

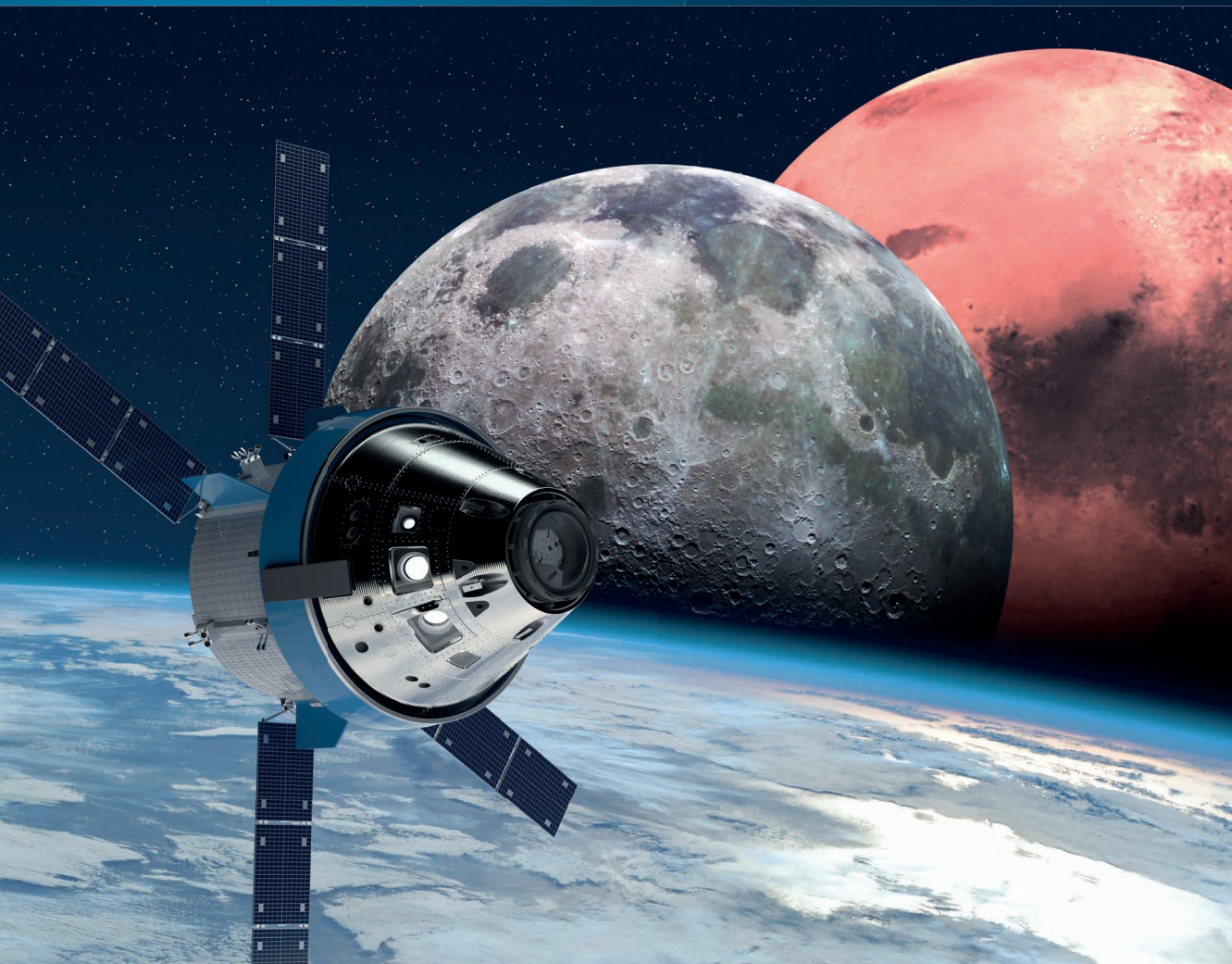
TTTech

NASA's Orion Spacecraft

Systems Integration with
Deterministic Ethernet

tttech.com/space ↗

TTEthernet:



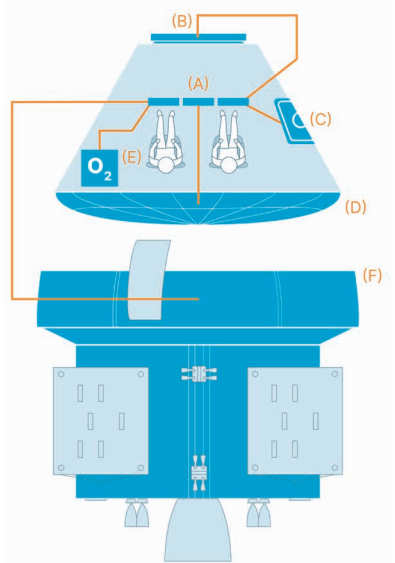
NASA's Orion is the successor to the famous Space Shuttle. Orion is an integral part of NASA Artemis that plans to land the first woman and first person of color on the Moon and enable future exploration to Mars. ↘



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- ... TTEthernet® data network
- (A) ... crew displays
- (B) ... docking adapter
- (C) ... entry hatch
- (D) ... heat shield
- (E) ... oxygen
- (F) ... European Service Module

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Orion – NASA’s next generation spacecraft: relying on TTEthernet®-based avionics network

After a first successful test flight in December 2014 (EFT-1), when Orion went into space through the Van Allen radiation belt, the first uncrewed test flight of the Artemis mission (Artemis I) was launched in 2022. On board for both flights was key technology from TTEch Aerospace and it was switched on during the entire flight. Why? One of Orion’s most important systems is the avionics system, often described as the “central nervous system” of the spacecraft.

It consists of a wide variety of electronics implemented into various independent systems, each responsible for performing specific, often critical functions. TTEthernet® is at the core of this “central nervous system” supporting a mixed-criticality architecture. It enables the use of one single network for critical and non-critical data with three traffic classes, i.e. best-effort, rate-constrained and Time-Triggered Ethernet, making it highly flexible and modular.

All independent avionics sub-systems of Orion are connected by using this single, fully deterministic high-performance Ethernet network technology developed by TTEch Aerospace and evolved in collaboration with NASA into an open standard (SAE AS6802). TTEthernet® was also baselined by NASA and its international space agency partners in the International Space Interoperability Standards (IASIS) for avionics networks for Artemis and future space missions.

We look forward to realizing the potential of TTEthernet® technology development, which provides a high bandwidth avionics databus capability supporting future technology insertion.

DEPUTY DIRECTOR
Programmatic and Strategic Integration,
Exploration Systems Development at NASA

At a glance ↘

Customer / Project	NASA/Lockheed Martin Space/Honeywell – on-board TTEthernet® data network and TTEthernet® testing infrastructure
Challenge	The customers required a future-proof, high-bandwidth data network with advanced safety features (fault tolerance in particular) for upcoming deep space missions.
Solution	TTEch Aerospace offered a certifiable, Ethernet-based solution which can handle both synchronous and asynchronous traffic without any conflicts and thus maximizes data throughput on GBit/s Ethernet lines while minimizing latency and jitter.
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.

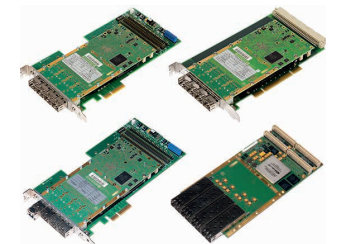
Doing more with less – at 1,000 times the speed

TTEthernet® is a highly deterministic version of Ethernet and is fully compatible with the standard IEEE Ethernet networks found in every office around the world. On board of Orion, TTEthernet® is capable of connecting up to 48 communication endpoints over 18 deterministic switches.

TTEthernet® moves data at a rate 1,000 times faster than those used on previous human-rated spacecraft (rates of up to 10/100/1000Mbit/s).

As a single network, TTEthernet® supports all of Orion’s data transfers and communication with reduced cabling (less mass). In addition, the simpler architecture enabled significant cost savings in respect of software and integration/testing. NASA and its prime contractor Lockheed Martin can seamlessly integrate highly critical real-time functions like flight controls and life-support systems with lower priority data on one single physical network while guaranteeing predictable system behavior.

TTEch Aerospace provided TTEthernet® chip IP, software, scheduling tools and various TTEthernet® equipment for ground-based development and test purposes (switches with and without monitoring capability and interface cards in different form factors).



TTEthernet Network Interface Cards



TTEthernet Development Switch 12 ports

TTEch Aerospace’s TTEthernet® products provide a flexible real-time Ethernet platform that facilitates the design of complex integrated systems with the most stringent safety requirements.

KURT DOPPELBAUER
Vice President Strategic Sales & Business Development,
Business Unit Aerospace, TTEch

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 Computertechnik AG operates under the umbrella of the TTTech Group, a globally oriented group of high-tech companies, founded and headquartered in Vienna, Austria. 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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