Lynx - Performant and Flexible Processing Board

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RUAG Space
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RUAG Space

RUAG Space

Leading independent supplier for space products

Preferred partner for institutional & commercial customers

Products on 1’000 payloads delivered to space

100% mission success

EUR 328 million net sales in 2017
RUAG Space on Earth
Close to our customers
Market leading portfolio
Across three product groups

Electronics
- Satellite and Launcher Computers
- Navigation Receivers & Signal Processing
- Power & Drive Electronics
- Microwave for Telecom
- Antennas

Spacecraft
- Satellite Structures
- Satellite Mechanisms
- Mechanical Ground Support Equipment
- Thermal Systems
- Slip rings

Launchers
- Launcher Fairings and Structures
- Adapters, Separation Systems, Dispensers
- Sounding Rocket Guidance Systems
Before Lynx
Traditional Single Board Computers

High quality products build with a specific mission in mind.

- Performance of ~100 DMIPS
- Very reliable and durable
- Functionality and interfaces defined my hardware
Modern On-Board Processing Challenges

- Artificial intelligence – selection of data before downlinking
- Visual navigation and autonomous control
- Image and signal processing
- Software defined radio

- High performance processing modules in standard form factor
Lynx
Cornerstones

- Connectivity
- Flexibility
- Performance
- Reliability
Lynx Overview

- World leading processing performance, up to 10 000 DMIPS
- World leading high data communication bandwidth, up to 10 Gbps
- Flexibility
  - Software defined interfaces
  - Extension capabilities
  - Operating system or hypervisor of your choice
- Standard form factor easily integrated in your equipment
Lynx Connectivity

- Custom high-speed interfaces using SERDES and PCI-express to interface e.g. external high-speed DAC/ADC, GPU, DSP or FPGA.

- Traditional interfaces such as SpaceWire, M1553, CAN, GPIO and UART to interface other units.

**Front**
- 3 x SpaceWire (opt.)
- 2 x UART
- 2 x MIL-STD-1553B (opt.)
- 2 x CAN (opt.)
- 16 x GPIO (configurable)
- Test & debug
  - Gigabit Ethernet
  - UART

**Backplane**
- 5 x HSSL (PCIe gen X) @ 3 Gbps
- 10 x SpaceWire
- 2 x I2C
- 6 x SPI
- 2 x UART
- 32 x GPIO
- Lynx cross-strapping
- Power supply
Lynx Cornerstones

- Connectivity
- Flexibility
- Performance
- Reliability
Lynx Flexibility

- Processor and FPGA can be selected independently for optimal balance between price, performance and reliability.

- Mezzanine connector allows extended functionality through daughter board extension.

- Several boards can be connected to increase performance or implement redundancy/voting mechanisms.

- Physical Interfaces are mounted only if they are necessary for the intended mission.
Lynx
Reliability

- State-of-the-art error detection and correction capabilities with ECC for processing, communication and non volatile memories.

- Radiation hardened FPGA, which includes TMR to further enhance reliability, can supervise a non-radiation hardened CPU.

- Radiation hardened alternatives are available also for the CPU for missions with very high availability/reliability requirements.

- Component latch-up protection by constant monitoring of current use.

- Hypervisor for isolation of independent software partitions.
Lynx Cornerstones

- Performance
- Reliability
- Flexibility
- Connectivity
Lynx
Performance

- PCI-express enables DMA data transfers between boards and fast communication between processors and FPGAs.

- Multi-core ARM CPU of more than 10 000 Dhrystone MIPS (DMIPS) in one board provides ample general purpose processing power.

- Modern FPGA for implementation of critical processing tasks.

- Mezzanine connector enable add-ons with additional FPGA, high-speed ADC/DAC, DSP or GPU etc.
Lynx Details

Front panel
- General Purpose IO
- SpaceWire
- M1553 (option)
- CAN (option)
- Test
- Ethernet

Led panel
- Test
- Osc.

Flexible IO Controller
- Communication Memory with ECC
- Non-volatile Memory with ECC
- Local power supply
- Processing Memory with ECC

Processor
- High Speed Serial Link
- SPI/I2C
- SpaceWire
- M1553 (option)
- CAN (option)
- Test

Backplane
- Power Supply
- General Purpose IO
- High Speed Serial Link
- SPI/I2C
- SpaceWire

IDE
- Compiler
- Debug
- System integration

Partition setup
- IDE
- Debug
- Real-time trace

Application development
- IDE
- Compiler
- Debug
- Rel-time trace

Guest OS
- IDE
- Compiler
- Debug
- Real-time trace

Hypervisor
- IDE
- Compiler
- Debug
- Real-time trace

Processor
- IDE
- Compiler
- Debug
- Real-time trace
Lynx Details

Key Features
- 6U SpaceVPX Serial (optional)
- Mezzanine board (optional)
- ARM processor with 4 x CPU cores
- 32 KiB L1 instruction cache
- 32 KiB L1 data cache
- 2 MiB L2 cache
- Gigabit Ethernet Debug Link
- Real-Time Processor Trace Dump
- Hardware Driver Software

Budgets
- Form factor
  - 6U-160, 5 HP
  - 234 x 160 x 25.4 mm
- Power consumption
  - 10-25 W
- Mass
  - 1 kg incl. frame
- In-orbit life time
  - 15 years
- Processing memory
  - 4 / 8 GiByte
- Non-volatile storage
  - 4 / 8 / 16 GiByte
- Communication memory
  - 512 MiByte
Lynx
High Performance Single Board Computer

We listen to make it right. We stay to make it real. A promise you can trust.

RUAG Space Heritage

> 2900 failure free equipment years in orbit
> 300 Launcher On-Board Computers
> 120 Satellite Data Handling Systems