

Internet Of (Big Rolling) Things @DB Cargo's European Rolling Stock

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Agenda

Company Overview
Deutsche Bahn & DB Cargo

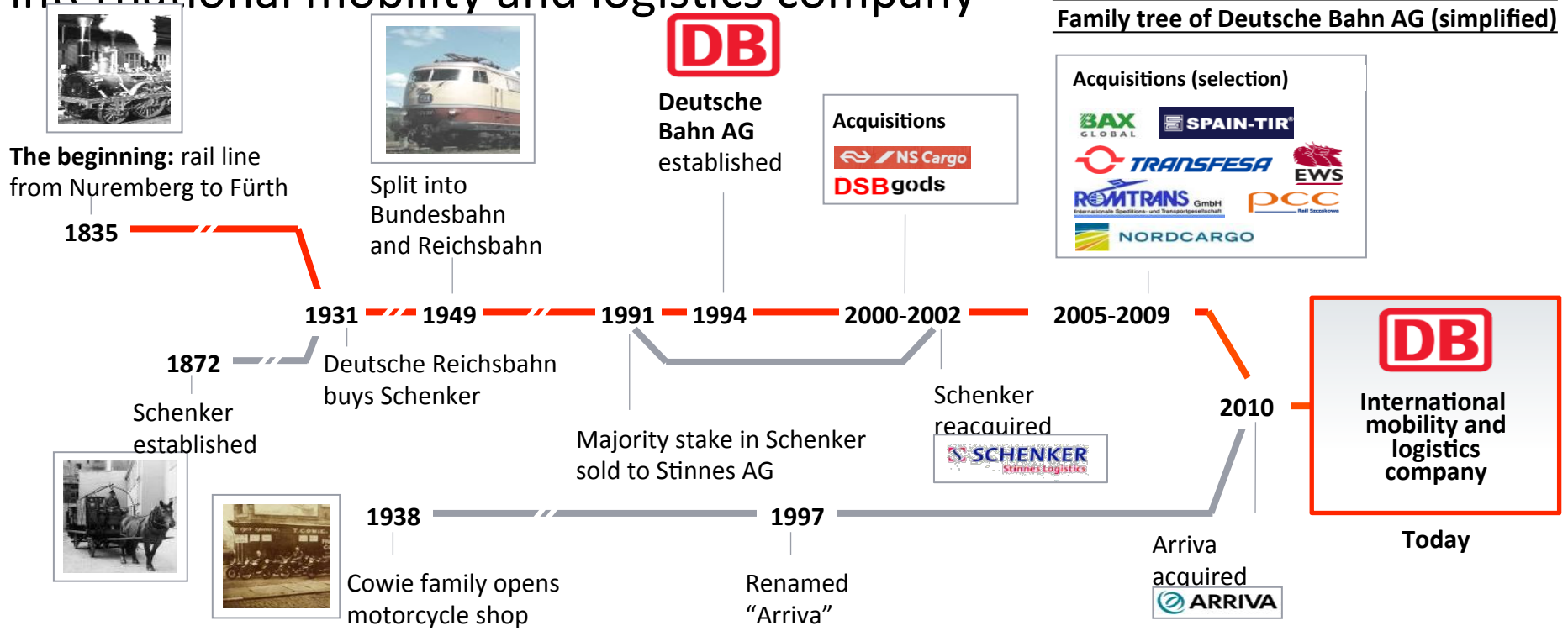
Project TechLOK

Business Case and Use Cases

Current Stage of Splunk Deployment

Summary and Outlook

The history of Deutsche Bahn is the history of several large, long-established companies that joined over the years to form an international mobility and logistics company



With Its Eight Business Units, DB Is Active In All Segments Of The Transport Market



Passenger Transport:

Domestic and European-wide mobility services

- **DB Long Distance**
Long-distance rail pass. transport²
- **DB Regional**
Regional/urban pass. transport (GER)
- **DB Arriva**
Regional/urban pass. transport (EU)³



Transportation and Logistics:

Intelligent logistics services via land, air and the sea

- **DB Cargo**
European rail freight transport
- **DB Schenker**
Global logistics services



Infrastructure:

Efficient and future-oriented rail infrastructure in Germany

- **DB Netze Track**
Rail network
- **DB Netze Stations**
Traffic stations
- **DB Netze Energy**
Traction current

1 The former business unit DB Services has been dissolved and its activities assigned to different divisions; 2 Within Germany as well as cross border traffic; 3 In UK with Arriva-affiliate 'CrossCountry' also long-distance passenger transport;

DB Cargo Has A Strong European Network And Is The Number One In European Rail Freight Transport



DB Cargo in 2015

Revenues	EUR 4,767 m
EBIT	EUR -183 m
Employees (FTE)	30,303
Metric ton km	98,445 m tkm
Freight carried	300 m. t
Fleet ¹	2,869 / 87,264
Avg. dist. transported	313 km

Profile

- With some **4,200 private customer sidings in Europe**, DB Cargo offers its customers access to one of the world's largest rail networks
- DB Cargo's **international network** follows the major European rail freight corridors
- DB Cargo offers European rail transport in the form of **block train, single wagonload** and **multimodal services**
- **Tailor-made transport and logistics solutions** are also available as additional services that can link the rail mode with road (trucking) and ocean freight service
- The **key industries** served by DB Cargo are metals and coal, chemicals, automotive, building materials, industrial and consumer goods, and intermodal transport
- DB Cargo's customers are primarily **key accounts**

¹ Locomotives / freight cars

- Most of DB Cargo's services are carried out using its own fleet of locomotives and freight cars

The Group's Digitalization Activities Are Organized In Six 4.0 Initiatives



Mobility 4.0

This initiative works to design new products with a focus on **customer centricity**, based on different scenarios for developments on the digital mobility markets. It also works to establish a strong **culture**

1 Innovation as a foundation. Logistics 4.0

This initiative uses **big data** and **smart assets** to develop a product portfolio for the future, **digital customer interfaces** and **web-based**

production processes. Infrastructure 4.0

This initiative focuses on digitalization in infrastructure: end-to-end **connectivity with customers**, digital **process improvements** and the creation of new **business models**.



Working Environments 4.0

This initiative centers on overarching topics involved in **working, communicating and learning**. Potential future scenarios are drawn up for **job profiles**.



Production 4.0

This initiative focuses on the **automation** and digitalization of rail operations and maintenance.



IT 4.0

This initiative works to develop a **smart, agile, effective, efficient** and **reliable IT landscape** for DB.



Project Scope TechLOK

Data Access

existing and additional sensors;
diagnosis boxes;
hardware interface

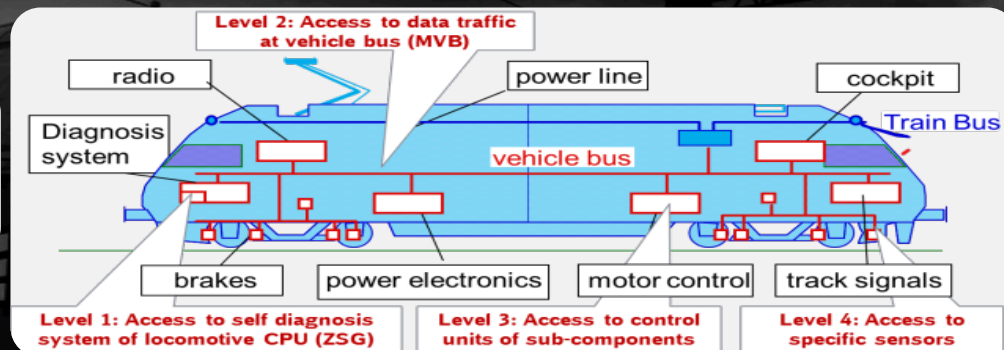
Data Collection

secure data transmission;
data translation;
combine different data sources

Data Visualization & Analytics

Development of use cases;
transform data into information
and results

**7,000 different diagnosis
codes or status messages
per locomotive type**



**60 different time series
values from sensor per
locomotive type**

2014

**2 locomotives types and 30
locomotives**

2016


**7 locomotives types and
800 locomotives**

2019

**16 locomotives types and
2,000 locomotives**

TechLOK Architecture

Data Collection



On Board Computer

Component / Sensor Interface

Data Reduction / GPS mapping

Train driver with ttable

((())) [Server Icon]

HTTPS & MQTTS

Fleet Control Engineering Maintenance Operations

Production Dashboards

Dashboards

Rule Engine Map Reduce & Data Indexer

Real Time Diagnostic & Predictive Analytics

Machine Learning

Automated Algorithms

Models & Technical Experience

Work Group

Data Warehouse

SAP Operation Planning Energy
Track Condition Weather ESM

Implemented And Upcoming Use Cases In 2016



**Driver, Hotline,
Technical
Fleet Management**

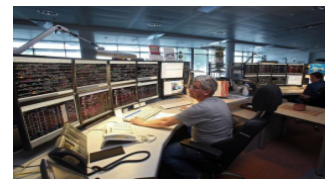
Action Recommendation (1:1)

Health Index

Maintenance Capacity

Failure Code Monitoring

**USE
CASES**



**Operations,
Disposition,
Fleet
Management**

Remote Locomotive Data Access

Condition Monitoring

Action Recommendation (1:1)



**Workshop,
Workshop Crew,
Maintenance
Program**

Root-Cause-Analyses

Diagnosis Tipp

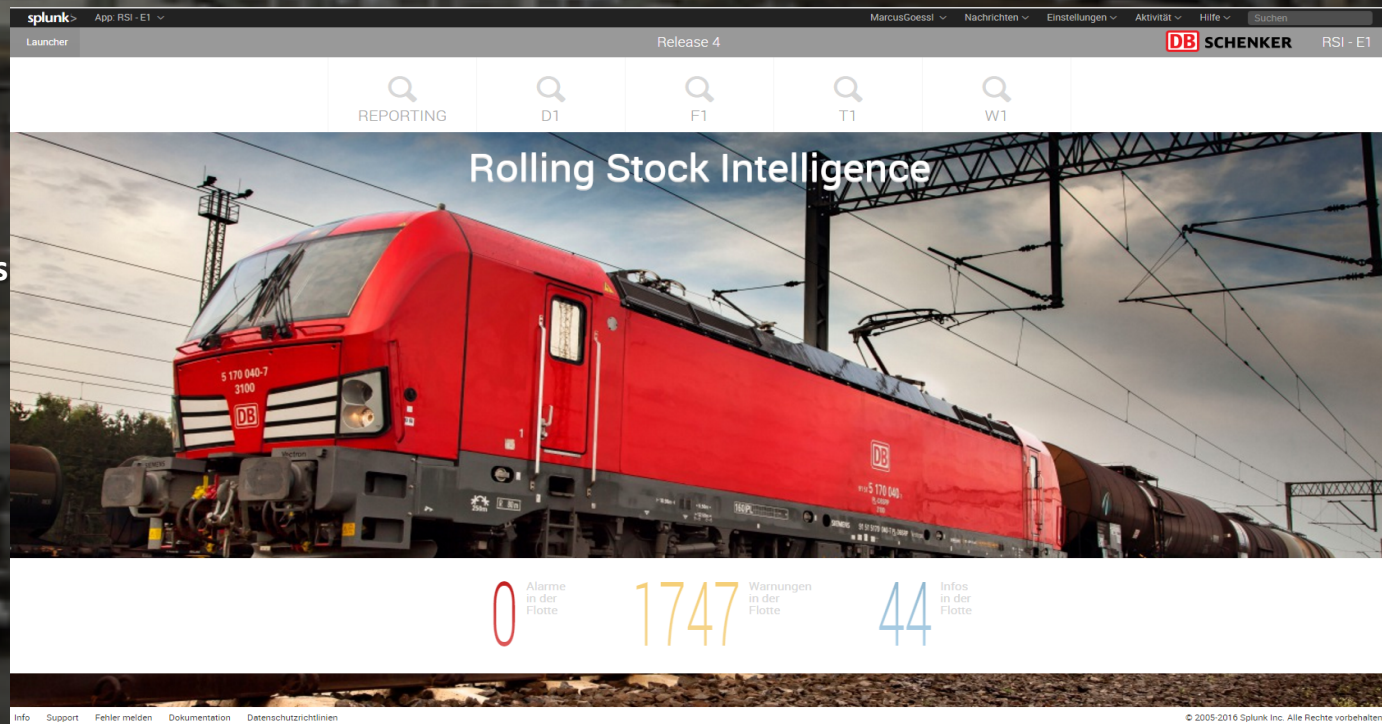
Mobile Maintenance

Maintenance Program

Splunk Application-Fleet Summary Of Alerts

About 800 locomotives sending diagnosis codes, status messages and time series values in near-time to TechLOK database

Fleet wide Summary of triggered Alarms, Warnings and information



Info Support Fehler melden Dokumentation Datenschutzrichtlinien

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Splunk Application – User Group Fleet Management

Fleet Overview about triggered alerts per locomotive class & single locomotive

Deep dive for failure classification based on the results of the Rule Engine

Advisory if & when a locomotive needs to get to a maintenance workshop for repair works

The screenshot displays the Splunk application interface for DB Schenker RSI-F1 locomotive fleet management. The interface is titled "RSI - F1" and "Release 4". It features a navigation bar with "splunk", "App: RSI-F1", "MarcusGoessel", "Nachrichten", "Einstellungen", "Aktivität", "Hilfe", and "Suchen". The main content area is divided into several sections:

- Hauptauswahl:** Includes "Baureihe" (BR185) and "Lok-Auswahl" (alle).
- Filter:** A section with "an/aus" toggle and "Alarm", "Warning", "Info", and "OK" filters.
- Zustandsübersicht - BR185:** A table showing locomotive status. The table has columns: LokNr, Energie / Antrieb (Motor / Getriebe), Fahr- / Bremssteuerung (inkl. Ffst), Überwachung / Sicherheit / Info, Mechanik, Brems / Pneumatik / NB, and HBU / elektrische Leitung. The table lists locomotives 004 through 017 with various status indicators (green, yellow, red).
- Regeldetails der Lok #007:** A table showing rule details. The table has columns: Schadcode, Fehlerzeitpunkt, Späterer Zeitpunkt, HPG, Text HPG, Level, Counter, Regeltext, Regelid, Status, Bestätige Status, geändert am, and Abhilfetext. It lists three rules (0446, 0447, 0509) with their respective details.
- Abhilfetext:** A popup window showing detailed instructions for handling a "Leuchtmelder DGKAUS" alarm. The text includes: "Ausfallursache: Störung Inettab ASG2 (2401-432)", "Abhilfemaßnahme I: Leuchtmelder DGKAUS", "Zuständige Stelle: Fahrerabgabe von F nach HUI verlegen", "FALLS STÖRUNG WETERAHN BESTEH: - Hauptschalter ausschalten", "- gestörtes ASG mittels Softkey 'ASG AUS' ausschalten", "HG einschalten", "HINWEIS: - wenn IR-ET160 angeschlossen wurde, betriebliche Maßnahmen beachten Gleichzeit um 50% verringern", "- zuständige Stelle verständigen", "Abhilfemaßnahme II: - zuständige Stelle verständigen", "FALLS STÖRUNG WETERAHN BESTEH: - Weiterfahrt mit einem Drehgestell", "HINWEIS: - zuständige Stelle verständigen", "Abhilfemaßnahme III: null", "SAP Schadencode: 31447".

Splunk Application – User Group Maintenance Workshop Experts

Supporting Root Cause Analysis based on current diagnosis messages and historical failure date of the locomotive

Access to additional data concerning current locomotive condition

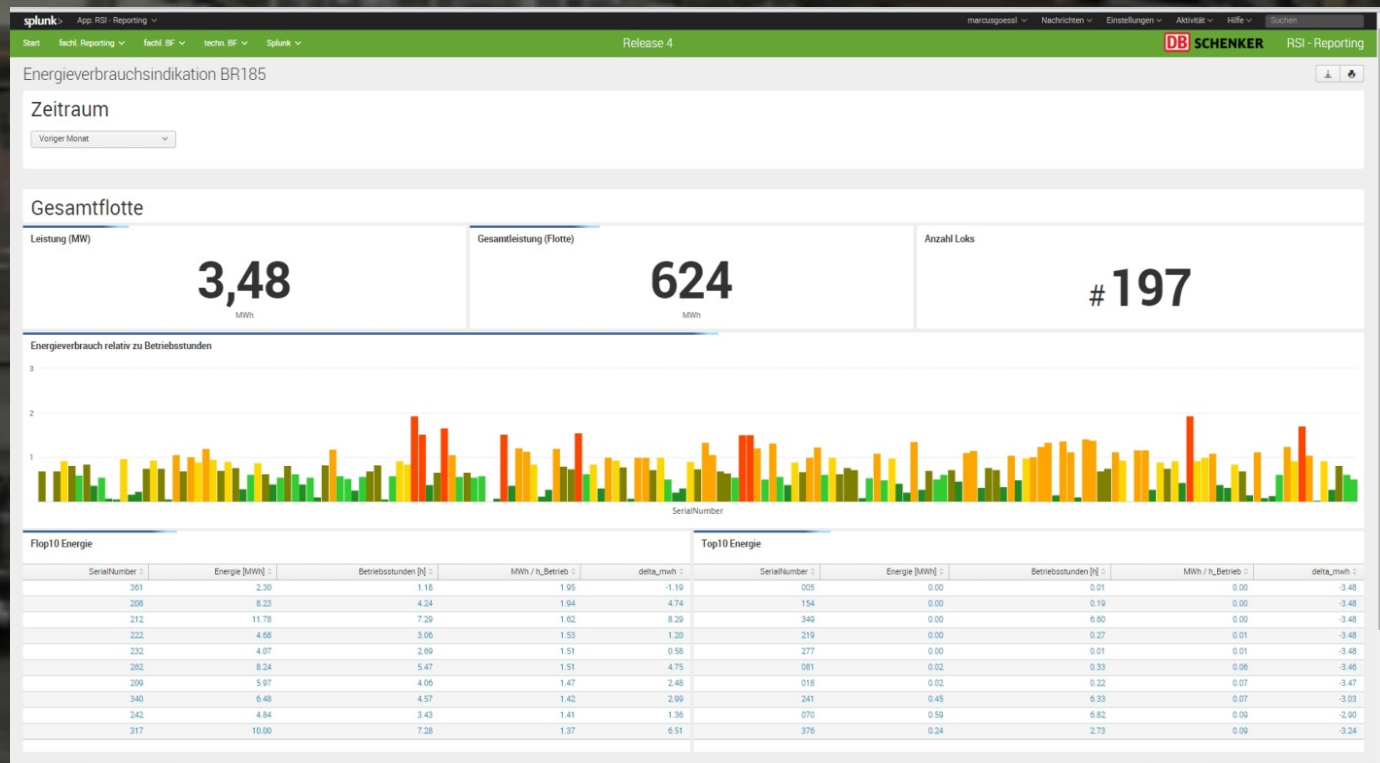
Knowledge exchange between maintenance workshop experts

The screenshot displays the Splunk application interface for locomotive maintenance. The top navigation bar includes the Splunk logo, application name 'App: RSI - W1', user 'Marcus Gressl', and various menu options like 'Nachrichten', 'Einstellungen', 'Aktivität', and 'Hilfe'. The main content area is titled 'RSI - W1' and 'Release 4'. It features a search bar and a user profile for 'DB SCHENKER RSI - W1'. The interface is divided into several sections:

- Hauptauswahl:** Includes filters for 'Baureihe' (BR185) and 'Zeitraum' (Letzte 30 Tage). There is also a 'Werkstatt' dropdown and a 'Werkstattflag setzen' button.
- Zustandsübersicht Lok #169 (BR185):** A table showing locomotive status with columns for 'LokNr', 'Energie / Antrieb (Motor / Getriebe)', 'Fahr- / Bremssteuerung (inkl. Pfst)', 'Überwachung / Sicherheit / Info', and 'Mechanik'. The table shows a single entry for locomotive 169 with various status indicators.
- Diagnosedaten für LokNr 169:** A detailed table of diagnostic events with columns for 'Beschreibung', 'Current', and 'Stored'. It lists various system and subsystem events with their respective values and timestamps.
- Rohdaten der Lok #169 (BR185):** A large table of raw diagnostic data with columns for 'Code', '#', 'kommt Zeitpunkt', 'geht Zeitpunkt', 'offen', 'Sys', 'SubSys', 'Beschreibung', and 'Ausfallursache'. It lists multiple events related to 'Feste Indirekte Bremse (pass.BiR)' and 'Fehler Zuluftventilator F2'.

Splunk Application – Reporting of Energy Consumption

Reporting to identify “bad” and “good” actor locomotives as basis for in depth analysis

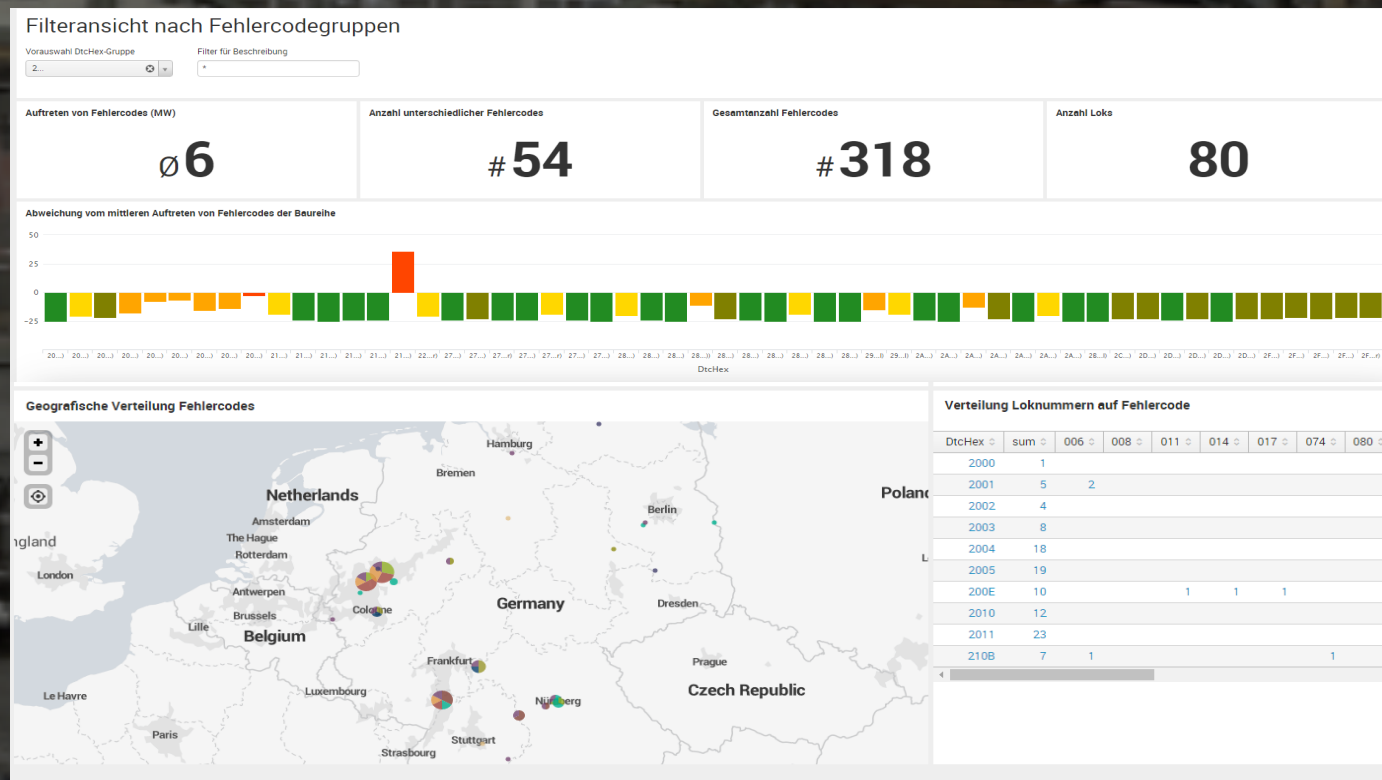


Splunk Application – Reporting of Locomotive Reliability

Reporting tool for analyzing the distribution of diagnosis codes across the fleet

Identification of failure hot spots as well as “bad” and “good” actor locomotives

Comparison of specific failures across the fleet enable the development of technical counter measures

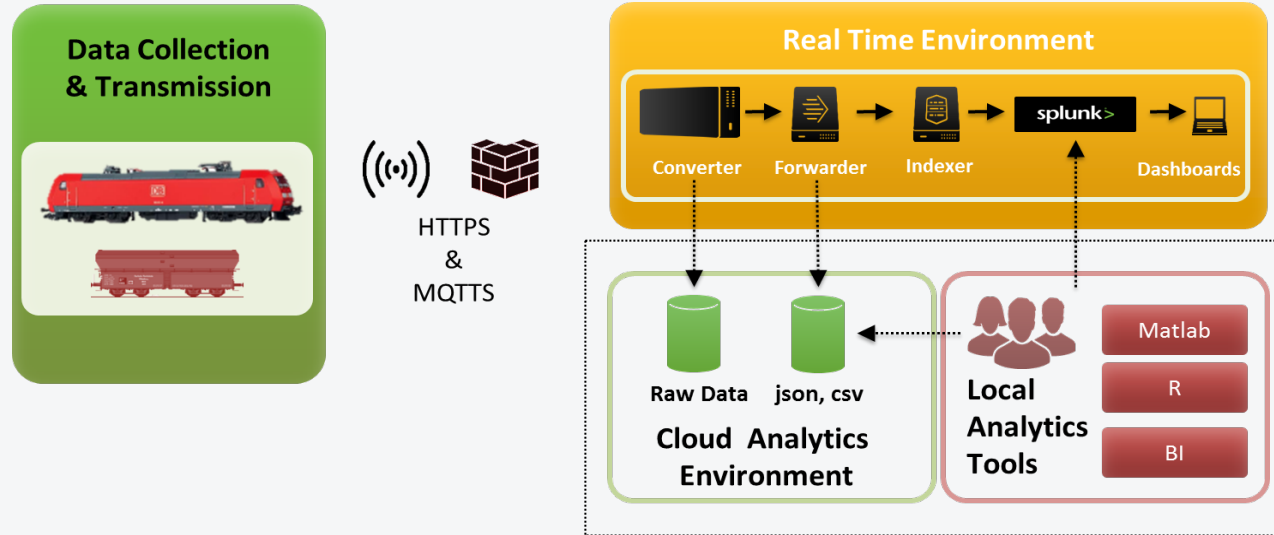


Splunk Approach And Benefits For Techlok

Live handling of technical data (continuous sensor values, diagnosis codes and location) from different locomotive types (Siemens, Bombardier, etc.) with different data sources and formats (json, csv)

Analyze and evaluate data with both simple and complex interlinks (e.g. time span and number of variables)

Easy to implement visualization for different user groups with specific roles



Summary And Outlook

TODAY

7,000 different diagnosis codes / status messages per locomotive type

60 different time series values from sensor per locomotive type

PoC DB Regio locomotives

7 locomotives types and 800 locomotives

PoC Wagon Intelligence with 750 freight cars

PoC Dispo 4.0 for empty freight car disposition

TOMORROW

16 locomotives types and 2,000 locomotives

Access to data via central locomotive bus system (MVB)

Interface to 3rd party Applications, e.g weather or BI-Tools

200 car types and 70,000 freight cars

Interface to all relevant internal IT Systems, e.g. SAP ERP

Splunk as central Big Data Platform DB Cargo Assets

THANK YOU

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