Robert Bosch Engineering and Business Solutions

Overview

Turnover 2017
$ 820M

Year of foundation
1990

Associates
19K+

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Domains

- Automotive
- Manufacturing
- Hi-Tech
- Healthcare
- Agriculture
- Aerospace

- **Embedded Leader**
  - Product Engineering
  - Engineering Consulting
  - Testing & Validation
  - Tool Development

- **Business Solutions Provider**
  - Application Lifecycle Management
  - Product Lifecycle Management
  - SAP
  - Oracle
  - Microsoft

- **Digital**
  - #JumpStartDigital
  - Factories of the Future
  - Smart Living
  - Connected Products
  - Personalisation and Proximity Solutions

- **Mobility**
  - Automated
  - Electrified
  - Connected
  - Shared

- **Innovation**
  - Data Analytics
  - Block Chain
  - Artificial Intelligence

Development Centers
- Bangalore
- Coimbatore
- Hyderabad
- Vietnam
- Mexico
- Poland

Embedded into industries
- Automotive Hi-Tech Manufacturing
- Manufacturing Healthcare
- Healthcare Agriculture
- Agriculture Aerospace
- Aerospace Development Centers

- Bangalore
- Coimbatore
- Hyderabad
- Vietnam
- Mexico
- Poland
Connectivity Engineering
Digital Roadmap for Things

Value Creation

Industry

Legacy Things
Digitally Enabled
Remote Monitored
Self-Monitoring/Service Enabled
Remote Controlled
Autonomous Things
Economy of Things
Economous Ecosystems

Next 5 Years

Things Maturity

Connectivity Engineering
Digital Roadmap for Things

Industry

Legacy Things
Digitally Enabled
Remote Monitored
Self-Monitoring/Service Enabled
Remote Controlled
Autonomous Things
Economy of Things
Economous Ecosystems

Value Creation

Digital Twin
Machine Modelling
Edge Analytics
Remote Conf./FOTA
Predictive Maintenance
Device Management
Basic Connectivity

Hierarchie of Services
Connectivity Engineering
Intelligent Asset Landscape – Our Perspective

Intelligent Services

Super System

Cloud Platform

Blockchain

Digital Twins

Autonomy

Operational Value

Flexibility & Optimization

Open Arch & System Engineering

Secure M2M Comm. & Token Exchange

Economy

Transactional Value
Connectivity Engineering
Current Scope of Machine Connectivity

- Remote Monitoring
- Predictive Maintenance
- Remote Conf.
Connectivity Engineering

Complete Scope of Connected Machines

**Business Workflow:**

- Trust Network
- Operational Constraints
- Operational Logic
- Process Logic
- Process Parameters
- System Logic
- System Constraints
- Edge Compute

**Operational Logic:**

- Operational Parameters
- Operational Constraints
- Process Constraints

**Process Logic:**

- Business Objectives
- Business Constraints

**System Logic:**

- Remote Mgmt & FOTA

**Remote Monitoring:**

- Remote Services

**Pred. Maintenance:**

- Statistic %
- Measurement Signals
- Parameters (Phy.)

**Gateway:**

- Data Point
- Events

**Message:**

- Next 3-5 Years
Connectivity Eco-System
A huge portion of the R&D spend of Bosch goes into engineering excellence. Today, we have over 50,000 research and engineering experts working on the cutting-edge digital technologies. Bosch IOT suite is one of the leading IOT platforms in the world today, and with its modular approach and customizable templates, is the perfect fit for the digital manufacturing enterprise. As an organization that holds trust and security in the highest regard, Bosch ensures security of your data with utmost diligence. The Bosch IOT Cloud & ESCRIPT security are data solutions for the future.
Connectivity Engineering
Coupled Device and Cloud Software for Seamless Data

**Devices**
- iTraMS CCU
- Other Bosch CCU
- 3rd Party CCU

**Applications**
- Dashboards
- User Applications
- Third Party Applications

**Vehicle Telematics Backend Services**
- iTraMS Microservices
  - Device Notification
  - Identity Management
- VHMS Microservices
  - Diagnostics & Monitoring
  - Device Management
- Application Microservices
  - Notification
  - Policy Management

**HDCS**
- Big Data Persistence
- Meta Data Management

*Load Balancing*
Device
Connectivity Engineering
Hardware – Connectivity Control Unit

Product Portfolio: Gen 1
- Product status: **In Series** (since May 2016)
- Key customers: OEM’s in India
- Devices in field: 10000+ (Tractors, Construction, CV)

Product Portfolio: Gen 2
- Product status: A Sample. Series in Q1/Q2 2019
- Key customers in South Korea, EU and NA region
Connectivity Engineering
EDGE Platform for Engines

Hardware

**In Cabin**
- **IP-52**
- Top + Bottom – PA66
- Main Connector: 36 pin, MX23A JAE
- 4G LTE CAT1, WIFI/BT, 2 CAN, Internal/external antenna support, opt. Ethernet, RS485, battery

**Engine Mount**
- **IP-69**
- Top – PA66, Bottom - Aluminium
- Main Connector: 48 pin, Molex-CMC
- 4G LTE CAT1, WIFI/BT, 2 CAN, Internal/external antenna support

Device Software
Common Linux OS Kernel Platform + BSP + Bosch Middleware/Firmware Platform
Yocto Linux based SDK

Look Ahead SW
- **Bosch e-Horizon Solution**
  - Energy efficient driving strategy for uphill and downhill coasting
  - Applicable for in-cabin variant, NA on HWY
Connectivity Engineering
Platform Variants

**Platform 1**
- Cellular: 2G/GSM/GPRS
- GNSS: GPS
- 1x CAN
- 10 I/Os
- 2 Freq inputs
- Configurable I/Os
- IP54 & IP67
- Voice Ckt, Secondary battery

**Platform 2**
- 4G / LTE Cat 4
- Integrated Appl. Proc. + Modem
- Wi-Fi + BT/BLE (4.2)
- USB 2.0
- Ethernet (Automotive)
- e-SIM / eUICC (MFF2)
  - 2x CAN-FD (5 Mbps, 2 Mbps)
  - Partial Networking (CAN)
  - 1x LIN, 1x RS-485
- e-Call, b-Call, i-Call
- Java + OSGi frame-work
- FOTA
- Support for External Antenna (opt.)
- 10 I/Os
- 1 Freq inputs
- IP52 & IP67
- Secondary battery

**Platform 2A**
- 4G / LTE Cat 1
- (Opt. Design Protection for Cat 4)
- Discrete Solution
- Supports Edge Processing Capabilities
- Wi-Fi + BT/BLE (4.2)
- 2x CAN-FD (5 Mbps)
- RS-485
- Java + OSGi frame-work
- Support for External Antenna (opt.)
- IP52 & IP67
- e-SIM / eUICC
- Embedded Linux OS

**Platform 3**
- IP54/67

**Platform 4**
- IP52

**Platform 5**
- IP67

**Platform 6**
- IP52

**Platform 7**
- IP67

**Platform 8**
- IP52

**Platform 9**
- IP67
Connected Services
Connectivity Engineering
Bouquet of Connected Solutions and Services

- Support different business models – cloud based and on premise hosting
- Data security: TLS 1.2 compliant
- Data ownership: OEM/customer owns the data
- Synchronization between DM/FOTA cloud and OEM Cloud
## Connectivity Engineering
### Bouquet of Services – Lifecycle View

<table>
<thead>
<tr>
<th>Enginet life cycle</th>
<th>Development</th>
<th>Validation</th>
<th>SOP</th>
<th>Ramp-up</th>
<th>Series Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>DRIVE REC High Perf.</td>
<td>DATA ACQUISITION &amp; TRANSMISSION (Communication Channel)</td>
<td>SERIES OBU Re-Use</td>
<td>SERIES CONNECTIVITY OBU</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>PLCS Connectivity tool suite</td>
<td>DATA MANAGEMENT (Storage, Search, Presentation)</td>
<td>X-SOP VALIDATION (Validation pre-SOP &amp; Series launch monitoring)</td>
<td>PREDICTIVE DIAGNOSTICS</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Connected services</td>
<td>WEB-BASED VALIDATION* (Components, Functions, Calibration)</td>
<td>REMOTE Flashing* (ECU Data Sets, ECU Program Versions)</td>
<td>FOTA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>REMOTE MONITORING* (Test Device Management)</td>
<td>Field Data Exploration</td>
<td>CLOUD-BASED SENSOR</td>
<td></td>
</tr>
</tbody>
</table>

* Development in progress for RC30 & RC40 series

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Connectivity Engineering
Extending Infrastructure to other Value Added Services

Automotive
- Vehicle Data Logger
- Alerts – Temperature, Overload & Service
- Driver Behaviour
- Fuel efficiency
- M/c or vehicle utilization
- Fuel theft alert
- Warranty analytics
- Predictive maintenance
- Monitoring functions like - Tyre, battery, etc.,
- B-call
- Field upgrade monitoring
- Vehicle data validation
- SOTA, FOTA
- SFDE, e-call
- Panic button
- Emission monitoring
- Accident recording
- Systematic Field Data Exploration

Geo
- Track-n-trace
- Geo-fencing
- Replay route
- Stolen vehicle monitoring
- Acreage
- Fleet monitoring
- Location based services

Farming 3.0
- Connected supplements
- Precision farming
- Autonomous farming
- Connected farming (sensors in land to monitor soil)
- Farm assist
- Weather information integrations
- Acreage tracking

Business 2.0
- ERP Integrations
- 'Uber' for tractors
- Renting and leasing services
- Usage Based Insurance
- Financing & recoveries
Connectivity Engineering

Transformation through sensors, Software and Services

1. Data Logging & Remote Diagnostics
2. Firmware Over The Air (FOTA)
3. Campaign Management
4. Predictive Diagnostics
Connectivity Engineering - Systematic Field Data Exploration (sFDE)

sFDE or Systematic Field Data Exploration is about use-cases where OEM / Supplier gets to understand more about the usage patterns of the vehicle and components (system) as a real-time feedback from the vehicle which will help to design system better in focus with end-user.

01 Design for Reliability
- Right Sized Product through analysis of field data with data mining
- Improvement in quality/robustness (risk assessment and validation using field data)

02 Evaluation
- Evaluation of field data to understand customer (based on captured field data)
- Field validation of new functions

03 Predictive Diagnostics & Preventive Maintenance
- Enhance availability using predictive diagnostics (based on captured data of sensors, actuators & learning algorithms)
- Preventive Maintenance algorithms for regular service intervals

04 Use the data to offer new services and explore new business models
Connectivity Engineering -
Key Feature - Systematic Field Data Exploration (sFDE)

**Benefit of sFDE**
- Re-Manufacturing
- Faster problem analysis
- Early detection of field problems
- Product observation & liability
- Re-Manufacturing
- Ideas for optimization
- Realistic specs
- Field Evidence, e.g. Eco Credits
- Data-based services

**Objectives:**
- Improve products
- Fulfil legal requirements (e.g. liability, field monitoring)
- Provide data for new services

**Use Case**
- **ECU HW**
  - Temp., Pres, Elec. loads, EEPROM write cycles
- **ECU SW**
  - Runtime, memory stack usage, resets
- **Functional**
  - min/max values of parameters, frequency of events
- **Component**
  - load profiles, fault pattern, wear

**Objectives:**
- Improve products
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**ECU HW**
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**ECU SW**
- Runtime, memory stack usage, resets

**Functional**
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**Component**
- load profiles, fault pattern, wear
Transformation through sensors, software and services

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3. Campaign Management
4. Predictive Diagnostics

Bosch IoT Ecosystem
FIRMWARE UPDATE OVER-THE-AIR (FOTA)

Warranty claims significantly reduce the profit margin.

BOSCH FOTA allows for a remote update of the vehicle’s ECUs and integrates into existing architectures.

FOTA saves approx. 50 Euros per vehicle compared to a field action.
System Overview

- From authoring to embedded – OTA optimized

- Connectivity Engineering – RBSN/BUD | 2018-08-22

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Connectivity Engineering

Transformation through Sensors, Software and Services

1. Data Logging & Remote Diagnostics
2. Firmware Over The Air (FOTA)
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Connectivity Engineering -

Transformation through Sensors, Software and Services

1. Data Logging & Remote Diagnostics
2. Firmware Over The Air (FOTA)
3. Campaign Management
4. Predictive Diagnostics

Bosch IoT Ecosystem
No more breakdowns? A car damage occurs always untimely.

Now Bosch introduces a new smart data & AI-based service, which predicts your car’s health constantly while driving.

It informs you – in time – about the remaining lifetime for all relevant systems & components.
Predictive Maintenance | Data Stream and Value

Our Data Stream
- Pressure
- Displacement
- Temperature
- Speed
- Structural Borne Sound

Extended Load Collectives
- Pressure
- Displacement
- Temperature
- Speed
- Structural Borne Sound

Health Index & Mission Data

Asset Data Function
Connectivity Engineering - Predictive Maintenance Contd.

Mission Data as Load Collectives

Know, what really happens

Health Index and Residual Lifetime

But is it Enough?
Connectivity Engineering -
E2E Predictive Maintenance Solution

- Scheduling
- Maintenance Scheduling
- Supply Chain

Business Process
- Detection
- Analysis
- Decision
- Dispatch
- Replacement

Support & Maintenance Processes

Business Applications (Procurement, Finance, Warehousing, Production, Logistics)

Predictive Analytics & Modelling

Device Management, Monitoring & FOTA

Remote Diagnostics & Services

Edge Analytics

Vehicle Platform

HMI

Maintenance
OEM/Vendor
Operator
Cloud Infrastructure and Application
Connectivity Engineering - Business Services (1/2)

**DOMAINS**
- Mobility
- Manufacturing
- Industrial Machinery
- Healthcare
- HiTech

**RB EI SERVICES**
- Business Analytics
- Smart Manufacturing I4.0 & IoT
- Mobility
- Process Optimization
- Landscape Optimization
- Governance
- Supply Chain
- Production Automation
- E-Learning Academy
- ALM & PLM
- Application Development
- Shared Services for Financial & HR
- IT Infrastructure

**TECHNOLOGY & TRENDS**
- INDUSTRY 4.0
- IOT
- CLOUD

Transformational

Operational
Connectivity Engineering - Complete Workflows: Vehicle Evaluation and Service Booking

DFC -> Microsoft Dynamics 365

Analysis

Component Health Estimation

Schedule Analysis

Risk Prioritization

System-level Aggregation

Failure Forecast

Go/No Go

Go/No Go

Workshop Schedule

Work Order

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Connectivity Engineering - Complete Workflows: Spare Part Dispatch

DFC → Microsoft Dynamics 365 → Analysis → Component Health Estimation

Component Identification → Maintenance BOM + BOP → Dispatch → Inventory Update → BI Dashboard
Connectivity Engineering - Complete Workflows: Mission Control Dashboards

Vehicle Status Overview
Connectivity Engineering - Complete Workflows: Service Anywhere Anytime

Decision on action

Automatic Creation of Work Order

CREATE SERVICE REQUEST

What is the subject of your request?
- Heating defect

Help us classify your request for a quicker response.
- Repair

Please describe your request.
- Machine defective. Most likely broken electric component.

Which of your equipment is affected?
- #0032

Need assistance?
- Contact us via phone, Skype, online or Twitter.

Go/No Go

Fleet Manager

Spare Part Logistics

Vehicle Repair Foreman

Vehicle Operator

No Go

Sub Action
Connectivity Engineering - Complete Workflows: Resource and Service Management

Service Technician Selection & Notification

... and Resource Optimization
Connectivity Engineering - Komatsu Forest Machines
Complete Workflows: No more Paperwork

Update service record

Technician

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Connectivity Engineering - Field Service Dashboard: Manage workshops effectively

**Fleet Insight**

**Completed Work Orders by Customer this Month**

- **SUMMARY**
  - Completed Work Orders this Month: 46
  - Customer Count: 46

- Work Orders by Customer
  - VanAndel Ltd.
  - Woodgrove Co.
  - A. Datum Co.
  - Abbots Agri.
  - Adventure...
  - Alpine Ski H.
  - Bellows Call...

- Revenue by Account and City
  - Vancouver
  - Portland

- Revenue from Completed Work Orders by Account
  - VanAndel L... 63
  - A. Datum Co... 0
  - Abbots Agri... 0
  - Adventure...
  - Alpine Ski H.
  - Bellows Call...
  - Bellows Hos...
  - Best For Y...
  - City Power...

- Work Order Details:
  - **Customer Name**: VanAndel Ltd.
  - **Resource Name**: Ryan Brin
  - **Booking Duration Minutes**: 113
  - **Work Order Type**: Service Call
  - **Incident Type**: Thermostat is broken
  - **Work Order System Status**: Open - Scheduled

- **Service Territory**:
  - **Service Territory**: WA

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Bringing It All Together...
Connectivity Engineering - Connected Engineering

Product Cloud

Product HW

Product SW

Control

Sensors

UX

Networking

Connectivity Communication

Energy Efficiency

Product Management

Benchmarking

Design & Development

Simulation

Testing & Validation

Data Management

Product Lifecycle Management

Solution Blueprint

Design and Architecture

Unified Communications

Cloud Services

Data Management

Application Development

Customization & Configuration

Support and Maintenance

Development

Requirements Modelling & Simulation

Design & DRBFM

Integration testing

Field testing

Reliability

Performance Testing

Unit Testing/Implementation
THANK YOU

Practitioner’s approach
Over two decades of being a practitioner, faster “time-to-value”

Focus on innovation
Part of Bosch innovation ecosystem
Continuous focus on innovation and improvement through investments in R&D

Value Driven Approach
Tech-centers for institutionalized productivity and quality
Reliability through Bosch processes
New age technology
Your Digital Transformation Partner

Sensors. Software. Services
All under one roof, you are Simply. Connected.

Thank You
THANK YOU
Connectivity Engineering
Bosch as a Design and Implementation Partner

1. Requirement Engineering
2. Solution design
3. Product Development and Test
4. Industrialization
5. Scale-up & Support

Customer

Bosch

Idea
End-user challenge
Solution design
Engineering
Industrialization
After Sales Support

A reliable & Safe Product in Market

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Connectivity Engineering - Collaboration Areas – Digital Engineering
Connectivity Engineering - Embedded Engineering

Competencies

- Product engineering
  Engineering for a smart future.
  - Hardware Engineering
  - Embedded Software Engineering
  - 3 ISO26262 Functional Safety Tool Qualification

Testing and Validation Services
Comprehensive end-to-end testing solutions
- Graphics Test System
- Electro Magnetic Compatibility Testing
- Reliability Testing
- Hardware-in-Loop Testing
## Connectivity Engineering - Regional LTE module

### Platform-2

<table>
<thead>
<tr>
<th>Regional Variants / Network Bands</th>
<th>North America (AT &amp; T)</th>
<th>Europe (+ UK)</th>
<th>Korea</th>
<th>China/India</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4G</strong></td>
<td>2, 4, 5, 7, 17(12)</td>
<td>1, 3, 7, 8, 20</td>
<td>1, 5, 7</td>
<td>1, 3, 8, 40, 41</td>
<td>1, 19</td>
</tr>
<tr>
<td><strong>3G</strong></td>
<td>2, 5</td>
<td>1, 8</td>
<td>-</td>
<td>1, 8</td>
<td>1, 6, 19</td>
</tr>
<tr>
<td><strong>2G</strong></td>
<td>850, 1900</td>
<td>900, 1800</td>
<td>-</td>
<td>900, 1800</td>
<td>-</td>
</tr>
</tbody>
</table>

### Platform-2A

<table>
<thead>
<tr>
<th>Regional Variants / Network Bands</th>
<th>North America (AT &amp; T)</th>
<th>EMEA</th>
<th>Japan</th>
<th>APAC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4G</strong></td>
<td>12, 2, 4</td>
<td>3, 7, 20</td>
<td>1, 19</td>
<td>3, 8, 28</td>
</tr>
<tr>
<td><strong>3G</strong></td>
<td></td>
<td>–</td>
<td>–</td>
<td>2100</td>
</tr>
<tr>
<td><strong>2G</strong></td>
<td>Dual-band 900/1800</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>
Enterprise