IoT: Internet of Trains

Gerhard Kreß
Vice President Data Services, Siemens Mobility

Topics of the presentation

- Quick overview on Siemens
  - Internet of Trains – What will it bring
    - Deep dive: Data Services

Global presence is key for Siemens to be close to customers all over the world

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Americas		Share of total worldwide
Revenue[1]	**€22.7 billion**	29%
Employees[2]	**72,600**	21%

Germany		Share of total worldwide
Revenue[1]	**€10.7 billion**	13%
Employees[2]	**113,400**	32%

Europe (excluding Germany), **CIS[3], Africa, Middle East**		Share of total worldwide
Revenue[1]	**€31.1 billion**	39%
Employees[2]	**102,300**	29%

Asia, Australia		Share of total worldwide
Revenue[1]	**€15.1 billion**	19%
Employees[2]	**62,700**	18%

1 by customer location
2 as of September 30, 2016
3 Commonwealth of Independent States

All figures refer to continuing operations.

Digitalization at Siemens: Combining the physical and digital worlds

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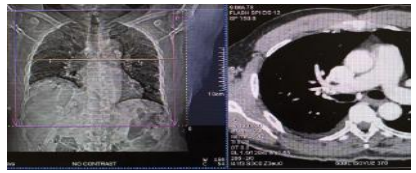
Virtual world

Analytics
Fleet management
Embedded software
Neural networks

Fault recovery
Smart grids
Network planning
Meter Data Management
Efficient buildings

Traffic management
CAx
e-Tolling
Digital Factory
PLM
Collaboration
MES
in the cloud



Imaging software
Image guided therapy
Decision support

> 280,000
connected devices

> 16 terabytes
of operations data every month

Physical world – Siemens installed base








Siemens AG provides technical products and solutions in a broad set of industries

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Managing Board of Siemens AG

Joe Kaeser President and CEO	Lisa Davis	Roland Busch	Cedric Neike	Michael Sen	Klaus Helmrich	Janina Kugel	Ralf P. Thomas

Divisions

Power and Gas	**Wind Power and Renewables**	**Power Generation Services**	**Energy Management**	**Building Technologies**
Mobility **Sabrina Soussan / Michael Peter** Business Units: • Mobility Management • Turnkey Projects and Electrification • Mainline Transport • Urban Transport • Customer Services	**Digital Factory**	**Process Industries and Drives**	**Healthcare***	**Financial Services**

*Healthcare Division as a separate unit

Target of the Internet of Trains is to provide flexible transport driven by customer needs – it requires 4 major levers to be implemented

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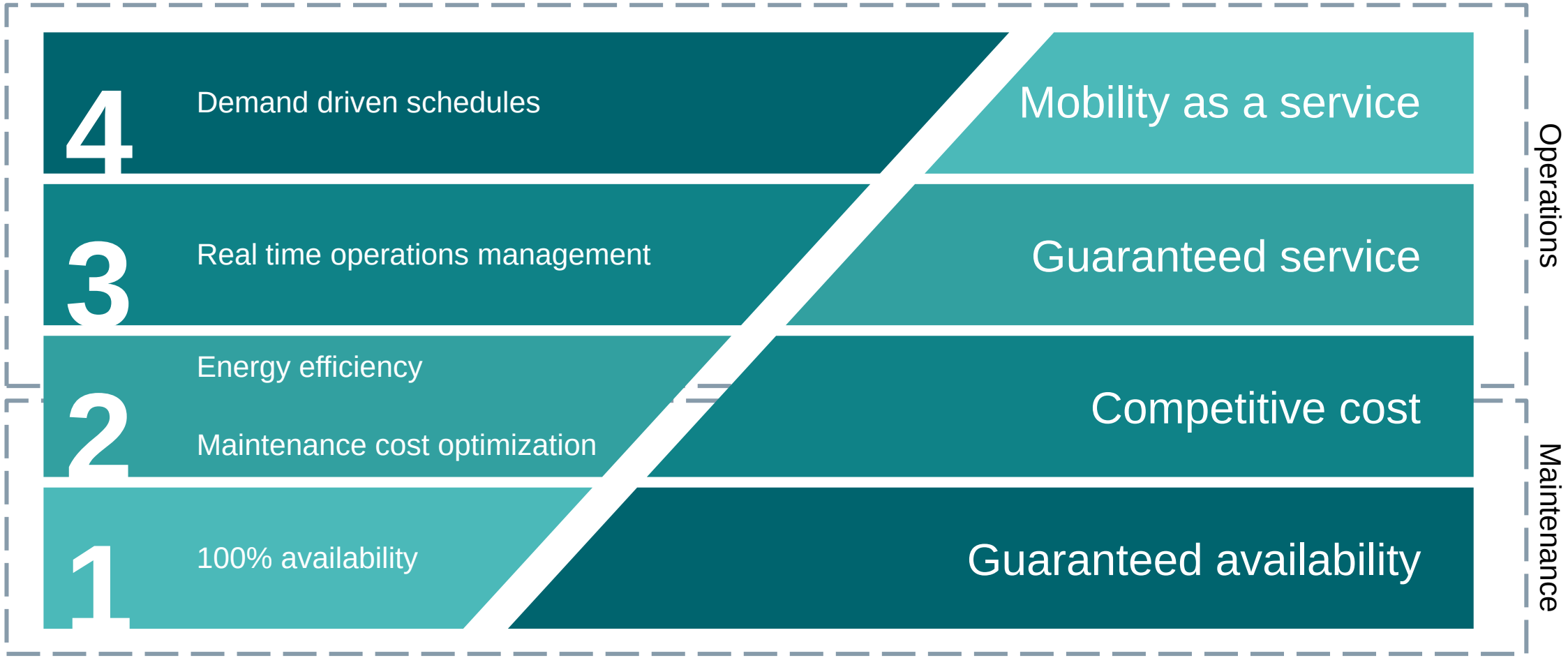

The „Internet of Trains“ is more then simple IoT – it is a web of systems – with decentralized intelligence

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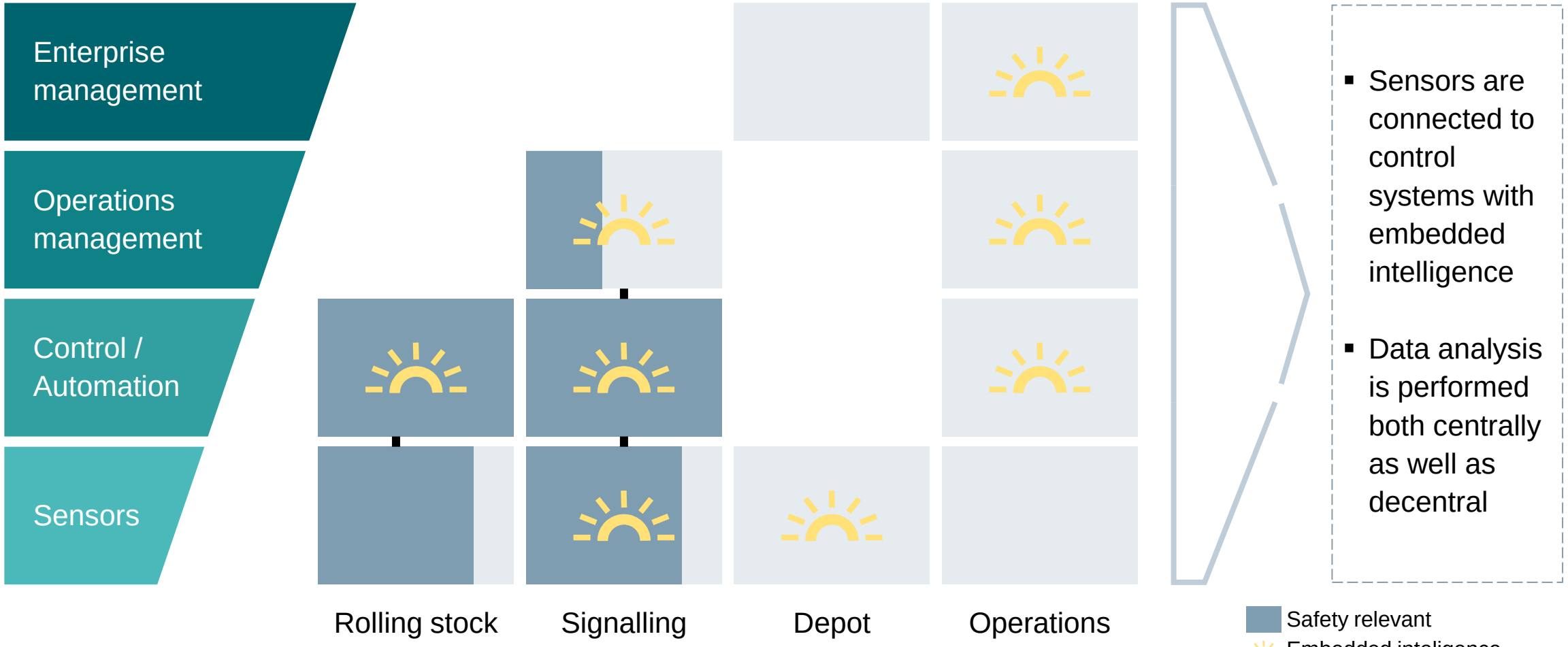
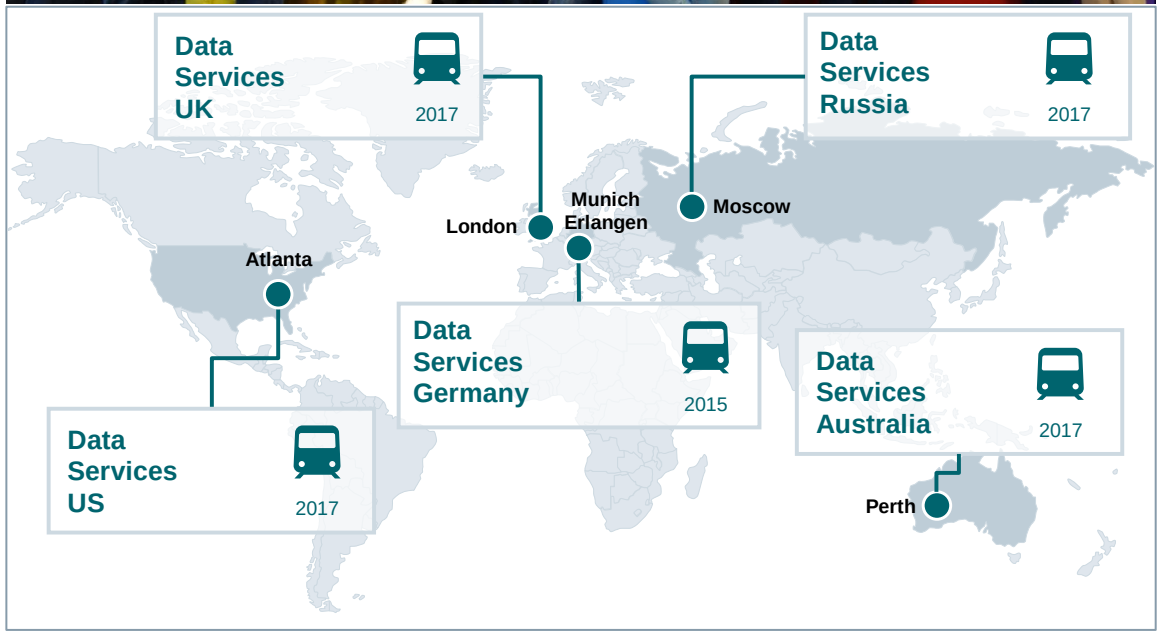


- Sensors are connected to control systems with embedded intelligence
- Data analysis is performed both centrally as well as decentral

The Siemens Mobility Analytics Center started in 2014 in Munich and has since grown into a global, integrated network



It combines the digital environment with the traditional rail world

To reach 100% availability, we have developed Railigent

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Rail asset data

Rolling stock

- Rail vehicles today send between 1 and 4 billion data points per year

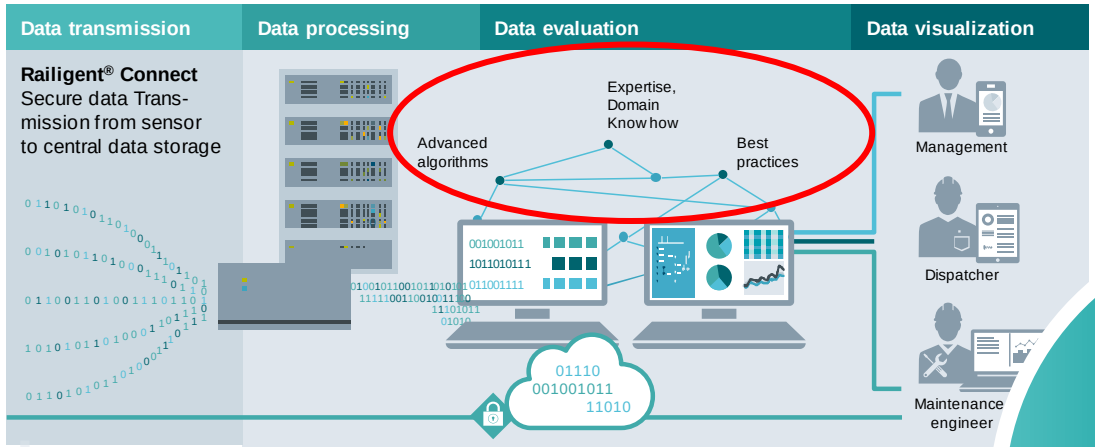
Signaling

- Rail infrastructure/signaling can send up to billions of messages per year inside the system

Infrastructure

- Measurement results from infrastructure provide up to 1 TB per run / measurement round

Railigent



Ensure 100% operational availability

A large set of use cases for rolling stock, signaling and infrastructure has already been implemented for customers

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	Rolling Stock	Signalling	Infrastructure
			
Availability improvement	▪ Evaluation of **component condition** for right timed maintenance activity ▪ Prediction of **component failures**	▪ Prediction of **field element failures**	▪ Analysis and prediction of **infrastructure wear**
Maintenance improvement	▪ **Automation** of manual tasks ▪ Increase of **"1st fix rate"** by identification of best fitting action	▪ Analysis of **complex problem situations**	▪ Reduction of **infrastructure downtime**
Operations improvement	▪ Optimizating **operations planning** ▪ Improving **freight wagon utilization**	▪ Increase of real **network throughput**	

Selected examples

Machine learning example: Automated failure prediction – Bearing monitoring on a high speed train

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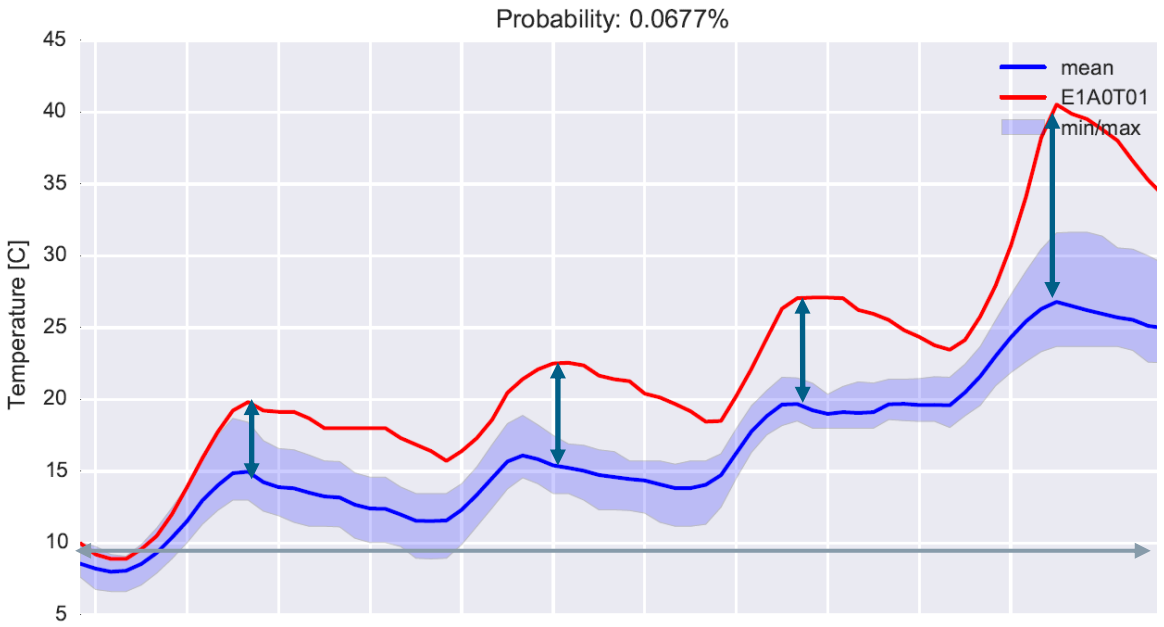
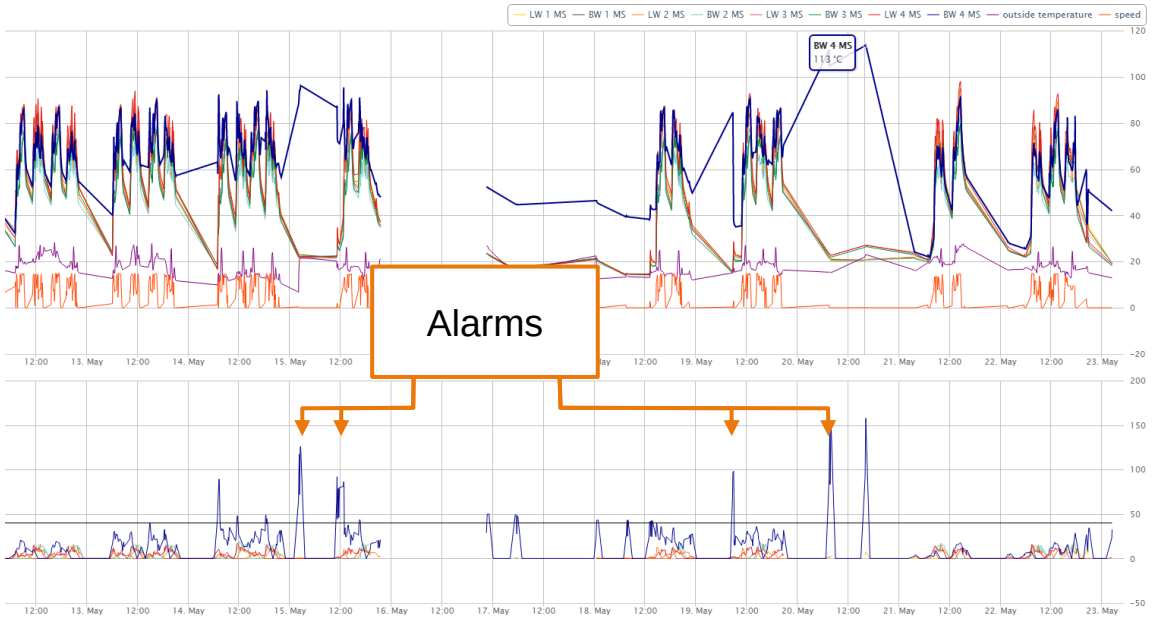
Machine learning

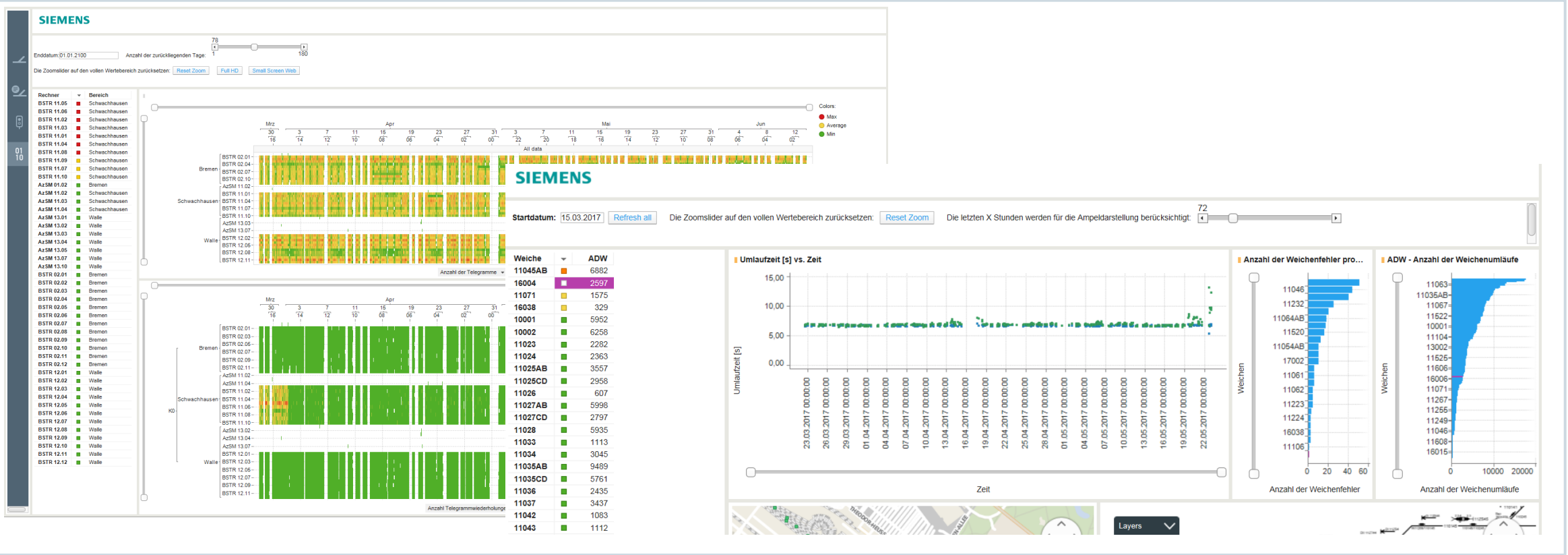


Operational application



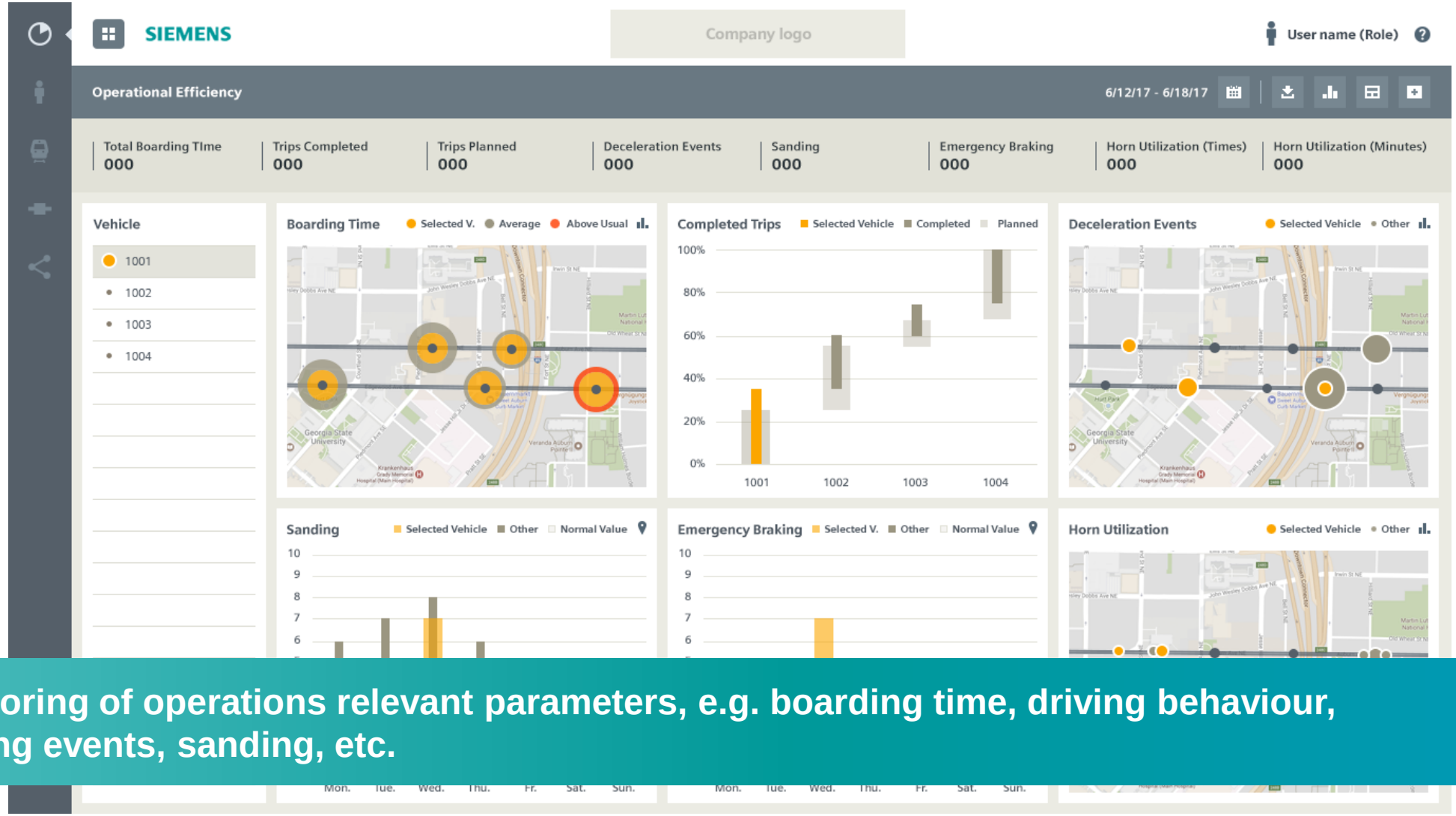
Simplified picture – In reality 8 machine learning models analyze the complete drive train and help identify the exact component and the failure type

Example – Point machine failure prediction without additional sensors



High end data analytics uses the available data to predict point machine failures without needing any additional sensors

Example –
Monitoring of light rail operations for passenger comfort and safety



Monitoring of operations relevant parameters, e.g. boarding time, driving behaviour, braking events, sanding, etc.

Key success factor is the combination of data analytics and deep domain know how

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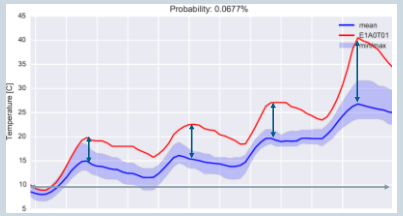
Data collection 1

Railigent Connect

Advanced data analytics 2

Detection
and prediction of failures



Best in class data analytics and machine learning expertise

Data Services

Validated action proposal 3

Analysis
by experts

Cross-project
experience

Deep domain, customer and engineering know how

Rail Support Center

Action implementation 4

Action performed
by field-service experts

Optimization of Spare-Parts usage

Customer or Siemens

Data services change the business models in the industry – from transactional into outcome focused partnerships

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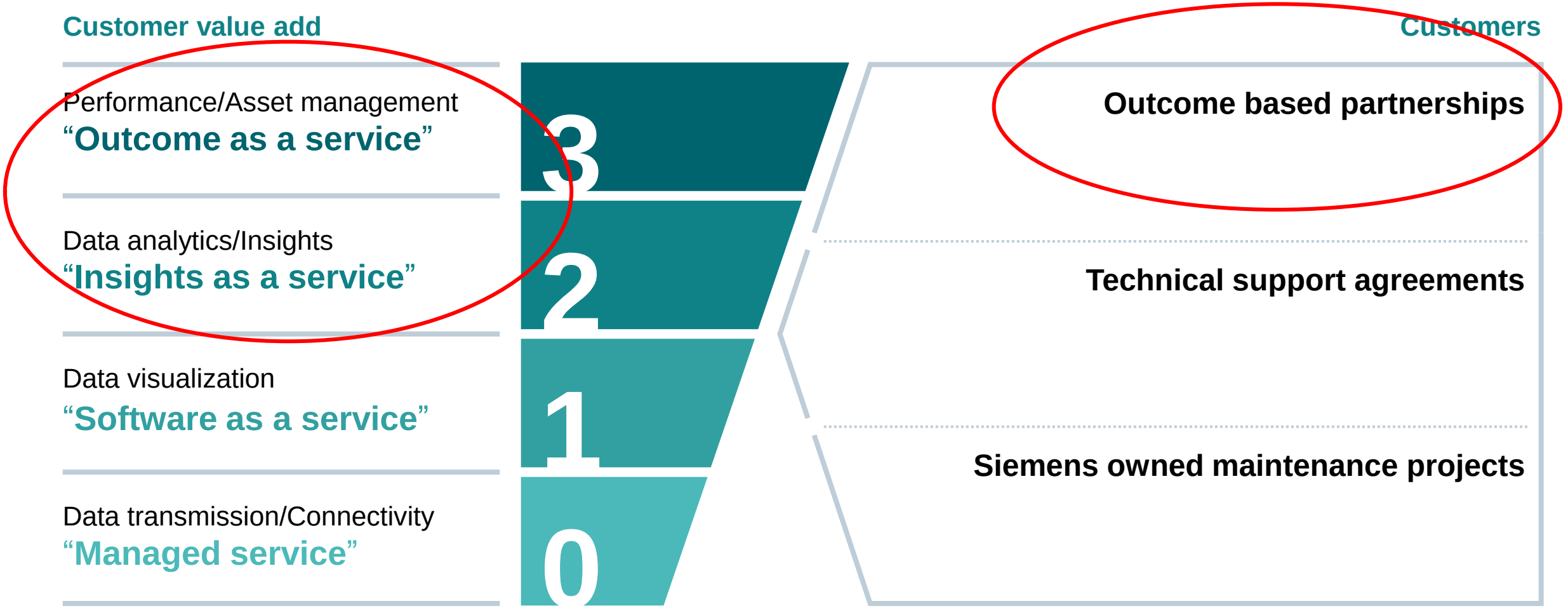

Real examples show: 100% availability is almost there!

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Examples

Velaro Spain		**Availability: 99.98%**
Metro Bangkok		**Availability: 99.96%**
Velaro Russia		**Availability: 99.99%**

Thank you for listening – Questions?