Timing in DoD Open System Architectures

A Leading Provider of Smart, Connected and Secure Embedded Control Solutions

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Modular Open Systems Approach (MOSA)

- **A DoD strategy for designing affordable and adaptable defense systems**
- **DoD MOSA tri-services memo mandated the use of MOSA in weapon systems in 2019 and again in 2024**
  - Codified into law under Title 10 U.S.C. 4401(b)
- **Specifies the use of modular components, open standards, and vendor independence**
- **Benefits of cost savings, rapid insertion of advanced technologies and sensors, and enhanced interoperability**

Sensor Open Systems Architecture

SOSA®
Sensor Open Systems Architecture™

- **A specific instantiation of MOSA focused on creating a common architecture for sensor systems**
- **SOSA is a technical standard governed by the SOSA Consortium**
  - Leverages other technical standards, such as OpenVPX and VITA
- **Defines:**
  - Hardware components (chassis, backplane, plug-in cards)
  - Mechanical interfaces between hardware components (edge connectors)
  - Electrical and software interfaces for interactions between components
- **SOSA was created to accelerate the transition of sensor systems to an open systems architecture**

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SOSA Hardware

SOSA Hardware

Chassis

Backplane

Plug-in Card

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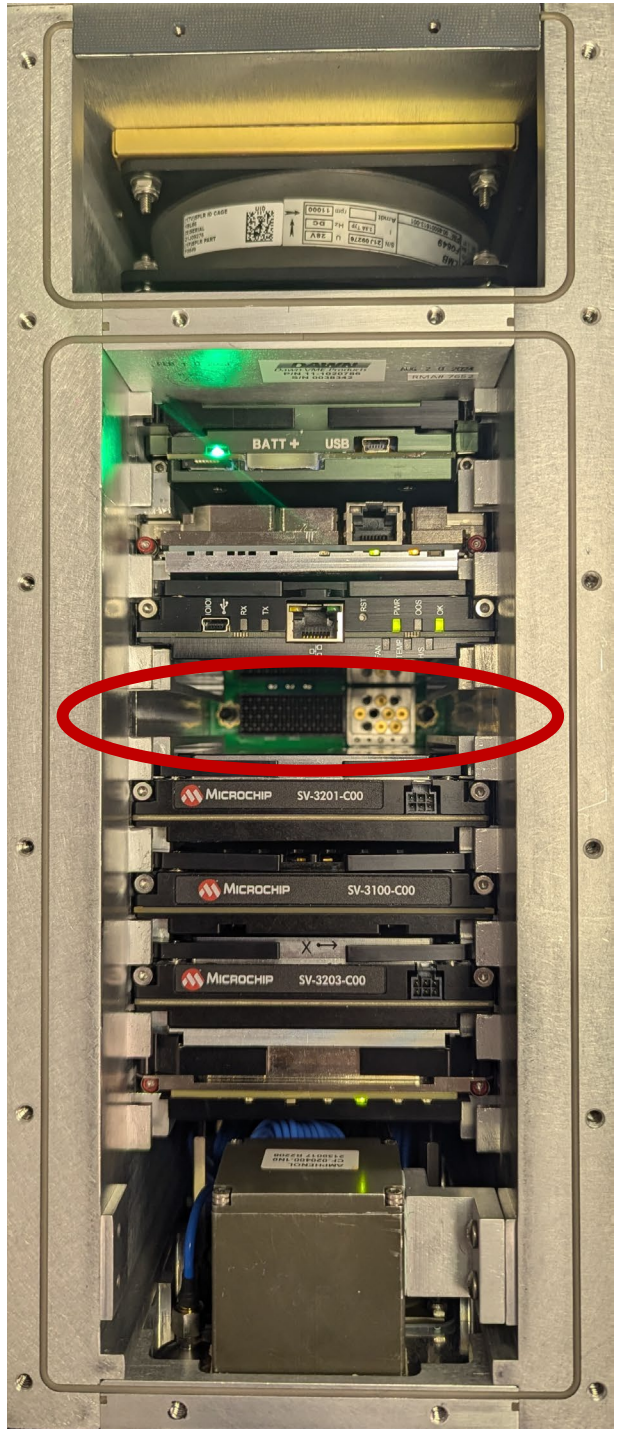
Chassis Layout

- **Backplane sits at the bottom of the chassis**
- **SOSA defines the edge connector on cards and the backplane slot profile based on card function**
  - Power slot
  - Chassis manager slot
  - Payload slots – these are wildcard slots
  - Radial clock card slot



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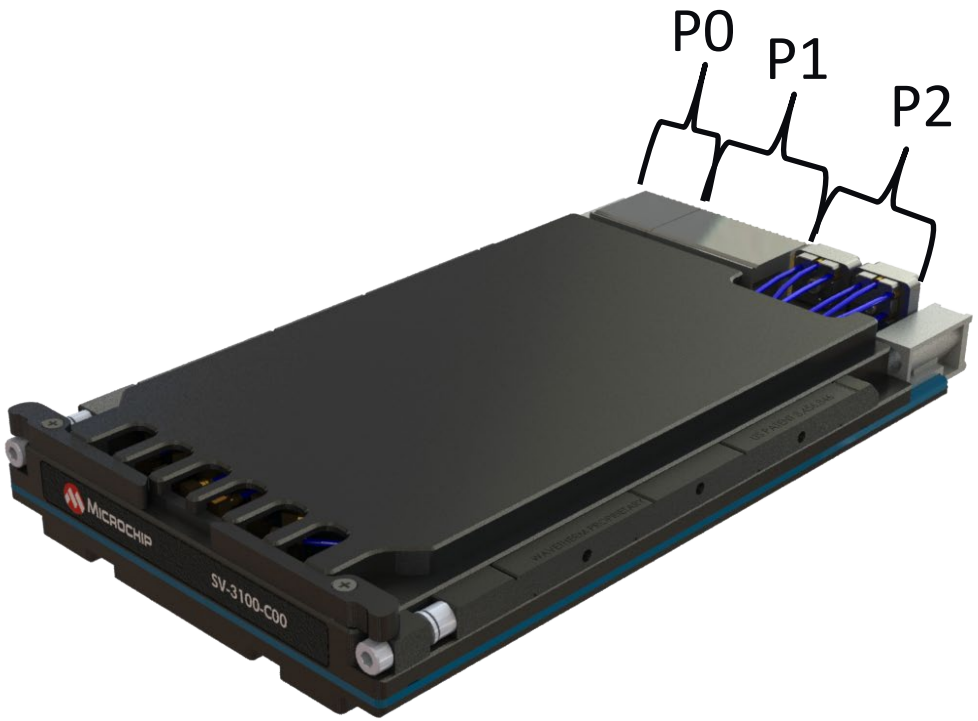
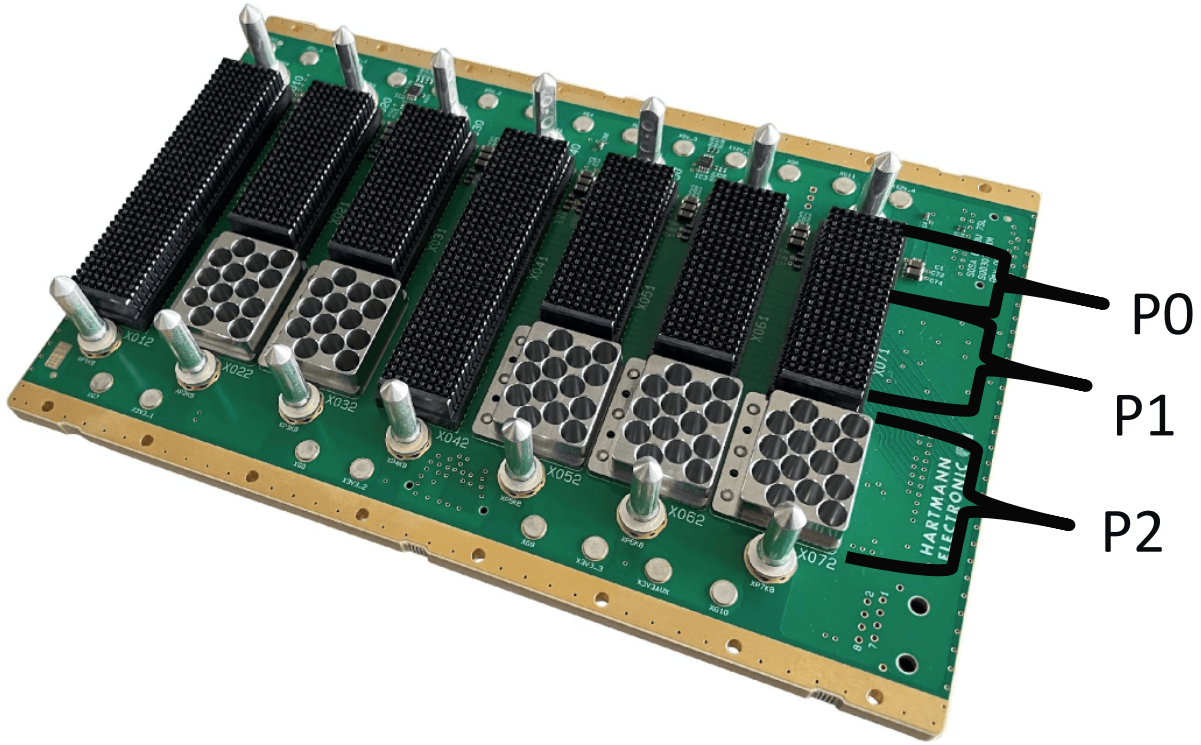
Card and Backplane Edge Connectors

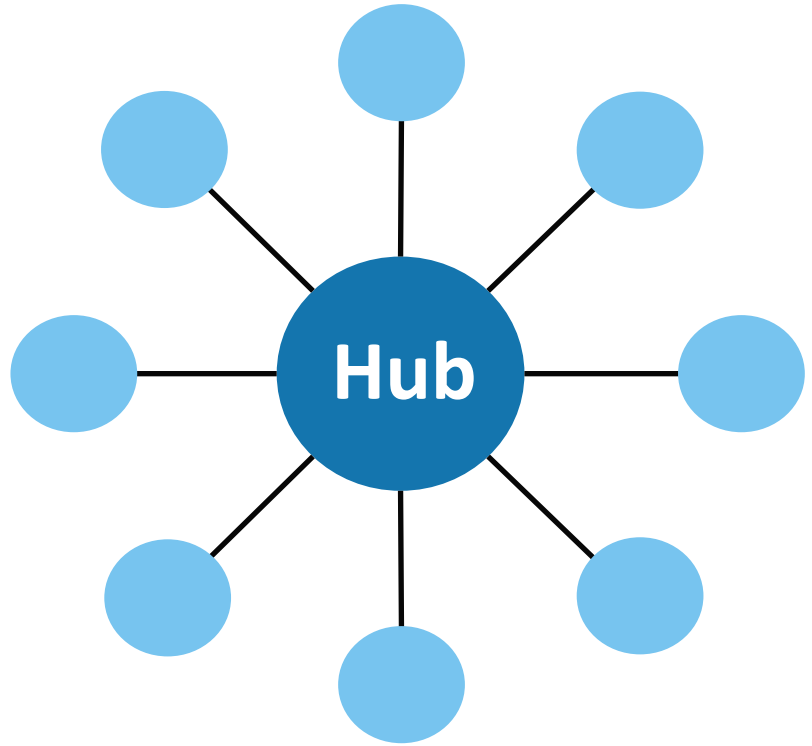


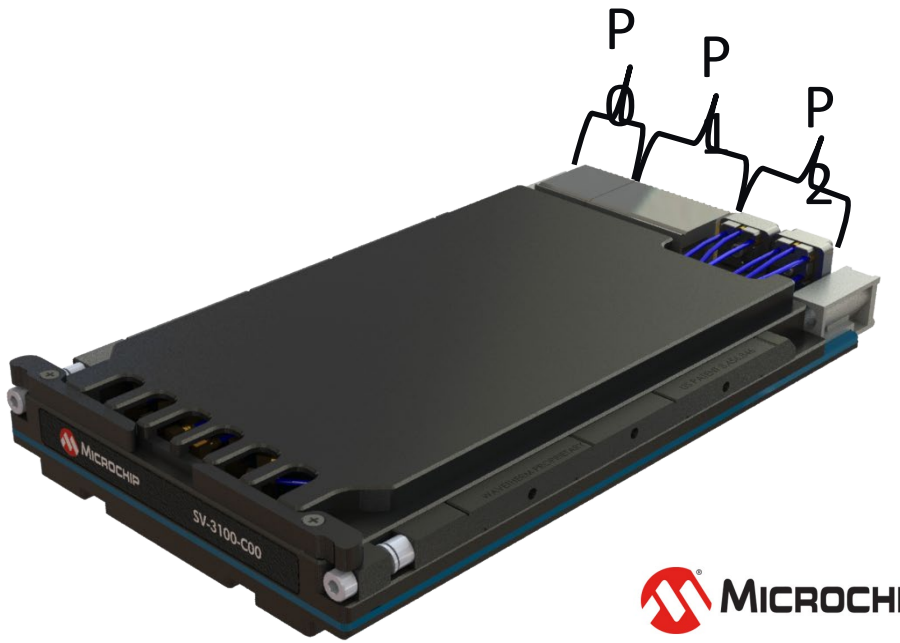


SOSA Timing

Radial Clock Card (RCC)

- **Radial clock distribution**
  - Hub and spoke, point-to-point connection between the RCC and other plug-in cards
  - Each card in the chassis receives a consistent, low skew signal (±25 ps)
- **11 differential pairs of 1 PPS auxiliary clocks and 100 MHz reference clocks off the P1 aperture**
- **P2 aperture can be used for further signal distribution**
  - Often used for signal inputs from external sources, antenna input, and other cards





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Radial Clock Card (RCC) External Connections

- **RCC often acts as a PTP grandmaster or boundary clock**
  - Provides IEEE 1588-2008 PTP via 1000BASE-KX/10GBASE-KR ports to synchronize multiple chassis in a network
  - Publish sensor data over ethernet with PTP timestamps
- **Distribute signals outside of a chassis via coaxial cables**
  - External sensors can be brought into a chassis via coaxial cables
- **Synchronization between chassis or sensors over fiber**
  - Example: Optical asynchronous two-way time transfer interface enables sub 100 picosecond accuracy between systems connected over fiber

Radial Clock Importance

- **Precise timing for intra and inter chassis synchronization**
- **Timestamping of sensor data**
  - Critical for sensor fusion algorithms, such as an INS
- **Resilient timing solutions**
  - Often works in parallel with PNT sources and sensors such as GNSS receivers, atomic clocks, and inertial measurement units (IMU)

Thank you!

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