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ETT 2015: SWaP and Modularity:
Extending VPX Concepts Into a Smaller Scale Using VNX

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Version 2

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

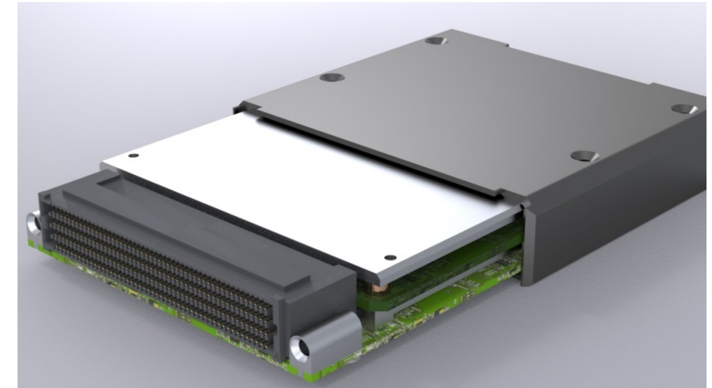
US subsidiary of CES S.A., Geneva

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

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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

Smart Display

VITA 75

½ ATR

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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)

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VPX Vs. VNX

VPX		VNX
History		
VITA 46 Draft	About 2005	VITA 74 “Released for Trial Use” 2013
VITA 46 Approved / Revised	2007 / 2013	
VITA 65 Approved / Revised	2010 / 2012	
Form Factor		
6U, 3U (generally not mixed)		19mm, 12.5mm (often mixed)
Environment		
✓ Air cooled		
✓ Conduction cooled		✓ Conduction cooled
✓ Two-level maintenance		✓ Two-level maintenance (?)

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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

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Simplified Comparison of VPX Vs. VNX

VPX	VNX
Connector	
Proprietary	Multiple suppliers
Fairly expensive	Less expensive
Metalwork & Hardware	
Complex heat-frame	Less complex heat-frame
Expensive wedgelocks	No wedgelocks
Expensive Screws & Hardware	Standard Screws & Hardware
Thermal	
Low thermal resistance	Higher thermal resistance
High power capable	Lower power and performance
Size & Volume	
3U size	< 50% size of a 3U module

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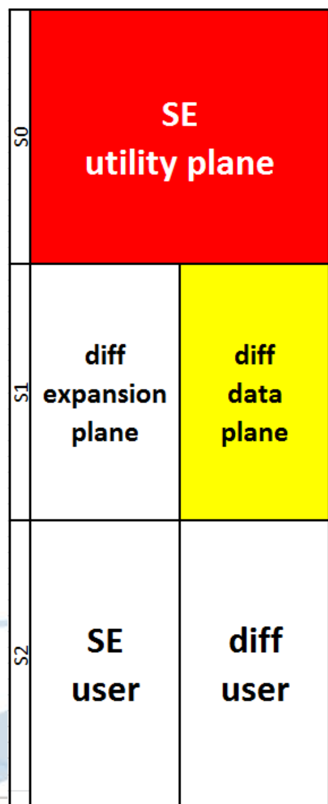
Backplane

	Row A	Row B	Row C	Row D	Row E	Row F	Row G	Row H
1	GA0	VSBY	GND	GND	VS1	VS1	VS1	VS1
2	GA1	VSBY	GND	GND	VS1	VS1	VS1	VS1
3	GA2	GND	GND	GND	VS2	VS2	VS2	VS2
4	UD	UD	GND	GND	VS2	VS2	VS2	VS2
5	GND	GND	GND	GND	VS3	VS3	VS3	VS3
6	UD	UD	GND	GND	VBAT	UD	VS4	VS4
7	UD	UD	GND	GND	GND	GND	GND	GND
8	GND	GND	I2CDATA	I2CCLK	NVMRO	UD	RFU	RFU
9	UD	SYSRESET*	GND	GND	UD	GND	UD	GND
10	UD	GND	UD	UD	GND	UD	GND	UD
11	GND	UD	GND	GND	RFU	GND	RFU	GND
12	UD	GND	UD	GND	RFU	GND	RFU	GND
13	GND	UD	GND	CLK3_P	GND	CLK1_P	GND	UD
14	UD	GND	GND	CLK3_N	GND	CLK1_N	GND	RFU
15	GND	UD	UD	GND	CLK2_P	GND	CLK0_P	GND
16	RFU	GND	UD	GND	CLK2_N	GND	CLK0_N	GND

Utility plane

	Row G	Row F	Row E	Row D	Row C	Row B	Row A
1	Vs1	Vs1	Vs1	No Pad*	Vs2	Vs2	Vs2
2	Vs1	Vs1	Vs1	No Pad*	Vs2	Vs2	Vs2
3	Vs3	Vs3	Vs3	No Pad*	Vs3	Vs3	Vs3
4	SM2	SM3	GND	-12V_Aux	GND	SYSRESET*	NVMRO
5	GAP*	GA4*	GND	3.3V_Aux	GND	SM0	SM1
6	GA3*	GA2*	GND	+12V_Aux	GND	GA1*	GA0*
7	TCK	GND	TDO	TDI	GND	TMS	TRST*
8	GND	REF_CLK-	REF_CLK+	GND	AUX_CLK-	AUX_CLK+	GND



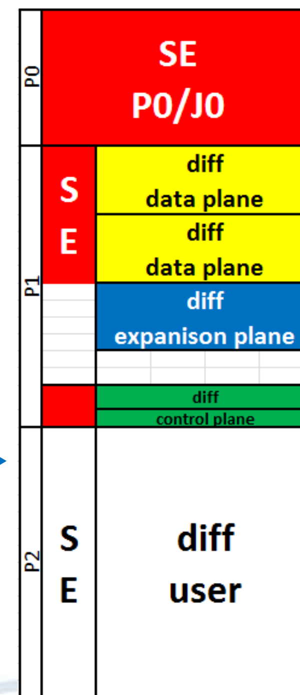
VNX

- 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



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Relative Adoption of VPX Vs. VNX

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SWaP vs. Modularity vs. Performance

Large,
hot,
heavy

SWaP

VME, CPCI
Low

6U VPX
Very high

3U VPX
High

More Vendors
More Profiles

VNX
Medium

Full custom

Legend
STANDARD
performance

Modularity, reuse

Modular, high reuse

no modularity, low reuse

- 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

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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

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Thank You

Questions? Please contact

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