VNX+ AT A GLANCE

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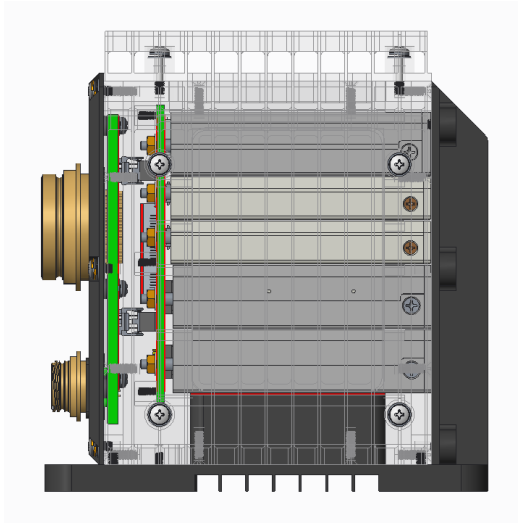
Tell Me Again ……. What is VNX+ ??

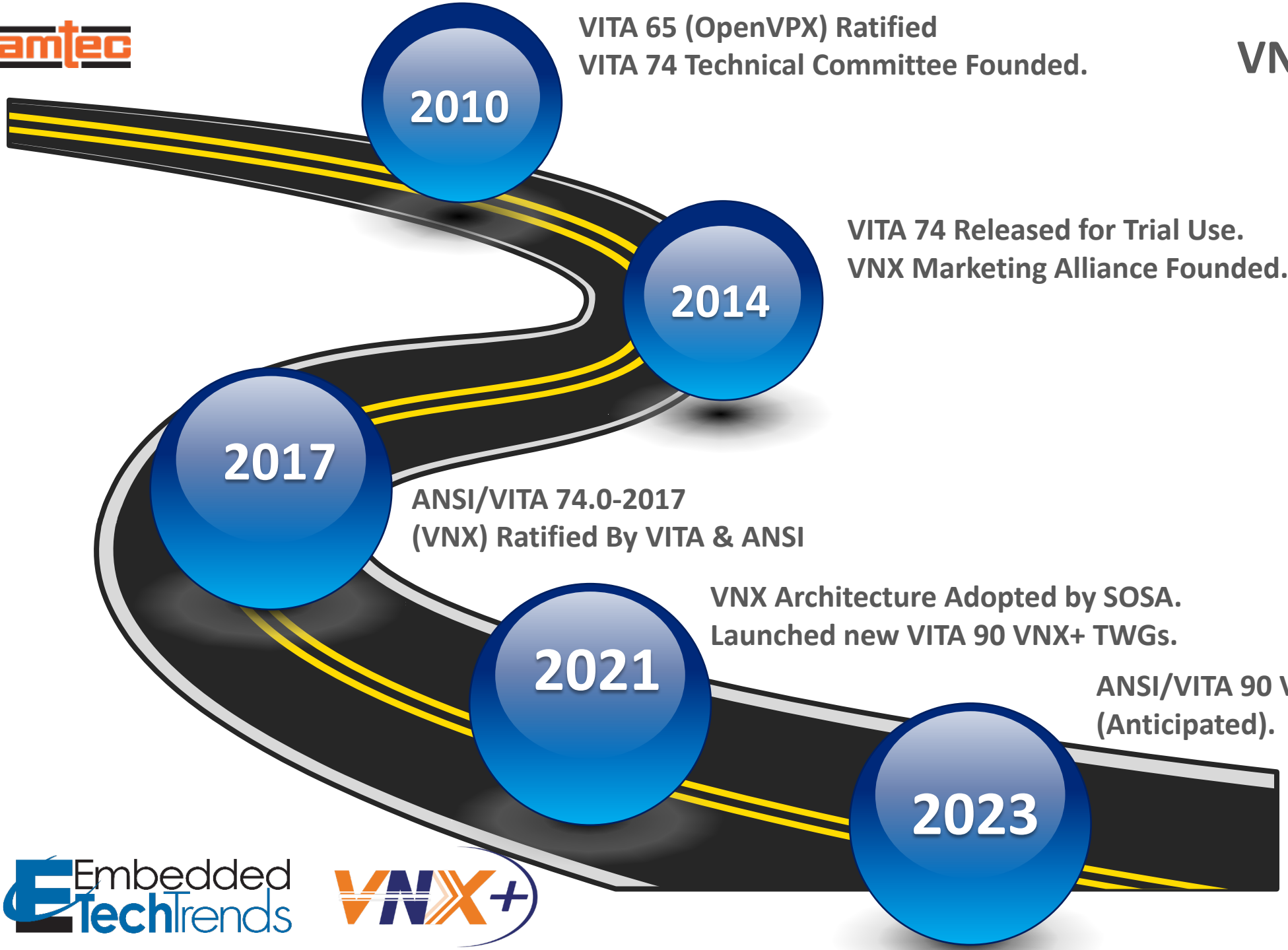
- VNX+ is often considered a “Down-Scaled Derivative” of VPX for Small Form Factor (SFF) deployments
  - SBC, GPU, FPGA, Input/Output, Storage, Sensors, RF/Video
  - Power Supplies, Filters, Hold-Up
- VNX+ is Purpose-Built, Rugged, & Conduction Cooled
  - Inherently rugged conduction cooled modules
  - Optimized for Space, Weight, Power, and to some extent, Cost (SWaP-C)
- **VNX+ is not intended to replace VPX, but to expand the VPX architecture & functionality into the SFF marketplace**



Why VNX+ ??

- Reducing SWaP & improving compute & I/O performance is everyone's "Holy Grail."
- Reducing price & "time to market" requires adherence to standards, modularity, & maximum reuse.
- VPX (and ergo VNX+) architecture is "mainstream" for MIL/Rugged MOSA deployments.
- VPX & VNX+ architectures are displacing custom designs.
- VNX+ fits in available spaces
  - Small LRUs and Common Launch Tubes
  - CubeSats & Small Spacecraft

VNX+ Timeline



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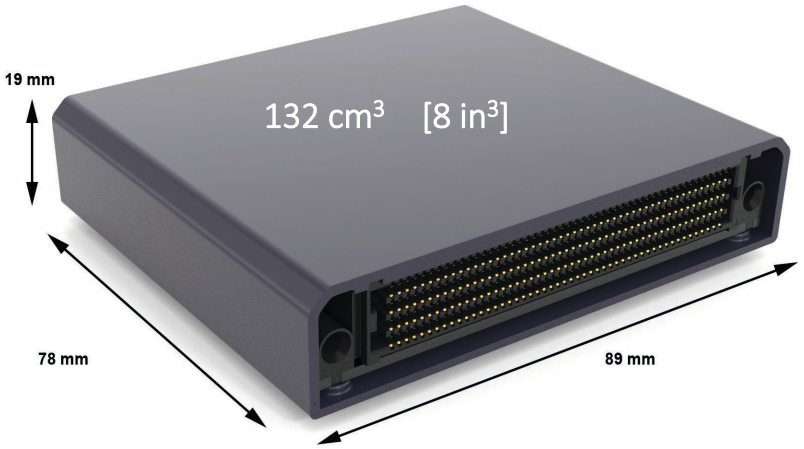
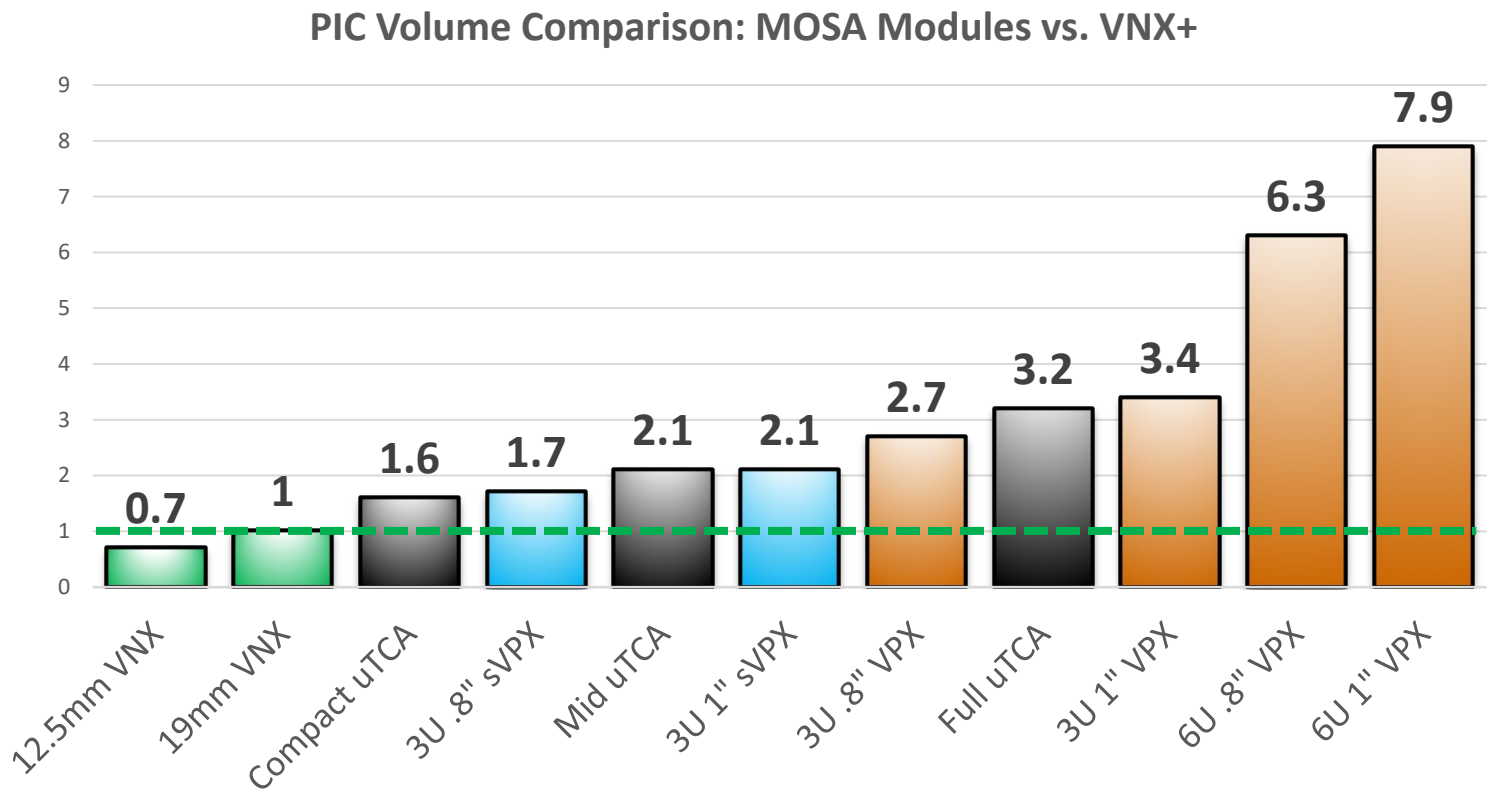
Plug-in-Card Volume Comparisons





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What Changed Between VNX and VITA 90 VNX+ ??

VNX (VITA 74)

- Originally Based on VITA 46
- Modules Only
- Optimized for Ease of Implementation
- PCIe Gen 1 to Gen 3 Speeds
- 19mm, 12.5mm
- Copper Only. No Coax/Optical Aperture
- Simple I^2C Sys Mgt
- 20 Watts/Module (19mm)

VNX+ (VITA 90)

- Based on VITA 65
- Module Centric + System Considerations
- Optimized for Max Signal Integrity
- PCIe Gen3 to Beyond PCIe Gen 4 Speeds
- 1x, 2x Multiples of 19mm, 12.5mm
- Apertures for Optical MT, Coaxial
- VITA 46.11 Sys Mgt or Legacy VNX
- Expanded Thermals ➔ 80 Watts or More

What is Included in the VNX Family of Standards ??

- VITA 74.0 VNX Legacy Base Standard

- VITA 90.0 VNX+ Base Standard
- VITA 90.1 VNX+ Slot Profiles & Naming Conventions
- VITA 90.2 VNX+ Optical & Coaxial (RF & Video) Contacts & Apertures
- VITA 90.3 VNX+ Power Conversion & Energy Storage Modules
- VITA 90.4 VNX+ Enhanced Mounting, Retention, & Thermal Solutions
- VITA 90.5 SpaceVNX+ Space Use Considerations

VITA 90.2 Apertures & Contacts

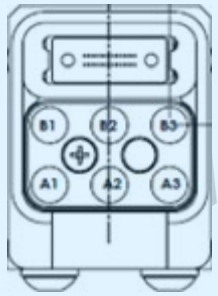
All Contacts Shrouded for Protection

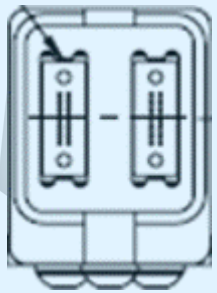
- Backplane & Module
- Half & Full Aperture

VITA 90.2 Contacts

- Coaxial
  - #20 50Ω RF
  - #16 50Ω RF
  - #16 75Ω Video
- Optical MT
  - 12 & 24 Fiber
  - 16 & 32 Fiber (Planned)

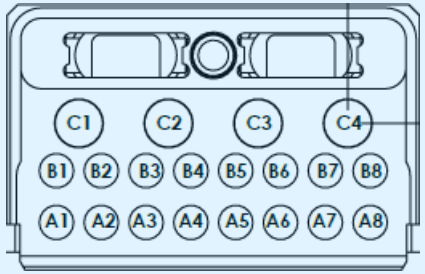
6x20 + 1xMT
RF + Optical



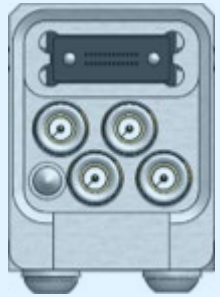


2xMT
Optical

2x16 + 2x20 + 1xMT
RF/Video + RF + Optical.

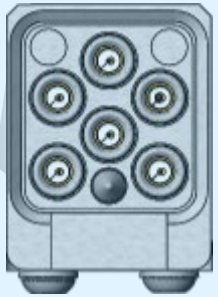


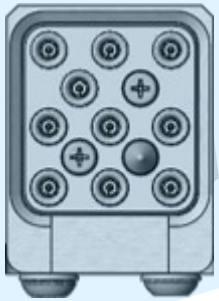
4x16 + 16x20 + 2xMT
RF/Video + RF + Optical.



4x16 + 1MT
RF/Video + Optical

6x16
RF/Video





10x20
RF

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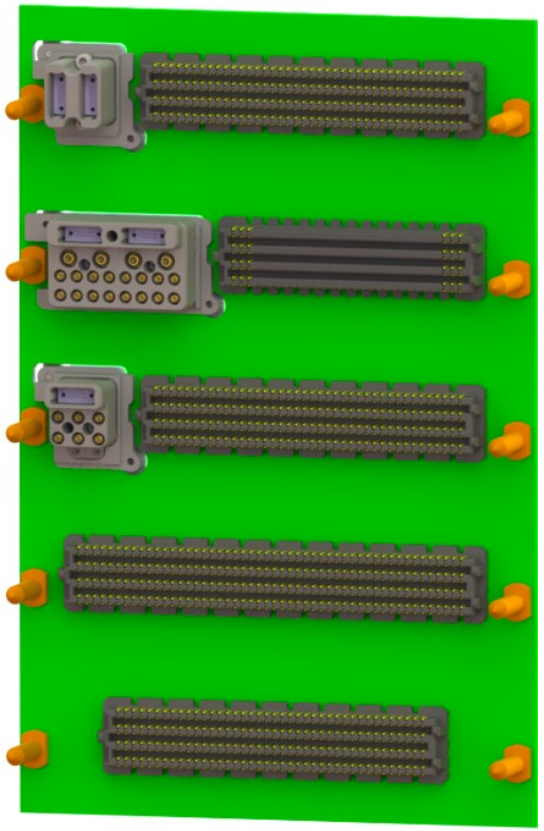
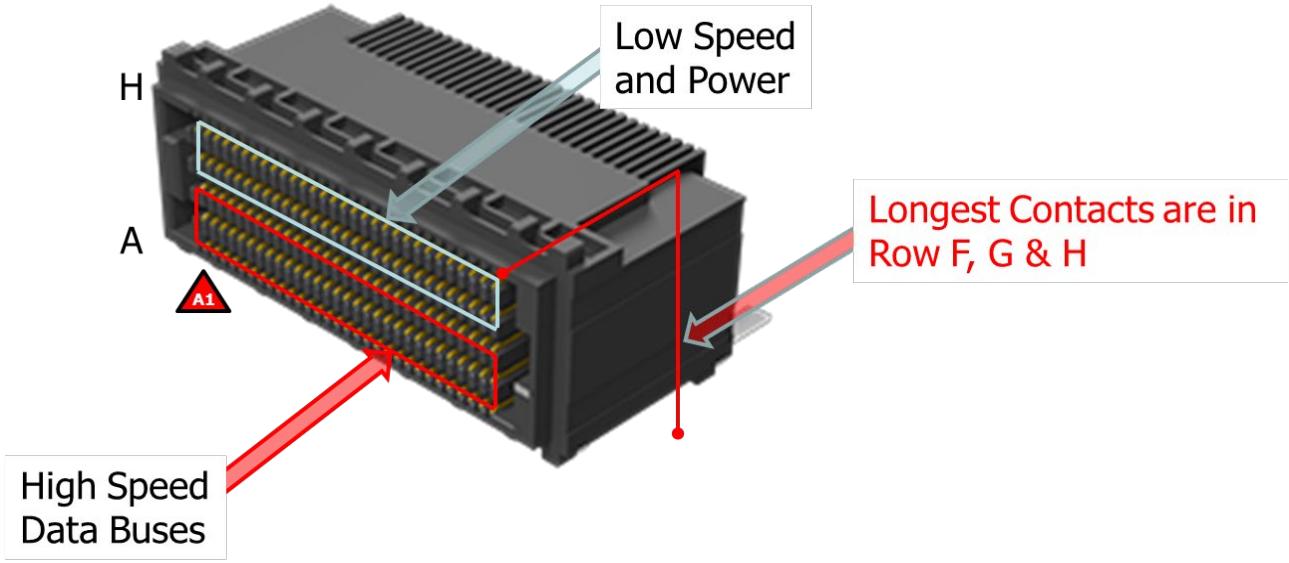
VNX+ Module Types with Aperture Examples

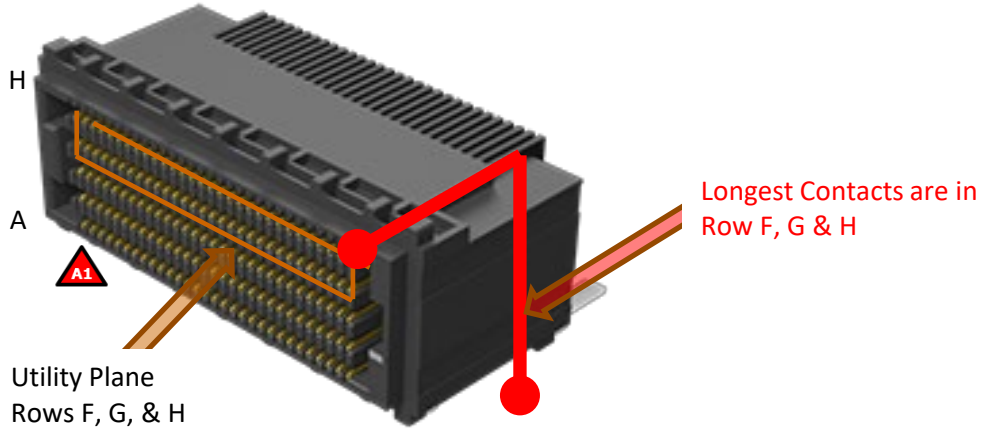
Backplane	Module & Aperture	Payload Module
	Half-Aperture, 2x MT	
	Full Aperture, 2x Coaxial & 2x MT	
	Half Aperture, 6x Coaxial, 1x MT	
	Zero Aperture, 400-Pin	
	Power Supply, 320-Pin	

Signal Integrity, “On Purpose, Instead of By Accident”

Connector Pin Assignments

- VITA 74
  - Optimized Backplane / Module Routing
  - Gen 2, Maybe Gen 3
- VITA 90
  - Optimized Signal Integrity
  - Gen 3, Gen 4, Approaching Gen 5





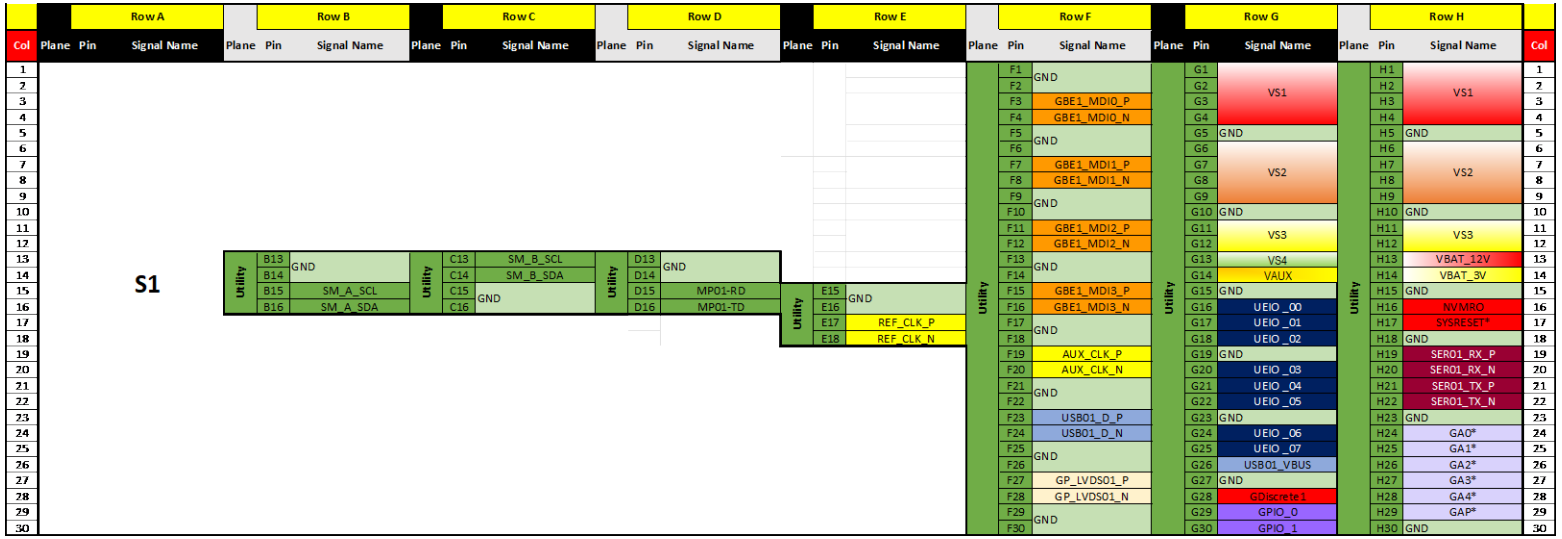
VNX+ Payload Module S0: Utility Plane

Common Use Signals

- Common Comms
  - GbE, USB, Serial, Maint Port
- System Management
  - GA, SM
- Unique External I/O (UEIO)
  - I2C, SPI
- Overhead
  - NVMRO, RESET, Clocks
  - GPIO, LVDS

Power Rails

- VSx: +12, +5, +3.3, -12 VDC
- VBATT: +12, +3 VDC
- VAUX: +3.3 VDC

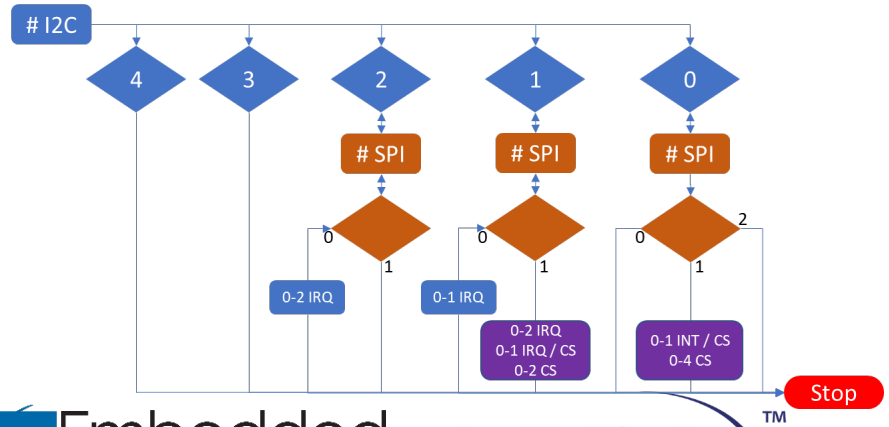


Unique External I/O (UEIO)

- 8x Pins in S0 - Configurable I²C / SPI

Pin Definition Mappings					
Pin	Mode 0	Mode 1	Mode 2	Mode 3	Mode 4
00	UNUSED	I2C3_SCL	SPI0_SCLK	N/A	I2C1_IRQ
01	UNUSED	I2C3_SDA	SPI0_MOSI	N/A	I2C0_IRQ
02	UNUSED	I2C2_SCL	SPI0_MISO	N/A	N/A
03	UNUSED	I2C2_SDA	SPI0_SS0_F	N/A	N/A
04	UNUSED	I2C1_SCL	SPI0_SS1_F	SPI1_SCLK	SPI0_IRQ
05	UNUSED	I2C1_SDA	SPI0_SS2_F	SPI1_MOSI	I2C0_IRQ
06	UNUSED	I2C0_SCL	SPI0_SS3_F	SPI1_MISO	N/A
07	UNUSED	I2C0_SDA	SPI0_SS4_F	SPI1_SS0_F	N/A

- Tightly Controlled Rules Based Config



Many available I/O interfaces which may be controlled by I²C/SPI available

- ADC / DAC / Sensor
- Discrete / GPIO
- Serial / Data Bus

Standard VNX module with abstract I/O

- I/O Transition Board & Front Panel
- Non-VNX Modules
- Dumb VNX Modules

VNX+ Payload Module S1: Control, Data, Expansion Planes

Plane Structure Similar to VITA 65

- Control Plane
  - 1x X1 Ultra-Thin Pipe (UTP)
  - Additional CP in S2 in Some Profiles
- Data Plane
  - 2x X4 Fat Pipe (FP)
  - May Be Concatenated
- Expansion Plane
  - 1x X8 Double Fat Pipe (DFP)
  - May Be Bifurcated

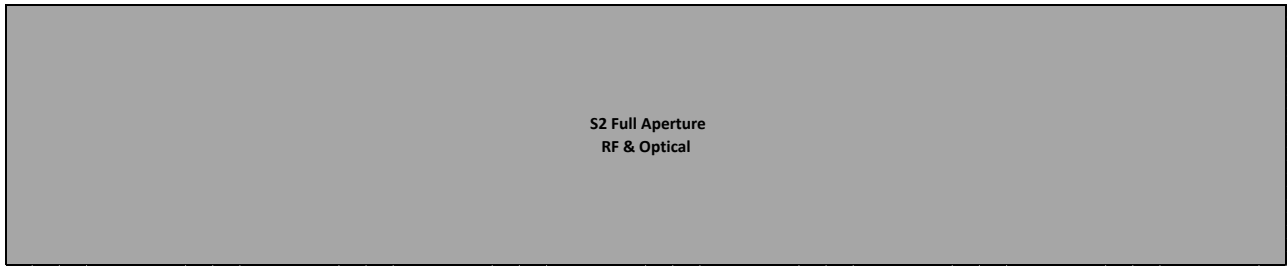
	Row A			Row B			Row C			Row D			Row E			Row F			Row G			Row H		
Col	Plane	Pin	Signal Name	Plane	Pin	Signal Name	Plane	Pin	Signal Name	Plane	Pin	Signal Name	Plane	Pin	Signal Name	Plane	Pin	Signal Name	Plane	Pin	Signal Name	Plane	Pin	Signal Name	Col
1	Expansion	A1	EP1_RX0_P	Expansion	B1	GND	Expansion	C1	EP1_RX3_P	Expansion	D1	GND	Expansion	E1	EP1_RX6_P										1
2		A2	EP1_RX0_N		B2			C2	EP1_RX3_N		D2			E2	EP1_RX6_N										2
3		A3	GND		B3	EP1_RX2_P		C3	GND		D3	EP1_RX5_P		E3	GND										3
4		A4			B4	EP1_RX2_N		C4			D4	EP1_RX5_N		E4											4
5		A5	EP1_RX1_P		B5	GND		C5	EP1_RX4_P		D5	GND		E5	EP1_RX7_P										5
6		A6	EP1_RX1_N		B6			C6	EP1_RX4_N		D6			E6	EP1_RX7_N										6
7	Data	A7	GND	Data	B7	DP1_RX1_P	Data	C7	GND	Data	D7	DP2_RX0_P		E7	GND										7
8		A8			B8	DP1_RX1_N		C8			D8	DP2_RX0_N		E8											8
9		A9	DP1_RX0_P		B9	GND		C9	DP1_RX3_P		D9	GND		E9	DP2_RX2_P										9
10		A10	DP1_RX0_N		B10			C10	DP1_RX3_N		D10			E10	DP2_RX2_N										10
11		A11	GND		B11	DP1_RX2_P		C11	GND		D11	DP2_RX1_P		E11	GND										11
12		A12			B12	DP1_RX2_N		C12			D12	DP2_RX1_N		E12											12
13	Control	A13	CP1_RX0_P											E13	DP2_RX3_P										13
14		A14	CP1_RX0_N											E14	DP2_RX3_N										14
15		A15	GND																						15
16		A16																							16
17		A17	CP1_TX0_P	Expansion	B17	GND	Expansion	C17	EP1_TX3_P	Expansion	D17	GND													17
18		A18	CP1_TX0_N		B18			C18	EP1_TX3_N		D18														18
19	Expansion	A19	GND		B19	EP1_TX1_P		C19	GND		D19	EP1_TX5_P		E19	GND										19
20		A20			B20	EP1_TX1_N		C20			D20	EP1_TX5_N		E20											20
21		A21	EP1_TX0_P		B21	GND		C21	EP1_TX4_P		D21	GND		E21	EP1_TX7_P										21
22		A22	EP1_TX0_N		B22			C22	EP1_TX4_N		D22			E22	EP1_TX7_N										22
23		A23	GND		B23	EP1_TX2_P		C23	GND		D23	EP1_TX6_P		E23	GND										23
24		A24			B24	EP1_TX2_N		C24			D24	EP1_TX6_N		E24											24
25	Data	A25	DP1_TX0_P	Data	B25	GND	Data	C25	DP1_TX3_P	Data	D25	GND	Data	E25	DP2_TX2_P										25
26		A26	DP1_TX0_N		B26			C26	DP1_TX3_N		D26			E26	DP2_TX2_N										26
27		A27	GND		B27	DP1_TX2_P		C27	GND		D27	DP2_TX1_P		E27	GND										27
28		A28			B28	DP1_TX2_N		C28			D28	DP2_TX1_N		E28											28
29		A29	DP1_TX1_P		B29	GND		C29	DP2_TX0_P		D29	GND		E29	DP2_TX3_P										29
30		A30	DP1_TX1_N		B30			C30	DP2_TX0_N		D30			E30	DP2_TX3_N										30

S0

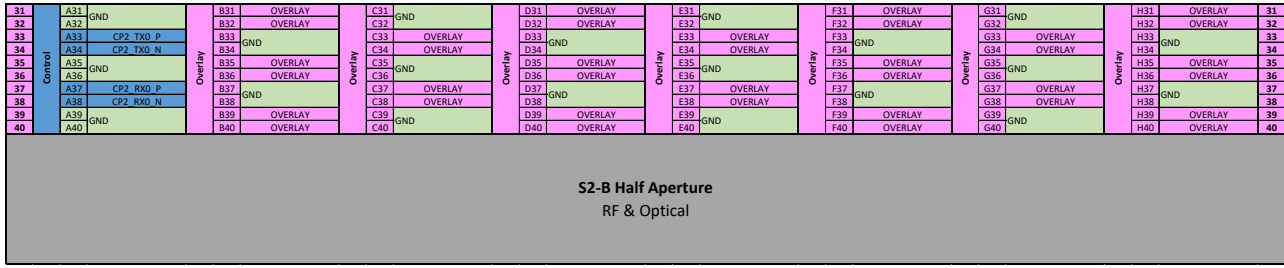
VNX+ Payload Module S2: Overlay Segment

S2 Size & Composition Varies With Module Type

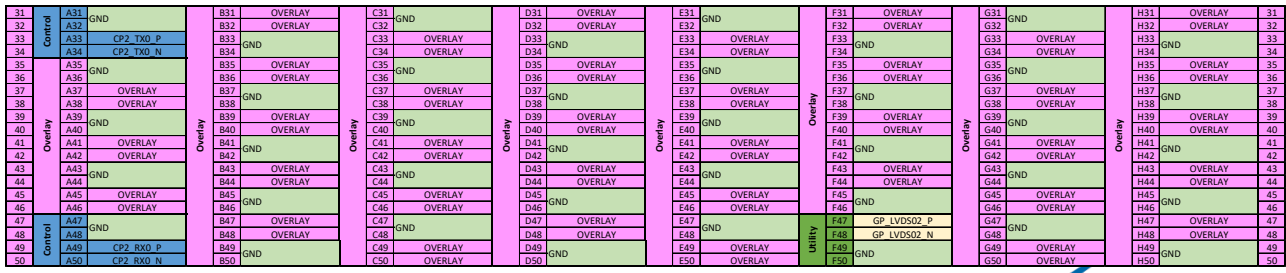
- 240-Pin High-Speed Data Connector
  - S2 is Full Aperture
    - Coaxial RF/Video and/or Optical MT Contacts



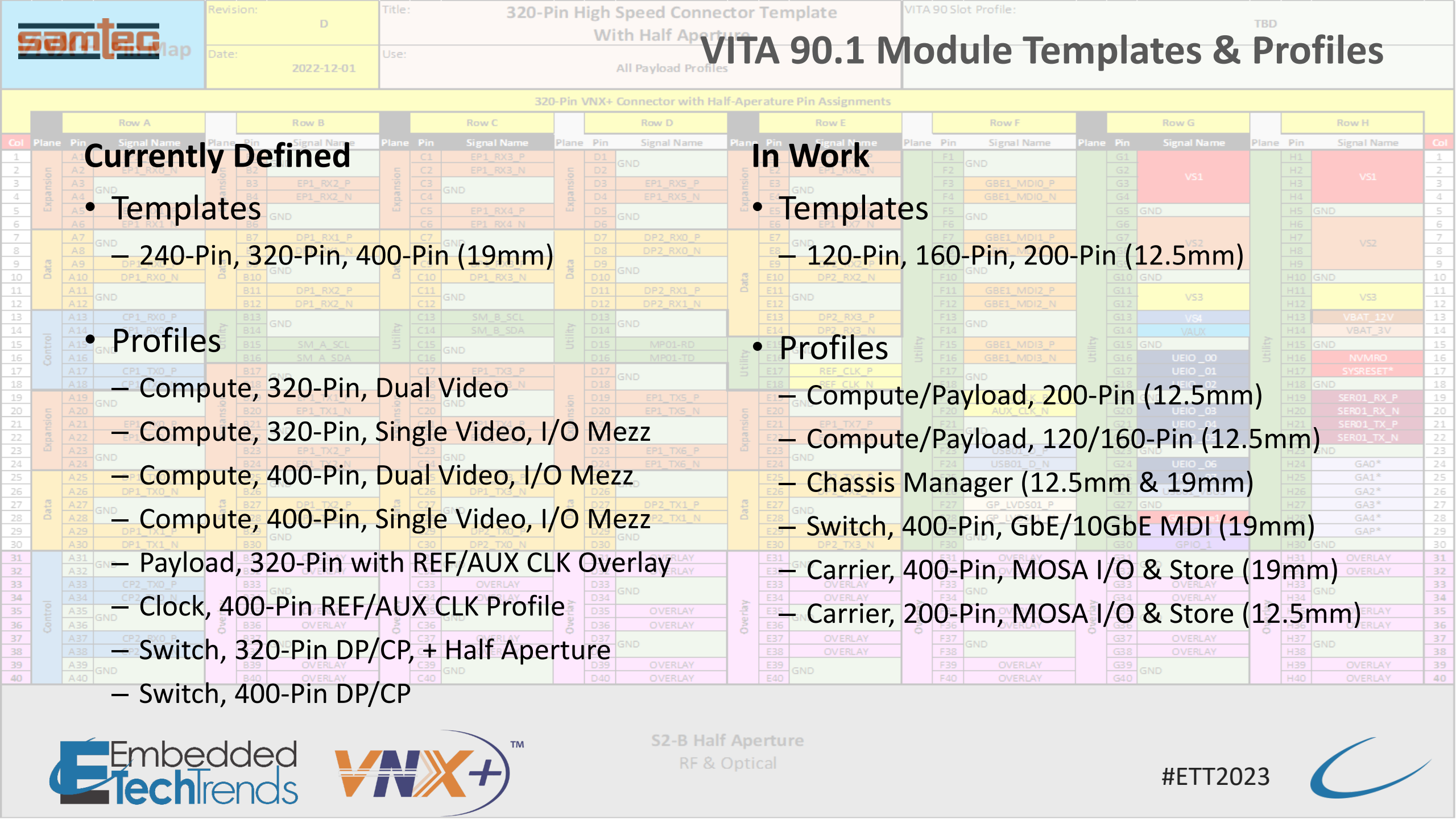
- 320-Pin High-Speed Data Connector
  - S2A is 80-Pins High-Speed Data Connector
  - S2B is Half Aperture
    - Coaxial RF/Video and/or Optical MT Contacts



- 400-Pin High-Speed Data Connector
  - S2 is 160-Pins High-Speed Data Connector
  - "Zero Aperture"



VITA 90.1 Module Templates & Profiles



Currently Defined

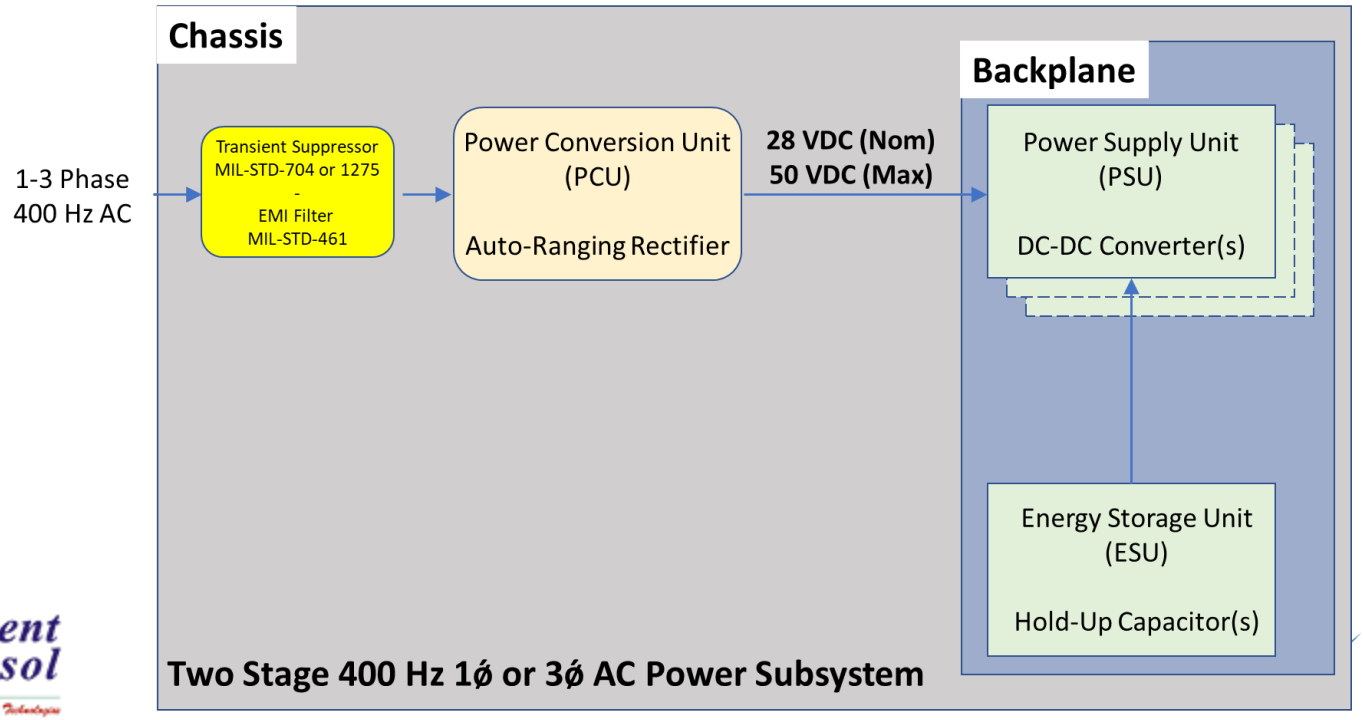
- Templates
  - 240-Pin, 320-Pin, 400-Pin (19mm)
- Profiles
  - Compute, 320-Pin, Dual Video
  - Compute, 320-Pin, Single Video, I/O Mezz
  - Compute, 400-Pin, Dual Video, I/O Mezz
  - Compute, 400-Pin, Single Video, I/O Mezz
  - Payload, 320-Pin with REF/AUX CLK Overlay
  - Clock, 400-Pin REF/AUX CLK Profile
  - Switch, 320-Pin DP/CP, + Half Aperture
  - Switch, 400-Pin DP/CP

In Work

- Templates
  - 120-Pin, 160-Pin, 200-Pin (12.5mm)
- Profiles
  - Compute/Payload, 200-Pin (12.5mm)
  - Compute/Payload, 120/160-Pin (12.5mm)
  - Chassis Manager (12.5mm & 19mm)
  - Switch, 400-Pin, GbE/10GbE MDI (19mm)
  - Carrier, 400-Pin, MOSA I/O & Store (19mm)
  - Carrier, 200-Pin, MOSA I/O & Store (12.5mm)

VITA 90.3 Power Supply Modules

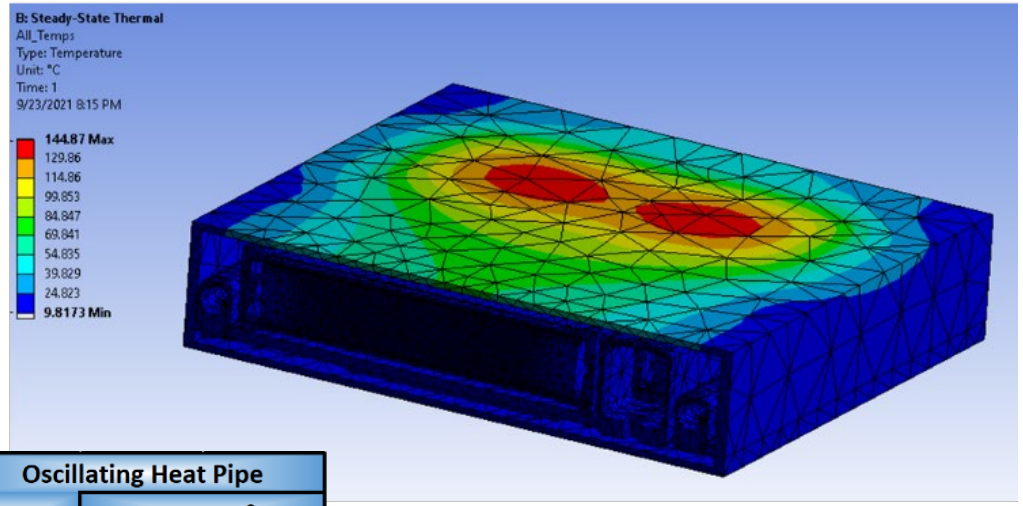
- Power Supply Modules (19mm)
  - 28 VDC Power Input (Single Stage)
  - 270 VDC Power Input (Dual Stage)
  - 120 VAC 3-Phase (Dual Stage)
- Power Output Variations
  - Balanced
  - 12V Heavy
  - 12V Only
- Load Share Capabilities
  - Load Sharing Between Like Supplies Only
  - Estimated 60-80 Watts/Slot
- Energy Storage Module (19mm)
  - MIL-STD-704A Hold-Up Caps, 50 mSec
- Filter Module (19mm)
  - MIL-STD-461 EMI Filter



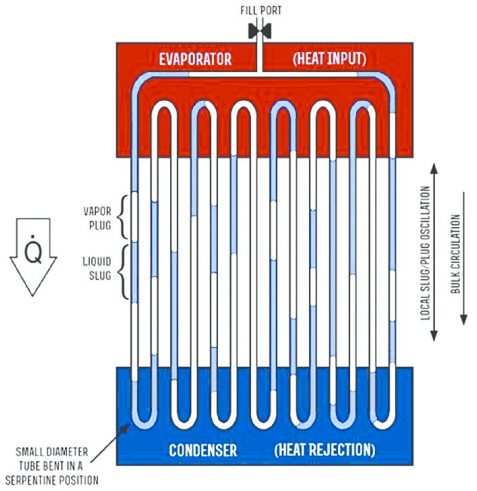
VITA 90.4 Achieving VNX+ Thermal Performance Targets

- VNX power initially pegged at 20W, but in practice increased to 25W to 30W or more.

- Recent studies show VNX+ allows power > 95 W/Module using advanced materials.



VITA 90 VNX+ Module Shell Material Thermal Study			Aluminum			Copper			Oscillating Heat Pipe		
				Ambient °C			Ambient °C			Ambient °C	
Power	Component	Watts	Rise °C	+55 C	+71 C	Rise °C	+55 C	+71 C	Rise °C	+55 C	+71 C
High 95W	FPGA	80	145	200	216	68	123	139	49	104	120
	Optical CODEC	7	132	187	203	71	126	142	39	94	110
	NVM	5.2	125	180	196	60	115	131	39	94	110
Med 55W	FPGA	40	86	141	157	49	104	120	38	93	109
	Optical CODEC	8	88	143	159	52	107	123	39	94	110
	NVM	5.2	78	133	149	40	95	111	28	83	99
Low 35W	FPGA	20	63	118	134	40	95	111	32	87	103
	Optical CODEC	10	66	121	137	43	98	114	35	90	106
	NVM	5.2	55	110	126	30	85	101	22	77	93
Legacy VNX (est.) 25W	CPU 4C Atom	15	54	109	125	38	93	109	30	85	101
	Support Logic	5	40	95	111	35	90	106	32	87	103
	NVM	5	40	95	111	27	82	98	21	76	92

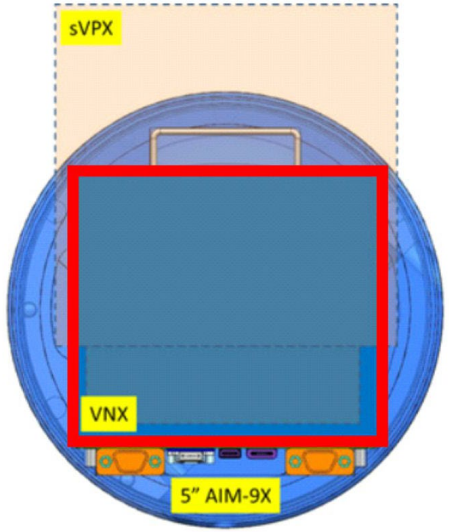


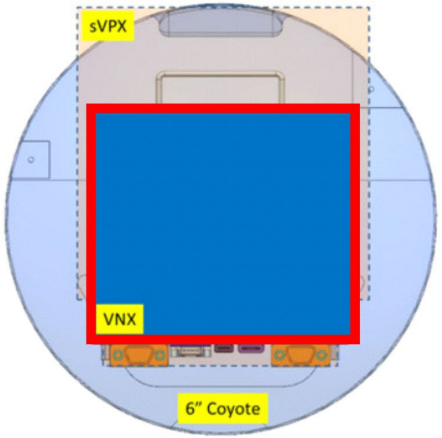
Application: Pod-Mounted Sensor Processor

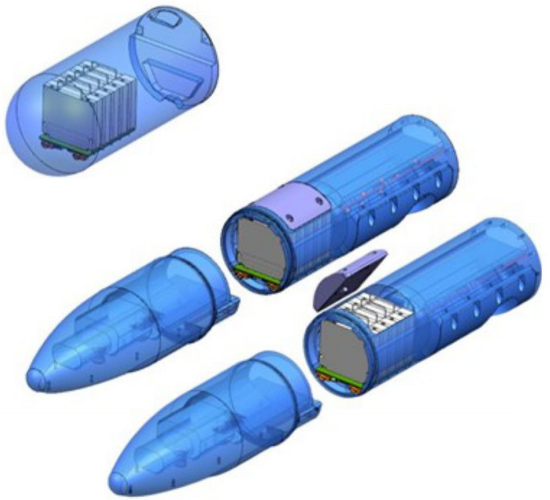
- In smaller pods, VNX+ is deployed as vertically oriented, conduction-cooled modules, using a traditional horizontal backplane, mounted longitudinally along the long axis.

- In larger pods, VNX+ is a natural fit for traditionally packaged ATR-style avionics boxes.

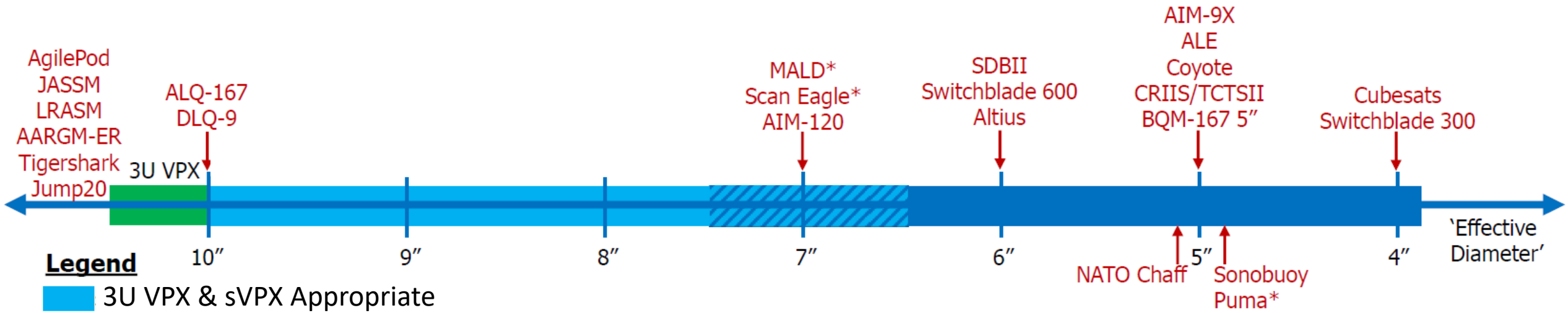
- Ideal for locating high-end compute, GPU, FPGA, and MPSoC signal processors in close proximity to sensors, seeker heads, navigation, and platform I/O.







SFF Target Platforms and Sizes



Legend

- 3U VPX & sVPX Appropriate
- sVPX & VNX+ Appropriate
- VNX+ Primary Use Case

SpaceVNX+ for CubeSATs

- VNX was designed from the inception for SFF Space-based Sensor Processor, Communications, and Surveillance systems.
- Practical deployments from a typical 100mm square 1U CubeSAT to 12U or larger SmallSATs.
- Framework may combine rad-hard (or tolerant) semiconductors, redundancy, as well as circumvention, and recovery approaches