Progress on FTTR-related projects in CCSA TC6

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CAICT

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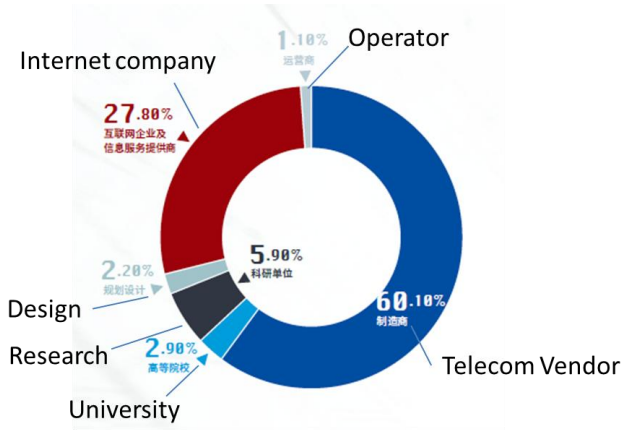
Intro of China Communication Standards association（CCSA）

- CCSA is a non-profit organization in China for carrying out standardization activities in the field of Information and Communications Technology (ICT) across China.
- CCSA has more than 700 members, including Telecom/Internet vendors, operators, institutes and universities.



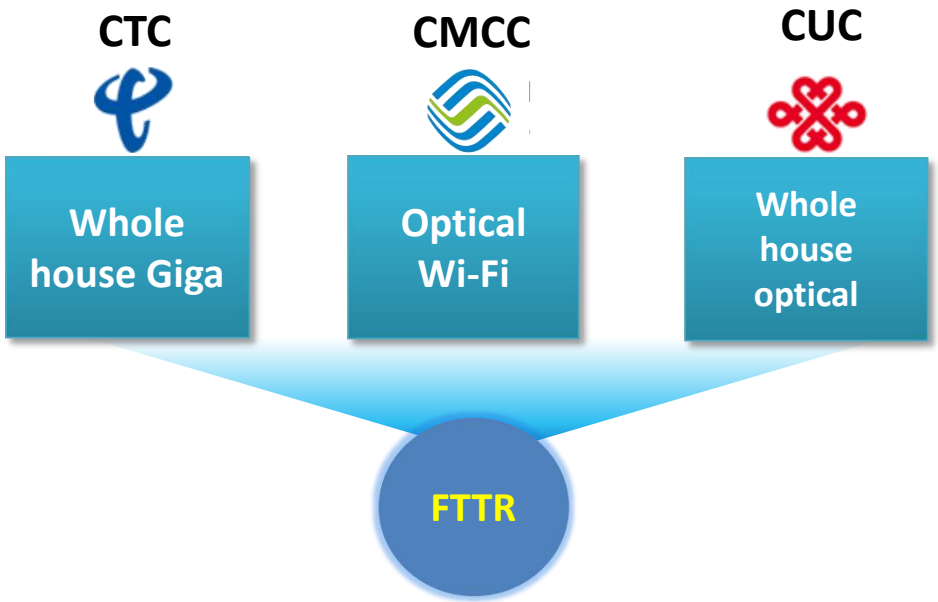
CCSA Technical Committees

- TC1: Internet and applications
- TC3: Network and service capability
- TC4: Power supply and station working environment
- TC5: Wireless communication
- **TC6: Transport and access network**
  - WG1: Transport network
  - **WG2: Access and home network**
  - **WG3: Optical fiber and cable**
  - **WG4: Optical devices**
- TC7: Network management and operation
- TC8: Network & data security
- TC9: Electromagnetic Environment & Protection
- TC10: Internet of things
- TC11: Mobile internet application and terminal
- TC12: Aerospace communication
- TC13: Industrial Internet

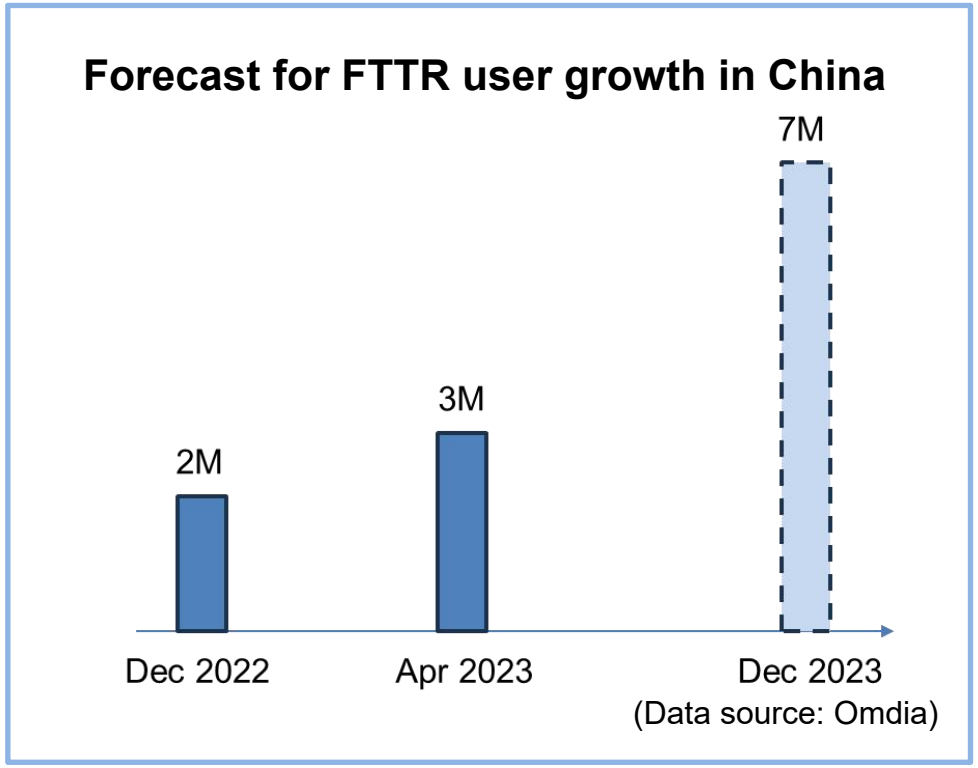
Standardization of FTTR system is in the scope of TC6

FTTR development growing rapidly in China

Operators in China have accelerated the development of higher speed networks and launched FTTR service brands



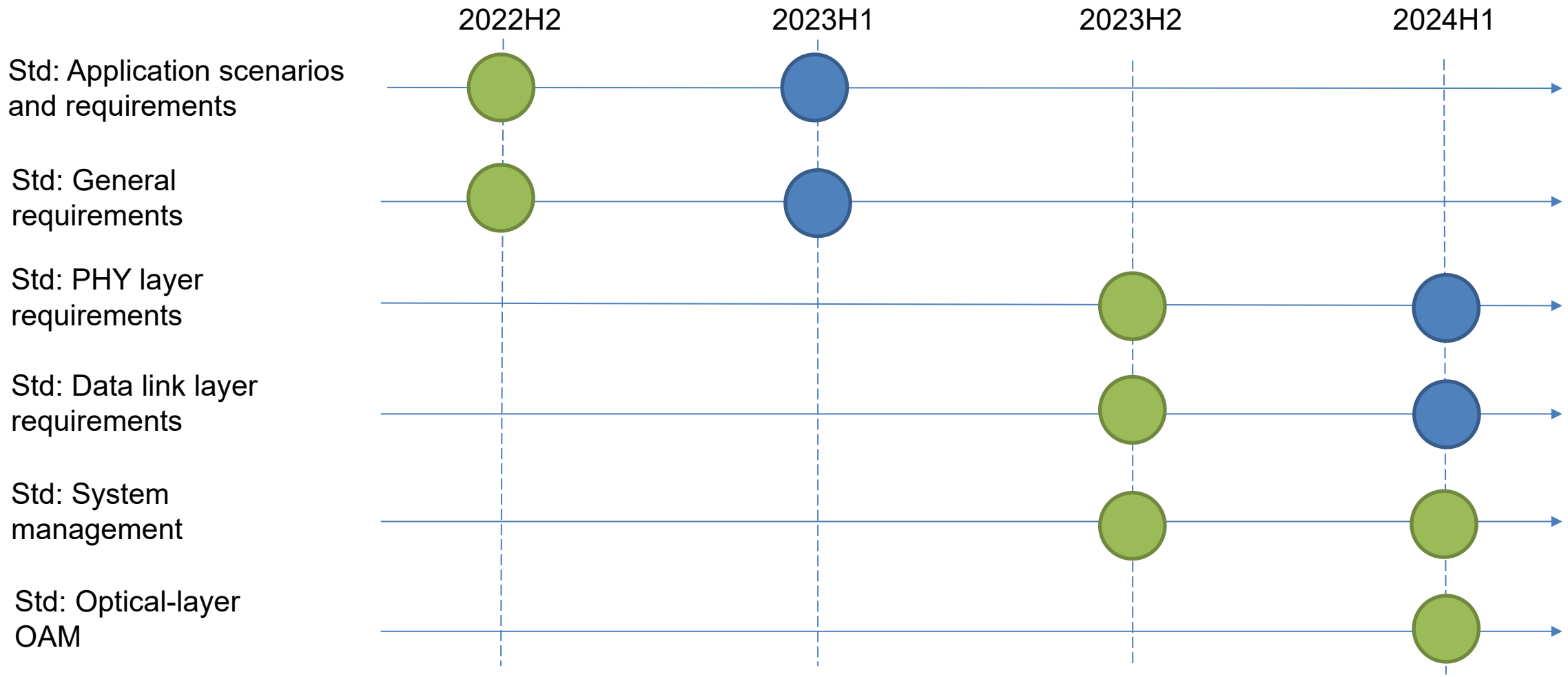
- ✓ full-service operations
- ✓ Acquire high-value users
- ✓ Enhance market competitiveness



Projects related to FTTR in CCSA

WG	Type	Title	Timing
WG2 /TC6	TR	Analysis for FTTR technology research and application (2021)	Finished
	Std	Technical requirements for broadband customer network based on public telecommunication network – FTTR – application scenarios and requirements (2023)	Finished
	Std	Technical requirements for broadband customer network based on public telecommunication network – FTTR – General requirements (2023)	Finished
	Std	Technical requirements for broadband customer network based on public telecommunication network – FTTR – PHY layer	2024Q2
	Std	Technical requirements for broadband customer network based on public telecommunication network – FTTR – DLL layer	2024Q2
	Std	Technical requirements for broadband customer network based on public telecommunication network – FTTR – Network Management	2024Q2
	Std	Technical requirements for broadband customer network based on public telecommunication network – Management and Control coordination based on Optical-layer OAM	2025Q2
	Std	Test methods for broadband customer network equipment based on public telecommunication network Part 6: Fiber to the room system	2024Q4
	TR	Next generation of free space optical communication (2022)	Finished
	TR	Fibre-based networking with integration of 45GHz mmWave Wi-Fi for broadband network (2023)	Finished
	TR	Technical report on end to end slicing by PON and FTTR coordination	2024Q4
WG3 /TC6	TR	Research on Indoor ODN Routing and Technology of FTTR (2023)	Finished
	Std	Indoor optical fibre cables - Part 7：Invisible optical fibre cable (Rev)	2024Q4
	Std	Drop optical fibre cables for telecommunication Part 4: Optical and electrical hybrid cables (2022)	Finished
WG4 /TC6	Std	Optical-electric hybrid connector for telecommunication Part 1: Type SC (2023)	Finished
	Std	Optical-electric hybrid connector for telecommunication Part 3: Type single LC	2024Q4
	Std	Optical-electric hybrid connector for telecommunication Part 4: Type XC	2024Q4

FTTR system standard projects roadmap



Key features agreed in General requirements Std

Optical Network topology

- P2MP, direct connection allowed if only 1 SFU exist
- Support not less than maximum 8 SFUs for Home scenario
- Support not less than maximum 32 SFUs for SME scenario

Rate options

- Symmetric: 2.5G/2.5G, 10G/10G
- Asymmetric: 1.25G/2.5G (for legacy equipment)

Optical path loss

- Class Ra: 0 – 18 dB, Class Rb: 13 – 28 dB

Wave length

- 1.25G/2.5G and 2.5G/2.5G : 1310nm/1490nm
- 10G/10G (class Rb): 1310nm/1490nm or 1270nm/1577nm

Coordination between optical link and Wi-Fi

- Support Centralized Wi-Fi data collection and control

Management framework

- Three northbound management interfaces defined: OMCI based, TR069 based, JSON/MQTT based.

Discussions on current PHY and DLL Std

How 2.5/2.5G equipment backward compatible legacy 1.25/2.5G equipment ? Several schemes are under discussion:

- Rx of MFU could support 1.25G/2.5G dual-rate selection, and only work on one rate
- Rx of MFU could support 1.25G/2.5G dual-rate co-existing in same network
- Tx of SFU could support dual-rate selection for connecting to legacy MFU

How to design optical channels to coordinate Wi-Fi transmission among FTTR gateways

- The FTTR frame structure will based on the GTC or XGTC frame with modification
- A fast channel needed for coordinate Wi-Fi transmission and traffic schedule
- A slow channel needed for Wi-Fi management and configuration

FTTR Evolution : Fiber + 45GHz Q-Band mmWave of Wi-Fi

Use case 1：Wireless Display

- 8K/16K P2P/P2MP transmission
- Support 1ms E2E latency
- Support non-compression video

Use case 2：Cloud Office

- Support P2P/P2MP transmission
- Support 1ms E2E latency
- Support light-compression medium

Use case 3：Network Attached Storage

- Simplified access protocols
- High data rate soft-bus (>10Gbps)
- Plug-and-Play

Use case 4：Auto stereoscopy

- 3D video & audio transmission
- Support 1ms/0.1ms E2E latency
- Support real-time interactivity

Technology evolution

- **Frequency Division Duplex & Time Division Multiple Access**

- FDD：simultaneous downlink & uplink through different channel

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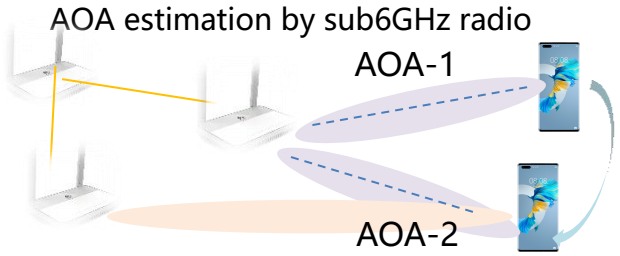
- TDMA: Terminals access the air interface by deterministic order and latency

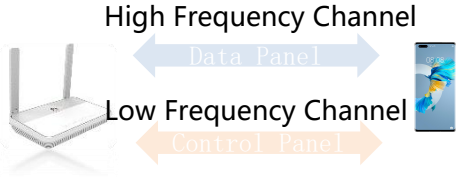
Guaranteed QoE

- **Beam tracking**：positioning based tracking & Non-training tracking



- Sub6GHz assisted AOA estimation and beam selection
- Unified coordinated system to support beam tracking between APs

- **Coordination between sub6GHz & mmWave Channels**



- Sub6GHz assisted roaming and data transmission.
- Sub6GHz based control panel and Q-Band based data panel.

- **Integration with FTTR**

Leveraging the centralized coordination mechanism based on P2MP FTTR to implement single network transmission

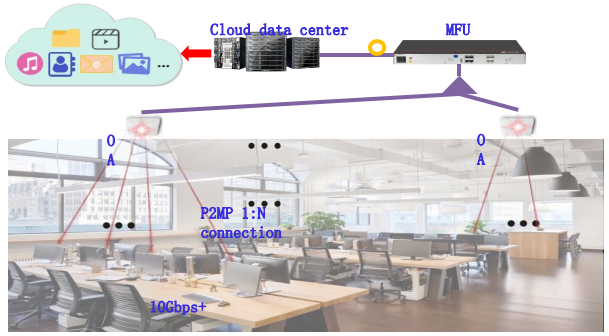
1、Unified radio and optical data transmission management

2、Centralized beam and link management

Source: Technical report “Fibre-based networking with integration of 45GHz mmWave Wi-Fi for broadband network”, CCSA TC6 WG2, 2023

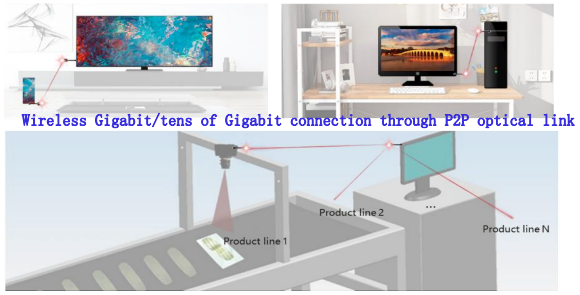
FTTR Evolution : Fiber + narrow-beam OWC

Use Case 1: Cloud-based Office



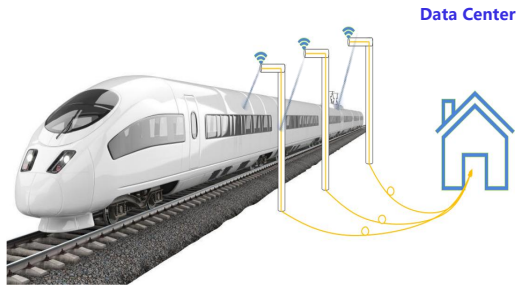
- Ultra-high bandwidth transmission Access of up to 32 or 64 users
- End-to-end low latency <10ms

Use Case 2: Wireless Gigabit Connection



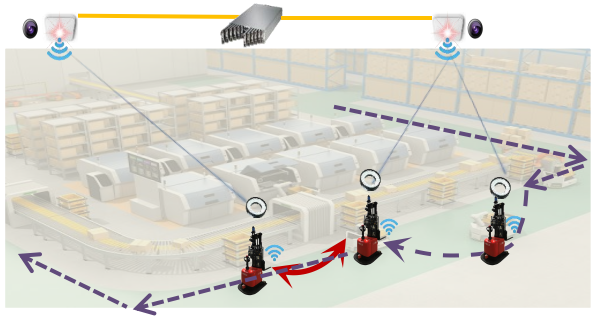
- Up to 10-100G for transmitting un-compressed video stream
- Simultaneous connection

Use Case 3: Station data backhaul



- Fast connection within 1 second
- Transmission bandwidth above 10G

Use Case 4: Precise positioning



- Precise positioning accuracy <5mm
- Delay <2ms，Real-time positioning
- Multi-target positioning and real-time tracking

Technology evolution

- **Point to Point/multi-point communication**

P2P: point-to-point direct Connection.

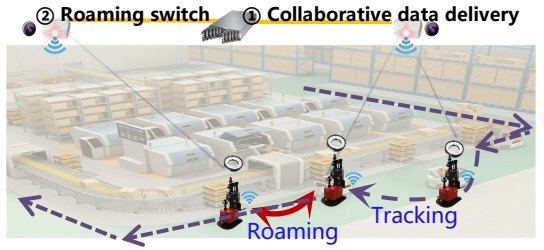
P2MP: AP uses a beam splitter to generate multiple beams, corresponding to multiple users.

- **Narrow beam alignment**: Rough alignment + Fine alignment

Rough alignment
- GPS positioning、3D mapping (privacy scene)
- Camera + Positioning marker (no privacy scene)

Fine alignment
- PD feedback (low-cost scene)
- PSD、QPD、PD-array (quick alignment scene)

- **Tracking and Roaming communication**



Tracking: The device (PSP、QPD、PD-array) feeds back the real-time position, and the beam is deflected to the target position.

Roaming: Multi-AP collaboration to realize precise positioning and switching of users.

- **Integration with FTTR**

Modify the current FTTR protocol to adapt the technology needs

Source: Technical report "Next generation of free space optical communication" , CCSA TC6 WG2, 2022

Thanks