WLAN Array

ARCHITECTURE

March, 2005

XIRRUS

Introduction

Network and IT administrators have been facing an ever-increasing demand for wireless capacity as the number of Wi-Fi™ clients and wireless applications proliferate in the enterprise. This paper outlines the issues for increasing wireless network capacity in the enterprise and explains the benefits of the Xirrus Architecture.

Providing Greater RF Capacity

Traditional approaches of providing greater wireless network system capacity have been developed and revolve around the following methods:

A Sea of Access Points

One common approach to increasing RF capacity is to simply increase the number of access points. While this approach may seem obvious, it presents a number of issues. The first is channel re-use. In the 2.4GHz band where 802.11b and 802.11g operate, only three non-overlapping channels exist. Given this, a maximum of three access points can be deployed in a given area. Due to the fact that clients and access points wait for a free channel before attempting to transmit packets, additional access points deployed within range of other access points on the same channel will, for the most part, add no additional capacity. Access points or clients that can "hear" each other will create latency as the other transmitter will wait before attempting to transmit their own packets. In effect, adding more access points on the same channel simply causes the cells to "merge" into a larger cell without any increase in throughput. Using 802.11a with its 12 non-overlapping channels is a good choice, but even on separate channels, co-located access points can still cause interference and diminish throughput. Additionally, the cost of deploying and managing a single access point on every available channel is prohibitive.

Beam Forming Techniques

Beam forming techniques use a large number of antenna elements that can shape the radio signal beam and "point" the beam at users to help increase range and data rates. While this technique may provide some benefit in outdoor environments, the angle spread and multi-path issues inherent in indoor environments greatly limits the expected improvement.

Beam-forming products are typically implemented on a large flat "panel" that must be pointed in a single direction. Multiple panels need to be installed to obtain 360° degrees of coverage. Other issues include the fact that only one beam may be active at any time without degrading overall throughput.

Higher Data Rates

Today's 802.11 data rates peak at 54Mbps. Future 802.11 standards may increase the maximum data rate. The issue with higher data rates is that higher data rates work over shorter distances. The second issue with increasing the data rate in an 802.11 wireless network is the medium is shared between all users associated to an access point. Therefore, the overall throughput is limited by the slowest user in that cell. An active user with a slow wireless connection rate will quickly cause the throughput of the entire cell to degrade to a lower average. Lastly, faster data rates are more easily affected by interference than low data rates. Deployments where channels are often re-used will cause interference with each other and degrade the ability to transmit at higher data rates forcing the network to fall back to slower data rates.

MIMO Techniques

MIMO is an acronym for Multiple-In-Multiple-Out antenna systems. This signal processing technique listens and transmits signals on multiple antennas simultaneously. This technique can improve data rates in a proprietary mode, but requires that both client systems and access points have MIMO capable radios. MIMO techniques can also help increase range. Increasing range without drastically increasing data rates will spread the available capacity even more thinly over a greater area. This leads to an even lower capacity per square foot of coverage than previous solutions.

WLAN Architecture Evolution

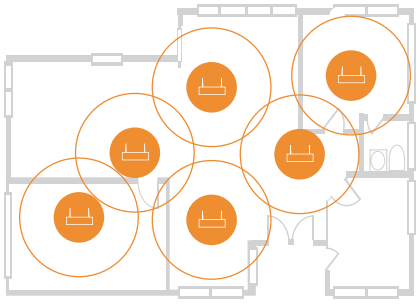
Initial Wi-Fi deployments consisted of full featured "fat" access points. In these early deployments, these access points functioned as stand alone devices lacking any centralized management making them difficult to deploy in large scale networks. Coupled with the relatively weak security standards available at the time, this architecture gave rise to the 2nd generation Wi-Fi architecture which centralized management and security functions in a "WLAN switch".

Vendors offering these proprietary 2nd Generation products lock IT administrators into solutions that do not scale. In order to increase the size of the WLAN, additional switches, appliances and/or software license upgrades must be purchased to support more access points, users and applications. While this architecture alleviated certain management and security functions, they are complicated and expensive to deploy.

Even more critical, these solutions don't address the fundamental issue of adding capacity to the network. While the customer requirement exists to provide centralized management, competitive offerings utilizing the wireless switch are flawed due to the mechanism they have chosen to deliver the functionality. Even the name "wireless switch" is a misnomer and vendors are backing away from this position as most products don't perform any switching functionality on the wireless side of the network.

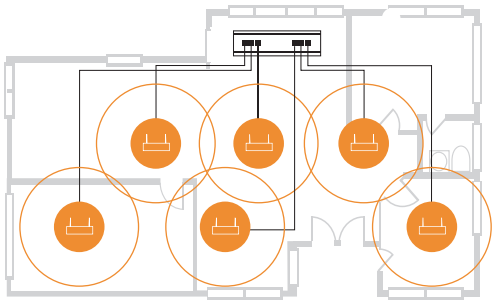
The Array Architecture offered by Xirrus can be compared to legacy deployments as depicted in the diagrams below, where a single WLAN Array can replace the entire infrastructure of legacy deployments.

Independent Access Points
1st Generation: 2001<



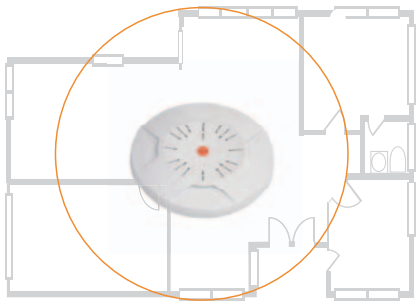
- "Fat" access points
- 802.11b dominant
- Lacked centralized management

WLAN Switch
2nd Generation: 2001-2004



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

WLAN Array
3rd Generation: Present



- Array Controller and Integrated Access Points
- Capacity and coverage maximized
- Fewer devices, cost effective and simple

Wireless LAN Array Architecture

Xirrus developed a new category of product called the Wireless LAN Array.

The Array Architecture delivers Gigabit-class (over 800Mbps) Wi-Fi capacity over four times the coverage area of legacy architectures. Xirrus eliminates the WLAN capacity bottleneck with sixteen times the capacity of other architectures— all in a single device.

No longer will Wi-Fi deployments require a sea of access points to be installed, managed and serviced. Today's bandwidth hungry applications such as Voice over Wireless LAN (VoWLAN) can now be easily provisioned and delivering RF capacity has never been more cost effective.

Architecture Components

The Wireless LAN Array Architecture is built on several patent-pending components that maximize RF capacity while staying 802.11 and Wi-Fi compliant. The level of integration in the Array Architecture creates a high performance system managed by the embedded Array Controller.

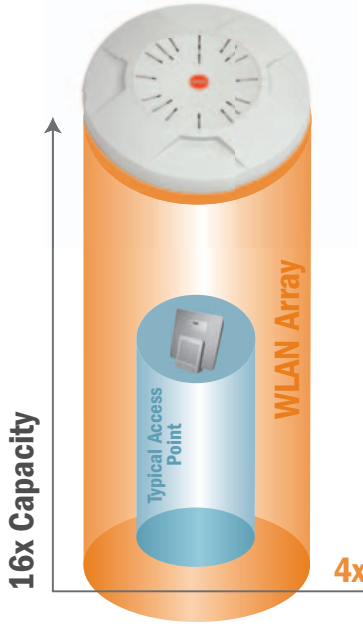
Array Controller

At the heart of the system, the embedded Array Controller provides the same functions found in today's WLAN switch and uses a Multi-channel MAC to control and optimize the RF interfaces of the WLAN Array. The Xirrus Multi-channel MAC provides unified control over the RF spectrum, wired and wireless packet flows and the Multi-Sector Antenna System.

The Array Controller is supported by 2Gbps of switching fabric giving it the scalability to accommodate future upgrades to the 802.11 standards. The Array Controller has 4 interfaces which provide upgradeability of the RF modules — each RF module contains up to 4 Integrated Access Points (IAPs).

Integrated Access Points

The Array Architecture supports up to 12 802.11a and 4 802.11a/b/g IAPs to maximize RF capacity across the 2.4GHz and 5GHz bands. Each IAP is assigned one of the 15 non-overlapping channels (12 in the 5GHz and 3 in 2.4GHz band) by the Array Controller to maximize the RF bandwidth available within a given coverage area.



WLAN Array Highlights

Architecture Highlights

- Embedded Array Controller (WLAN switch)
- Supports up to 16 Integrated Access Points
- High-gain Multi-sector Antenna System

Architecture Benefits

- Over 800Mbps of RF bandwidth
- 4x the coverage area per deployed device
- Deploy and manage fewer devices
- Simple and cost effective

In addition to maximizing RF capacity, the Array Architecture provides an additional IAP that can be used as a dedicated RF "sniffer" for monitoring the RF environment for security threats such as rogue access points.

The IAPs are controlled by the single, Multi-channel MAC resident on the embedded Array Controller creating the "thinnest" access points of any architecture. Different versions of the WLAN Array support different IAP configurations of 16 (XS-3900), 8 (XS-3700) and 4 (XS-3500) versions.

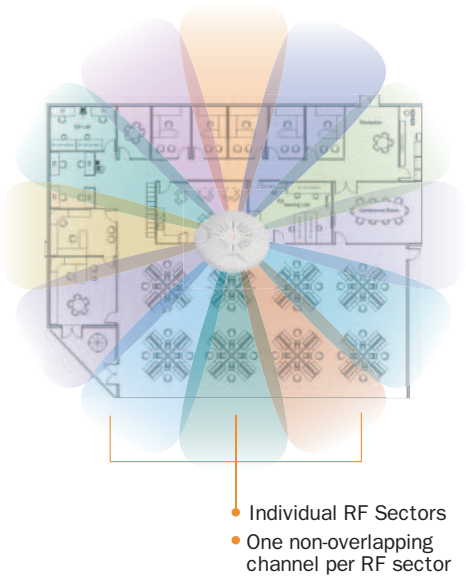
Multi-sector Antenna System

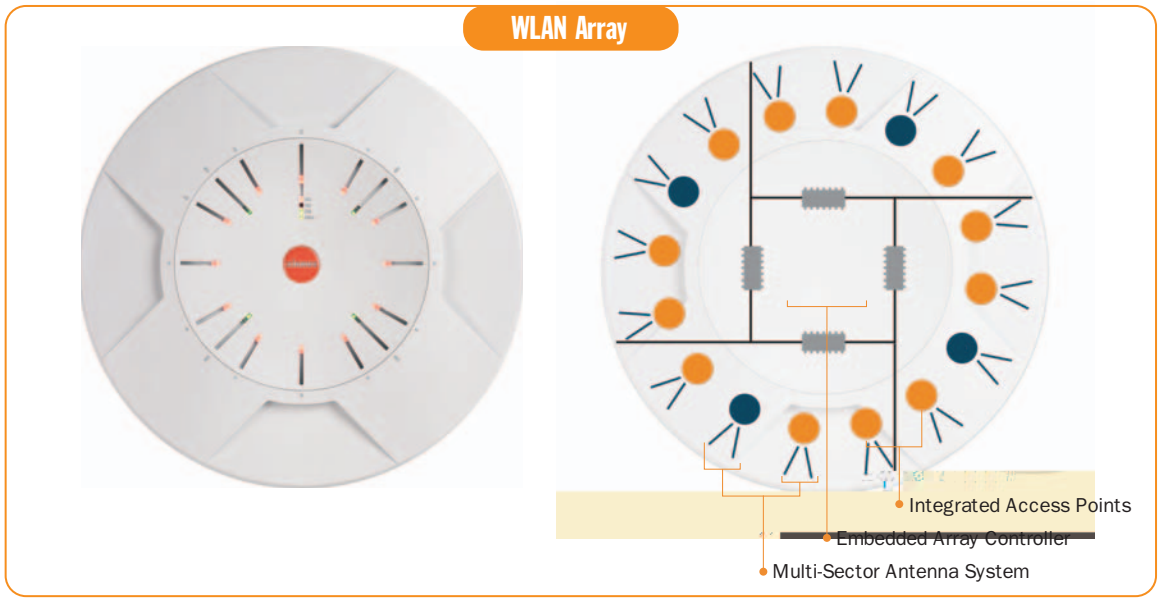
The RF interface of the WLAN Array is delivered through a Multi-sector Antenna System. This high gain (6dBi) antenna system carves the airspace up into equal sections or sectors; the increased directional transmit and receive gain allows the WLAN Array and its respective clients to hear each other at greater distances producing an extended coverage area.

The Multi-sector Antenna System creates a coverage pattern that resembles a typical omni-directional antenna but covers approximately 4x the area.

Each RF Sector is assigned a non-overlapping channel by the Array Controller. Additionally, the WLAN Array has an internal 360° omni-directional antenna that is used by the dedicated RF monitor.

The Multi-sector Antenna System, Integrated Access Points and the Array Controller solve the fundamental issues of co-locating several 802.11 radios in a single device providing an innovative new way to take Wi-Fi networks to the next level.





WLAN Array Architecture Benefits

The WLAN Array Architecture delivers important benefits for high capacity deployments:

Gigabit-class Capacity

- Generate wireless capacity of up to 864Mbps (16 x 54Mbps). By providing up to 16 separate IAPs (one can be used as a dedicated RF sniffer) in a single platform, Xirrus has solved the capacity issue of today and tomorrow's bandwidth intensive applications while handling hundreds of simultaneous users.
- The embedded Array Controller (WLAN switch) features a 2Gbps switching fabric and provides unprecedented coordination of the RF spectrum, security and Quality of Service (QoS) functions across the Integrated Access Points.
- Makes use of every available non-overlapping channel allowing the best possible channel plan as conditions change in the environment. Provides a superior level of automatic channel planning while maximizing RF capacity across the 5GHz and 2.4GHz bands.

Extended Coverage Area

- Uses a multi-sector, high gain directionalized antenna system to create a 360° coverage pattern.
- Provides 2x the range in all directions yielding 4x the coverage area.

Superior TCO Model

- Delivers high density RF service under a superior TCO model without the management pains of legacy products. Instead of installing large numbers of access points and complicated WLAN switches, a single Xirrus WLAN Array can be used.

Standards Compliant

- Is completely Wi-Fi interoperable; no special hardware or software is needed to support 802.11a/b/g clients.

Deployment Efficiency

- Eliminates re-architecting and re-deployment of the wireless network. Legacy architectures force the need to continuously re-architect, re-wire and re-deploy the wireless network.
- The high performance Array Controller and the modular design of the Integrated Access Points provide upgradeability paths as new 802.11 standards become available.
- With the Xirrus WLAN Array, you are instantly provided with the maximum possible bandwidth to "deploy once and forget it".

The close coordination the embedded Array Controller brings to the Array Architecture provides many additional characteristics that separate it from current solutions:

Enhanced RF Control

- Best view and command of all RF channels.
- Directionally aware of clients and the RF environment and knows which direction packets were sent from and "where users are"
- Enhanced penetration of RF obstacles (i.e. walls and cubicles).
- Provides flexible RF propagation patterns.
- Multiple SSIDs that are visible on every RF channel.

High Performance System

- 2Gbps of switching fabric and 2 Gigabit Ethernet uplink ports.
- Enhanced load balancing and wireless 802.11e Quality of Service optimized for wireless applications such as Voice over Wireless LAN (VoWLAN).
- Manages the largest number of actively associated users.

Enterprise-class Design

- Integrated and extensible MAC and Encryption Engines can be upgraded to support future 802.11 standards.
- Allows expansion of key components such as system memory and FLASH storage.
- Modular RF interface future-proofs the wireless investment.
- Automatic RF, Uplink and complete Array failover.

Summary

Today's legacy equipment cannot keep pace with the increased demand for wireless capacity. Some techniques are attempting to mitigate capacity issues but fall far short of what is truly needed for the enterprise. The Xirrus Array Architecture enables IT administrators to meet capacity demands, simplify deployments, provide rock-solid security and drastically reduce the cost of delivering RF bandwidth.

About Xirrus

Xirrus, Inc. is lead by Dirk Gates, former Chairman and CEO of Xircom (acquired by Intel). Headquarted in Westlake Village, California, Xirrus was founded in late 2003 to advance the value of Wireless Local Area Networks (WLANs) in the enterprise. Xirrus has delivered the next generation enterprise Wi-Fi Architecture. The highly integrated Wireless LAN Array combines the functionality of a WLAN switch and an array of access points. This revolutionary architecture provides maximum Wi-Fi capacity, coverage and investment return on WLAN deployments.

A privately held company, Xirrus reunites a proven leadership team with a track record of success developing wireless technology solutions as well as growing start-up companies into market leaders.

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March 2005