- 802.1 internetworking
- 802.2 LLC
- 802.3 Ethernet/CSMA/CD
- 802.4 token bus
- 802.5 token ring
- 802.6 DQDB used in SMDS for MAN
- 802.7 Broadband LAN
- 802.8 technical advisory group on fiber optics/FDDI
- 802.9 Integrated services Local Area Network
- 802.10 Interoperable LAN/MAN security (SILS)

- WIRELESS LAN WLAN
- 802.11

INTRO

- Wireless LAN tech is rapidly becoming crucial component of computer networks and is growing by leaps and bound. Thanks to the finalization of the IEEE 802.11 wireless LAN standard, wireless technology has emerged from the world of proprietary implementations to become an open solution for providing mobility as well as essential network services where wire line installations proved impractical. The inclusion of the newer IEEE 802.1la and 802.11b versions of the standard offers a firm basis for high-performance wireless LANs. Now companies and organizations are investing in wireless networks at a higher rate to take advantage of mobile, real-time access to information.

- Most wireless LAN suppliers now have 802.11 –compliant products, allowing companies to realize wireless network applications based on open systems. The move toward 802.11 standardization is lowering prices and enabling multi-vendor wireless LANs to interoperate. This is making the implementation of wireless networks more feasible than before, creating vast business oppurtinities for system implementation companies and consultants. However, many end user companies and system integrators have limited knowledge and experience in developing and implementing wireless network systems. In many cases, there is also confusion over the capability and effectiveness of the 802.11 standard.

- The implementation of wireless networks is much different than that of traditional wired networks. In contrast to Ethernet, a wireless LAN has a large number of setup parameters that affect the performance and interoperability of the network. An engineer designing the network and the person installing the network must understand these parameters and how they affect the network.

WLANs benefit what? Why?

- Mobility
- Installation in difficult-to-wire areas
- Increased reliability
- Reduced installation time
- Long term cost savings

WLANs benefit: mobility

- Easy to move physically while using an appliance, such as a handheld PC or data collector pda.
- Many jobs require workers to be mobile, such as inventory clerks, healthcare workers, policemen, and emergency care specialist.
- Mobility result to mobile application
- Mobile applications requiring wireless networking include those that depend on real-time access to data – usually stored in centralized databases

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- Mobile applications requiring wireless networking include those that depend on real-time access to data – usually stored in centralized databases
- E.g. in **retail store –** for accurate and efficient price markdowns, ppl use wireless networks to interconnect handheld bar code scanners and printers to data bases having current price information.
- Another e.g. **– formula 1** and indy race cars have sophisticated data acquisition sytems that monitor the various onboard system in the car. When the cars come around the track and pass their respective teams in the pit, this information is downloaded to a central computer, thereby enabling real-time analysis of the performance of the racecar.

WLAN benefit: Installation in difficult-to-wire areas

- The implementation of wireless networks offers many tangible cost savings when performing installations in difficult to wire areas.
- E.g. two building that separate by river/road/railroad track (fig 1.2). A wireless soln may be much more economical than installing physical cable or leasing communications circuits, such as T1 service or 56kbps lines.
- To apply wireless connection in this situation may be cost a lot of money. But it will benefit in the long run. (long term investment)

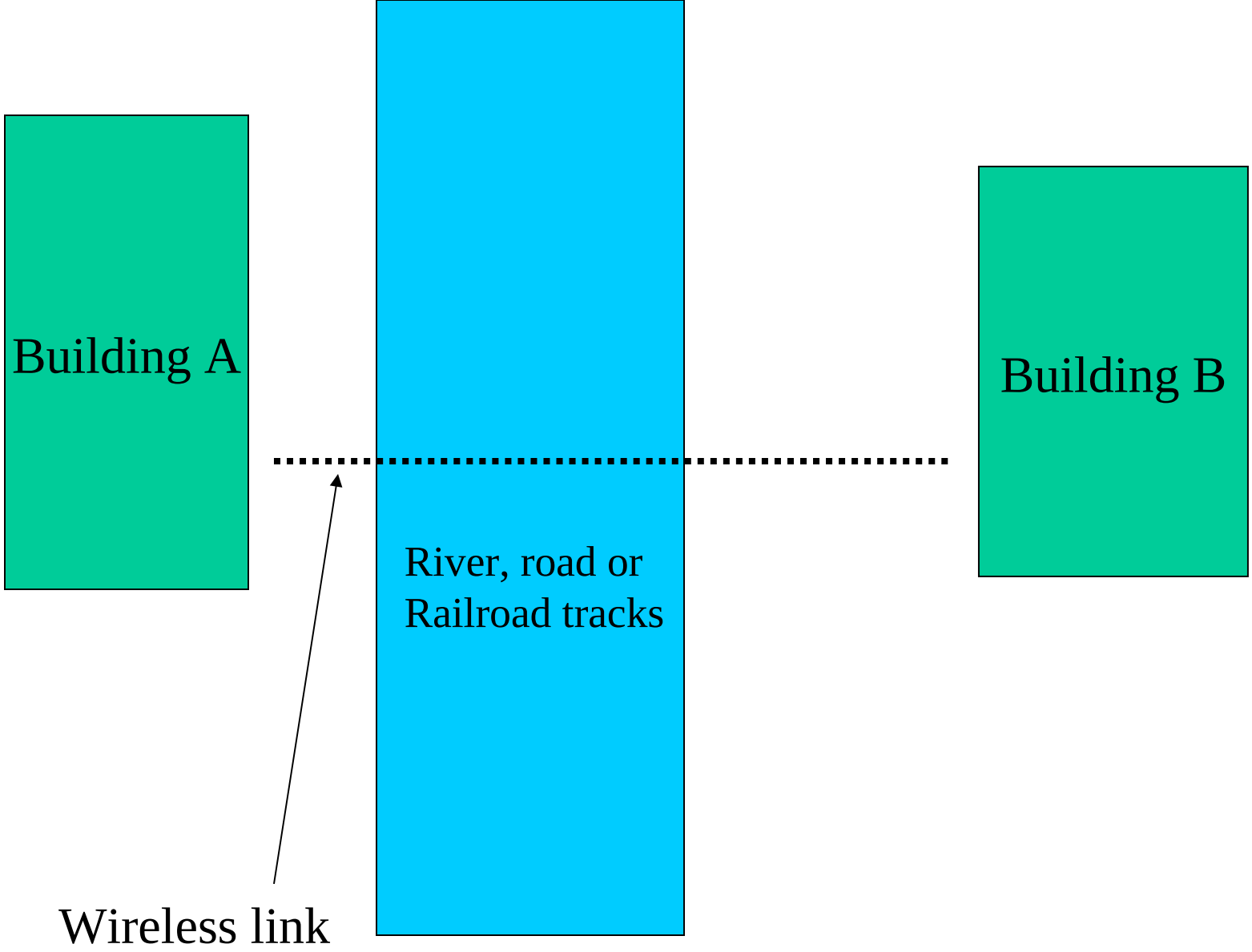

Fig. 1.2 wireless networks make it cost effective to provide network Connectivity in situations that are difficult to wire

- Another good reason to apply wireless soln is due to health risk when the workers try to install network cabling in some building area which contain asbestos particles.
- Some org remove the asbestos first, making it safe to install cabling. This process is very expensive. It is better to spend money on setting up wireless networking rather than wasting money to remove the asbestos.
- Wireless n/w to preserve historical sites
- In some cases, it might be impossible to install cabling. Some municipalities, for e.g. may restrict us from permanently modifying older facilities with historical value. This could limit the drilling of holes in walls during the installation of n/w cabling and outlets. In that situation, a wireless network might be the only soln.

WLAN benefit: Increased Reliability

- A problem inherent to wired network is downtime due to cable faults. E.g. moisture erodes metallic conductors via water intrusion during storms and accidental spillage or leakage of liquids.
- With wired networks, a user might accidentally break his network connector when trying to disconnect his PC from the network to move it to a different location.
- Imperfect cable join can cause signal reflections that result in unexplainable errors. The accidental cutting of cables can bring down a network immediately.
- An advantage of wireless networking, therefore, results from the use of less cable. This reduces the downtime of the network and the costs related with replacing cables.

WLAN benefit: reduced installation time

- The deployment of wireless network greatly reduces the need for cable installation, making the network available for use much sooner.
- But the isntallation of cabling is often a time-consuming activity. For LAN, installer must pull twisted-pair wires or optical fiber above the ceiling and drop cables through walls to network outlets that they must affix to the wall. These task can take days or weeks depending on the size of the installation.
- What about to install optical fiber which involve digging trenches… it is messy task task that could take weeks or possibly months to finish it.

WLAN applications

- Retail
- Warehousing
- Healthcare
- Hospitality
- Home and small office
- General enterprise systems
- Wireless services

All student pls visit this site: www.wireless-nets.com/cases.htm

This site includes a collection of wireless network paper, case studies And breaking news about wireless network mostly about WLAN.

Wireless LAN technology

- There are Several WLAN specifications and standards that we can choose from when developing WLAN products or integrating WLAN solutions into corporate systems. For e.g. HiperLAN, HomeRF SWAP, and Bluetooth,
- The emphasis of this lecture is on IEEE 802.11 compliant wireless LANs because 802.11 is expected to continue being the preferred standard for supporting WLANs applications.
- Other technologies may become stronger competitors to 802.11 in the future.

HiperLAN

- Began in Europe somewhere in 1996 by European Telecommuniations Standards Institute (ETSI)
- Began with hiperLAN/1, old version, operates in the 5GHz radio band at up to 24MBps.
- Similar to ethernet, HiperLAN/1 shares access to the WLAN among end user devices via a connectionless protocol. HiperLAN/1 also provides quality of services (QoS) support for various needs of data, video, voice and images.
- ETSI is currently improving HiperLAN/2 under an organization called the HiperLAN/2 Global Forum (H2GF).
- HiperLAN/2 will operate in the 5GHz band at up to 54Mbps using a connection-oriented protocol for sharing access among end user devices.

- HiperLAN/2 will include QoS support and be capable of carrying ethernet frames, ATM cells and IP packet.
- Refer to HiperLAN/2 Global forum web site at
- http://www.hiperlan2.com
- For additional details on the HiperLAN/2 Specification.
- Compare to japanese version hiperLAN/2 called HisWANa.

HomeRF SWAP

- In march 1998, the homeRF Working Group (HRFWG) announced its existence and set out to provide an open industry specifiaction, Shared wireless access protocol (SWAP), for wireless digital communication between PCs and consumer electronic devices within the home.
- The SWAP specification defines a common wireless interface supporting voice and data at 1MBps and 2MBps data rates using frequency hopping spread spectrum modulation in the 2.4Ghz frequency band.

- HRFWG is currently developing a 10Mbps version of SWAP based on recent Federal Communication Commision (FCC) approval for wider bandwidth for frequency hopping systems.
- Refer HomeRF website for more details
- http://www.homerf.org

Bluetooth

- Bluetooth is a specification published by the bluetooth special interest group (SIG), with some big promoters including 3COM, ericsson, IBM, Intel, Lucent, Microsoft, Motorola and etc.
- Bluetooth isn’t wireless a WLAN. Instead, it is a wireless personal area network (PAN), which is a subset of a WLAN.
- Bluetooth operates at 1Mbps, with relatively low power over short ranges using frequency hopping spread spectrum in the 2.4Ghz frequency band. Refer to bluetooth.com for more details.

IEEE 802.11

- Somewhere in 1997, IEEE finalized the initial standard for wireless LANs: IEEE 802.11. This standard specifies a 2.4Ghz operating frequency with data rates of 1 and 2 Mbps. The initial 802.11 standard defines two forms of spread spectrum modulation: frequency hopping (802.11 FHSS) and direct sequence (802.11 DSSS).
- In late 1999, the IEEE published two supplements to the 802.11 standard. 802.11a and 802.11b.

802.11a

- The 802.11a standard defines operation at up to 54Mbps using orthogonal frequency division multiplexing (OFDM) modulation in the roomy 5Ghz frequency band.
- The 802.11a standard has a wide variety of high-speed data rates available: 6, 9, 12, 18, 24, 36, 48 and 54Mbps.
- It is mandatory for all products to have 6Mbps, 12Mbps, and 24Mbps rates. Products implementing the 802.11a standard should begin appearing on the market in the late 2001.

802.11b

- (commonly known as “Wi-Fi*”) describes the wireless networking standard for WLANs that operate in the 2.4 GHz radio band (ISM frequency band). 902Mz-5.85Ghz
- 802.11b-based WLANs are far more common than 802.11a or 802.11g networks and can achieve a maximum data rate of 11 Mbps per second at distances up to approximately 300 feet.
- 802.11 b was the first WLAN technology offered to consumers and enabled the creation of instant wireless networks in offices and homes.
- Devices certified by Wi-Fi Alliance bear the official Wi-Fi logo. Most wireless LANs implemented today comply with the 802.11b version of the standard.

802.11g

- IEEE 802.11g is a new standard, describing a wireless networking method for WLANs that operates in the 2.4 radio band (ISM frequency band). Industrial-Scientific-Medical
- using OFDM (Orthogonal Frequency Division Multiplexing) technology 802.11g-based WLANs can achieve a maximum speed of 54 Mbps.
- 802.11g-compliant equipment, such as wireless access points, can provide simultaneous WLAN connectivity for both 802.11g and 802.11b equipment.

Terms widely used in WLAN

- Spread spectrum
- Frequency Hopping Spread Spectrum (FHSS)
- Direct Sequence Spread Spectrum (DSSS)
- Orthogonal Frequency Division Multiplexing (OFDM)

Spread Spectrum Technology

- Most wireless LAN systems use spread-spectrum technology, a wideband radio frequency technique developed by the military for use in reliable, secure, mission-critical communications systems.
- Spread-spectrum is designed to trade off bandwidth efficiency for reliability, integrity, and security.
- In other words, more bandwidth is consumed than in the case of narrowband transmission, but the tradeoff produces a signal that is, in effect, louder and thus easier detect, provided that the receiver knows the parameters the spread-spectrum signal being broadcast.
- If a receiver not tuned to the right frequency, a spread-spectrum signal looks like background noise. There are two types of spread spectrum radio:
- frequency hopping and direct sequence.

Frequency-hopping Spread-Spectrum (FHSS)

- Frequency-hopping spread-spectrum (FHSS) uses a narrowband carrier that changes frequency in a pattern known to both transmitter and receiver.
- Properly synchronized, the net effect is to maintain a single logical channel.
- To an unintended receiver, FHSS appears to be short-duration impulse noise.

Direct Sequence Spread Spectrum (DSSS)

- Direct-sequence spread-spectrum (DSSS) generates a redundant bit pattern for each bit to be transmitted. This bit pattern is called a chip (or chipping code).
- The longer the chip, the greater the probability that the original data can be recovered (and, of course, the more bandwidth required).
- Even if one or more bits in the chip are damaged during transmission statistical techniques embedded in the radio can recover the original data without the need for retransmission.
- To an unintended receiver, DSSS appears as low-power wideband noise and is rejected (ignored) by most narrowband receivers.

Orthogonal Frequency Division Multiplexing (OFDM)

- *Orthogonal Frequency Division Multiplexing* (OFDM) is a method that allows to transmit high data rates over extremely hostile channels at a comparable low complexity.
- OFDM has been chosen as the transmission method for the European radio (DAB) and TV (DVB-T) standard. Due to its numerous advantages it is under Discussion for future broadband application such as wireless ATM as well.

- **Orthogonal FDM's (OFDM) spread spectrum technique distributes the data over a large number of carriers that are spaced apart at precise frequencies. This spacing provides the "orthogonality" in this technique which prevents the demodulators from seeing frequencies other than their own. The benefits of OFDM are high spectral efficiency, resiliency to RF interference, and lower multi-path distortion. This is useful because in a typical terrestrial broadcasting scenario there are multipath-channels (i.e. the transmitted signal arrives at the receiver using various paths of different length). Since multiple versions of the signal interfere with each other (inter symbol interference (ISI)) it becomes very hard to extract the original information.**
- OFDM in detail you can get at:
- www.iss.rwth-aachen.de/Projekte/Theo/OFDM/www_ofdm.html
- http://www.wave-report.com/tutorials/OFDM.htm

Other technology: **Infrared Technology**

- Commonly used but still not popular. I don't know why.
- Maybe because little used in commercial wireless LANs,
- Infrared (IR) systems use very high frequencies, just below visible light in the electromagnetic spectrum, to carry data.
- Like light, IR cannot penetrate opaque objects;
- is either directed (line-of-sight) or diffuse technology.
- Inexpensive directed systems provide very limited range (3
- ft) and typically are used for personal area networks but occasionally are used in specific wireless LAN applications.
- High performance **directed IR is impractical** for mobile
- users and is therefore used only to implement fixed subnetworks.
- Diffuse (or reflective) IR wireless LAN systems do
- not require line-of-sight, but cells are limited to individual
- rooms. Developed by http://www.irda.org/

What ISN'T a Wireless LAN

- Cellular data and voice
- Satellite
- Licensed spectrum
- Wireless "MAN" (e.g. Ricochet)
- Currently no Palm device supports WLAN