Train Communication Networks

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Identify obstacles for the adoption of the new Ethernet Train Backbone (IEC 61375-2-5) standard
Contents

• Intro to Train Control and Management Systems (TCMS)

• Train Communication Networks

• Railway industry

• Conclusions
Train compositions

Closed Train

Multiple Unit Train

Open Train
Train compositions

Closed Train

Multiple Unit Train

Open Train

[2]
Train compositions

Closed Train

Multiple Unit Train

Open Train

[2]
The Modern Train
Train Control and Management System

Consists of

- Processing units (Computers)
- Networks (Buses and bus protocols)
- Subsystems (Controllers)
- Interfaces to subsystems (Application protocols)
Train Control and Management System

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Purpose

- Control and Monitor (Crew)
- Diagnostics (Maintenance)
- Upgrade and reconfiguration (Operator)
Train Control and Management System
Train Control and Management System

Train Communication Network

TRAINNET® TCMS, FOR THE MONITORING, CONTROL AND AUTOMATION OF:

1. HVAC
2. Bearing temperature ( Sic.L 2)
3. Speed measurement ( Sic.L 2)
4. Lateral vibration ( Sic.L 2)
5. Brakes
6. Traction
7. PIS/PA
8. Diagnostics
9. Lights
10. Water tanks
11. CCTV
12. Batteries
13. Doors
14. Emergency communications
15. Data protection (event recorder)
16. Train-to-waist communications

Aalto University
Train Communication Networks

Originally based on Industrial Fieldbuses
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- Slow bit rate (~1 Mbit/s)
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• Slow bit rate (~1 Mbit/s)
• Not designed for train environment
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• No standard \(\rightarrow\) Proprietary solutions
Train Communication Networks

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Examples
- LonWorks
- CAN
- Profibus
The Train Communication Network (TCN)

The TCN standard (IEC 61375-1)

- Designed for trains

[2]
The Train Communication Network (TCN)

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- Designed for trains
  - Hardware and protocols

[2]
The Train Communication Network (TCN)

The TCN standard

• Designed for trains
  • Hardware and protocols
• Automatic reconfiguration

(IEC 61375-1)

[2]
The Train Communication Network (TCN)

The TCN standard

- Designed for trains
  - Hardware and protocols
- Automatic reconfiguration
- Specifies network services
  - Topology, process data, etc.
  - Subsystem interfaces

(IEC 61375-1)

[2]
The Train Communication Network (TCN)

The TCN standard (IEC 61375-1)

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  - Hardware and protocols
- Automatic reconfiguration
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Cost reductions
The TCN standard

- Designed for trains
  - Hardware and protocols
- Automatic reconfiguration
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(IEC 61375-1)

BUT!

Overall network bandwidth still low
The Ethernet Train Backbone (ETB)

• Same architecture as TCN
  • Same benefits

(IEC 61375-2-5)
The Ethernet Train Backbone (ETB)

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  - Same benefits

- New functionalities
  - More flexible
  - Separation of control and multimedia data

(IEC 61375-2-5)
The Ethernet Train Backbone (ETB)

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- High network bandwidth
  - >100 Mbit/s

(IEC 61375-2-5)
The Ethernet Train Backbone (ETB)

• Same architecture as TCN
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• New functionalities
  • More flexible
  • Separation of control and multimedia data

• High network bandwidth
  • >100 Mbit/s

(IEC 61375-2-5)

All good! Agreed?

[4]
Railway industry
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• Rolling stock has long life cycle (>20 years)
Railway industry

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• Safety and security conscious
Railway industry

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• Safety and security conscious

• Conservative
Railway industry

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• Political
  • Operators (buyers) largely government controlled
Conclusions
Conclusions

• Few technical reasons
  • Inherent risk of adopting new technology
  • Backwards compatibility due to long life cycles
Conclusions

• Few technical reasons
  • Inherent risk of adopting new technology
  • Backwards compatibility due to long life cycles

• Biggest obstacles
  • Financial
  • Strategic
  • Political
Sources


