Wireless LAN

BACKGROUNDER

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XIRRUS

Introduction

The growth of wireless LAN (WLAN) or Wi-Fi™ clients and applications in the Enterprise market has created the need for the next generation in Wi-Fi architectures that provide the capacity, bandwidth and quality of service that users expect from their wired connections.

As companies take advantage of the productivity gains from the wirelessly connected mobile worker, the demand for increased bandwidth (data rate) and capacity (number of users) will force WLANs to move from a shared medium to a more capacity-orientated architecture just as wired Ethernet did in the 1990's— unleashing the explosive growth in networking that followed.

The WLAN market is fast approaching a similar point as wired Ethernet due to the explosive growth of Wi-Fi-enabled portable and handheld computers and hybrid cellular/Wi-Fi phones. The resulting mobility-centric applications that run on these devices will become mission-critical business enablers leaving legacy Wi-Fi network architectures incapable of operating effectively.

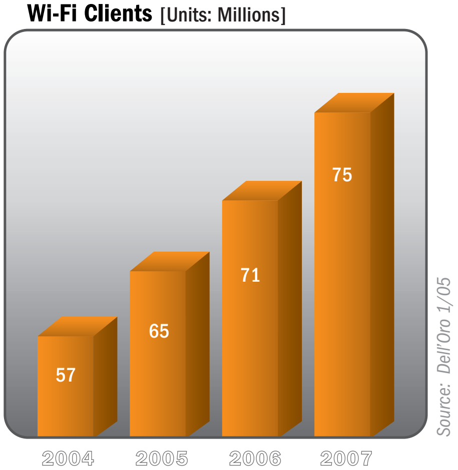
Xirrus has created the next generation Wi-Fi architecture for the discerning enterprise customer— the Wireless LAN Array. The Wireless LAN Array maximizes RF capacity over an extended coverage area, simplifies network design and reduces the cost to deliver wireless bandwidth.

Market Drivers

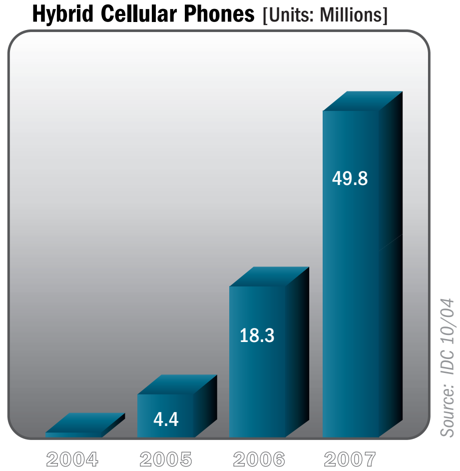
According to IDC, shipments for WLAN access points are expected to reach nearly 25 million units by 2006 generating over $2.4 billion in revenue. These access points provide the critical link between the wireless client and the wired network allowing them to stay connected as they roam the corporate campus.

In addition to the influx of "traditional" Wi-Fi computing clients which are expected to reach 60 million units in 2005, the number of application-specific devices such as Wi-Fi enabled handsets and hybrid cellular phones is expected to reach 70 million units by 2007— these new devices will be able to carry voice traffic over an available WLAN or the existing cellular network. This explosion in client connectivity along with the time-sensitive nature of voice traffic will force capacity to the forefront of deployment issues to resolve within the enterprise.

Wi-Fi Clients [Units: Millions]



Hybrid Cellular Phones [Units: Millions]



IEEE 802.11 Background

The first WLAN standard (designated 802.11 by the IEEE) was ratified in 1997 for data rates up to 2Mbps in the 2.4GHz unlicensed spectrum set aside by the FCC. As usage of the technology grew, the IEEE ratified two amendments to the 802.11 standard in 1999 to address the speed and capacity issues inherent in the first standard.

The first amendment to the IEEE standard was 802.11b which added support for 5.5 and 11 Mbps data rates utilizing a Direct Sequence Spread Spectrum (DSSS) modulation technique within the same 2.4GHz band.

The second amendment, 802.11a, added support for data rates up to 54Mbps within the 5GHz band using a radio transmission technique called Orthogonal Frequency Division Multiplexing (OFDM).

	802.11b	802.11g	802.11a
Data Rate	11Mbps	54Mbps	54Mbps
Frequency	2.4GHz	2.4GHz	5GHz
Type	DSSS	OFDM	OFDM
Congestion	High	High	Low
Overlapping Channels	3	3	Up to 23

Several types of devices ranging from microwave ovens to cordless phones operate in the 2.4GHz spectrum making it relatively congested whereas fewer devices work in the 5GHz spectrum limiting interference issues and providing "cleaner" spectrum.

802.11a provides more scalability (capacity) because there are more independent, non-overlapping channels available. Within the OFDM encoding scheme, a total of 12 (with more being added) non-overlapping 20Mhz channels are used; each channel is divided into 52 subcarriers. Each subcarrier is transmitted in parallel with each one representing a portion of the total data that makes up the signal. This encoding scheme greatly increases the aggregate amount of information that can be sent. In contrast, only 3 non-overlapping channels are available when using 802.11b in the 2.4GHz spectrum.

Cost-effective 802.11a-based products took longer than expected to bring to market leaving users with a need for WLANs that operated at higher data rates. This delay caused the IEEE to ratify the 802.11g amendment in 2001 to provide these higher data rates. 802.11g supported the higher data rates of 802.11a (54Mbps) while remaining in the 2.4GHz band and being backwards compatible to 802.11b.

Channel Utilization and Capacity

Over the past three years, most enterprise WLAN deployments were based on the 802.11b standard and were driven by the need to provide the maximum amount of coverage with the fewest number of access points. Providing coverage was the key driving factor in these deployments because only a small number of users were supported and there was a desire to deploy a limited number of access points due to cost considerations.

As more and more Wi-Fi clients started accessing the network, IT administrators would add additional access points to handle the increased capacity. However, these additional access points create issues of channel interference given the limited number of non-overlapping channels that exist within the 802.11b standard.

The 802.11g standard is now gaining acceptance in certain segments (especially consumer) due to its higher data rates (54Mbps) and its backward compatibility to 802.11b. While accommodating the large installed base of 802.11b clients and its backward compatibility to 802.11g have merit, both of these standards lack the scalability to accommodate very dense or capacity-orientated WLANs due to the lack of non-overlapping channels.

The limited number of non-overlapping channels imposes a significant restriction on 802.11b/g networks as only 3 access points can be installed within a coverage area without experiencing channel interference. This forces access points to be placed in such a way so the same channels can be “re-used” frequently throughout the coverage area, increasing the probability of co-channel interference for that area.

Co-channel interference significantly impacts the overall performance of the WLAN. Access points operating in the same coverage area using overlapping channels will cause packets to collide with each other forcing re-transmissions and ultimately degrading the overall performance of the network. Even when access points that are using overlapping channels are placed far apart from each other, they can still create increased back off times (the time between client transmissions) which will cause clients to defer transmission if they “hear” traffic from other access points. An elevated noise floor will force the access points to use lower data rates (to reduce the error rate) and further impacts the overall performance of the network.

Simply put— once a network has maximized its use of non-overlapping channels within the coverage area, adding more access points will only degrade the networks throughput and lower its overall capacity.

IEEE 802.11a: The Standard For Enterprise WLANs

The issue of non-overlapping channels makes the 802.11a standard optimal for Enterprise deployments on a go forward basis. 802.11a offers IT administrators the advantage of more non-overlapping channels along with higher data rates in the less congested 5GHz spectrum. Recent regulatory changes have opened up even more spectrum in the 5GHz band, creating the potential for over 20 non-overlapping channels.

The number of non-overlapping channels is the primary determinant for the overall capacity of the WLAN as the total number of non-overlapping channels determines the maximum amount of network capacity. The issue of capacity and clean spectrum are becoming critical for IT administrators as they deal with the increased number of clients and the need to support new applications (such as voice and video) over the WLAN.

These issues will ultimately drive the migration from 802.11b/g to dual-band deployments supporting 802.11a and 802.11b/g within the Enterprise market and for a new architecture that cost effectively uses all non-overlapping channels. Supporting this migration is the availability of tri-mode, dual band clients that support IEEE 802.11a/b/g which allows IT administrators to migrate their networks over time as they refresh their installed base.

Capacity and Range

As mentioned earlier, initial WLAN deployments focused on providing the maximum amount of RF coverage so the range of an access point was a critical factor in the purchase process. While still important, range becomes less of an issue as more clients connect to the network given the inherit limitations of today’s access points. This is even more apparent within 802.11b/g networks because of the channel reuse issues inherit within those specifications.

Today's access points, whether they are "thin" or "fat" still suffer from the channel reuse issues inherit within the IEEE specifications. In many cases, to maximize capacity, their actual range must be reduced to limit bleed over to other access points. Bleed over can create packet collisions or an elevated noise floor; in either case, it reduces the overall network capacity and limits the amount of bandwidth available to clients.

The optimal WLAN deployment makes the maximum number of non-overlapping channels available while deploying the fewest number of access points in a given coverage area. This provides for the greatest amount of aggregate network capacity for Wi-Fi clients. This is especially critical for applications such as VoWLAN that drive a substantial number of clients in a given area.

Wireless LAN Array

Xirrus has created the next generation Wi-Fi architecture capable of handling the clients of today while providing a platform for IT administrators to deploy the applications of tomorrow. The WLAN Array combines a Wireless LAN switch and up to sixteen 802.11a/b/g compliant access points to provide Gigabit-class Wi-Fi capacity in a single device.

This unique architecture includes an embedded Array Controller that provides the functionality found in today's WLAN switch and coordinates up to 16 Integrated Access Points (IAPs). Utilizing a high-gain Multi-sector Antenna System, the IAPs simultaneously use up to 15 non-overlapping channels to maximize the RF bandwidth available to Wi-Fi clients. Also provided within the Array Architecture is a dedicated IAP for monitoring the RF environment for rogue access points and other security threats.

The WLAN Array can deliver over 800Mbps of RF bandwidth within an extended coverage area. Simply put— maximize RF bandwidth while hanging fewer devices reducing the cost to deliver RF capacity.

The XS-3900 WLAN Array is the first in a series of products designed to provide IT administrators with a cost-effective solution for deploying capacity-orientated WLANs. The XS-3900 WLAN Array aggregates 16 IEEE 802.11a/b/g access points in a circular configuration to deliver increased rate and range in all directions. Xirrus provides two additional versions of the WLAN Array, each includes an embedded Array Controller supporting 8 (XS-3700) or 4 (XS-3500) Integrated Access Point configurations to support a variety of deployment types.

Conclusion

The increased penetration of Wi-Fi into portable computing devices and new applications such as VoWLAN are driving the need for increased capacity in Wi-Fi networks.

Optimized WLAN deployments make the maximum number of non-overlapping channels available to clients while using the fewest number of devices. This provides the greatest amount of aggregate network capacity and is critical for applications such as VoWLAN that create a substantial number of Wi-Fi clients in a single cell.

Xirrus has created the next generation Wi-Fi architecture— the WLAN Array maximizes the use of non-overlapping channels across IEEE 802.11a/b/g networks allowing IT Administrators to deploy capacity-orientated Wi-Fi networks. ●

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