FTTH PROJECT

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FTTH Solution Overview

Huawei Technologies Co., Ltd.

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Updates

Doc version	Publish Time	Change Description
01-02	2013-2014	First release of FTTH solution overview.
03	2015.06.08	First version for new contents, new style. 9 solution of smart interconnect, smart service and smart OAM of FTTH are introduced.
04	2015.07.30	Correct 10G PON specification mistake. Delete HG9021 of Hybrid ONT.
05	2016.01.20	Add TMS in Acronyms. Update Hybrid ONT and ONTs for Any Port Any Service. Correct some mistakes.
06	2016.07.20	Update the 10G GPON hardware.
07	2016.12.30	Updated the IODN device information.
08	2017.05.20	1. Delete “Fast Connection to Users Through Hybrid ONT” 2. Update AP Products

FTTH Network Architecture

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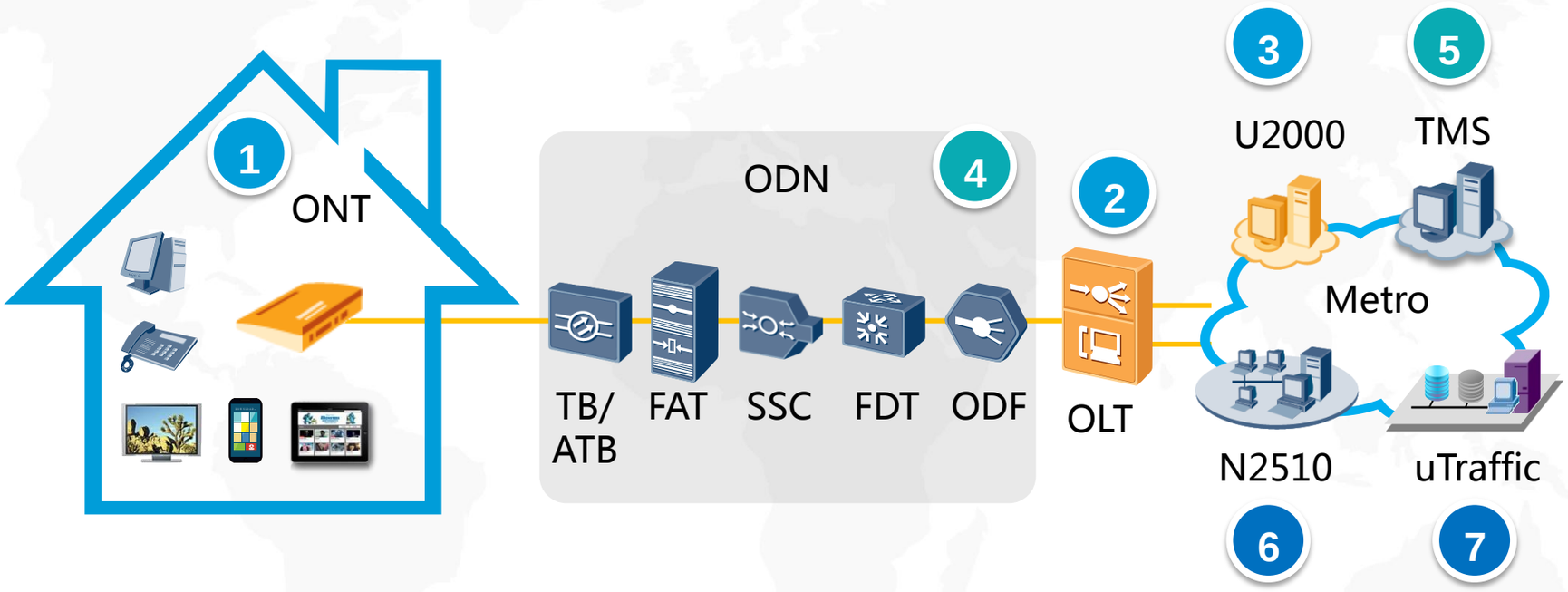
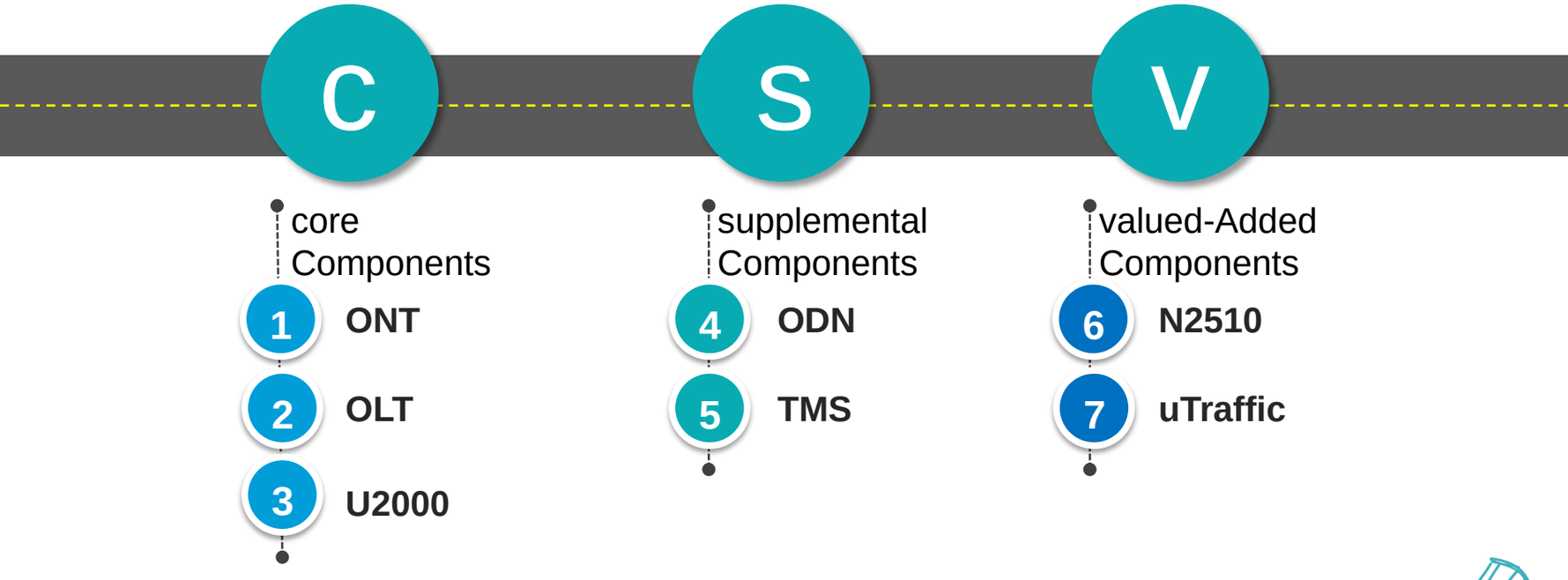
FTTH Network Architecture



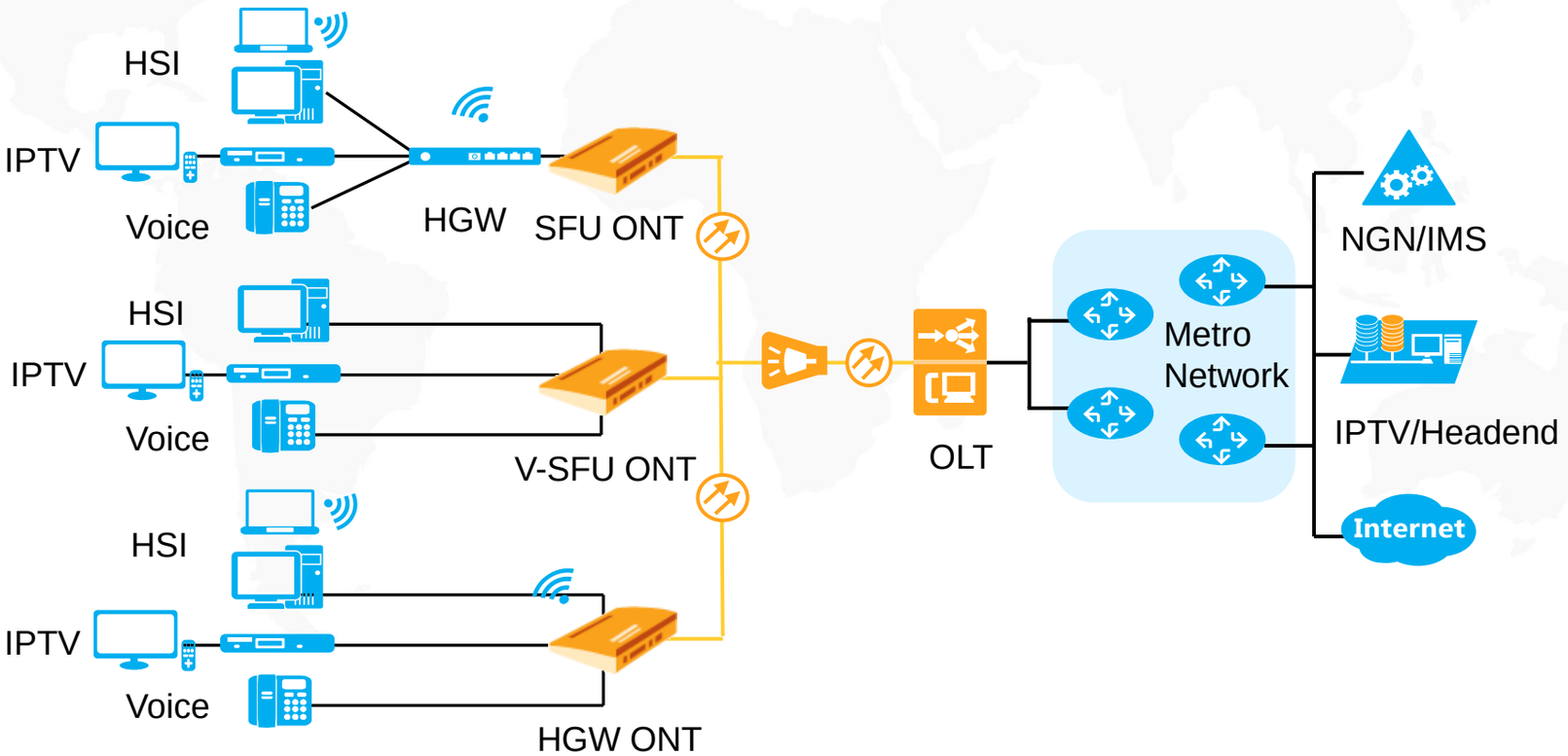
Seven Major Components of an FTTH Network



FTTH Typical Networking

FTTH Typical Networking

FTTH has the following three typical networking models. SFU ONT can be regarded as a pipe providing L2 data and voice services. HGW ONT provides L3 services; it is the center of a manageable home network and can be regarded as the "tap" of the smart pipe.



1 Bridging-type ONT+HGW

Equipped with a built-in IAD, HGW provides users with Internet access, VoIP, and IPTV services. The bridging-type ONT works with the OLT to provide L2 channels.

2 Bridging+Voice-type ONT

Equipped with a built-in IAD, the ONT provides users with L2 data services and voice services. This scenario provides transparent transmission channels and requires simple service configuration, so this scenario applies to L2 networking.

3 Gateway-type ONT

Equipped with a built-in IAD, the ONT provides services to users. The gateway-type ONT can provide L3 services such as DHCP/ PPPoE dial-up, NAT, and IGMP snooping, facilitating device interconnection in a house.

Wi-Fi Coverage for Homes

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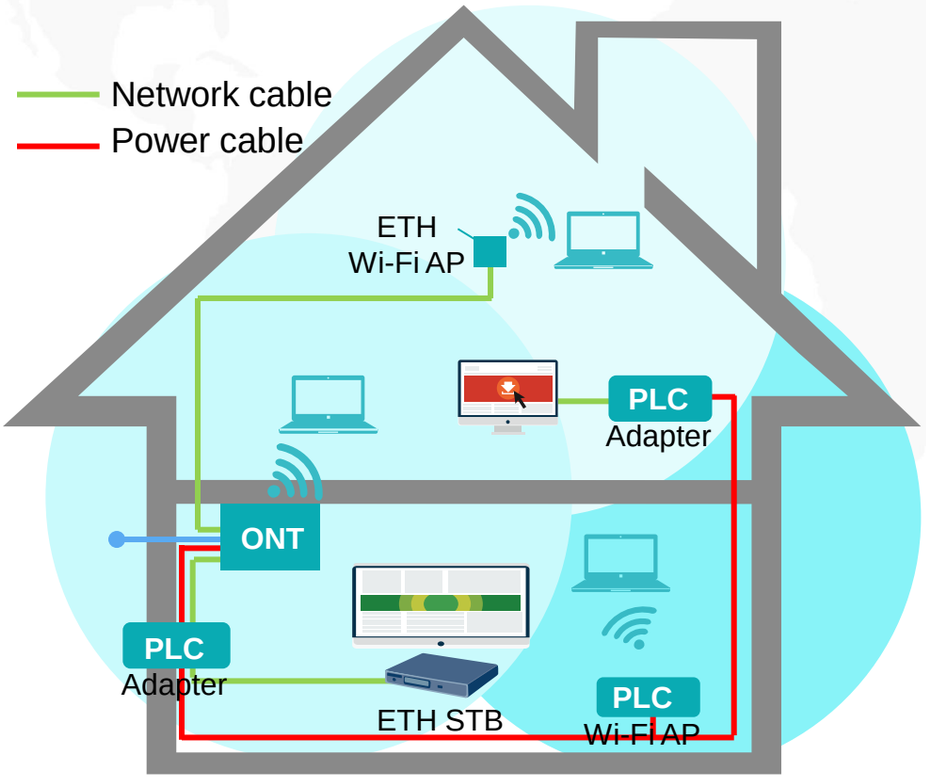
ONTs with Wi-Fi capabilities can address the needs of most households for Wi-Fi services. However, for large houses or villas, a single ONT cannot provide indoor Wi-Fi coverage for the entire house. So, how to tackle this problem?

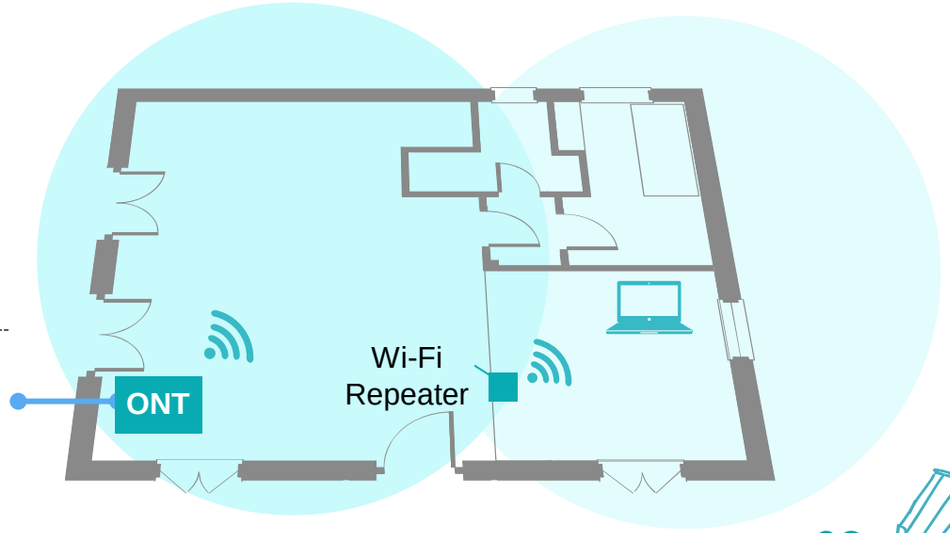
Huawei Solution



1 In areas with power cables, Wi-Fi signals can be extended using PLC adapter+PLC AP.

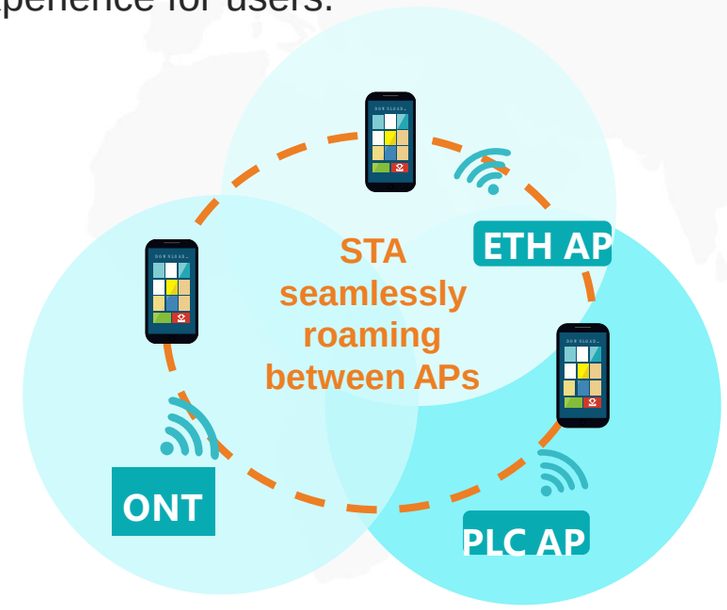
2 In areas with network cables, Wi-Fi signals can be extended using ETH AP.

3 In areas without network cables or power cables, Wi-Fi signals can be extended using Wi-Fi repeaters.



Huawei's AP Solution for FTTH

Huawei provides an AP solution for implementing FTTH. The solution enables plug-and-play (PnP) APs and allows mobile terminals to seamlessly switch between APs, delivering better Wi-Fi experience for users.



■ External PnP APs

Set the required SSID information for each AP on the ONT. After the external AP connects to the ONT, the ONT automatically issues the SSID parameters (such as SSID name, authentication/encryption mode, and password) to the AP, and the AP can be directly used without requiring any manual configuration.

■Stations (STAs) seamlessly roaming between APs

- As an STA is on the move, it receives weakening signals from the original AP. In such a case, the STA will automatically disconnect from the AP and connect to an AP with stronger signals. When connecting to the new AP, the STA uses an SSID the same as that of the original AP on the ONT. Therefore, the STA does not require re-configuration.
- The IP addresses of STAs are centrally assigned by the ONT (external APs connected to ONT in bridge mode) and will not change when the STAs are mobile terminals. This eliminates the need for obtaining a new IP address and ensures fast switching, thereby implementing seamless roaming.

Wi-Fi Coverage for Homes

AP产品

Supported only when the AP works with Huawei smart home gateway(e.g. HS8245W)

Product	Description	Appearance
PA8010	G.hn Gigabit Powerline Adapter G.hn PLC +1GE (Upstream and downstream to each other, interchangeable)	
PA8011V	G.hn Gigabit Powerline Dual-Band Wi-Fi AP Upstream: G.hn PLC (supports MIMO) Downstream: 1 GE+ 2.4G Wi-Fi + 5G Wi-Fi Notes: Better performance when the STA supports 802.11k or 802.11v	
WA8011V	AC1200 Dual-Band Wi-Fi Gigabit AP Upstream: 1GE/5G Wi-Fi Downstream: 1GE+2.4G Wi-Fi+5G Wi-Fi Notes: Better performance when the STA supports 802.11k or 802.11v	

Any Port Any Service

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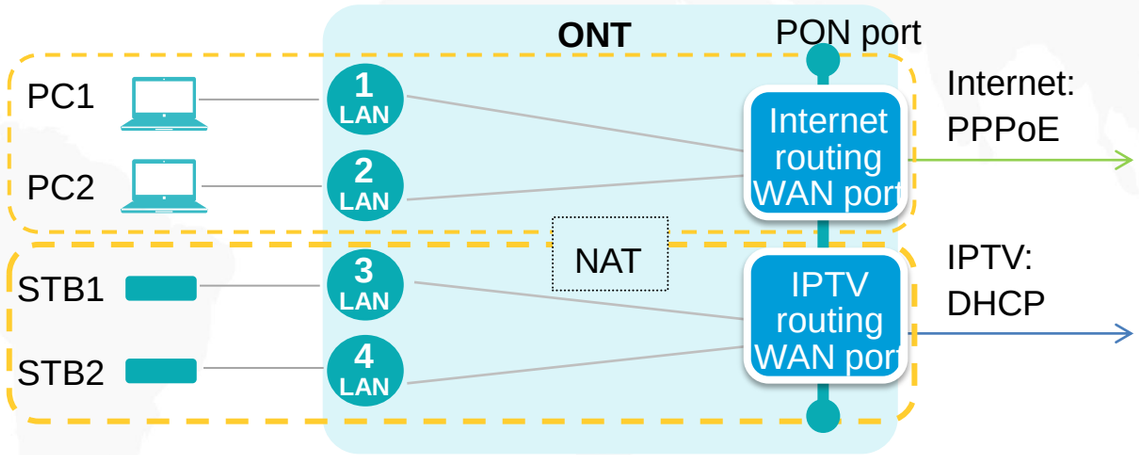
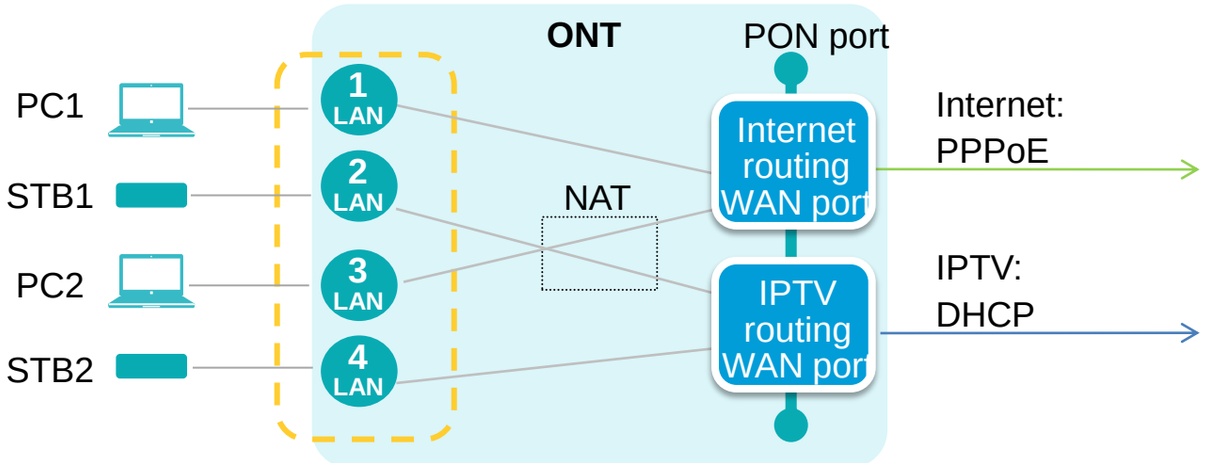
In FTTH applications, services such as IPTV, Internet access, and VoIP are provisioned to users through ONT Ethernet ports. However, IPTV and Internet service terminals need to be bound to the respective ports, and users usually make wrong connections because the mappings between ONT Ethernet ports and services are not clear to them. Is there any solution to improve the ease of use in this scenario?



Huawei Solution

Huawei ONTs implement Any Port Any Service using the DHCP option 60 and full tunnel modes. User terminals such as PCs and STBs can be connected to any Ethernet port of the ONT, and then the ONT automatically binds the port to the corresponding service based on the user's connection. This solution improves user experience and drives down related OAM costs for operators.



Any Port Any Service

Implementing Any Port Any Service

- **By using DHCP option 60:** Services of the devices connected to the ONT are identified by DHCP option 60, for example, IPTV (STB), and Internet (PC, laptop). ONT identifies the service type according to the DHCP option 60 information, and forwards the packets to the routing WAN port (IPTV WAN or Internet WAN) bound with the corresponding service type.
- **Using the full tunnel mode:** The destination IP address or domain name is the only flag for differentiating service WAN ports. Packets carrying different destination IP addresses or domain names are forwarded through different WAN ports. The DHCP server sends DHCP option 121 information to the ONT WAN ports for defining static routes.

ONTs Supporting Any Port Any Service

Product	Access Port Specifications	DHCP Option 60	Full Tunnel
HG8245H	4GE+2POTS+1USB+Wi-Fi	Y	N
HG8247H	4GE+2POTS+1RF+1USB+Wi-Fi	Y	N
HG8245Q	4GE+2POTS+2USB+2.4G/5G Wi-Fi	Y	N

Sharing Hotspots Through Home Wi-Fi

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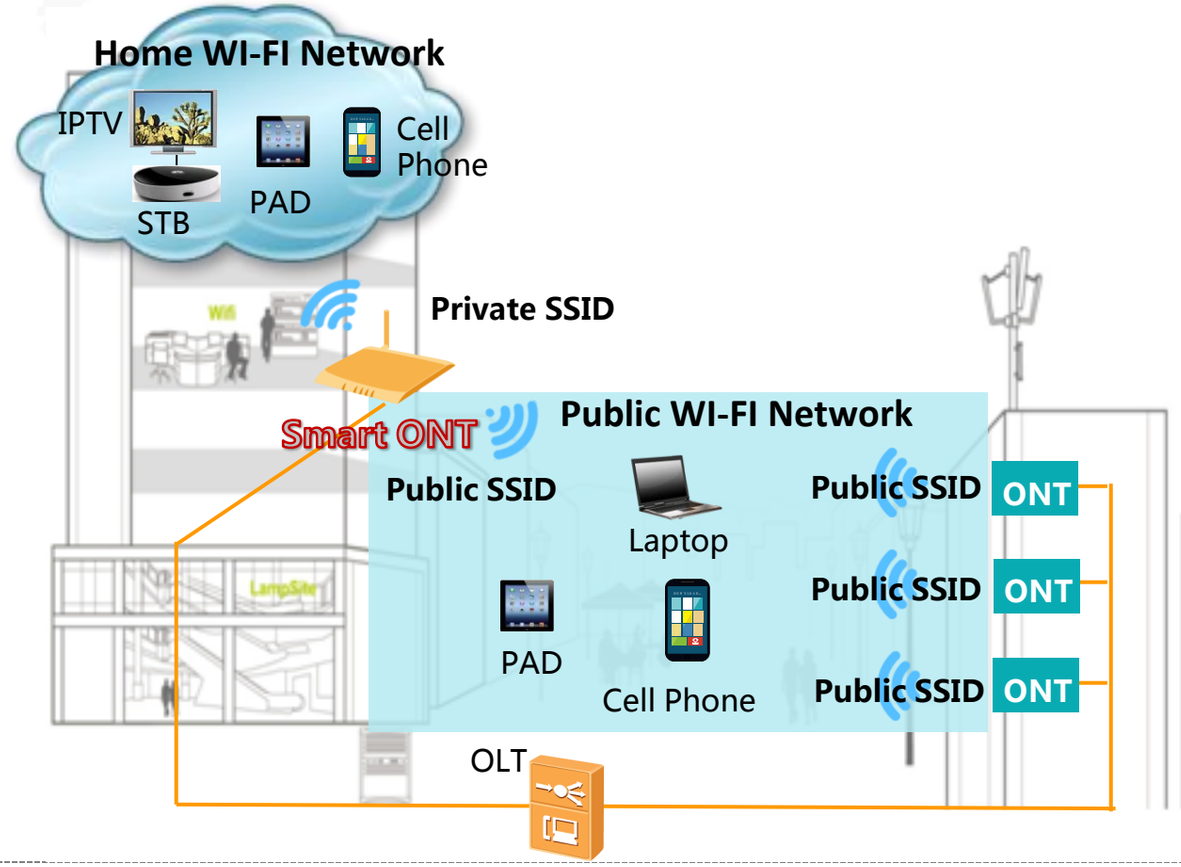
Wi-Fi coverage has been a common requirement for public areas such as streets, shopping malls, and stadiums. In contrast, currently mobile broadband hotspots are seriously insufficient. Add more micro or macro base stations? It's too costly!

Huawei Solution

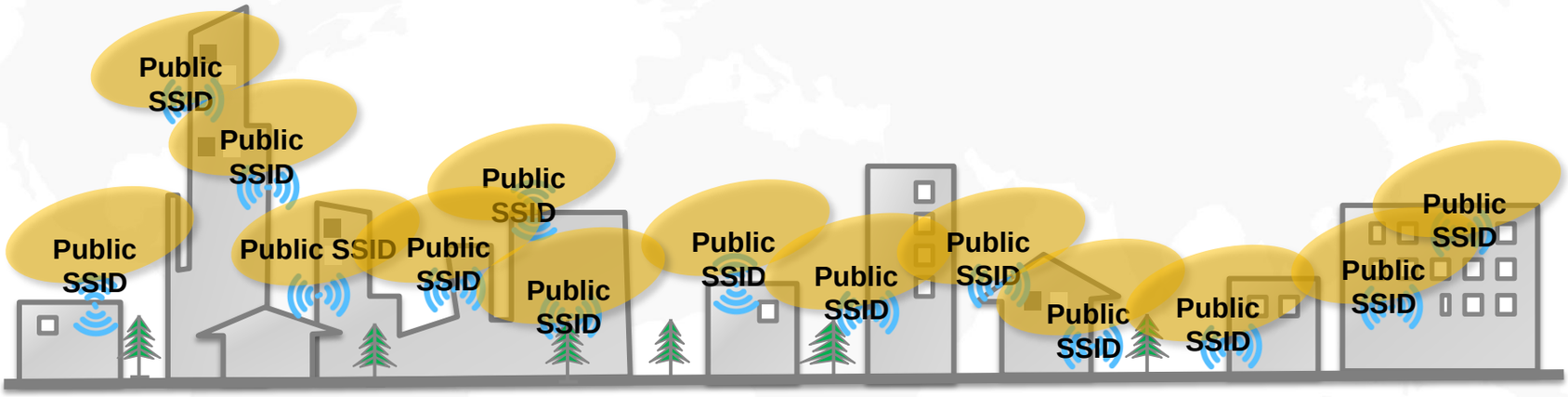
ONT supports multiple SSIDs, providing home Wi-Fi and public Wi-Fi coverage at the same time. Through home Wi-Fi sharing, more public hotspots can be provided and quickly deployed.

- Each SSID can be configured with its own parameters such as the encryption/authentication mode, bandwidth, and QoS. In this way, the public Wi-Fi service does not affect the Wi-Fi traffic usage and security of home Wi-Fi. Public Wi-Fi supports the Portal and 802.1x authentication modes.
- Different security levels and policies can be configured for different SSIDs (different user groups) to implement auto-operating and wholesaling of Wi-Fi services.

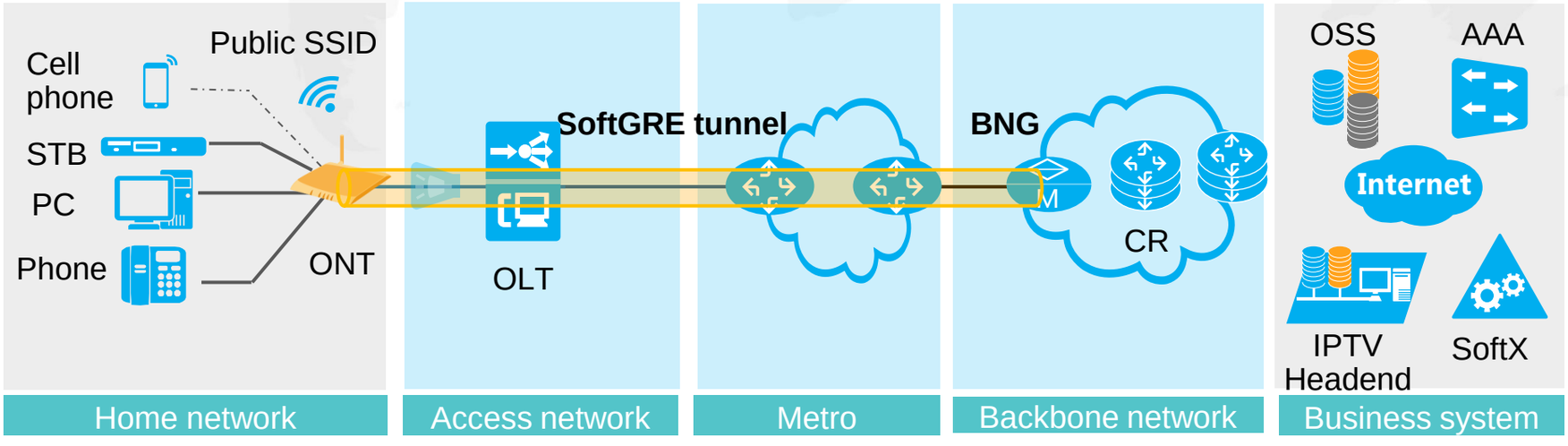


Sharing Hotspots Through Home Wi-Fi

Hotspots shared through home Wi-Fi increase from several dozen thousand to several million, realizing networked Wi-Fi and Wi-Fi roaming.



Public Wi-Fi Based on SoftGRE



Advantages of the SoftGRE solution:

- Applicable to live network deployment. Tunnels are established between ONTs and BNGs across the metro L3 devices, meeting the requirements for service isolation, security, and billing.
- User IP addresses are centrally allocated and managed on a network-wide basis, so users can smoothly switch between hotspots.

Smart Pipes Based on OTT Services

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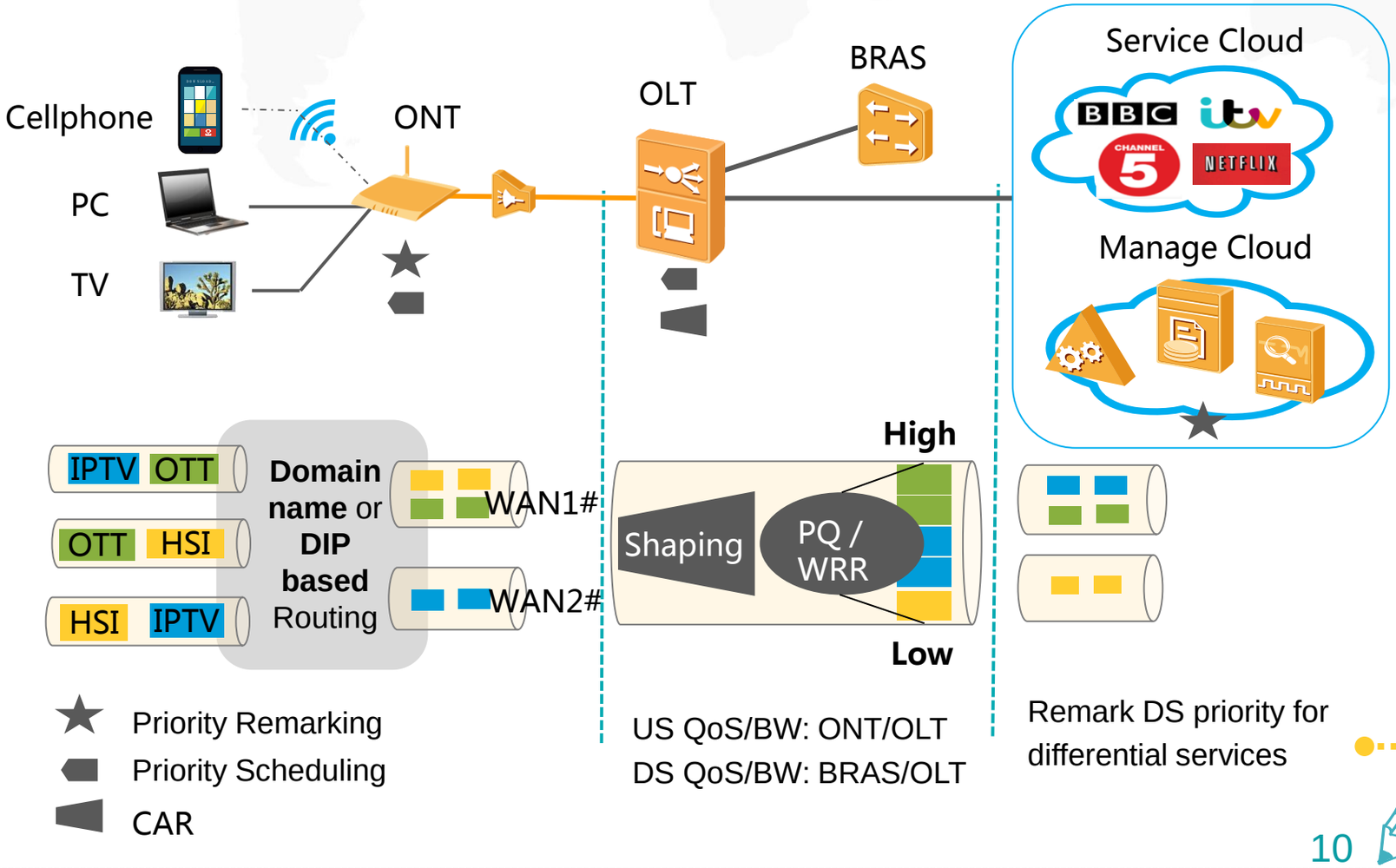
FTTH networks can continuously provision bandwidth-intensive services and enable operators to develop OTT video services. High-quality video service experience not only fulfills users' requirements for differentiated bandwidth services, but will also promote bandwidth consumption.

So, how to ensure the high bandwidth and quality of OTT video services?

Huawei Solution

When supporting Any Port Any Service, ONTs can also identify HSI, OTT, and IPTV services based on domain name or destination IP address. The ONTs will forward services to the respective WAN ports or mark the services with different priorities, implementing different levels of QoS assurance for different services.



GPON/10GPON FTTH

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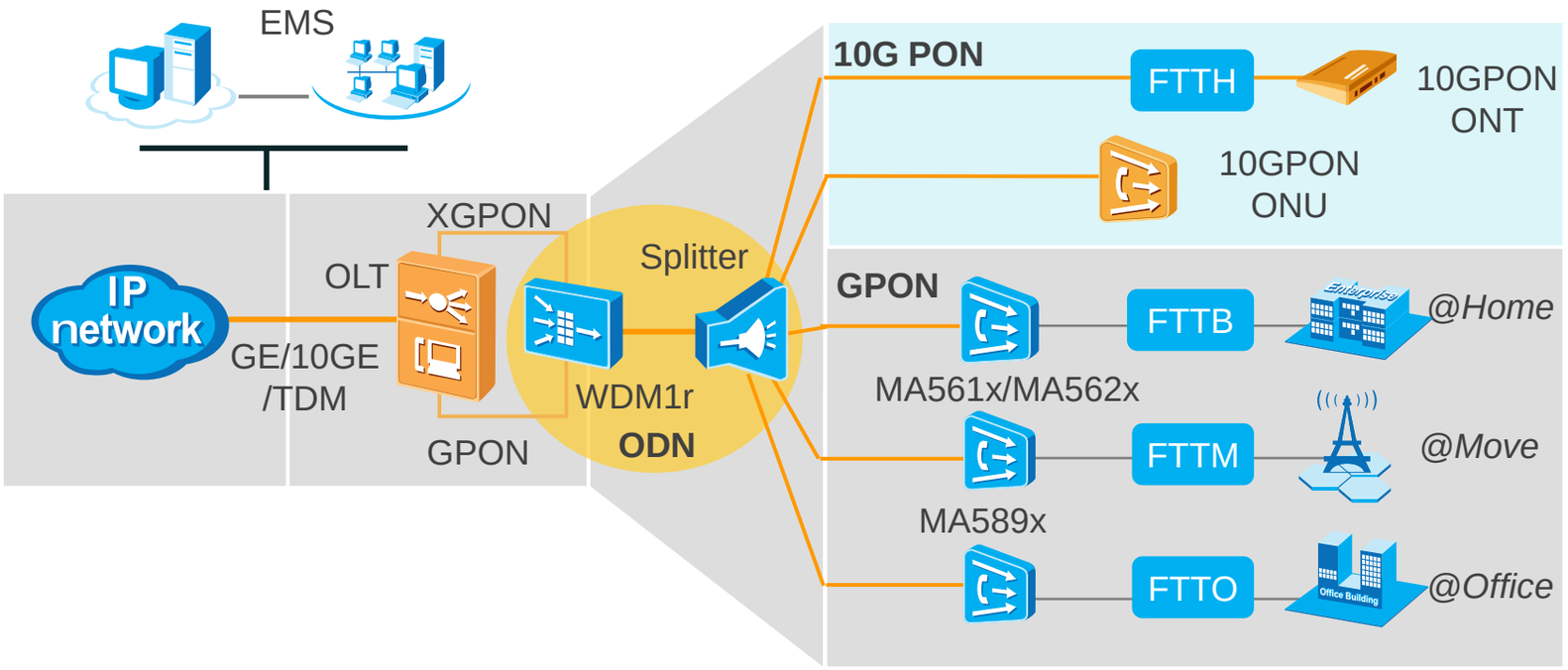
PON has become the mainstream technology for building FTTx networks. With users' increasing demands for high-bandwidth services such as OTT video and 4K TV, NGPON is also being commercially applied.

Huawei Solution

Huawei's FTTH solution supports GPON and 10G GPON. 10G GPON has two network building modes:

- **Newly built 10G GPON network:** 10G GPON and GPON networks are physically separated. The clear network architecture facilitates management and centralized service planning.
- **Hybrid network:** The existing ODN networks are fully reused. Based on the original GPON coverage, ultra-high-speed access is provided to users requiring high bandwidths. Physically GPON and 10G GPON share the same network, but logically they are separated.



GPON/10GPON FTTH

Advantages of 10G GPON

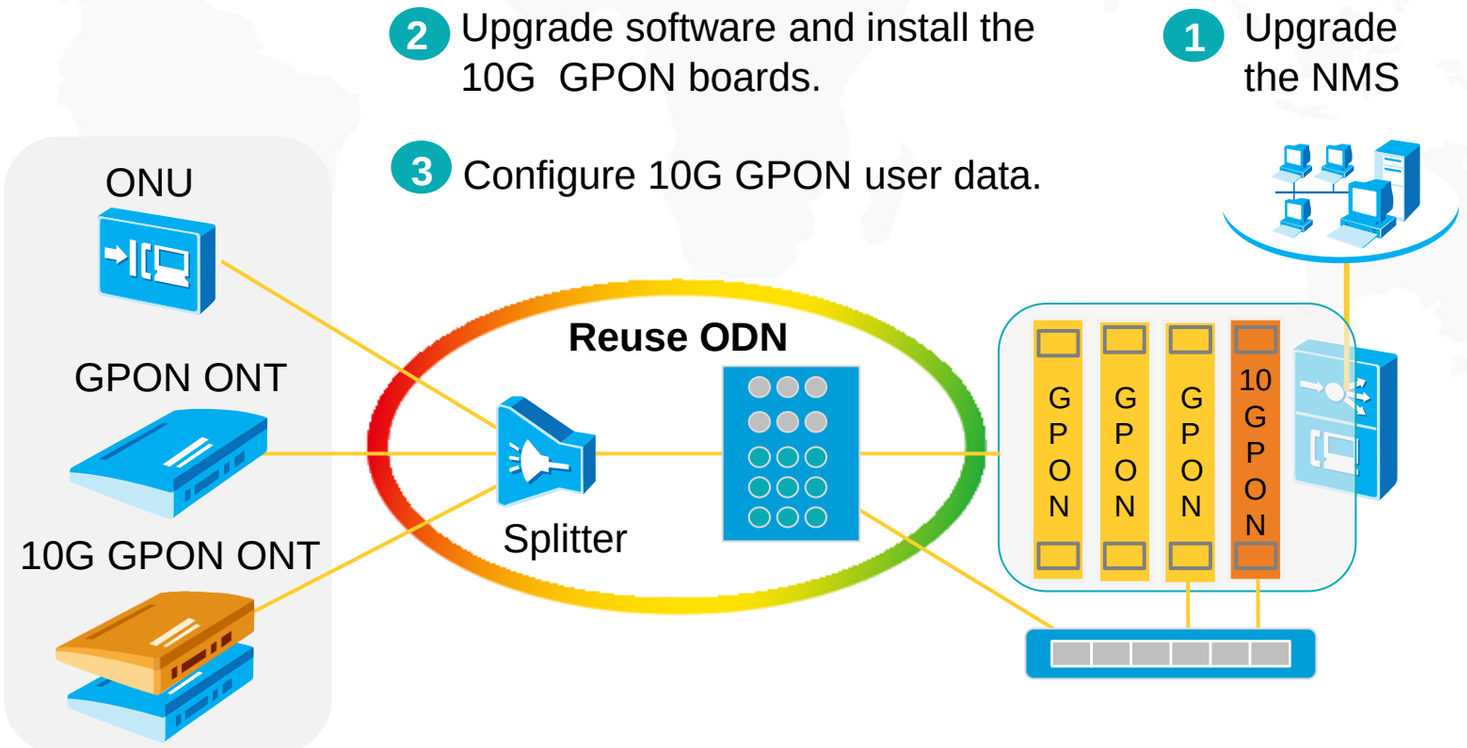
1. Supports smooth evolution to high-quality video services such as 4K TV
2. Covers high-rise densely populated buildings with a large split ratio (1:128 or 1:256), and provides bandwidth as high as 50-100 Mbit/s, effectively saving OLT port and CO resources
3. Allows existing GPON networks to smoothly migrate to 10G GPON

Technical Specifications of 10G GPON and GPON

Item	GPON (G.984)	10G GPON G.987&G.988)
Line rate	2.5G DS / 1.25G US	10G DS / 2.5G US
Wavelength plan	1480-1500nm DS 1290-1330nm US	1575-1580nm DS 1260-1280nm US
Split ratio	128	256
Power budget	Class B+: 28dB ClassC+: 32dB	N1 : 29dB N2: 31dB E1/E2: 33/35dB
Upstream Line code	NRZ	NRZ
Frame structure	GEM	XGEM

Smooth Evolution from GPON to 10G GPON

Operators can choose to deploy a new 10G GPON network, or smoothly upgrade the GPON network to 10G GPON. Specifically, add the WDM1r component to the OLT so that GPON and 10G GPON signals are multiplexed and transmitted over the same ODN.



OLT Boards Supporting 10G PON

OLT	Board	Specifications
MA5600T	H801XGBD	8 x 10G GPON ports, maximum split ratio 1:256
	H802XGBC	4 x 10G GPON ports, maximum split ratio 1:128
MA5800	H901XGHD	8 x 10G GPON ports, maximum split ratio 1:256
	H901XSED	8 x 10G GPON ports, maximum split ratio 1:256

ONTs Supporting 10G PON

Product	Access Port Specifications	10G PON Type
HN8245Q	4GE+2POTS+2USB+2Wi-Fi	10G GPON Asymmetric 10G EPON
HN8055Q	4GE+1*10GE+2USB+2Wi-Fi	10G GPON
HN8240	4GE+2POTS	10G GPON

Automatic Service Provisioning

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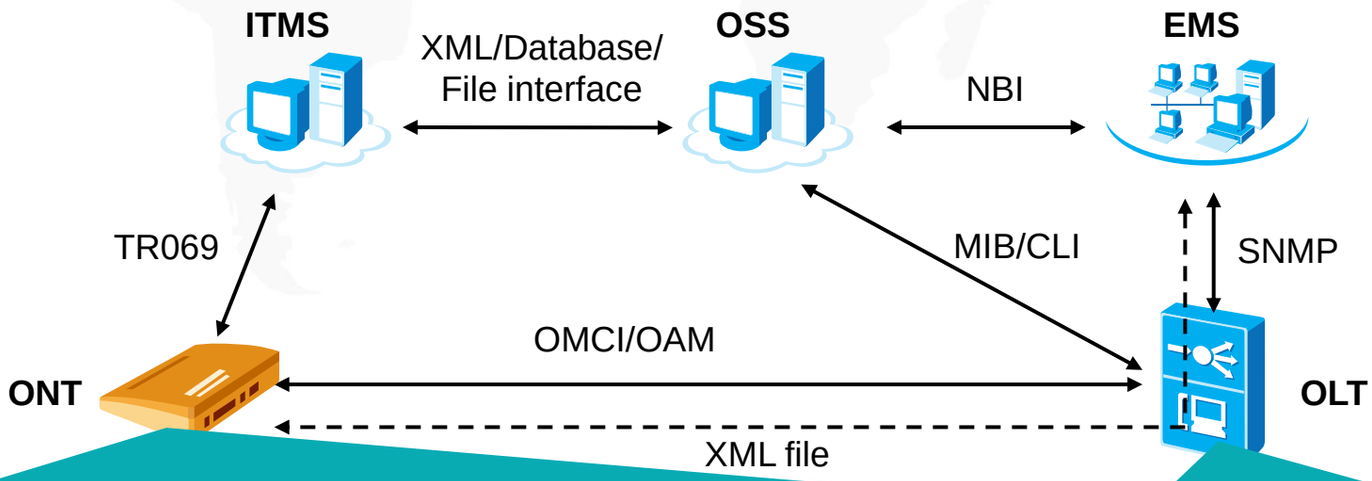
When services need to be provisioned to a large number of ONT users, the manual provisioning mode has low efficiency and also involves a complicated process. This scenario calls for automated service provisioning where ONTs can plug and play without requiring engineers to visit the site.

Huawei Solution

There are diversified scenarios. For example, different ONT models are used, NMS/ITMS is available or is not available, and services are provisioned through NMS, ITMS, or the directly interconnected device. Huawei's FTTH solution supports multiple protocol schemes to meet such requirements.



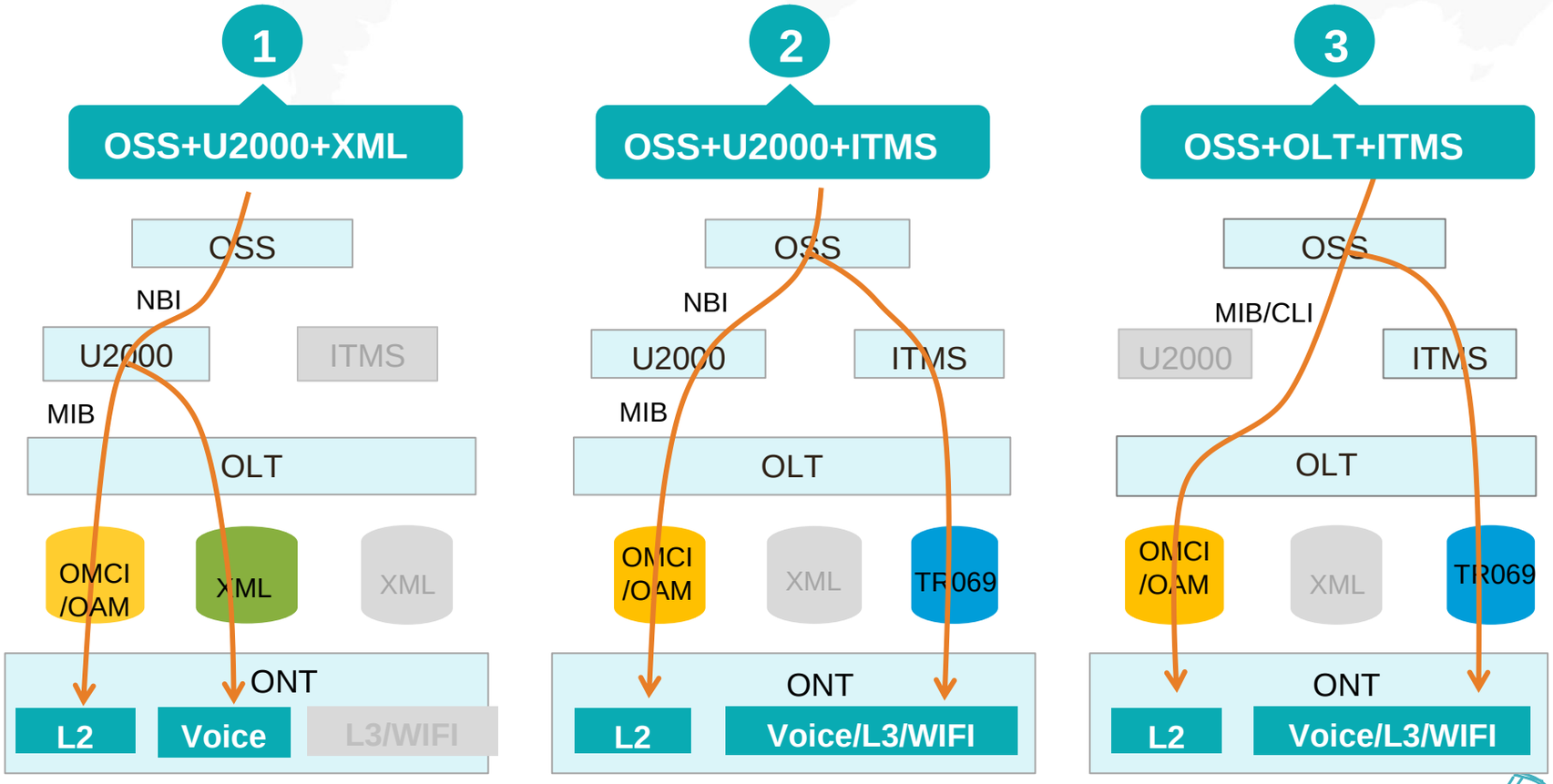
	OMCI/OAM	XML	TR069
L3 management channel (TR-069)	Y	Y	-
PON line	Y	N	N
L2 services	Y		Y
Customized voice parameters	Y	Y	Y
Common voice parameters	N	Y	N
L3 functions		Y	Y
Wi-Fi		N	Y
Security			Y

OLT Pre-configuration
Network side (VLAN/uplink port)
Profiles (line, traffic, etc.)
IPTV resources
Service flows
etc.

Automatic Service Provisioning

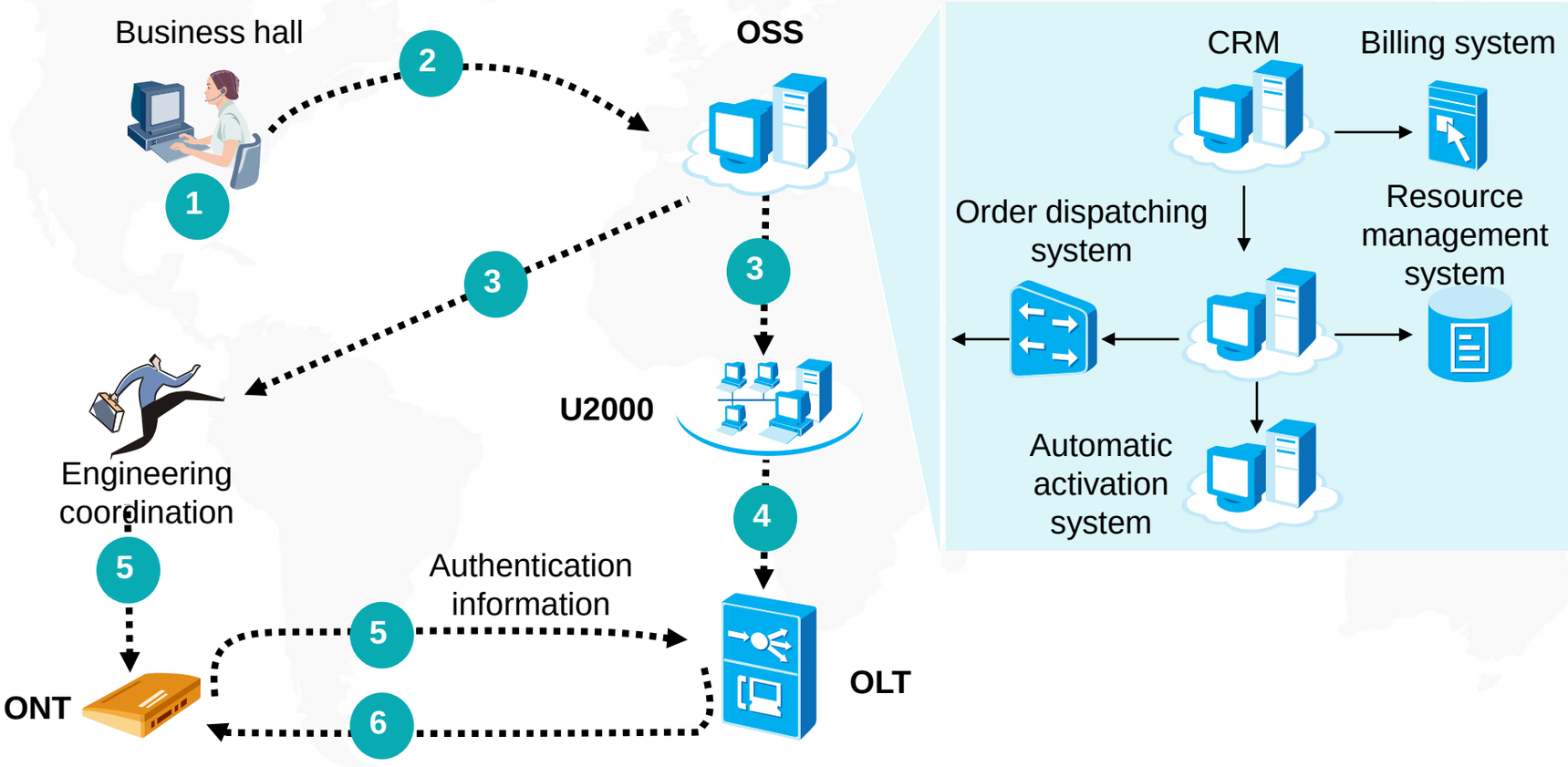
Typical Service Provisioning Modes of FTTH

Service Provisioning Mode	SFU+HGW	V-SFU	HGW
1 OSS+U2000+XML	-	Recommended	-
2 OSS+U2000+ITMS	Recommended	-	Recommended
3 OSS+OLT+ITMS	Use this mode when U2000 is not available and OSS is directly interconnected with OLT.		
U2000	Use this mode when OSS is not ready.		
Local web page	Used temporarily at early deployment phase.		



Automatic Service Provisioning

FTTH Service Provisioning Process (OSS+U2000)



1. User applies for service at business hall.
2. Manually confirm resources, and input user information and service information into CRM system.
3. OSS automatically configures resources according to the order, activates a series of sub-orders, and dispatches the orders.
4. EMS pre-configures service data to OLT and FTP server (voice configuration data).
5. Fiber installation engineer installs drop pigtails, installs ONT, and inputs ONT authentication information in the case of LLID authentication mode.
6. ONT goes online and automatically obtains related service configuration data from OLT.

Smart Isolation of Rogue ONTs

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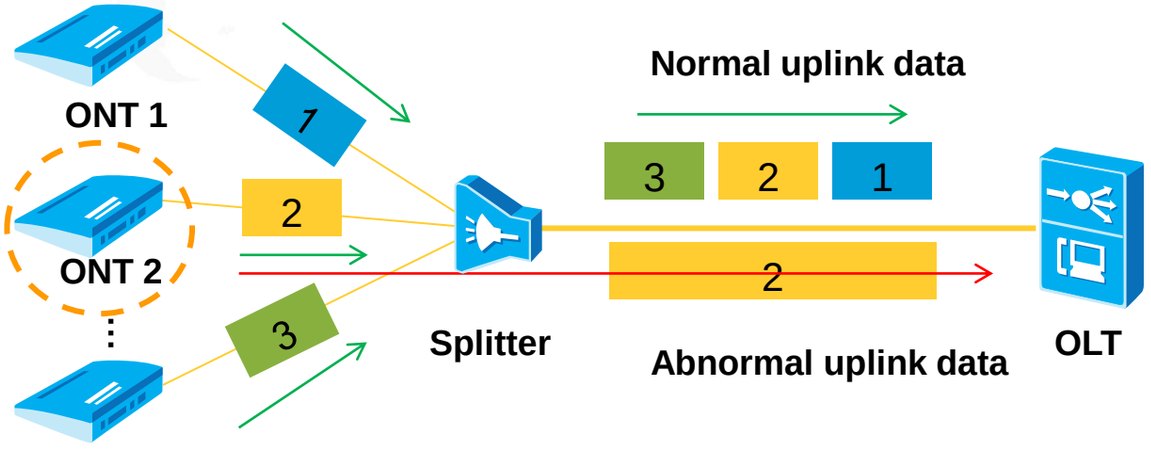
In a PON network, due to external factors or component quality reasons, there may be some ONTs that emit light continuously or randomly. Such ONTs are called rogue ONTs and will cause all ONUs under the PON port to failure to work, resulting in service interruption. Identifying a rogue ONT by removing and re-inserting fibers one by one is time- and labor-consuming. Therefore, a method for effectively detecting and isolating rogue ONTs is an indispensable function in PON network OAM.

Huawei Solution

Based on different hardware, Huawei's FTTH solution provides two mechanisms for automatically detecting and isolating rogue ONTs.



To be continued

Smart Isolation of Rogue ONTs

Continue to

OLT Periodic Detection Mechanism

The OLT periodically **checks** PON ports for rogue ONTs that continuously emit light. When detecting a rogue ONT, the OLT starts **identifying** the ONT by shutting down the Tx power of ONT optical modules one by one based on the light availability mechanism. After locating the rogue ONT, the OLT shuts down the Tx power of the corresponding optical module to **isolate** the rogue ONT.

It takes a relatively long detection period and interrupts services; applicable only to rogue ONTs that continuously emit light.

OLT Real-time Detection Mechanism

In the case of ONTs equipped with the SD5115 chip, the OLT can detect and identify the rogue ONTs in real time and automatically isolate the rogue ONTs.

OLT detects rogue ONTs in real time and does not interrupt services; applicable to rogue ONTs that emit light continuously or randomly.

Smart Isolation of Rogue ONTs

OLT Boards Supporting Real-time Detection to rogue ONTs

OLT	Board	Specifications
MA5600T	H807GPBH	8 x GPON ports, maximum split ratio 1:128
	H805 GPFD	16 x GPON ports, maximum split ratio 1:128
	H801XGBD	8 x 10G GPON ports, maximum split ratio 1:256
MA5800	H901GPHF	16 x GPON ports, maximum split ratio 1:128
	H901GPSF	16 x GPON ports, maximum split ratio 1:128
	H901XGHD	8 x 10G GPON ports, maximum split ratio 1:128
	H901XSED	8 x 10G GPON ports, maximum split ratio 1:256

Acronyms and abbreviations

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AP	access point
BNG	broadband network gateway
EPC	evolved packet core
EMS	element management system
eOTDR	embedded optical time domain reflectometer
FAT	fiber access terminal
FDT	fiber distribution terminal
FTTH	fiber to the home
HGU	home gateway unit
IAD	integrated access device
ITMS	intelligent terminal management system
LTE	long term evolution
OAM	operation, administration and maintenance
ODF	optical distribution frame
ODN	optical distribution network
OMCI	optical network terminal management and control interface
OTDR	optical time domain reflectometer
OSS	operations support system
OTT	over the top
PLC	power line communication
RAN	radio access network
SFU	single family unit
SNMP	simple network management protocol
TMS	terminal management system
WAN	wide area network