Choose the right number of CPE devices per home

Use case

How many devices are there in the home?

As a communications service provider (CSP), you want to offer your customers the right broadband services. This includes bringing high-speed broadband to the home, but also ensuring that your end-users can benefit from high speeds throughout the home.

To bring all these functions may require multiple devices, but there is a mutual requirement to reduce the number of devices in the home:

• As a CSP, you may need to manage these devices, adding to the operational expense.

• End-users usually don't like too many devices in their living room. There is the visual aspect, space requirements and the need to power all those devices.

So, it is crucial to find the right balance between offered functionality and number of devices.

Required functions in the home

In this document, we will look at a fiber-to-the-home (FTTH) deployment, but the rationale is the same for all broadband access technologies.

In such a FTTH deployment, the following functions are required:

• **Fiber termination.** The fiber connects into a fiber modem that will convert the optical signals from the fiber into electrical signals, mostly an Ethernet connection. The fiber termination is called a Layer 2 function, following the OSI model.[1]

• **Residential gateway (RGW)**. A device that allows you to connect client devices (laptops, tablet, smartphones, etc.) either via an Ethernet cable or via Wi-Fi. A RGW performs functions for Layers 3 to 5, following the OSI model.

• **Wi-Fi mesh devices.** To extend the broadband connectivity throughout the home, a Wi-Fi mesh technology is needed, whereby additional mesh devices can be added to extend the coverage. The advantage of a mesh network, compared to repeaters and extenders, is that a mesh network results in a single, seamless Wi-Fi network.

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1 The Open Systems Interconnection model (OSI model) is a conceptual model that describes the universal standard of communication functions of a telecommunication system or computing system. See OSI model - Wikipedia

Mapping functions onto devices

Option 1: all separate devices

With this option, all the functions are implemented in separate devices: the fiber termination in a fiber modem, the RGW, the mesh Wi-Fi devices.
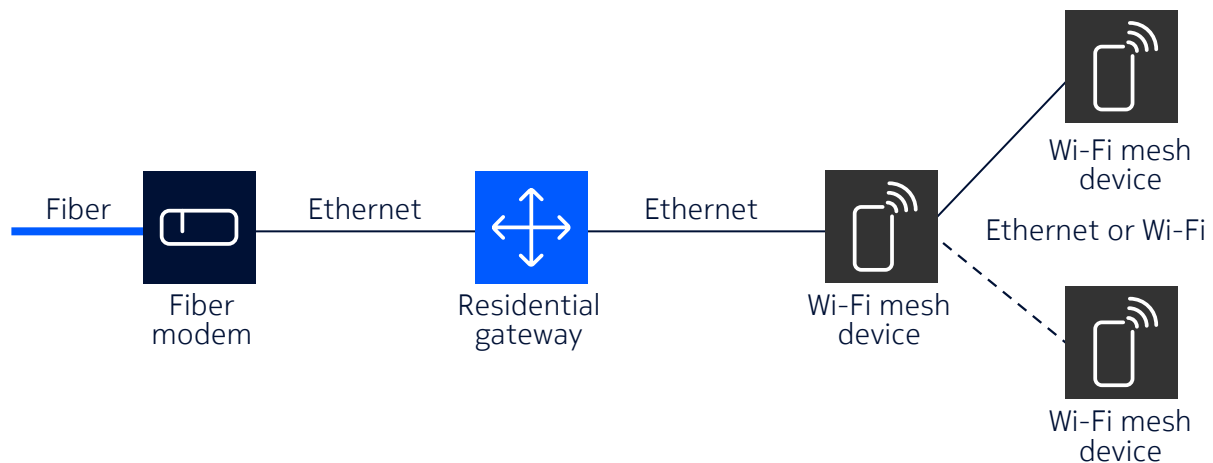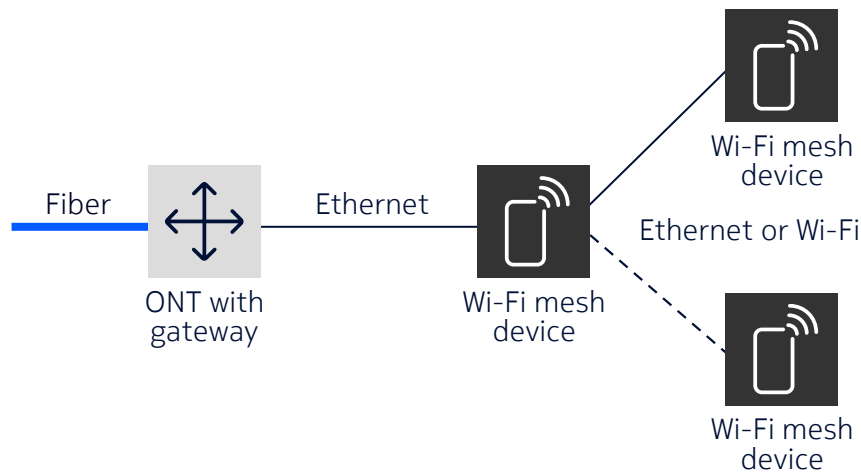

Advantages

- While an operational lifecycle of 10 years or longer can be expected for a fiber modem, the Wi-Fi version on an RGW is outdated in 5 years or less.

- The fiber modem can be placed closer to the fiber entry point itself. In some countries for example, the fiber enters via the cellar. The fiber modem can then be placed in the cellar, while the RGW is placed in the living room.

- In terms of manageability, there are specialized management protocols for the fiber modem and the RGW, which helps when the two devices are managed by different teams in the CSP's organization:

  – The fiber modem is remotely managed over OMCI, a GPON standard embedded OLT-fiber modem communication channel.

  – The RGW can be managed via TR-069.

Disadvantages

- Multiple devices lead to higher operational costs.

- When the fiber modem and the RGW are installed in physically separate rooms (cellar and living room respectively, for example), an Ethernet cable needs to be installed between the two rooms.

Option 2: a Layer 3 ONT and mesh devices

In this option, the fiber modem and the RGW are combined into a Layer 3 optical network terminal (ONT), or ONT with RGW functions.
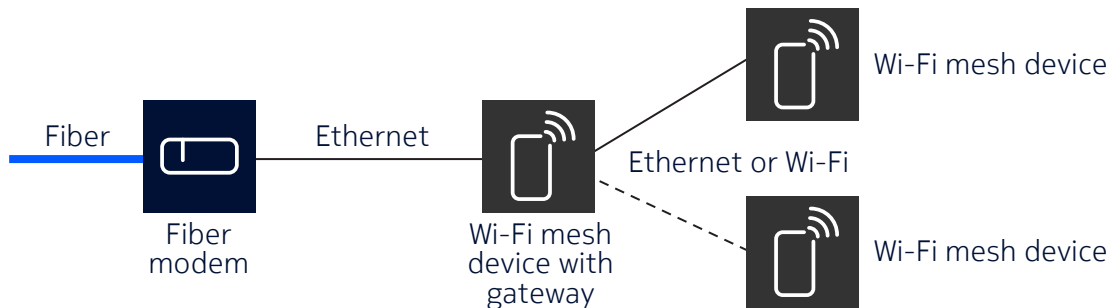

Advantages

- One fewer device to manage for the CSP.

- One fewer device to power and place for the end-user.

Disadvantages

- The inherent lifecycle difference between a fiber modem and RGW implies a drawback for their integration.

- There may be a challenge to get the fiber into the living room, where the RGW is usually installed.

- When two separate organizations need to manage the fiber modem and the RGW, there is the issue of remotely managing an integrated ONT-RGW. This will be resolved over time because of the emerging TR-369 ecosystem.

  – TR-369 or User Services Platform (USP), which was defined in 2018, allows for a virtual software-defined fiber modem and RGW partitioning without requiring a physical separation. When a fiber modem and RGW are operated by different companies or separated entities in the same company, TR-369 will remove an obstacle to fiber modem-RGW integration. TR-369 is backwards compatible with TR-069, and facilitates IoT device management and user interaction with devices and services via the users' own smart devices.

Option 3: a Layer 2 ONT and a mesh device with gateway functions

Here, the RGW is complemented with Wi-Fi mesh capabilities, so it can control a Wi-Fi mesh network. Additional mesh Wi-Fi devices can then be easily added to extend the Wi-Fi coverage.
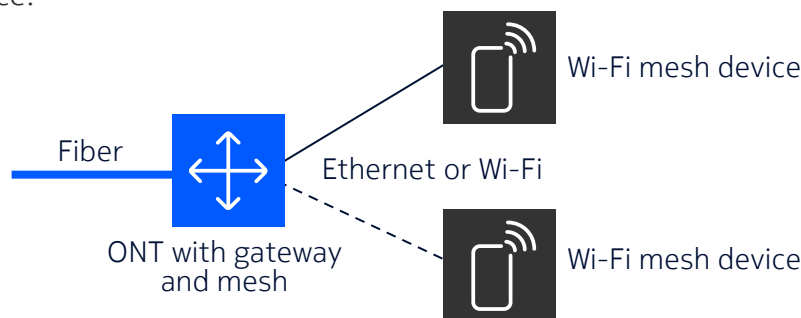

Advantages

- The longer lifecycle of the fiber modem means it only needs to be replaced after 10 years or so.

- The fiber modem can be placed closer to the fiber entry point itself.

- Manageability may be more straightforward, with one team within the CSP using OMCI to manage the fiber modem, and another team using TR-069 to manage the Wi-Fi mesh device with RGW function.

Disadvantages

- Multiple devices, leading to higher operational costs.

- Where the fiber modem and the RGW are installed in physically separate rooms, an Ethernet cable needs to be installed between the two rooms.

Option 4: the all-in-one solution

In this option, all the functions are combined into a single device: the fiber termination, the RGW, the mesh Wi-Fi device.

Advantages

- One single device for the end-user to place and power.

Disadvantages

- More complex for the CSP to manage.

- The lifecycle of this product is determined by the fastest changing technology, and that is Wi-Fi. So, this option leads to a discrepancy between the Wi-Fi lifecycle (roughly 2-3 years) versus the fiber modem's lifecycle (roughly 10 years).

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Conclusion

There is no one-size-fits-all. The right choice for any CSP will depend on the type of services that need to be offered, the way these devices are managed, and whether the fiber access network has recently been upgraded or not.