# 5G for people and things
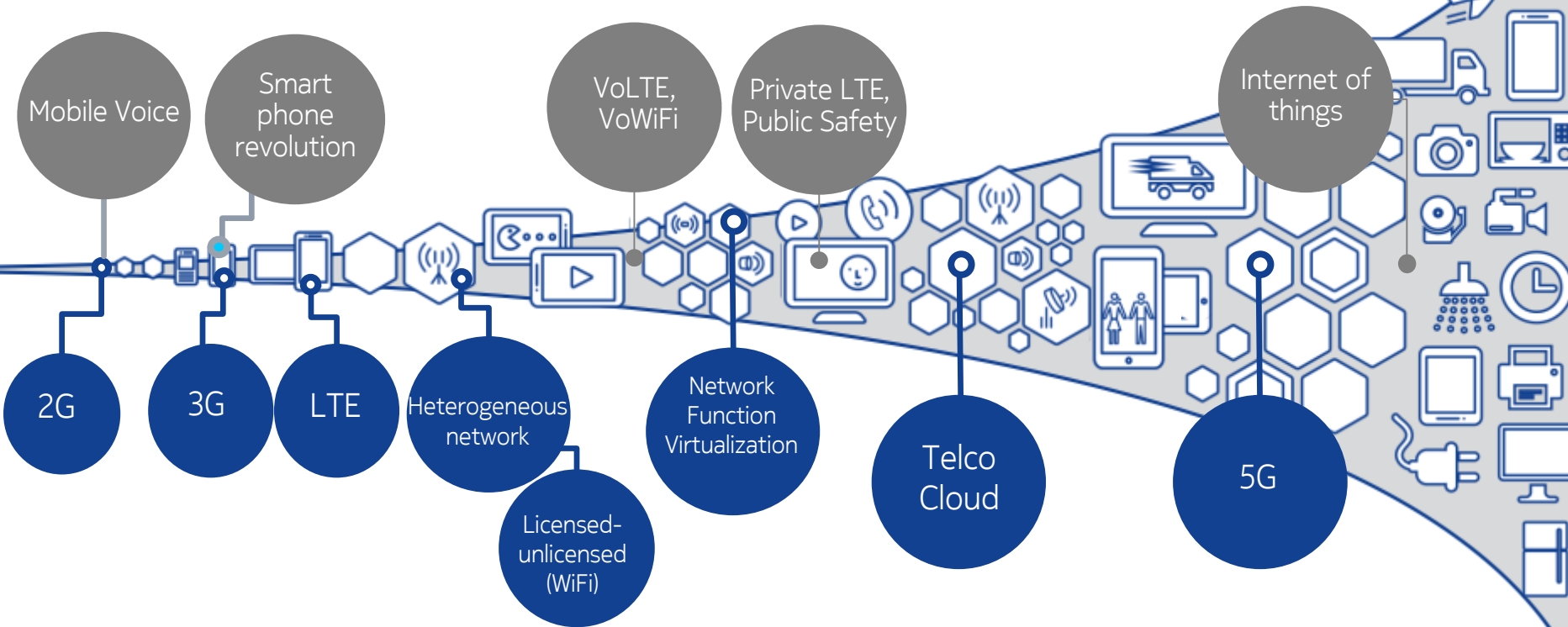
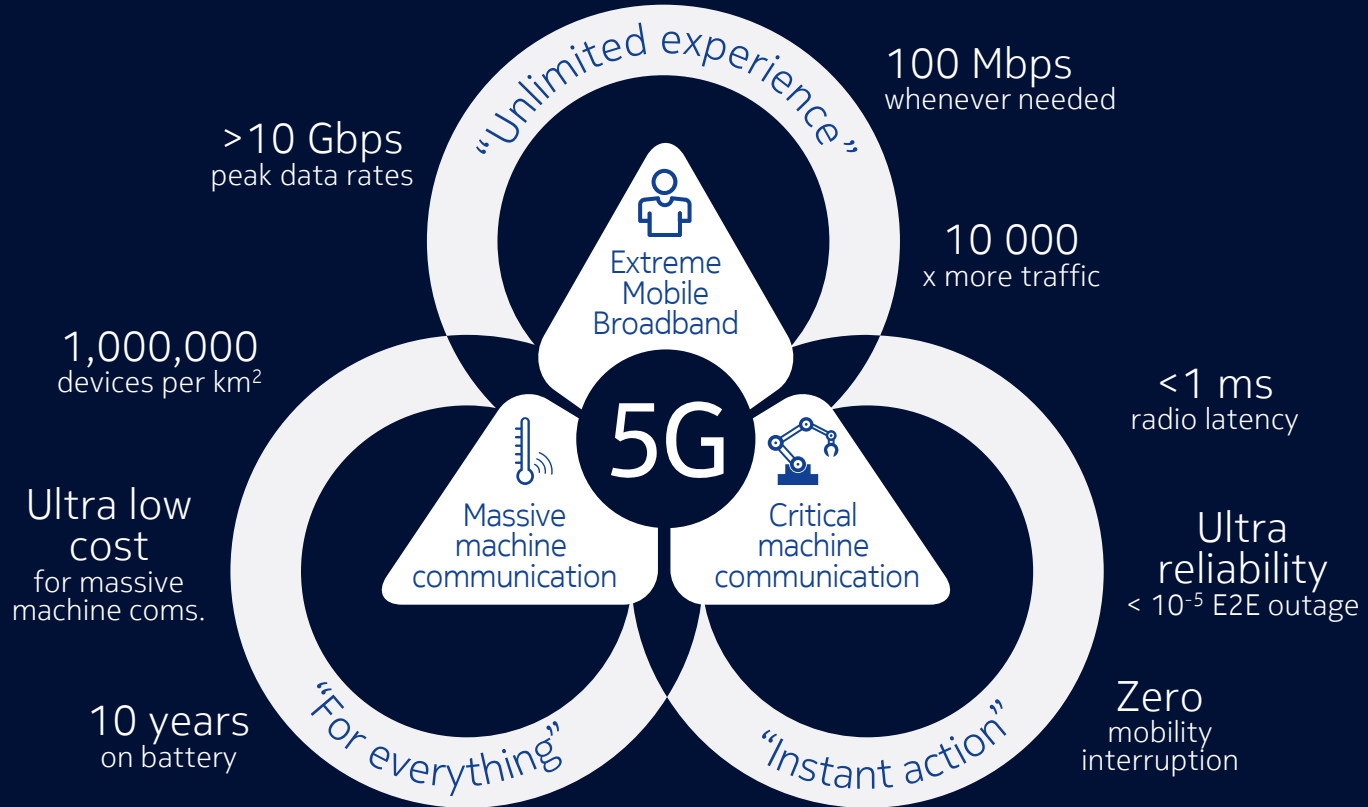Ulrich Rehfuess
Head of Spectrum Policy
ulrich.rehfuess@nokia.com

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# The journey for human technology
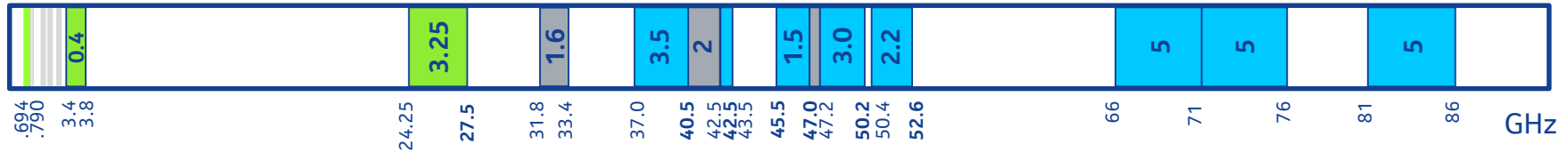## Mobile networks today and tomorrow



Mobile Voice

Smart phone revolution

VoLTE, VoWiFi

Private LTE, Public Safety

Internet of things

2G

3G

LTE

Heterogeneous network

Network Function Virtualization

Telco Cloud

5G

Licensed-unlicensed (WiFi)

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# 5G will change the world



>10 Gbps
peak data rates

"Unlimited experience"

100 Mbps
whenever needed

10 000
x more traffic

Extreme
Mobile
Broadband

1,000,000
devices per km$^2$

5G

<1 ms
radio latency

Ultra low
cost
for massive
machine coms.

Massive
machine
communication

Critical
machine
communication

Ultra
reliability
< $10^{-5}$ E2E outage

10 years
on battery

"For everything"

"Instant action"

Zero
mobility
interruption

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# 5G Pioneer Bands in Europe: 700 MHz, 3.4-3.8 GHz, 24.25-27.5 GHz

## 5G needs spectrum below 1 GHz, in between 1 and 6 GHz, and above 6 GHz



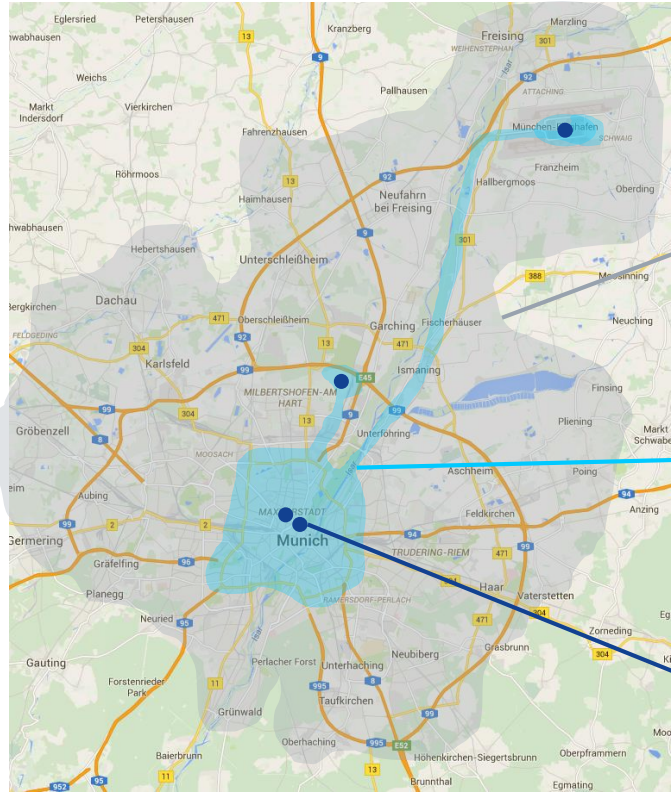| 694-790 MHz<br>Wide area coverage<br>for mMTC* and URLLC* | 700 MHz band targeted to become available latest 2020 in Europe<br>Re-use of existing 900/800 MHz grids allows for timely coverage<br>Pre-condition for new services like connected cars, smart sensors etc. |
|---|---|
| 3.4-3.8 GHz<br>Urban coverage<br>for initial eMBB* | C-band is sparsely used in most parts Europe<br>Re-use of existing 1800/2100/2600 MHz grids<br>Carrier bandwidths of 100 MHz + allow for single Gbps data rates |
| 24.25-27.5 GHz<br>Initially hot spots<br>of true eMBB* | Common tuning range with 28 GHz range (US, Korea) is expected to allow for common economies of scale.<br>Carrier bandwidths of several 100 MHz allow double digit Gbps data rates |

   * mMTC: massive machine type communication, URLLC: ultra reliable low latency communication, eMBB: enhanced mobile broadband

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# Unlocking new spectrum assets in European Football Championship 2020 cities
## Leveraging EU 5G pioneer bands 700 MHz, 3.4-3.8 GHz, 26 GHz

**Vision on commercial 5G deployments in 2020, e.g. in Munich**

### 700 MHz layer with 1 ms latency
- large area coverage with outdoor-to-indoor penetration
- Supports massive machine type communication (mMTC)
- Supports ultra reliable – low latency communication (URLLC)
- Moderate invest on existing 800/900 MHz grids

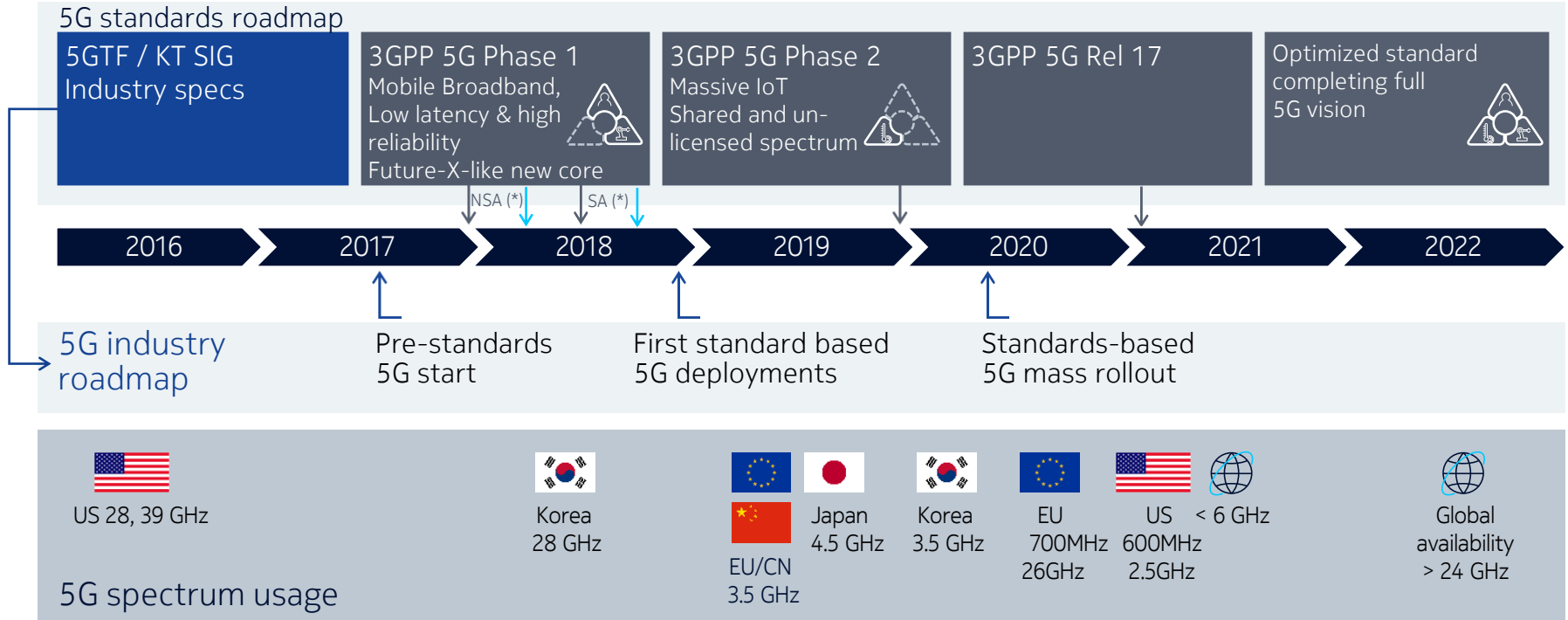### 3.4-3.8 GHz layer with ~1 Gbps and 1 ms latency
- Dense urban coverage + airport + stadium + public transport
- Supports initial enhanced Mobile Broadband (eMBB)
- Moderate invest on existing 1800/2100/2600 MHz grids

### 26 GHz layer with ~10 Gbps and 1 ms latency
- Coverage in selected hot spots (airport, stadium, press center)
- Supports full enhanced Mobile Broadband (eMBB)
- Moderate invest in selected areas

© Nokia 2017

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# Nokia active in 3GPP standardization and supporting early adopters
## 5G spectrum – Nokia engaged in all relevant 5G frequency bands

**5G standards roadmap**

| 5GTF / KT SIG Industry specs | 3GPP 5G Phase 1 Mobile Broadband, Low latency & high reliability Future-X-like new core | 3GPP 5G Phase 2 Massive IoT Shared and un-licensed spectrum | 3GPP 5G Rel 17 | Optimized standard completing full 5G vision |
|---|---|---|---|---|

NSA (*)   SA (*)

**2016   2017   2018   2019   2020   2021   2022**

**5G industry roadmap**

Pre-standards 5G start

First standard based 5G deployments

Standards-based 5G mass rollout

US 28, 39 GHz

Korea 28 GHz

EU/CN 3.5 GHz

Japan 4.5 GHz

Korea 3.5 GHz

EU 700MHz 26GHz

US 600MHz 2.5GHz

< 6 GHz

Global availability > 24 GHz

**5G spectrum usage**

*) NSA: Non standalone; SA: Standalone      ... functional freeze      ...protocol (ASN.1) freeze

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