EDUCATIONAL BRIEF

Demystifying Wi-Fi Roaming

What You Need to Know to Avoid Costly Mistakes

A wide variety of modern conveniences are made possible through Wi-Fi Networking. Home automation, real-time multimedia streaming, and VoIP communications are just a few of the Wi-Fi enabled applications that have become an integral part of the connected home or office environment.

While these new technologies are very convenient, implementation of the underlying network isn't always trouble free. Building a Wi-Fi network that delivers uninterrupted coverage to mobile or "roaming" devices can be a significant challenge—especially as coverage requirements increase. This challenge becomes considerably more manageable when the issue and the deployment alternatives are well understood.

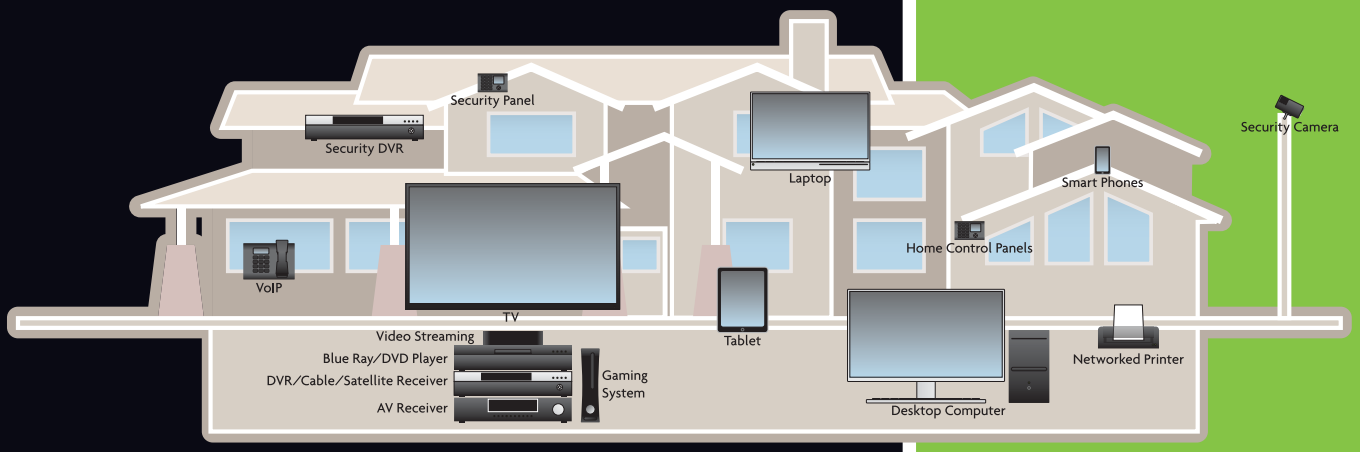

Image 1: The Connected Home Environment

LUXUL

Simply Connected

Many networking vendors don't want the average "uncertified" installer to understand the issue of device roaming for one simple reason—their business model thrives on complexity. This being the case, there is a lot of misinformation about the "roaming issue" and how it impacts the average user. While there is certainly a place for complex networking topologies, the vast majority of residential and small business Wi-Fi networks need not be overly complex or expensive if you're using the right technology.

In this article we will discuss the things you need to know about Wi-Fi roaming so you can better educate your customers and provide them with sensible and affordable solutions.

WHAT IS ROAMING AND HOW DOES IT WORK?

Roaming occurs when a wireless client device moves outside the usable range of one wireless access point (AP) and connects to another AP—usually one with a stronger signal. There is no "roaming" issue as far as the AP is concerned. As long as the APs are setup properly, client devices can roam seamlessly from one AP to another. The issue and challenge comes in the actual "handoff " process, which, according to the IEEE 802.11 standard [1], is dictated by the client device. The handoff is the process of the client device disconnecting from one AP and then re-associating with another. This process consists of 3 phases:

1. Scanning: As the device moves away from the AP to which it is connected and the RSSI (Received Signal Strength Indicator) values begin to drop below certain levels, the client device sends out probe packets to identify AP alternatives. Upon discovery of accessible APs, the device then selects its next AP based on certain criteria, as defined by the device itself.
2. Authentication: During this phase, the client device sends an authentication request to the new AP and waits for a response from the AP to approve or reject the request.
3. Re-association: Upon approval by the new AP, the client sends a re-association request and waits for a response. Once the re-association is complete, the new AP sends out a disassociation packet to the old AP so that the routing tables can be updated. The handoff process is now complete.

If APs are properly setup, research has demonstrated that this handoff process typically takes less than 500 milliseconds (less than ½ second), with the scanning phase contributing to the majority of the delay [2]. It is also worth mentioning that the scanning phase can be reduced substantially simply by ensuring that only valid wireless profiles are stored on the device. With the handoff process taking less than half a second, why does the delay often seem much longer? The answer is that roaming is dependent on the client device's "roam trigger." In other words, the client decides when it is time to drop one AP and move to another. Some client devices are more sophisticated and do a better job of determining at what point to let go of an AP, while others will measure only RSSI values and may hang on for a longer period of time before triggering a roam to a new AP. The important thing to understand is that the roam trigger is completely client dependent.

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WHAT ARE THE TECHNOLOGY ALTERNATIVES FOR MINIMIZING HANDOFF DELAYS?

Given that roaming is a client dependent function, how can uninterrupted Wi-Fi service be achieved? Under current 802.11 standards, the ONLY reliable method is to keep devices from executing a handoff. Anytime there is a handoff, there is risk of dropping packets and delays in service. With most conventional Wi-Fi networking technologies, eliminating the need for handoffs between APs is simply not an option.

So what are the alternatives for minimizing handoff delays? There are various approaches and technologies on the market, as summarized below:

1. Non-Controller Multiple AP Approach: Perhaps the most common approach to date, installers have traditionally used multiple APs set to the same SSID and security level—doing their best to isolate the APs into logical zones in an attempt to reduce the number of handoffs a device may require. This generally has the same effect as the "configuration controller" option described below—but at a lower cost. Clients are still responsible for determining when to trigger the handoff, resulting in some delays when moving from AP to AP.

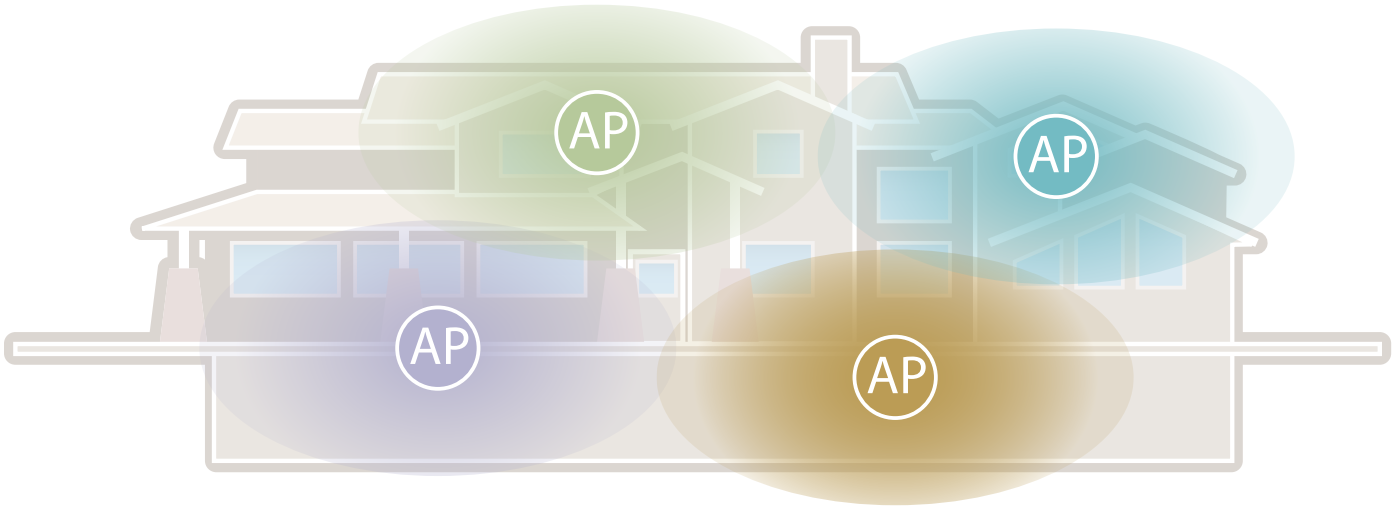

Image 2: Non-Controller Multiple AP Approach

2. Configuration Controllers: A configuration controller is used in conjunction with multiple vendor-specific low powered APs and typically does little more than optimize the AP setup by pushing the settings out to the APs on the network and ensuring they are all set to the same SSID and security levels. The client device must still determine at what point to jump from one AP to another and go through the same handoff process.

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3. Management Controllers: The purpose of a management controller is to optimize the handoff process between APs. While the handoff process may become somewhat faster, the client must still determine at what point to move from one AP to another, which typically takes more time than the handoff process itself.

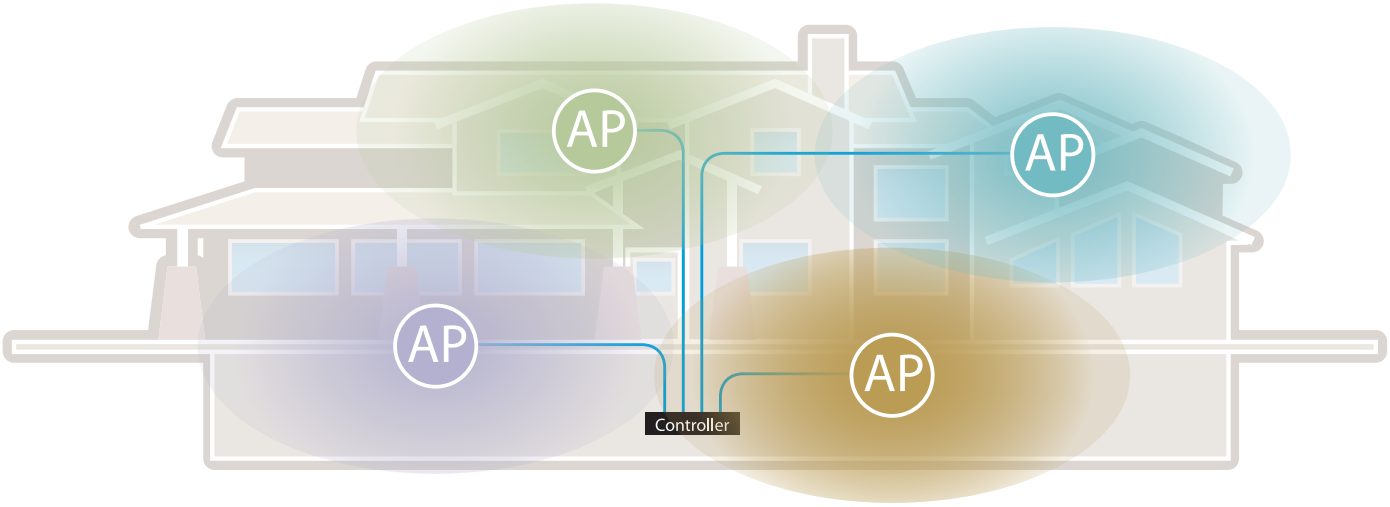

Image 3: A controller-based Wi-Fi Network

4. Wireless Network Virtualization: While still employing the use of a controller, this method is significantly more sophisticated than the aforementioned controller solutions. In this scenario, the controller actively monitors and "listens" to all APs on the network, selecting the best one for transmitting data to the client. Roaming is eliminated because the client sees all APs as a single AP. For certain enterprise applications, this is an effective solution, but for home and small office use, the benefits may not outweigh the hardware, setup and maintenance costs.

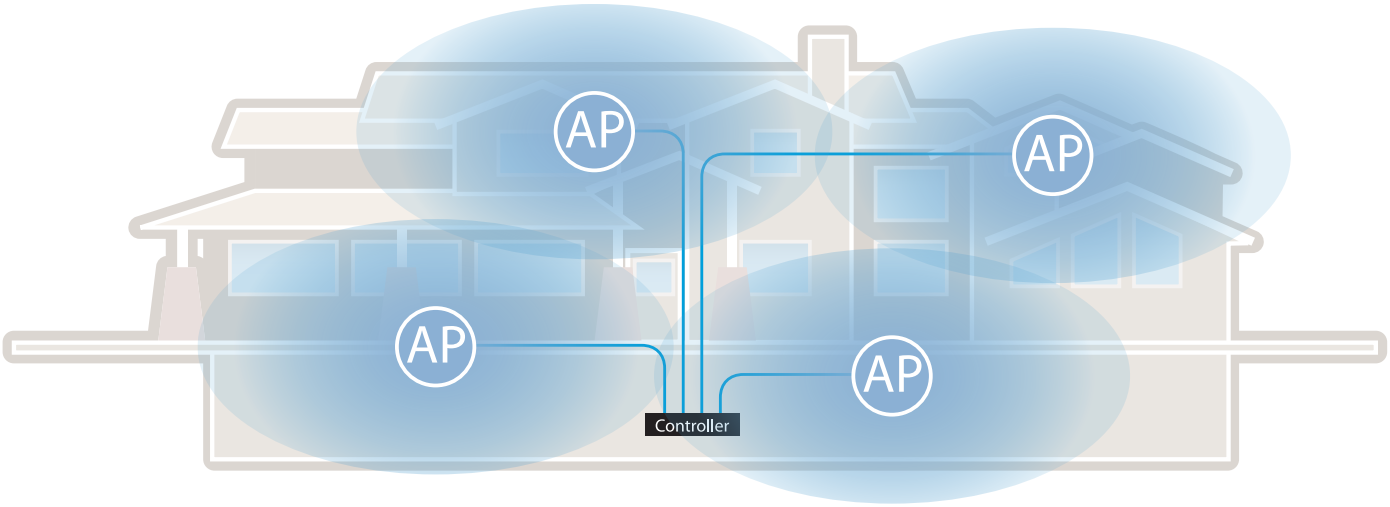

Image 4: Wireless Network Virtualization

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The important thing to remember is that while a controller-based network may help reduce handoff issues for certain applications and situations, the fact still remains that the client device determines at what point it moves from one AP to another. Depending on the client, the user may still experience some delays in transitioning between APs, and perhaps not a significantly greater delay than if simply using the non-controller multiple AP approach. With that in mind, a controller-based solution may not be the best option for your customer's network.

Also, while each of the controller-based options is designed to solve certain issues, none is designed with the home or small office network in mind. Another important consideration is that these solutions typically start at several thousand dollars and can easily reach $20,000 or more—not to mention the added costs of installation and maintenance. Unless milliseconds make a difference to your customer, the high costs and complexity can far outweigh any benefit that may be gained.

The ONLY truly reliable Wi-Fi roaming option is to eliminate the handoff altogether.

IF NOT CONTROLLERS, THEN WHAT IS THE RIGHT SOLUTION?

As previously discussed, the ONLY truly reliable Wi-Fi roaming option is to eliminate the handoff altogether. Wireless Network Virtualization accomplishes this, but at a price that most home owners and small business owners may find difficult to justify—especially if they understand that there is an alternative.

So what is the alternative? It's simple—increase the performance of your AP so that it covers a larger area and eliminates the need for a client to roam. This is the concept behind the unique Luxul Xen™ High Performance Access Point series. A Luxul Xen AP increases coverage area by as much as 400% over traditional APs. For most home and small office environments, this completely eliminates the need for using multiple APs and the inherent handoff delays. In situations where more than one AP is required, setup is the same as that for using traditional APs. The difference is that you have 75% fewer APs—and 75% fewer handoffs.

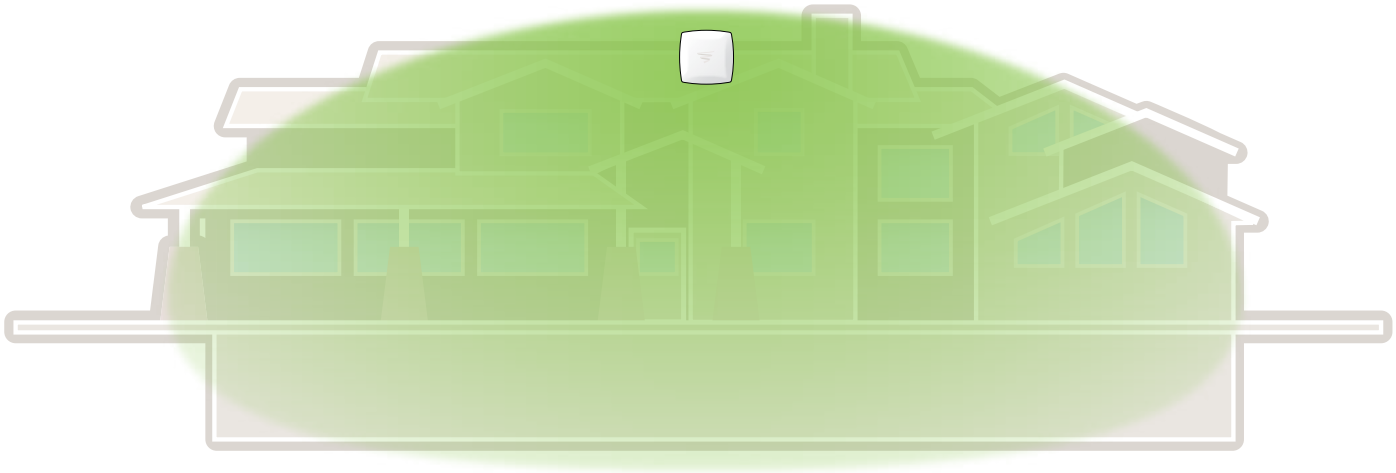

Image 5: The Luxul Xen™ Wi-Fi Network eliminates the need for client handoffs

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Image 6: Luxul Xen™ Access Point Family

Unlike controller based solutions, Luxul Xen APs are designed specifically for use in eliminating handoff issues in home and small office networks. Because a single AP does the work of four traditional APs, roaming, installation, and service issues are all minimized at a substantial cost savings over contemporary alternatives.

Understanding the Wi-Fi client roaming issue can help installers avoid making costly and ineffective recommendations to customers. While Luxul Xen high performance APs may not be the answer for every Wi-Fi network installation, using this unique technology can help eliminate roaming and other issues associated with traditional Wi-Fi networking methodologies.

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REFERENCES

1. IEEE Standard 802.11, 2007. IEEE Standard for Information Technology Telecommunications and Information Exchange Between Systems Local and Metropolitan Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications. Institute of Electrical and Electronics Engineers. New York, USA.
2. Murray, D., M. Dixon and T. Koziniec, 2007. Scanning delays in 802.11 networks. Proceedings of the International Conference on Next Generation Mobile Applications, Services and Technologies. Sept. 12-14. IEEE Computer Society. Washington, DC. USA.

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