



Enterprise Wireless Access Point Deployment

How Cisco Deployed Wireless
Access Points Worldwide



A Cisco on Cisco Case Study: Inside Cisco IT

Overview

- Challenge

Provide secure, reliable, consistent, high-performance, and cost-effective wireless services worldwide

- Solution

Cisco® wireless LAN (WLAN) is a Cisco end-to-end solution based on Cisco Aironet® 350 Series access points, 802.11b standards, Cisco Aironet Security Suite, and global distributed AAA architecture based on global standards

- Results

Cisco WLAN is currently deployed worldwide with more than 3100 Cisco Aironet 350 Series access points installed at more than 280 sites in 85 countries, supporting greater than 40,000 wireless clients and more than 35,000 users—essentially every Cisco employee

Overview (Contd.)

- Next Steps

Cisco is improving security, enhancing capabilities, and adding new applications to make employees more productive

Challenge – Provide Secure Wireless LAN Framework

- Security

A solid security framework that protected corporate traffic, yet did not introduce unwieldy or overly complex security requirements for end users was essential

- Reliability

Because WLANs are susceptible to interference and environmental conditions, Cisco® IT had to ensure the reliability of the service and overcome these variables if it were to be widely accepted by employees

- Performance

An architecture was needed that would meet the performance requirements of all users sharing finite bandwidth

Challenge – Deploy a Standard, Cost-Effective Global Wireless LAN

- Consistency

Cisco® IT required a standard global design and implementation of its WLAN networking technology to ensure ease of use, deployment, support, and maintenance

- Cost effectiveness

Design and deployment costs needed to be controlled, as well as ongoing support and maintenance expenses, operational overhead, and potential outsourcing costs, while maintaining a high standard of service

- Global deployment

The wireless network was deployed to all Cisco offices, supporting all Cisco staff, which meant installing more than 3000 access points at more than 280 sites in more than 85 countries, serving greater than 35,000 active users

Solution – Phased Global WLAN Deployment

- Cisco® successfully deployed a global wireless LAN in three phases

Developed guidelines and architectural standards for deployment under the direction of an architectural team

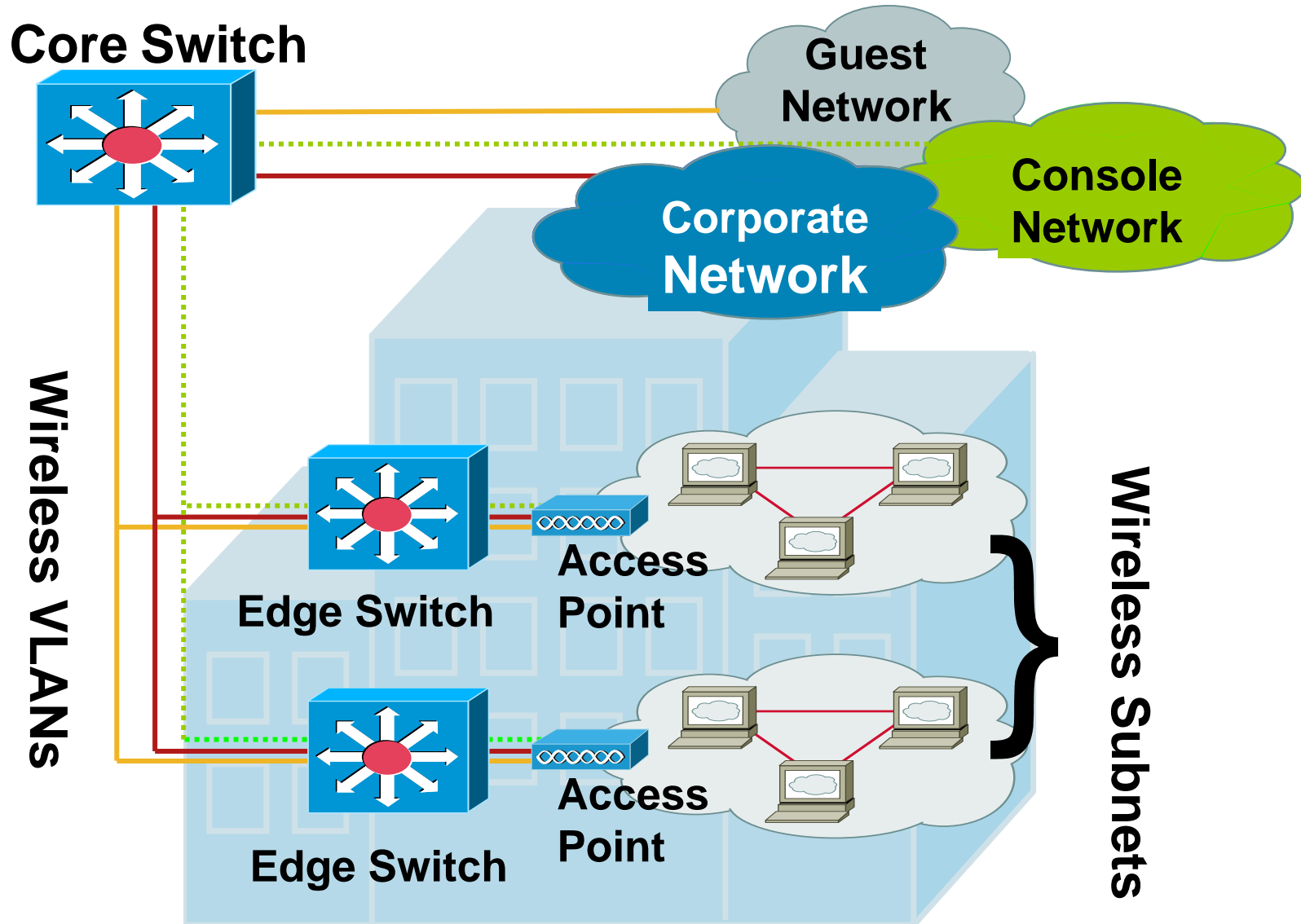
Conducted pilot deployments to substantiate architectural standards

Carried out global deployment under the direction of a global program management team

Solution – Guidelines and Architectural Standards

- WLAN Architectural team developed global architectural standards
- Standards covered equipment, networking protocols, data encryption, user-to-access point ratios, signal strength, roaming characteristics, and device naming standards

Solution – WLAN Architecture



Solution – Equipment Standard

- Cisco® Aironet® 350 Series and Aironet 1100 Series access points

Aironet Access Point 350 Series selected as the global standard; added Aironet 1100 and 1200 series access points as they became available

Connected to nearest access-layer switch

Separate cable provided console access to each access point device, even in the event of a loss of network connectivity

Mounted in ceiling in United States and on a wall in many other countries

Metal enclosure provided plenum rating in United States

Powered over data cable (Power over Ethernet or PoE)

Power injectors used in some areas

Solution – Equipment Standard



**Cisco[®] Aironet[®]
350 Series
Access Points**

**Cisco Aironet
1100 and 1200
Series Access
Points**



Power Injector



Solution – Protocol Standard

- IEEE 802.11b networking standard

 - Provides 2.4 GHz with throughput rates up to 11 Mbps

 - Only widely deployed standard when WLAN being deployed

 - Standard networking protocol selected by Architectural team

- Adding IEEE 802.11g/a support

 - Provides throughput rates up to 54 Mbps; 802.11a supports greater access point density

Solution – Encryption Standard

- Cisco® LEAP Wireless Encryption

Wired Equivalent Privacy (WEP) is the standard used by 802.11 devices to provide security, but ...

- Use of static key made it vulnerable to hackers

- WEP deemed unwieldy and insufficiently secure for enterprise deployment

- Cisco Wireless Networking Business Unit (WNBU) developed Cisco LEAP

- Based on the Extensible Authentication Protocol (EAP) framework, part of the IEEE 802.1x evolving standard

- EAP replaced WEP fixed key with a one-use key

Solution – Encryption Standard (Contd.)

- Cisco IT later implemented Cisco Wireless Security Suite
 - Provided Temporal Key Integrity Protocol (TKIP)
 - Also supported Message Integrity Check (MIC)

Solution – Topology Standards

- Network Topology

WLAN designed as a secondary network complementing the existing wired network

Each large building would use a single Layer 3 domain across all floors to ensure session integrity for wireless devices moving on or between floors

Wired and wireless would share common VLAN in smaller buildings with less than 20 to 30 users

Solution – Access Point Deployment

- User-to-Access Point Ratio

IT Architecture team had to determine how many users could share an access point without performance issues

Traffic analysis tests showed ratio of 25:1 would provide adequate performance

Users encouraged to use wired network for bandwidth-intensive applications such as network backups or video streaming

Even with the limitation of the 802.11b data rate of 11 Mbps (actual throughput of 6 Mbps) there have been no adverse affects on performance

Solution – Signal Strength Standards

- Signal Strength

WLANs broadcast signals into the surrounding area

Signals extending beyond the building can increase security risks posed by hackers

Cisco® Aironet® 350 access points broadcast up to 100mW, potentially reaching parking lots and public areas

Architecture team established standards that call for using minimum power to reach all areas within buildings, and never exceed 20mW

To cover “dead” spots, additional access points were to be installed rather than increasing transmit power to over 20mW

Solution – Wireless Access Point Roaming Standards

- Roaming

Most buildings require multiple WLAN antennas or transmitters to ensure coverage in every area

If the radio architecture isn't well designed, the user can be switched back and forth between transmitters

Architecture team resolved this issue by creating guidelines for cell overlap and locking in transmission rates

- Overlap of about 15 percent (approximately 10 feet in most buildings)

- Only scan for a better access point when the current signal strength has dropped below a specified threshold

- Lock in data rate at 11 Mbps

Solution – Authentication Standards

- Cisco® Access Control Servers

Cisco adopted the IEEE 802.1x standard using Cisco LEAP

Made up of three separate services

Supplicant – Client

Authenticator – Access Point

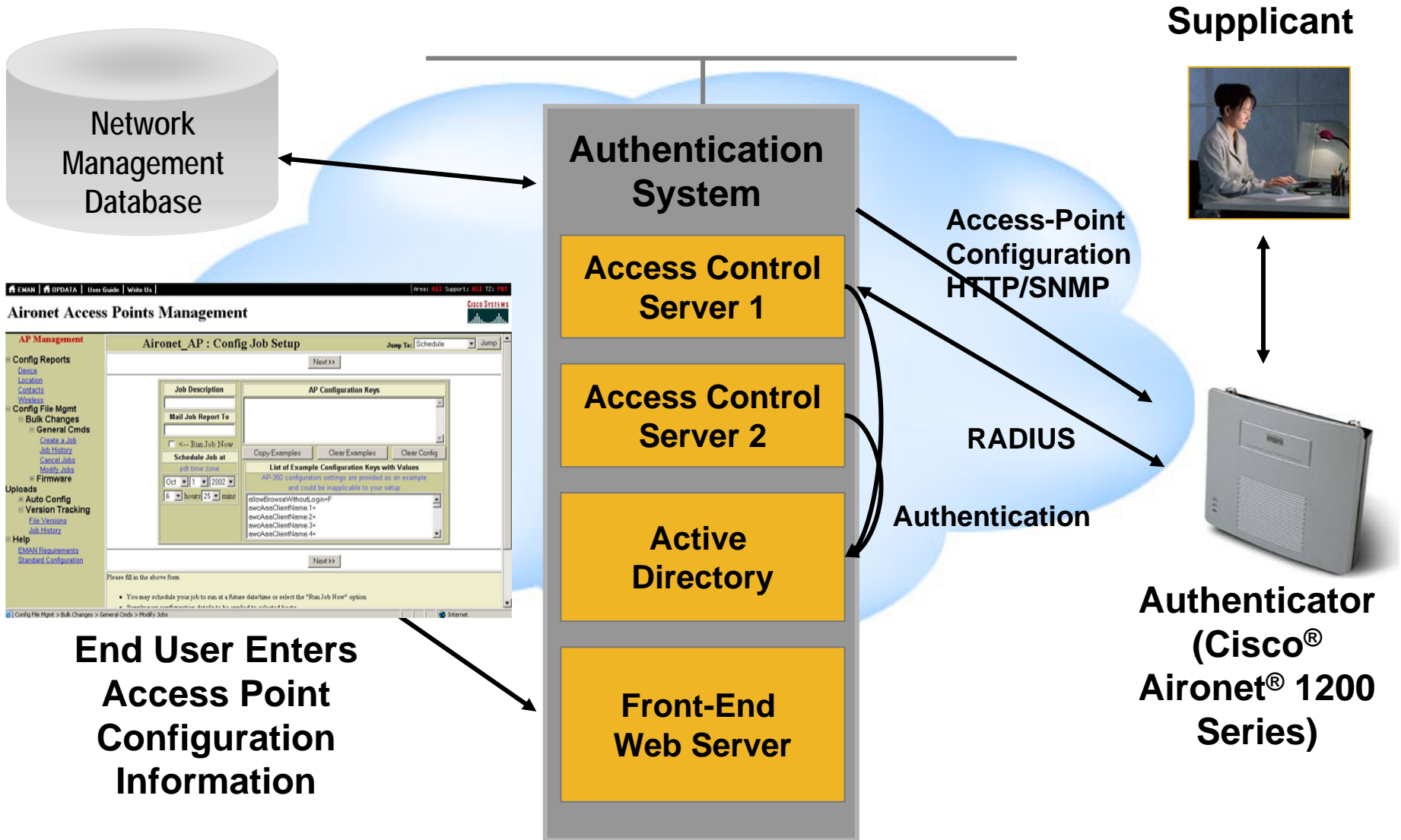
Authenticator Server – ACS/AAA

Users must be authenticated against the authentication server when they log on to the network

This authentication function performed by the AAA server

Architecture team standardized on the Cisco Access Control Server (ACS) to perform this task for WLAN users

Solution – Authentication Diagram



Solution – Global Deployment Teams

- Cisco® IT assembled a Global Program Management team under the direction of a global program manager
- Representatives selected from each of four regions worldwide: Europe, Asia Pacific, the Americas, and corporate headquarters
- Vendors hired for bulk of work; each local team selected contractors

Solution – Global Deployment Teams (Contd.)

- Deployment carried out in five stages:
 - Site survey
 - Cabling
 - Access point configuration
 - Testing
 - Distribution of network cards and instructions
- Almost all sites deployed within a 4-month timeframe

Solution – Site Survey and Cabling

- Site Survey

Site survey determined placement of access points and antennas to maximize coverage throughout a building and minimize “dead” spots

Each building unique; formal and well-defined site survey was, and remains, critical to successful WLAN deployment

Site survey teams estimated access point location using floor plan, then physically measured signal strength, coverage, and cell overlap throughout the space using laptop loaded with WLAN client software and the Cisco Aironet® client utility

Solution – Site Survey and Cabling (Contd.)

- Cabling

Following site survey, local contractors (different from the site survey firm):

- Installed cabling

- Mounted Cisco® Aironet® 350 Series access points

- Connected and powered up Aironet 350 Series access points

Solution – Configuration and Testing

- Access point configuration

Access points preconfigured with “generic” configuration; enabled Cisco® IT to communicate with them and “push” the final production configuration

IP address, channel assignment, and transmit power settings most critical

Assigning wrong channel, setting transmit power too high, or assigning duplicate IP address could create performance problems

Solution – Configuration and Testing (Contd.)

- Testing

Following configuration, site survey contractors returned to conduct post-installation acceptance tests on WLAN in each building

Globally consistent and clearly defined acceptance tests included:

- Ability to roam from access point to access point

- Transfer file at a minimum designated speed

- Ensuring correct overlap between access point cells and no “dead” spots

Solution – Wireless LAN Management

- Cisco® IT uses CiscoWorks Wireless LAN Solution Engine (WLSE), an appliance for managing WLAN deployments, in conjunction with an internally developed enterprise management system (EMAN)
- CiscoWorks WLSE assists in WLAN network, host, and radio management, site surveys, and rogue access point detection

Solution – Wireless LAN Management (Contd.)

- Priority network

Initially WLAN was considered a secondary network to wired network, WLAN managed as Priority 4

Due to widespread adoption and usage, support for WLAN has become equivalent to Priority 2

Cisco access control servers (AAA servers) managed as a Priority 3

Results – Summary

- Cisco® WLAN is fully deployed worldwide with more than 3100 Cisco Aironet® 350, 1100, and 1200 series access points installed at more than 280 sites in 85 countries, serving more 40,000 wireless clients and more than 35,000 users
- 97 percent of Cisco employees use wireless access at least once a day and 25 percent use it as their primary or only method of access
- Only 800 WLAN-related calls are received by technical support each month, or an average of just 0.3 calls per user per year
- Cisco IT estimates the gain in productivity at between \$9 million and \$18 million per year

Results – Productivity Improvement

- WLAN costs break even with only one minute time savings per employee

Total cost of Cisco® IT WLAN: 72¢ per employee per day

Value of improved productivity: \$1.25 per minute per employee per day

- NOP World Technology study (2003) of 400 businesses using WLANs reported productivity increase of 90 minutes per employee per day
- Cisco IT estimates (conservatively) improved productivity savings of 5 to 10 minutes per day; \$9M to \$18M per year

Next Steps – SWAN, CCKM, EAP FAST, New Access Points

- Cisco® IT has embraced Cisco Structured Wireless-Aware Network (SWAN), an important step to achieving an intelligent network that combines today's separate wired and wireless networks
- Cisco IT plans to implement Cisco Centralized Key Management (CCKM), which provides fast Layer 2 roaming
- Cisco IT is migrating from Cisco LEAP to a new and improved EAP mechanism known as Extensible Authentication Protocol –flexible authentication through secure tunneling (EAP FAST), which addresses the weaknesses of LEAP

Next Steps – SWAN, CCKM, EAP FAST, New Access Points (Contd.)

- Cisco is deploying new access points, and eventually will replace all existing single-band 11 Mbps 802.11b access points with faster dual-band 54 Mbps 802.11a/g access points

Next Steps – ECT, PDAs, Wireless IP Phones, Flexible Workplace

- As part of the Enterprise Class Telecommuter program (ECT), Cisco® IT will be implementing a fully managed, end-to-end wireless solution that will incorporate access for wireless access points and IP phones in the near future
- Cisco is adopting a framework to provide secure, scalable support for smart wireless handheld devices such as smart phones and PDAs

Next Steps – ECT, PDAs, Wireless IP Phones, Flexible Workplace (Contd.)

- Cisco IT will continue to deploy the latest generation of wireless LAN handsets developed by Cisco, which will incorporate the cellular and WLAN function into a single device
- Cisco Workplace Resources and IT are developing new workplace designs based on wireless and IP telephony mobility, reducing real estate costs, and improving collaboration

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CISCO



Americas Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883


Asia Pacific Headquarters

Cisco Systems, Inc.
168 Robinson Road
#28-01 Capital Tower
Singapore 068912
www.cisco.com
Tel: +65 6317 7777
Fax: +65 6317 7799

Europe Headquarters

Cisco Systems International BV
Haarlerbergpark
Haarlerbergweg 13-19
1101 CH Amsterdam
The Netherlands
www-europe.cisco.com
Tel: +31 0 800 020 0791
Fax: +31 0 20 357 1100

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