

Wireless Network Solutions

Paul Williams
Systems Engineer SPLOB Southern Africa
pawillia@cisco.com



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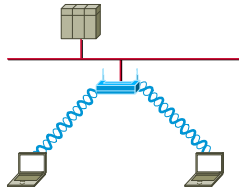
Wireless LAN Topologies

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Two Different Implementations of Wireless LAN Technology

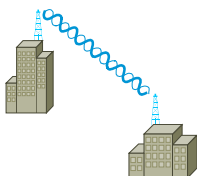
Wireless Networking

- Mobile user connectivity



Wireless Bridging

- LAN-to-LAN connectivity



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What Are Wireless LANs?

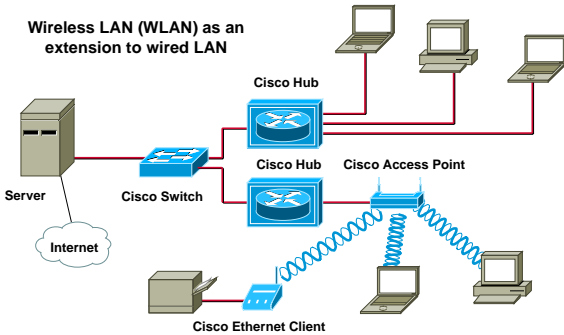
- They ARE:
 - Local, not wide area
 - In-building or campus area coverage for mobile users
 - Up to several miles for point-to-point (LAN to LAN)
 - Radio or infrared
 - FCC licenses not required
 - Customer owns the equipment (no usage charges)

- They ARE NOT:
 - Cellular phones/DECT
 - Pagers
 - Packet Data
 - Ardis
 - CDPD
 - RAM Mobile Data
 - PCS

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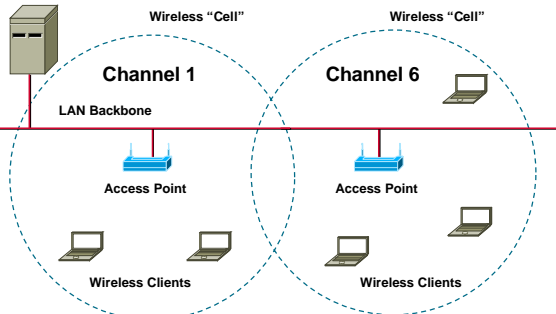
Local Area Network (LAN)

Wireless LAN (WLAN) as an extension to wired LAN

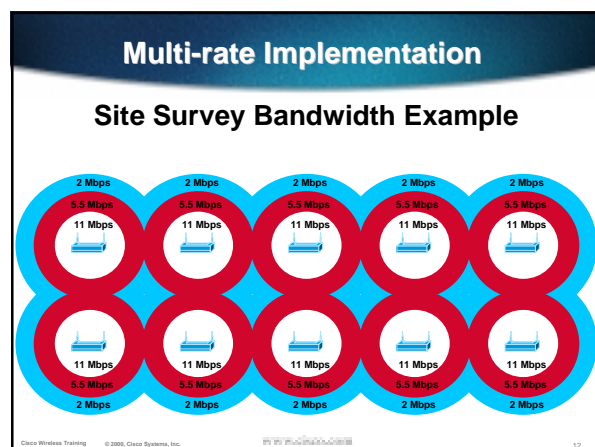
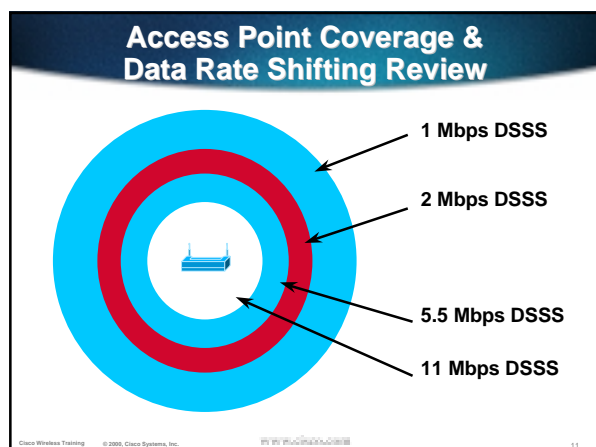
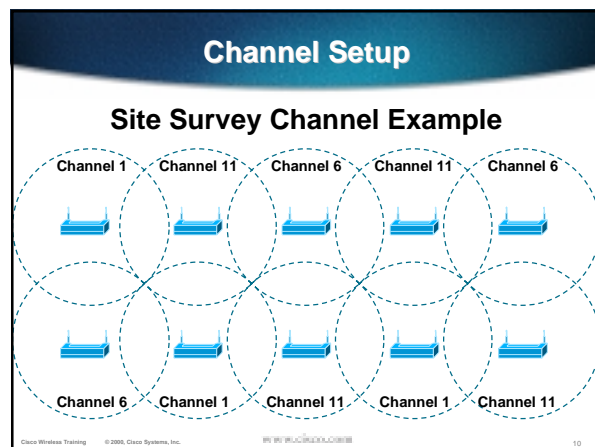
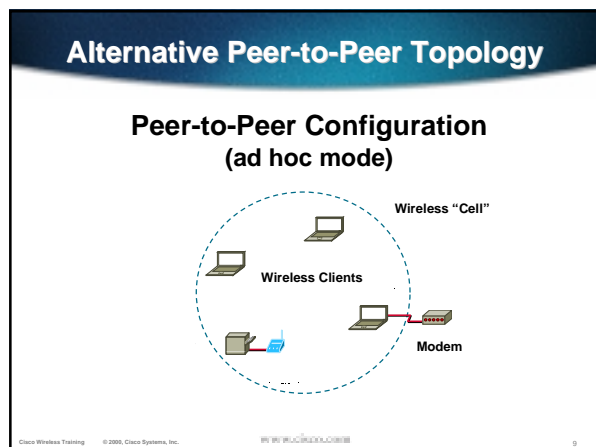
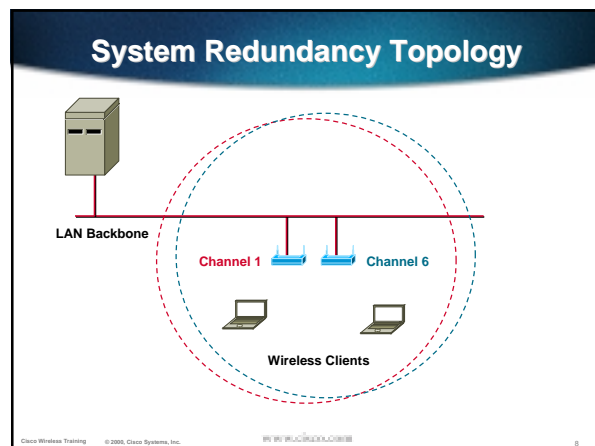
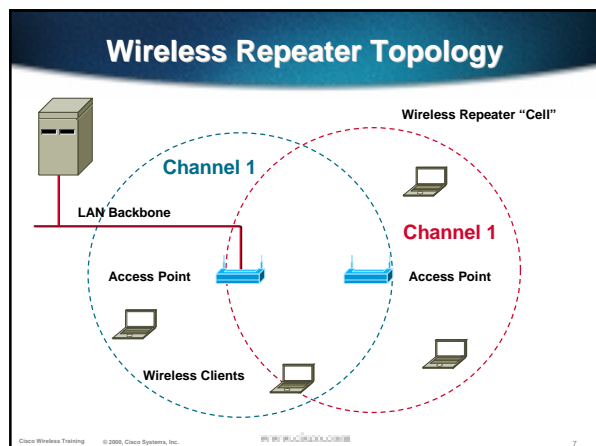


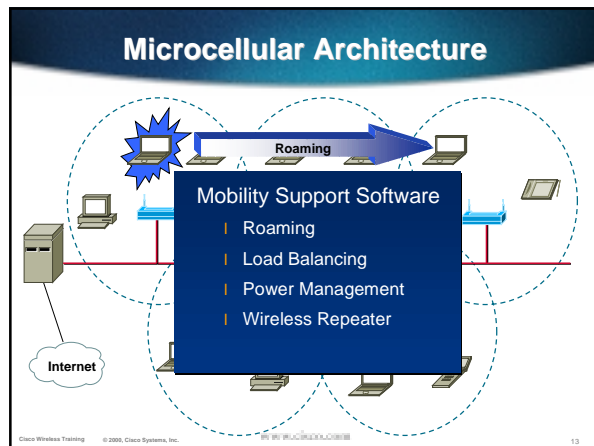
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Typical LAN Topologies



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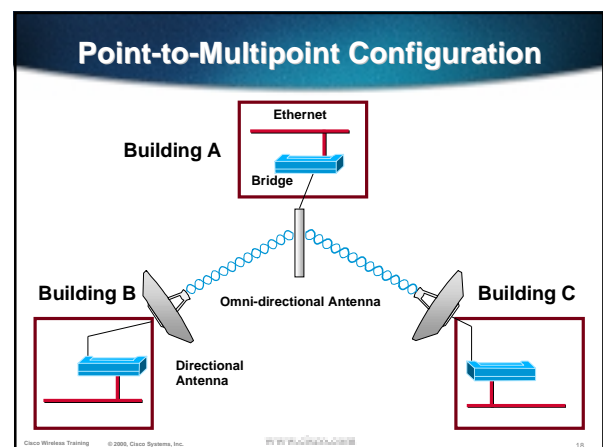
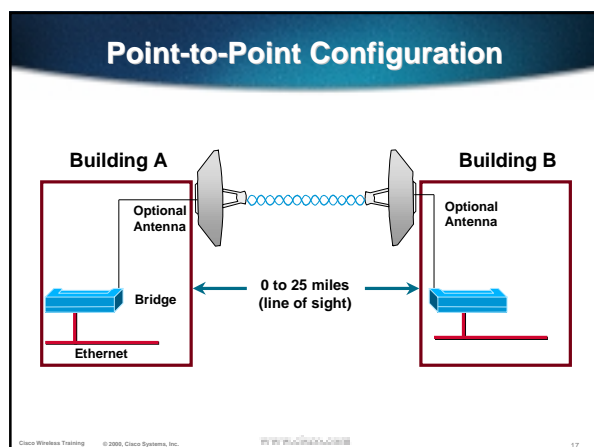
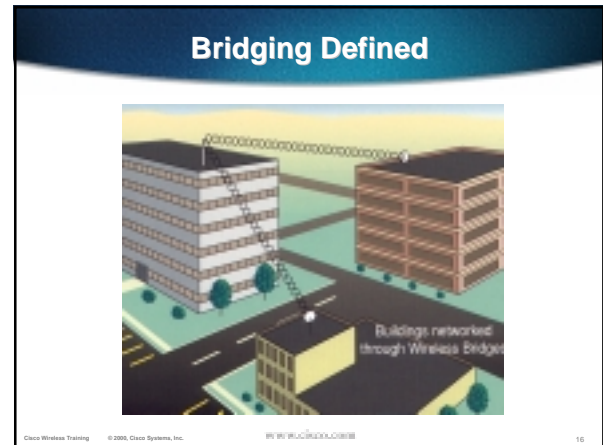
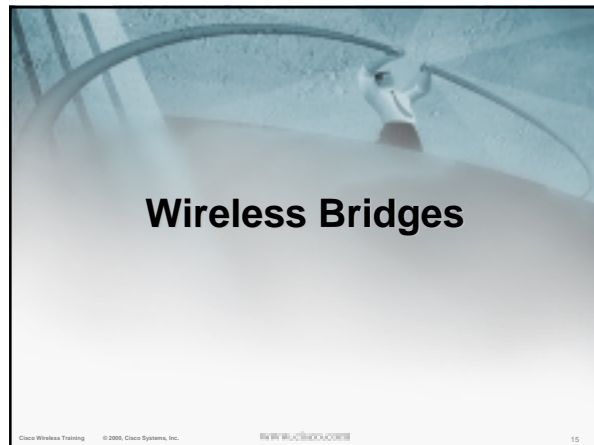




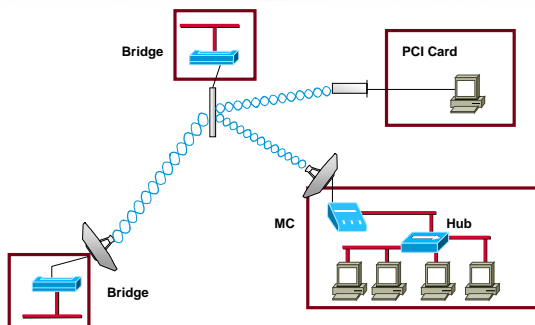
Common Questions

Questions	340 Series
How fast?	
Maximum data rate	11 MB
Typical throughput	5.5 MB
How far (at maximum data rate)?	
Outdoors	500 feet
Indoors	100 feet
How many?	
Maximum clients per AP	2048
Typical clients per AP	Same as Ethernet seg.
Co-located APs	3

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New Addition to the System!



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Products: Wireless Bridges

Bridge Model	Data Rate	Max. Distance	Optional Antenna	Standard Cable (6.7dB/100FT)
340	11Mb	11.5 Miles	21dBi Dish	50ft/side
	11Mb	18 Miles	21dBi Dish	20Ft/side
	5.5Mb	16 Miles	21dBi Dish	50ft/side
	2Mb	25+ Miles	21dBi Dish	50ft/side
	1Mb	25+ Miles	21dBi Dish	50ft/side

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What Makes Cisco's Bridges Best?

- Flexibility: point-to-point and multipoint
- Management capabilities
 - SNMP, telnet, FTP, HTML
 - 802.1d spanning tree
- Breadth of product line
 - 1,2,5.5, and 11mbps
 - Antenna/range options
- Price/performance



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Optional Antennas for Long Range



13.5dBi Yagi
Distances over
6.5miles @ 2Mbps and
2miles @11Mbps



21dBi Solid Dish
For distances up to
25+ miles @ 2Mbps
11.5miles @ 11Mbps

Note: Distances include 50 feet of low loss cable and 10dB fade margin

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Common Questions

	340 Wireless Bridge	
How Fast?		
Max data rate	11Mbps	2 Mbps
Typical throughput	5.5Mbps	1.4 Mbps
How Far? (at MAX rate)		
Yagi antenna	2miles	6.5 miles
Dish antenna	11.5 miles	25+ miles

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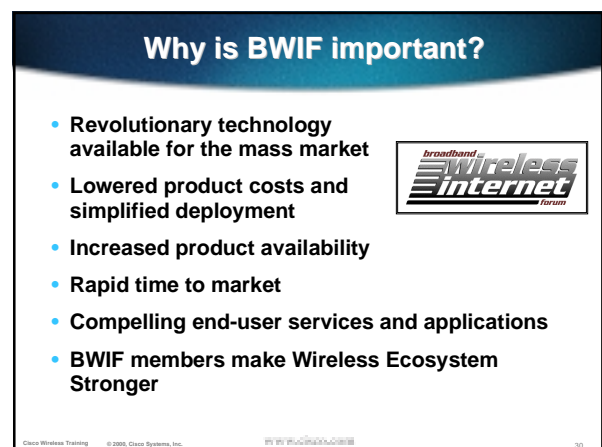
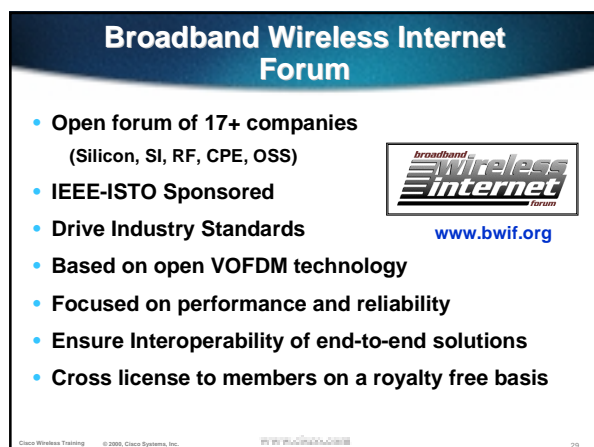
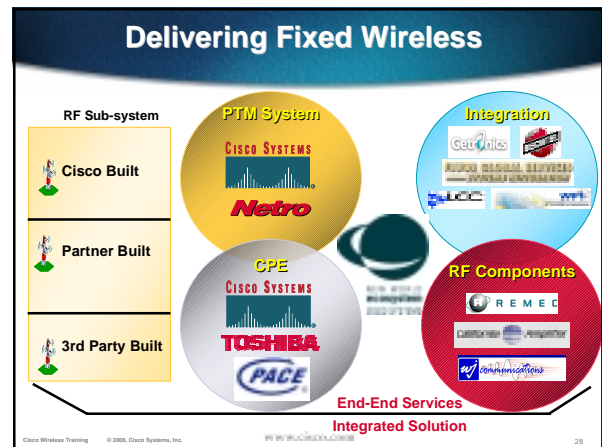
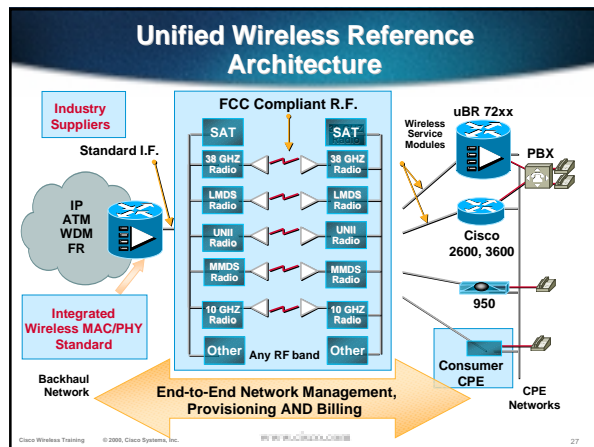
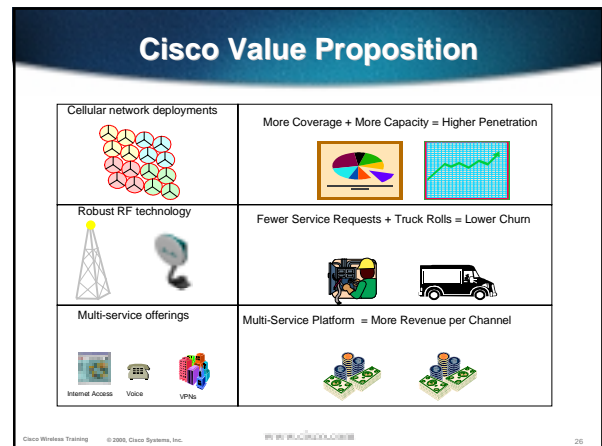
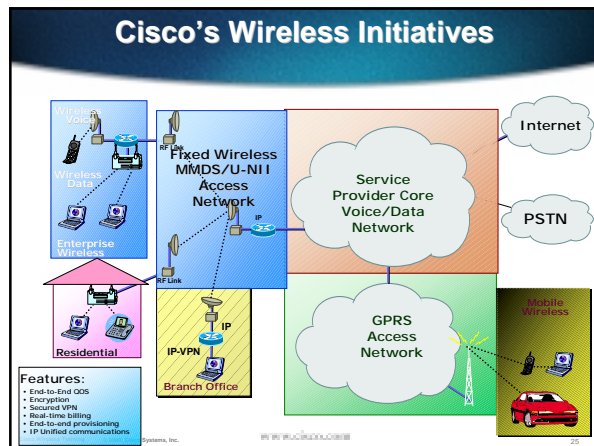
Fixed Broadband Wireless



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Activities to Date

- First Meeting August 30, 2000
 - Over 60 companies Attended
 - Presentations from Service Provider Customers, Industry Analysts, BWIF Members, IEEE-ISTO
- Public Relations Program Beginning
- Technical Councils and Marketing Committees formed
- BWIF Version 1.0 VOFDM Specifications approved by board and released to members



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MultiPoint Spectrum

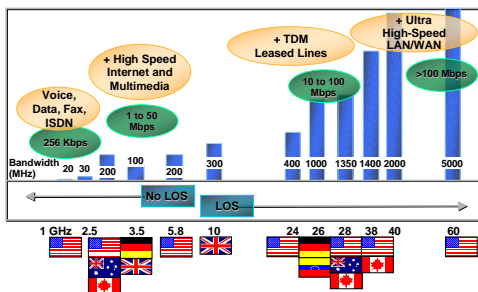
- Licensed spectrum
 - North America: 2.5GHz, 24GHz, 28/31GHz, 38GHz
 - Europe: 3.5GHz, 10GHz, 26GHz, 28GHz, 41GHz
 - Latin America : 3.5GHz, 10GHz, 26GHz, 28GHz, 38GHz
 - Asia: 3.5GHz, 28GHz, local allocations, others TBD
- Unlicensed spectrum
 - North America: 2.4 GHz (ISM), 5.7GHz (U-NII)
 - Europe: 2.4 GHz (ISM)
 - Latin America: 2.4 GHz (ISM)
 - Asia: 2.4 GHz (ISM)

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Access Spectrum Availability



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The Old Way: Macrocells and LOS

- Towers, zoning, installation
- Spectrum is consumed for only one Macrocell
- Less bandwidth per subscriber
- Coverage holes exist due to obstructions
- Large capital outlay; requires many subscribers for ROI

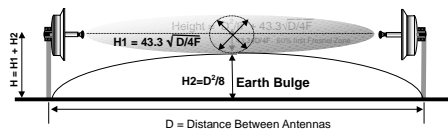


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Line-of-Sight



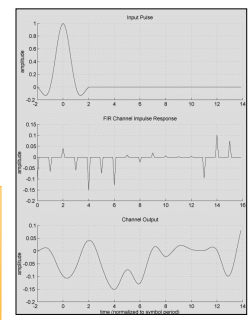
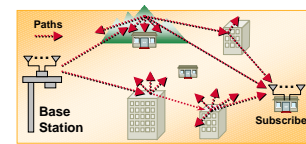
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Multipath Wireless Communication

- Wireless communication involves multipath transmission
- Each path has an associated delay which causes intersymbol interference (ISI)
- Conventional wireless approaches exhibit degraded performance
- Other approaches designed to mitigate the effects of multipath:
 - Equalization
 - Direct sequence spreading
 - Complex adaptive space-time Coding solutions



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The Solution

- Thus far, the wireless communication field has concentrated on “mitigating multipath”
- Multipath actually presents a fundamental advantage to communication capacity
- Cisco's breakthrough technology exploits multipath - VOFDM
- **High bandwidth N-LOS communication is now possible**



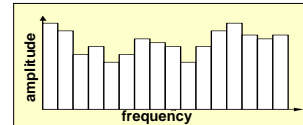
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OFDM Concept

- Narrow, slower channels are free of ISI
- OFDM splits data into parallel independent narrowband channels (“tones”)
- Exploit frequency diversity instead of equalization
- Bit error rate (BER) performance is greatly improved!



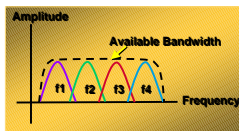
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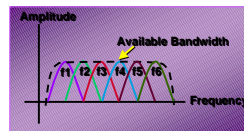
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OFDM Concept

- The carriers for each channel are made orthogonal to one another, allowing them to be spaced very close together, without individual carrier guard band overhead as in FDM



Frequency Division Multiplexing



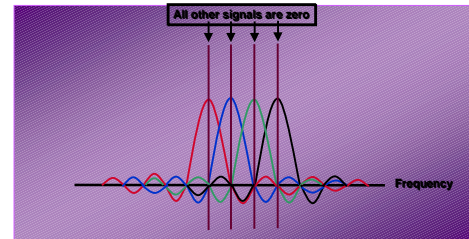
Orthogonal Frequency Division Multiplexing

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OFDM Concept



The spectrum of each carrier has a null at the center frequency of each of the other carriers in the system

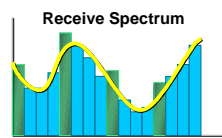
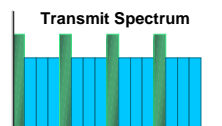
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Frequency Diversity

- Each OFDM burst carries data and training
 - Corrects for amplitude and phase shifts caused by the channel
 - Reduces effect of frequency offset
- OFDM, interleaving and coding
 - Create a robust processing technique for multipath fading and narrow band interference



Channel Training Tone
Data Tone

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VOFDM

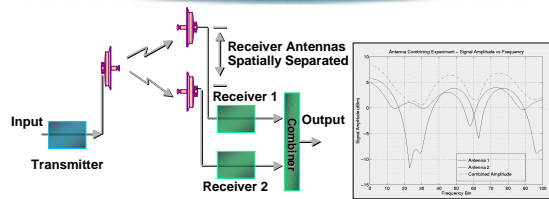
- Conventional OFDM utilizes single transmit and receive antenna.
- Cisco solution combines OFDM with spatial processing: VOFDM (Vector Orthogonal Frequency Division Multiplexing)
- Great benefit comes from exploiting both frequency and spatial diversity

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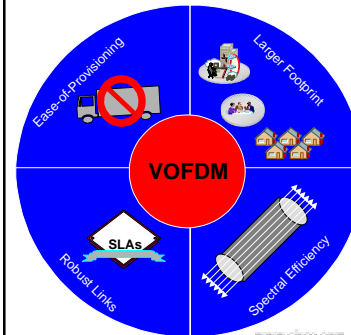
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Spatial Diversity



- In the presence of multipath fading, two received signals will have uncorrelated fading effects due to different path lengths
- Thus, a combined received signal will have a higher SNR than any of the individual signals
- The greatest processing benefits come from exploiting both frequency and spatial diversity

VOFDM Wireless Technology: Open Standards Based Market Enabler



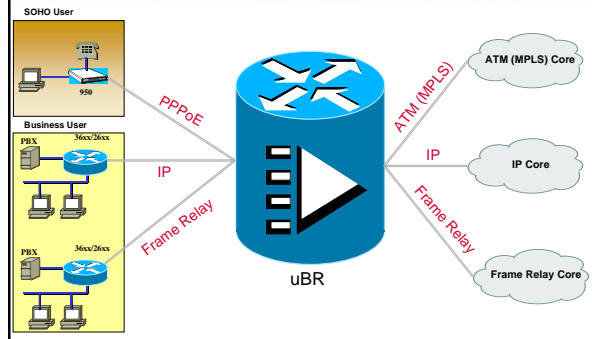
- Space/Frequency diversity increases SNR and allows operation in channels that disable single carrier QAM
- Improves penetration through enhanced spectral efficiency and coverage
- Lowers install costs
- Improves robustness, BER and availability

WT 2750 Wireless Technology Suite

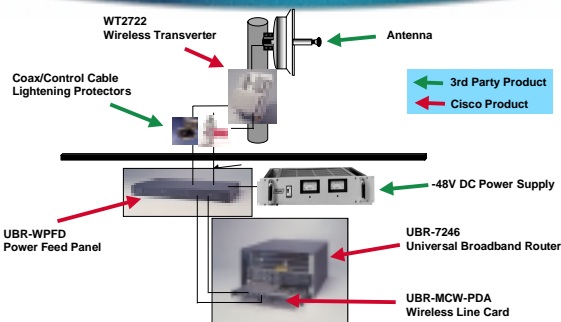


- Point-to-point T3/E3 wireless solution
- uBR Universal Broadband Router Family
- Wireless Modem Line Card
- Power Feed Panel
- RF Head (ODU)

Flexible Access and Transport Options



WT2700 Components for P2P



WT-2700 Key Features for P2P

- IP Packet Based Solution
- Up to 44.4 Mbps full-duplex throughput (12 Mhz)
- Fiber quality link
 - > 10⁻¹¹ BER for Data
- Integrated to uBR 7246 and uBR 7223
- Supports UNNI (5.7 GHz) ~ 20-25 miles LOS
- Encryption support: 56 bit DES with RSA key management
- Managed via IOS CLI and CiscoWorks

