



**Enterprise  
Wireless LAN**  
EVOLUTION

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**XIRRUS**

## Next Generation WLANs Arrive

Early deployments of Wireless Local Area Networks (WLANs) in the enterprise have demonstrated the value of mobile connectivity within business environments and left users wanting more. So much more that, like most breakthrough technologies before them, the original network architecture deployed has reached a crossroads of diminishing returns as it attempts to scale economically and technologically with demand.

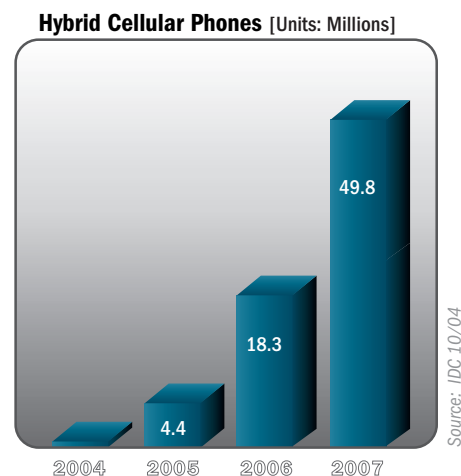
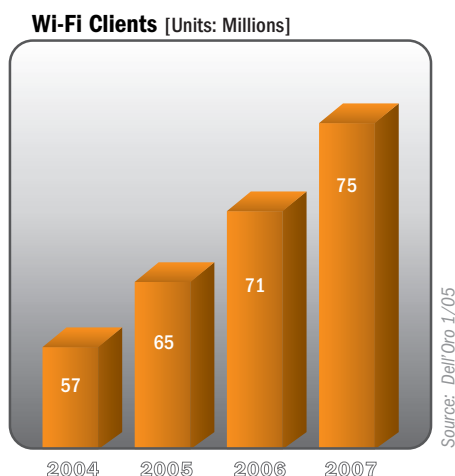
Not designed for the imminent growth on the enterprise horizon, current WLAN architectures physically can't deliver the cost-performance, coverage or capacity needed to unfetter millions more workers, devices and applications over the next five years. Along with cost and administrative issues, inherent design limitations preclude current WLAN architectures from delivering sufficient bandwidth to meet the needs of mobile workers in Fortune 1000 companies and application-intensive vertical industries such as healthcare, education and manufacturing.

Fortunately, a revolutionary new WLAN architecture has been developed to facilitate growth and overcome the barriers to scale in high-volume wireless or Wi-Fi™ deployments in the enterprise. This paper introduces the Wireless LAN Array—the next generation WLAN architecture using breakthrough technology to maximize capacity and coverage, simplify network design, streamline management and optimize security in full-blown enterprise deployments.

## Explosive Demand Signals Next Generation

Current WLAN architectures have shown how valuable Wi-Fi technology is in freeing workers to access information while moving about the enterprise. During the next few years, the number of users seeking wireless connectivity will surge as:

- Shipments of Wi-Fi clients exceed 60 million units in 2005.
- More than 90% of mobile computing devices become Wi-Fi compatible within the next two years.
- More than 70 million WLAN-enabled cellular phones ship worldwide by 2007.
- Voice over WLAN (VoWLAN) growth explodes as businesses transition voice traffic to low-cost IP networks.
- Shipments of enterprise-class access points reach 7.2 million devices in 2007.



Fueled by these trends, the market for enterprise class WLAN access equipment is expected to reach \$1B by 2007. Along with the sheer rise in demand, several less quantifiable market dynamics are converging to increase the need for a next-generation wireless LAN.

#### **Expectations of Better Performance**

Even if usage weren't on the brink of exploding, IT administrators would be confronted with re-architecting WLANs to improve coverage/capacity metrics to more seamlessly mesh with the wired LAN. In addition, emerging applications such as voice over Wi-Fi and wireless video require substantially greater bandwidth for seamless performance.

#### **Industry Standard/Application Evolution**

To date, the 802.11b/g standards have dominated WLAN deployments but both specify a limited number of non-overlapping channels that will not accommodate the exponential growth described above. Going forward, only 802.11a with data rates up to 54Mbps and four times (at a minimum) the number of non-overlapping channels will suffice. 802.11a also leverages the less congested "cleaner" 5GHz band for improved performance, a factor that will increase in importance as time-sensitive applications such as voice evolve onto WLANs.

IDC Research writes, "Growing interest in Voice over WLAN (VoWLAN) will result in rising demand for faster WLAN connectivity in mobile devices. Given its architecture and bandwidth limitations, 802.11b access points are simply not capable of handling a number of simultaneous VoIP calls. Even 802.11g access points, offering bandwidth up to 54Mbps, are limited to only four or five calls. 802.11a access devices, however, can support approximately thirty VoIP calls simultaneously."

As usage takes off and wireless LANs are increasingly held to the same standards as their wired counterparts, a major migration from 802.11b/g to 802.11a will take place. For the foreseeable future, enterprise WLANs will need to accommodate them all, maintaining 802.11b/g support while embracing the more powerful value proposition inherent in 802.11a.

The net of these changing market dynamics is higher expectations among WLAN users, IT managers and enterprise senior management for overall performance and return on investment (ROI). As we'll now see, current WLANs have not been architected to deliver either.

#### **Current WLAN Architectures: More Translates Into Less**

As in other networks faced with rising usage, network administrators first instinct and only real option has been to "throw more bandwidth" at the Wireless LAN; adding more access points, introduce centralized switches, beef up security policies and allot more man hours to provisioning and management. Vendors' first attempts to help customers keep up with demand was to introduce the concept of a "WLAN switch" into the network to centralize the provisioning and management of access points. At the time, WLAN authentication and encryption standards were relatively weak and enterprise IT managers used these new switches to segment the WLAN from the wired network. Stronger encryption and better authentication mechanisms have since come into being, creating greater desire and expectation among network administrators for the WLAN to behave like, or become an extension of the wired LAN.

### Independent Access Points

The first wireless LANs extended Wi-Fi coverage to a limited number of clients that needed mobility within the enterprise. Serving few, these early “fat” access points essentially operated as self-contained, disparate networks unto themselves. These fat access points lacked any centralized management and the model of patchworking them together as demand increased didn’t scale physically or economically. Provisioning and management were tedious and only got worse as the network grew. Attempting to grapple with these complexities, vendors responded with additional devices designed to provide centralized coordination.

#### Independent Access Points 1st Generation: 2002<



- “Fat” access points
- 802.11b dominant
- Lacked centralized management

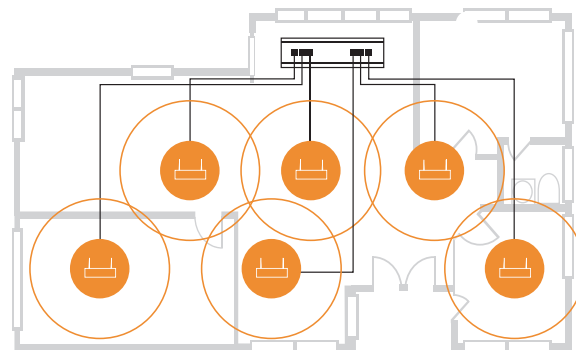
### Stop-gap Deployments: The WLAN Switch

As previously noted, current WLAN architectures evolved to include centralized WLAN switches that essentially group access points together to streamline management and security. Access points became “thin” with some functionality (intelligence) moving to the switch and security improved slightly as the WLAN grew more segmented from the wired network.

But despite imposing order on the randomness of early WLANs, the centralized switch model remains a “Band-Aid” approach. Many more access points still must be deployed to support growth in Wi-Fi clients, and while individual

access point costs are lower, build-out costs and the complexity level of these networks remain high.

#### WLAN Switch 2nd Generation: 2002-2004



- “Thin” access points with centralized switch
- Addressed management and security issues
- Complicated and expensive

Beyond the administrative complexities and diminishing returns on continued investment, the true underlying problems with WLAN infrastructures to date lie in two fundamental architectural limitations:

### Limited Channel Availability

The 802.11b and 802.11g specifications used in most WLANs today operate in the 2.4GHz spectrum where only three non-overlapping channels exist. The low number of available channels forces access points to be placed in such a way that the same channels can be “re-used” frequently throughout the coverage area increasing the probability of co-channel interference.

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 retransmissions and ultimately degrading the overall performance of the network. Even when access points 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 transmissions if they “hear” traffic from the other access points.

This 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. Deployments in this scheme become complicated to provision and manage.

### Collision Avoidance

The “Carrier Sense, Collision Avoidance” mechanism that governs data transmission in the 802.11 specifications requires devices to wait for the medium to be free before attempting to transmit packets. In congested networks, wait times mount as each device “listens” for a free channel and then “backs off” if the medium is busy before transmitting packets— this ultimately lowers the overall throughput and capacity of the network. As more clients and applications saturate current networks, the more the overall network performance degrades.

To compensate, IT managers have tried to maximize capacity by sacrificing coverage, reducing the range of each access point to limit the bleed-over between them, alleviate the issues created by co-channel interference and the overall performance issues created by the collision avoidance scheme used by 802.11. Also, because each access point operates in a vacuum without any centralized coordination at the MAC layer, network administrators are limited in their ability to manage channel availability and traffic collisions even as they sacrifice coverage to limit contention for bandwidth.

On top of these issues, current architectures typically use omni-directional antennas that radiate coverage out in all directions. Deploying access points within range of one another becomes extremely difficult as each unit must be close enough to “hear” clients but far enough away from other access points to minimize overlap and co-channel interference.

Along with these fundamental technological issues, deploying countless more access points and switches presents an obvious disconnect from a “simple mathematics” standpoint.

To justify ongoing investment, technologies should deliver greater value and achieve lower cost points in high-volume deployments. With today’s wireless LANs, however, the costs associated with continued deployment and provisioning of more equipment do not diminish significantly in full-blown deployments while the management complexities offset productivity gains elsewhere.

### The Bottom Line

Once a network has maximized its use of non-overlapping channels within a coverage area, adding more access points won’t sustain acceptable data rates and actually degrades throughput and overall Wi-Fi capacity. Obtaining the best coverage and capacity becomes a balancing act while the mass of equipment creates administrative nightmares.

*“More” delivers “less.”*

Between the burgeoning demand for Wi-Fi access and the limitations of current generation WLANs, the market is primed for a quantum leap in performance and overall value. The enterprise is ready and waiting to invest in higher-capacity Wi-Fi solutions to support more users and applications.

### Next Generation WLAN Architecture: Wireless LAN Array

The Wireless LAN Array eclipses previous architectural models by integrating a WLAN switch and up to sixteen 802.11a/b/g Wi-Fi access points in a single device. This approach maximizes capacity and coverage while delivering a superior return on investment.

Designed to overcome the limitations inherent in current architectures and support the needs of more users and advanced applications, the WLAN Array reduces equipment needs, simplifies network architectures and introduces powerful new cost-performance metrics in the areas enterprises value most:

- **Capacity:** Gigabit-class Wi-Fi bandwidth.
- **Coverage:** 4x greater per device deployed.
- **Cost:** Fewer devices, cost-effective and simple.

As occurred with wired Ethernet LANs in the 1990s, capacity demands are necessitating the evolution of WLANs from a shared medium to a more capacity-orientated architecture. The WLAN Array architecture accomplishes this shift with a level of integration not found in today's Wi-Fi deployments.

### Maximizes Capacity— Extends Coverage Area

Each WLAN Array contains an embedded Array Controller to provide an unprecedented level of management and coordination for up to 16 Integrated Access Points while performing the same functions found in a WLAN switch.

The WLAN Array employs an intelligent antenna system that maximizes performance and extends the coverage area. Where first-generation WLAN architectures use access points that transmit and receive packets in all directions over relatively short distances, the WLAN Array employs a sophisticated high gain Multi-sector Antenna System in which each RF sector (an equal slice of the coverage area) can reach greater distances with minimal channel overlap and interference. The Array Controller assigns each RF sector one of the 15 non-overlapping channels and can adjust the transmit power settings in each RF sector to decrease or increase signal strength in specific directions.

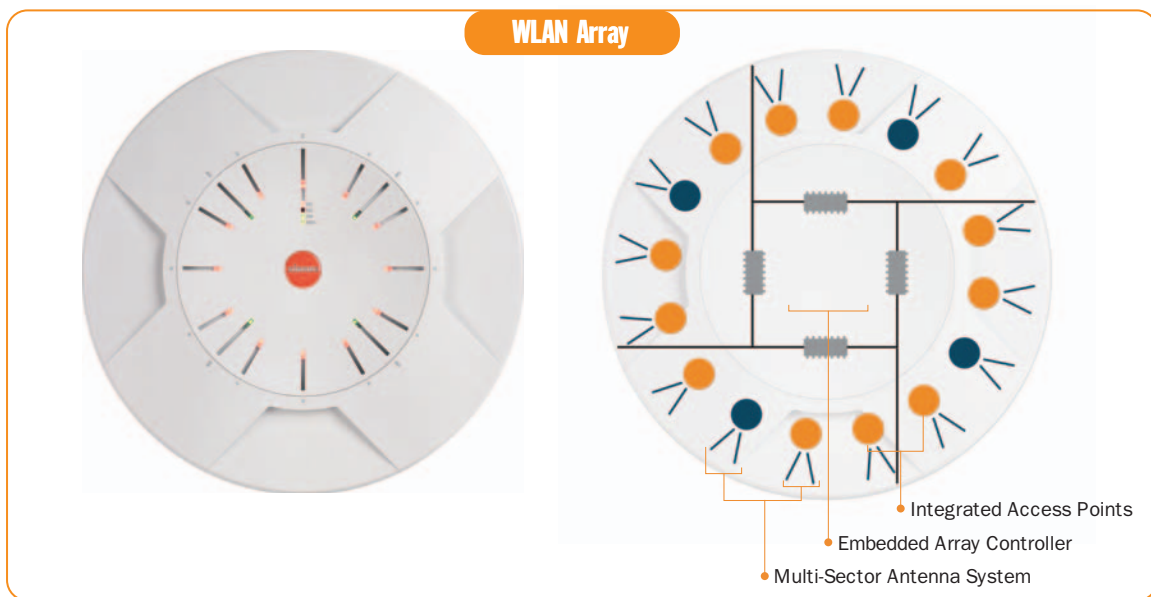
Working in tandem, the embedded Array Controller, the Integrated Access Points and the Multi-sector Antenna System maximizes RF capacity by simultaneously using all the non-overlapping channels available in the 5GHz and 2.4GHz bands.

The Multi-sector antenna system delivers a 4x improvement in coverage using a fraction of the equipment found in current architectures. When combined with the simultaneous use of non-overlapping channels, the WLAN Array maximizes coverage and capacity simultaneously versus pitting them against one another.

### Investment Protection and Simplicity

The WLAN Array offers a flexible architecture that can grow and adapt as the WLAN changes. By simultaneously utilizing all non-overlapping channels, IT administrators get up to a 16x increase in capacity producing over 800Mbps of RF bandwidth to 1,000 Wi-Fi clients.

A central issue in delivering RF bandwidth in existing WLANs is maintaining throughput rates across greater distances. This will factor even more heavily as higher bandwidth applications permeate the enterprise. Faster data rates are more easily compromised by interference than lower data rates, so



traditional deployments where channels are re-used will cause interference that forces the system to fall back to slower data rates.

The extended coverage area and extensive support for 802.11a lets the IT administrator deploy and manage fewer devices. The resulting WLAN network is simple, cost effective and is capable of higher throughputs over a larger area, supporting more users and applications than other solutions.

### Next Generation ROI Arrives

With fewer devices required, management simplified and performance maximized, the WLAN Array improves the business case for full-blown WLAN deployments, making Wi-Fi viable in some industries for the first time, and enhancing the value proposition in others. Using less equipment to support more users, traffic and advanced applications than current architectures, the WLAN Array lowers the cost to deliver RF bandwidth while simplifying the network design.

More importantly, the WLAN Array's true impact on the long-term value proposition for enterprise WLANs becomes more pronounced as its standards-based, upgradeable architecture scales as the WLAN grows and changes.

### Architecture Cost Comparison

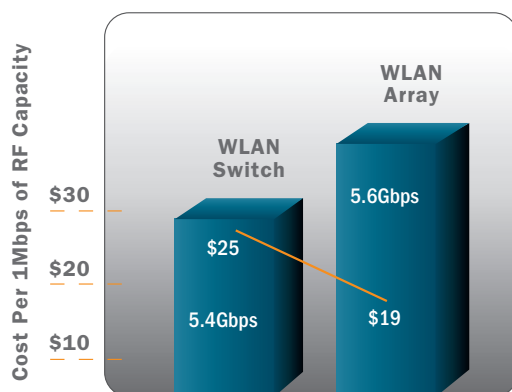
The Array Architecture helps IT administrators avoid re-architecting and re-deploying the Wi-Fi network to accommodate growth of the client base and new applications. In the deployment example below, the WLAN Array architecture provides more bandwidth using 1/6 the number of devices. The cost to deliver each 1Mbps of RF bandwidth is 25% less when using the WLAN Array vs. a typical WLAN switch architecture.

Enterprises evaluating WLANs will find the next-generation architecture as compelling for today as it is reassuring about the future:

- More RF Bandwidth
- Deploy fewer devices
- Superior cost/performance metrics

Users are ready. Device manufacturers are ready. Wi-Fi is ready. The standards are ready. Now, with the limitations of capacity, coverage and costs of deployment addressed for the foreseeable future, the enterprise WLAN is ready. The next generation Wireless LAN infrastructure has arrived with increased power and potential in tow. With the Wireless LAN Array, the future of WLANs has arrived. ●

### Architecture Comparison

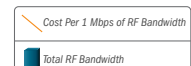


- More RF bandwidth
- 1/6 the number of deployed devices
- 25% less per 1Mbps RF bandwidth

Architecture	WLAN Switch	WLAN Array
Total RF Bandwidth Delivered	5.4Gbps	5.6Gbps
Number of Devices Used	50+	8
Cost Per 1Mbps or RF Bandwidth	\$25	\$19
Total cost to deploy	\$137K	\$106K

#### Deployment Details

Site Sq. Ft	210,000
Number of Users	1,000
Users Per Radio	10
Minimum Data Rate	54Mbps





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