

Aktuelle Anwendungen von mm Wellen im Rahmen von 5G und Ausblick in die Zukunft

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Agenda

Key trends shaping the world of 2030

But where do we come from and where do we go?

Why do we need mmWave?

Concrete mmWave use cases

Outlook to 6G

Key technologies and market dynamics

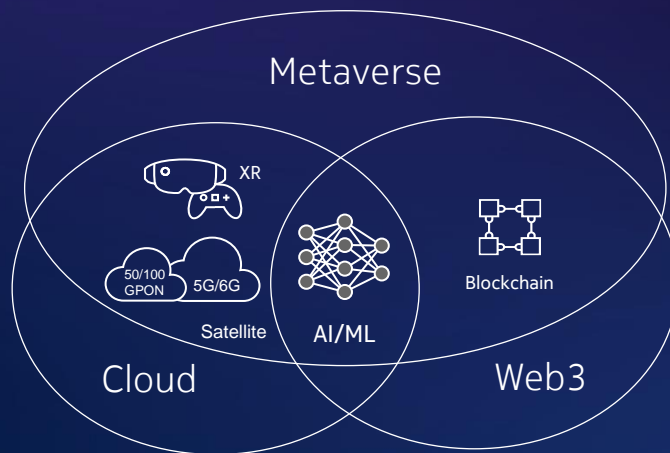
Key trends shaping the world of 2030

Driving requirements for the ecosystem and the network

Socio-economic & geopolitical

Deglobalization	State-driven innovation
Cybersecurity	Sustainability

Technology



User needs

Industry	Enterprise
Consumer	Developer

Evolved experiences	Digital-first
Service-optimized connectivity	New purchasing priorities

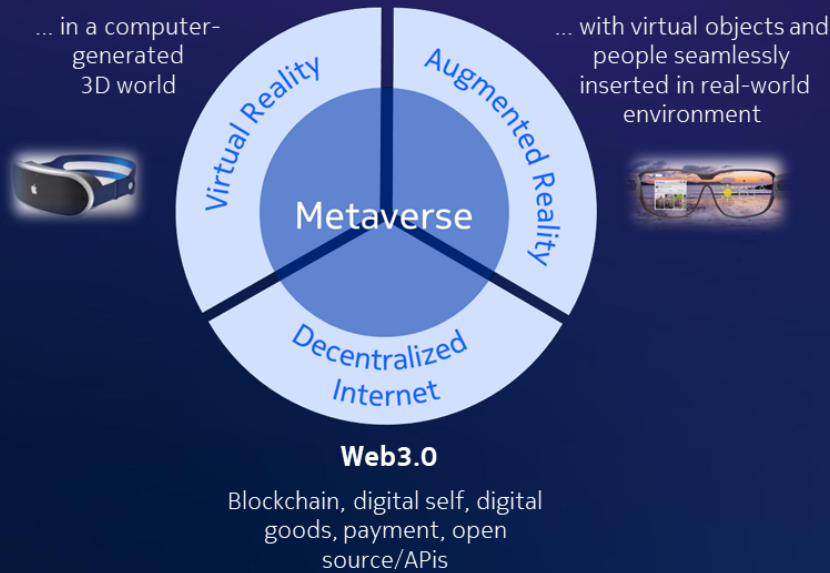
5G Advanced and 6G capabilities

New use cases requiring new technologies

Digital-Physical fusion

Human augmentation

Multi-user immersive interactive experience ...



Application aware Radio

Latency (e.g. L4S)

Network as Code

Edge Cloud Processing

Optimized IoT (RedCap)

Mobility Resilience

Precise Positioning

Network as Sensor

Quantum Security

Industrial Solutions

Non-Terrestrial Networks

...Network of Networks

e.g. FRMCS (railway)

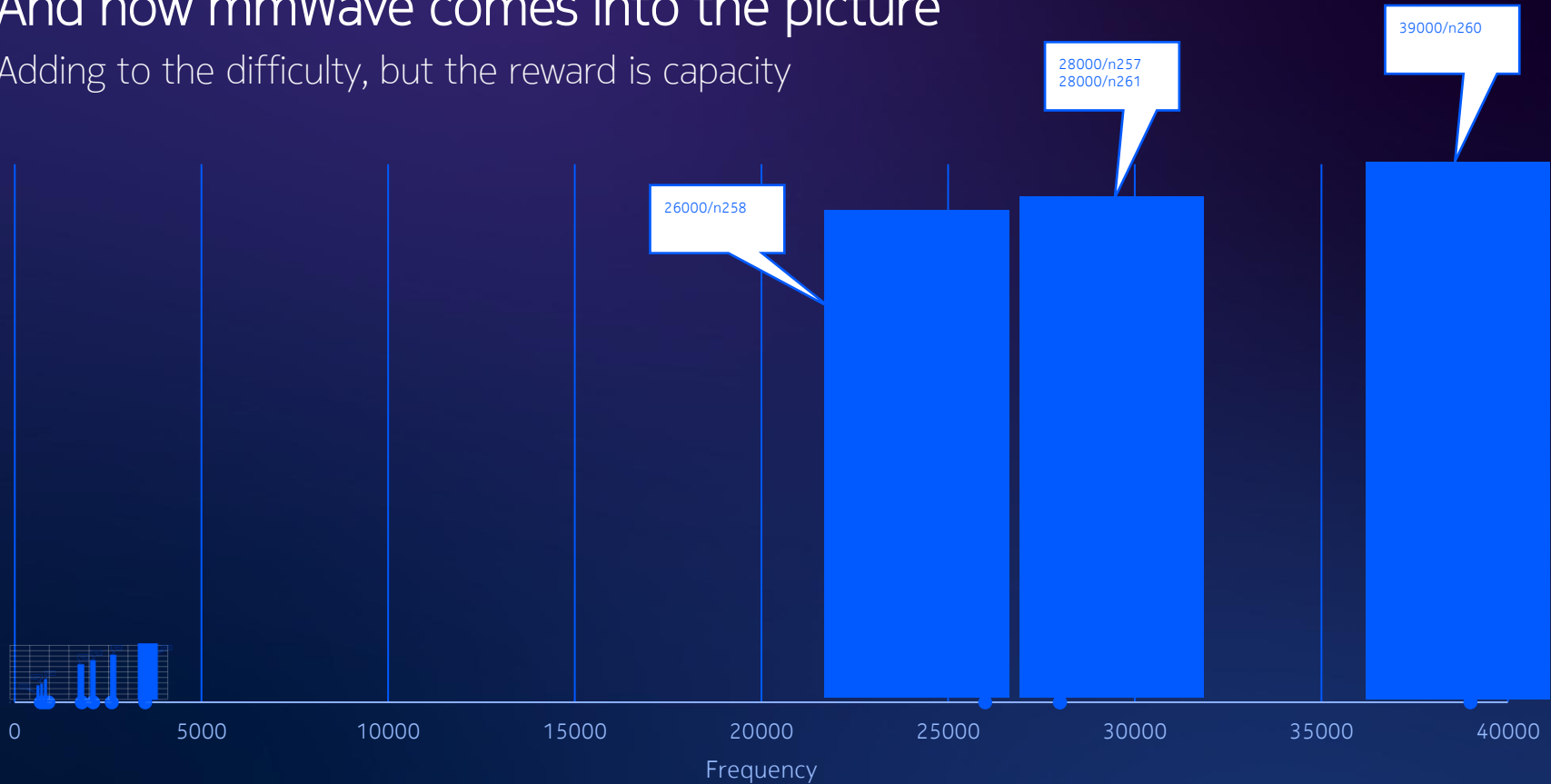
... But where do we come from?

And the GSM standard was capacity



And now mmWave comes into the picture

Adding to the difficulty, but the reward is capacity



What are the top use cases for mmWave?

Driving requirements for the ecosystem and the network

Fixed wireless access with fiber optic speed

High capacity layer for specific locations

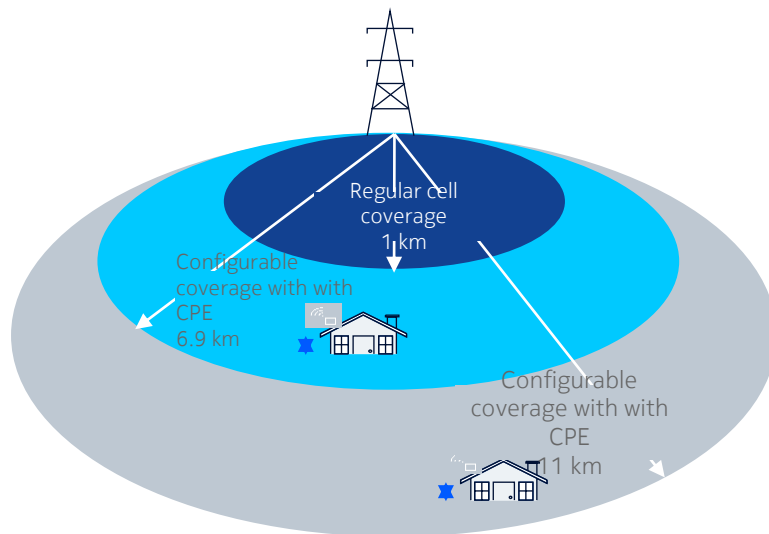
Use cases for Enterprises

Fixed wireless access with fiber optic speed

Standardization framework

mmWave cell coverage

- 3GPP standard for PRACH preamble format limits cell range
- 1 Gbps with extended cell range



Fixed wireless access with fiber optic speed

High Gain CPE technology



Extreme performance in LOS

Performance, adaptivity and ease of installation in NLOS

Long Reach Receiver

- Rural/Sub-Urban
- **30 dBi gain, 53 dBm EIRP**

Outdoor 360 High Gain Receiver

- Sub-Urban/Rural
- **27 dBi gain, 47 dBm EIRP**

Indoor 360 High Gain Gateway

- Urban/sub-suburban
- **24 dBi gain, 44 dBm EIRP**

High capacity locations

Stadium, Malls, etc



mmWave base stations



Use cases for Enterprises

<h2>Rail</h2> <p>Massive data exchange in stations. Indoor hotspots in yards, depots.</p>	<h2>Logistics & Retail</h2> <p>Future use cases e.g. AGV video uploads.</p>	<h2>Utilities</h2> <p>Outdoor hotspots in power plants, utility logistics sites. URLLC for teleprotection for energy transmission (PtP)</p>
<h2>Aviation/Airports</h2> <p>Massive data exchange w/ airplanes. Point2Mpoint backhaul (FWA). CCTV uploads (remote marshal).</p>	<h2>Automotive & Road</h2> <p>Indoor data shower (SW download). Outdoor hotspots (highway/test track).</p>	
<h2>Maritime</h2> <p>Video uploads in port terminals.</p>	<h2>Discr & Proc Manufacturing</h2> <p>Indoor hotspots, AR/VR (DM). Indoor/outdoor hotspots (PM).</p>	<h2>U-Telco</h2> <p>Outdoor FWA to residential users.</p>
<h2>Public Safety</h2> <p>Deployables (FWA)</p>	<h2>Defense</h2> <p>Smart/large deployable base (FWA). Indoor hotspots for AR/VR/logistics.</p>	<h2>Oil, Gas & Mining</h2> <p>Massive uplink Tput in semi fixed tele-remote zones and cV2X apps</p>

Outlook to 6G

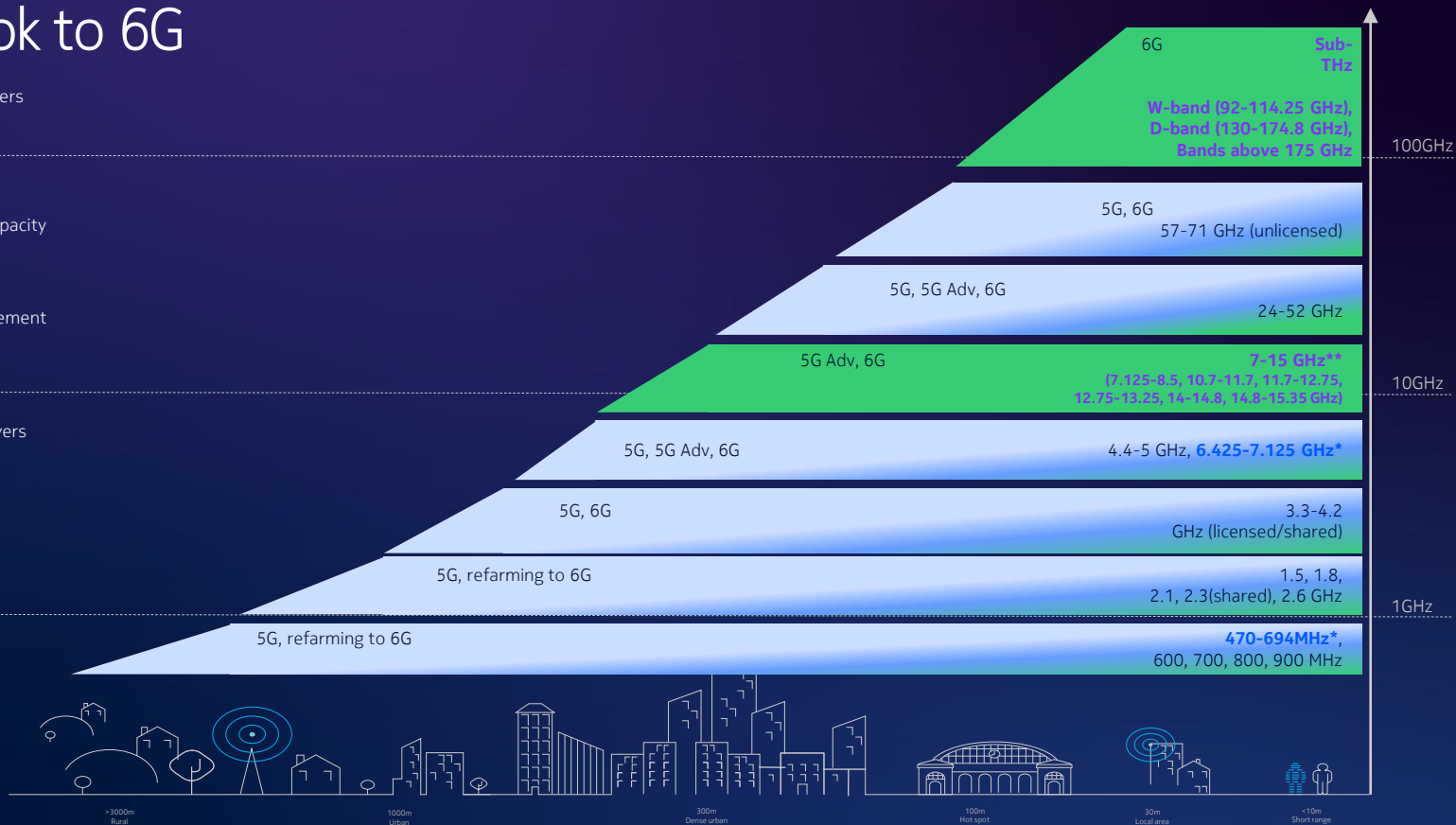
Peak capacity layers

Localized high capacity

Capacity enhancement layers

Basic capacity layers

Basic coverage layers



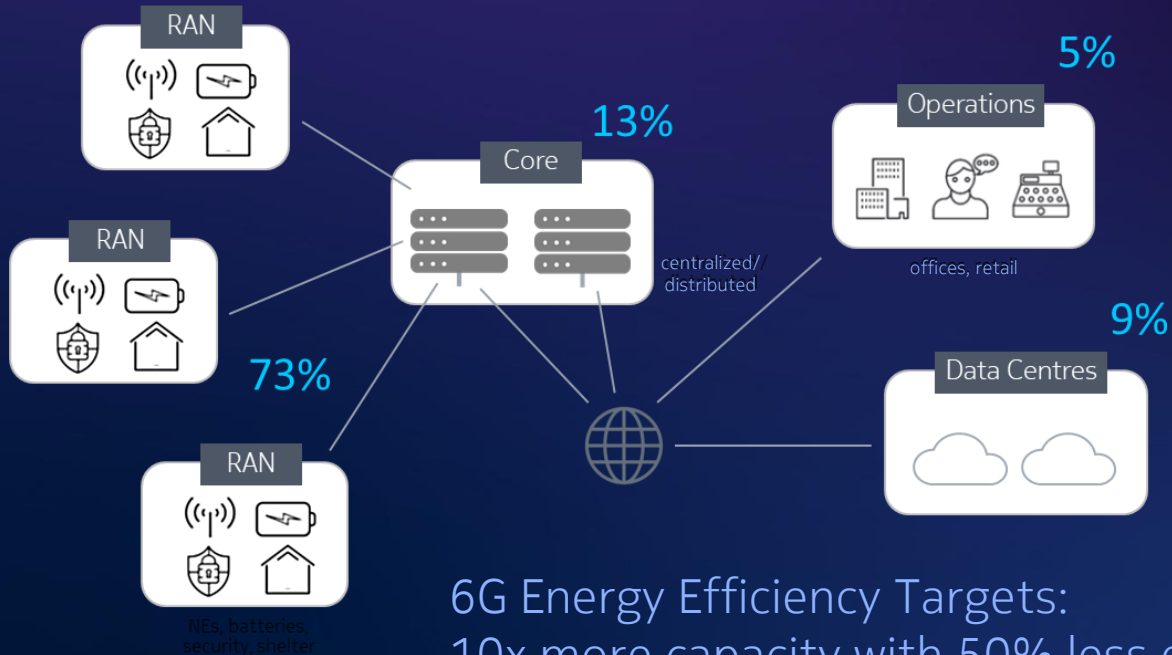
* Discussed in WRC-23

** Potential range for WRC-27 agenda

Energy Consumption

Radio Network dominating – with comprehensive toolbox of measures

Distribution of energy usage across a mobile network



6G Energy Efficiency Targets:
10x more capacity with 50% less energy

Optimization & Planning
dimensioning, spectrum planning, analytics

Software Capabilities
traffic aware switch-off, AI/ML, traffic balancing

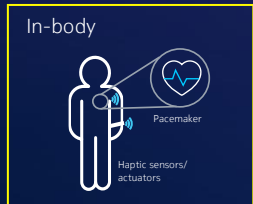
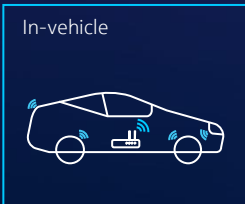
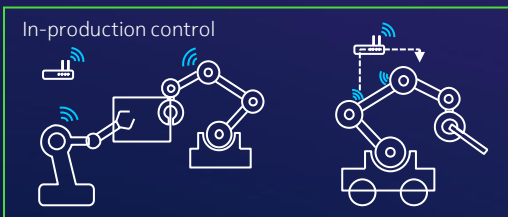
Technology Evolution
4G to 5G traffic migration, retire legacy eqt./"G"s

Hardware evolution
silicons (SoC), new gen. PAs, HW utilization

Market dynamics are changing

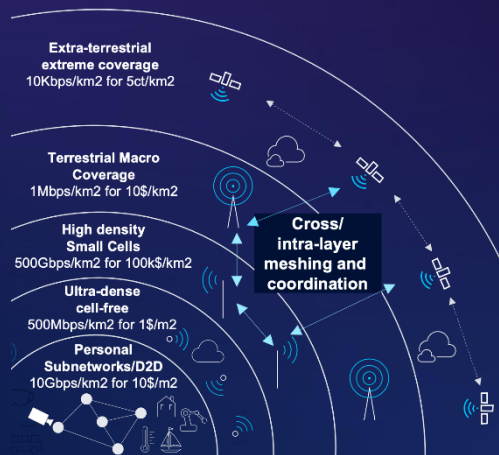
From a connectivity-dominated value chain to a multi-party value ecosystem, leveraging new network capabilities

Extreme performance specialized networks



Highly engineered localized solutions for achieving mission-critical performance

Network of Networks



A hierarchy of collaborative network layers providing enhanced ubiquity and local capacity

- **Partner ecosystems**, not single providers, will **drive innovation and value creation**
- Open ecosystem, where **any player can pursue different roles and approaches** per selected opportunity
- The **role of developers** moves to center stage
- **Speed and flexibility** are key competitive qualities

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