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Explore the broadband technologies for the Metaverse

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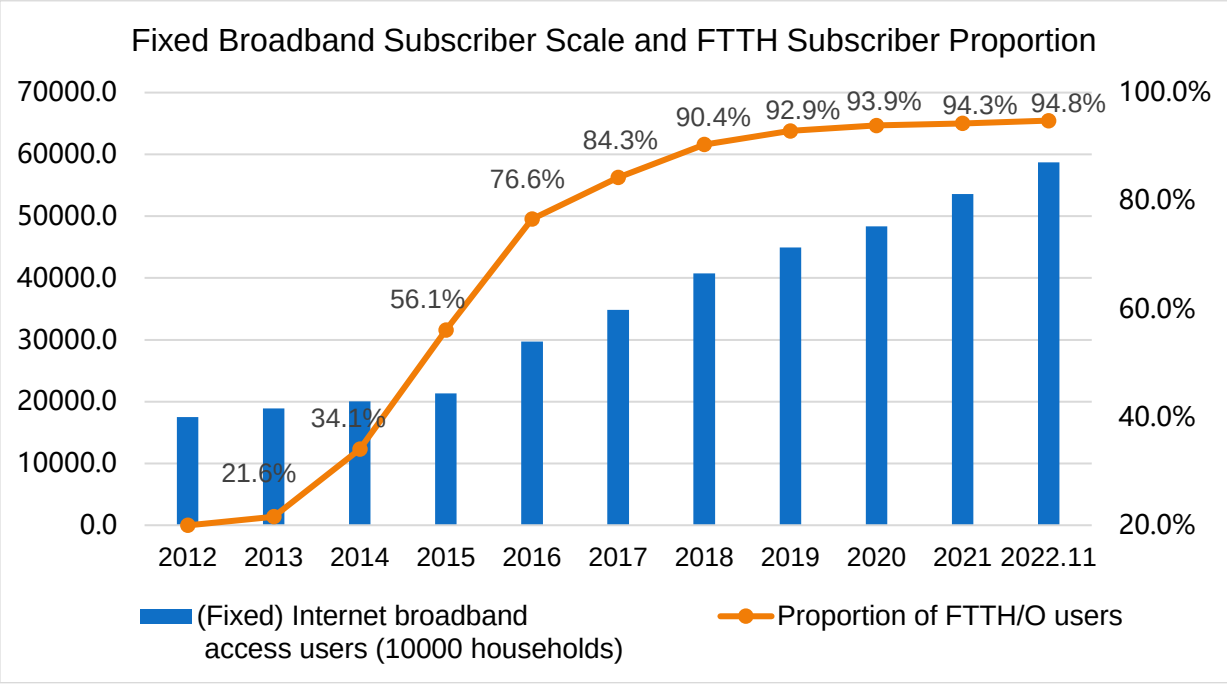
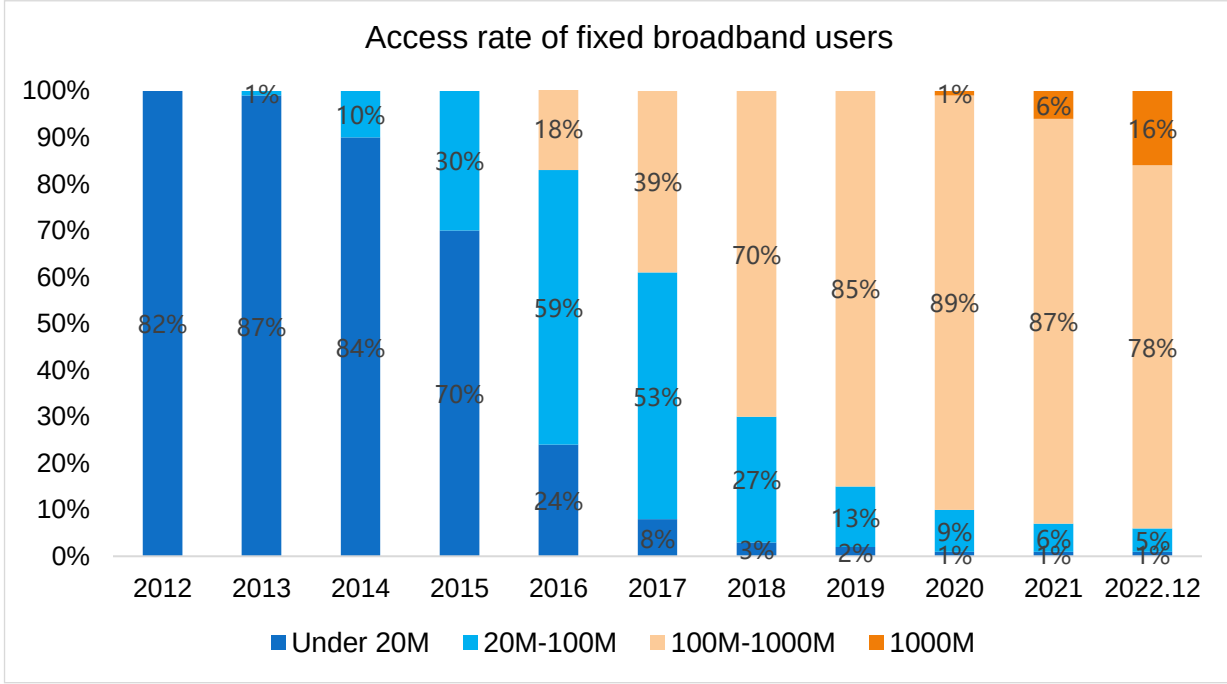
Fixed broadband network in China: Using optical fiber instead of copper wire

- FTTH covers almost all households in urban and rural areas. All cities have been built into optical network cities, laying a foundation for gigabit development.
- The proportion of fiber optic users to fixed broadband users has risen from 18% in 2010 to 94.8% at the end of Nov. 2022, ranking among the top five in the world.
- As of the end of 2022, country's gigabit optical network has the ability to cover more than 500 million households and the number of broadband users with access rates of 1000Mbps and above has reached 91.75 million, ranking first in the world.





Mobile broadband in China: From popularization to 5G commercial use

- The 4G network in China has achieved latecomer catch-up, and the scale of 4G base stations accounts for more than half of the global total.
- The world largest 5G SA network has been built in China, including 2.312 million 5G base stations (accounting for more than 60% of the world, covering all cities and county towns in the country), and 561 million 5G mobile users.

The world's largest 5G network has been built in China

Data source: MIIT

At the end of 2022, China has built 2.312 million 5G base stations

The number of 5G mobile phone users has reached 561 million

5G innovative applications have played an enabling role in many industries such as industry, transportation, and medical care, with more than 20,000 application cases covering 40 major categories of the national economy

Telecommunication universal service is being further promoted

"Telephony service to village" project

Universal service pilot project

2004 — to promote telephone services to every administrative village

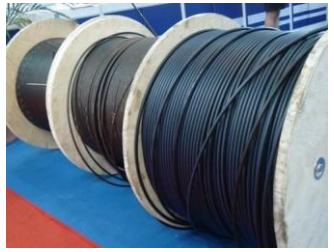
2015 — Supporting optical fiber construction

2018 — Supporting 4G mobile broadband coverage in rural areas

2022 — Supporting 4G and 5G network coverage

The latest progress

- ✓ It has supported the construction of optical fiber networks in 130,000 administrative villages and more than 70,000 4G base stations in rural areas.



- ✓ Administrative villages and cities have basically realized "**the same network, the same speed**".

- ✓ By the end of 2021, all administrative villages have access to broadband network and the problem of communication difficulties in remote and areas has been historically resolved.

Proportion of deeply poor villages with access to broadband

100%

Less than 30%

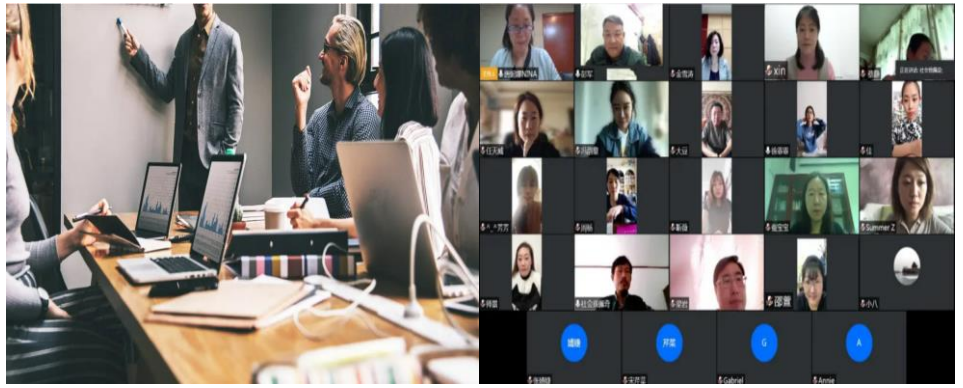
Metaverse partly conforms to the inevitable trend in the future digital world

- Metaverse is a continuation of the natural imagination of this trend, as the virtual and the real are becoming more and more integrated and the focus of the world is shifting to the virtual world.
- New elements and new business forms of next generation Internet, 3D immersive experience, uniform user ID, UGC content revenue expectation and human-oriented intelligent terminals, a new network society that integrates the real and the virtual and is open and connected.
- The concept of Metaverse covers a diverse, broad spectrum of technologies and leaves great room for imagination in the future.

Life

43% of users use mobile social software for two to three hours a day

Work



29% of online office meeting users are willing to pay

Creating new experience: Immersive experience of Metaverse, the Metaverse digital world is no longer subordinate to the physical world

- People's further demand for a better life has put forward new requirements for forms of experiencing digital information, and "free and immersive" Internet experience has become the "new" demand as regular iterations in the dimension of audio and visual quality, such as resolution and frame rate, can hardly bring about an incremental leap in user experience.

Present - virtuality and reality separation

The real world

The virtual world

Metaverse - virtuality and reality integration

Two Paths to Immersive Experience in Metaverse That Integrates the Real and the Virtual

The actualization of the virtual world

Virtual Metaverse (Transforming the real into the virtual)

The digitalization of the physical world

Augmented Metaverse (Transforming the virtual into the real)

Focus on the direction of development

Form of information in Metaverse
2D→ 3D

Mode of interaction in Metaverse
Weak interaction→ Strong interaction

The development and opening of Metaverse immersive business forms depends on the upgrade of the industrial ecosystem of 2D weak interaction technologies to that of 3D strong interaction

Key Scenario 1: A redefinition of "reality" by Metaverse, transforming the virtual into the real

- Metaverse will trigger a redefinition of the "real world" by human beings and is expected to become a personalized "holographic" life assistant for humanity, which can push the right information to the right people in an appropriate virtual-real form wherever and whenever appropriate.

The current real world = **A homogeneous, static reality (the physical world)**

The "new" real world in Metaverse = **1) differentiated; 2) combined; 3) open; 4) strongly interactive reality (the digital and physical hybrid)**

① Differentiated: people in reality would have different spatial experiences in the same time and space, and the real space would no longer be homogeneous and fixed, with the presentation of its structure and hierarchy depending on which Metaverse app the user runs

② Combined: computation would be embedded in reality and reality in computation, a physical scene could be anchored to multiple Metaverse digital content resources and Metaverse apps would be installed in the physical world to produce multiple real-world experiences

③ Open: Metaverse apps would be interconnected to form a non-static and editable reality and would leave in the real world virtual content other people could discover and use if running continuously in any spatial area indoors or outdoors

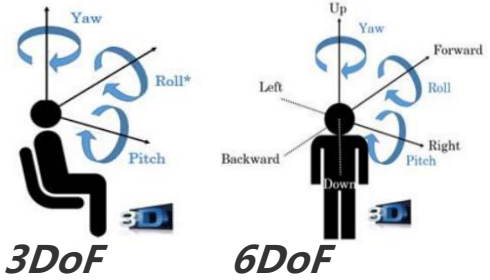
④ Strongly interactive: active and passive interaction based on LBS/VPS/natural input, low-friction interaction would trigger a Metaverse interaction mechanism based on visual and natural interaction

Key Scenario 2: A redefinition of "virtuality" by Metaverse, transforming the real into the virtual

- Metaverse brings new demands on previous audio and video and graphics rendering capabilities: greater audio and video content interactivity, specifically involving 360-degree 3D free view, 6 DoF spatial video, non-linear video, avatars, etc.

① 360-degree panorama 3D free view

② Spatial video 3DoF→6DoF



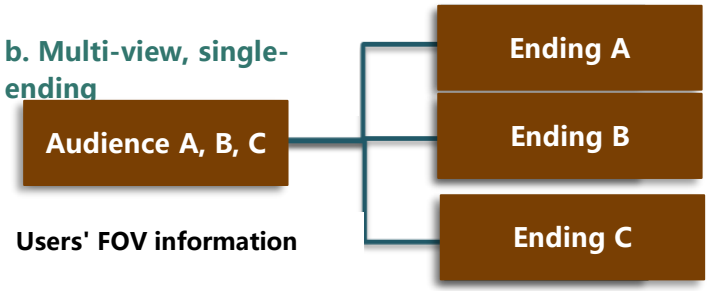
Spatial video can generate much more immersive user experience and its compatibility with high-quality 6DoF content acquisition systems, techniques of expression in video shooting, supporting environment on the cloud, networks and terminals, scene representation and coding and decoding algorithms will become the focus.

③ Non-linear video: "You watch the video, which in turn watches you"

a. Single-view, single-ending

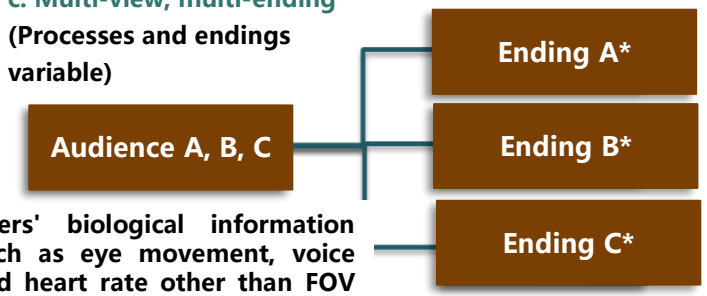
Lack of user interaction

b. Multi-view, single-ending



Users' FOV information

c. Multi-view, multi-ending (Processes and endings variable)



Users' biological information such as eye movement, voice and heart rate other than FOV information

④ Avatars (digital selves)

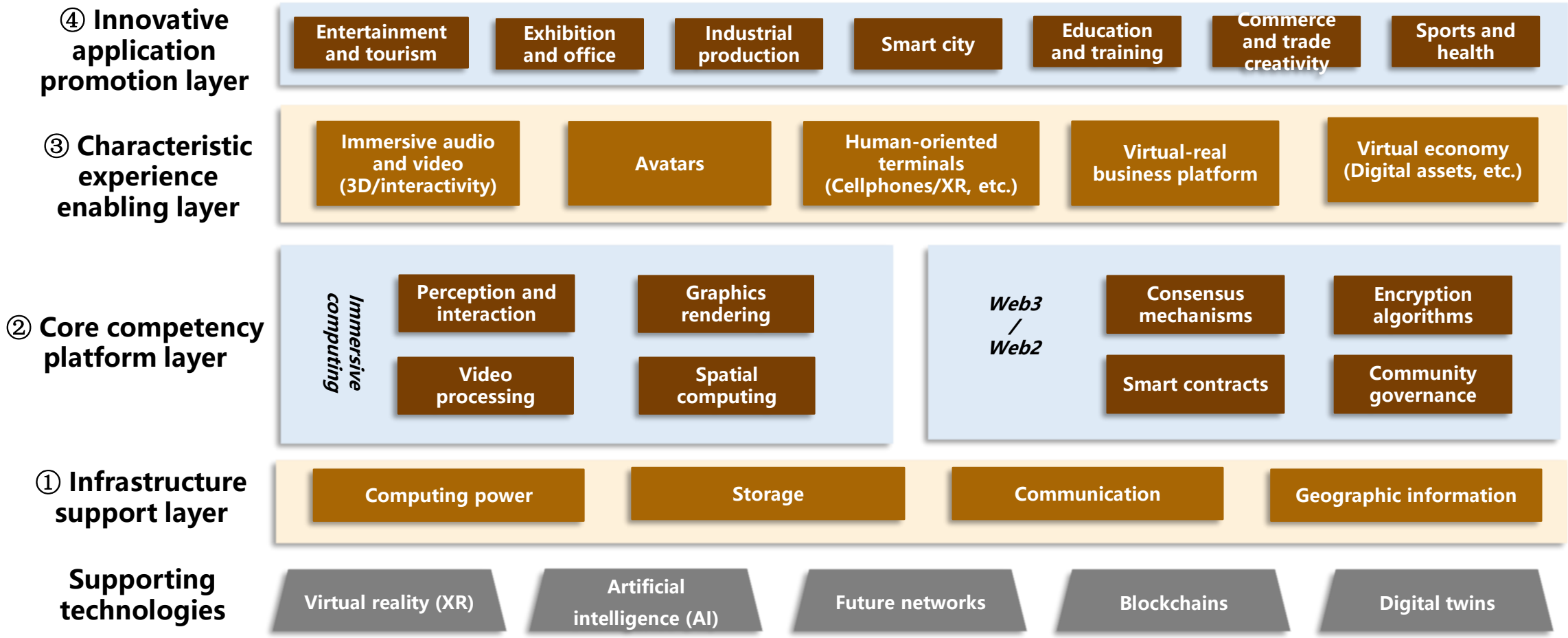
Avatars become interactive participants in diversified activities in Metaverse

With their own 3D avatars, people attend classes, meetings, socialize or exercise in digital spaces that integrate the real and the virtual

Real-time drive, widespread use and user-friendliness, and high degrees of simulation become development trends

Elements of the Metaverse industry

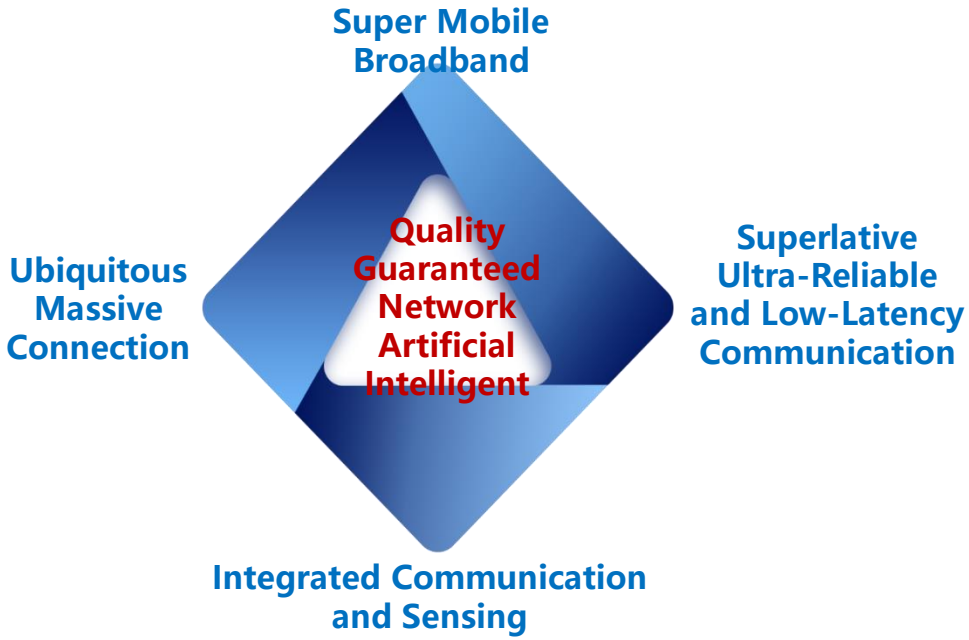
- Metaverse enterprises should focus on the development opportunities of immersive business forms and the virtual economy, with emphasis on key areas such as virtual-real business platforms, 3D immersive audio and video, XR intelligent terminals, avatars and supporting infrastructure in the former case and on new digital identities and digital assets in the latter case.



6G is expected to help realize the intelligent connection of human, physical and digital worlds

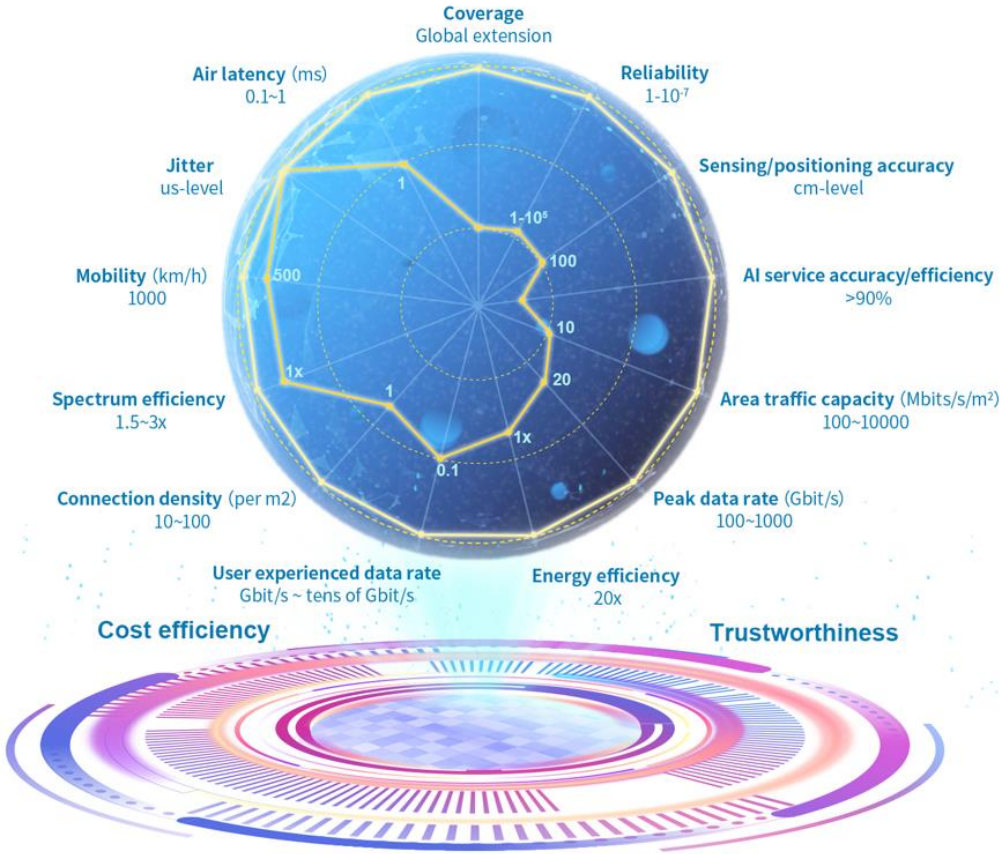
- Scenarios are fully immersive and interactive. Multi-dimensional sensing and native intelligence are integrated and symbiotic. virtuality and reality are deeply integrated.

Vision: intelligent connection of everything, digital twin



ubiquitous connections	global seamless coverage
proliferation of intelligence	green & low carbon emissions
multi-dimensional sensing	security and trustworthiness

Development philosophy: Together for 6G shared beautiful world



6G use cases trends: Immersive, intelligent, ubiquitous

Intelligent Interaction

Immersive Cloud XR

Holographic Communications

Sensory Interconnection

Proliferation of Intelligence

Digital Twins

Machine control and coordination

Communication for Sensing

Global Seamless Coverage

1 Immersive

2 Intelligent

3 Ubiquitous

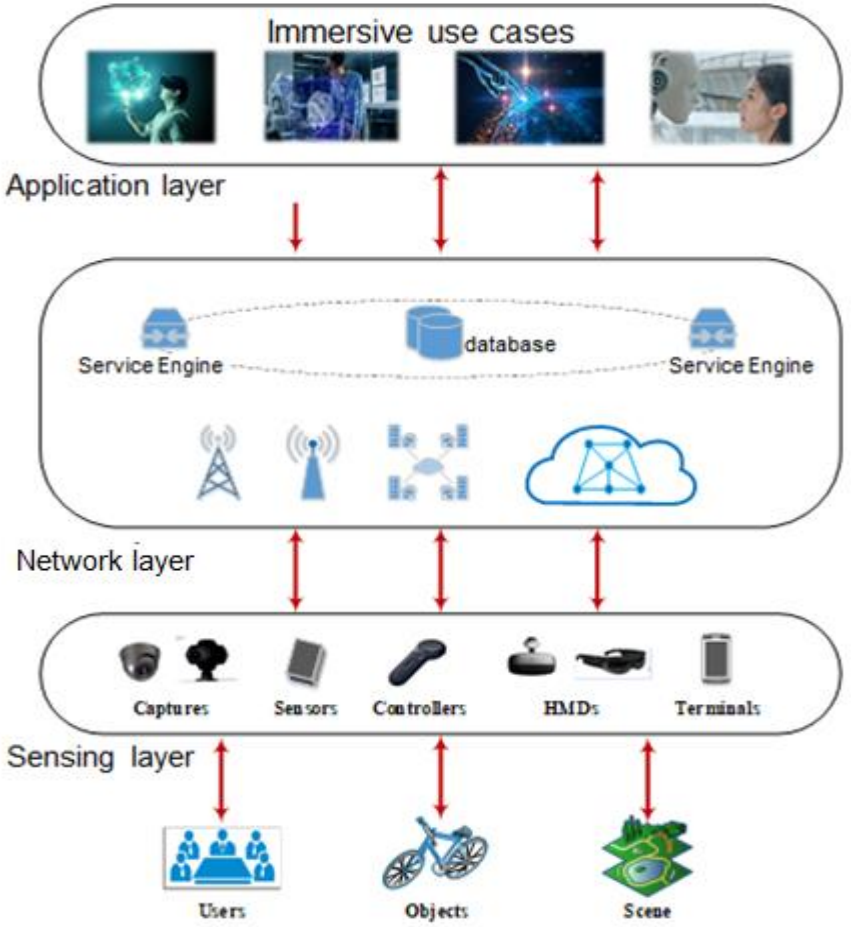
Candidate Use Cases of 6G

6G immersive use cases

- Immersion application will realize the three-dimensional dynamic interaction of people, objects and their surrounding environment, break the boundary between virtuality and reality, and enable users to enjoy extreme experience.

Immersive Cloud XR — A Broad Virtual Space	
Communication	User experienced data rate: Gbps level
	Air interface latency : <2.5ms
Computing, Intelligence	Distributed computing supporting cloud rendering and multi-touch fusion
Sensing	Multi-dimensional sensing: location, motion trajectory, touch, etc.
	Sensing accuracy, sensing information transmission latency
Energy Efficiency	Power-limited terminals, focusing on low-power solutions

Holographic Communications — Extremely Immersive Experience	
Communication	• User experienced data rate may reach tens of Gbps • Dynamic holograms may require Tbps-level peak data rates
	Latency <Sub ms~10ms
	Multi-dimensional holographic information needs to be strictly synchronized
Computing, Intelligence	large computing power
Sensing	Multi-dimensional sensing
Security	Sensitive information such as facial and voice features requires secure network transmission



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