802.11n Wi-Fi in RFID

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The rapid growth of Wi-Fi based RFID (WFID) can be attributed to the increasingly widespread coverage of Wi-Fi networks. As an active RFID technology, WFID is used in many application areas including asset tracking, vehicular tolling, and telemetry, among others.

While Wi-Fi network deployment in offices, warehouses, factories, and other work areas is growing more widespread each day, the demands on these networks for increased coverage and throughput are rising. The 802.11n draft standard, which is enjoying wide adoption thanks to the Wi-Fi Alliance's certification program, meets these demands through higher data rates and diversity techniques that improve range of operation. Real-Time Location Systems (RTLS) can be directly integrated into these Wi-Fi networks, which through access points provide a set of receiving and transmitting devices distributed evenly across the area of operation that RTLS solutions require.

The 802.11n draft standard was created to enhance user data throughput in a variety of location scenarios. It uses high data rates on air and multiple antennas carrying multiple streams of data. These features result in increased device complexity, which small, low-power tags can ill afford. However, the standard also provides for single-stream handheld devices that do not need to be equipped with multiple antennas. RTLS tags fall in this category.

Incorporating 802.11n compliant wireless processing in an RTLS tag can be challenging in terms of minimizing power consumption and controlling device complexity. Tags that use 802.11n wireless technology specifically designed for small silicon area and ultra-low-power consumption, such as Redpine Signals' Find-iT RTLS tag, enable 802.11n compliance throughout the network while ensuring that battery life and cost remain comparable or better than legacy 802.11b or 802.11g tags.

Even in a single-stream mode, 802.11n can provide higher throughputs. But more important than this is its ability to help preserve network capacity. The presence of legacy 802.11a/b/g clients forces the 11n nodes to use protection mechanisms, reducing overall network capacity by 30 percent or more. Figure 1 illustrates how this happens.

[Figure 1 | Having legacy 802.11a/b/g clients in an 11n network can help decrease overall network capacity.]

The 802.11n standard defines how multiple antennas at the access point can be used to enhance the operational range of client devices and improve the range-throughput equation in various deployment scenarios, especially those involving moderate or heavy multipath reception. These methods include transmit diversity through space-time block codes and transmit beamforming. Enabling a higher data rate of operation in a given scenario results in longer battery life because tag data can be transmitted or received in less time. Using higher data transfer rates enables Wi-Fi tags to spend a greater percentage of time in a sleep state, thereby increasing battery life.

RTLS systems use one or more techniques to determine the location of a tag. Well-known methods include ranging through received signal strength measurement at the tag, reader, or access point and transmission delay measurement as well as ranging through the time difference of arrival method. The presence of multiple antennas at the access point or reader can help improve the accuracy of these measurements by combining multiple readings.

RTLS tags based on 802.11n are therefore poised to be the mainstay of location systems in emerging enterprise networks, offering high performance and compatibility with next-generation networks while at the same time decreasing battery consumption and the size of tags based on legacy 802.11b/g standards.

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