Advanced Embedded Data Platforms for Distributed Power Management

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Company Key Facts

- Globally oriented high-tech company, headquartered in Vienna, Austria
- Innovation leadership - successful transfer of groundbreaking research to high-volume production
- Privately held joint stock company with solid financial base and diversified shareholder basis
- More than 400 employees with offices in 10 countries (2015)
- Flexible supply network with leading industry partners and research institutions

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Our Markets and USPs

Markets

- Automotive
- Aerospace
- Industrial
- Off-Highway

Product Examples

- ADAS Platform
- 3U VPX Switch
- Deterministic Ethernet Switch
- High-end ECU

TTTech USPs

- TTTech is the technology leader in robust networked safety controls
- TTTech is the innovator of Deterministic Ethernet and the driving force behind the TTEthernet standard
- TTTech transfers proven aerospace network technology to mass markets like automotive and industrial

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Integrated Modular Avionics

The needs

- Higher system efficiency (SWaP reduction)
- New functional capabilities
- Minimized maintenance/lifecycle costs

The solution: Integrated Avionics Architectures

- Longer maintenance intervals …
- Less parts, higher commonality, modularity
- Increased levels of functional Integration
- New capabilities, System level optimization

Many functions hosted on common embedded resources

Embedded Virtualization!

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More Electric Aircraft Data Network

The needs

- Higher system efficiency (Single energy)
- New functional capabilities
- Minimized maintenance/lifecycle costs

The solution: More Electric Aircraft

- Longer maintenance intervals …
- Less parts, higher commonality, modularity
- Time and Space distribution
- New capabilities, System level optimization

Many functions hosted on common embedded resources
Embedded Virtualization!

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Distributed Power Systems with „private“ embedded system and networks

More Electric Aircraft

- Distributed embedded controls
- Aircraft-wide hard RT system integration capability
- IMA-style infrastructure
- Ethernet-based data systems?
Control Loops like Hard Real Time Determinism!

Data network latency and jitter increase complexity in the control equations!!!
TTEthernet: Combining three worlds

Asynchronous / Event Triggered
- ARINC 664 (AFDX®) / AVB
- Rate-constrained
- Avionics
- Audio/video & Sensor fusion

Synchronous / Hard Real Time
- SAE AS6802 synchronization
- Real-time control
- Ultra-low latency
- Safety systems

Best Effort Ethernet (IP)
- IEEE 802.3 standard traffic
- Best effort (IP)
Synchronized Global Time

- Precise latency and minimum jitter (< 1µs)
- Distributed fault-tolerant synchronization
- Robust time base
TTEthernet Mixed Network

✔️ AFDX® network
TTEthernet Mixed Network

- Starting point: AFDX® network
- TTEthernet switches configured to operate as pure AFDX
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- TTEthernet switches configured to operate as pure AFDX
- Add function using time-triggered services (TT messages, GPS…)

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TTEthernet Mixed Network

- Starting point: AFDX® network

- TTEthernet switches configured to operate as pure AFDX

- Add function using time-triggered services (TT messages, DIMA, GPS…)

- Do further changes (e.g., add other AFDX® network, BE Ethernet E/S, Distributed IMA)
IMA and Distributed Power Data Systems (1/3)

Segregated model

- One MEA IMA-like embedded data platform (trans-ATA) separated from main avionics IMA system
- IMA runs only asynchronous (ARINC664/AFDX®) traffic
- Distributed Power data network runs synchronous (TT) traffic
- Both traffic coexist seamlessly at the interface
Towards more integration

- Some high level MEA functions integrated in the avionics IMA
- Mix of asynchronous and synchronous traffics in the aircraft IMA. Both traffic coexist in the IMA
- Comprehensive safety and efficiency analysis needed
- Impact on the OEM/Tier 1 relationship!!!
IMA and Distributed Power Data Systems (3/3)

Subsidiarity!

- Most of high level MEA functions integrated in the avionics IMA
- Only low level and/or backup systems at MEA data network level
- Mix of asynchronous and synchronous traffics in the aircraft IMA
- Strong impact on the OEM/Tier 1 relationship!!!
Summary: Distributed Power Data Systems and Controls

Distributed Power data System & Controls

- Distributed power systems can be controlled by IMA-style embedded data systems and controls
- Synchronous capability required to host strictly deterministic and fast controls
- A combination of SAE AS6802 and ARINC664 make it viable

Potential Optimization

- More functions hosted in common infrastructure
- Lower SWaP, less connections, higher commonality
- Simplified design of reusable, modular and scalable architectures
- Functions can reside anywhere in the system, not tied to specific box or unit
- Simplified reconfiguration and improved dispatch