802.11 Tutorial March 96

802.11 Architecture

 1

802.11 Tutorial March 96

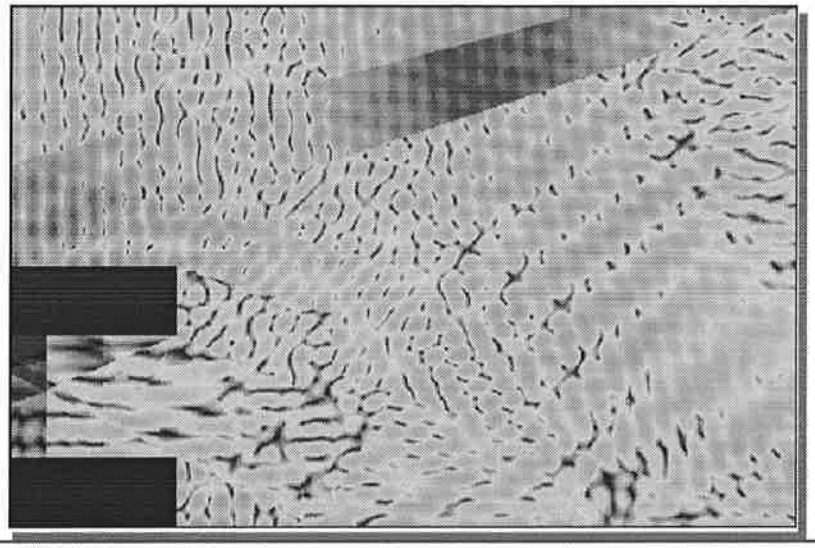
What is unique about wireless?

- 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

 2

802.11 Tutorial March 96

Medium Variations



 3

802.11 Tutorial March 96

Uniqueness of Wireless (continued)

- **Mobility**
  - **variation in link reliability**
  - **battery usage: requires power management**
  - **want "seamless" connections**
- **Security**
  - **no physical boundaries**
  - **overlapping LANs**

 4

802.11 Tutorial March 96

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.

 5

802.11 Tutorial March 96

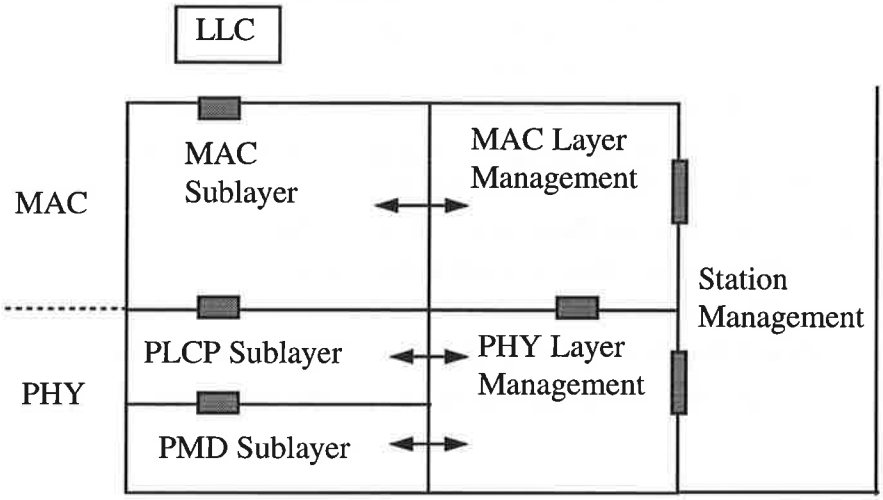
Architecture Overview

- 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"

 6

802.11 Tutorial March 96

802.11 Protocol Entities



 7

802.11 Tutorial March 96

802.11 Protocol Architecture

- **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)**

 8

802.11 Tutorial March 96

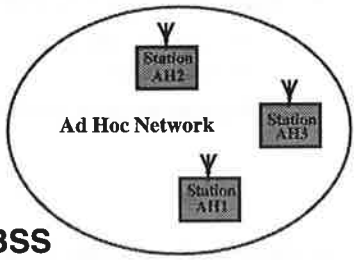
802.11 Protocol Architecture (cont.)

- 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

 9

802.11 Tutorial March 96

802.11 Configurations - Independent

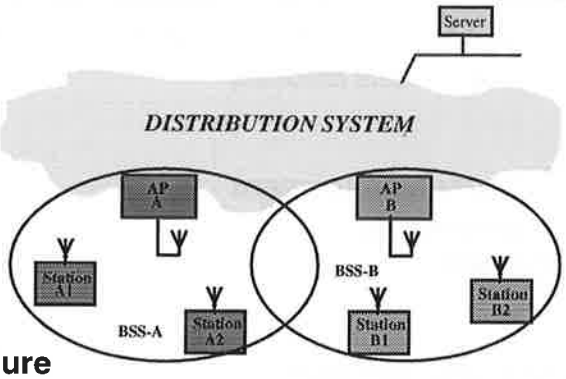


- Independent
  - one "Basic Service Set", BSS
  - "Ad Hoc" network
  - direct communication
  - limited coverage area

 10

802.11 Tutorial March 96

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

 11

802.11 Tutorial March 96

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

 12

802.11 Tutorial March 96

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

 13

802.11 Tutorial March 96

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

 14

802.11 Tutorial March 96

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

 15

802.11 Tutorial March 96

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

 16

802.11 Tutorial March 96

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

 17

802.11 Tutorial March 96

PHY Layer Services

- PHY_DATA transfers
  - multiple rates
- Clear Channel Assessment (CCA)
  - carrier sense
- PHY Management
  - channel tuning

 18

802.11 Tutorial March 96

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

 19