中国电信
CHINA TELECOM

An Outlook on cellular Infrastructures for the Support of Metaverse

Dr. Qi Bi

2001 Bell Laboratories Fellow & IEEE Fellow

Chief Expert of China Telecom

President of the Expert Committee

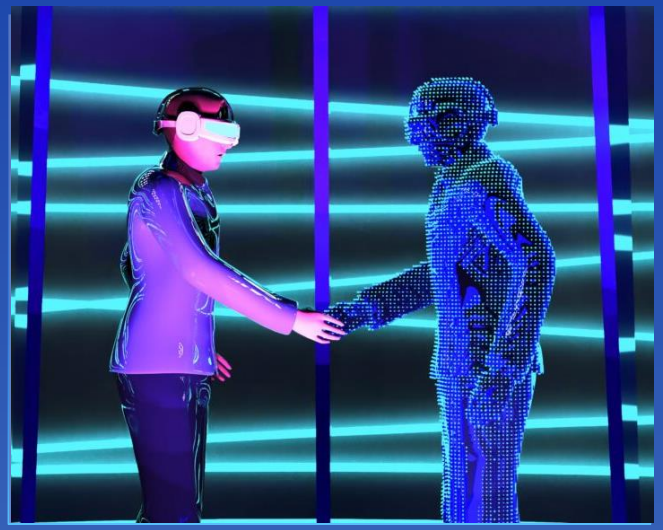
of China Telecom Research Institute

Market Projections of Metaverse

- The Metaverse market size is expected to become $800 billion by 2024
- $1 trillion market size predicted for the Metaverse in the future according to JP Morgan
- $10 billion investment from Facebook for the Metaverse.
- $400 billion growth in the Gaming world is expected by 2025.
- Epic Games raised $1 Billion for metaverse plans.
- Microsoft got a $22 billion contract for Mixed Reality technology
- Supersocial raised $5.2 million to make Games on the Roblox platform
- ook created mo than 10,00 a

Expected Evolution of Metaverse

Virtue people & objects



Immersive AR/VR/XR

Multi-dimensional metaverse

The support of metaverse by cellular network will evolve in phases

Metaverse Use Cases

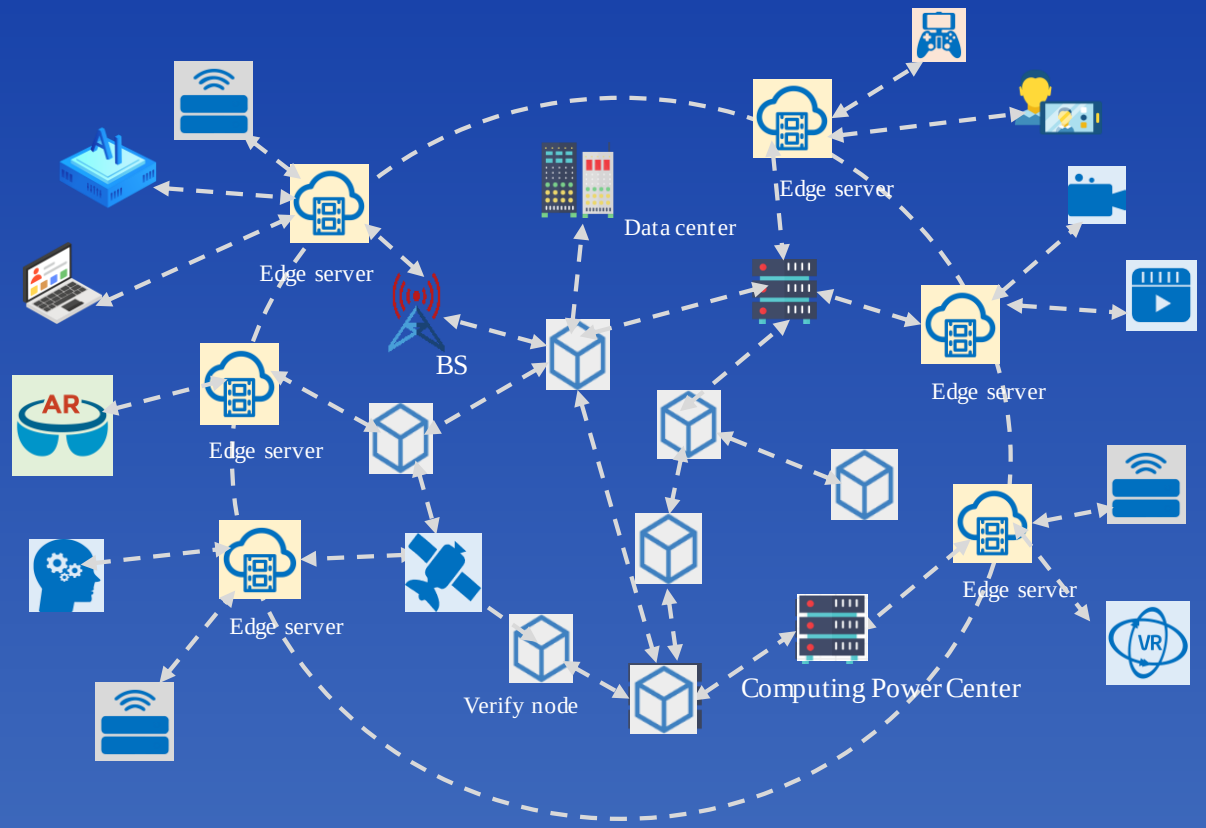
- **Immersive Games**
- **Virtual Workspaces, Communities**
- **Digital Entertainments**
- **Social Commerce and e-commerce**

- **Smart Manufacturing**
- **Healthcare**
- **Education**
- **Entertainment**





Metaverse Needs Network & Computing



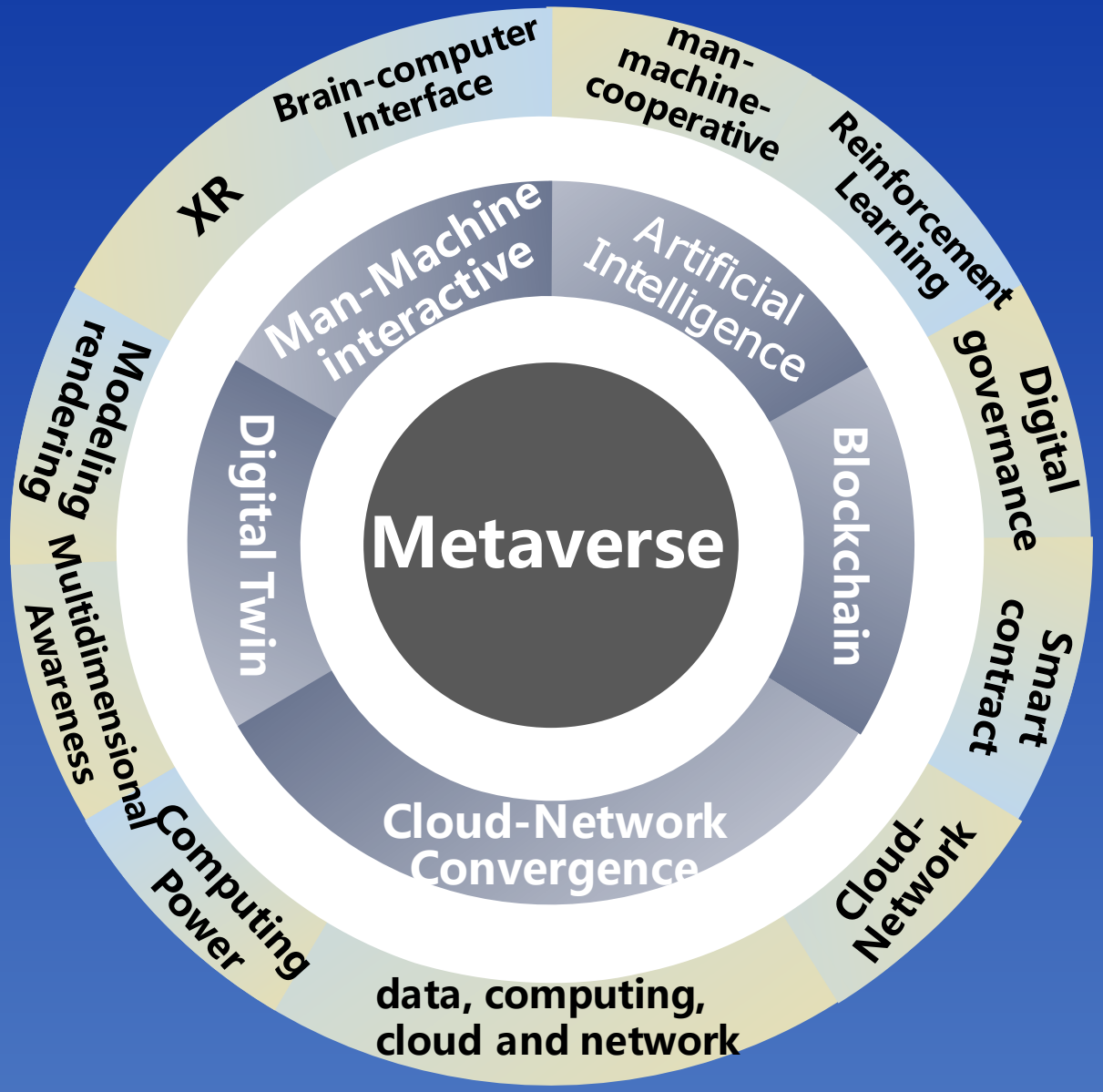
- Data
- Computing
- Cloud
- Network

Efficient matching of heterogeneous network resources

End-to-end resource transaction and distributed collaboration

Network bandwidth is a clear critical component for the support of metaverse

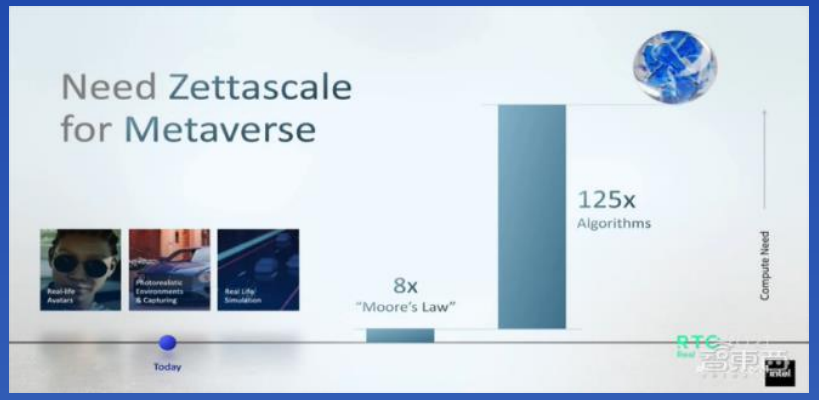
Core Technologies of the Metaverse



- Blockchain
- Artificial Intelligence
- Man-Machine interface
- Digital Twin
- Cloud-Network Convergence

CPU Requirement for the Metaverse

Computing power **> 10^{18} flops**
1000 times current CPU capacity



Meta: Research Super-Cluster
Monopolize 10% of global computing resources

- PS5 level game VR game 4k@60Hz, requires 10Tflpos computing power.
- In the metaverse, the AR/VR computing power should reach 3900EFLPOS

Metaverse needs far more computing power than Moore's law.

Network Requirements for Immersive Experience

Entry
20~50Mbps
40ms

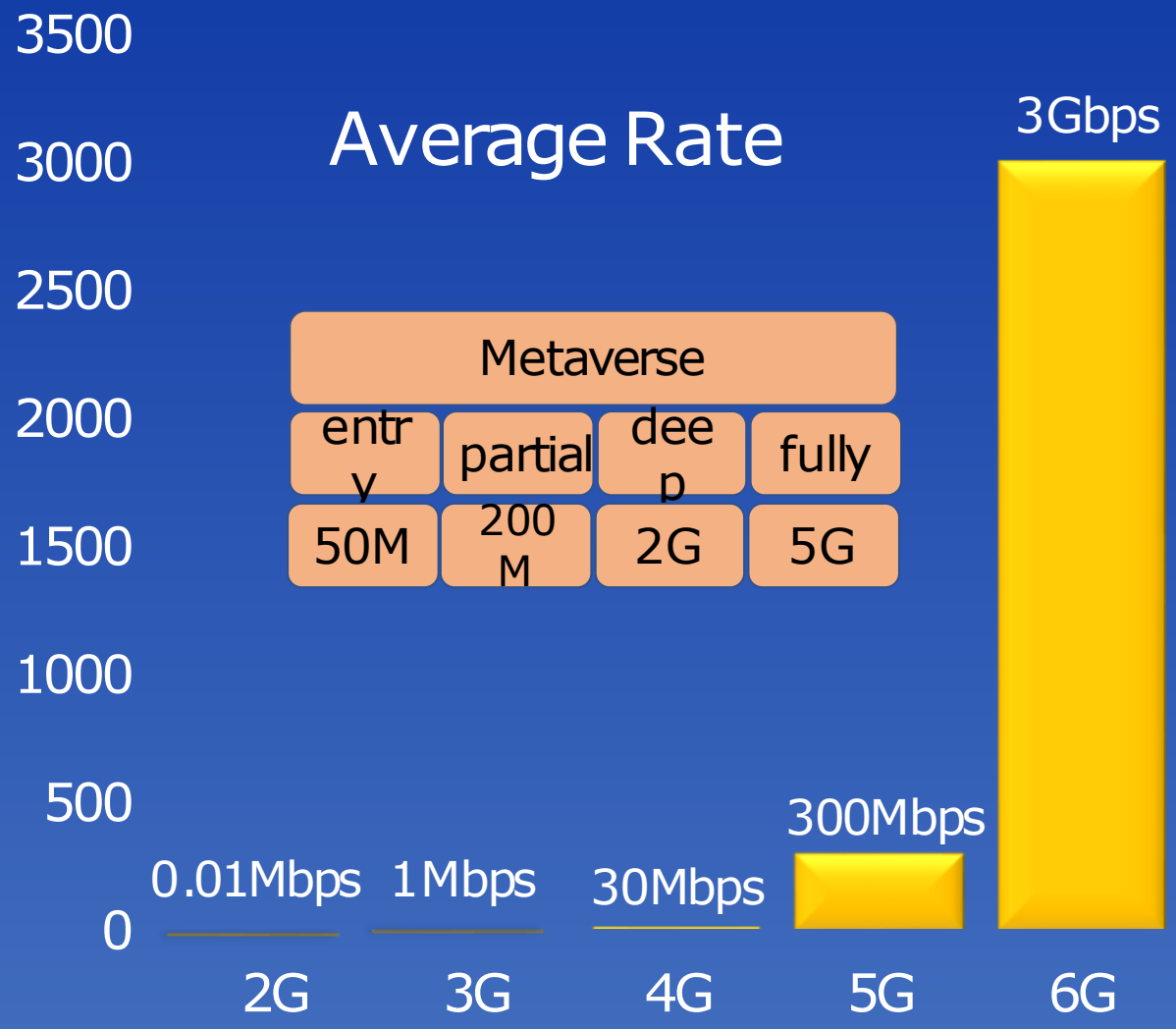
Partial
50~200Mbps
30ms

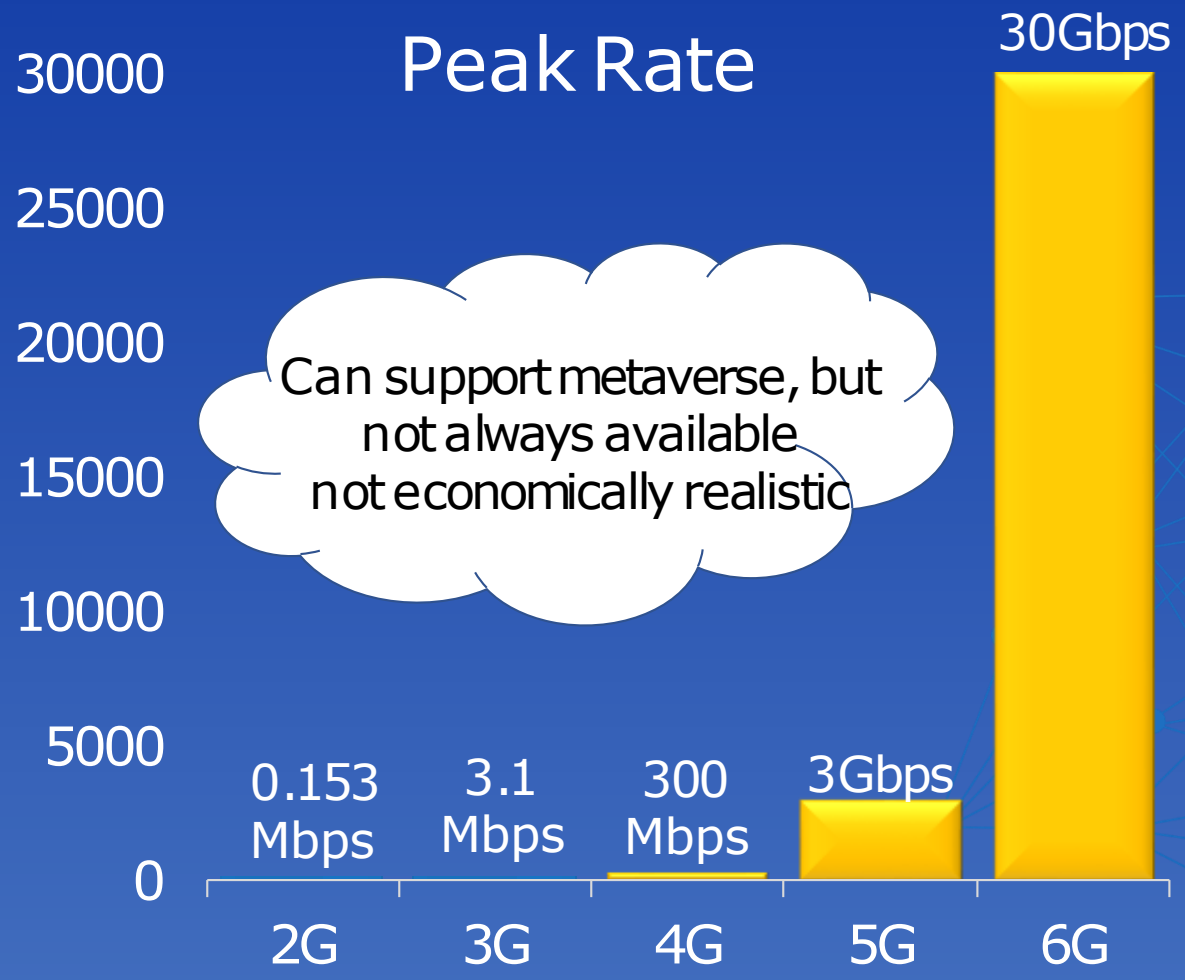
Deep
200M~2Gbps
20ms

Full
2~5Gbps
10ms

Based on Huawei iLab

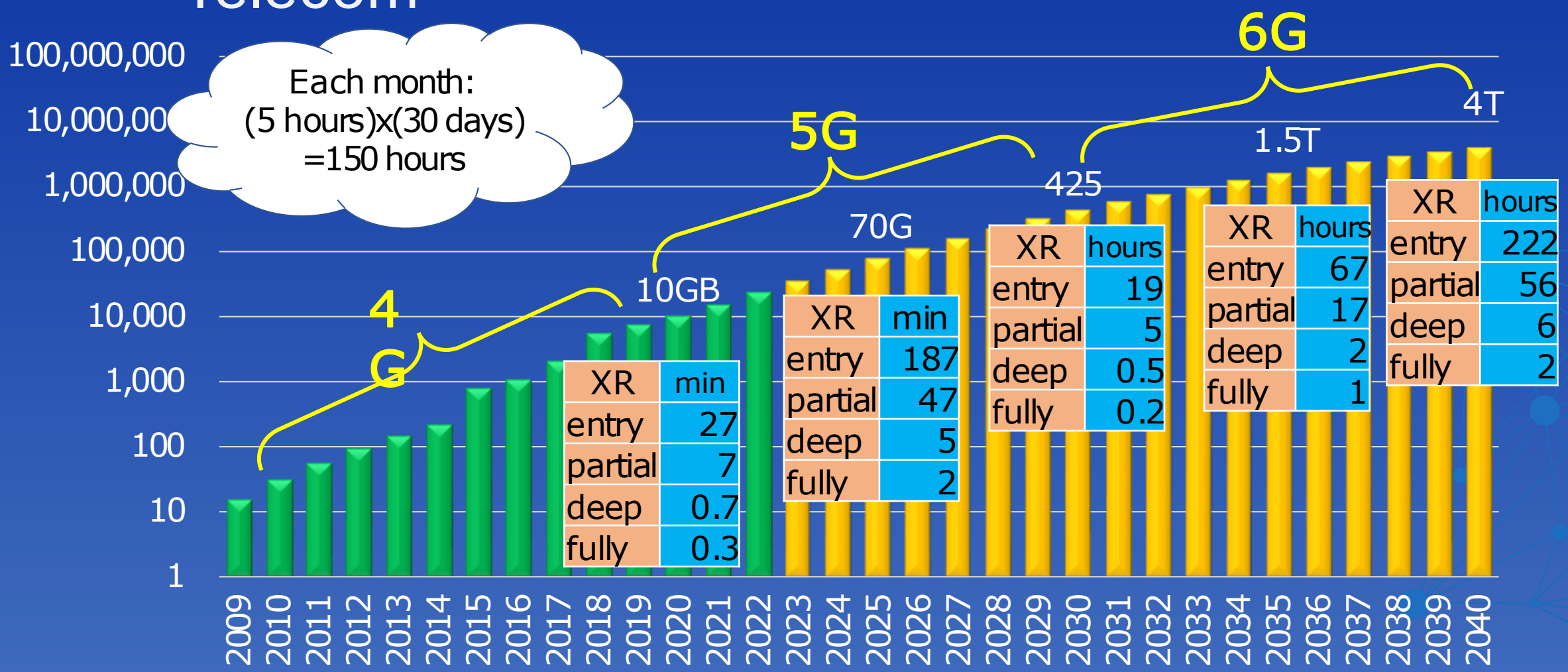
Evolution of the Cellular Data Rates





It appears 5G can support metaverse partially, 6G can support fully

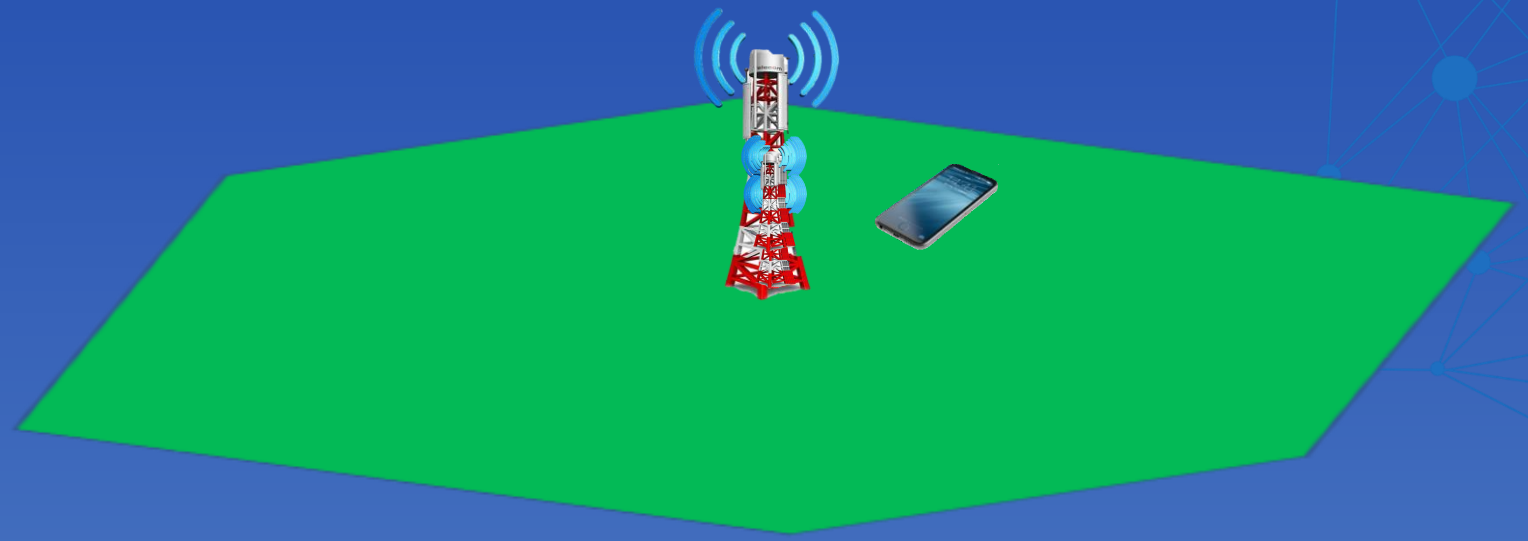
Personal Monthly Data Usage in China Telecom



Metaverse cannot be supported economically unless new approaches can be found

Architectural Solution for the Cellular Capacity

- Best Technical Solution ： Ultra Dense Network (UDN)
  - But cannot afford economically
  - CAPEX grows exponentially with the cell counts
  - Not worked for 4G & 5G; Not expect to work for 6G
- Use smartphones as repeaters
  - Architectural revolution
  - CAPEX-light, SDN
  - Web 3.0 infrastructure
  - Uber style operation
  - An approach for 6G

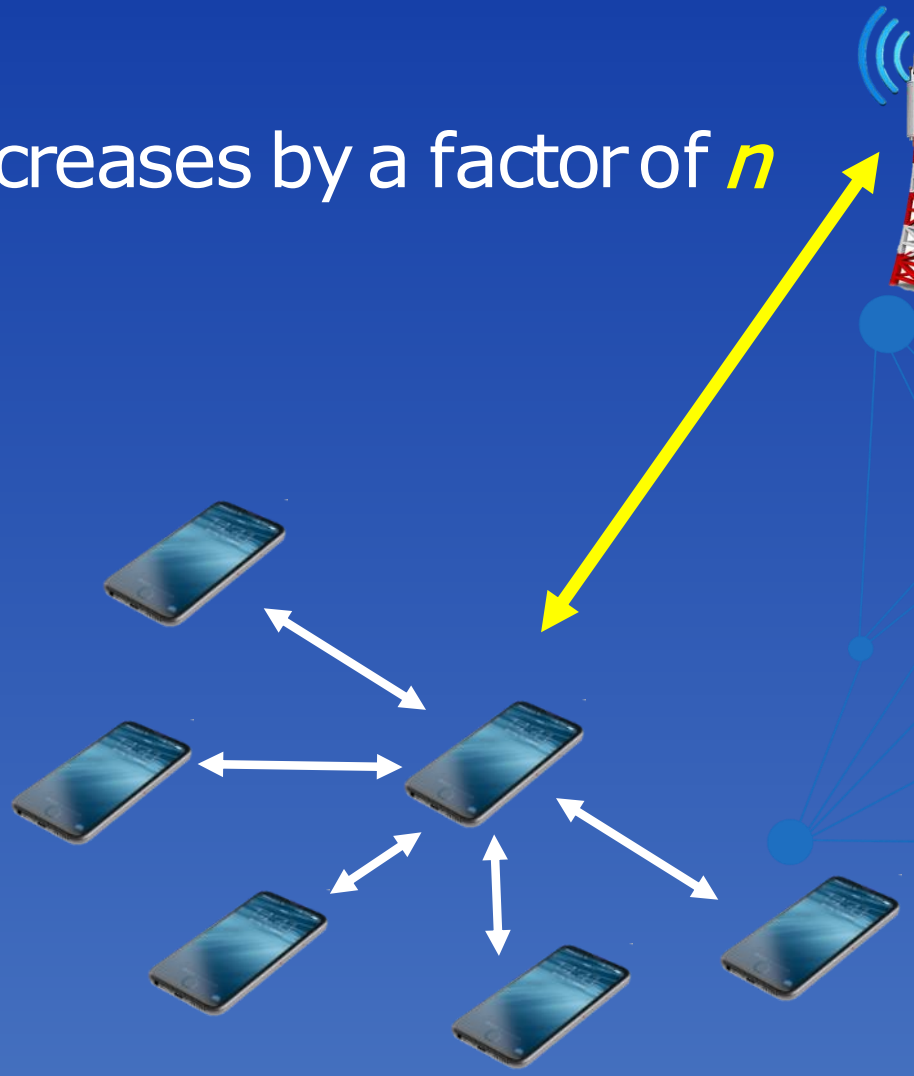


Smartphones are expected to be part of the network infrastructure in 5G and 6G

Capacity Increase by D2D Based P-RAN

Proximity – Radio Access Network

System Capacity increases by a factor of *n*



P-RAN Service by China Telecom

- China Telecom launched P-RAN commercial service branded eMC "e-Mutual Connect" in Nov, 2022
- It becomes the first operator globally to launch D2D based service for cellular operations using smartphones
- Current service focus on solving the 5G indoor coverage problem
- The objective is to evolve the service to full P-RAN network in 6G for capacity & coverage improvements for metaverse & other services

China Telecom Metaverse Roadmap

Vendors
Platform
APPs
Research
Finance
.....

Partner Collaborations

Infrastructure

- Network
- Cloud computing
- MEC
- Networked computing
- .....

Based on the convergence Of the network & Cloud

Platform Integration

- XR Platform
- Platform for digital twin
- Platform for verticals
- AI Platform
- .....

Integrate capabilities to build Metaverse platform

APP Aggregation

- VR/AR、games
- Entertainments
- Digital economy
- Smart city
- .....

With partners to build Ecosystem for immersive services

China Telecom Metaverse Platform

Innovative explore

Industry promotion:

- Technical Standards
- Protocol Specification
- Asset right
- Trust mechanism

Application practices


AR Guide


XR Commercial complex


VR Live


MR数字人


XR Education

Core capability:

CT Chain

Sharding consensus
Multi-certification
Distributed Networks

Smart contract
Multi-encryption
Resource Synergy

Spatial construction ability

Real-time face reconstruction
3D space digitization
AI content generation
Machine Vision
Digital human

Ecological cooperation

- Content
- Application
- Algorithm
- Terminal

New infrastructure foundation

5G Infrastructure Network
High Speed Ubiquitous 、Space-Earth Integration

5G SA | MEC edge node | Gigabit optical bandwidth | NB-IoT

Cloud platform
Distributed, self-controlled, secure, trustworthy

PaaS | Real time cloud rendering | IaaS | CDN | ECX

Conclusions

- Current cellular architecture and evolution has the technical capability to support metaverse with no problem
- The glitch is in the business case
- New revolutionary architecture changes and technology breakthroughs are needed to make the support of metaverse economically in mainstream
- With the efforts on technological advances, the support of metaverse in mainstream by cellular network remains hopeful

Thank you