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VITA 90-VNX+

A NEW CHAPTER IN DEFENSE & AEROSPACE

DESIGN > DEVELOP > DEPLOY

WHITE PAPER

EST. 1972 50+ Years

How VITA 90-VNX+ enables a new chapter for Defense, Aerospace, and Edge AI

Examining how the VITA 90-VNX+ group of standards will bring high-density computing power to SWaP-C² constrained environments

VITA 90-VNX+ (VNX+ for short) is a group of small form factor (SFF) computing modules and back-plane standards developed by the VMEbus International Trade Association (VITA). Already referenced in industry and consortium documents and in the latest Snapshot of the Sensor Open Systems Technical Standard (SOSA®) standard, VNX+ holds substantial promise for **SWaP-C²** constrained military and aerospace applications (such as UAVs, sensor pods, and edge AI) and serves as an evolution of the prior VITA 74 (VNX) standard.

In this whitepaper, we will undertake an explanation of the specifications of the VNX+ standard, while additionally exploring the historical context of the standard, potential applications in traditional and emerging fields, an examination of SOSA TS alignment, and venturing an outlook on the standard's applications.

OVERVIEW

Like VITA 74-VNX before it, the nomenclature "VNX+" is often used synonymously with "VITA 90" to refer to these small form factor plug-in module systems for rugged embedded computing.

This emerging small form factor standard, whose smallest modules are roughly the size of a deck of cards (78 x 89 x 19 mm), represents an improvement on computing ability and thermal/power management in comparison to VITA 74 (VNX) while maintaining a size advantage when compared to previous, larger systems (like 3U OpenVPX) in **SWaP-C²** constrained environments.

VNX+ introduces a higher-density, higher-performance modular architecture. Its updated interconnect scheme supports greater signal integrity and bandwidth, while expanded module sizes and improved thermal and power management enable the integration of more capable processors (such as Intel® and NVIDIA®) and radio frequency (RF) payloads.

This makes the standard—and its superior scalability and ruggedization—an improvement over models not only in current use for traditional **SWaP-C²** constrained applications, but for emerging use cases as well, such as in edge AI applications.

We will begin our exploration with an in-depth look at the specifications of VNX+, in their current form as developed by VITA.

DESCRIPTION AND SPECIFICATIONS

This section provides an overview of the VITA Standards Organization, the VITA 90 (VNX+) family of standards, and the key mechanical, electrical, and architectural characteristics that define the platform.

About VITA

Founded in 1982 as the VMEbus Manufacturers Group, VITA is an industry standards organization that develops open specifications for embedded computing systems, particularly for defense, aerospace, and industrial applications. Best known for standards like VPX (VITA 46), OpenVPX, and newer small-form-factor efforts such as VNX+ (VITA 90), VITA focuses on interoperability, ruggedization, and high-performance modular architectures that enable multi-vendor ecosystems and long-lived system designs.

About the VITA 90 (VNX+) family of standards

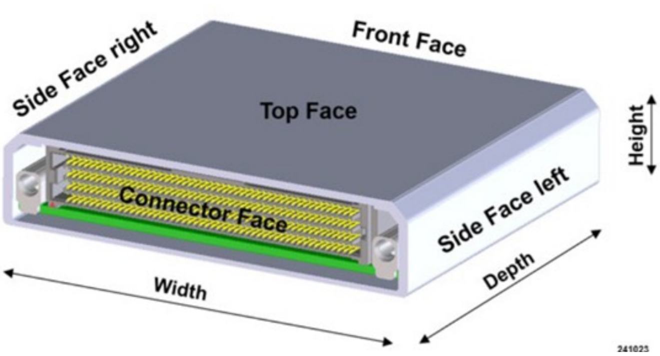
VITA defines the VNX+ small-form-factor modular computing architecture. Rather than a single document, it is a coordinated family of specifications covering mechanical, electrical, thermal, and system-level design.

Current components of the VITA 90 family include:

- **VITA 90.0 VNX+ Base Standard**
- **VITA 90.1 VNX+ Profile Tables**
- **VITA 90.2 VNX+ VDSTU – VNX+ Optical and RF**
- **Connector Modules – Type 2 (Trial Use)**
- **VITA 90.3 VNX+ Power and Storage Modules**
- **VITA 90.4 VNX+ Cooling and Mounting**
- **VITA 90.5 VNX+ Space Use Considerations**
- **VITA 90.7 VNX+ Optical and RF Modules Type 7**

Together, these documents define not only the physical module format, but also how systems are powered, cooled, interconnected, and deployed across terrestrial and space platforms.
The "flagship" 19mm VNX+ module is the size of a deck of playing cards, at standard height.
The standard also features optimized pin counts when compared to the previous small form factor standard, VNX.

726 Series VNX+ 6U



From VITA 90 Standards Documents

Dimensions

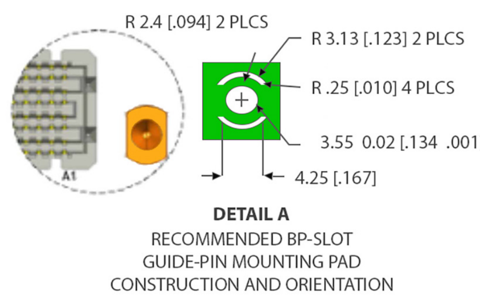
A typical VNX+ module is ~ 78 mm × 89 mm with variable thickness module height such as 13 mm, 19 mm, 27mm (or 39 mm for double-height) depending on power/complexity.

Connector/pin counts

VNX+ uses rugged connectors with 200-pin, 240-pin, 320-pin or 400-pin versions depending on slot profile and function.

VNX+ Backplane PCB Footprint

- The backplane slot that supports a 13/27mm PIM shell utilize the 200-Pin 4-row BP HSDC. See VITA 90.0
- The backplane slot that supports a 19/39mm PIM shall utilize one of 400, 320, 240-Pin 8-row BP HSDC. See VITA 90.0 for footprints.
- The backplane footprint for the two BP Guide-Pins should conform to VITA 90.0



Source: VITA-90 Open Standards

Power & energy modules

VNX+ includes parts (for example, VITA 90.3) defining power supply modules, energy storage modules, and filtered power modules.

Backwards compatibility note:
Although VNX+ builds on earlier small form factor efforts, it is not backward compatible with its predecessor, VITA 74, in many respects because pin-assignments and module profiles were optimized.

Primary Power Supply Rails (Voltage, Tolerance, Ripple)

Primary Power to PIMs is provided by the four Primary Power Supply Rails referred to as VS1, VS2, VS3, and VS4. Each of these Power Supply Rails are referenced to Ground (GND).

VSx	Voltage	Tolerance	Max Ripple 0-20 HHz
VS1	+12.0	± 5%	120 mVPP
VS2	+5.0	± 5%	50 mVPP
VS3	+3.3	+5/-2.5%	50 mVPP
VS4	-12.0	± 5%	50 mVPP
VAUX	+3.3	± 5%	50 mVPP
VBAT_3V	+3	+5/-100%	na
VHeater	+12	+5/-100%	na

Source: VITA-90 Open Standards

Thermal capabilities

Designed for **SWaP-C²** constrained environments, VNX+ balances a compact form factor with robust power and thermal capabilities. While smaller modules naturally operate within tighter thermal envelopes—often around ~35 W for conduction-cooled implementations, the standard is engineered to scale beyond those baselines.

Ongoing implementations point to supported power dissipation in the 35–90 W range. This flexibility allows VNX+ to support higher-performance processors, RF payloads, and AI-accelerated workloads that were previously impractical in similarly sized embedded platforms.

Key advantages of VNX+

The VNX+ standard represents a significant evolution over earlier small form factor architectures, most directly VITA 74. VITA 90 delivers greater flexibility, higher integration density, and improved system scalability within tightly constrained **SWaP-C²** environments.

At the architectural level, VNX+ defines multiple slot profiles, including payload, switch, and radial clock roles. These profiles support different connector pin counts (400-pin, 320-pin, 240-pin and 200-pin) and configurable apertures for optical and coaxial blind-mate connectors. This modular approach allows system designers to tailor backplane and chassis configurations to specific mission requirements while maintaining a compact mechanical footprint.

The SOSA Technical Standards (SOSA TS) are structured such that Snapshots (interim drafts) are published to share progress, and eventually an Edition becomes the formal basis for conformant product design.

Equally important, VNX+ maintains alignment with the SOSA TS and other open standards. This standards-based approach simplifies module reuse and enables system integrators to take advantage of a growing interoperable ecosystem—accelerating development timelines while preserving long-term upgrade paths within the broader VITA 90 framework.

Key features at a glance

Highly capable with a small footprint:
VNX+ delivers nearly all the technical capabilities of 3U OpenVPX in a form factor roughly 30% of the size per slot—making it ideal for applications where VPX performance is required, but VPX simply won't fit.

High-bandwidth I/O:
The standard supports blind-mate optical MT and coax connectors alongside high-speed copper planes, enabling dense sensor, radio, and video data paths within extremely constrained volumes.

SOSA alignment:
VNX+ content was significantly expanded in SOSA TS Edition 2, allowing suppliers and integrators to design and deploy conformant modules and backplanes with confidence.

Comprehensive ecosystem:
Defined slot profiles, power and energy-storage modules, and detailed cooling and mounting guidance help accelerate the development of deployable, mission-ready systems.

SOSA technical standard alignment

The Sensor Open Systems Architecture (SOSA®) Consortium, a collaborative industry and government forum established under The Open Group®, creates standards for embedded computer modules, reconnaissance systems, and communications systems with applications in aerospace and defense. These standards maintain interoperability across vendors and systems. They leverage and draw on existing standards (for example, from VITA Standards Organization in the hardware domain) but then narrow them down and constrain those to a subset, so that modules/backplanes can be truly interchangeable in a system.

The SOSA Technical Standards (SOSA TS) are structured such that Snapshots (interim drafts) are published to share progress, and eventually an Edition becomes the formal basis for conformant product design.

The latest Snapshot of the SOSA TS (Edition 2.0, Snapshot 3) includes VNX+ slot profiles and development guidance, making VNX+ a valid form factor for SOSA-aligned systems.

However, the alignment is relatively new and still maturing. Vendors are still developing prototypes and working through full implementation of all facets (power, management, test & verification) for VNX+ under SOSA. The SOSA TS Snapshot notes: "VITA 90 dot standard documents are, at the time of writing this document, still being drafted and may either be incomplete or subject to change. Care has been given to include here only material that has been balloted by the VITA 90.x working groups."

Design for SWaP-C² constrained environments

VNX+ (VITA 90) is explicitly engineered for **SWaP-C²**-constrained environments, that is, systems where Size, Weight, Power, Cost, and Cooling must be minimized without sacrificing performance or ruggedness.

As mentioned, the VITA 90 standard served as an extension from the earlier VITA 74 concept, which aimed to bring modular open systems architecture (MOSA) benefits to smaller platforms like unmanned aerial vehicles (UAVs), ground robots, and edge sensors. VNX+ takes this a step further by defining a high-density, small-form-factor architecture that maintains interoperability and scalability while still fitting into chassis as compact as a few inches in each dimension.

In the mid-2010s, the defense and aerospace embedded-computing community began to feel growing pressure from platforms that could no longer accommodate traditional 3U and 6U VPX payloads. The rapid expansion of ISR sensors, electronic warfare payloads, autonomous and unmanned systems, and edge-processing nodes exposed a gap between available compute capability and the physical, thermal, and power envelopes of emerging platforms

The mechanical design of VNX+ is central to its **SWaP-C²** optimization. Modules are significantly smaller (19 × 89 × 78 mm) than the 3U and 6U OpenVPX standards, allowing designers to pack powerful compute, sensor, or signal-processing capabilities into tight spaces.

As touched upon in the Description and Specifications section, the connectors and module stacking method are designed for rugged conduction cooling rather than active airflow, eliminating fans and reducing power draw. The chassis are lightweight aluminum or composite and use high-speed serial interconnects, which reduces both weight and mechanical complexity while improving reliability under vibration and temperature stress.

Electrically, VNX+ supports high-speed serial fabrics (PCIe Gen4, Ethernet, SATA) on a low-power bus architecture optimized for minimal noise and heat dissipation.
Modules can deliver heterogeneous compute (CPU, GPU, FPGA), or mixed-signal processing, while staying within strict power envelopes typical of edge and tactical systems. The standard also includes provisions for power and thermal management, allowing systems integrators to tune performance dynamically depending on mission needs or environmental constraints.

By early 2025, industry blogs, vendor announcements, and prototype demonstrations increasingly positioned VNX+ as "nearly application-ready" —a small-form-factor architecture that bridges the gap between legacy VPX performance and next-generation platform constraints. Though not yet as ubiquitous as OpenVPX, VNX+ is now widely viewed as a credible, forward-looking option for programs that require high-bandwidth, modular computing in spaces where VPX simply cannot fit.

HISTORICAL CONTEXT

In the mid-2010s, the defense and aerospace embedded-computing community began to feel growing pressure from platforms that could no longer accommodate traditional 3U and 6U VPX payloads. The rapid expansion of ISR sensors, electronic warfare payloads, autonomous and unmanned systems, and edge-processing nodes exposed a gap between available compute capability and the physical, thermal, and power envelopes of emerging platforms. While OpenVPX continued to scale in performance, its mechanical footprint increasingly limited adoption in tightly constrained **SWaP-C^2** environments.

Early responses included incremental reductions in VPX-derived architectures and interim standards such as VITA 74 (VNX), which demonstrated demand for smaller conduction-cooled modules but also revealed limitations in I/O density, scalability, and long-term alignment with emerging open-architecture initiatives. At the same time, system architects were seeking modular, interoperable alternatives that preserved VPX-class signaling, blind-mate I/O, and ruggedization—without the volumetric overhead of legacy form factors.

By 2021, VNX+ (VITA 90) began to coalesce through industry discussions, white papers, and vendor roadmaps as a more comprehensive small-form-factor solution. Unlike earlier efforts, VNX+ was conceived not merely as a size reduction, but as a next-generation acknowledgment of how processing, sensor fusion, RF, and networking workloads were shifting toward the edge. Key design goals included higher connector density, support for optical and coaxial blind-mate interfaces, and slot profiles that enabled heterogeneous system architectures within extremely limited space.

Momentum accelerated in 2023–2024 as VNX+ became formally recognized within the SOSA TS. The publication of SOSA TS Edition 2 (Snapshot 2) in 2024 marked a significant milestone, explicitly incorporating VITA 90-VNX+ as a supported form factor. This endorsement signaled to system integrators and suppliers that VNX+ was aligned with broader DoD open-systems goals, including reuse, interoperability, and vendor competition.

In parallel, the VITA standards process continued refining VITA 90 definitions around mechanics, slot profiles, power delivery, and cooling assumptions—particularly for ground vehicles, unmanned platforms, and other **SWaP-C^2**-constrained deployments. While the standard is still maturing, the combination of VITA documentation and SOSA TS guidance has provided sufficient clarity for early adopters to design compliant backplanes, payload modules, and reference architectures.

By early 2025, industry blogs, vendor announcements, and prototype demonstrations increasingly positioned VNX+ as "nearly application-ready"—a small-form-factor architecture that bridges the gap between legacy VPX performance and next-generation platform constraints. Though not yet as ubiquitous as OpenVPX, VNX+ is now widely viewed as a credible, forward-looking option for programs that require high-bandwidth, modular computing in spaces where VPX simply cannot fit.

TRADITIONAL AND POTENTIAL APPLICATIONS

For traditional applications in defense and aerospace, VNX+ offers clear advantages. Unmanned platforms can now carry more onboard intelligence and sensor-fusion capabilities without exceeding payload limits, while ground vehicles and sensor pods benefit from their ruggedness and modularity.

The standard's support for optical and coaxial apertures and high-speed data fabrics makes it ideal for C5ISR, electronic warfare, and other sensor-intensive missions. Compared to older architectures, VNX+ reduces both system size and integration complexity, allowing designers to rapidly deploy next-generation capabilities in tighter spaces with lower thermal and power overhead.

Unmanned Aerial Vehicles (UAVs)

VNX+ is ideal for unmanned aerial vehicles because it delivers high-performance computing in a compact, lightweight form factor. UAVs often face extreme **SWaP-C²** (size, weight, and power) constraints, making traditional 3U or 6U VPX systems impractical. VNX+ modules could enable onboard processing for real-time sensor fusion, target recognition, navigation, and AI-assisted autonomy. With support for high-speed data fabrics (PCIe, Ethernet) and optical/coax I/O, UAVs can integrate radar, EO/IR, and SIGINT payloads without relying on remote ground control for data processing, improving autonomy and resilience in GPS-denied or jammed environments.

Pods

For mission or sensor pods—including reconnaissance, targeting, or electronic warfare pods—VNX+ provides a ruggedized, modular platform that can be mounted externally on aircraft or vehicles. Its conduction-cooled design withstands vibration and temperature extremes while fitting within tight cylindrical or aerodynamic housings. Pods equipped with VNX+ modules can handle onboard image processing, RF analysis, or electronic countermeasure workloads directly within the pod. This reduces cabling complexity and latency, allowing faster data turnaround and modular upgrades between missions (for example, swapping out AI, radar, or comms modules depending on mission type).

Ground vehicles, including unmanned ground vehicles (UGVs)

In manned and unmanned ground vehicles, VNX+ supports distributed mission computing, situational awareness, and vehicle autonomy within rugged, space-limited enclosures. The small footprint enables integration in turrets or sensor masts while withstanding shock, dust, and thermal stress. VITA 90-VNX+ modules can host CPUs, GPUs, or FPGAs to power driver-assist vision systems or battlefield networking nodes. Because it aligns with the SOSA/MOSA frameworks, VNX+ allows defense integrators to upgrade compute modules or sensors over time without redesigning entire systems, a key advantage for long-lifecycle military fleets.

Missiles

In missiles and precision-guided munitions, every gram and watt matters, making VNX+ a strong candidate for onboard guidance and target-recognition electronics. Its miniaturized, conduction-cooled modules can withstand high G-forces and temperature gradients while delivering reliable compute performance. A VNX+ architecture could integrate navigation, inertial measurement, and AI-assisted targeting directly within the missile's electronics bay, enabling smarter, more adaptive guidance systems.

Satellites

The compact, modular architecture of VNX+ allows integrators to combine compute, I/O, power, and storage modules within tight payload spaces like CubeSats and smallsats. The standard supports high-speed SEARAY connectors and advanced fabrics for data-intensive onboard processing and communication, while its conduction-cooled design and ruggedized mechanical structure ensure reliability in vibration, vacuum, and thermal extremes. VNX+ also includes a dedicated "Space VNX+" (VITA 90.5) profile that accounts for radiation tolerance and long-term reliability.

Edge AI systems

VNX+ is especially powerful for edge AI deployments, where intelligence needs to live directly on the platform. Its high-bandwidth interconnects and support for GPU/AI accelerator modules (like NVIDIA Jetson or custom FPGA AI cores) make it well-suited for real-time inference and object detection on the edge. By enabling compact, low-latency compute nodes, VNX+

allows drones, vehicles, and field-deployed systems to process massive data streams locally rather than depend on cloud links, which in turn reduces latency, conserves bandwidth, and improves autonomy in contested or remote theaters.

As defense and aerospace systems move toward distributed, AI-enabled networks, VNX+ provides the modular and scalable hardware foundation that will allow edge AI to be applied across a wide range of platforms.

FUTURE OUTLOOK

The VITA 90-VNX+ set of standards has not yet been fully released. However, as of the publication of this whitepaper, VNX+ is gaining traction. The SOSA TS Edition 2 Snapshot supports the standard, and vendor/industry blogs highlight ground vehicle applications and autonomous systems adopting the form factor.

The evolution of the standard also matches the evolution of high-speed fabrics, connector and cooling technologies (for example, optical/coax blind-mate, advanced cooling), which enable the form factor to deliver more capability in tighter spaces, which makes it more relevant. One example of this emerging relevance is the standard's potential applications for edge AI.

SUMMARY

In brief, the VITA 90-VNX+ set of small form factor standards represents an improvement on the previous VITA 74 standard on which it is based, and additionally on previous 6U and 3U OpenVPX standards. It was developed under the VMEbus International Trade Association (VITA) to bring modular embedded computing into **SWaP-C²** constrained platforms (for example, in drones, pods, and ground vehicles) while retaining many of the features of larger standards like OpenVPX.

While the SOSA TS Edition 2.0 has not yet been released, which aims to ratify the standards, the latest Snapshot represents a robust, nearly finalized set of interoperable standards. ANSI is set to ratify the standard soon, and is in "public review for release," and according to VITA, "working groups are developing drafts for each level of VNX+."

As of the publication of this whitepaper, the standard is nearly finalized—and it represents a much-needed standard in the realm of fast-developing military and aerospace applications. A particular point of note is edge AI applications, where VITA 90-VNX+ represents the leading edge of ability for the standard.

ABOUT ATRENNE

For more than 50 years, Atrenne Computing Solutions has been designing, developing and deploying rugged electronic packaging, chassis, backplanes, and integrated assemblies.

We are proud to provide customers with fully tested, reliable, electromechanical solutions on-schedule and with world-class quality. In addition, our design-to-build model and custom engineering capabilities foreground us in the market. Our mission-critical and performance critical, embedded computing platforms are currently deployed in over a hundred programs, operating reliably in the harshest environments.

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CONTACT INFORMATION

www.atrenne.com
sales@atrenne-cs.com
508.588.6110 or 800.926.8722

General Inquires: +1 800 926 8722

Atrenne Computing Solutions, US: +1 508 588 6100

sales@atrenne-cs.com | atrenne.com

Atrenne | @AtrenneOfficial