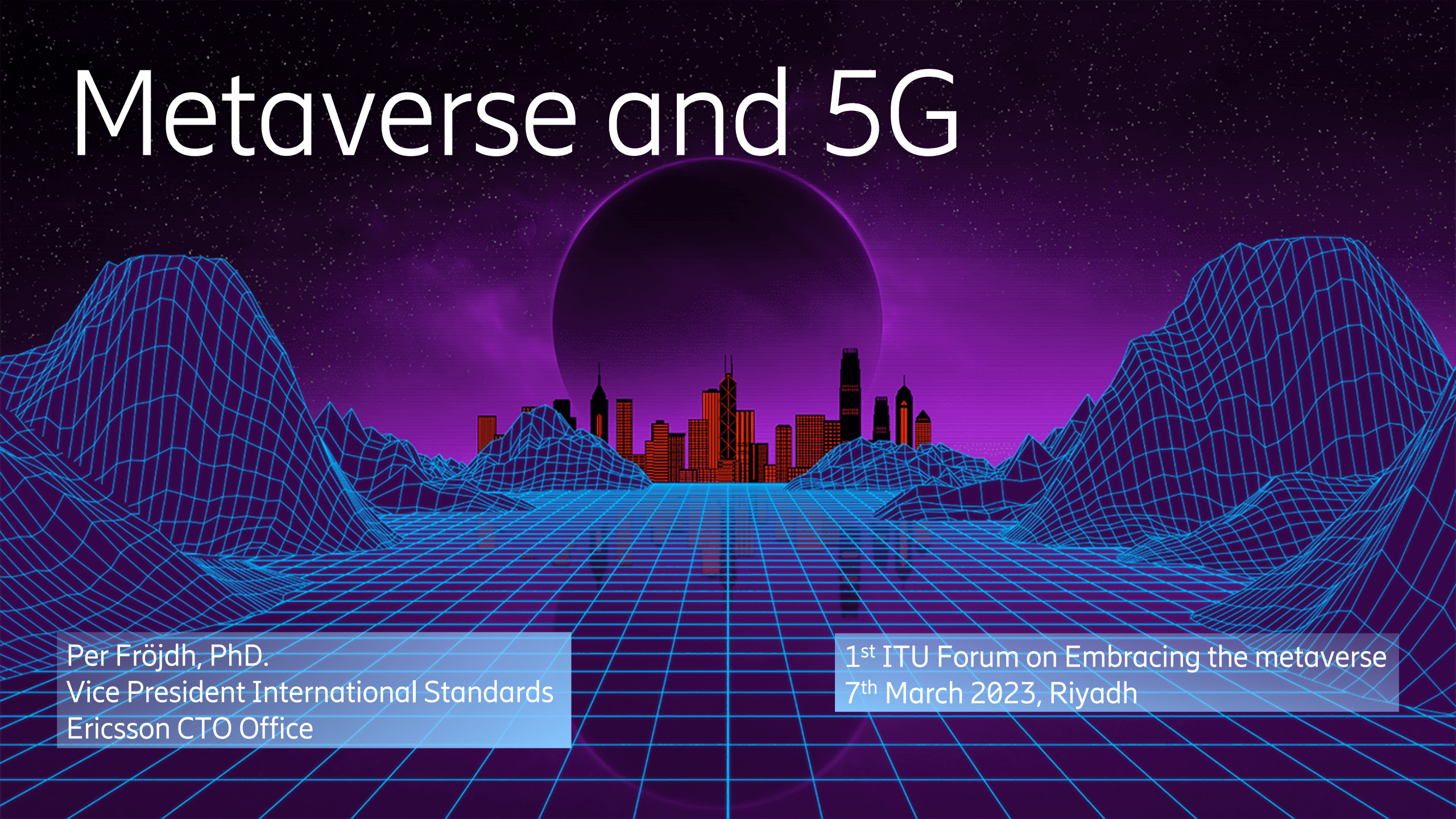
Metaverse and 5G



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1st ITU Forum on Embracing the metaverse
7th March 2023, Riyadh

Challenge:
Technical requirements of designing a seamless metaverse experience

Terminology

Real-time interaction

Multiple users

Extended Reality (XR)

Umbrella concept covering technology that alters reality or virtual environments by adding digital objects (gateway to the metaverse)

Metaverse

VR and AR/MR experiences within a shared and persistent virtual universe

Real world environment

Extended Reality

Fully virtual environment

Augmented Reality (AR)

Digital overlay over real world objects, i.e. real- world experiences enhanced by immersive simulations

Mixed Reality (MR)

Digital elements interacting with real world objects, often used interchangeable with AR

Virtual Reality (VR)

Fully digital virtual environment, i.e. simulated experiences that are highly immersive

XR can be the next paradigm shift after the smartphone

VR to AR
Short term

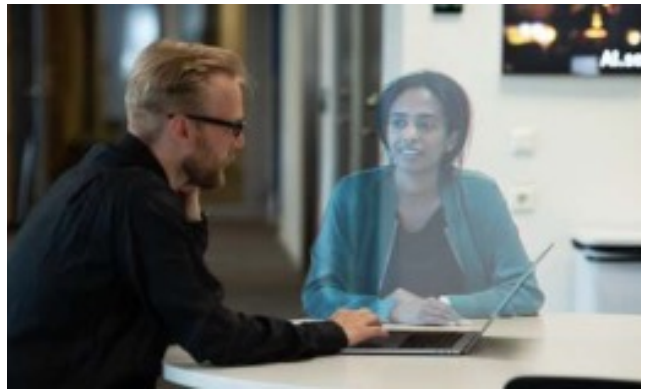
Head-Up-Display, blended information

AR takes lead
Mid term

Recognize surroundings, geo-specific

All day XR
Long term

Fully immersive



Likely scenario development

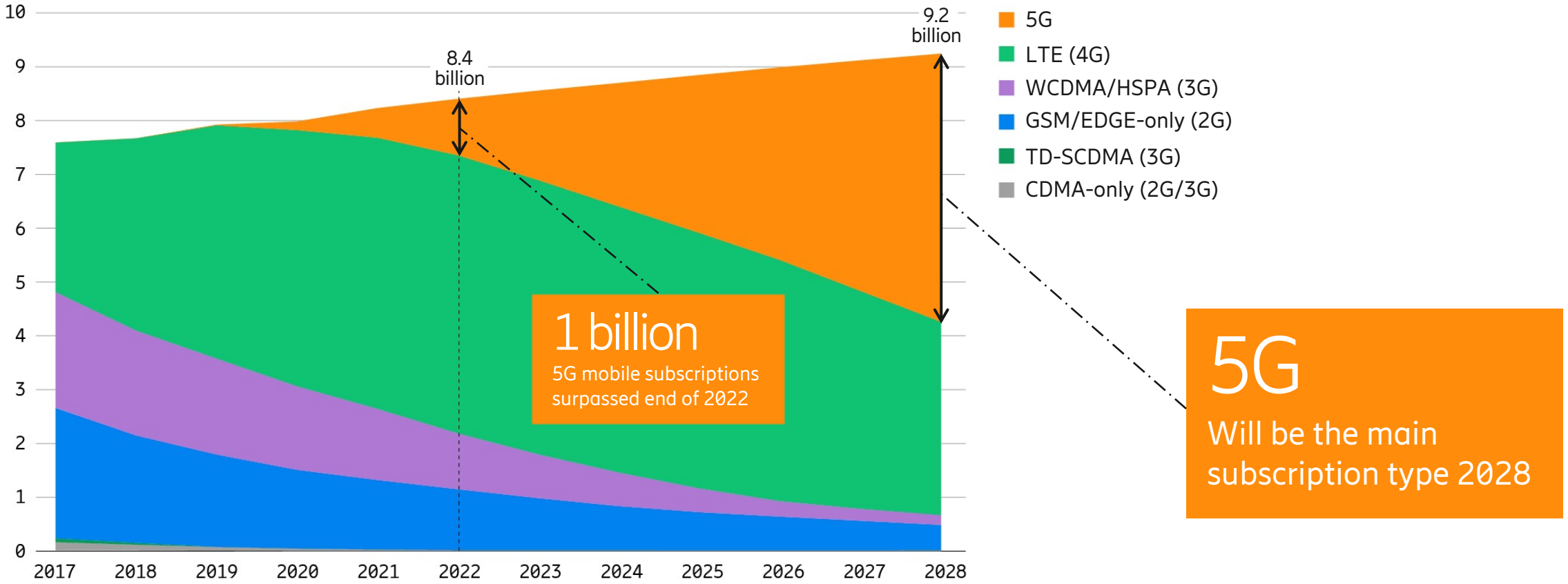
- VR (video pass-through), simple AR / HUD
- Local area
- Static, on device, tethered
- Best effort MBB services

- Glasses-style
- 5G AR takes lead
- Local → wide area
- Shared spatial maps → uplink

- Global adoption
- Stand-alone, multi-user
- Privacy key
- Cloud compute → Low latency connectivity (UL/DL)

5G is set to become the dominant access technology

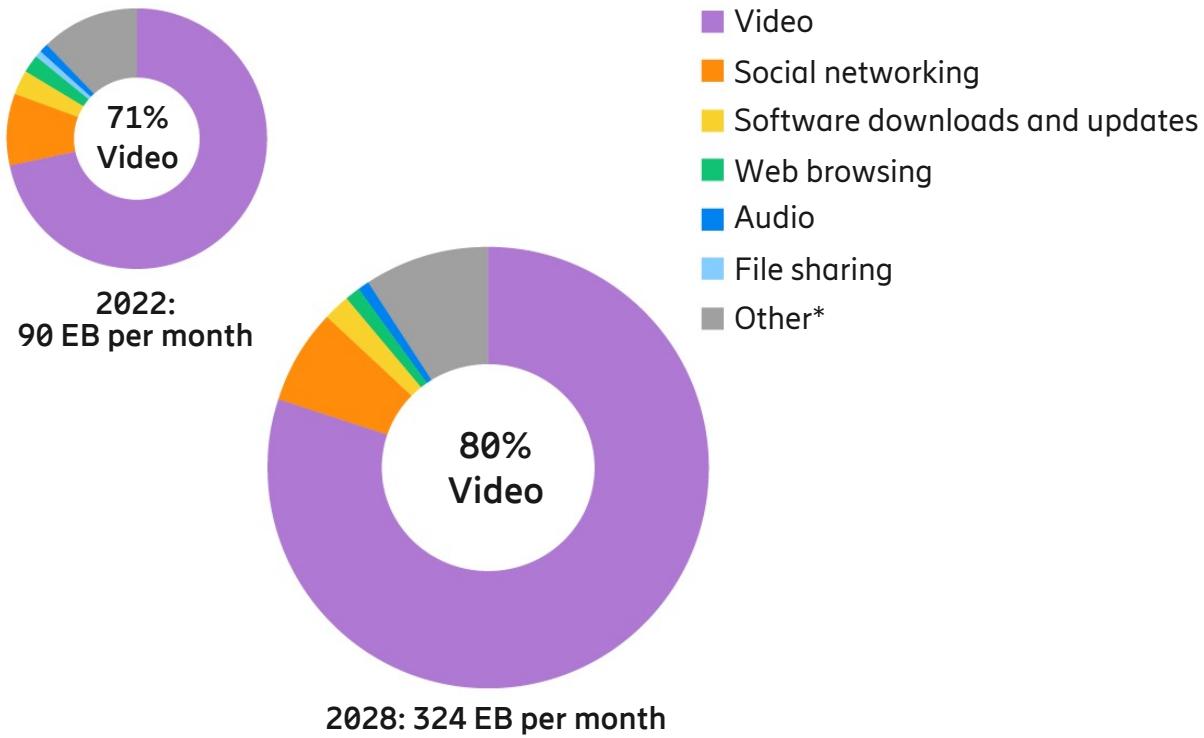
Mobile subscriptions by technology (billion)



Source: Ericsson Mobility Report, November 2022

Video content rules

Mobile data traffic by application category per month



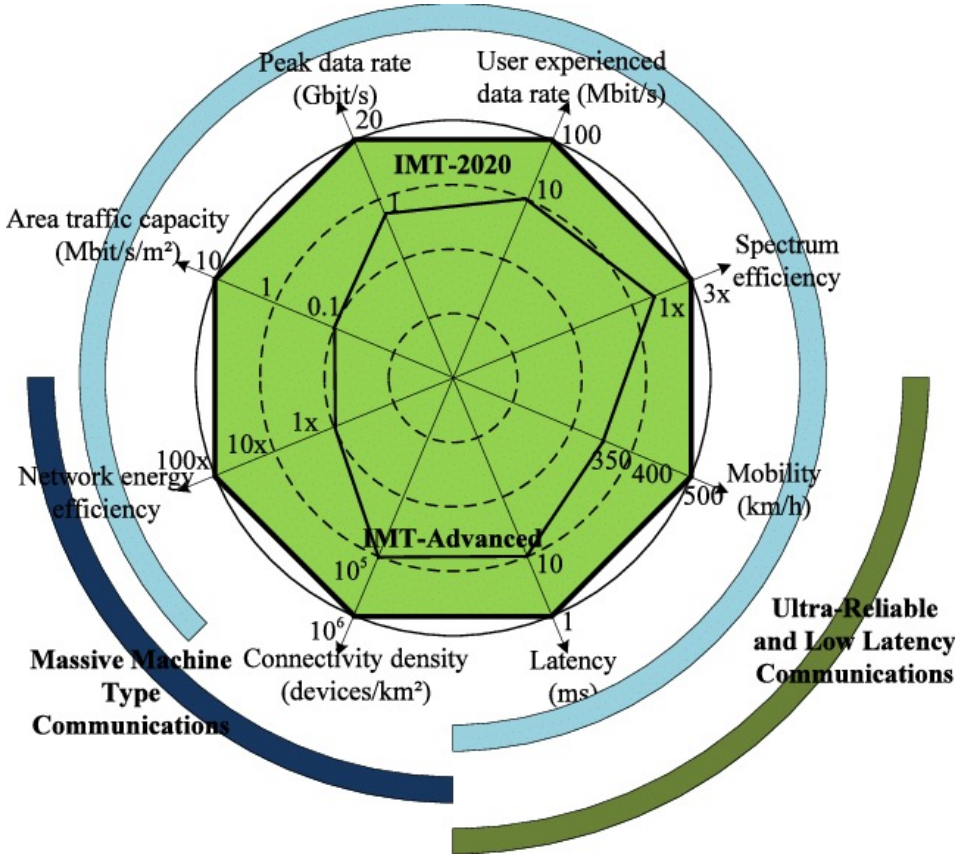
Video is the largest and fastest-growing mobile data segment

➢ Annual growth of 30%

Uptake of XR devices and applications has the potential to significantly change relative volumes

Source: Ericsson Mobility Report, November 2022

Three type of connectivity (“slices”) for 5G XR



5G eMBB Enhanced Mobile Broadband

- Peak data rate : 10 to 20 Gbps
- 100Mbps whenever needed
- 10000 times more traffic
- Supports macro and small cells
- Supports high mobility - 500 Kmph
- 100x Network energy savings

5G mMTC massive Machine Type Communications

- High device density (about 2 x 10^5 in $10^6/Km^2$)
- Low data rate (about 1 to 100 Kbps)
- 10-year battery life (reduced complexity)
- Asynchronous access

5G URLLC Ultra Reliability and Low Latency Communications

- Less than 1 ms air interface latency.
- 5 ms end-to-end latency between UE and 5G eNB (base station).
- 99.9999% availability
- Low to medium data rates (about 50 kbps to 10 Mbps).

Related: 3GPP XR activities (TR 26.918, TS 26.118)

Metaverse Network Requirements

Wide range of XR requirements from a single device:

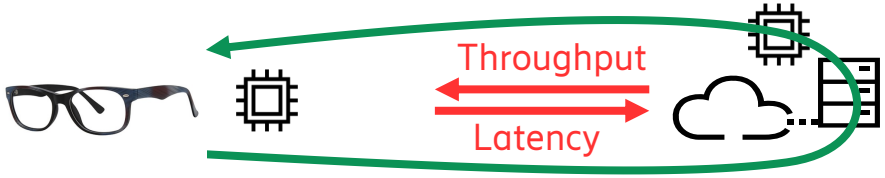
Use cases	DL bitrates (Mbps)	UL bitrates (Mbps)	One-way latency (ms)	Frame realibility (%)
Cloud gaming	8-30	~0.3	10-30	≥99
VR	30-100	< 2	5-20	≥99
AR	2-60	2-20	5-50	≥99

XR Compute offload drives network requirements

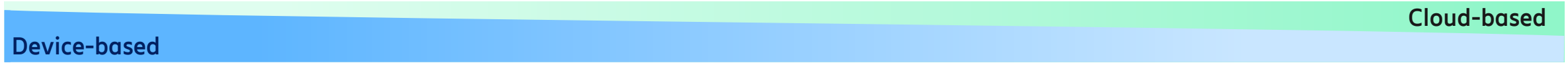
Processing in device + companion

Processing in device + companion + edge cloud

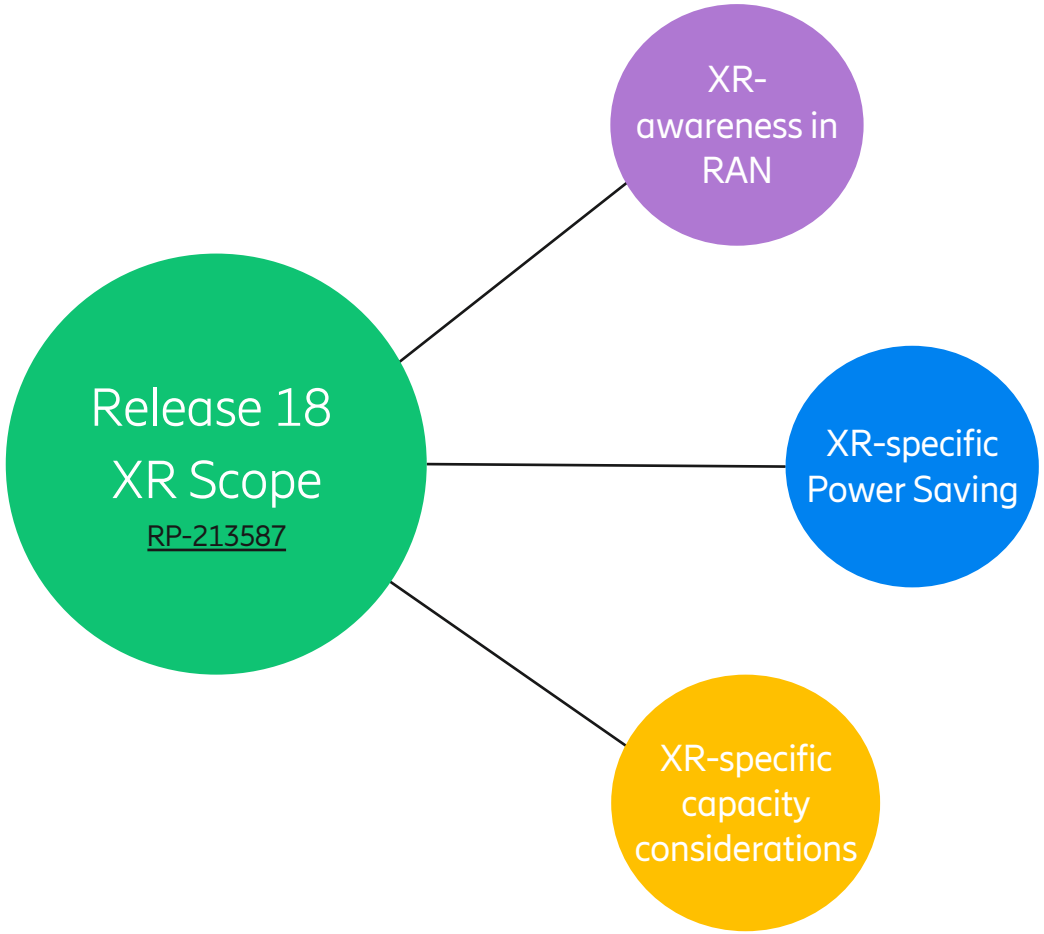
Radio modem and some processing in device + most processing in edge cloud

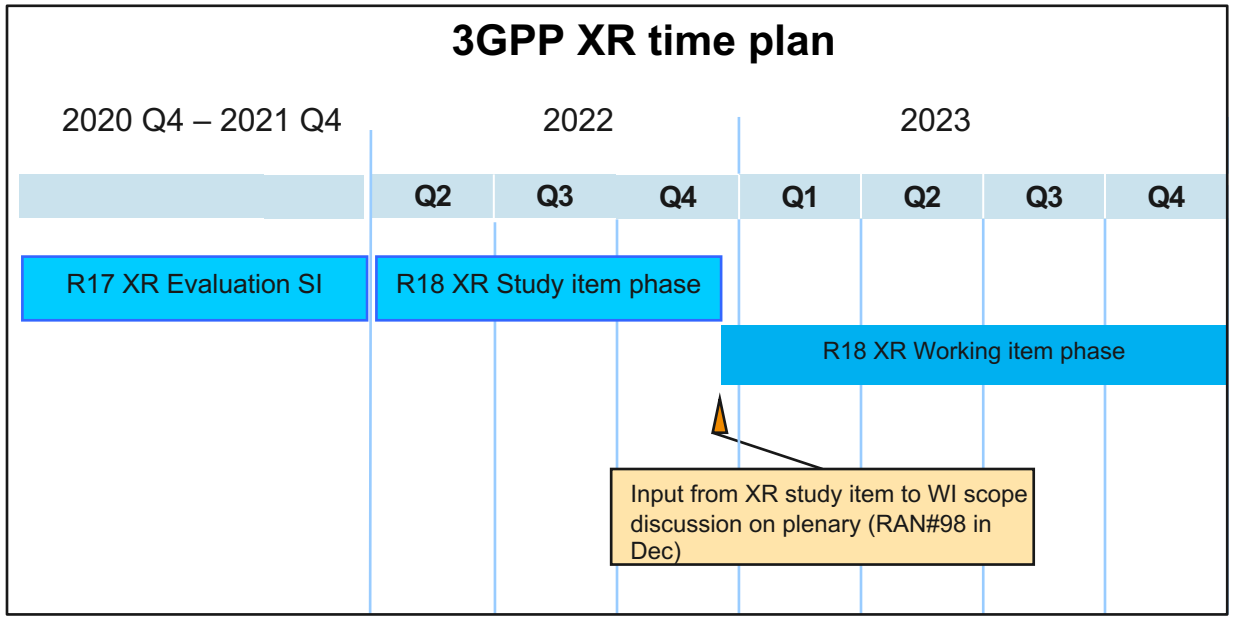


Spatial compute (localization, mapping, object detection) & rendering



3GPP RAN XR Scope and Timeline



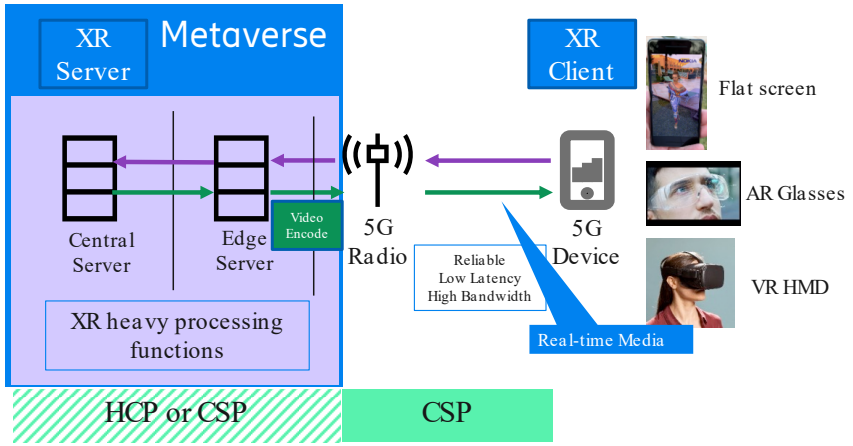


5G Infrastructure will enable advanced XR scenarios

Use Case 1

XR offloading with cloud processing UL/DL

- Battery saving
- UL: SLAM+ haptic + pose, etc.
- DL: Graphics/video (2D Video projection)

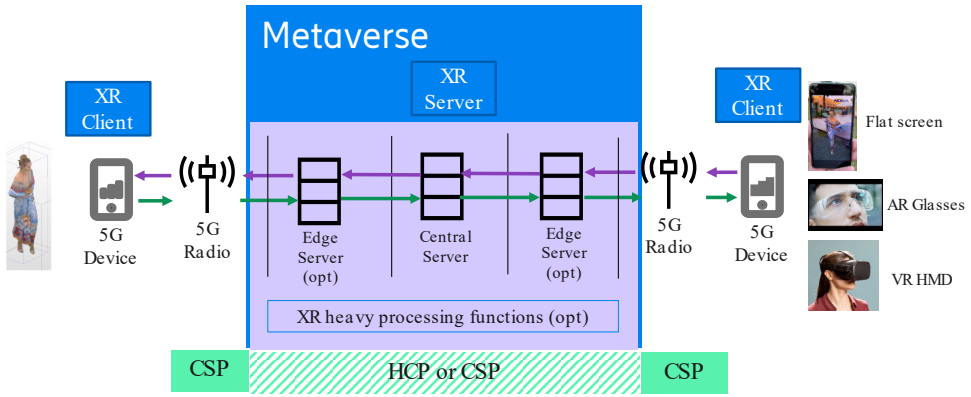


UC1: XR offloading with cloud processing UL/DL (Illustration)

Use Case 2

XR Holographic communication

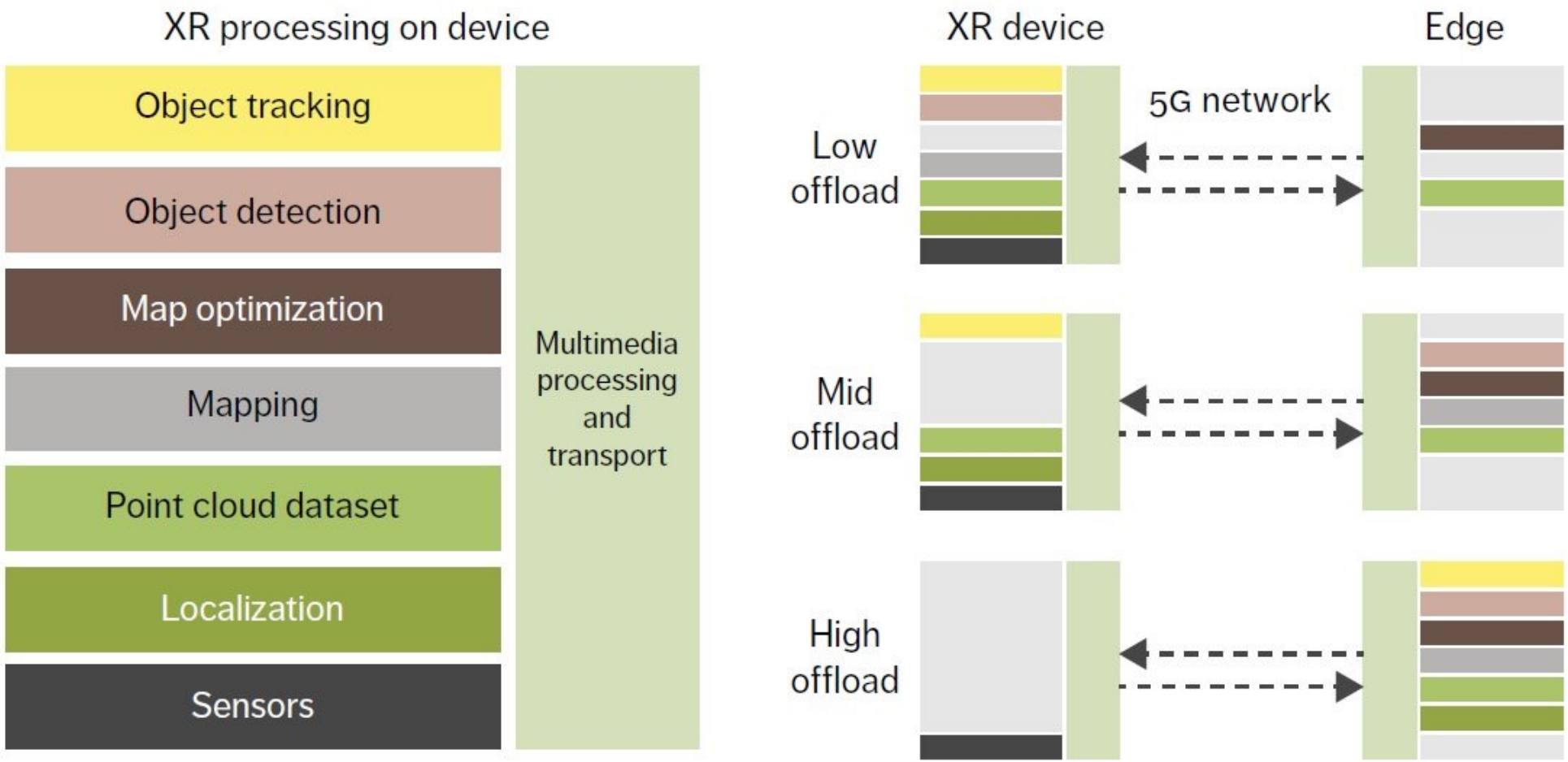
- Battery saving
- Real Time Communication (RTC)
- UL: Volumetric Video (EU encoding)
- DL: Volumetric Video (EU decoding / Edge Projection processing to 2D video)



UC2: XR Holographic communication (Illustration)

Note that these ***use cases have many variants***,
some of them can be DL or UL intensive only or a combination of both;
this will depend on the service and how this is implemented and deployed.

* https://www.ericsson.com/en/reports-and-papers/ericsson-technology-review/articles/holographic-communication-in-5g-networks


XR processing on device
Object tracking
Object detection
Map optimization
Mapping
Point cloud dataset
Localization
Sensors
Multimedia processing and transport
XR device
Edge
5G network
Low offload
Mid offload
High offload

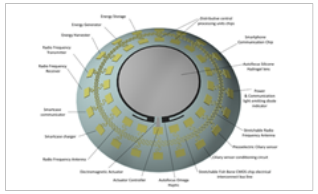
XR Devices: Possible roadmap with 5G and beyond

Tethered AR devices
Single user, no offload: MBB
Single user, low offload: 3 Mbps DL, 10 Mbps UL, 30 ms latency
Conversational AR: 15 Mbps in UL and DL, 40 ms latency

5G integrated AR
low offload
DL: 20 Mbps
UL: 10 Mbps
30 ms latency

5G integrated AR
medium offload
DL: 40 Mbps
UL: 20 Mbps
20 ms latency

5G/6G integrated AR
high offload
DL: ... Mbps
UL: ... Mbps
... ms latency



6G integrated AR
extreme offload
DL: ... Mbps
UL: ... Mbps
... ms latency

2022 near term — medium term — long term

ericsson.com/5g