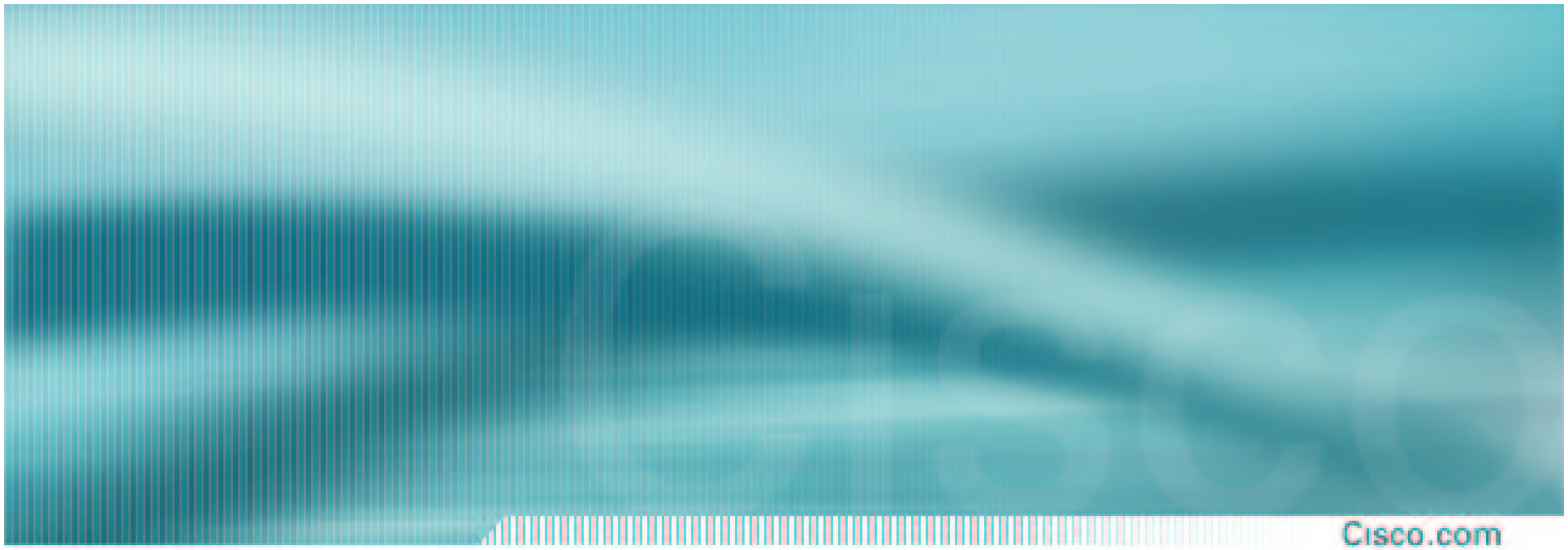


Wireless LANs: Secure Ethernet Access Anywhere, Anytime

Eric Holstein, CCIE #6002

Systems Engineer, Cisco Systems

(eholstei@cisco.com)

Confusion in the Market About Wireless

WECA

3G

WAP

HiperLAN 2

RangeLAN2

802.11

GPRS

1xRTT

2G

OpenAIR

802.11b

Bluetooth

HomeRF

Wi-Fi

802.11a

UMTS

HyperLAN

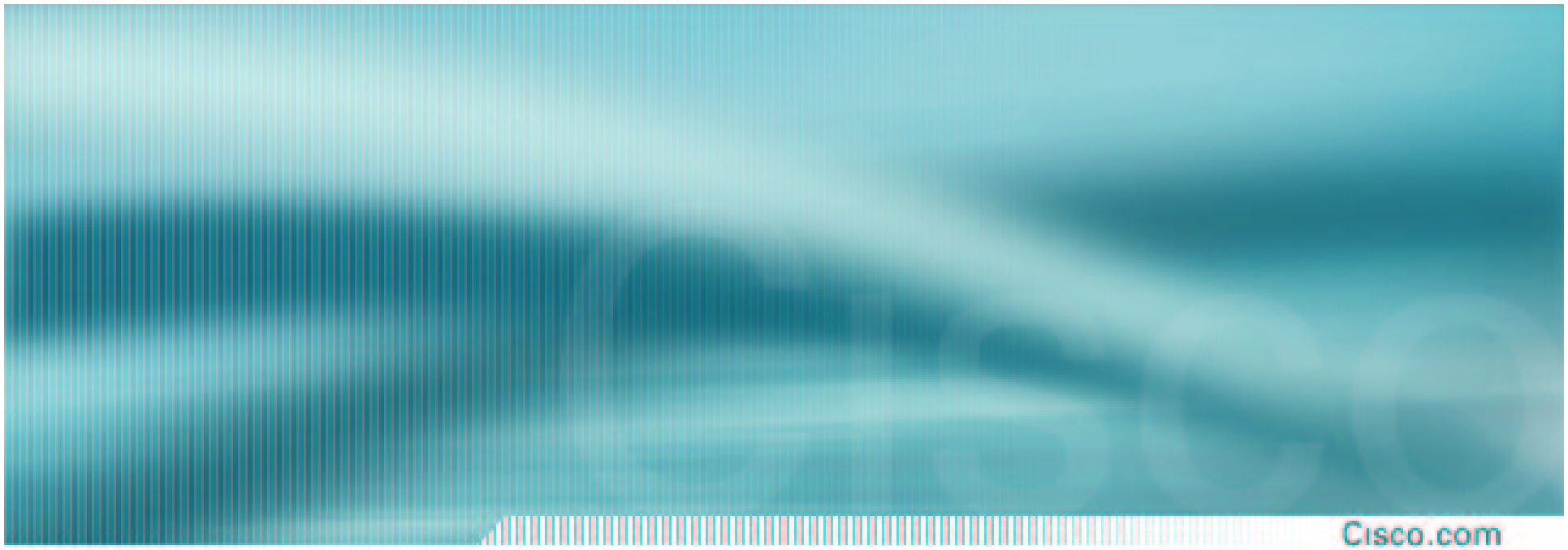
2.5G

xML

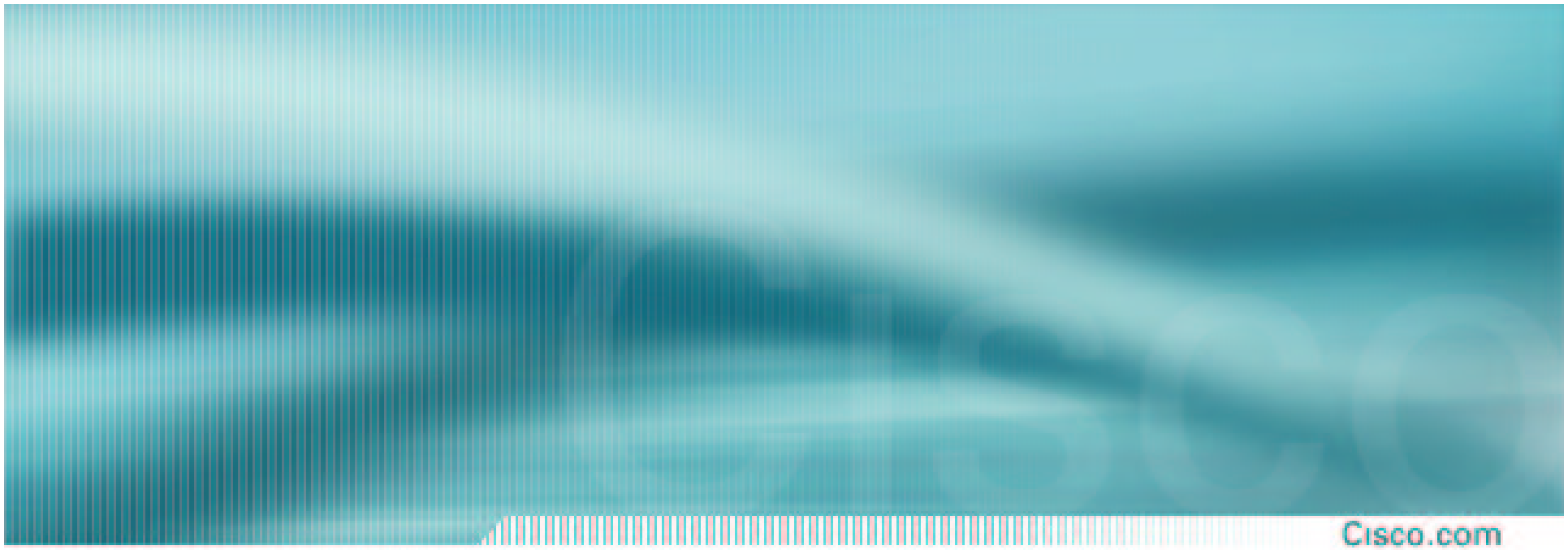
Agenda

- Introduction to WLANs
- Wireless Security: 802.11i, .1x
- Future of Wireless LANs:

  (Alphabet Soup: 802.11a,b,g,l …)



Introduction to Wireless

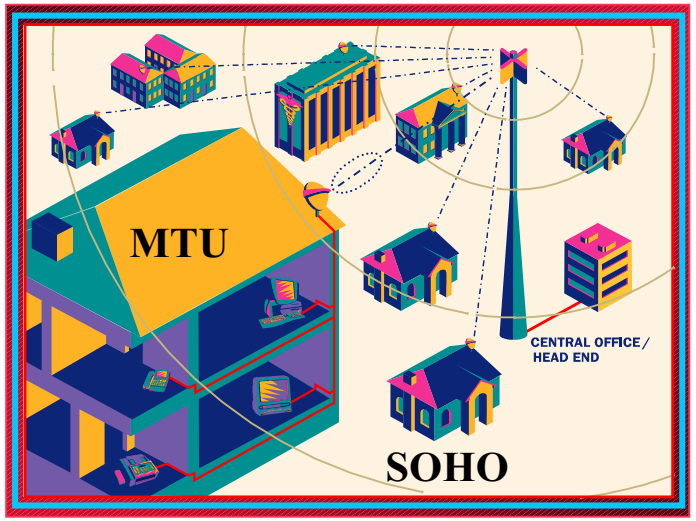


Radio Frequency Overview

US Unlicensed Spectrum Overview

- Various unlicensed frequency bands
- Mobile—low data rate
- Fixed—high data rate

- Spread spectrum
- Residential, SOHO, and small/medium business
- Multi-sectored node sites
- Up to 6 miles in multipoint, 15 miles in point-to-point



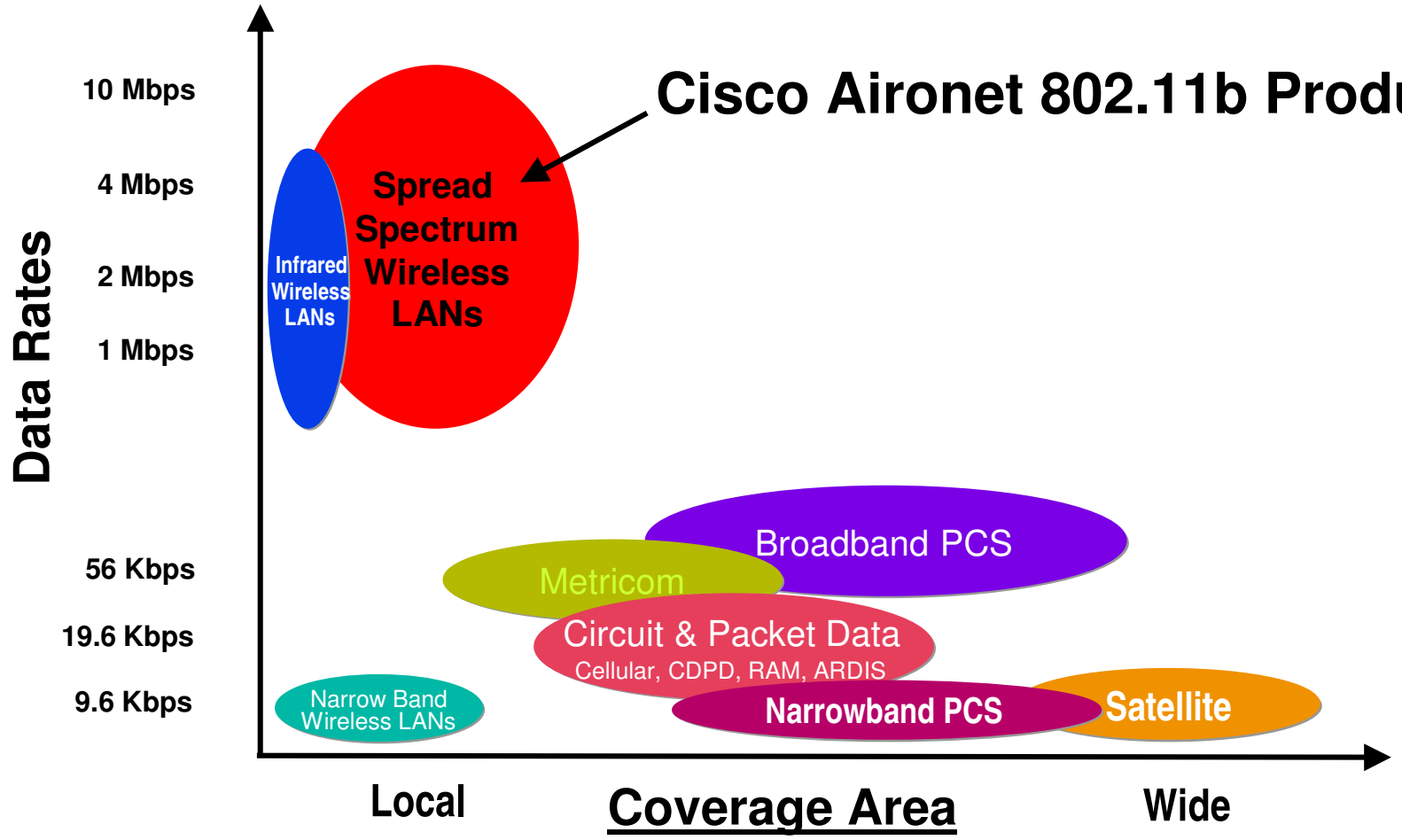
900 MHz — 26 MHz Channel, Ricochet

2.4 GHz — 83.5 MHz Channel, 802.11x WLAN

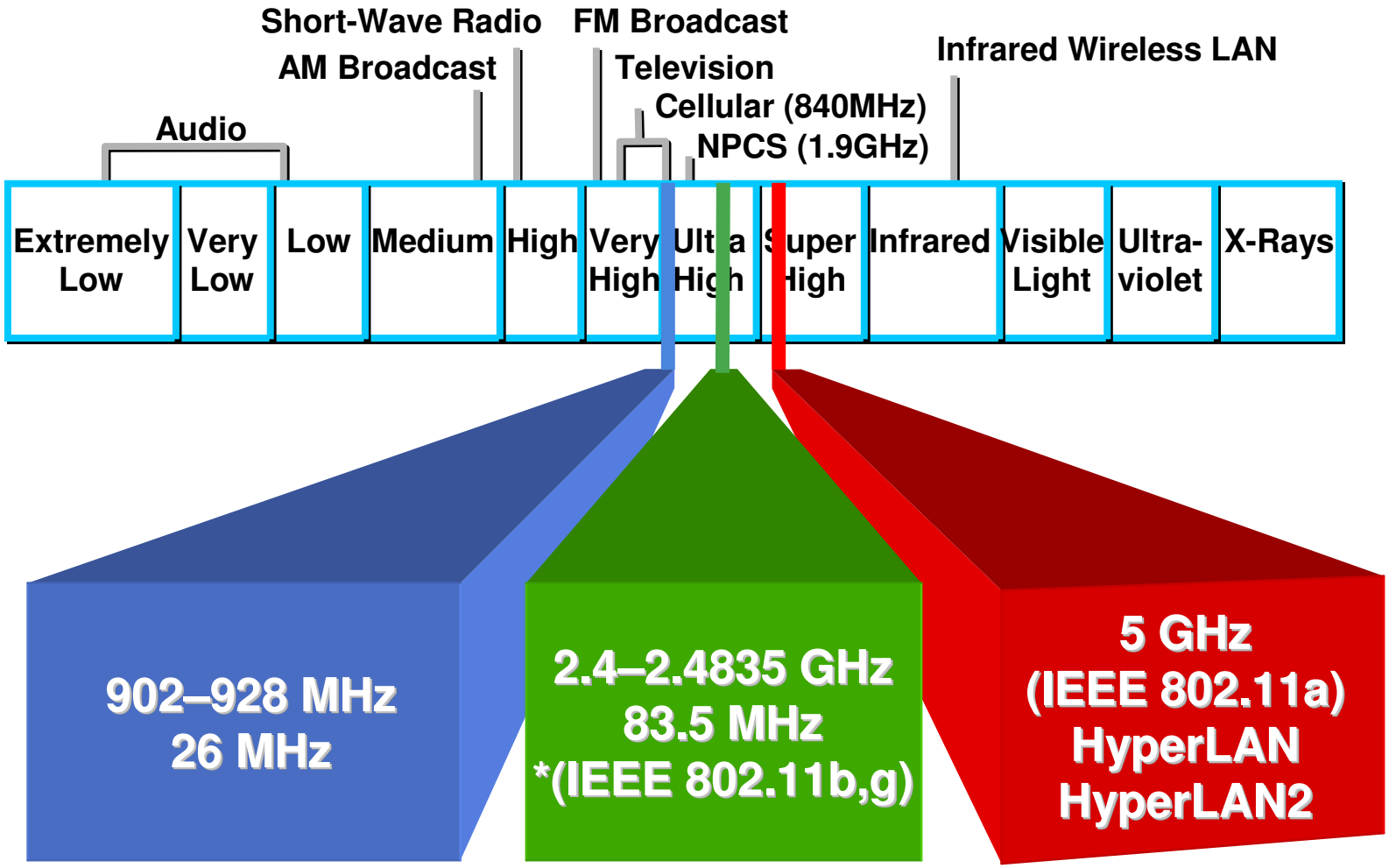
U-NII

- **5.1-5.35 GHz** — 200 MHz Channel, Next Generation WLAN
- **5.7 GHz** — 100 MHz Channel, Broadband Wireless

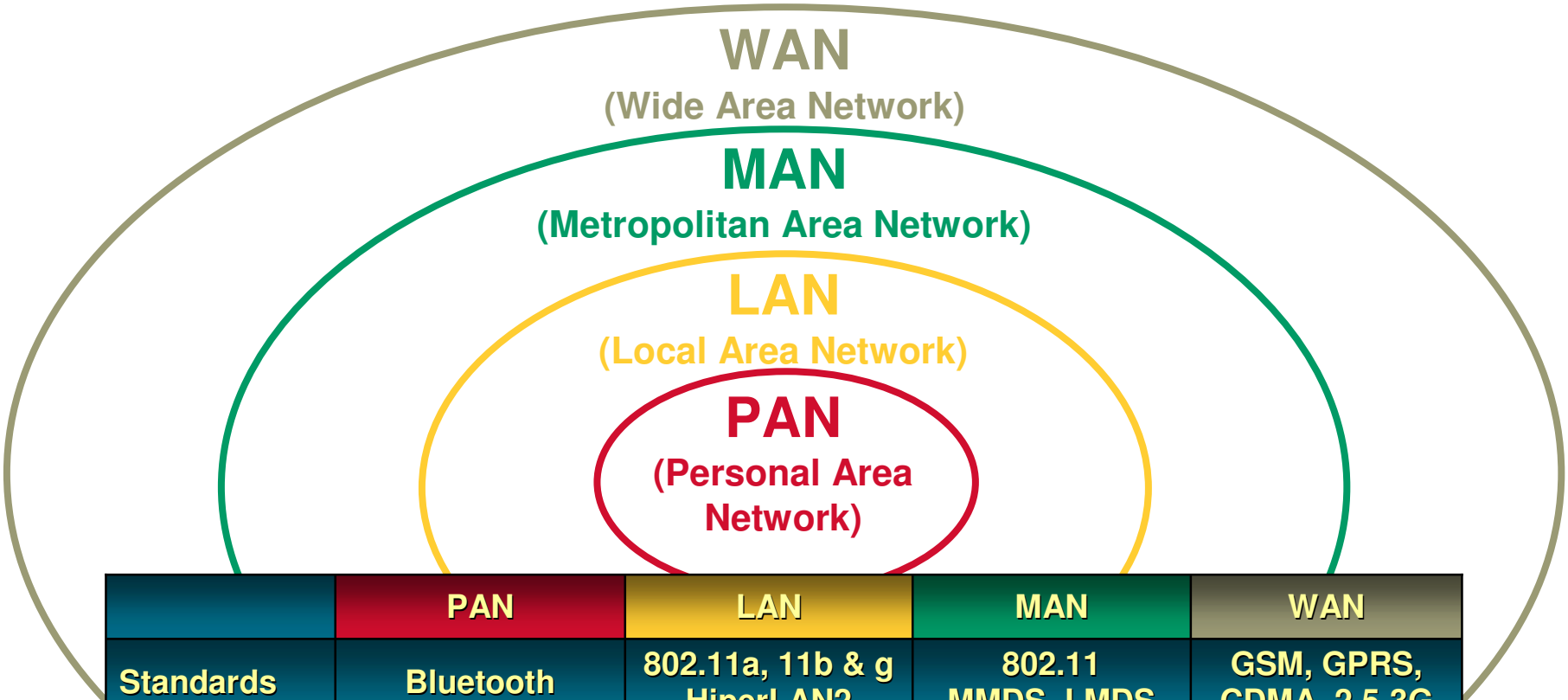
Where Does 802.11b Fit?



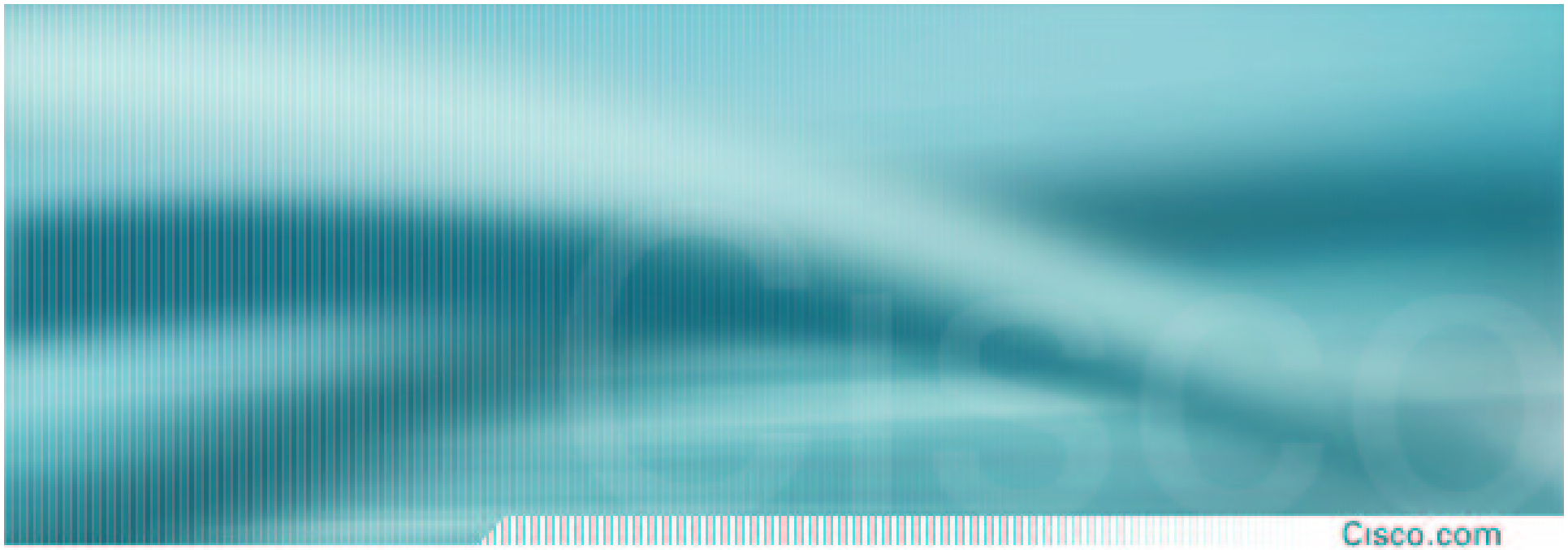
ISM Unlicensed Frequency Bands



Wireless Technologies



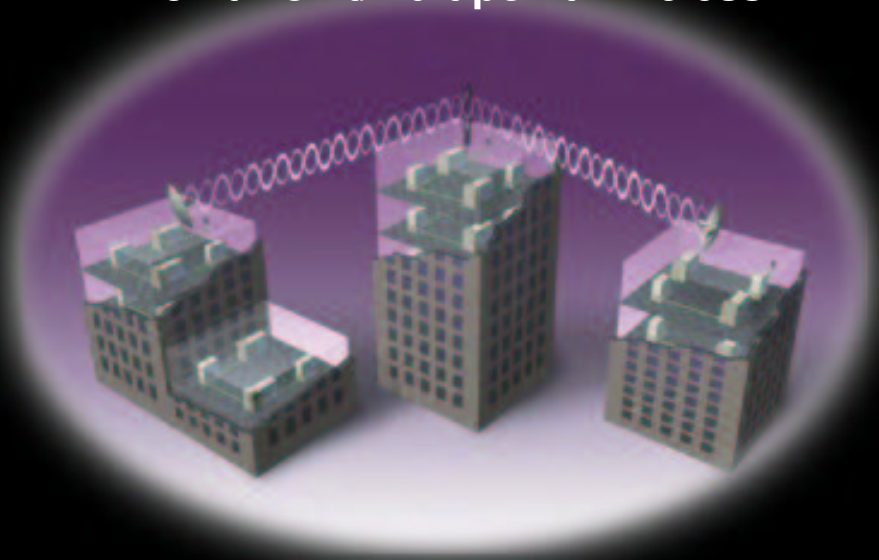
	PAN	LAN	MAN	WAN
Standards	Bluetooth	802.11a, 11b & g HiperLAN2	802.11 MMDS, LMDS	GSM, GPRS, CDMA, 2.5-3G
Speed	< 1 Mbps	2 to 54+ Mbps	22+ Mbps	10 to 384 Kbps
Range	Short	Medium	Medium-Long	Long
Applications	Peer-to-Peer Device-to-Device	Enterprise networks	Fixed, last mile access	PDAs, Mobile Phones, cellular access



Wireless LANs

Cisco's Wireless Initiatives

Point-Point/Multipoint Wireless

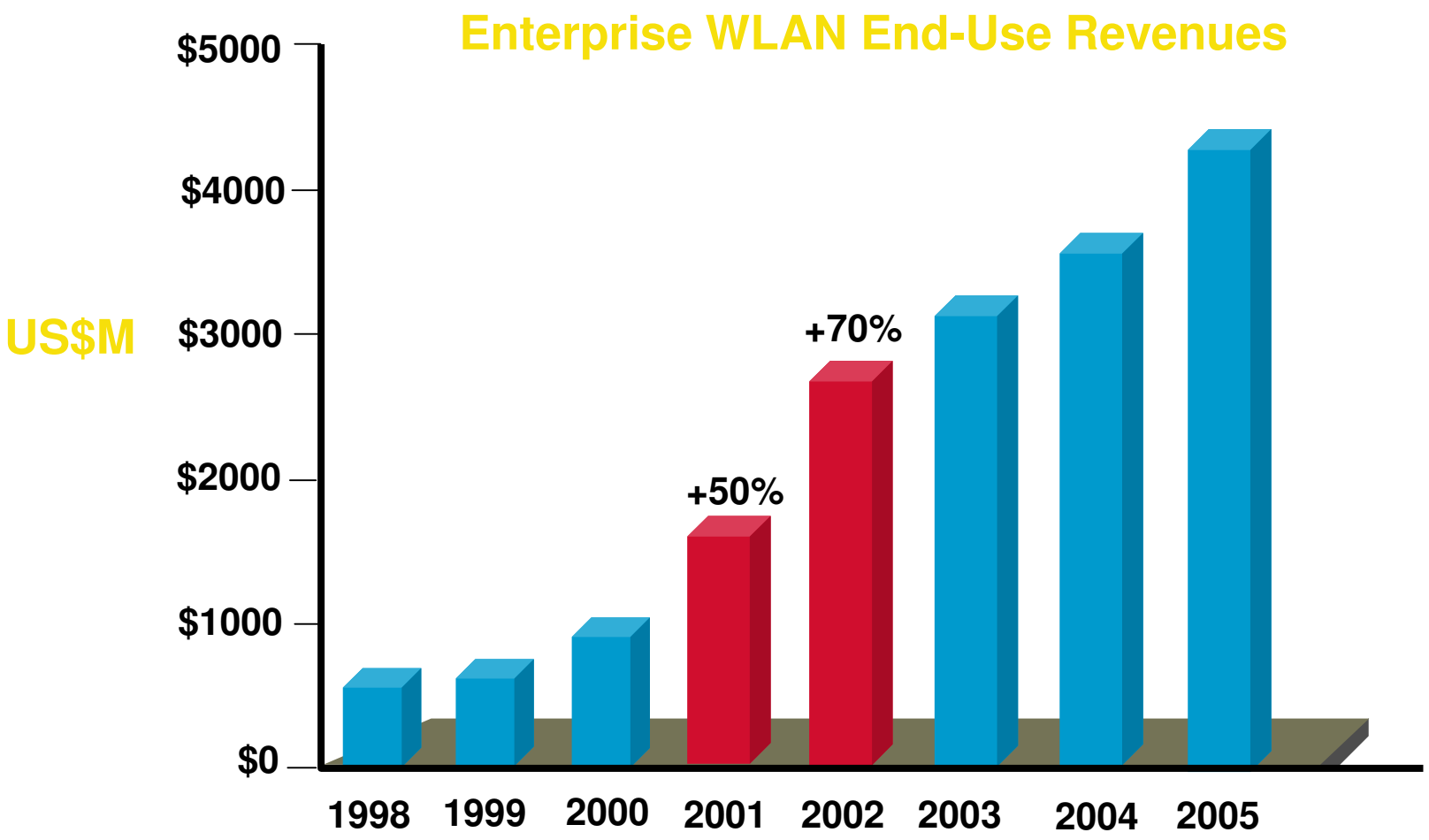


Wireless LAN

Wireless Local Loop

Telecommuter

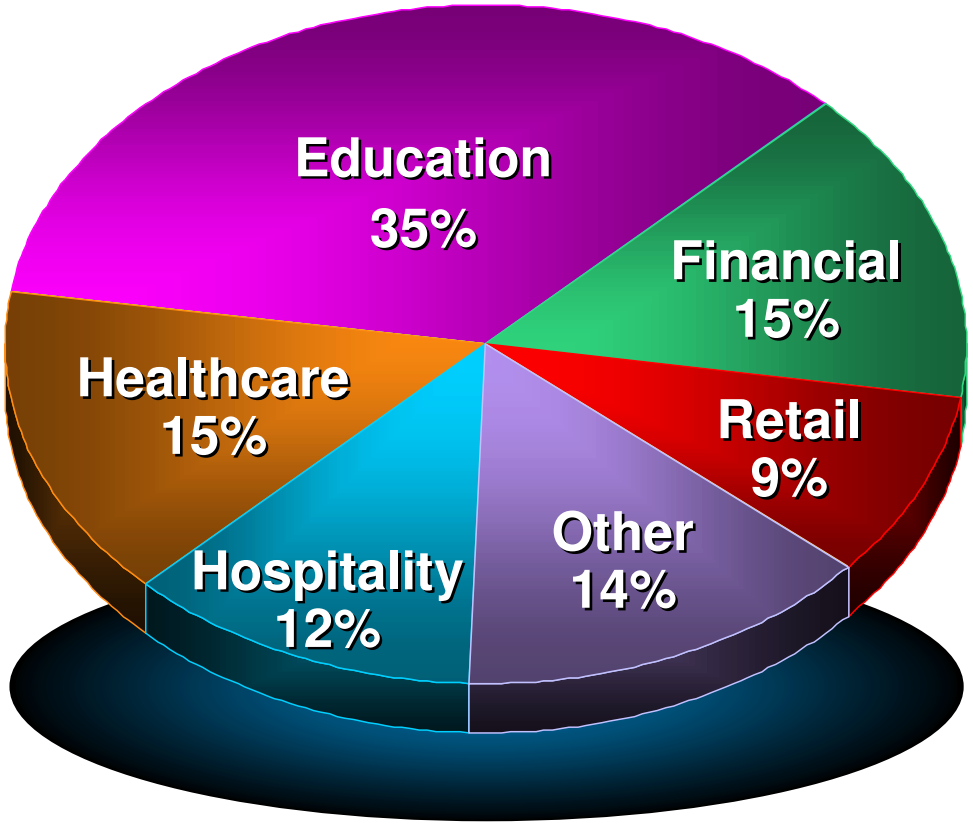
WLAN is Taking Off



Source: Cahners In-Stat Group, 2001

Key Verticals Adopting Wireless

Wi-Fi Shipment Forecast for 2001



Source: Cahner's In-Stat Group 2001

High-Speed Access Everywhere You Are

Cisco.com

Ethernet Everywhere

At Home

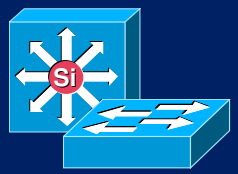
At School

On the Move

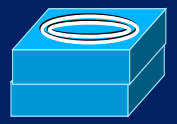
At Work

Environments

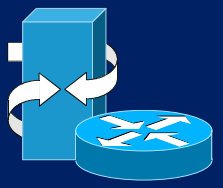
Wireless



Switches



Security



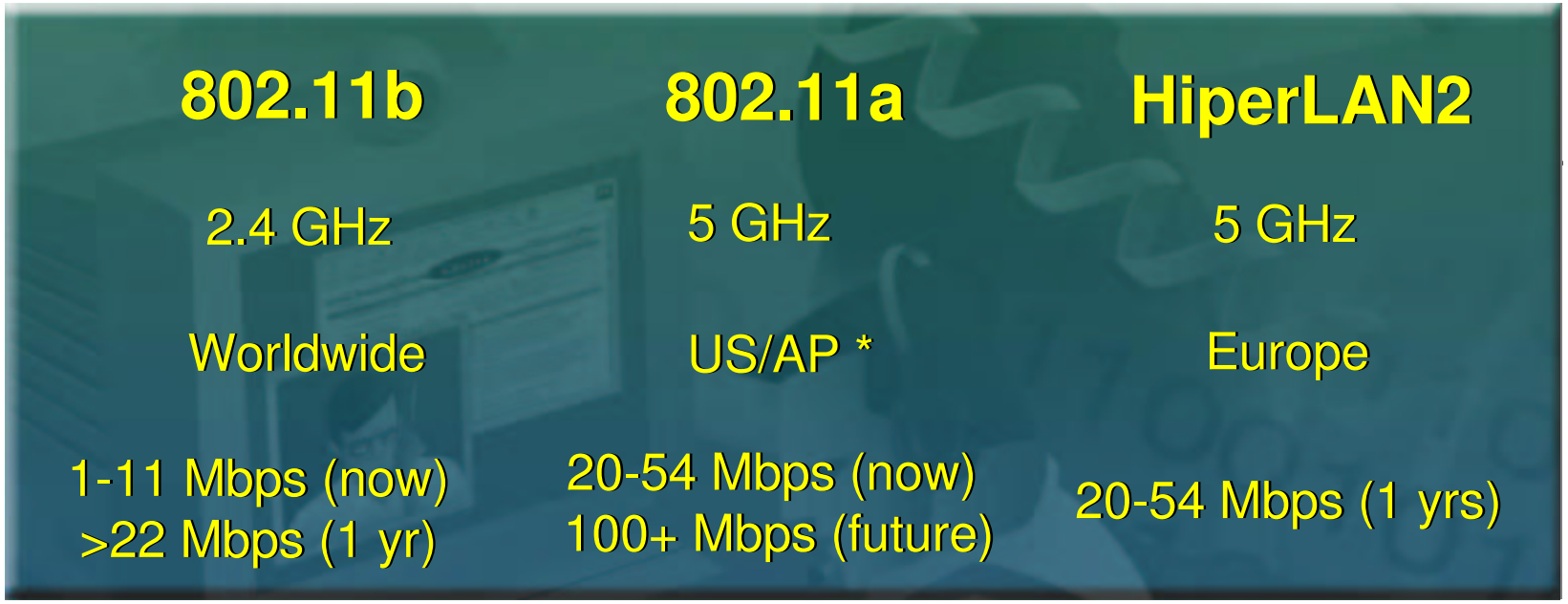
Access

Solutions and Building Blocks

Wireless Ethernet | 10/100 Ethernet | Gigabit Ethernet | Layer 3 Switched Ethernet | Long-Reach Ethernet

Ethernet Technologies

Wireless LAN Technologies

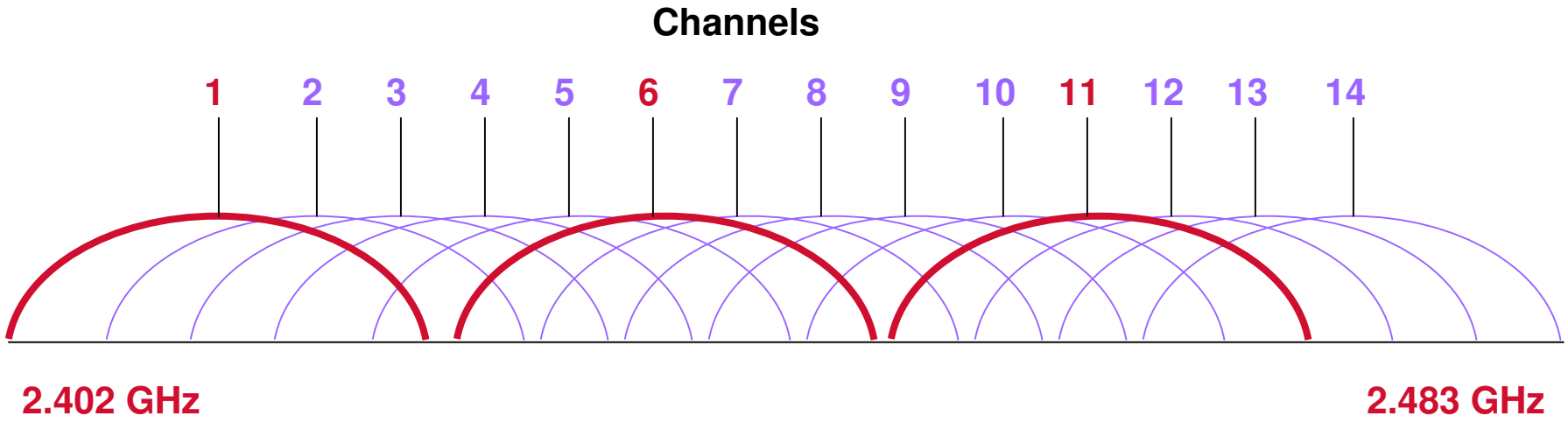


The Laws of Radio Dynamics:

Higher data rates = shorter transmission range
Higher power output = increased range, but lower battery life
Higher frequency radios = higher data rates, shorter ranges

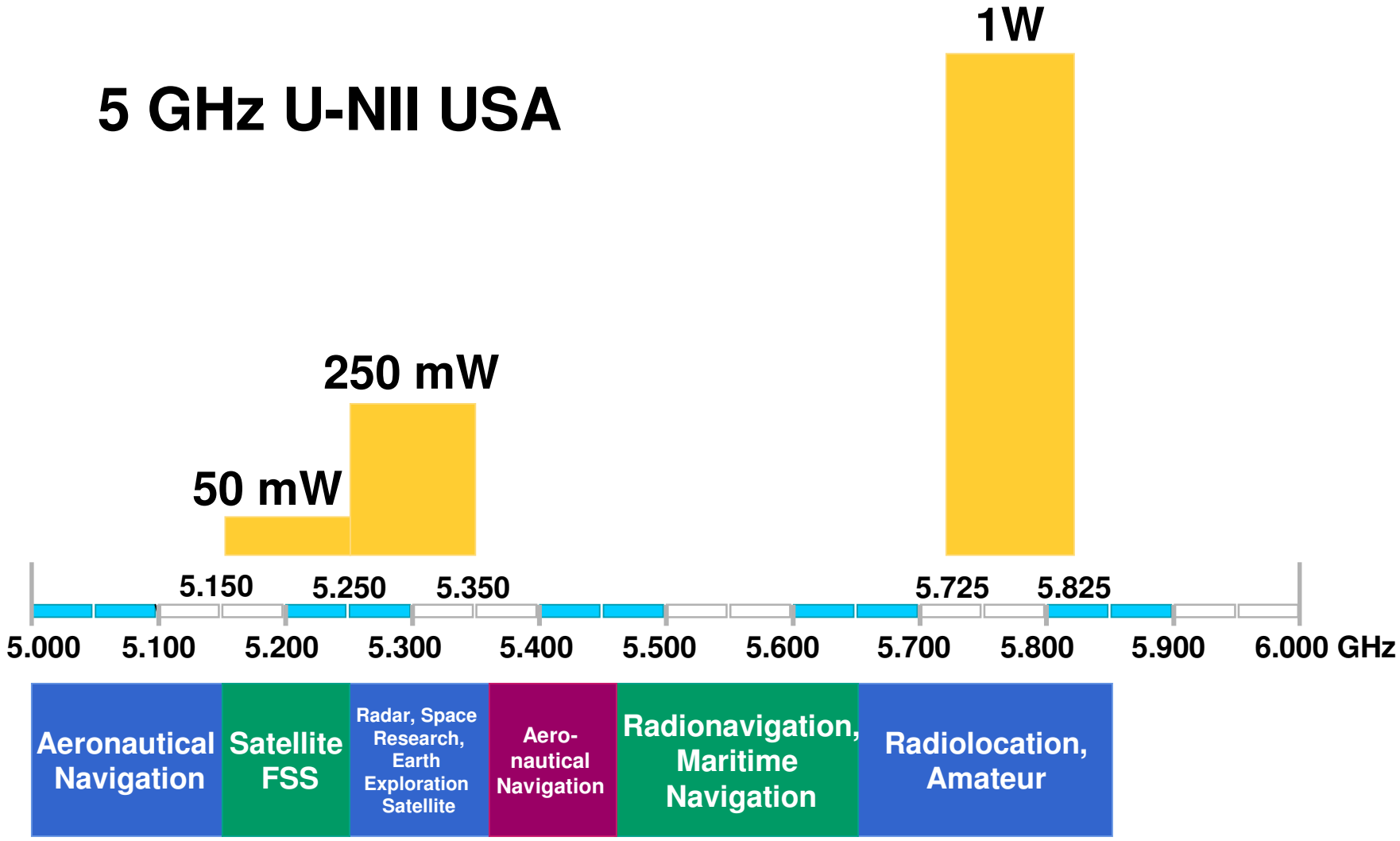
* Europe requires 802.11h (Dynamic Power and Frequency Management), 802.11e (QoS)

802.11 Direct Sequence Spread Spectrum

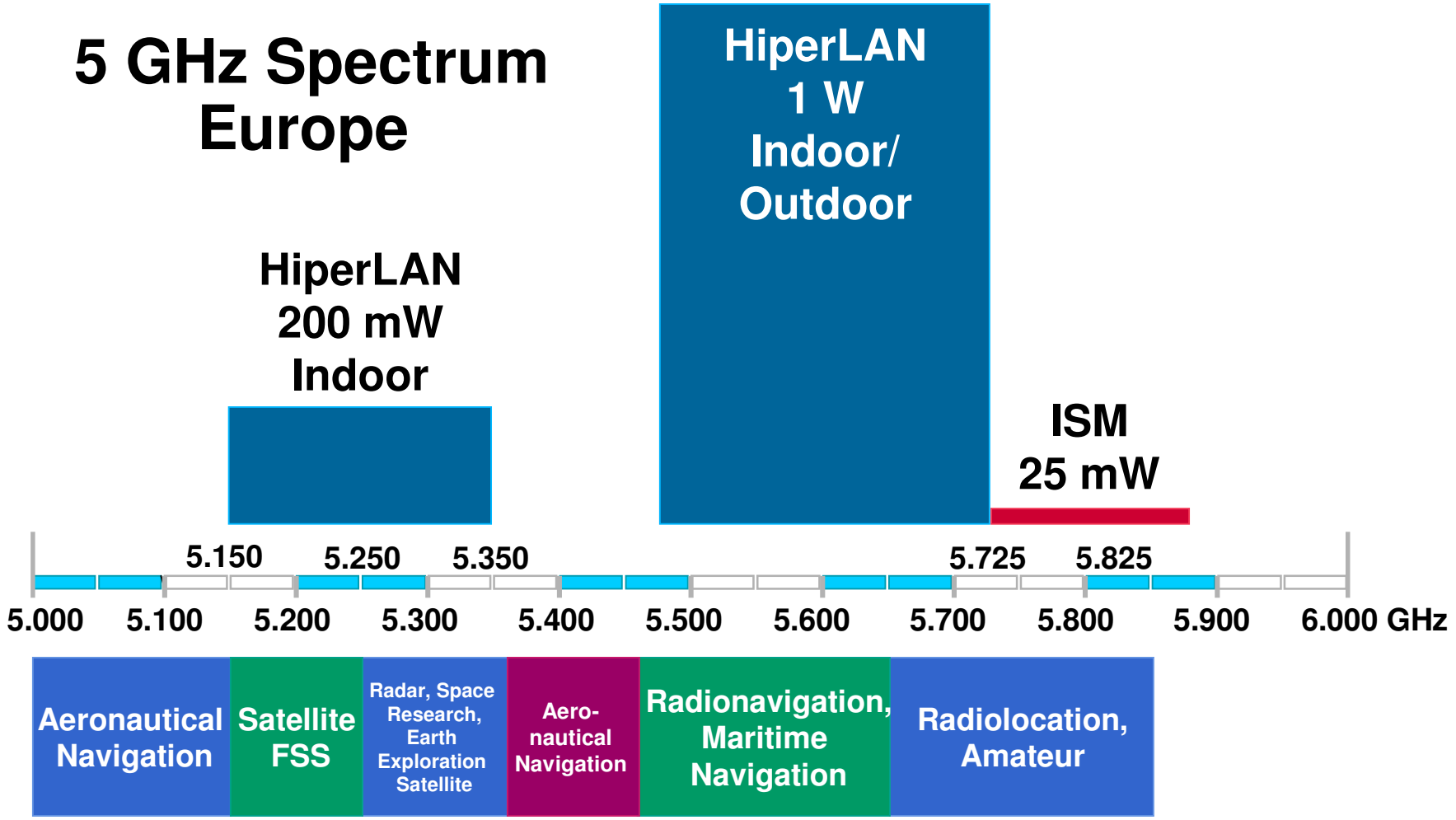


- (14) 22 MHz wide channels
- 3 non-overlapping channels (1, 6,11)
- 11 Mbps data rate
- 3 Access Points can occupy the same space for a total of 33 Mbps aggregate throughput

Implementation Differences Regional Regulations for 5 GHz



Implementation Differences Regional Regulations for 5 GHz



Characteristics of 802.11a

- Orthogonal Frequency Division Multiplexing (OFDM)
  - Data rates supported: 54, 48, 36, 24, 12 & 6Mbps
  - Can “downshift” to lower data rates for longer range
- Compliant with FCC and Japanese regulations
  - Initial offering will not be available in EMEA & portions of Asia/Pacific
- 5GHz band has more channels than 2.4GHz band
  - UNII-1 + UNII-2 = 8 non-overlapping channels (vs. 3 channels for 2.4GHz)

Both frequency bands will be successful!

802.11 Positioning

5GHz - 802.11a

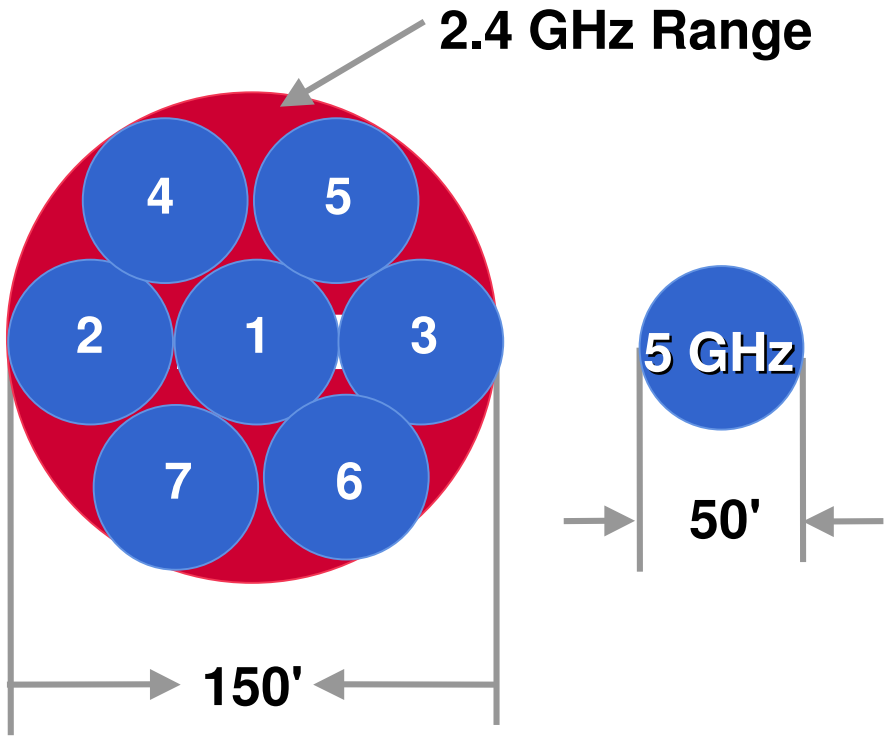
- Maximum Wireless LAN performance: 54Mbps
- Higher expected throughput than 802.11g
- 8 channels
- Works only in U.S., Japan, and other FCC countries
- 5 GHz band has less interference

2.4GHz - 802.11b & g

- 11Mbps → 36Mbps → 54Mbps
- 3 channels
- Worldwide compatibility
- Compatibility with installed base of 802.11b products
- Wide selection of client devices
- Lower cost products
- Lower power products (important for handhelds)

5GHz (802.11a) vs. 2.4GHz (802.11b)

- Range of 5 GHz is much much less—about 30%
- Overall investment of infrastructure is much higher (more APs)
- Not simply a "replace radio" for upgrade
- Will require a new survey/install when upgrading from 2.4 GHz to 5 GHz



Other 5 GHz Issues

- **Security—quote from recent Network World article covering new 5 GHz product indicates:**

  "Some management and security features found in its 802.11b products are missing from the 802.11a product, at least for the first pass, which is one reason for the moderate pricing."

- **Interoperability—No present Wi-Fi standard for interoperability; therefore no guarantee that what you buy will work with other vendors products**

- **Wi-Fi5 ?**

Market Positioning

- .11b is ideal for customers:
  - Requiring lowest acquisition cost
  - That have a large installed base of .11b
  - That have lots of roaming users (to other .11b sites)
- .11a is ideal for customers:
  - Requiring higher data rates
  - Requiring greater capacity (more channels)
  - Concerned about Bluetooth interference
  - With a small installed base of .11b

Bottom Line

- This market is still in its infancy, not completely clear how 2.4 and 5Ghz markets will play out.

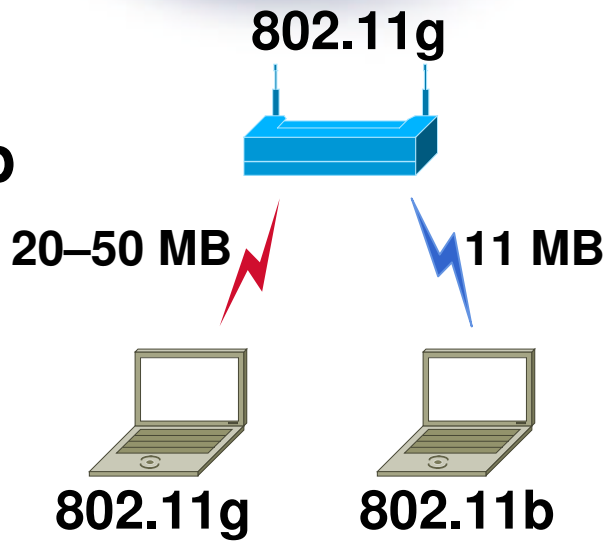
- 5Ghz will appeal to Enterprises (where the installed base of 2.4 is little to none).

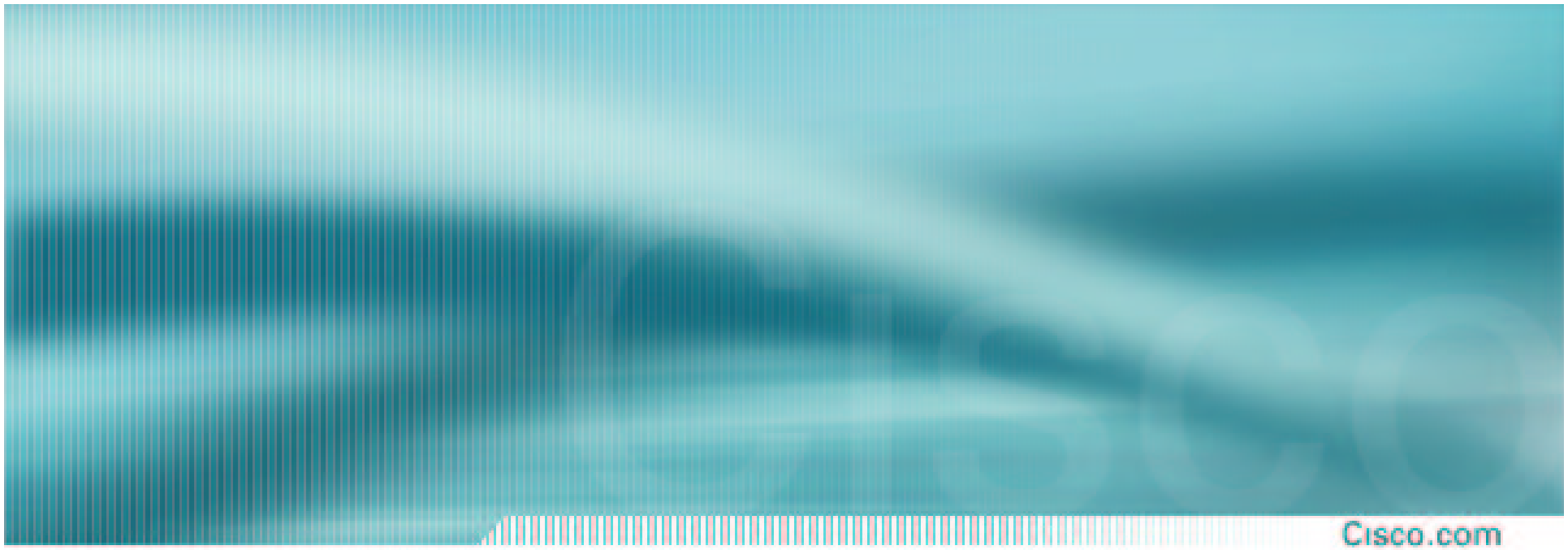
- 5Ghz is NOT as well suited in the verticals or University environment where cost, power and range are key factors.

- Cisco must have both solutions, and present the customer with both options. We want to be the customer's trusted partner.

What about IEEE802.11g?

- Provides **higher data rates** @ 2.4 GHz
- **Similar speeds** as 802.11a
- **Backward compatible** with 11 Mbps (802.11b)
- Same modulation as 802.11a—**OFDI** (other three proposals eliminated)
- May take upto six months to develop and ratify as part of IEEE 802.11





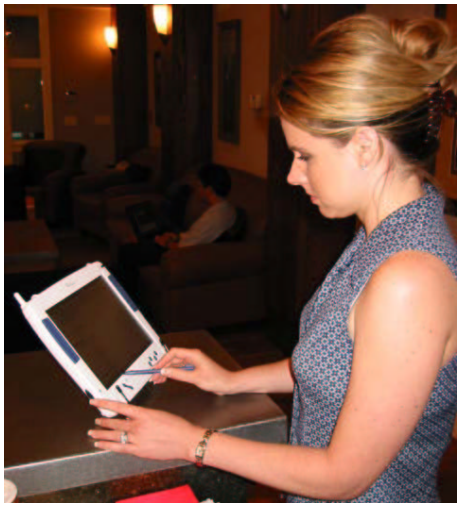
Wireless Market Uses

Historical Market Inhibitors

- Positioning of wireless as a separate solution
- Immature technology
  - Low data rate & throughput speeds
  - Security concerns
  - Vertical marginalization of technology
  - Lack of standards
- Limited to vertical applications solving specific problems
  - Manufacturing
  - Healthcare
  - Retail
  - Education

Key Growth Drivers

- **Standardization**
  - IEEE 802.11b standards - Interoperability
- **Technological maturity**
  - Better security – 128-bit encryption
  - 11 Mbps data rate speeds
  - Ease of installation and management
- **Horizontal applications**
  - Extension of wired solutions
  - Connecting mobile users
  - More Mobile computing devices



Standards Compliance

- **IEEE 802.11b**

  Design specs for high performance WLAN

  Wireless Security, Interoperability, QoS

- **WI-FI Certification by WECA (WI-FI.ORG)**

  Ensures user level interoperability; all vendors products should work together (like cell phone technology).

  Provide an accurate account and results of disparate vendor interoperability testing.

  Cisco was a founding member!

802.11b Interoperability

Wireless Ethernet Compatibility Alliance

Wi Fi™ The Standard for Wireless Fidelity

The Role of Verticals

- **Aironet has credible track record in vertical markets**
- **Key verticals have already adopted wireless technology:**
  - **Manufacturing**
  - **Healthcare**
  - **Transportation**
  - **Finance**
  - **Education**
  - **Hospitality/retail**
  - **Government**

Horizontal Market Requirements

Requirement

- Wireline-class security
- High performance and reliability
- Enterprise-scale manageability
- Low total cost of ownership
- Standards foundation

Solution

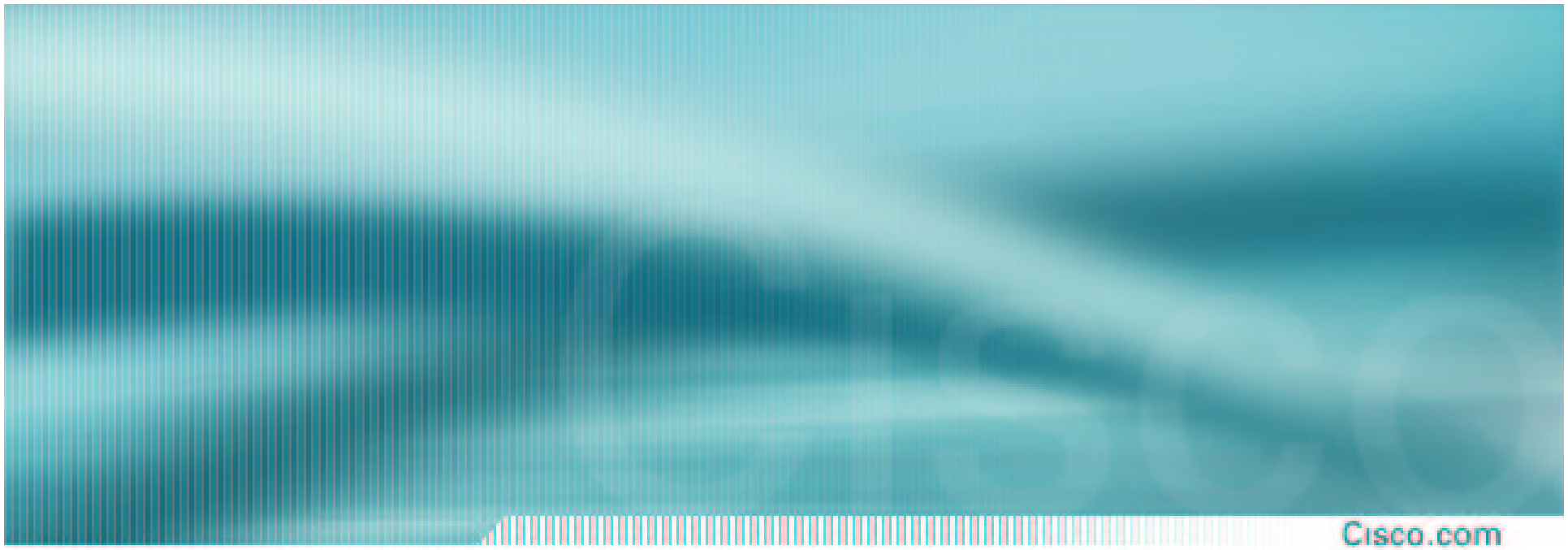
- Centrally managed authentication, dynamic encryption keys (LEAP)
- Market-leading performance and reliability in radios, platforms, services
- Easy-to-use point tools; integration with existing management infrastructure
- Features that simplify installation and remove “hidden costs”
- Compliance with and innovation of standards contributing to interoperability and usability (802.11, 802.1X, EAP, WECA)

Horizontal Applications

- Extend wired networks providing mobility
- Eliminate expensive wiring problems (moves, adds & changes)
- Provide a complete networking solution for small companies/SOHO
- Integrate home, travel, and work environments for flexible, consistent connectivity (Cisco does NOT offer a consumer product).
- Circumvent physical restrictions that limit network expansion
- Provide flexible LAN solutions in fast-changing environments

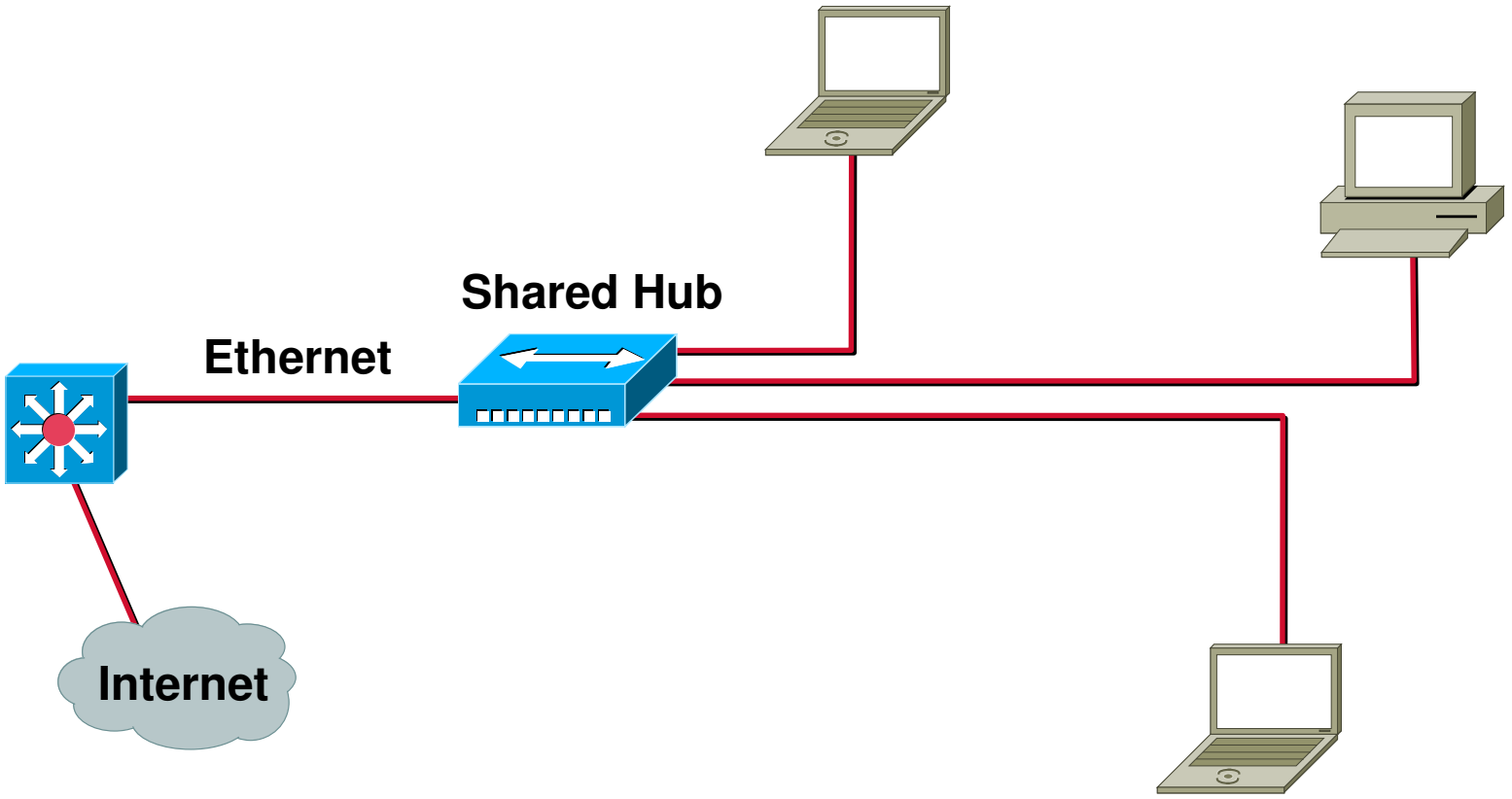
Wireless Access Today

- No longer just a vertical/niche technology
- Basic network building block
- Delivers network ubiquity
- Standards are emerging
- Interoperability is now proven
- Increasing demand for higher bandwidth
- Opportunity for true mobility

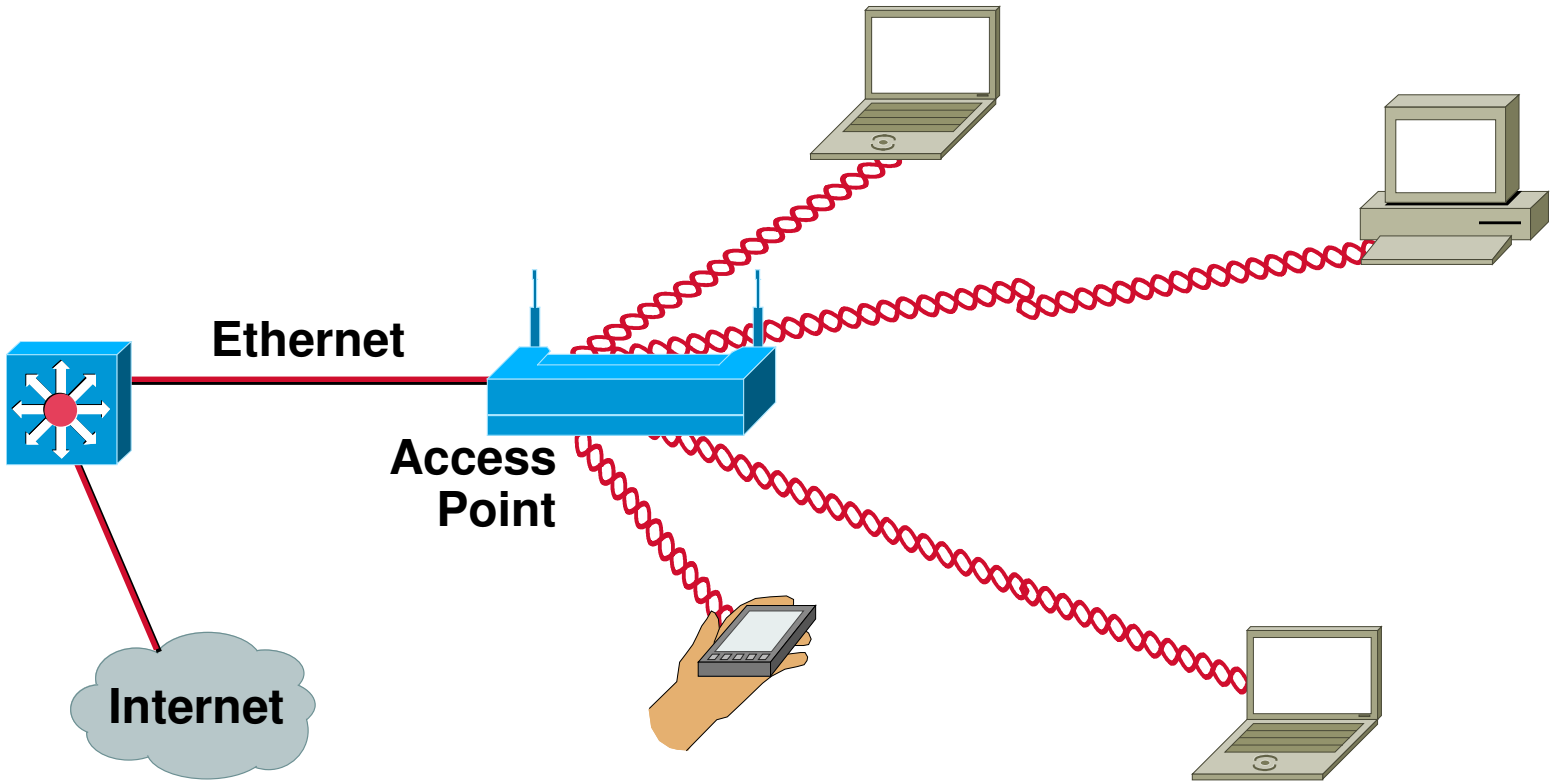


Wireless LAN Topologies

Shared Local Area Network (LAN)

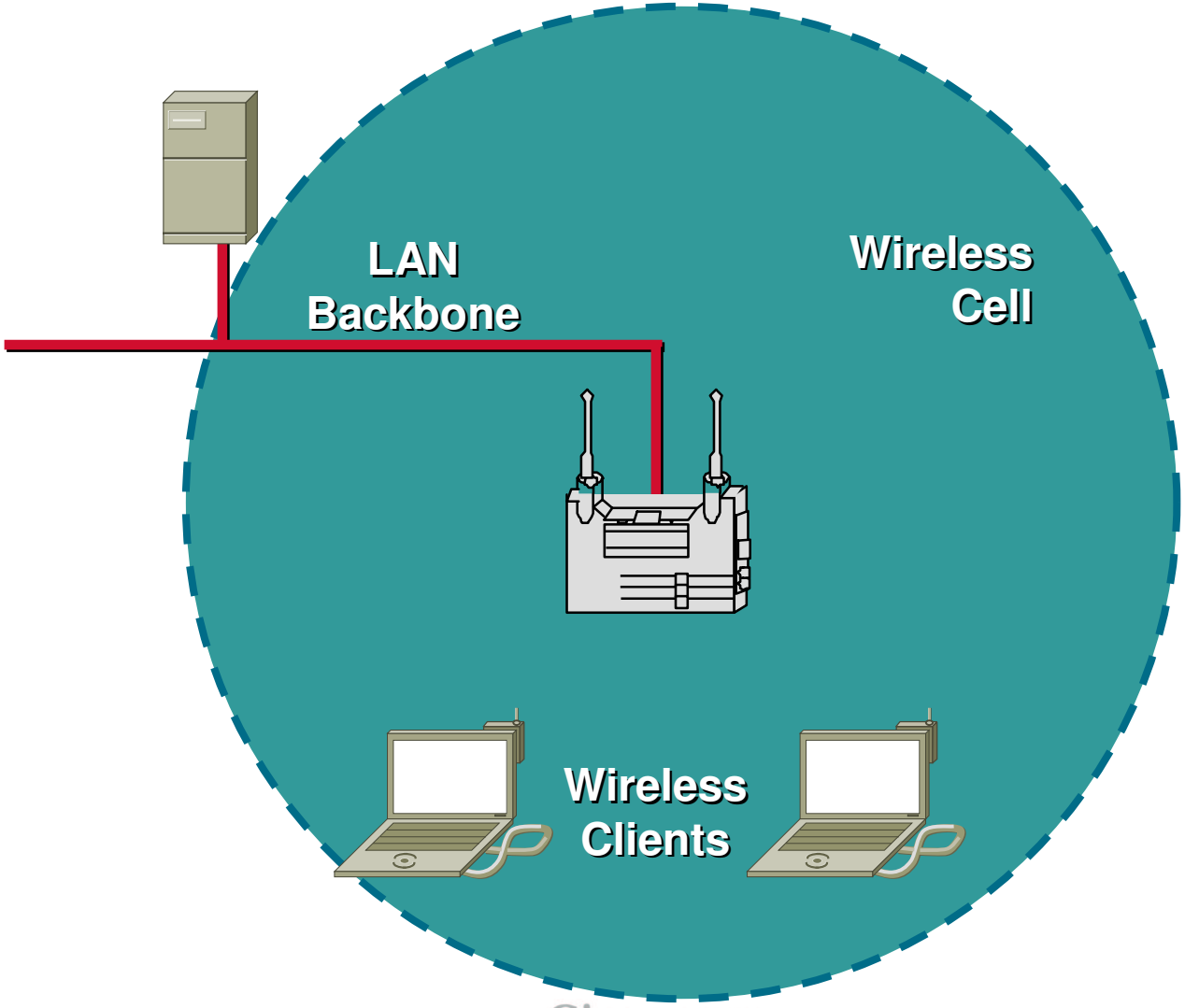


Wireless Local Area Network (WLAN)

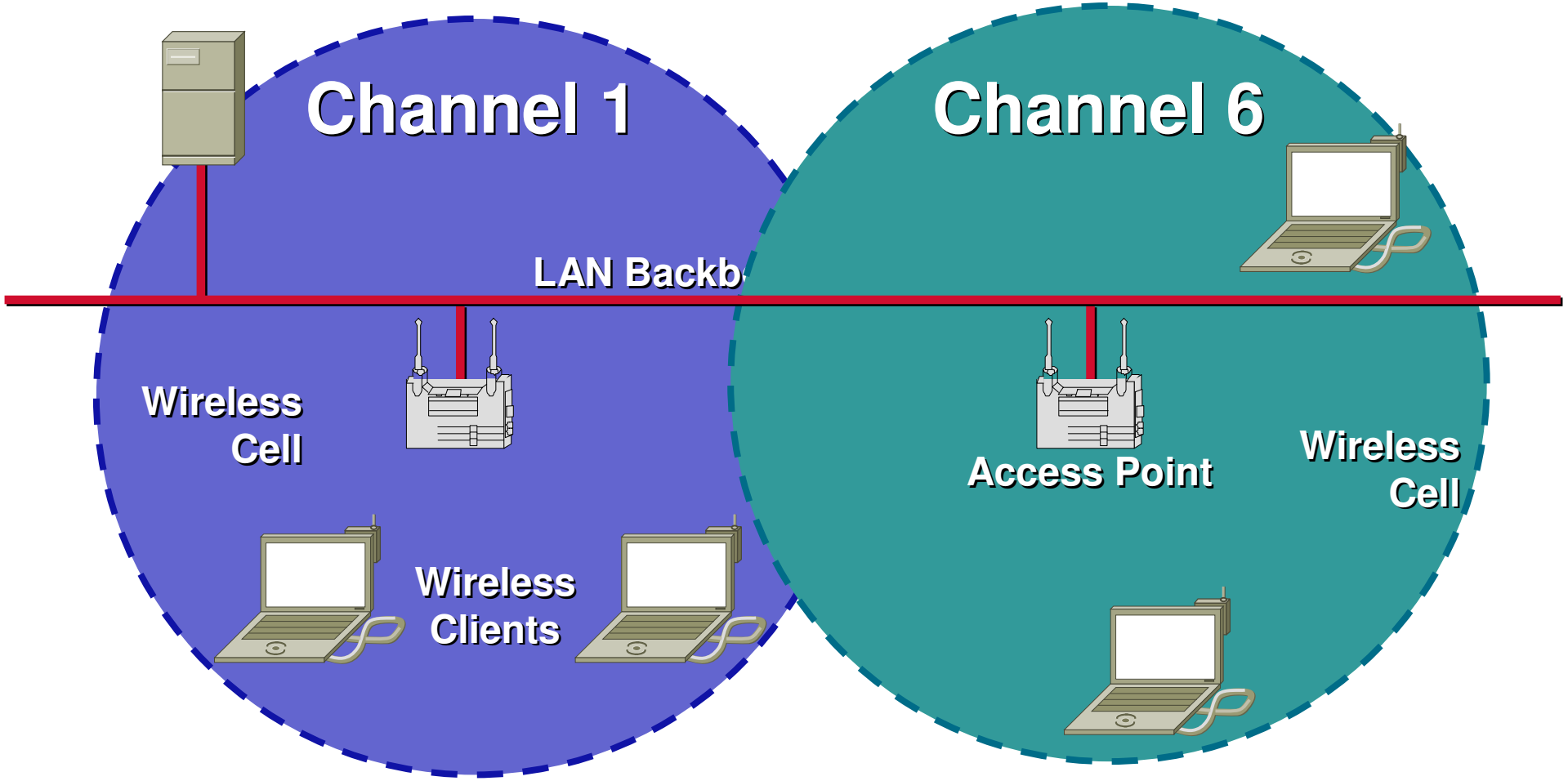


Remember: An Access Point is a SHARED device and has similar performance to a SHARED Ethernet HUB

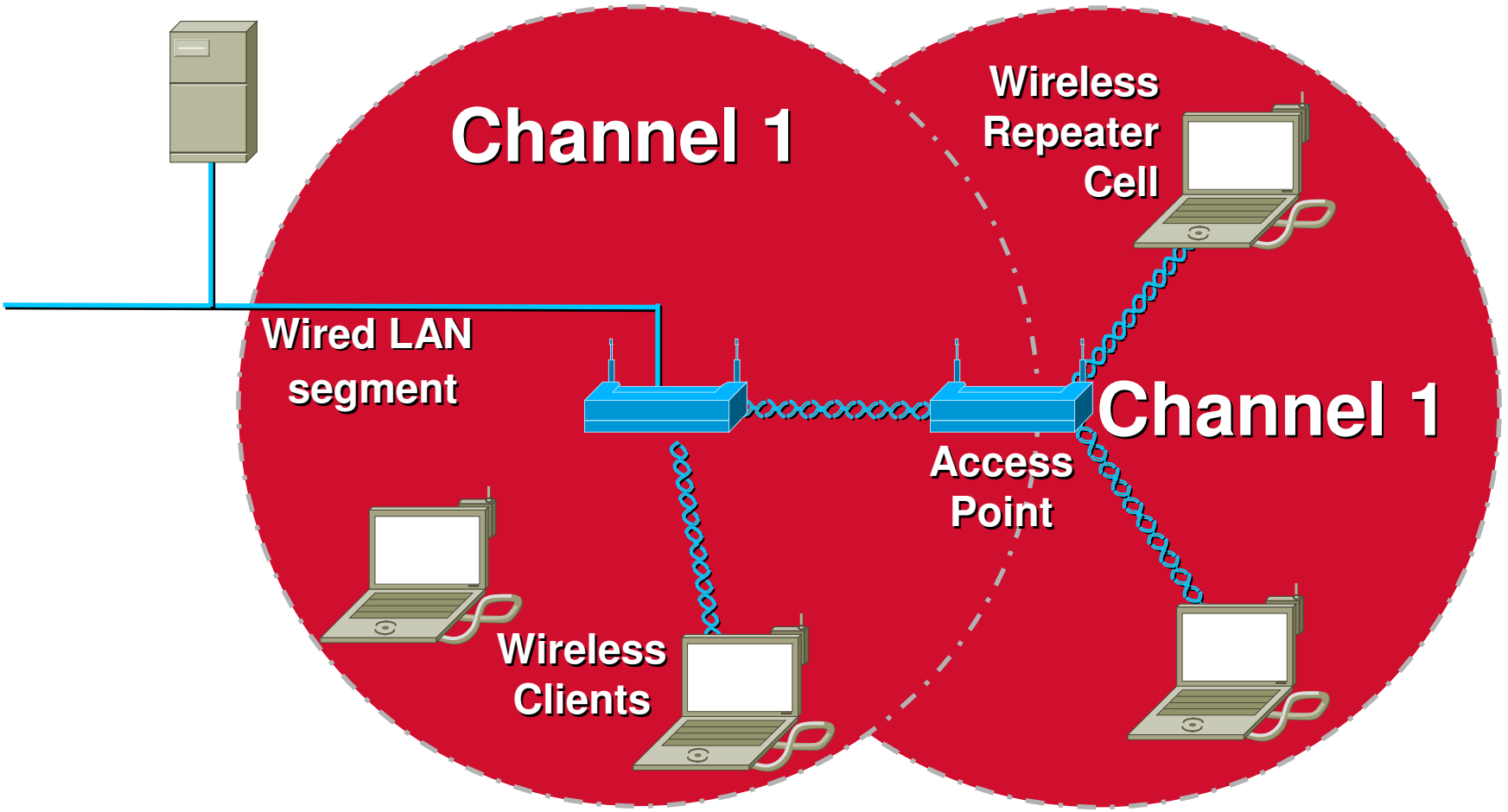
Typical Single Cell Configuration

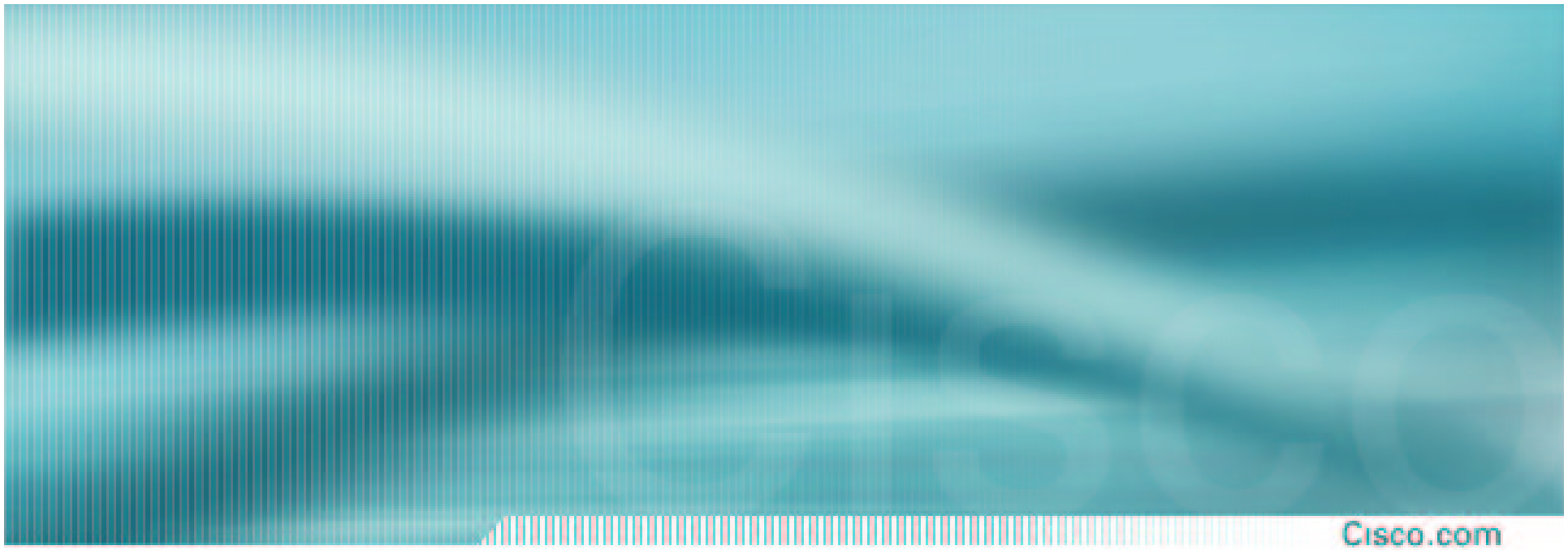


Typical Multicell Configuration



Wireless Repeater

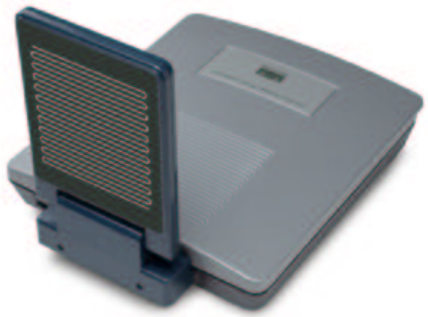




Wireless LAN Components

Wireless LAN Components

- PC Card/PCI and ISA Client Adapters
- Access Points
- Line-of-Sight Bridge Products
- Antennas & Accessories



Client Adapters

- PCMCIA card for Laptops and PDAs
- PCI adapter for Desktops
- Driver Support
  - Windows 95, 98, 2000, XP
  - Windows NT 4.0
  - Windows CE
  - Linux
  - Mac OS 9, 10

- Also supports Novell Netware Clients
- Utilities include user configuration and site survey tool for simple installation and upgrade

Client Gadgets

IP Phones

Palm and PocketPC with built-in scanner

NetVision data phone

Thumb-sized portable scanner

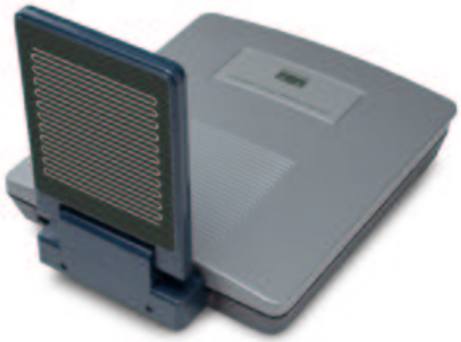
Cisco's WLAN Product Evolution

340 Series

- 30 mW radio
- AC powered
- 802.11b compliant

350 Series

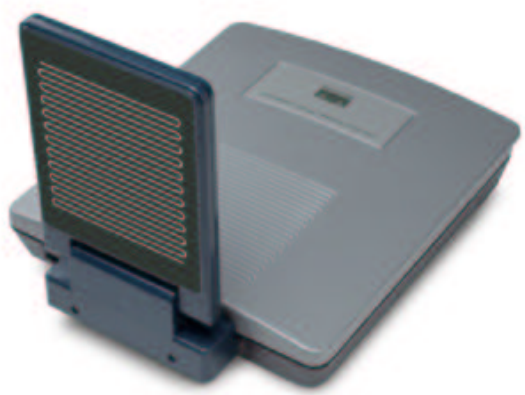
- 100 mW radio
- In-line powered
- 802.11b compliant
- Improved motherboard
- Plenum ratable



1200 Series

- 100 mW embedded radio
- Modular design
- 802.11b (initially)
- 802.11a and g, radios shortly
- AC powered or in-line
- Plenum ratable

Investment Protection and Future Proofing

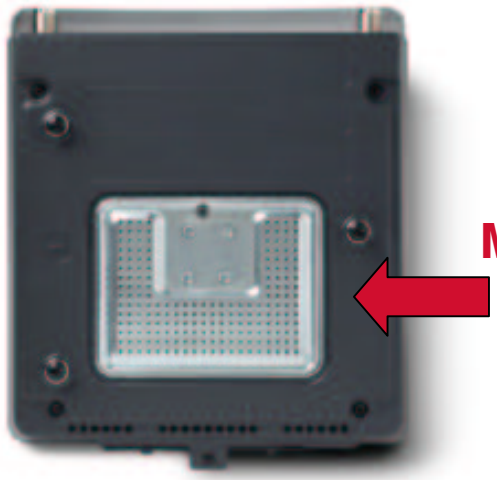


- Modular platform for single or dual band operation
- Field upgradeable radios
- Eight megabytes of storage and support for Cisco management tools

Flexibility

- **Ideal for both office and rugged environments**
  - **Office interior ascetics, broad operating temperature range**
- **Wall and ceiling mount capabilities**
  - **Metal case and UL 2043 for Plenum ratability**
- **Support for both in-line power over Ethernet and local power**
- **Variable transmit power and broad selection of antennas**

Field upgradeable

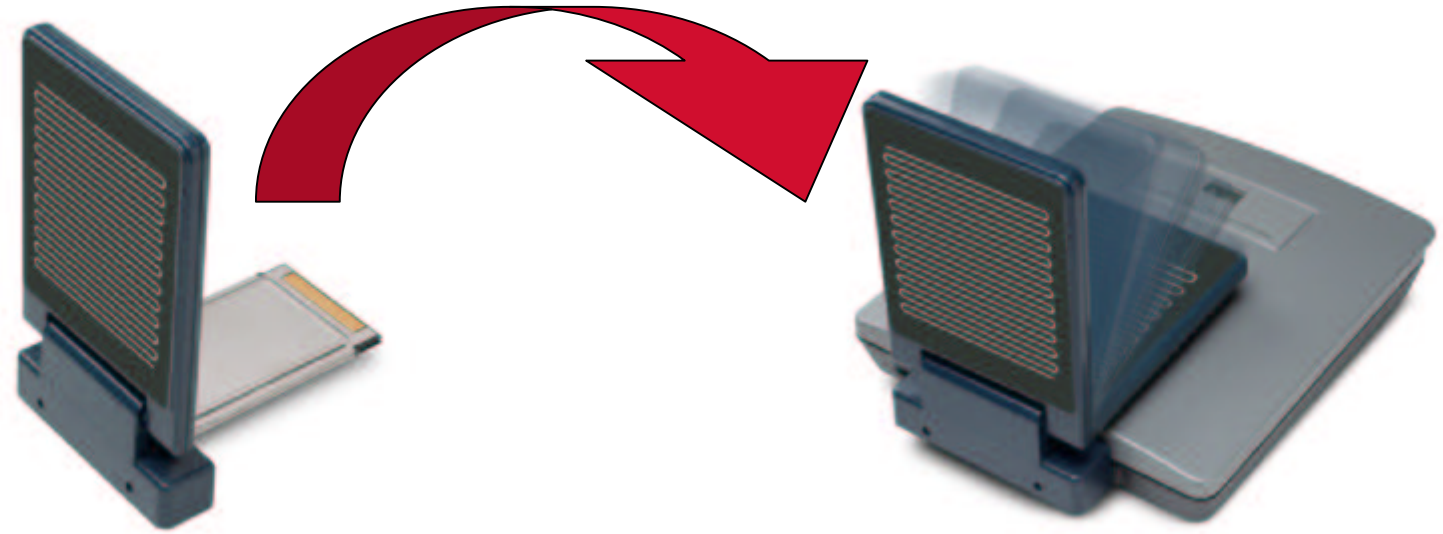


Mini-PCI 2.4 GHz slot

5 Ghz Radio Module slot

- **Both the 2.4 GHz and 5 GHz radios are field upgradeable**

Dual band capabilities

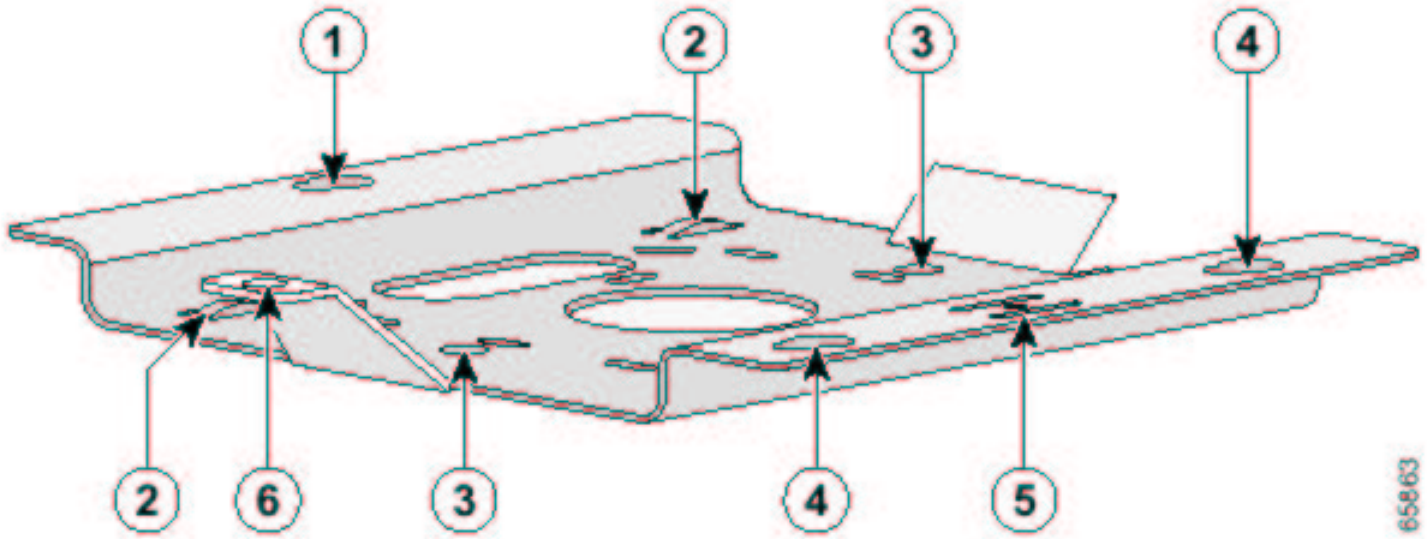


- **Module slot for 802.11a radio**
- **Will be able to run both 802.11b and 802.11a simultaneously**

Mounting

- Mounting bracket separate from AP
- Kensington lock port
- Pad lock holes lock-in AP to mounting bracket as well as any 802.11a Module
- AP when attached to mounting bracket hides the mounting screws for enhanced security

Mounting Bracket



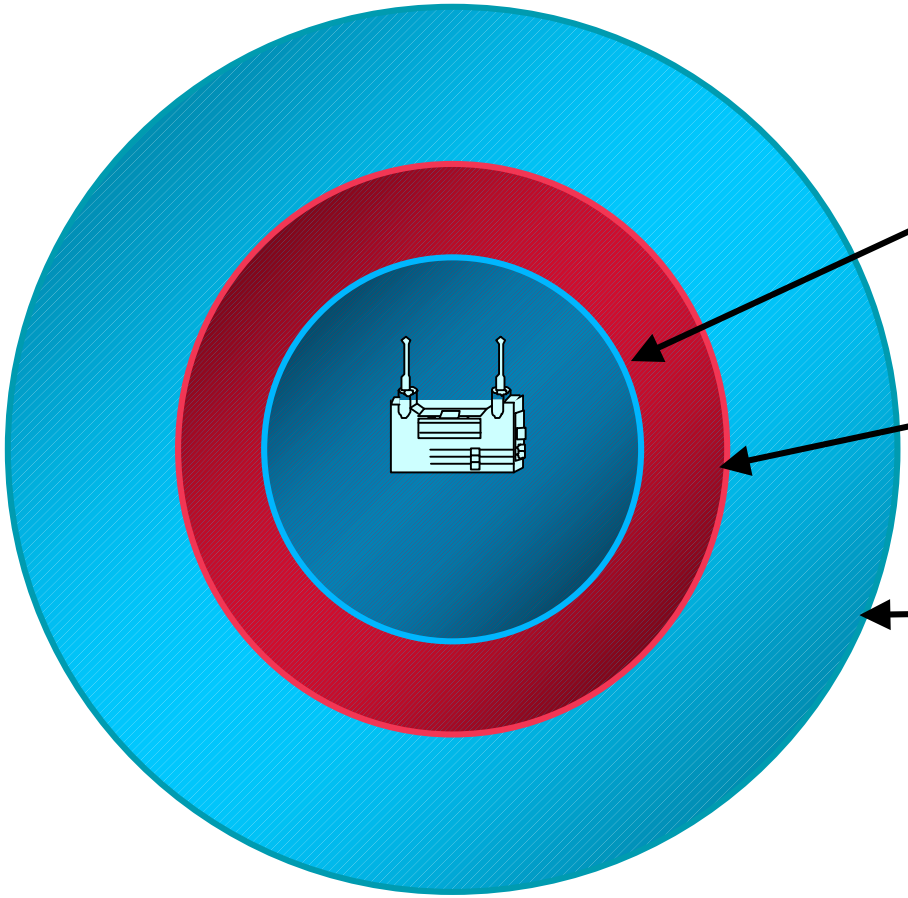
1	Access point mount	4	Access point mounts
2	Cable tie points	5	Locking detent
3	Ceiling mount holes	6	Security hasp

Transmit Power

- Transmit power is 100mW (+20dBm)
- Other supported power levels can include:

  50, 30, 20, 5, and 1mW

30mW Cell Size Comparison

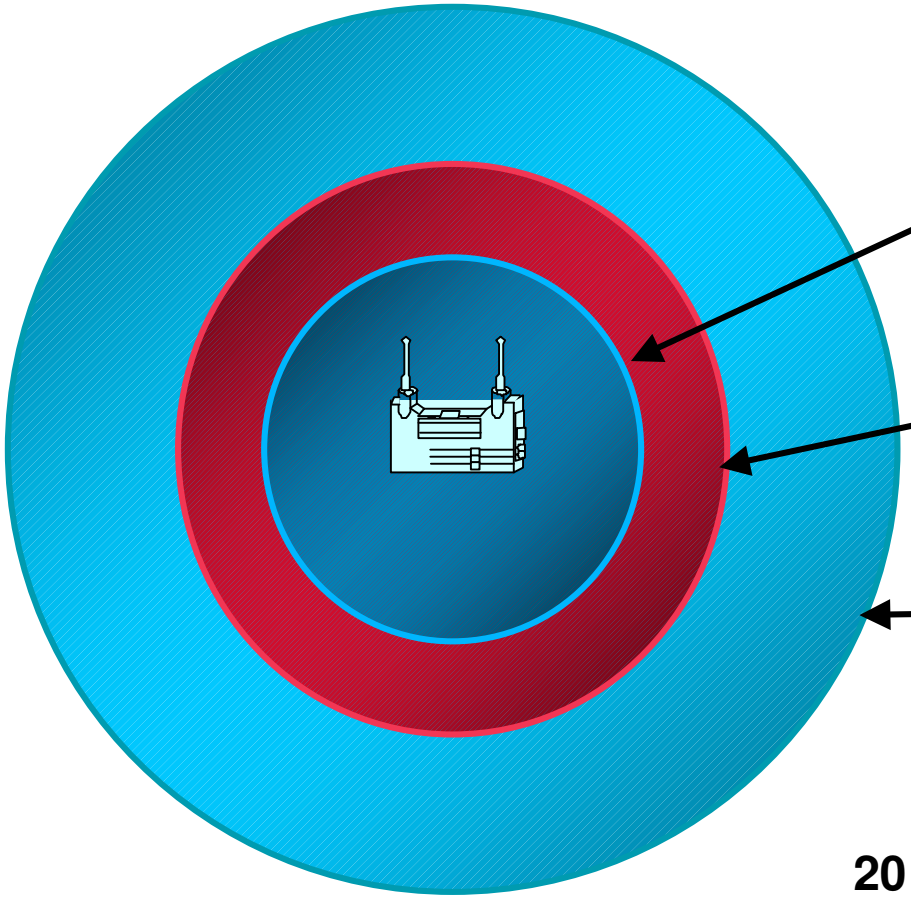


11 Mbps DSSS
80-100 feet radius

5.5 Mbps DSSS
100-200 feet radius

2 Mbps DSSS
200-275 feet radius

100mW Cell Size Comparison



11 Mbps DSSS
100-150 feet radius

5.5 Mbps DSSS
150-250 feet radius

2 Mbps DSSS
250-350 feet radius

20 to 50% increase in range!

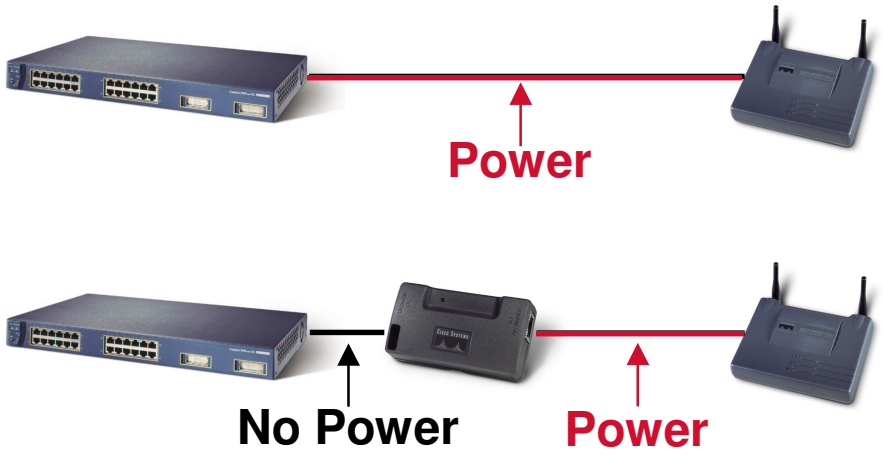
AC Power Requirements

- Cost of AC cabling can be astronomical at times.
- As much as $30K for a building in San Jose (3 story Cisco offices)
- In line power has reduced the cost of providing AC power to each A.P.

Aironet 350
Ethernet In-Line Power

Ethernet In-line Power Source:
- Catalyst 3524 Power Switch
- Catalyst 6000 Power Blade
- Catalyst 4000 Power Blade
- 48 Port Power Patch Panel

Ethernet In-line Power Source:
- Aironet Power Injector



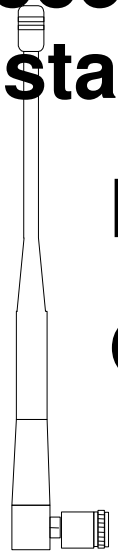
- Aironet 350 uses Ethernet in-line power ONLY
- Eliminates need for local power and AC infrastructure cost
- Draws in-line power from edge devices (-48 Volts)
- Catalyst power switches support device discovery mode

Cisco Aironet Series Bridges

- Building-to-Building connectivity at up to 25 miles (line of sight)
- Cost effective alternative to leased line/T1
- Rapid, simple deployment and re-deployment
- Point-to-Point and Point-to-Multipoint
- No government license required

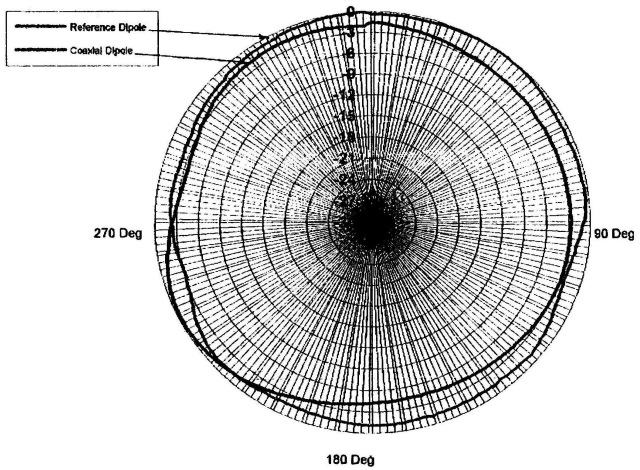
Dipole Omni Directional Whip

- **The Dipole Omni-Directional Whip:**
- **Access Points and PC boards are usually installed with this antenna.**



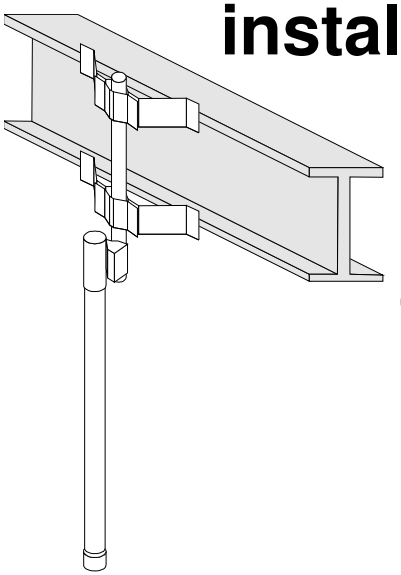
Polarization:Vertical

Gain: 2.14dBi



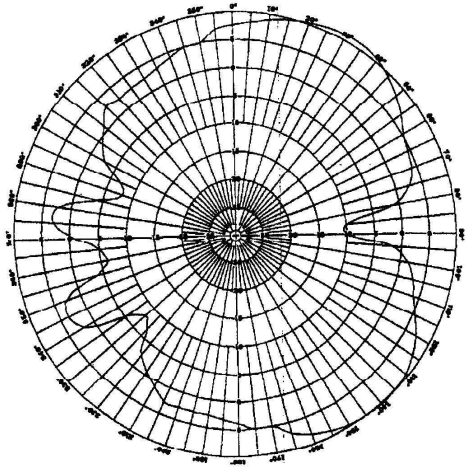
Omni-Directional Antenna

- The High-Gain Omni-Directional:
- This antenna covers a significantly greater area than can be covered with the unity-gain Omni-directional type. Access Points are usually installed with high-gain antennas.



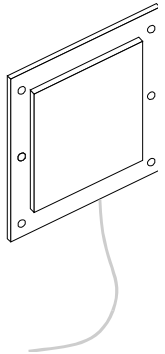
Polarization: Vertical

Gain: 5.2 and 12dBi



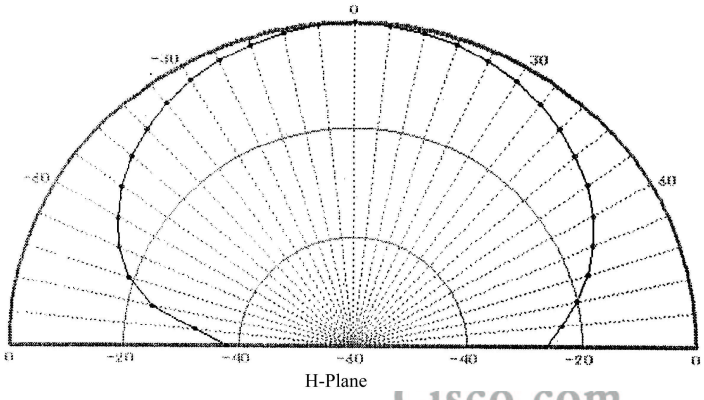
Hemispherical Patch Antenna

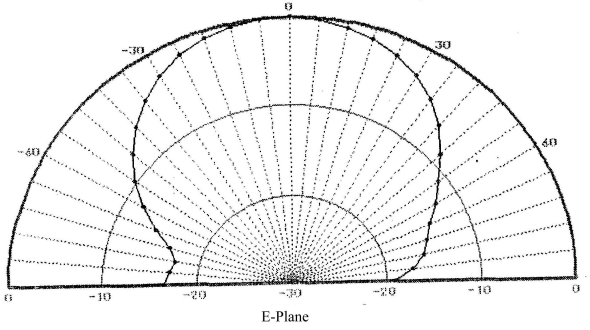
- **The Patch:**
- **This is a directional antenna with a very wide pattern. It is sometimes easier to mount the “patch” than any other type antenna.**



Gain: 6dBi and 8.5dBi

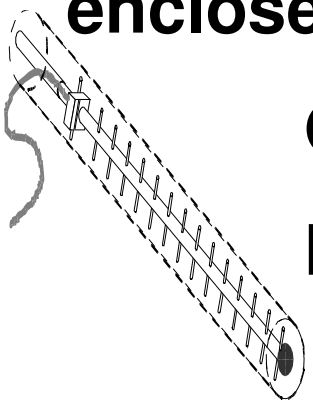
F





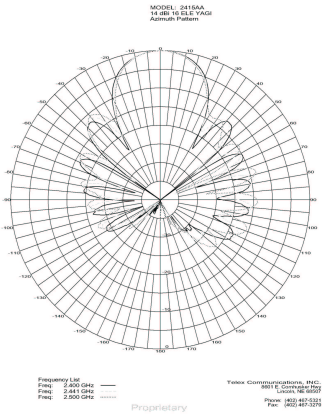
High Gain Yagi

- This is a very directional antenna with a beam width of only 30 degrees. When the high-gain Yagi is used in a warehouse facility it can provide long directional coverage from walls adjacent to rack shelving. This type of Yagi is enclosed in a plastic casing.



Gain: 13.5dBi

Frequency: 2.4 GHz



Misc. Accessories

- Wireless Accessories that complement Cisco's product offerings

TerraWave products include:

Site Survey Tools

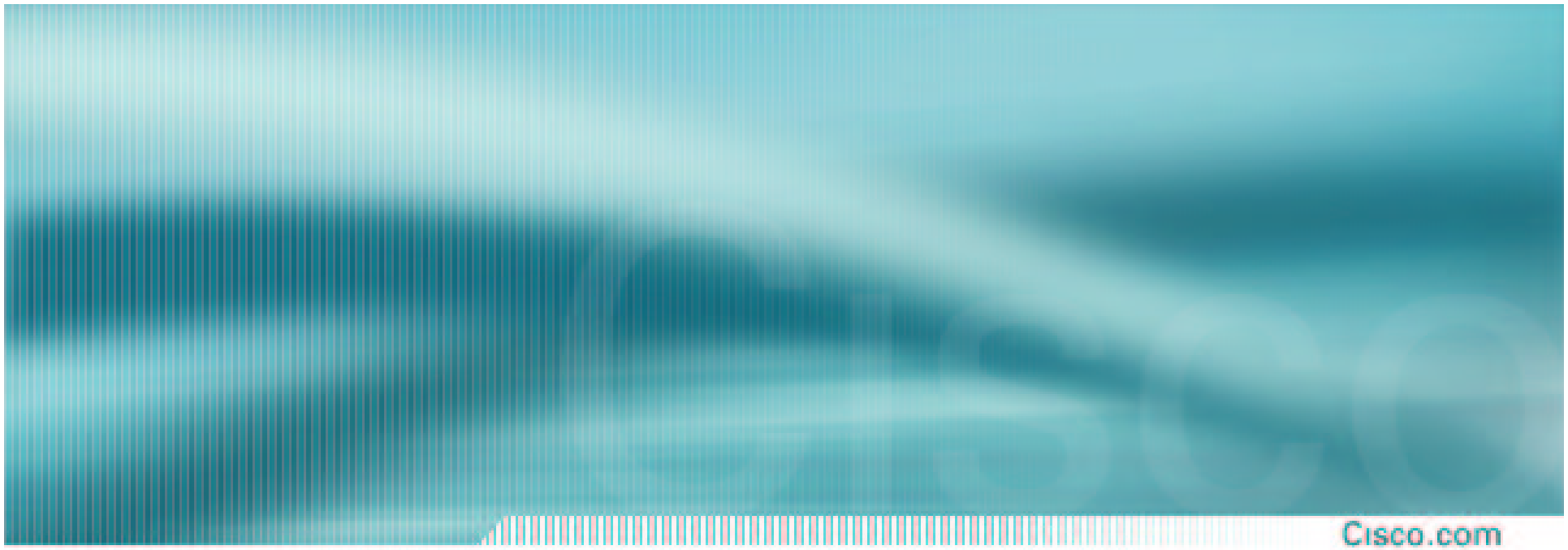
Antenna Splitters

Custom Cables and Connectors

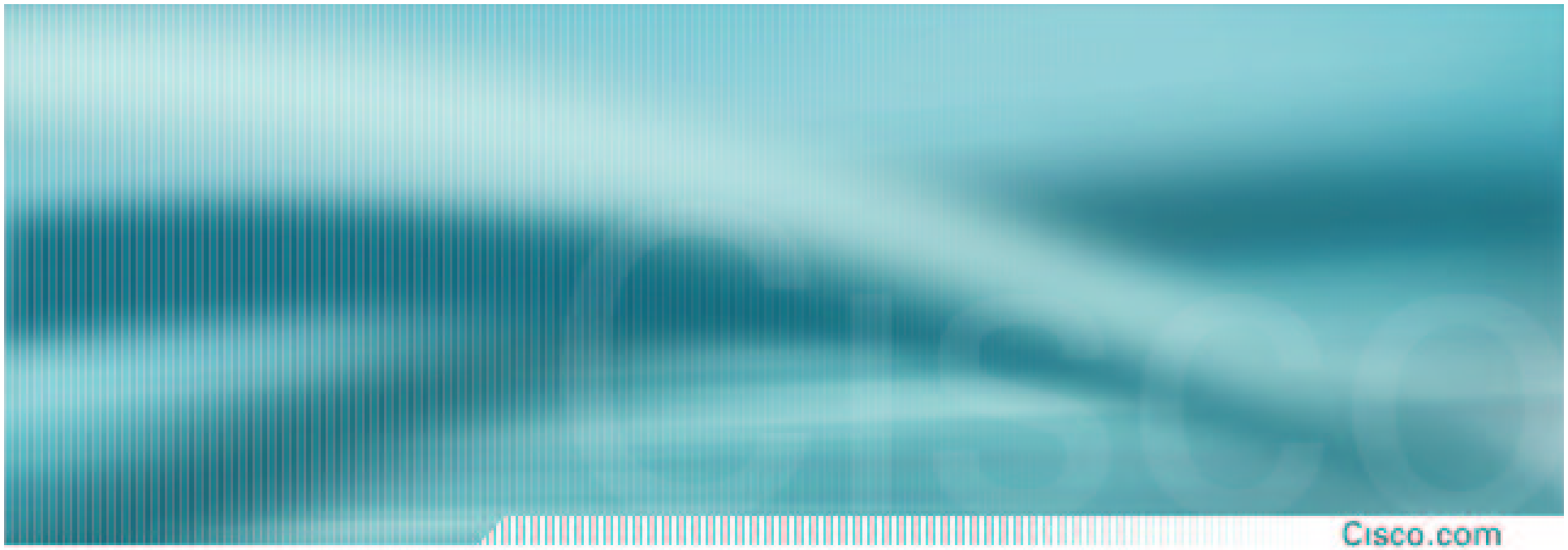
NEMA Enclosures

Custom Mounting Solutions

Contact TerraWave at 210-375-8482 or www.terra-wave.com



WLAN Demo

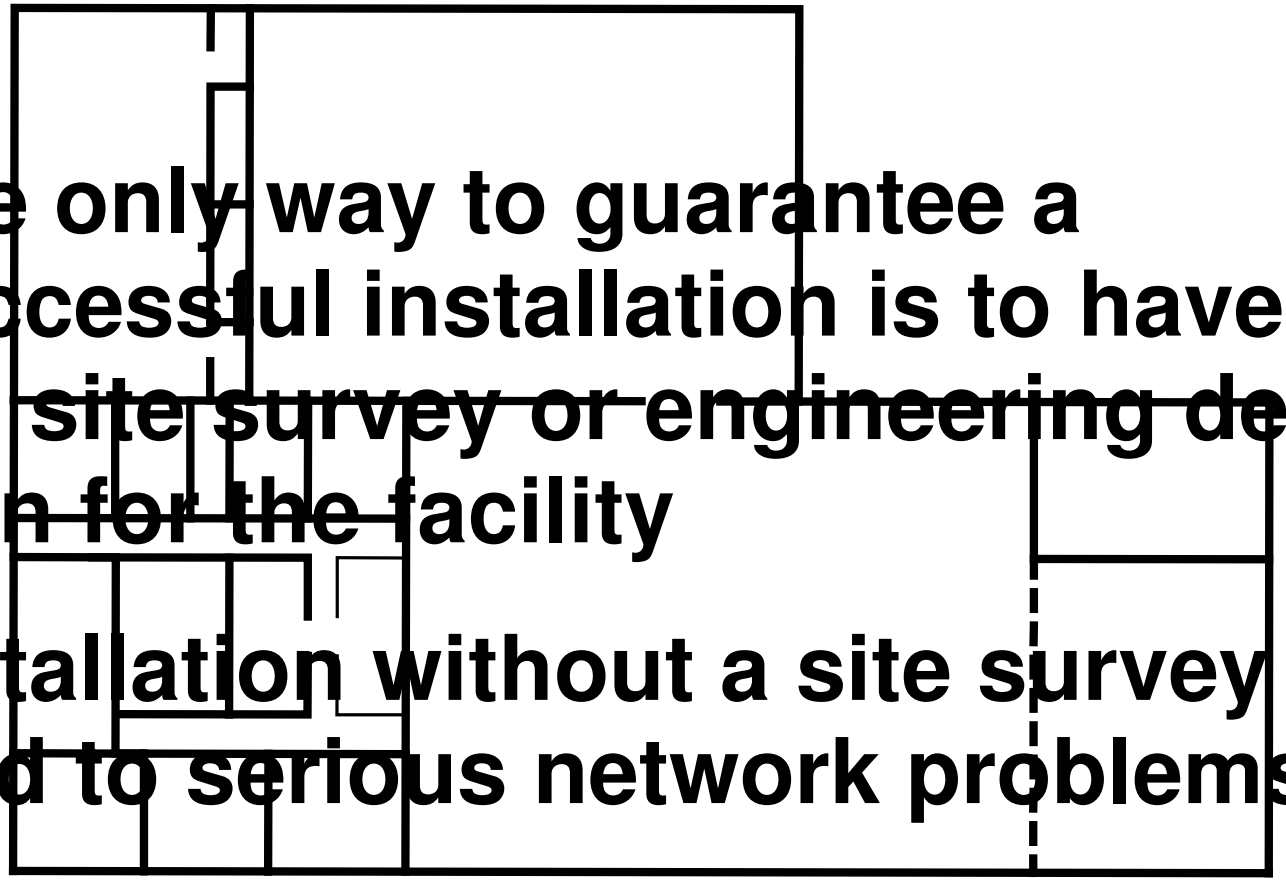


Site Planning

Pre-Site Survey

- A form of data collection
  - Information that will dictate how or where the survey is conducted
  - This helps to determine overall project requirements such as:
    - Throughput needed
    - Redundancy and overlap
    - Number of users
    - Type of applications which dictate performance
    - Survey restrictions and special needs

Site Survey



- The only way to guarantee a successful installation is to have a full site survey or engineering design plan for the facility
- Installation without a site survey can lead to serious network problems

What You Need

- Test Equipment
- Antennas & Cables
- Ladder or Lift
- Safety Equipment
- Marking Materials
- Site Drawing
- Meet with MIS
- Conduct a Walk-through of the Site

- **A Qualified Partner**

Training Partner

http://www.giga-wave.com/

GigaWave Technologies, LTD.

10521 Gulfdale

San Antonio, Texas 78216

Phone: 210-375-0085

FAX: 210-375-8382

Networking Professionals Connection

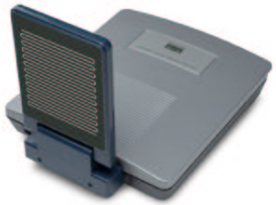
Visit Our Interactive Web Site for:

- Discussion forums
- Online events
- Biweekly newsletter

www.cisco.com/go/netpro

Test Equipment

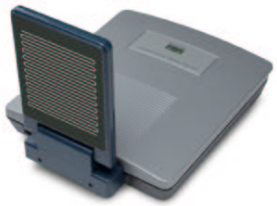
- Selection of antennas
- AP model that will be installed
- Wireless Laptop or client device used
- Spectrum Analyzer



Antennas & Cables

- Always test with the antenna to be installed
- Any antenna extension cables needed for the installation should be used for the Site Survey too

Laptop or Client Device



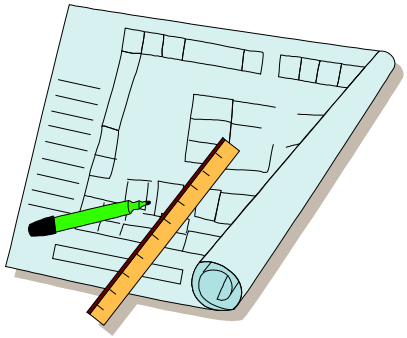
- Any device used for testing the connection between the AP and Client device must be able to run diagnostic utilities to test the link
- Laptops are normally used however sometimes client devices are specified such as pen based PC's

Other Test Tools

- A Spectrum Analyzer is sometimes used to locate sources of Radio Frequency Interference (RFI)
- A handheld Frequency Counter can provide a quick reference to specific emissions in a close area
- An Electromagnetic Field Probe can detect local sources of Electro-Magnetic Interference (EMI)

Site Drawing

- **A set of drawings or prints are needed to annotate:**
  - **AP locations**
  - **Coverage areas**
  - **Cable and electrical requirements**
  - **Sources of interference**

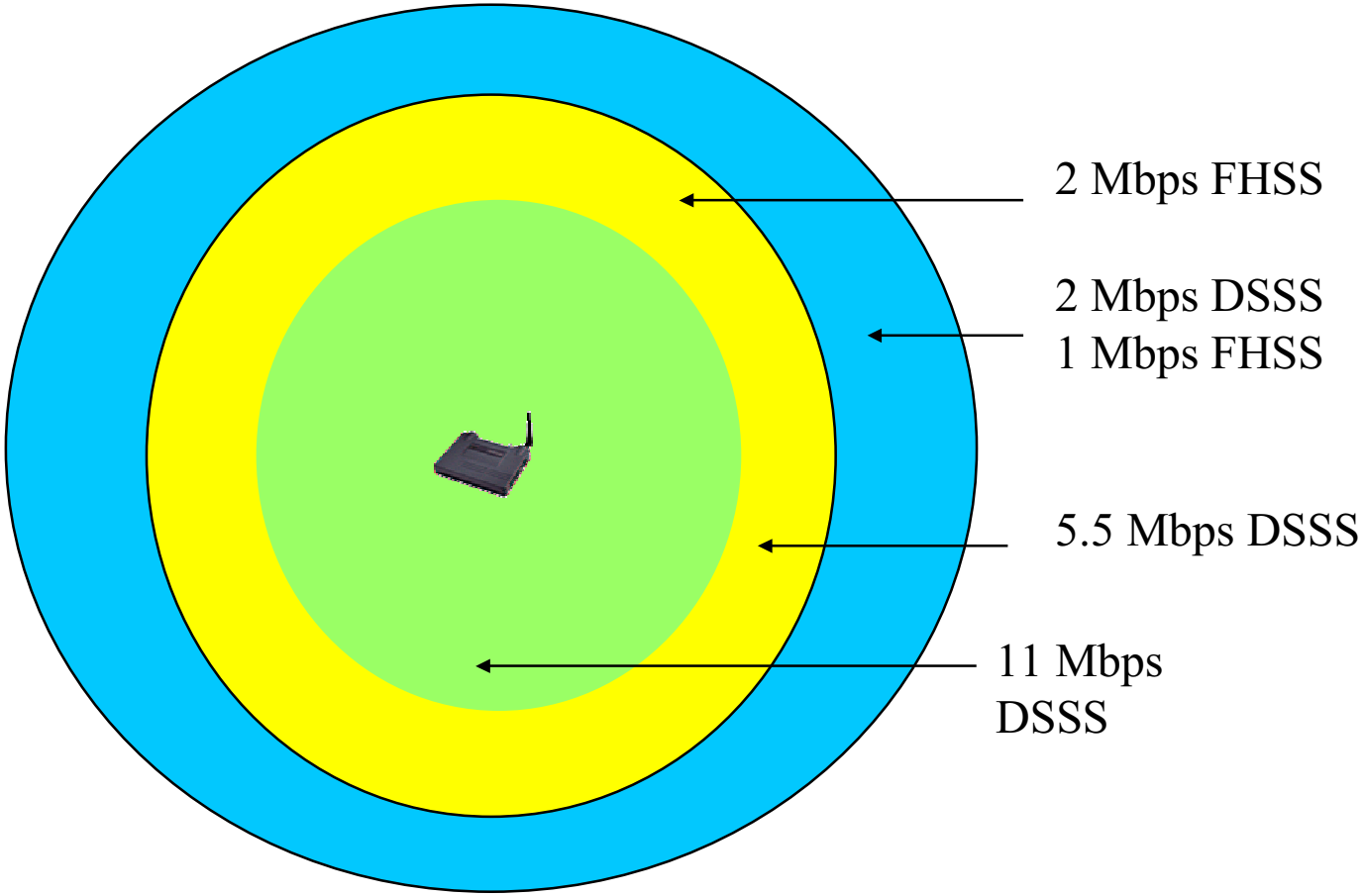


- **A set of colored pens, ruler and of course something to mark the locations in the facility such as flagging tape are also needed**

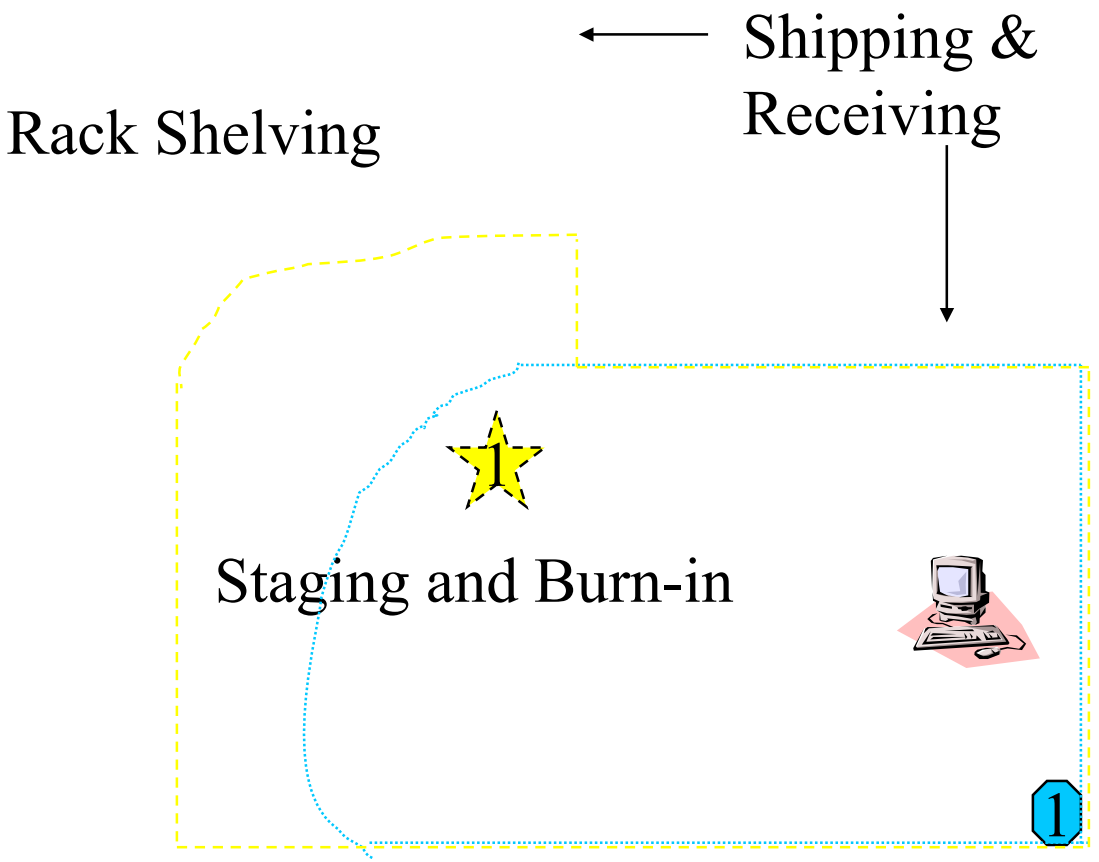
Site Walkthrough

- **A walkthrough is necessary for:**
  - **Defining coverage areas desired**
  - **Identifying environmental restrictions**
  - **Familiarizing with the facility to develop a game plan for the Site Survey**

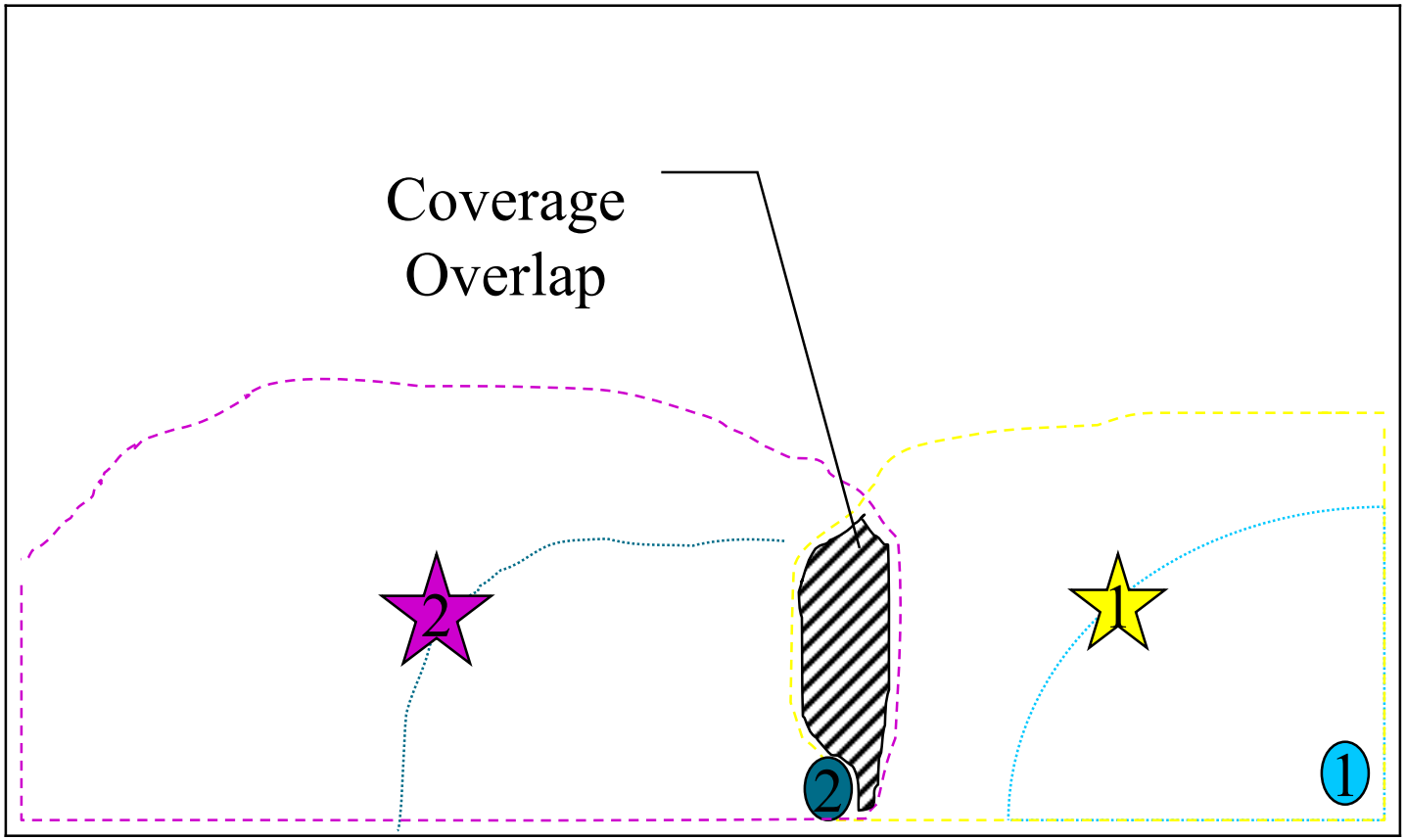
Think of Rate vs. Range



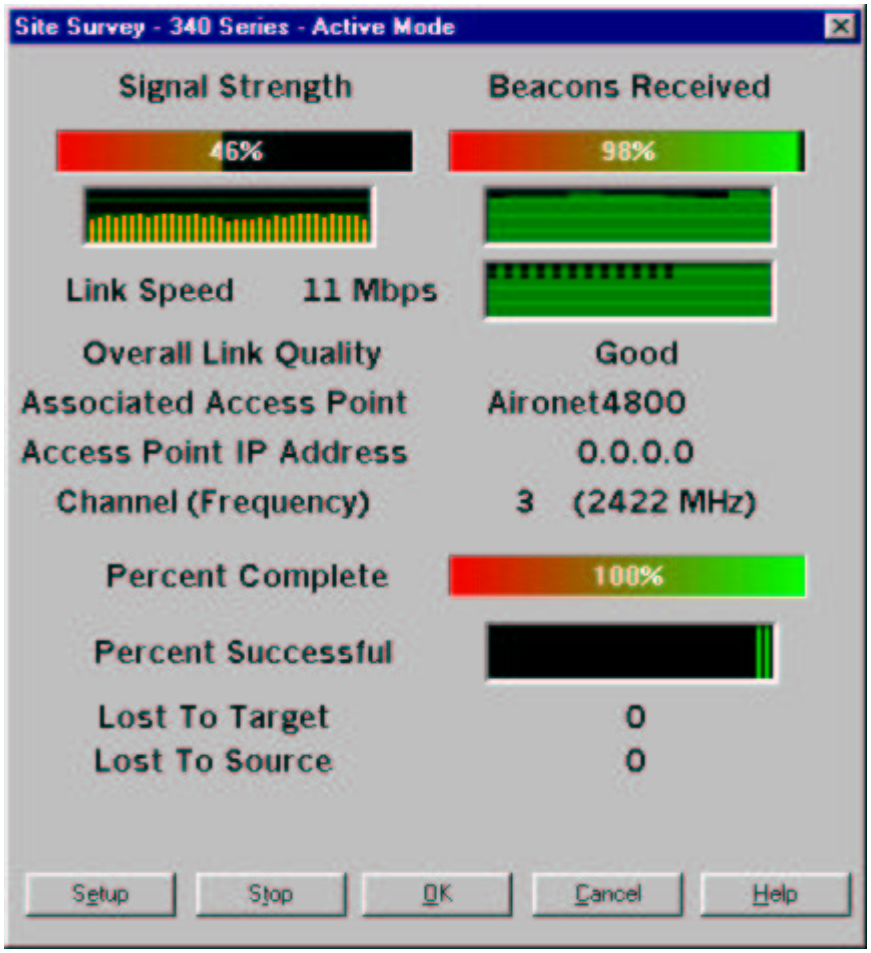
Facility Layout

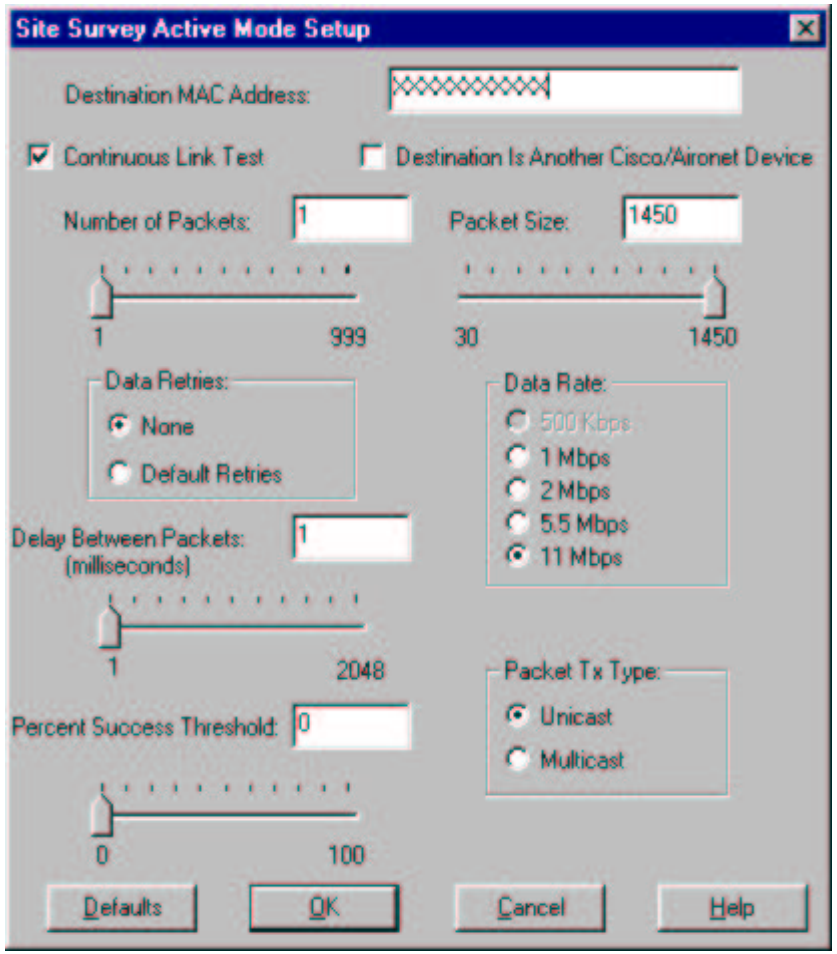


Continuing the Survey



Site Survey Utilities





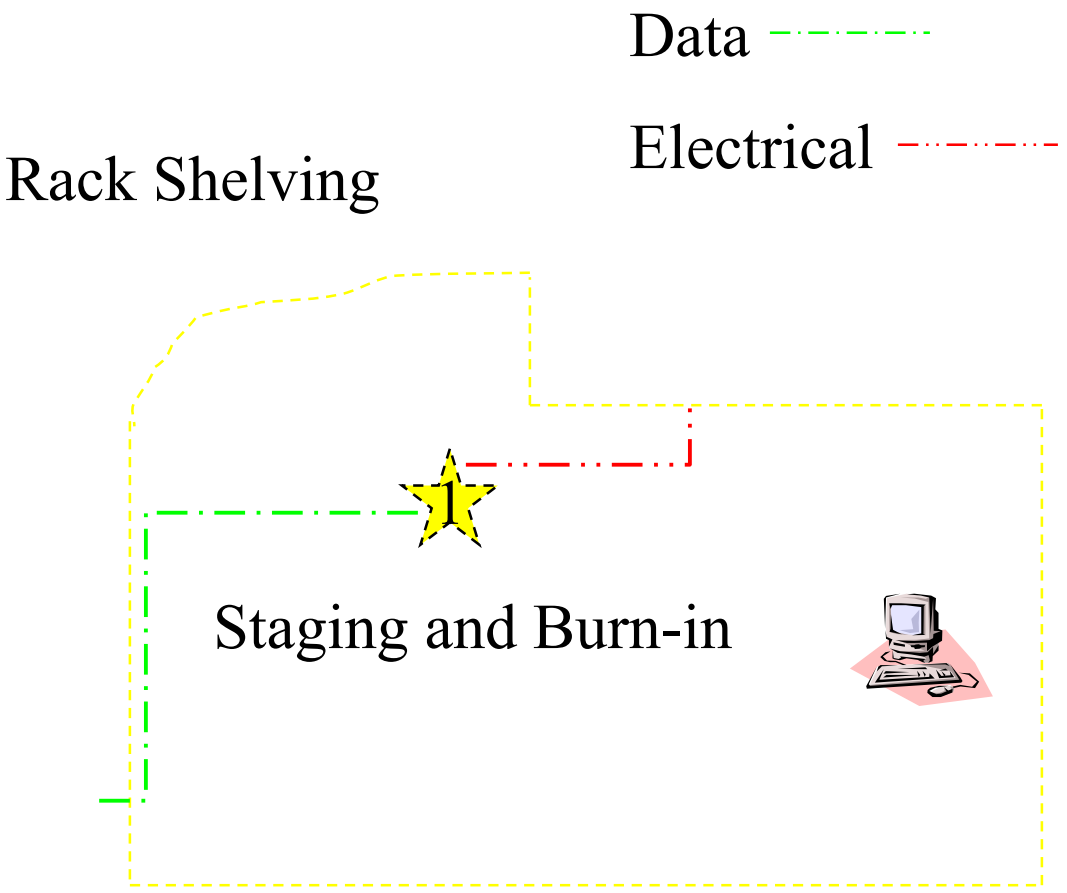
Site Survey Report

- **A good site survey report should include specific information:**
  - **Contact information**
  - **AP locations and Antennas used**
  - **Configuration notes**
  - **Cable and/or power requirements**
  - **Installation notes**
  - **Diagrams**

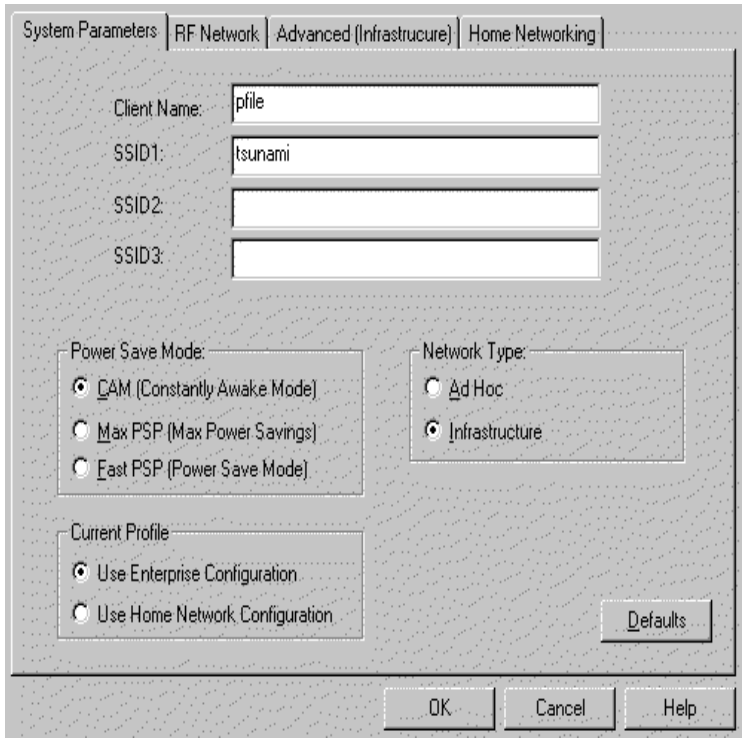
Installation of Equipment

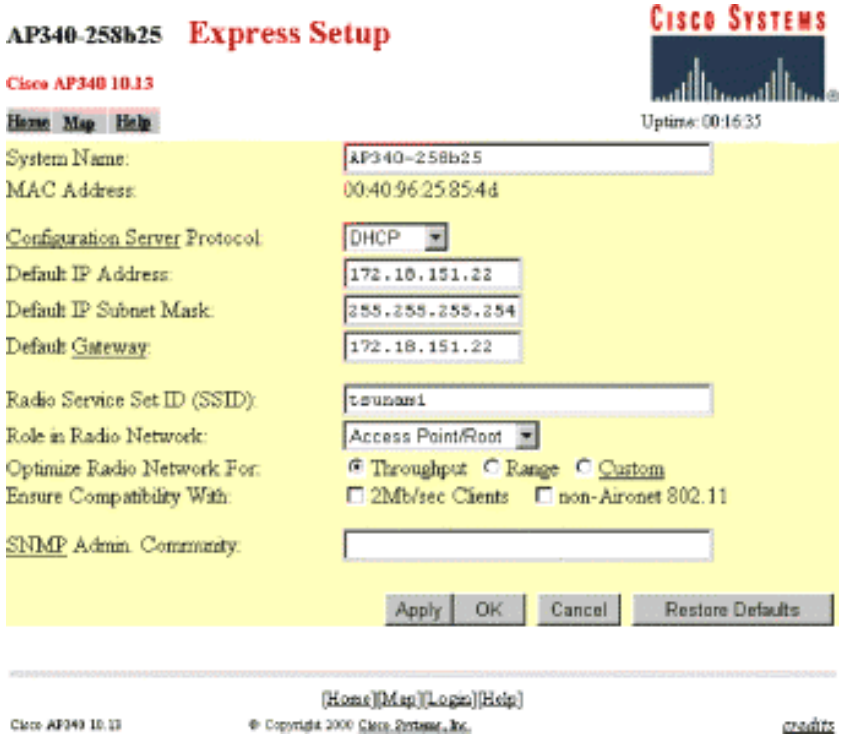
- Install Cabling and Electrical needs
- Inventory the equipment on site
- Configure access points
- Install access points, antennas and antenna extension cables if needed
- Connect all devices, power on and do a certification test to verify coverage

Cabling and Electrical



Inventory and Configuration

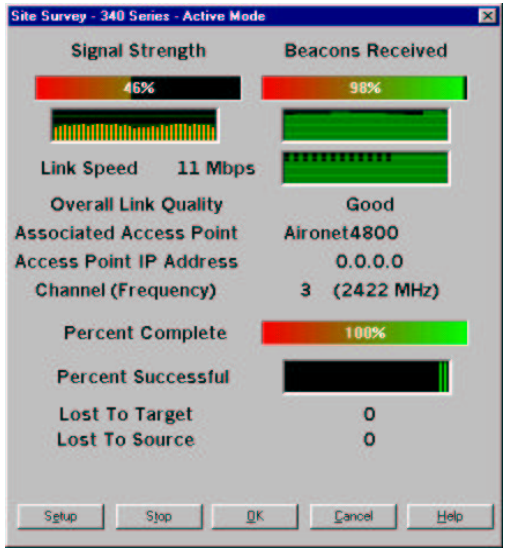




Be sure to connect Antennas before powering on!

Connect and Test

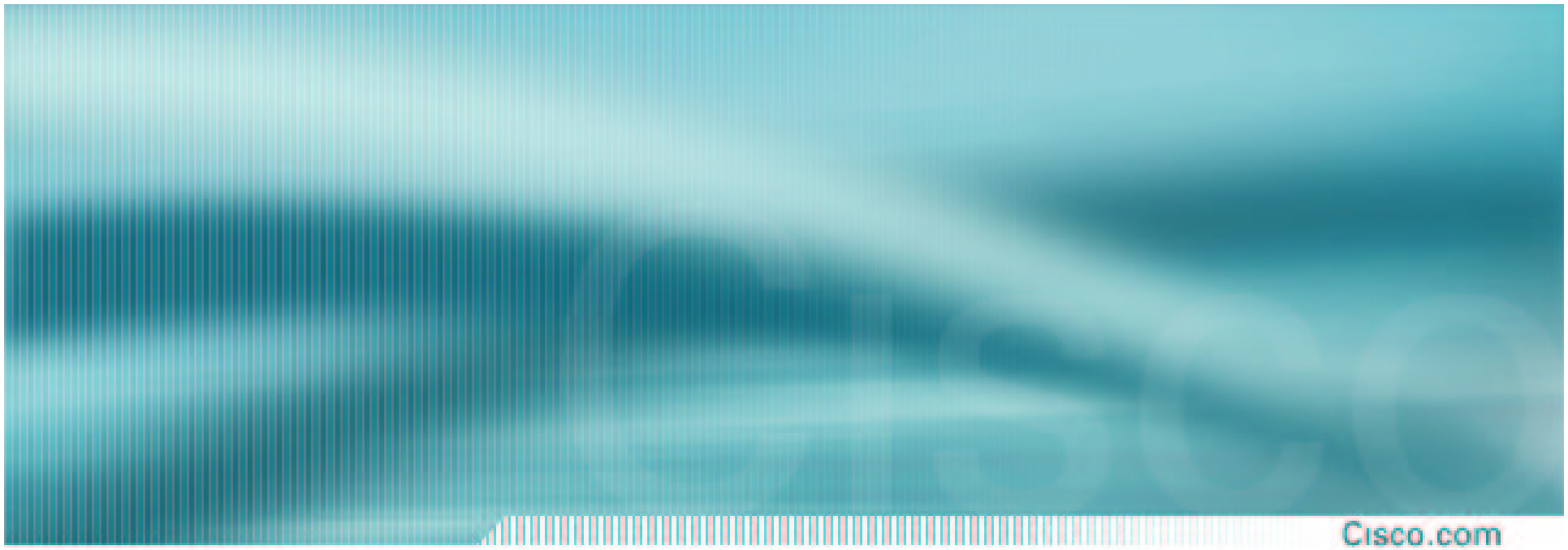
- Be sure to properly connect all devices then apply power
- Use the Cisco Site Survey utility to verify the installed coverage is right
- Check roaming
- Check data rate
- Check quality
- Check strength



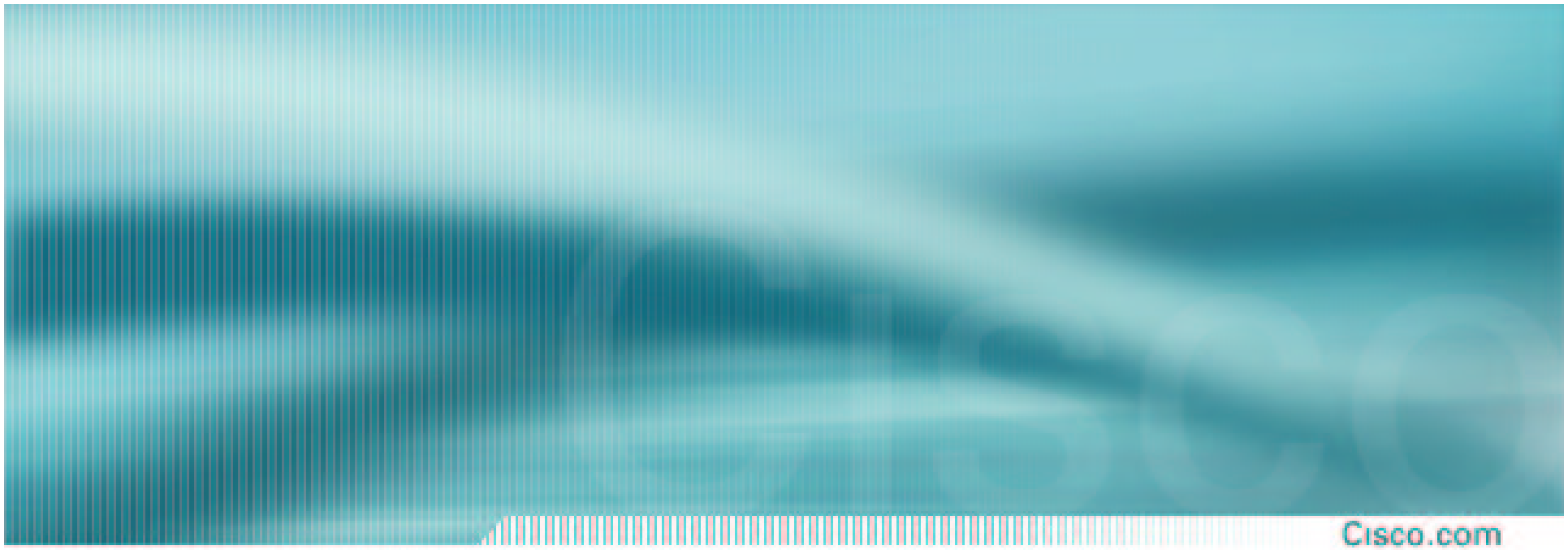
Professional Services

- MSI systems integrators
- IP Revolution
- NetCom International

  -focused verticals



Wireless LAN Security: Ready for Prime Time



Future of Wireless LANs

IEEE 802.11 Standard Activities

- 802.11a - 5GHz- ratified in 1999
- 802.11b - 11Mbps 2.4 GHz- ratified in 1999
- 802.11d - Additional regulatory domains
- 802.11e - Quality of Service
- 802.11f - Inter-Access Point Protocol (IAPP)
- 802.11g - Higher Data rate (>20 Mbps) 2.4 GHz
- 802.11h - Dynamic Frequency Selection and Transmit Power Control mechanisms
- 802.11i - Authentication and security