FRONTGRADE

A GRADE ABOVE

Mission Processing MAMBA

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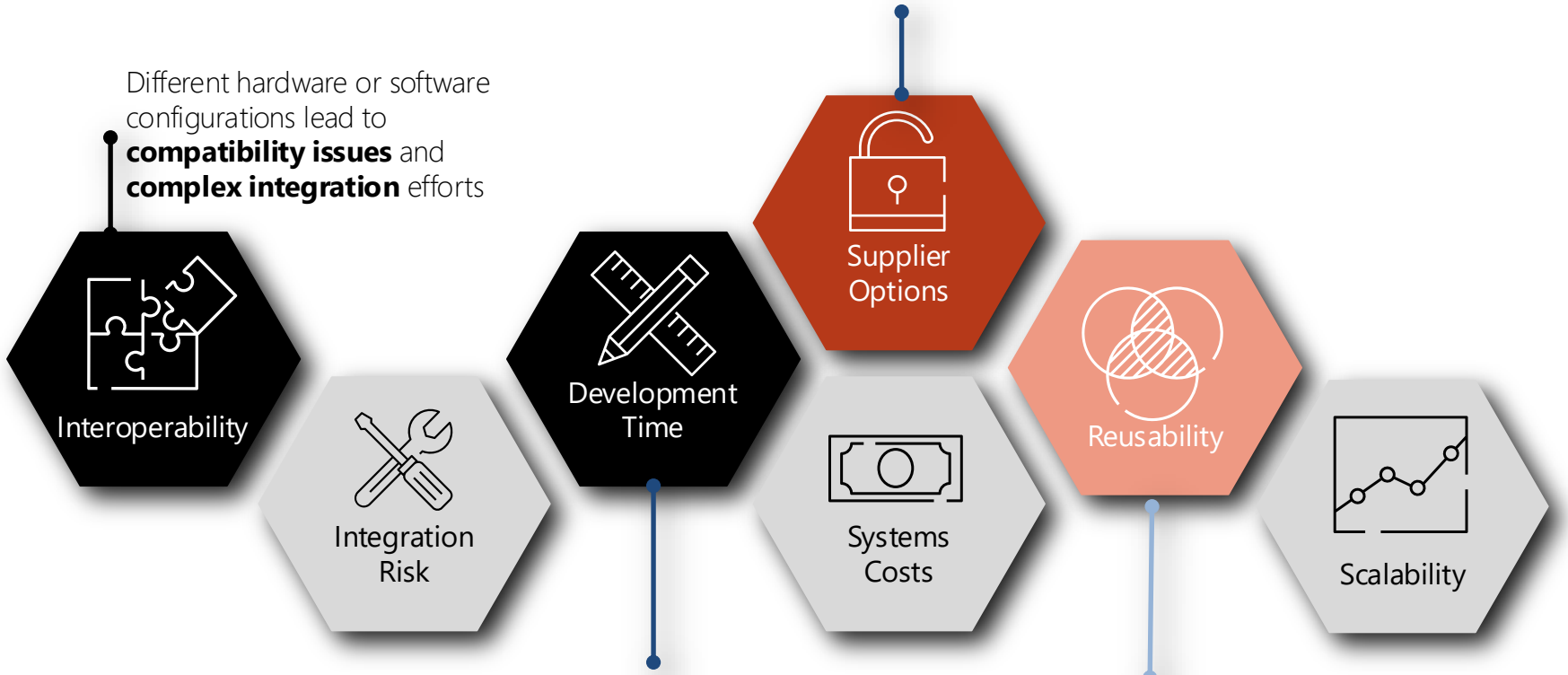
Industry Pain Points

Restricted to a **limited pool of suppliers** potentially **limiting competition** and increasing costs

Different hardware or software configurations lead to **compatibility issues** and **complex integration** efforts



Custom configurations lead to **delayed mission timelines** due to the need for **custom engineering**, unique documentation, and **specialized testing**

Absence of standard processing environment makes it **harder to reuse hardware or software** components across missions

Ideal Capabilities

Multi-mission

Multi-domain

Sensor Agnostic

Reconfigurable

Open Interfaces

Software Defined

Mature Dev Environment

High Mission Assurance

Speed to On-Orbit

The MAMBA Solution

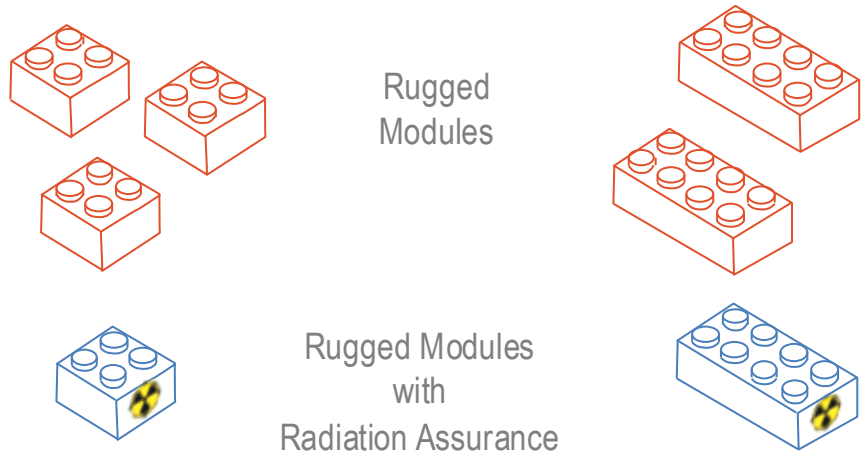
MAMBA

Modular Aproach for Mission Processing with Bifurcated Architecture

MAMBA is Frontgrade's multidomain Mission Processing Architecture. It addresses the 3-fold challenges of **Time-to-develop**, **Cost-to-develop** and **Scalability** of multi-domain operations with assets in Space, in the Air, on the Ground and at Sea

MAMBA is a scalable LEGO like architecture leveraging Frontgrade's portfolio breadth from RF integration to multicore and re-configurable mission processors.

MAMBA is a single architecture that addresses all domains with additional Fault Tolerance and Radiation Assurance when critically needed.



ANSI VITA-90 VNX+ for cost effective SFF applications

→ SmallSat Payloads
→ CMOSS / C5ISR

ANSI VITA-78 3U SpaceVPX for higher performance and Fault Tolerant applications

→ Satellite Payloads (5G, SAR, .)
→ S/W defined EW/SIGINT/Radar

Features

- Modular, industry standard system building blocks
- Industrry leading muti-core CPUs, AI enabled FPGAs and network processors
- Conduction cooled
- Quantified COTS "Q-COTS"
- Rad Tolerant options

Applications

- C5ISR/SOSA integration
- Digital Radioheads
- Reconfigurable mission systems and avionics
- Satellite payloads
- Radar / SIGINT / EW
- Unmanned Systems

Capabilities

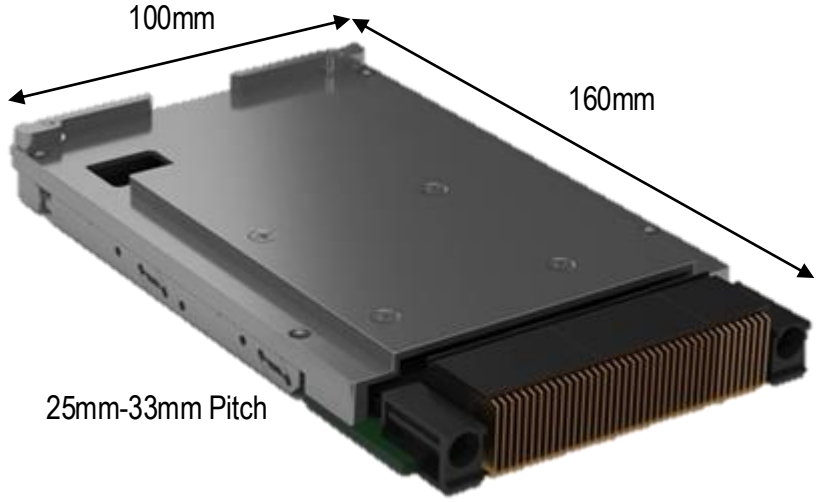
- Enables rapid system development & deployment

Domains

Network enabled processing that seamlessly operate across Land/Air/Sea/Space domains

VPX / VNX+ Form Factors

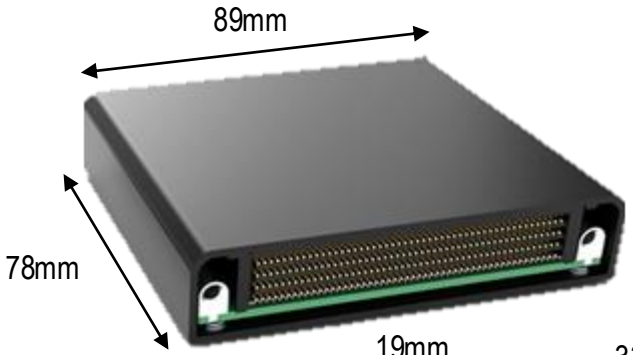
VITA 78.0 SpaceVPX

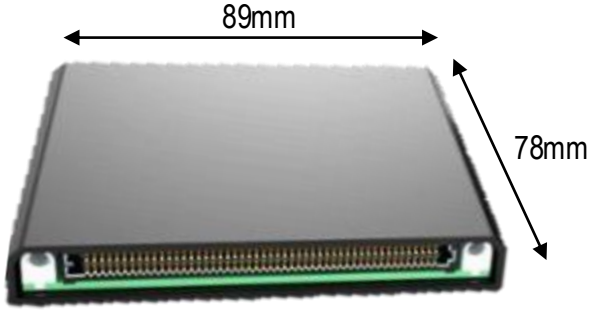


- I/O Speed 10-16Gbps
  - Moving to 28Gbps
- Thermal 200W+

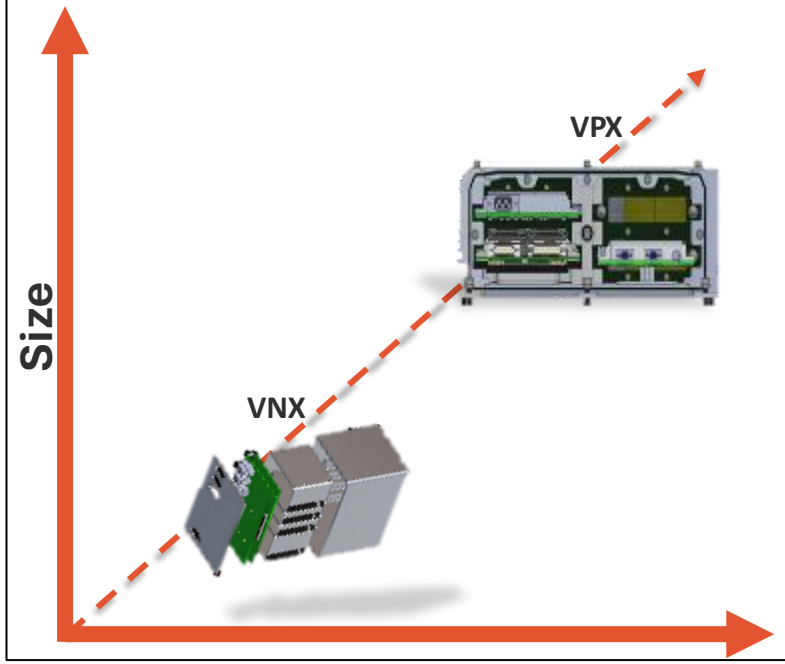
Example Chassis

VNX+ (VITA 90.x)





Additional 33mm, 39mm



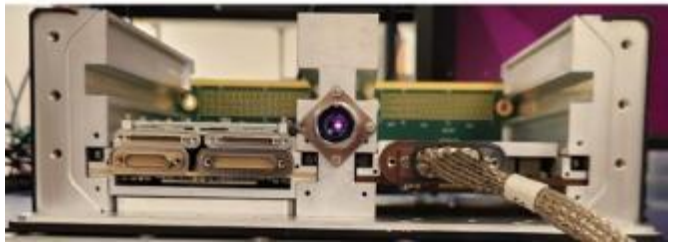
- Thermal Up to 95W
- Fits 5” Tube Diameter & 100mm CubeSat

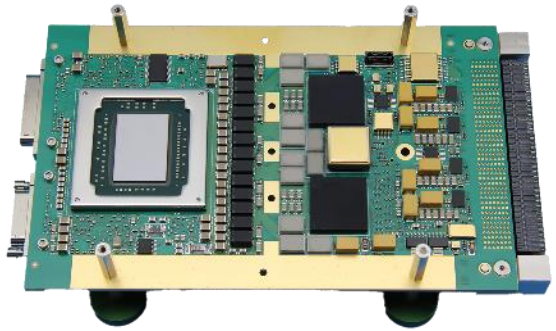
Example Chassis

FRONTGRADE

MAMBA: Scalable, Modular, Extensible Architecture

SpaceVPX Larger FF
(VITA 78.0)





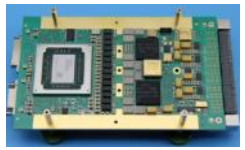
- Subsystem Boxes
- Power Supplies
- Single Board Computers
- Versal Reconfigurable Modules
- Ethernet I/F Modules
- RF Modules
- Storage Modules
- System Controller Modules

VNX+ Small FF
(VITA 90.0)

MAMBA Modules View: ITAR free!

Mission Processing

SpaceVPX RPM (VC1902 ACAP Module)
- 16GB DDR4
- 128GB NAND
- 128MB-1GB MRAM Boot
- Mezz & BP with 16 GTYs ea.


RPM-SVPX

RPM I/O Mezzanine
- XMC+ Daughter Card
- 4x SpW, 5x 1GbE-T
- 3x RS-422 In, 1x RS-422 Out
- 3x LVDS In, 1x LVDS Out
- 1x SE Input, 4x SE Outputs


IOM-SVPX

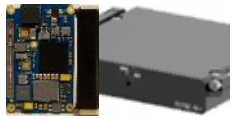
SpaceVPX E-net Phy Module
- 8 Channel
- FP: 1G to 10GBASE-T
- BP: SGMII-USXGMII


SEIM-SVPX

SpaceVPX L-Band RF Module
- AD9176S 12.6GSPS 16bit DAC
- AD9213S 10.3GSPS 12bit ADC
- 2x8 JESD204B connections


SRFM-SVPX

VNX+ RPM (VE2302 AI Edge Module)
- 8GB DDR4 + 8b SECDED
- 32GB e.MMC 5.1 Storage
- BP: PCIe 3.0, 4x 10Gbase-KR 8x JESD204-C, RS422, others


RPM-VNX+

VNX+ RF Front End
- TI AFE7950, L-Band 1GHz-2GH
- 2x RX ADC & 2x TX DAC


RFFE-VNX+

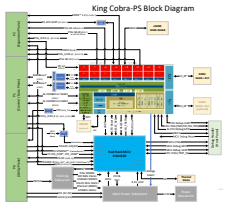
SBCs & Storage

SpaceVPX & VNX+ SBC2A72 (NXP LS1028/Vorago VA7230)
- Dual Arm Cortex A72
- Graphics Acceleration Unit
- 15K DMIPS / 10 DP GFLOPs
- 32GB e.MMC 5.1 Storage
- 128MB-1GB MRAM Boot
- PCIe 3.0, 4x 1GbE TSN, 4x 6.25 SERDES (SPVX), USB 30, DisplayPort 1.3, etc.


SBC2A72-SVPX

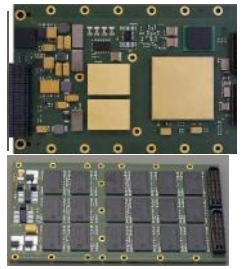

SBC2A72-VNX+

SpaceVPX & VNX+ SBC16A72 (NXP LX2160)
- 16 Arm Cortex A72
- 200k DMIPS
- Up to 32GB DDR4
- 32GB e.MMC 5.1 Storage
- 3x PCIe 3.0 x4, 6x 10GBase-KR 2x 25GBase-KR, 2x 1GbE-TX USB 3.0, RS-422, SpW, GPIO



SBC16A72-SVPX

SpaceVPX SpaceStor MMU
- 1.33TB – 3.97TB Capacity
- SpW Command & Control
- Redundant PCIe 2.0 x4 Data
- 4Gbps aggregate data rate
- Supports File System
- Robust ECC and Fault tolerance


SSMMUxxT-SVPX

SpaceVPX SimpliStor Recorder
- 2.5TB Capacity
- 1GbE-TX Command & Control
- 10GBase-KR Data
- Simple UDP Protocol
- Network Attached Storage (NAS)


SSDR2.5T-SVPX

Power

SpaceVPX 28V Power Supply
- 28V (22V-36V) Input
- 12V Output
- 1 unsw, 6 switched
- 150W nom / 240W peak
- Isolated input with EMI filtering
- >90% Efficient


PSM28-SVPX

VNX+ 28V Power Supply
- 28V (22V-36V) Input
- 12V Output & 3.3V Aux
- 1 unsw, 2 switched
- 150W peak
- Isolated input with EMI filtering
- >90% Efficient


PSM28-VNX+

Europe Focus

MAMBA with Gaisler

Phased approach to support Europe

- Gaisler storefront for ITAR free MAMBA Products
- Built, tested and supported in Europe
- Gaisler designed modules

Benefits

- European Strategic Sovereignty
- Contracting with European entity
- Mitigates impacts of US policy change

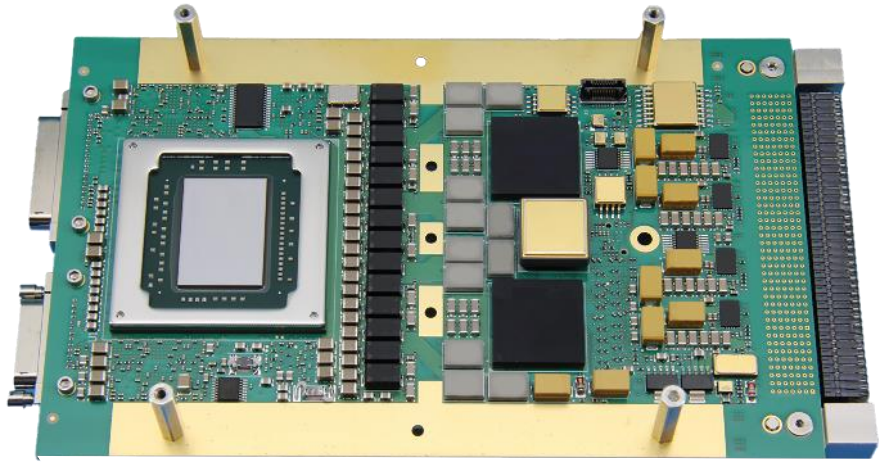
MAMBA Products Overview

RPM-SVPX : ITAR free!

3U SpaceVPX Reconfigurable Processing Module

In a 3U SpaceVPX form-factor, the RPM-SVPX is the most compact, conduction cooled, Versal VC1902 ACAP SoC module on the market. With 16GB of user DDR4, local non-volatile storage and XMC+ mezzanine for I/O expansion, the RPM-SVPX is a powerful, high-performance, reconfigurable mission processing solution for multiple Payload and Sensor fusion workloads

> Frontgrade's RPM-SVPX is designed for reconfigurable edge processing applications requiring low latency and high throughput on heterogeneous workloads (state/vector/parallel).
>
> Its innovative thermal design delivers Versal performance for compact conduction cooled systems



Delivering

- EM: 8-12wk ARO
- Flight: 3Q 2026

Features

- 3U 160mm VPX module
- Versal ACAP VC1902 SoC
- 16GB 2400MT/s DDR4
- 8Gb Dual QSPI MRAM
- Up to 150GB UFS mounted NAND flash
- XMC+ user I/O expansion
- 16x 10Gbps SERDES lanes
- 8x 10.3125Gbps USXGMII
- 125W power (max)
- Conduction cooled
- TID >30krad / ndSEL > 40

Applications

- 5G NTN and regen payloads
- On orbit SIGINT and image classification

Capabilities

- User I/O mezzanine for expansion / host platform integration

Domains

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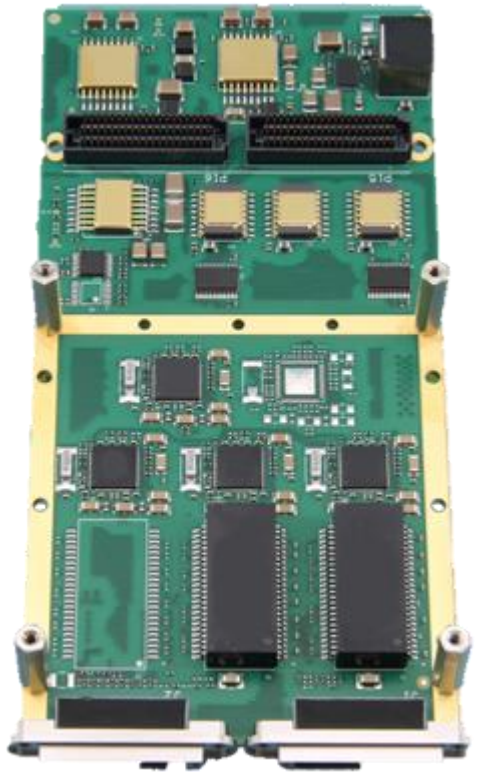
IOM-SVPX: ITAR free!

3U SpaceVPX I/O Mezzanine Card

IOM-SVPX is an XMC+ I/O Expansion Mezzanine daughter card designed to plug onto the Frontgrade 3U SpaceVPX RPM-SVPX, to provide additional front panel interfaces beyond those of the host module.

Frontgrade's IOM-PS provides additional ports and front panel connectivity for 100/1000BaseT Ethernet, SpaceWire, RS422, LVDS and LVTTL / LVCMOS.

Its daughter card format is ideal for host platform integration without consuming VPX backplane slots



Delivering

- EM: 8-12wk ARO
- Flight: 4Q 2026

Features

- XMC+ daughter card
- Discrete Inputs
  3 LVDS, 3 RS-422,
  1 LVTTL/LVCMOS
- Discrete Outputs
  1 LVDS, 1 RS-422,
  4 LVTTL/LVCMOS
- 4 SpaceWire up to 200Mbps
- 5 100Base-TX/1000Base-T PHYs with RGMII to RPM
- 7W Power (max)
- TID >30krad / ndSEL > 40

Applications

- GNC processors
- Host platform integration
- Intra-system C2

Capabilities

- Flexible interface solution via front panel connections to access the VC1902

Domains

FRONTGRADE

PSM28-SVPX : ITAR free!

3U SpaceVPX Power Supply Module

PSM28-SVPX combines within a single module a high efficiency VITA 78.0 power supply and 6-channel Power Supply Switch profiles to create a main, unswitched, 12V rail with 6 additional switched 12V rails for other cards. Each rail supports up to 100W continuous power. For additional power, 2 modules can operate in parallel.

Frontgrade's PSM28-SVPX is a cutting edge PSU designed for demanding multi-card edge processing applications requiring fault protection and EMI filtering.

It's radiation tolerant system controller provides health status and telemetry and management for switched output rails

Delivering

- EM: 8-12wk ARO
- Flight: 4Q 2026

Features

- 3U 160mm VPX module
- 150W nominal / 240W peak
- >90% Efficiency
- 28V (22V to 36V) Vin range
- 7x 12V VS1 outputs
  1x unswitched, 6x switched
- Conduction cooled
- TID >30krad / ndSEL > 37
- MIL-STD-461G

Applications

- Multi-module satellite payloads
- Deep Space Missions

Capabilities

- Table-stakes building block for SpaceVPX systems
- Parallel operation for additional load capacity
- Ensures mission continuity, via power cycling rails

Domains

FRONTGRADE

SBC16A72-SVPX : ITAR free!

3U SpaceVPX 16-Core ARM A72 Single Board Computer

SBC16A72-SVPX is an ultra high-performance, Single Board Computer (SBC) boasting 200k DMIPS performance for advanced payload compute and on-board processing applications with high data rate networking requirements

Frontgrade's SBC16A72-SVPX delivers extreme compute capability with manifold high-bandwidth communication interfaces in a standard 3U SpaceVPX conduction cooled module

It features 16x 2.2GHz ARM A72 cores capable of 200k DMIPS aggregate performance, making the SBC ideal for compute intensive applications

Delivering

- EM: 3Q 2026
- Flight: 1Q 2027

Features

- 3U 160mm VPX Module
- NXP LX2160 processor w/ 16 ARM A72 cores
- 200K DMIPS@ 2.2GHz
- 6x 10Gbase-KR ports
- 2x 25Gbase-KR ports
- 4x PCIe G3 x4 Ports
- 8x 6.25Gbps & PCIe 3.0 x1
- 2x 1000Base-T Ehernet
- 16GB ECC DDR4 1600MT/s * Option for 32GB DDR4
- 32GB eMMC 5.1
- TID 30-50krad / nd-SEL >37

Applications

- Imaging & EO/IR payloads
- 5G NTN
- HP Data Handling and OBC

Capabilities

- High performance compute
- Extensive Networking

Domains

FRONTGRADE

SSDRG12T-SVPX (SimpliStor) : ITAR free!

High-performance, 2.5TB Solid State Data Recorder

The SSDRG12T-SVPX is a space-qualified, high-density, high-throughput, solid-state data recorder which is available with 2.5TB of storage. It is optimized for long, continuous data streams in SWaP-optimized form factor.

Part of the MAMBA offering, the SSDRG12T-SVPX is a next-generation, radiation-tolerant data recorder designed specifically for modern space missions that demand high-capacity and high-throughput data storage.

Ideal companion storage for Frontgrade RPMs and SBCs

Delivering
- EM: 1Q 2026
- Flight: 3Q 2026

Features
- 2.5 TB of storage
- SLC-mode flash
- 10Gbase-KR Data link
- 33 mins record at 10Gbps
- UDP protocol
- Erase-Store-to-Full policy
- Low latency, 100us

Applications
- EO/IR data buffering
- Scientific data collection
- ISR
- LEO/GEO satellites
- Deep space data logging

Capabilities
- Network Attached Storage solution with simple data transaction protocol.
- Includes PCIe express side-band option for local processing

Domains

SBC2A72-VNX+ : ITAR free!

Dual-Core ARM A72 VNX+ Single Board Computer

SBC2A72-VNX+ is a high-performance, low-power Single Board Computer (SBC) designed for SWAPC constrained edge computing and graphics applications.

Frontgrade's SBC2A72-VNX+ delivers exceptional compute and interface capabilities in a 19mm VNX+ conduction cooled module

It features dual 1.5GHz ARM A72 cores with integrated GPU for graphics, AI and other Command & Control (C2) workloads with low-latency, tightly coupled processing.

Delivering

- EM: 1Q 2026
- Flight: 3Q 2026

Features

- 19mm VNX+ Module
- Vorago VA7230 / LS1028A w/ dual 1.5GHz ARM A72 cores and GPU Accelerator
- 15K DMIPS / 10.4 GFLOPS
- TSN enabled Ethernet
- 8GB ECC DDR4 1600MT/s
- 32GB eMMC 5.1
- -20C to +65C Operation
- Conduction Cooled
- TID 30-50krad / nd-SEL >37

Applications

- Robotics & Motion Control, Effectors
- HMI for rugged C2, Avionics Real Time Secure Edge

Capabilities

- Versatile processor for multiple applications

Domains

FRONTGRADE

SDRKa2L-VNX+ : ITAR free!

VNX+ L-Band to Ka-Band Software Defined Radio

SDRKA2L-VNX+ is an advanced, modular VNX+ SDR communications platform engineered for high-throughput data processing, real-time signal conditioning and mission adaptability from terrestrial UAS to LEO and GEO constellations.

Frontgrade's VNX+ SDR integrates PSU, RF ADC/DAC & signal conditioning and Versal FPGA. It is a highly capable SDR platform with 1GHz IBW, 25W SSPA providing coverage from L to Ka-Band with configurable up/down conversion.

Its small form factor is ideal for SWAPC constrained missions in harsh contested domains.

Delivering

- EM: 3Q 2026
- Flight: 1Q 2027

Features

- VNX+ chassis, <3kg
- -25C to +65C Operation
- 30GHz-40GHz Ka-Band
- 1GHz-2GHz L-Band
- ALC & Power Detect
- TID 30-50krad / nd-SEL >37

Applications

- LEO to GEO Satcom regenerative payloads
- UAS Data Links
- Tactical Edge ground stations
- Airborne C2 Platforms
- EW & Spectrum Operations

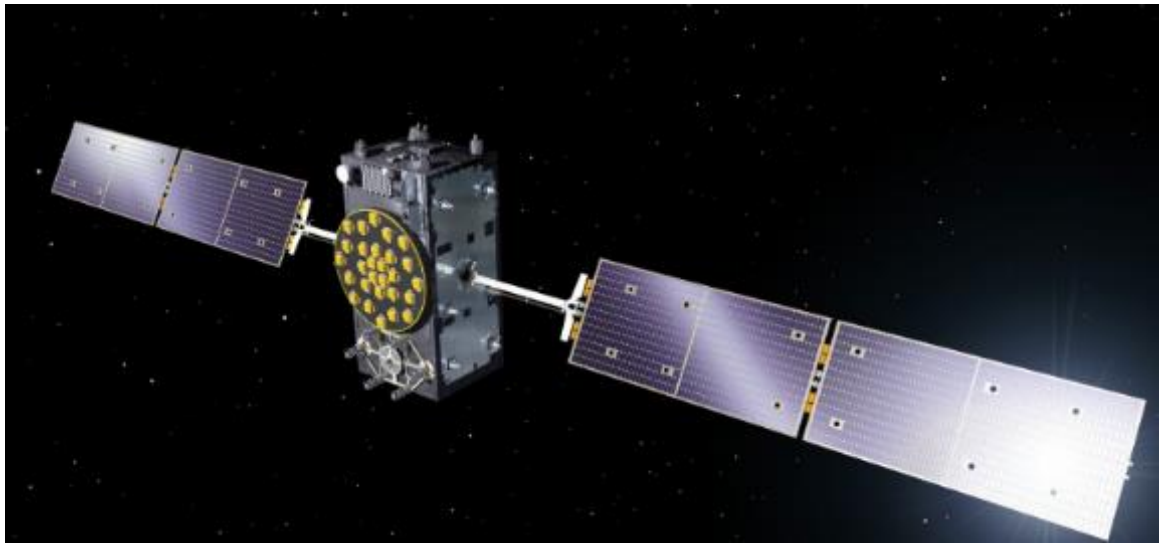
Capabilities

- Small form factor SDR platform enabling user's to conveniently implement their custom waveform processing algorithms

Domains

Take Away

Take Away



- Suite of Mission Processing modules achieved high TRL
- ITAR free
- VPX / VNX architectures supporting multi domain operations
- Gaisler storefront of U.S. MAMBA modules
- Roadmap for Made in Europe MAMBA modules

Thank You