Von LTE bis 5G Release 17

Torsten Musiol

MECSware

Revolution oder Evolution?

Öffentliche Netze: 2G → 3G → 4G/LTE → 5G → *Campusnetze*

Neu!

Private Netze	Wi-Fi 1/2 (802.11a/b)	Wi-Fi 3 (802.11g)	Wi-Fi 4 (802.11n)	Wi-Fi 5 (802.11ac)	Wi-Fi 6 (802.11ax)

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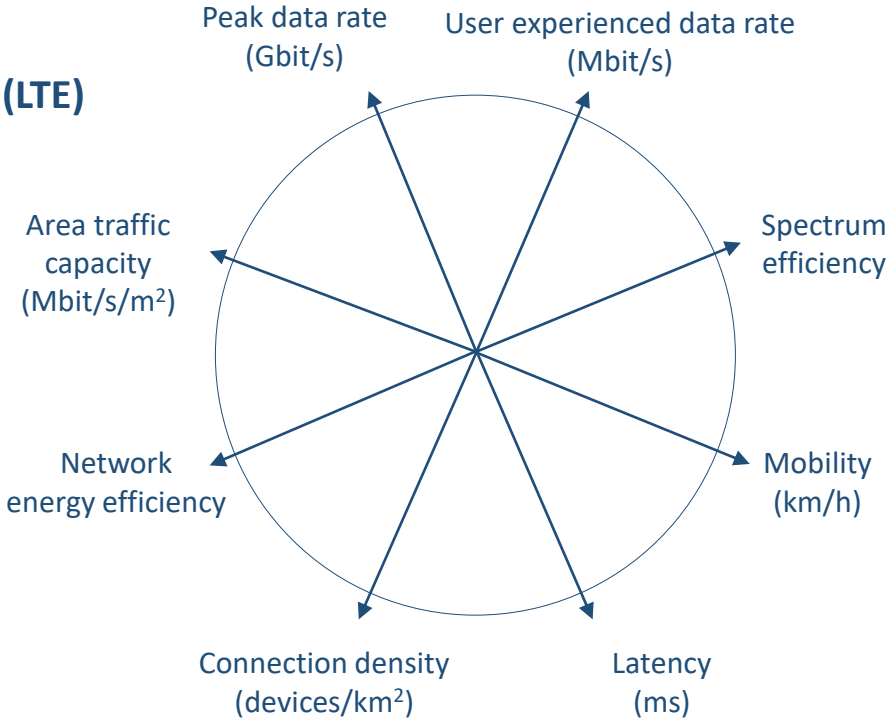
International Mobile Telecommunications (IMT) Standards

Zieldefinition der International Telecommunication Union (ITU)

IMT-2000 = 3G
IMT-Advanced = 4G (LTE)
IMT-2020 = 5G



ITU-R M.2083-0 “IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond”

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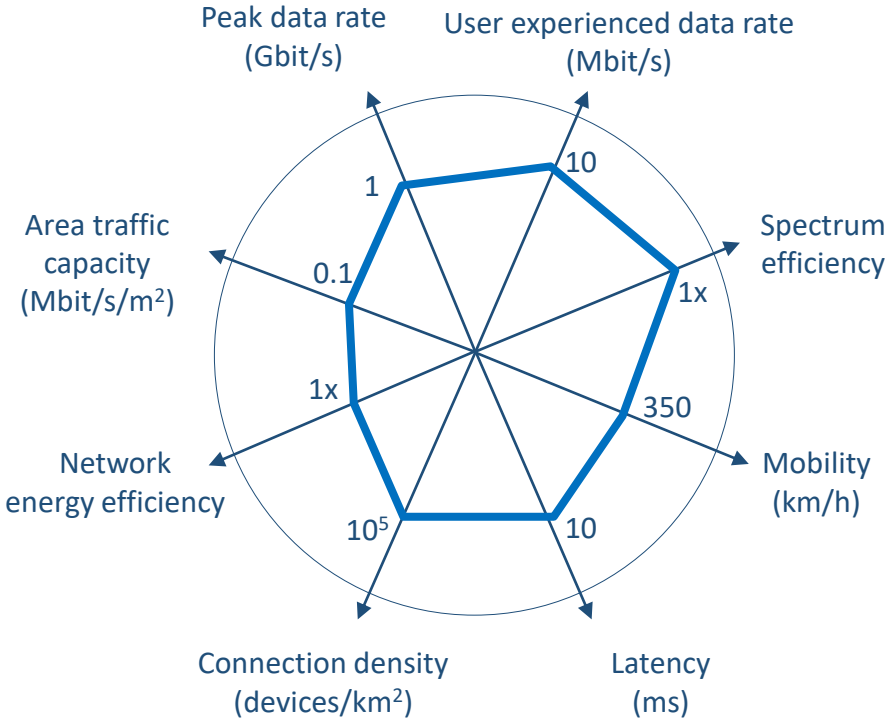
LTE = IMT-Advanced

LTE



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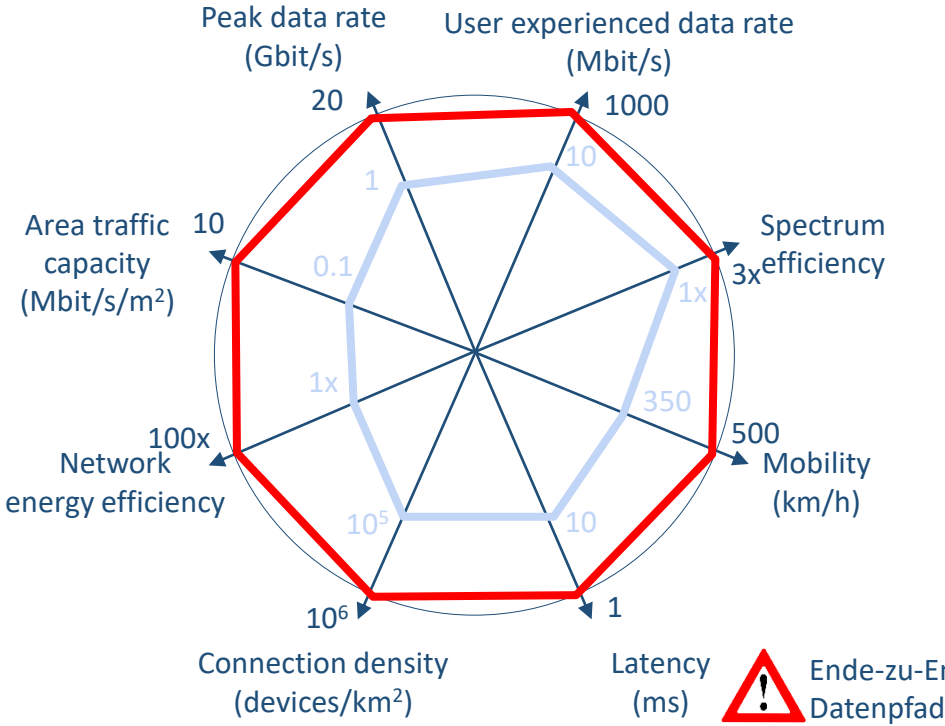
5G = IMT-2020

Bandbreite >> 100 MHz

5G



Ende-zu-Ende
Datenpfadoptimierung

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IMT-2020 Use Cases

- Enhanced Mobile Broadband (eMBB)
- Ultra-Reliable & Low-Latency Communications (URLLC)
- Massive Machine-Type Communications (mMTC)

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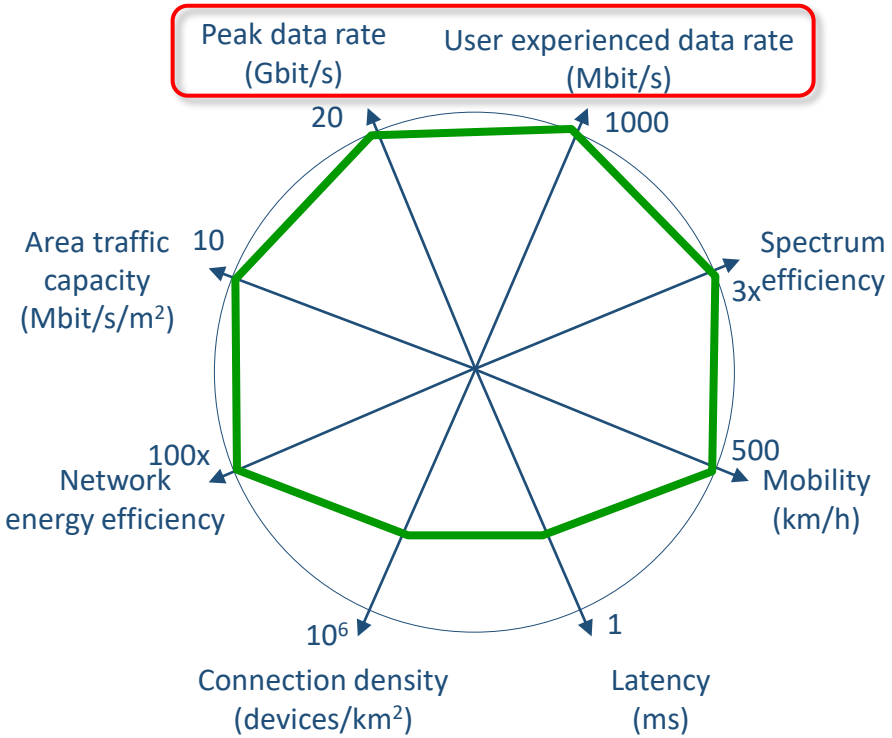
Enhanced Mobile Broadband (eMBB)

New Radio (NR)

Rel.15



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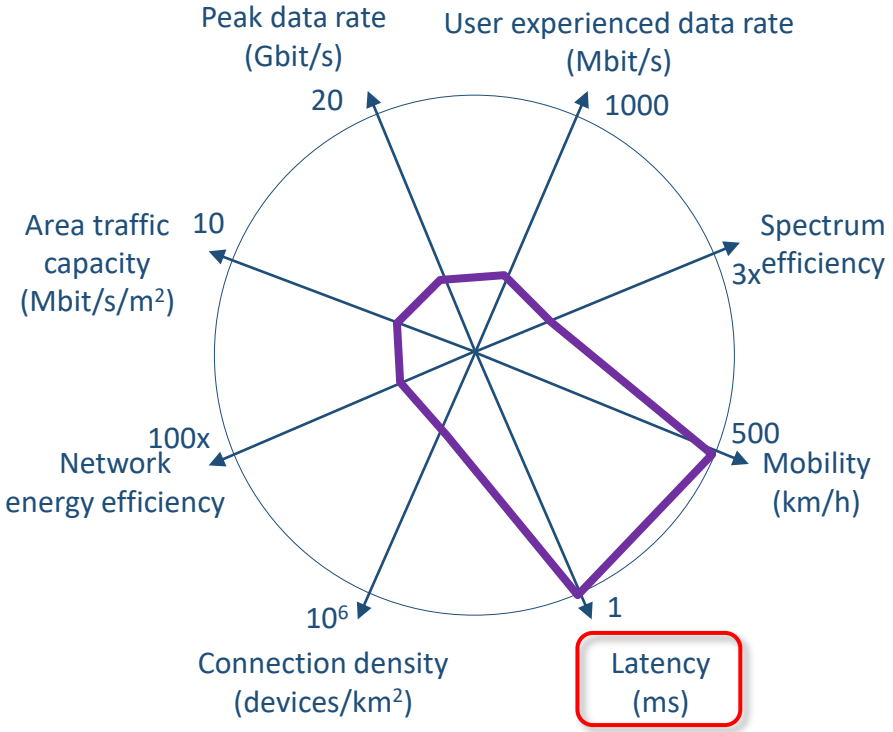
Ultra-Reliable & Low-Latency Communications (URLLC)

NR Evolution: Dual connectivity, improved scheduling, TSN, …

Rel.16



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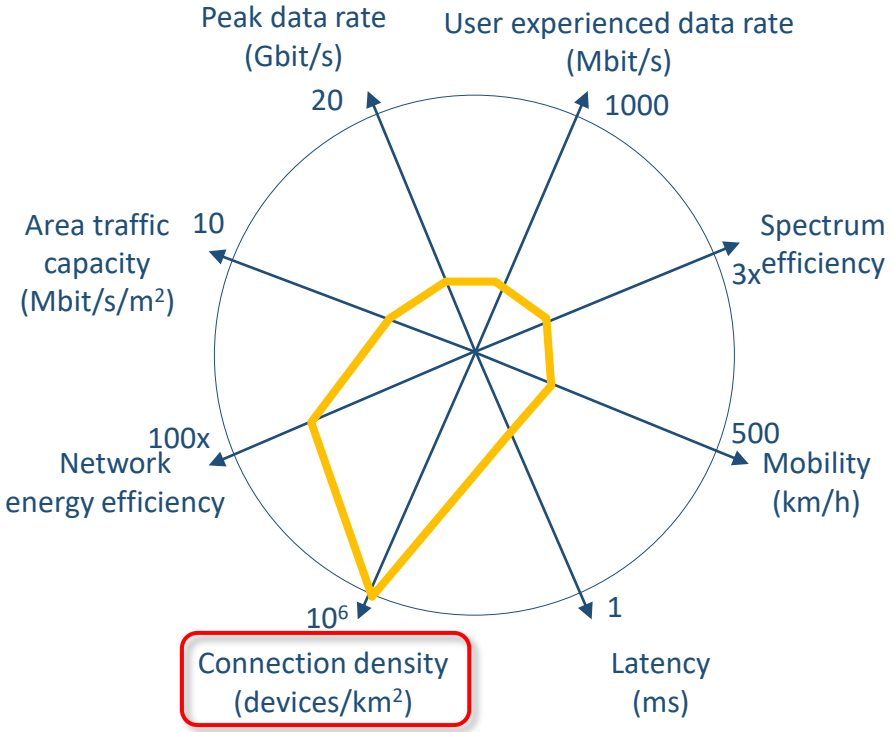
Massive Machine-Type Communications (mMTC)

NR Evolution: UE power-saving, improved positioning, …

Rel.17



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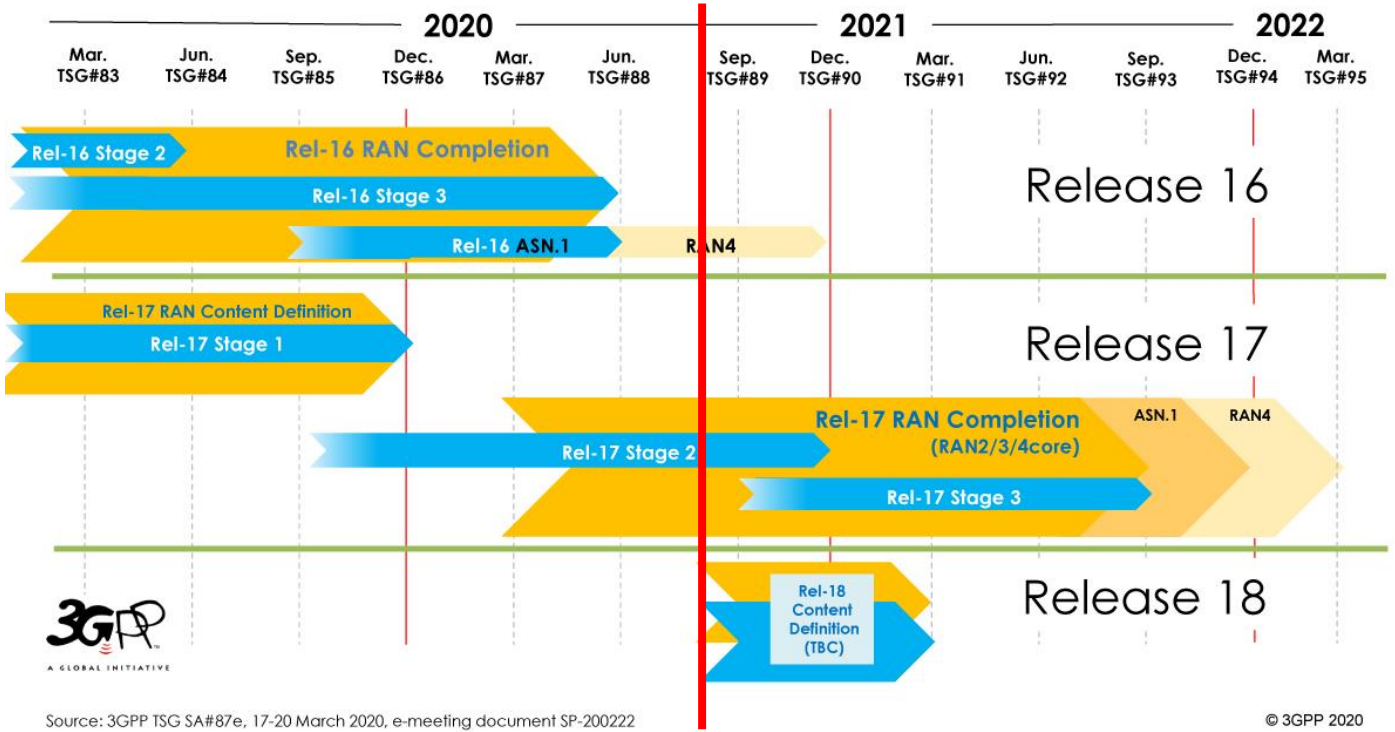
5G Releases

3rd Generation Partnership Project (3GPP)

Rel-15



https://www.3gpp.org/specifications/67-releases

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Die Anwendungen bestimmen die Technologieauswahl

Requirement	Remote Control for Proc. Autom.	Closed Loop Motion Control	Additive Sensing for Proc. Autom.
Cycle time	50 ms	0.5 ms - 2 ms	1h - 1 day
Message size	n/a (video stream)	20-50 Bytes	100 Bytes - 10 MBytes
Data rate per entity	1 Mbit/s - 100 Mbit/s	1 Mbit/s - 10 MBit/s	(burst transmission)
Message error rate	10^{-7}	10^{-9} - 10^{-8}	10^{-4}
Latency	50 ms	<<50% of cycle time	not in focus
Distance of entities	up to several 100 m	up to several 10 m	up to several km
Velocity	n/a	2 - 20 m/s	n/a
Traffic type	cyclic, on-demand	cyclic, uni- or multicast	cyclic, uni- or multicast
Entity density	1,000 /km^2	0.1 /m^2	Up to 10,000 /km^2

http://www.tacnet40.de/

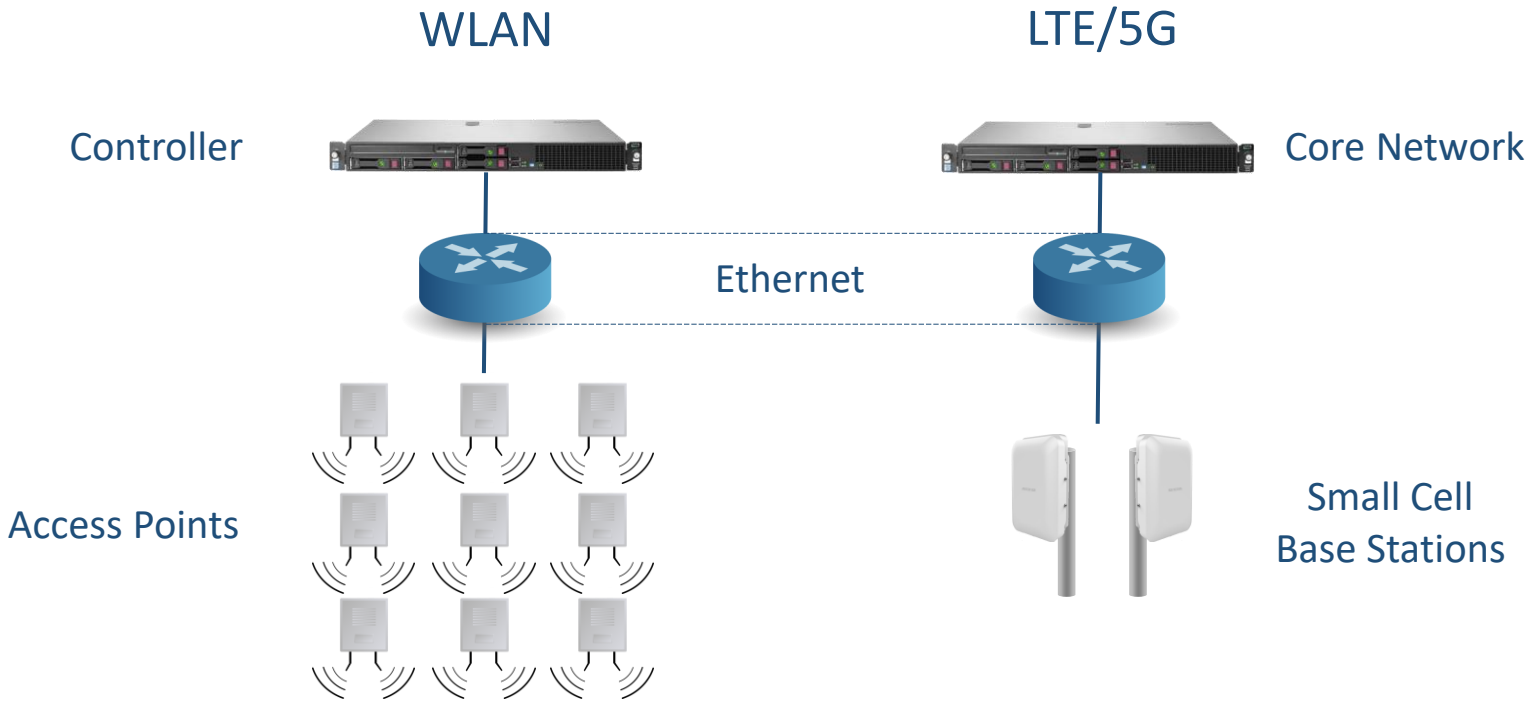
LTE Rel.15 Rel.16 Rel.17

Industrielle Anforderungen wirtschaftlich erfüllen

Mehr als nur Funktechnologieparameter

Installierbarkeit

Integration von LTE/5G in existierende Ethernet Infrastruktur



Bedienbarkeit

IT Mitarbeiter haben i.A. kein 4G/5G Expertenwissen

AMF AUSF SMF gNB MME HSS eNB SGW UPF NG1 UE PGW PCF NG2 S1 PCRF DSF S5 AMBR NG3 NRF S6a QCI 5QI NG5 S11 Sx SGi NG8 NG6

3GPP

Switching Routing

Ethernet IP

IEEE IETF

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MECSware campusXG® - Einsatzbeispiel

Fahrerloses Transportfahrzeug (FTF) / Automated Guided Vehicle (AGV)

https://www.goetting.de/news/2019/video-hannover-messe-5g-kate

https://www.youtube.com/watch?v=ImJgHRVJH4U

The LTE/5G Campus Network Company

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