Cisco Expo
2009

Cisco Unified Wireless Networking

Welcome to the Human Network.

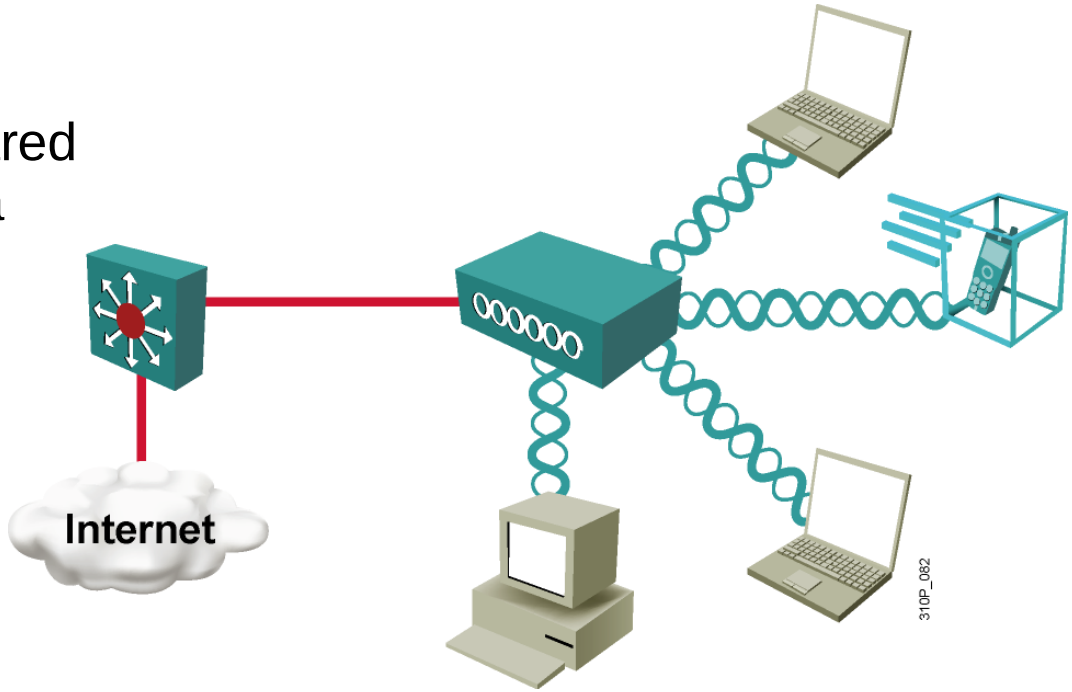
Agenda

- WLAN Technology Overview
  - Design Considerations
  - Driving the standards
- 802.11n Overview
- 1140/ 1250 AP & M-Drive Technology
- Cisco Outdoor Wireless Mobility Solutions

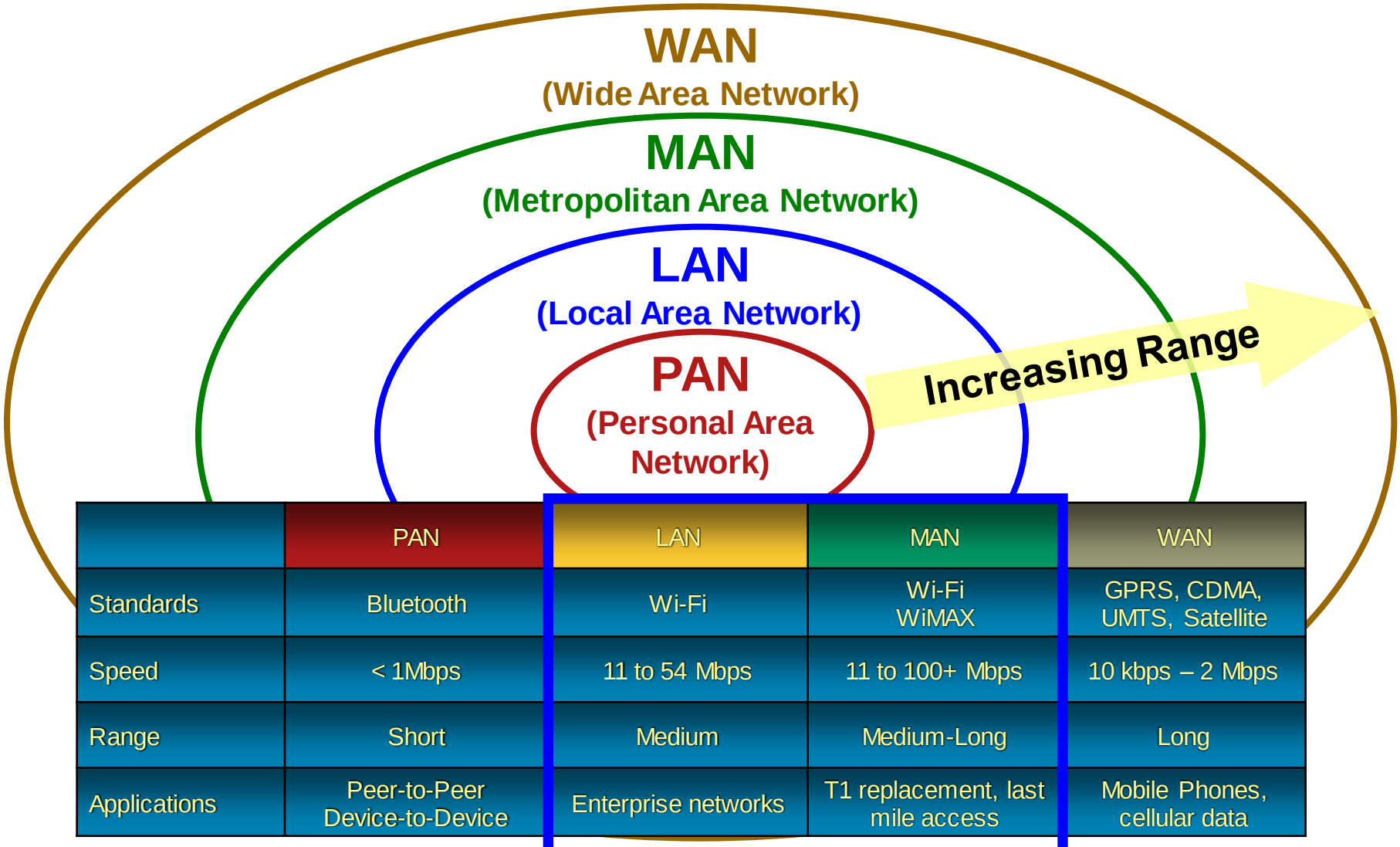
WLAN Technology Overview

Wireless LAN (WLAN)

- A WLAN is a shared RF network
- An a access point is a shared device and functions like a shared Ethernet Hub.
- Uses CSMA/CA protocol
- Two-way radio communications (half-duplex) are used
- The same radio frequency is used for sending and receiving (transceiver)



Wireless Technologies

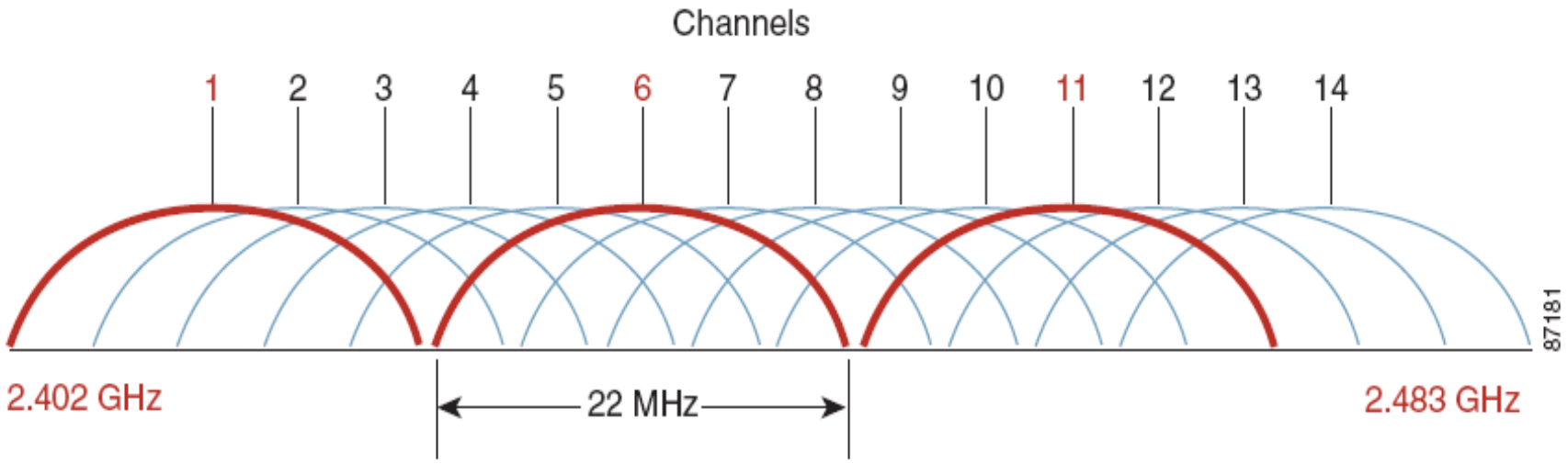


	PAN	LAN	MAN	WAN
Standards	Bluetooth	Wi-Fi	Wi-Fi WiMAX	GPRS, CDMA, UMTS, Satellite
Speed	< 1Mbps	11 to 54 Mbps	11 to 100+ Mbps	10 kbps – 2 Mbps
Range	Short	Medium	Medium-Long	Long
Applications	Peer-to-Peer Device-to-Device	Enterprise networks	T1 replacement, last mile access	Mobile Phones, cellular data

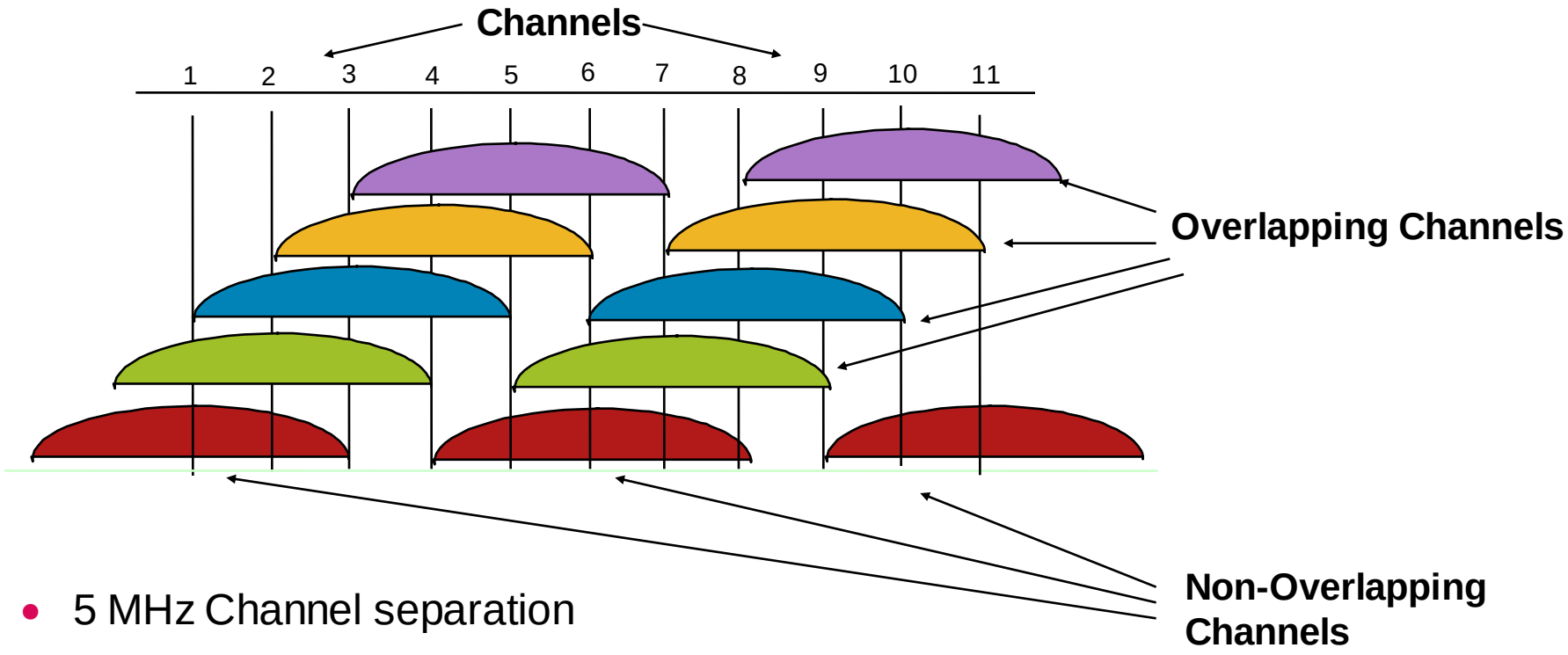
802.11b/g Channels (2.4 GHz)

- Non-overlapping channels should be used when deploying WLAN
- Non-overlapping channels have 22 MHz of separation
- There are 3 non-overlapping channels in the 2.4 GHz (ch 1,6,11)
- 3 APs can occupy same area - set at different frequencies

Channel 14 can be used as a fourth non-overlapping channel for Japan when using 802.11b access points

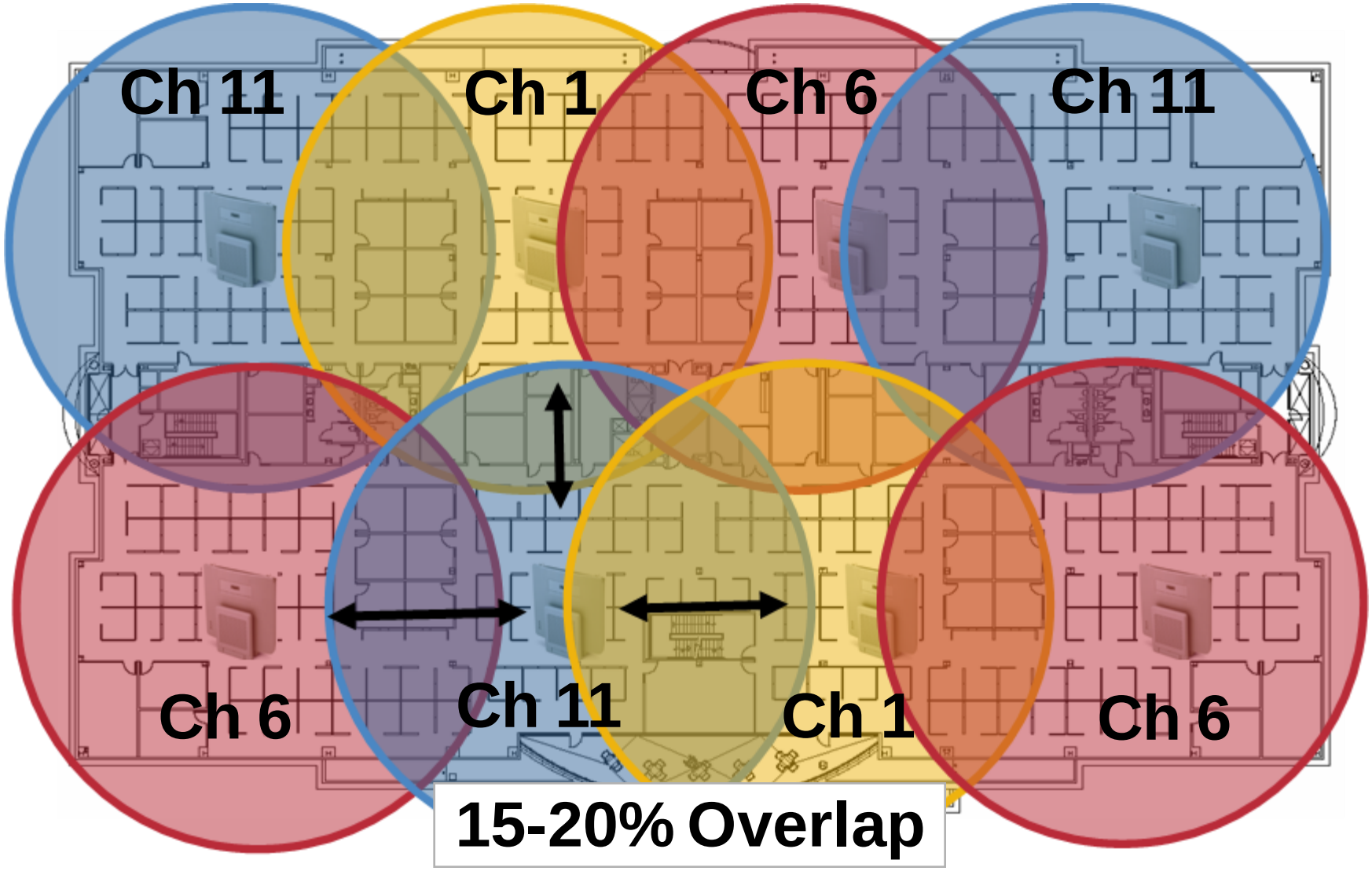


IEEE 802.11b/g Channel Allocations



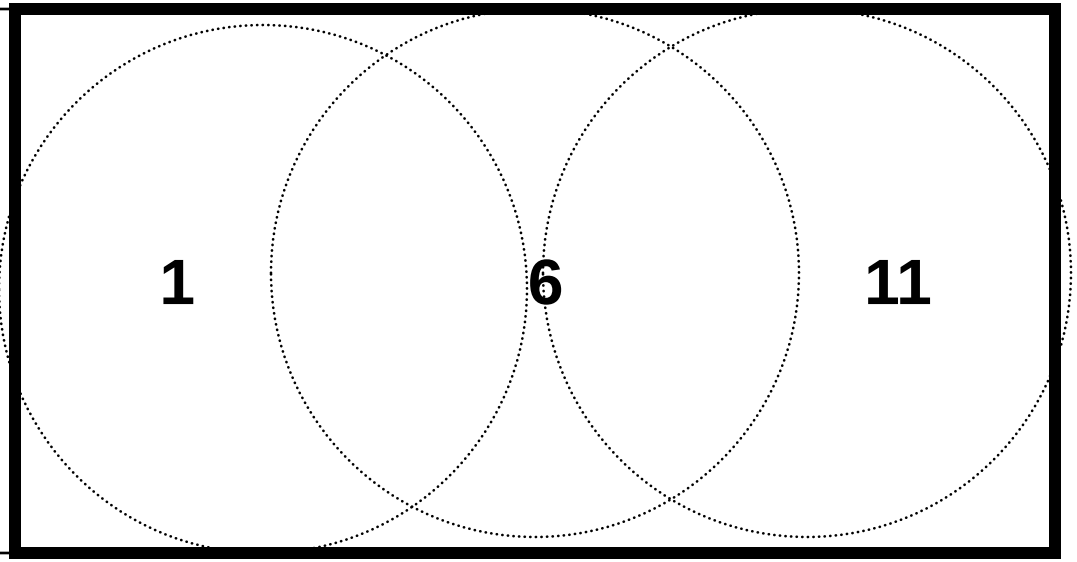
- 5 MHz Channel separation
- 22-MHz-wide stationary channels
- 3 nonoverlapping channels (1, 6, and 11)
- 3 APs can occupy same area - set at different frequencies

802.11b/g Channel Mapping Design

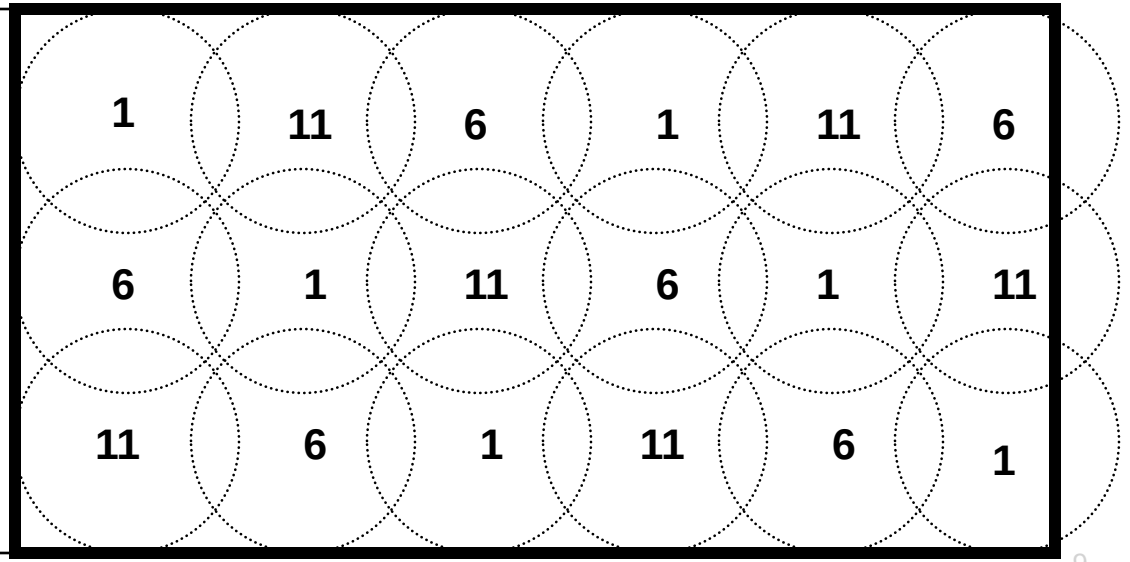


Increasing Capacity by Design

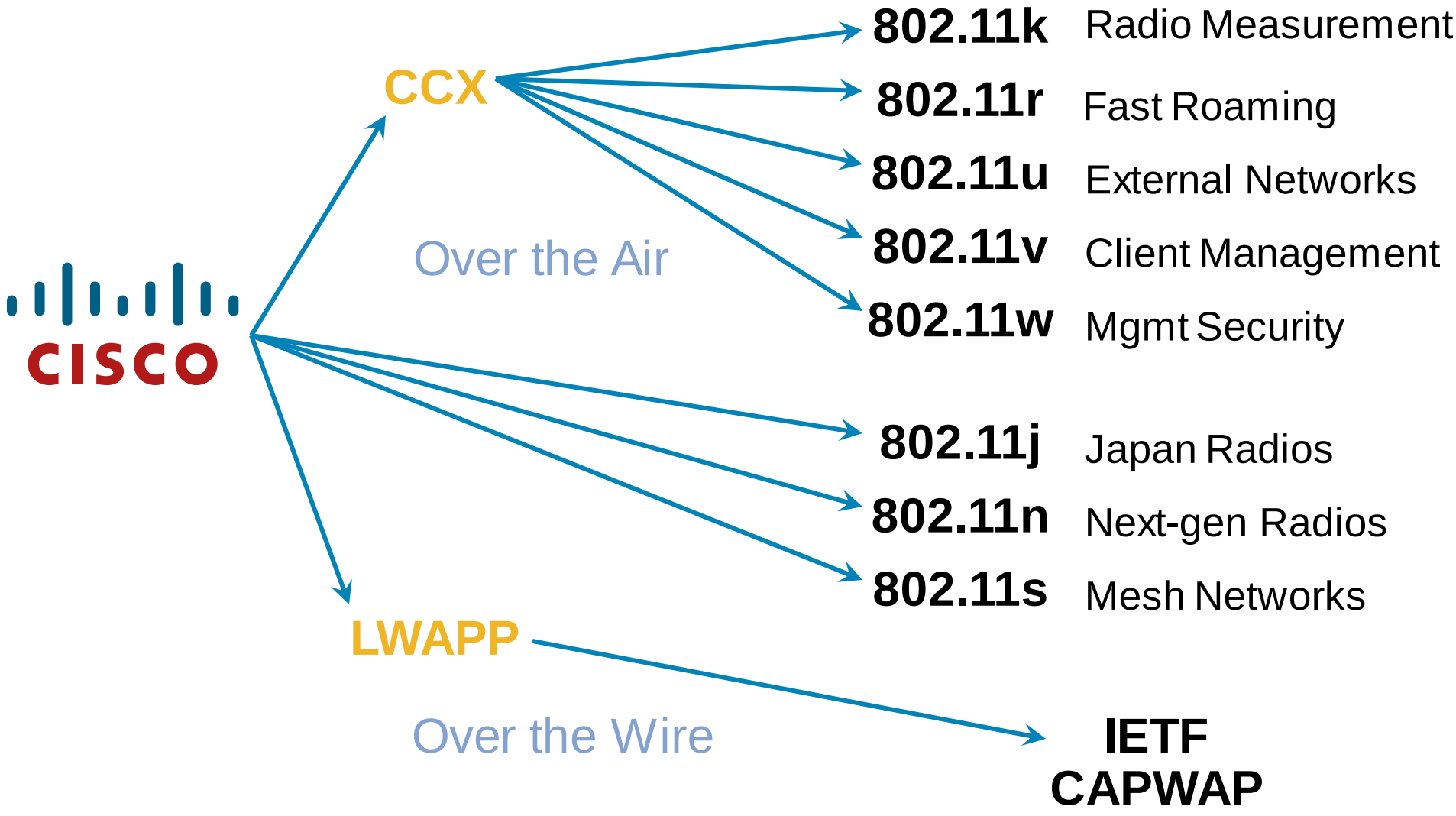
- 200 Users on the Floor
- Full Antenna Power: 30mW
- 3 Access Points
- 67 Users per AP of shared bandwidth



- 200 Users on the Floor
- Reduce Antenna power to 5mW
- 18 Access Points
- 11 Users per AP of shared bandwidth



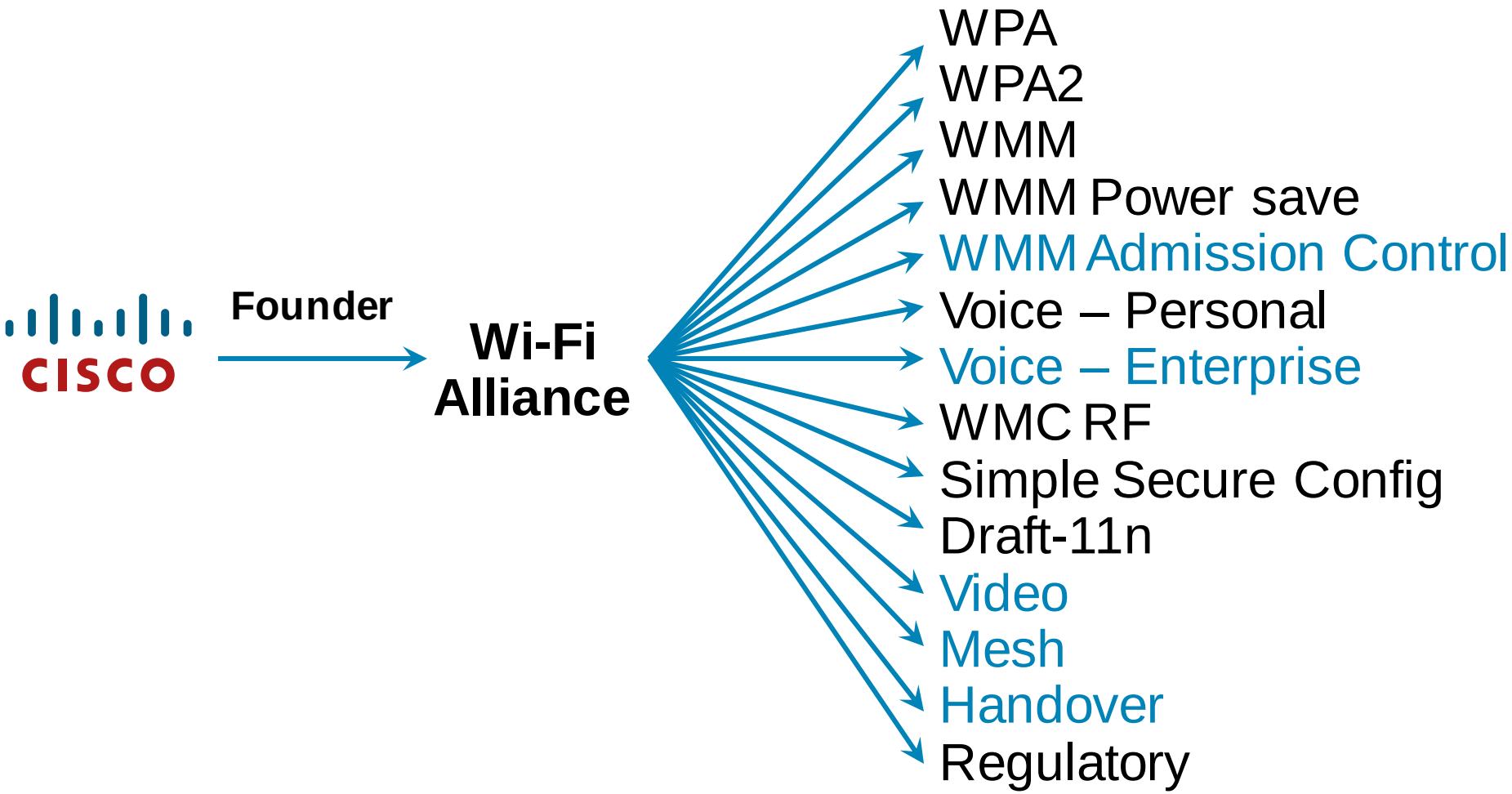
Cisco Drives Wireless Standards (IEEE)



802.11n – Standards
Higher Rates

- Extends both 802.11a and 802.11g
  - Both 2.4 GHz and 5 GHz
  - Up to 300 Mbps
- Entirely new radio using MIMO technology
  - Current radios use a single Tx and Rx, implement Rx diversity
  - 11n uses multiple Tx and Rx, simultaneously, combining multiple received signals to improve quality
- Draft-11n certification launched by WFA
  - Cisco is in WFA Draft-11n testbed

Cisco Drives Wireless Certification (WFA)

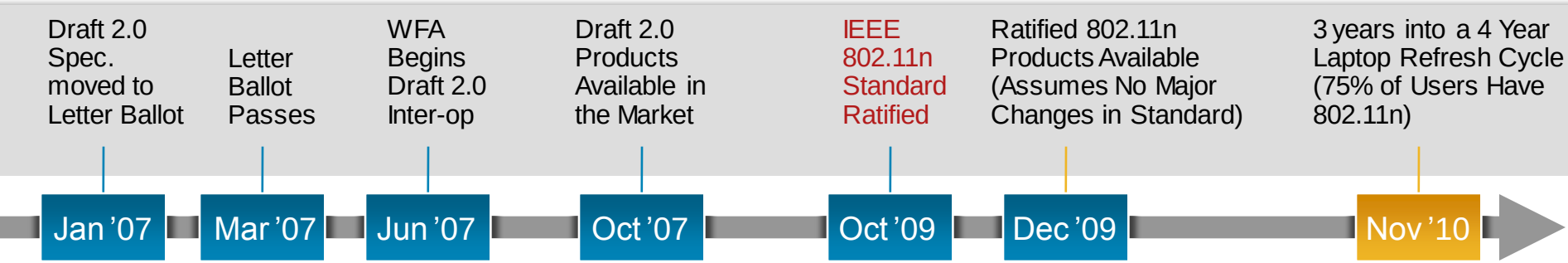


802.11n Overview

Welcome to the Human Network.

802.11n Standard Update

- **IEEE 802.11n standard is in final stages of development**
  - Major changes to the standard are not expected (base features are stable, a few optional features are changing)
  - Architectural and Security reviews completed
  - Expected official ratification date is October 09



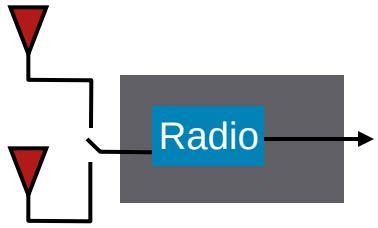
802.11n Closer Look

- Better end-user experience for high BW data.
  - Higher throughput for BW intensive applications (e.g. video)
  - More consistent, reliable coverage for applications requiring high QoS (e.g. voice)
- Backwards compatibility with 802.11a/g clients
  - A mix of 802.11a, 802.11b/g, and 802.11n (2.4 and 5 GHz) clients will co-exist for a long time
- Primary 802.11n Components

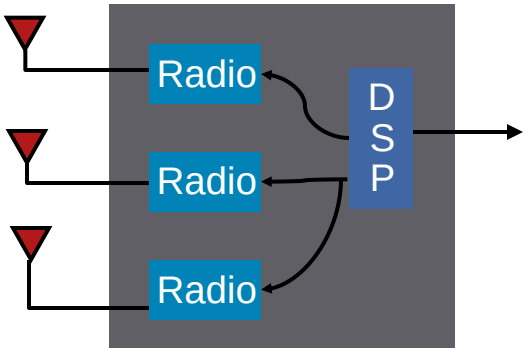
Multiple Input Multiple Output (MIMO) Radio Technology

- Spatial Multiplexing
- Beam Forming
- and Maximal Ratio Combining (MRC)

Comparing SISO & MIMO Signal Reception

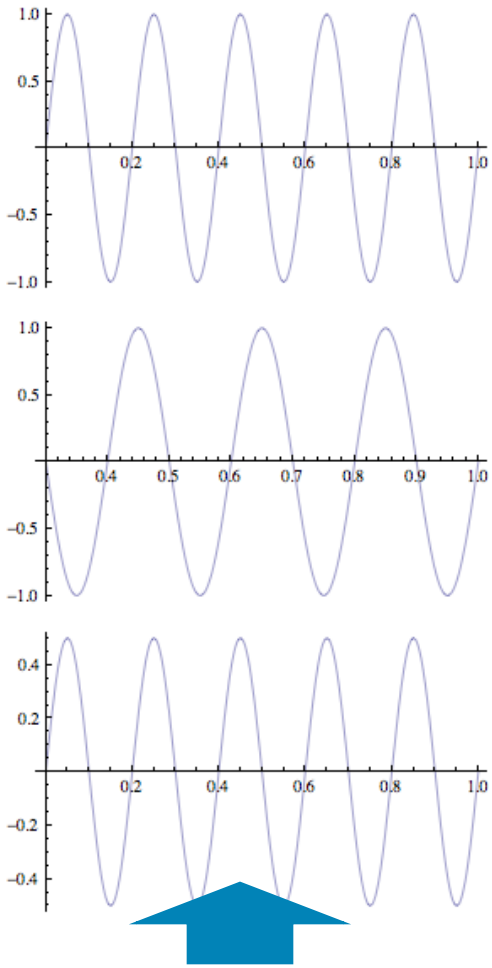


- One radio chain
- Radio "chooses" which diversity antenna to receive on
- Multipath degrades signal

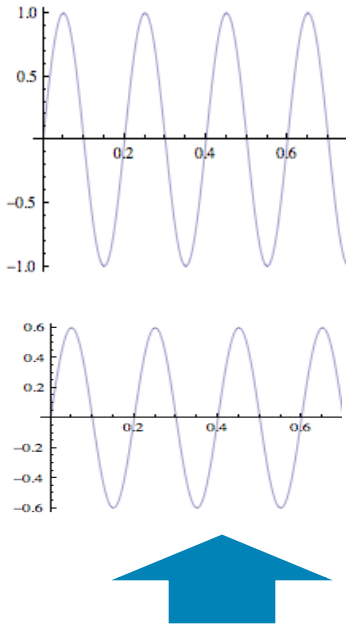


- Three radio chains
- Multipath improves signal
- Better immunity to noise
- Better SNR than SISO

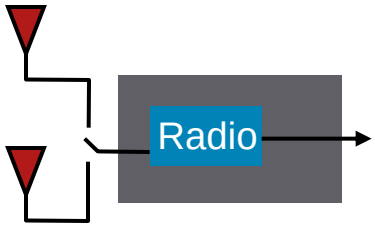
Illustration of 3 Multipath Reflections to SISO AP

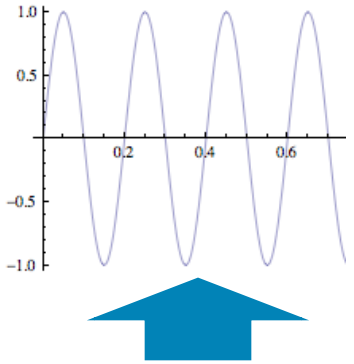


Multipath Reflections of Original Signal



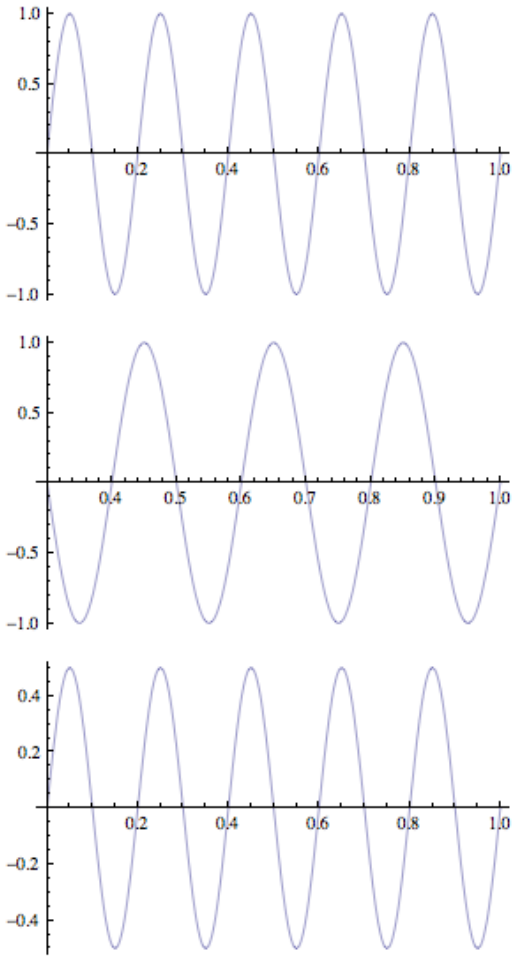
Signal Each Antenna Sees Due to Multipath Effect



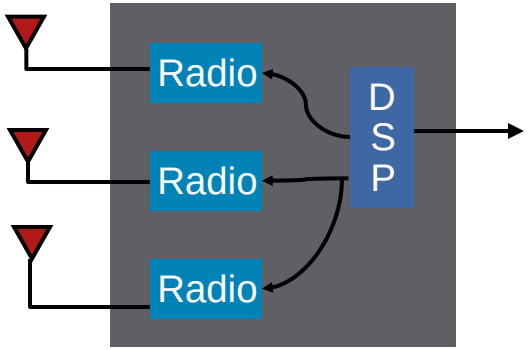


Radio Switches to Best Signal with Least Multipath Effect

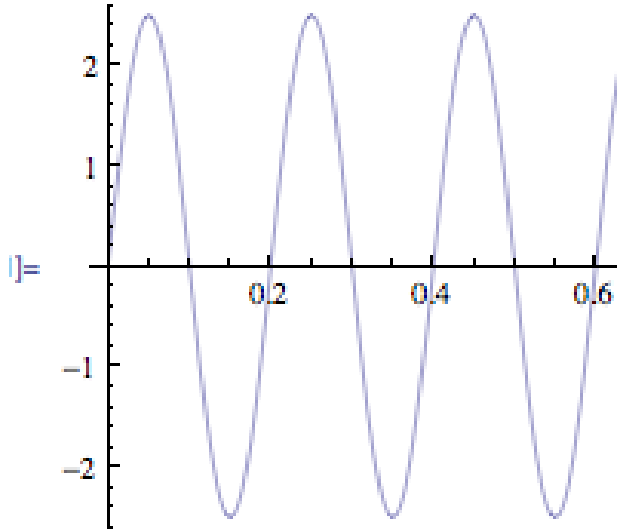
3 Multipath Reflections to MIMO AP with MRC



Multipath Reflections of Original Signal

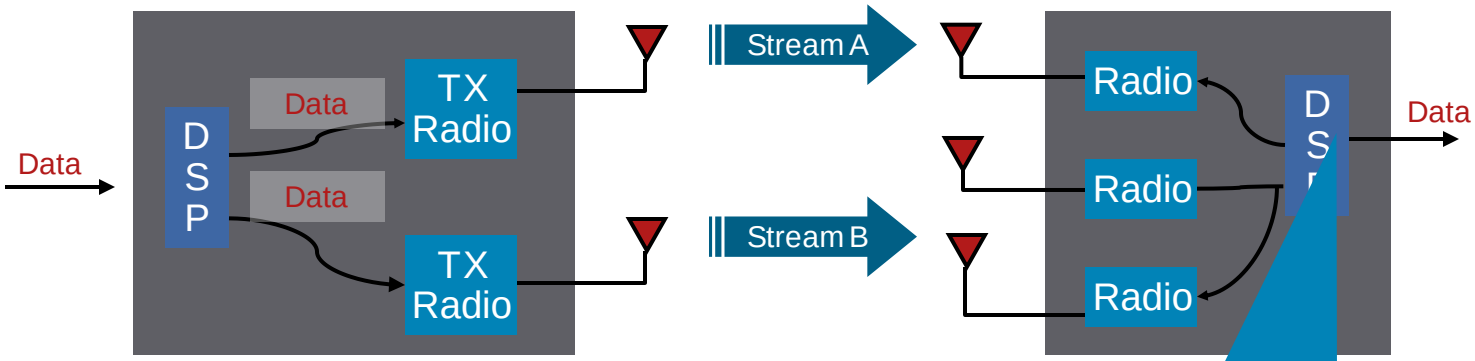


The DSP Adjusts the Received Signal Phase So They Can Be Added Together



The Resulting Signal Is Addition of Adjusted Receive Signals

More Efficient Spectrum Utilization with MIMO Spatial Multiplexing

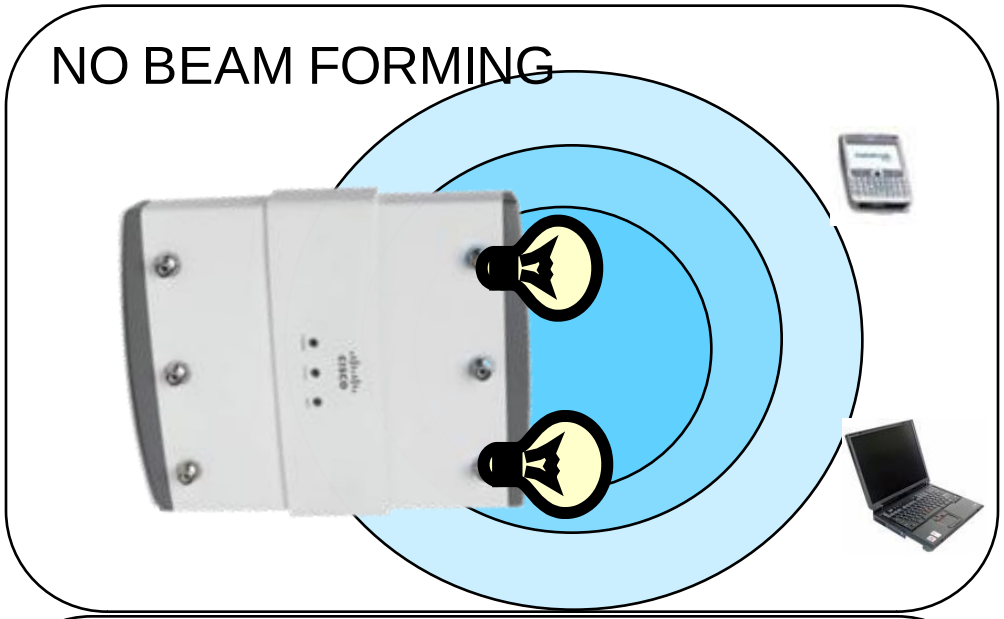


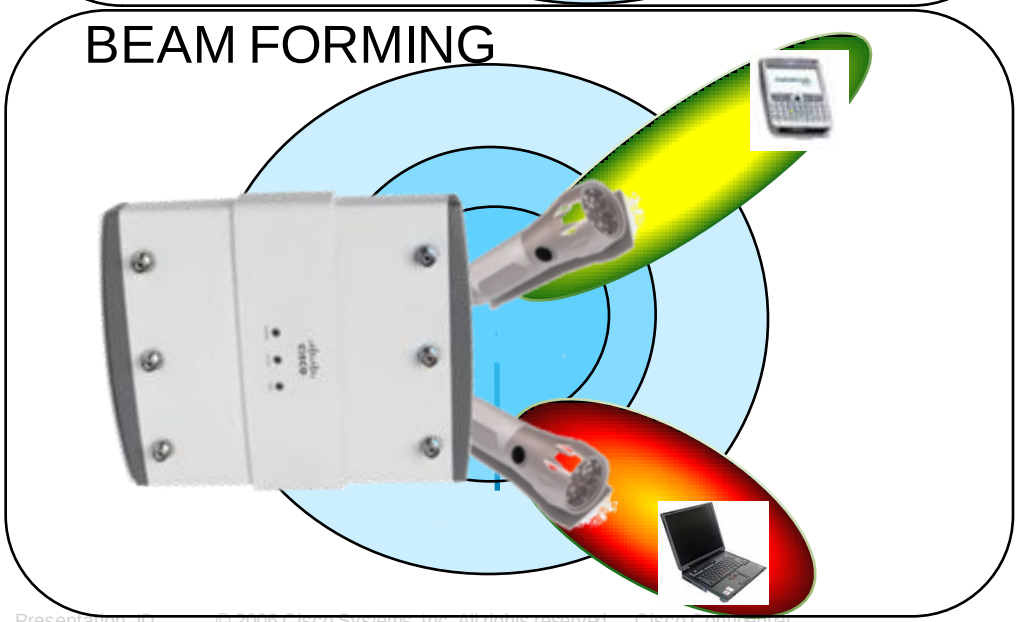
- The data is broken into two streams transmitted by two transmitters

I Can Recognize the Two Streams Transmitted at the Same Frequency Since the Transmitters Have Spatial Separation

Using My Three RX Antennas with My Multipath and Math Skills

Beam Forming





What is Beam Forming ?

Signals from 2 transmit antennas are focused on 1 client:

- Increased range of higher throughput data-rates
- Increased coverage reduces blind spots

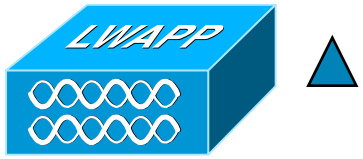
Who will benefit ?

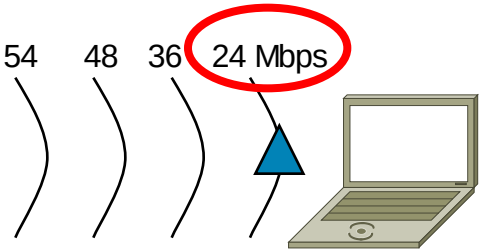
- All 802.11a/g clients download data faster
- Enhanced reliably at longer range
- Improved system performance

MIMO Increases PHY Data Rates for all clients

- ☒ Maximal Ratio Combining (MRC)
- ☒ Beamforming
- ☒ Spatial Multiplexing

802.11a/g AP (non-MIMO)

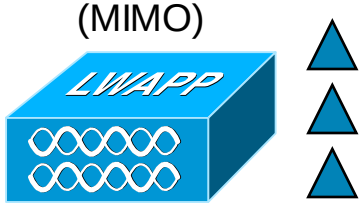


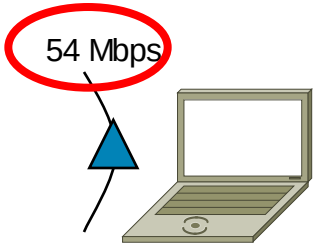


802.11a/g client (non-MIMO)

- ☑ Maximal Ratio Combining (MRC)
- ☑ Beamforming
- ☒ Spatial Multiplexing

802.11n AP (MIMO)

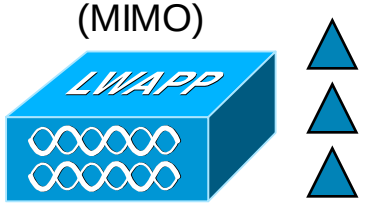


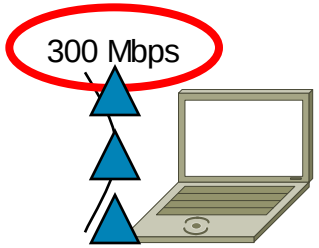


802.11a/g client (non-MIMO)

- ☑ Maximal Ratio Combining (MRC)
- ☑ Beamforming
- ☑ Spatial Multiplexing

802.11n AP (MIMO)

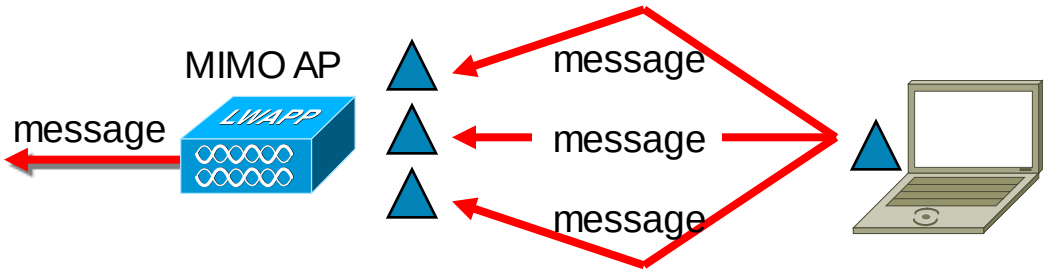




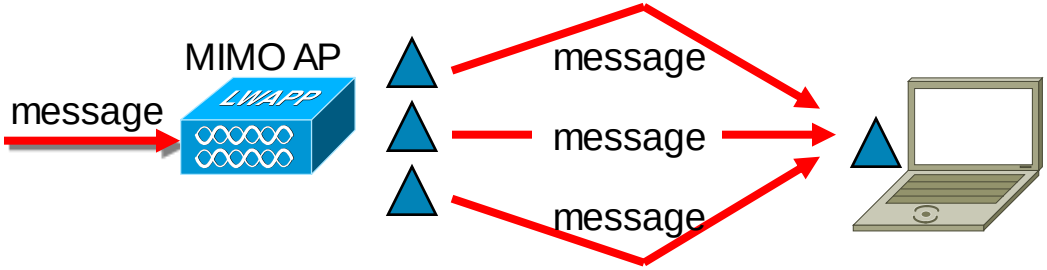
802.11n client (MIMO)

MIMO Summary

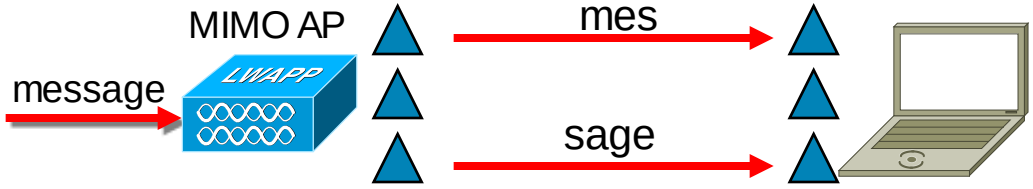
Maximal Ratio Combining
- Performed by receiver
- Combines multiple received signals
- Increases receive sensitivity
- Works with non-MIMO and MIMO clients



Transmit beam forming
- Performed by transmitter
- Ensures signal received in phase
- Increases receive sensitivity
- Works with non-MIMO and MIMO clients



Spatial Multiplexing
- Transmitter and receiver participate
- Multiple antennas txmt concurrently on same channel
- Increases bandwidth
- Requires MIMO client



1140/ 1250 and M-Drive Technology

Welcome to the Human Network.

Cisco Aironet 1140 AP

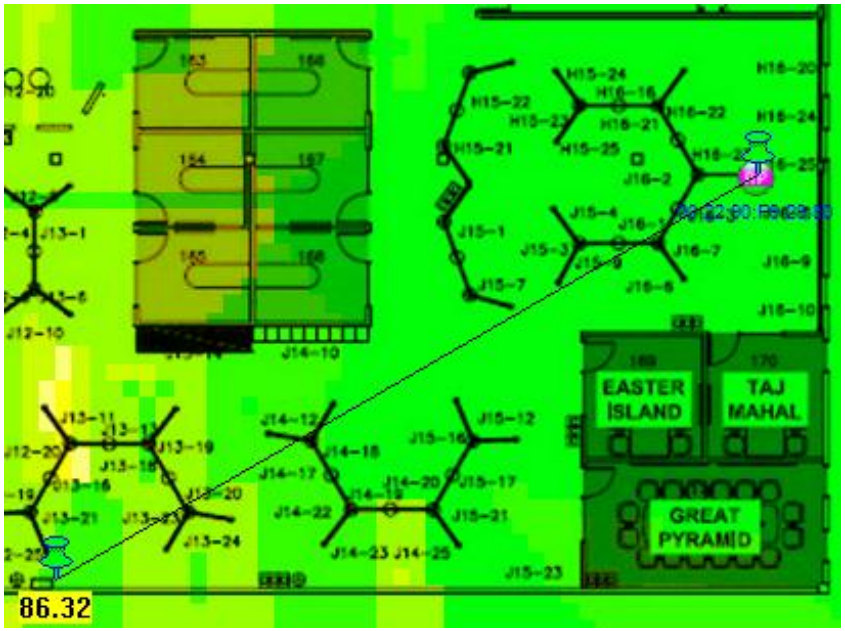
- **1140 Series Takes 802.11n Mainstream**
  - Guaranteed Interoperability – Tested/Validated
  - Built on the most widely deployed enterprise 802.11n technology in the industry
  - Backwards compatible with A/B/G
- **Simple Deployment/Energy Efficient**
  - Sleek design with integrated antennas
  - High performance energy efficient 802.3af power
  - 10 AP Eco-pack—efficient, easy, eco-friendly
- **RF Excellence**
  - Cisco M-Drive technology is a system-wide approach that manages corporate spectrum; improves wireless coverage, and increases system capacity and performance

6X performance of A/G

abg WiFi n DRAFT CERTIFIED®

BF, MRC; Improved Coverage

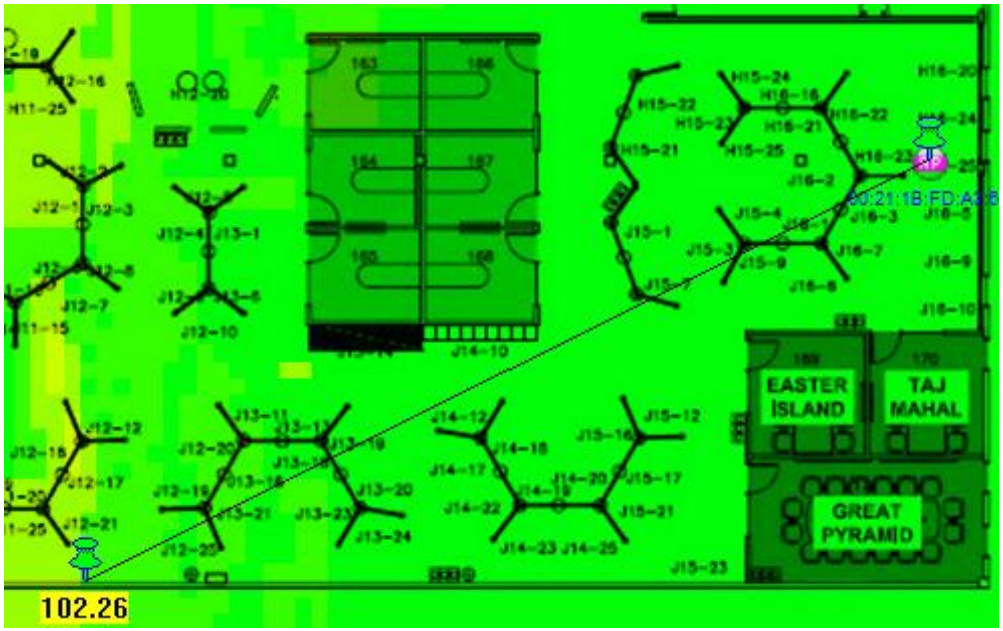
1130 vs. 1140 Active Survey



1130 Survey

48 Mbps Coverage

86 Feet



1140 Survey

48 Mbps Coverage

102 Feet

18% Increase in 802.11g Coverage

Cisco Aironet AP1250

- The Aironet AP1250 is the industry's first enterprise 802.11n upgradeable access point
  - Initial release supports 802.11a and 802.11g MIMO radio modules with smart antenna capabilities
  - Designed to support future 802.11n radio modules
- Modular platform
  - Ruggedized design
  - Field upgradeable radio modules
  - Flexible powering options
- Base chassis supports higher speed WLAN technologies
  - Faster CPU to handle higher data throughput
  - 10/100/1000 Ethernet port for high capacity uplink
  - Larger power supply to handle greater power requirements
  - Increased memory for expanded feature set

Cisco Next-Generation Wireless APs

- Cisco Aironet 1140 Series
  - Carpeted Indoor Environments
  - Easy to Deploy-Sleek design with integrated antennas
  - 802.11n performance with efficient 802.3af power
  - Blends seamlessly into the environment

- Cisco Aironet 1250 Series
  - Rugged Indoor Environments
  - Versatile RF coverage with external antennas
  - Modular flexible platform
  - Flexible power options for optimal RF coverage

Cisco Unified Wireless NW with M-Drive Technology

- RRM – continuously monitors, adjusts AP power, channel settings to help mitigate co-channel interference and signal coverage problems.
- Beam Forming – reduces coverage holes for 802.11a/g and 802.11n clients.
- Tools – Helps IT build and operate a WLAN without the need for extensive RF engineering skills.
- CleanAir Technology— Cisco offers a spectrum intelligence solution to detect, classify, locate and mitigate Wi-Fi and non-Wi-Fi interference:

  Bluetooth, microwave ovens, cordless phones and more.

Cisco Outdoor Wireless Mobility Solution

Welcome to the Human Network.

Cisco Mobility Services

Security

- Automatic, 24 x 7 security and compliance monitoring for wireless breaches
- Network access control based on user location
- Monitor device movement

Guest

- Guest networks for customers, partners and auditors
- Vendor replenishment networks
- Public access networks

Voice

- Real-time mobile voice communications
- Improved collaboration via mobile unified communications
- Faster customer service response

Location

- Asset tracking and management
- Location based security and content distribution
- Streamlined workflows
- Business policy enforcement

Real-Time Mobile Data Services

Wirelessly Extending Resources to Individuals Irrespective of Time or Location

Wireless Whenever You Need It, Wherever You Are Needed

The Cisco Outdoor Wireless Network Extends the Cisco Unified Wireless Network to Any Environment Where Traditional Wi-Fi Networks Cannot be Deployed

Outdoor Wireless Coverage Challenges

Dynamic outdoor environments with changing RF obstacles and interferences

Need for connectivity in difficult environmental conditions and remote areas

Cabling across Wireless LAN is not practical (regulations or interferes with aesthetics)

Benefits of Mesh Product

Integrated intelligent RF monitoring for dynamic, adaptive optimized wireless coverage

Designed to withstand difficult conditions with environmental specifications and business requirements

Provides effective coverage for large and remote or hard to reach areas without wiring for every AP (wireless backhaul)

What Does the Cisco Outdoor Wireless Solution Provide?

- **Complete Indoor and Outdoor Networking Solution**

  Part of the Unified Wireless Network for a complete end-to-end wireless solution for the mobile workforce

- **Scalable Mesh Architecture**

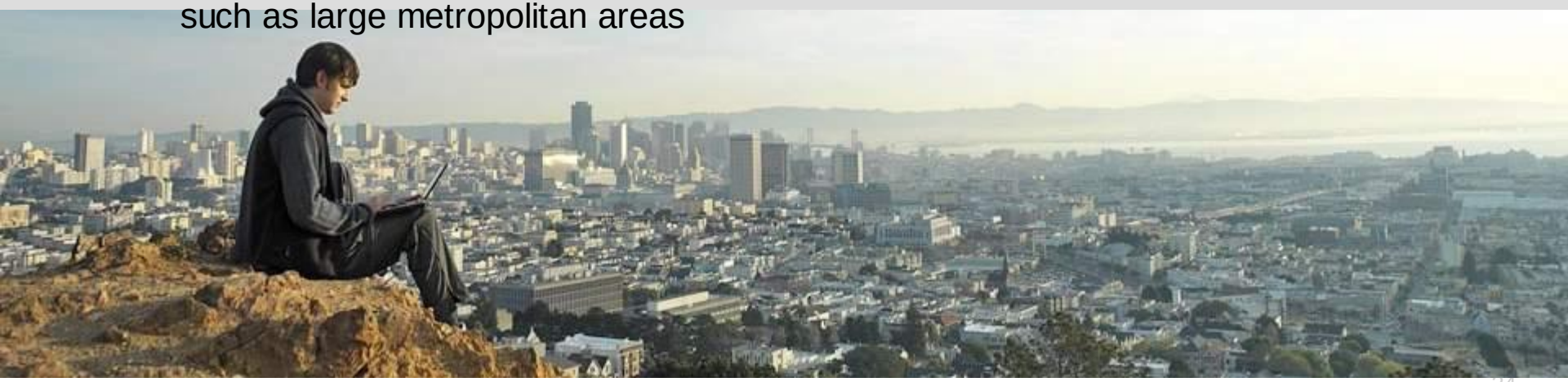
  Designed to scale to various size networks from campus deployments to extensive outdoor environment such as large metropolitan areas

- **Mobility Services and Applications**

  Designed to support robust integrated security services, guest network (public access) and vertically-focused applications

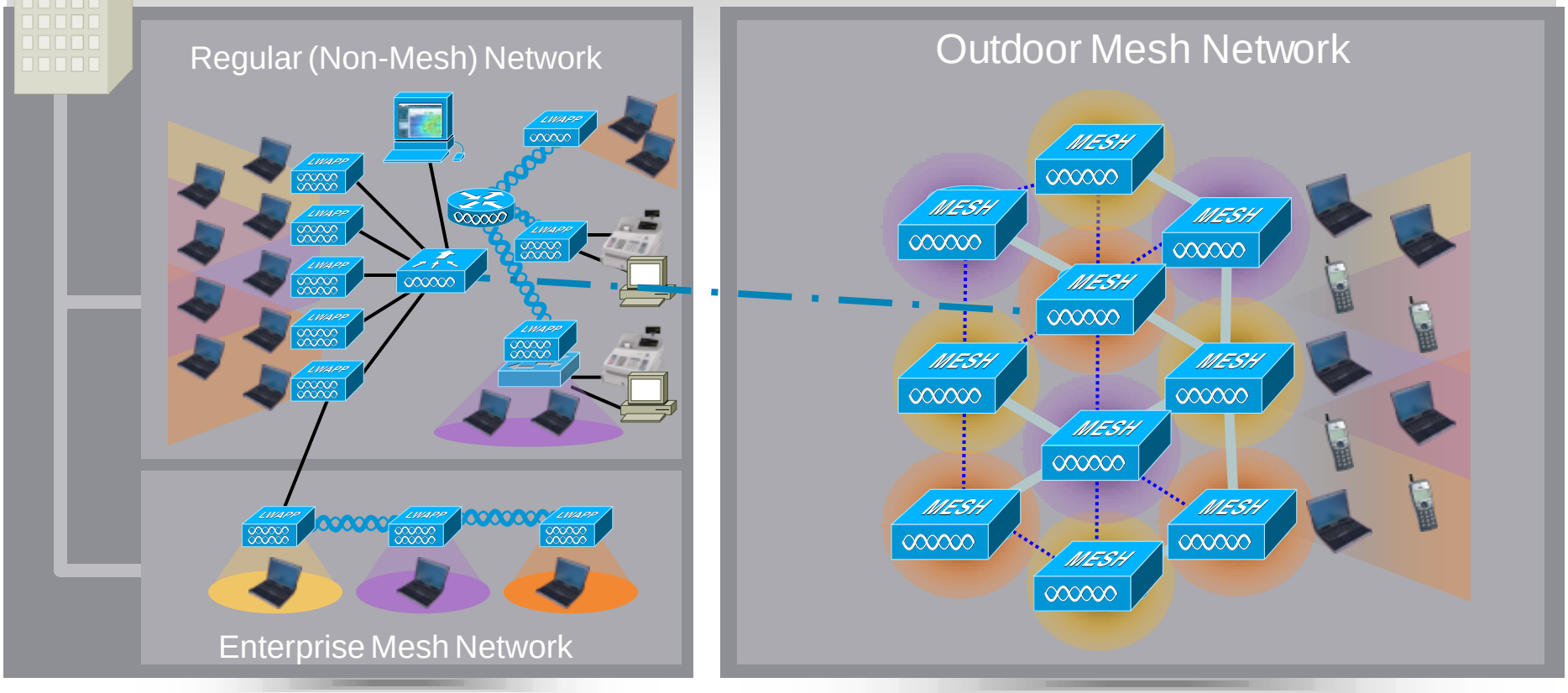
- **secure wireless solutions**

Prevent unauthorized Wireless connection

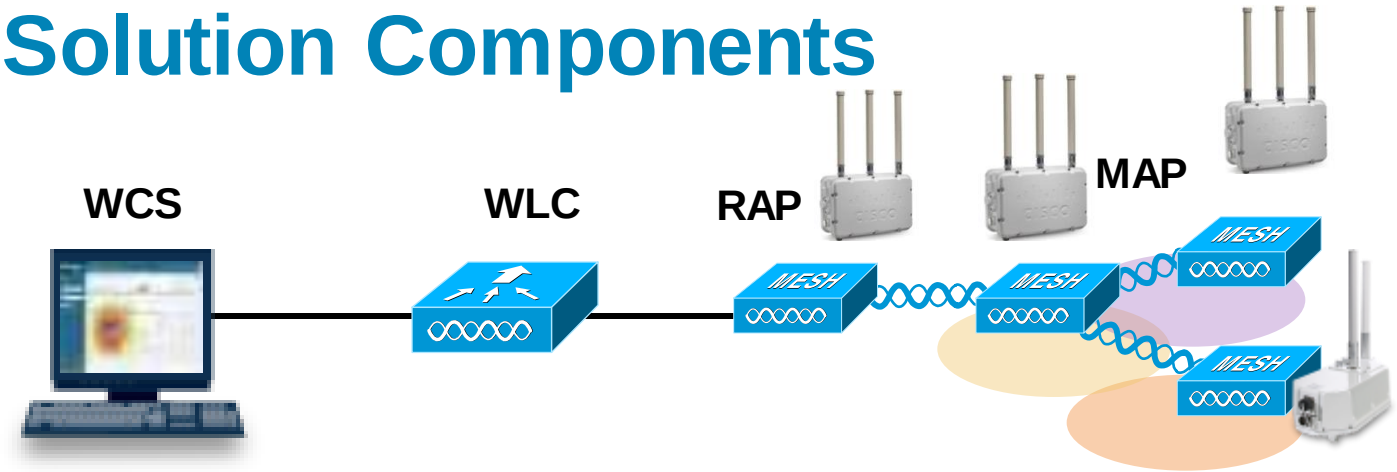


Wireless Connectivity Indoor Outdoor

- Extend wireless coverage from the indoors to the outdoors
- Integrate Wi-Fi with indoor and outdoor mesh
- A wireless solution for each environment



Outdoor Wireless Mesh Solution Components



Wireless Control System (WCS)

- Wireless Mesh Management System enables network-wide policy configuration and device management
- SNMPv3, Syslog, IPSec, AAA, etc.

Wireless LAN Controller

- Handles RF algorithms and optimization
- Seamless L3 Mobility
- Security and Mobility control
- Image Management

Root Access Point

- Serves as “Root” AP to the wired network
- Typically located on roof-tops or towers
- Connects up to 35 Mesh APs using 802.11a

Mesh Access Point

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

Industry-Proven Devices at Every Layer

1520 Mesh APs for the Most Challenging Environments

- Wind Loads
  - Sustained Winds: 100 mph
  - Wind Gusts: 165 mph
- Environmental Ratings
  - IP67 and NEMA4X
  - –40 to +55°C (–40 to +131°F) plus Solar Loading
  - Humidity 0 ~100%
- Safety
  - UL/EN/IEC 60950
  - CAN/CSA-C.22No 60950
- Radio Approvals (FCC Part 15.247, 90.210)
- EMI and Susceptibility (FCC Part 15.107, 15.109)
- Federal Compliance (FIPS 140-2)

Indoor / Outdoor with Single Controller

Managing Indoor and Outdoor Mesh Wireless Network

Cisco WCS

- Seamless roaming across indoors and outdoors

Single Controller

RAP/MAP:
1522 & 1524

RAP

iMesh

MAP

LWAPP

LWAPP

Network Connectivity

MAP1

RAP1

MAP3

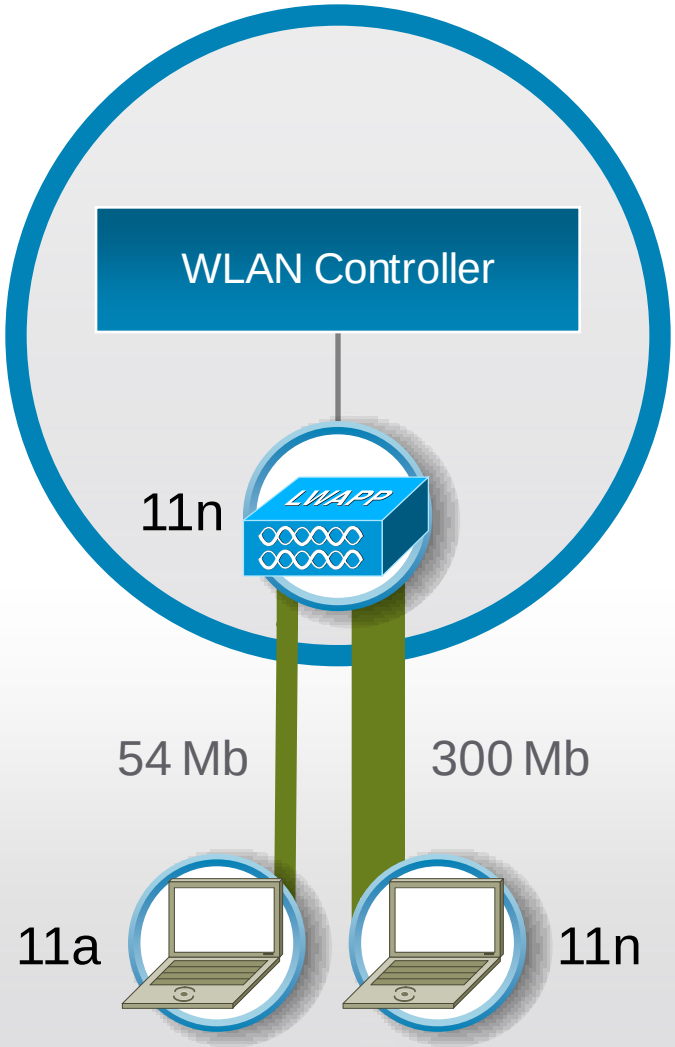
MAP2

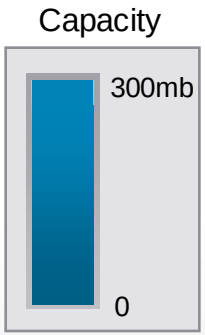
Indoor AP:
Mesh & Non Mesh AP's

Indoor Wireless Network (Mesh & Non Mesh)

Outdoor Wireless Mesh Network

Mixed Mode Performance





- 3 Modes of operation supported
  - Legacy
  - Green Field
  - Mixed
- Mixed mode experiences slight performance impact due to ABG clients
- 11n clients still transmit at full performance
- PHY and MAC for 11n provides co-existence and protection for ABG clients