



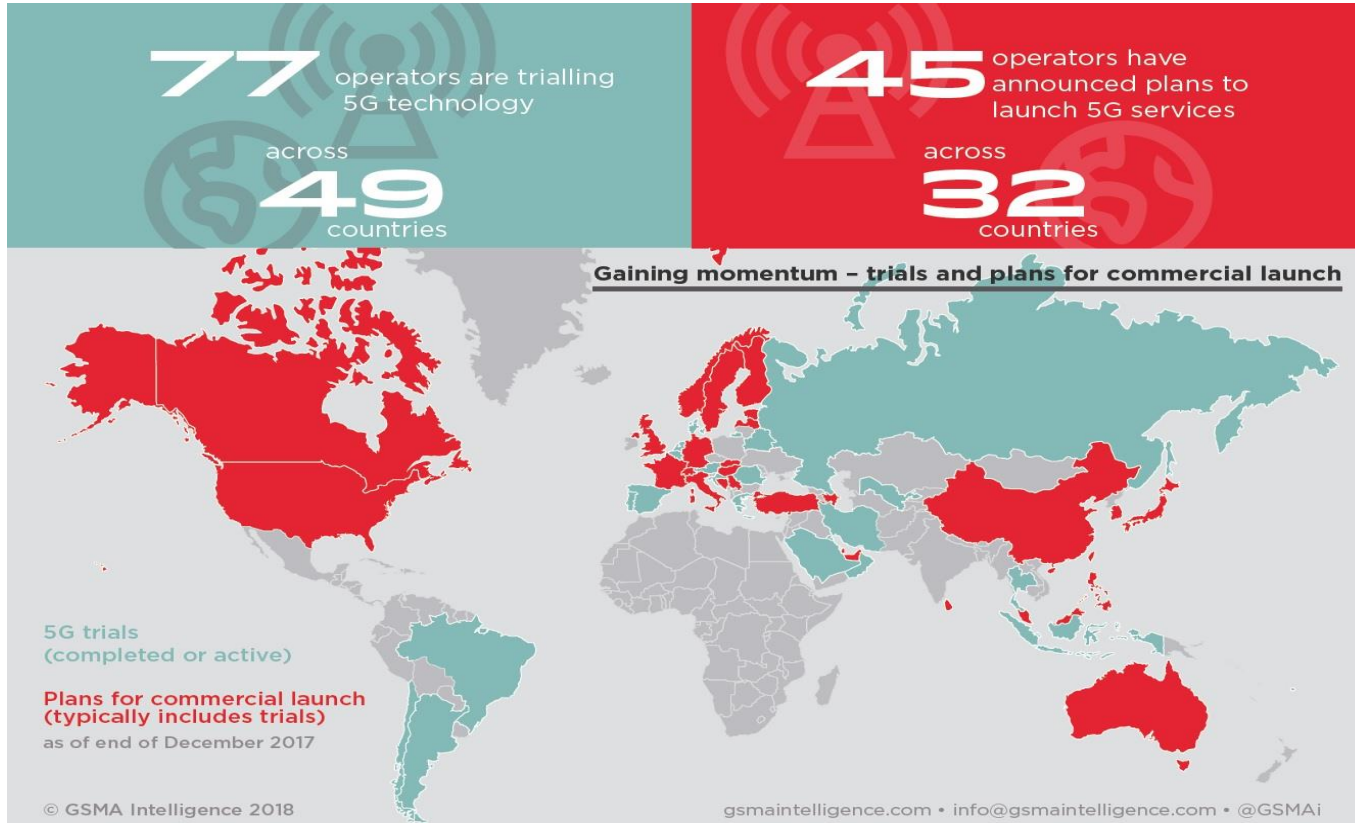
The activities of GSMA on 5G and Cloud AR/VR

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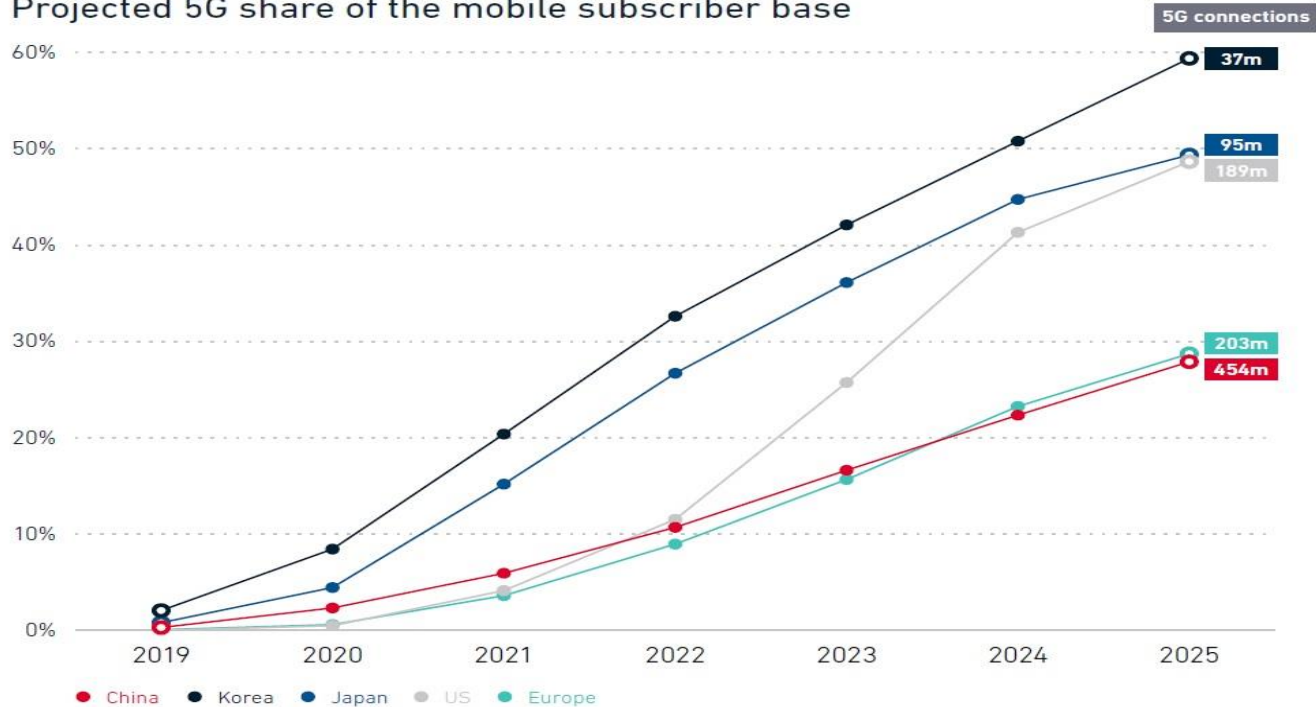
Commercial phase of 5G is on the way





1.36 billion 5G consumer connections by 2025

Projected 5G share of the mobile subscriber base



Source GSMA Intelligence



VR/AR becomes one of the key 5G services

Concert (Tencent)



Sports (BT)



Olympics (KT)



Medical (MindMaze)



Big Game (Sony)



Design (Holodeck)



Social (Facebook)



Education (HeiVR)



“What is the biggest problem of these projects?”

**“Is the system deployment /
secondary deployment easy?”**

“Is it convenient and easy to use?”

**“Can user have enough budget to
buy a video card?”**

**“Can the user maintain the
system?”**

**“Can content and software update
be installed?”**

What 5G can bring for VR/AR?

5G



Reduce the terminal costs



Reduce the difficulty of terminal deployment



Reduce the terminal maintenance pressure

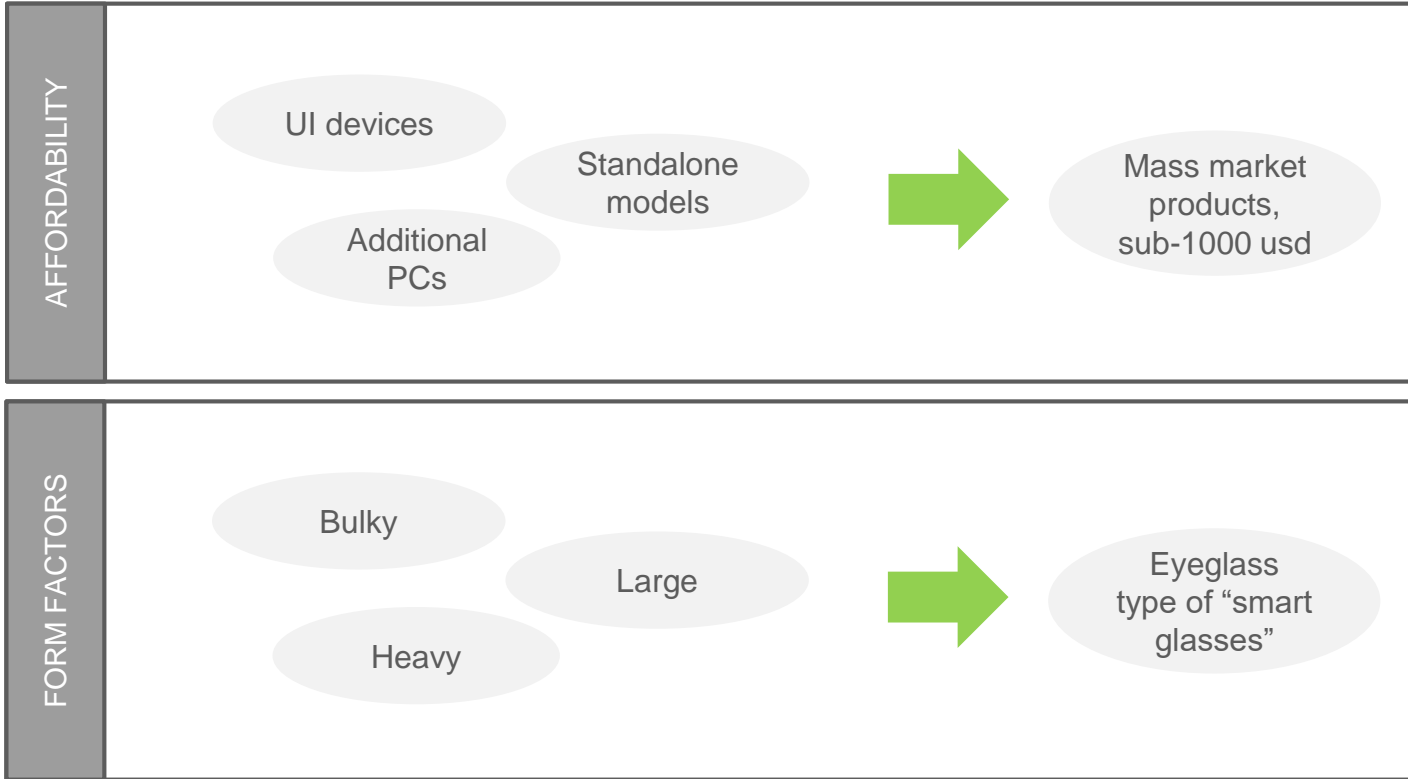


Reduce training costs on the application side



Challenge #1:

Form factor and high cost barriers





Challenge #2:

High computing is indispensable

CURRENT HMD COMPUTING NEEDS



Additional PC with 
CPU: INTEL i5 – 4590 or higher
GPU: NVIDIA GTX 970 / AMD R9 290

≈5000
GFLOPS

COMPUTING POWER COMPARISON

Smartphone



Samsung S7
GPU: ≈ 400 Gflops
Cost: €800



Serves 1
User



Battery
Powered

Consoles



Router, PS4 / Xbox²
GPU: <2000 Gflops
Cost: €400



Serves 1 - 3
users



Grid
Powered

Network Edge



Blade Server
X Tflops
Cost: €20 - 50k



Grid
Powered

Central Data Center



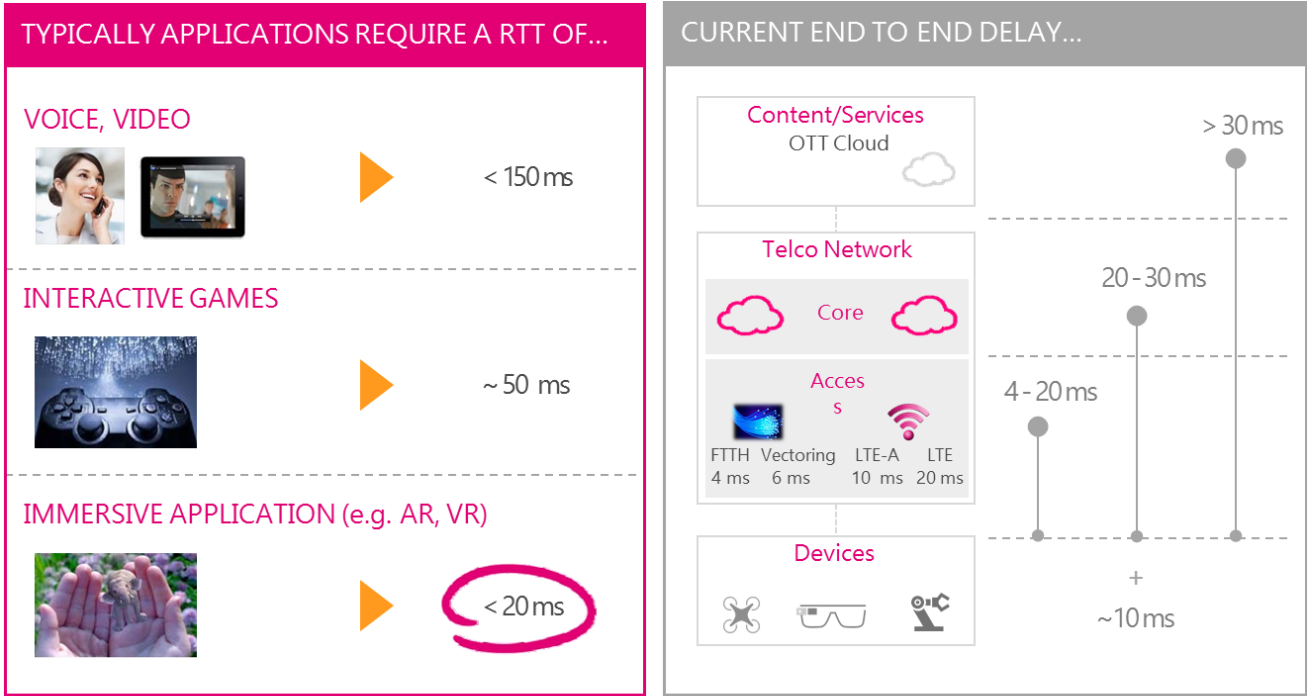
Blade Servers
Y Exa-Pflops
Cost: €1 - 5mn



Grid
Powered



Challenge #3: Latency is the key



Source: Graphical Processing for Immersive VR, AMD; Expert estimation, two way delay/network performance, Deutsche Telekom



5G and operator Edge Cloud is the solution

Thin device



5G Connectivity



Edge Cloud



Contents



Mobile VR



PC VR



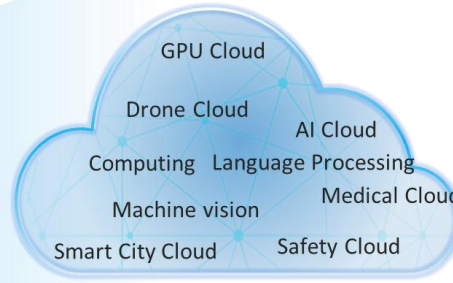
Stand-alone VR



Cloud VR



5G



Operator's cloud

Cloud VR thin device: the evolution of current VR terminal, low cost, easy to wear, with mobility

"100+Mbps"
And
">5ms Latency"

Operators' cloud : not only serving Cloud VR/AR, but also providing services such as vehicle cloud, AI cloud, medical cloud, drone cloud, etc.

matterport



Tencent 腾讯



SONY

psious



NEXTVR

JAUNT

zSpace

Operators can also cooperate content providers on new business opportunities



Key technologies – Edge Cloud

- The edge data centres typically placed within the operator networks hosting general compute, storage, network.
- It is specifically designed to support the AR/VR accelerator hardware, e.g. GPUs for rendering, AI/ML as well as hardware support for encoding/decoding.
- The main challenge of edge cloud is to be able to apply the cloud principles to those accelerators in order to achieve similar cost efficiencies as those achieved in cloud computing.
- **Edge Cloud** reduces the overall latency bringing the contents nearer to customers.



Key technologies - Low Latency Codec

- The current family of H.26x codecs suffers from high latency
 - Encoding, transmission, and decoding performed in a serial mode;
 - Jitter occurs during network transmission;
 - The decoding time of different frames also jitters;
 - The entire E2E system running status is affected by software processing latency.

- In order to overcome those limitations **new codecs** are required.

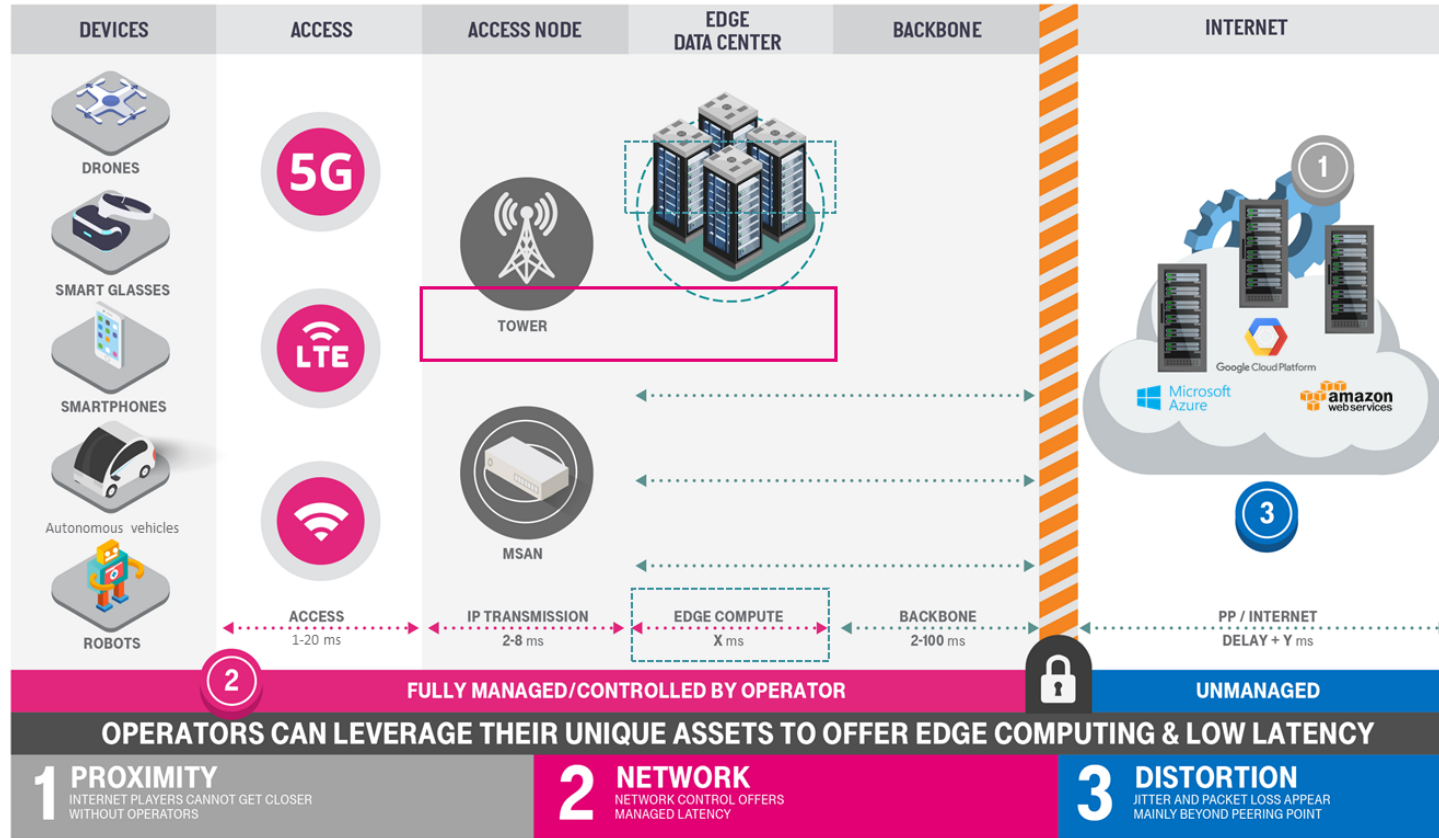


Key technologies – Lightweight Client

- As the compute-intensive parts of the AR/VR application are offloaded to the edge cloud what remains on the device is called 'lightweight client'.
- In one model, the entire application that was previously running on the device is moved into the edge cloud.
- Another possibility is to deploy a **hybrid approach**, where only some elements of the application are offloaded.



Operators have clear zone to play





Activities of GSMA in 5G and XR

Future Networks Programme

5G Cloud XR Forum

5G Network Slicing Task Force (NEST)



GSMA 5G Cloud XR Forum

- The GSMA 5G Cloud XR Forum was established in 2018.
- It aims to accelerate the delivery and adoption of 5G cloud-based AR and VR, with focus on following:
 - Identify the key use cases in Cloud XR;
 - Investigate value chain, stakeholders and business models;
 - Share case studies and best implementation practices;
 - Define a recommended service architecture to accommodate 5G Cloud based services.



GSMA 5G Cloud XR Forum's Call for industry partners to boost global cloud AR/VR adoption

Builds an AR/VR ecosystem for scale

Defines reference service architecture; simplifies interfaces for developers to easily deploy services

Promotes the key service differentiator of 5G NR

Studies further Edge Cloud based 5G Services



<https://www.gsma.com/futurenetworks/technology/understanding-5g/cloud-ar-vr/>



GSMA Cloud AR/VR project objectives

- While single solutions for cloud AR/VR use cases already exist today they do not scale as the whole stack is custom built for every single case.
- Long-term investments based on this paradigm are difficult due to the uncertainty if this model will be deployed widely.
- The GSMA Cloud AR/VR project *harmonizes requirements and implementations* and therefore stimulate the whole ecosystem.



GSMA Cloud AR/VR project objectives

- The project will establish common patterns that will help operators to commercialize Cloud AR/VR based products and services.
- This will help the whole value chain to scale and grow towards mass adoption.
- The GSMA Cloud AR/VR forum is open also for non-GSMA members to contribute.



GSMA documentation and additional info

- The Permanent Reference Documents (PRD)
<https://www.gsma.com/newsroom/gsmadocuments/>
- Technical Documents
<https://www.gsma.com/newsroom/gsmadocuments/technical-documents/>
- Background information on Cloud VR/AR Forum
<https://www.gsma.com/futurenetworks/digest/gsma-launches-new-forum-to-support-5g-cloud-based-ar-vr/>



Summary

- For Cloud VR/AR to take off, the industry must collaborate.
- As the services will be more popular untethered and on the move, the current networks convert as bottlenecks.
- Offering new capabilities, 5G and edge cloud can provide contents with more reliable experience and ultra-low latency.
- **Industry-wide collaboration** avoids market fragmentation.

