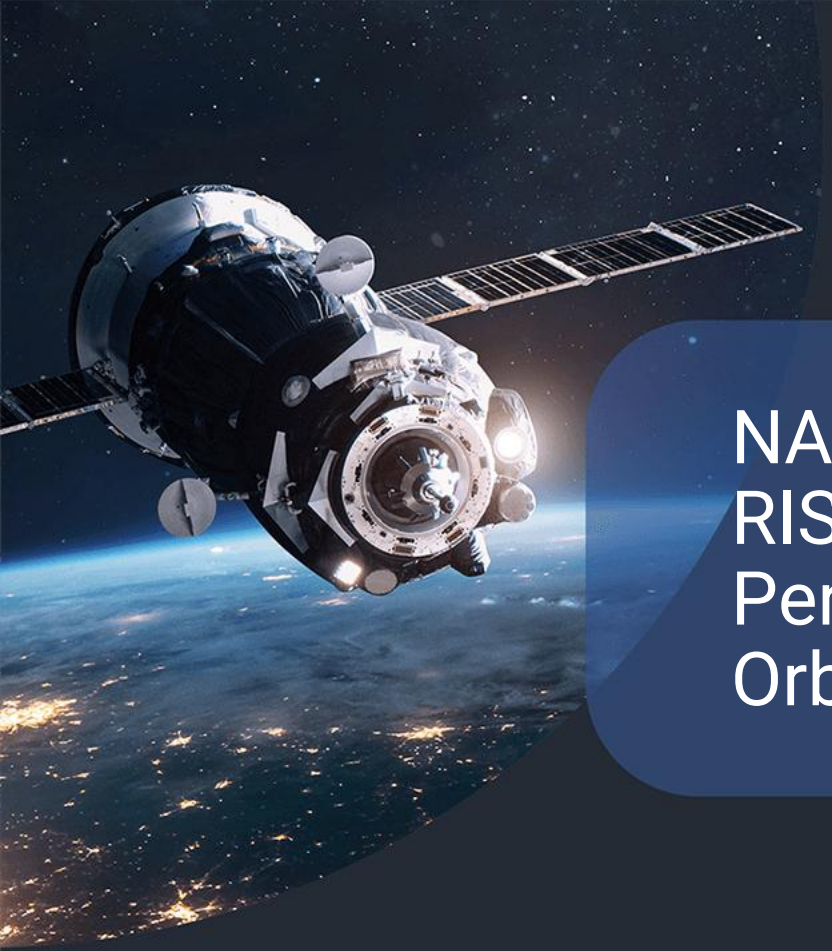

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NANOhpc-obc: Scalable Multicore RISC-V based Fault-Tolerant High Performance OBC Platform for In-Orbit AI Applications

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About SkyLabs

SkyLabs is platform subsystems provider for emerging space market

Electrical Power Systems

- All-in-one solutions
- High-level of integration

Remote Terminal Units

- Build-in high-level functionality
- Scalable & modular approach

On-Board Computers

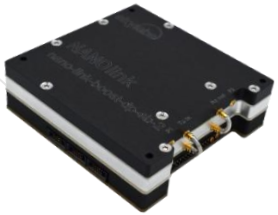
- Highly miniaturised with FT
- Mid- to high-performance

Attitude Determination and Control System

- E-ADCS (Prime: Indra-Deimos)
- 6U – 75kg

Communication

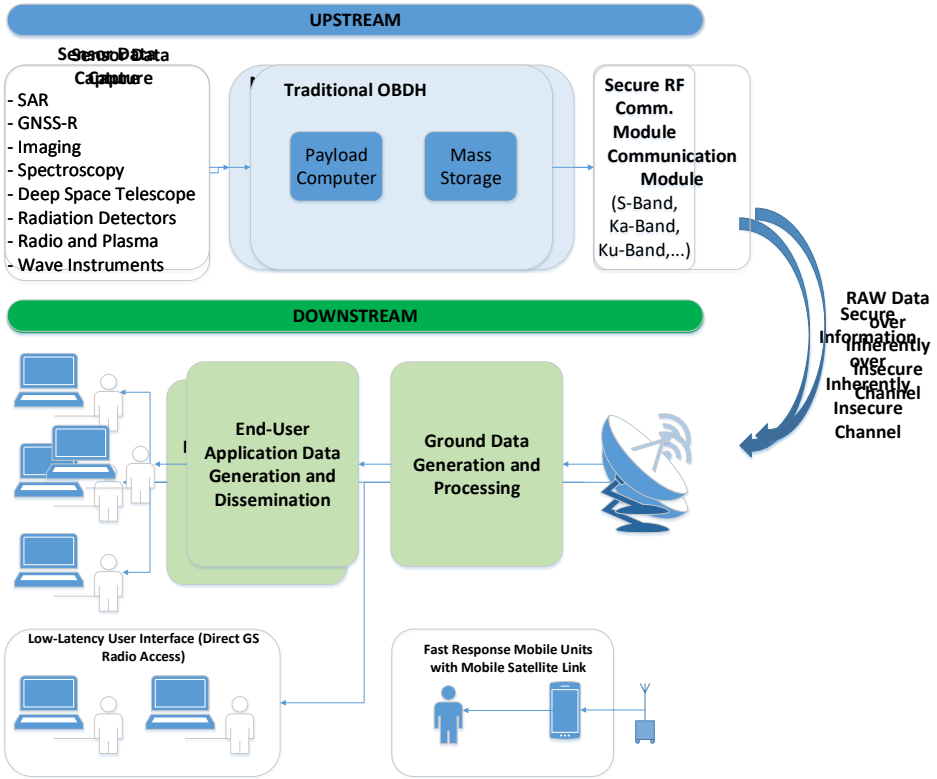
- S-BAND, X-BAND
- Best SWaP & CCSDS compliant
- ***SDLP-Secure*** connectivity



High Processing Computing

- Fault Tolerant reliable HPC
- Clustering supported
- HW AI Extension

Intro: AI@EDGE in Space Paradigm



- Satellites collect massive amounts of data from its sensors
- Transferring raw data to ground is highly inefficient
- AI@EDGE: Process raw data on-board, transmit only results
- Our solution: Scalable, fault tolerant, high-performance computing (HPC) in space

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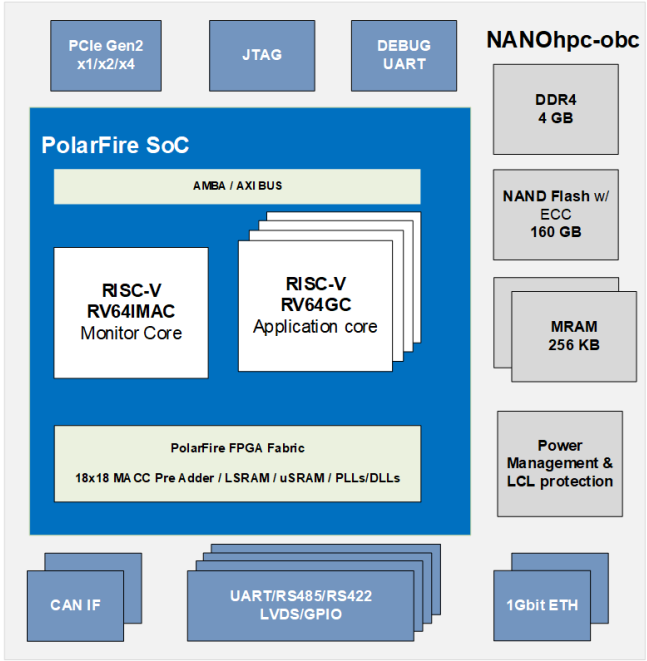
- **Processor with programmable logic**
  - 4x RISC-V 64-bit processor cluster (RV64IMAFDC) in PolarFire SoC FPGA
    - Fully compliant with the RISC-V ISA specification
    - 32 kB L1 instruction cache with SECDED
    - 32 kB L1 data cache with SECDED
  - 1x RISC-V 64-bit monitor processor (RV64IMAC) in PolarFire SoC FPGA
    - 16 kB L1 cache with SECDED
  - Running at 600 MHz
- **Memory**
  - 4GB DDR4
  - Mass storage NVM 160 GB – NAND FLASH
  - 256 kB SECDED protected non-volatile MRAM
- **External Interfaces:**
  - 2x CAN bus (N+R)
  - 4x LVDS or 4x RS422/485 or 4x UART or 16 GPIOs
  - 2x 1 Gbps Ethernet
- **Internal Extension Interface:**
  - PCIe x4, Gen2
  - 3.3V and 5V power supply
  - 2x LCL interfaces
  - GPIOs, Analog channels



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- **Fault tolerance**
  - SEL Immune FPGA
  - Main DCDC is protected by SS-LCL (auto-retriggerable LCL)
  - All memories and PHYs are SEL protected by C-LCL (SS-LCL and C-LCL are SkyLabs proprietary protection mechanisms)
  - EDAC/ECC protected memories
  - Supervisor Module for monitoring and controlling - FDIR
  - Radiation characterized Building Blocks

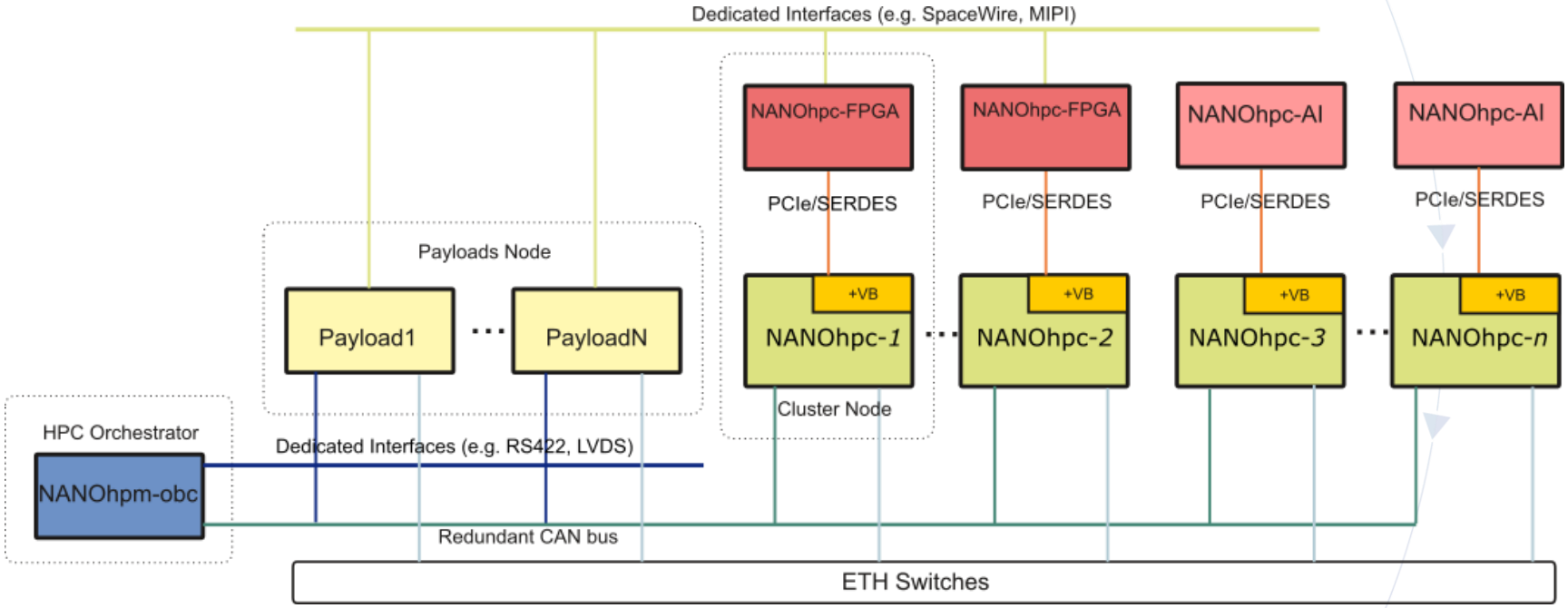
- **Operating system:** Linux (Yocto)
- **Power supply:** 5V DC (+/- 5%)
- **Board dimensions:** 95 x 91 x 12.7 mm
- **Mechanical interface:** Fully compliant to PC104 form factor

NANOhpc-obc Extensions

- **Extension 1:**
  NANOhpc-obc-FPGA
  - AMD Zynq™ UltraScale+™ MPSoC ZU7EV
  - Application Processing Unit: Quad-core Arm Cortex-A53 MPCore up to 1.5 GHz
  - Real-Time Processing Unit: Dual-core Arm Cortex-R5F MPCore up to 600 MHz
  - 504K system Logic Cells

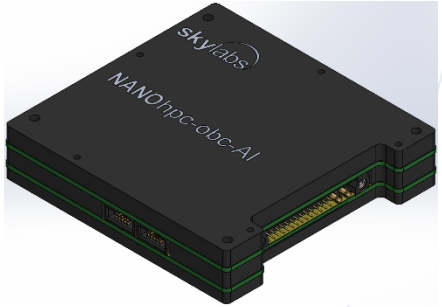
- **Extension 2:**
  NANOhpc-obc-AI
  - Extension with **2x HW AI Accelerator**, each providing >20 TOPS
  - AI frameworks: TensorFlow, TensorFlow Lite, Keras, PyTorch, and ONNX

SkyLabs HPC Cluster Architecture

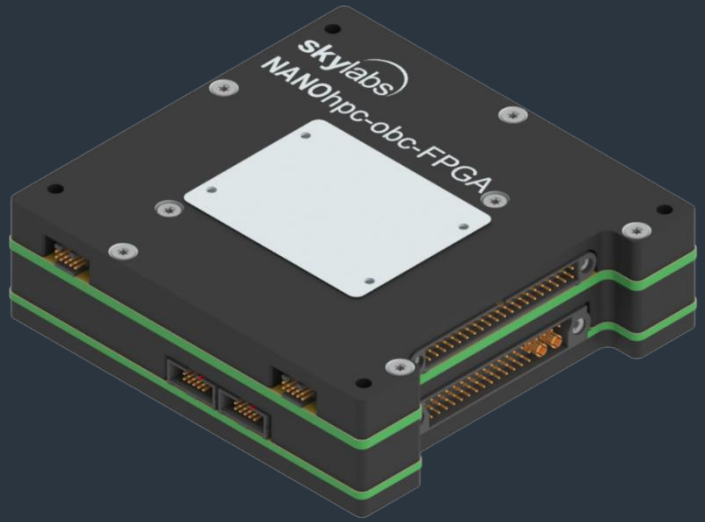


Conclusions

- **NANOhpc-obc** enables AI@EDGE for Earth Observation missions, directly addressing the critical data bottleneck challenge in space-based processing
- Compact yet powerful architecture with modular extensibility and flexible scalability to meet diverse mission requirements
- Drives operational efficiency for commercial operators, institutional agencies, and system integrators through edge processing capabilities
- Positions SkyLabs strategically in the emerging space data processing market, creating new revenue opportunities and competitive advantages



Thank you!



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Radiation Tolerant High Performance FPGA Cluster
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