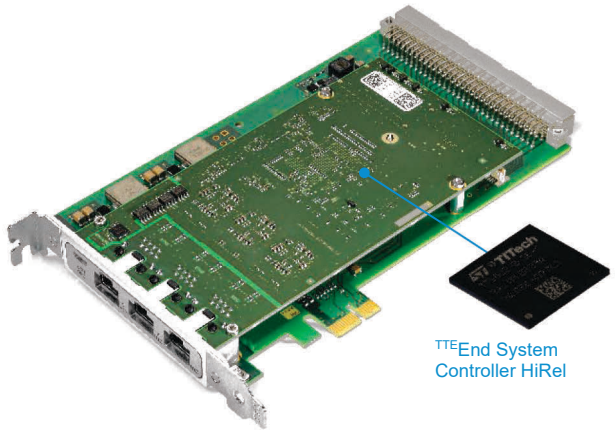
TTEEnd System Lab Space (PCIe)

TTEthernet® end system card based on the TTEEnd System Controller HiRel ASIC



Key Benefits

- Deterministic Ethernet evaluation and development platform for space applications
- Three supported traffic classes
  - Best-effort Ethernet (IEEE 802.3)
  - Rate-constrained (ARINC 664 part 7)
  - Time-triggered traffic (SAE AS6802)
- Three Ethernet ports, full duplex at 100/1,000 Mbit/s
- Based on the TTEEnd System Controller HiRel ASIC

The TTEEnd System Lab Space (PCIe) has been developed to support laboratory evaluation, development and testing applications. It features three traffic classes with time-triggered, rate-constrained and best-effort Ethernet and 1 Gbit/s physical link speed. As core it uses a TTEEnd System Controller HiRel ASIC, which is based on a radiation-tolerant technology. Based on these and more features, this card is an optimal end system solution for a large variety of application areas and especially suited for space programs.

Non-synchronized and synchronized functions over Ethernet

TTEthernet permits the integration of synchronized and non-synchronized functions in Ethernet-based distributed systems. While hard real-time applications enjoy reserved bandwidth, full determinism and delivery jitter below 1 µs by using TTEthernet, standard IEEE 802.3 Ethernet traffic operates without impact on these time-critical and synchronized functions.

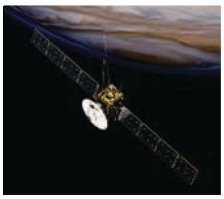
Virtual links and protocol support

The TTEEnd System Lab Space (PCIe) allows the configuration of up to 256 sending and 512 receiving virtual links (VLs). Virtual links can be configured with 8 priorities and a bandwidth allocation gap (BAG) of 0.5 ms to 1,600 ms. The configuration of the network is stored in an end system's non-volatile memory (NAND Flash 1 Gbit).

End system function

The TTEEnd System Lab Space (PCIe) includes:

- TTEEnd System Lab Space (PMC) card
- PCIe carrier card
- A link for a convenient download of a Linux Driver with API manual, a user manual, and example applications



Applications

- TTEthernet technology evaluation
- Laboratory prototype application development
  Note: Flight cards must be used for verification.
- Electrical ground support equipment (EGSE)
- Testing of other equipment

Key features	• 256 send and 512 receive VLs
	• 2,048 send and 4,096 receive COM ports
	• 3x 100/1,000 Mbit/s full-duplex Ethernet ports (enables up to three redundant channels)
	• Three network traffic classes:
	  ○ Best-effort (IEEE 802.3 Ethernet),
	  ○ Rate-constrained (ARINC 664 part 7) and
	  ○ Time-triggered (TTEthernet, SAE AS6802) traffic.
	• Jitter: <1 µs
	• Flexible configurable periods (µs granularity)
	• TTEEnd System Controller HiRel onboard, which is also used in flight hardware
	• Redundancy management and rate-constrained traffic shaping implemented in hardware
	• IP/UDP network stack implemented in hardware (for critical traffic)
	• Passive PCIe/PCI bridge on carrier board
	• 1 Mbyte on-chip RAM (for frames and LEON2 software)
	• 1 Gbit NAND Flash memory (for storing configurations)

Connectors	• 3 x Ethernet ports (100BASE-TX/1000BASE-T), RJ45 connectors • PCIe connector
Form factor	• PCI Express x1 (PCIe), revision 1.1, • Board size: 178.8 mm x 107 mm
Environmental operating ranges	• Operating temperature: 0 °C…+70 °C (air cooled) • Storage temperature: -40 °C…+85 °C • Operating @humidity: 25%...90%
Power	• Power supplied through PCIe interface (3.3 V) • Total max. power consumption: < 5.7 W
Order number	• 13791: TTEEnd System Lab Space (PCIe, Rev. C) 13511: TTEEnd System Lab Space (PCIe, Rev. B, discontinued)
Software	• Included driver for Ubuntu Linux 20.04 (64-Bit), CentOS 8 and Stream (64-Bit) • 13056: TTETools 5 Starter (mandatory, not included software) • 13057: TTETools Bundle v5.x (Expert) – see TTETools flyers for more information

Note: For flight software verification the TTEEnd System Space 3U cPCI card has to be used, because of functional differences to the TTEEnd System Lab Space (PCIe).

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