M2M and IoT solutions and use cases for railways

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A long history of successful change

1871
Siemens Com
Motorola Solutions
Alcatel-Lucent

2014 Mobile devices
2015

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CCWC Amsterdam 31st May – June 2nd 2016
Our journey

- Internet of Things (IoT) Introduction
- Nokia’s connected mobility vision for railways
- Nokia’s IoT portfolio for railways
- Connected Mobility References

CCWC Amsterdam 31st May – June 2nd 2016
The Internet of Things has a transformational impact on all industries, re-shaping business models, value chains, and entire industry configurations.
Industrialized IoT Solutions All Need the Same Basic Building Blocks

- Devices & Things
- Connectivity Networks
- Applications
- Platforms

CCWC Amsterdam 31st May – June 2nd 2016
The Internet of (hacked) Things on the rise
As we connect more devices, and create more value from the generated data, the risk for abuse, and security breaches goes up

October 2014
Millions of smart meters in Spain compromised

February 2015
2.2 million BMWs impacted

July 2015
1.4 million Chryslers recalled
Our journey

Internet of Things (IoT) Introduction

Nokia’s connected mobility vision for railways

Nokia’s IoT portfolio for railways

Connected Mobility References
A myriad of use cases will unleash the potential of connected mobility

Trends and drivers in railways

Digitization and connectivity is speeding up in railways

GE’s latest locomotive are equipped with more than 250 sensors that measure 150,000 data points per minute

35% of initial delays are due to failure of train or infrastructure components

80% of locomotives require repairs within 4 weeks after a planned maintenance - to be reduced by big data collection

6.4B connected things and more than 5M new things connected everyday

2016

2020

150,000 data points per minute

80%

35%

1 cnet.com; 2 T-Systems; 3 Gartner
Nokia is addressing 3 railway markets with connected mobility

- **Connected train**
  - IoT services to main-line rails, urban rails & mass transit passenger rails (on the track and in stations)
  - IoT services to rolling stock

- **Smart rail operations management**
  - IoT services to service vehicle
  - IoT services to trackside infrastructure

- **Smart facility management**
  - IoT services to train stations
Example use case: Connected mobility brought to railway operations

Rail track infrastructure monitoring
Minimize effort of maintenance.
By connecting multiple sensors alongside rail tracks, switches and signals to an intelligent IoT platform, the condition of infrastructure can be monitored remotely and predictive actions can be taken by using big data analytics.

Fleet and asset management
Keep track of your fleet and leverage from a new efficiency.
Track, monitor and manage your assets such as rolling stock and field operations. Benefit for example from a reduced time for compiling freight trains.
Example use case: Smart building energy management

Use case driver

- Average commercial building energy consumption\(^1\)
- 40% heating and cooling
- 30% lightning
- 8% energy wastage due to improper configurations

Use case overview

Manage energy demand efficiently.

Better monitor and understand energy performance of buildings integrating dynamic building environment in real or near real time. Move building management system from a standalone or closed environment into a wider network of data collection, sharing and system management.

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\(^1\) ABI Research
Example use case: Connected mobility brought to railway operations

Inventory and repair management

Reduce downtime of vehicles and increase maintenance throughput.

Trains and rolling stock connected to workshop technicians allow a preparatory analysis of the vehicle condition to prepare over-night maintenance and repairs already during operations.
Example use case: Smart video surveillance with edge analytics

Use case driver

Video cameras are cheap and everywhere creating lots of data but nobody is really looking at it.

Existing video analytics solutions have many false positives. Real scenes are too complex for traditional object recognition approach.

Use case overview

Leverage from real-time video analytics with lower error rate and intelligent machine learning.

Turn a camera into a sensor with real-time insights and intelligent machine learning anomaly detection. Allowing a multi camera feed support automatically detect:

• wrong direction
• speeding and running
• crowd congregation
Three main challenges for connected mobility

1. Cyber security
   Ensuring e2e secure connectivity between backend services / applications and connected devices to prevent unauthorized access and to preserve business continuity

2. Interoperability between use cases
   Enabling services / applications to talk with each other to leverage from crowd sourced intelligence and to overcome silo use cases

3. Business model
   Valuable use cases must be identified and appropriate business models must be developed.

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Connected mobility solutions for railways
Unleashing the potential of connected mobility

- read sensors, collect and analyze data in a backend
- remotely trigger actions inside the connected device
- remote software and service management
- secure IoT connectivity management

Horizontal IoT platform

- manage connected devices to remotely update software, certificates and keys
- detection and analysis of the connectivity link to the connected device
- identification of malware and anomalies

Secure connected mobility

- Wi-Fi and private LTE networks
- Mobile edge computing
- Backhauling
- Data center compute and storage

Intelligent communication infrastructure

- Advanced video analytics
- Fleet and asset management
- API for 3rd party applications

Connected mobility applications & analytics
A horizontal approach to meet challenges

Connected mobility platform
Every vehicle. Every use case.

1. One single secure interface to the vehicle.
2. Crowdsourced intelligence with data collection across use cases.
3. Using synergies with revenues and OPEX / CAPEX savings across use cases.

Vertical approach

Horizontal approach
Nokia and connected mobility

Connected vehicle, connected asset and connected facilities

Communication infrastructure

Secure connected mobility
- Security management, secure connectivity link

Intelligent communication infrastructure
- Low-latency vehicle-to-vehicle communication, mobile edge computing

Backend

Connected mobility applications & analytics
- Video analytics, fleet management, asset management, API for 3rd party applications

Horizontal IoT platform
- Remote vehicle & component management, vehicle data collection & management, Remote fault management, remote software update & management, remote registration & inventory management
Horizontal IoT platform highlights

**Multi-protocol**
- OMA-DM
- LWM2M
- TR-069
- Custom

**Horizontal IoT-platform**
- Application enablement
- Data collection and processing
- Device management
- Connectivity management

**Intelligent gateway**
via LWM2M supporting multiple protocols

**Highly scalable**
(100M+)

**Multiple deployment models**
- Hosted Deployment
- Public Cloud Deployment
- Private Cloud Deployment

**Open and standard-based ecosystem**
- OMA standards
- Rich APIs for integration (northbound and southbound)

**Multi-tenant**

**Industry leading device certification**
IMPACT IoT platform building blocks

Hosted applications
Application enablement platform lets you significantly lower the costs and reduce the risks involved in developing and deploying connected mobility solutions (cloud and distributed via mobile edge computing).

Monetize
With data collection and processing platform data is turned into value (data / event collection and management, diagnostic, location, fault management, enterprise management...)

Manage devices
With connected device platform all the connections can be managed centrally worldwide (discovery, upgrades/updates, configuration, reset/reboot, security,...)

Manage service
Connectivity management platform can handle effectively thousands of businesses and millions of devices.

Nokia applications, partner applications, 3rd party applications

Application development and execution

Data collection and processing

Connected device management

Connectivity management

IMPACT IoT platform
Nokia Device Management
Some Numbers

~800 million managed devices across home, mobile and enterprise networks
17% fixed device management market share
18% mobile device management market share

1 Billion savings for our top 10 customers

+1 firmly places Nokia in device management across home, mobile and enterprise networks with over 260+ customers

Combination of Nokia and Mformation offers customers a comprehensive, secure and cross-industry platform for the IoT-optimized network

+10 Billion connected devices need to be managed – that is an average of 1.7 devices for every person on the planet
Nokia’s comprehensive approach for secure connected mobility

Overview

1. Manage endpoints to establish trust
   Using industry best practices (2-way authentication; signed software delivery from trusted source to ensure authenticity; certificates; keys; encryption)

2. Endpoint profiling
   Alert and mitigate any deviation

3. Analyze traffic pattern and detect anomalies using analytics

IMPACT IoT platform

NetGuard ES
Analyze traffic pattern and detect anomalies using analytics and NetGuard ES at the example of connected car

**Problem statement**

- The car is connected to consume different services, potentially through parallel/multiple mobile connections
- An (infected) customer mobile might even infect the car (e.g. vehicle head unit) via Bluetooth or USB

**Solution**

Add **NetGuard endpoint security** client into the car

- Perform active security monitoring to detect attacks and abnormal behavior
- Support dynamic configuration of communication profile
- The analytics tool can track and analyze all attacks to all cars
- Trigger and manage mitigation actions such as firmware update over-the-air
Connected mobility applications and analytics

- Real-time traffic and crowd monitoring
- Intelligent machine learning anomaly detection
- Automatically identify wrong direction, speeding, crowds

Video analytics

- Localization
- Resource allocation
- Alarm management

Asset tracking

- Rich API for integration of 3rd party applications

Fleet management

- Localization
- Alarm management
- Sensor data collection and analysis
- Software updates
- Trip recording

3rd party integration
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Some connected mobility references

**Mercedes-Benz via Verizon (USA)**
- Secure remote management of connected car devices
  - [https://www.mbusa.com/mercedes/mbrace](https://www.mbusa.com/mercedes/mbrace)

**Continental (Global)**
- Firmware updates for vehicle head units and legacy electronic control units
- Being selected out of 14 vendors

**WESTbahn (Austria)**
- Broadband on train
- Train monitoring and fleet management
- Integrated pricing server

**Velaro RUS project (Russia)**
- Broadband on train
- Trains equipped with 2/3G backhaul
- Entertainment, restaurant camera, train information visible on in-seat monitors for premium class

**“Digital motorway test bed” motorway A9 (Germany)**
- Test bed of German Government for mobility 4.0 innovations
- Low-latency car-2-car communication via LTE with mobile edge computing

**Chorus as part of Nokia’s ng Connect Program (New Zealand)**
- Remote management of in-vehicle components

**Chunghwa Telecommunications Laboratories (Taiwan)**
- Taiwan’s first live LTE trial involving high-speed railways
- High-definition video call

**Digital motorway test bed**
- Motorway A9 (Germany)

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Car-2-car communication
Overview low-latency communication

Central cloud for connected cars

Distributed „cloudlets“ for connected cars

LTE network

20 ms
Conclusions

Horizontal platforms based on widespread IoT standards (OMA, LWM2M, ...)

Mobility has to be connected to the Cloud (via 4G/5G)

Security down to the End Point is of utmost importance

Open API’s for Application Self-Services, next to traditional Enterprise Applications
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