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Video Big Data

Concurrent Multi-screen Streaming in Homes Bring Opportunities and Challenges

Huawei iLab Video Gene Big Data Team 2017.06

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With the popularization of Internet TVs, PCs, and smartphones, concurrent multi-screen streaming has become the norm in homes.

How many Internet connected devices are there in a household?

How many Internet connected devices are used concurrently during prime time?

Can users play 4K videos smoothly?

What opportunities do industry players face?

What challenges do home networks face?

What's the biggest challenge and how can we solve it?

With these questions in mind, Huawei iLab conducted an in-depth research and analysis.

Key findings

1. In 2017 Q1, every household in China owns **5.64** Internet connected devices on average. During prime time (20:00–22:00, GMT+8), every household uses **2.9** devices concurrently on average. Internet TV is the main source of concurrent multi-screen streaming, occupying the most traffic.
2. 4K TVs have entered thousands of homes and 4K videos will become popular in the next 2–3 years, bringing great opportunities to the industry.
 - There were 48.36 million 4K TV inventories in 2016. It is expected that the sales volume of 4K TVs will reach 23.11 million in 2017, accounting for **59.5%** of total TV sales.
 - Platforms such as Netflix, YouTube, and iQIYI have **more than 1000 4K** videos on average, totaling 800 hours.
 - Guangdong province took the lead in releasing the *4K TV Network and Industry Development Implementation Solution*. It is expected that the production value of 4K-related industries will exceed **600 billion RMB (about USD\$88.36 billion)** by 2020.
3. With the popularization of 4K videos, access networks are the first to be affected, driving carriers to upgrade their GPON and EPON networks to **10G PON** ones.

	Home Devices Used for Concurrent Streaming	Downstream Bandwidth Required for Smooth Streaming	Total Bandwidth Required on the PON Line Side (Optical Split Ratio 1:64)	PON Selection
Without Internet TV	1 tablet + 1 PC + 1 smartphone	5 + 10 + 5 = 20 Mbit/s	1.28 Gbit/s	GPON
With Internet TV (1080P video)	1 Internet TV + 1 tablet + 1 PC + 1 smartphone	10 + 20 = 30 Mbit/s	1.92 Gbit/s	GPON
With Internet TV (4K video)	1 Internet TV + 1 tablet + 1 PC + 1 smartphone	25 + 20 = 45 Mbit/s	2.88 Gbit/s	10G PON
With Internet TV (4K video + VR sometimes)	1 Internet TV + 1 tablet + 1 PC + 1 smartphone	45 + 80 = 125 Mbit/s	8 Gbit/s	10G PON

Note: Unlike other services, video services require long online periods, concurrent streaming during prime time, and a low bandwidth convergence ratio.

- Family members in a household generally enjoy different video contents. During prime time (20:00–22:00, GMT+8), nearly 50% of homes use 3 or more devices concurrently.
 - Current GPON and EPON networks support an optical split ratio of **1:64** or **1:32**, meeting users' demands for playing high definition (HD) videos.
 - Concurrently, streaming multiple screens of 4K video smoothly in homes requires bandwidth of more than **2.88 Gbit/s** on the PON line side, requiring 10G PON.
 - Access networks have multiple nodes, so the upgrade workload is heavy. Therefore, carriers need to consider in advance the smooth evolution from GPON and EPON to 10G PON.
4. Home Wi-Fi constrains users' video experience. To solve this problem, carriers urgently need a solution to ensure good home Wi-Fi coverage due to the following reasons:
 - Wi-Fi is the precondition for concurrent multi-screen streaming. Current Wi-Fi penetration rate has reached **92.7%**, making Wi-Fi the main connection method in homes.

- The average downloading speed in Wi-Fi is only 25%–60% of that in broadband access. Worse still, Wi-Fi quality is unstable. As a result, users cannot enjoy concurrent multi-screen streaming smoothly.
- Therefore, stable and reliable 100 Mbit/s Wi-Fi coverage is a rigid demand for streaming videos smoothly in every room.

5. To solve challenges, Huawei advises carriers to deploy 10G PON and use 100+ Mbit/s home Wi-Fi solutions.



1. Concurrent Multi-screen Streaming Has Become the New Norm

Previously, family members usually enjoyed TV programs together. Today, family members tend to enjoy different contents on different devices.



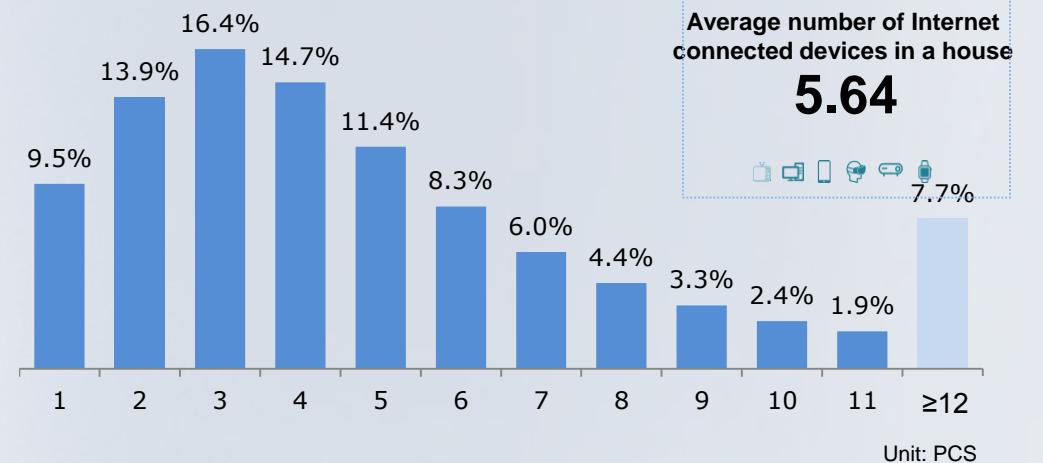
The past

Today

The number of home electronic devices is on the rise and users have different demands for video content. Concurrent multi-screen streaming has become the new norm. Research conducted by Huawei iLab and iResearch has discovered that:

1.1 In 2017 Q1, every household in China owns an average of 5.64 Internet connected devices.

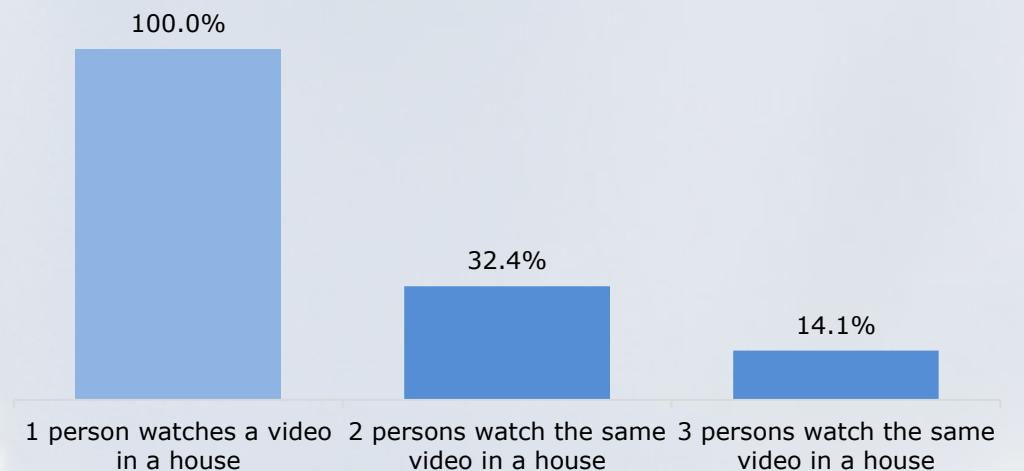
Distribution of screen devices in Chinese households



Data source: Huawei iLab & iResearch

1.2 Family members watch different video contents. For a family with 3 members, there is a possibility of 85.9% for them to watch different contents.

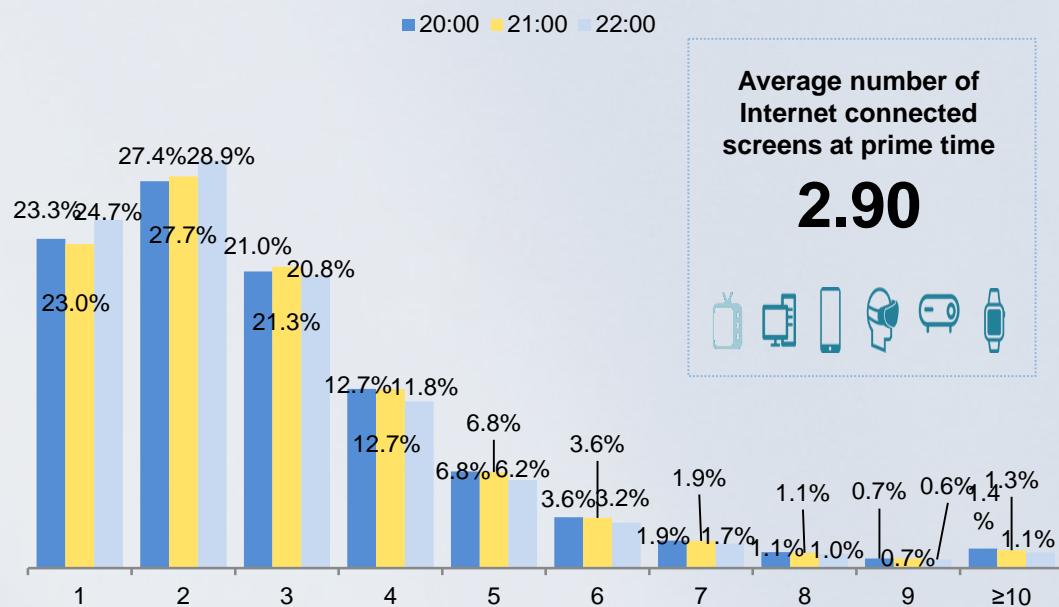
Possibility (%) of watching the same video by families with different number of members



Data source: Huawei iLab & iResearch

1.3 During prime time (20:00–22:00, GMT+8), households use an average of 2.9 devices concurrently and nearly 50% of households use 3 or more devices concurrently.

Distribution of concurrent multi-screen streaming at prime time (%)

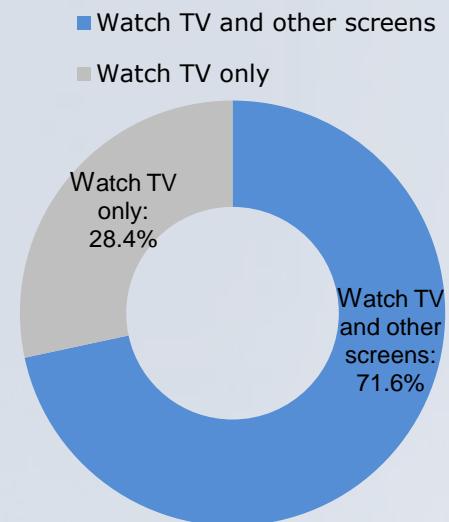


Unit: PCS

Data source: Huawei iLab & iResearch

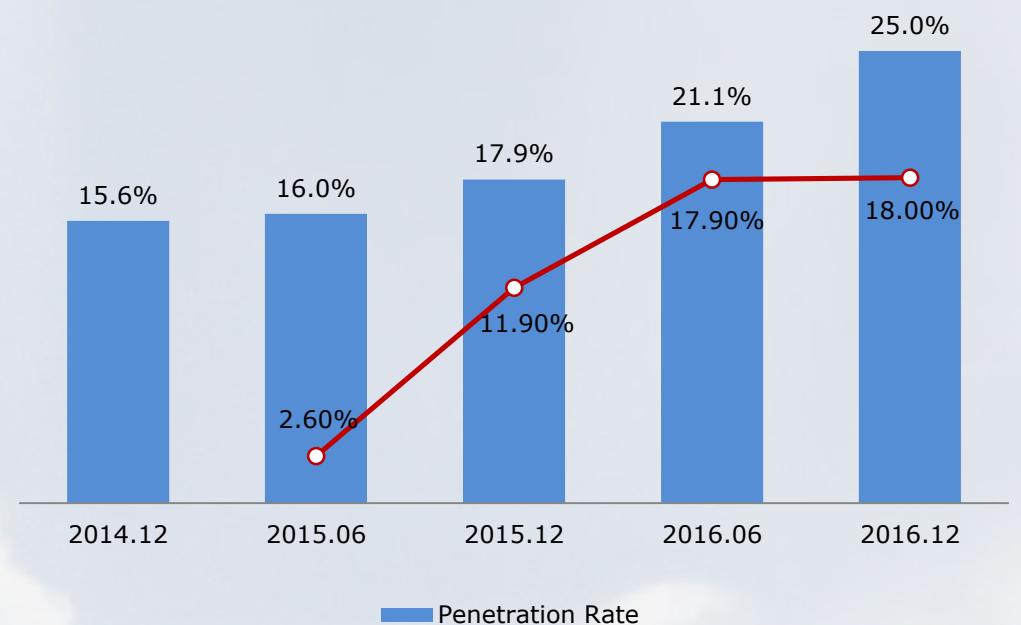
1.4 Internet TV has become the No.1 screen in homes, occupying the most traffic during concurrent multi-screen streaming. In 2016, the number of Internet TV inventories exceeded 150 million and the penetration rate among netizens was 25%, an increase of 39.7% compared to 2015.

Proportion of users watching Internet TV and other screens



Data source: Huawei iLab & iResearch

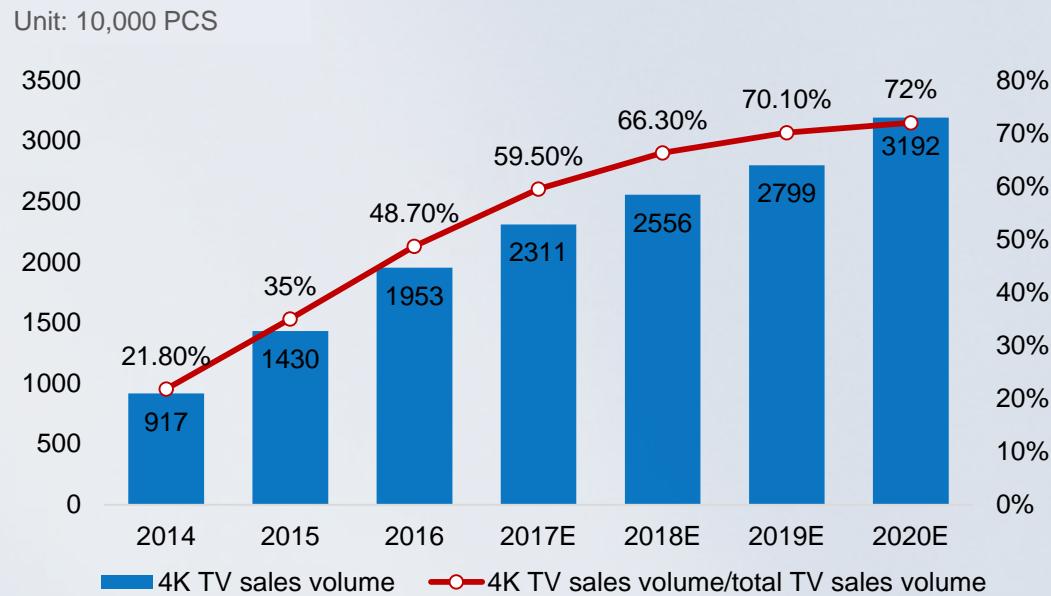
Penetration rate of Internet TVs among netizens



Data source: CNNIC

1.5 Internet TV has gradually shifted to 4K TV and 4K TV is rapidly growing in popularity. In 2016, the number of 4K TV inventories was 48.36 million and the penetration rate was 10.6%. It is expected that in 2017, 23.11 million of 4K TVs will be delivered, accounting for 59.5% of new TV purchases.

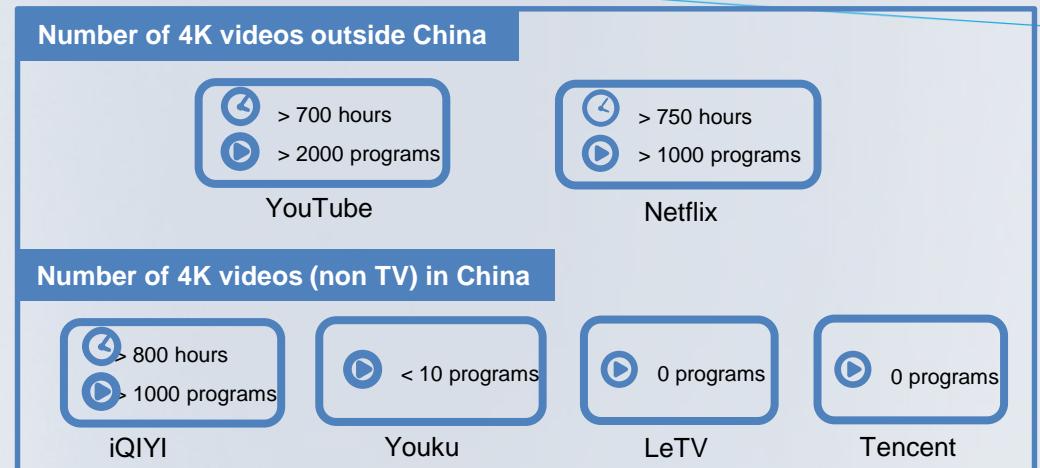
China's 4K TV sales in 2014-2020



Data source: Ovum 2017

1.6 4K contents will be supplemented in 2–3 years, fueled by over the top (OTT) videos and driven by policies.

- YouTube has over 2000 4K videos and Netflix has over 1000 such videos, but in China, only iQIYI has more than 1000 such videos.



Data source: Huawei iLab's global video big data

- Guangdong authorities took the lead in releasing the *4K TV Internet and Industry Development Implementation Solution (2017–2020)*. Guangdong province is striving to build an ultra-high definition (UHD) interactive digital home network centered on 4K TV in the next 3–5 years, and accelerate the development of 4K services and contents.

Plan	Province's FTTH Rate	Number of 4K Users	4K Contents
End of 2017	79%	New users: 3 million	1000 hours of 4K programming
End of 2019	88%	New users: 8 million	3000 hours of 4K programming
End of 2020	93%	Total users in the entire province: 20 million	Two 4K channels (Over 70%users in the province can watch 4K programs.)

Note that Huawei's iLab and iResearch will release the research report on concurrent multi-screen streaming in July 2017.



2. Concurrent Multi-screen Streaming Will Bring New Challenges

With the popularization of concurrent multi-screen streaming and 4K videos in homes, access networks are the first to be affected, driving carriers to upgrade their GPON and EPON networks to 10G PON ones. Therefore, stable and reliable 100 Mbit/s Wi-Fi coverage has become a rigid demand.

2.1 4K videos are driving carriers to upgrade GPON and EPON networks to 10G PON ones.

In each household, different devices are used for different purposes. When using these devices, users also have different bandwidth requirements. Video services require long online periods, concurrent streaming during prime time, and a low bandwidth convergence ratio.

	Consumption Behavior at Homes	Connection Method	Bandwidth Duration	Downstream Bandwidth Required for Smooth Streaming
Internet TV	TV	Wi-Fi/Ethernet cable	Long	1080P: 10 Mbit/s 4K: 25 Mbit/s
Tablet/smartphone	Video	Wi-Fi	Long	5 Mbit/s
Tablet/smartphone	APP Social contact/gaming/other Apps	Wi-Fi	Short	5 Mbit/s
PC	Video/gaming/office/other Apps	Ethernet cable	Medium	10 Mbit/s
Smart home	Security camera/other smart home appliances	Wi-Fi/ZigBee/Bluetooth	Medium	< 1 Mbit/s

Data source: Huawei iLab's global video big data

In concurrent multi-screen streaming scenarios, long-playing videos require stable downstream bandwidth. Widely-deployed GPON and EPON networks support an optical split ratio of 1:64 or 1:32, which can meet HD video demands when only a small number of households play 4K videos. With the popularization of 4K videos, there is a rigid demand for 2.88 Gbit/s bandwidth on the PON line side. To meet this demand, carriers need to upgrade their GPON and EPON networks to 10G PON ones.

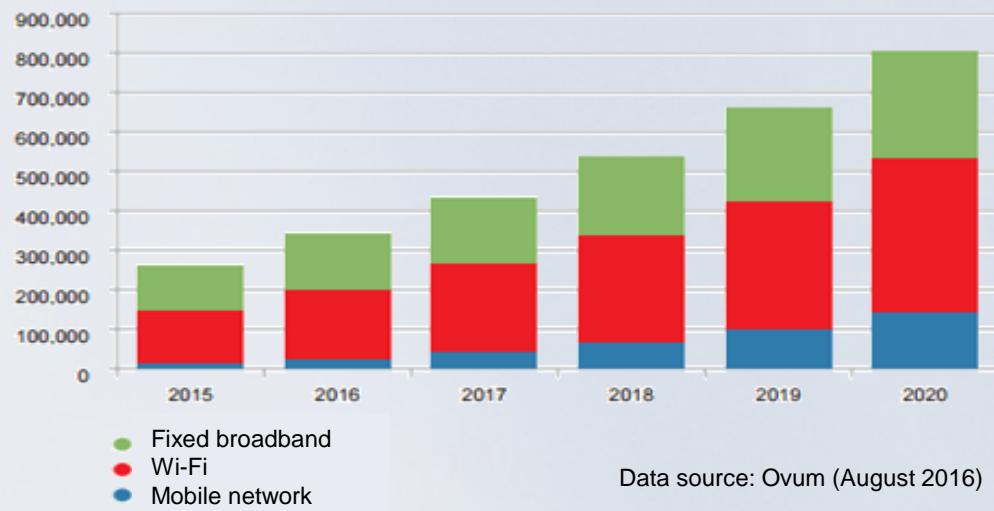
	Home Terminal Concurrent-streaming Assumption	Downstream Bandwidth Required for Smooth Streaming	Total Bandwidth Required on the PON Line Side (Split Ratio 1:64)	PON Selection
Without Internet TV	1 tablet + 1 PC + 1 smartphone	5 + 10 + 5 = 20 Mbit/s	1.28 Gbit/s	GPON
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Note: Unlike other services, video service features long online period, concurrent streaming at prime time, and low bandwidth convergence.

2.2 Wi-Fi constrains users' broadband experience

Wi-Fi is the main connection method used in home networks. According to CNNIC's statistics, over 92.7% of netizens in China accessed the Internet through Wi-Fi in 2016, while data from Ovum shows that about 50% video traffic around the world is streamed through Wi-Fi connections.

Global video traffic distribution of different networks



Statistics show that the Internet access speed of Wi-Fi connection is only 25%–60% of that of Ethernet cable connection, indicating that Wi-Fi bottlenecks home network experience.

Wired and Wi-Fi test rate comparison (carrier 1)

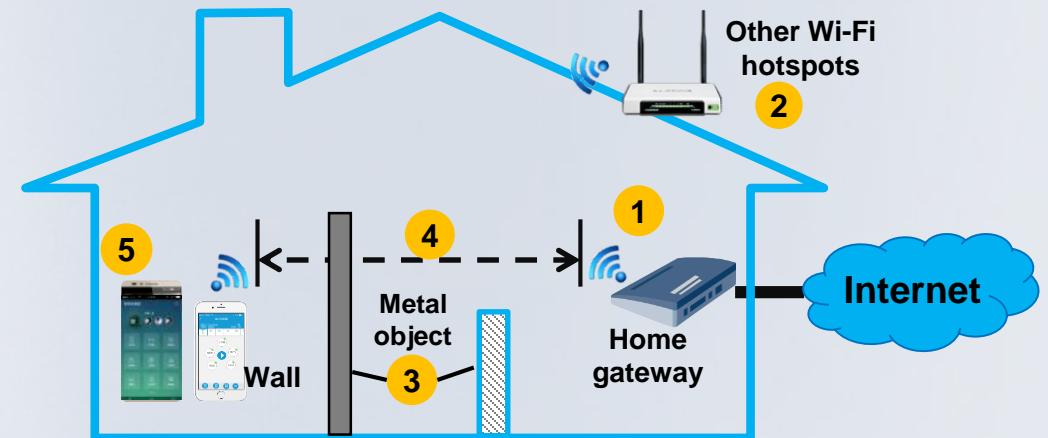


Wired and Wi-Fi test rate comparison (carrier 2)



Data source: www.speedtest.cn (May 2017)

Poor Wi-Fi coverage is the top issue for home Wi-Fi networks. Due to factors such as interference, obstacles, signal attenuation, frequency, and device performance, users have different Wi-Fi experience in different rooms.



1. Home Wi-Fi performance: Wi-Fi standard, operating frequency, and antenna
2. Co-channel interference from neighboring Wi-Fi
3. Obstacles
4. Signals attenuate as the distance increases
5. Smartphone and PC performance: NIC and antenna



3. Suggestions

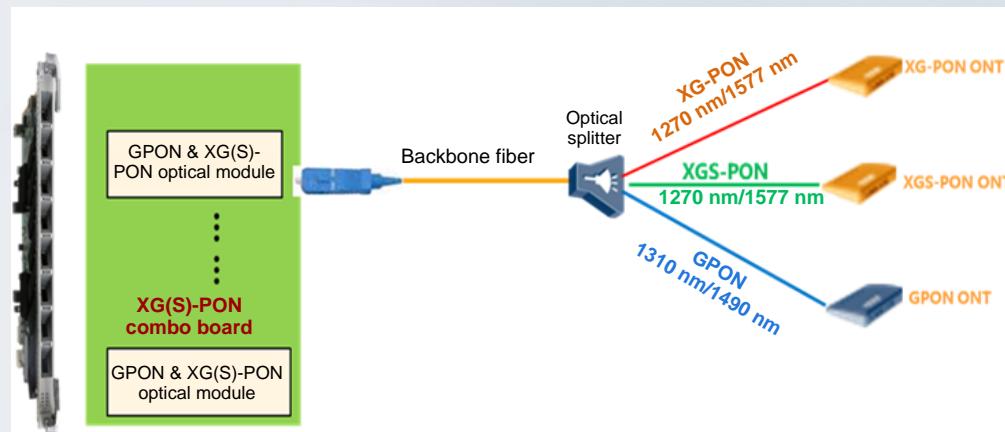
3.1 Use Huawei's PON combo solution to smoothly evolve networks from GPON to 10G PON.

Carriers have a lot of GPON and EPON devices on their live networks. It is impossible for them to replace these devices with 10G PON ones all at once. 10G PON includes 10G EPON and 10G GPON. 10G GPON also involves asymmetric XG-PON and symmetric XGS-PON.

10G EPON ports are compatible with EPON ports so both EPON and 10G EPON ONTs can be deployed on the same optical distribution network (ODN). When 10G GPON is used together with GPON, external WDM1r

multiplexers are required. To achieve smooth evolution to XG-PON or XGS-PON without affecting provisioned services, carriers need an economical and efficient solution that simplifies network evolution.

Huawei's PON combo solution caters to this evolution and integrates GPON, XG-PON, and XGS-PON. Under this solution, GPON, XG-PON, and XGS-PON ONTs can coexist in the same ODN. It is recommended that during new GPON deployment, carriers should use combo boards to avoid wasting investments and to facilitate smooth upgrades in the future.



3.2 Use Huawei's GigaHome solution to provide 100 Mbit/s @ anywhere through Wi-Fi in homes.

For carrier Y in city X in 2016, over 30% of complaints from home broadband users were related to Wi-Fi. According to these users, broadband service providers should be responsible for providing high-quality home networks. Poor Wi-Fi experience in homes negatively affects brand perception and causes high churn rates. In addition, with the development of videos, smart home, and mobile terminals, Wi-Fi has become a rigid demand of users and a challenge for carriers to develop new services.

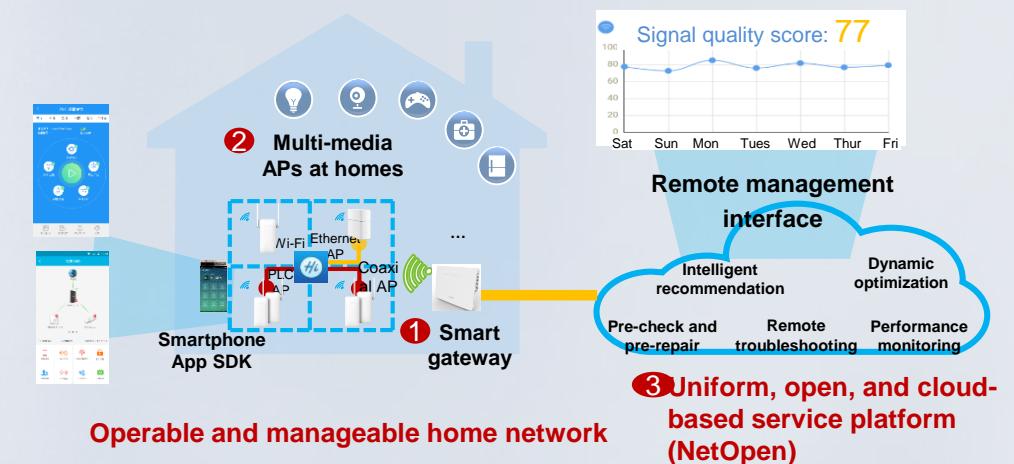
To ensure high-quality home Wi-Fi coverage, the following requirements need to be met:

(1) Home networks are easy to deploy. Routed indoor cables or Wi-Fi can be used to realize full Wi-Fi coverage in houses.

(2) Automatic Wi-Fi roaming and real-time Wi-Fi quality monitoring are supported. This means that when home network environments change (for example, there is interference from external Wi-Fi signals), home Wi-Fi networks can be automatically optimized. Such automatic optimization ensures real-time video experience.

(3) Carriers are able to identify home Wi-Fi faults in a timely manner and initiate O&M actively.

Huawei's GigaHome solution achieves 100 Mbit/s @ anywhere. It supports smart connections, visible and manageable Wi-Fi networks, and open capabilities. By using this solution, carriers can deploy home Wi-Fi services rapidly, increase O&M efficiency within a short period, and mine new business opportunities in the medium or long term through big data analysis.



- Smart connections**
 - Full Wi-Fi coverage (10 Mbit/s)
 - Multi-medium and -protocol for interconnection and plug and play (PnP) deployment
 - Seamless roaming to ensure real-time video experience
- Visible and manageable networks**
 - Visible home network & Wi-Fi connection and quality
 - Automatic Wi-Fi fault diagnosis & optimization
 - Installation and maintenance and user App (SDK) for flexible deployment and visible management
- Open capabilities**
 - Open platform capabilities of carriers
 - Integration of partners' services
 - Ready for smart home