EBOOK

Multi Access Point Topologies

How ElasticMIMO™ Changes the Game

Introduction

Living in an increasingly digital world fuels the growing demand for reliable, high-speed wireless connectivity. From home to work, people expect continuous, high-quality internet access as it allows communities to stay up-to-date and relevant in this modern world.

Smartphones, computers, and other mobile devices on a network share a finite amount of resources. When multiple devices are connected to a wireless network, people often start to experience connection problems. At some point, the online game begins to lag, or the movie that's streaming starts to look fuzzy.

Needless to say, people get upset when it happens. Often, they end up leaving their service provider. This ebook shares information that can help network professionals learn how to address wireless coverage and capacity limitations of traditional large cell architectures by implementing multiple access point architectures

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Why Home Wi-Fi Networks Need Multiple Access Points

Each access point can handle only a certain number of connections and a limited amount of network load. If a large or multi-floor house has a single access point, not all areas of the building will have fast, reliable internet access. Not only that, there could be reduced performance if multiple devices share the same network.

Service providers can offer a multiple AP (access point) solution to homeowners who are having internet connectivity issues. By installing multiple APs on a home network, more devices can join the network, without affecting the performance. Not to mention, the entire house can potentially have good internet coverage.

Figure1 shows a house with multiple Wi-Fi consumers.

Figure2 shows the Wi-Fi coverage of this house when served with a single access point. The colors indicate that the Wi-Fi signal quality degrades as you move away from the AP.

Why Home Wi-Fi Networks Need Multiple Access Points

Figure3 shows the Wi-Fi coverage of the same house when served by multiple APs.

Overlapping Wi-Fi access points in a single channel allows a simple and easy network configuration supporting multiple nodes that can communicate in a daisy chain and self-heal when one of the nodes is not available, enabling clients to easily roam between the APs. However, this method can also create some challenges considering the potential signal interference of all devices sharing the same channel which will impact the available airtime and degrade the network performance.

Another option that minimizes the channel airtime constraints is to configure the APs to work on separate channels. In this configuration, users have to roam between channels if they move to a different part of the house. On the bright side, homeowners can enjoy more capacity in areas where multiple channels overlap. Implementation of a multiple channel network is best achieved using dual or triband extenders, supporting multiple bands that can independently support each of the fronthaul and backhaul links on separate channels.

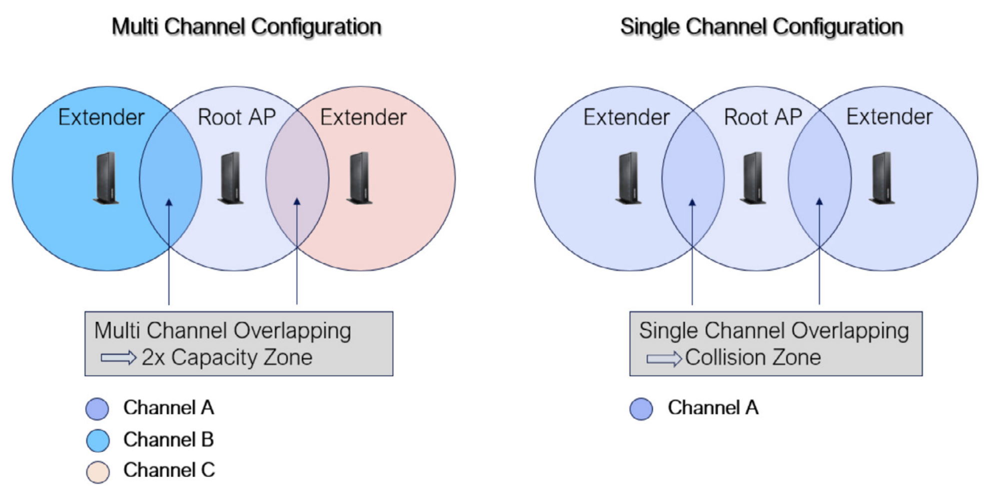


Figure4: Multiple Routers running on the same channel vs. using multiple channels

In a typical home, the network conditions and load can vary throughout the day. One challenge that service providers often face is how to build a network that can provide optimal performance that will guarantee best coverage and throughput under variable Wi-Fi usage patterns and changing network conditions.

Types of Network Topology

Wi-Fi networks can be built in different topologies. Here are a few of the factors that may influence the Wi-Fi coverage in a home, and should be taken into account:

Home Dimensions

Wi-Fi coverage may be limited in remote locations of a large house.

Physical Obstacles

Multi floors and brick walls will typically limit the Wi-Fi coverage.

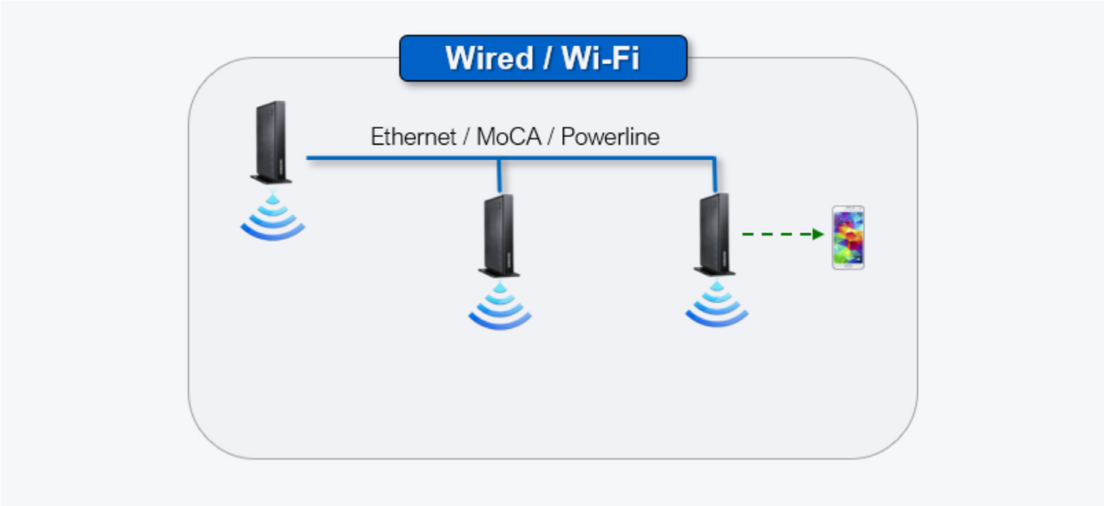
Communication Infrastructure

Availability of standard home communication wire types (Ethernet, Powerline, Coax, etc.) can be used as a communication backbone, providing a robust backhaul communication link over a wired network.

Types of Network Topology

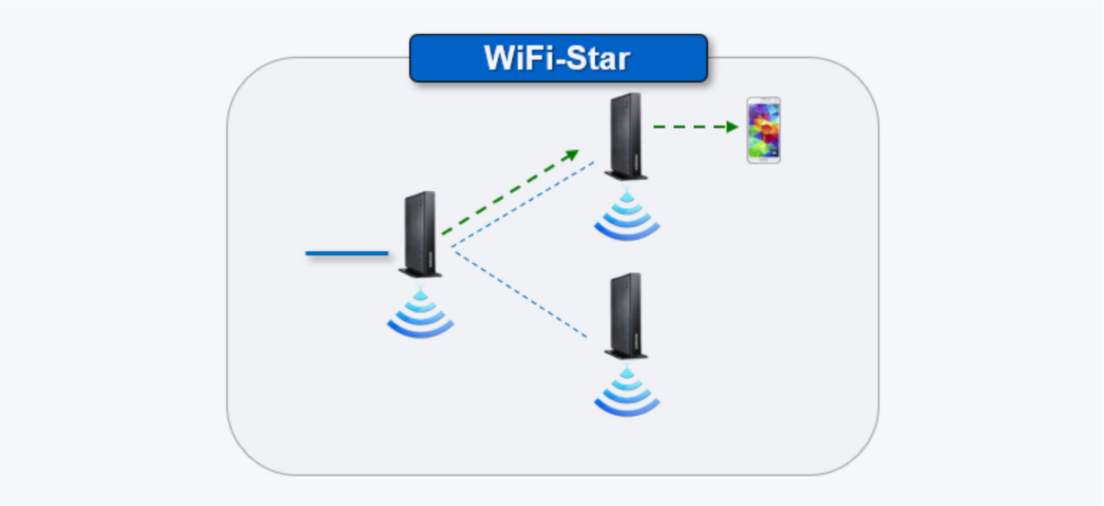
The following topologies can be considered:

HYBRID NETWORK



A hybrid Wired/Wi-Fi network would seem to offer the best of both worlds in terms of coverage and throughput. Such a network takes advantage of standard home communication wire types (Ethernet, Powerline, Coax, etc.) to provide communication between APs. In this configuration satellite access points (extenders) connect to the main router and to each other over the cabling using standard communication protocols. The wired backbone is typically resilient to radio interference and does not load the Wi-Fi network and does not consume airtime. Having a wired backhaul would free the AP Wi-Fi to service clients without the need to use valuable Wi-Fi resources for backhaul communication. A Hybrid network provides best Wi-Fi efficiency by eliminating the need for using Wi-Fi to retransmit packets between APs.

WI-FI STAR NETWORK



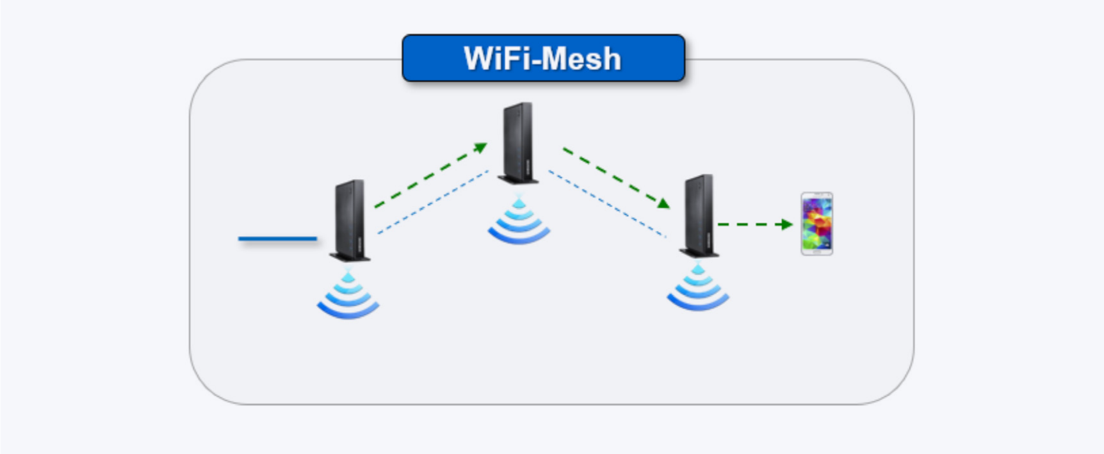
In a Wi-Fi star topology, all Wi-Fi AP extenders directly communicate with a central router. In this configuration each of the extender APs supports Wi-Fi backhaul communication to the central router while also serving the clients over the Wi-Fi network. As depicted in the diagram above, a central router transmits data to an access point and from there, data is retransmitted to a connected device, thus consuming twice the airtime. Since every device has to be connected to the central router, each user consumes more airtime compared to a wired network, which means it decreases the overall Wi-Fi capacity of the home.

Dual band APs are often used in a Star network. With dual band availability the APs can be configured to allocate one band for the backhaul Wi-Fi link and the other band for serving clients.

Types of Network Topology

This topology requires proper configuration to optimize the Wi-Fi resources of both bands in order to enable reliable and dynamic Wi-Fi performance that can adapt to changing network requirements by clients and services throughout the day.

WI-FI MESH NETWORK



Mesh is a network of multiple access points that are placed around the house and can connect to each other in daisy chain. A mesh network is reliable and offers redundancy. When one access point can no longer operate, the rest of the nodes can still communicate with each other, directly or through one or more intermediate access points.

While a Wi-Fi mesh network topology can cover a wider range, there is a tradeoff. Since data has to be transmitted from one access point to the other, each packet consumes a significant amount of airtime. In turn, the capacity of the connection decreases as the number of hops increases.

In a basic Wi-Fi mesh network, all APs and interfaces can be configured to operate on the same channel. This configuration enables all nodes to communicate with each other and to find alternative routes through redundant signal paths. However, the drawback in this configuration is that each packet retransmission between one AP to the other consumes valuable airtime and slows down the entire network.

A more advanced Wi-Fi mesh solution can be based on dual and tri-band access points. Such APs support multiple bands that can be configured to use different channels for different links in the network. This method, however, poses a more challenging routing logic by the network to support redundancy paths when operating on different channels and best use of the bands for guaranteeing optimal performance of the Wi-Fi backhaul and fronthaul, taking into account changing network conditions throughout the day.

What is the New EasyMesh Standard?

Nowadays, mesh Wi-Fi systems provide incredible wireless internet coverage across wide areas. The Wi-Fi Alliance, which is the organization responsible for setting Wi-Fi standards, created a standards-based approach for Wi-Fi networks that implement multiple APs. It's called the Wi-Fi Certified EasyMesh.

The new standard brings many smart and efficient capabilities to home Wi-Fi networks. For instance, it requires technologies to adopt a flexible design, allowing the optimal placement of multiple access points. The EasyMesh standard supports easy setups through automatic device onboarding, as well as configuration. To maximize performance, the Wi-Fi Alliance encourages technologies with self-optimizing and self-organizing networks that gather information and respond to conditions.

Additionally, the EasyMesh standard promotes effective load balancing. This capability enables devices to roam and find the best connection without any interference. Best of all, this supports highly-scalable devices, which enable users to add as many wireless APs as they need, wherever they need them.

Optimizing Multiple AP Home Networks with Elastic MIMO

The increased demand for capacity across the whole home, that is consumed by multiple concurrent devices spread across range, makes solutions aiming for scalable geo-capacity favorable. For Wi-Fi, managed multi-AP network in the form of extenders, repeaters, mesh-nodes is a growingly adopted topology. Having multiple access points that are serving the entire covered area, with possibly different backhaul needs, different front-haul needs and services, complicates a design of a single hardware that can be easily installed in consideration of the end-user location preference, while providing the performance benefits and coverage expected.

Elastic MIMO, allows homes with a mesh architecture of access points to maximize the full capacity of their network.

It addresses one of the most common problems of mesh topologies—capacity. Whether users want to focus on the backhaul or the fronthaul, Elastic MIMO can dynamically adapt MIMO configurations based on Wi-Fi usage patterns and network conditions, enabling them to optimize Wi-Fi performance.

It is challenging to predict the usage rates in each Wi-Fi band. Elastic MIMO can help take out the guesswork from the Access Point design and help adjust to changing usage trends in the field.

Enabling dynamic configuration of MIMO per band is imperative today, but even more so in the near future when the highly-anticipated 802.11ax standard will be applied to 2.4 and 5 GHz bands.