board



Example VXS Backplane

Diagram 2 - Example of VXS Backplane Wiring

