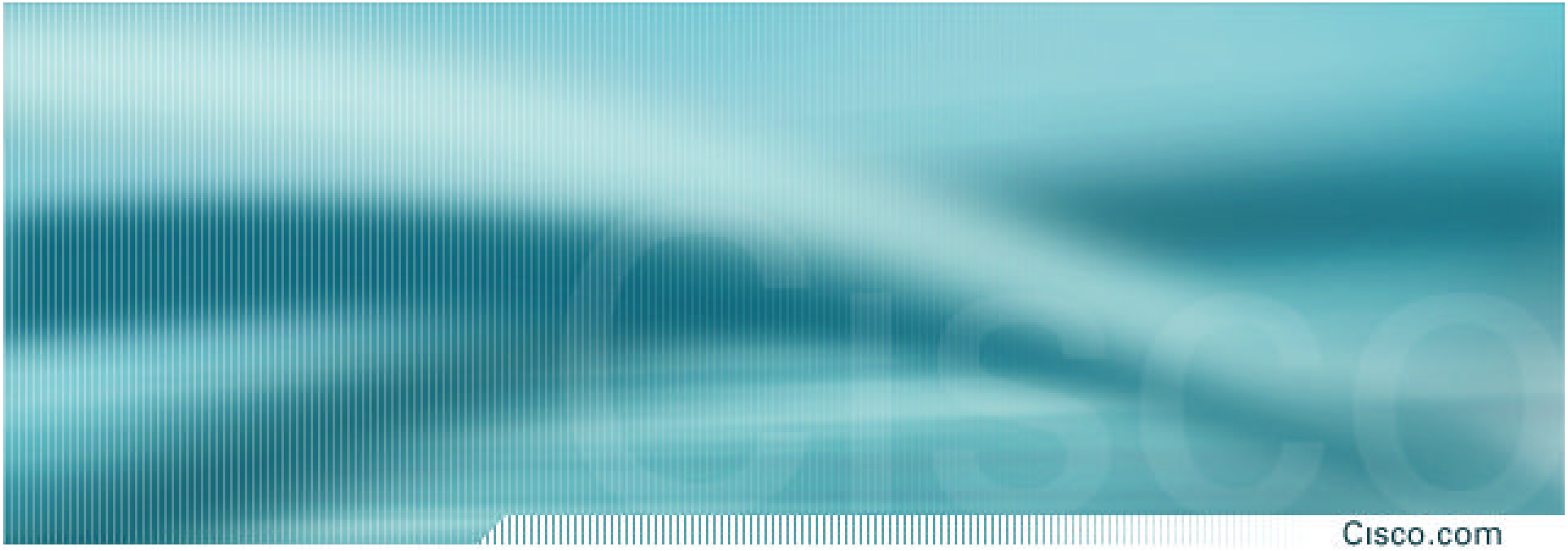


New Technologies for Wireless LANs

Bruce Alexander
Cisco Aironet Wireless Networking Business Unit

The Productivity Paradox

Why is it that the only location where employees have access to all their productivity tools...

...is the one location where they spend the least amount of time—

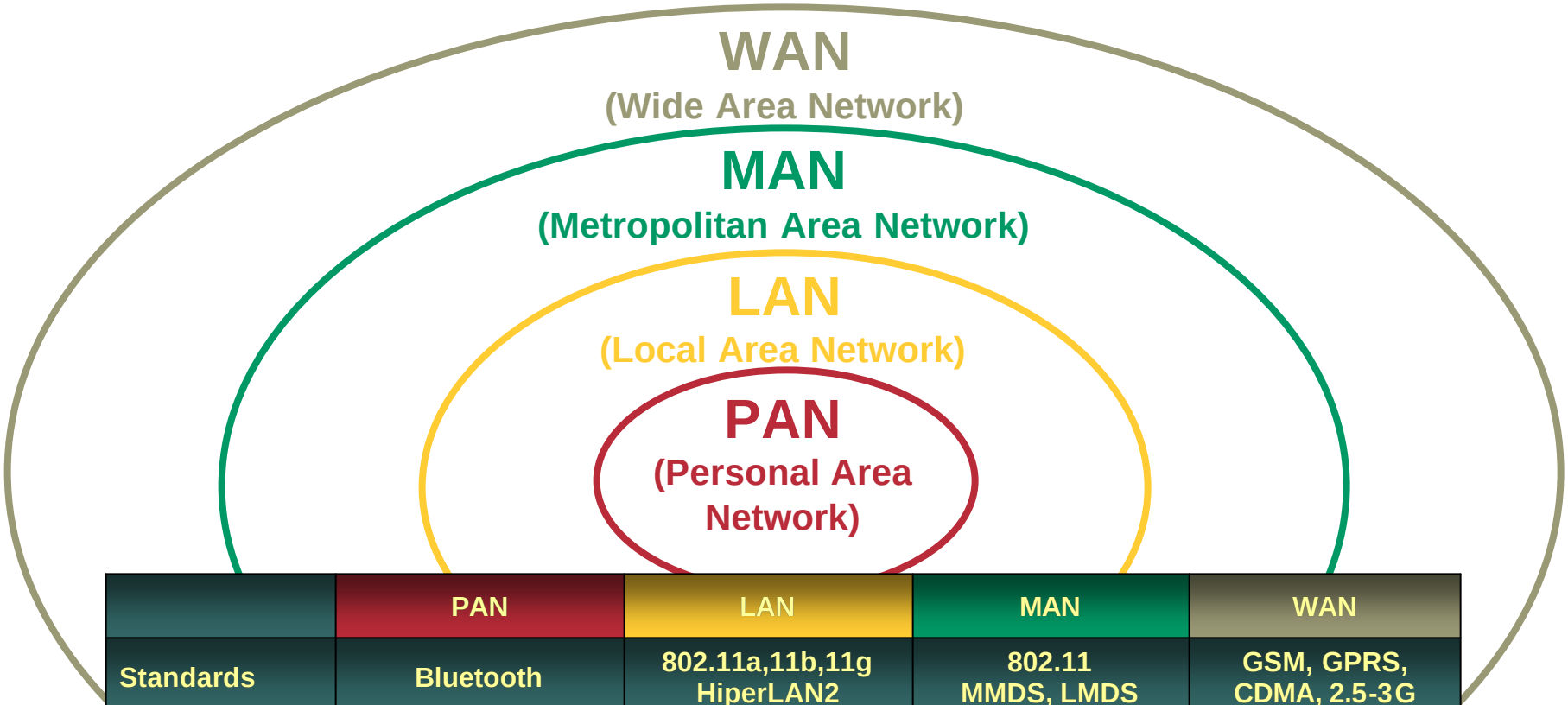
their desks

Technology that is available TODAY can help you build a WLAN that will continue to work for TOMORROW.

Seminar Overview

- WLAN Technologies
- 802.11a, 802.11b, 802.11h, and 802.11g
- When to use what technology
- Comparing 802.11a and 802.11b
- Combining technologies
- Security (Quick Update)

Wireless Technologies



	PAN	LAN	MAN	WAN
Standards	Bluetooth	802.11a,11b,11g HiperLAN2	802.11 MMDS, LMDS	GSM, GPRS, CDMA, 2.5-3G
Speed	< 1Mbps	2 to 54+ Mbps	22+ Mbps	10 to 384Kbps
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 LAN Technologies

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	802.11b	802.11a	802.11g
Frequency Band	2.4 GHz	5 GHz	2.4 GHz
Availability	Worldwide	US/AP	Worldwide
Maximum Data Rate	11 Mbps	54 Mbps	54 Mbps

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

802.11a

- Ratified as Standard in September, 1999
- Provides similar technology to HylerLAN2
- Data rates to 54Mb defined
- Provides 8 indoor WLAN channel
- Regulation differ extensively across countries

802.11a Issues

- 8 channels (UNII1 and UNII2 combined)

  May not be able to use adjacent channels in adjacent cells due to sidebands

- Interoperability—Some independent testing has been completed. Wi-Fi testing expected to start in late spring, early summer
- Not qualified for Europe

  TX power control and Dynamic Frequency Selection required- not part of 802.11a

802.11b
11Mb 2.4GHz Direct Sequence

Cisco.com

- Ratified as Standard in September, 1999.
- 11Mb 2.4Gz
- 11 US channels
- 13 ETSI channels
- 14 Japan Channels
- Power levels of 36dBm EIRP-FCC
  20dBm EIRP- ETSI
- Virtually approved for world wide use.

802.11h-
Spectrum Managed 802.11a

- **Still in Draft mode.**
- **Dynamic Frequency Selection (DFS)**

  Enables transmitter to move to another channel when is encounters other RF on its channel.
- **Transmit Power Control (TPC)**

  Provides minimum required transmitter power for EACH user

  Provides minimal interference to any other users or system
- **Required for ETSI for 5GHz.**

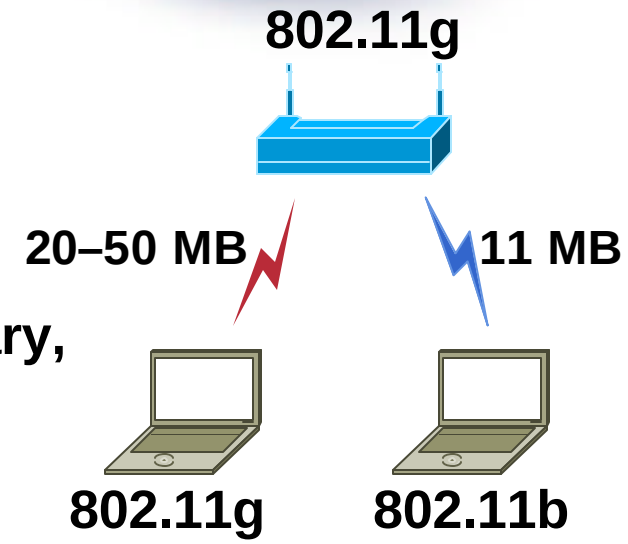
IEEE802.11g

Standard for Higher Rate (20+ Mbps) Extensions in the 2.4GHz Band

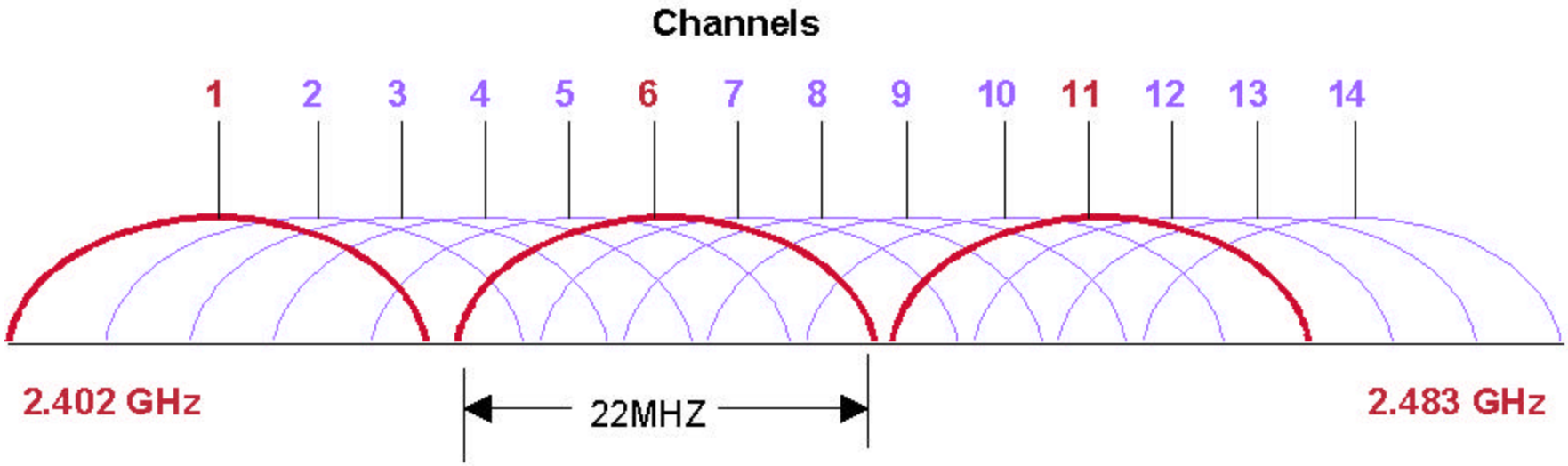
- **Working on Draft for Letter ballot.**

  Passed the task group committee only in November.

- **Provides higher data rates @ 2.4 GHz**
- **Similar speeds as 802.11a**
- **Backward compatible with 11 Mbps (802.11b)**
- **Same modulation as 802.11a—OFDM**
- **Estimated to complete specification in January, 2003.**



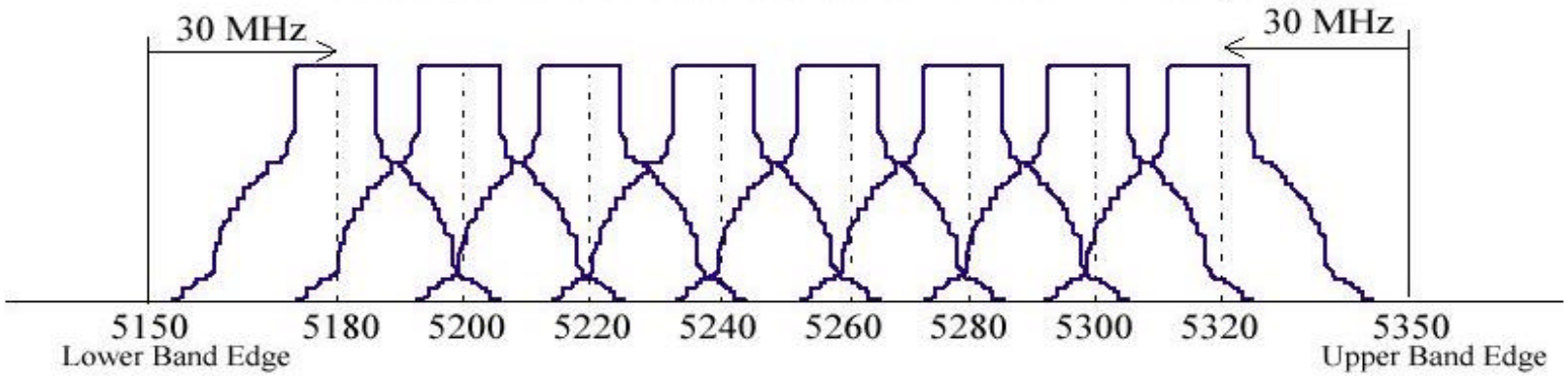
802.11b Channel Usage
Comparing WLAN Technologies



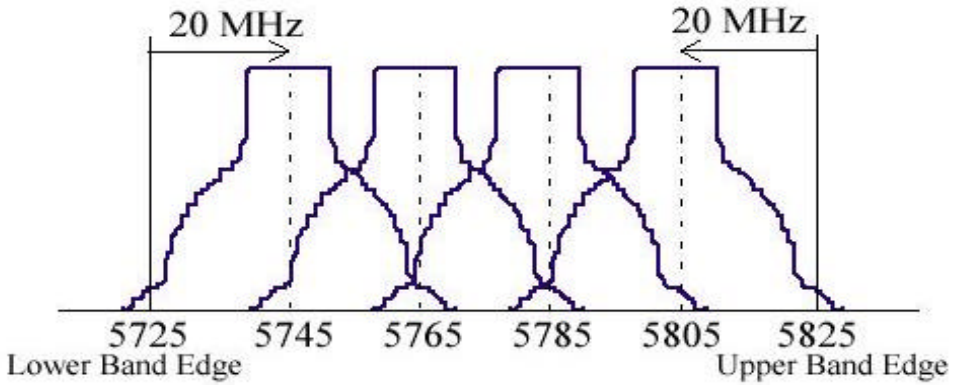
- **(14) 22 MHz wide channels (11 under FCC/ISTC)**
- **3 non-overlapping channels (1, 6,11)**

802.11a UNII-1 & UNII-2 ISM Channels

Lower and Middle U-NII Bands: 8 Carriers in 200 MHz / 20 MHz Spacing



Upper U-NII Bands: 4 Carriers in 100 MHz / 20 MHz Spacing



When to use

.11b for customers who…

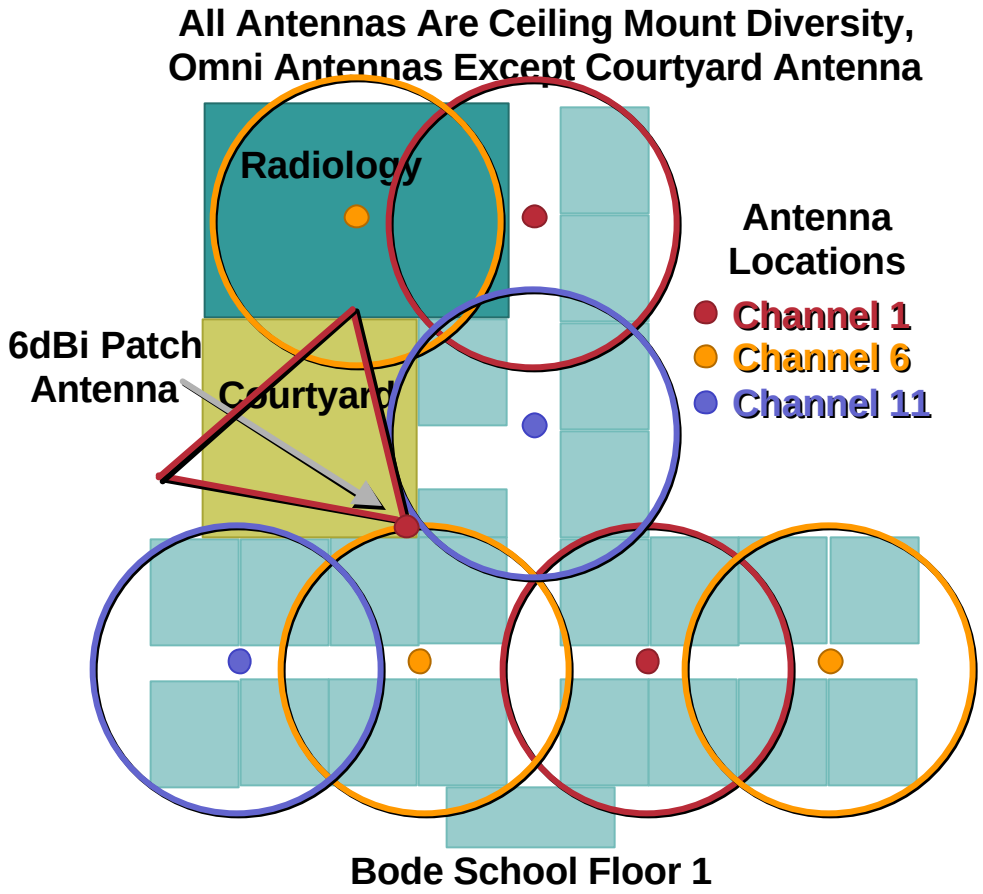
- Are transaction intensive
- Have a large installed base of .11b
- Have lots of roaming users (to other .11b sites)
- Require lowest acquisition cost

.11a for customers who…

- Require higher data rates
- Have a small installed base of .11b
- Require greater capacity (more channels)
- Are concerned about Bluetooth interference

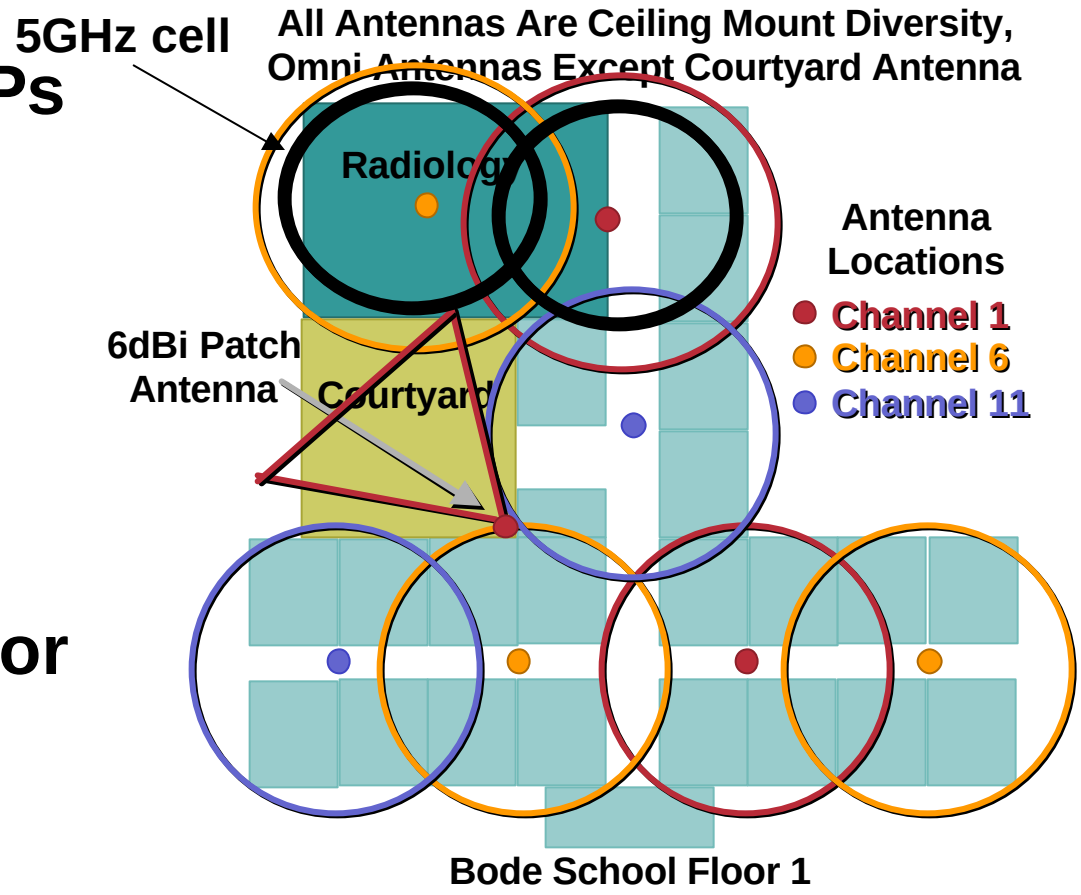
Healthcare Facility

- **Survey was based on 11Mb**
- **Antennas are diversity ceiling mount omni (blends in well) except courtyard**
- **Works well except Radiology!**

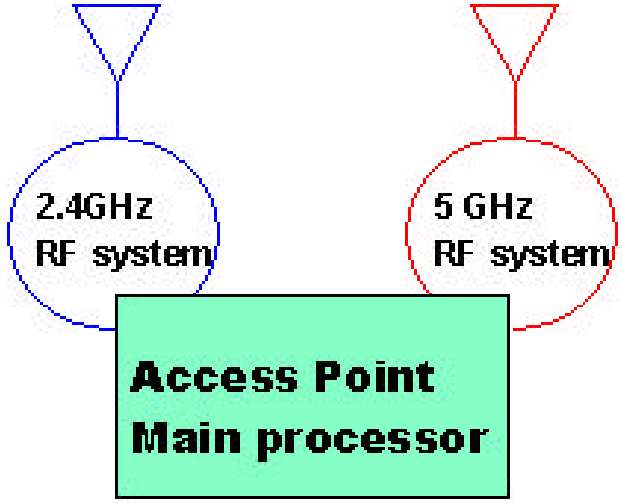


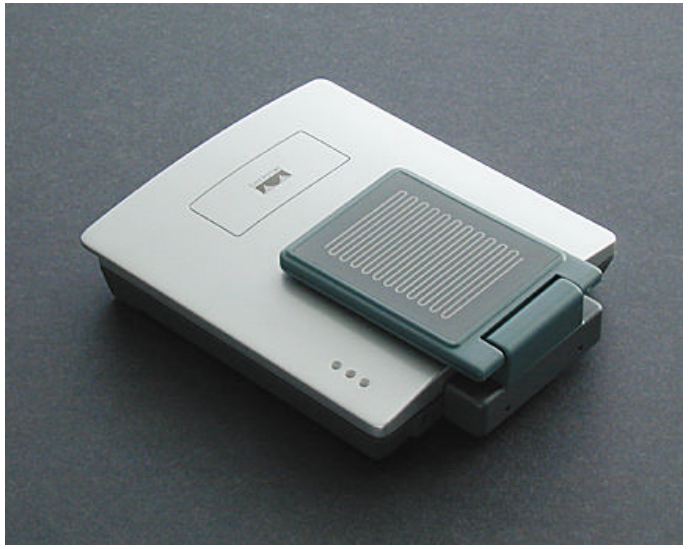
Healthcare Facility

- Add Dual Band APs for Radiology
- 802.11b 2.4Ghz devices usable everywhere
- 802.11a provides higher datarates for Radiology room



Dual Mode products

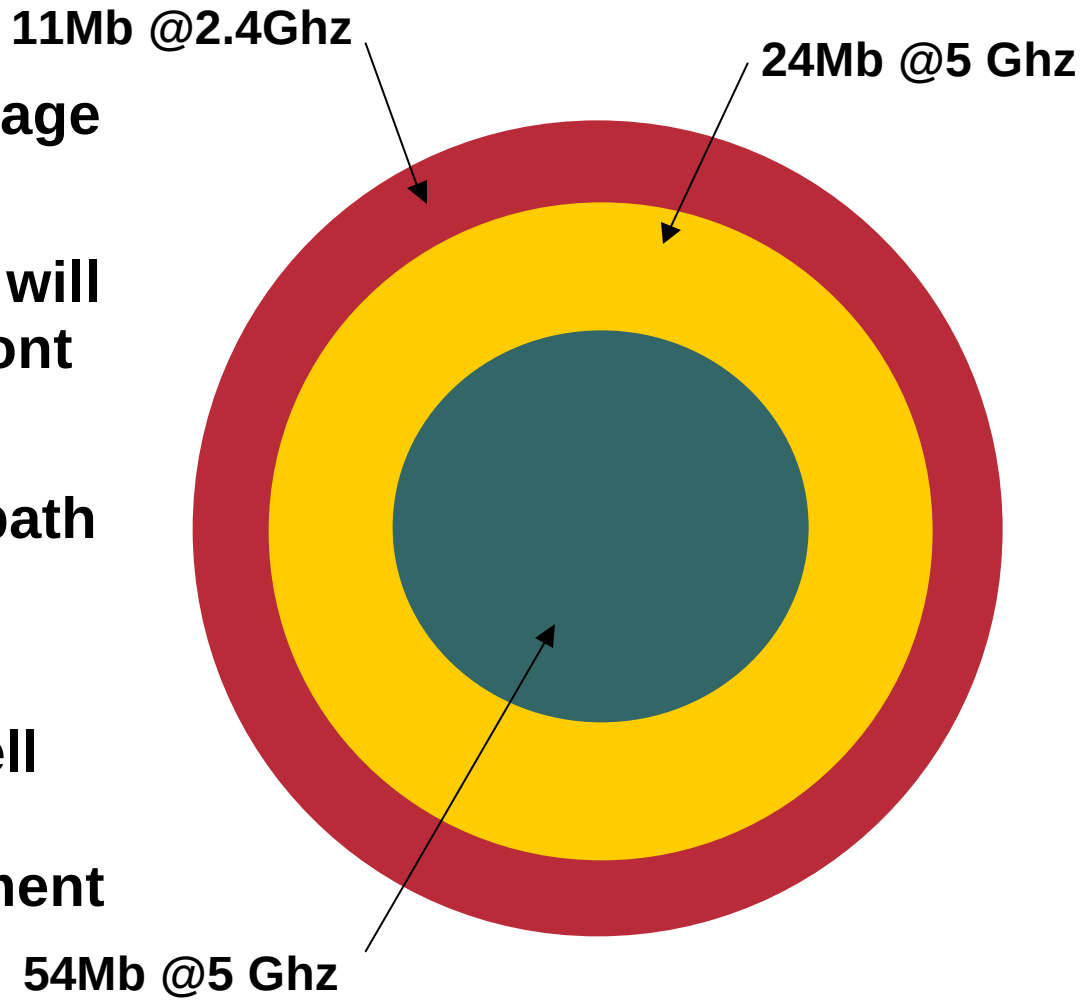




- **Dual Band Access points are available now**
- **Provides access and coverage for both 2.4 and 5Ghz clients simultaneously.**
- **Can be used to increase aggregate bandwidth per cell**

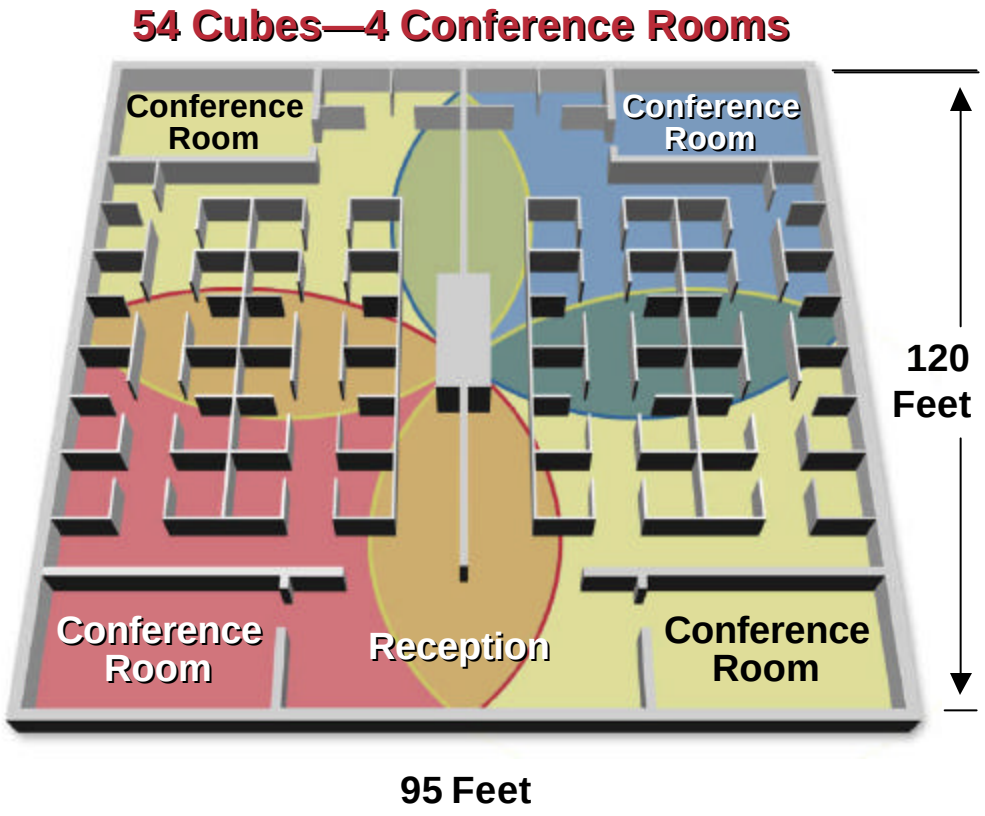
Coverage Differences

- 5GHz different coverage areas
- Mixing technologies will require a good up front design
- Provides migration path and increased throughput
- Design the 2.4ghz cell size to compliment future 5GHz deployment

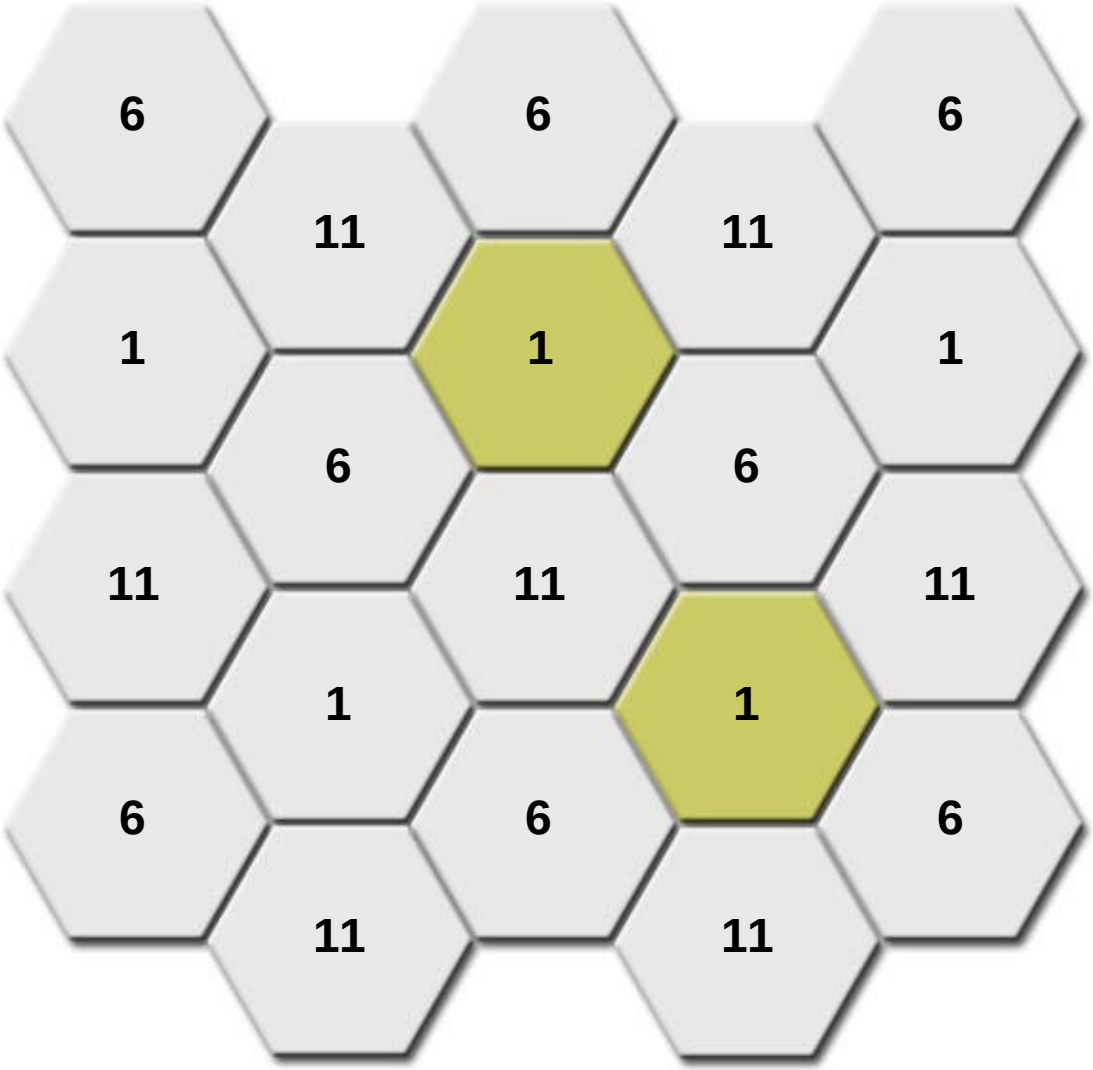


WLAN Implementation 802.11b

- 4 APS Used- 100mW
- Rate shifting NOT used- locked data rate @ 11Mbps
- Maximum per access point throughput is 6.8Mbps
- Standard 2.2dBi antennas used
- 14 users per access points with no Conference rooms provides approx .5 Mbps per users
- 14 users + 1 conference room (10 users) = 24 total users provides approx 280Kbps per user

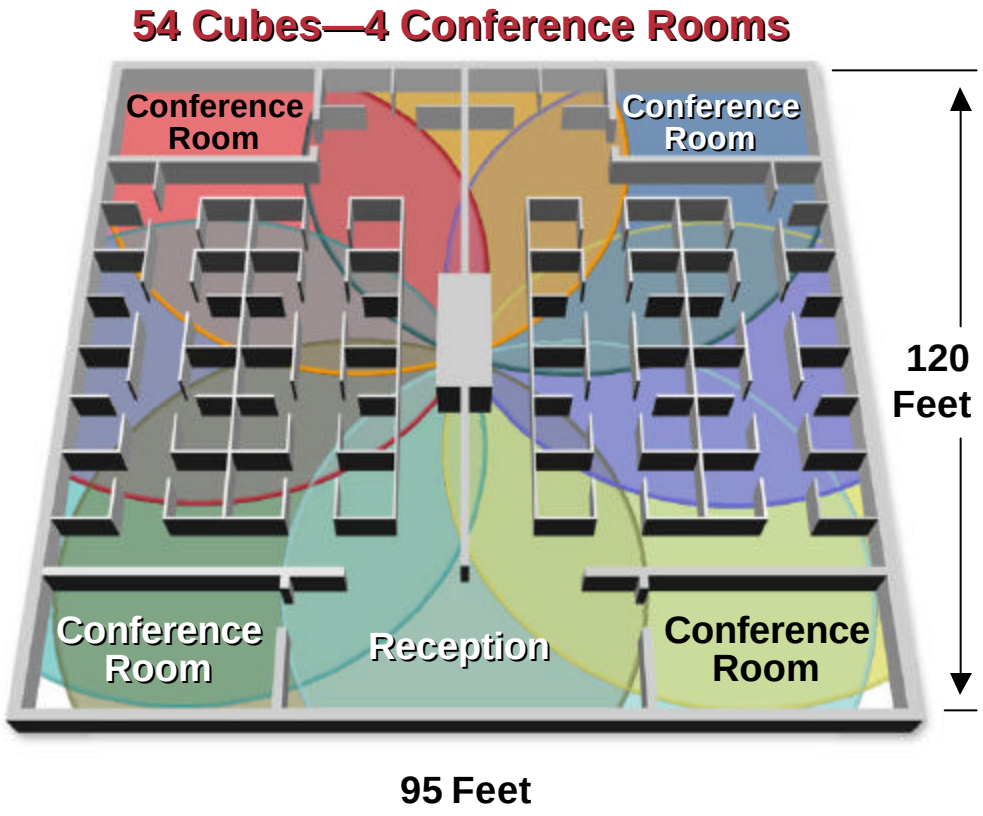


WLAN Design
Channel Reuse 802.11b

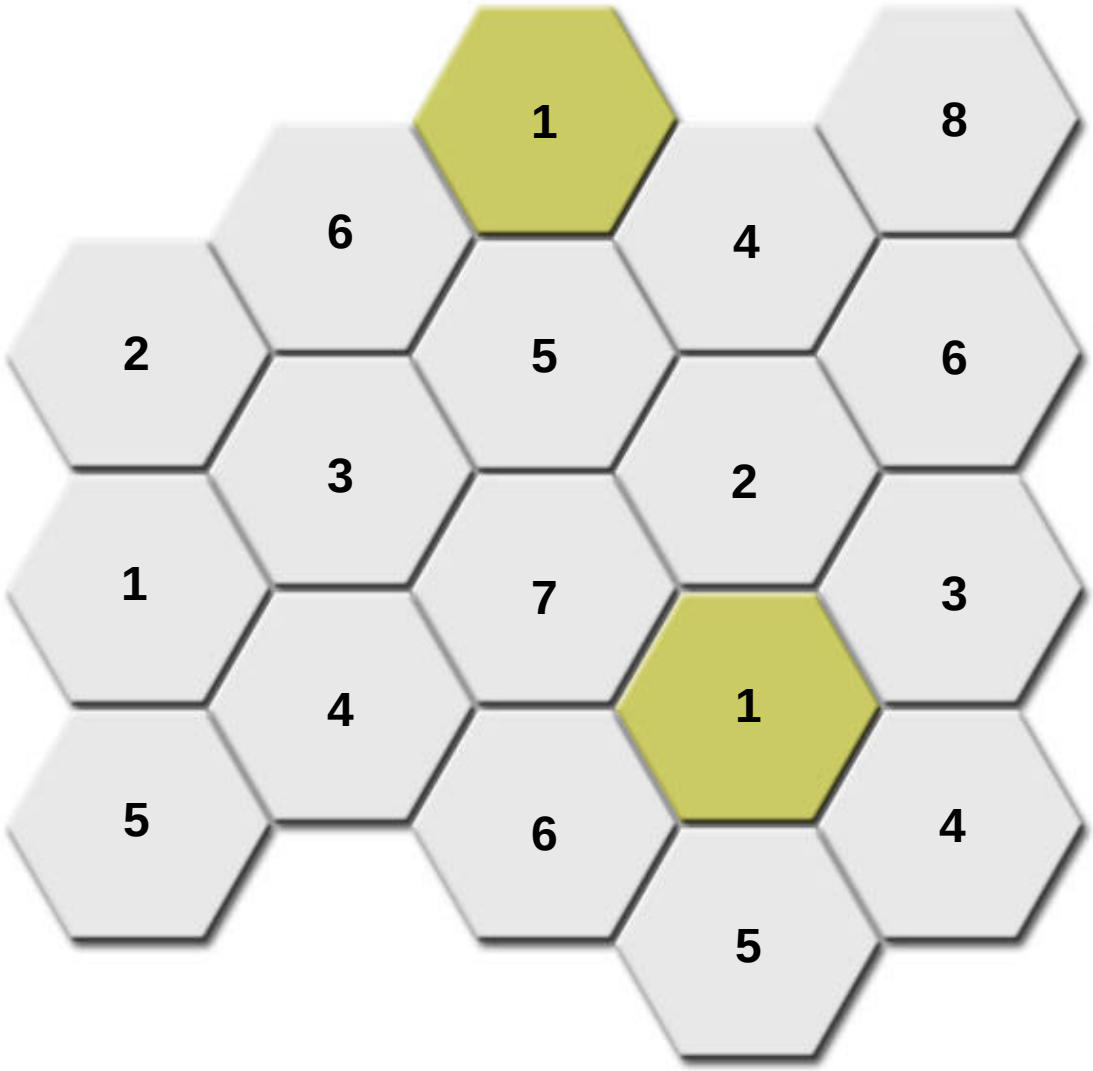


WLAN Implementation
802.11a Maximum Data Rate Example

- Power Output -40mW not adjustable
- 8 Access Points are used Maximum Cell/User density is 6 Users per Access Point + 10 users per conference room
- Maximum per access point throughput 32Mbps
- Fixed 2.2 dBi antenna used
- 7 users per access points with no Conference rooms provides 4.5 Mbps per users
- 7 users + 1 conference room (10 users) = 17 total users provides 1.8 Mbps per user

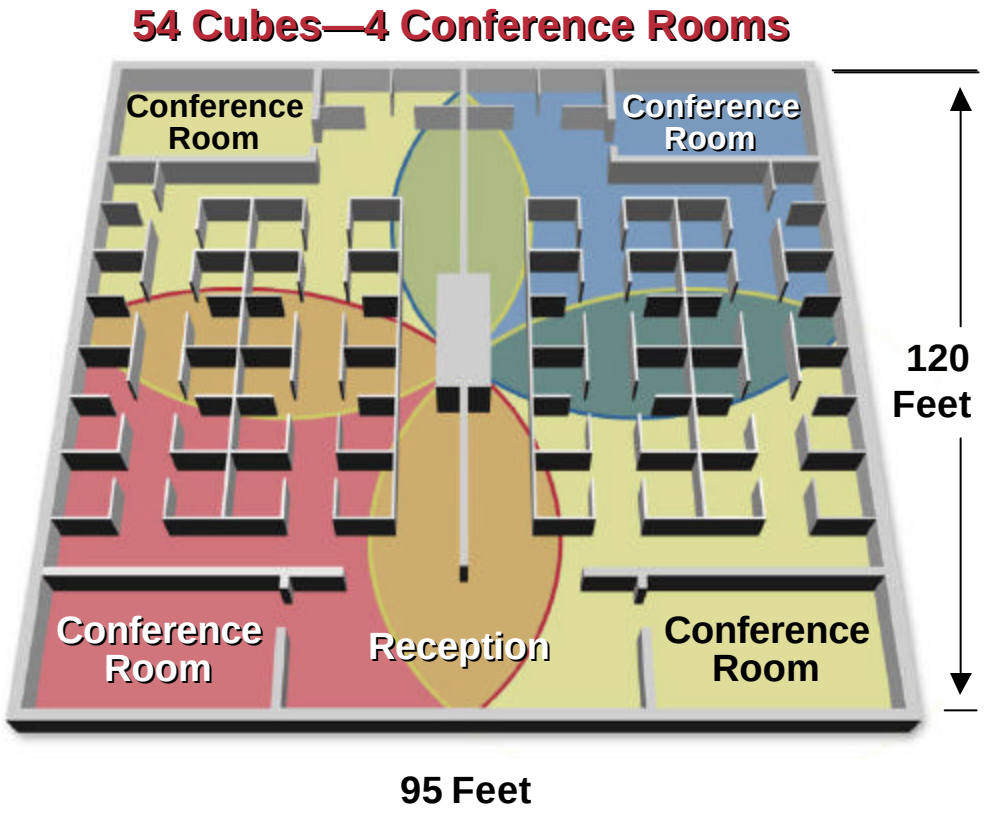


WLAN Implementation
Channel Reuse 802.11a

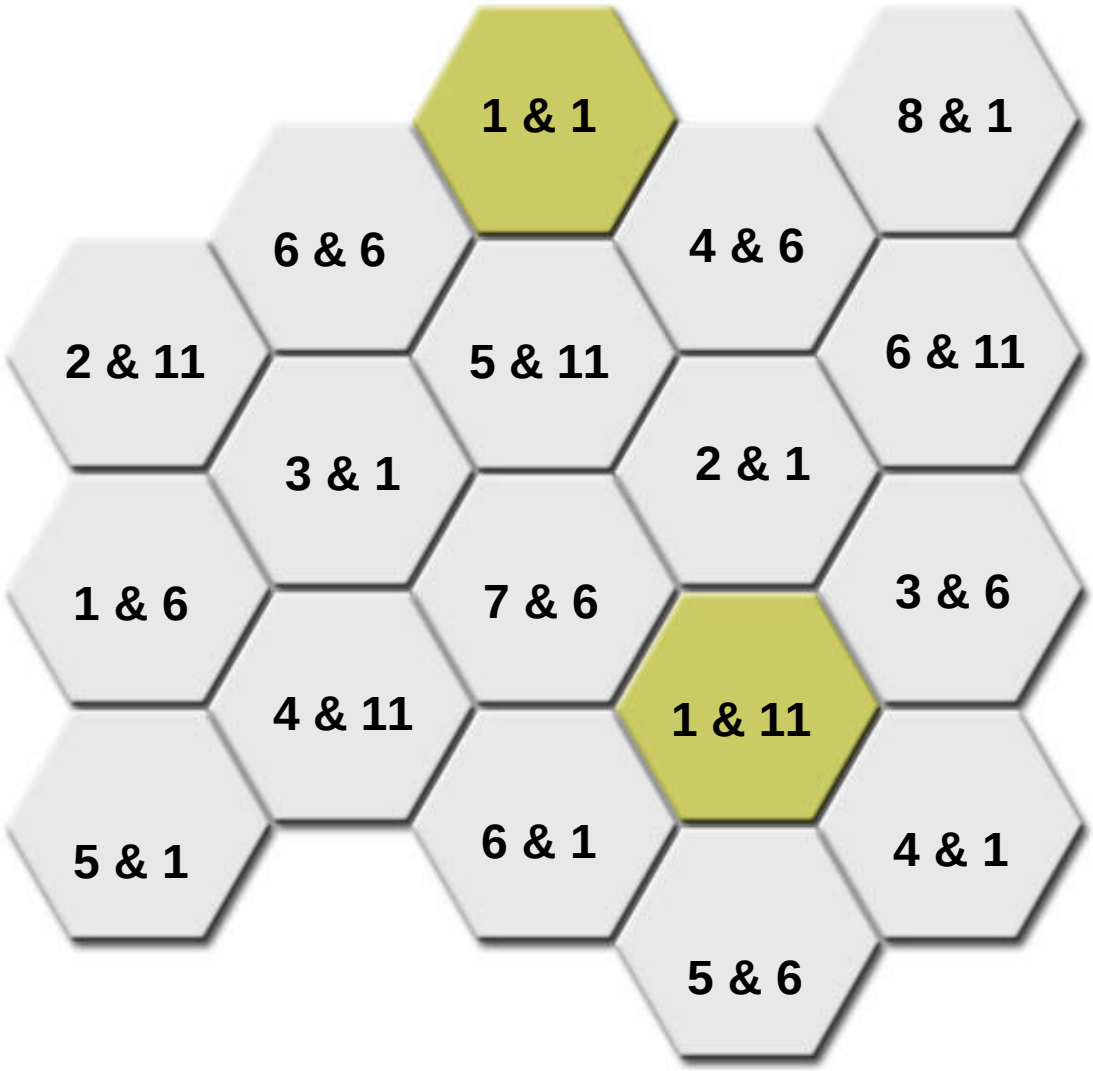


WLAN Implementation
802.11a migration strategy

- Dual band access points deployed
- 802.11a 5GHz users get datarates from 54Mb close in to 12Mb @max range
- Max users = 24 = 426Kbps
- 802.11b 2..4Ghz all run at 11Mb
- Worst case ALL users have 11Mb or more, with maximum of 12 users per system.



WLAN Implementation
Channel Reuse 802.11a & 802.11b



Cisco Security Profiles

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Open Access

No WEP and Broadcast Mode

Public Access

Basic Security

40-bit and 128-bit Static Encryption Key

Telecommuter & SOHO

Enhanced Security

Dynamic Encryption Key
Scalable Key Managem't
Mutual 802.1x/EAP Authentication
TKIP (® AES)

Mid-Market and Enterprise

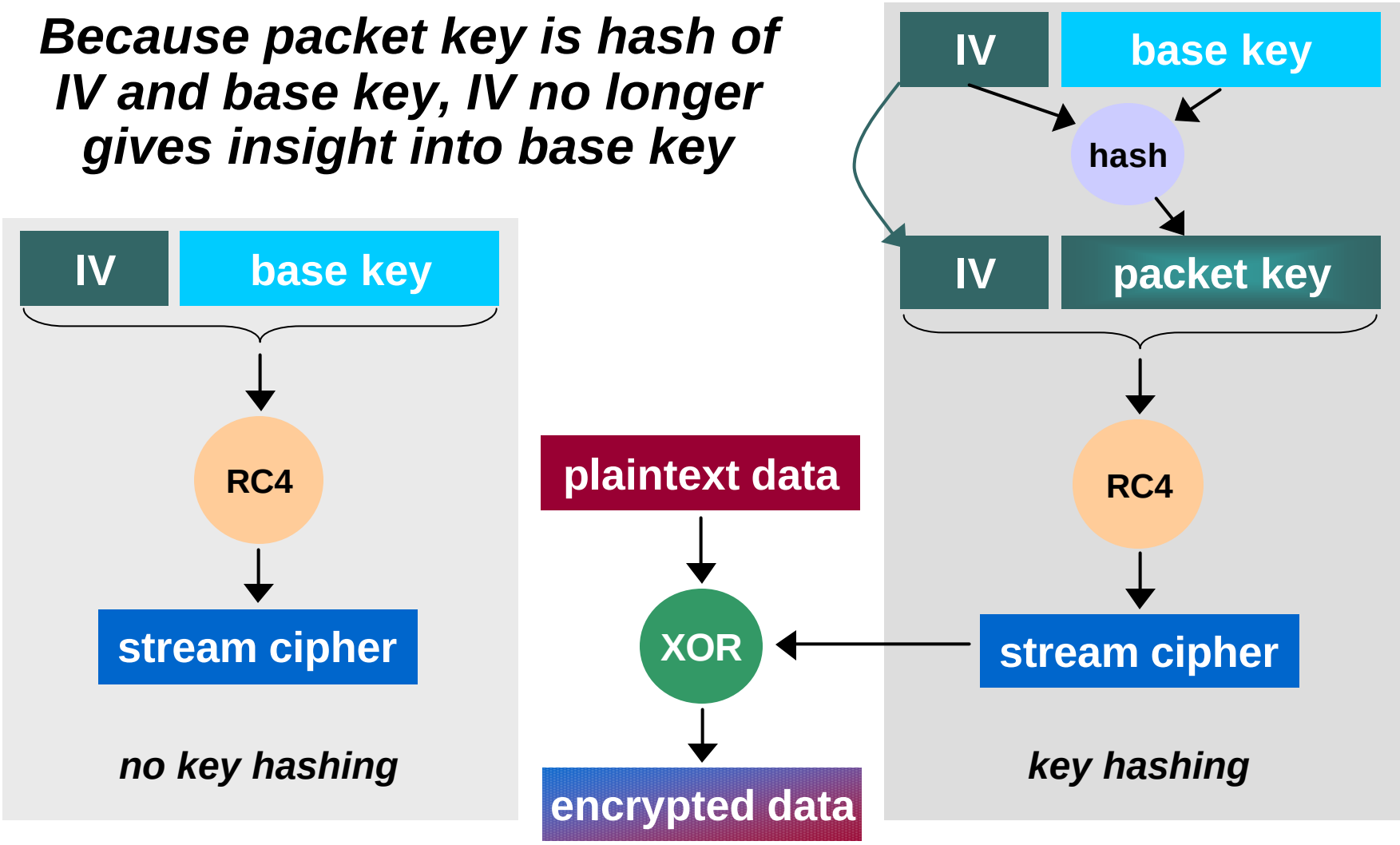
Public Network Security

Virtual Private Network (VPN)

Special Apps./ Business Traveler

TKIP- Improving the Encryption Scheme

Because packet key is hash of IV and base key, IV no longer gives insight into base key



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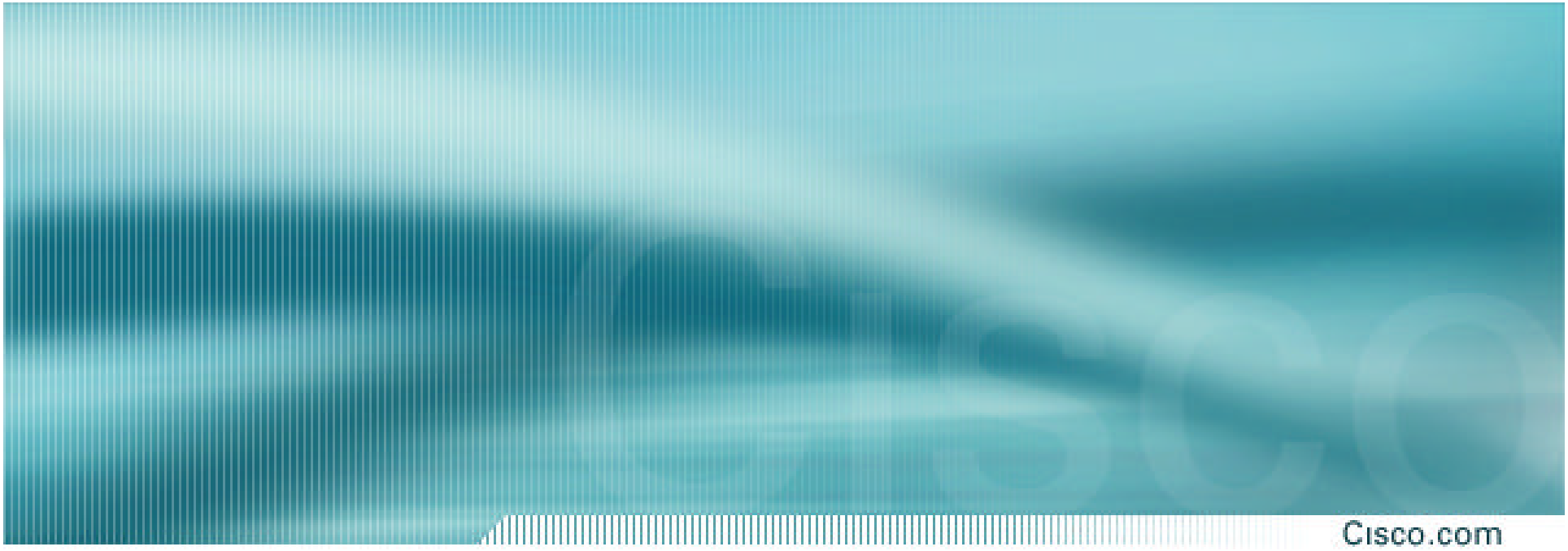

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