



Wi-Fi CERTIFIED EasyMesh™

Technology Overview

February 2020

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Home Wi-Fi® is evolving

The massive increase in connected devices has resulted in heightened demand for Wi-Fi® connectivity throughout the home. Consumers own multiple mobile devices, including IoT and smart home connected products, revealing a need to blanket the home and outdoor areas with uniform Wi-Fi coverage in the most intuitive way. Traditionally, home Wi-Fi deployments included a single Wi-Fi access point (AP) or router, which may or may not fully envelop the desired coverage area (Figure 1). The structure surroundings, such as the type of walls, floors, and wiring, can affect Wi-Fi coverage. Additionally, the growing number of connected devices and services in use brings extra traffic to Wi-Fi networks. Increased throughput, improved efficiency, reduced interference, and easier AP placement and network configuration are welcome enhancements to Wi-Fi networks.

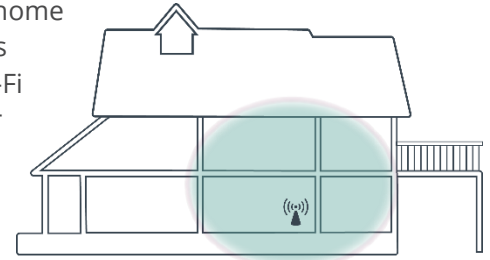


Figure 1: Wi-Fi coverage at large home using one access point

Depending upon the size and materials of a structure, single AP solutions are frequently not sufficient to blanket the space with excellent Wi-Fi coverage. To avoid poor coverage, some deployments use range extenders, but this approach can result in a decrease in throughput and leaves the home network a patchwork of individual parts instead of a unified entity, which can be challenging to manage.

There is a clear market need for full coverage, efficient, self-configuring Wi-Fi networks that require minimal work to set up and that largely maintain themselves. The industry has responded by creating proprietary solutions primarily for homes and small offices that employ multiple APs interconnected to create a single network, such as the one shown in Figure 2. These products intend to deliver to users the benefits of extended Wi-Fi coverage, but do not provide multi-vendor interoperability.

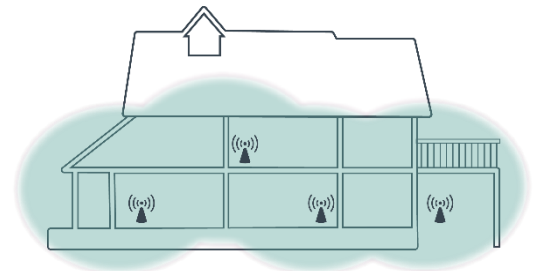


Figure 2: Wi-Fi coverage at large home using multiple access points

Smart Wi-Fi networks now offer interoperability

[Wi-Fi CERTIFIED EasyMesh™](#) is a Wi-Fi Alliance® certification program that brings a standards-based approach to multiple AP Wi-Fi networks. Built on the [promise of quality and interoperability of Wi-Fi CERTIFIED™](#) programs, Wi-Fi EasyMesh™ extends Wi-Fi coverage and enhances performance throughout the home or office, while allowing the addition of other Wi-Fi EasyMesh APs from a variety of vendors.

Wi-Fi EasyMesh networks utilize multiple APs that work together to ensure all areas of the home have complete Wi-Fi coverage and adapt to changing network conditions to deliver a consistent, high quality user experience. The Wi-Fi EasyMesh program, based upon the [Wi-Fi Alliance Multi-AP Technical Specification](#), leverages Wi-Fi standards and protocols to make it easier to install Wi-Fi EasyMesh networks, add new Wi-Fi EasyMesh devices, and form a unified, adaptable network that can adjust its topology and balance the load of its APs. The result is a smarter Wi-Fi network that provides extended network coverage, increased performance, capacity, and effective throughput.

Wi-Fi EasyMesh

The Wi-Fi EasyMesh program defines the control protocols between APs, mechanisms to route traffic within the network, and the data objects necessary to enable easy onboarding, provisioning, control, and automated management of APs in a Wi-Fi EasyMesh network.

Wi-Fi EasyMesh networks use a controller to manage the network, with agent APs connected to it. Wi-Fi EasyMesh controllers are often located in the main gateway which connects a home network to the service provider infrastructure. The main gateway frequently includes the controller and an integrated agent AP that the controller also manages as indicated in Figure 3 below. The controller can be located anywhere in the network—not only in a gateway device.

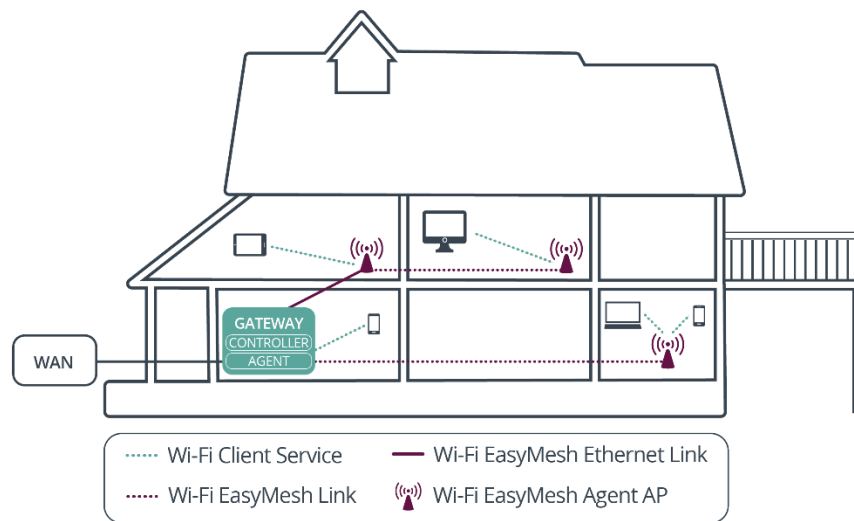


Figure 3: Wi-Fi EasyMesh network example with both wired and Wi-Fi links

The number of devices in a Wi-Fi EasyMesh network depends upon the site needs: some installations work well with one controller and two agents while other sites will need one controller and several agents. These networks are incredibly scalable so long as there is a controller to manage the agents.

Simple access point placement

Many homes do not have a wired Ethernet connection in every room. Therefore, to facilitate optimal placement of APs in the home, Wi-Fi EasyMesh devices can connect to each other using several networking technologies, including Wi-Fi, Ethernet, and others supported by the Institute of Electrical and Electronics Engineers (IEEE) 1905.1 protocol. This allows implementers and deployers to combine different technologies, Wi-Fi radios, or bands to interconnect agents, balancing cost and capacity tradeoffs. The use of a Wi-Fi link is attractive because it enables the installation of agents almost anywhere without the need to run cables.

Figure 4 shows some of the Wi-Fi EasyMesh link options, including:

- Wi-Fi 2.4 GHz
- Wi-Fi 5 GHz low band: channels 36~65, U-NII-1, U-NII-2A
- Wi-Fi 5 GHz high band: channels 100~165, U-NII-2C, U-NII-3
- Ethernet

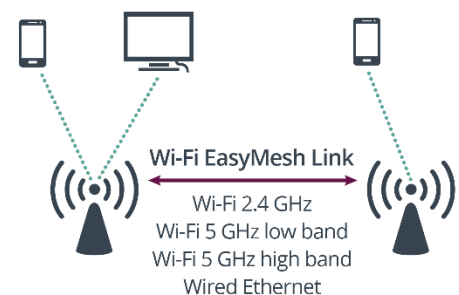


Figure 4: Example of Wi-Fi EasyMesh link options

Wi-Fi EasyMesh controller

In a Wi-Fi EasyMesh network, the controller is a logical entity that can be located in a single device anywhere in the network or in a device that performs multiple network functions, such as a gateway device. The controller provides the functionality to onboard and provision other Wi-Fi EasyMesh network devices onto the network. It also manages all Wi-Fi EasyMesh agents. The controller receives metrics and capability data from all devices in the network and controls the operating parameters of the agent APs in the network, such as channel of operation, data flow topology, and client roaming between agents. It also sends control commands to the agents to improve load balancing and other management functions.

Wi-Fi EasyMesh agents

All APs in a Wi-Fi EasyMesh network are agents. A Wi-Fi EasyMesh agent is also a logical entity. It executes commands from the controller and reports measurements and capabilities to the controller and other agents in the network. An agent also serves as the Wi-Fi interface to client devices.

Flexible data path connections

Client devices such as mobile devices, TVs, and laptops connect to agents through a standard Wi-Fi connection, referred to as fronthaul in the Multi-AP Technical Specification. The agents then deliver the data to their destination, such as another AP or the internet, via backhaul links. Fronthaul and backhaul links may use separate radios for better performance, depending on capabilities offered by each device.

The Wi-Fi EasyMesh certification program supports a diverse set of variants for backhaul and fronthaul links, such as those indicated in Figure 4. In addition to providing support for a variety of network connections, Wi-Fi EasyMesh networks can also change fronthaul and backhaul paths to adapt to network conditions. This enables the controller to effectively manage traffic routing and, by extension, improve performance. Wi-Fi EasyMesh agents may use multiple radios as well as specific bands and channels to manage traffic on the network. The technology allows for radios to support both fronthaul and backhaul roles simultaneously, or one dedicated role at a time, to improve performance.

Network setup and operation

Setting up and maintaining a wireless home network is daunting for many consumers. Wi-Fi EasyMesh networks can be deployed in minutes regardless of technical expertise. While the details of installing a Wi-Fi EasyMesh network depend upon vendor implementation, installation and setup is simple and requires very little intervention from the user. This makes Wi-Fi EasyMesh networks a great choice for both consumers and service providers who supply equipment to their customers. Once the controller is set up, it takes on the role of configuring each agent in the network. Wi-Fi EasyMesh networks are also easy to expand by adding new agents, even from multiple vendors. New agents are automatically discovered and configured by the controller.

Onboarding, discovery, and configuration

Onboarding is the process by which a Wi-Fi EasyMesh agent establishes a data link connection to a Wi-Fi EasyMesh network. This can be done through Wi-Fi or a wired connection. Wi-Fi EasyMesh provides easy onboarding and supports both Wi-Fi CERTIFIED WPA2™ and Wi-Fi CERTIFIED WPA3™ security for the backhaul connection between agents.

Once the Wi-Fi EasyMesh agent is installed on the Wi-Fi network, the network initiates the protocol that enables the controller and agents to discover each other. This protocol allows the controller to query the network for information about what agents are connected and what their capabilities are, including how many radios each agent has and the versions of Wi-Fi they support. Then the controller decides how to best configure those devices based on capability (see “Capability reporting” section below).

Wi-Fi EasyMesh extends the IEEE 1905.1 procedures to enable the controller to configure each of the radios of an agent. It also includes mechanisms to configure control-related policies on agents, such as policies that relate to metrics and steering. Additionally, the controller determines the topology of the network of agents, which can adapt to changing network conditions.

Wi-Fi EasyMesh supports logical separation of traffic for multiple networks, such as a home network and a guest network. Each network is separate from the other(s) with its own virtual local area network (VLAN). This feature works on both wired and Wi-Fi backhaul links.

Network operation mechanisms

In addition to facilitating the optimal placement of multiple APs in a network, Wi-Fi EasyMesh includes mechanisms needed to create and maintain a self-optimizing network that maximizes performance and improves client roaming.

Capability reporting

Wi-Fi EasyMesh agents describe and report capabilities to the controller, such as:

- Number of Wi-Fi radios within the device
- Wi-Fi technology supported
- Bands and operating classes (channels and channel widths) supported

The controller uses the information sent by each agent to maintain optimal network performance. Based on network conditions reported by the agents in the network, the controller could send control commands to one or more agents to move to a different channel, decrease transmit power, or report when a certain amount of bandwidth is being utilized.

Channel selection

The Wi-Fi EasyMesh controller can query the agent for preferred operating channels. In addition, a Wi-Fi EasyMesh controller can request agents to perform a channel scan to gain an understanding of the radio frequency environment and neighboring basic service sets (BSSs) that each agent sees. Then it sets the operating configuration for each radio in the agent, including preferences and restrictions for operating classes, channels, and transmit power. By default, an agent operates a radio at its maximum nominal transmit power allowed by applicable regulatory rules. However, the controller may limit the nominal transmit power to improve system signal conditions. A Wi-Fi EasyMesh controller may choose to delegate some of the local action decisions to an agent to increase network responsiveness.

To assist in efficiently meeting regulatory requirements in various geographies, a controller may request an agent perform channel availability checks (CACs), or provide their CAC status. The agents execute CAC operation as requested and then report the CAC information to the controller.

Link metric collection

The Multi-AP Technical Specification for Wi-Fi EasyMesh defines the protocol for network devices to convey link metric information associated with the network. These metrics pertain to the network overall, and do not include metrics specific to a particular client device. Wi-Fi EasyMesh agents also leverage IEEE 802.11 Beacon report measurements, Beacon report technologies included in [Wi-Fi CERTIFIED Agile Multiband™](#), and key performance indicators defined by [Wi-Fi CERTIFIED Data Elements™](#) to report metrics about network health, including the quality of the links between an agent and its associated clients.

Wi-Fi EasyMesh complements Wi-Fi Data Elements™, which helps operators gather network information to more proactively identify and resolve Wi-Fi network issues. These link metric collection methods work together to enable Wi-Fi EasyMesh networks to adapt to the network dynamics, which in turn can deliver more consistent Wi-Fi experiences to users.

Client steering

A controller may choose to send control messages to “steer”, or suggest, a client move its connection from one agent to another. This balances the network load between agents and optimizes client roaming. These decisions are made based on the controller’s accumulated knowledge of the Wi-Fi EasyMesh network and its clients. The control messages enable steering of any client. Devices that support technologies in Wi-Fi Agile Multiband™, such as IEEE 802.11v BSS Transition Management (BTM), will likely experience faster transitions.

Optimizing connections

An important function that makes Wi-Fi EasyMesh networks smarter is the ability to better manage the connections between APs. A controller can select the best path, band, and channels for backhaul connections between APs to optimize the network resources (Figure 5).

Wi-Fi EasyMesh uses Wi-Fi Agile Multiband to collect key information about the Wi-Fi environment, to efficiently manage the network resources and optimize load balancing on the APs. It does this by steering client devices to the most suitable band, channel, or AP.

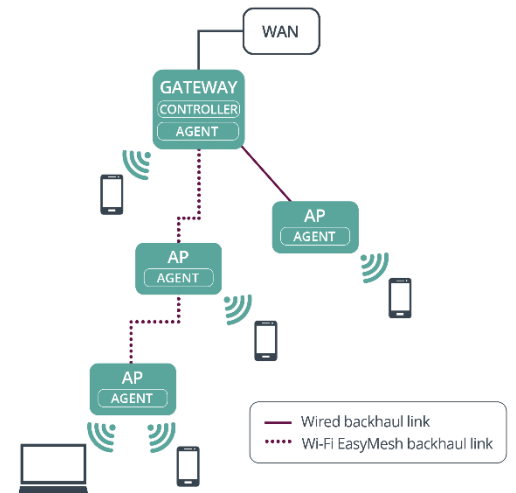


Figure 5: Wi-Fi EasyMesh topology

Summary

The increased desire for full coverage, uniform Wi-Fi in the home compelled the market to provide multiple AP Wi-Fi systems to bring extended coverage. Most of these systems are based on proprietary technologies. In response to this market need, Wi-Fi Alliance has introduced a standards-based solution that offers both service providers and Wi-Fi users a consistent approach to simplifying the installation of multiple AP networks. Wi-Fi EasyMesh networks form unified, multiple AP networks that extend coverage and simplify network management to improve end-to-end quality of service (QoS) throughout the home or office. Wi-Fi EasyMesh enables a strong ecosystem of interoperable Wi-Fi CERTIFIED devices and provides more flexibility and choice in selecting devices to bring smart, adaptive Wi-Fi networks to the home.

More information about Wi-Fi EasyMesh is available at: <https://www.wi-fi.org/discover-wi-fi/wi-fi-easymesh>.

About Wi-Fi Alliance®

www.wi-fi.org

Wi-Fi Alliance® is the worldwide network of companies that brings you Wi-Fi®. Members of our collaboration forum come together from across the Wi-Fi ecosystem with the shared vision to connect everyone and everything, everywhere, while providing the best possible user experience. Since 2000, Wi-Fi Alliance has completed more than 50,000 Wi-Fi certifications. The Wi-Fi CERTIFIED™ seal of approval designates products with proven interoperability, backward compatibility, and the highest industry-standard security protections in place. Today, Wi-Fi carries more than half of the internet's traffic in an ever-expanding variety of applications. Wi-Fi Alliance continues to drive the adoption and evolution of Wi-Fi, which billions of people rely on every day.

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