Overview

One of the most common problems experienced by Wi-Fi users is inadequate wireless ranges, particularly in areas where concrete walls are used in buildings. A similar problem that everyone experiences occurs with mobile phones, where the quality of the connection can vary widely simply by moving the handset very small distances.

There are multiple reasons that affect the range and quality of signal including signal strength, walls, interference from other electric equipment and optimal rate selection on wireless access points.

Wireless signals significantly lose their strength as they go through walls containing concrete, stone or brick, causing a much greater loss of signal and negative impact to Wi-Fi users. These type of walls are common throughout Europe

Wireless signals inside a building travel from one point to another by reflecting and scattering off the walls instead of going through them. Interference from electronic devices including microwave ovens, wireless DECT telephones and Bluetooth devices can give the appearance of poor range. As the signal weakens, rate adaptation algorithms lower the wireless transmission rate. An acceptable wireless throughput can still be achieved at a distance, however many Wi-Fi implementations are not very successful at selecting the optimum transmission rate, leading to dropped data packets and causing a high amount of data retransmissions. This can significantly lower the actual throughput seen by the user.

Common Solutions

High gain antennas

High gain antennas inside buildings with concrete walls have minimal benefit. Antenna gain focuses the wireless energy to a specific direction and can have a significant impact in outdoor line of sight applications. Indoors where the transmitter and the receiver are not seeing each other, signals are travelling by reflecting and scattering off the walls and other objects, focusing the wireless signals to one direction does not improve the range.

Two antennas

Two antennas increase performance. Given that wireless signals travel from transmitter to receiver through multiple paths, all the signals combine at the receiver antenna and interfere with each other. The interference may be constructive and destructive depending on the path taking by the signals. When they combine destructively on one antenna there is a good chance that they combine constructively on the other antenna located a few centimetres away from the first one. 802.11n devices combine the signal received from both antennas making the total received signal strength better than the signal received on one antenna alone.

2X2 802.11n

Wireless devices that support 2X2 802.11n standard send and receive signals as two separate streams over two antennas. When the devices are close to each other double the speed is achieved, when the devices are apart from each other the wireless signals are combined in a way to provide good performance at medium distances and slow performance at longer distances. 802.11n range performance is significantly better than that of the older 802.11g standard, however it still cannot provide coverage range through multiple walls nor can it provide high performance and broad coverage through walls.

AirTies
Wireless Networks

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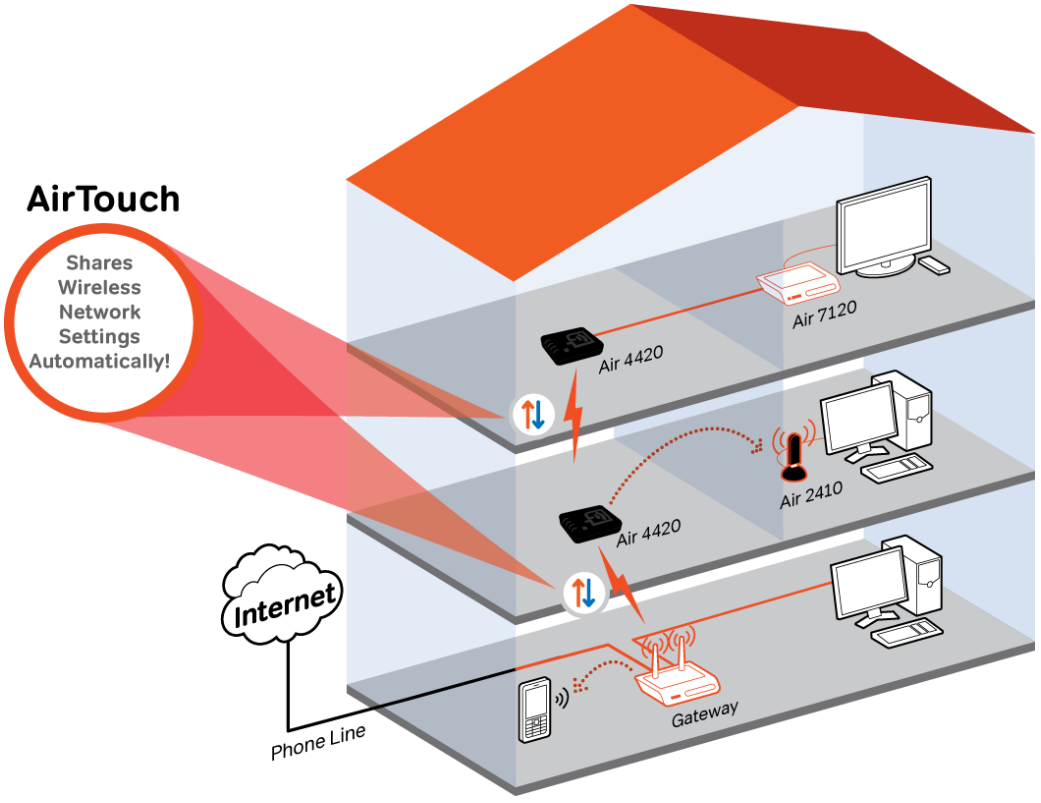
AirTies MESH

Every AirTies device inclusive of Gateways, Routers, AP, Bridges and Set Top Boxes contain MESH functionality, which extends the range of networks.

A packet is sent from point A to point B, which resends it to point C. Every hop over a MESH repeater point effectively doubles the physical range without any loss in performance. If adequate signal strength cannot be achieved by adding an AirTies Set Top Box or USB Host device then a small AP/repeater can be placed at a location to repeat the network. The MESH network is securely setup by simply pressing the AirTouch button.



AirTies real world implementations of MESH includes thousands of large networks installed at hotels, schools, business campuses and interconnecting campuses up to 2KM apart.

(See MESH technology link for more details)

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Technical Details

As with all AirTies technologies we start with a standard and then dramatically improve upon it, in this case the WDS protocol that is part of the 802.11 standard. The chip vendor drivers and MAC layer software has been re-written to support the features below and has been optimized to minimize lost/dropped packets, as well as rate selection algorithm improvements to focus on reliable packet delivery. We have also integrated advanced security methods inclusive of operating WPA2 over MESH.

AirTouch technology dramatically simplifies MESH network set up. By simply pushing AirTouch buttons on two devices all MESH network set up items are automatically configured including SSID, security settings, MESH ID as well as routing paths. Configuration changes or security password changes can be done on a single AirTies device, afterwards the changes are automatically propagated between all AirTies devices within the MESH network.

Roaming: Any laptop or client device can freely roam between all AirTies devices, selecting the best signal. The client will automatically select the best signal and change without any user intervention. This allows for a user to roam around a MESH network seamlessly.

MultiSSID: All AirTies devices support 4 wireless networks simultaneously. Each network name can have a different set of security levels and passwords. Each network is assigned to a separate VLAN, further enhancing security. For example a guest SSID with a simple password can be used for guests to access the Internet while fully isolating them from the rest of the network.

Dynamic channel change: The 2.4GHz band is filled with WiFi devices, dect phones, Bluetooth phones, microwaves and other interference sources, this leads to a dramatic impact on performance. AirTies devices constantly go to the various available channels (22 at 5GHz) and measure actual noise, interference and the amount of traffic on the wireless channel. All of this information is analysed to pick the best available channel. The root AP communicates with the other AirTies devices to change channels synchronously, moving the entire network to the best performance channel. This occurs without even dropping a single packet.

Coming soon: Further improvements are in development that includes self-healing the network. If for any reason a MESH node is out of service then a new MESH/path is formed automatically and communication continues. Best path routing between the MESH nodes will occur on a per packet basis, e.g. communication between TV Set Top Box to TV Set Top Box without routing via the main gateway. Each node will measure signal strength, link quality, and loading and route the packets accordingly.

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