Building Hybrid Rugged Systems Using a Mix of Applicable Embedded Standards

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News Flash ----- Shameless Plug for New Standard: VITA 74.0 (VNX) Status

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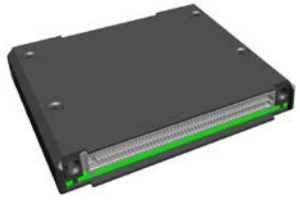
- VITA-74 (VNX) a small form factor, conduction cooled module standard, has completed VITA balloting and is on its way to ANSI !

- VNX is Small Form Factor architecture with internals very similar to VPX Architecture

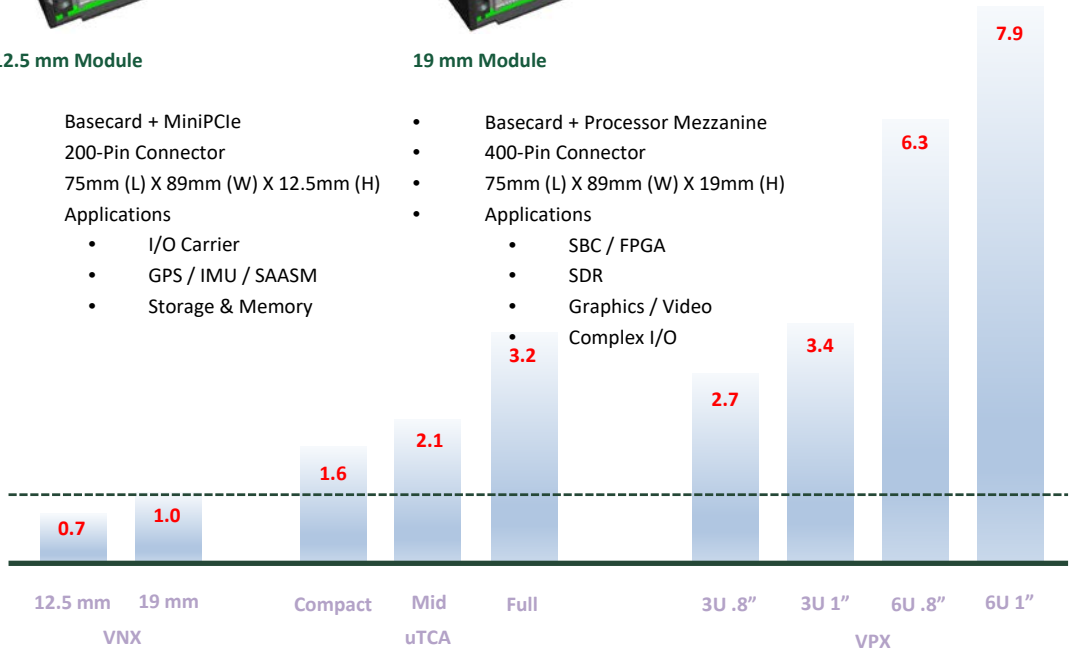


12.5 mm Module

- Basecard + MiniPCIe
- 200-Pin Connector
- 75mm (L) X 89mm (W) X 12.5mm (H)
- Applications
  - I/O Carrier
  - GPS / IMU / SAASM
  - Storage & Memory

19 mm Module

- Basecard + Processor Mezzanine
- 400-Pin Connector
- 75mm (L) X 89mm (W) X 19mm (H)
- Applications
  - SBC / FPGA
  - SDR
  - Graphics / Video
  - Complex I/O



Relative Size of VNX vs. Conduction Cooled VPX & Rugged uTCA

Statement of Problem

- Customer base is driving COTS system providers to reduce SWaP-C
  - Space
  - Weight
  - Power
  - Cost
- What is the best way to meet all of these “desirements”?
- It is fairly easy to get any 3 out of 4, but sometimes the goals seem mutually exclusive

Statement of Problem

- A “Hybrid System” will, in a large number of cases, allow the system designer to use the best of all standards.
  - More efficient use of Space, with corresponding weight savings
  - “Right Size” the chassis, processor, I/O, sensors, storage
    - Right Size the physical form factor
    - Right Size the performance
    - Right Size the power
    - Right Size the cos

Changing Paradigm

In general as we move from Left to Right:

- Costs has lowered, but not necessarily price, especially if trying to shoehorn technology to fit
- Size generally has generally reduced with technology
- Scalability and Obsolescence Management has improved with use of COTS
- Reusability improves with proper system design

Building Systems

- Completely Custom (Pre 1970)
- Packaging Standardized (ARINC 404)
- Standardized Internal Architecture (VME)
- Evolutions of Standard Architectures (VME to VPX)
- Build everything to preferred Standard Architecture
- Hybrid system using mixture of applicable standards often achieves lowest SWaP-C concerns

Trends of Midplane Design

- Multiple COTS Interfaces
  - SBC
    - COMe
    - 3U VPX
    - VITA 74 (VNX)
  - I/O
    - MiniPCIe
    - XMC / PMC
    - FMC (+)
    - Essential I/O on Midplane

- (Continued)
  - Sensor Interfaces
    - XMC, XMC, and …….. XMC
  - Storage
    - SATA
    - mSATA
    - nVME
    - PCIe
  - Power Supplies
    - Standard Plug-In
    - Bricks

Historical Buying Habits

- Back in the “Old Days” :
- Used to be that customer provides at least a requirements document
  - Now provider is lucky to get a 1-page set of vague requirements
- Used to be that customer pays for a custom system that is exactly what he wants.

- *Now customer does not even want to look at a solution that is not already COTS.*

Historical System Design

- Historically, engineers would design and build a system exactly to the specifications of a particular project
- If the specification parameters were rigid and never expected to change, the engineers and project leaders would choose the easiest path, sometimes taking costs into consideration, sometimes over-engineering the project
- In recent decades, the number of applicable COTS standards and product building blocks have increased with time and adoption.
- Some “bad standards” that did not catch on have simply fallen by the wayside.

What Does a Midplane System Look Like ?

- For a certain class of systems, the box does not have to look like a typical ARINC-404 ATR chassis.
  - Put small remote processors in peripheral equipment
  - Powerful processor with minimal I/O
  - Systems with requirements for small and low are preferred
  - Where space is restricted

Trends of Midplane Design

- Building “custom” midplane using best set of standards for the application
- Chassis usually becomes smaller
- System becomes reconfigurable
- More choices for processor and I/O that is “right sized” for the application
- Often less total connector interfaces than a pure slotted (blade) solution
- Easy to develop common ways to implement midplane based design for systems that don’t have to look like “ATR Boxes”
- It is possible to “standardize” the way that you design “custom midplane” to have max reusability from application to application

Products or Projects ?

- Over time, more and more embedded hardware solutions providers are choosing to develop Products rather than Projects
  - Not all companies can make that transition
    - Old (expensive) habits are hard to break
  - Initial NRE costs are borne by system provider
    - Provider designs in reusability and versatility.
  - Less propensity for requirements creep, since provider designs baseline box.

Historical Buying Habits

- Customer now expects to pay for “Customized” at COTS prices.
  - Customers generally want to pay what they think it would cost them if they had their very best people that had nothing else to do designing the system
  - Build in as much flexibility without compromising performance
- Customer changes requirements along the way, and the scope creeps, and creeps….
  - Lack of documentation in the procurement process, especially in the prototype phase, makes it very hard to control requirements creep.
- Customer eventually ends up with a proper solution, often at a price higher than expected, often with extended delivery schedule
  - Taking shortcuts often end badly

Historical Selling Habits

- Provider often “over-sells and under-delivers”
- Recycles and redesigns previous projects, redefining the meaning of COTS
- Avoids small quantities, prototype programs, and science projects
- Sometimes puts on a maximum effort to win production deal, often without playing in the prototype phase

A typical M-COTS Clydesdale which morphed from previous project

Example of Typical Hybrid System

- Typical COTS Hybrid System
  - COMe Type 6 SBC or COMe Type 10 SBC
    - ARM to Xeon, and everything in between
  - Main XMC Payload Card
    - Graphics In/Out/Overlay/Compression
    - Software Defined Radio
    - FPGA / DSP
  - MiniPCIe
    - MIL-STD-1553, ARINC 429
    - Discrete, Analog and Serial I/O
    - Small FPGA
  - Sensors
    - IMU, INU, GPS, Diff GPS

- Typical Hybrid Applications
  - Display Processor
  - Digital Map
  - Video Recorder
  - EW / SIGINT Recorder
  - Mission Computer
  - CPU / GPU Processor

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