Wi-Fi

the

802.11 Standard

and

Security

What is Wi-Fi?

- Short for ***wi**reless* ***fi**delity.*
- It is a wireless technology that uses radio frequency to transmit data through the air.
- Wi-Fi is based on the 802.11 standard:
  - 802.11a
  - 802.11b
  - 802.11g

Wi-Fi Alliance

- Non-profit standards organization.
- Global organization that created the Wi-Fi brand name.
- Formerly the Wireless Ethernet Compatibility Alliance.

Wi-Fi Certification

- The Wi-Fi CERTIFIED logo from the Wi-Fi Alliance.
  - Rigorous interoperability testing requirements.
  - Certifies the interoperability of 802.11 products from the many different vendors.

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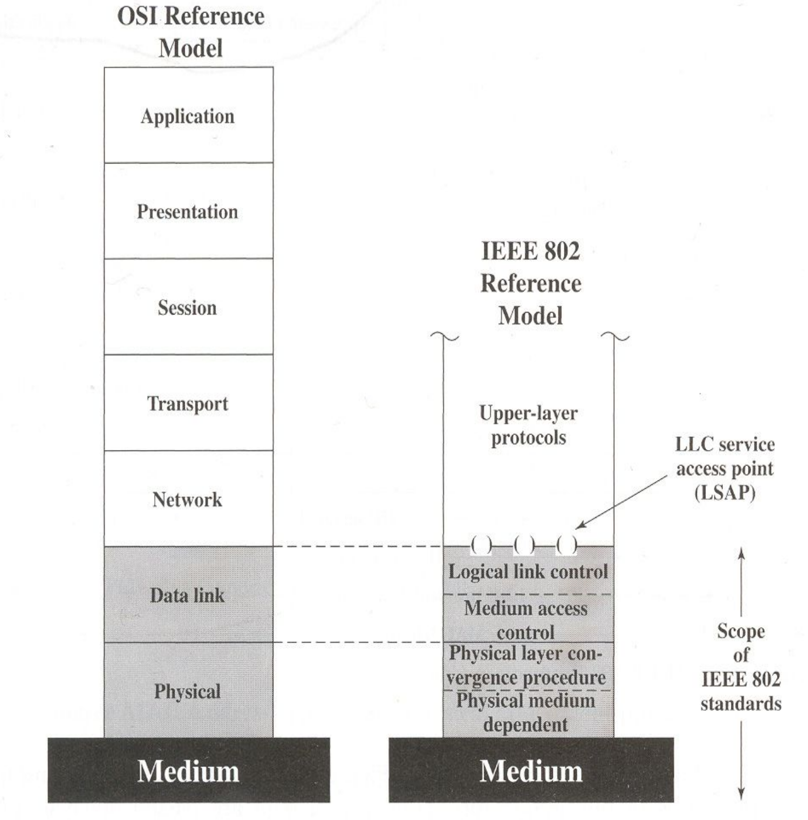
Brief History

- IEEE (Institute of Electrical and Electronics Engineers) established the 802.11 Group in 1990. Specifications for standard ratified in 1997.
- Initial speeds were 1 and 2 Mbps.
- IEEE modified the standard in 1999 to include:
  - 802.11b
  - 802.11a
  - 802.11g was added in 2003.
- IEEE Created standard, but Wi-Fi Alliance certifies products

802.11 Standard

- 802.11 is primarily concerned with the lower layers of the OSI model.
- Data Link Layer
  - Logical Link Control (LLC).
  - Medium Access Control (MAC).
- Physical Layer
  - Physical Layer Convergence Procedure (PLCP).
  - Physical Medium Dependent (PMD).



IEEE 802 Protocol Layers Compared to OSI Model

802.11b Standard

- Well-supported, stable, and cost effective, but runs in the 2.4 GHz range that makes it prone to interference from other devices (microwave ovens, cordless phones, etc) and also has security disadvantages.
- Limits the number of access points in range of each other to three.
- Has 11 channels, with 3 non-overlapping, and supports rates from 1 to 11 Mbps, but realistically about 4-5 Mbps max.
- Uses direct-sequence spread-spectrum technology.

802.11g Standard

- Extension of 802.11b, with the same disadvantages (security and interference).
- Has a shorter range than 802.11b.
- Is backwards compatible with 802.11b so it allows or a smooth transition from 11b to 11g.
- Flexible because multiple channels can be combined for faster throughput, but limited to one access point.
- Runs at 54 Mbps, but realistically about 20-25 Mbps and about 14 Mbps when b associated
- Uses frequency division multiplexing

802.11a Standard

- Completely different from 11b and 11g.
- Flexible because multiple channels can be combined for faster throughput and more access points can be co-located.
- Shorter range than 11b and 11g.
- Runs in the 5 GHz range, so less interference from other devices.
- Has 12 channels, 8 non-overlapping, and supports rates from 6 to 54 Mbps, but realistically about 27 Mbps max
- Uses frequency division multiplexing

Advantages

- Freedom – You can work from any location that you can get a signal.
- Setup Cost – No cabling required.
- Flexibility – Quick and easy to setup in temp or permanent space.
- Scaleable – Can be expanded with growth.
- Mobile Access – Can access the network on the move.

Disadvantages

- Speed – Slower than cable.
- Range – Affected by various medium.
  - Travels best through open space.
  - Reduced by walls, glass, water, etc
- Security – Greater exposure to risks.
  - Unauthorized access.
  - Compromising data.
  - Denial of service.

Basic Security Strategies

- Block your Service Set Identifier (SSID) from being broadcast.
  - Wireless beacon so PCs can easily find the access point.
- Change the default network name in the access point.
- Change the default access point password.
- Center the access point in the middle of the building/house.

Media Access Control (MAC) Filtering

- Every network device has a unique MAC address
  - Allocated by the manufacturer.
- MAC Filtering only allows certain addresses access.
- Mostly for home use.
  - Tedious to implement on a large scale

Wired Equivalency Protocol (WEP)

- Basic encryption technology.
  - Uses an RC4 stream cipher.
    - Pseudo-random bytes.
  - Two versions: 64-bit and 128-bit versions.
- Built into Wi-Fi certified equipment.
  - Implemented at the MAC level.
- Protects radio signal between device and access point.
  - Does not protect data beyond the access point.
- Uses static encryption keys.
  - Easy to crack.
    - Still better then nothing.

Wi-Fi Protected Access (WPA)

- Designed to replace WEP.
    - Firmware update.
    - 128-bit Temporal Key Integrity Protocol (TKIP) encryption.
        - Uses a master key that is regularly changed.
    - User authentication.
    - Data Integrity.
- Protects radio signal between device and access point.
- Built into Wi-Fi certified equipment.
    - Implemented at the MAC level.
- Available in two versions:
    - WPA2 Personal.
    - WPA2 Enterprise.

Wi-Fi Protected Access 2 (WPA2)

- Designed to replace WEP.
  - 128-bit Advanced Encryption Standard (AES).
- Based on the IEEE 802.11i standard.
- Provides government level security.
- Also available in two versions:
  - WPA2 Personal.
  - WPA2 Enterprise.

Extended EAP

- EAP - Extensible Authentication Protocol.
- Addition to the Wi-Fi Protected Access.
  - Used in internal network.
- Extra security for enterprise and government Wi-Fi LANs.
- Several versions available.

Virtual Private Network (VPN)

- Creates a secure virtual “tunnel” from remote device to VPN server.
  - Creates an encryption scheme.
  - Requires authentication.
- Works across the internet.
- Many types and levels of VPN technology.
  - May include hardware and software components.
  - Some very expensive.
  - Windows provides a basic implementation in its server software.

Firewall

- Can make the network or computer invisible to the internet.
- Block unauthorized users.
- Monitor and control flow of data to/from a network or computer.
- Many types and levels of firewall technology.
  - Hardware and software combinations
  - Software only versions.
    - ZoneAlarm
- Many devices provide basic firewall capability.
  - Gateways and access points.
    - Network address translation.
  - Windows XP operating system.

Kerberos

- Created at MIT.
- Network authentication based on key distribution.
  - Nodes provide their own authentication.
- Checks for data stream integrity.
  - Checks for modification.
- Uses Data Encryption Standard (DES).

Bringing it all together

- Any combination of these security techniques can be used.
- The more security the more of a hassle.
  - Important when supporting users.