



Wireless Mesh Networking

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Field Engineer
Wireless Mesh Networking



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MARKET OVERVIEW FOR WIRELESS MESH

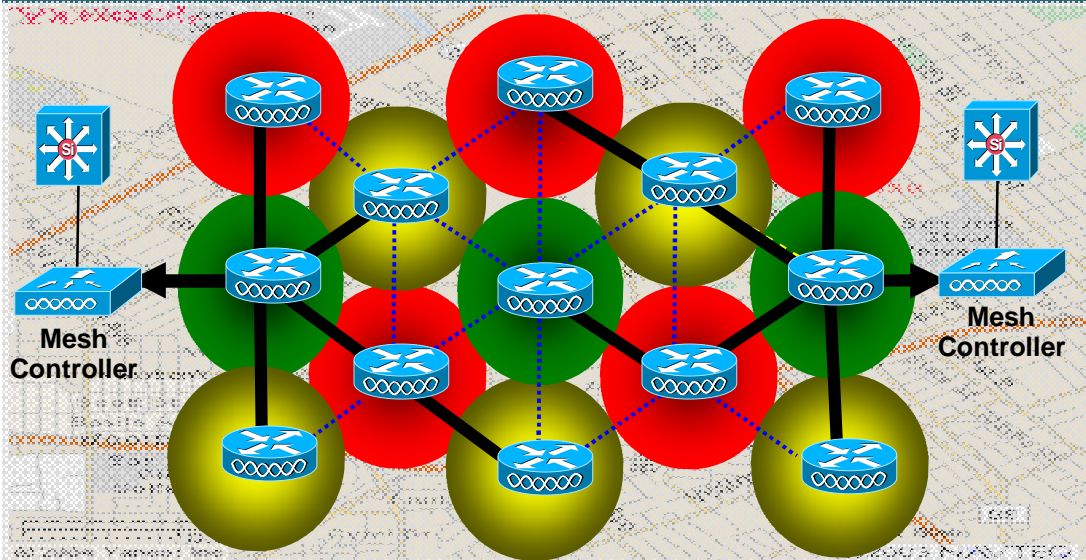


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Wireless Mesh Networking Defined



"Mesh networking in various applications is becoming a low-cost alternative for municipalities."

Jeff Vinin
Vice President of Gartner Research
Mesh Networking Improves First Responder's Efficiency

- Mesh is a network topology where devices are connected via many links and select the optimal path to forward traffic
- A Wireless Mesh Network provides local 802.11g access to clients and connects neighbors using 802.11a “backhaul”
- The Wireless Mesh is self-forming/self-healing and selects the optimal path back to the “wired” network

Mesh Networking Markets

Enterprise Mesh <i>Moving Indoor WiFi Outside</i>	Municipal Mesh <i>State, County & City</i>	Service Provider <i>Managed WiFi Services</i>
<ul style="list-style-type: none"> • Universities & Healthcare Extending WiFi coverage throughout the ent campus • Hospitality Indoor/Outdoor mesh can open up new hospitality markets (EMEA) • Manufacturing - Shipping & Receiving Inventory applications, hand-held scanner, RFID, etc. • Wireless Bridging P2P/P2MP links between buildings 	<ul style="list-style-type: none"> • Public Safety/Homeland Defense Police, fire and 1st responders Wireless Infrastructure, Vehicles & Clients • Wireless Access for Fixed Applications Video Surveillance, Sensors • Public Service Hot Spot access for city workers, utilities, inspectors • Digital Divide & Economic Development WiFi Broadband Access in under-served communities 	<ul style="list-style-type: none"> • “Hot Zones” Extend the existing “Hot spots” into “Hot Zones” covering high traffic outdoor areas • Wireless ISPs Competitive Last-mile access providers using WiFi for Broadband service • Cable Operators Extend the network offering beyond the cable plant

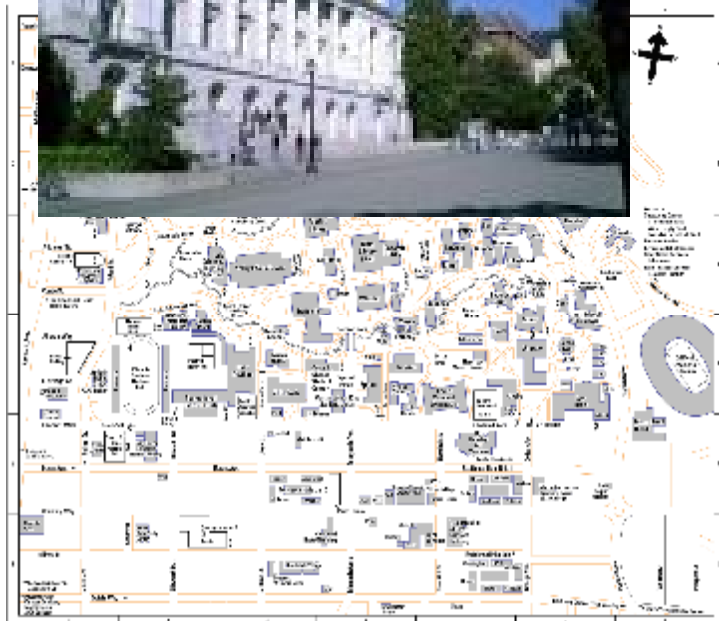
Extending the Enterprise Network

Growth Areas and Emerging Markets

Hot-zones and Next Generation Access for consumer/SMBs

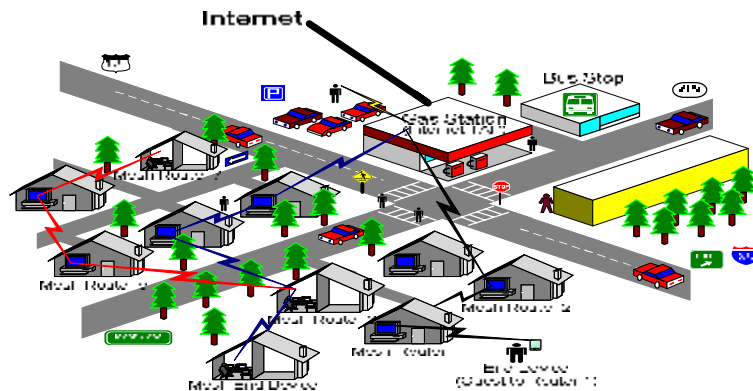
Indoor/Outdoor Wireless Solutions for Education Customers

Berkeley
University of California



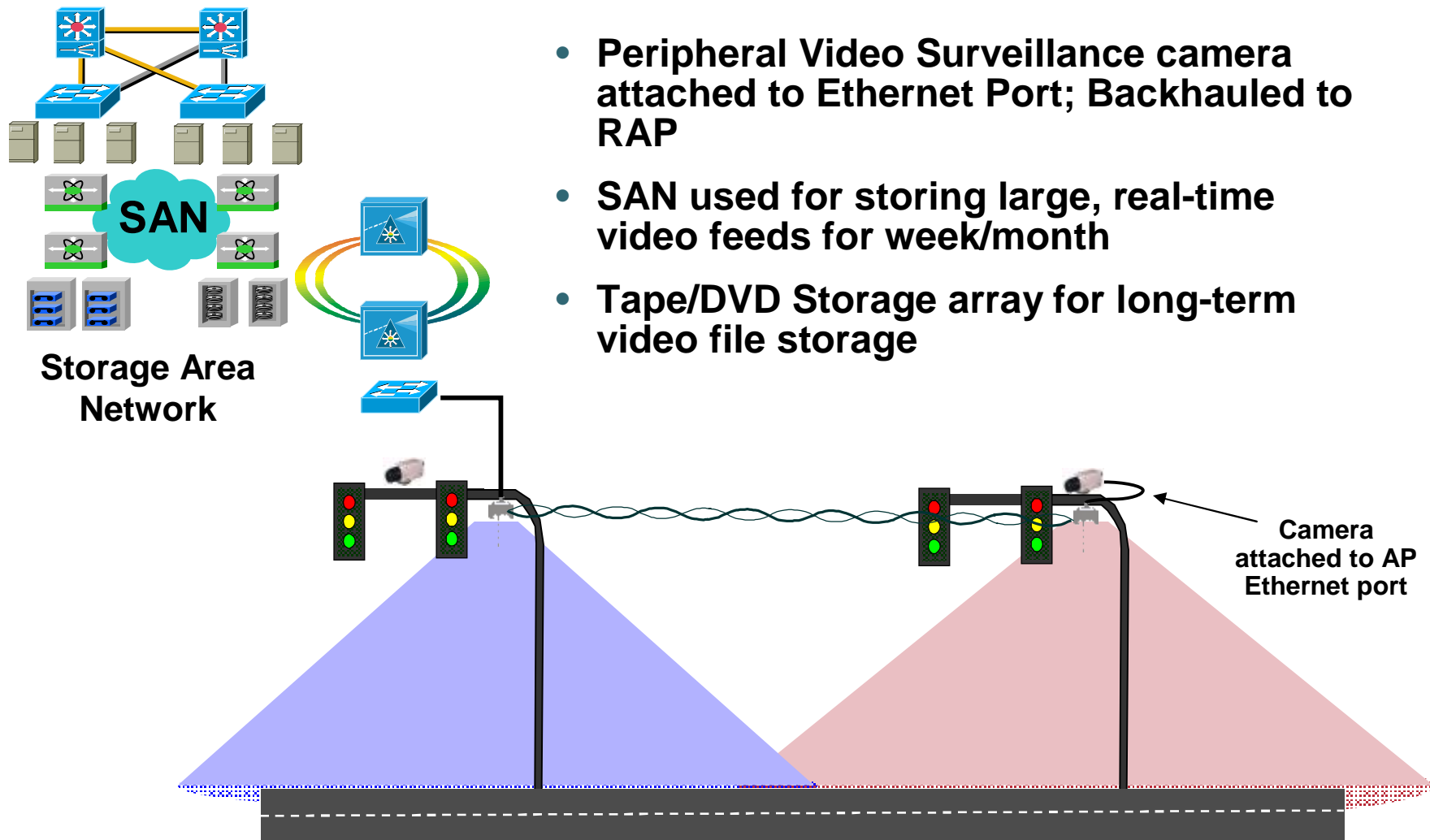
- **Users**: Students, Administration, Facilities
- **Applications**: Student/Admin Access, Video Surveillance, Facilities Mgmt
- **Value Proposition**: Hot-Spots, Service, Safety, Application Access
- **Requirements**: Closed User Groups, Identical Indoor/Outdoor Policies and Mgmt, Cost-aware

Hot-Spots to Hot-Zones WiFi Access

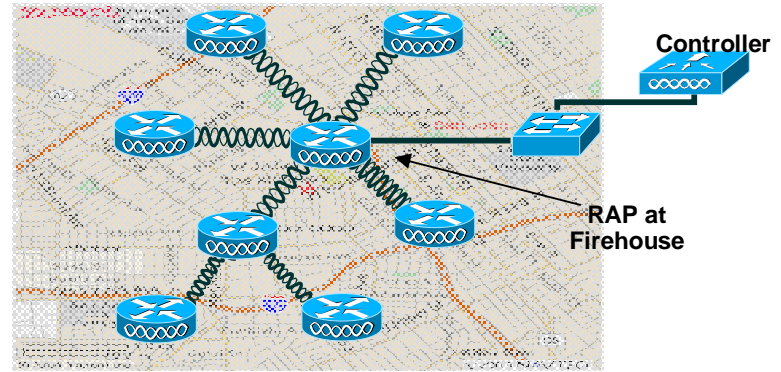
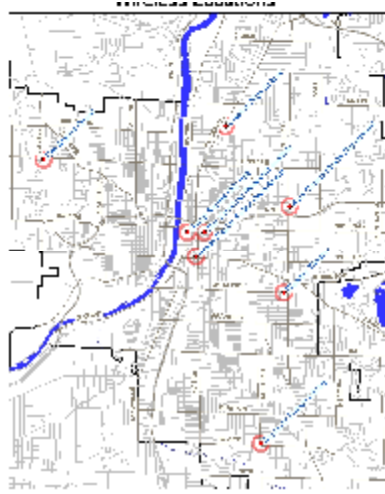


- **Users:** Consumer / SMB
- **Applications:** Extending Hot-spot coverage to Hot-Zones, cost efficient access for Digital Divide communities, Wireless ISPs for broadband access
- **Value Proposition:** Fee-based Service for ISP
- **Requirements:** SP Billing and Management Integration

Connecting Peripheral Devices Across the Mesh



Establishing Hot-Zones for Public Safety Departments



- **Users:** Public Safety
- **Applications:** Uploading arrest reports, critical suspect or Amber Alert picture downloads. Real-time maps for Fire/Ambulance
- **Value Proposition:** Police officers can work on reports while in the field, not at their desk
- **Requirements:** Back-end application integration (eg, Northrop Grumman's Arrest Report s/w)

Key Municipal Applications for Mesh Networks

- **Police - high bandwidth access for applications**
 - Real-time application access for reports, etc
 - Amber Alert, Fugitive Watch, DMV and Federal photos
 - Video Surv access in schools, buildings, etc
- **Fire - real-time access to large gif files and information**
 - On-line city Maps
 - Hazmat
 - Traffic Info
- **City Services - fast, efficient file upload and permit access**
 - Building Inspection & Code Enforcement
 - Parking Services



How *Real* is the Municipal Mesh Market?

<http://muniwireless.com/reports/docs/July2005report.pdf>

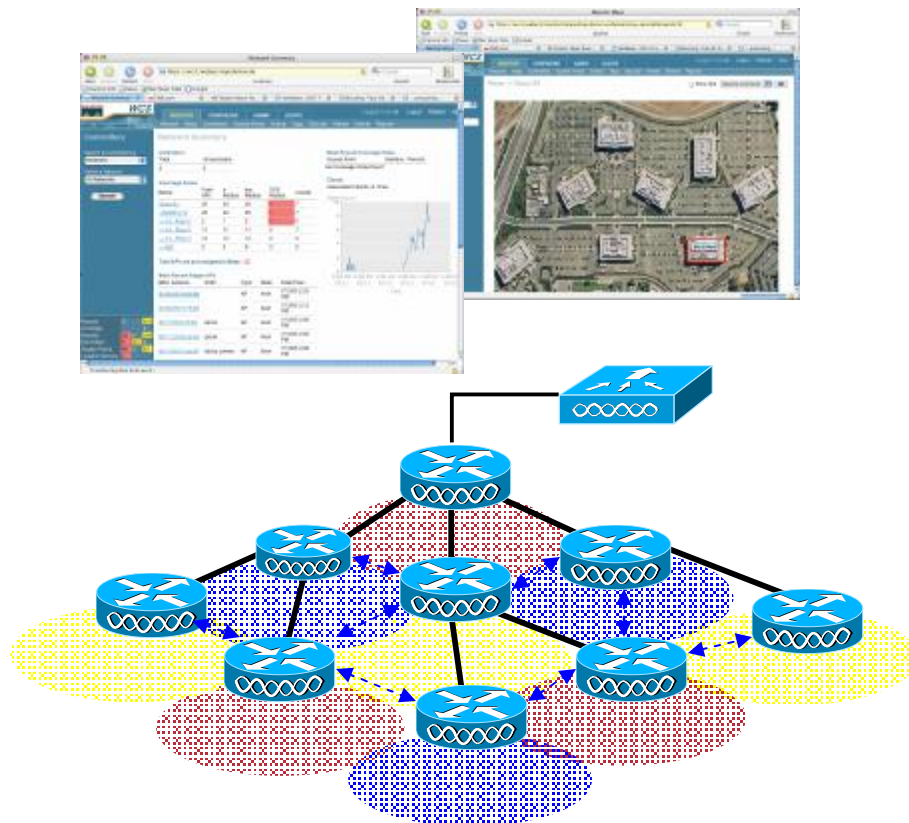
- **>100 city hot-zones, or city and regional broadband networks that provide Public Access**
- **33 city-wide networks for Municipal Services - 29 in the US**
- **Currently 42 planned projects, some very large**
- **7 new RFPs in the last week of July '05 alone**

*Source:
Esme Vos, MuniWireless.co*

CISCO WIRELESS MESH NETWORKING OVERVIEW



The Industry's 1st Intelligent Wireless Mesh Solution



- **Self-Configuring, Self-Healing Mesh**
 - Zero-Touch Configuration
 - Cisco's new Adaptive Wireless Path (AWP) Protocol
- **Engineered with Ease of Deployment and Management as Top-of-Mind**
- **Robust Embedded Security**
- **Provides Seamless Mobility**
- **Identical Indoor & Outdoor Policy Management**

Dynamic

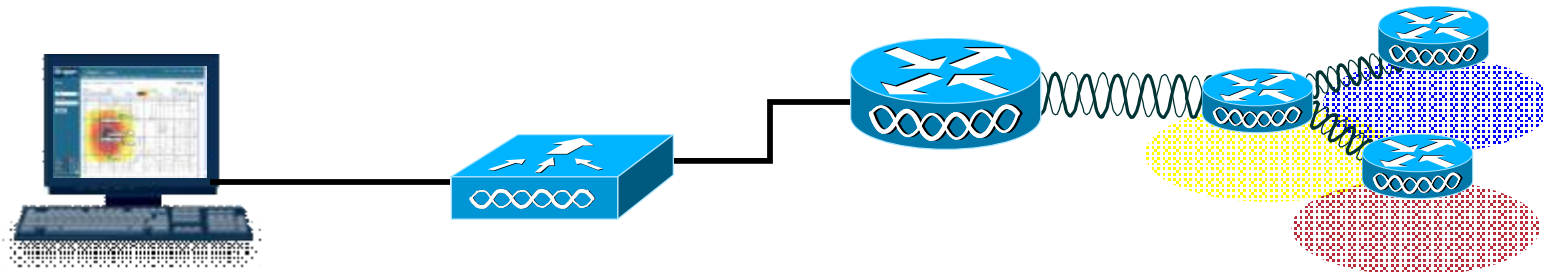
Secure

Reliable

Scalable

Manageable

Outdoor Wireless Mesh Solution Components



Cisco Wireless Control Systems

- Wireless Mesh Management System
- Enables network-wide policy configuration and device management
- Supports SNMP and Syslog

Cisco Wireless LAN Controller

- Links the Wireless Mesh APs to the wired network
- Handles RF algorithms and optimization
- Seamless L3 Mobility
- Provides Security and Mobility Management

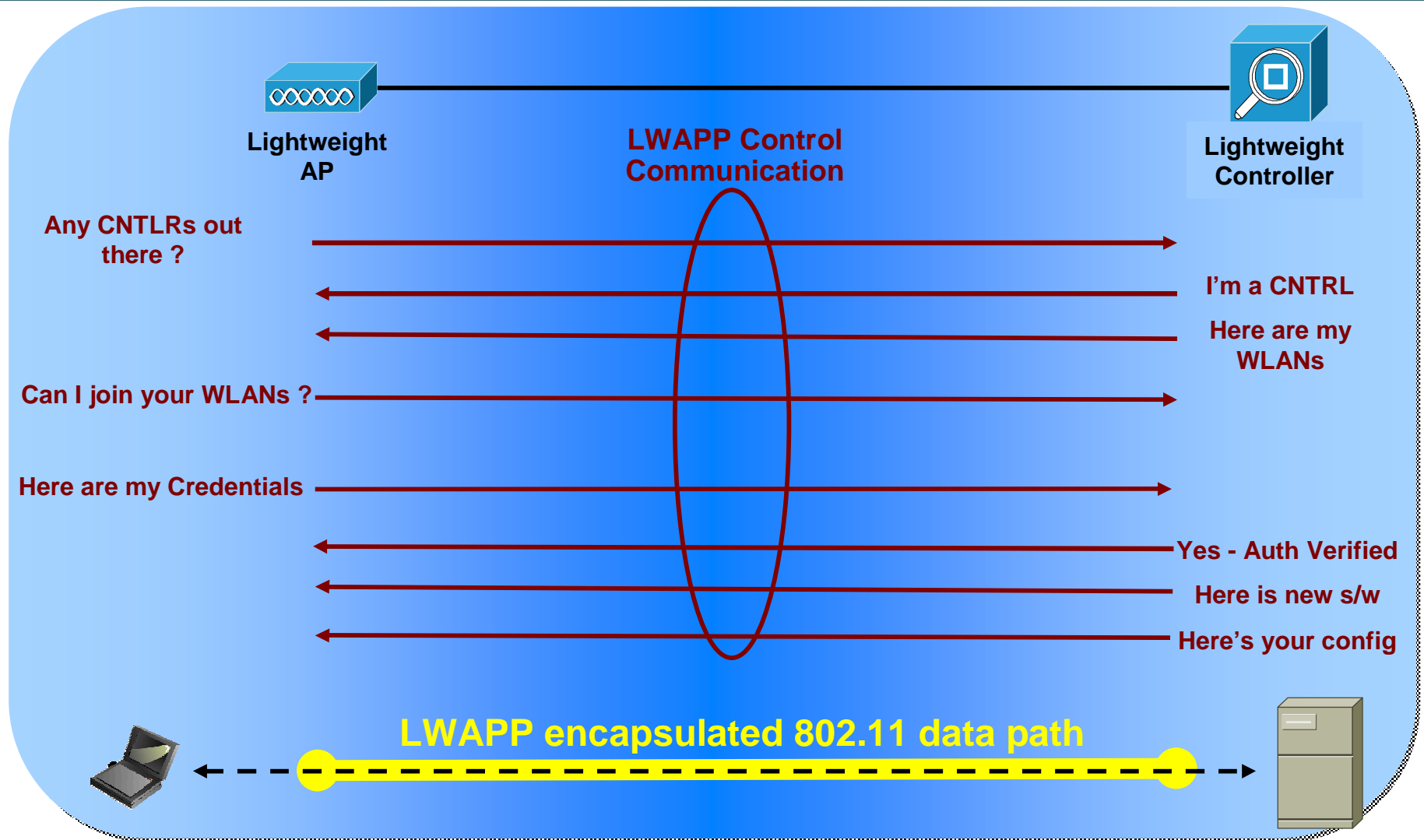
Root-top Access Point

- Serves as “Root” or “Gateway” AP to the wired network
- Typically located on roof-tops or towers
- Connects up to 32 “Pole-top” APs using 802.11a

Pole-top Access Point

- Provides 802.11b/g client access
- Connects to Root AP via 802.11a
- Takes AC or DC power; PoE capable
- Ethernet port for connecting peripheral devices

Lightweight System Overview

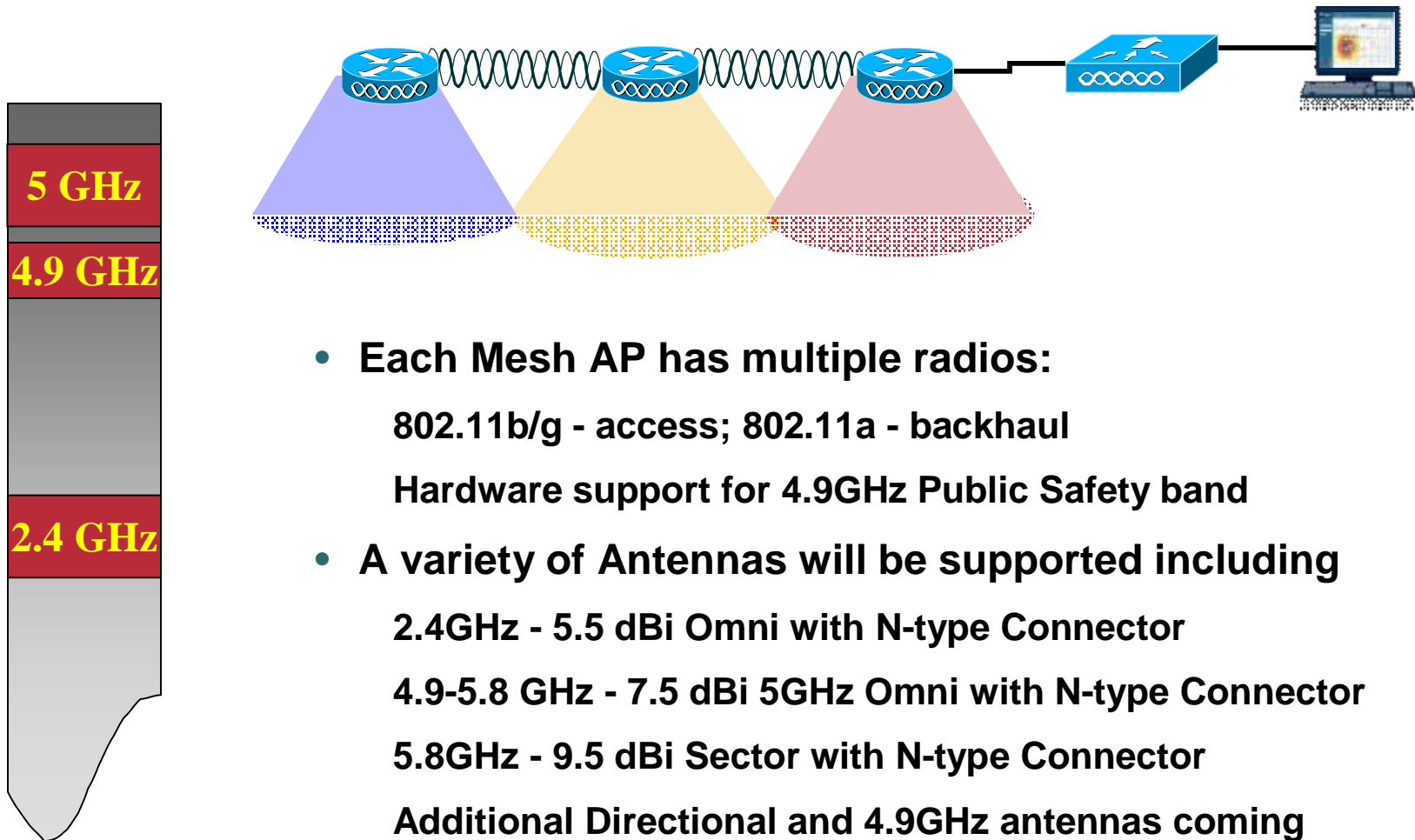


Aironet 1500 Lightweight Mesh AP

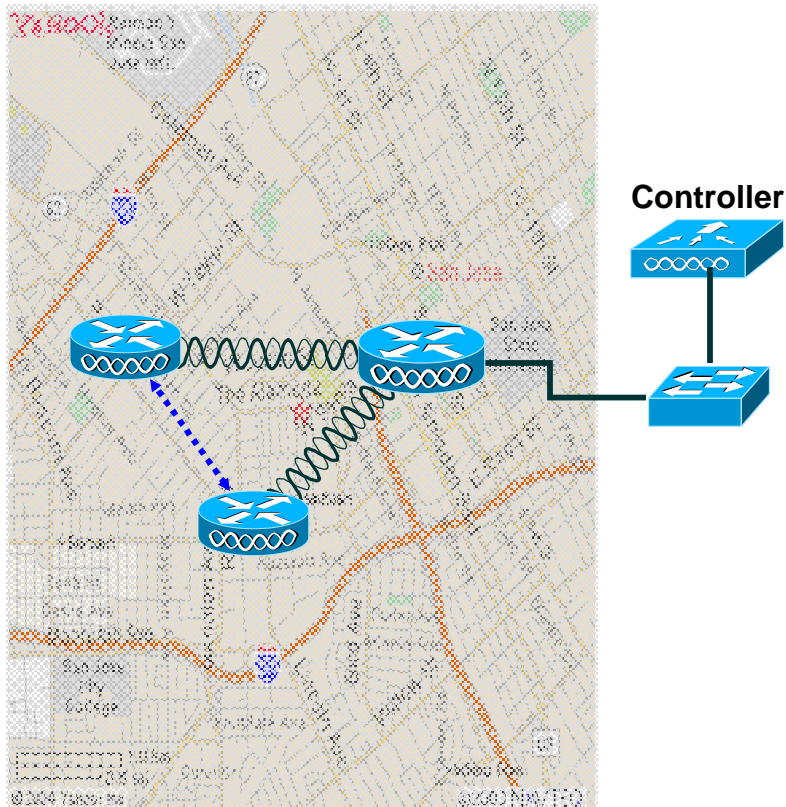
- **2.4GHz, 4.9GHz and 5GHz capable radios**
- **Multiple Power Options**
 - PoE, Street Light tap, Mil-Spec AC Plug
- **Vertical or Horizontal Pole Mounting**
- **NEMA, Weatherized Enclosure**
 - 35C +55C temperature ranges



Multiple Radios for Wireless Backhaul and Access



Easy Installation and Configuration



- **Mesh APs automatically establish connection to controller**
 - Root via wired connection
 - Pole-top via self-configuring backhaul connection
- **Pole-top AP uses Cisco's Adaptive Wireless Pathing to establish best path to Root**
- **AP authenticates to controller and downloads configuration and radio parameters**

Automatic

Secure, Zero-Touch Mesh AP Configuration

Providing Mesh Security at Each Step

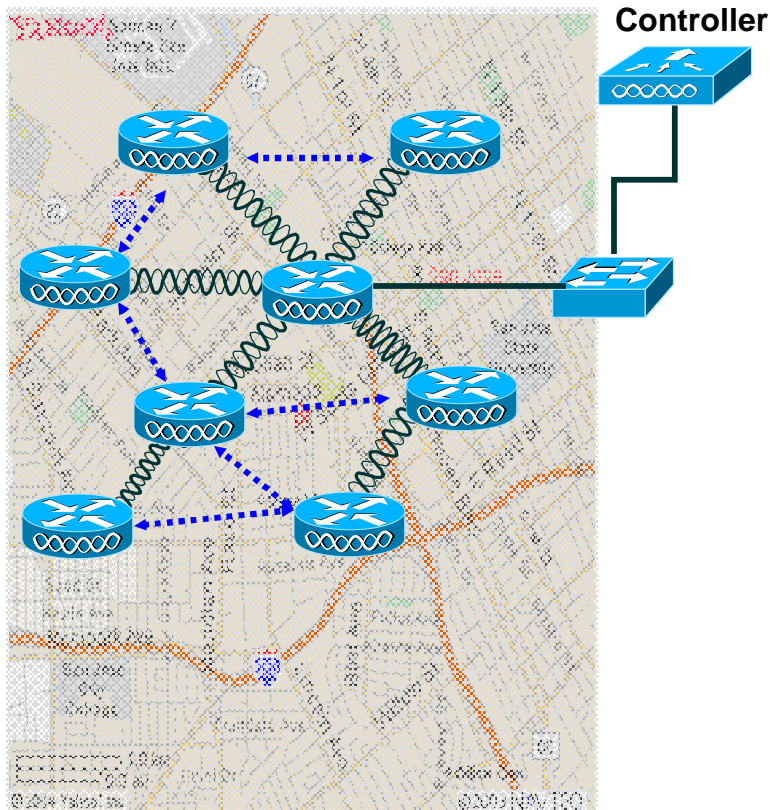


- Dynamic WLAN VLAN Assignment + 802.11i WPA/WPA2 Security
- HW-based AES encrypted Backhaul Links
- AP Authentication protects against “imitation APs”
- Secure Control Traffic between AP and Controller
- IPSec VPNs for “confidential” mesh client traffic

Secure

Uncompromising Security at Every Layer

Dynamic, Intelligent Path Selection



- **Adaptive Wireless Path (AWP) Protocol**

- 25 yrs of Cisco routing knowledge + 20 yrs of building RF networks

- **AWP establishes an optimal path to Root**

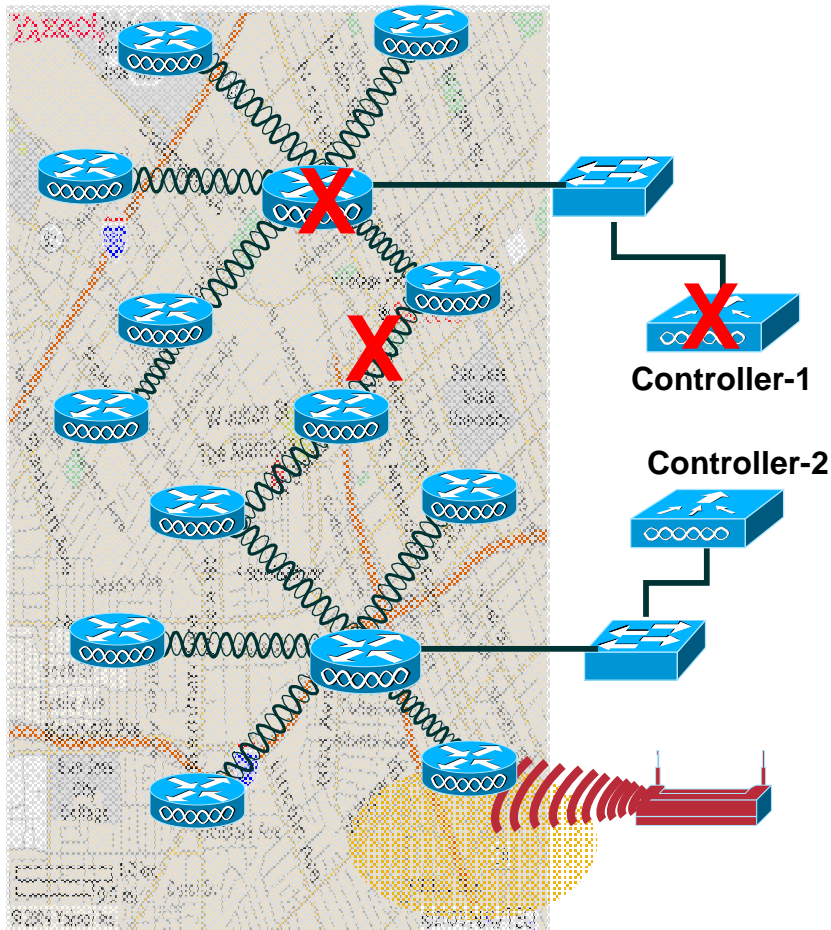
- **Each AP carries feasible successor(s) if topology or link health changes**

- Note: AWP uses a “parent sticky” value to mitigate route flaps

Reliable

Self-configuring, Self-healing, Dynamic Path Optimization

Self-Healing Mesh Networks



- **Automatic Service load-balancing across Wireless LAN Controllers**

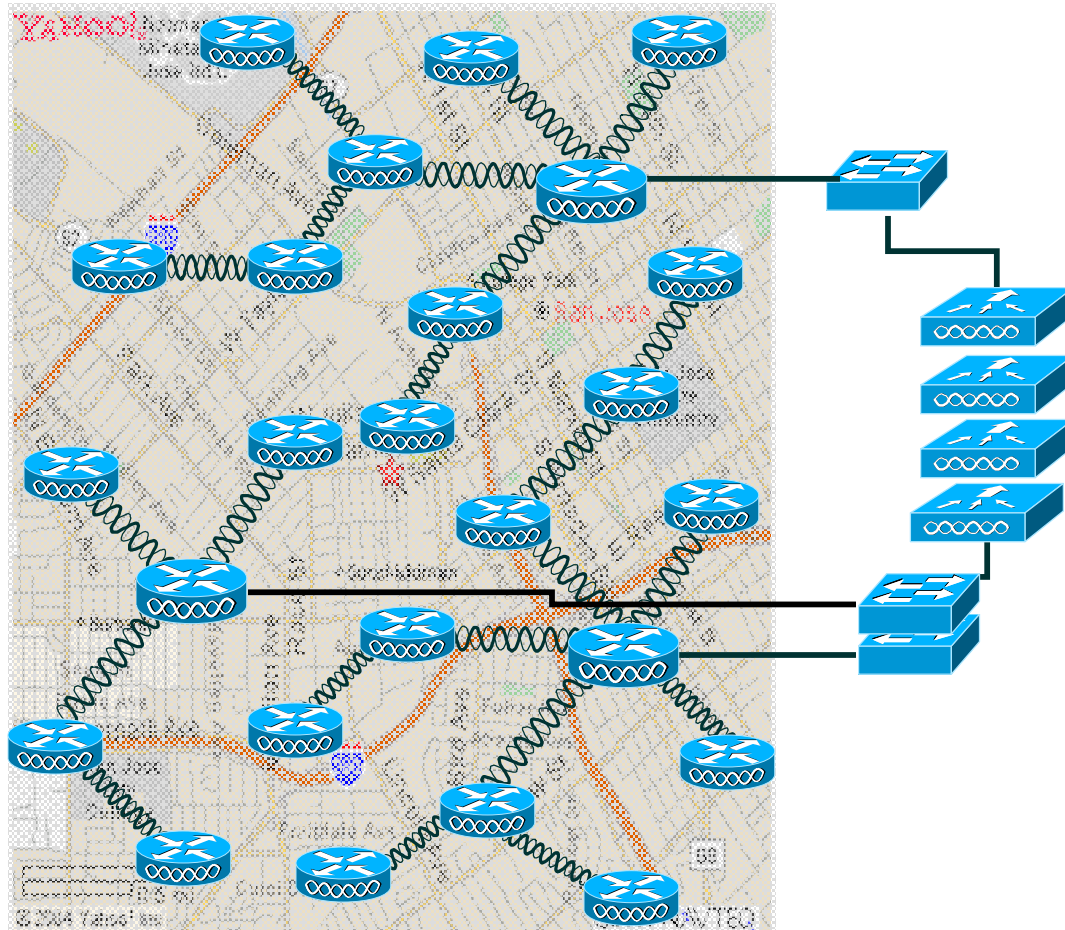
LWAPP communicates controller load to APs

- **APs learn secondary and tertiary Wireless LAN Controllers at “Network Join”**
- **Channel re-assignment in event of Channel conflict**
- **Connection to Alternate Controller**

Reliable

Delivering Mission-Critical WiFi Access

Easily Adding Capacity...

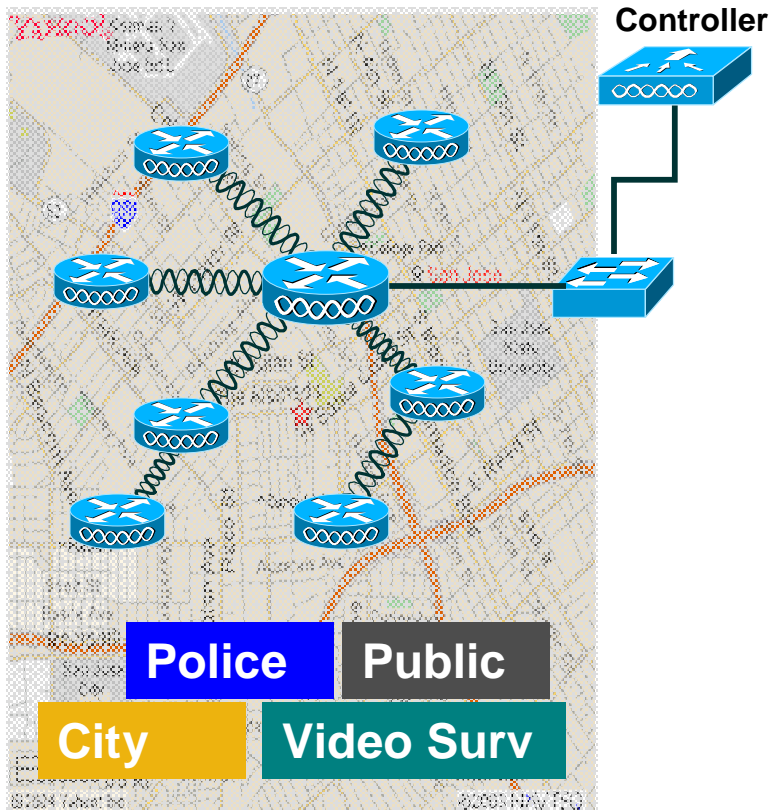


- **Scalable Architecture**
- **Increase AP Density**
 - Up to 32 Pole-top APs per RAP
 - Mesh can be up to 8 hops deep (3-4 hops recommended)
- **Add Root/Gateway APs**
 - Pole-top APs can join new RAPs with better path metrics
- **Add Controllers**
 - Up to 24 controllers can be part of an N+1 cluster

Scalable

Scalable, Service-Ready Architecture

...And Services

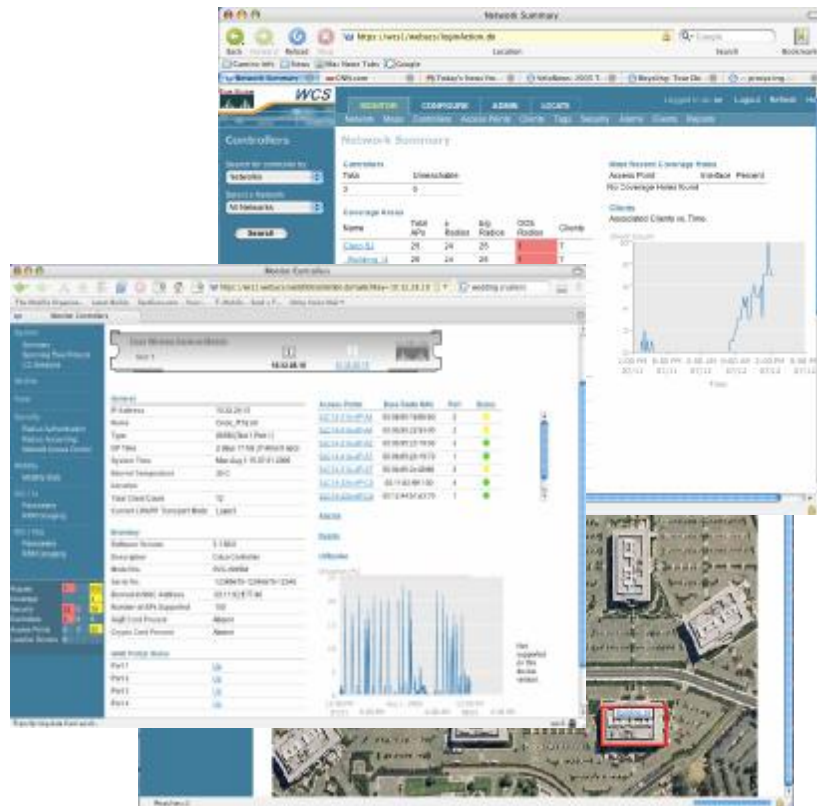


- **16 MBSSIDs Supported**
- **Ethernet port for connecting peripheral devices**
- **802.11e QoS Capable**
- **Traffic Rate-limiting for “hog” mitigation**
- **Architecture is ready for additional radios when extra capacity is required**

Scalable

Scalable, Service-Ready Architecture

Cisco's Award Winning Management Solution



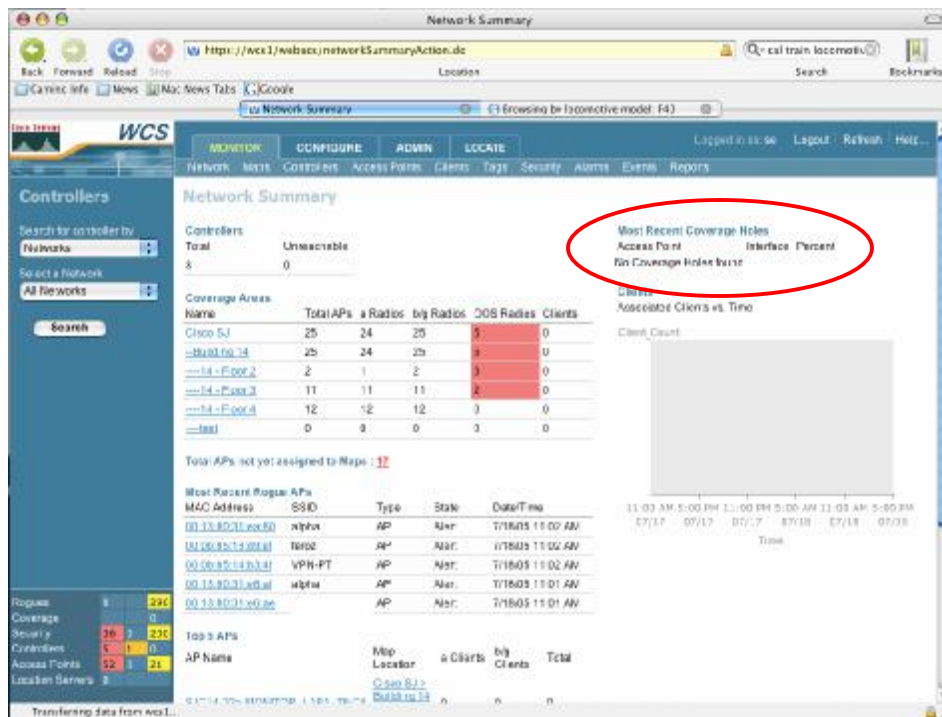
- **Identical Management Software and RM Features as Indoor Solution**
- **SOAP/XML interfaces for NMS integration**
- **Detailed AP, Radio information including**
 - Noise and Interference by Channel**
 - Neighbors lists and RSSI detail**
 - Link Metrics, PER, Tx/Rx detail**
- **Link Tests Tools for RAP-to-PAP troubleshooting**
- **SNR and Noise Floor Histograms**

Manageable

Easy to Deploy, Easy to Manage

Real-Time RF Management

Intuitive, GUI-based Management

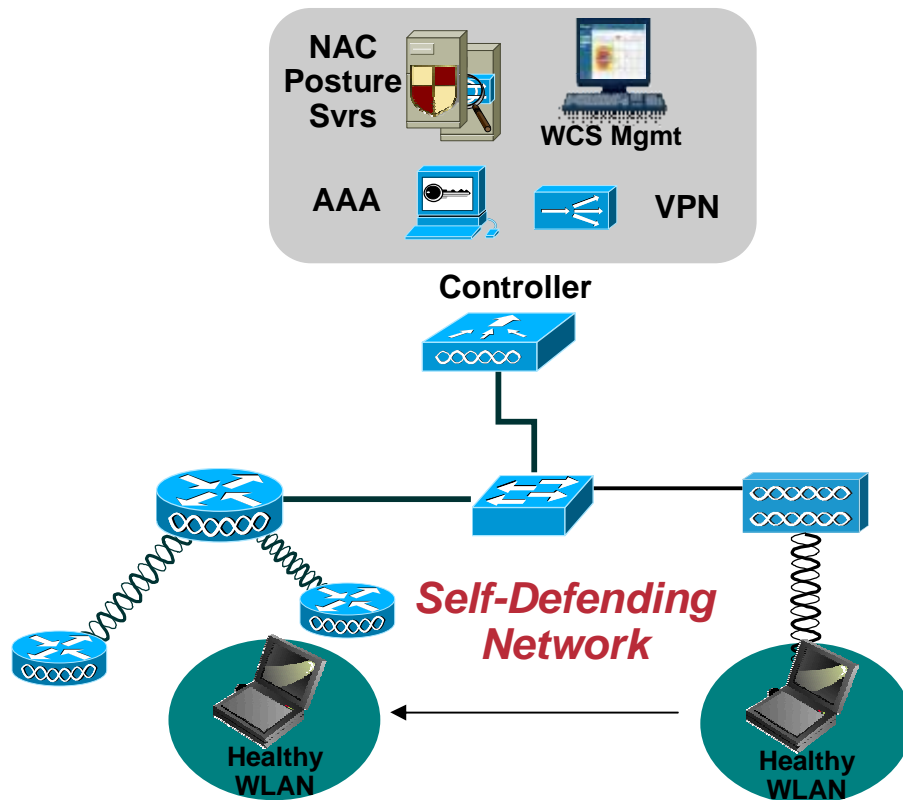


- Dynamic Channel Assignment
- Dynamic Power Optimization
- Identify/Avoid RF Interference
- Identify and Eliminate Coverage Holes (Future)
- Optimize Coverage Area

Manageable

Curtail Costly, Time-intensive Surveys

Unified Indoor and Outdoor Management and Configuration



- Unified User and Policy Configuration
- Common Management Station
- New Indoor WLAN features are “Inherited” by the Mesh Solution

Innovation

Common Wired, Indoor/Outdoor Policies and Tools

CISCO SYSTEMS



EMPOWERING THE INTERNET GENERATION



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Countries available for FCS

- **US**
- **Canada**
- **Australia & New Zealand**
- **NZ**
- **Taiwan**