

SNP – Secure Network Processor

Securely Connecting pLEO Small-Sats



Secure Network & Data Transfer Payload Solution,
Compliant to NEBULA v3.06

High Speed Networking (10 Gbps throughput):
MPLS or DSCP and ECN

Integrated Type 1 HAIPE Compliant Cyber Capability

Red and Black Xilinx Versal Processors -
2x A72 Processor Cores, 8GB EDAC RAM

350GB + Non-volatile Memory

Overview

The newly-released Secure Network Processor (SNP) provides secure networking and data-transport mission payload functionality enabling smallsats to seamlessly and securely link into Proliferated low Earth orbit (pLEO) constellations faster and easier than ever before.

The SNP encompasses all requirements into one fully-integrated and Rad-tolerant SWaP-optimized unit that meets the most demanding LEO orbits, including Proliferated Warfighter Space Architecture (PWSA) and large constellation orbits. Stringent requirements include red-side network switching, black-side routing, mesh-network management, data traffic optimization with Type 1 HAIPE crypto capability.

NSA certification of the SNP is pending, expected by the end of 2025, leveraging NSA certified embedded space crypto with secure bypass, secure trusted boot, black-side reverse tunnel decryption, and full on-orbit re-programmability capabilities. The SNP eliminates the challenges and delays of integrating red and back data flows.

Schedule & Maturity

Anticipating the change landscape of the space domain in 2021, General Dynamics Mission Systems began researching and investing in the development of this product designed to accelerate the integration of smallsats into constellations to deliver needed capability to the warfighter.

Flight quality engineering units will be built by mid-2025, with characterization in Q3 2025.

Key Features and Benefits

- On-orbit re-programmability w/multiple images stored in non-volatile memory
- IPv4 & IPv6 networking support
- Zero Trust Architecture informed framework
- 5 year mission life in LEO
- 28V (24V to 34V) input voltage
- Class C Mission Assurance
- Built-in fault management and recovery
- Memory integrity checks, SEU mitigation
- Modular, flexible and scalable for many applications
- Software and hardware power management tailorable to mission needs
- Designed for ease of integration into existing smallsat architectures

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Solving Problems Other Network Payloads Can't!

Problem: Obtaining approval to fly NSA certified crypto solutions and approved TEMPEST testing takes time and presents schedule risks. Interim Authority to Operate (IATO) and waivers comes with their own set of risks, schedule challenges, and unique additional scope.

Solution: The SNP currently includes an NSA certified non-HAIPE version. We expect to receive IATO by the end of March 2025 and NSA certification by the end of June 2025.

Problem: Integrating separate red switches, black routers, and crypto boxes takes time and causes schedule risks to the constellation for different variations of products, further complicating variant communications with each other and through the ground systems.

Solution: The SNP comes pre-integrated with the red switches, black routers, and crypto boxes aligned in hardware, firmware, and software – ready to talk to TACLANE® encryptors – including NEBULA compliant software for network management.

Problem: Data traffic gets jammed, and data packets get dropped at various spacecraft nodes or at various ground entry point antennas during high data rate events (e.g., Triton UAV data flows, tracking data calibration runs to ground, etc.).

Solution: The SNP comes with a high performance black side router processing capability that can be enhanced with network protocol processing software to provide flow control, data packet prioritization, and can re-route data traffic around bottlenecks, ensuring data packets do not get dropped.

Technical Specifications

■ Cyber Capability

- Type 1, Will have HAIPE v4.2.5 Interoperable
- Up to 10 Gbps supported transfer rate per port
- Crypto-bypass capable
- Reverse tunnel decryption for Black side updates
- Supports Symmetric and Asymmetric cryptography for secure boot

■ Power-on Root of Trust

- Secure and Authenticated Boot Up
- Zero Trust Architecture Informed Framework
- Physical Unclonable Function (PUF) Secure Boot & Secure Storage Supported

■ Input / Output

- 4 Red side ports @ 10 Gbps (10G, 5G, or 2.5G configurable) BASE-SR
- 4 Red side ports @ 1 Gbps (1000 BASE-T)
- 4 Black side ports @ 10 Gbps (10G, 5G, or 2.5G configurable) BASE-SR
- 4 Black side ports @ 1 Gbps (1000 BASE-T)
- Ethernet Command/Data interfaces
- Networking Protocols: IPv4, IPv6, MPLS
- 1 Pulse per Second (1PPS) on both Red and Black sides
- 10MHz input on both Red/Black sides to accommodate timing needs

■ Networking Capabilities

- MPLS Routing --multiple label depth --Support for Auto. Dynamic Routing
- DSCP and ECN with IP or MPLS Support
- Layer 3 IP Routing
- IPv4 and IPv6 Support

■ Hardware Management

- Hardware watchdog controller
- Configuration Management
- Status Control
- Interrupt Routing
- Fault Management
- Rest and Reboot of FPGA/processing elements
- RAM memory integrity checks
- SEE and SEU Mitigation, ND-SEL recovery

■ Physical/Environmental

- Size: 13.27" x 13.56" x 4.53" (3U-VPX)
- DC Power: < 150 W. Nominal DITL average use-case < 130 W
- Weight: 15.5 kg
- Radiation Tolerant to LEO orbits 1100km and lower (polar included)
- Vibration: NASA GEVs Compliant/Pyro Shock: 2000 G
- Steady-State Baseplate/Mounting Temp Range: -24°C to +40°C

■ Mission Adaptable

- Fully on-orbit reprogrammable
- Multiple reserved spare module slots
- Powerful Versal FPGA SoC Design

GENERAL DYNAMICS

Mission Systems

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