5G in Process Industry
Martin Schwibach
17. Oktober 2019 –
5G – Transforming our world through interconnectivity

Up to now…
Connecting people

The future…
Building ecosystems
### Economic impact through megatrend wireless connectivity

<table>
<thead>
<tr>
<th>Industry</th>
<th>Potential Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>~$1.4-1.7T</td>
</tr>
<tr>
<td>Autonomous cars</td>
<td>~$2.0-2.5T</td>
</tr>
<tr>
<td>Health</td>
<td>~$400-700B</td>
</tr>
<tr>
<td>Retail</td>
<td>~$400-500B</td>
</tr>
<tr>
<td>Smart cities</td>
<td>~$1.0-1.2T</td>
</tr>
<tr>
<td>Smart home</td>
<td>~$200-350B</td>
</tr>
<tr>
<td>Logistics</td>
<td>~$600-800B</td>
</tr>
<tr>
<td>Office</td>
<td>~$70-100B</td>
</tr>
</tbody>
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**$6-8 Trillion** economical impact 2025-2030

Source: Qualcomm
5G key features

**eMBB**
Enhanced mobile Broadband

**mMTC**
Massive Machine Type Communication

**uRLLC**
Ultra-Reliable and Low-Latency Communications

- Gigabytes in a second
- 3D video, UHD Screens
- Work and play in cloud
- Augmented reality
- Industry automation
- Factory of the future
- Deterministic real time
- Self driving car
- Mission critical applications

New air interface
- Massive MIMO Beamforming
- mmWave
- Flexibility and spectrum efficiency

New architecture
- Service based architecture
- Slicing
- One physical network
- Multiple Applications

Source: Huawei
5G in Chemical Industry
Requirements – Use Cases

Our Requirements:
• Compliance with maximum latency times
• Provide minimum upload speed
• Compliance with the many legal and normative requirements
• Agility and sustainability

Our Use Cases:
• Augmented Reality
• Support for mobile working
• use of drones and assistance robots
• Remote Operation etc.
5G at BASF
Site Ludwigshafen: a city in the city …

Characteristics of production sites of the chemical industry:
• no closed indoor production halls
• campus / area locations, comparable with medium-sized small towns or city districts in large cities:
• Areas lie within defined plant boundaries
• 100% owned by the responsible operator

Example Site Ludwigshafen:
• area 10 km²; 106 km road, 230 km rails
• ca. 39000 employees
• ca. 2000 buildings,
• ca. 200 productions plants
=> comparable with small cities Delft (Netherlands), Cannes (France)

Example Site Schwarzheide:
• area ca. 2,9 km²; 12 km roads; 20 km rails
• ca. 2000 employees;
• 17 production plants;
=> compare with Hamburg Harbour City
Frequencies for process industry

Activities of BASF

- **since 2017**: Cooperation with 5G ACIA (initiative of ZVEI)
- **05/2018**: Visit of BMVI with presentation of the AGV solution and the related industrial mobile radio network
- **07/2018**: Hearing at the Presidential Chamber of Federal Network Agency (BNetzA)
- **08/2018**: Visit of MdB Herzog at BASF (representative of the German Federal Bundestag)
- **09/2018**: BASF statement for industrial networks (similar positions issued by VCI, ZVEI, VDA, VDMA etc.)
- **10/2018**: Participation NAMUR (M. Fankhänel) at Gigabit Summit of the BDI (Federation of German Industries) in Berlin
- **10/2018**: Exchange of experience NAMUR / AIDA (Automatisierungstechnik In Der Automobilindustrie)
- **11/2018**: Statement BASF, VCI: Clarification of requirements of large production sites
- **11/2018**: Letter of Martin Brudermüller: Adress need for BASF to BNetzA, Bundestagsabgeordnete, Landesregierung etc.
- **11/2018**: USA: Statement of BASF to US regulation authority FCC
- **11/2018**: EU: Statement of BASF to European regulation authority
- **11/2018**: Visit of Wirtschaftsministerium RLP: presentation of AGV solution and the industrial mobile radio network
- **08/2019**: BMWi; BMF, BNetza: Need for action to enable formal application process for local frequencies
- **09/2019**: Michael Heinz, Member of Board BASF SE contributes zu Handelsblat 5G Conference
Frequencies for the industry – a basic prerequisite for the success of smart manufacturing/ “Industry 4.0”

- The German Federal Network Agency (BNetzA) provides the first time spectrum for local and regional mobile networks for Industry 4.0 applications
- BASF announced in accordance with other industry associations the demand of 100MHz bandwidth for industrial 5G networks in Germany

**BUT:** Formal Application Process and Condition are still missing!

**Regionale und lokale Netze**

Frequenzen für das Betreiben regionaler und lokaler drahtloser Netze zum Angebot von Telekommunikationsdiensten

**Frequenzen im Bereich von 3,7 GHz bis 3,8 GHz**

Use Cases

Mobile Automation

Autonomous Logistic Systems

M+O Sensors

Hazard Alarm Technology
Mobile Automation

Everyone, Anytime, Anywhere - The next step for technology is universal access

Bill Gates - October 4th, 1999
Augmented Reality
Remote expert
Operator rounds
Plant asset management
Mobile HMI
Turn around support
Use of mobile devices

• Mobile user support in production and technology units
• Provision and collection of process-related information and data

Requirements

• Sufficient bandwidth and latency for human control to carry out processes and video calls
• High reliability and availability
• Security zoning
• Network coverage in production areas
The regular operation of automated and connected driving has a direct link to the digital performance of our infrastructure.

BMVI – Federal Ministry for traffic and digital infrastructure
Telemetry data
Product condition
Steering control
Live HD video streams
Communication infrastructure for logistics systems

- (Semi) autonomous transport systems precisely move containers
- Control and monitoring including HD cameras from a central control room

Requirements

- High transmission rate, low latency
- High availability and safety requirements
- Site-wide, QoS-based network coverage on roads surrounded by production plants
M+O Sensors

Wireless communication is a central enabler for innovative solutions for automation technology.
Drones

Plant condition sensors

Equipment tracking

Predictive Maintenance
Communication infrastructure for sensor technology

- Enabler for I4.0 applications
- Used with focus on the areas of monitoring + optimisation
- Wireless sensors provide a transparent view of the plant

Requirements

- Low in terms of response time and availability compared to core automation
- Network coverage in production areas
- Use of standard communication technology
Hazard alarm technology

Reliable communication when it matters
21.10.2019

- Gefahrenmeldetechnik
- Video surveillance
- Emergency systems
- Fire and gas alarms
- Warning systems
- Traffic displays
- Lone worker
- PA Systems
- Traffic displays
Communication infrastructure for hazard alarm technology

- Use of mobile communication as the main path or redundancy path for hazard alarm technology
- Communication paths independent of existing communication infrastructure

Requirements

- High availability, dedicated fallback and redundancy concepts
- Prioritisation of communication
- QoS-based network coverage
- Security zoning
Overview of selected industrial use cases according to their basic service requirements

- **eMBB** (Enhanced mobile Broadband)
  - Autonomous logistic systems
  - Augmented Reality
  - Remote access and maintenance
  - Process automation - plant asset management
  - Process automation - monitoring
  - Human remote control of automation equipment
  - Control to control communication
  - Process automation - closed loop control
  - Massive wireless sensor networks
  - Mobile robots
  - Mobile control panels with safety functions

- **mMTC** (Massive Machine Type Communication)
- **uRLLC** (Ultra-Reliable and Low-Latency Communications)

Source: ZVEI
5G for industrial requirements

Industry trends
- Predictive and preventive maintenance
- Factories with full mobility
- Autonomous logistic systems
- Big data analytics with increased automation

Solution
- Private 5G networks
- Frequency spectrum for industry

Connectivity requirements
- End to end reliability and availability
- Quality of service classes
- Security
- Coverage in production plants
- Maintainability and manageability
- Standard communication technology
- Cost efficiency
Private mobile networks for local and customized services

Private mobile networks for production sites
- Dedicated equipment and local coverage
- Independent of implementation of quality parameters
- Optimized for industry use cases
- Managed individually

Public mobile networks
- Managed by national mobile operator
- Equipment shared with other user traffic
- Wide area coverage as business model
- Use cases for generic voice and data services

Simplified layout of a private mobile network

Simplified layout of a public mobile network
5G Industrial Network Architecture

- 5G enables flexible service based architecture
- Service prioritization can be distributed across the network
- Multiple options of deployment possible
- Operation models can vary from pure MNO support to pure private responsibility, tbd. best mode of operation for BASF
Core requirements

- Reliability of operation for production areas to ensure the operator responsibility
- Clear focus on industry end user requirements
  - e.g. download/upload ratio, prioritization of safety and production critical communication
  - no conflict of interest with mass consumer market. (Netflix vs. AGV not acceptable)
  - antenna deployment in production areas

Next steps

- light house project started
- Piloting of the industry 100MHz pioneer band
- Evaluation of technology aspects with partners (ARENA 2036, Digital Factory, 5GACIA, etc.)
- 5G for BASF in the global context (Europe, North America, Greater China, Asia)
We create chemistry