ZyXEL Smart Antenna - The solution to Wi-Fi challenges

White Paper

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Executive Summary

Reliable, high-speed wireless connectivity with sufficient capacity is a critical component of today's networking environment. With the proliferation of smart devices such as phones, tablets and notebooks, the ability to connect to the Internet anytime, anywhere is essential. This document introduces the Wi-Fi challenges that can impede a smooth connection, and demonstrates how the ZyXEL Smart Antenna overcomes these challenges.

Upgrading to 802.11ac is the next step for all Wi-Fi networks. The ZyXEL WAC6500 series of access points equipped with the ZyXEL Smart Antenna is the perfect choice for easy 802.11ac migration.

Wi-Fi Challenges

Unreliable wireless connection

Obstacles such as walls or office partitions can impede Wi-Fi signals, resulting in poor or non-existent connections in hard-to-reach areas. Intermittent signal issues while moving in an enclosed space often make it difficult to perform even basic tasks, like surfing the Internet or receiving emails.
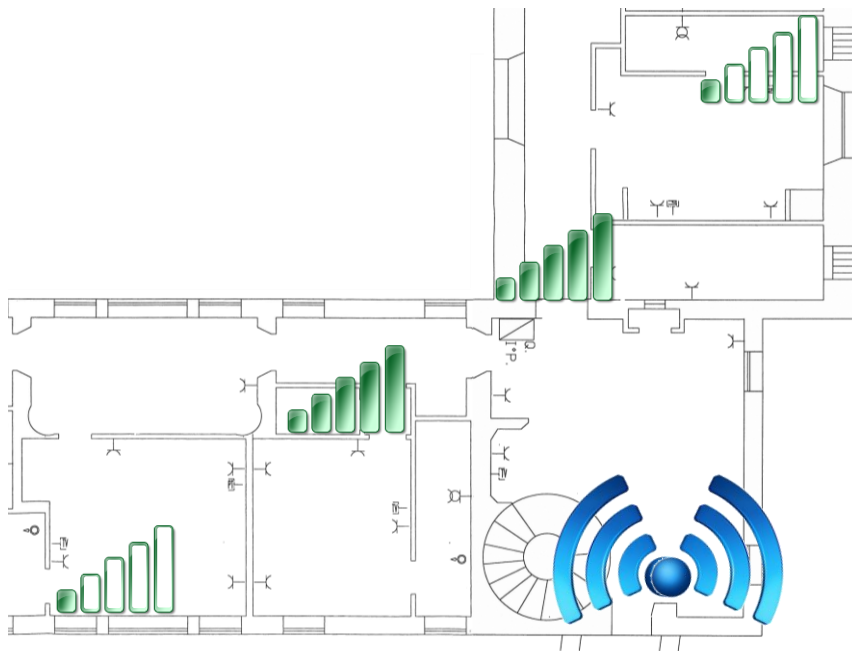
Figure 1. Poor signal strength in hard-to-reach areas.

Interferences interrupt wireless connections

Non-Wi-Fi devices such as wireless phones, microwave ovens and wireless cameras, which operate within frequency ranges that often overlap those used by Wi-Fi can cause

Wi-Fi performance degradation or loss of connection. Other Wi-Fi access points or clients in the same or adjacent channels interfere with and affect network performance as well.

Figure 2. Interference result from non-Wi-Fi devices, other access points or nearby clients.

BYOD demands universal Wi-Fi connectivity and impacts network capacity

The ubiquity smart phones and tablet PC's drives the need for Wi-Fi connectivity anytime, anywhere. In the past, individual network users were usually limited to a single notebook PC. However, the boom in smart devices such as smart phones and tablet PC's has driven demand for Wi-Fi connectivity to 3-4 times previous levels, and is still increasing.

Figure 3. Requests from Wi-Fi-enabled handheld devices drive demand for unbiquitous connectivity.

Advanced applications increase demand for bandwidth

With the growing popularity of video streaming and online gaming over wireless networks, as well as VoWi-Fi, users are increasingly unwilling to accept any amount of data delay or lag. These types of applications require considerably more bandwidth than standard web

surfing activities. Upgrading to the latest wireless 802.11ac technology provides the easiest pathway to increased network bandwidth.

Figure 4. Advanced applications like video streaming demand more bandwidth.

Industry Solutions

In proposing methods to mitigate the challenges facing Wi-Fi, we have identified two solution paths within the industry:

Better air-time utilisation – speed upgrade

The next generation of Wi-Fi standard, 802.11ac, can achieve three (3) times greater performance over 802.11n under the same 3x3 spatial streams as shown in figure 5. According to IEEE 802.11ac primarily employs three (3) techniques: providing more spatial streams, higher density modulation, and wider bandwidth to achieve higher speeds. With the spatial streams identical, and the modulation technique advancing from 64-QAM to 256-QAM when transitioning from 802.11n to 802.11ac — representing a 33% theoretical throughput increase — "wider bandwidth" contributes to the remaining percentage increase in 802.11ac performance. Also of note is the fact that increased bandwidth results in fewer usable channels (figure 6).
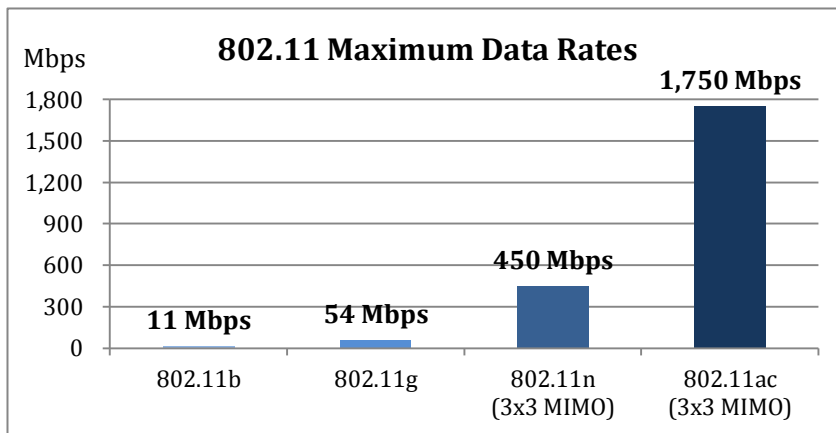

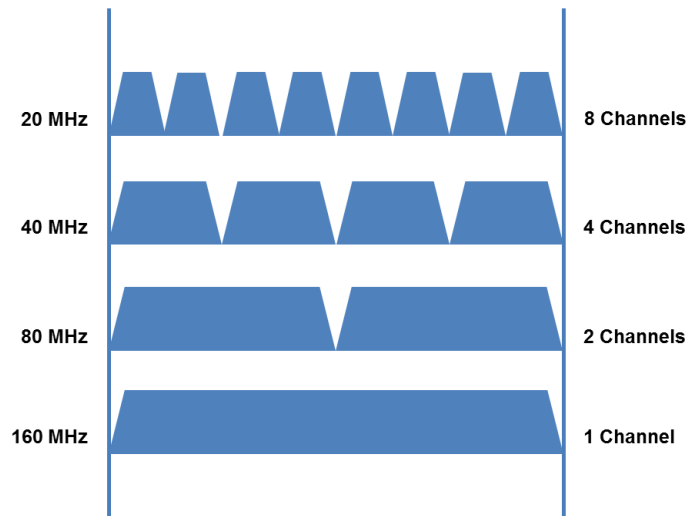*Figure 5. 802.11ac performs three times better than 802.11n.*

Figure 6. Increased bandwidth results in fewer usable channels.

Total capacity increase - channel reuse

As BYOD and advanced applications increase demand for Wi-Fi capacity, users leverage channel reuse for additional capacity. As shown in figure 7, the "square" area is served by 4 APs in different channels. If we narrow individual AP coverage, reducing AP RF power output while minimizing co-channel interference, ideally channels can be reused in the same area, increasing overall capacity. Yet, this solution requires additional investment and potentially takes more time and higher technical skill level to set up.
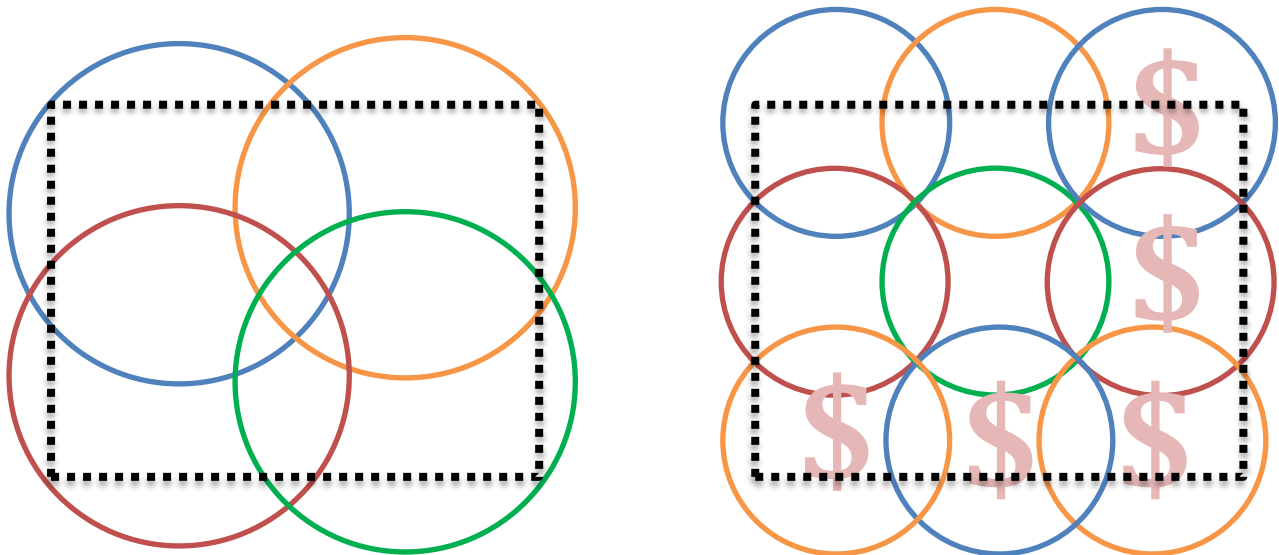

Figure 7. Reduce APs' signal coverage to deploy more APs for more capacity.

ZyXEL Smart Antenna - The solution to Wi-Fi challenges

Key features

- Optimised patterns focus RF energy to target clients
- Optimised patterns mitigate interference
- Dynamic beam shaping guarantees best performance at all times
- Double performance over conventional antennas
- Increased capacity supports more clients
- Enhanced signal maintains connection over greater distances

Design at a glance

- Three (3) antenna elements for 5GHz, and three (3) for 2.4GHz generate more than 700 antenna patterns on each band.
- Intelligent algorithm analyses and selects optimal antenna patterns on the go on a per-client basis.
- Client-independent — performance boosts immediately with existing Wi-Fi clients. The "switch-beam" technique running at the physical layer requires no effort on the part of the end-user.
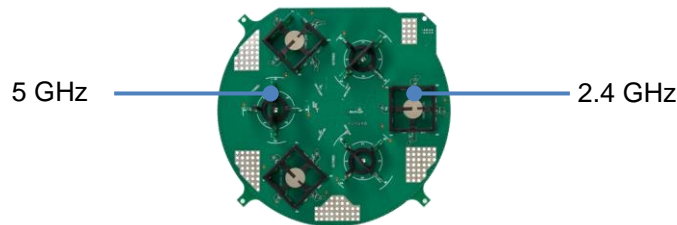
5 GHz ———————— 2.4 GHz

Figure 8. ZyXEL Smart Antenna – 3x3 model

	ZyXEL Smart Antenna	**Conventional Antenna**
Antenna Patterns	700+ on each band	Only 1
Pattern Optimization	Dynamic patterns for best performance at all times	Static pattern
Interference Mitigation	Null the beam toward interference dynamically	NA

ZyXEL Smart Antenna vs. Conventional Antenna.

How does it work?

The embedded intelligent algorithm in a ZyXEL Smart Antenna scans the environment for the clients and interference. It then computes and selects the optimal beams from over 700 pattern combinations. Within a fraction of a second, an optimal beam combination is shaped for each client. This cycle is repeated as necessary to dynamically shape different patterns in response to changing environments.
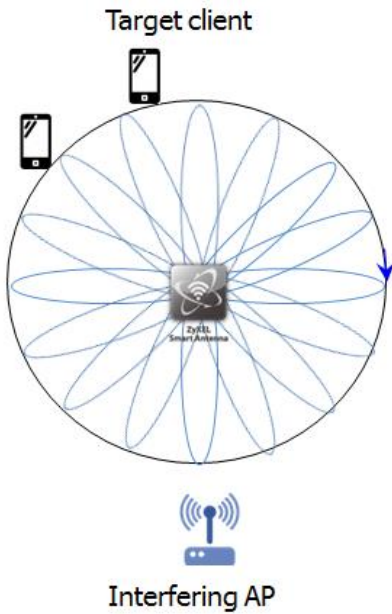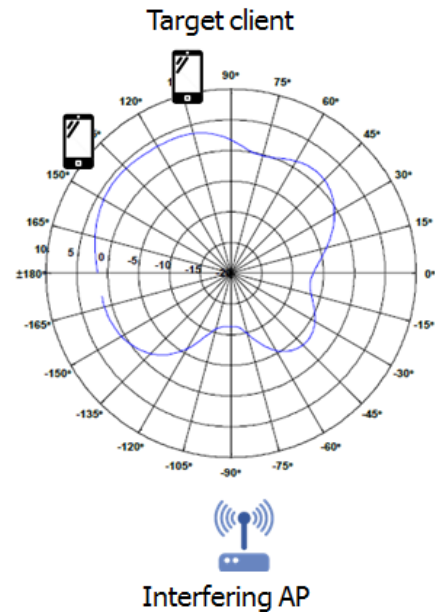

Figure 9. Scans the environment

Figure 10. Forms an optimal beam combination

Benefits

Reliable Wi-Fi in hard-to-reach locations

Based on field-proven test result, AP's can deliver better throughput with ZyXEL Smart Antenna, especially in hard-to-reach locations. Reliable Wi-Fi carries out all-around.

Smooth connections without interruption from interference

The ZyXEL Smart Antenna detects interference. It then nulls the beam to limit the reception of interference, avoiding performance-inhibiting noise.

One-to-one AP replacement from 802.11b/g/n to 802.11ac

Higher frequency wireless signals cover shorter distances. Because 802.11b/g/n works primarily at 2.4GHz, while 802.11ac operates at 5GHz, it is often necessary to conduct a costly and time-consuming wireless site survey when migrating to the newer standard, re-designing the network with more APs. Thanks to the ZyXEL Smart Antenna, a simple one-to-one AP replacement completes the migration.

Full 360° coverage and enhanced performance fit high-density environments

In high-density environments, too many clients sharing bandwidth can degrade performance, and several corners can become Wi-Fi dead spots. The ZyXEL Smart Antenna solves this problem with 360° full coverage. With over 700 antenna patterns, ZyXEL Smart Antenna dynamically shapes patterns specifically for each client according to the real-time environments. Hence, the challenges presented by high-density environments such as hotels, campuses, or public areas, are more easily overcome, ensuring an optimal Wi-Fi experience.

Invisible antenna design blends into any environment

With traditional antenna technology, a larger antenna generally provides better gain. In the past, one was forced to choose between aesthetics and performance. The invisible ZyXEL Smart Antenna makes it easy to blend your APs into their environment, while still delivering better performance than a larger conventional antenna.

Future-proofing technology for booming Wi-Fi clients

The demand for speed and capacity never wanes. By adopting state-of-the-art technology like the ZyXEL Smart Antenna, the WAC6500 series of AP meets that need with interference mitigation capability for reliable connections — a critical component of today's premium wireless experience.

Why ZyXEL?

Migrating to 802.11ac has become a prevailing trend in the Wi-Fi related industries. The transition from legacy 802.11b/g/n to 802.11ac is a significant challenge that requires costly and time-consuming site re-survey. The advanced benefits of Smart Antennas — increased performance, interference mitigation, and full 360° coverage — allow one-to-one AP replacement, which will in turn reduces costs and simplifies 802.11ac migration. The WAC6500 series with Smart Antenna offers the ultimate AP design, delivering industry-leading performance over 802.11ac APs, making 802.11ac migration a nearly effortless undertaking.