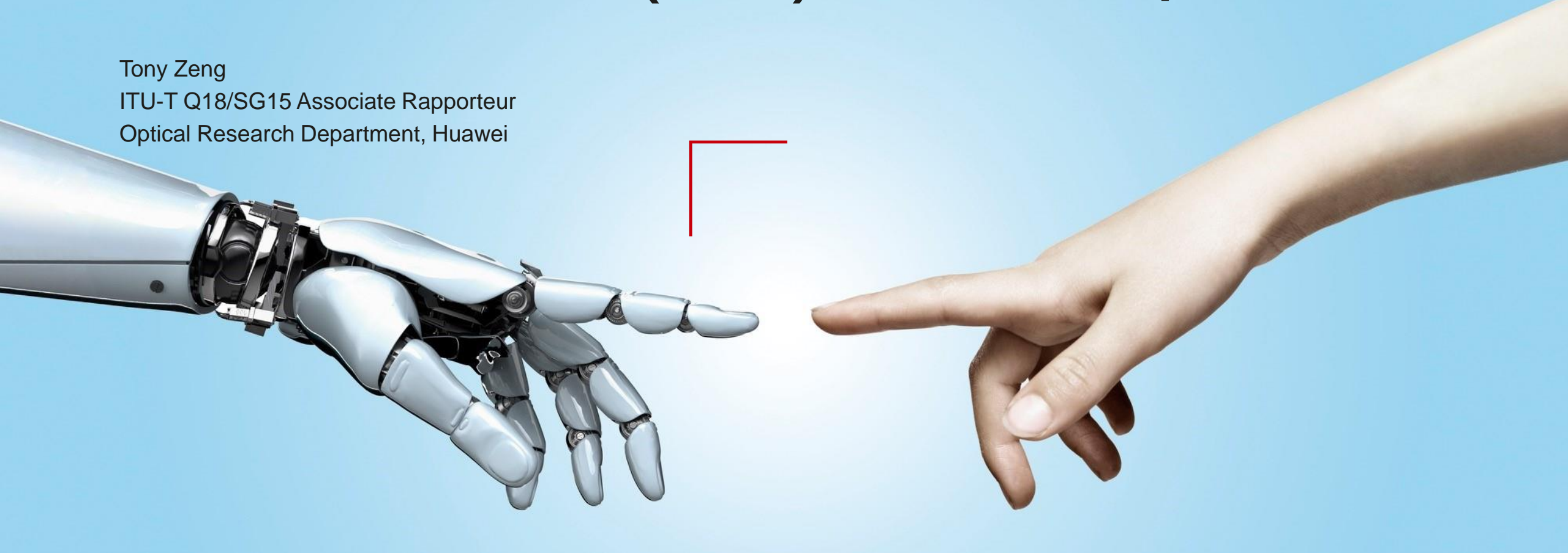
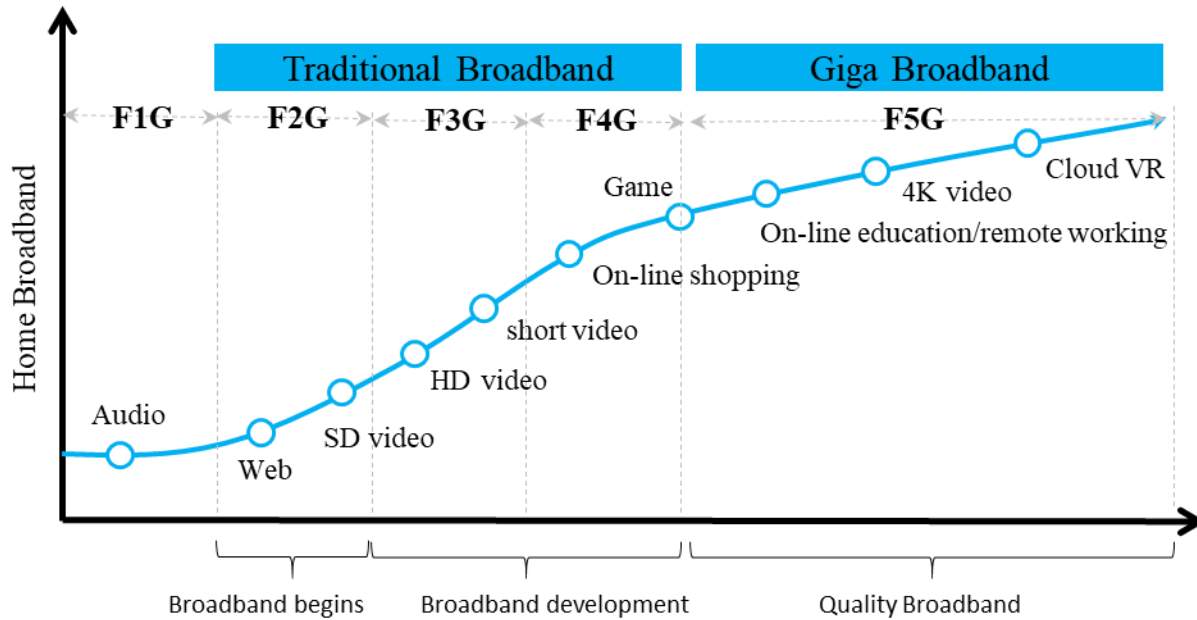


Fibre-to-The-Room (FTTR) in ITU-T Q18/SG15

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Emerging Home Service Requires Giga Home Broadband



As is (F4G)

To be (F5G)

Service: Web, HD video

Network: 100M, insensitive to PLR and latency

Technology: G/EPON, Wi-Fi 5

Service: On-line gaming/ education, Live streaming/Cloud VR

Network: Gigabit, Guaranteed QoS

Technology: 10GPON, Wi-Fi 6, FTTR

Source: Broadband Development Alliance, WP, Gigabit broadband with high quality: service QoE and network optimization, 2021

Network requirements for new services in HN

Type	Throughput	Latency	Jitter	Packer loss
On-Line Edu. Remote Wor.	5~20Mbps	≤60~150ms	≤100~200ms	≤1.0E-3
On-Line gam.	≥2Mbps	≤60	≤100	≤1.0E-1
4K IPTV Unic.	≥50Mbps	≤20ms	/	≤1.4E-4
8K IPTV Unic.	≥280Mbps	≤15ms	/	≤1.0E-5
4K IPTV Bro.	≥54Mbps	/	≤50ms	≤1.0E-5
8K IPTV Bro.	≥150Mbps	/	≤30ms	≤1.0E-6

Source: Broadband Development Alliance, WP, Gigabit broadband with high quality: service QoE and network optimization, 2021

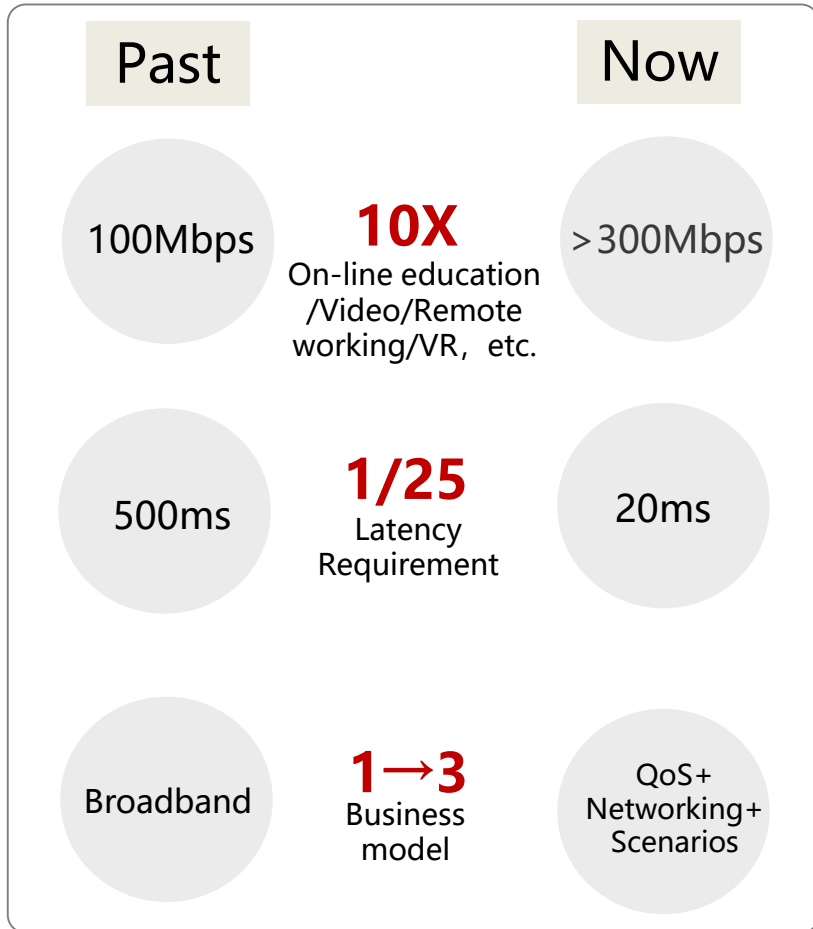
Network requirement of Cloud VR

Level of Quality	Fair-experience Quality	Comfortable -experience Quality	Ideal-experience Quality	
Strong interaction content resolution	4K	8K	8K/16K	
Typical terminal resolution	4K	8K	8K/16K	
Strong-interaction VR service	Bitrate	≥40Mbit/s	≥90Mbit/s	≥360Mbit/s (8K) ≥440Mbit/s (16K)
	Bandwidth requirement	≥80Mbit/s	≥260Mbit/s	≥1Gbit/s (8K) ≥1.5Gbit/s (16K)
	E2E Network RTT	<20ms	<15ms	<8ms

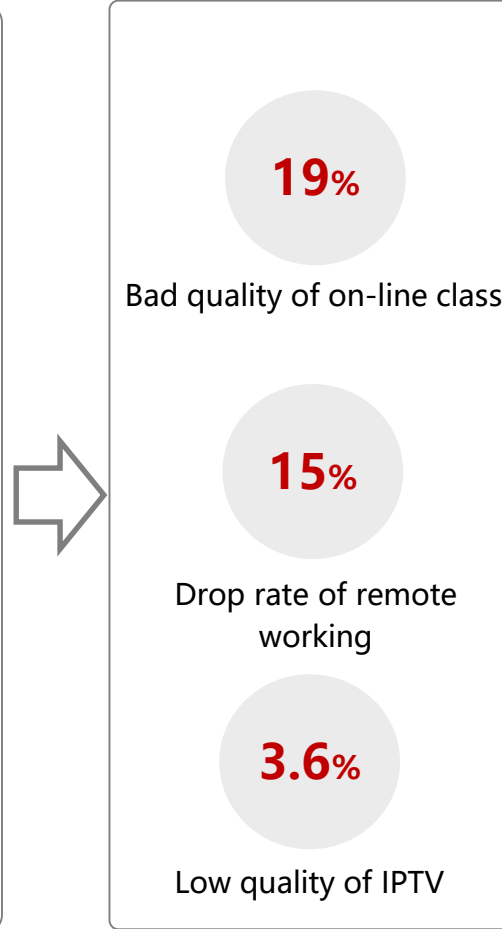
Source: ITU-T SG15 G.9976 UHD video over G.hn, 2021

Issues for Blocking Giga Home Broadband

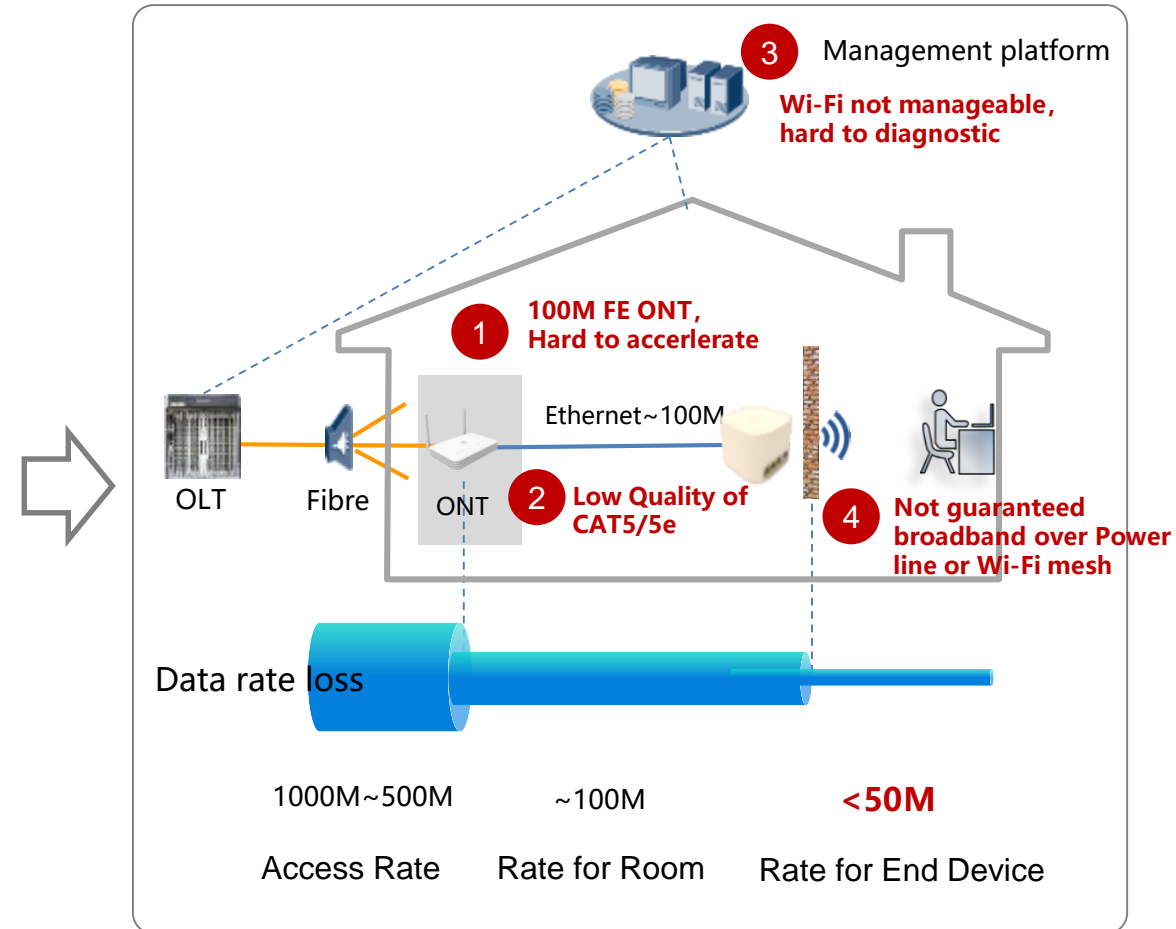
Evolving Home Broadband Requirement



Bad Experience under Current Home Network

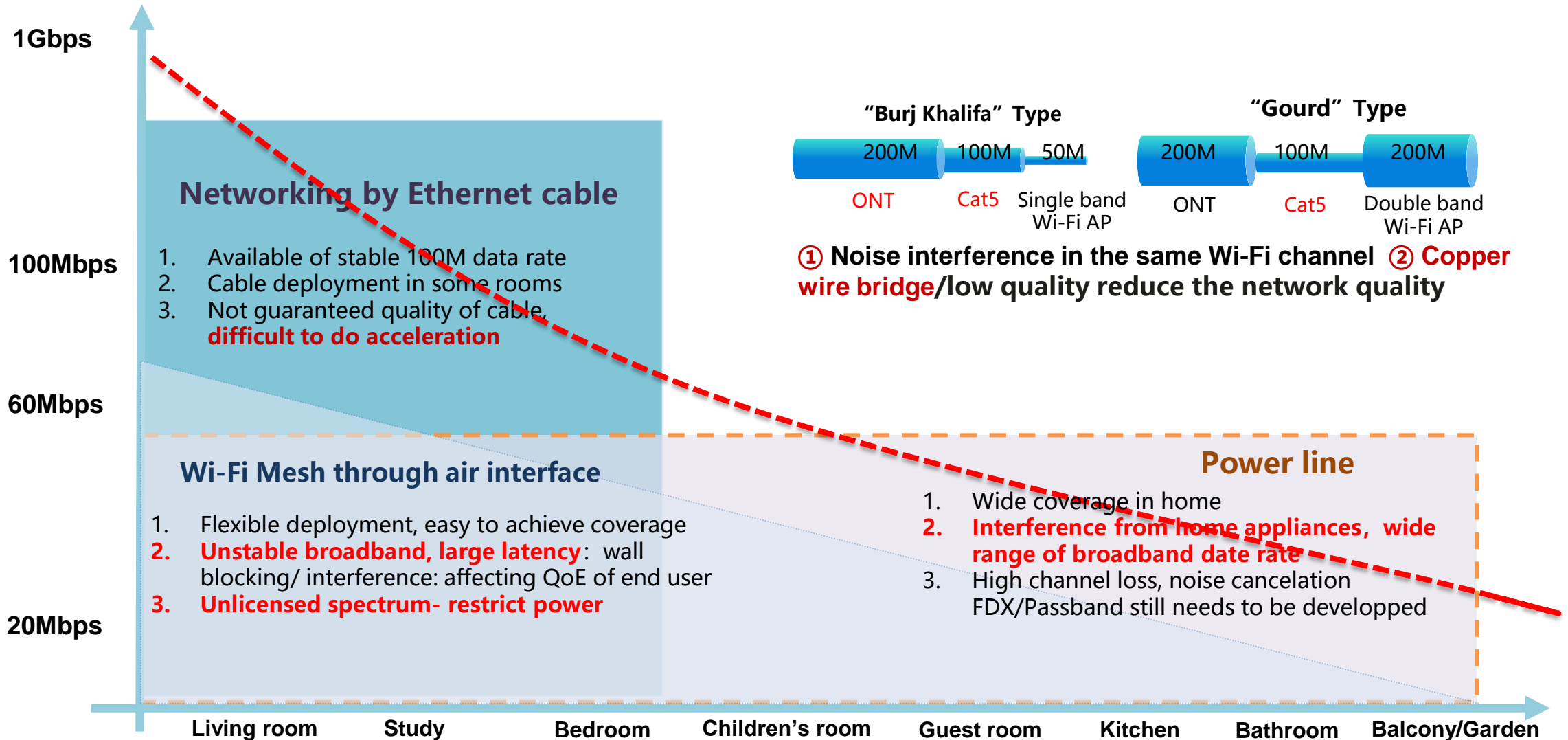


4 key factors affecting Giga Broadband experience



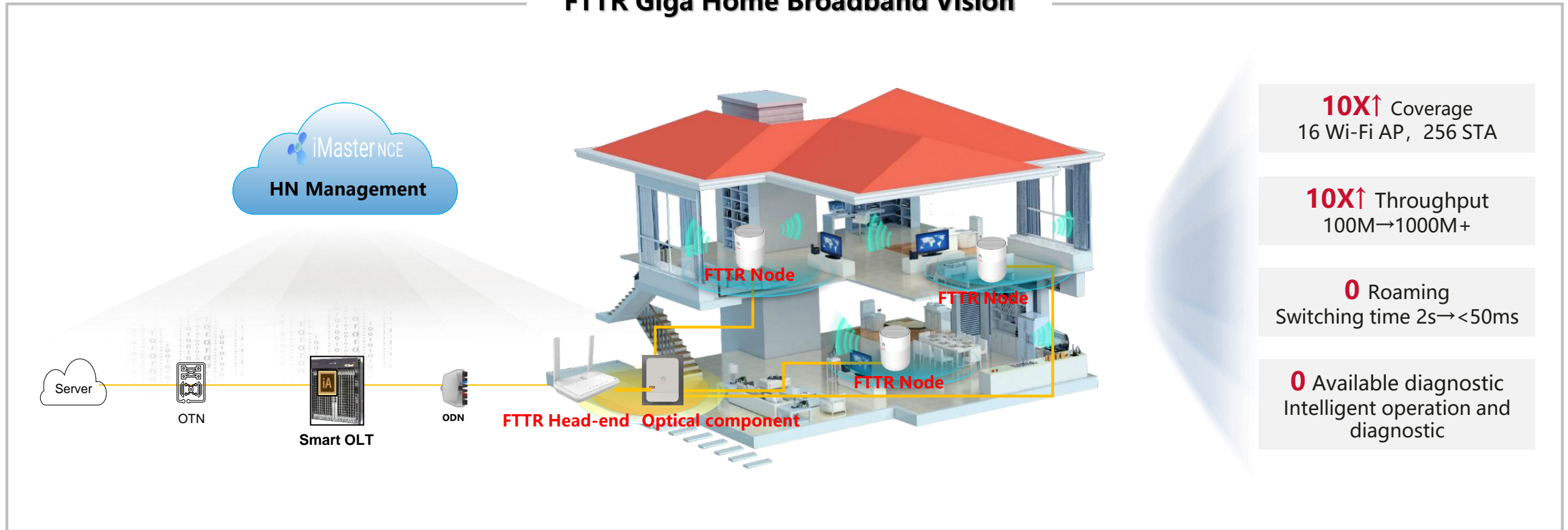
Take an example of FTTH in China, the optical Fibre is only to information box, access broadband is around 200M for 70% cases. However, the actual downloading average broadband is around **41Mbps (2020 Report of Broadband Development Alliance)**

Easy Giga rate for Access, Difficult Giga rate for Home



Fibre-to-The-Room(FTTR): Provide Stable Giga Home Broadband

FTTR Giga Home Broadband Vision



Full Fibre Connection

- Fibre extends to Rooms
- Smart ODN

Giga Broadband Coverage

- Wi-Fi6 160 MHz
- Giga rate to STA

Wi-Fi Roaming

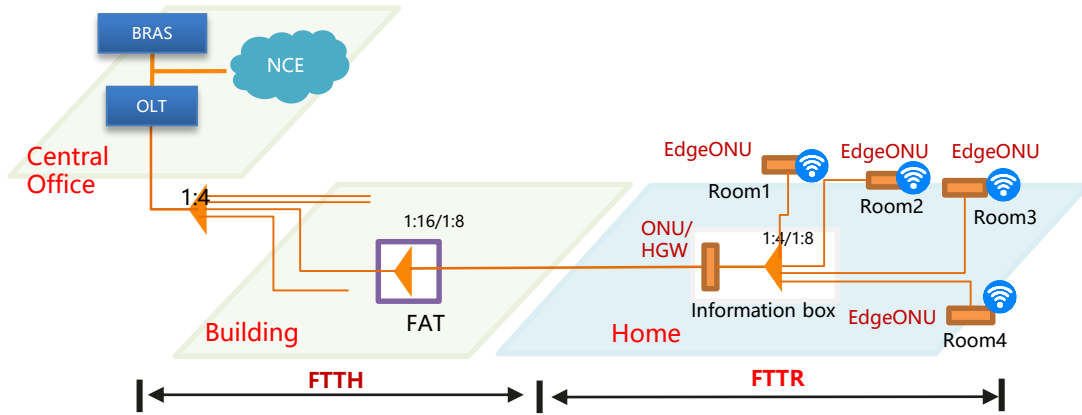
- Seamless roaming
- Switch time <X0ms

Intelligent operation

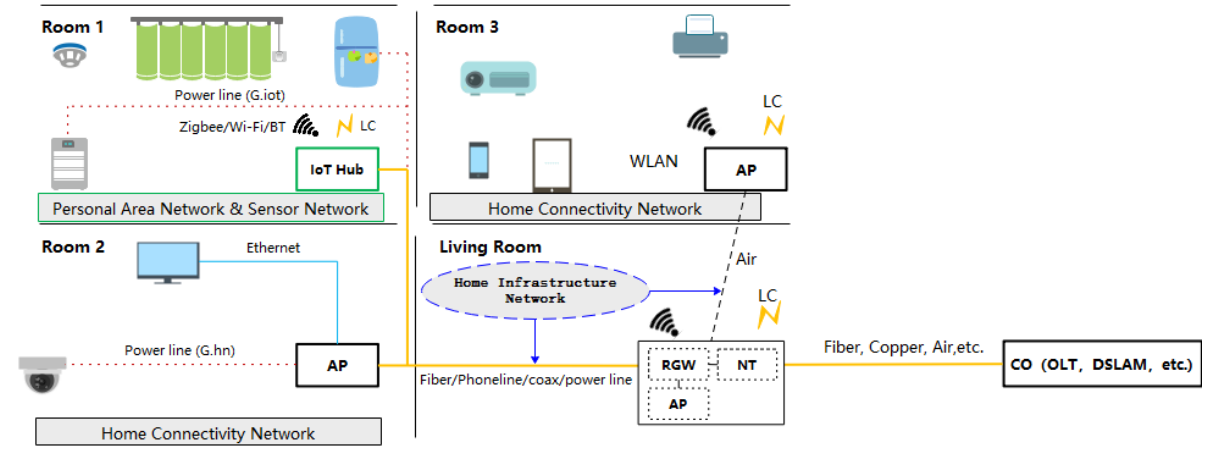
- Intelligent operation, devices visibility, easy diagnostic

Difference between access and home over optical network

Network: Access to Home



Connection: Service oriented



Change

1. **Small Loop length** (50-100m, 20-30dB channel gain), Transmission latency $< 0.1\mu s @ 30m$
2. Less nodes with **QoS requirements for nodes**: VR/Video/IoT

1. **Close to service**: Guaranteed QoE, from enough throughput to enough latency and packet loss rate
2. **Close to device**: Various device types and tech generations

New

1. **P2MP networking**: South-North streaming to East-West streaming: New opportunities on system design and protocol

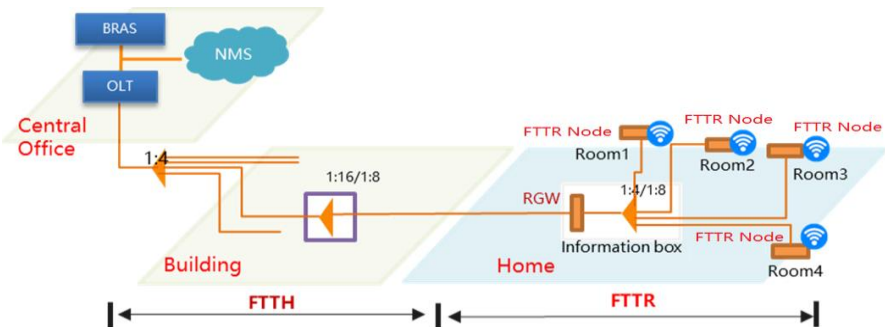
1. **Low power devices**: IoT center-control low power mode
2. **One single network**: Optimized FTTR + Wi-Fi network

Evolution

1. **Industry/Verticals**: TSN design & other scenario oriented design
2. Smart office/building/campus

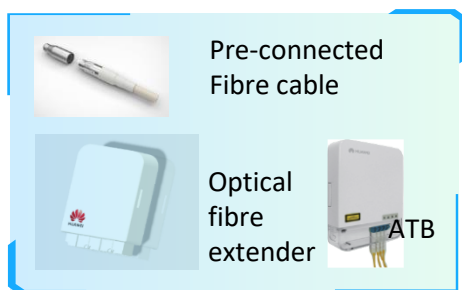
Use case & Network requirement of FTTR (1)

① High Quality Wi-Fi Backhuling



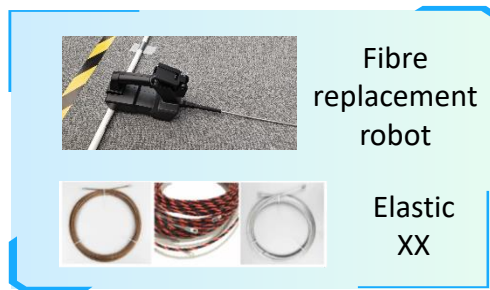
- Throughput 100Mbps \gg 1Gbps \gg 10Gbps
- Roaming 1s \gg 10ms \gg <1ms

③ Low Complexity and Easy ODN



In-premises ODN

Pre-connectorized fibre,

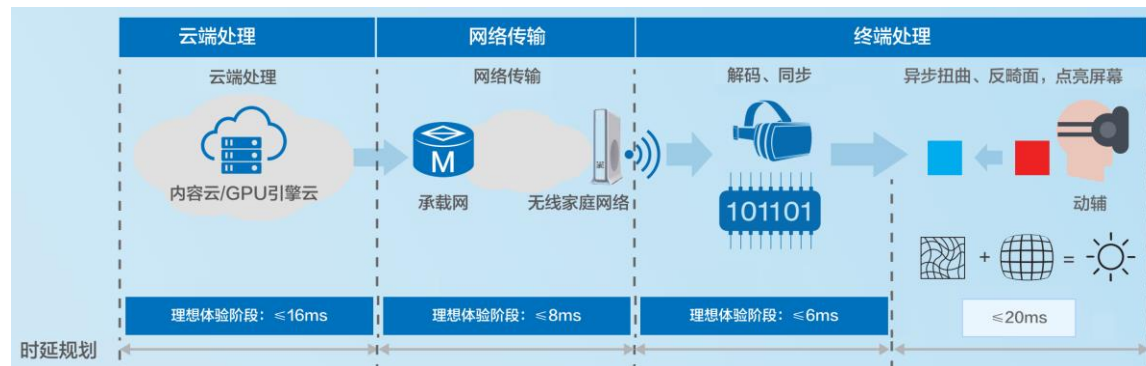


Engineering Tool

fast fibre installation, high successful rate

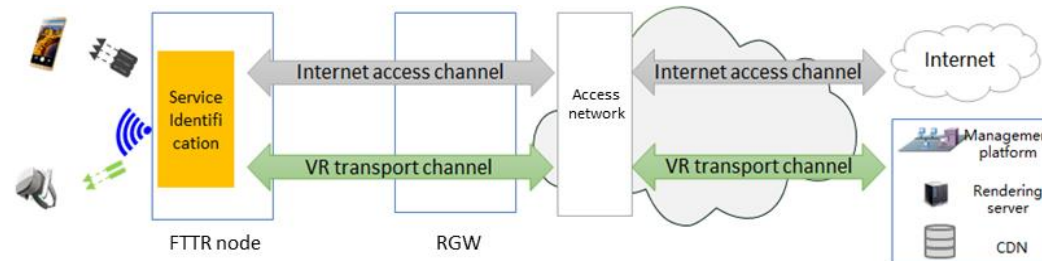
Source: ITU-T SG15 Q18, FTTR use cases & network requirement, 2021

② Support of Extremely low latency



- Stable networking, extremely low latency: <1ms, jitter<1%

④ FTTR Slicing



- Service type recognition, high priority channel
- FTTR+Wi-Fi coordination & optimization

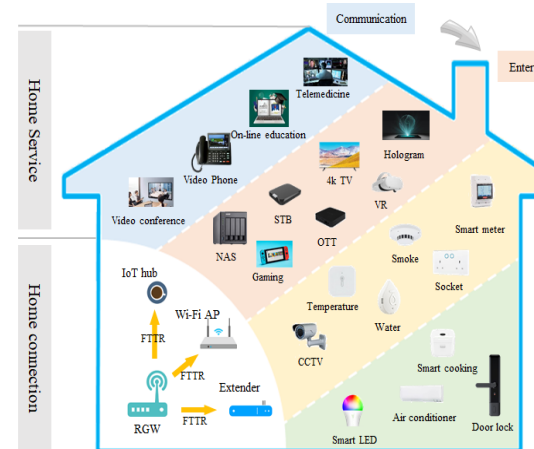
Use case & Network requirement of FTTR (2)

⑤ East-West Streaming



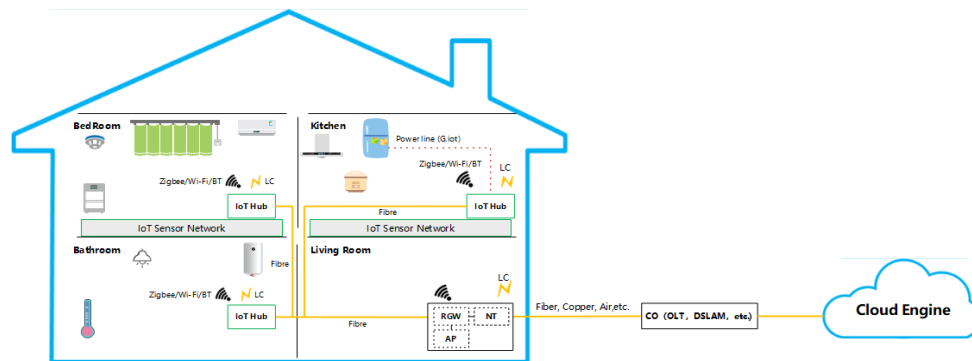
- **HN service:** Real-time security camera, IoT service, audio control, data storage
- **Network requirement:** East-West streaming, dynamic adjustment
- **FTTR architecture:** FTTR-head end routing

⑥ Support Various Device Types



- **Devices:** video, audio, IoT hub, AP, etc.
- **Network requirement:** low complexity, multiple rates/modulations,
- **Multiple generations:** FTTR1.0/2.0/3.0

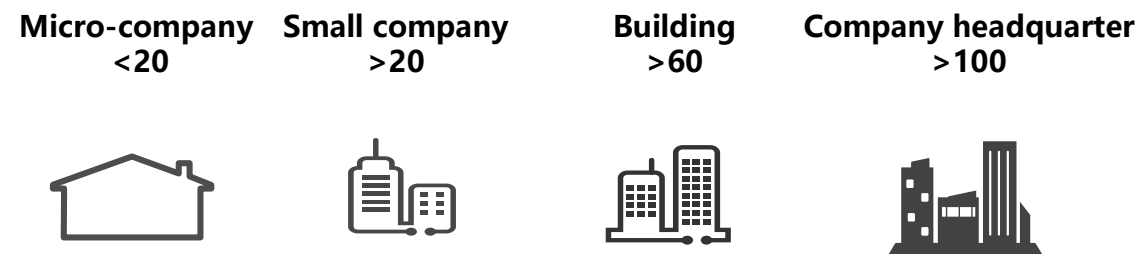
⑦ Enable Smart Home Connections



- Central control low power mode

Source: ITU-T SG15 Q18, FTTR use cases & network requirement, 2021

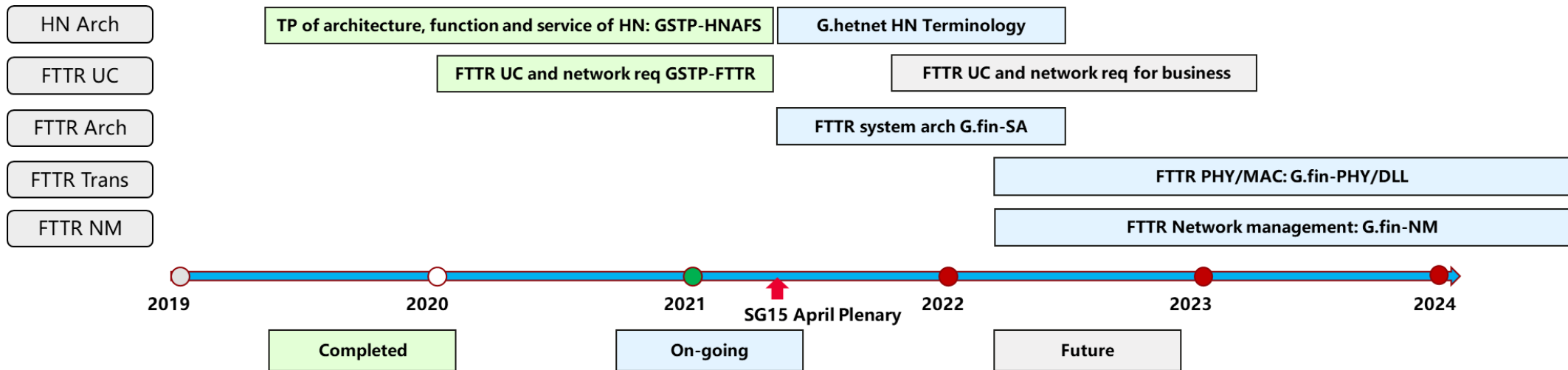
⑧ FTTR Applications



- **More connection:** Home -> small company -> building -> Headquarter

ITU-T Q18/SG15 In-premises Networking

- **Question Lead** (Huawei & Maxlinear)
- **Participants:** Huawei, Maxlinear, CAICT, NTT, Signify, PPC, China mobile, China Telecom, China Unicom, Devolo, Iberola, E.on, ISSI, Hisilicon, HHI, Futurewei, etc.
- **Project series:**
 - G.hn series:** In-premises networking technology based on powerline/twisted pair/coax/POF
 - G.vlc series:** visible light communication, based on G.hn PHY and ACO-OFDM PHY
 - G.occ series:** Optical camera communication
 - Smart grid:** PRIME, G3-PLC, G.hn applications in smart grid, G.iot
 - HN Architecture:** TP, G.hetnet (Terminology of home network)
 - FTTR (G.fin) series:** Fibre based in-premises networking:



Thank you.