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802.11 Architecture

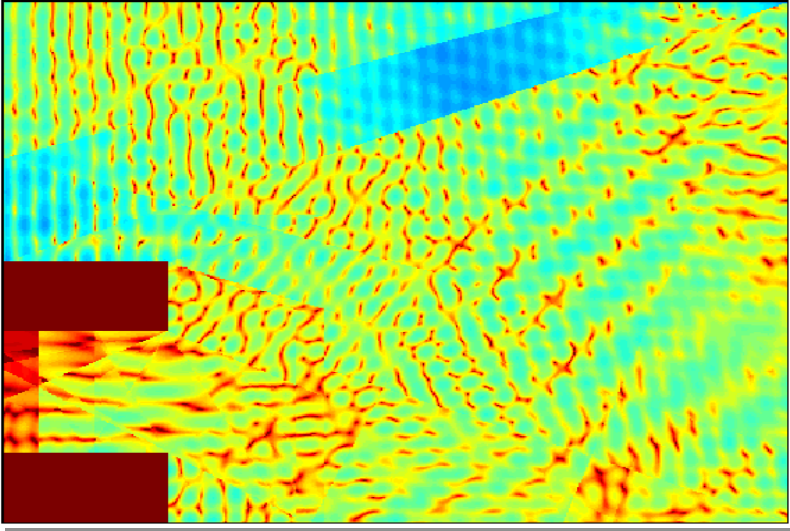**802.11 Tutorial** **March 96**

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**

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Medium Variations

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Uniqueness of Wireless (continued)

- **Mobility**
  - **variation in link reliability**
  - **battery usage: requires power management**
  - **want "seamless" connections**

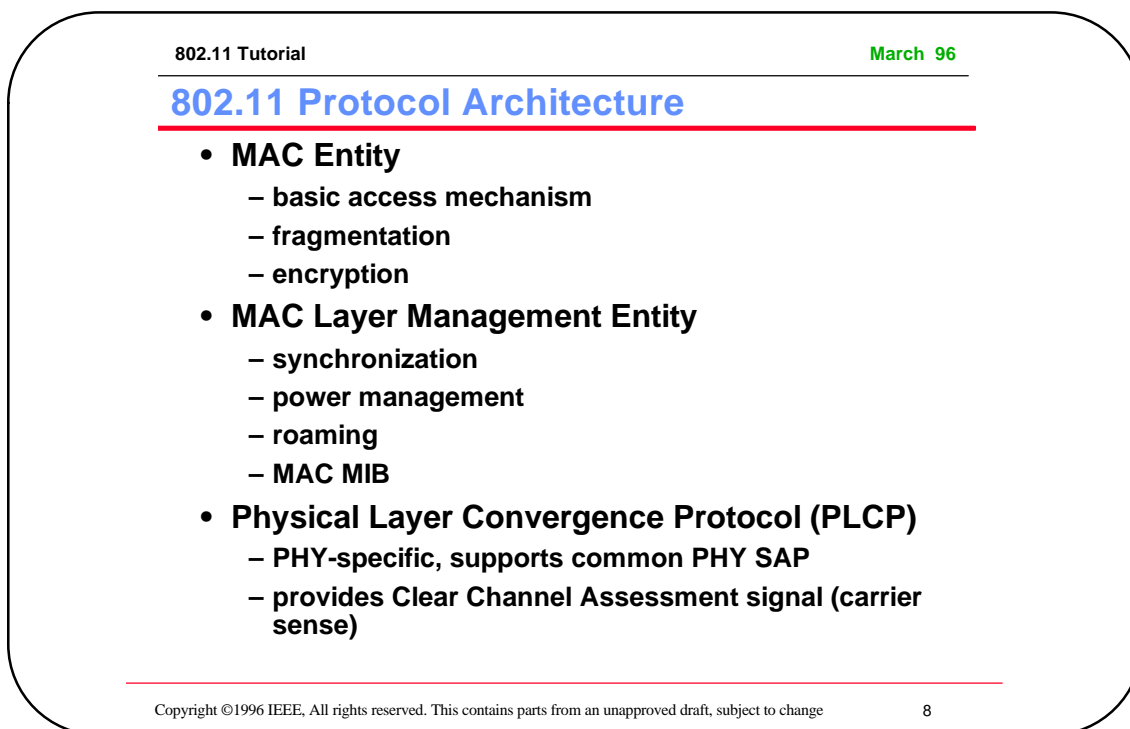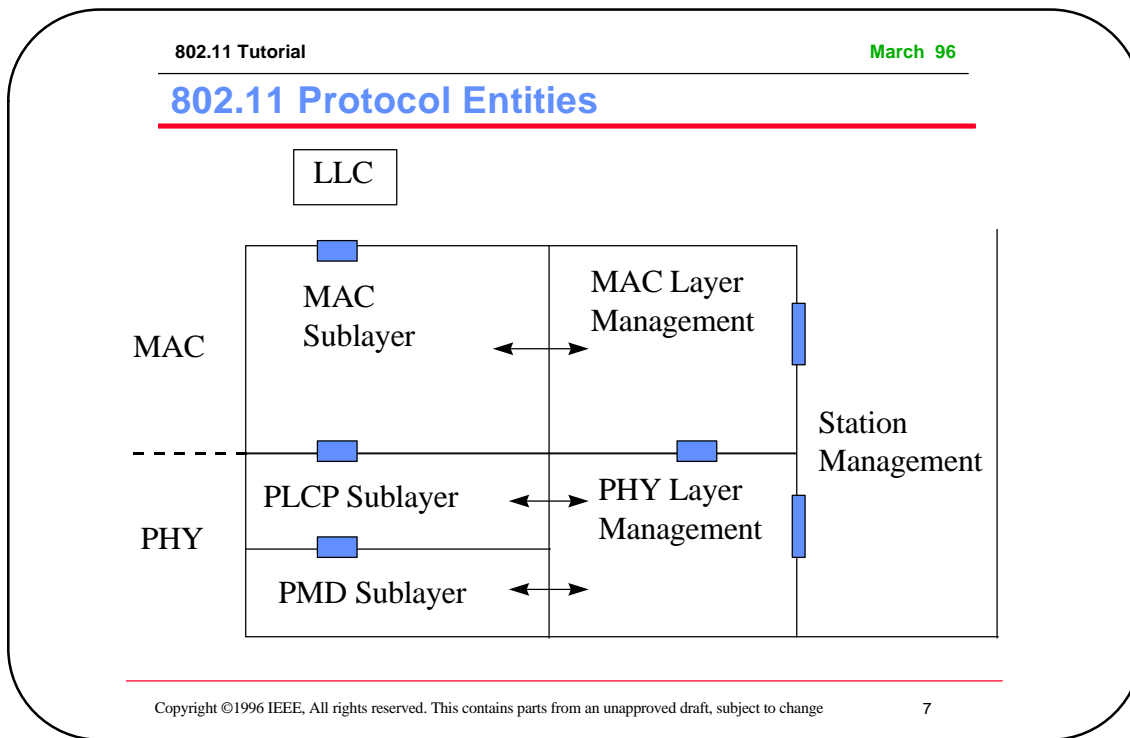- **Security**
  - **no physical boundaries**
  - **overlapping LANs**

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"**

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802.11 Protocol Entities

LLC

MAC — MAC Sublayer ↔ MAC Layer Management

PLCP Sublayer ↔ PHY Layer Management

PHY

PMD Sublayer ↔

Station Management

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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)**

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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**

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802.11 Configurations - Independent

Ad Hoc Network

Station AH2

Station AH3

Station AH1
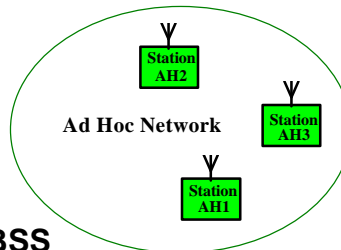
- **Independent**
  - **one "Basic Service Set", BSS**
  - **"Ad Hoc" network**
  - **direct communication**
  - **limited coverage area**

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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**

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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**

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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**

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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**

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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**

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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**

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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**

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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**

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