Managed Wi-Fi in an MDU

Trade-offs among signal, coverage and interference make installing Wi-Fi in multifamily housing a challenge – but not an insurmountable one.

By Andrew Peterson / *Calix Consulting Services*

The following is adapted from a report on the first multiple-dwelling-unit installation of Calix GigaCenters – a combination ONT, residential gateway and 802.11ac Wi-Fi access point. The GigaCenters were installed in the Deer Ridge Apartments in Jamestown, N.D., a deployment described in detail in the October 2015 issue of ***Broadband Communities****. The report's findings were discussed at the 2016* ***Broadband Communities*** *Summit.*

Calix Consulting Services assisted with the design and testing of the wireless network for a planned Dakota Central Telecom (DakTel) deployment of Calix 844G GigaCenters in a 163-unit apartment building in Jamestown, N.D. The deployment included a dedicated GigaCenter in each apartment unit. Wireless connectivity is used for Internet access only; IPTV is handled via wired connections within each unit.

The density of deployment raised concerns regarding the performance of the wireless network. Specifically, co-channel interference had to be kept to a minimum because of the close proximity of the GigaCenters in neighboring apartments. The limited channel space available at 2.4 GHz presented a particular challenge.

The initial design used RF simulation tools to model the structure of the building and the placement of GigaCenters within it. The design consisted of building material simulation, access point placement, channel width and assignments, and transmitted power levels. The second floor of the three-floor building was chosen as a "worst case," as it included potential interference from above and below.

All these factors were taken into account to produce detailed simulations of the following:

- Signal strength as seen by a receiver (RSSI)
- Signal-to-noise ratio
- Channel overlap
- Estimated throughput.

The objective of the design was to maximize throughput within individual units while minimizing impact to neighboring units. Each client needs to see only a single GigaCenter, though many are visible from any given location. At minimum, a client device within a given unit had to attain the following metrics when associated to its GigaCenter on either band:

- Minimum -65 dBm RSSI
- Minimum 20 dB SNR
- Minimum 150 Mbps predicted PHY rate on 5 GHz
- Minimum 80 Mbps predicted PHY rate on 2.4 GHz
- No more than 1 GigaCenter visible on the unit's assigned 5 GHz channel.

In dense housing, setting Wi-Fi access points to operate in narrow channels and at low power settings may help avoid interference.

Our goal was to minimize, if not eliminate, tenants' purchases of third-party Wi-Fi equipment.

The on-site survey tested several metrics:

- Adequacy of coverage and data rate in a variety of unit sizes with neighboring units' GigaCenters active
- Presence of outside interference sources, particularly radar, which can temporarily cause the GigaCenter to shift traffic away from the DFS channels and impacts the channel plan.
- Validation of assumptions regarding construction materials and absorption.

RECOMMENDATIONS

On-site testing of the channel plan resulted in the following recommendations:

- Disable the 802.11b modulation setting on all radios. This legacy modulation scheme propagates much farther than 802.11g/n and is unnecessary in consumer deployments.
- Consider disabling the 2.4 GHz radios and re-enabling them if a subscriber has devices that do not support 5 GHz. This could be done on a trial basis during deployment of the first building, and call volumes could be assessed to determine the impact. In the long term, monitor use of 2.4 GHz and disable it when possible.
- Signal bleed between floors was higher than the model predicted, violating the requirement for absolute isolation between units at 5 GHz. As a result, the recommendation was to use a 20 MHz channel plan instead of a 40 MHz channel plan at 5 GHz. A 20 MHz plan still offers sufficient throughput to support 100 Mbps data service but with less co-channel interference. In a fully loaded RF environment, contention between neighboring stations is a more serious issue than raw speed.
- Generally, the GigaCenters in most units should be configured at 10 percent power for both 2.4 GHz and 5 GHz bands.
- The channel plan should be designed to minimize co-channel interference between units and provide as much isolation as possible between channels.
- The channel plan should make use of dynamic frequency selection (DFS) channels, which share spectrum with military and weather radar. Should a unit detect a radar signal in the DFS band, it will select another channel for use. On-site testing with a spectrum analyzer confirmed that it was safe to use these channels in the plan. Though the majority of client devices are capable of using DFS channels, some 5 GHz devices are not. Older non-DFS clients should be allowed to associate to the 2.4 GHz radio in a unit that happens to be assigned a DFS channel at 5 GHz.
- The channel plan was formulated to exclude channels 112–128 as well as 140, 144 and 165, which have been shown to be problematic with some client devices.
- Different SSID names should be used at 2.4 GHz and 5 GHz so that users will prefer the less-congested 5 GHz band. There are two important considerations:
  - The 5 GHz SSID should sort before the 2.4 GHz SSID in alphanumeric order so that iOS devices will prefer it if both SSIDs are defined.
  - The 5 GHz SSID should have a more attractive name, such as "Unit138_FAST," so that users can readily distinguish SSIDs without having to know the details of 5 GHz versus 2.4 GHz. ❖

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