Enhancing Situational Awareness through Rail ICT digitalization

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Driven by new ICT technologies, transportation service operation modes, and even transportation itself, are undergoing significant changes.

Three Directions for Digital Transformations of Transportation Services

- **Operational Automation**
  - Automatic train operation
  - Driverless car
  - Intelligent Transportation System

- **Work Mobility**
  - Self-service check-in
  - Mobile office
  - Internet access anytime, anywhere

- **Service Visualization**
  - Mobile maintenance inspection
  - Data visualization
  - Baggage tracking
  - Visibility into the whole express delivery process
  - Real-time vehicle position
  - E2E visibility into flight services
  - Real-time asset status
Rail ICT Trends
For Enhanced Safety, Reliability, Security and Passenger Satisfaction

- GSM-R / LTE
- ETCS / CBTC
- CCTV
- Passengers Services
- IoT
- Predictive Maintenance
- Asset Management
- Big Data
- Analytics
- Cloud Computing
- Operational Optimization

Resource Optimization
Costs Reduction
Business Productivity
What’s happening now with Rail operational communication?

**Signalling**
- ETCL2,
- ETCS L3,
- CBTC

**Ground to Train**
- GSM-R,
- LTE
- WiFi
- Tetra

**Standards**
- EIRENE,
- FRMCS

**Today**
- Single radio access technology
- Dedicated networks
- Dedicated spectrum for railways
- Simple/static on-board devices and interfaces
- Clear implementation objective

**Future situation as envisaged by ERA**
- Multiple radio access technologies
- Dedicated/shared/public networks
- Dedicated / shared radio spectrum
- More complex and flexible on-board technology
- Challenging transition phase continuous evolution

*Evolution of legal framework in the EU railway Domain (ERA, May 2017)*
The creation of the GSM-R successor

UIC FRMCS Project
- Consists of Rail operators (UIC Members)
- Consolidation of Requirements and use cases
- Scope: Functionality, Technology, Spectrum
- Note: scope is not limited to Europe

ETSI TC RT
- Transfer of contributions into 3GPP with input from Rail industry
- Contributions to ECC on spectrum items
- Preparation of (European) Standards

ERA:
- 2018 CCS TSI update is planned, Some of FRMCS could be included
- 2021-22: CCS TSI update with Full FRMCS, Legal framework ready for FRMCS deployment

3GPP
- Drafting of Specifications for (4G, 5G): features and radio frequency bands for each technology

Industry view on FRMCS Architecture
- Applications
  - Voice Services
  - Data Services
  - Group Communication
  - Train Control
  - Location Services
  - GSM Services
  - Video Services
  - Others

Core Network
- 3GPP Core
- 3GPP Session Control & Management
- EPC
- NGI

Access Network
- 3GPP R5
- LTE & 5G RAN
- Wi-Fi
- Satellite
- Fixed Network IP based

Terminal Equipment
- Fixed Terminals
- Others
New ICT will Be Market Drivers in Railways
Strong investment in Digitalization across transport sector

50B$ Market in Railway Digitalization

Source: "IoT in Transportation Market, Analysis and Forecast to 2020", from MarketsandMarkets
New ICT Infrastructure: Synergy Among Cloud, Pipe, and Device

**Cloud**
- Data center
- Cloud OS
- Big Data analytics platform

**Pipe**
- Agile campus network
- Data center network
- 5G/IOT/LTE-R network
- IP network
- Transmission network
- WLAN

**Device**
- IoT
- Agile gateway
- Telepresence
- Videoconferencing/IVS

**Safety**

**Services**

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New ICT Technology is Injected into Railway Solutions

1. Railway Cloud
   - Fusion OCC
   - Fusion Cloud, Big Data
   - BYOD, IoT, LTE, SDN
   - IoT, Edge Computing

2. Video Surveillance
   - Intelligent Video
   - Video PaaS, Intelligence Analysis

3. Trackside
   - Operational Communication

4. Rolling Stock
   - Digital Train
   - IoT, Edge Computing

BYOD, IoT, LTE, SDN
IoT, Edge Computing
Video PaaS, Intelligence Analysis
Intelligent Video
Fusion OCC
Fusion Cloud, Big Data
Operational Communication
LTE Solution for Urban Rail

CBTC ---- LTE-Licensed
Dual-network redundancy, 99.999% availability of the whole network

Dispatching ---- LTE-Licensed
3GPP Rel-13 Voice Service, multimedia dispatching (3GPP Rel-14)

PIS & CCTV ---- LTE-Licensed
eMBMS for 720P Video broadcast
UL 12Mbps for high-definition CCTV

Internet ---- LTE-Unlicensed
2.4GHz/5GHz
2*WiFi coverage, high data throughput, less and smooth handover

Track-Side Device Monitor ---- LTE-IoT
- Real time data report, predictive maintenance
Innovative Practice: Railway Integrated IoT monitoring

- **Intelligent Railway Platform (AnySense)**
- **IoT Platform**: OceanConnect
- **Big Data Platform**: FusionInsight
- **Central platform in OCC equipment room**
- **Communication module (IoT Agent inside)**
- **Monitoring units (base stations along the line)**
- **Private wired network**
- **IoT transmission network**
- **Edge Computing**
- **Access Network**
- **Trackside**: On-site device monitoring
- **Service-centric Quick development**
- **Unified Platform**
- **Information Sharing**
- **Service Integration**

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Cooperation in Germany to Explore IoT Used in Railways

**Challenge**
Maintenance: Manual work, facing safety risks, low efficiency

>10 mins/_switch

**Joint Solution**

- Autonomous health states transmission to cloud center. Reduce maintenance costs by 25%.
- Failure prediction optimizes asset lifecycles, reducing capital expenditure by 20%.

**Result**

- KONUX Third-party APP
- Smart operation and maintenance
- 2 Access Modes
- eLTE
- IoT Gateway
- Sensors
- Trackside
- Train

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More than 40% of the train accidents occurred at unmanned level crossings.

Level crossing accidents are the No.1 cause for accidents on rail networks.

60% of railway accidents occurred at uncontrolled crossing.

Hidden dangers on train level crossings

- India: 40%
- Turkey: No.1
- Pakistan: 60%

Unmanned level crossings are the No.1 hotspot for accidents on rail networks.

The list goes on and on...
1. No need for mains supply thanks to solar power supply
2. When a train is approaching the crossing:
   1. an audible and visual alarm can be triggered at the crossing through the proximity sensor or GPS information (mutual backup)
   2. the train receives real-time video of the crossing within a certain range based on the distance information provided by the GPS
3. After a train passes through the crossing, the audible and visual alarm automatically stops.

Level crossing solution available today, operating on 5.8 GHz
Video Surveillance: Cloud Platform with Intelligent Analysis

Railway smart platform
- Video application software
- Intelligent analysis platform
- Video management platform

Passenger service/PA
- Ticketing
- Emergency command
- Railway police

Station
- Ticket lobby
- Station entrance
- Passage/Hall
- Barrier gate
- Platform
- Carriage
- Section
- Station exit

Train operation
- Passenger transport
- Maintenance
- Police

Video Surveillance: Cloud Platform with Intelligent Analysis
- Crowd Abnormal behavior detection
- Identity check
- Suspect identification
- Crowd density
- Congestion detection
- Biometric recognition
- Tripwire detection
- Full-process real-time visualization
- Abnormal behavior detection
- Disaster prevention monitoring
- 24/7 perimeter monitoring
- Biometric recognition
- Fare evader detection

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Known as the No.1 railway station in Asia:
- Runs world's 3rd largest passenger traffic
- Upgraded to HD video,
- reuse of existing devices
- seamless integration with SD video system

Huawei video cloud platform:
- Integration of existing hardware (8 types of non-Huawei cams)
- Improved reliability thanks to Safevideo patented technology
- Excellent image quality in low light scenarios, 0.04LUX

Maximized ROI and data reliability: New and original systems were seamlessly integrated. Storage stability of the original system is enhanced.
LTE-Based Network as a converged bearer network

**Benefits**
- **High Reliability**: 9-level QoS, smooth handover at high speeds
- **Low Costs**: Multiple services over a unified bearer network, reducing OPEX
- **Easy O&M**: Long-distance coverage of a base station, No equipment required in tunnels
- **Visualized Dispatching**: Coordinated dispatching over voice, data, and video

**Signaling**, **Trunking**, **PIS**, **CCTV**, **PA**

**Bearer network**

**LTE**

Leaky cable
LTE-M is Benefiting the Operation of Zhengzhou Metro

**Traditional technology**

- **Spectrum cost**
  - Use the public spectrum (5 GHz) for free

- **TCO**
  - Five-year TCO = 580 + 237.6 x 5 = 1768

**LTE**

- **Spectrum cost**
  - 1795-1805 10M bandwidth
  - Cost of the dedicated spectrum: CNY150/base station/year, about 10,000/year in total

- **TCO**
  - Five-year TCO = 1218 + 63.2 x 5 = 1534

Maintenance cost of LTE is 25% of traditional wireless technologies.

The five-year TCO of LTE is 80% of traditional wireless technologies.
• Dedicated-frequency LTE network has strong anti-interference capabilities and stable large bandwidth, thus reducing unexpected train stoppages.
• The long-distance coverage of a single base station greatly reduces in-tunnel equipment and simplifies maintenance.
• Atom GPS + 1588 V2 clock synchronization simplify network deployment.
1. Dedicated frequencies and dual-coverage of networks A and B enhance the overall reliability of the signaling system.

2. The 1588v2 clock synchronization system simplifies deployment of the LTE network.
Footprint of Huawei’s Urban Rail Solution

- Serving 100+ urban rail lines worldwide, with a total length of 2000+ km
- Leading digital transformation of urban rails by actively participating in the formulation of LTE-M and urban rail cloud specifications

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eLTE Solution Alliance: Promote Healthy Ecosystem Development

- Founded in February 2014, now 107 members
- Joint Innovation
- Joint Marketing
- Joint Promotion of Industry Standards

Standards organization, Applications, Carriers, Consulting and Design Partners

Integrators

Component and Terminal Providers

Solutions Alliance Online registration address: http://www.elteia.org/
THANK YOU