

What is Industrial 5G?

Industrie 4.0 with intelligent factories and the Industrial Internet of Things (IIoT) – this is the future of industrial manufacturing. Making production facilities and intralogistics more flexible, autonomous, and efficient requires appropriate communications framework conditions and comprehensive connectivity. The new 5G communication standard is opening up new prospects in this area. One of the benefits of 5G is the significantly greater bandwidth which allows much more data to be sent simultaneously than previously. Estimates start at ten gigabits per second, 10 times more than with 4G. In addition to this, 5G will have a substantially lower latency and greater reliability than current mobile technologies. And the number of subscribers able to be connected in a defined area will also be considerably higher.

| 1G | 2G | 3G | 4G | 5G |
|---|--|--|---|---|
| <p>Released: 1979</p> <p>Standards: NMT, AMPS & TACS</p> <p>Capabilities:</p> <ul style="list-style-type: none"> Analog voice | <p>Released: 1991</p> <p>Standards: GSM & CDMA</p> <p>Capabilities:</p> <ul style="list-style-type: none"> Digital voice Encrypted communication Limited roaming SMS & MMS <p>Extensions:</p> <ul style="list-style-type: none"> GPRS (2.5G) CDMA2000 (2.5G) EDGE (2.75G) | <p>Released: 2002</p> <p>Standards: UMTS & EV-DO</p> <p>Capabilities:</p> <ul style="list-style-type: none"> Mobile broadband Locating services Multimedia streaming Seamless global roaming <p>Extensions:</p> <ul style="list-style-type: none"> HSPA+ (3.5G) | <p>Released: 2009</p> <p>Standards: LTE</p> <p>Capabilities:</p> <ul style="list-style-type: none"> High Speed mobile Internet IP-based packet switching HD multimedia streaming Seamless global roaming <p>Extensions:</p> <ul style="list-style-type: none"> Feature extension through new category/releases | <p>Released: 2019</p> <p>Standards: 5G</p> <p>Capabilities:</p> <ul style="list-style-type: none"> Private networks (local use frequency) (IIoT) Ready Massive Machine Type communication Ultra-low-latency Ultra-high reliability Millimeter wave support <p>Extensions:</p> <ul style="list-style-type: none"> Feature extension through new categories/releases |
| <p>0.0024 Mbit/s</p> | <p>0.064 Mbit/s</p> | <p>42 Mbit/s</p> | <p>1000 Mbit/s</p> | <p>10,000 Mbit/s</p> |
| <p>Industry Impact: -</p> <ul style="list-style-type: none"> No impact on industrial applications | <p>Industry Impact: 0</p> <ul style="list-style-type: none"> Remote control / Telecontrol Text messages from and to remote machines | <p>Industry Impact: +</p> <ul style="list-style-type: none"> Video monitoring Remote Access to machines (e.g. for teleservice) Remote Condition Monitoring | <p>Industry Impact: ++</p> <ul style="list-style-type: none"> Mobile service Technicians Service via smart phones Wireless Backhaul | <p>Industry Impact: +++</p> <ul style="list-style-type: none"> Autonomous Logistics Autonomous Machines Assisted Work Wireless Backhaul Edge Computing Mobile Equipment |

5G has three key scenarios

- **Enhanced Mobile Broadband (eMBB)** is, amongst other things, important for wireless applications in the fields of augmented and virtual reality, for example, to support employees on assembly lines with overlays on smart glasses. The computing power comes directly from the cloud.
- Equally important for industry is the fact that the availability of the mobile network (ultra-reliable) and its latency (low-latency) have been significantly improved. This is particularly relevant when controlling the movement of machines or determining the position of robots. **Ultra-Reliable Low-Latency Communication (URLLC)** provides high system reliability and promises reaction times in the low millisecond range.
- **Massive Machine-Type Communication (mMTC)** allows up to one million devices to be connected in a square kilometer – substantially more than before. This is particularly relevant in the process industry where many different sensors are installed to help to monitor each step of the process. A further benefit is that 5G should require less energy despite better performance and therefore reduce costs.

Eight characteristics of 5G have been defined to meet all the requirements from the three key scenarios. These are laid out in the table below with their relevance to the various scenarios.

| Characteristic | Description | Requirement | Scenario |
|--|---|--|-----------------|
| Peak data rate | Maximum data rate | 20 Gbit/s (Downlink) 10 Gbit/s (Uplink) | eMBB |
| (Actual) data rate experienced by the user | Achievable data rate over the area of coverage | 1 Gbit/s | eMBB |
| Latency | Max. delay over the mobile network | 1 ms | URLLC |
| Mobility | Max. speed for handoff and quality of service requirements | 500 km/h | eMBB/URLLC |
| Density | Total number of devices per unit area | $10^6/\text{km}^2$ | mMTC |
| Energy efficiency | Sent/received data per unit of energy consumption (device or network) | As 4G | eMBB |
| Spectrum efficiency | Throughput per unit wireless bandwidth and per network cell | 3 to 4 × 4G | eMBB |
| Area traffic capacity | Total traffic across area of coverage | 1000 (Mbit/s)/ m^2 | eMBB |