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Wireless LANs
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IEEE 802.11 Overview

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Outline

- IEEE 802 Standards
- IEEE 802.11 Overview
- IEEE 802.11 Services

Why Wireless LAN not so popular in last ten years?

- Low data rate
- High price
- Lack of standard
  - Proprietary products

Types of Standards

- Official Standard
  - Controlled by an official standard organization
  - E.g. IEEE
- Public Standard
  - Controlled by a private organization
  - E.g. Wireless LAN Interoperability Forum
  - Called "De Facto Standard"

Why Std. is so important?

- Interoperability
  - Multiple-vendor products
- Fast product development
  - Well-tested blueprint
- Stable for migration
  - IEEE 802.3 → 10 → 100/1000 Mbps
- Price Reduction
  - Low research & development budget
  - Increase price competition
- Easy to manage

IEEE

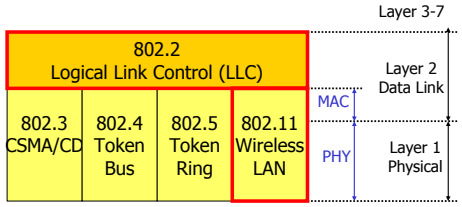
- **I**nstitute for **E**lectrical and **E**lectronic **E**ngineers
- Nonprofit organization
- Publication, conferences, accreditation, standard developments
- Based in the US. → 150 countries

IEEE 802 LAN Std. Family

802	Overview and Architecture
802.1	Network Management
802.2	Logical Link Control (LLC)
802.3	CSMA/CD - Ethernet
1802.3	Conformance Test Methodology for IEEE 802.3
802.4	Token Passing Bus
802.5	Token Ring
802.6	Metropolitan Area Network (MAN) : DQDB

802.7	Broadband LAN
802.8	Fiber Optic
802.9	Isochonous LAN
802.10	Integrated Service Security
802.11	Wireless LAN
802.12	Demand Priority
802.15	Wireless PAN
802.16	Broadband Wireless Access (Wireless MAN)
802.17	Resilient Packet Ring
802.18	Radio Regulatory

IEEE 802 LAN Std. Family

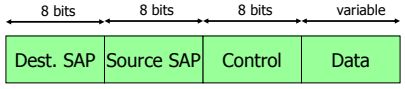


IEEE 802.2 LLC

- Data link control protocol
- Exchange data between end users across LAN using a 802-based MAC
- Independent
  - Network topology
  - Transmission medium
  - MAC

IEEE 802.2 LLC services

- Unacknowledged Connectionless
- Connection-oriented
- Acknowledged Connectionless



LLC Protocol Data Unit (PDU)

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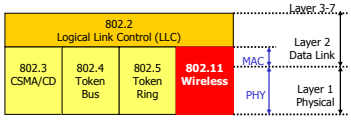
IEEE 802.11 design concern

- Wireless / Wired LANs Differences
- Power management
  - Switch to low power mode (sleep)
- Bandwidth
  - Compress data, utilize of the available BW
- Security
  - Works with IEEE 802.10
- Addressing
  - Location / destination address → mobileIP

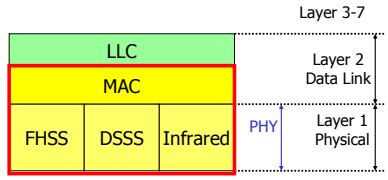
IEEE 802.11 Logical Architecture

- Deliver **M**AC **S**ervice **D**ata **U**nit (MSDU) between peer LLC
- Transparent to higher layer (LLC)
- Provide both MAC and PHY functionality
- Typically resides in NIC or Access Point



IEEE 802.11 Logical Architecture

- Define the network operation
  - Topology → necessary physical components



802.11 MAC Layer

- Provide access control functions
  - Addressing
  - Access coordination
  - Frame check generating / checking
  - LLC PDU delimiting
- CSMA/CA
  - Cannot Tx/Rx simultaneously

802.11 Physical Layers

Radio Frequency

- Frequency Hopping Spread Spectrum (FHSS)
- Direct Sequence Spread Spectrum (DSSS)
- Orthogonal Frequency Division Multiplexing (OFDM)

802.11 Physical Layers

Infrared

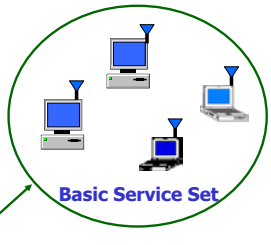
- 850-950 nM, Peak power = 2 Watts
- 16-Pulse position Mod, PPM (1 Mbps)
- 4-PPM (2 Mbps)

IEEE 802.11 Topology

- Independent Basic Service Set (IBSS)
- Extended Service Set (ESS)

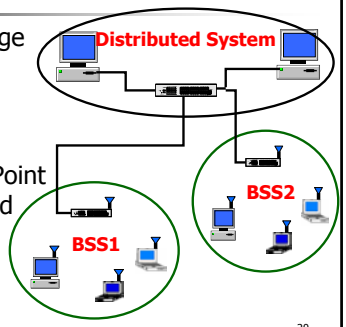
Independent Basic Service Set (IBSS)

- Stand-alone BSS
- No backbone infrastructure
- At least 2 stations
- **Ad hoc** Network
- Small area



Extended Service Set (ESS)

- Extending range
- Arbitrary size
- Multiple cells interconnect
- Need Access Point and Distributed system



802.11 Mobility Types

- No-transition
  - Not move
  - Moving within a local BSS
- BSS-transition
  - Move from one BSS to another BSS, same ESS
- ESS-transition
  - Move from one BSS to another BSS, different ESS
- Guarantee for No-transition and BSS-transition
- IBSS & ESS are transparent to the LLC

BSS Physical Configuration

- Partial overlap
  - Contiguous coverage in a defined area
  - No disruption
- Physical disjoint
  - No contiguous coverage →no distance limit
- Physical collocate
  - Redundant or high-performance network

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802.11 Services

- Station Services (in wireless st.)
  - Authentication / Deauthentication
  - Privacy
  - MSDU delivery
- Distribution System Services
  - Association / Disassociation / Reassociation
  - Distribution / Integration

Authentication

- Prevent unauthorized access
- Open system authentication
  - send authen. with ID → get back if recognize
- Shared key authentication
  - Secret shared key (through secure channel)
  - Authen. through shared key
  - Required Wireless Equivalent Privacy Algorithm (WEP)

Privacy

- 802.11 offers a privacy service option
- Based on 802.11 Wireless Equivalent Privacy (WEP) algorithm
  - Encryption

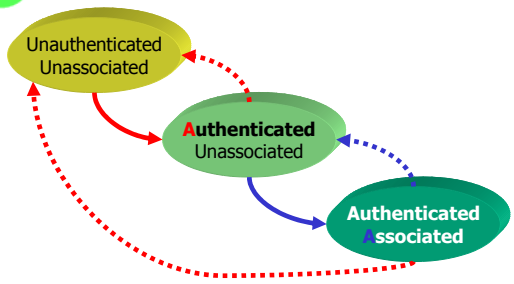
Association

- Perform @ access point
- Map a station to the distribution system via access point
- Otherwise the transmission is not allowed

Reassociation

- Change the status of association
- Support BSS-transition mobility
- Change the association attribute

802.11 State Diagram



IEEE 802.11 Family (*May 2002*)

- IEEE 802.11b
  - 2.45 GHz / 11 Mbps / DSSS
- IEEE 802.11a
  - 5.8 GHz / 54 Mbps / OFDM
- IEEE 802.11g
  - 2.4 GHz / 54 Mbps / OFDM / Security