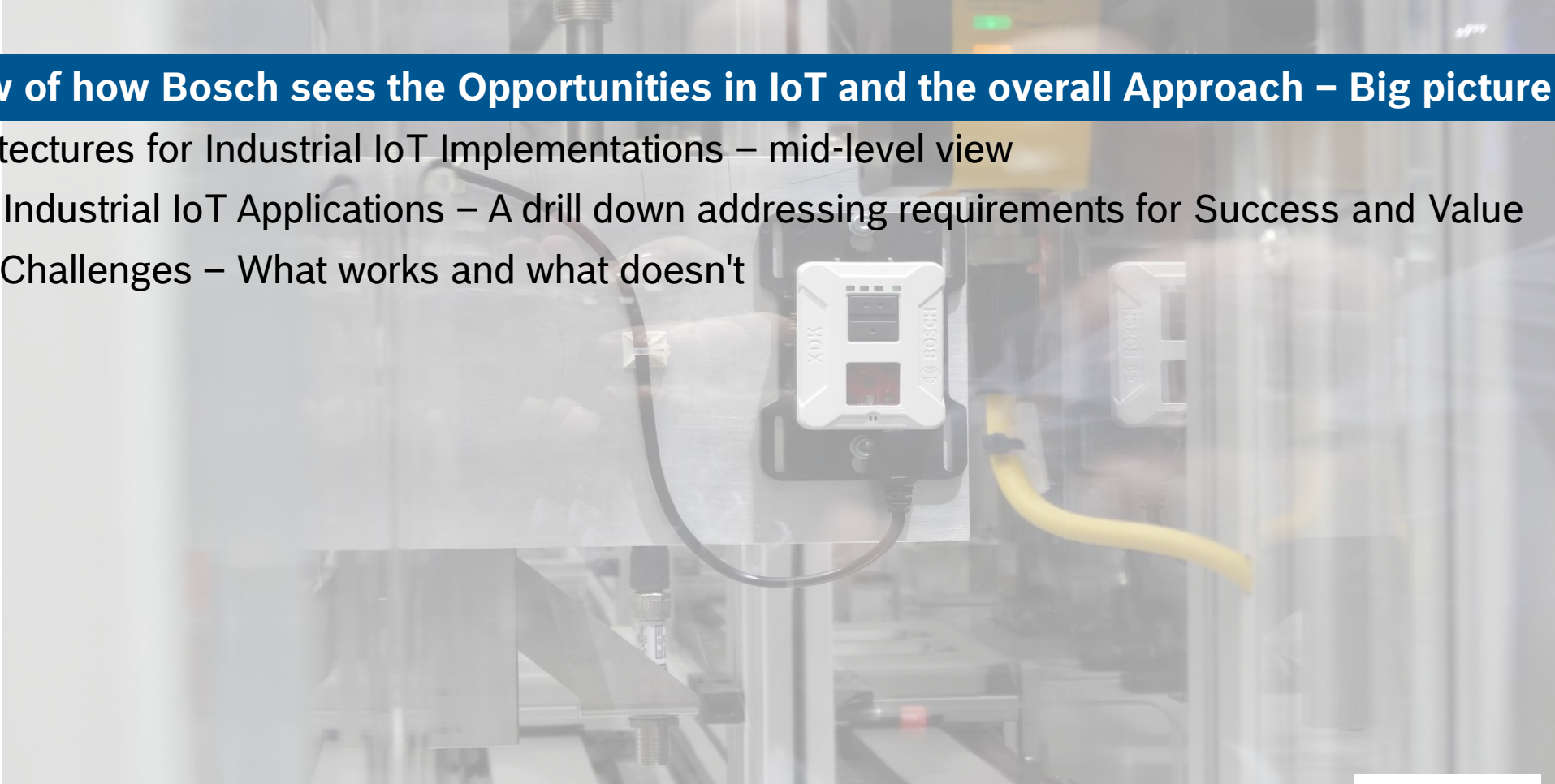


OVERALL ARCHITECTURES FOR INDUSTRIAL IOT IMPLEMENTATIONS – MID-LEVEL VIEW. A BOSCH PERSPECTIVE



Agenda

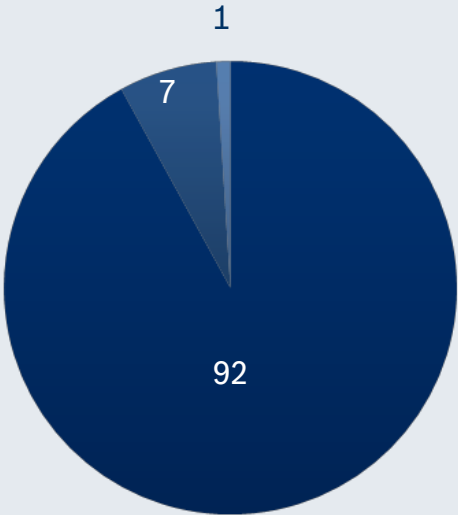
- 1. An Overview of how Bosch sees the Opportunities in IoT and the overall Approach – Big picture**
2. Overall Architectures for Industrial IoT Implementations – mid-level view
3. Examples of Industrial IoT Applications – A drill down addressing requirements for Success and Value
4. Summary of Challenges – What works and what doesn't



Bosch Group

Overview & Key Figures

Shareholders



1 Robert Bosch GmbH
7 Bosch family
92 Robert Bosch Stiftung

4

Business Sectors and Divisions

Mobility Solutions

Industrial Technology

Consumer Goods

Energy and Building Technology

Mobility Solutions



World's largest supplier of cutting-edge automotive technology

Industrial Technology



Leading in drive and control technology, packaging, and process technology

Consumer Goods



World's largest power tool manufacturer
Leading the field in household appliances

Energy and Building Technology



Leading manufacturer of thermo, and building security technology; World's largest supplier of heat pumps

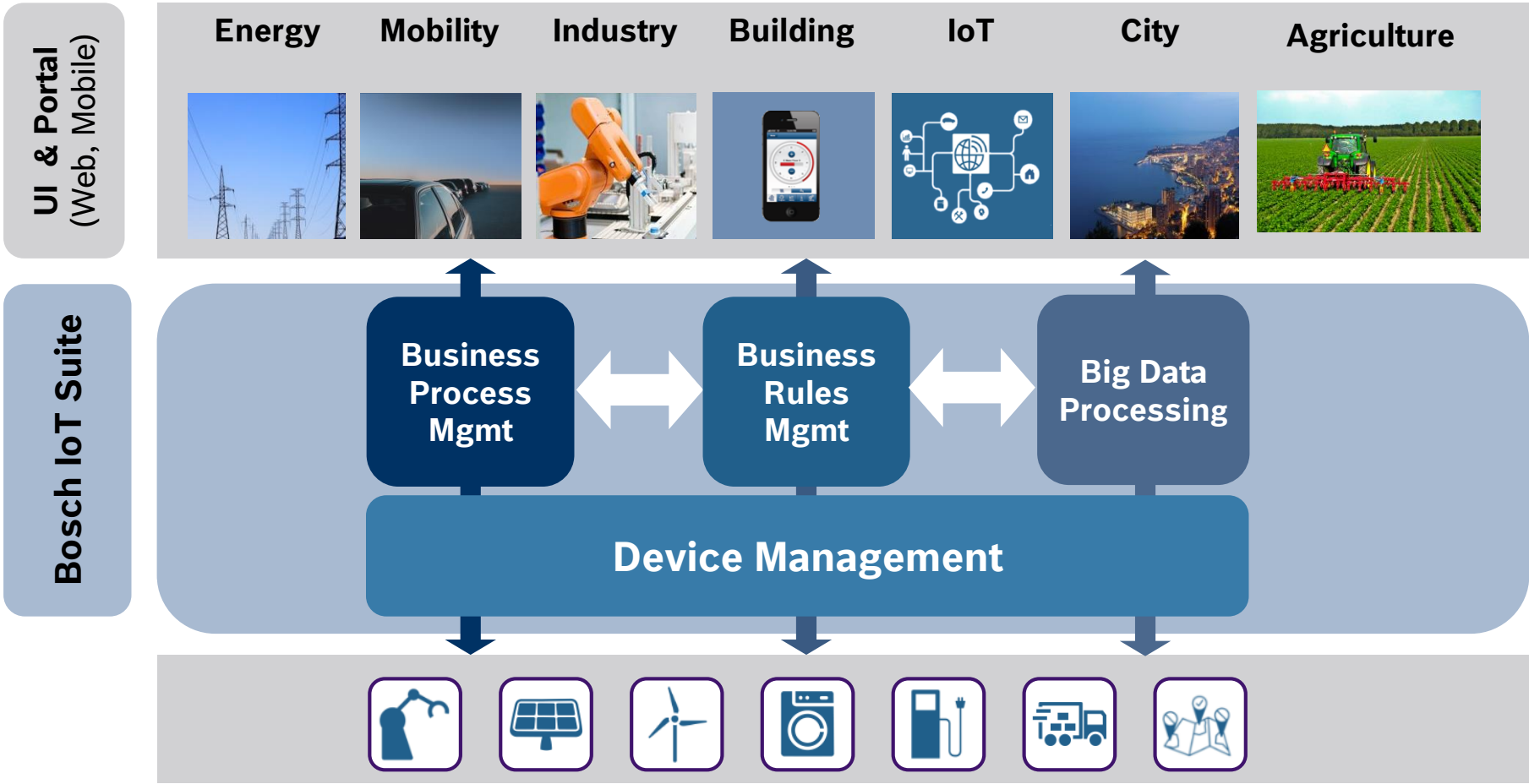


approx. **390,000** associates

73.1 billion euros in sales in 2016

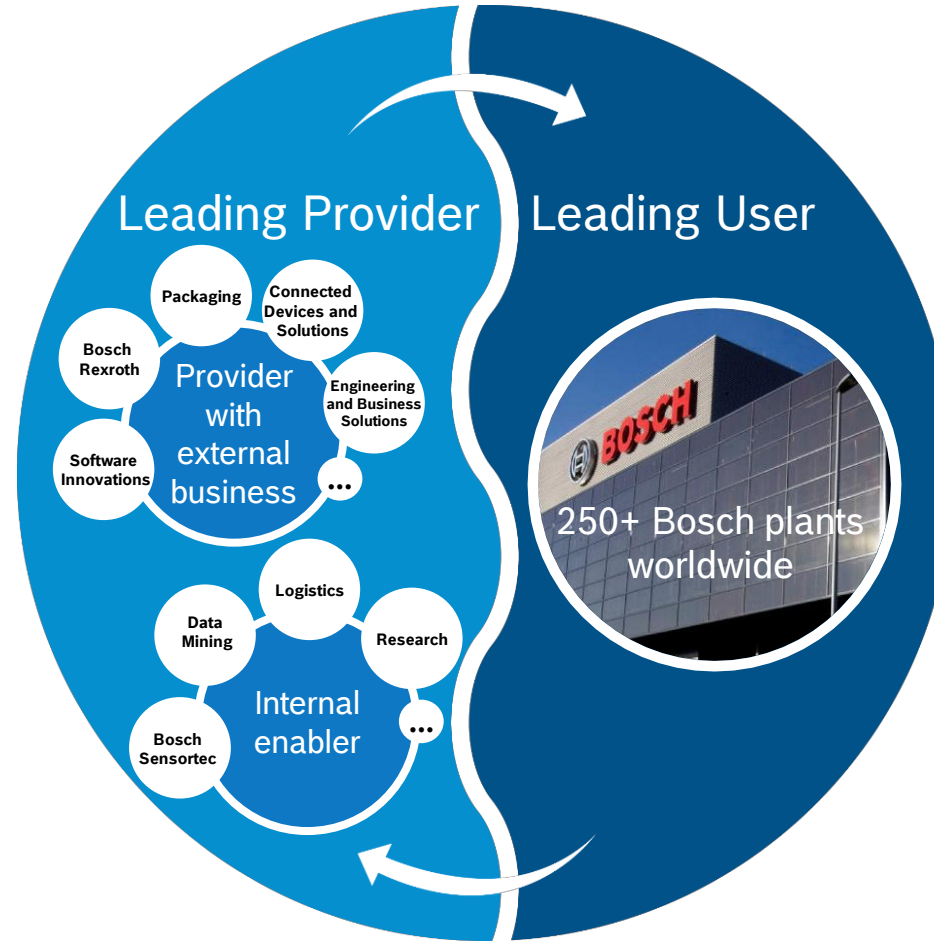
Bosch's overall IoT Approach

Bosch IoT Suite



Bosch's overall IoT Approach

Example 14.0: Dual strategy for a Connected Industry



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Internet of Things at Bosch

Architecture for IoT Implementation – Sensors as a Starting Point

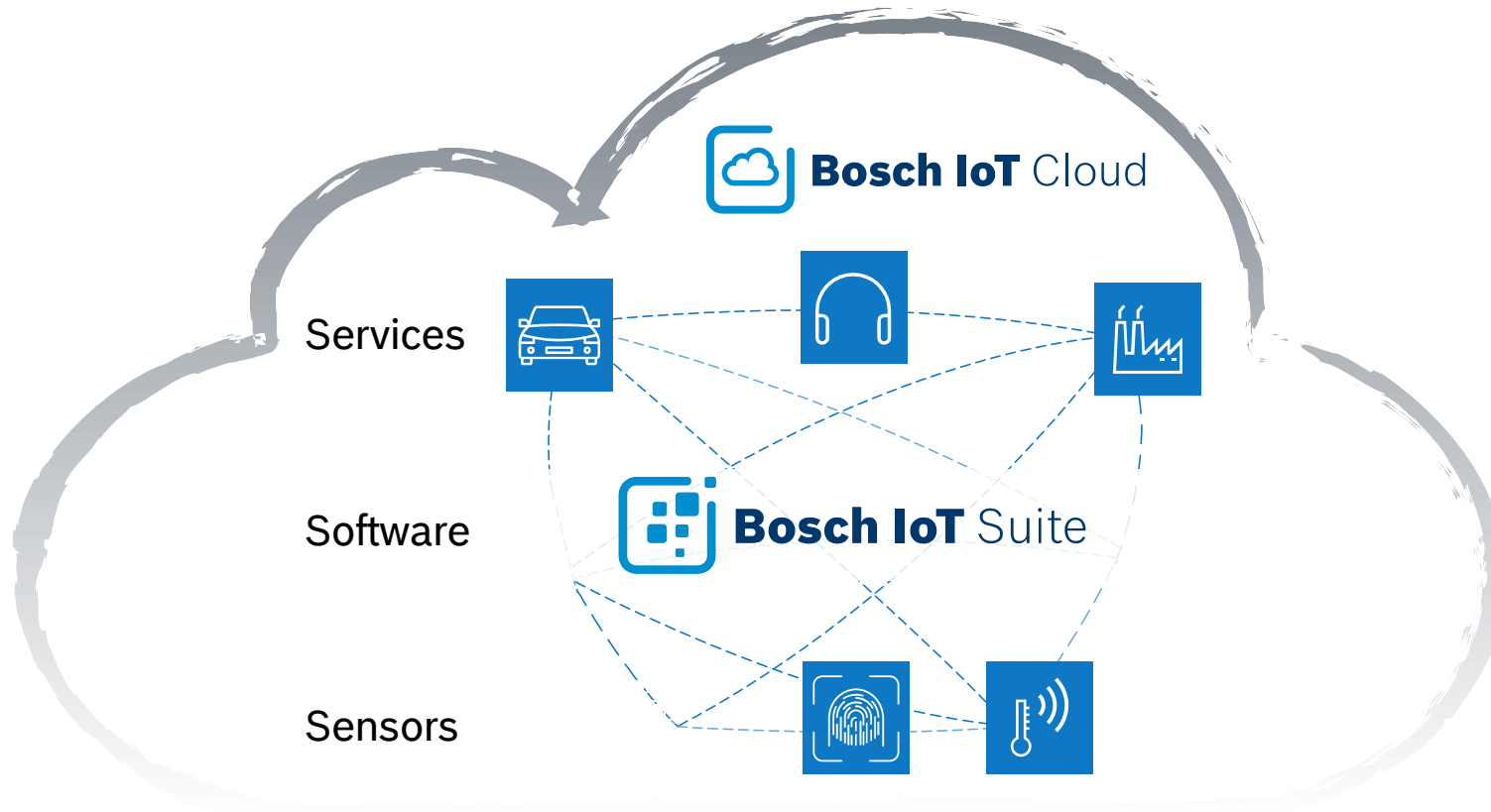


Sensors are indispensable for the IoT

- ▶ Bosch uses sensors to teach things how to feel
- ▶ Bosch is the world's leading supplier of MEMS sensors (4 million a day)
- ▶ **Sensors** and **Software** are the basis for a multitude of new **Services**, such as connected parking in the mobility sector
- ▶ This is why we at Bosch often speak about the **3 Ss** of the IoT

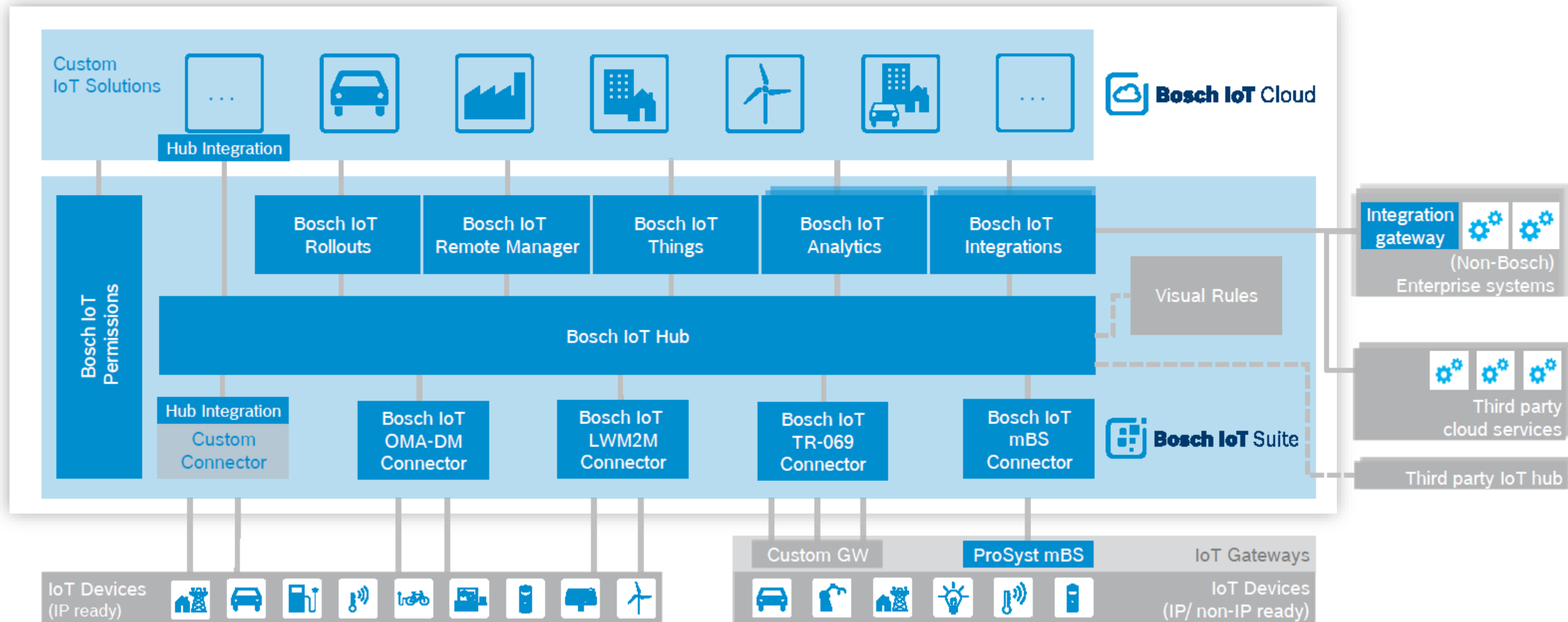
Internet of Things at Bosch

Architecture for IoT Implementation – 3 S Philosophy



Internet of Things at Bosch

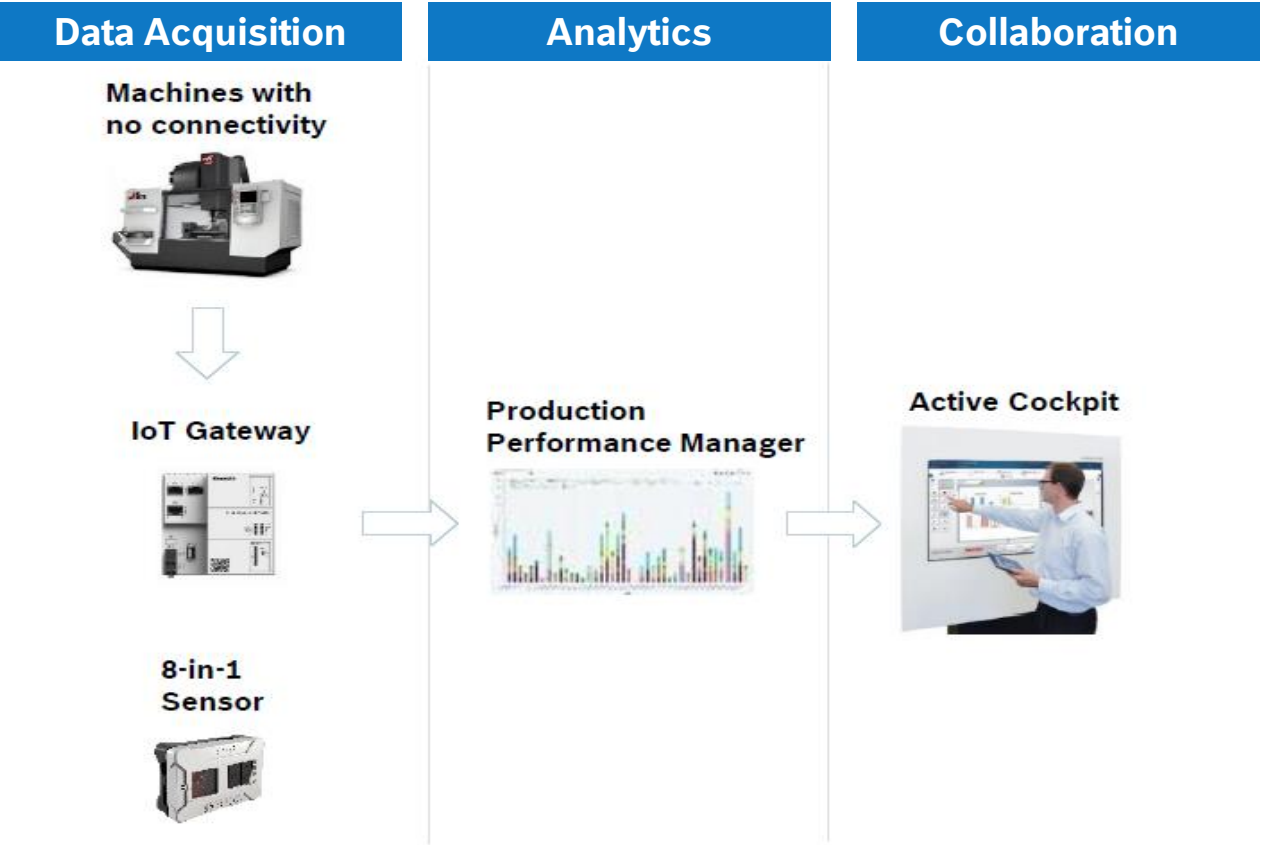
Architecture for IoT Implementation – Detailed View



Internet of Things at Bosch

I4.0 Live at Bosch

Condition Monitoring and Collaboration



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Industry 4.0 live at Bosch

i4.0 Use Cases and Benefits – Examples

Digital Supply Chain

- ✓ stock saving
- ✓ efficiency increase
- ✓ transparency along supply chain

Convertible Equipment

- ✓ fix cost reduction
- ✓ efficient M2H collaboration
- ✓ human relief of heavy load / repetitive tasks

Shop Floor Mgmt. Information

- ✓ real time data
- ✓ fast escalation
- ✓ paperless

Power / Energy Management

- ✓ peak reduction
- ✓ energy cost saving

Operator Support

- ✓ agility & quick reaction
- ✓ quality increase
- ✓ efficiency increase

Predictive Maintenance

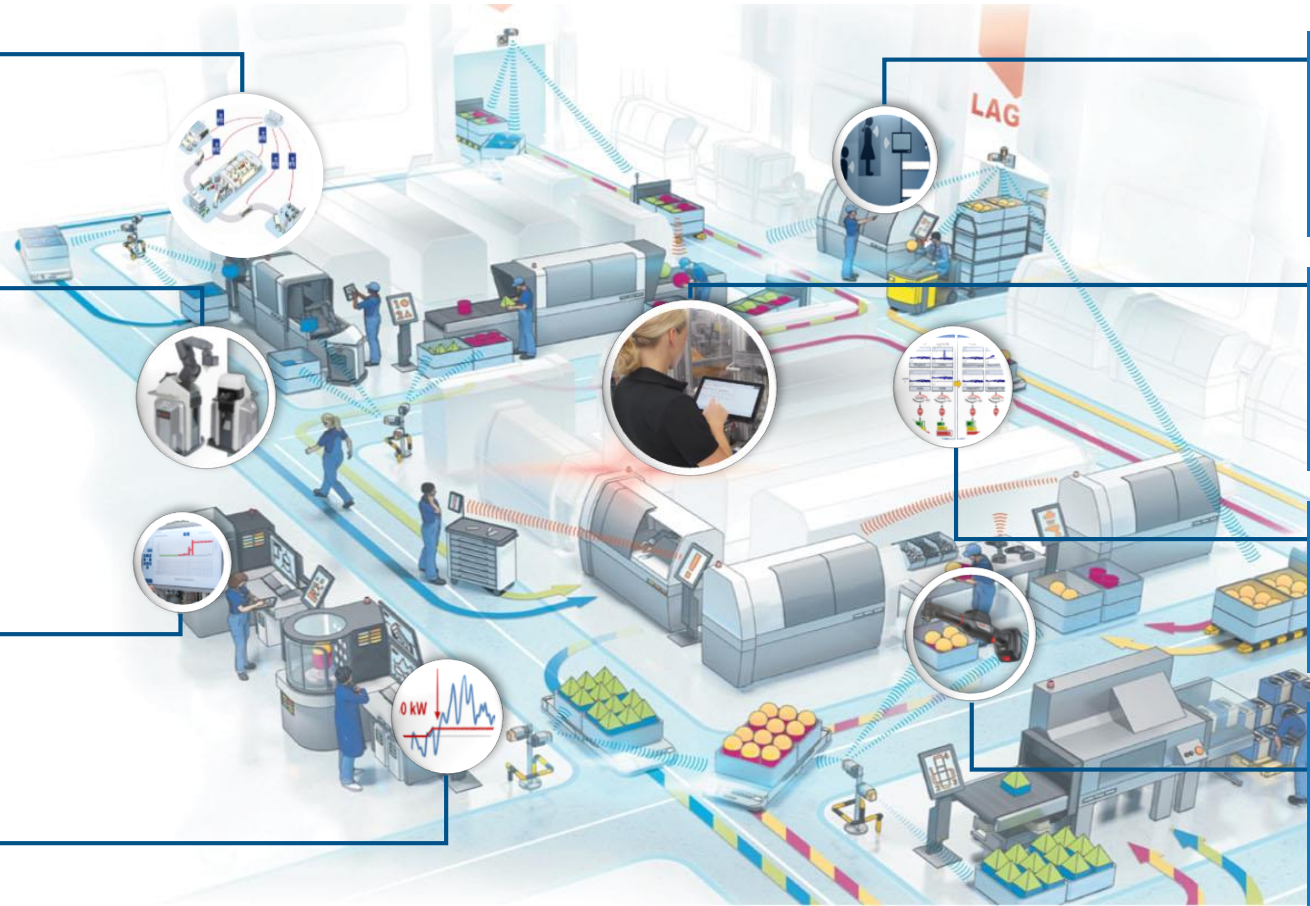
- ✓ improve OEE
- ✓ no sudden breakdown

Adaptive Testing

- ✓ increase efficiency
- ✓ less invest

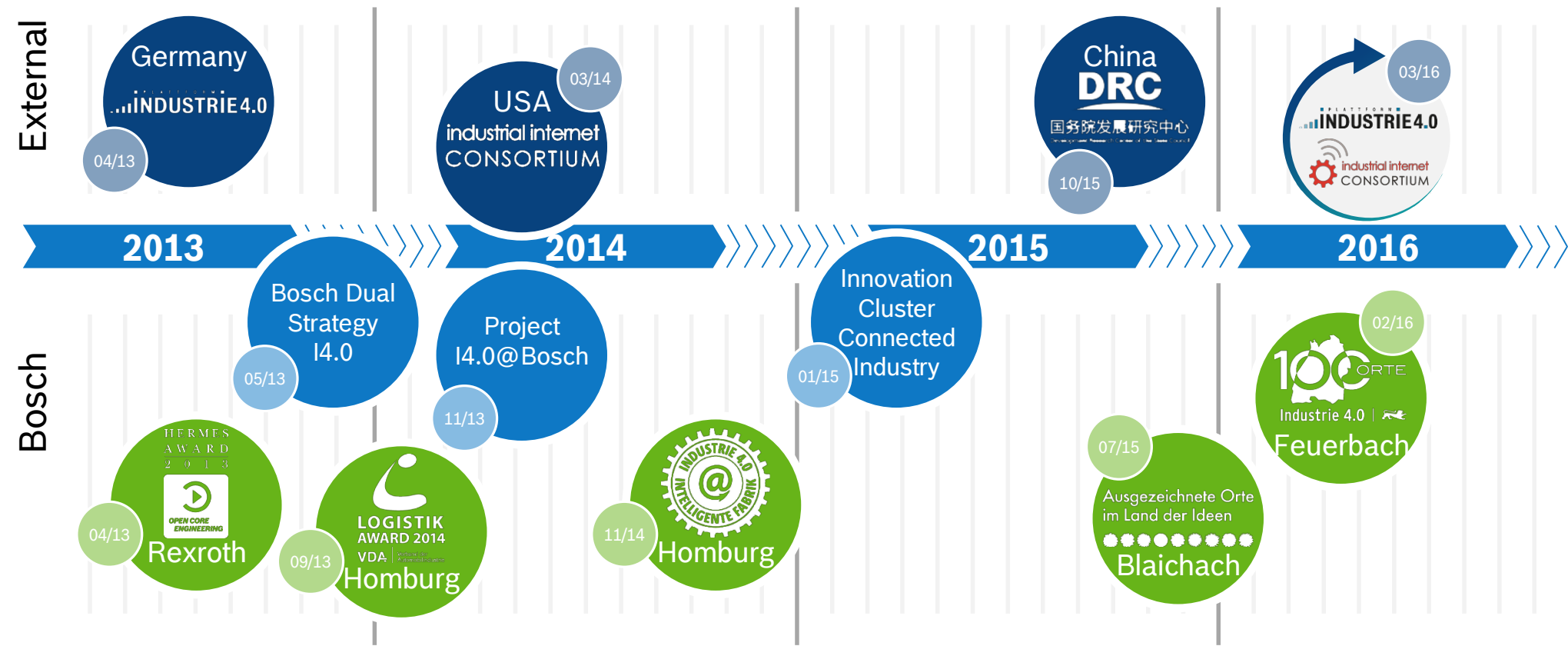
Quality Improvement

- ✓ instant feedback
- ✓ fast identification of error sources



Industry 4.0 live at Bosch

i4.0 Our Journey and Achievements



Industry 4.0 live at Bosch

Bosch Achievements

Models at top speed:

A component is drafted on the computer, sent to the device, and produced there from a base material.



Rapid prototyping:

3D- printers have a place in the smart production. One application at Bosch is prototype production.

Predictive quality:

Close examination of questionable parts based on millions of data points.



Data mining for quality:

At the Anderson plant in the U.S. "Data-Mining" already gets used to improve quality.

Facilities predict problems:

Smart lines analyze data and report problems directly to the service department.



Predictive Maintenance:

A pilot is up and running at Bosch. Bosch Software Innovations offers this type of solution.

Data from Tools:

Tools are networked and send important data to server for quality proof.



"Nexo" Smart Tightening:

Screwdriver is able to measure and submit the tightening torque and screwing angle for quality prove.

Flows of Goods, digitally recorded:

Due to automatic data capture the supply chain is virtually mapped and logistics are optimized.



RFID technology:

In pilot projects the plant is already aware of the condition of products and containers via RFID technology.

Faster Work with technical aids:

Warehouse associates receive their orders and operating instructions directly on displays.



Smart glasses:

Technical aids like smart glasses make work easier. Initial tests are being conducted in Bosch plants.

Industry 4.0 live at Bosch

i4.0 In an Entire Line – Example Homburg

Handling of dangerous, strenuous, or monotonous tasks so associates don't have to.



The mobile production assistants of the APAS family already work hand in hand with their human colleagues.

APAS: Automated production assistant

Components tell machines how they need to be shaped. The system then adjusts itself accordingly.



A manufacturing system with batch size of one already is in place producing many products on one line.

stock reduction,
no setup

Up to
0.5 mio €
savings
year / line

10%
output
increase



Bosch Connected Devices and Solutions

14.0 – Connected Industrial Sensor Solution (CISS)



- ▶ Increase your manufacturing efficiency by monitoring your machines, processes and environmental conditions.
- ▶ Retrofit your machines with CISS as digital twin.
- ▶ Creates a valuable additional multi-sensor context to machine data.
- ▶ Connects to existing machines without intervening to the machine control.

Sensors and Functions

-  Acceleration Sensor
-  Humidity Sensor
-  Pressure Sensor
-  Temperature Sensor
-  Digital Light Sensor
-  Gyroscope Sensor
-  Acoustic Sensor
-  Bluetooth low energy & Wi-Fi
-  32-Bit Microcontroller
-  Li-ion rechargeable battery

Bosch Connected Devices and Solutions

I4.0 – CISS Use Cases

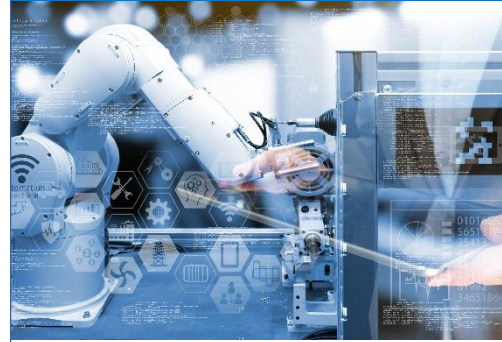
Motivation

Condition Monitoring



Optimizing production yields by condition monitoring

Digital Twin



Retrofit existing machines with CISS as digital twin

Predictive Maintenance



Saving costs by predictive maintenance

Use Case

- ▶ Simulation abilities
- ▶ Modelling efficiency
- ▶ Increased reliability of sensor data with environmental sensor

- ▶ Support of Data-Mining approaches by adding sensor data to already existing manufacturing data sets

- ▶ Recording endurance of tools and expendable parts
- ▶ Early identification of indications of wearout

Bosch Connected Devices and Solutions

I4.0 – XDK110 Cross Domain Development Kit

**Predictive
Maintenance**

**Condition
Monitoring**

**Flexible
Customization**



Accelerometer



Gyroscope



Magnetometer



Humidity sensor



Pressure sensor



Temperature sensor



Acoustic sensor



Digital light sensor



Li-Ion rechargeable battery



32-bit Microcontroller ARM



Wireless LAN



Bluetooth LE

Bosch Connected Devices and Solutions





Logistics – Transport Data Logger (TDL)

Benefits

- ▶ Simplified visualization via mobile application
- ▶ Creates transparency within the entire supply chain
- ▶ Battery with an outstandingly long lifetime resulting in less handling effort



Sensors and Functions

-  Acceleration Sensor
-  Humidity Sensor
-  Temperature Sensor
-  Battery life time: up to 2 years

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Summary of challenges

What works and what doesn't

Existing Market Perspectives	Vs	Requirements for successful IoT Solutions
<ul style="list-style-type: none">▶ Products: Customized vs. Standard▶ Availability: Off the shelf vs. Lead-time▶ Volume: High vs. Low	Vs	<ul style="list-style-type: none">▶ Close collaboration with costumers & partners▶ Long-term view and commitment▶ Solution understanding and consulting required

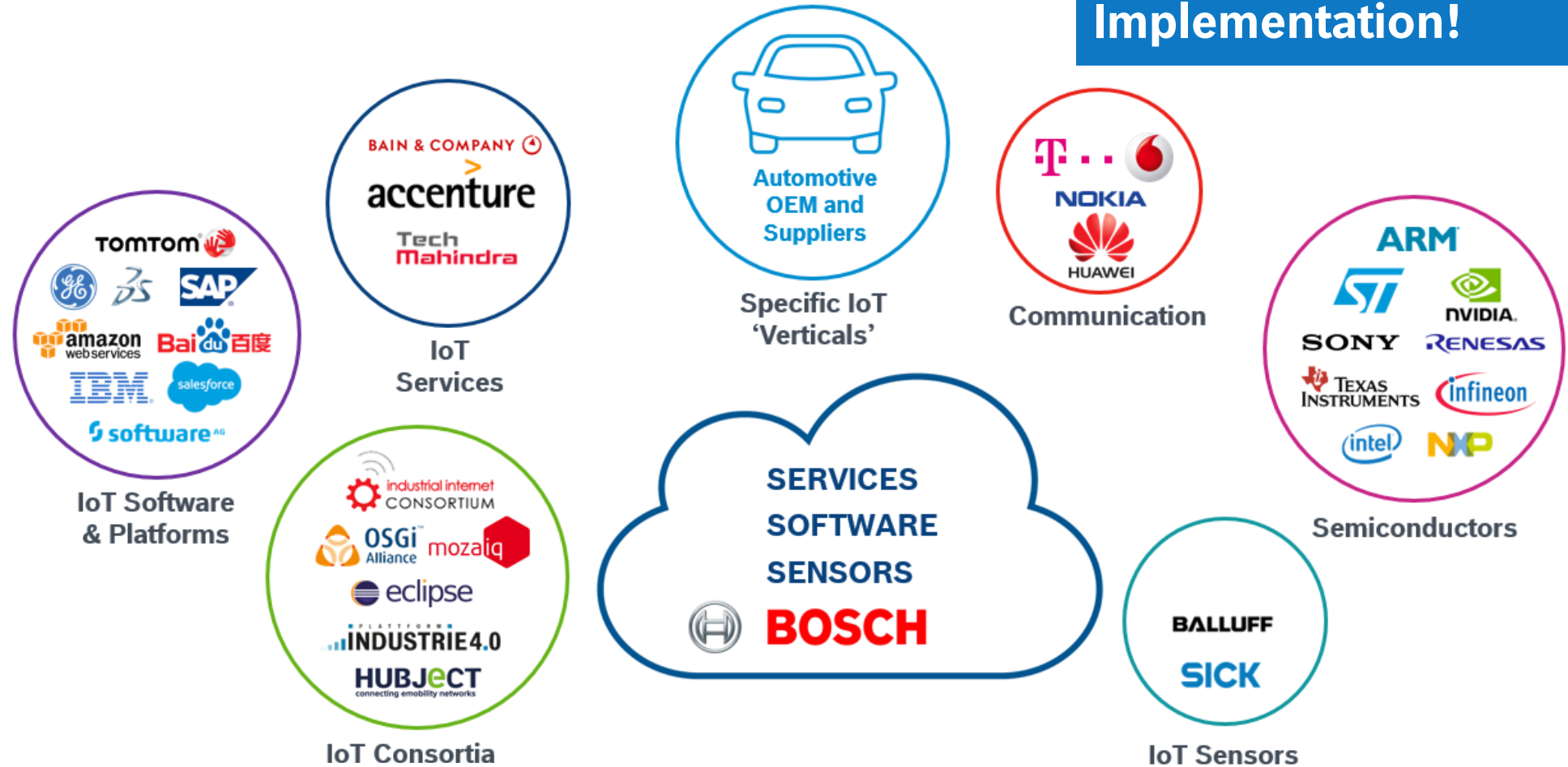
Example – Connectivity: There is no “One Size fits all”



Summary of challenges

The Importance of an Ecosystem

An Ecosystem of Partners is the Basis for a successful IoT Implementation!



CONNECT WITH US!

Regional Contact ASEAN:

Robert Bosch (SEA) Pte Ltd

Bosch Connected Devices and Solutions

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