»Wie industrielle Anwendungen von 5G profitieren können«

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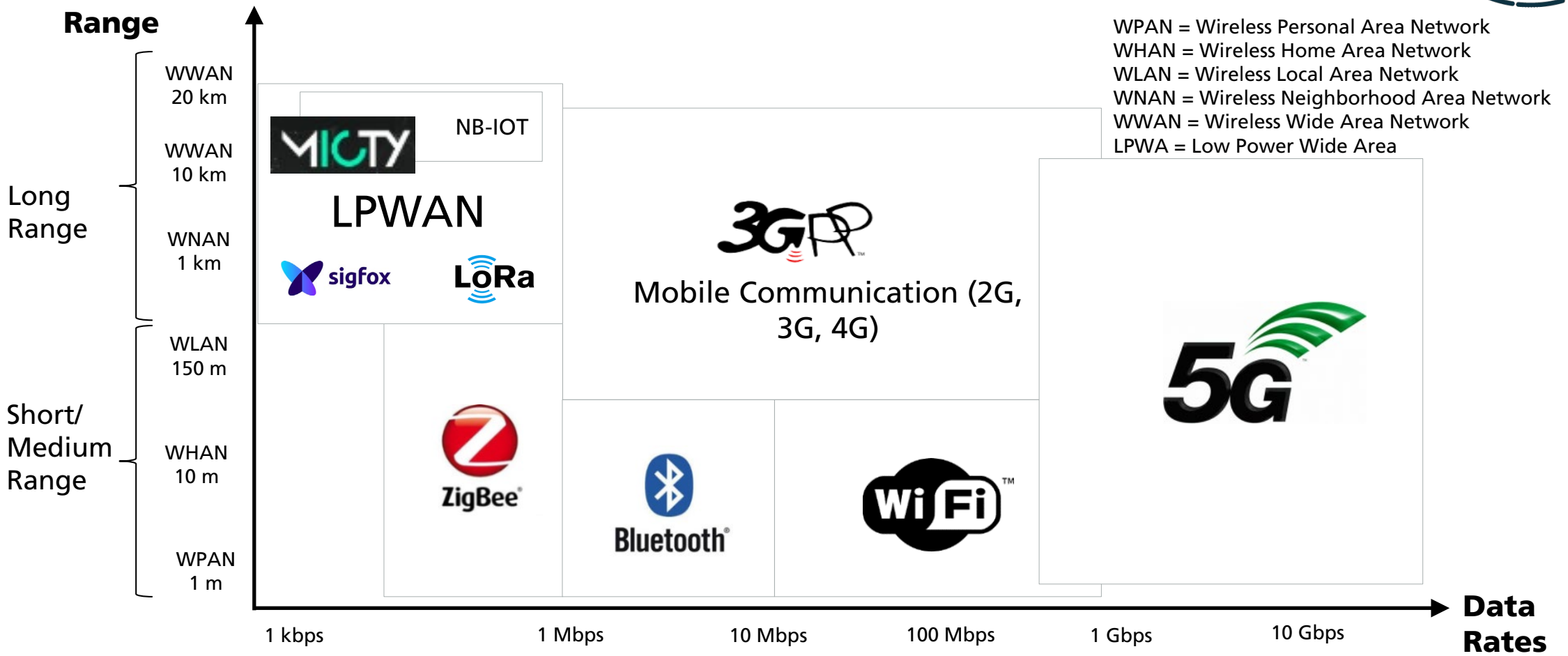
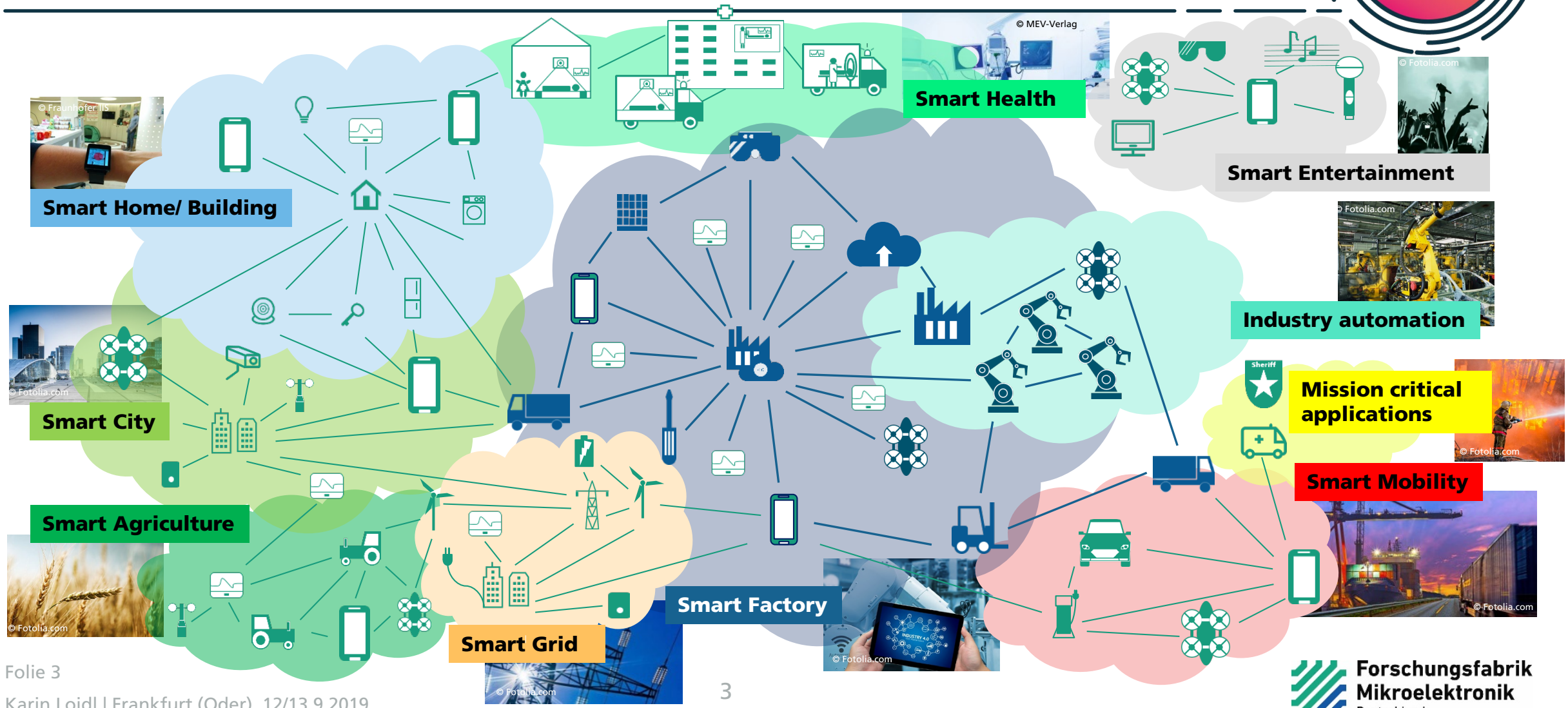
5G – A short introduction

Wireless Communication Technologies



WPAN = Wireless Personal Area Network
WHAN = Wireless Home Area Network
WLAN = Wireless Local Area Network
WNAN = Wireless Neighborhood Area Network
WWAN = Wireless Wide Area Network
LPWA = Low Power Wide Area

What's 5G New Radio? – Use Cases



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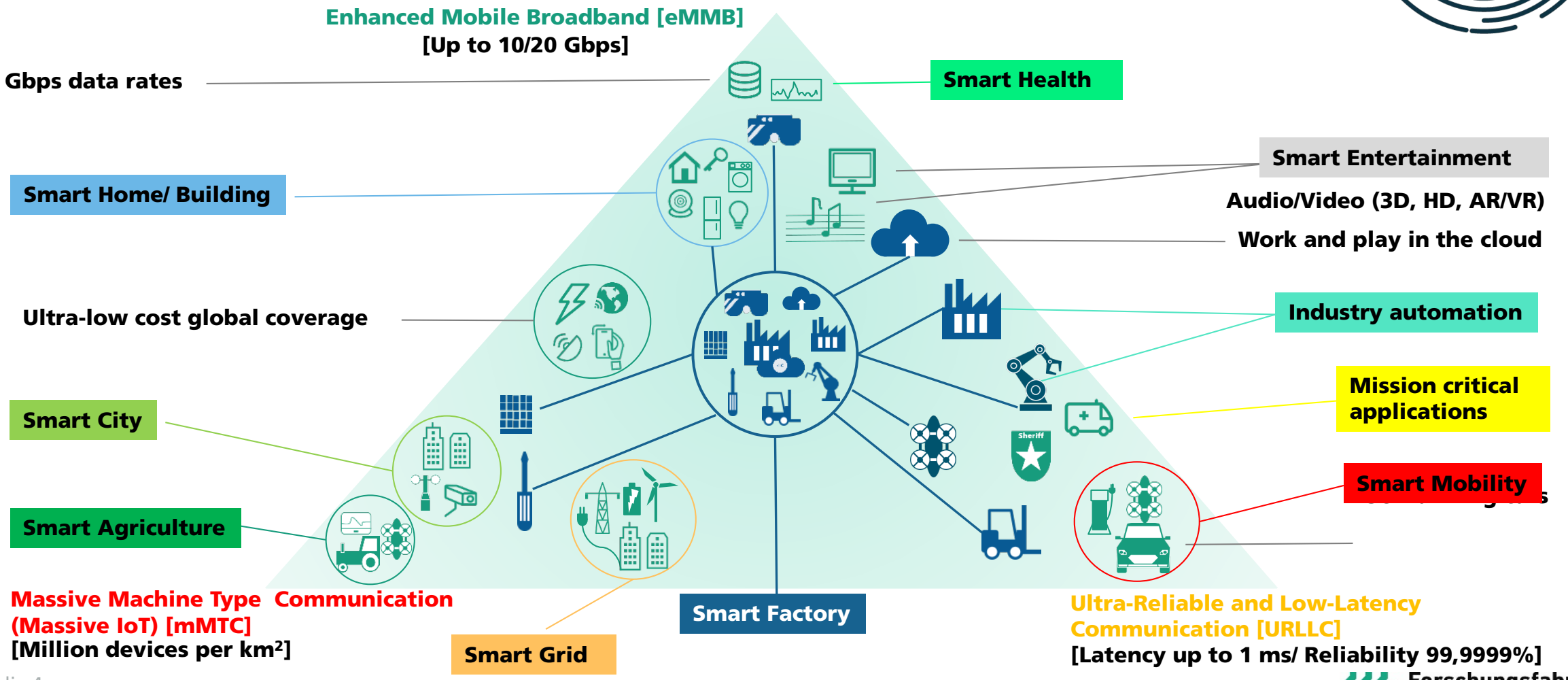
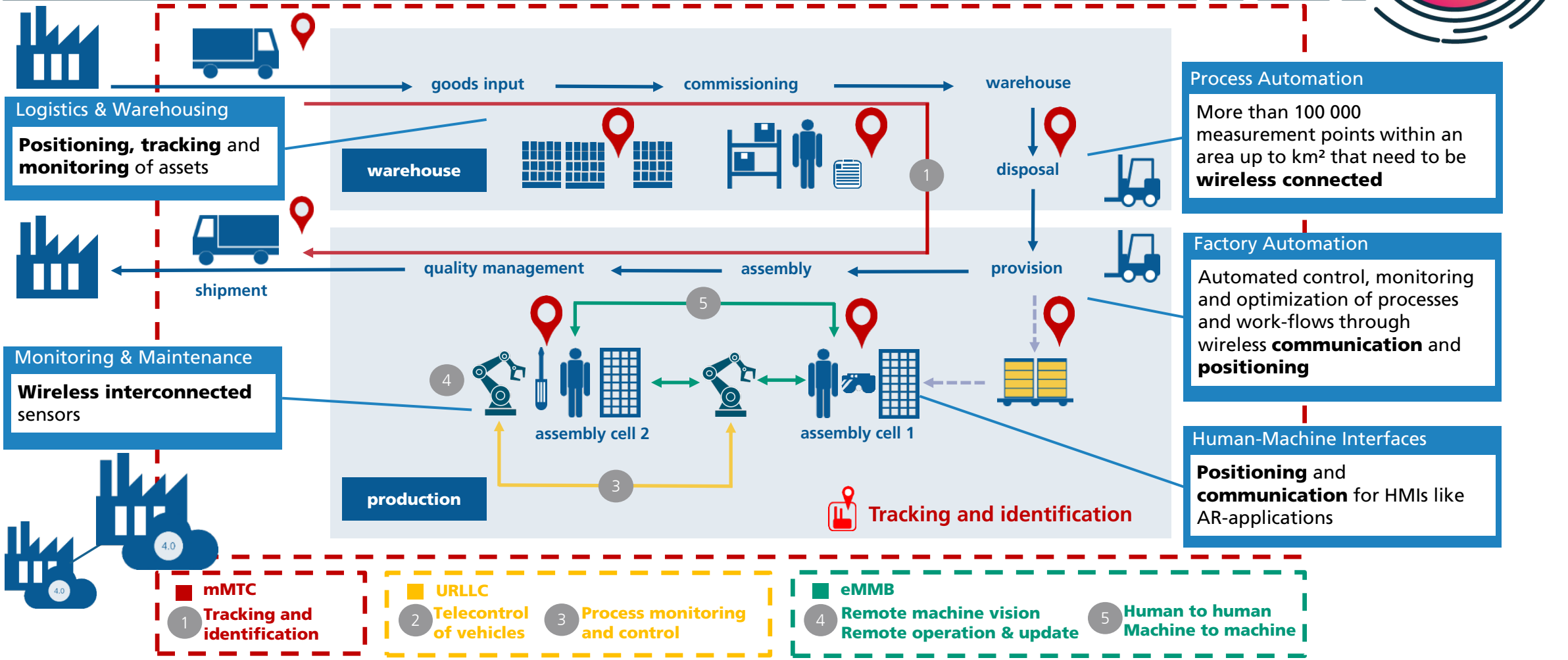
What's 5G New Radio? – Features



What's 5G New Radio? – Selected Use Cases

5G Smart Factory



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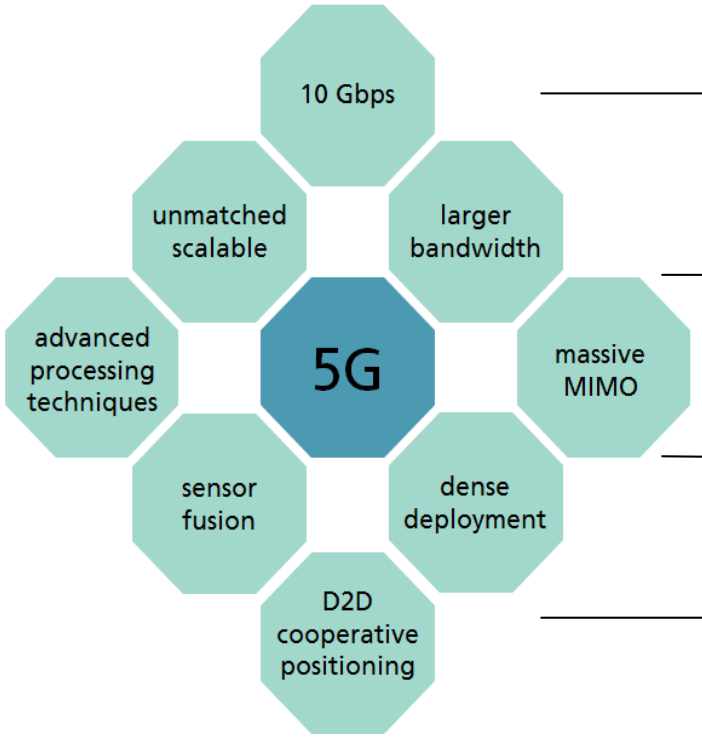
3GPP SA1: Positioning Requirements (TS 22.104,17.0.0)

Scenario	Horizontal accuracy	Vertical accuracy	Availability	Heading	Latency for position estimation of UE	UE Speed	Corresponding Positioning Service Level in TS 22.261
Mobile control panels with safety functions (non-danger zones)	< 5 m	< 3 m	90 %	N/A	< 5 s	N/A	Service Level 2
Process automation – plant asset management	< 1 m	< 3 m	90 %	N/A	< 2 s	< 30 km/h	Service Level 3
Flexible, modular assembly area in smart factories (for tracking of tools at the work-place location)	< 1 m (relative positioning)	N/A	99 %	N/A	1 s	< 30 km/h	Service Level 3
Augmented reality in smart factories	< 1 m	< 3 m	99 %	< 0,17 rad	< 15 ms	< 10 km/h	Service Level 4
Mobile control panels with safety functions in smart factories (within factory danger zones)	< 1 m	< 3 m	99,9 %	< 0,54 rad	< 1 s	N/A	Service Level 4
Flexible, modular assembly area in smart factories (for autonomous vehicles, only for monitoring proposes)	< 50 cm	< 3 m	99 %	N/A	1 s	< 30 km/h	Service Level 5
Inbound logistics for manufacturing (for driving trajectories (if supported by further sensors like camera, GNSS, IMU) of indoor autonomous driving systems))	< 30 cm (if supported by further sensors like camera, GNSS, IMU)	< 3 m	99,9 %	N/A	10 ms	< 30 km/h	Service Level 6
Inbound logistics for manufacturing (for storage of goods)	< 20 cm	< 20 cm	99 %	N/A	< 1 s	< 30 km/h	Service Level 7

How to Obtain Position Indoors with 5G

Positioning in 5G offers huge benefits compared to 4G and solutions based on GNSS for use cases like Industry 4.0. These benefits are grounded on improvements in accuracy and availability due to a larger bandwidth of higher frequencies and dense deployments.



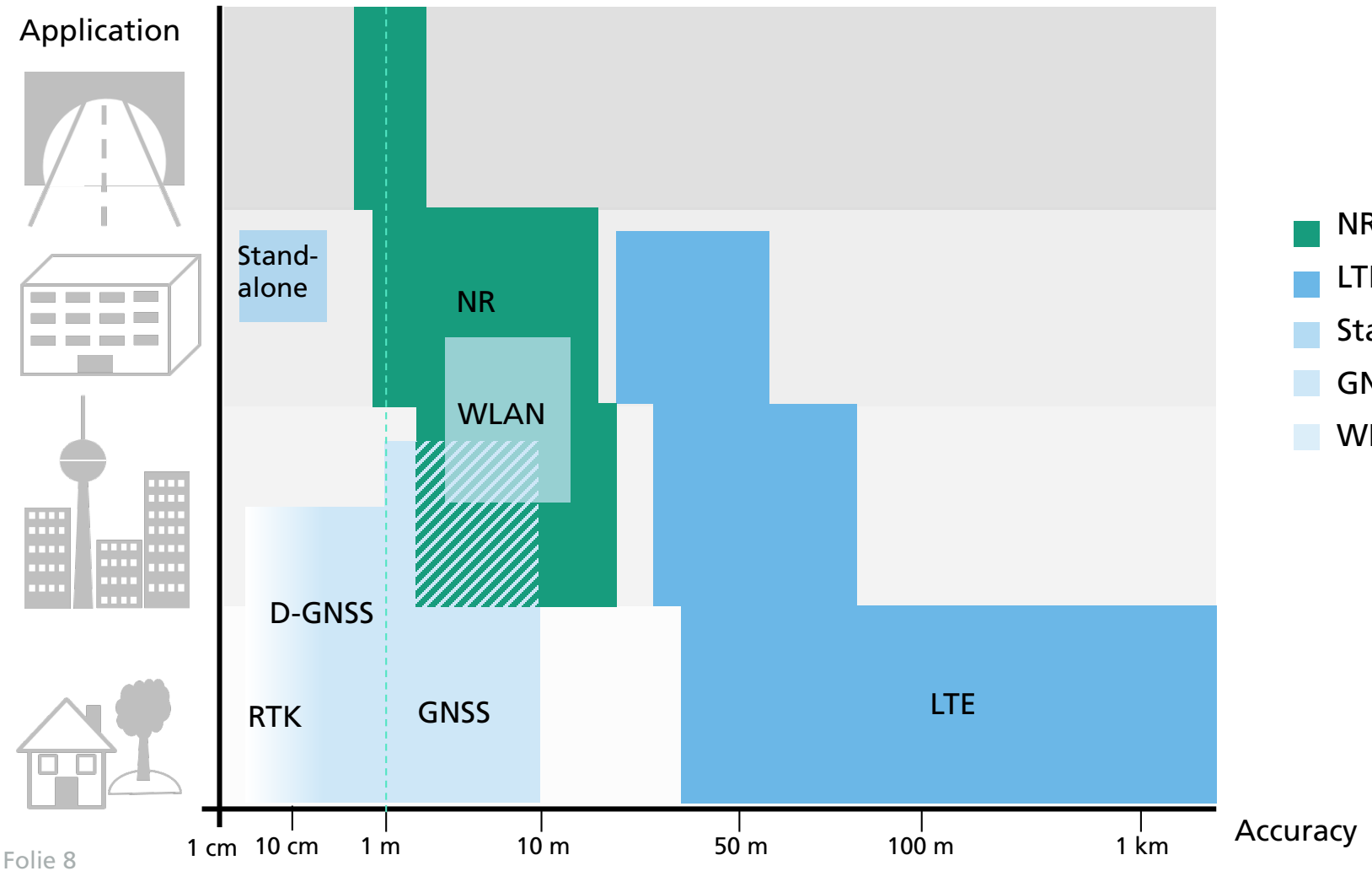
mm-Wave - mm-Wave transmission allows accurate positioning using larger bandwidths and taking advantage of the beamforming approaches

Massive MIMO - antenna arrays consisting of a large number of antenna elements to allow precise positioning

Dense Deployment - improves the performance through redundancy and achieving a better geometry.

D2D Positioning - due to D2D communication, mobile terminals can collaborate to help each other to determine their own position

Expected Positioning Performance of 5G NR



- NR
- LTE
- Stand-alone systems (e.g. UWB)
- GNSS
- WLAN

Project Example: Outlook on Industrial Indoor Application

FMD Expertise und Leistungsangebot im Bereich 5G

- Spezielle Bewertungskompetenz im Bereich Ortungs- und Kommunikationslösungen für Mobilitäts- und Industrieanwendungen
  - Auslegung von Funksystemen (z.B. brauche ich 5G oder nicht)
  - Erstellung von Anforderungsprofilen mit hoher Marktrelevanz
  - Anwendungsorientierte Vorbereitung der Chipentwicklung (z.B. Energieverbrauch, Prozessorleistung, Speicher, Miniaturisierung, Aufbau)
- Führendes Test- und Anwendungszentrum für Kommunikations- und Lokalisierungslösungen
  - In- und Outdoorbereich inkl. Außenfahrstrecken für die realitätsnahe Nachbildung von Industrie- und Mobilitätsanwendungen
  - Möglichkeit zu Langzeitmessungen
  - Möglichkeit zu reproduzierbaren Messungen durch Referenzsysteme

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