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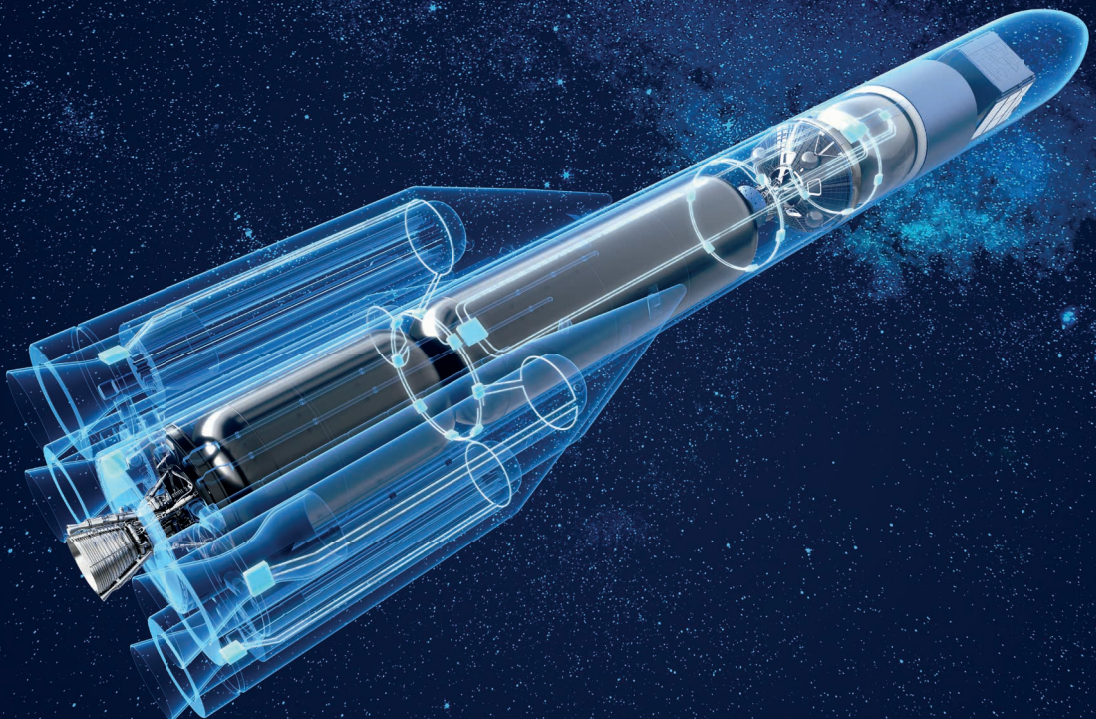
European launcher
Ariane 6

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

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TTEthernet:

Europe's new flagship launcher Ariane 6 will ensure 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 most 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 soft-ware 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 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 and packaged in a cost-efficient plastic package. This ensures high reliability in harsh environments requiring radiation tolerance and latch-up immunity for applications like launch vehicles and LEO satellites.

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
CEO, ArianeGroup

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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 at component level.
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 ᵀᵀᴱSwitch Controller HiRel and ᵀᵀᴱEnd System Controller HiRel ASICs are the key components to achieve fully deterministic high-speed connectivity.
TTEthernet⁝	TTEthernet® solution: uniquely integrates three standards i.e. IEEE 802.3, ARINC 664 part 7 and SAE AS6802 (Time-Triggered Ethernet). In 2019, TTEthernet® was baselined as the IASIS standard for avionics by NASA and its space agency partners. In 2021, it was released as the ECSS-E-ST-50-16C engineering standard by ECSS in cooperation with ESA and the European space industry. Both standards ensure interoperability and compatibility, especially for space programs where many partners and suppliers are involved.

TTEthernet®-based data networks reduce software complexity for faster integration and reduced program risk

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 network. This reduces cabling as well as system complexity, integration, and testing efforts.

Fault-tolerant, automated time synchronization and fault containment are implemented in hardware which increases safety and ensures the system is operational at all times. The familiarity of the engineering community with Ethernet and the usage of moderately priced, 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. Finally, built-in fault tolerance and safety features allow for superior reliability and availability needed in launchers and other spacecraft.

ᵀᵀᴱSwitch
Controller HiRel

ᵀᵀᴱEnd System
Controller HiRel

ᵀᵀᴱSwitch
Lab Space

Exploring new ways to simplify spacecraft software and system architectures

About TTTech Aerospace

TTTech Aerospace provides deterministic embedded network and platform solutions for aerospace and space applications. Its products have already completed over 1 billion flight hours in Level A safety-critical applications like fly-by-wire, power systems, avionics, engine controls and environmental control systems and covered distances of more than two million kilometers in deep space. Proven, mature solutions help customers in the aerospace and space industries to develop integrated, modular and scalable deterministic network platforms that increase safety, fault-tolerance and availability.

In addition, integrated solutions reduce size, weight, power and cost (SWaP-C), allowing for easier handling of equipment and lowering total lifecycle cost.

TTTech Aerospace is part of the TTTech Group, a globally oriented 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, headquartered in Andover, MA and with offices in, among others, Houston, TX, is also part of the TTTech Group.

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