Abstract

SWaP and Modularity: Extending VPX Concepts Into Smaller Scale Using VNX

- Reducing size, weight and power consumption of rugged embedded computer systems, while at the same time pushing computing and I/O performance to ever higher levels has been the “holy grail” of embedded electronic design for many years.

- Price pressure and the need to shorten the “time to market” of new technology calls for modularity and a maximum of reuse when designing a new system.
  - Industry standards such as VPX and VNX help to achieve this.
  - VPX is just now hitting the mainstream of rugged embedded systems designs.

- By extending the same concepts that made VPX successful, into a still smaller form factor, VNX makes modularity accessible in areas which were up-to-now dominated by custom designs.
Introduction

Name Bill Ripley

“Building electronic systems for aerospace since the beginning of time”
Business Development, Product Management, Engineering
CES, Themis, GE/SBS, Bell Helicopter

Company CES-CAL in Raleigh, North Carolina, USA

US subsidiary of CES S.A., Geneva
CES has apx.100 employees in N America and Europe
Founded in 1981

Supplier of computer modules (single board computers, processors and peripherals) and systems for aerospace, defense, physics, and telecom markets
What is VNX?

- VNX is a standard for plug-in modules
  - Compute, Processing, Sensors, Memory and I/O
  - 19mm and 12.5mm

- VNX was designed from the ground up to be inherently rugged and conduction cooled

- VNX was designed for the Small Form Factor marketplace

- VNX is designed to be similarly architected to VPX systems, but at a smaller size, lower power, and lower cost
VNX Standard Module Size and Application

19 mm Module
- Basecard plus optional mezzanine card
- 8 Row connector (400 pins)
- Receptacles for backplane daggers for locating and ESD grounding
- 75mm (L) X 89mm (W) X 19mm (H)
- Applications
  - Single Board Computer
  - Software Defined Radio
  - Graphics / Video
  - FPGA Processor
  - Complex I/O Cards

12.5 mm Module
- Basecard alone, or Basecard with small mezzanine
- 4 Row connector (200 pins)
- Receptacles for backplane daggers for locating and ESD grounding
- 75mm (L) X 89mm (W) X 12.5mm (H)
- Applications
  - I/O Carrier
  - GPS / IMU / SAASM
  - Storage & Memory
What VNX is Not

- VNX is not a system standard
  - Boxes do not have to look like a “cube”
  - Cards can go in any form factor enclosure
  - Cards can be used in conjunction with other standards
CES Chassis Strategy

• Different sizes:
  – Array of chassis to accommodate 1 to 10 slots
  – Commercial & MIL connectors
  – VNX or combination VNX & VPX

• Different cooling strategies
  – Natural convection (Fins)
  – Coldplate or baseplate cooling (Heat dissipation through structure)
  – Forced air conduction cooling (Sidewall fins & skins, plenum)
  – Liquid (Sidewall heat exchangers)
## VPX Vs. VNX

<table>
<thead>
<tr>
<th></th>
<th>VPX</th>
<th>VNX</th>
</tr>
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<tbody>
<tr>
<td><strong>History</strong></td>
<td></td>
<td></td>
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<tr>
<td>VITA 46 Draft</td>
<td>About 2005</td>
<td>VITA 74 “Released for Trial Use” 2013</td>
</tr>
<tr>
<td>VITA 46 Approved / Revised</td>
<td>2007 / 2013</td>
<td></td>
</tr>
<tr>
<td>VITA 65 Approved / Revised</td>
<td>2010 / 2012</td>
<td></td>
</tr>
<tr>
<td><strong>Form Factor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6U, 3U (generally not mixed)</td>
<td>19mm, 12.5mm (often mixed)</td>
<td></td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓ Air cooled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓ Conduction cooled</td>
<td></td>
<td>✓ Conduction cooled</td>
</tr>
<tr>
<td>✓ Two-level maintenance</td>
<td></td>
<td>✓ Two-level maintenance (?)</td>
</tr>
</tbody>
</table>
How Are VPX and VNX Alike

• Both are VITA Standards
• VNX was designed the lessons learned from VPX
• VNX was designed to allow use of other standards (*Com Express Mini, Mini PCIe*)
• VNX is a “scaled derivative” of VPX
• VNX backplane topology and connectivity is identical to similarly equipped VPX system
• VPX can support higher performance (higher power) processors
• VNX processors can perform many useful tasks such as Mission Computing, Display Processing, Sensor Processing, I/O Control, Storage Management, etc. with the right amount of processing power for the application
• VNX systems are optimized for Space, Weight and Power (SWaP) as well as Cost
• VNX and VPX both have VITA Marketing Alliances
## Simplified Comparison of VPX Vs. VNX

<table>
<thead>
<tr>
<th></th>
<th>VPX</th>
<th>VNX</th>
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<tbody>
<tr>
<td><strong>Connector</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proprietary</td>
<td>Proprietary</td>
<td>Multiple suppliers</td>
</tr>
<tr>
<td>Fairly expensive</td>
<td>Fairly expensive</td>
<td>Less expensive</td>
</tr>
<tr>
<td><strong>Metalwork &amp; Hardware</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex heat-frame</td>
<td>Complex heat-frame</td>
<td>Less complex heat-frame</td>
</tr>
<tr>
<td>Expensive wedgelocks</td>
<td>Expensive wedgelocks</td>
<td>No wedgelocks</td>
</tr>
<tr>
<td>Expensive Screws &amp; Hardware</td>
<td>Expensive Screws &amp; Hardware</td>
<td>Standard Screws &amp; Hardware</td>
</tr>
<tr>
<td><strong>Thermal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low thermal resistance</td>
<td>Low thermal resistance</td>
<td>Higher thermal resistance</td>
</tr>
<tr>
<td>High power capable</td>
<td>High power capable</td>
<td>Lower power and performance</td>
</tr>
<tr>
<td><strong>Size &amp; Volume</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3U size</td>
<td>3U size</td>
<td>&lt; 50% size of a 3U module</td>
</tr>
</tbody>
</table>
Backplane

- Utility plane
  - Up to 32 diff pairs in S1
  - Up to 18 diff pairs + 36 SE signals in S2

VPX
- Up to 32 diff pairs + 16 SE signals on P1
- Up to 32 diff pairs + 16 SE signals on P2

4 Fat Pipes = 32 diff pairs
Relative Adoption of VPX Vs. VNX

VPX
- Lots of new technology to develop
- Slow adoption at onset
- Midcourse correction
- Problems addressed
- Growing popularity
- Very bright future

VNX
- Not as much new ground to plow
- Potentially faster adoption rate
- Used lessons learned
- Growing interest as SFF marketplace settles
- Very good potential

Today

Adoption

Relative Time

VITA 46 VPX
VITA 74 VNX
VITA 65 Open VPX
SWaP vs. Modularity vs. Performance

- Legacy form factors provide high modularity at lower performance density.
- VPX and VNX provide a spectrum of size, weight and power.
- VNX offering medium performance at minimum size

Legend

- Full custom - Standard performance
- VNX - Medium
- 3U VPX - High
- VME, CPCI - Low

SWaP

- Large, hot, heavy
- Modularity, reuse

Modular, high reuse - no modularity, low reuse

More Vendors
More Profiles
Enhancement Potential (Via “Dot-Specs” or Supplier Innovation)

- VPX-REDI Analogous Implementation for VNX

- Connectivity recommendations
  - Alternative Fabrics (Serial RapidIO, Infiniband, etc.)
  - Alternative Module to Module Topology (Mesh, Star, etc.)
  - Box to Box Communications

- Thermal management
  - Improved shell design
  - Improved module contact with chassis

- RF and High Speed I/O
- Optical I/O
Thank You

Questions? Please contact

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