Deutsche Bahn AG | 03. June 2024 | Berlin

Eco-Efficiency in Motion
The Power of Sustainable Automation

DB

Train Academy Day at Norske tog

Rolf Härdi CTIO Deutsche Bahn AG

For the climate. For the people.

5700 railway stations

33.400 km track

40.000 train services per day

2 Billion passengers

222 Million tonns of freight

> 600 M EUR
Unplanned Maintenance

65%
Punctuiality

> 90 000
Technical Disturbances

40´000 Services
Cancelled

>1,1Mio Minutes of Delay

>100 FTE´s
For Repair Work

Herleitung Zielebenen für eine Starke Technik

STRONG Technology

System Capacity

Digital Automatic Coupling (DAC)

Digital Automatic Coupling as pre-condition for ETCS & efficient single waggon traffic.

ERTMS

European Rail Traffic Management System (ERTMS) as pre-condition for digital Rail.

Artificial Intelligence

AI as enabler to increase capacity on existing infrastructure.

Asset Cost & Availability

Digital Maintenance

Digital maintenance to automate de entire maintenance process for vehicles and infrastructure.

API

Asset Performance & Improvement (API) to analyse and improve all assets & process of operation.

Standardisation

Increased reliability and availability with standard proven products and systems.

Structural Change

Gigabit-Capability

The gigabit-extension as base for a future proof connectivity.

Green Rail

Green rail technology to ensure a true sustainable railway.

Skilled Workforce

Closing the skilled labour gap through automation and simplification.

The System Capacity Conundrum:
DAC Expanding Rail Networks for Efficiency

DB

Digital capabilities of freight wagons with DAC

Efficiency:
Manual Processes

70.000
Coupling actions with

20-30 Kg
Heavy coupler in DB Cargo

0
digital interfaces on manual couplers

Capacity:
Competitive Capacity

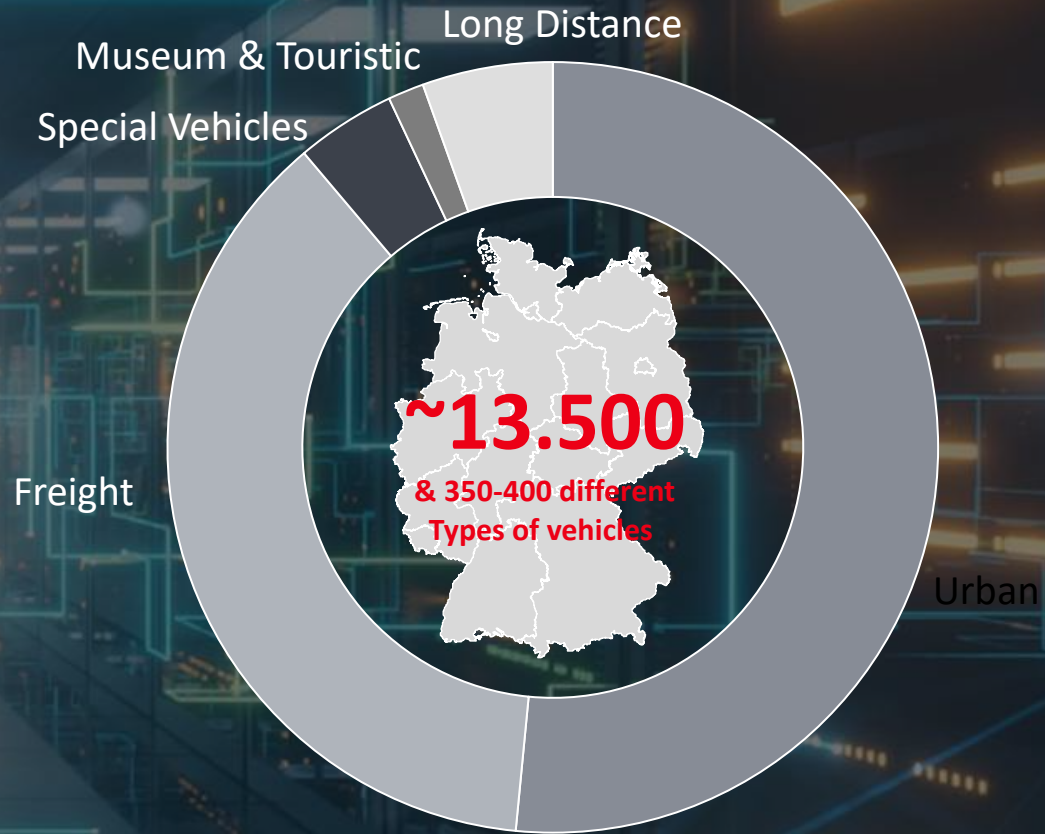**+45%**
Capacity increase in shunting yards

760 Mio.
Euro financial benefits für european railway undertakings

The System Capacity Conundrum:
ERTMS – ETCS

with **1.200 new rolling stock with** ETCS or ETC-ready until 2030 to drive implementation

Long Distance

Museum & Touristic

Special Vehicles

Freight

~13.500
& 350-400 different Types of vehicles

Urban

Modernisation of ca. **8.000** vehicles planned until 2030

The System Capacity Conundrum:
With AI towards more capacity and punctuality on existing infrastructure

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Intelligent utilisation of our infrastructure with AI

Planning: Identification and elimination of bottle necks

- Deutschlandweite **Transparenz** über baubedingte, unterjährige **Kapazitätsengpässe**
- **Automatisierte Vorschläge** für **Umleitungsrouten** & optimierter **Auslastungsprognose**

Target 2024:

22.000   Lost Units reduction
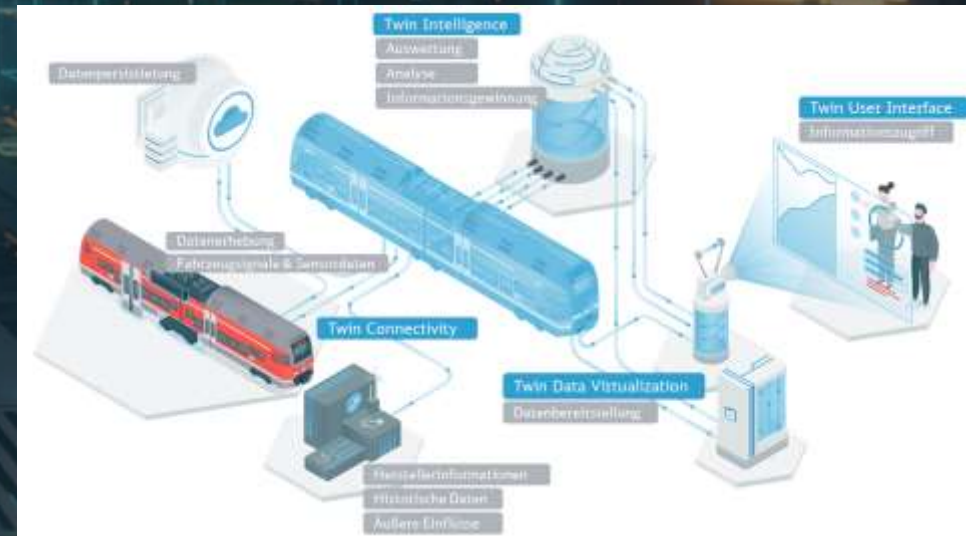
Service: Reducing delays

- **Automatisierte Vorschläge** zur **Reduktion** von **Verspätungs-minuten** mit den S-Bahnen
- Erweiterung auf **Mischverkehrs-strecken** mit Regio & Fernverkehr
- Konzeption **durchgängige, digitale Disposition** mit Netz

Target 2024:

90.000   Minutes of delay reduction

Data-Driven Excellence:
The Power of Digital Maintenance

Vision | Green Rail Technology is contributing through technical innovations to the sustainable progress of Deutsche Bahn

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Nature Protection

Four of five trees in Germany are **sick.**
(Bundesministerium für Ernährung und Landwirtschaft, 2022)

Ressources Protecion

414 Million Tonnes Rubish
per year
in Germany.
(Umweltbundesamt, 2022)

Noise Protection

1,6 Mio. people in Germany are affected by Rail Traffic Noise.
(EBA, 2020)

Climate Protechtion

Up to **5,7 degrees Celsius** the earth temperature is increasing to the year 2100 in comparison to pre- industrial conditions – with devastating consequences
for people and environment**.**
(Umweltbundesamt, 2024)

Social Responsibility

Less than **one third** of managers in Germany are **female.**
(Statistisches Bundesamt, 2022)

Natur Protection

Up to 150 species per day are vanishing from our plant – for ever!
(Nabu, 2020)

Ressourcenschutz

One fourth of all people in the world are without **save water** supply.
(Vereinte Nationen, 2023)

Klimaschutz

148 Mio. Tonnes CO2-Emissions caused by traffic in Germany.
(Umweltbundesamt, 2024)

Vision | Green Rail Technology is contributing through technical innovations to the sustainable progress of Deutsche Bahn

Reduction of 50 % CO$_2$e-Emissions;
80 % Green Electricity DB-Rail Power Mix

100 % Green Electricity
in all workshops, and stations

Decrease of 50 %
Rail related Noise

Climate neutral
Enterprise

30 % woman
in management

100 % Ecco sustainable
Rail-rewards

Increase of Recycling:
Track Steel to 45 %
Ballast to 40 %
concrete sleepers to 30 %

100 % Green Electricity

Total
circular Economy

Elimination of
Rail related Noise
to living areas

Recycling Quote above 95 %

2024   2025   2030   2038   2040   2050

Vision | Green Rail Technology is contributing through technical innovations to the sustainable progress of Deutsche Bahn

Climate

- Emission reduction with the target for zero emission operations
- Coherent energy optimisation of the overall system

Nature

- Cost efficiency and improved reliability of planning and operations

Ressources

- Material waste and cost reductions for components in infrastructure and rolling stock
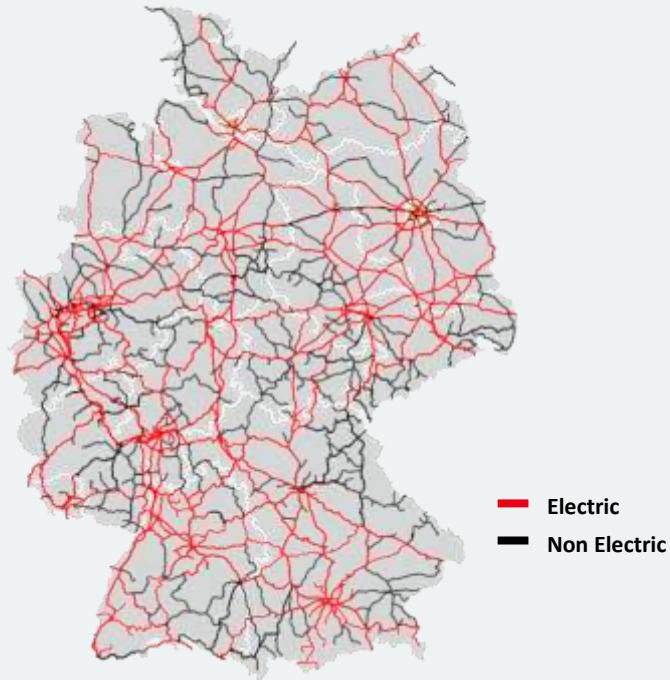- Resilience of the supply chain

Noise

- Risk mitigation an efficiency increase of planning and building projects
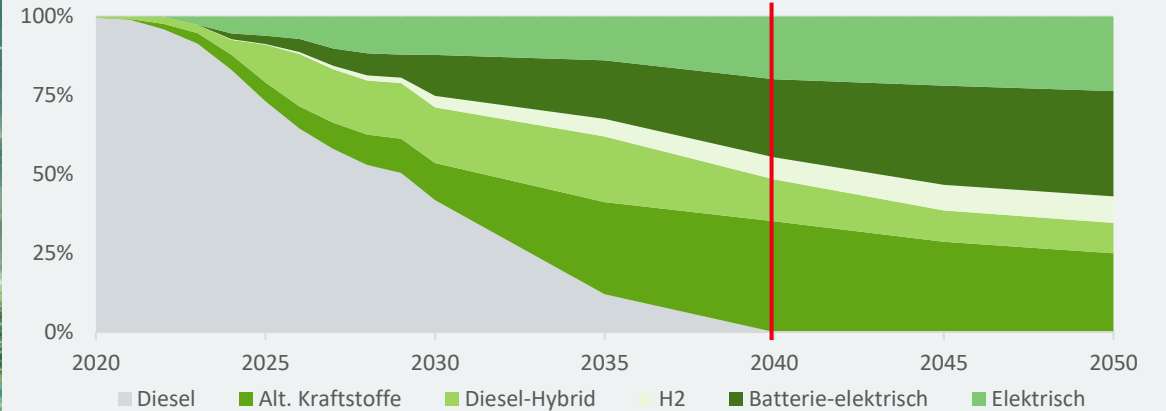- Increased capacity of traffic

Riding the Green Rails
75 % electrification → Sustainable Propulsion

Rail Network Germany

- 61% of the rail network are electrified, extension to is 67% planned
- Already 90% of the total rail service is provided by electricity

Fleet Progrssion

Legend: Diesel | Alt. Kraftstoffe | Diesel-Hybrid | H2 | Batterie-elektrisch | Elektrisch

Flotte

- At present we have about 3000 diesel-engines with a consumption of about 250 Mio. Liters Diesel p.a. We ar still getting diesel vehicles delivered.
- Plan: until 2040 approx. 50% of the diesel fleet is converted to electric traction or battery electric traction.
- In the year 2040 we would have still 40% fuel based vehicles in service (about 800 - 1000 vehicles, since no technical alternatives are available)
- Lon live Cycle of assets 30+ years

Map legend: Electric (red), Non Electric (black)

Riding the Green Rails
Sustainable Innovations in the Railway Industry

Energy Optimisation

Recouperation of braking energy and peak load management

Value Add

- Increase **Recouperation** 2-3 % (locomotives)
- **Reduction** of **traction energy** and operations cost

HVAC Optimisation

Innovative control and management of interior climate

Value Add

- **Increased** energy **efficiency** of auxiliary systems
- **Reduction** of **energy** consumption (~5%) and cost

Geothermal Energy in Tunnels

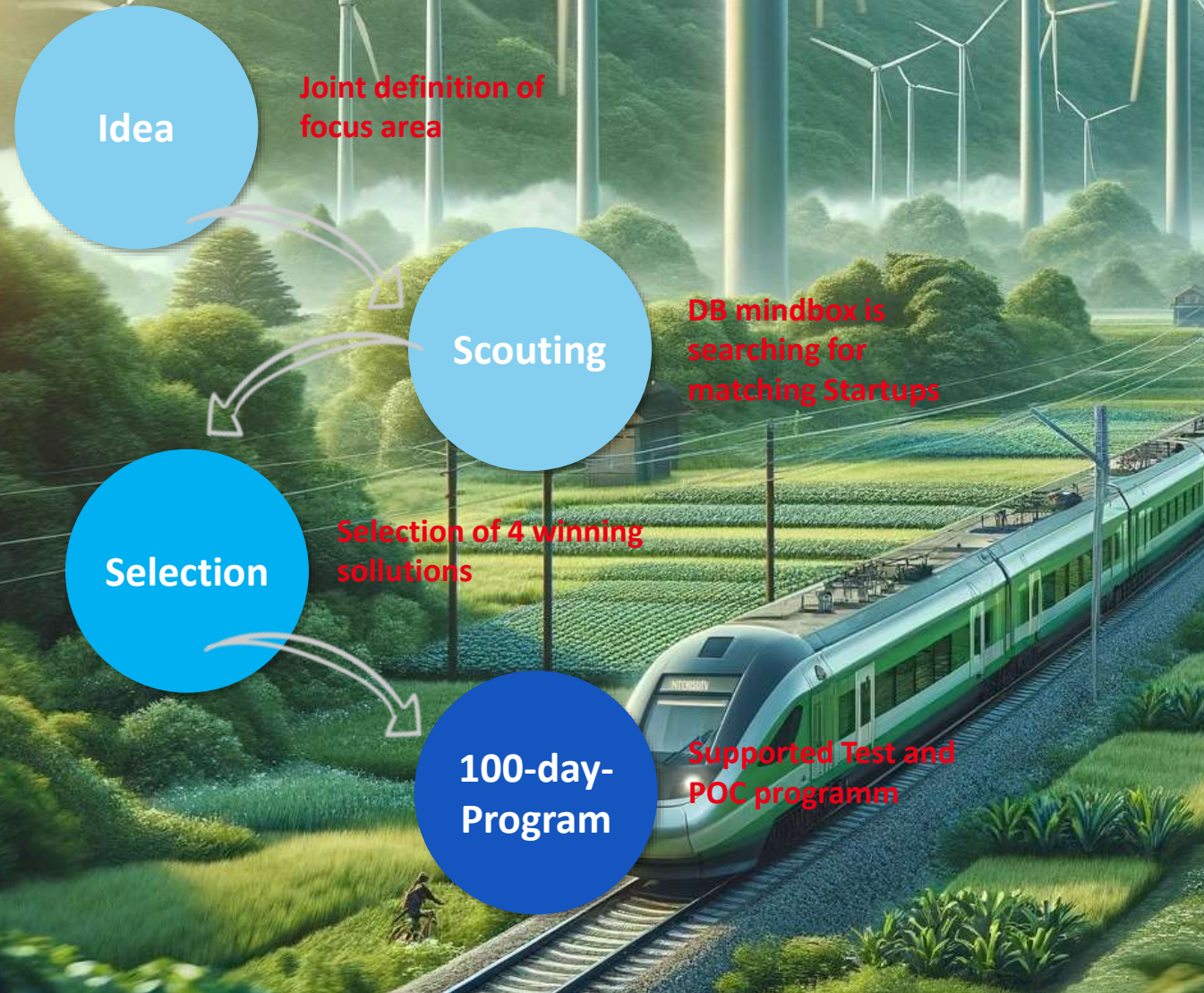Utilisation of earth energy in combination with cooling of tunnels

Value Add

- **Utilisation** of existing Resources, i.e.. additional usage of heat dissipation
- Simplified **Homologation** for Infrastructure Projects

Green Technology

Co2 Negative Structures → Strong by Form

Green Technology
Transparent Noise Protection→ MetaWindow

Green Technology
Co2 Negative Structures → Olivin basrd concrete

Four leavers of improvement

Cooperations

Technology Management

Standardisation

Data Management

Cooperations

Technology Management

40 Technology Communities driving key technologies

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Technologies

1. AR/VR
2. DLT Blockchain
3. Human-Machine-Interface
4. HCP & QC
5. Künstliche Intelligenz
6. Sensorik
7. Digital Twin & IoT
8. 3D-Druck
9. Drohnen
10. Robotik
11. Alternative Bahnantriebe
12. ATO/ETCS (fahrzeugseitig)
13. Intelligente Leittechnik
14. Innovative Betriebsstoffe
15. Akustik & Vibration
16. Innovative Werkstoffe
17. Erneuerbare Energien
18. Luftreinhaltungstechnologie
19. WLAN

Foundations

1. Konnektivität
2. Cloud Services
3. Cyber Security
4. Entwicklungsplattformen
5. Datenmanagement
6. Standardisierte Plattformen
7. Intelligente Normung
8. Dynamisierte Planung
9. Robuste Sicherheit
10. Automatisierte Dokumentation

Rail Technologies

1. Einstiegsysteme
2. Bremse, Luftbeschaffung
3. Klimatechnik
4. Fahrwerk
5. Antriebsstrang
6. Fahrgastinformationen

Enablers

1. Rad-Schiene Kontakt
2. Zulassung
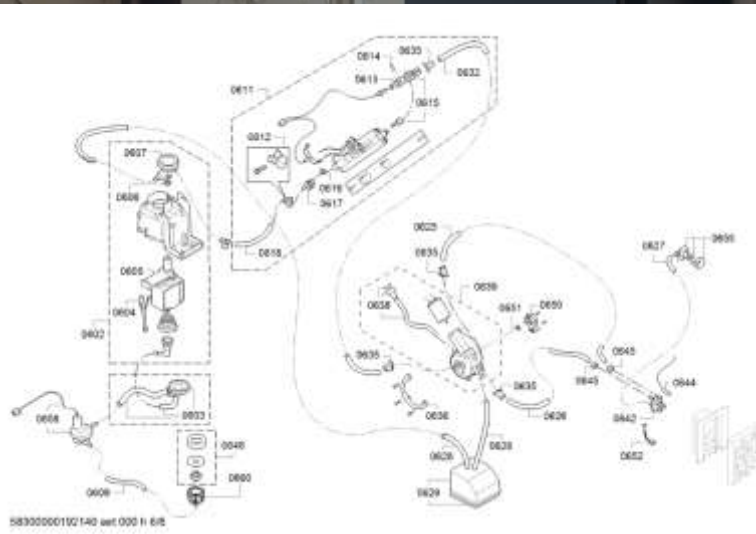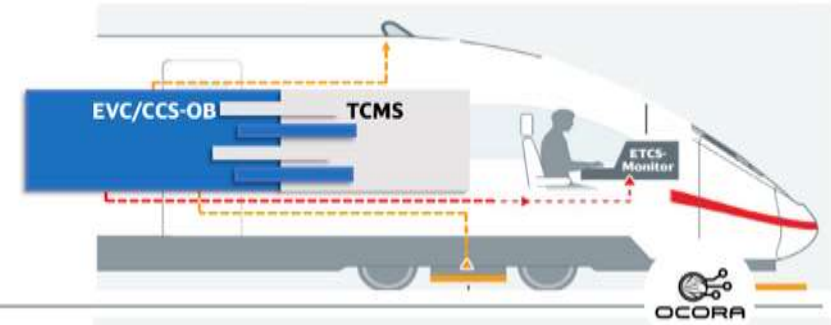3. TechScreening
4. Analytics Bahntechnik

Standardisation

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(0) Aktuelle Situation:
- Monolithische CCS (Command, Control & Signalling) -Onboard (OB)-Architektur, eng verwoben mit dem TCMS (Train Control & Monitoring System)
- CCS-Umrüstung setzt das Verständnis des individuellen, proprietären TCMS voraus (welches nur der Hersteller besitzt)
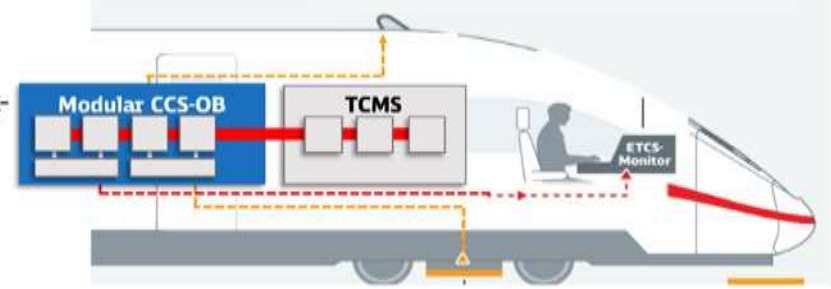
(1) Functional Vehicle Adapter als erster Schritt:
- Modulare, upgradefähige CCS-OB-Architektur
- Functional Vehicle Adapter (FVA) entkoppelt das TCMS vom CCS-OB (+ATO) über definierte Schnittstellen
- CCS-Umrüstung setzt nun kein Verständnis des TCMS-Systems voraus; Abstimmungsgeflechte der Hersteller entfallen
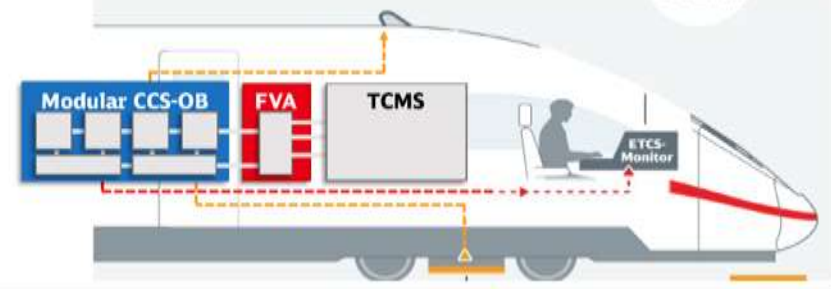
(2) Langfristige Perspektive:
- Übergreifender Next-Gen-Communication Network-Bus zur Anbindung aller Zugsteuerungs- und sicherungssysteme (CCS und TCMS)

Data Management

THANK YOU