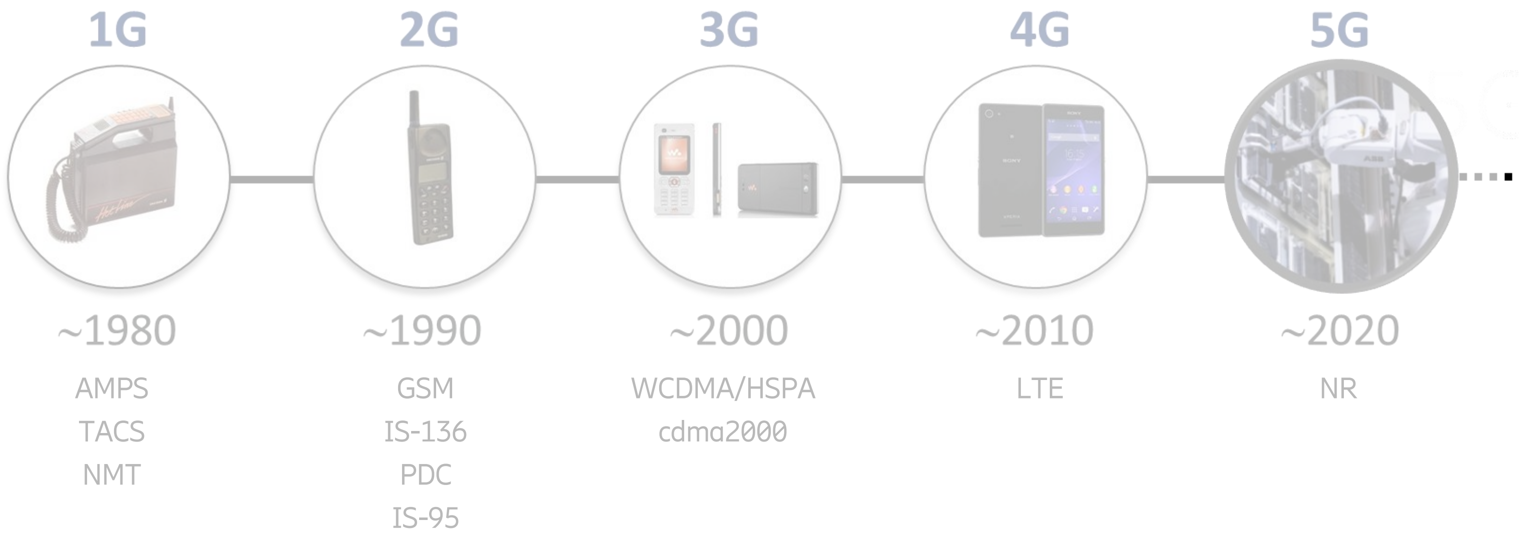
6G wireless connectivity

Something new or more of the same?

Wireless generations



6G – Why, what and how?

What should we focus on?

Don't

- Higher peak rates
- Lower minimum latency
- …

Avoid extreme numbers of no practical relevance !

Do

- Higher ***achievable*** data rates
- ***Predictable*** low latency
- Reliability, availability, resilience, …
- Improved energy performance
- Lower cost
- …

Important to understand real-traffic characteristics

Real traffic is bursty

Efficient handling of small packets

- Do not optimize for full-buffer scenarios

Quickly start transmitting data

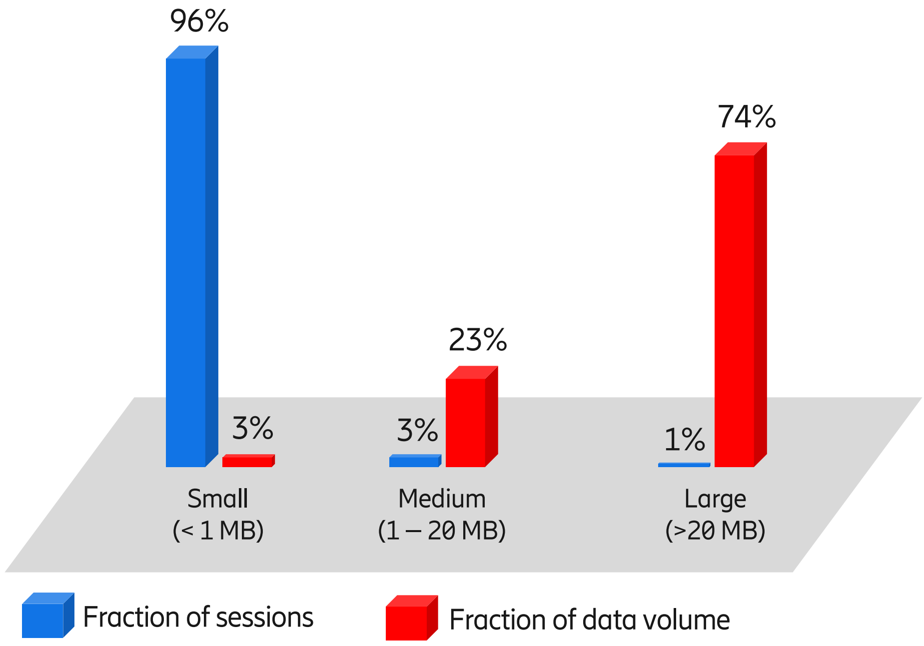
- Camp on the right carrier, rapid connection setup, early CSI reports, …

Spectrum-efficient transmission of large packets

- MIMO, accurate CSI, carrier aggregation, …

Most sessions (96%) are small

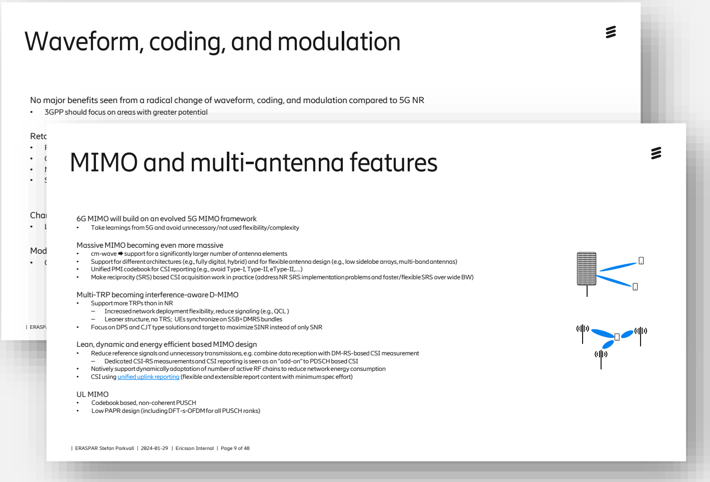
Few sessions (1%) carry most of the data (74%)



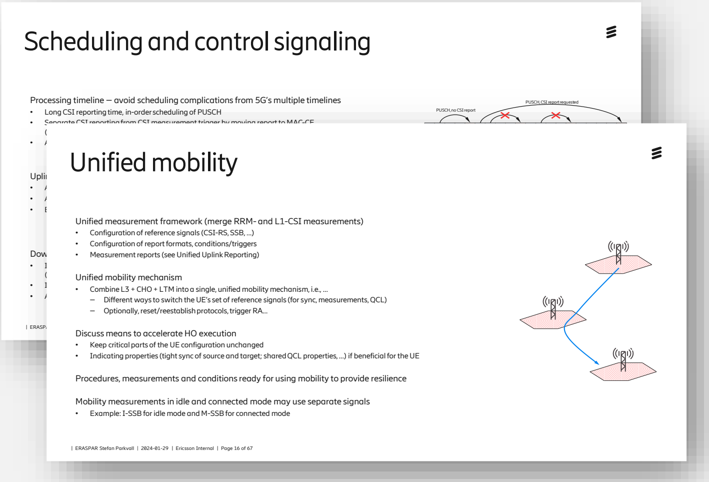
6G wireless access

Technology-wise, 6G will inherit much from 5G

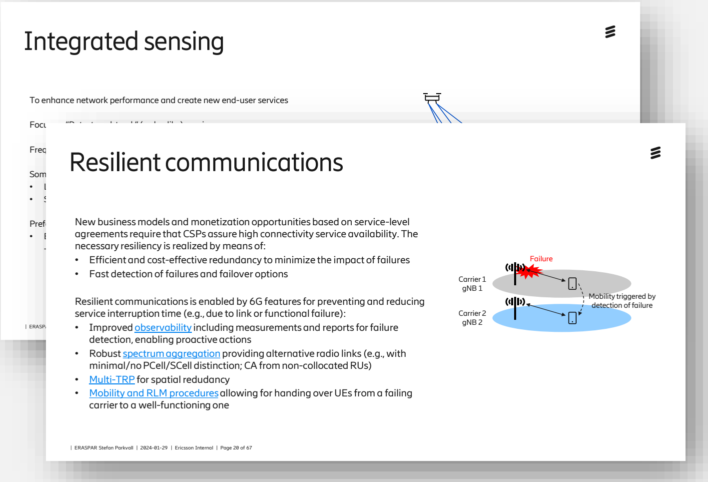
Keep
things that work well



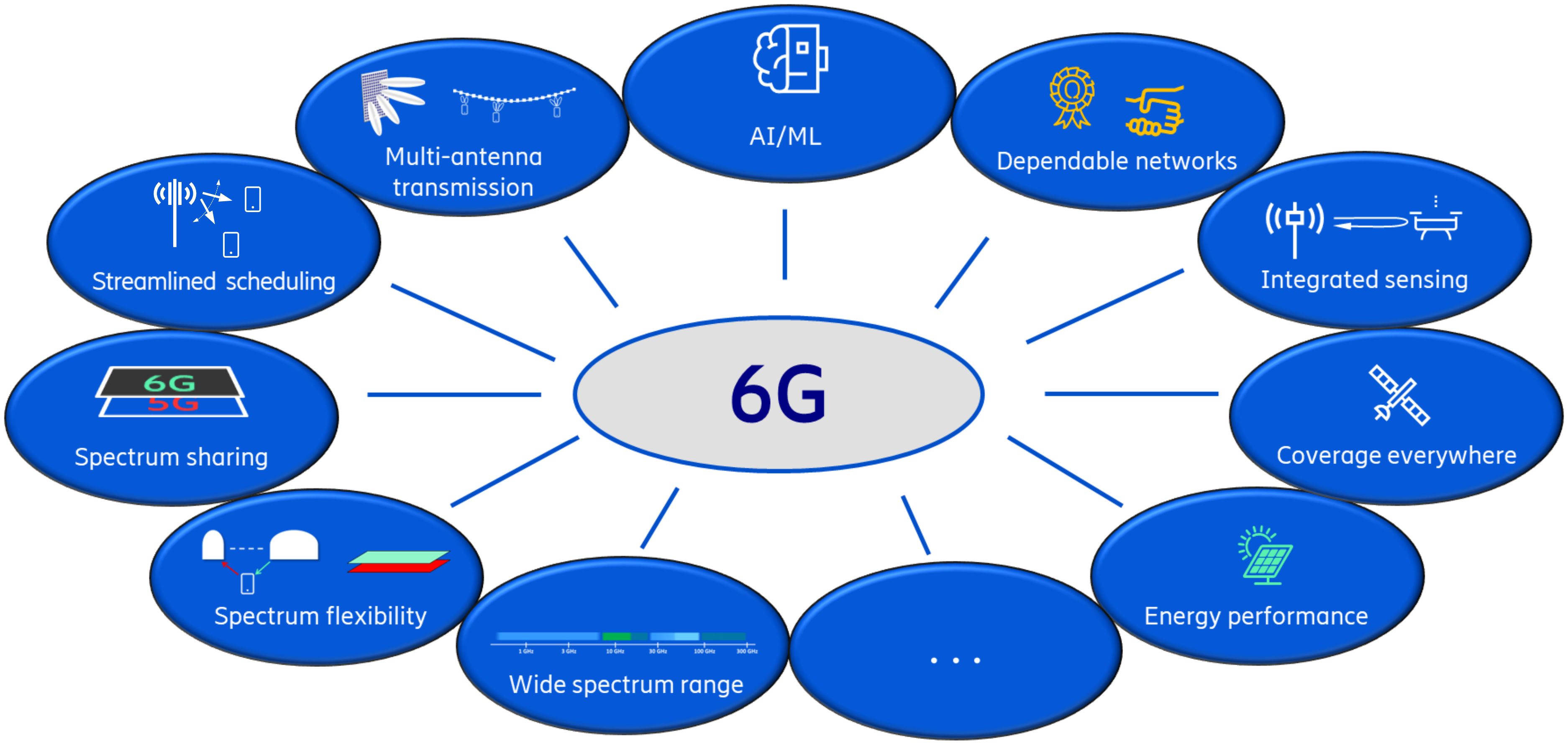
Change
when motivated



Add
functionality for new use cases



6G wireless access
Some important technology components



Spectrum for 6G

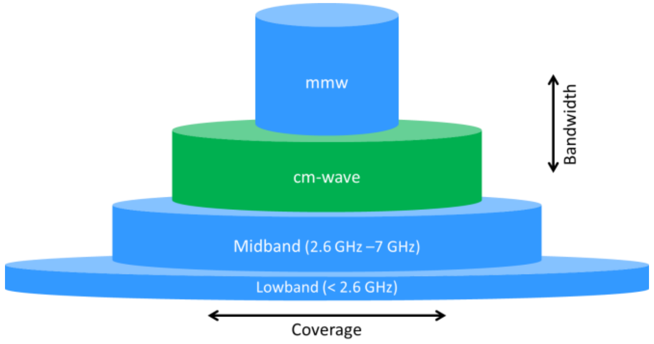
Current 4G/5G spectrum

- Below 7 GHz
- mmw

New 6G spectrum

- cm-wave – “the new 6G band”
- Sub-THz?

A coverage vs bandwidth trade-off



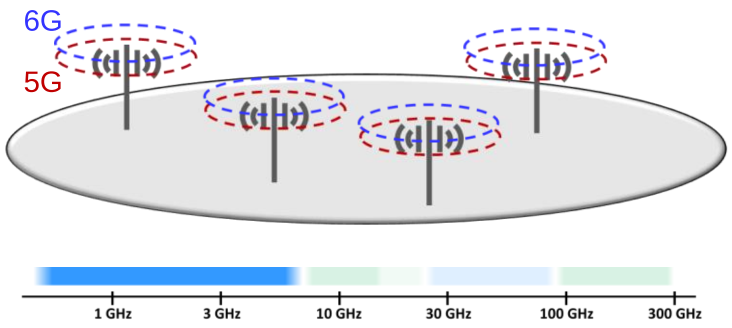
Limited amount of *new* 6G spectrum

Spectrum sharing

5G/6G spectrum sharing

Allow for 6G to be deployed on top of 5G

⇨ *Smooth introduction of 6G in existing spectrum*



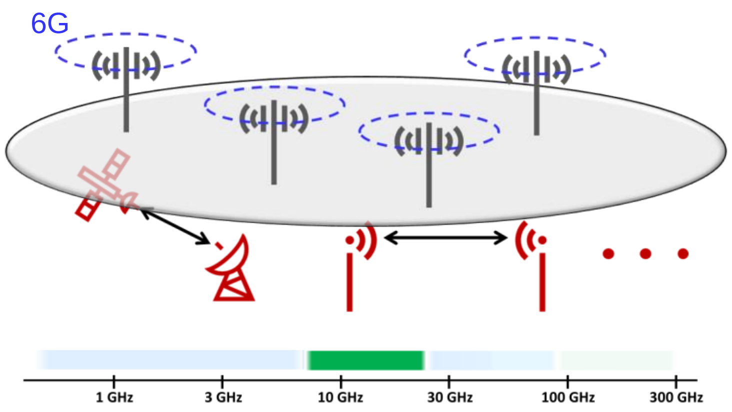
Need for 5G-compatible 6G waveform

Efficient spectrum sharing enabled by 5G "lean design"

Co-existence with other usages

Enable 6G deployment on top of other technologies

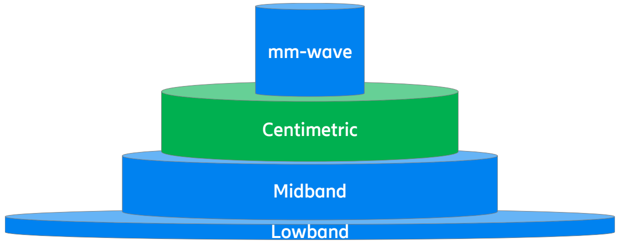
⇨ *Smooth access to new spectrum*



Spectrum flexibility

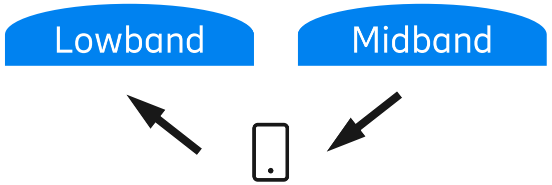
Multiple bands at each site

System view – not per-carrier view



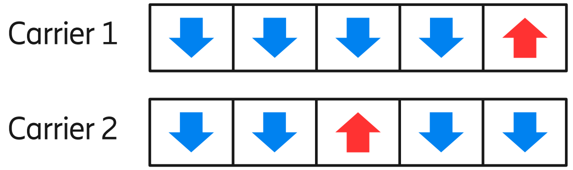
UL-DL decoupling

Best DL band might not be best UL band



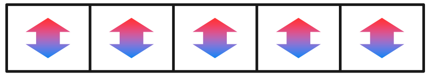
Staggered TDD aggregation

Potential for reduced latency



Dynamic TDD and full duplex

Potential for reduced latency
Only feasible for small cells

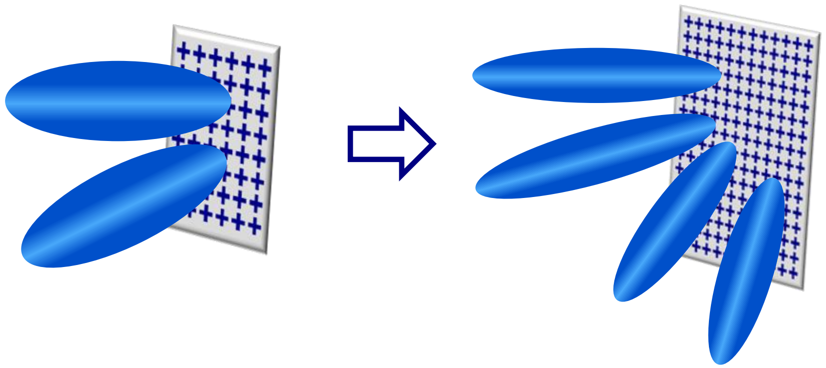


...and more!

Multi-antenna transmission

Remains a main tool to enhance link performance within current grid

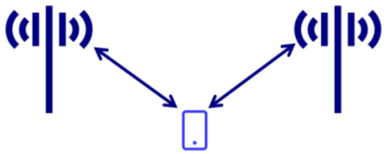
Even larger arrays



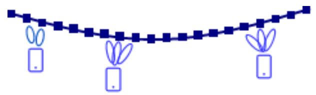
Physically larger antenna constellations

More antenna elements for a given area

Multi-point transmission (“distributed MIMO”)



From macro deployments ...



... to extremely dense deployments

Enables more uniform quality over the coverage area

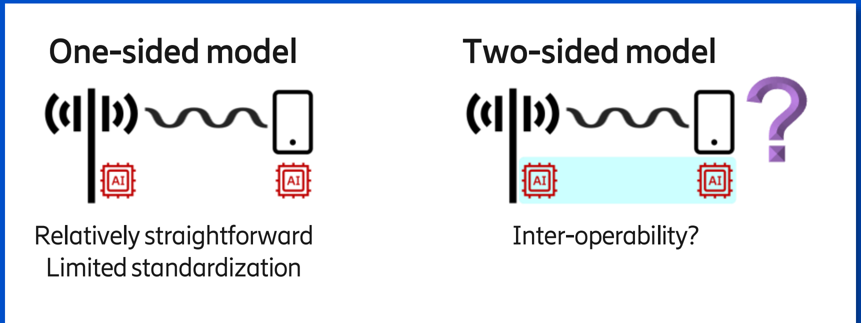
AI for communication – where, when and how?

High-dimensional problems for which
- there is no good model
- deriving the "optimal" solution is difficult/impossible

Some examples
- Beam management
- Scheduling
- Mobility
- Network deployment
- ....

Improved Performance

Reduced cost



Mainly implementation with limited specification impact

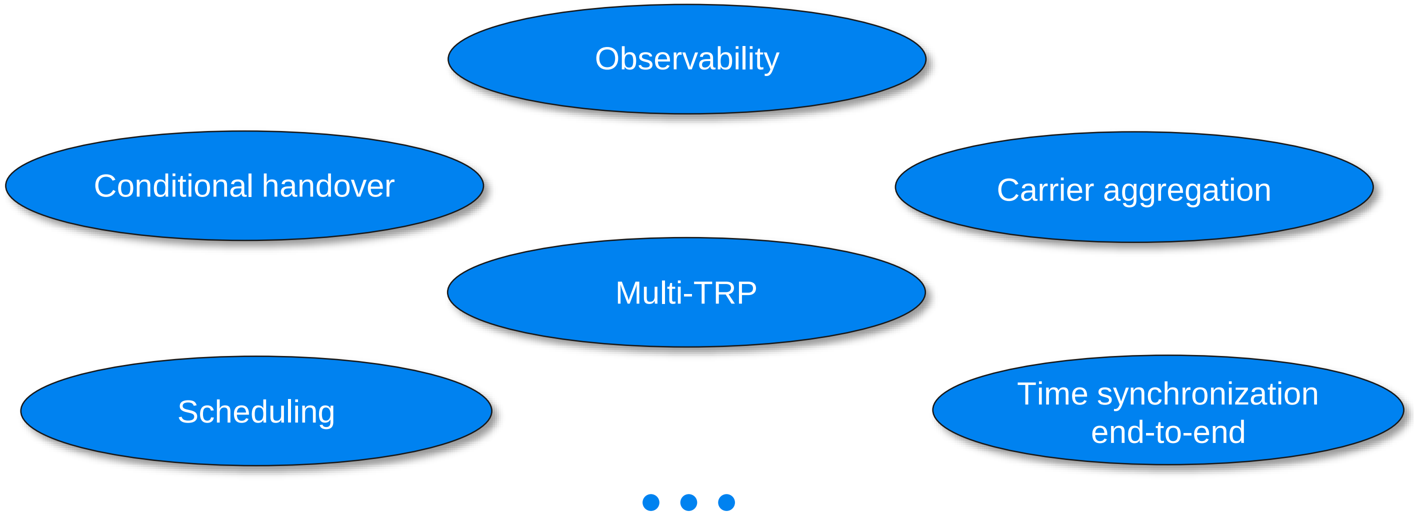
Mission-critical connectivity and dependable networks

A high-performance network that one can truly trust and depend on

Observability to detect problems before they happen

Redundancy to ensure availability

Synchronization to enable extreme time-critical services

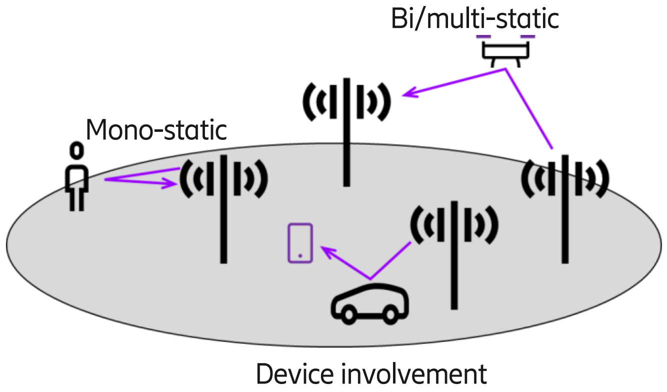


Public networks
- Highly automated vehicles
- Professional video production
- Managed IT devices
- …

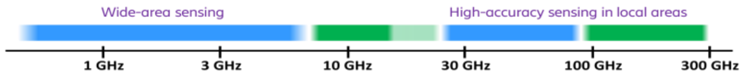
Dedicated networks
- Manufacturing
- Mining
- Connected workers
- …

Integrated communication and sensing

"Situational awareness"



Sensing: Detect the presence/location/movement of passive objects



ICAS: Sensing as an integrated part of the communication network

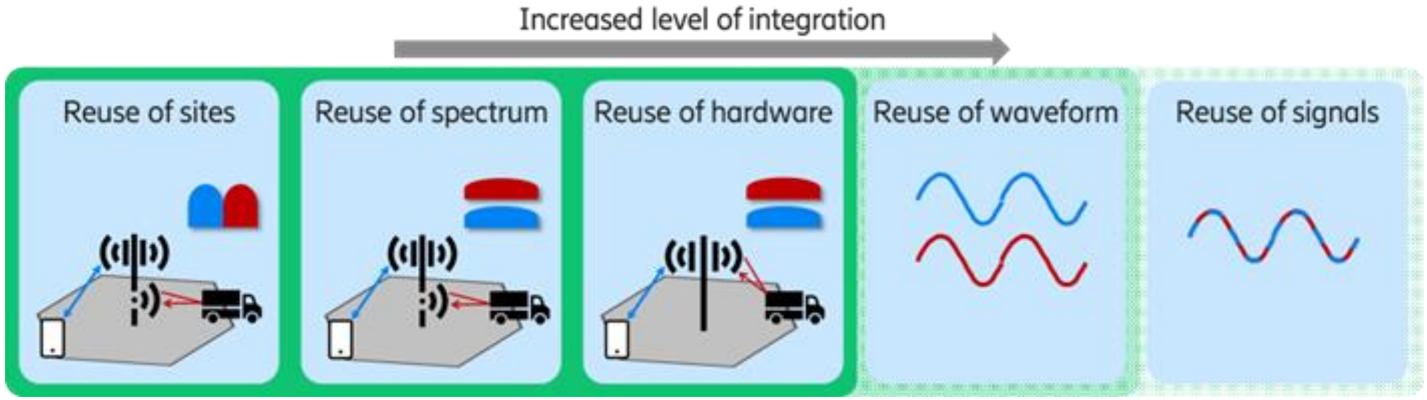
- Reuse of communication resources (infra-structure, spectrum, devices, ...) for sensing

⇩

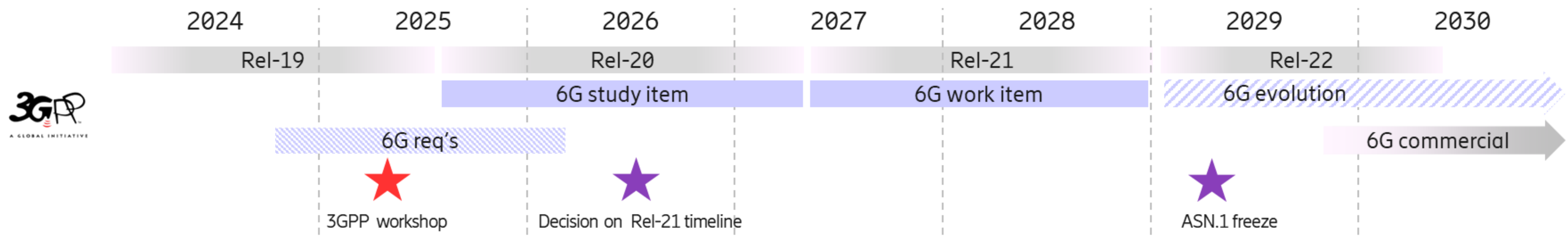
Introduction of sensing functionality with low incremental cost

Enable new/enhanced services

Enhanced network performance



6G wireless access – Standardization timeline



Summary

6G will inherit much from 5G

- Keep when working well, change when motivated, add features enabling new use cases
- Avoid spending time/effort on solving already solved problems

6G will further extend the capabilities of wireless access

- Dependable communication, situational awareness, …

6G standardization activities have started

6G is critical to ensure the long-term evolution of wireless connectivity

Thank you!