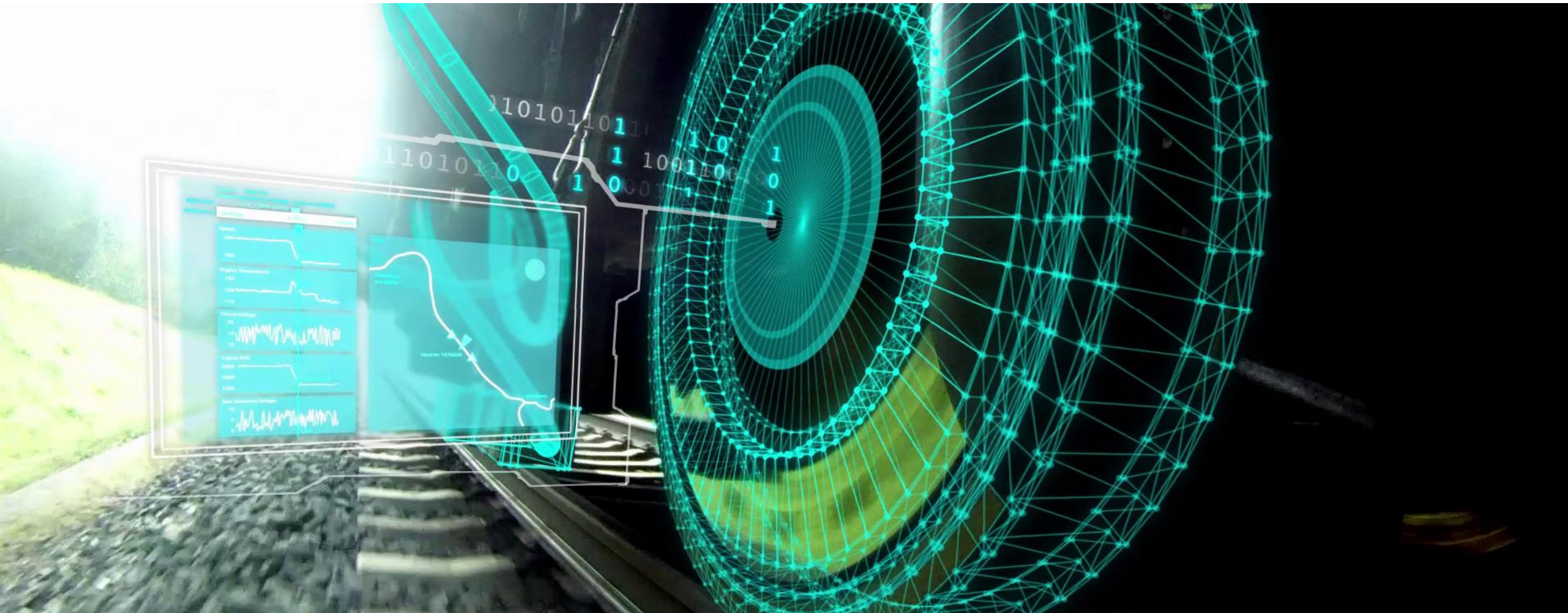


Digitalization: The future of mobility

Innotrans 2016 | Pre-press conference |
June 28, 2016 | Jochen Eickholt, CEO Mobility

Exponential growth of digitalization will change rail and road transportation enormously – and has already begun!

SIEMENS

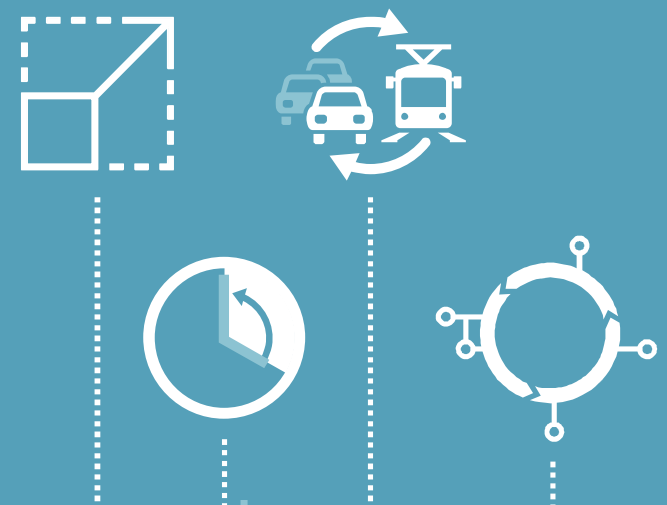


Siemens meets key transportation sector requirements

The needs of passengers and motorists



Operators and cities have to react



Siemens solutions provide

Guaranteed availability



Maximum throughput



Enhanced passenger experience



Digitalization is key to fulfilling customer demand for availability, throughput and passenger experience

SIEMENS

Guaranteed availability



- Smart data analytics for infrastructure and vehicle service
- High vehicle and infrastructure performance combined with best-in-class service and maintenance

Maximum throughput



- Integrated resource management
- Software for next-generation train control
- Next-generation, digitally enhanced interlockings

Enhanced passenger experience



- Passenger information and assistance systems
- Broadband and entertainment services
- Automated fare collection “be-in/be-out”

Grades of automation in the rail and automotive sectors: Autonomous systems for rail operation are more mature than those for road traffic

Partially automated

Supervised by driver

Highly automated

Limited driver action

Fully automated

No supervision by driver



Automated train control



Driver assistance systems



Automated train operation



Driverless and unattended train operation

Product status

Series

Series for local transport/R&D for long-distance

GoA0¹

GoA1

GoA2

Grade of automation / Status

GoA3

GoA4

SAE 0²

SAE 1

SAE 2

SAE 3

SAE 4

SAE 5



Assistance systems



Advanced driver assistance systems for highways



Auto pilot

Challenge:
In case of failure, the system must be able to achieve a safe state at any time

Product status

Series

Development

Research

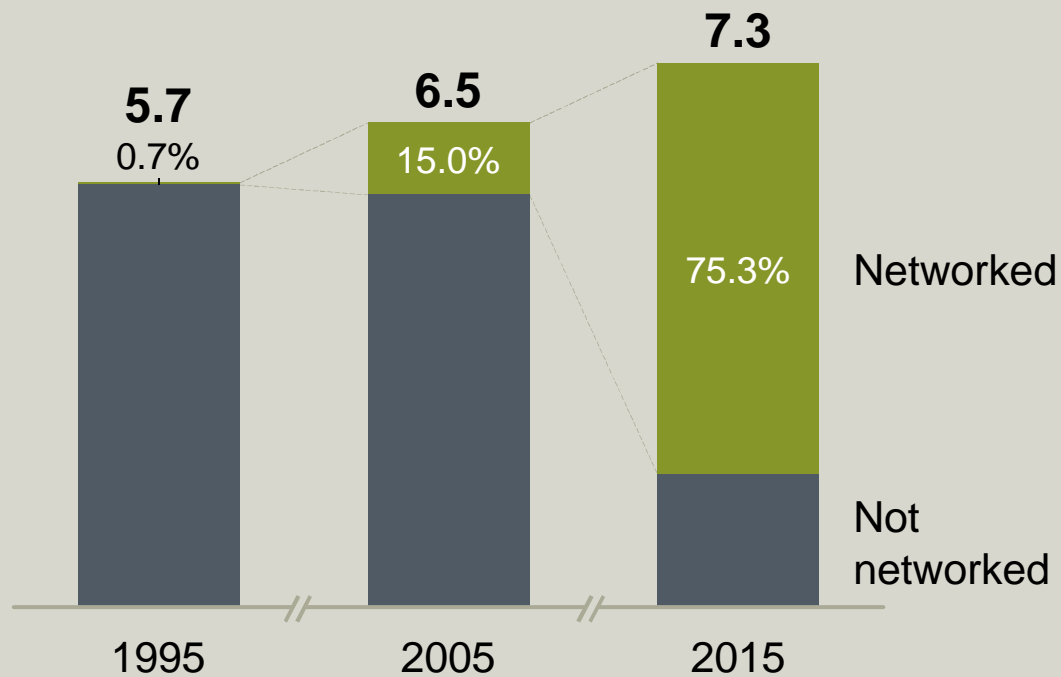
N/A

¹ GoA = Grade of Automation, according to the International Electrotechnical Commission/Commission Électrotechnique Internationale, Internationaler Standard 62290-1
² SAE Levels 0-5: Grades of automation defined by the Society of Automotive Engineers (SAE)

Automation / digitalization of mobility market are expected to grow rapidly

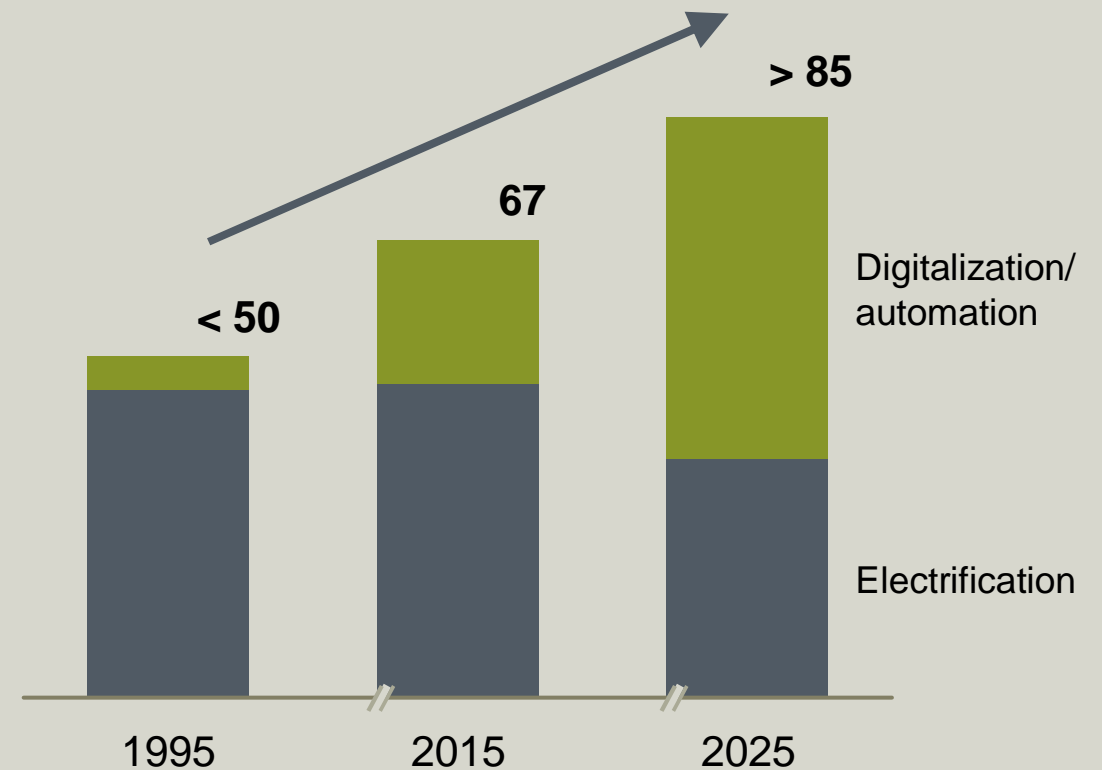
Share of networked people as % of world population¹

World population in billions



Rail and road market

in billions of €



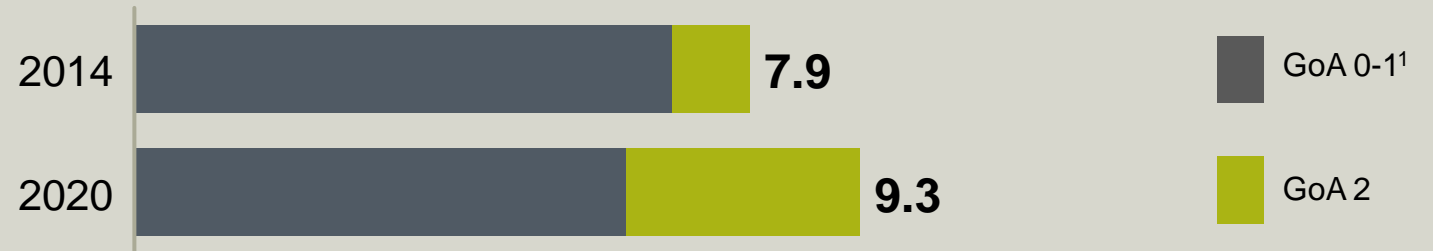
¹ Industrie 4.0 Produktion, Automatisierung und Logistik. Publisher: T. Bauernhansl; M. ten Hompel; B. Vogel-Heuser. Springer Fachmedien Wiesbaden, Wiesbaden 2014

The market for highly and fully automated transportation is growing rapidly

Mainline and freight rail

Rail control world market

incl. industrial and mining in billions of €



Mainline and freight on path to higher automation

Partially automated

Supervised by driver

Highly automated

Limited driver action

Fully automated

No supervision by driver

Mass transit on path to higher automation

Mass transit

Rail control world market

in billions of €



¹ GoA = Grade of Automation defined by the International Electrotechnical Commission / Commission Électrotechnique Internationale, Internationaler Standard 62290-1

Siemens is global market leader for highly and fully automated mass transit systems (> €3 billion in orders in the last five years)

SIEMENS



Highly automated (GoA 2)



- ✓ Beijing Line 10 (2008)
- ✓ Budapest Line 2 (2008)
- ✓ Guangzhou Lines 4+5 (2008/10)
- ✓ Paris Lines 3,5,9,10,12 (2009)
- ✓ Algiers Line 1 (2010)
- ✓ Nanjing Lines 2+1 (2009/10)

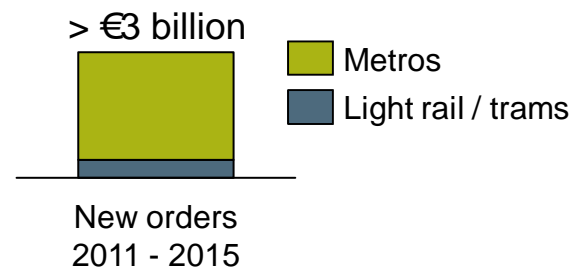
Fully automated (GoA 3-4)



- ✓ Istanbul Line 1 (2010/12)
- ✓ Suzhou Line 1 (2012)
- ✓ Guangzhou Guang-Fo (2010/12)
- ✓ Chongqing Line 1 (2011/12)
- ✓ Beijing Olympia Line 8 (2012/13)
- New York PATH (2017)
- ✓ Metro Nuremberg (2006)
- ✓ Metro Paris Line 1 (2011)
- ✓ Sao Paulo Line 4 (2012)
- ✓ Budapest Line 4 (2014)
- ✓ S-bane Copenhagen (2016)
- Metro Riyadh (2018)

Solutions for GoA 2-4¹

CBTC/Trainguard MT, Controlguide, Sicas, Westrace, Airlink



Orders in 2014-2016 (selection)

Queens Boulevard New York City, Xian Linie 3 (China), Fuzhou Line 1 (China), Sosa Wonsi (Korea), Paris Metro Line 4

Jahr = Vergabe/Betriebsstart

GoA = Grade of Automation, ATO = Automated Train Operation, CBTC = Communications-Based Train Control
 1 Siemens Mobility Products/systems/solutions for rail automation

Paris Metro: Building up long-term and sustainable customer ties through competence in digital mobility

SIEMENS



- 1998: Construction of Line 14 for fully automated operation
- Since 2004: Rail automation systems for Lines 3, 5 and 9
- 2006: Modernization of Line 1 for fully automated operation
- 2014: Extension of Line 14
- 2016: Expansion and modernization of Line 4 for fully automated operation

Riyadh's fully automated metro system: transporting the equivalent of a small town's entire population every hour

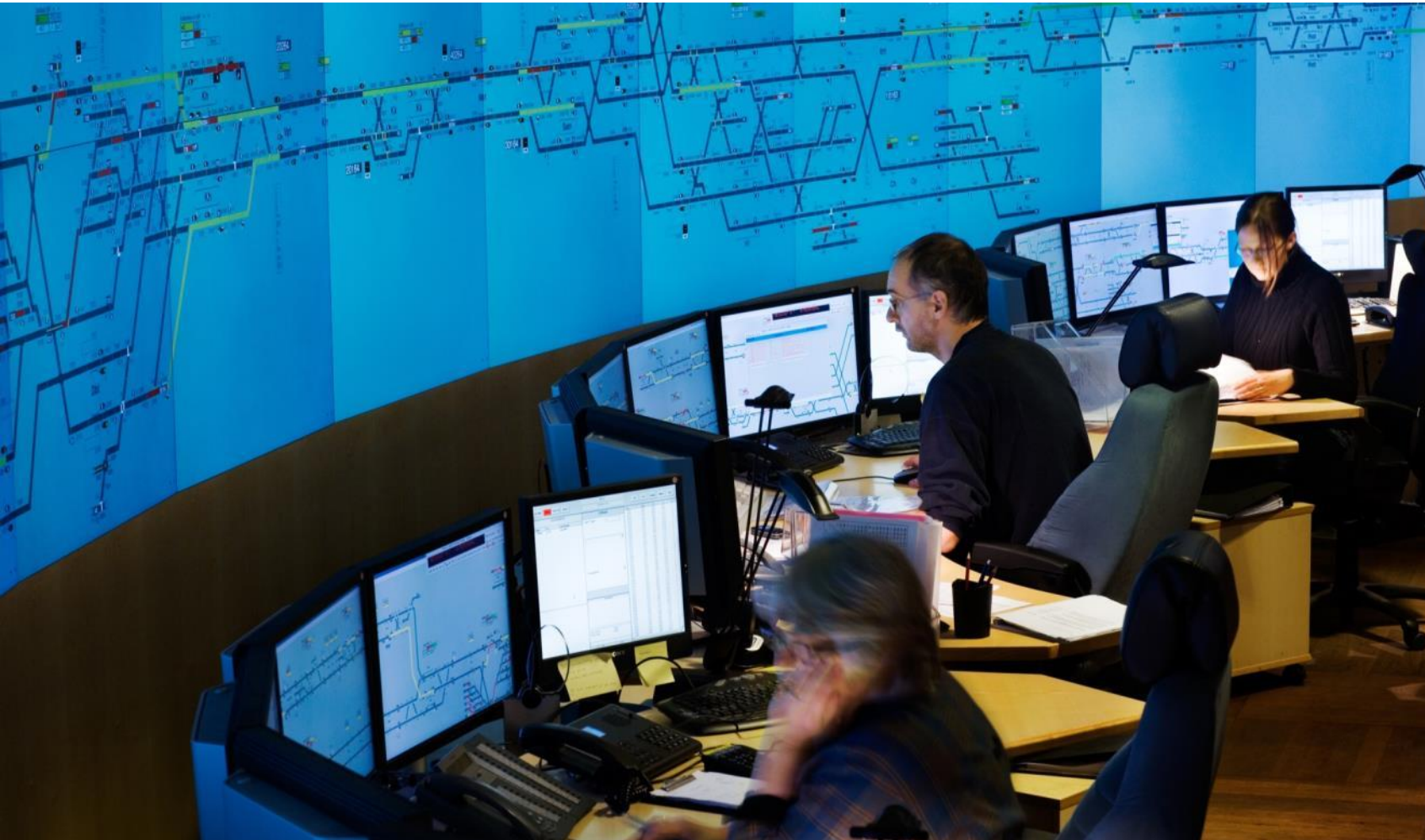
SIEMENS



- World's largest urban transport project with 7 metro lines, total length of 175 km
- Turnkey systems for Lines 1 and 2: Metro trains, electrification, signaling/communication, interlockings
- Signaling and train control technology ensure that trains can operate at 90-second intervals
- High operating frequency enables the system to handle 21,000 passengers per hour

S-bane Copenhagen: Partially automated controls with driver participation in operation since March 2016

SIEMENS



- All the network's lines are equipped with CBTC (Communication Based Train Control) for fully automated operation
- Train intervals in the inner city zone shortened from 120 seconds to 90 seconds
- Low maintenance costs due to elimination of trackside signals in the network
- Mixed transport with regional trains at the Hillerød terminal station

Thameslink London: A showcase for Siemens' innovative strength in all areas of digital mobility

SIEMENS



Guaranteed availability

- Smart predictive maintenance in the Thameslink depots
- Faults are spotted before they occur – ensuring full availability of the trains

Maximum throughput

- 24 trains per hour in London's inner city
- Automated train operation with ERTMS (European Rail Traffic Management System), Level 2

Enhanced passenger experience

- “Always connected” – innovative passenger information system

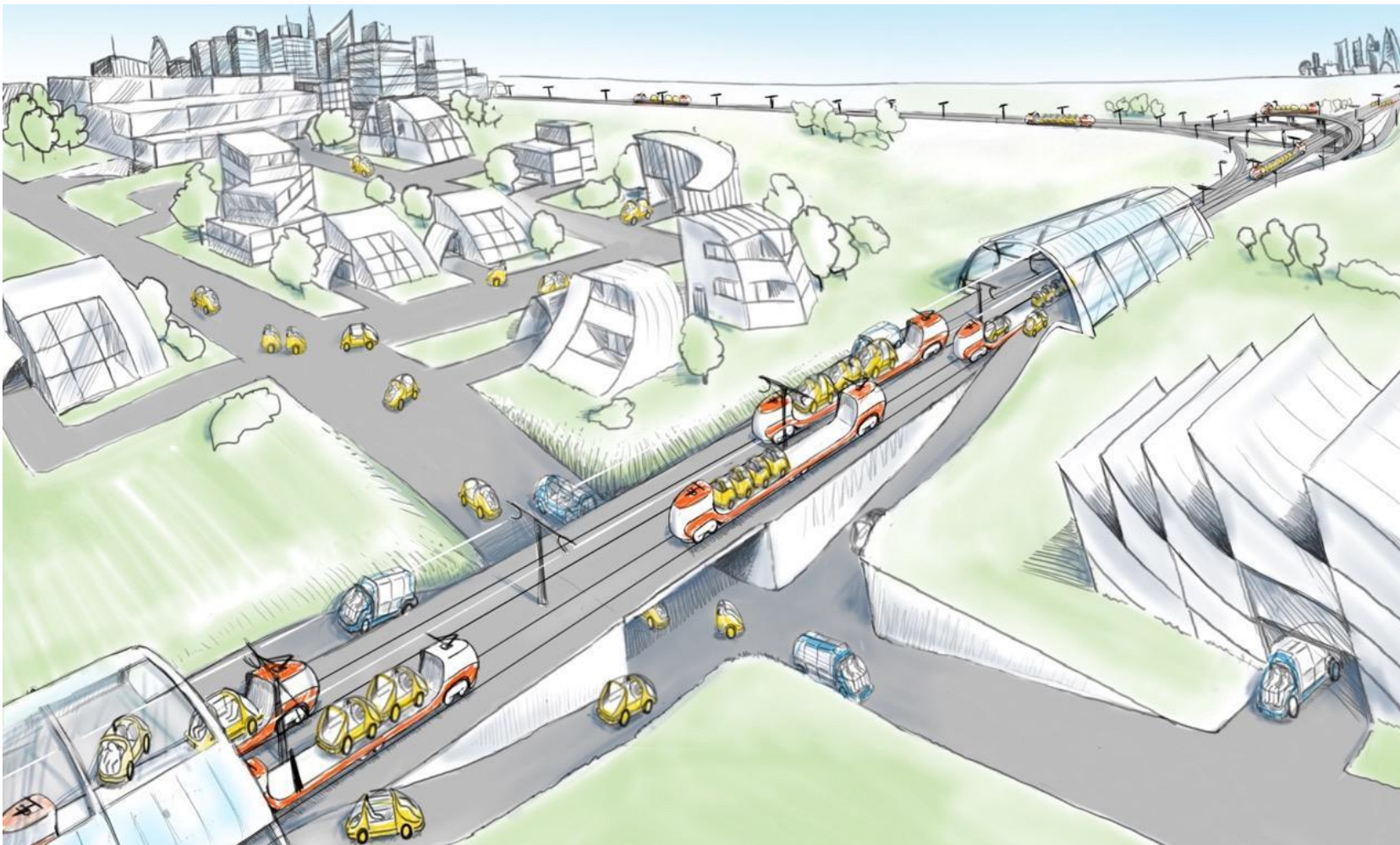
Cooperation with DB Cargo: First demonstration project worldwide for automated driving in rail freight transport

SIEMENS



- **Successful tests for:**
 - Sensor-controlled hazard detection
 - Automated coupling to freight train
 - Automated braking and acceleration to adjust to line speed limits
 - Tablet-controlled remote departure and precise stopping of the train
- **Advantages:**
 - Increased transport capacity and flexibility
 - Energy consumption reduced by around 20 percent

Vision 2050: The future of mobility will be exciting



- All vehicles will be autonomous (GoA 3¹ or higher)
- Especially for low-density traffic, vehicles will connect/scale for longer distances (vehicle transporters or connected driving)
- Traffic flows will be supported by intelligent streets/roads and distributed control centers
- Safety levels will improve substantially for high- and low-density traffic
- Energy consumption will be reduced
- Capacities and flexibility will be increased dramatically
- Seamless intermodal travelling will be standard

¹ GoA = Grade of Automation according to International Electrotechnical Commission / Commission Électrotechnique Internationale, Internationaler Standard 62290-1

Highlight at Innotrans: Digital Service – Highest availability of our transport systems with the help of IT-based data analytics

SIEMENS

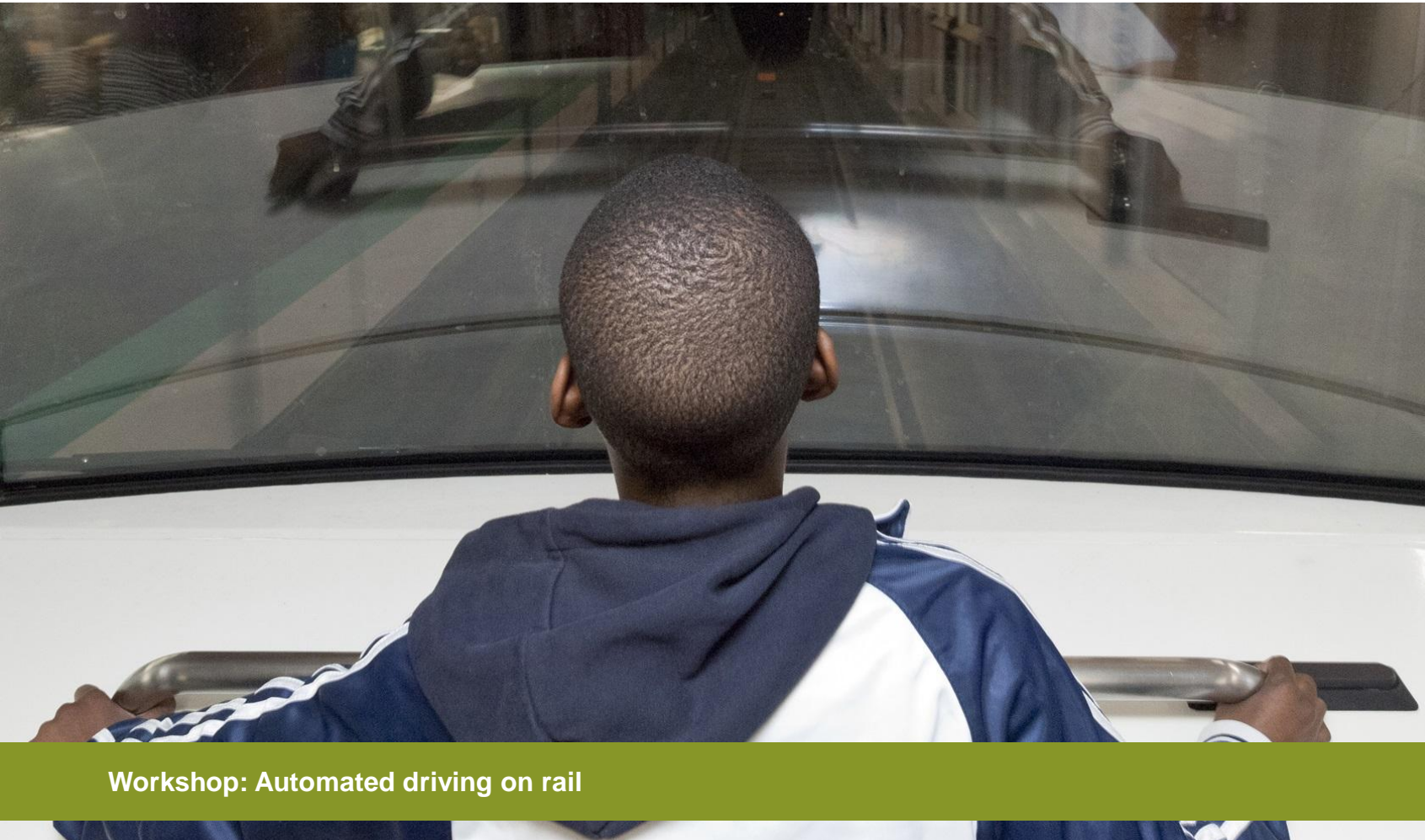


Presentation: Mobility systems data analytics for optimized operations

- **Our basis:** Modern rail vehicles transmit over one billion data points a year
- **Our competence:** Analyzing this data with algorithms and deriving measures to prevent downtimes in operation
- **Our goal:** Support our customers by providing highest availability of vehicles and optimal maintenance
- **Our reference:** Data analytics used with the Velaro Spain for predictive maintenance and avoiding costly downtimes

Highlight at Innotrans: Automated train control – greater flexibility together with higher safety and reduced energy consumption

SIEMENS

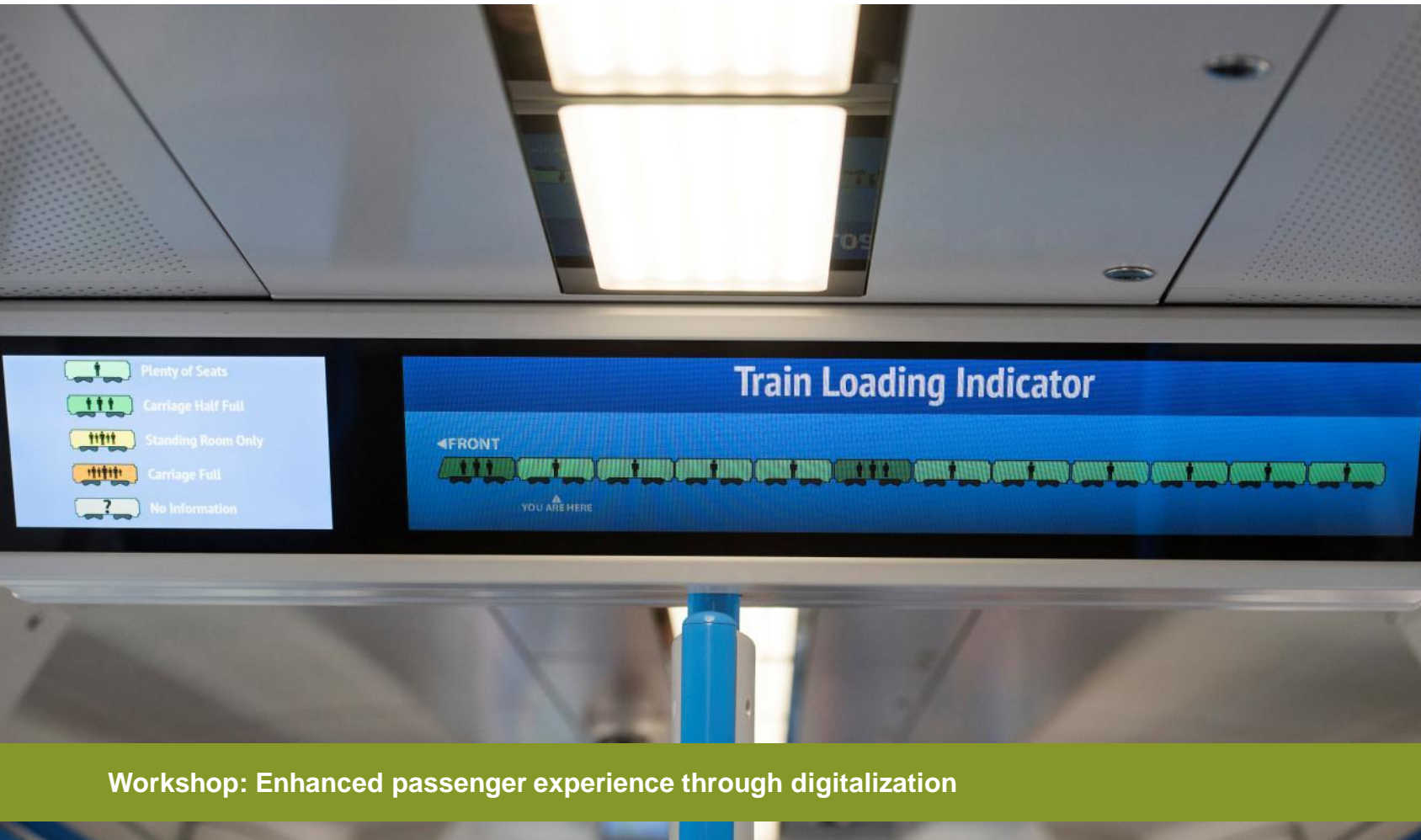


Workshop: Automated driving on rail

- **Our basis:** Demand for high and fully automated rail systems is growing rapidly in transportation markets
- **Market leader:** Siemens is the market leader for high and fully automated rapid transit systems
- **Future:** The next stage of development in automated train control will enable seamless travel between regional and rapid transit systems
- **Reference:** Thameslink is the world's first realization of an "ATO over ETCS" system

Highlight at Innotrans: Integrated, intermodal and connected solutions for passengers

SIEMENS



- **Always connected:** Integrated solutions for passenger assistance and entertainment during the journey
- **PIS+:** Passenger information and guidance systems in the train – depending on passengers location and traffic situation
- **SiMobility:** Solutions for information and transactions across transportation modes – incl. hands-free ticketing “Be-in/Be-out“
- **iCCTV:** Automated recognition solutions, incl. detection of empty seats and availability of wheelchair space
- **Train-IT:** Fully integrated IT backbone for flexible and future-proof train applications

Workshop: Enhanced passenger experience through digitalization

Highlight at Innotrans: Mireo – Intelligence on rail



Workshop: The new modular vehicle concept for regional trains

- **Energy efficiency:** Lighter & LCC-optimized regional and light rail trainsets
- **Consequent development of train IT concept:** Separation of safety-relevant control network, operator network and passenger network
- **Always Connected:** Siemens solutions for networked regional trains
- **Predictive maintenance:** E.g. through real-time field data acquisition and analysis
- **Flexible train concept:** To meet capacity and infrastructure requirements
- **Infrastructure-protective bogies**
- **Financing from one hand**

Highlight at Innotrans: Interoperability of the charging system for electric buses in Hamburg

SIEMENS



- **Our goal:** Interoperability of Siemens' charging system for electric buses from different manufacturers
- **Success:** Siemens is worldwide the first producer of fully automated charging systems that ensure compatibility of the charging infrastructure with vehicles from different manufacturers
- **Details:**
 - Beginning in summer 2016, 109 buses from Solaris and Volvo will be charged on the innovation line with the existing Siemens charging system
 - Reliable Siemens charging technology for transportation companies and bus manufacturers is based on the international standard IEC 61851-23

Highlight at Innotrans: Vehicles displayed outside



**Vectron
Finland**



**Desiro
City SWT**



**Desiro ML
ÖBB cityjet**



**Velaro
Turkey**



**Metro
Riyadh**



**Avenio
QEC**

Current news: Munich Metro gives limited authorization for the first Siemens C2 trains on a section of the U6 line

SIEMENS



© SWM/MVG

- Commissioning taking place on the section Kieferngarten – Garching Research Center
- Total order: 21 articulated trains
- Energy-saving LED interior and exterior lighting
- Dynamic braking nearly to a full stop; braking energy fed back into power system
- Transmission of video and diagnostics data during operation
- Video cameras and modern monitors for the passenger information system

Thank you!

Innotrans 2016 | Pre-press conference
June 28, 2016 | Jochen Eickholt, CEO Mobility