Good afternoon, Professor Zhu, ladies and gentlemen:

First of all, according to the tradition of my speech, this is count down for today’s lecture. Let’s go together! Ten, nine, …

# 6. 3 Wireless LAN

## 0 history

| | |
|---|---|
| 1979 | F.R. Gfeller and U. Bapst published a paper in the IEEE Proceeding reporting an experimental wireless local area network using diffused infrared communications. |
| 1980 | P. Ferrert reported on an experimental application of a single code spread spectrum radio for wireless terminal communications in the IEEE National |
| 1984 | a comparison between infrared and CDMA spread spectrum communications for wireless office information networks was published by Kaveh Pahlavan in IEEE Computer Networking Symposium which appeared later in the IEEE Communication Society Magazine |
| 1985.5 | the efforts of Marcus led the FCC to announce experimental ISM bands for commercial application of spread spectrum technology. Later on, M. Kavehrad reported on an experimental wireless PBX system using code division multiple access. |
| These efforts prompted significant industrial activities in the development of a new generation of wireless local area networks and it updated several old discussions in the portable and mobile radio industry. | |
| 1 | The first generation of wireless data modems was developed in the early 1980s by amateur radio operators, who commonly referred to this as packet radio. They added a voice band data communication modem, with data rates below 9600-bit/s, to an existing short distance radio system, typically in the two meter amateur band.  |
| 2 | The second generation of wireless modems was developed immediately after the FCC announcement in the experimental bands for non-military use of the spread spectrum technology. These modems provided data rates on the order of hundreds of kbit/s.  |
| 3 | The third generation of wireless modem then aimed at compatibility with the existing LANs with data rates on |

| | |
|---|---|
| | the order of Mbit/s. Several companies developed the third generation products with data rates above 1 Mbit/s and a couple of products had already been announced by the time of the first IEEE Workshop on Wireless LANs  |

"The first of the IEEE Workshops on Wireless LAN was held in 1991. At that time early wireless LAN products had just appeared in the market and the IEEE 802.11 committee had just started its activities to develop a standard for wireless LANs. The focus of that first workshop was evaluation of the alternative technologies. By 1996, the technology was relatively mature, a variety of applications had been identified and addressed and technologies that enable these applications were well understood. Chip sets aimed at wireless LAN implementations and applications, a key enabling technology for rapid market growth, were emerging in the market. Wireless LANs were being used in hospitals, stock exchanges, and other in building and campus settings for nomadic access, point-to-point LAN bridges, ad-hoc networking, and even larger applications through internetworking. The IEEE 802.11 standard and variants and alternatives, such as the wireless LAN interoperability forum and the European HiperLAN specification had made rapid progress, and the unlicensed PCS Unlicensed Personal Communications Services and the proposed SUPERNet, later on renamed as U-NII, bands also presented new opportunities.

WLAN hardware was initially so expensive that it was only used as an alternative to cabled LAN in places where cabling was difficult or impossible. Early development included industry-specific solutions and proprietary protocols,

but at the end of the 1990s these were replaced by standards, primarily the various versions of IEEE 802.11 (in products using the Wi-Fi brand name).

An alternative ATM-like 5 GHz standardized technology, HiperLAN/2, has so far not succeeded in the market, and with the release of the faster 54 Mbit/s 802.11a (5 GHz) and 802.11g (2.4 GHz) standards, almost certainly never will.[citation needed]

Since 2002 there has been newer standard added to 802.11; 802.11n which operates on both the 5Ghz and 2.4Ghz bands at 300 Mbit/s, most newer routers including those manufactured by Apple Inc. can broadcast a wireless network on both wireless bands, this is called dualband.
A HomeRF group was formed in 1997 to promote a technology aimed for residential use, but disbanded at the end of 2002.[5]

1997

| Standard | Release | Frequency | Licensed | Data Rate | Memo |
|---|---|---|---|---|---|
| 802.11b | 1999.9 | 2.4~2.485GHz | No | 11Mbps | Competing for frequency spectrum with 2.4GHz phones and microwave ovens. |
| 802.11a | 1999.9 | 5.1~5.8GHz | Yes | 54Mbps | Short transmission distance , Suffer more from multipath propagation |
| 802.11g | 2003.6 | 2.4~2.485GHz | No | 54Mbps | Low frequency band and being backwards compatible with 802.11b yet with the higher-speed transmission rates of 02.11a |
| 802.11n | 2009.10 | 2.4~5GHz | ~ | >200Mbps | IEEE 802.11n 2009, not finalized, multiple-input multiple output antenna |
| 1. All three use the same medium access protocol, CSMA/CA.<br>2. All three use the same frame structure for their link-layer frames as well.<br>3. All three standards have the ability to reduce their transmission rate in order to reach out over greater distances.<br>4. All three allow for both “infrastructure mode” and “ad hoc mode” | | | | | |

# The 802.11 Architecture

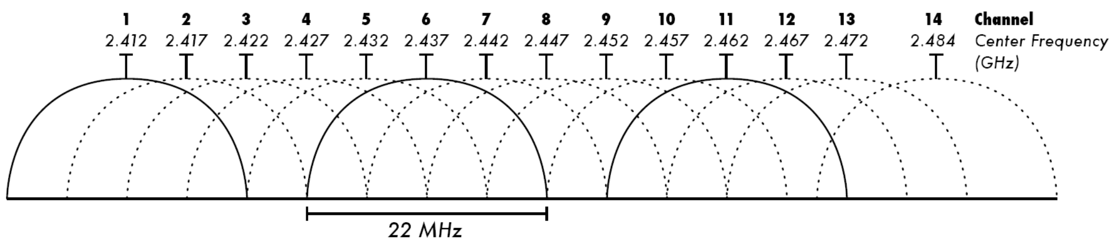
BASIC Service Set, BSS

Access Point, AP, with a MAC address

Base station

Infrastructure wireless LAN

SSID, Service Set Identifier is assigned to an AP. From 2.4~2.485GHz, within this 85MHz band, 802.11 defines 11 partially overlapping channels. Any two channels are non-overlapping if and only if they are separated by four or more channels. Especially that channel 1, 6, 11 are the only non-overlapping



This means that you can install three 802.11b Aps at the same physical location, assigning channels 1, 6 and 11 to the Aps, and interconnecting each of the Aps with a switch.

WiFi Jungle

A WiFi jungle is any physical location where a wireless station receives a sufficiently strong signal from two or more Aps.

# 802.11 Mac Protocol

CSMA with collision avoidance, CSMA/CA

Suppose the IEEE 802.11 RTS and CTS frames were as long as the standard DATA and ACK frames. Would there be any advantage to using the CTS and RTS frames? Why or Why not?

No, there wouldn't be any advantage. Suppose there are two stations that want to transmit at the same time, and they both use RTS/CTS. If the RTS frame is as long as a DATA frames, the channel would be wasted for as long as it would have been wasted for two colliding DATA frames. Thus, the RTS/CTS exchange is only useful when the RTS/CTS frames are significantly smaller than the DATA frames.

Describe how the RTS threshold works.

Each wireless station can set an RTS threshold such that the RTS/CTS sequence is used only when the data frame to be transmitted is longer than the threshold. This ensures that RTS/CTS mechanism is used only for large frames.

Describe the role of the beacon frames in 802.11

APs transmit beacon frames. An AP's beacon frames will be transmitted over one of the 11 channels. The beacon frames permit nearby wireless stations to discover and identify the AP.

# 6.3.3 IEEE 802.11 Frame

| 2 | 2 | 6 | 6 | 6 | 2 | 6 | 0 - 2312 | 4 |
|---|---|---|---|---|---|---|---|---|
| frame control | duration | address 1 | address 2 | address 3 | seq control | address 4 | payload | CRC |