

# Wireless LAN Tutorial: Products and Systems

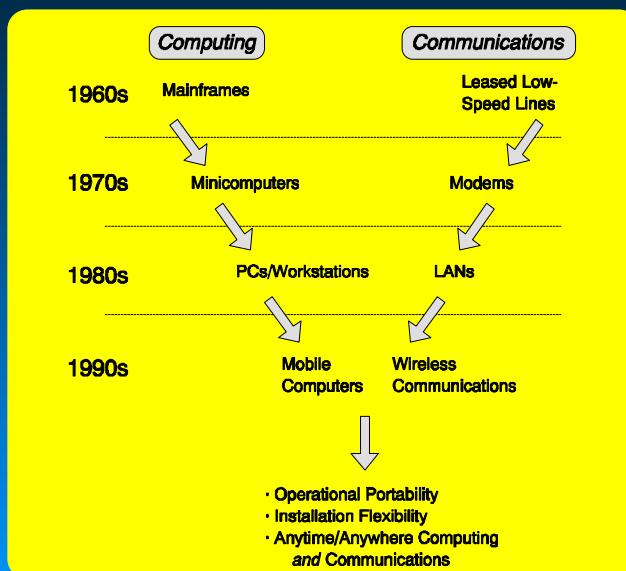
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## *Convergence...*



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## *Wireless LANs - Introduction*

- ▶ The goal: make the air look like a LAN
- ▶ Primary applications
  - Reduce costs - moves/add/changes, etc.
  - Simplify installation
    - ▶ Time or physical constraints
  - In-building and campus **mobility**
- ▶ Modern systems are little more complicated than wired LANs
  - Only minimal knowledge of radio issues is required



## *Wireless LANs - Advantages and Disadvantages*

- ▶ Advantages
  - Fast, easy installation (well, mostly!)
  - Recoverable investment
  - Goes where wire can't
  - Enables dynamic mobility
- ▶ Disadvantages
  - Larger up-front investment (usually)
  - Lower measured performance (usually)
  - Radio/IR propagation issues - uncertainty



## Wireless Network Topologies

### ▶ Three (Wireless) Topologies:

#### • Peer-to-Peer

- ▶ Every node must "see" every other node
- ▶ Performance can suffer as network grows
- ▶ Best for small, simple networks
- ▶ Can be extended with access points

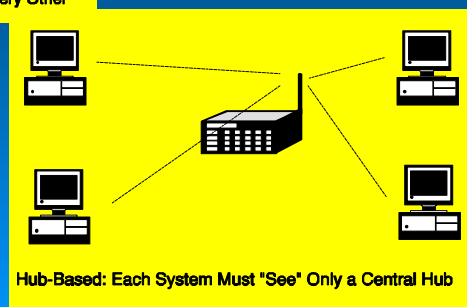
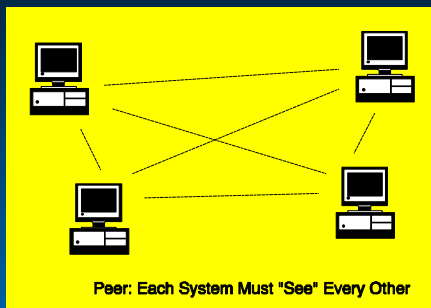
#### • Hub

- ▶ Central hub enforces radio protocol
- ▶ Hub is logical place to connect to backbone
- ▶ But: cost; single point of failure
- ▶ Hubs are evolving into access points

#### • Microcellular



## Peer vs. Hub Topologies

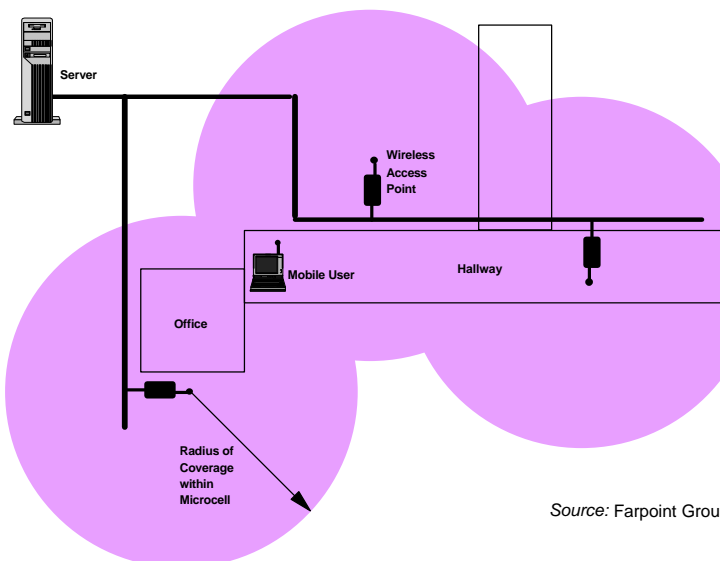


## *Access Points and Roaming*

- ▶ An "access point" provides a bridge from wireless to wire
- ▶ A "repeater" extends the range of a signal
- ▶ "Microcellular" architectures - similar in concept to the cellular phone system, with handoffs between access points
- ▶ A "wire protocol" is used for communication between access points
- ▶ Power management is always an issue
- ▶ Most systems use RF - Spectrix uses IR



## *Roaming - A Schematic*



Source: Farpoint Group



## *Interface Options*

- ▶ **Two System Interface Choices:**
  - **Network Replacement** - physical and data-link layers. Custom boards, adapters, drivers
  - **Wire Replacement** - physical layer only. "Looks like" wire; no software impacts
    - ▶ A wired network adapter (NIC) is required
    - ▶ Makes moving between wireless and wired easy



## *Operational Modes*

- ▶ **Two Form Factors:**
  - **Stationary/Fixed**
    - ▶ Advantage: AC power
    - ▶ Disadvantage: AC power
    - ▶ Justification: cost savings; rapid deployment; wire-to-the-desktop replacement
  - **Portable/Mobile**
    - ▶ Light weight; usually low power
    - ▶ "Relocatable" or "operationally portable"
- ▶ **The most important trend is to mobility extended by access points**



## *Wireless LANs - Throughput*

- ▶ Take whatever the vendor tells you and derate it by 50-66%
  - Not really that different from wire!
- ▶ The environment is always a factor - and it can change from moment to moment
- ▶ Benchmarking is very difficult
- ▶ Perceived performance is more important than real performance



## *Performance - Key Variables*

- ▶ The distance/data-rate inverse problem
- ▶ Antenna type and placement
- ▶ Physical topology and building construction (or terrain)
- ▶ Prevailing RF environment
- ▶ Allotted bandwidth
- ▶ Modulation (including spread-spectrum if used)
- ▶ Radio design
- ▶ Network OS and protocols
- ▶ A spectrum analyzer can be used for initial evaluation and troubleshooting



## *Range (Distance)*

- ▶ Two arguments:
  - More is better (the traditional high-power approach)
  - Small is beautiful (microcells and roaming)
- ▶ In the US, the FCC allows up to 1W plus 6 db (4X power)
- ▶ A major objective should be to make the best possible use of a scarce resource - the radio spectrum
  - Regulatory concerns play a major role
  - Improvements in radio design - there are no regulatory limits, for example, on receiver gain...



## *Security*

- ▶ Spread-spectrum is "inherently" secure
- ▶ Many products offer security codes and data scrambling
- ▶ 100% security is an abstract, theoretical concept
- ▶ Encryption is always advisable - even on wire!
  - It is easier to tap a wired LAN than a wireless LAN!
- ▶ More networks will adopt security features over time
  - Limited security exists in the draft 802.11 standard



## *Safety*

- This is the only wireless issue which cannot be adequately addressed today
- ▶ Too many unknowns; very difficult to evaluate
- ▶ Low-frequency radiation issues - MPR-II rules
- ▶ The medical equipment/cellular phone issue
- No documented health/safety effects for limited exposure
- ▶ Be prudent, not paranoid



## *Wireless Bridges*

- ▶ A fixed application
- ▶ Licensed - to T3 (45 Mbps)
- ▶ Infrared - to 155 Mbps; 900 feet
- ▶ Unlicensed - 2-10 Mbps; a few miles
- ▶ Line-of-sight is usually required
- ▶ Primarily used for internetworking (LAN bridging), and, increasingly, Internet access
  - Voice is sometimes optional in the form of a T1 subchannel
- ▶ New 10 Mbps unlicensed products with link costs below \$10K





## Wireless LAN Product Classes

- ▶ Proprietary (the majority)
- ▶ 802.11 (single MAC, multiple PHY)
- ▶ Wireless LAN Interoperability Forum (WLIF) - Proxim RangeLAN2
- ▶ Medium-Speed (3-4 Mbps)
  - Wave Access - Jaguar
- ▶ High-Speed (>5 Mbps)
  - Windata, Clarion; 3Com; RadioLAN
- ▶ SUPERNet; HIPERLAN
- ▶ ???



## Wireless LANs - Products, cont'd.

Company	Product	Technology	Topology	System Interface	Versions	Range (manufacturer specifications)	Performance (manufacturer specifications)
Aironet Wireless Communications	ARLAN 1000/2000 Series	DSSS (902 and 2.4)	Micro-cellular	Network replacement	ISA, Micro-Channel, PC Card, parallel, access point, bridge	300-1000 feet	1.35 Mbps (902 MHz.); 2 Mbps (2.4 GHz.)
Aironet Wireless Communications	ARLAN 3000 Series	FH (2.4)	Micro-cellular	Network replacement	PC Card, access point	500-1000 feet	1 Mbps
BreezeCom	BreezeNET	FHSS (2.4)	Micro-cellular	Wire replacement (Ethernet)	10baseT hub, PC Card, access point	200-600 feet (offices); 3000 feet (maximum)	3 Mbps
Clarion	MerLAN M10	DS (2.4)	Peer	Wire replacement (Ethernet)	External transceiver	3000 feet	10 Mbps

Source: Farpoint Group



## Wireless LANs - Products, cont'd.

Company	Product	Technology	Topology	System Interface	Versions	Range (manufacturer specifications)	Performance (manufacturer specifications)
IBM	IBM Wireless LAN	FHSS (2.4)	Hub with roaming	Network replacement	ISA/MC and PC Card	1600 feet (maximum)	.5 - 1.2 Mbps (nominally 1 Mbps)
IBM	IBM Wireless LAN Entry	FHSS (2.4)	Micro-cellular	Network replacement	PC Card, access point	1200 feet (maximum)	350 Kbps
JVC	VIPSLAN-10	Directed IR	Peer	Wire replacement (Ethernet)	Satellite/Node PC Card/Mobile	33 feet (long range); 3 feet (short range)	10 Mbps
Lucent Technologies	WaveLAN	DSSS (902)	Micro-cellular	Network replacement	ISA, PC Card, access point	800 feet	2 Mbps
Netwave Technologies	Netwave	FHSS (2.4)	Micro-cellular	Network replacement	PC Card, parallel, access point	40-50 meters	1 Mbps
OTC Telecom	AirEZY	DSSS (902)	Peer	Wire replacement (Ethernet)	External transceiver	500 feet	1 Mbps

Source: Farpoint Group



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## Wireless LANs - Products, cont'd.

Company	Product	Technology	Topology	System Interface	Versions	Range (manufacturer specifications)	Performance (manufacturer specifications)
Proxim	RangeLAN2	FHSS (2.4)	Micro-cellular	Network replacement	ISA, PC Card, parallel, access point	800 feet	1.6 Mbps
Raytheon	Raylink	FH (2.4)	Micro-cellular	Network replacement	PC Card, access point	500-800 feet	2 Mbps
RDC Networks	PortLAN	FH (2.4)	Micro-cellular	Network replacement	ISA, PC Card, access point	150-450 feet	1 Mbps
Spectrix	SpectrixLite	Diffuse IR	Micro-cellular	Network replacement	Serial port, PC Card, access point	50 feet	4 Mbps
Symbol Technologies	Spectrum/24	FHSS (2.4)	Micro-cellular	Network replacement	PC Card, access point	180-250 feet (typical); 1000 feet (open office)	1 Mbps

Source: Farpoint Group



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## Wireless LANs - Products, cont'd

Company	Product	Technology	Topology	System Interface	Versions	Range (manufacturer specifications)	Performance (manufacturer specifications)
Wave Access	Jaguar	FH (2.4)	Micro-cellular	Network replacement	PC Card, access point	450 feet	3.2 Mbps
Windata	FreePort	DS (2.4 and 5.7)	Hub	Wire replacement (Ethernet)	External transceiver, hub	260 feet	5.7 Mbps

Source: Farpoint Group



## Aironet - ARLAN 2000/3000 Series

- ▶ Part of Telxon; acquired Telesystems SLW - first roaming system
- ▶ Very broad and complete product line
- ▶ 902-928 and 2.4 GHz. models (really two separate product lines)
- ▶ Can be used with wired LAN adapter for simple bridge
- ▶ New 3000 series - 2.4 GHz., FH, one-piece

Radio Technology	DSSS, 902-928 MHz. and 2.4 GHz.
Configurations/Prices	ISA (\$845/945), PCMCIA (\$645/745), Access Point (\$1,995/2,495), Bridge (\$2,495/2,995)
Throughput	1.35 Mbps (902 MHz.); 2 Mbps (2.4 GHz.)
Range	1000 feet (open office), 300 feet (typical), 150 feet (closed office)
Features	More than 8 million system IDs for security; optional boot ROM



## *BreezeCom - BreezeNET*

- ▶ Claimed high throughput; low price
- ▶ Wire-replacement
- ▶ 802.11 Draft D2 compliant
- ▶ DSP-based
- ▶ Fault-tolerant "WIX" architecture
- ▶ Sales through VARs, SIs, OEMs
- ▶ Second-generation product set announced with raytheon

Radio Technology	FHSS, 2.4 GHz.
Configurations/ Prices	10baseT adapter (\$695/1 port; \$995/4 ports), PCMCIA (\$395), Access Point (\$1,295)
Throughput	3 Mbps (fallback to 2 and 1 Mbps)
Range	200-600 feet (office), 3000 feet (open space)
Features	SNMP; diversity antenna; downloadable firmware; roaming speeds to 25 MPH



## *DEC - A Radio-Independent Infrastructure Provider*

- ▶ DEC's mission is the overall network, not wireless
- ▶ Supplies a "universal" access point - uses PCMCIA radio
  - Standalone and DEC hub versions
  - Also sold by Solectek
- ▶ Mobile IP roaming software

Radio Technology	AT&T WaveLAN; Proxim RangeLAN2; others possible
Configurations/ Prices	Access Point (\$1,903), Bridge (N/A)
Throughput	Depends upon radio
Range	Depends upon radio
Features	PCMCIA slot; BNC and RJ-45 ports



## *IBM - IBM Wireless LAN*

- ▶ Requires OS/2-based "base station" system; acts as controller and bridge to wire
- ▶ Uses TDMA over the air
- ▶ Three-year warranty
- ▶ Sold via "Options by IBM" PC add-on operation
- ▶ AS/400 wireless LAN is based on Aironet

Radio Technology	FHSS, 2.4 GHz.
Configurations/ Prices	ISA/MCA (\$795), PCMCIA (\$795)
Throughput	.5 - 1.2 Mbps
Range	120-180 M (open office), 25-60 M (typical), 15-30 M (closed office)
Features	Antenna cable extension (170M, \$495); SNMP; compression; encryption



## *IBM - IBM Wireless LAN Entry*

- ▶ Not compatible with IBM Wireless LAN
- ▶ Separate, dedicated access point (model 8227)
- ▶ Unique hemispherical antenna
- ▶ One-piece PCMCIA design
- ▶ Also: IR system licensed from Photonics

Radio Technology	FHSS, 2.4 GHz.
Configurations/ Prices	PCMCIA (\$445), Access point (\$1,350)
Throughput	350 Kbps
Range	1200 feet (maximum)
Features	SNMP; optimized for low power consumption; bridge software included with access point



## *Lucent Technologies (and OEMs) - WaveLAN*

- ▶ One of the oldest wireless LAN products
- ▶ Originally developed by NCR for retail systems
- ▶ Strong OEM channels
- ▶ A volume leader
- ▶ Often wins published benchmarks
- ▶ Good large-account support
- ▶ New dual-PC Card access point

Radio Technology	DSSS, 902-928 MHz. (2.4 GHz. in Europe)
Configurations/Prices	ISA (\$695), PCMCIA (\$695), Access Point (\$1,995)
Throughput	2 Mbps
Range	120-180 M (open office), 25-60 M (typical), 15-30 M (closed office)
Features	Optional DES encryption, boot ROM; point-to-point diagnostics



## *"The WaveLAN Mafia"*

- ▶ Digital Equipment Corp. - DEC WaveLAN (ISA, PCMCIA, Access Point)
- ▶ Digital Ocean - Grouper (Macintosh/Newton)
- ▶ Persoft - Intersect Concentrator and Remote Bridge
- ▶ Pure Data - PureLAN
- ▶ Solectek - AirLAN (ISA, Parallel, PCMCIA, Access Point, Bridge)
- ▶ New Media (PCMCIA and software)
- Interoperability is not implied here



## *Netwave Technologies - Netwave*

- ▶ The first one-piece RF PCMCIA adapter
- ▶ Originally developed and sold by Xircom
- ▶ Product line has been spun off to Netwave Technologies

Radio Technology	FHSS, 2.4 GHz.
Configurations/ Prices	PCMCIA (\$399), Access Point (\$1,499)
Throughput	1 Mbps
Range	40 - 50 meters (typical)
Features	Power management; encryption; compact access point (token ring version announced)



## *Proxim - RangeLAN2*

- ▶ One of the oldest wireless companies (1984)
- ▶ Second-generation product (original RangeLAN was 902 MHz., DSSS, 242 Kbps)
- ▶ OEM orientation
- ▶ Building-to-building bridge (RangeLink) also available

Radio Technology	FHSS, 2.4 GHz.
Configurations/ Prices	PCMCIA (\$695), Access point (\$1,895)
Throughput	1.6 Mbps
Range	500 feet (typical), 1000 feet (open office)
Features	SNMP; site- survey tools; power management; 15 channels (hopping patterns)



# Symbol Technologies - Spectrum/24

- ▶ Company is a leader in data collection systems
- ▶ Second-generation product (replaces 9.6 Kbps Spectrum/1)
- ▶ One-piece PCMCIA adapter
- ▶ Direct sales to end users
- ▶ Emphasizing future 802.11 compatibility

Radio Technology	FHSS, 2.4 GHz.
Configurations/ Prices	PCMCIA (\$895), Access point (\$1,895)
Throughput	1 Mbps
Range	180-250 feet (typical), 1000 feet (open office)
Features	SNMP; Flash ROM; Optional external antenna; Optional NetVISION configuration/ management tool



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