

# How digitalization is transforming rail infrastructure

Trends and solutions for tomorrow's networked rail transportation





Digitalization is the key to increased availability, automation, connectivity and sustainability in rail infrastructure.

# The future of digital rail infrastructure





How will the current technological trends drive and shape the digital transformation?

**Our vision:**  
**A fully networked rail infrastructure**

## The future of digital infrastructure

- The digital transformation of rail transportation is picking up speed
- Digitalization will give rail-based mobility an unprecedented boost: greater flexibility, efficiency and a significantly enhanced network of mobility solutions
- Multimodal travel opportunities are increasing and becoming more individualized
- Transportation companies need to expand, improve, and future-proof their offerings to stay competitive
- Digital trends present tremendous opportunities for operators: master high traffic volume without having to lay new tracks, make rail travel more sustainable and passenger-friendly, and achieve greater efficiency

# The first step: Automated driving



From highly automated to completely driverless operation, Siemens is a market leader in fully and highly automated mass transit solutions and a pioneer in the implementation of these solutions in mainline traffic.



## ATO over ETCS

Automatic train operation (ATO) and the European Train Control System (ETCS) are important basic technologies for increasing the efficiency of rail transportation systems and for creating standardized, transnational automation. The combination is referred to as ATO over ETCS.

## Automated driving

- Growing demand for high operational availability while possibilities for network expansion are limited
- ATO allows trains to run at optimal speed and increases timetable stability by exchanging data with TMS systems
- ETCS monitors train movements and speed limits on the tracks
- ATO over ETCS allows increased capacity while significantly reducing energy consumption
- Standardized interfaces in line with European frameworks



# ATO References



## Thameslink Program

- The world's first-ever commercial ATO over ETCS application in mainline traffic
- Increasing the capacity of London's north-south link
- Providing an enormous boost to the public mass transit system since its implementation in 2018



## Digital S-Bahn Hamburg

- Collaboration with Deutsche Bahn AG (DB), S-Bahn Hamburg and Siemens Mobility
- Blueprint for ATO over ETCS solutions in Germany
- Equipping 23 km of track and 4 S-Bahn trains with ATO over ETCS as part of DB's "Digital Railway Germany" strategy



## Test Drives SBB (Schweizerische Bundesbahnen)

- Together with Swiss Federal Railways SBB, Siemens implemented an ATO demonstrator
- Performing first train trips using ATO over ETCS in compliance with UNISIG (Union of Signaling Industry) standards
- A route along Lake Geneva between Lausanne and Villeneuve, Switzerland

# Contact

## Automatic Train Operation (ATO)

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**Signal**  
0.1578  
2.457343  
1.99194

**Balise**  
2.13498  
1.931545  
0.001943

# Digital Twin of the infrastructure

BIM improves and accelerates collaborations between different partners across time zones, companies, and national borders





In order to migrate an entire rail network to digital technologies, **a digital twin** of the infrastructure with all its components is required.

## Building Information Modeling (BIM) for railways

- BIM is a state-of-the-art methodology for complete virtual planning
- Geo-referenced point cloud is generated from scan data, which serves as a base for the 3D model
- Digital twin of infrastructure with all components can be inspected and experienced virtually in an early project phase
- Benefits: integrates all planning partners and available information, improves collaboration, planning quality, and productivity for the entire project, unlimited access to a shared database for all partners



## Snow removal process on tracks with BIM

- BIM data can be used beneficially in field work as well
- Snow plow operators are provided with accurate data: Looking out for track elements belongs to the past
- With data from the Digital Site Survey (DSS) information on upcoming assets and their distance to the snow plow is available for operators
- App (Snow Removal Asset Warning) will warn operators on time when approaching a track element
- No new hardware required for the app: runs on iOS devices already in operation
- Avoiding operational disturbances & repair costs



# BIM Services

## Data Preparation - Unleashing data potential through digital site surveys

- ✓ Saves time and costs, and enhances quality by reduction of the site survey speed up process
- ✓ Increases sustainability and quality, and saves time through precise GPS accurate data in a CAD format that is broadly applicable



## Digital Track Capturing - Processing the scanned track into a point cloud

- ✓ Increases availability and transparency through compact functionality and GPS accurate data

Balise

Point machine

4.1298

0.41356

0.23194

Signal



## 3D Model - Supporting Collaboration and enhancing Simulation

- ✓ Enables better collaboration and validation through digital collision check

## Apps - Asset Lifecycle Management and Training

- ✓ Increases flexibility, efficiency and quality through error detection and data consistency
- ✓ Increases transparency with up-to-date data reliability, evaluations and reporting.
- ✓ Reduces costs through elimination of errors and route knowledge extraction
- ✓ Enhances safety standards and quality



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## Building Information Modeling

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## Vehicle Information Modeling (VIM): Augmented Reality for ETCS Retrofit

- 3D visualization of scaled system integration in real vehicle environment
- System integration scenarios
- Realtime system integration feasibility check
- 3D ETCS system component library
- Human factor and usability analysis
- Clash detection analysis (virtual components to real vehicle)
- Integrated use of results for further engineering activities



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## Vehicle Information Modeling

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ETCS Level 3 is a step change providing significant benefits to the rail sector.

## ETCS Level 3

Functionality analogue to ETCS Level 2 with significant advantages:

- Track vacancy detection is no longer carried out by the interlocking, but by the RBC with assistance of the train control unit (OBU)
- Division of track into fixed blocks becomes obsolete ("Moving Block")
- Hybrid Level 3: possibility of installation of level 3 equipment to supplement other levels (level 0-2)
- Other systems (e. g. ATO) can be integrated



- Less trackside equipment & trackside work resulting in improved work safety
- Shorter headway times, improved flexibility and higher reliability
- Significant energy savings with DAS and ATO
- Simplified interlocking functions
- Improved track utilization



- 15% capacity increase
- 20% less infrastructure costs

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## ETCS Level 3 & Hybrid Level 3

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# Our vision and innovations at a glance



We expand **digital infrastructure** for networked transportation



Europe-wide standards like ERTMS/ETCS are the basis for **comprehensive data recording and automation**



Smart data analysis procedures transparently prepare **the most useful data from your fleet**



**All trackside components** other than point machines and balises are to be **virtualized**



Ceaseless **research and development** in IoT-capable components



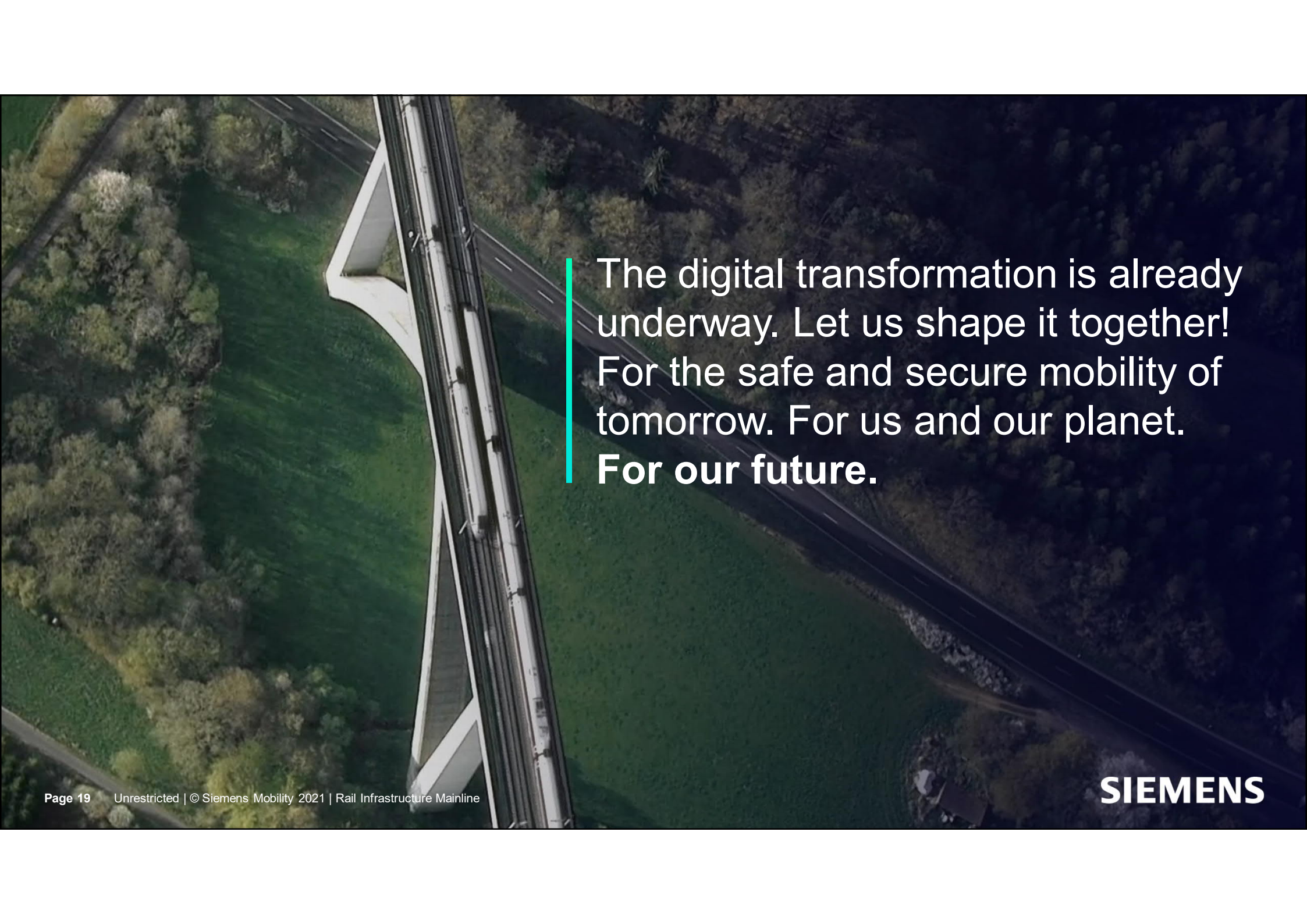
**Highest security standards** (Safety Integrity Level 4), supported by innovative developments like the data capture unit (DCU)



Large investment and maintenance volumes lead to **flexible business models**



We realize pioneering work in the transportation industry to **sustainably and seamlessly transport** people and freight from the first mile to the last



The digital transformation is already underway. Let us shape it together!  
For the safe and secure mobility of tomorrow. For us and our planet.  
**For our future.**