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A Bosch Company

RE 95407 / 2022-09-23

BODAS Connect All-In-One-Connectivity | RE95407

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1 BODAS Connect

Bosch Rexroth Digital Application Solutions – BODAS stands for the entire portfolio of IoT solutions, software and electronic hardware for the off-highway market.

BODAS Connect is Bosch Rexroth's integrated telematics solution that **enables** machine **OEMs**

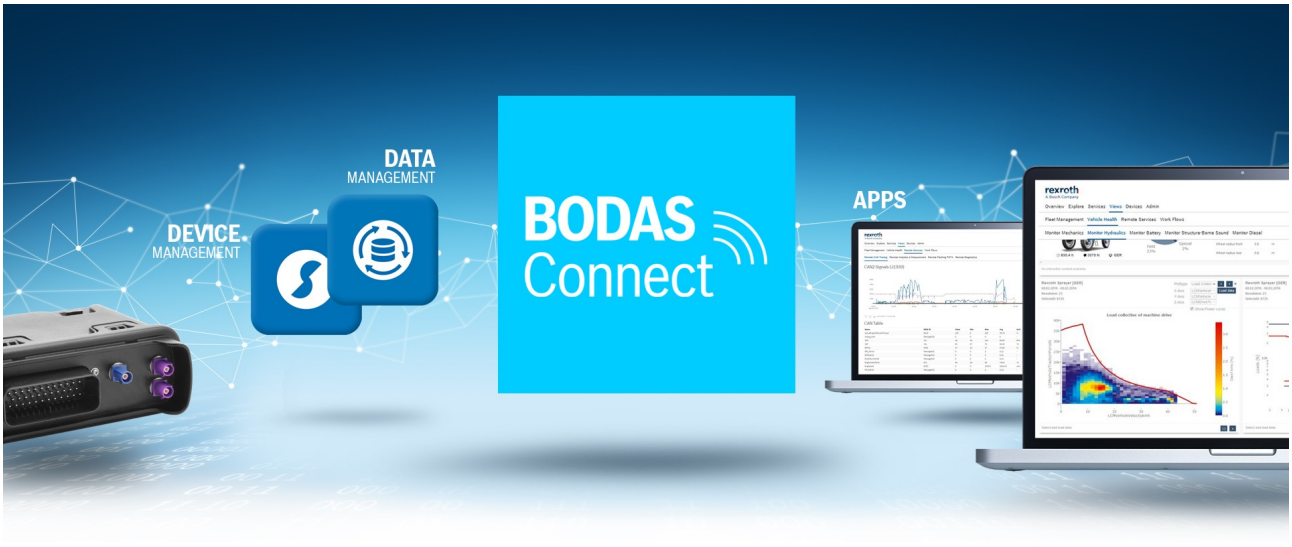
- to **gain** internal R&D and customer support **efficiency**,
- to establish external **data driven business** models

both based on a **industry-proven infrastructure**, which OEMs can fully customize to leverage their **core competencies**.

The respective BODAS Connect packages are described in:

- Rexroth Connectivity Unit (RCU): RE95430
- Device Connectivity (Device Management for RCU): RE95406
- All-In-One Connectivity (Data Management and features for off-highway applications): RE95407

BODAS Connect is a modular end-to-end connectivity solution to transfer data from and to the mobile machine. Unbundled and freely selectable services consisting of device management, data management and ready to use apps for fleet management, vehicle health, remote R&D services and vehicle operation workflows.



It is built on the Linux-based Bosch Rexroth Connectivity Unit (RCU), which is remotely managed and administrated via the Bosch Device Management Portal. Data storage, processing and analysis are performed via the data management in Bosch IoT Insights, which is an integral part of the Bosch IoT Suite.

Depending on customer requirements, BODAS Connect is flexibly customizable and offers both specific device management and data management functions.

The following figure shows an overview and the classification of the Bosch Rexroth IoT solution with the two products "Device Connectivity" for device management and "All-in-One Connectivity", which adds data management on top.

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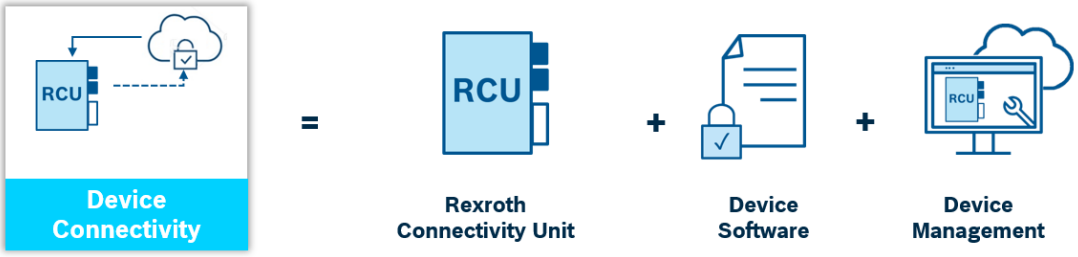
1.1 Device Connectivity

The digital transformation of the off highway market is already well underway and has given rise to new challenges for mobile machines. In our continuous effort to support clients as a strong partner and solutions provider, Bosch Rexroth combines in depth applications expertise and the BODAS software and hardware portfolio to create an integrated Internet of Things (IoT) solution BODAS Connect.

As an integral part of BODAS Connect, Device Connectivity uses the Rexroth Connectivity Unit (RCU) to enable numerous options to wirelessly access the control networks of off highway vehicles. Interactions include flashing, diagnosis and parametrization of Rexroth Controllers (RC). For customers with preexisting data management, BODAS Connect Device Connectivity offers an ideal package for connecting their mobile machines.



1.2 All-in-one Connectivity

BODAS Connect All-in-one Connectivity extends the functions of BODAS Connect Device Connectivity with industry-proven data management services. Based on the BOSCH IoT Suite with over 10 million connected vehicles, this fully integrated IoT solution for mobile machinery handles, processes and stores data obtained from Rexroth Connectivity Units (RCU). It provides an ever-growing variety of off-the-shelf fleet management and condition monitoring services. Our REST-API and MATLAB interfaces as well as our customizable front end, Bosch IoT Insights, offer even more data analysis options.

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2 Variants

Category	Service	Material Number	Description
Features	Fleet Management	R917014008	Web portal for data visualization containing fleet management dashboards
	Condition Monitoring	on demand	
Cloud storage	600 MB	R917014011	Base infrastructure incl. cloud data volume (per RCU in total) for storing and processing e.g. machine data. Additional volume can be booked upfront, otherwise pay-per-use pricing for excess volume. Assumption: Upload of pre-ordered cloud data volume is evenly distributed over several months
	3.000 MB		
Usage based elements	Additional computing power	R917014012	If additional online computing power is needed
	Additional volume processed data	R917014013	If processed data is to be available beyond the default storage period

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3 Data formats

Raw data storage for all incoming data from the RCU or other sources, e.g. other data bases or cloud sources

- Raw data is stored for maximum **5 years**
- In order to display data, raw data first needs to be processed by the appropriate features and turned to processed data
- Raw data can be downloaded by the customer
- **Additional raw data** storage available on top of 3.000 MB per RCU tariff
- **Pooling** of data volumes across multiple RCUs, i.e. additional data volume of one machine can be compensated by reduced volume from another machine
- Maximum allowed data increase within two weeks: 125% of included raw data storage / 60 months (e.g. for the 3000 MB tariff this is 50 MB * 125% = 62,5 MB)
- If the cloud storage volume tariff is exceeded, "**pay per use**" applies after pooling of data volumes across multiple RCUs with the same tariff of the respective customer fleet
- Rexroth will calculate the average consumption of the data volume. Rexroth will invoice the additional data volume based on the declared pricing after pooling
- The number of "Connected RCUs" is equal to the number of
- The data volume is queried every hour
- The pricing is calculated based on the highest data volume (peak) measured during a month
- A "Device" in the Data Management will be considered and charged in the same way as a "connected RCU"
- 2 decoders included - further possible upon request

Processed data storage for processing, analyzing and visualization purposes

- **Short-term** data collection
  - Short-term data collection is stored for maximum **14 days.** Afterwards, the processed data will be deleted
  - The reason for the differentiation in raw and processed data is the fact that processed data's volume is significantly larger than raw data. Raw data is basically only the value in the data base (e.g. value 26), while processed data also contains additional information (e.g. pressure A on pump 1 = 26 bar)
  - Processed data can be re-processed from raw data. The exact re-processing and access time depends on data volume and other factors. Rough rule of thumb: data of one machine for one day takes several minutes re-processing according to number of signals
  - After the re-processing, the processed data remains active for the agreed data lifetime (14 days)
  - Data can also be processed, merged, stored and visualized by **customer-specific code**. This may require additional storage capacity and computing power at additional cost
  - processed data can be downloaded by the customer any time at no extra cost
  - **Additional processed data storage** and **longer storage time** is available upon individual request
- **Long-term** data collection
  - Long-term data collection is stored for maximum **2 years.** Afterwards, the processed data will be deleted
  - Compared to the short-term data collection, the long-term data collection is for storing and visualizing aggregated machine data over a long period of time
  - The Long-term data collection can provide **long-term statistics** (e.g. average fuel consumption per months and machine operating hours) and **long-term events** (e.g. important events and critical errors)

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- The data volume of the long-term data collection counts with the data volume of the raw data storage

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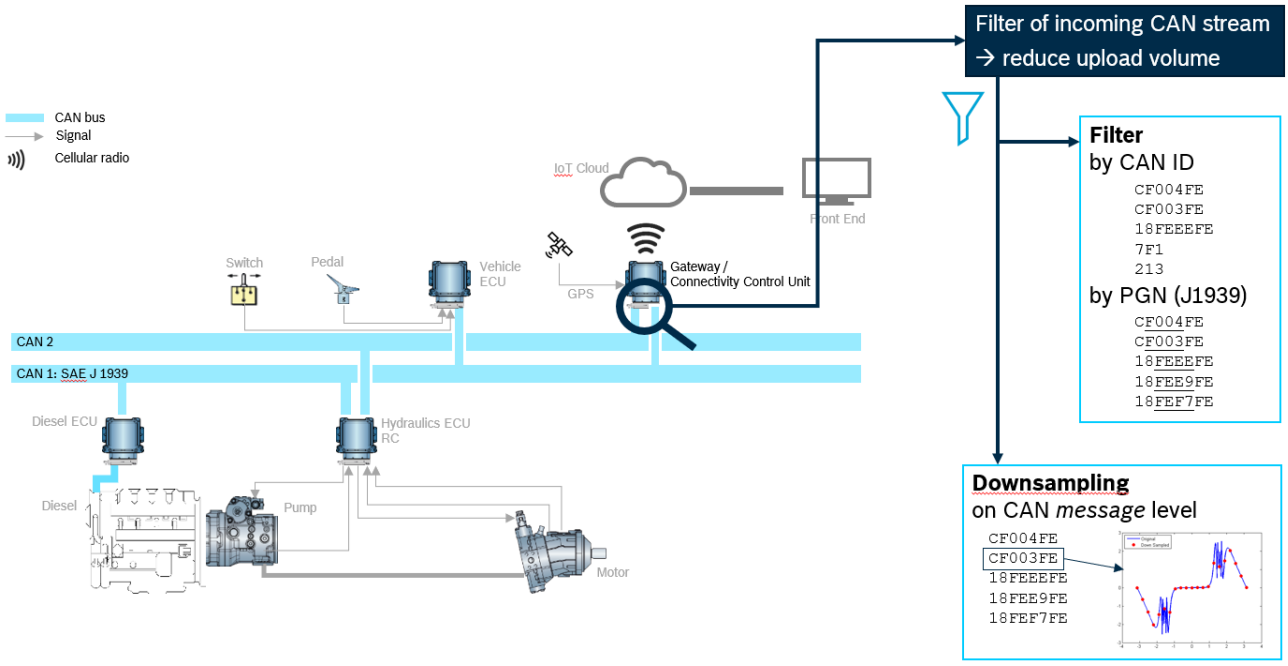
4 Features

4.1 CAN filtering, high-frequency sampling and downsampling

With BODAS Connect selected (with a filter) CAN messages are collected from up to 4 CAN networks simultaneously. CAN messages with slow changing signals (changes occur after more than 1 seconds) such as temperature or driving gears can be downsampled while keeping the data quality.



4.2 Data compression

CAN message are compressed before being uploaded to the cloud services. This is done by using a specific algorithm.

4.3 Cloud data storage

BODAS Connect Data Management provides two types of data bases for organizing your machine data. A raw database which contains all raw and compressed machine data and a database for processed data. Both databases are MongoDB databases.

4.4 Processing pipelines

BODAS connect data management provides configurable pipelines for processing machine data. Pipelines provide a basic set of building blocks that you can use to tailor the data to your specific needs. You can upload your application specific and IP-Protected algorithms in a pipeline for generating more knowledge out of your machine data.

4.5 Extensible dashboards

BODAS connect provides a rich set of widgets and a query language for customizing existing dashboards or creating your own dashboards. BODAS connect dashboards are able to connect to external data sources (e.g. metrological data sources). Moreover, created or existing dashboards can be embedded in external

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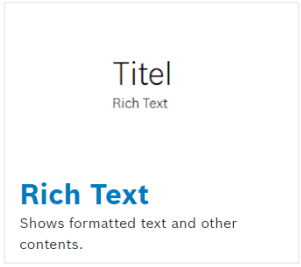
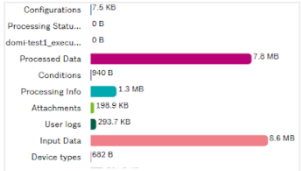
websites with iFrame codes.



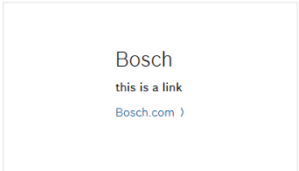
Rich Text

Shows formatted text and other contents.



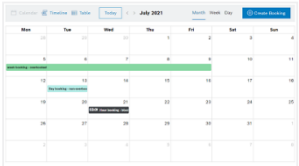
Project Stats

Shows statistics about the current project



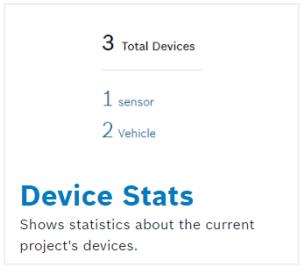
Link Panel

Shows links as teaser panel



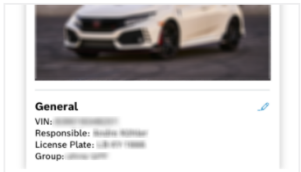
Calendar

Shows a calendar.



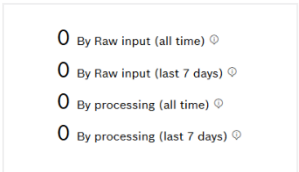
Device Stats

Shows statistics about the current project's devices.



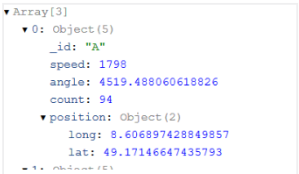
Device Details

Display a single device's information blocks.



Duplicates

Shows duplicates in current project



Tree

Displays data in a tree view.

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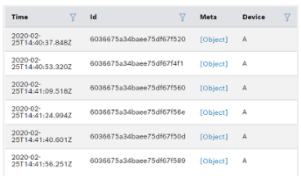
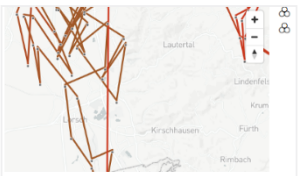
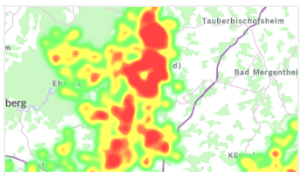


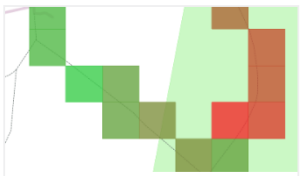
Table
Displays data in a table view.



Colored Tour
Shows data as a colored Tour

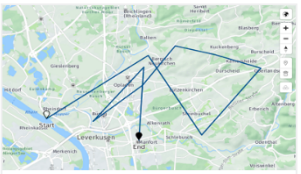


Heatmap
Shows data as a heatmap



Friction Map
Shows data as a friction map

Location Map
Displays geo coordinate data on a map



Tour Map
Displays data in a tour map.

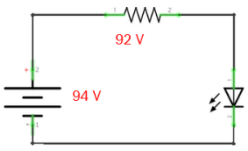
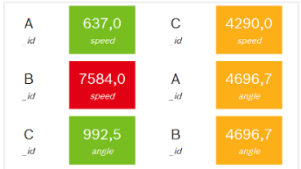
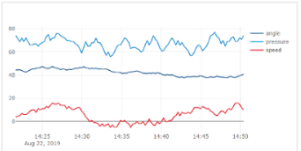


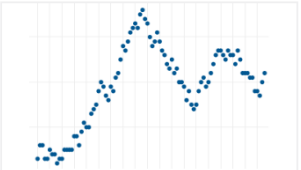
Illustration
Display values on a custom image



Value
Displays data in a value view.

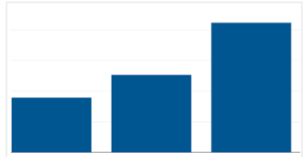


Line
Shows data as line chart.

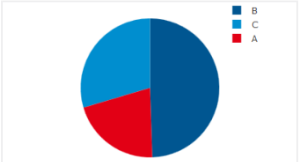


Scatter Plot
Shows data as markers.

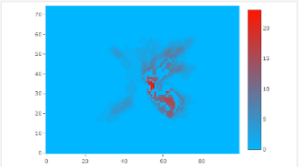
Signal Chart
Shows data as signals.



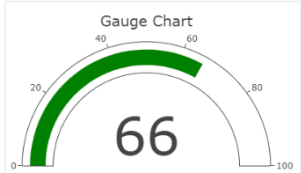
Bar
Shows data as bars.



Pie
Shows data as pie chart.

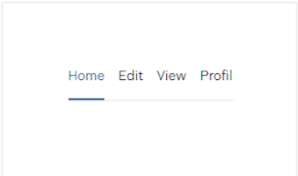


Heatmap
Shows data as colored markers.

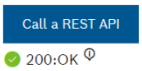


Gauge Chart
Shows data as gauge chart.

Treemap Chart
Shows data as treemap.



Tab Widget
Displays several widgets into tabs



Action Button
Configuration of a REST request to a third-party system to be executed by clicking the Action Button.

4.6 Digital twin model

BODAS connect provides a tool for creating a virtual representation of your machine types. A standard representation is provided by default in which you can map the CAN topology of your machine. Moreover, this virtual representation can be enhanced with information on machine type specific components such as the maximum pressure allowed for a hydraulic pump and the maximum measured pressure for the given pump.

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4.7 Customer identity access management (CIAM)

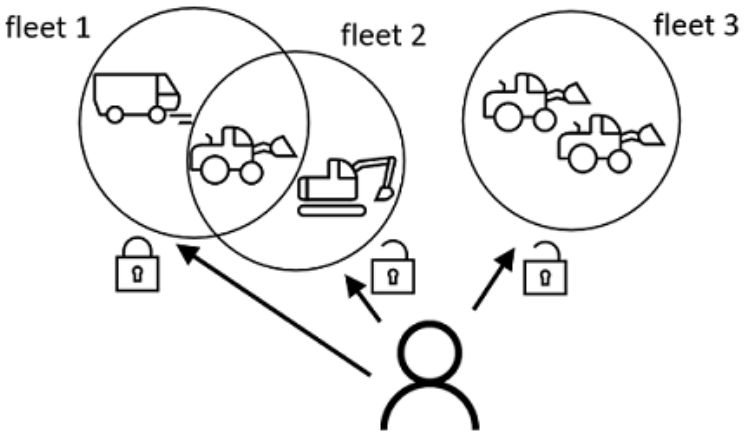
BODAS connect contains a default identity provider: SingleKey ID. Moreover, you can integrate your company identity provider in BODAS Connect data management. This enables you to integrate BODAS connect data management in your IT landscape and keep your existing log in mechanisms.

4.8 Access control

BODAS connect data management enables you to flexibly defines what dashboards, functionalities, and machine data a user can access.

4.9 Fleet management

With BODAS connect fleet management you can organize your machines in different fleets (group of machines). With defined fleets, it is possible to show only a subset of machines in dashboards. BODAS connect fleets can contains multiple machines of one or several machine types (mixed fleet) and it is possible to assign a machine to several fleets at a time.



4.10 Monitoring and tracking

Monitoring and tracking is a key feature of BODAS Connect Data Management. Based on GPS and CAN data of the machines in your mixed fleet, it enables a variety of use cases for different personas such has getting the last known positions or getting an overview across fleets whether errors occur, service is necessary, or e.g. fuels are low. It also displays machine activities with historical machine data.

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4.11 Aggregation and statistics

BODAS connect data management allows you to aggregate your data and allows to analyze data over a long period of time. It gives a quick overview about the machine productivity and usage (e.g. operating hours,

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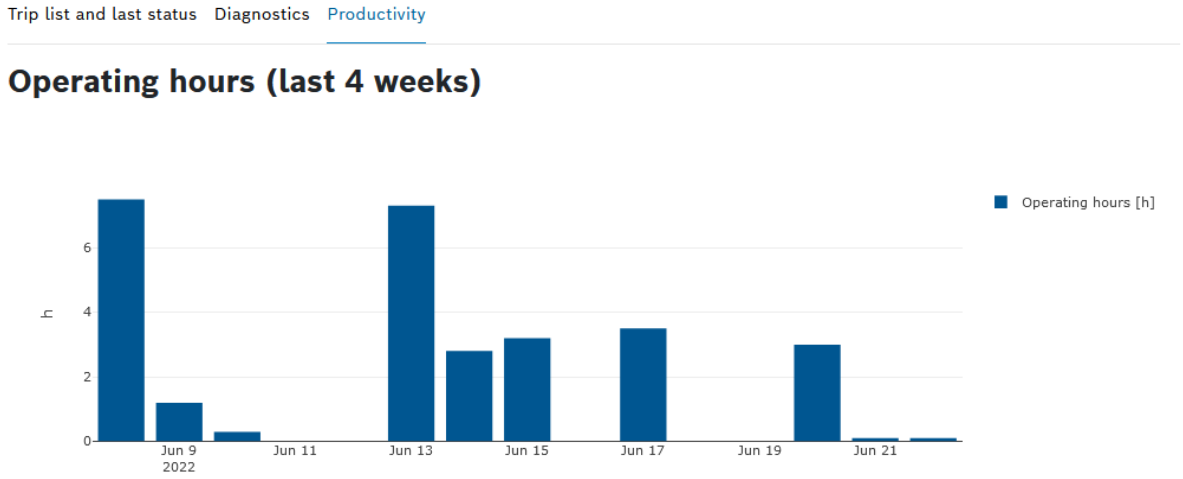
driving distance, fuel consumption) and allows to identify trends (e.g. engine load, temperatures).



4.12 Machine errors monitoring and diagnostic

BODAS Connect data management can decode and display machine errors. By default, you can decode and visualize standard j1939 DM1 machine errors. BODAS Connect data management can be extended to decode and visualize your ECU specific errors which are cyclically available on the CAN network of the machine.

Number of active DTC

Select columns

active DTCs	Malfunction indicator lamp	Red stop lamp	Amber warning lamp	Protect lamp	Link
4	fast flash	fast flash	off	off	DTC analysis

Active DTC

Select columns

SA	SA Label	SPN	SPN Label	FMI	FMI Label	Occurence counter	Last detected at	
0	Engine	21	Engine ECU Temperature	12	Failure	3	2022-01-18T14:06:32.287Z	Repair instructions
0	Engine	18	Engine Fuel Pressure (Extended Range)	2	Erratic, Intermittent, or Incorrect	2	2022-01-18T15:38:51.605Z	Repair instructions
0	Engine	23	Generator Oil Pressure	11	Other Failure Mode	1	2022-01-18T11:15:19.587Z	Repair instructions
0	Engine	16	Engine Fuel Filter Differential Pressure	0	High - most severe	5	2022-01-18T13:34:37.441Z	Repair instructions

For a detailed failure analysis of re-occurring service issues and R&D use cases, BODAS Connect data management provide an analysis dashboard which historical machine errors and a heatmap with the error density per GPS position.

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DTC density map

DTC history

Select columns

SA	SA label	SPN	SPN label	FMI	FMI label	Occurrence counter	Detected at	
0	Engine	28	Accelerator Pedal 3 Position	19	Data Error	1	2022-01-18T09:44:58.088Z	Repair instructions
0	Engine	24	Generator Coolant Temperature	19	Data Error	1	2022-01-18T10:15:36.211Z	Repair instructions
0	Engine	36	Clutch Plates	20	Data Drifted High	1	2022-01-18T10:37:58.443Z	Repair instructions
0	Engine	23	Generator Oil Pressure	11	Other Failure Mode	1	2022-01-18T11:15:19.587Z	Repair instructions

4.13 REST API interfaces | ISO 15143-3

Different REST endpoints are provided to retrieve your machine data. Query templates are prepared and can be executed to query machine data.
The international standard ISO 15143-3 specifies telematics data that are exchanged in a worksite. BODAS Connect supports the exchange of data based on the ISO 15143-3 standard. A defined set of J1939 CAN signals has been selected to create custom end points for the ISO 15143-3 interfaces. Those custom end points can be freely configured to use machine specific can signals.

4.14 Conditional Actions

Using Conditional Actions, you can define rule-based actions in BODAS Connect Data Management. Possible actions are: notification per Email or SMS and REST API Call.

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5 Security & Privacy

5.1 Security

BODAS Connect is Bosch Security Engineering Process (SEP) compliant.

BODAS Connect uses security concepts like trusted certificates. For specific use cases, hardware security modules (TPM, trusted platform module) as part of the RCU-hardware can be used.

Managing access to BODAS Connect Data Management is done by creating users and using the created users for connecting to the solution. BODAS Connect distinguishes between **Technical users** and **UI users**.

Technical users are used to create tokens or credentials that are used by mobile machines or any data source for sending data to BODAS Connect Data Management. Moreover Technical users can also be used for accessing data through provided RESTful APIs.

All communication is secured through HTTPS and encrypted through TLS 1.2 by default. Unencrypted communication is not allowed.

5.2 Privacy

As the BODAS Connect servers are located in the EU, BODAS Connect is subject to GDPR and is compliant with the respective regulations.

Please check out the respective data privacy statement on the Bosch Rexroth website:

https://www.boschrexroth.com/en/dc/data-protection-notice/

Privacy by Design and Privacy by Default is provided by BODAS Connect:

- It is ensured that only the required amount of data sets are stored and the service does not save or create any extra data
- Personal data can be deleted after elimination of the purpose and your application can delete any data which was stored in the service
- Log files are deleted after their purpose has been removed. Access and integrity of log files is protected and technical logs are deleted automatically. Access to the logs is limited to the operators of the service (Bosch Software Innovations GmbH, Robert Bosch GmbH).

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6 Project Planning Notes

6.1 Software & Bus configuration for allowing IoT Services

Rexroth will provide a customized software for reading out CAN values from CAN bus. For this, following prerequisites are among others to be fulfilled from the customer side:

- Machine with fully functional E/E architecture including CAN-bus interface
- Cabling to connect the Rexroth Connectivity Unit (RCU)
- Customer provides CAN Configuration (e.g. DBC) with parameters which should be read out from the vehicle/ machine and visualized on the dashboard

For the entire catalogue of prerequisites please get in touch with your sales interface or contact connect.bodas@boschrexroth.de

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