5G for Vertical Industries – The BOSCH Perspective

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5G for Vertical Industries

BOSCH – A Brief Overview

Mobility Solutions

Industrial Technology

Energy and Building Technology

Consumer Goods

~375.000 associates

71 bn EUR revenues

~250 manufacturing sites

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5G for Vertical Industries

Why 5G is relevant for BOSCH

5G

Extreme Broadband

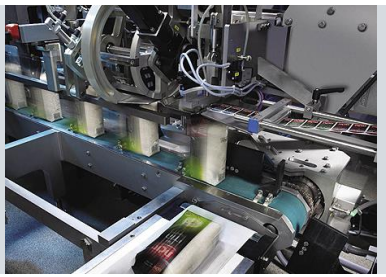
- >10 Gbps peak data rates
- 100 Mbps when-ever needed

Massive Machine-Type Communication

- 10 years on battery
- ultra-low cost
- 10 – 100x more devices

Ultra-Reliable Low Latency Communication

- <1 ms latency
- ultra-high reliability



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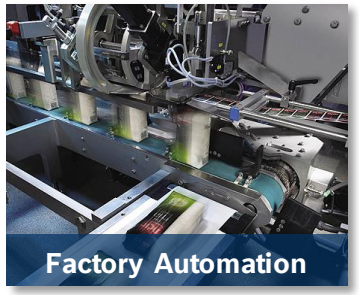
Example: 5G for the Factories of the Future

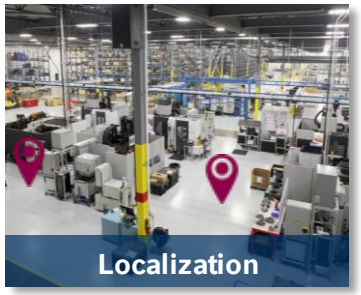


Goal

Improve flexibility, versatility, user support & cost-efficiency in manufacturing and logistics

Major Challenges

- **End-to-end QoS (reliability, latency)**
- **Highly Diverse Requirements**
- **Security & Privacy**
- **Seamless Integration**



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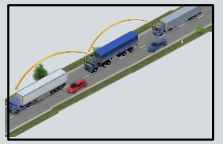
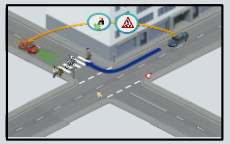
5G for Vertical Industries
Overview of Selected Key Requirements

	Industry 4.0			Automotive	
					

	Motion Control	Condition Monitoring	Augmented Reality	Platooning	Sensor Data Exchange
Latency / Cycle Time	250 µs – 1 ms	100 ms	10 ms	<5 ms	<50 ms
Reliability (PER[1])	1e-8	1e-5	1e-5	1e-5	1e-5
Data Rate	kbit/s – Mbit/s	kbit/s	Mbit/s - Gbit/s	kbit/s	Mbit/s
Typical Data Block Size	20-50 byte	1-50 byte	> 200 byte	500 kbyte	Stream/Packet
Battery Lifetime	n/a	10 years	1 day	n/a	n/a
	uRLLC[2] → most challenging	**Massive MTC[3]**	**Extreme Broadband + Low Latency**		

CR/AEH4 - Andreas Mueller | 09 November 2016 [1]Packet Error Rate [2]Ultra-Reliable Low Latency Communication [3]Machine-Type Communication

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Selected Challenges – Technological Aspects

New Air Interface(s)

for uRLLC[1] & mMTC[2]

End-to-End QoS[3]

across technologies, countries, operators

Multi-Tier Cloud Architecture

with simple provisioning & efficient scaling

Multi-RAT[4]

integration of existing & future wireless technologies

Small Packets

require joint optimization of payload & overhead

Source: BOSCH

CR/AEH4 - Andreas Mueller | 09 November 2016 [1]Ultra-Reliable Low Latency Communication [2]Massive machine-Type Communication [3]Quality of Service [4]Radio Access Technologies

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Selected Challenges – Technological Aspects

Self-Management

high ease-of-use during whole lifecycle

Scalability & Adaptivity

to serve wide range of applications in a flexible way

Security

jamming, key management, latency-optimized

Privacy

of sensitive data with full user control

Seamless Integration

into existing ecosystems + seamless migration path

Source: BOSCH

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Selected Challenges – Business Aspects

New Billing Models

for machine-type communication

New Business Models

enabled by 5G (e.g., pay-per-use)

New Ecosystems

close collaboration between verticals & telecoms

Private 5G Networks

role of operator? Spectrum sublicensing? I/Fs?

Long-Term Availability

of components, networks & services

Source: BOSCH

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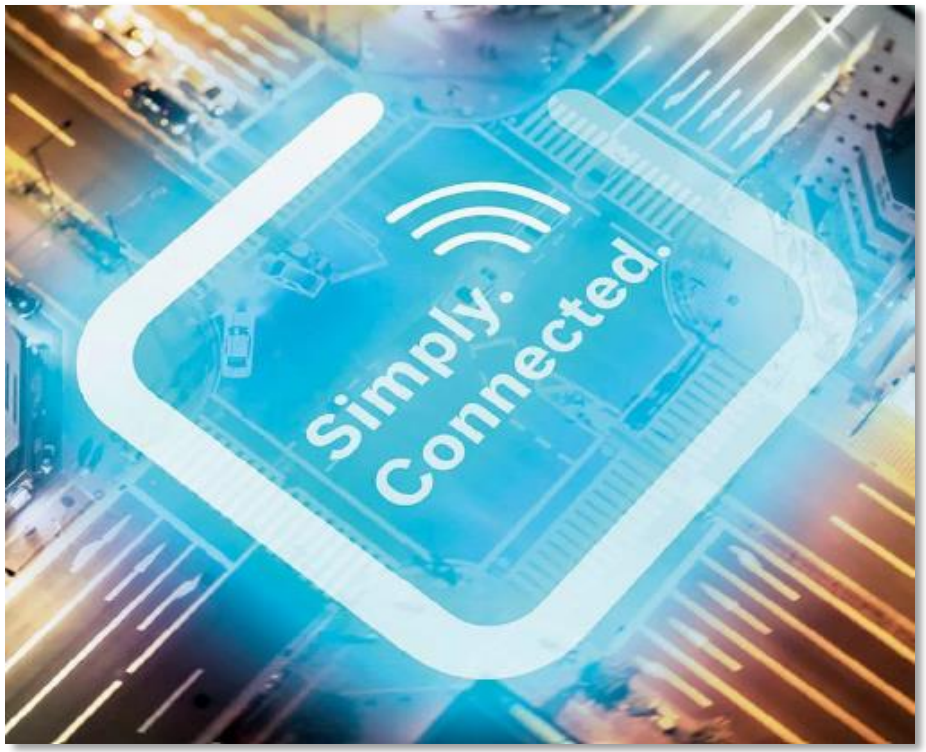
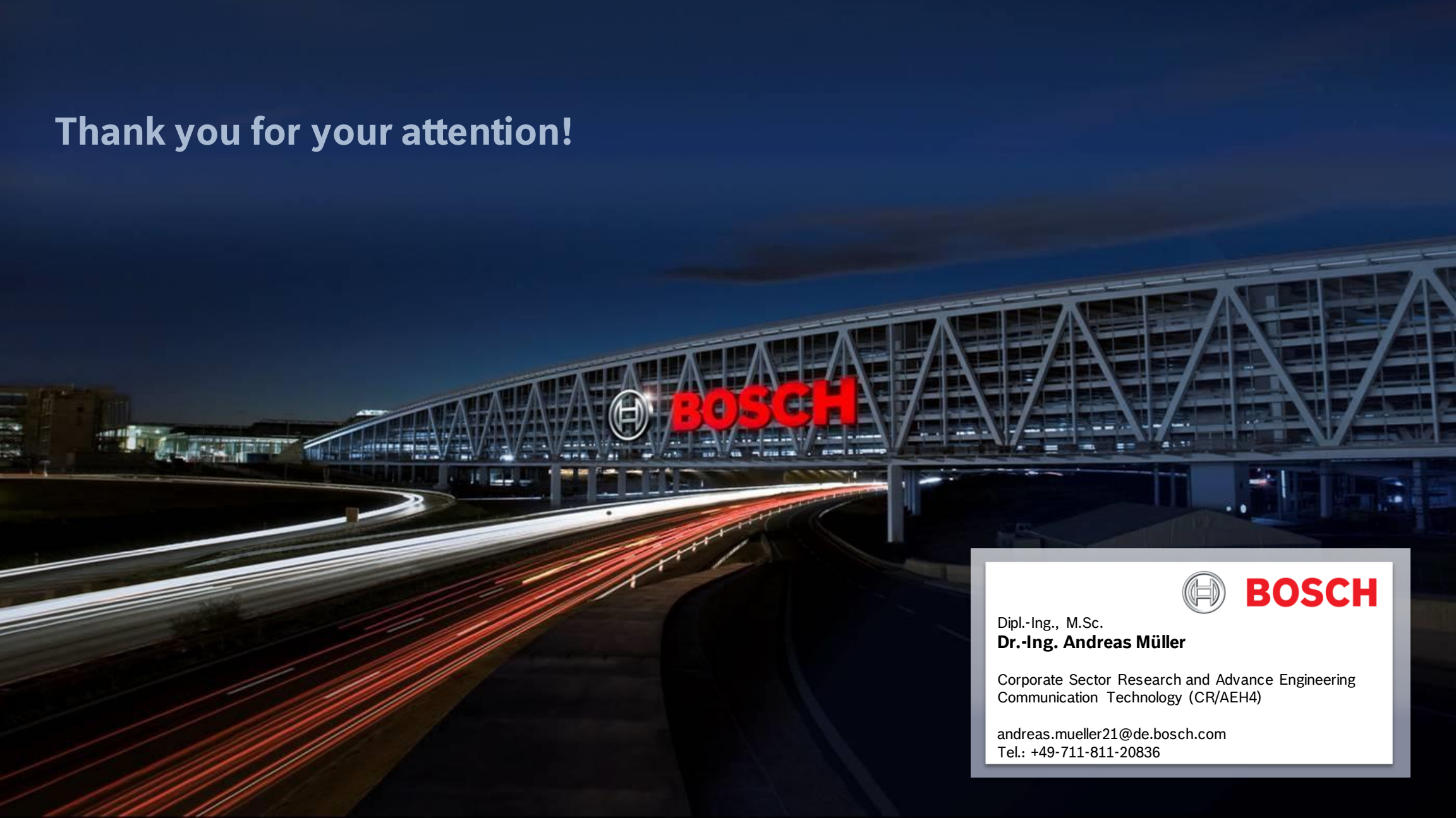
5G for Vertical Industries
Conclusion

1. **5G will have a significant impact on vertical industries**
2. **Many different use cases in many different domains**
3. **Highly diverse requirements require high scalability**
4. **New air I/F, MEC + network slicing as key technologies**
5. **Many technological & business-related challenges**
6. **Close collaboration between vertical industries & the telecom industry required to leverage full potential**



Source: BOSCH

Thank you for your attention!



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