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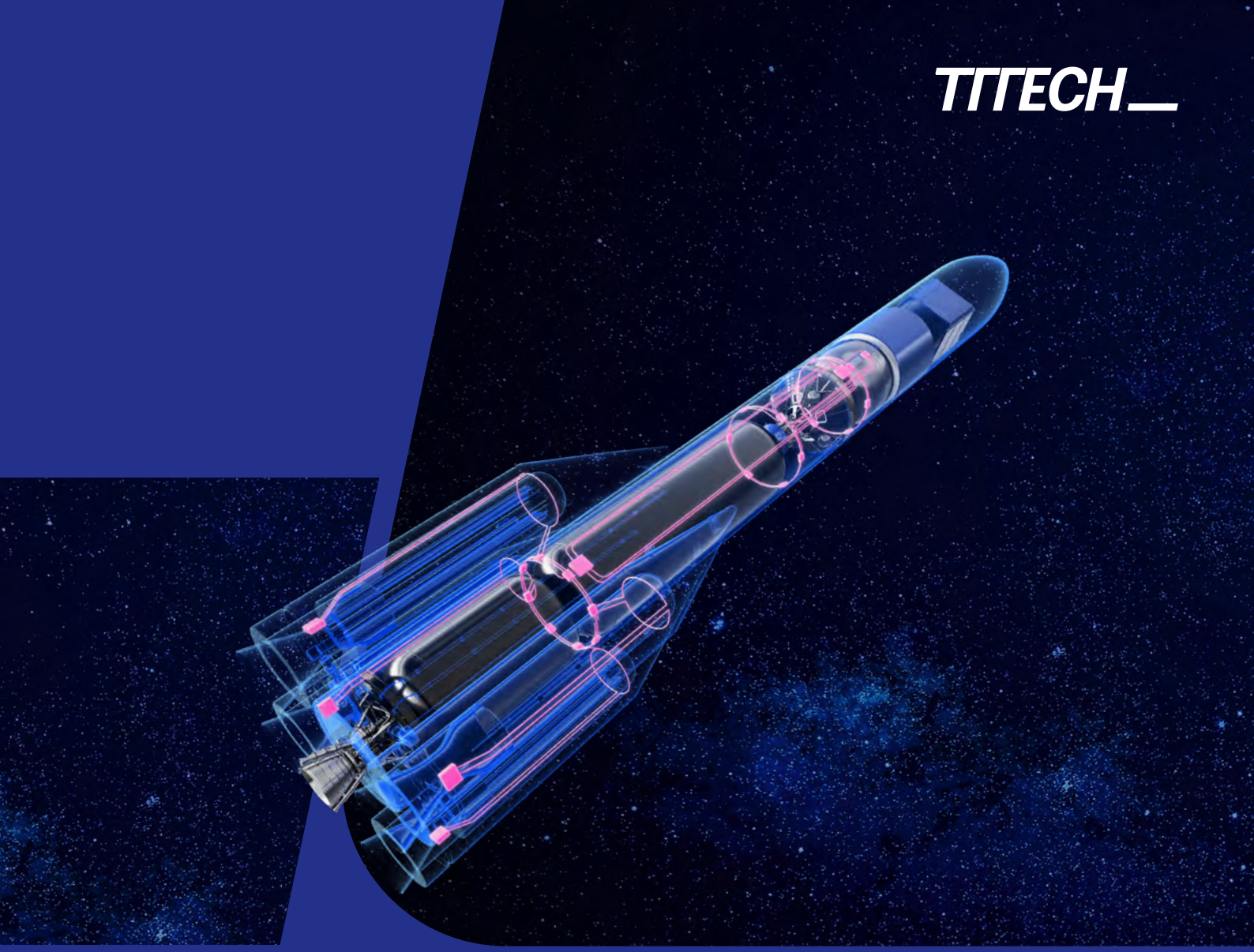

EUROPEAN LAUNCHER ARIANE 6

Creating a single, redundant avionics network for all data traffic with TTEthernet®

AEROSPACE by TTTECH

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EUROPE'S FLAGSHIP LAUNCHER ARIANE 6 ENSURES INDEPENDENT ACCESS TO SPACE FOR THE EUROPEAN SPACE SECTOR.

Over the last decades, space launch vehicle designs have used different solutions for handling safety-critical command and control data. The robust MIL-1553 data bus was used often. However, this required two MIL-1553 buses running in parallel for redundancy, which made management of the system more complex. In addition, the MIL-1553 bus is limited to 1 Mbit/s data rates. To meet the demands of modular avionics and higher data throughput, the developers of Ariane 6 looked for a data network that could provide about ten times more bandwidth and at least the same level of reliability of the MIL-1553 bus without increasing cost and complexity.

The development and qualification of the radiation-hardened TTEthernet® controller chip for the avionics backbone network and the related embedded software started within a research activity co-funded by the French Space Agency (CNES) and then later the European Space Agency (ESA) via its Future Launchers Preparatory Program (FLPP). TTTECH Aerospace has developed, manufactured, and qualified this radiation-hardened ASIC in both HiRel and space quality with Ariane 6 being one of its first users.

HIGHLY RELIABLE, FLIGHT-PROVEN ASICS CONNECT MORE THAN 50 AVIONIC UNITS TO A SINGLE, REDUNDANT TTETHERNET NETWORK

TTTECH Aerospace's qualified TTESwitch and TTEEnd System Controller HiRel ASICs and the related software are used to connect all safety-critical units. They are integrated into more than 50 avionic units handling functions such as computing, power distribution or thrust-vector actuation which all connect to a single, redundant TTEthernet network, the launcher's "nervous system".

The controller chips are based on a radiation-hardened design process. This ensures high reliability in harsh environments requiring radiation tolerance and latch-up immunity for applications like launch vehicles and LEO satellites. They are used in all variants of the Ariane 6.

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Using TTTECH Aerospace's TTEController HiRel ASICs to implement TTEthernet connectivity allowed us to reduce our recurring cost. These components come in automotive-grade packaging, and qualifying both this 'off-the-shelf' solution and the Ethernet-based data network is one of several key innovations in Ariane 6.

ANDRE HUBERT ROUSSEL
Former CEO, ArianeGroup

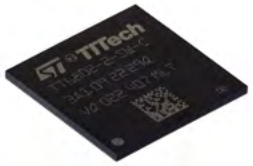
AT A GLANCE

PROJECT	Launcher avionics
CHALLENGE	Avionics need to cope with increasing data rates and enable more modular architectures. At the same time, launchers face strong market pressure through increased competition, affecting both development and recurring cost. Further challenges are avoidance of both obsolescence and export restrictions.
SOLUTION	TTEthernet® enables cost savings thanks to modular, scalable systems architectures. It has been chosen as the single avionics network for Ariane 6. TTTECH Aerospace's European-made TTESwitch Controller HiRel and TTEEnd System Controller HiRel ASICs are the key components to achieve fully deterministic, high-speed connectivity. They also power the TTESwitch MYTHOS HiRel which aggregates video streams on board of the launch vehicle. This Ethernet network switch was developed within an ESA FLPP activity triggered by the Ariane 6 use case.
TTEthernet:	TTEthernet solution: uniquely integrates three standards i.e. IEEE 802.3, ARINC 664 part 7 and SAE AS6802 (Time-Triggered Ethernet). In 2021, the ECSS-E-ST-50-16C engineering standard for Time-Triggered Ethernet was released by ECSS in cooperation with ESA and the European space industry to ensure interoperability and compatibility.

TTETHERNET-BASED DATA NETWORKS REDUCE SOFTWARE COMPLEXITY AND ENABLE TRUE MODULARITY

TTEthernet enables cost savings thanks to modular, scalable system architectures. Safe and secure partition of data, bandwidths scaling up to 1 Gbit/s and precise time distribution ensure that three traffic classes (best-effort, rate-constrained and Time-Triggered Ethernet) for critical control and command data, as well as non-critical payload data can be transmitted on the same physical network. This reduces cabling as well as system complexity, and integration efforts.

Fault-tolerant, automated time synchronization and fault containment are implemented in hardware which increases safety and eliminates the need for dedicated software solutions. The familiarity of the engineering community with Ethernet and the usage of off-the-shelf Ethernet test and monitoring equipment are added benefits. Recurring component cost is minimized by using automotive-like packaging and qualification instead of a full-blown space grade approach and by standardizing on a single interface to the network. Most importantly, the on-board TTEthernet network can be configured smartly so that both variants of the launch vehicle (Ariane 62 and Ariane 64) can be flown with the same configuration and the same software – true modularity proven ins use.



TTESwitch Controller HiRel

TTESwitch MYTHOS HiRel

TTESwitch Lab Space

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ABOUT TTTECH AEROSPACE

TTTECH Aerospace supplies and develops highly dependable networking and embedded computing platform solutions for time-, mission- and safety-critical applications. Its products are based on open data networking standards (Ethernet, ARINC 664 part 7, TSN), time-triggered technology, and deep know-how in safety certification. Its network switches and network interface solutions are used by global champions and technology leaders such as Collins Aerospace, Honeywell, or Thales, and can be found, for example, in the Airbus A- 220, Boeing 787 and Embraer C-390 aircraft, NASA's Lunar Gateway, the Ariane 6 launch vehicle and in critical infrastructure.

TTTECH Aerospace is a business entity of the TTTECH Group, a globally operating group of high-tech companies, founded and headquartered in Vienna, Austria. TTTECH is the innovator of Deterministic Ethernet and a driving force behind the IEEE TSN and the SAE AS6802 Time-Triggered Ethernet standards. TTTECH North America Inc serves the US market with offices in Andover, MA, and Houston, TX.

HEADQUARTERS

TTTECH Computertechnik AG
Schoenbrunner Strasse 7
1040 Vienna/Austria

P +43 1 585 34 34-0
E products@tttech.com