



Review of optics in WP1 and the ION 2030 set of projects

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WP1 major projects under development

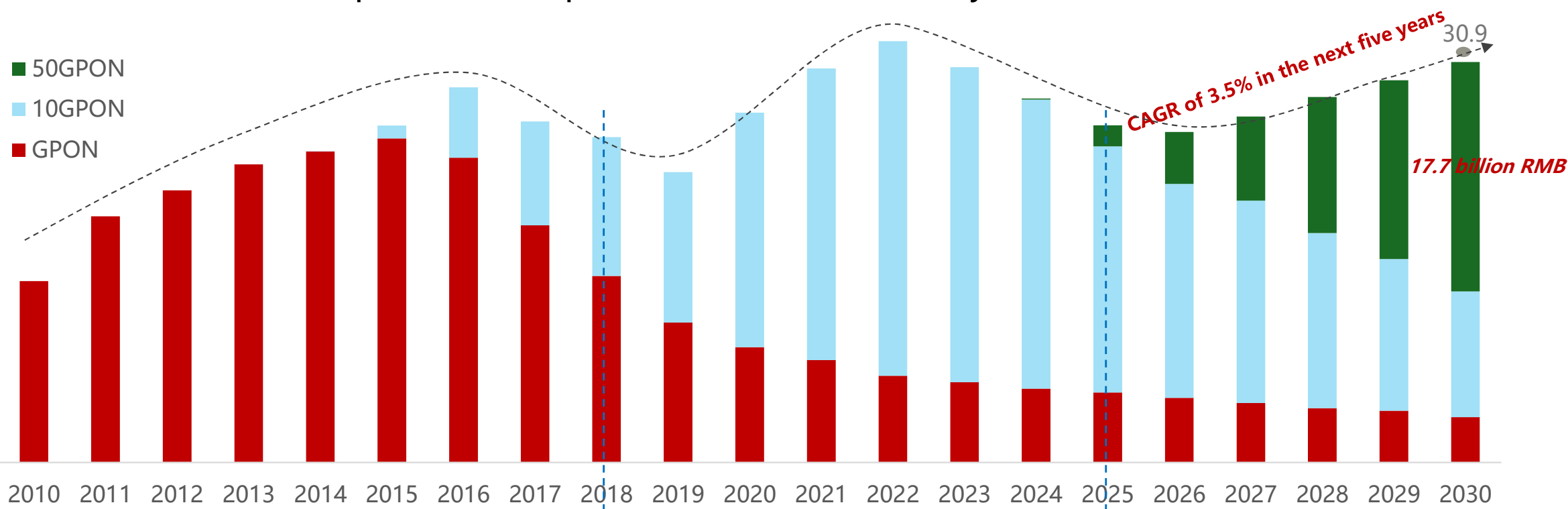
- Working party 1 is responsible for broadband access and home networks
- Passive Optical Network (PON) technology is being developed in Q2/15, in a long series of standards
 - G.982 pi-PON
 - G.983 A/B-PON
 - G.984 G-PON << The most successful PON in the world
 - G.98(0)7 XG(S)-PON << The upgrade system for G-PON
 - G.989 TWDM-PON << First multi-wavelength PON standard
 - G.9804 50G-PON << The upgrade system for XG(S)-PON
 - G.sup.VHSP << What comes after that
- Fiber in-home Network (FIN) technology is being developed in Q3/15
 - G.9930 P2P systems
 - G.9940 P2MP Architecture
 - G.9941 P2MP Physical layer
 - G.9942 P2MP Data link layer
 - G.9943 P2MP Management



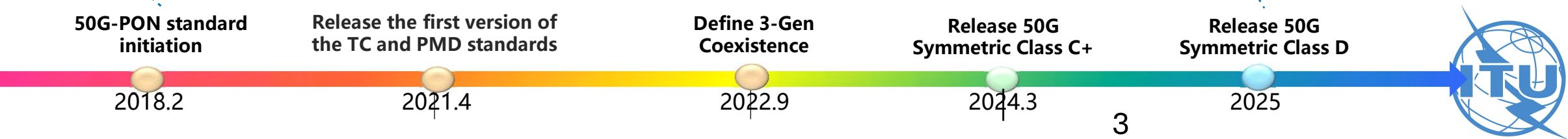
ITU-T 50GPON standard is mature for deployment

In China, 50GPON has started massive deployment since 2025

Estimated 13 million ports will be provided in the next five years (\$2 billion in 2030)

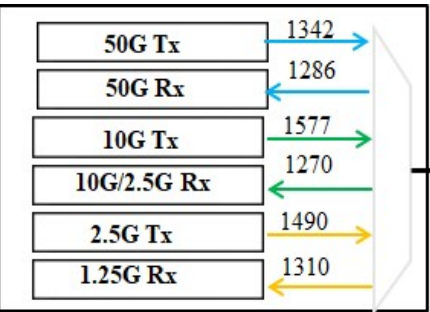


Source: Huawei MI & Omdia

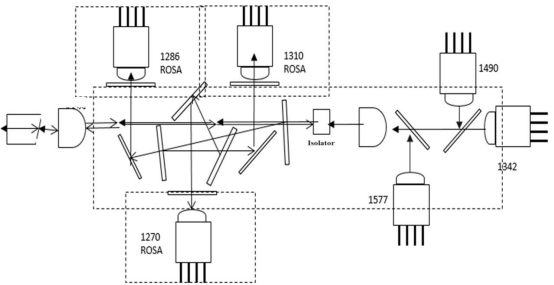


50G-PON Triple and dual generation coexistence Field Trial

50G-PON/XG-PON/GPON MPM field trial

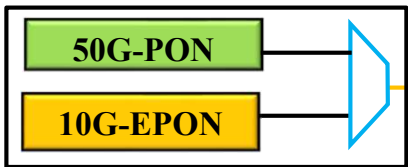


50G/XG/G-PON OLT MPM module



50G-PON/10G-EPON MPM field trial

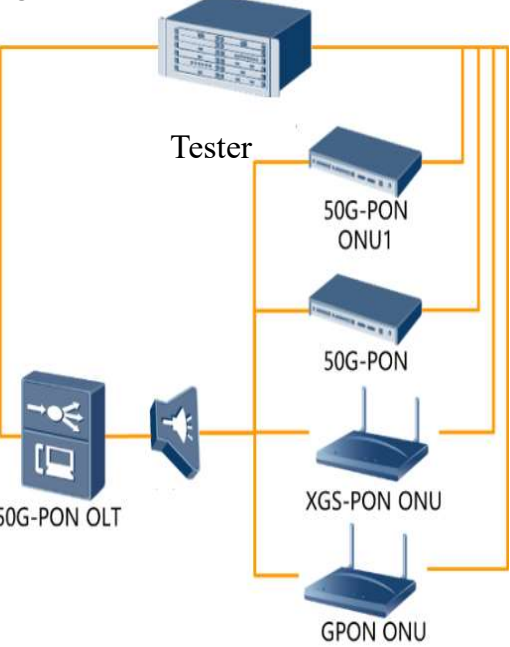
50G-PON&10G-EPON MPM



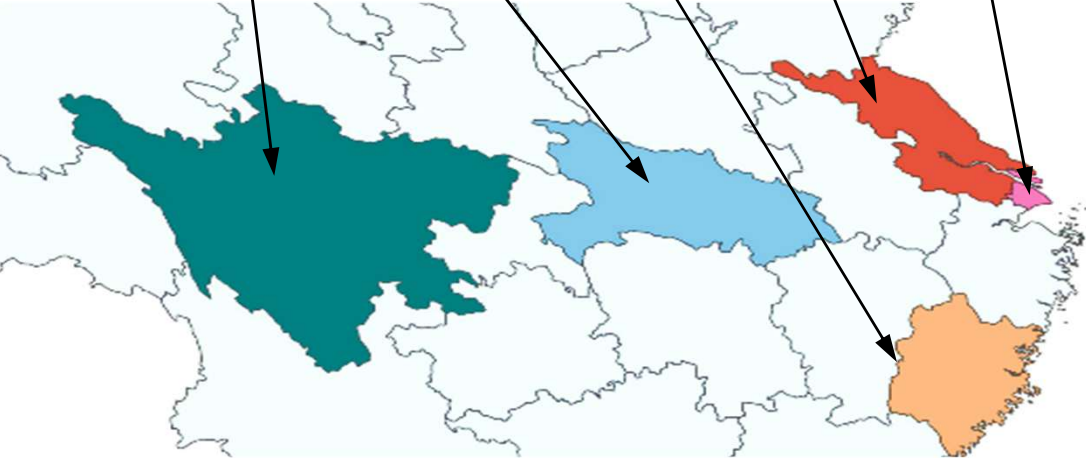
GPON Triple generation coexistence field trial



50G-PON OLT 设备
50G/XG/G MPM
XGS-PON ONU
GPON ONU
50G-PON ONU*2



Sichuan Hubei Fujian Jiangsu Shanghai



Five province 10G-EPON&50G-PON Field Trials with CTC in China

Source : <https://www.c114.com.cn/4app/3542/a1238387.html>

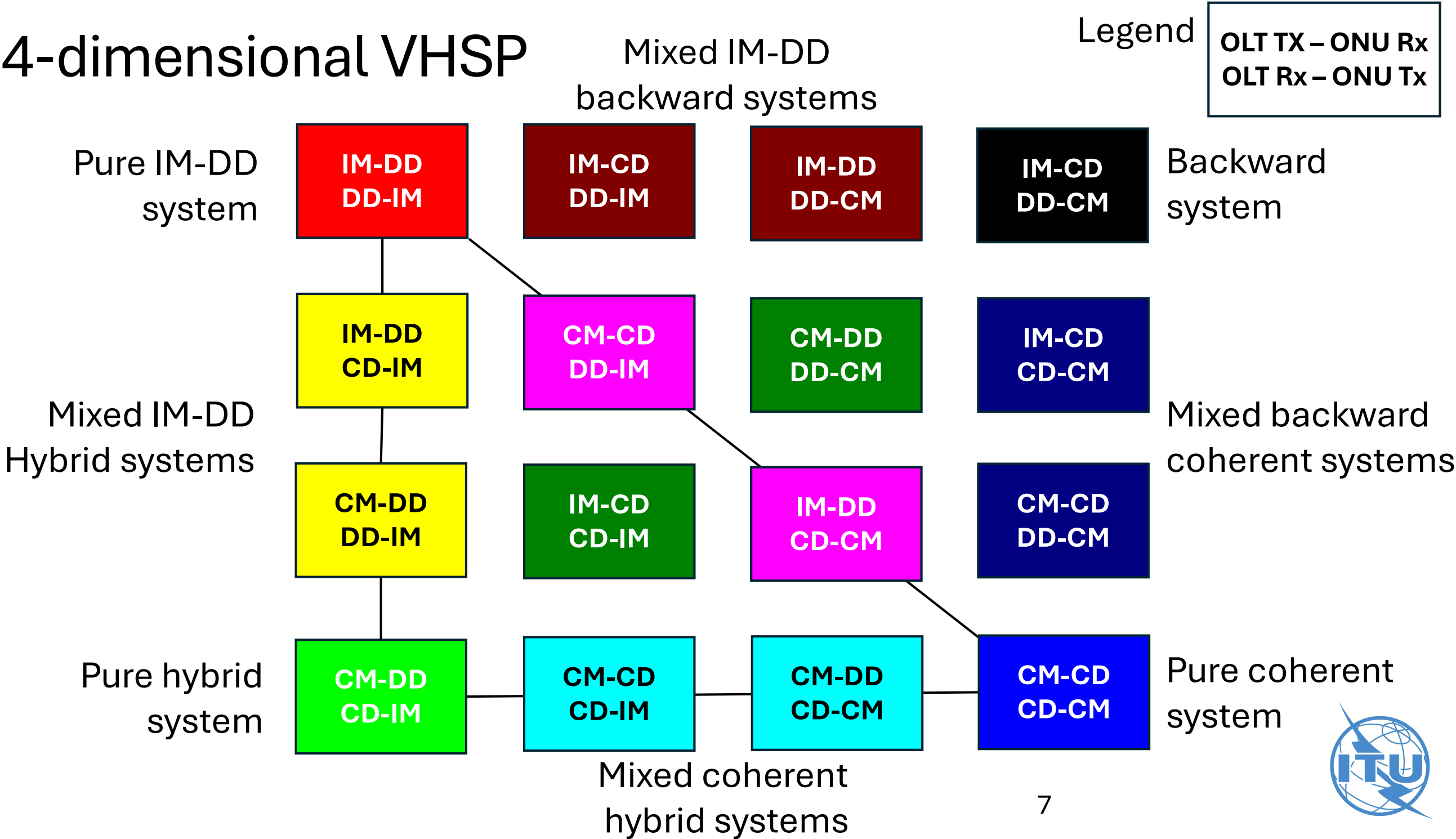


Very High Speed PON supplement

- Now that 50G-PON is moving into deployment, the industry has started work to consider what comes next
- Approximate target is 200 Gb/s system payload capacity, with user interface rates up to 100 Gb/s
- The problem here is 200 Gb/s IM-DD is technically difficult using the same PON infrastructure
 - G.652 fiber dispersion becomes a very significant issue
 - Supporting ~30 dB loss budget continues to raise the difficulty
- Three major approaches are elaborated
 - IM-DD: Low cost, but reaching the limits of the fiber channel
 - Coherent: Very good performance, and a price tag to match
 - Hybrid: Trying to combine the best of IM-DD and Coherent



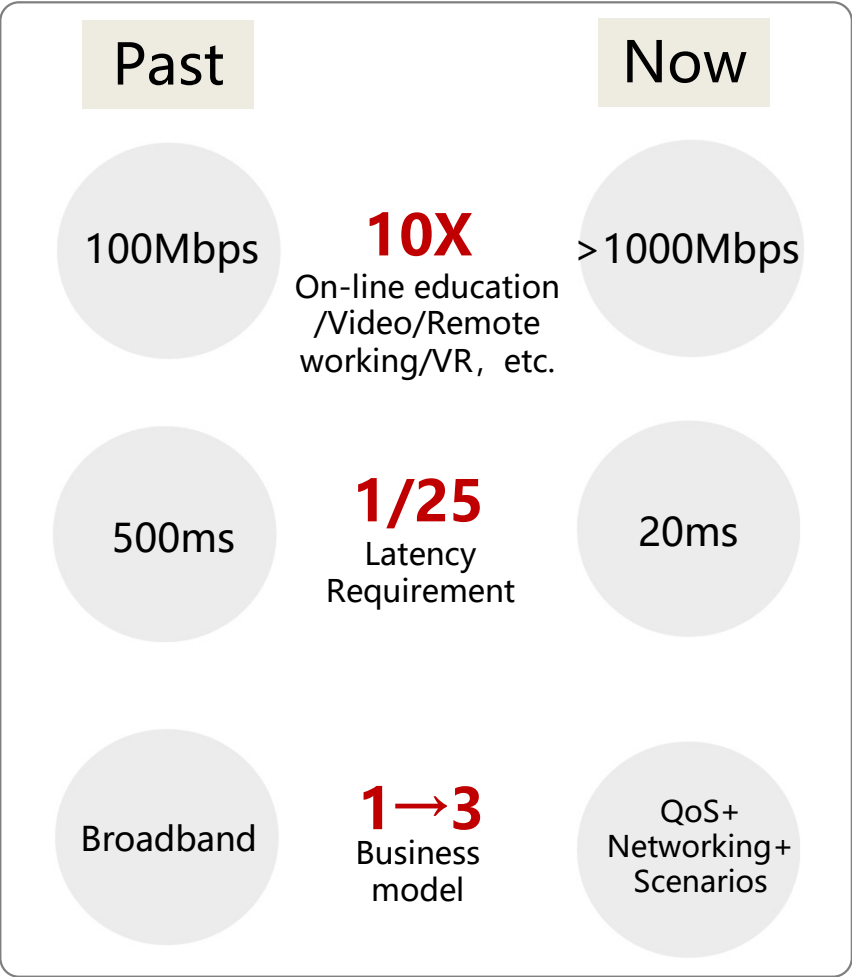
4-dimensional VHSP



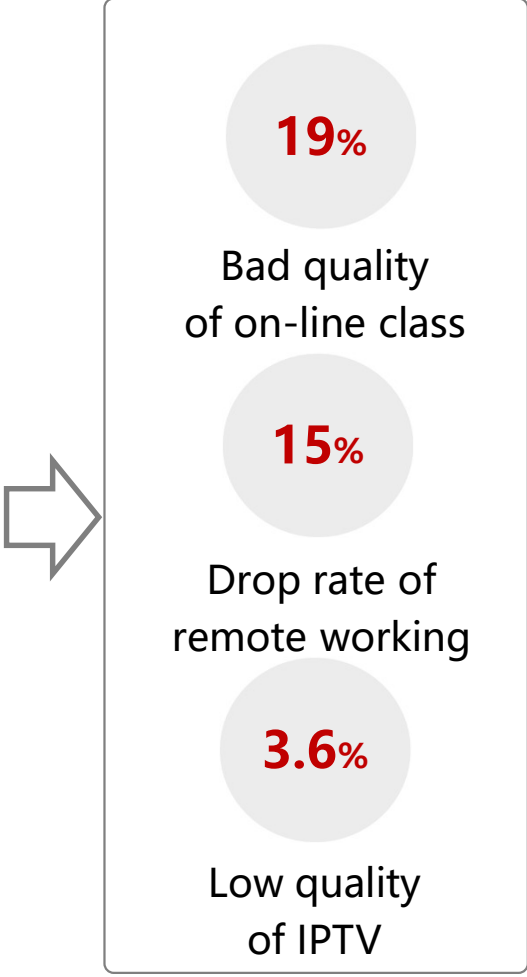
Current issues for high-quality giga home broadband

Evolving Home Broadband

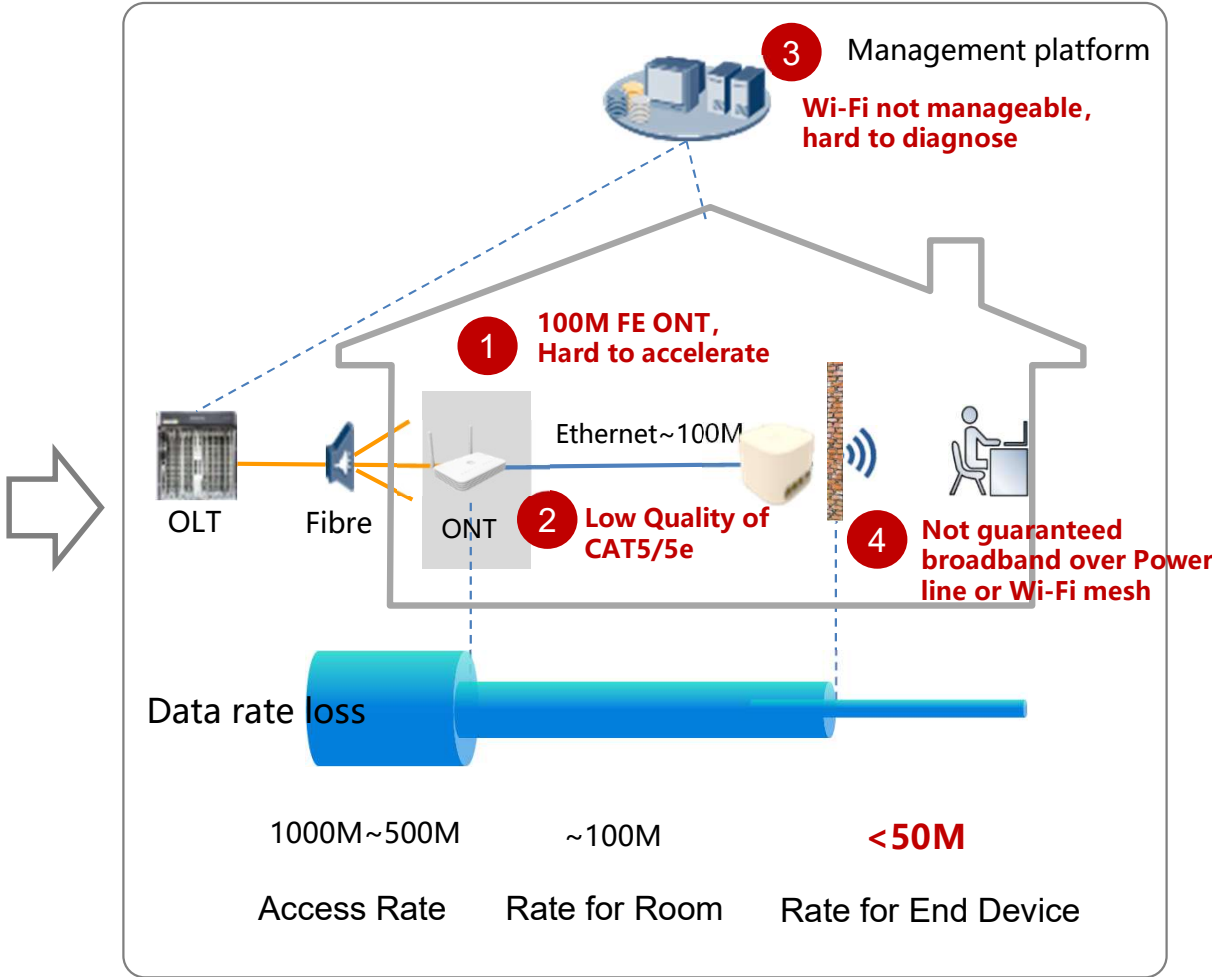
Requirements



Bad Experience under Current Home Network



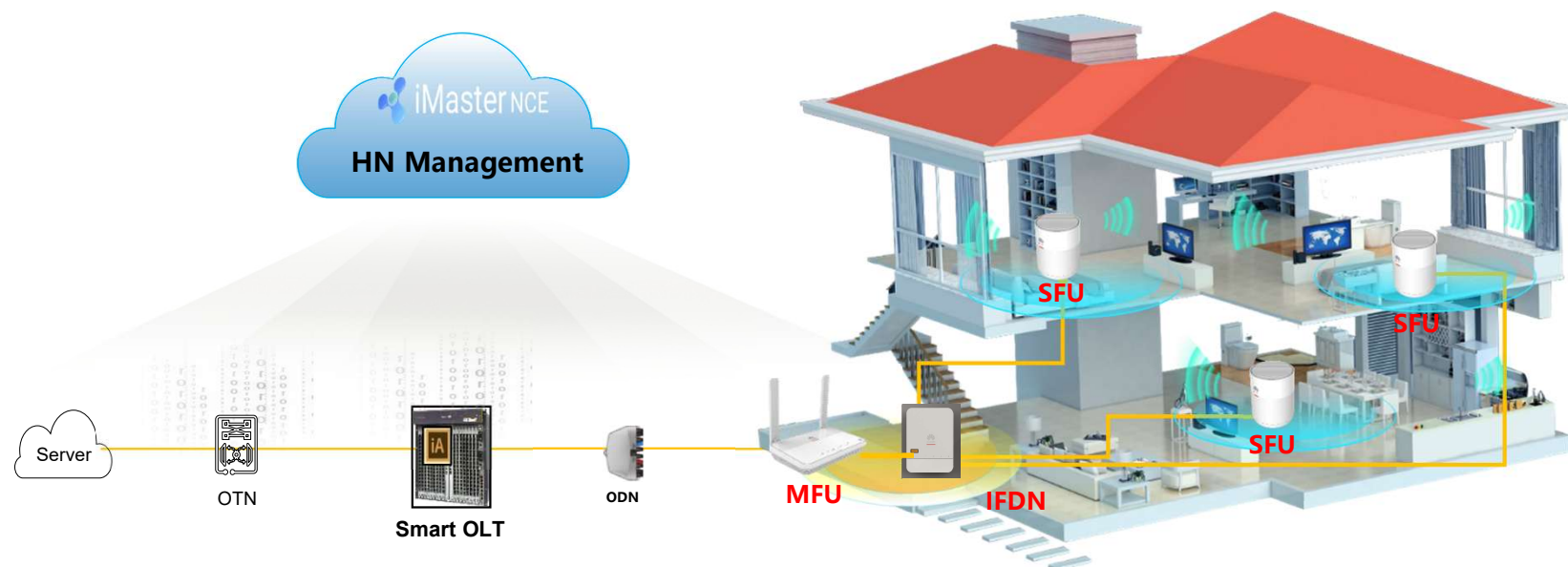
4 key factors affecting Giga Broadband experience



Example FTTH in China: Fibre is only to gateway device. Access is around 200M for 70% cases. But, average downloading speed is around **41Mb/s** (2020 Report of Broadband Development Alliance)

FTTR: Provide Stable Giga Broadband

FTTR Giga Home Broadband Vision



10X↑ Coverage
16 Wi-Fi AP, 256 STA

10X↑ Throughput
100M→1000M+

0 Roaming failures
Switching time
 $2s \rightarrow < 50ms$

Available
diagnostics
Intelligent operation

Full Fibre Connection

- Fibre extends to Rooms
- Smart ODN

Giga Broadband Coverage

- Wi-Fi6 160 MHz
- Giga rate to STA

Wi-Fi Roaming

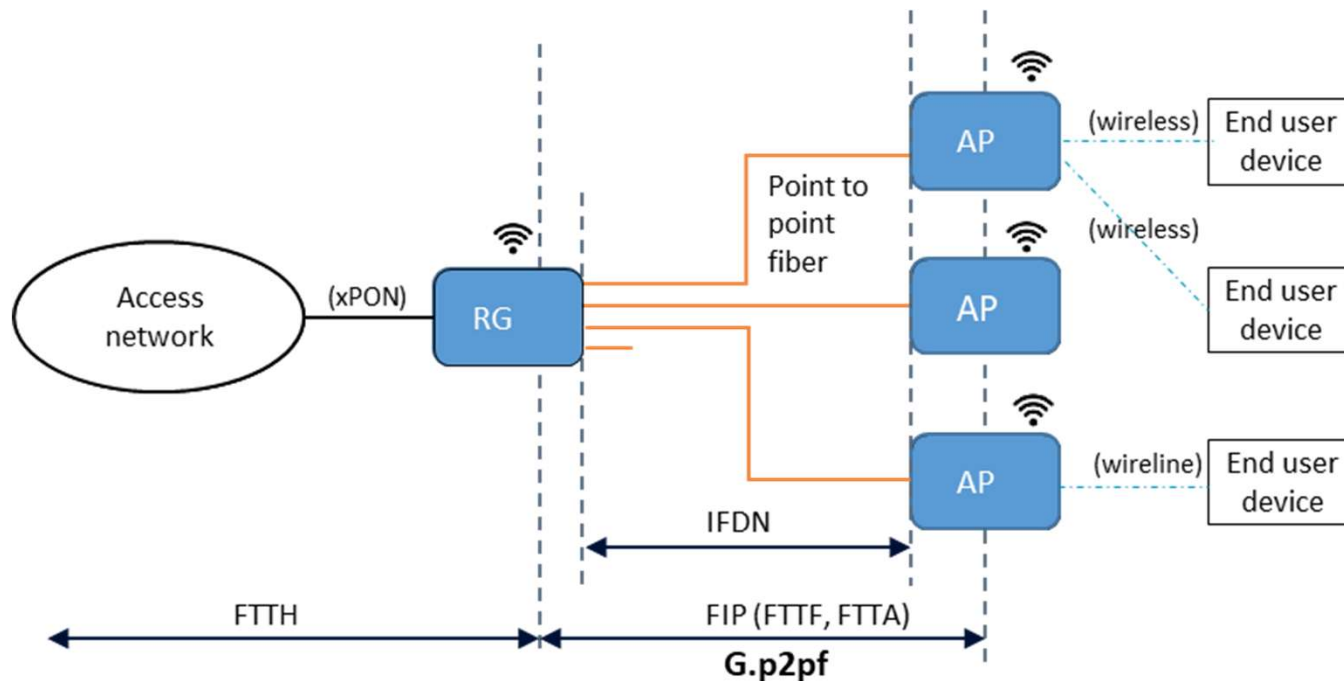
- Seamless roaming
- Switch time <10 ms

Intelligent operation

- Intelligent operation, devices visibility, easy diagnostic



G.9930 Point to Point Architecture



Description

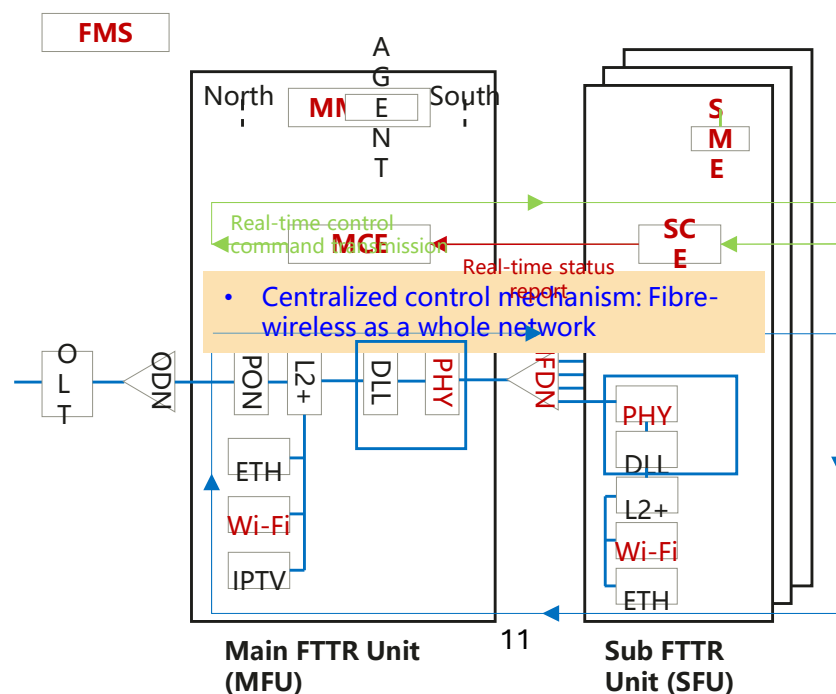
- Optical Ethernet connections are used for connecting RG and repeaters
- Two types of connectivity:
 - RG/Repeaters are connected directly to the fibre infrastructure (IFDN) using devices with optical outputs
 - RG/Repeaters are connected to external optical/electrical converters using Ethernet. In this case, an external switch is needed on the RG side

Source: G.9930 draft – Under review in the approval process

G.994x: Fiber In-home Network

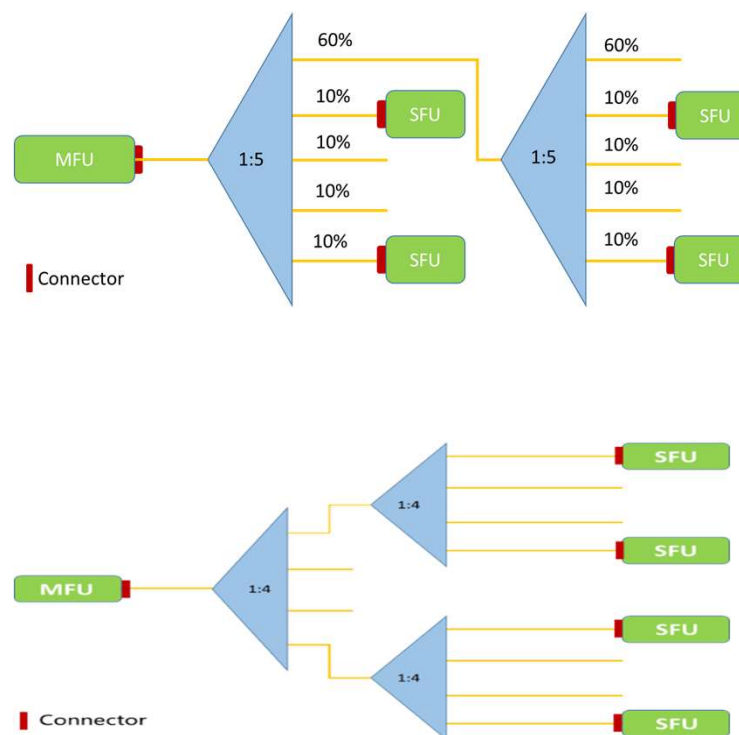
G.9940: Architecture

- P2MP network that leverages many of the constructs



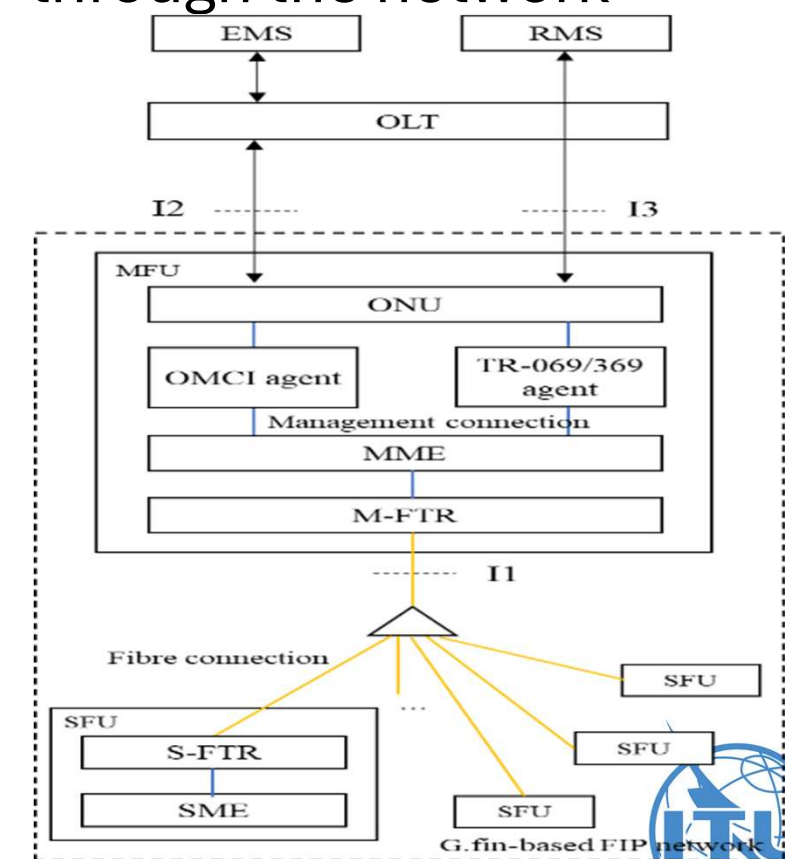
G.9941: PHY layer

- Optical interfaces for interoperability

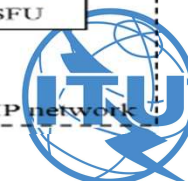


G.9942: DLL

- Defining the data flows through the network



G.9943: Management



The nature of access demand

- Most access networks are residential, and it drives the general level of system bandwidth
- Residential services largely revolve around delivering video streaming to the occupants of the home
 - The amount of video that can be consumed by a human is limited
 - 100 Mb/s per person is going to saturate this application
 - Supposing 200 users per PON, this amounts to 40 Gb/s per PON
- Indeed, what we see in the market is a saturation of bandwidth demand from consumers
- To overcome this, we must go beyond feeding eyeballs
 - Not just a distribution system, but an intelligence creation system
 - Not just providing telecom services, but generating value for customers
 - In short: we need to integrate with the new technology

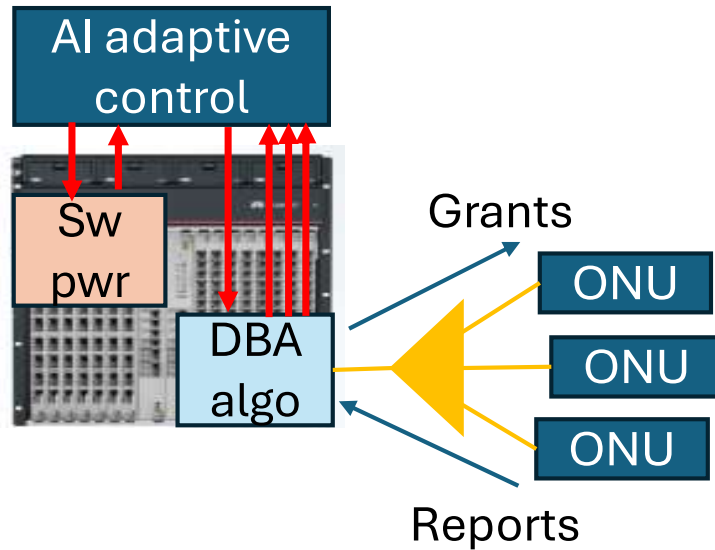
AI and Broadband access and home

- As we can see now, AI has demonstrated a nearly insatiable demand for bandwidth, processing, memory, power, space
 - The current mania is probably an exaggeration, but too big to ignore
- Technologies that don't figure out how to fit into this new world will likely suffer
 - At best, a lack of investment and resources
 - At worst, a replacement with alternatives
- In its initial development, AI has been confined inside the data center, with relatively little bandwidth into the network
- How can AI and broadband access networks work together?
 - AI can serve the network: enhancing and automating existing functions
 - The network can serve AI: provide a more distributed computing platform
 - And together they can support new services to open new revenue streams

AI for Broadband

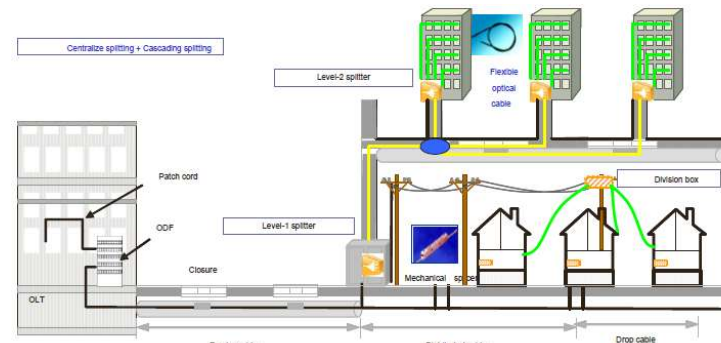
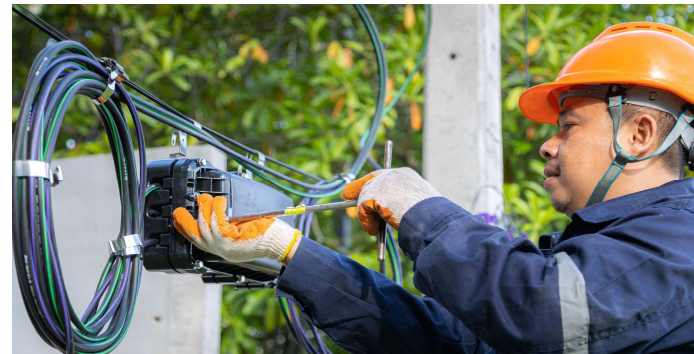
- AI for DBA / power

- Now: Static algos working on direct BW reports
- New: Dynamic algos using a wide range of inputs, predictive performance



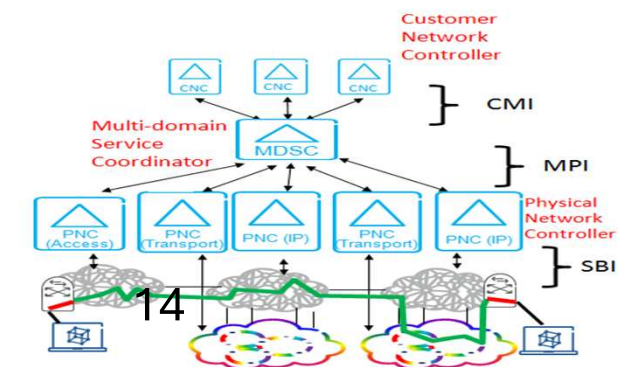
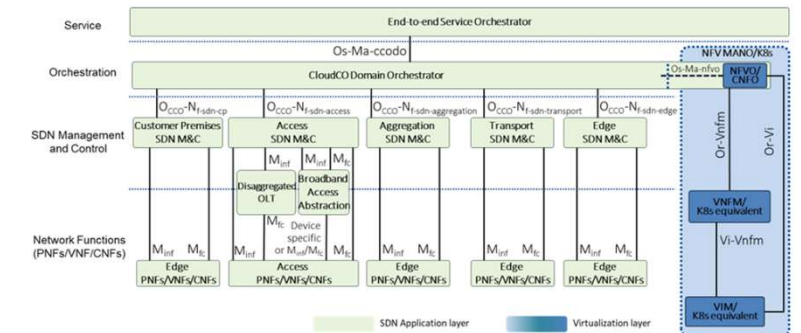
- AI for deployment

- Now: Human designers, automation, and legacy
- New: AI working to digest all data, reveal meaning, and produce designs



- AI for management

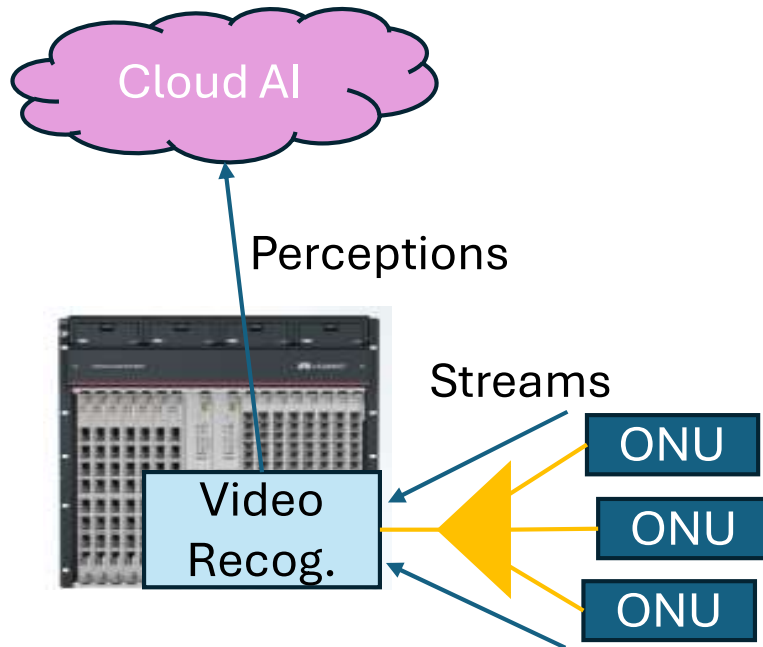
- Now: Controllers and APIs manually integrated
- New: Interfaces and algorithms become dynamic and interactive



Broadband for AI

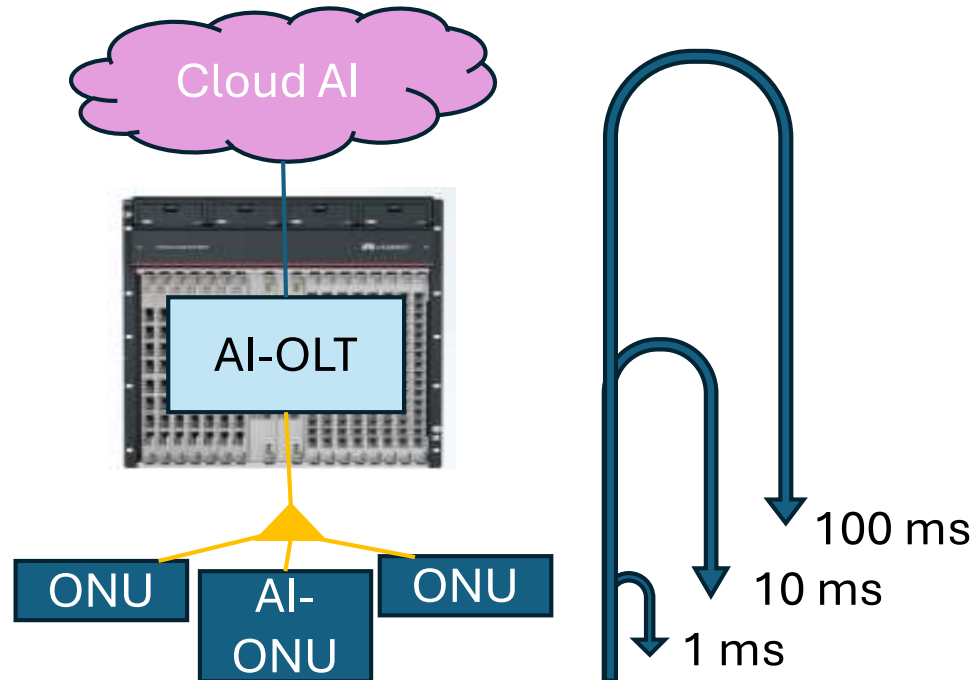
- AI-OLT for privacy

- Now: Private streams sent over network, security issue
- New: Machine vision keeps streams local, sending only summary perceptions



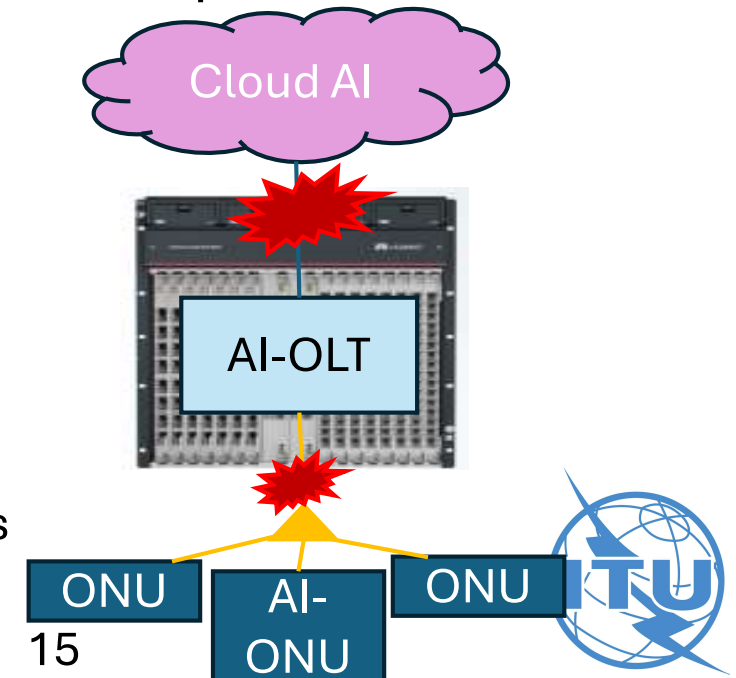
- AI-OLT for latency

- Now: All workflows cross the entire network (100 ms)
- New: Workflows to OLT (10 ms) or to ONU (1 ms)



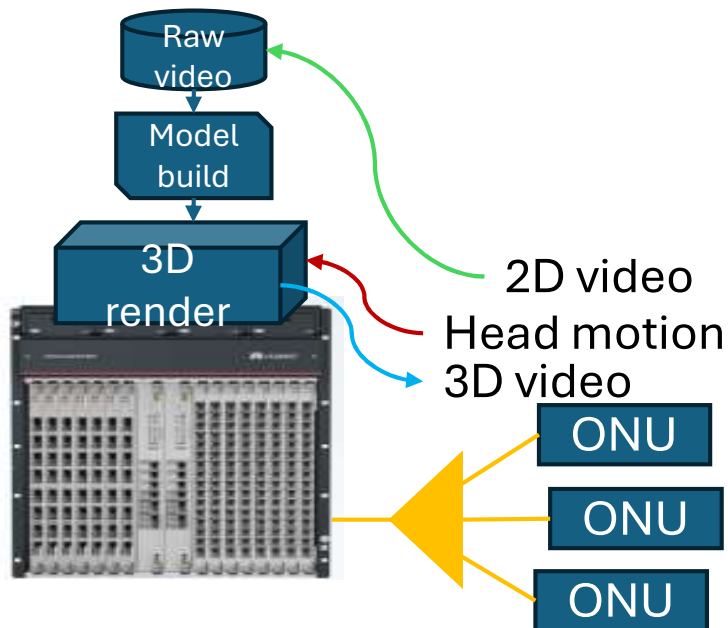
- AI-ONU for reliability

- Now: Cloud-based AI depends on network
- New: Distributed AI gives users multi-levels of reliable backup

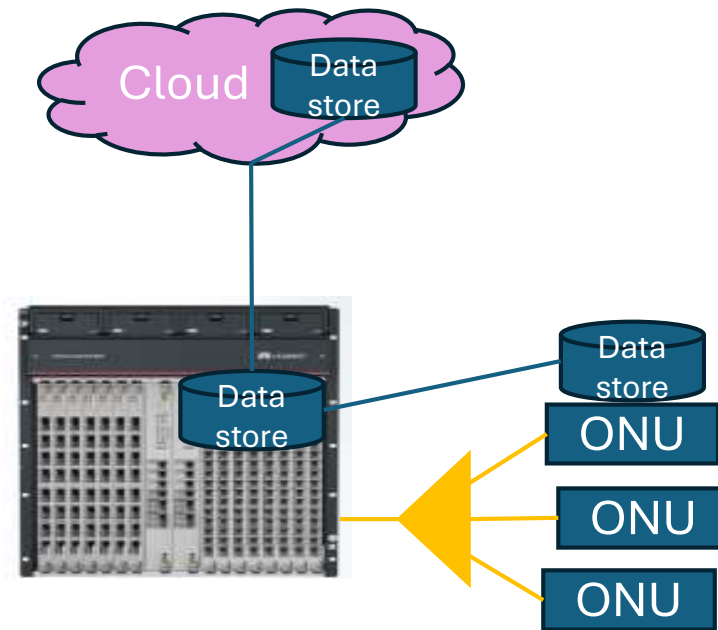


AI Broadband services

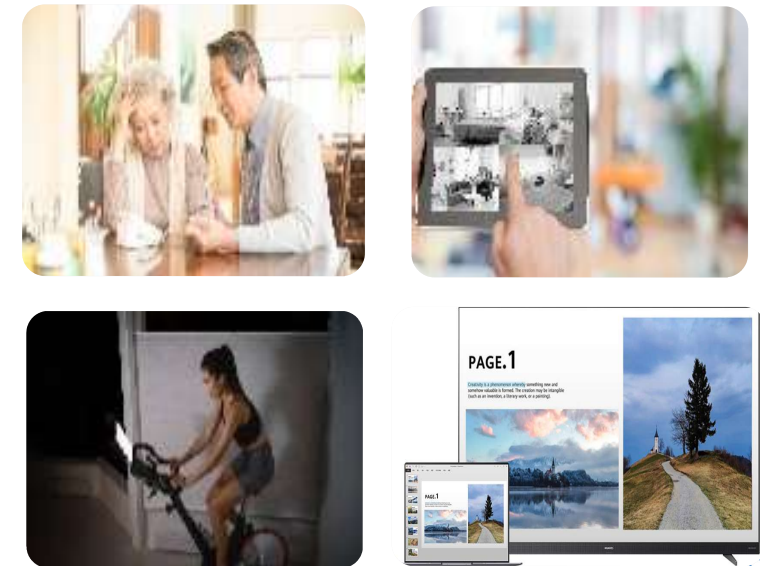
- 2D to 3D video
 - Now: 3D content scarce, specialized cameras
 - New: User's own video can be converted into 3D experiences live



- User storage
 - Now: User's data cloud largely beyond control
 - New: User's data remains much closer to home, under better control



- Child/Elder-care
 - Now: Large and growing need for care
 - New: AI agents can privately monitor occupants, and alert if something is wrong



ITU-T SG15: ION 2030 family of documents

- Initiative was kicked off in March 2025, with GSTR-ION 2030 “International Optical Networks towards 2030”
 - Intended to guide SG15 work on systems and networks, end-to-end
 - While the “I” is for international, it can also mean “intelligent”
 - Project was completed in record speed: Oct 2025
- This first step has spawned several related projects, each focusing on the implications for the technologies in the various questions
 - GSTR-ION-aiDC in Q6/15: Optical interfaces
 - G.sup.ION-aiBB in Q2/15: Access networks
 - G.sup.ION-aiHome in Q3/15: Home networks
- We expect that each of these will spawn a further set of recommendations to continue the technical development



Thank you

