Types of Wireless Networks

There are three major “modes” a Wi-Fi device can use. These modes define the role a WiFi device has in the network, and networks must be built out of combinations of devices operating in these different modes. How the devices are configured depends on the types of connections you want to use between parts of the network.  
 In discussing these modes and the examples below, several types of devices are used. In addition to the phones, tablets, and laptops you use in accessing a network, routers make up the hardware that runs the network.

The three wireless roles are:Wireless Clients (Station) Devices such as computers, tablets, and phones are common Clients on a network. When you are accessing a wireless hotspot, or the router in your home or office, your device is the client. This client mode is also known as “station mode” as well. Some routers can operate as Clients as well, which allows them to act like the wireless card in a computer, and connect to other Access Points. This can bridge two Ethernet networks, or connect to more distant APs. A Wireless Client is similar to a person in the audience of a play or movie. They are one of several or many people accessing information through the same conduit - someone speaking.

Access Points (Master) Most wireless networks are made using Access Points - devices that host and control the wireless connection for laptops, tablets, or smart phones. If you use Wi-Fi in your home or office, it is most likely through an Access Point. When a router is set up as an AP, it is said to be in “Master” or “Infrastructure” mode. An AP is sometimes a stand-alone device that bridges between a wireless and wired (Ethernet) network, or is part of a outer. APs can cover a range of areas with a wireless signal, depending on the power of the device and the type of antenna. There are also some APs that are weatherproof, designed to be mounted outdoors.  
 An Access Point is similar to a person on stage, addressing an audience or crowd - they are providing the information for everyone else. Those audience members can ask questions of the person on the stage, and receive a response.

Ad-Hoc Node (Mesh) Some wireless devices (laptops, smart phones, or wireless routers) support a mode called Ad-Hoc. This allows those devices to connect together directly, without an Access Point in-between controlling the connection. This forms a different type of network - in Ad-Hoc mode, all devices are responsible for sending and receiving messages to the other devices - without anything else in between. In an Ad-Hoc network, every device must be in this role, and using the same configuration to participate. Not all devices use this mode, and some have it as a “hidden” feature. Ad-Hoc devices are used to create a Mesh network, so when they are in this mode, they are called “Mesh Nodes”.  
 An Ad-Hoc or Mesh node is similar to an individual in a group or roundtable discussion. They can take equal part in the conversation, raising their hand when they want to speak so the others will listen. If someone at the end of the table cannot hear, one of the individuals in-between can repeat the original message for the listener.

**Wireless devices in networks**  
 Treat the three types of roles above - Clients, Access Points, and Ad-Hoc nodes - as the building blocks for large networks. Below are several examples that demonstrate how devices configured for different roles can be used.

**Access Point - Home or Office network**  
Wireless networks used in your home or office are generally a combination of a router and a wireless Access Point (AP).

In the diagram:  
• 1 represents the connection to the Internet (Optional - networks can function without the Internet).  
• 2 represents the router that assigns IP addresses and provides a firewall between your network and the Internet.  
• 3 represents the Access Point, providing a wireless bridge between the router and the users’ devices.  
• 4 represent user devices, such as laptops, tablets, and smartphones.

In many home networks, or small office networks, the router and AP may be combined into a single device. This is usually just called a wireless router. It may also have a DSL, Cable, 3G, or 4G port to provide the connection to the Internet. In large office scenarios, there may be several AP devices spread throughout the building to provide more even wireless coverage, connected back to the router through long Ethernet cables.

**Point to Point link - Long Distance Connections**  
 Wireless networks can be used to connect distant buildings or areas. It usually requires very focused antennas - such as a dish antenna - that can send a narrow beam in a specific direction.  
 A long-distance connection is often called a “point-to-point”, or “PtP” link. The name describes the concept: two points are connected together, and nothing else. This requires two wireless devices: one configured as an Access Point; the other configured as a Client. In the example below, two wireless devices are configured to create a point-to-point link.

**Mesh - Neighbor-to-neighbor Networks** A mesh network takes the principle of Point-to-Multipoint, and extends it to the idea of every node connecting to every other node in range. In effect, this creates a “Multipointto-Multipoint” network. This requires that all the devices are in the Ad-Hoc mode – wireless devices all in AP mode or Client mode can’t perform the same function.  
 The diagram below demonstrates one model for how this works. Wireless mesh nodes are installed on the rooftops of various buildings, and those nodes that are in range and don’t have anything blocking the signals will connect. These nodes will share all resources connected to them such as local servers hosting applications and connections to the Internet. They can also be connected to computers, Access Points, or routers inside the buildings so users can access the resources anywhere on the network.

In the diagram:  
• 1 represents the connection to the Internet.  
• 2 represents a Mesh Node with a connection to the Internet, with an omnidirectional (all directions) antenna.  
• 3 represents Mesh Nodes with omnidirectional (all directions) antennas. These nodes are receiving Internet access from Mesh Node B. They may be connected to different devices inside the building.  
• 4 represents small Access Points distributing wireless service inside the building.

**Hybrid Networks** When designing and building town or community-sized networks, it may be difficult or impossible to use a single method to connect everyone. For instance, a single Point-toMultipoint network may not cover an entire community. Mesh nodes can be used to extend client sites to nearby buildings. Point-to-point connections can bridge longer distances and join several disconnected networks together.

In the diagram below, we can see an example of a hybrid network. There is no single example that can cover all of the possible uses for a network! In the activity that follows, you will explore the different ways to build a network by working through scenarios.

One last note before we move on to the activity - in the examples above, and in the activity that follows, the diagrams focus on building networks across rooftops or from building to building. This is generally the best way to build networks that cover neighborhoods, towns, or communities. In the diagrams, the way people connect to this network isn’t always shown.