**Ensuring Reliable Networks**   **TTTech**

## NASA's Orion
## Multi-Purpose Crew Vehicle

## Systems Integration with
## Deterministic Ethernet

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success story online

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**TTEthernet**

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

*Thomas W. Rathjen,*
*Deputy Director, Programmatic and Strategic Integration,*
*Exploration Systems Development at NASA*

© NASA

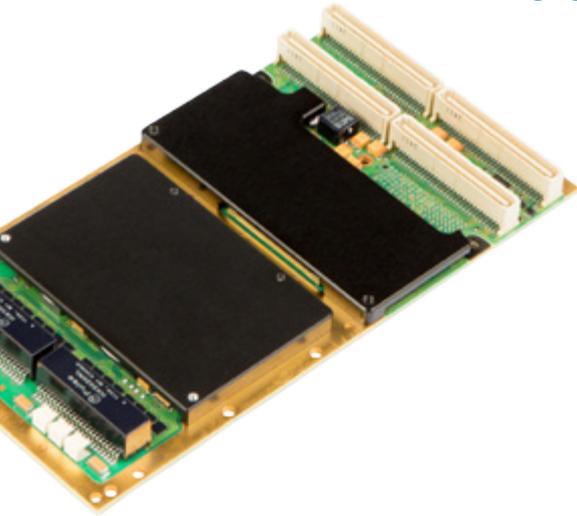## Orion – NASA's Next Generation Spacecraft: Relying on TTEthernet-Based Avionics Network

NASA's Orion Multi-Purpose Crew Vehicle (MPCV) is the successor to the famous Space Shuttle. As a next generation spacecraft it will enable humanity to explore space beyond low earth orbit, including distant asteroids, the moons of Mars or Jupiter and other places in our solar system. During its first flight in December 2014 (engineering test flight one – "ETF 1") the Orion MPCV successfully went into space through the Van Allen radiation belt and back to earth. On board was key technology from TTTech 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 "brains" of the spacecraft. It consists of a wide variety of electronics assembled into various independent systems, each responsible for performing specific, often critical functions. TTEthernet is at the core of this "nervous system" supporting a mixed criticality architecture using all three traffic classes of TTEthernet, i.e. standard, rate-constrained and time-triggered Ethernet, thus being highly flexible and modular. All independent avionics sub-systems of the Orion MPCV are connected by using this single, fully deterministic high-performance Ethernet network technology engineered by TTTech. This data network performed flawlessly during ETF 1.

## 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 MPCV, 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 the old
systems of the space shuttle. As a single network
it supports all of Orion MPCV data transfers and
communication with reduced cabling (less mass).
In addition the simpler architecture enabled
significant cost savings in respect to 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. TTTech 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).

▸ CUSTOMER / PROJECT

NASA/Honeywell – on-board data
network

▸ 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

TTTech offered a certifiable,
Ethernet-based solution which
can handle both synchronous and
asynchronous traffic without any
conflicts and thus maximizes data
throughput on Gbps Ethernet lines
while minimizing latency and jitter.

◂ AT A GLANCE

**TTEthernet**

The core services of
"Time-Triggered Ethernet
(TTEthernet)" have been
standardized in SAE AS6802.

# Exploring New Ways to Simplify Spacecraft Software and System Architectures

## About TTTech Computertechnik AG

TTTech Computertechnik AG is the leading supplier of dependable networking solutions based on time-triggered technology and modular safety platforms. The company's solutions improve the safety and reliability of networked electronic systems in the transportation and industrial segments. Our product portfolio offers best-in-class certifiable products according to IEC 61508, ISO 26262, EN 13849, DO-254 and DO-178B requirements.

TTTech customers win as they deploy dependable networks and real-time controls more efficiently and profitably. Benefits include shorter time-to-market due to re-use of proven architecture, higher integration with reduced cost, ease of system integration, and obsolescence management as well as highly scalable and modular open real-time architectures.

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