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ELMA
Your Solution Partner

VNX+™ (VITA 90)

High-performance embedded computing with minimum SWaP
(Size, Weight and Power)

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elincom

D&E event

Introduction:

- Specialized component distributor serving machine- & equipment manufacturers

  Power - EMC - Energy - Housing - Connectivity - Auto-ID - Thermal management - LED

- Specialized distributor in EMC shielding and T&M equipment

  Conductive compounds – EMC components – Shielding materials – Thermal interfacing – EMC chambers – T&M equipment

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EEMC

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Conductive compounds – EMC components – Shielding materials – Thermal interfacing – EMC chambers – T&M equipment

ELMA
Your Solution Partner

German site:
System Platforms
Embedded Computing Systems
Backplanes
Rugged Cabinets

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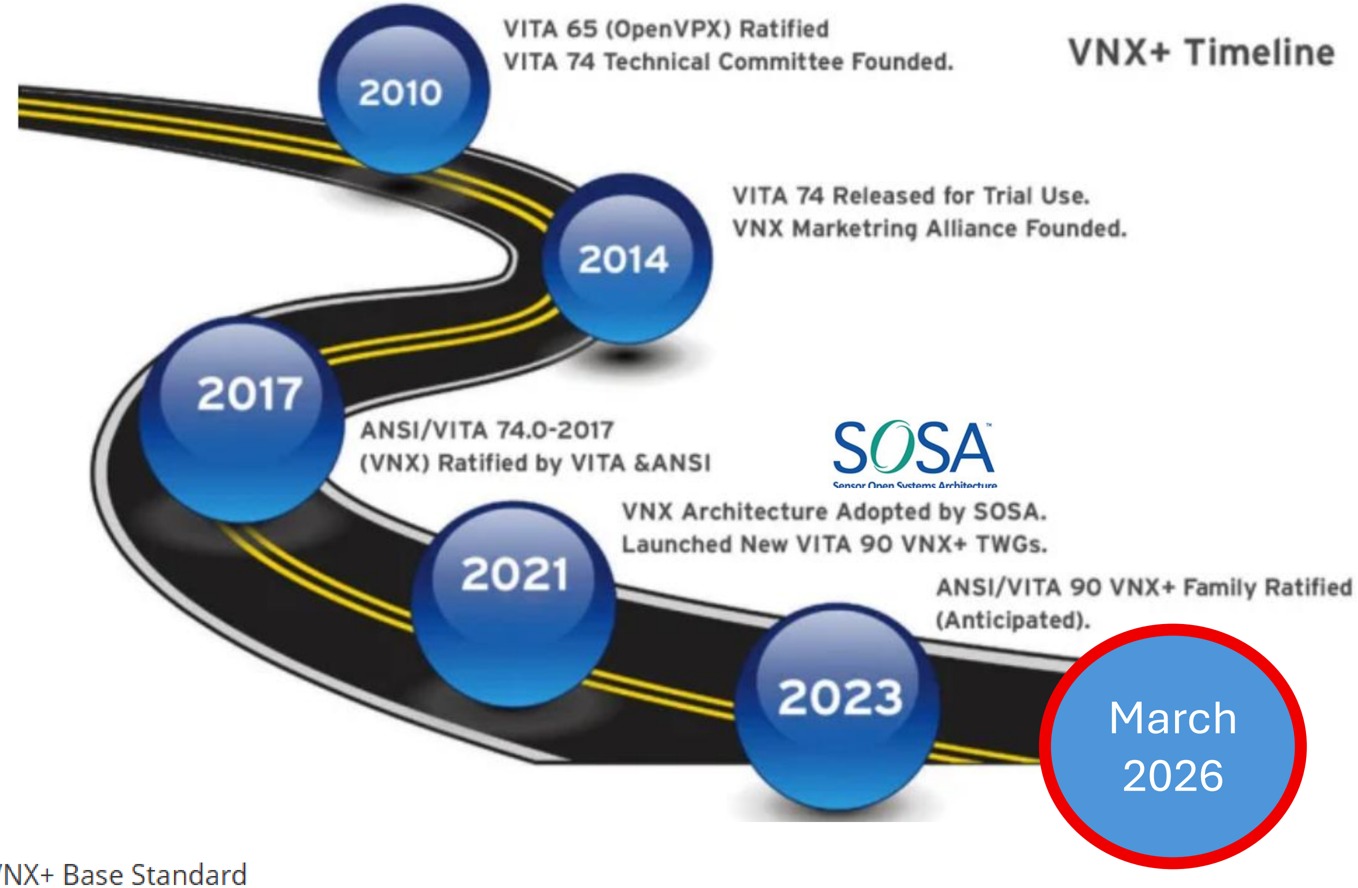
Figure 4: Cheetah Tactical Router in rugged VNX+ format (Figure: Sundance)

www.elma.com



VITA 90 is ratified

- VITA 90.0: VNX+ Base Standard
- VITA 90.1: VNX+ Profile Tables
- VITA 90.2: VNX+ Optical and Coax Apertures
- VITA 90.3: VNX+ Power Supply and Storage Modules
- VITA 90.4: VNX+ Cooling and Mounting Systems
- VITA 90.5: Space VNX+
- VITA 90.7: VNX+ Optical and NanoRF Coax Apertures Standard

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History VITA 74 to VITA 90

Use cases

Building Blocks

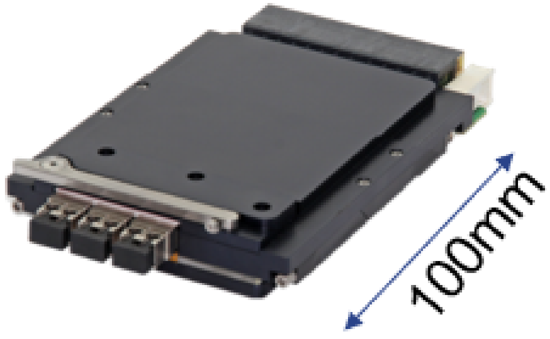
System Platforms

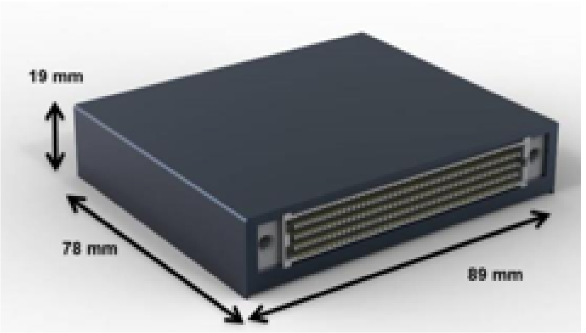
Cooling

VITA 74 → VITA 90

History VITA 74 to VITA 90

- **Launched in late 2019**
  - Charter: to explore options for hardware "physically smaller than 3U VPX" and to draft standards language for inclusion into the SOSA Technical Standard
- **Two form factors chosen:**
  - Short VPX: Same as normal VPX but shortened to 100mm
  - VNX: But significant enhancements were needed to make it suitable for the SOSA Technical Standard





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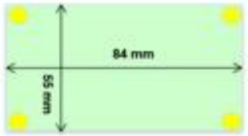
VITA 74

History VITA 74 to VITA 90

Why Nano-ETXexpress ??

THEMIS



- Small Formfactor => 84mm x 55mm
- Com Express Interface
- Enough Board Area for a Low Power CPU (Atom, ARM)
- Supports Legacy Interconnects => PCI, ATA, VGA, Audio, USB
- Supports New Fabrics => PCI-E, SATA, Gbit Enet

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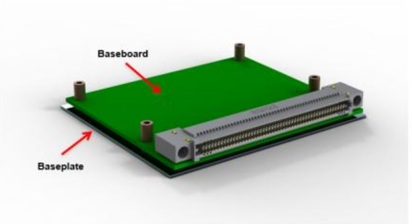
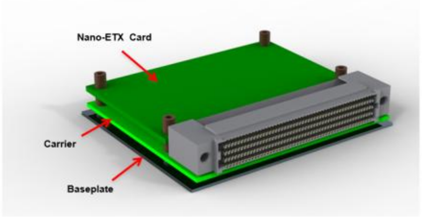
Module Internal Board Stackup

THEMIS

12.5mm Module



19mm Module



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Base Modules

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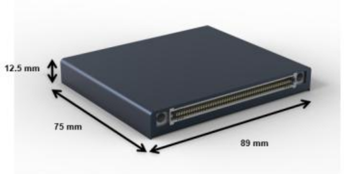
- 12.5mm Module
  - I/O, Storage
  - 4 Row Connector (200 pins)



- 19mm Module
  - CPU, FPGA, DSP
  - 8 Row Connector (400 pins)

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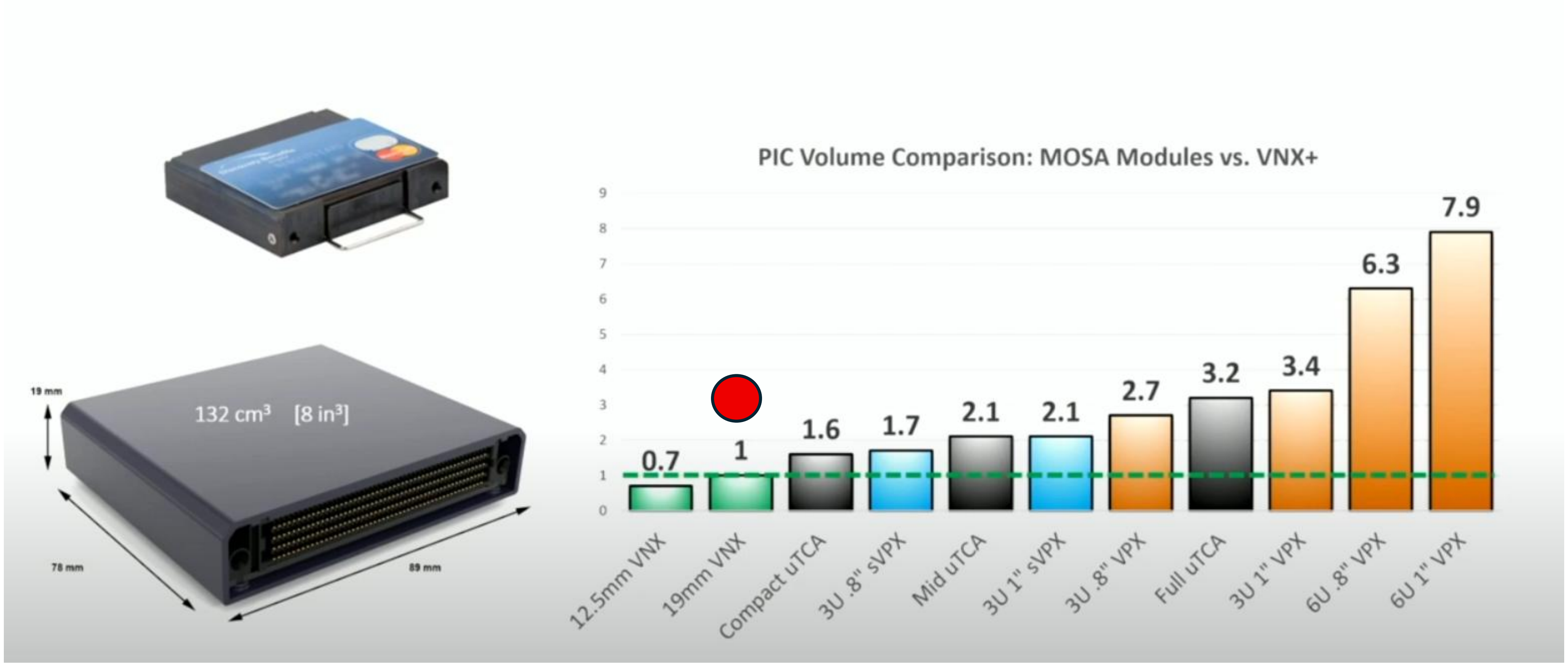
VITA 74

History VITA 74 to VITA 90



19 mm x 89 mm x 78 mm

VITA 74

VITA 90

History VITA 74 to VITA 90

samtec

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)

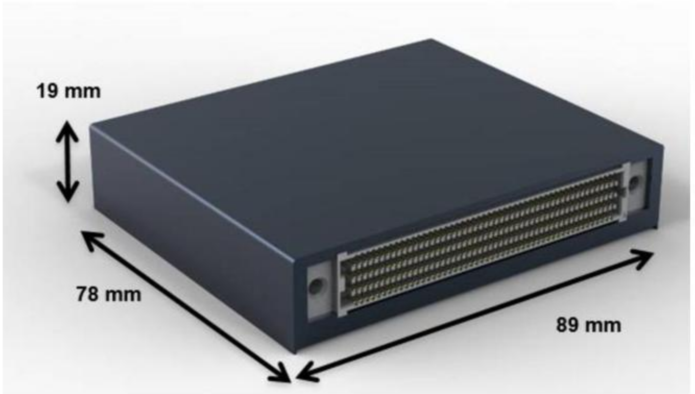
VNX+ (VITA 90)

- 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

VITA 90

History VITA 74 to VITA 90

- **Modular form factor standard**
- **Two module sizes**
  - 79mm x 89mm x 12.5mm
  - 79mm x 89mm x 19mm <<< Selected by SOSA
  - 39mm is also part of the new spec <<< Selected by SOSA
  - 19mm is ~30% of the size of 3U VPX per-slot
- **Backplane based**
  - Follows Data Plane / Control Plane / Expansion Plane model
- **High-speed connectors: Support up to 56 Gbps PAM4**
- **Sized so that SBCs can be constructed using COMe mini**
- **Supports blind-mate Coax and Optical**
- **Naturally rugged construction**
  - Can support 25-30W modules at 70°C in the configuration shown
  - Can support more (perhaps 55-60W) with more advanced cooling structures



History VITA 74 to VITA 90

They all got together……………

VNX

Participating committee members

* Chair

Trident infosol — Creating Deployable Solutions

Samtec

THEMIS

NAVAIR

Reflex Photonics

Acromag

Lockheed Martin

ELMA — Your Solution Partner

Mercury Systems

VITA — Open Standards, Open Markets

molex

WaveTherm

Observing committee members

Curtiss-Wright

Other companies involved

CEI Colorado Engineering, Inc.

ALPHI Technology Corporation

Pentek — Setting the Standard for Digital Signal Processing

VectorNav — Embedded Navigation Solutions

Rockwell Collins

Milcots — Safer World Group — Rugged, Trusted

nls neuro logic systems — Military and Industrial Display Solutions

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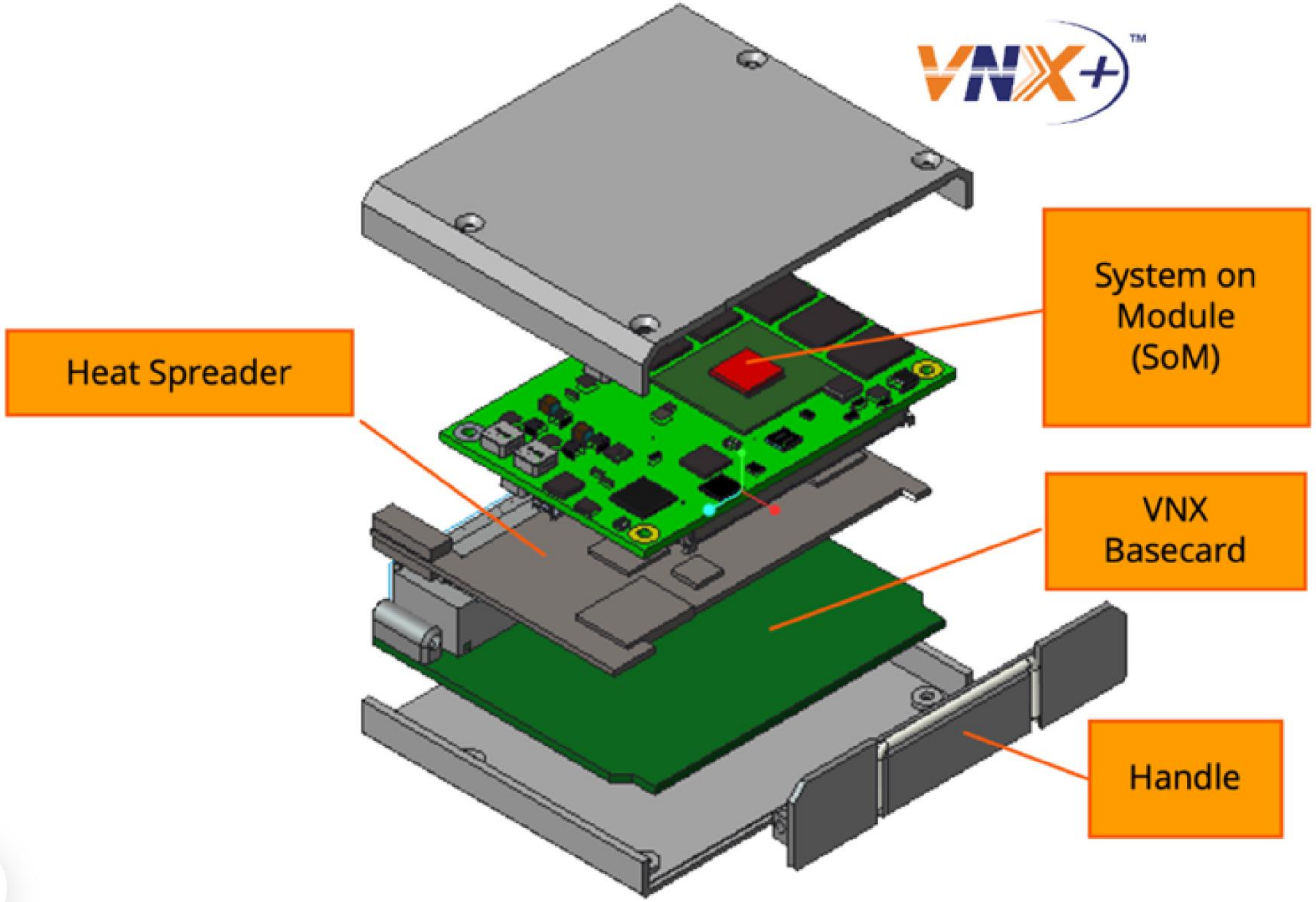
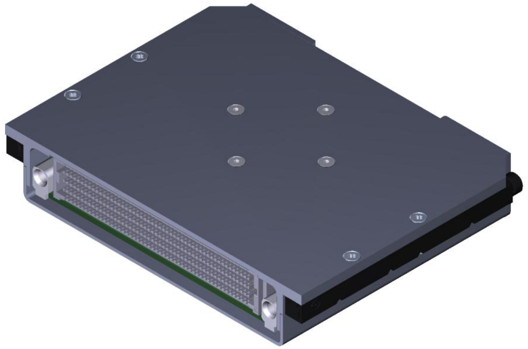
VITA 90

History VITA 74 to VITA 90





SOSA Sensor Open Systems Architecture

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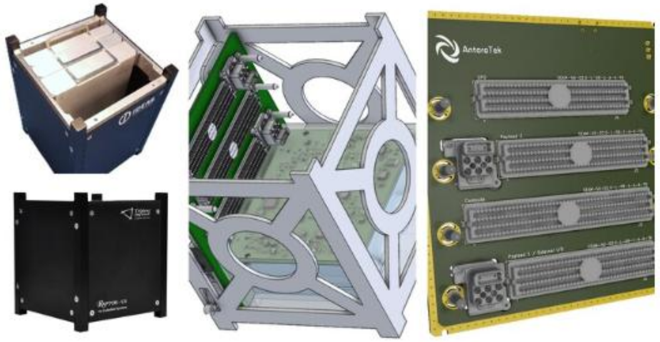
VITA 90

Use cases

SpaceVNX use cases

Obvious use cases for SpaceVNX include single standalone 1U CubeSat satellites requiring high performance data collection and analysis at a lower cost. A larger variant with networked high-performance computers with a scalable data-collection and processing capability is possible by expanding the card cage to a 1.5U or 2U configuration. The small satellites may also be used as a disaggregated cluster of networked satellites designed for a variety of data collection and analysis applications with a single sensor. The next step would be to use the same network of LEO satellites with multiple sensors, where the networked cluster fuses the data from all active sensors. Figure 2 shows an example of an existing rugged VNX system.



[Figure 7 | Pictured is a 1U CubeSat with SpaceVNX modules. Photos: Trident-Infosol, Ideas-Tek, Antara Teknik.]

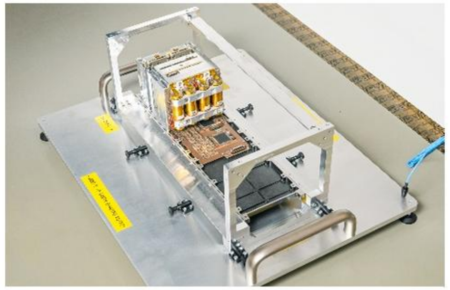
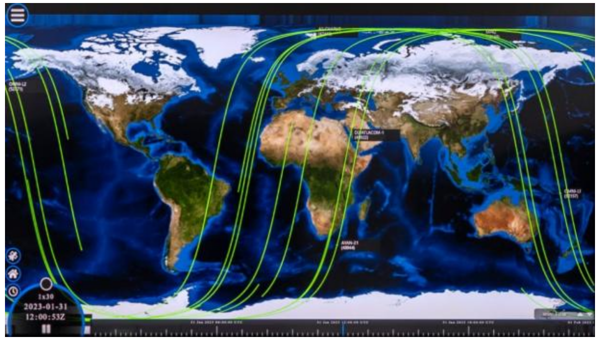


Figure 6.5: C3S 3U CubeSat Structure. Credit: Complex Systems & Small Satellites.



D&E event

SOSA Sensor Open Systems Architecture

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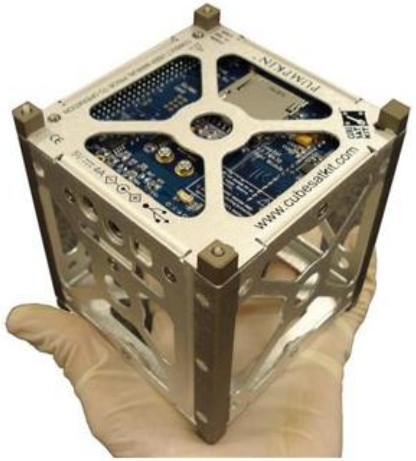
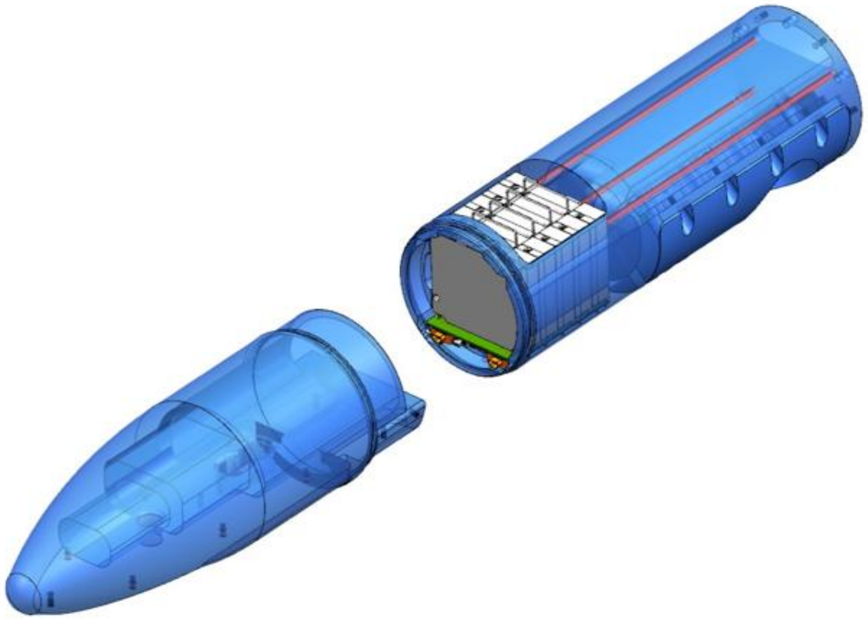
VITA 90

Use cases





Enables systems not possible with VPX

- Common Launch Tube applications
- Missile-bodies
- Cubesats
- Small unmanned vehicles
- Potentially very attractive to non-defense applications

SOSA Sensor Open Systems Architecture

SOSA Sensor Open Systems Architecture MEMBER

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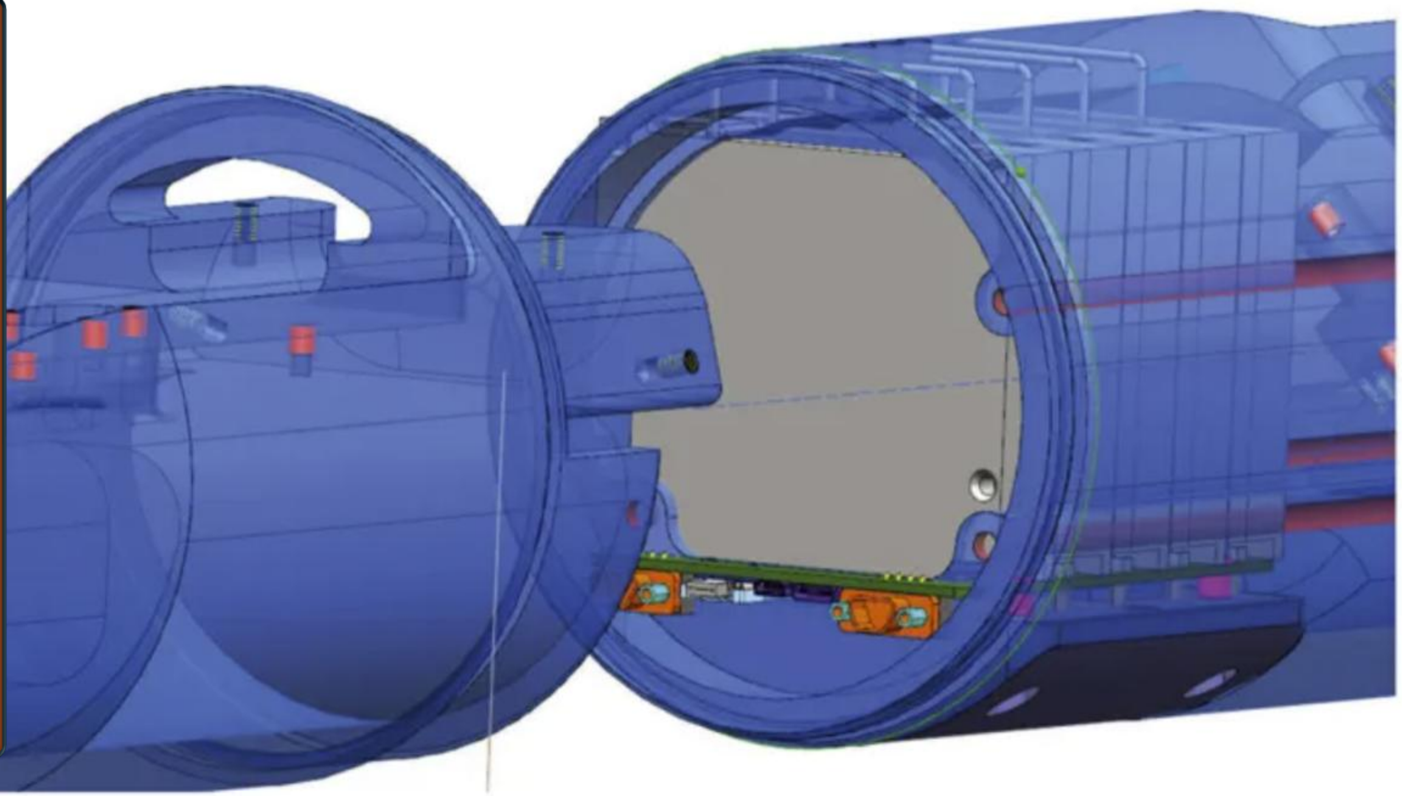
VITA 90

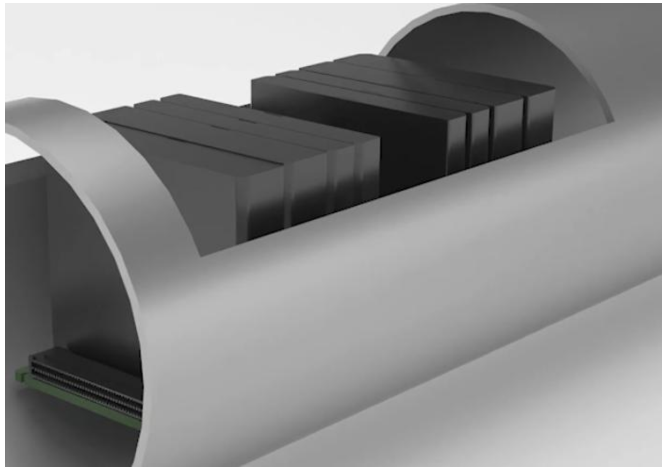
VNX+ DEPLOYMENTS IN TYPICAL UAV PLATFORMS

samtec

Use cases



A VITA 90 system mounted inside of a 5-inch AIM-9-sized pod. (Image: Collins Aerospace)



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SOSA™ Sensor Open Systems Architecture

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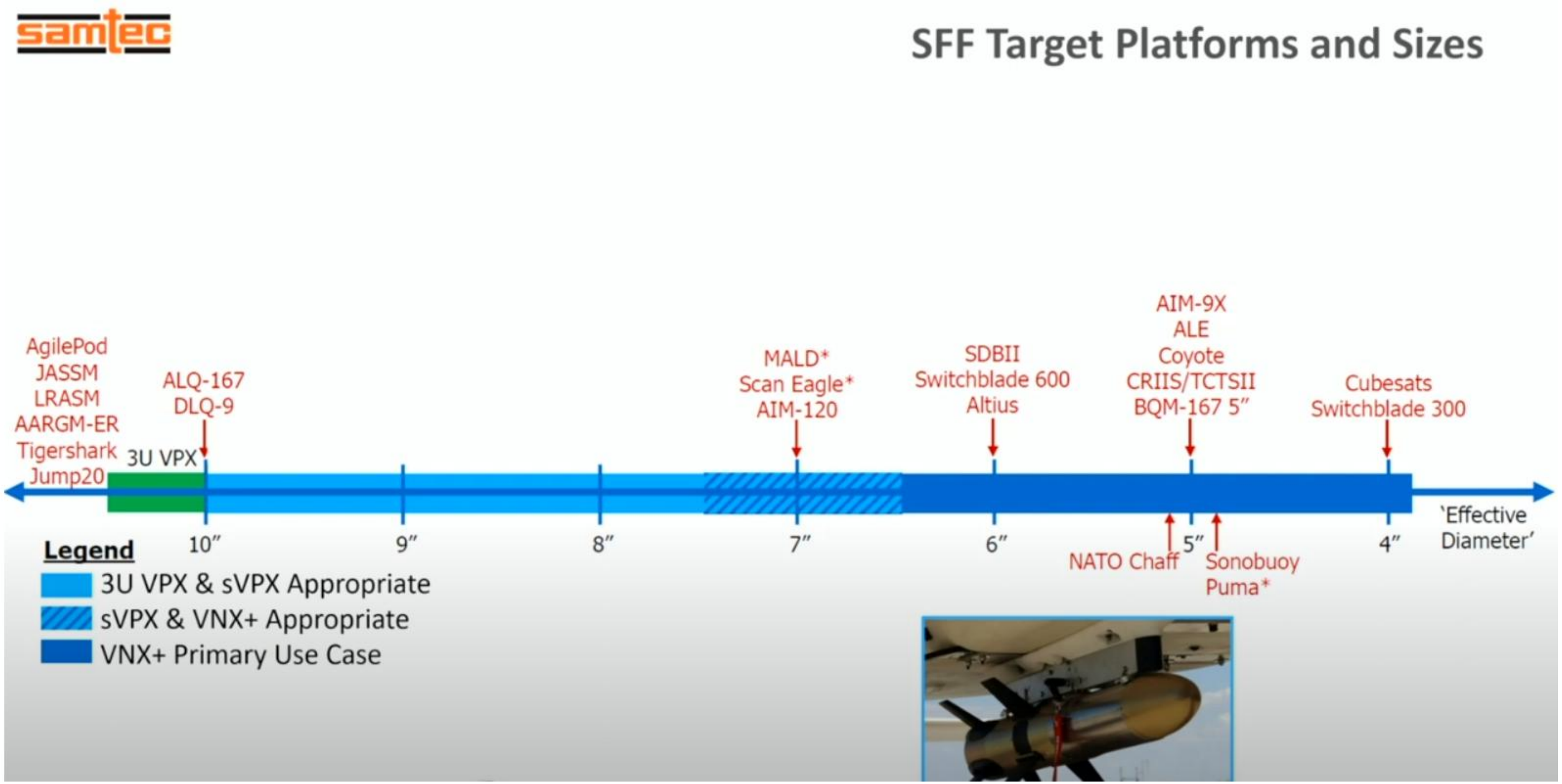
VITA 90

Use cases



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VITA 90

Use cases

Why should we use a modular system in a missile?

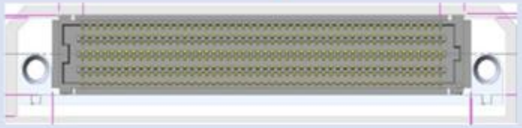
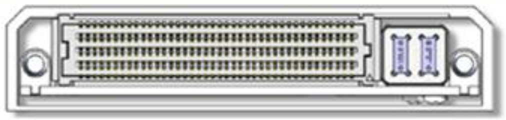
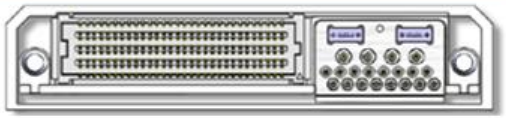
The rocket is built in the 90 ies and will be used now, you can easily change modules and a newer software ....

D&E event

SOSA
Sensor Open Systems Architecture

VITA 90

Building Blocks

Connector/Aperture Combination	Config Class	Connector Type	Aperture Fill Config	Image
VNX+ Connector Only	1	400-pin	None	
VNX+ w/ Small Aperture	2	320-pin	2x MT	
VNX+ w/ Small Aperture	3	320-pin	1x MT 6x RF	
VNX+ w/ Large Aperture	4	240-pin	2x MT 20x RF	

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VITA 90

Building Blocks

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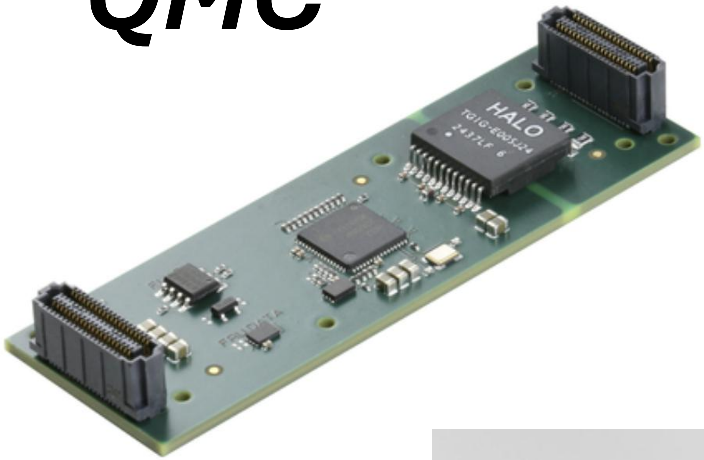
Building Blocks

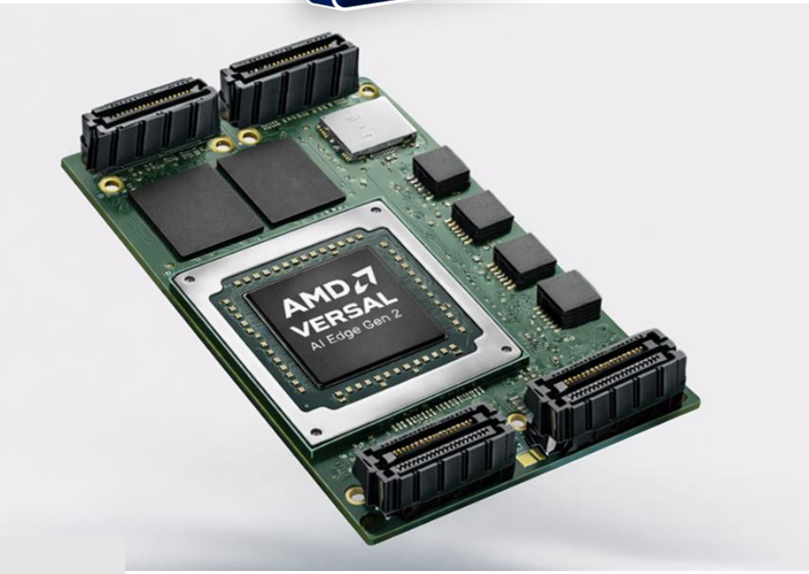
QMC

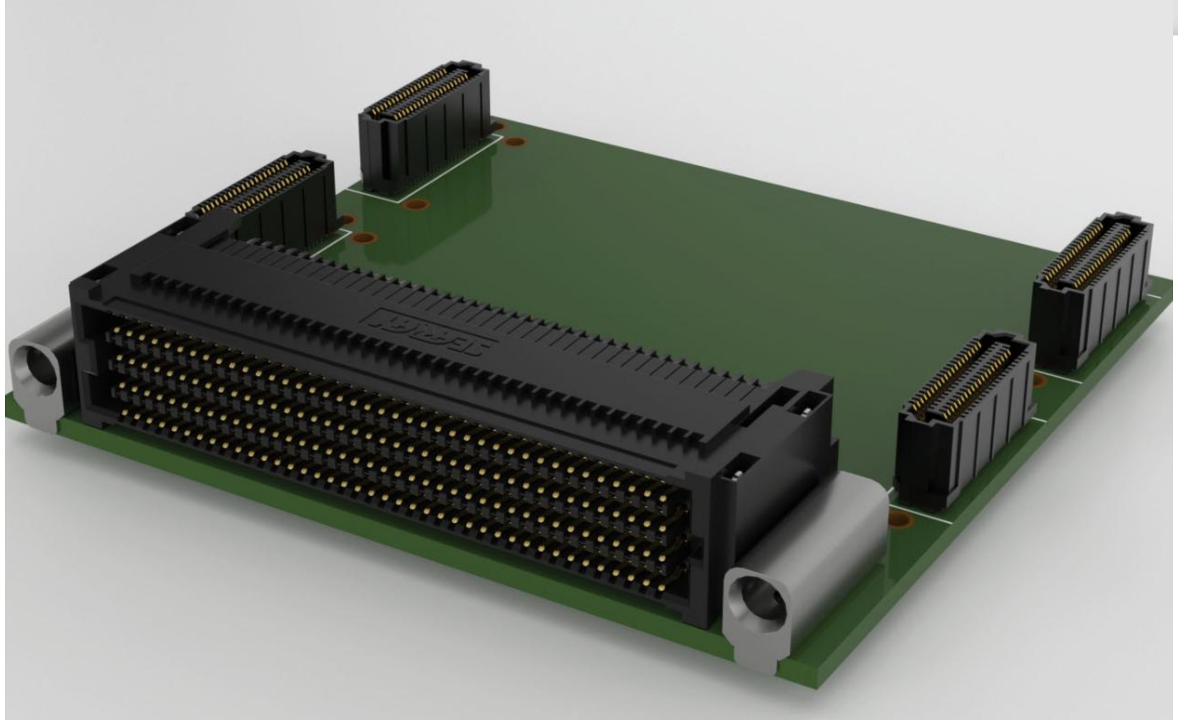


VITA 90

RS232, RS422,RS485
MILbus 1553
ADC, DAC
FPGA
Shelf Manager
Switches

VITA 93





AI accelarators
Digital I/O
ARINC 429
Media converter
....

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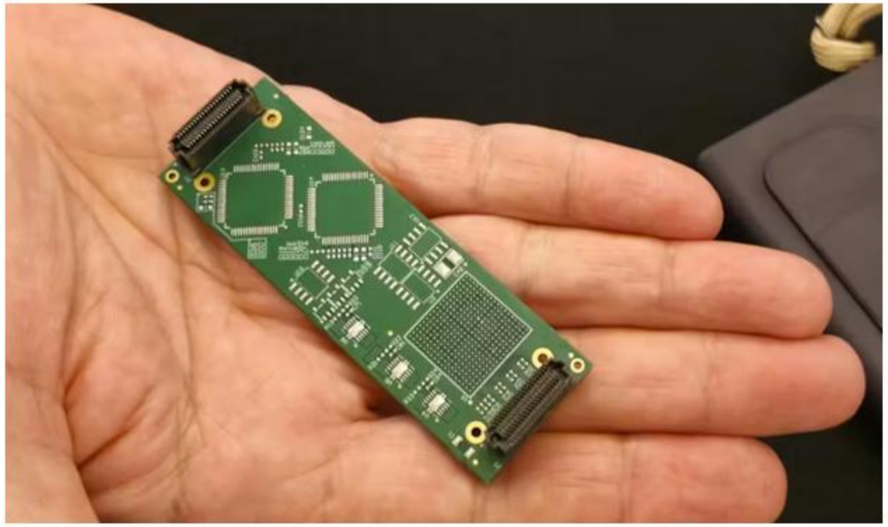
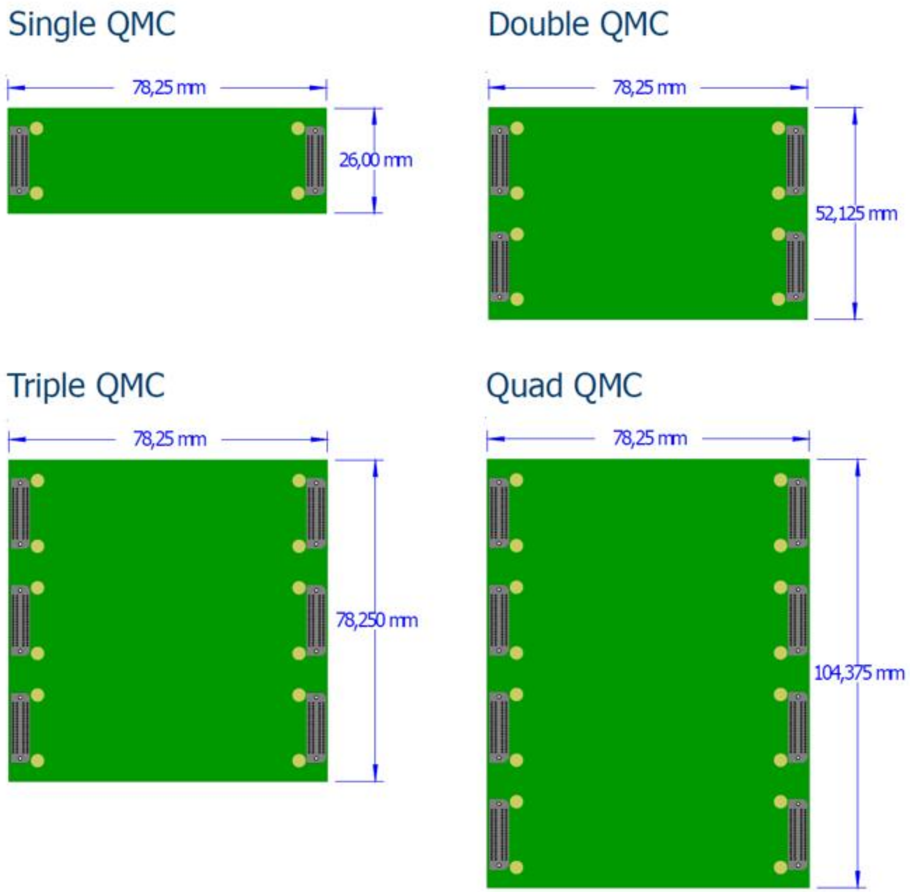
VITA 90

Building Blocks

VITA 93-Small Form Factor Mezzanine





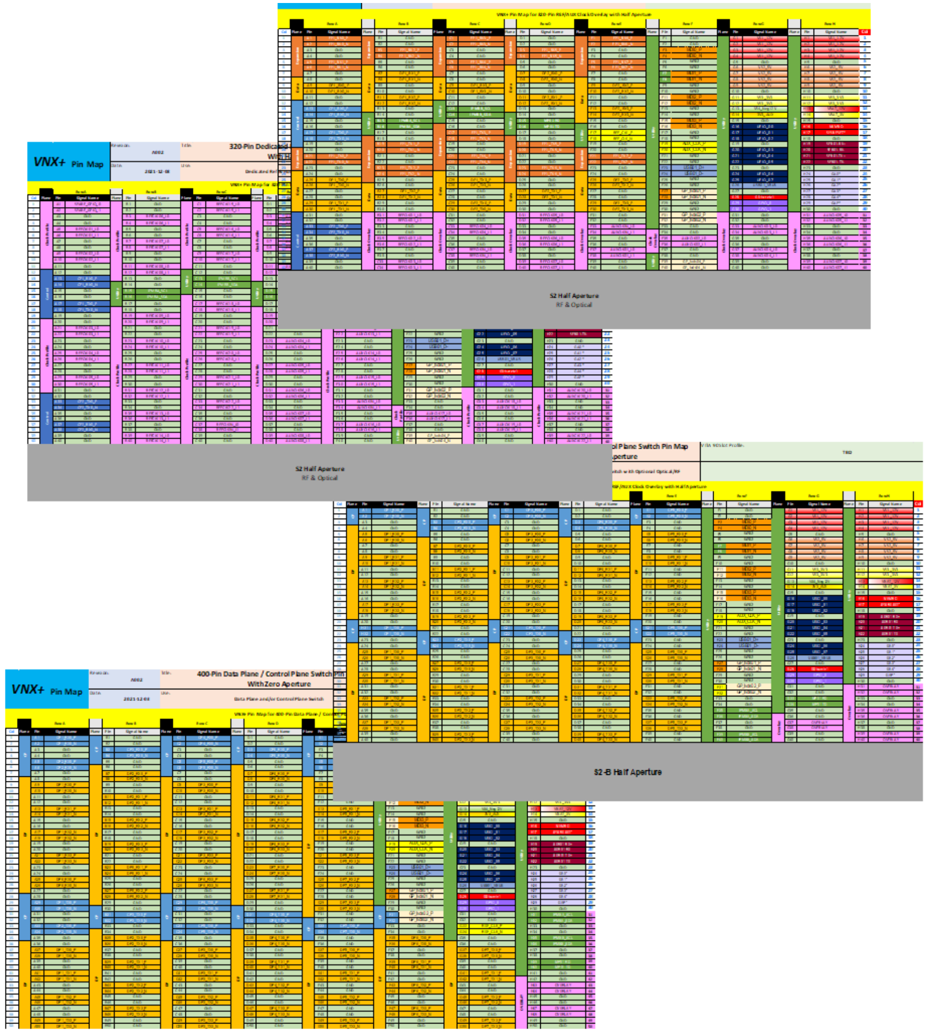
The standard scaling options of VITA 93 (QMC) include:

	PCIe	I/Os
Single QMC	x4	40
Double QMC	x8	80
Triple QMC	x12	120
Quad QMC	x16	160

VITA 90

Building Blocks

- **240 Pin Payload**
  - Although this may be removed from the SOSA standard
- **400 Pin Switch**
  - 7x Data Plane, 7x Control Plane
- **320 Pin Switch**
  - 5x Data Plane, 5x Control Plane
  - Dual MT Optical
- **7-Slot Radial Clock**
  - Based on the Payload Template
  - 7x REF_CLK/AUX_CLK pairs
- **High-density 320 pin Radial Clock**
  - Not based on the template
  - 22x REF_CLK/AUX_CLK pairs
- **400-pin and 320-pin payloads will be in the next SOSA snapshot release (including special space profiles)**



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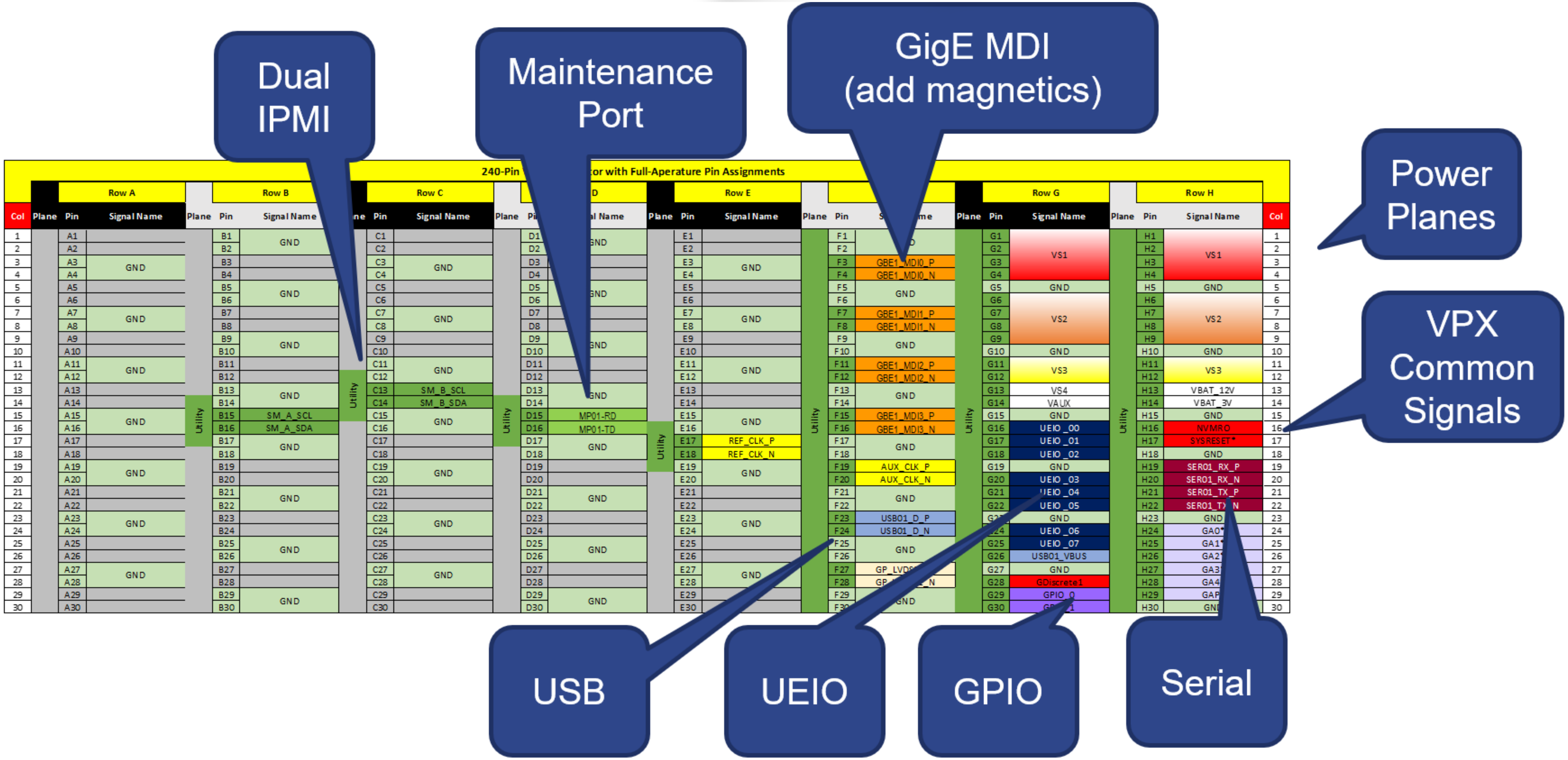
VITA 90

Building Blocks



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VITA 90

Building Blocks

- 8x Expansion Plane Lanes
- 2x FP Data Planes
- 2x UTP Control Planes
- Copper and Aperture Overlay Region

320-Pin VNX+ Connector with Half-Aperature Pin Assignments

Col	Plane	Pin	Row A Signal Name	Plane	Pin	Row B Signal Name	Plane	Pin	Row C Signal Name	Plane	Pin	Row D Signal Name
1	Expansion	A1	EP1_RX0_P	Expansion	B1	GND	Expansion	C1	EP1_RX3_P	Expansion	D1	GND
2		A2	EP1_RX0_N		B2			C2	EP1_RX3_N		D2	
		A3	GND		B3	EP1_RX2_P		C3	GND		D3	EP1_RX5_P
		A4			B4	EP1_RX2_N		C4			D4	EP1_RX5_N
		A5	EP1_RX1_P		B5	GND		C5	EP1_RX4_P		D5	GND
6		A6	EP1_RX1_N	Data	B6			C6	EP1_RX4_N	Data	D6	
7		A7	GND		B7	DP1_RX1_P		C7	GND		D7	DP2_RX0_P
8	Data	A8			B8	DP1_RX1_N	Data	C8			D8	DP2_RX0_N
9		A9	DP1_RX0_P		B9	GND		C9	DP1_RX3_P		D9	GND
10		A10	DP1_RX0_N		B10			C10	DP1_RX3_N		D10	
		A11	GND		B11	DP1_RX2_P		C11	GND		D11	DP2_RX1_P
	Control	A12			B12	DP1_RX2_N	Utility	C12			D12	DP2_RX1_N
13		A13	CP1_RX0_P		B13	GND		C13	SM_B_SCL		D13	GND
14		A14	CP1_RX0_N	Utility	B14			C14	SM_B_SDA	Utility	D14	
15		A15	GND		B15	SM_A_SCL		C15	GND		D15	MP01-RD
16		A16			B16	SM_A_SDA	Expansion	C16			D16	MP01-TD
		A17	CP1_TX0_P		B17	GND		C17	EP1_TX3_P		D17	GND
		A18	CP1_TX0_N	Expansion	B18			C18	EP1_TX3_N	Expansion	D18	
		A19	GND		B19	EP1_TX1_P		C19	GND		D19	EP1_TX5_P
20	Expansion	A20			B20	EP1_TX1_N		C20			D20	EP1_TX5_N
21		A21	EP1_TX0_P		B21	GND		C21	EP1_TX4_P		D21	GND
22		[illegible]	EP1_TX0_N		B22			C22	EP1_TX4_N		D22	
23		[illegible]	GND		B23	EP1_TX2_P		C23	GND		D23	EP1_TX6_N
24	[illegible]	[illegible]			B24	EP1_TX2_N	Data	C24			D24	EP1_TX6_N
		A25	DP1_TX0_P		B25	GND		C25	DP1_TX3_P		D25	GND
		A26	DP1_TX0_N	Data	B26			C26	DP1_TX3_N	Data	D26	
27		A27	GND		B27	DP1_TX2_P		C27	GND		D27	DP2_TX1_P
		A28			B28	DP1_TX2_N		C28			D28	DP2_TX1_N
		A29	DP1_TX1_P		B29	GND		C29	DP2_TX0_P		D29	GND
		A30	DP1_TX1_N		B30			C30	DP2_TX0_N		D30	
	Control	A31	GND	Overlay	B31	OVERLAY	Overlay	C31	GND	Overlay	D31	OVERLAY
		A32			B32	OVERLAY		C32			D32	OVERLAY
33		A33	CP2_TX0_P		B33	GND		C33	OVERLAY		D33	GND
34		A34	CP2_TX0_N		B34			C34	OVERLAY		D34	
35		A35	GND		B35	OVERLAY		C35	GND		D35	OVERLAY
36		A36			B36	OVERLAY		C36			D36	OVERLAY
37		A37	CP2_RX0_P		B37	GND		C37	[illegible]		D37	GND
38		A38	CP2_RX0_N		B38			C38	[illegible]		D38	
39		[illegible]	GND		B39	OVERLAY		[illegible]	[illegible]		D39	OVERLAY
40		[illegible]			B40	OVERLAY		[illegible]	[illegible]		D40	OVERLAY

Plane	Pin	Row E Signal Name	Plane	Pin	Row F Signal Name	Plane	Pin	Row G Signal Name	Plane	Pin	Row H Signal Name	Col
Expansion	E1	EP1_RX6_P	Utility	F1	GND	Utility	G1	VS1	Utility	H1	VS1	1
	E2	EP1_RX6_N		F2			G2			H2		2
	E3	GND		F3	GBE1_MDI0_P		G3			H3		3
	E4			F4	GBE1_MDI0_N		G4			H4		4
	E5	EP1_RX7_P		F5	GND		G5	GND		H5	GND	5
	E6	EP1_RX7_N		F6			G6	VS2		H6	VS2	6
	E7	GND		F7	GBE1_MDI1_P		G7			H7		7
Data	E8			F8	GBE1_MDI1_N		G8			H8		8
	E9	DP2_RX2_P		F9	GND		G9			H9		9
	E10	DP2_RX2_N		F10			G10	GND		H10	GND	10
	E11	GND		F11	GBE1_MDI2_P		G11	VS3		H11	VS3	11
	E12			F12	GBE1_MDI2_N		G12			H12		12
	E13	DP2_RX3_P		F13	GND		G13	VS4		H13	VBAT_12V	13
	E14	DP2_RX3_N		F14			G14	VAUX		H14	VBAT_3V	14
	E15	GND		F15	GBE1_MDI3_P		G15	GND		H15	GND	15
Utility	E16			F16	GBE1_MDI3_N		G16	UEIO _00		H16	NVMRO	16
	E17	REF_CLK_P		F17	GND		G17	UEIO _01		H17	SYSRESET*	17
	E18	REF_CLK_N		F18			G18	UEIO _02		H18	GND	18
	E19	GND		F19	AUX_CLK_P		G19	GND		H19	SER01_RX_P	19
Expansion	E20			F20	AUX_CLK_N		G20	UEIO _03		H20	SER01_RX_N	20
	E21	EP1_TX7_P		F21	GND		G21	UEIO _04		H21	SER01_TX_P	21
	E22	EP1_TX7_N		F22			G22	UEIO _05		H22	SER01_TX_N	22
	E23	GND		F23	USB01_D_P		G23	GND		H23	GND	23
Data	E24			F24	USB01_D_N		G24	UEIO _06		H24	GA0*	24
	E25	DP2_TX2_P		F25	GND		G25	UEIO _07		H25	GA1*	25
	E26	DP2_TX2_N		F26			G26	USB01_VBUS		H26	GA2*	26
	E27	GND		F27	GP_LVDS01_P		G27	GND		H27	GA3*	27
	E28			F28	GP_LVDS01_N		G28	GDiscrete1		H28	GA4*	28
	E29	DP2_TX3_P		F29	GND		G29	GPIO_0		H29	GAP*	29
	E30	DP2_TX3_N		F30			G30	GPIO_1		H30	GND	30
Overlay	E31	GND	Utility	F31	GP_lvds03_P	Overlay	G31	GND	Overlay	H31	OVERLAY	31
	E32			F32	GP_lvds03_N		G32			H32	OVERLAY	32
	E33	OVERLAY		F33	GND		G33	OVERLAY		H33	GND	33
	E34	OVERLAY	Overlay	F34			G34	OVERLAY		H34		34
	E35	GND		F35	OVERLAY		G35	GND		H35	OVERLAY	35
	E36			F36	OVERLAY		G36			H36	OVERLAY	36
	E37	OVERLAY		F37	GND		G37	OVERLAY		H37	GND	37
	E38	OVERLAY	Utility	F38			G38	OVERLAY		H38		38
	E39	GND		F39	GP_lvds04_P		G39	GND		H39	OVERLAY	39
	E40			F40	GP_lvds04_N		G40			H40	OVERLAY	40

S2-B Half Aperture

RF & Optical

FHI Federatie van technologiebranches

System Platforms

Natural convection cooling

Forced air cooling

Test systems

FlexNX+
ELMA
Your Solution Partner

D&E event

SOSA
Sensor Open Systems Architecture

System Platforms

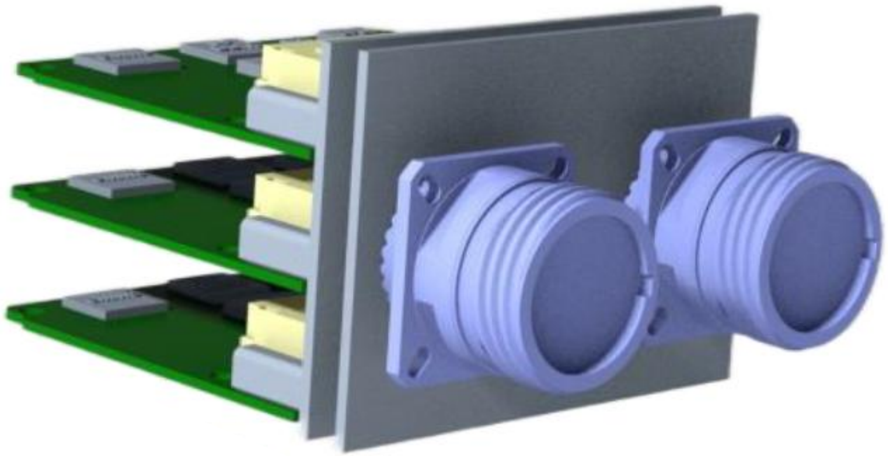
We know that program requirements are not one-size-fits-all. Therefore, we offer a range of precision solutions tailored to meet specific performance and SWaP-C targets.

Certus Evo:

System Platforms

Rear loader

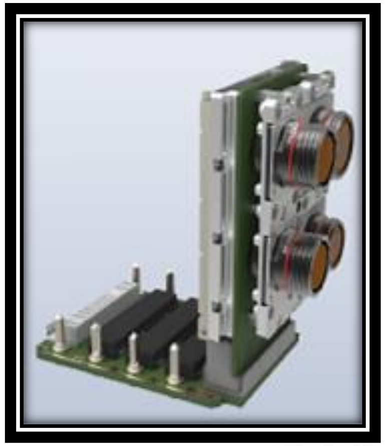
Pros	Cons



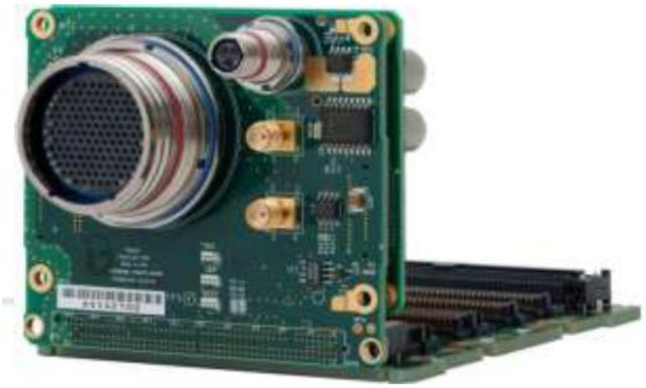
SOSA™
Sensor Open Systems Architecture

System Platforms

Top loader
I/O board connected either with a 90° connector or straight



Pros	Cons



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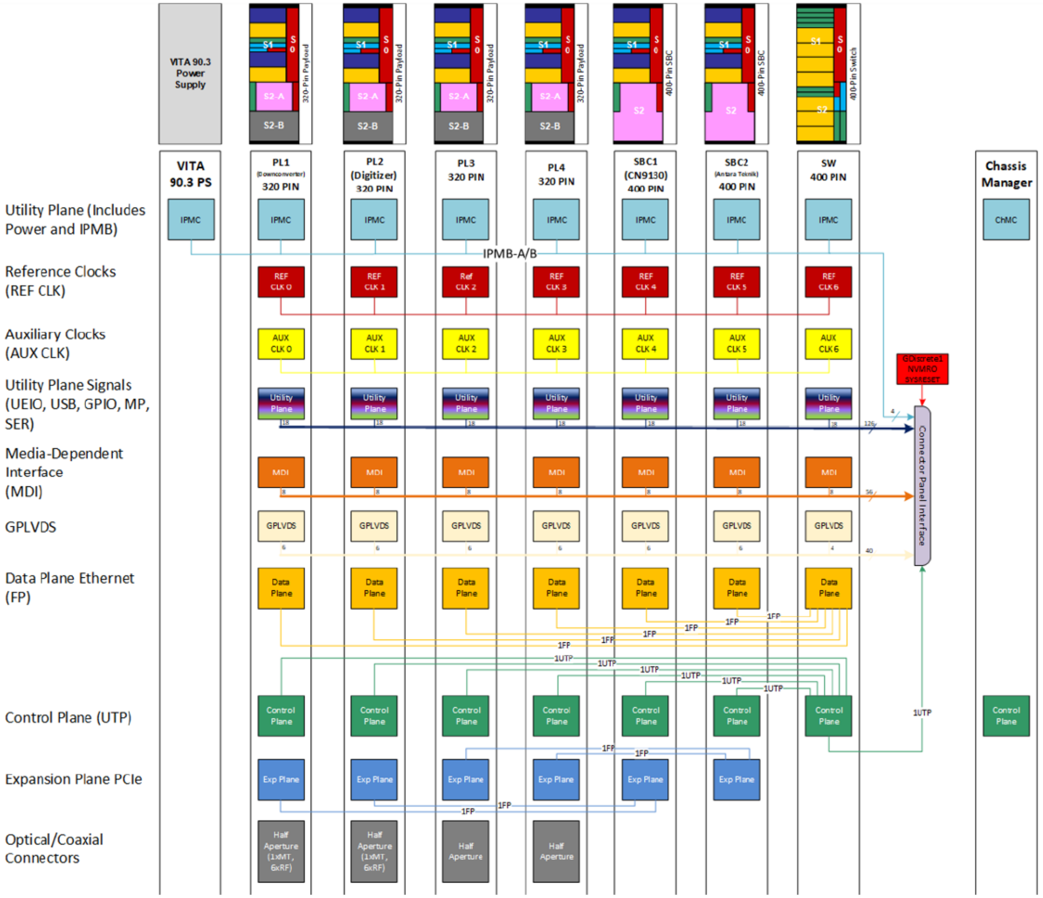
VITA 90

System Platforms



D&E event

SOSA Sensor Open Systems Architecture

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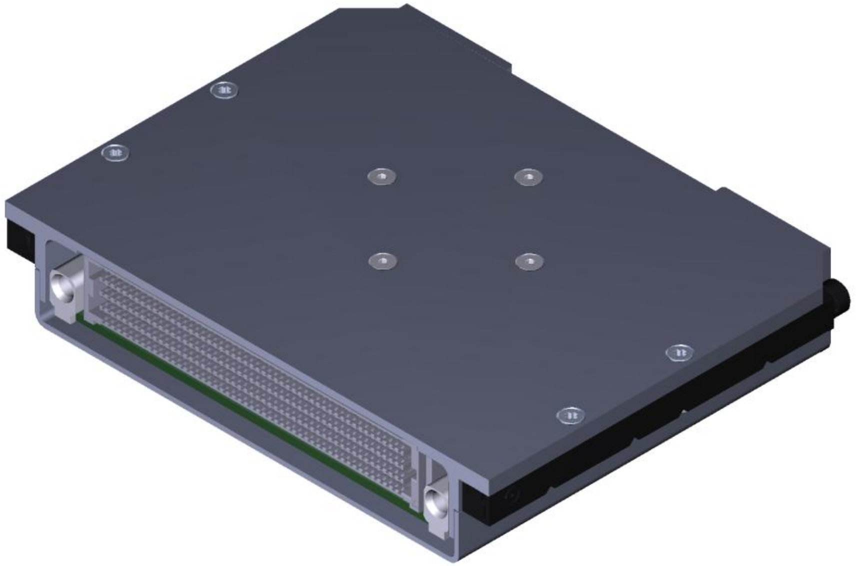
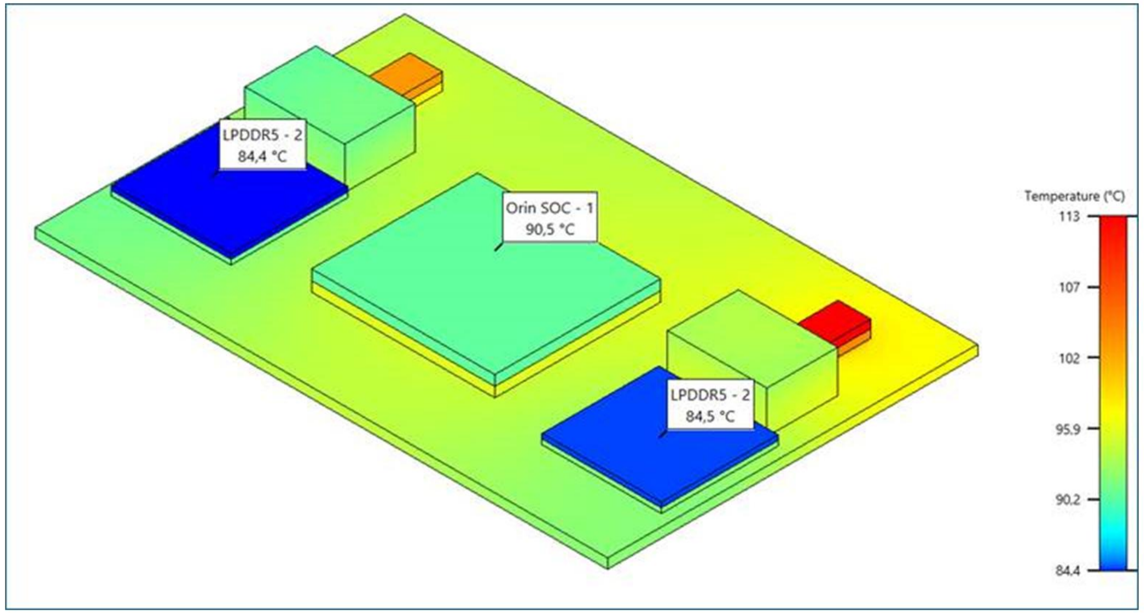
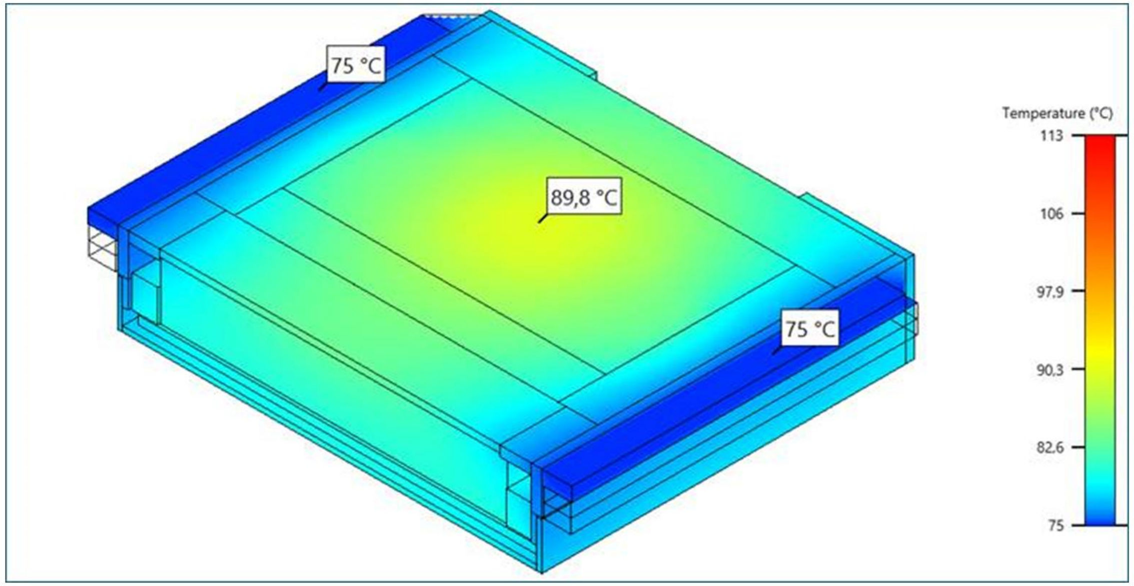
VITA 90

Cooling



Jetson Orin NX 16GB Thermal Performance for 25 W Operational Mode





D&E event

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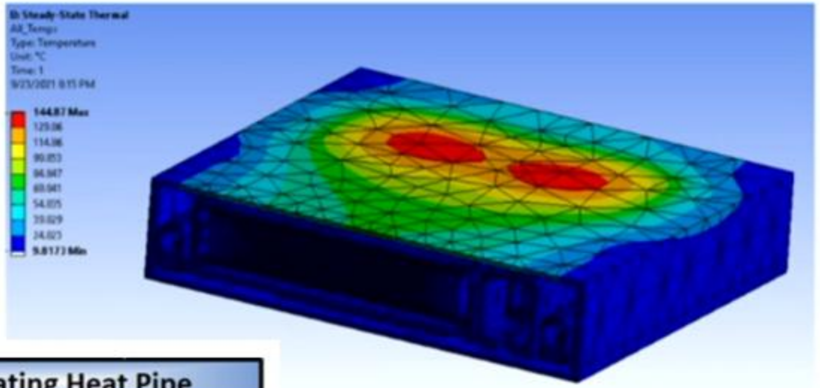
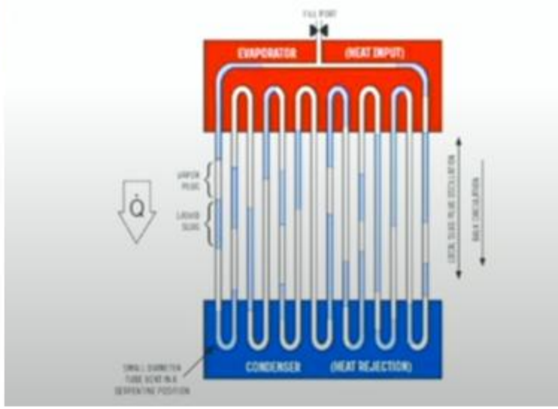
VITA 90

Cooling

- 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.





Collins Aerospace

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

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VITA 90

Summary

To take with

VNX+

- is an edge computer
- Is very tiny
- Is low to high performance computer- depending on the cooling
- Part of SOSA
- Has already a big community

D&E event

Where to Apply VNX+?

MODULAR OPEN SYSTEMS APPROACH

Answer: most SWaP-constrained environments requiring high-performance computing and I/O – i.e. SOSA-type systems

- Autonomous ground vehicles
- 360° situational awareness systems
- Active protection systems
- SIGINT/EW
- Software defined radios
- Network processors

SOSA Sensor Open Systems Architecture

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