What is unique about wireless?

- Difficult media
  - interference and noise
  - quality varies over space and time
  - shared with “unwanted” 802.11 devices
  - shared with non-802 devices (unlicensed spectrum, microwave ovens)
- Full connectivity cannot be assumed
  - “hidden node” problem
- Multiple international regulatory requirements
Medium Variations

Uniqueness of Wireless (continued)

- Mobility
  - variation in link reliability
  - battery usage: requires power management
  - want “seamless” connections

- Security
  - no physical boundaries
  - overlapping LANs
Requirements

• Single MAC to support multiple PHYs.
  – Support single and multiple channel PHYs.
  – PHYs with different “Medium Sense” characteristics.

• Should allow overlap of multiple networks in the same area and channel space.

• Need to be “Robust for Interference”.
  – Microwave, other non-802.11 interferers.
  – Co-channel interference.

• Need mechanisms to deal with “Hidden Nodes”.

• Need provisions for Time Bounded Services.

Architecture Overview

• One MAC supporting multiple PHYs
  – currently Frequency Hopping, Direct Sequence and Infrared PHYs

• Two configurations
  – “Independent” (ad hoc) and “Infrastructure”

• CSMA/CA (collision avoidance) with optional “point coordination”
802.11 Protocol Entities

- MAC Entity
  - basic access mechanism
  - fragmentation
  - encryption

- MAC Layer Management Entity
  - synchronization
  - power management
  - roaming
  - MAC MIB

- Physical Layer Convergence Protocol (PLCP)
  - PHY-specific, supports common PHY SAP
  - provides Clear Channel Assessment signal (carrier sense)
802.11 Protocol Architecture (cont.)

- Physical Medium Dependent Sublayer (PMD)
  - modulation and encoding

- PHY Layer Management
  - channel tuning
  - PHY MIB

- Station Management
  - interacts with both MAC Management and PHY Management

802.11 Configurations - Independent

- Independent
  - one “Basic Service Set”, BSS
  - “Ad Hoc” network
  - direct communication
  - limited coverage area
**802.11 Configurations - Infrastructure**

- **Infrastructure**
  - Access Points and stations
- **Distribution System** interconnects Multiple Cells via Access Points to form a single Network.
  - extends wireless coverage area

**Distribution System**

- **Used to interconnect wireless cells**
  - multiple BSS connected together form an ESS, Extended Service Set
  - Allows mobile stations to access fixed resources

- **Not part of 802.11 standard**
  - could be bridged IEEE LANs, wireless, other networks …
  - Distribution System Services are defined
Access Points

• Stations select an AP and “associate” with it

• Support roaming

• Provide other functions
  – time synchronization (beaconing)
  – power management support
  – point coordination function

• Traffic typically (but not always) flows through AP
  – direct communication possible

802.11 Defines the Airwaves IF

• The airwaves interface between stations (including that between station and AP) is standardized
  – PHY and MAC

• No exposed MAC/PHY interface specified

• No exposed interface to Distribution System
  – required DS services are defined

• Internals of Distribution System not defined
MAC Services

- **Asynchronous MSDU Data Delivery**
  - provided to LLC (2304 octet maximum)

- **Time Bounded Services**
  - optional point coordination function

- **Security Services**
  - confidentiality, authentication, access control

- **Management Services**
  - scanning, joining, power management

MAC Functionality

- **Independent and Infrastructure configuration support**
  - Each BSS has a unique 48 bit address
  - Each ESS has a variable length address

- **CSMA with collision avoidance**
  - MAC-level acknowledgment
  - allows for RTS/CTS exchanges
    - hidden node protection
  - MSDU fragmentation
  - “Point Coordination” option
    - AP polling
MAC Functionality (continued)

- Roaming support within an ESS
  - station scans for APs, association handshakes

- Power management support
  - stations may power themselves down
  - AP buffering, distributed approach for IBSS

- Authentication and privacy
  - Optional support of “Wired Equivalent Privacy” (WEP)
  - Authentication handshakes defined

PHY Layer Services

- PHY_DATA transfers
  - multiple rates

- Clear Channel Assessment (CCA)
  - carrier sense

- PHY Management
  - channel tuning
Three PHYs

- **Frequency Hop Spread Spectrum**
  - 2.4 GHz band, 1 and 2 Mbps transmission
  - 2GFSK, 4GFSK
  - hop over 79 channels (North America)
- **Direct Sequence Spread Spectrum**
  - 2.4 GHz band, 1 and 2 Mbps transmission
  - DBPSK, DQPSK
  - 11 chip Barker sequence
- **Baseband IR**
  - Diffuse infrared
  - 1 and 2 Mbps transmission, 16-PPM and 4-PPM