
TTTech
Exploring New Ways to
Simplify Spacecraft Software
and System Architectures

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5 Minutes

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1 Old & New

2 A6, Moon, Mars

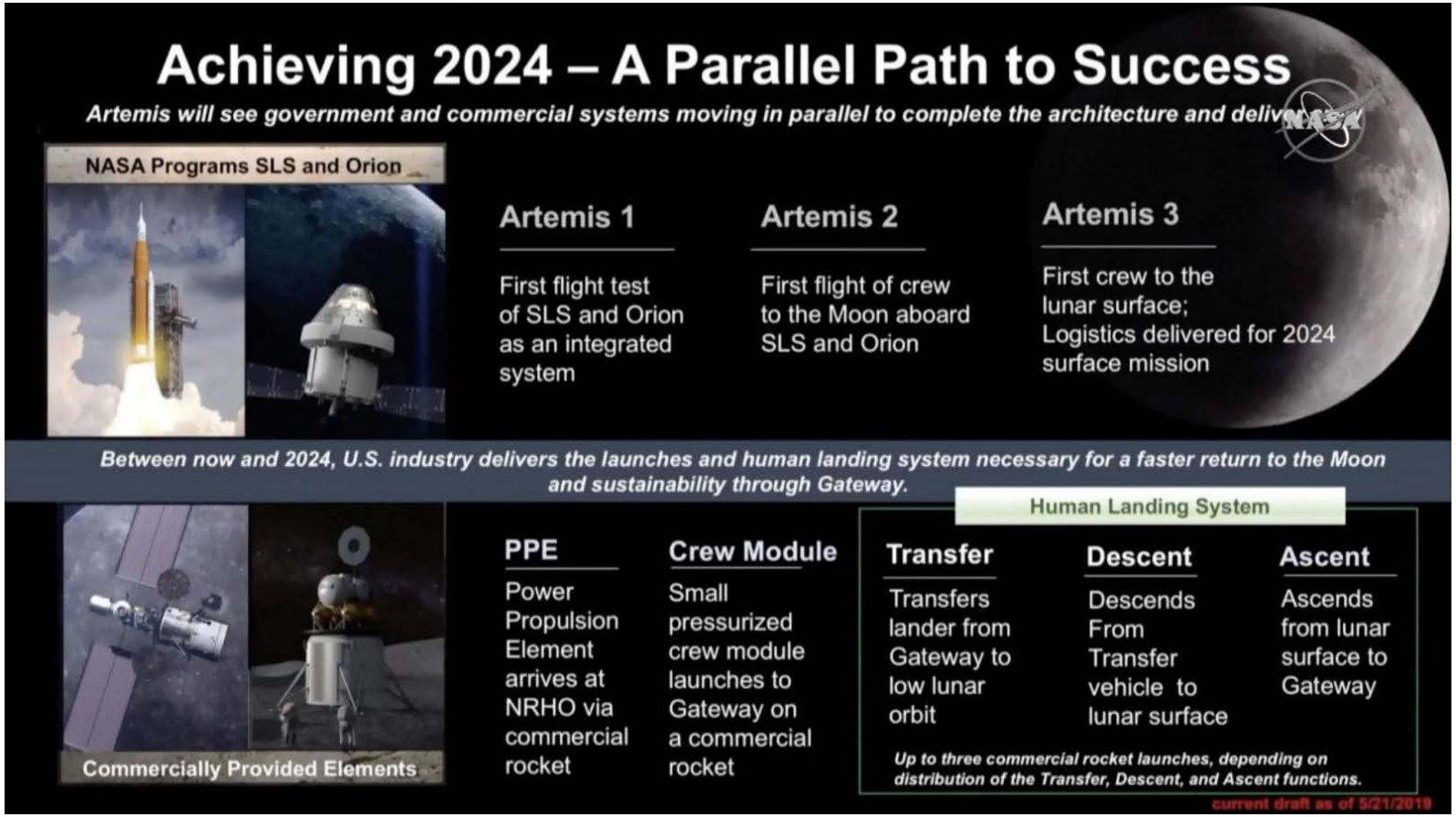
3 Technology, Chip, **Equipment**

4 Outlook

Old & New

- Regular exhibitor – TTTech is still TTTech
- The other two constants are ~~Aeroflex~~ Cobham and ~~Atmel~~ Microchip
- SAE standard on Time-Triggered Ethernet almost 10 years old…
- First ADCSS for two colleagues (David “EPOS” Jelem and Ivan Masar)
- Our (new) partner for space equipment: ~~Saab~~ RUAG Space Austria

A6, Moon, Mars (Artemis + Gateway)



Launchers, landers, orbital infrastructure – global cooperation, US lead

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Avionics for “System of Systems”

- International partnership requires open, international standards: *www.internationaldeepspacestandards.com*
- “Networks for vehicle command and control functions need to support various voting schemes such as exact match, fault-tolerant averaging…”
- Rendezvous and docking (IRSIS): “Inter-element networking”
- “A synchronized, unified time information shall be maintained by all vehicles in the overall architecture, including visiting vehicles as well as the target vehicle.”
- “Utilization **of strong space-time partitioning** to accommodate mixed criticality and data types” (similar to Distributed Integrated Modular Avionics – DIMA approach in aeronautics)
- Simple, ideally “COTS” interfaces for crew and science => Ethernet!

Avionics Simplification = Software Simplification

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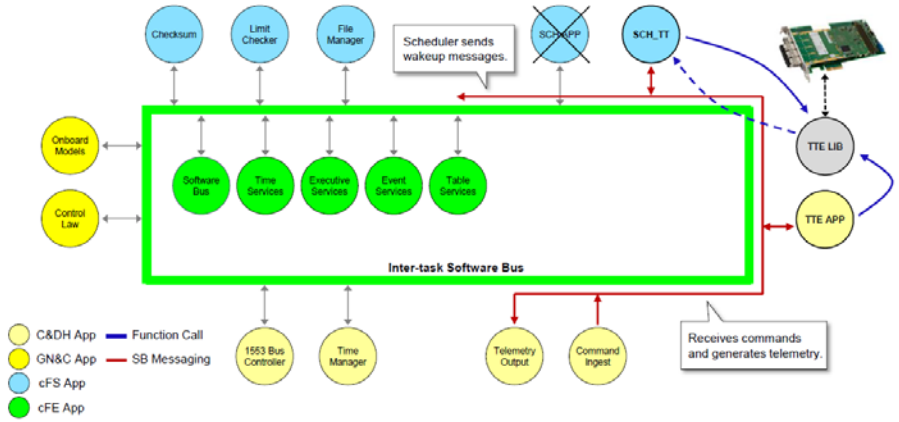
Less Code, Reduced Testing

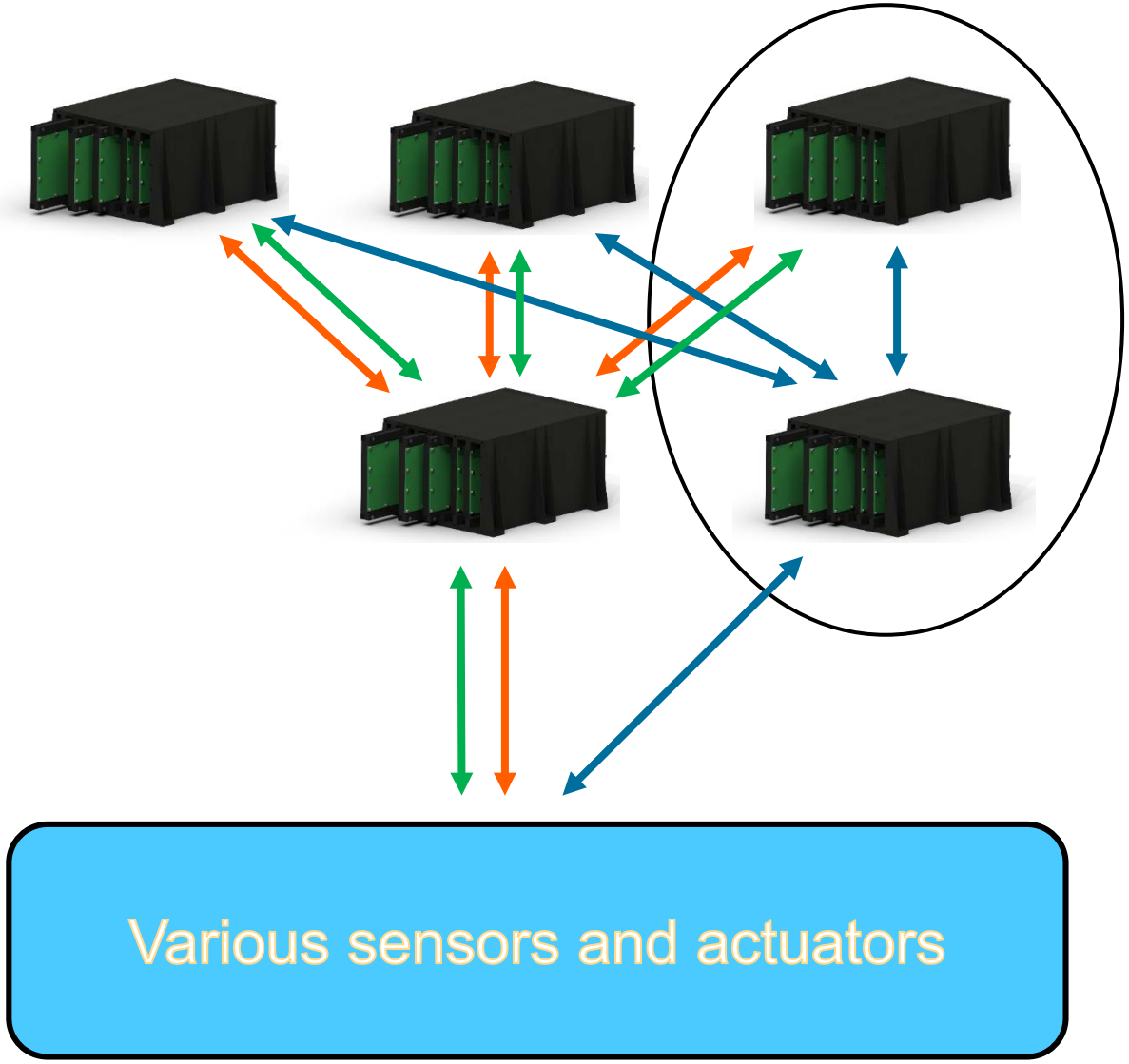
- Key elements of redundancy and fault management in hardware
- Fault-tolerant synchronization in hardware (distributed clock) – vs. in software
- Known states incl. deterministic message sending order ➡ simplified software architecture and V&V

More Re-Use, Advanced Tools

- Common, open/openly available, but version-controlled framework – like AUTOSAR or SAVOIR
- …or NASA Core Flight System “cFS”
  - “Flight software command, control and communication framework based on a common message distribution capability”
  - “Common developer toolset for application development and integration”



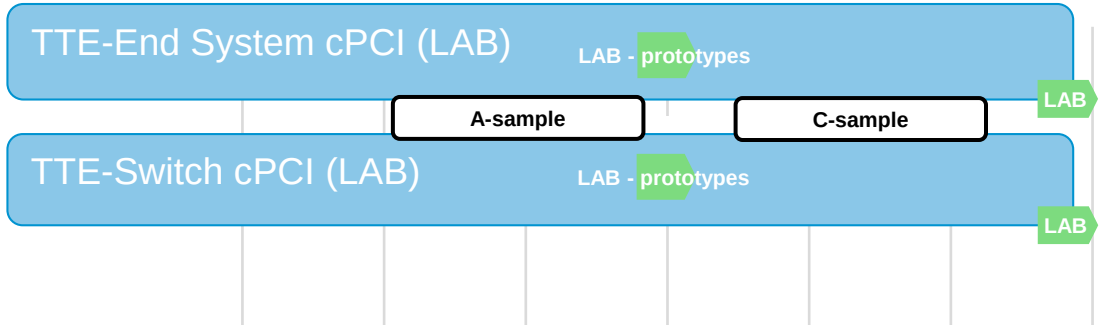
Modularity Through Common Equipment

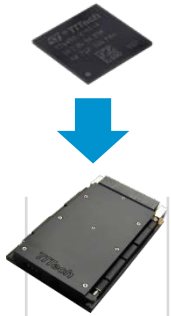


- Standardized hosting units
- Standardized fault-tolerant switches and network interface cards
- Integration of various types of on-board computers
- Partitioning and redundancy management in hardware, elimination of voting software
- Scalable…

From Chip to Equipment

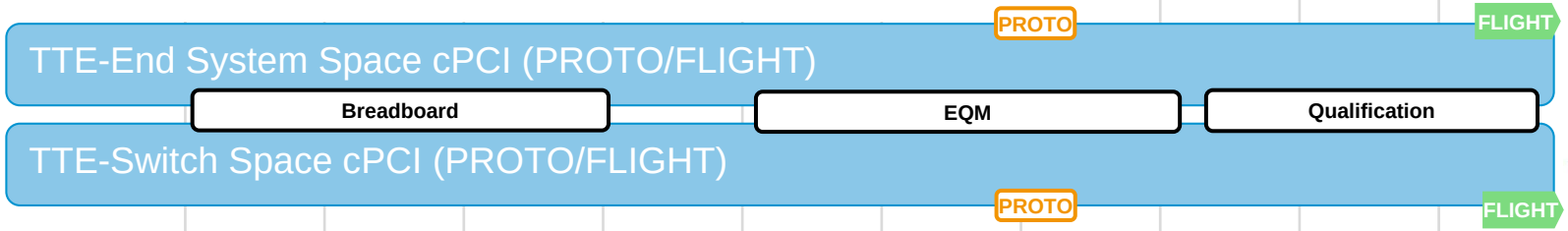
EPOS Phase I: Lab Equipment

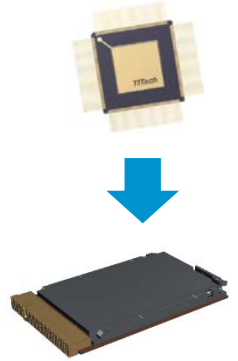




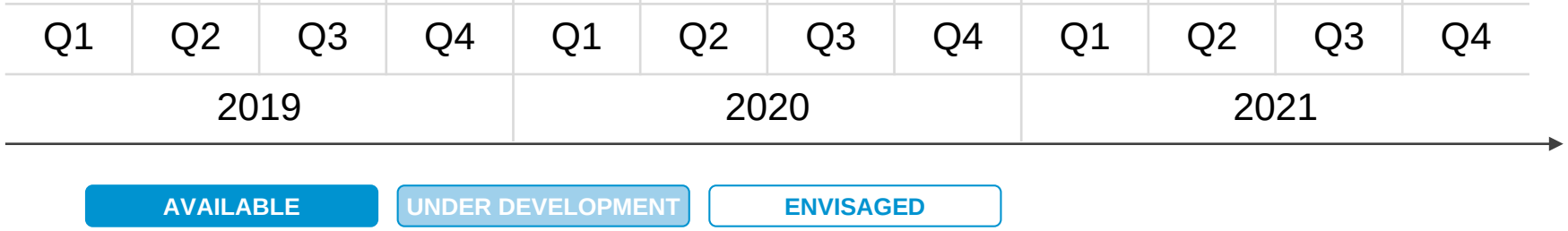
Based on TTE-Controller HiRel

EPOS Phase II: Flight Equipment





Based on TTE-Controller Space



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