



# IEEE 802.11 Overview (1)

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# Outline

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- IEEE 802 Standards
- IEEE 802.11 Overview
- IEEE 802.11 Services
- History and present of IEEE 802.11



## Why Wireless LAN not so popular in the past?

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



# Types of Standards

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- 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
  - IEEE 802.11b → 802.11g → 802.11n
- 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

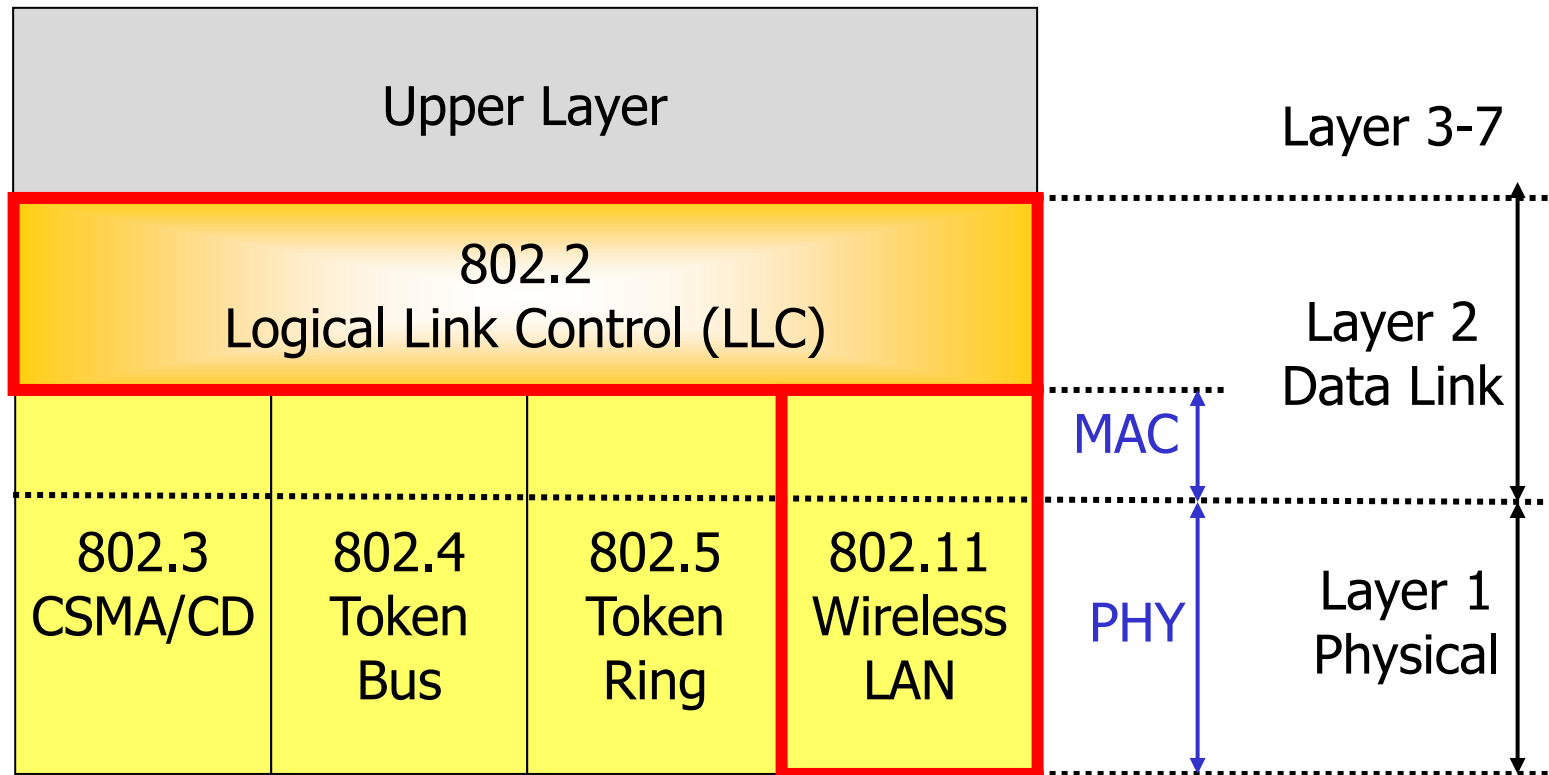
|                  |   |
|------------------|---|
| 802              | Overview and Architecture                         |
| 802.1            | Network Management                                |
| <del>802.2</del> | <del>Logical Link Control (LLC)</del>             |
| 802.3            | CSMA/CD - 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

|                   |   |
|-------------------|---|
| <del>802.7</del>  | <del>Broadband LAN</del>                          |
| <del>802.8</del>  | <del>Fiber Optic</del>                            |
| <del>802.9</del>  | <del>Isochronous LAN</del>                        |
| <del>802.10</del> | <del>Integrated Service Security</del>            |
| 802.11            | <b>Wireless LAN</b>                               |
| <del>802.12</del> | <del>Demand Priority 100BaseVG</del>              |
| 802.15            | <b>Wireless PAN</b>                               |
| 802.16            | Broadband Wireless Access ( <b>Wireless MAN</b> ) |
| 802.17            | Resilient Packet Ring                             |
| 802.21            | <b>Media Independent Handoff</b>                  |

~~————~~ Disbanded / Inactive



# IEEE 802 LAN Std. Family







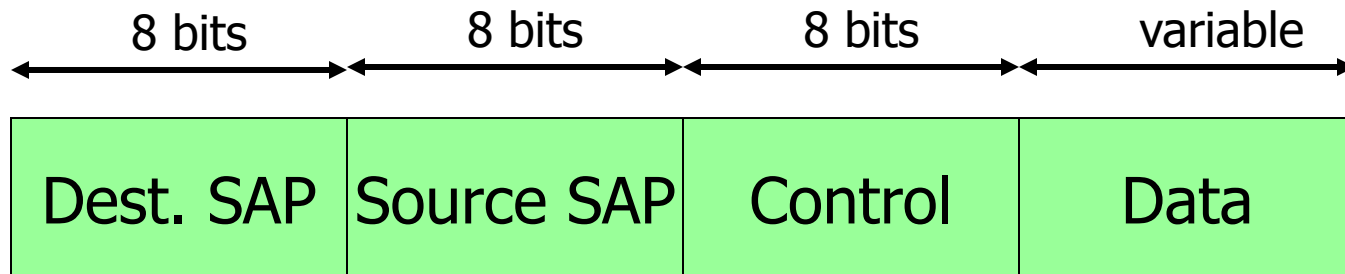
# IEEE 802.2 LLC

- 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

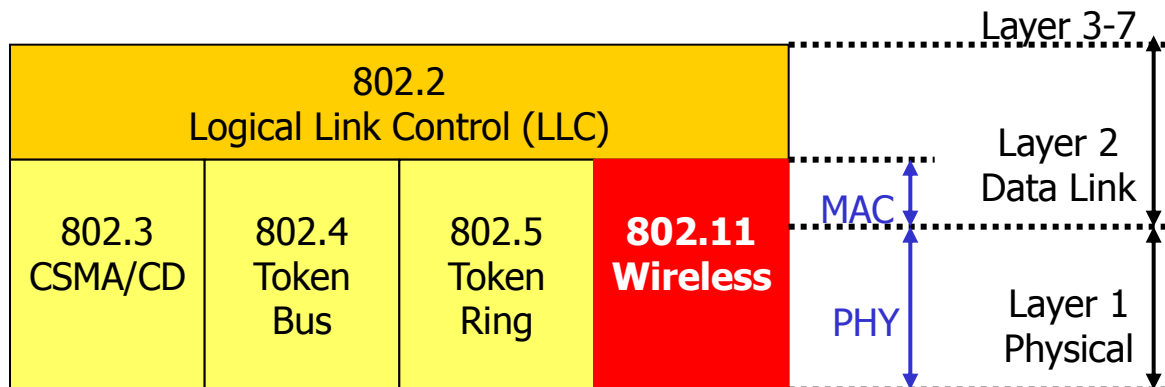
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- Wireless / Wired LANs Differences
- Power management
  - Switch to low power mode (sleep)
- Bandwidth
  - Compress data, utilize of the available BW
- Security
  - Works with IEEE 802.10
- Addressing
  - Location / destination address → mobileIP



# IEEE 802.11 Logical Architecture

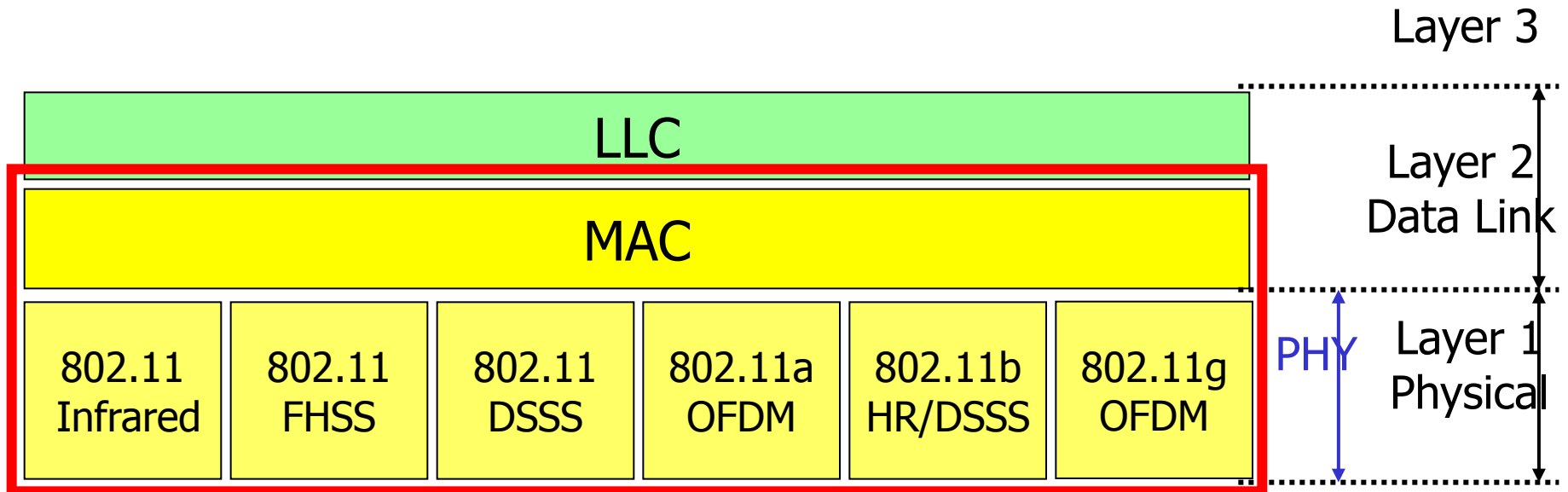
- Deliver **MAC Service Data Unit** (MSDU) between peer LLC
- Transparent to higher layer (LLC)
- Provide both MAC and PHY functionality
- Typically resides in NIC or Access Point





# IEEE 802.11 Logical Architecture

- Define the network operation
  - Topology → necessary physical components





# 802.11 MAC Layer

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



# 802.11 Physical Layers

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## Radio Frequency

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





# 802.11 Physical Layers

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## Infrared

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



# IEEE 802.11 Topology

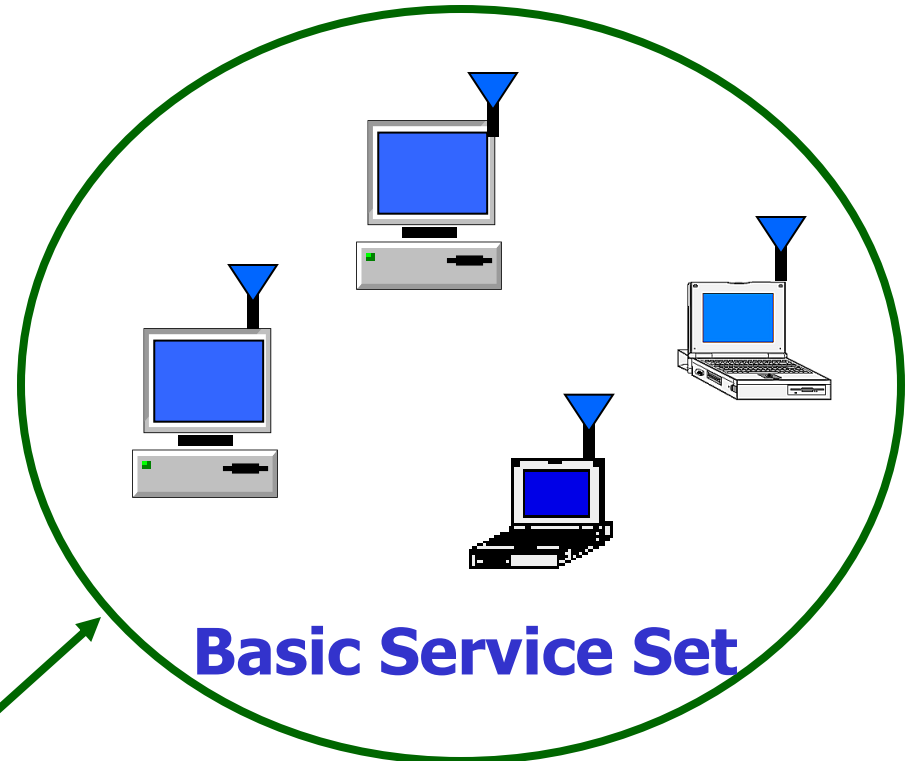
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- Independent Basic Service Set (IBSS)
- Extended Service Set (ESS)

# Independent Basic Service Set (IBSS)



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

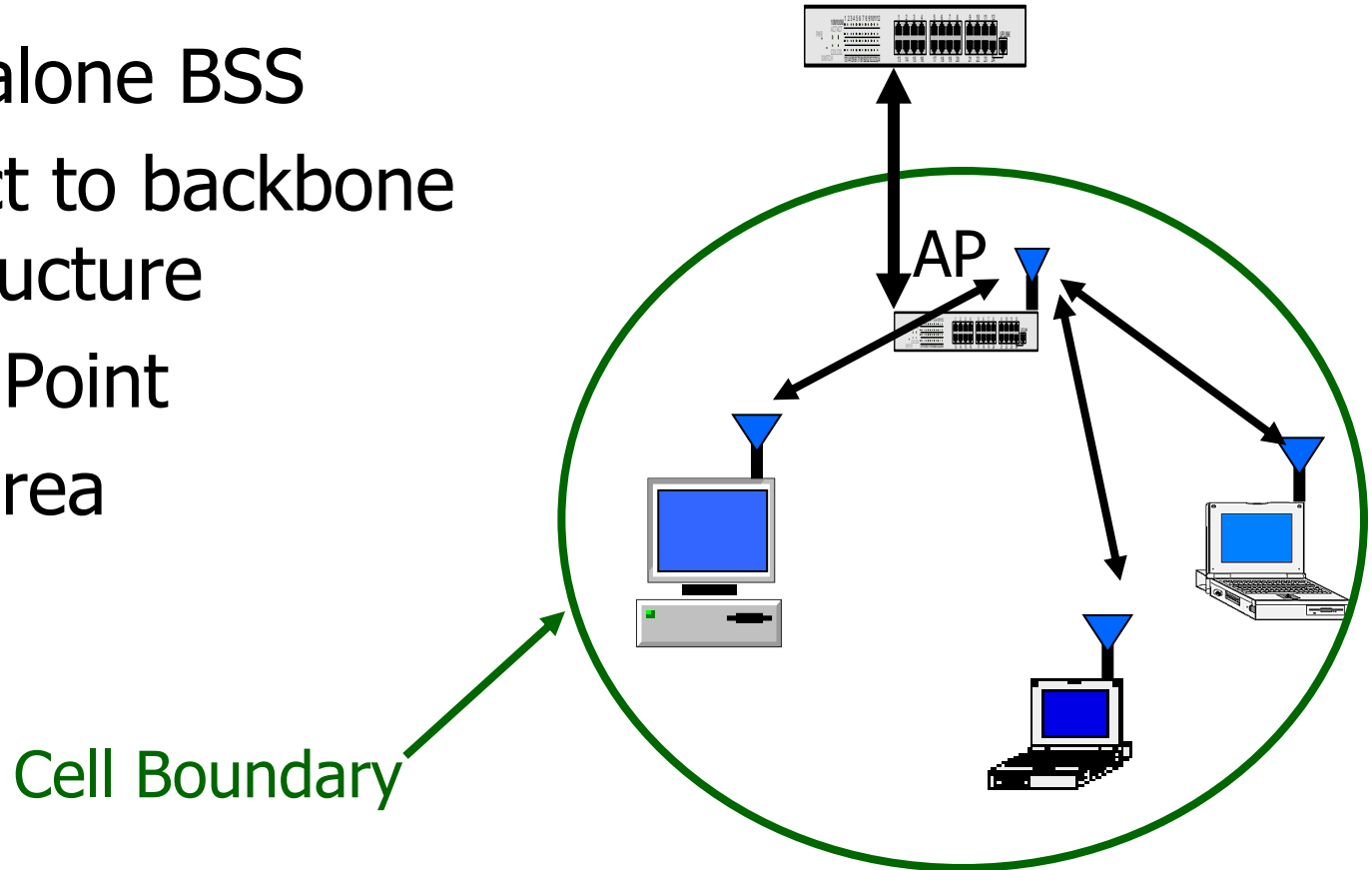


Cell Boundary



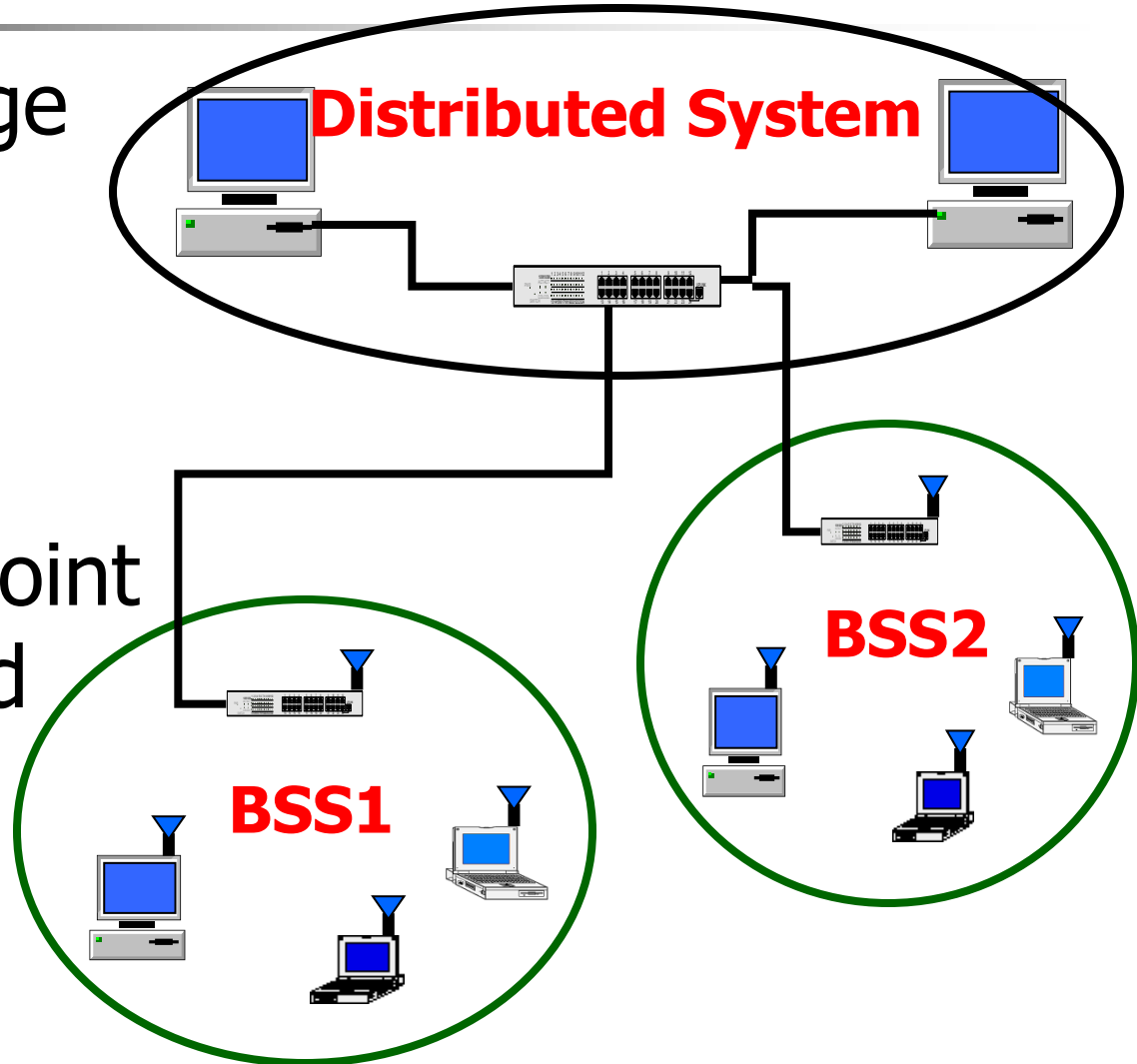
# Infrastructure Basic Service Set

- Stand-alone BSS
- Connect to backbone infrastructure
- Access Point
- Small area



# Extended Service Set (ESS)

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





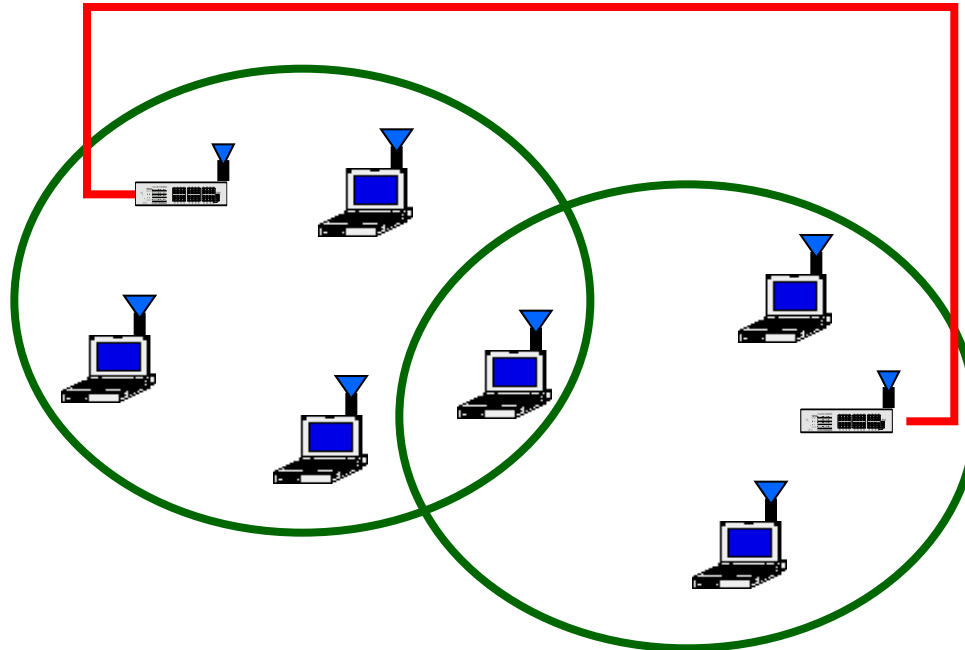
# 802.11 Mobility Types

- 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



# ESS Physical Configuration

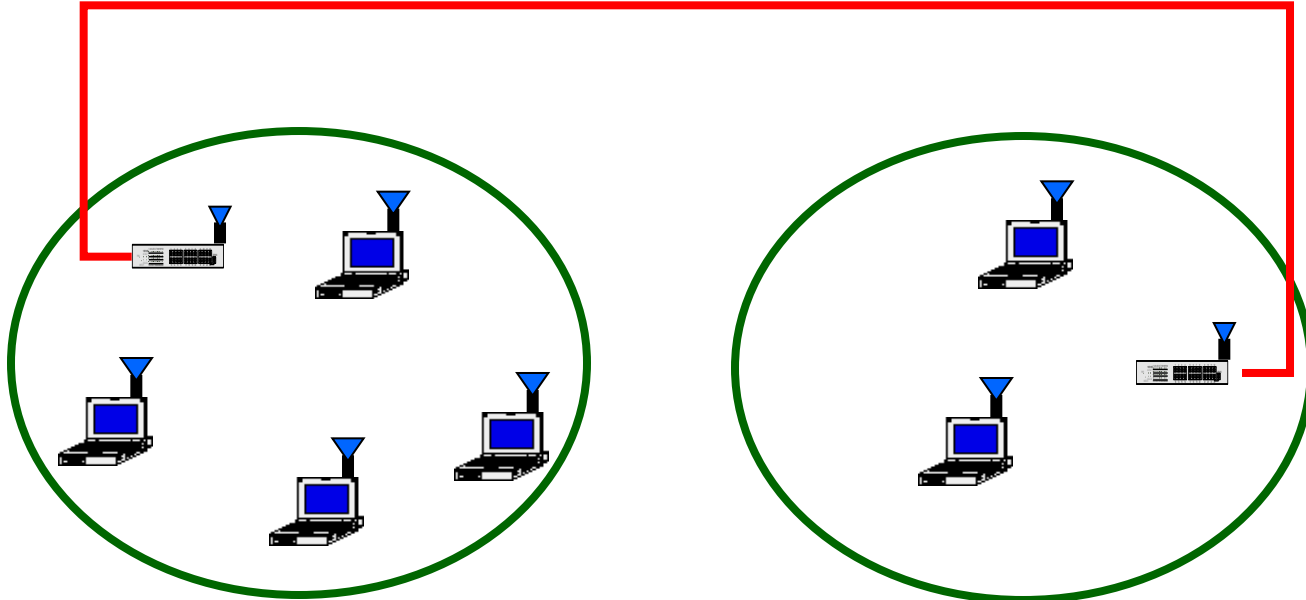
- Partial overlap
  - Contiguous coverage in a defined area
  - No disruption





# ESS Physical Configuration

- Physical disjoint
  - No contiguous coverage → no distance limit

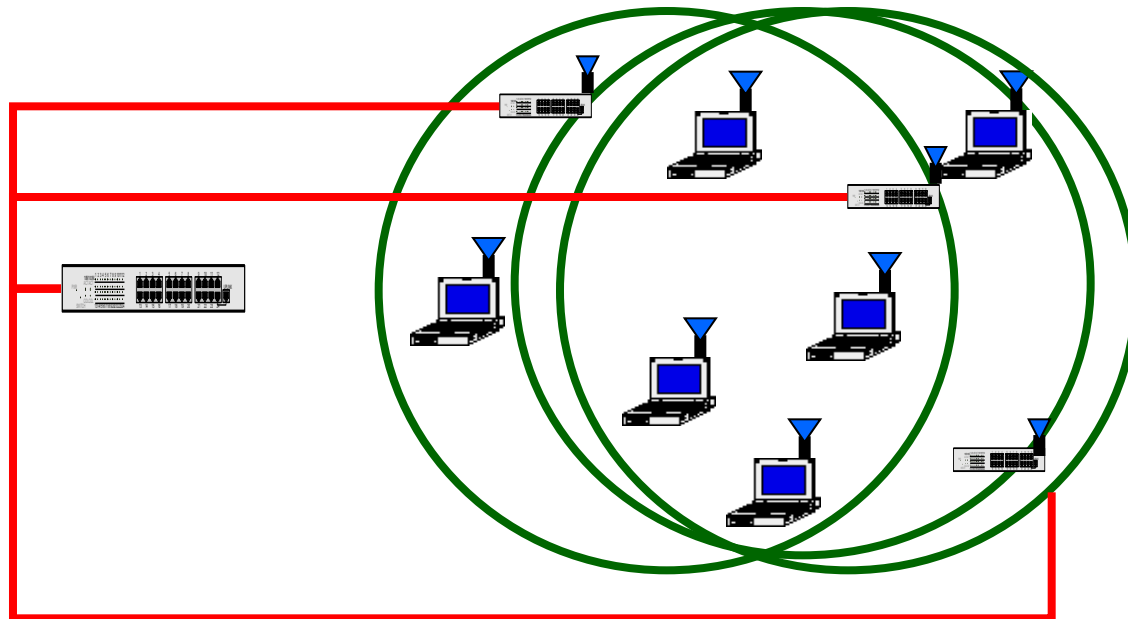






# ESS Physical Configuration

- Physical collocate
  - Redundant or high-performance network





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- **IEEE 802.11 Services**
- History and present of IEEE 802.11



# 802.11 Services

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



# Authentication

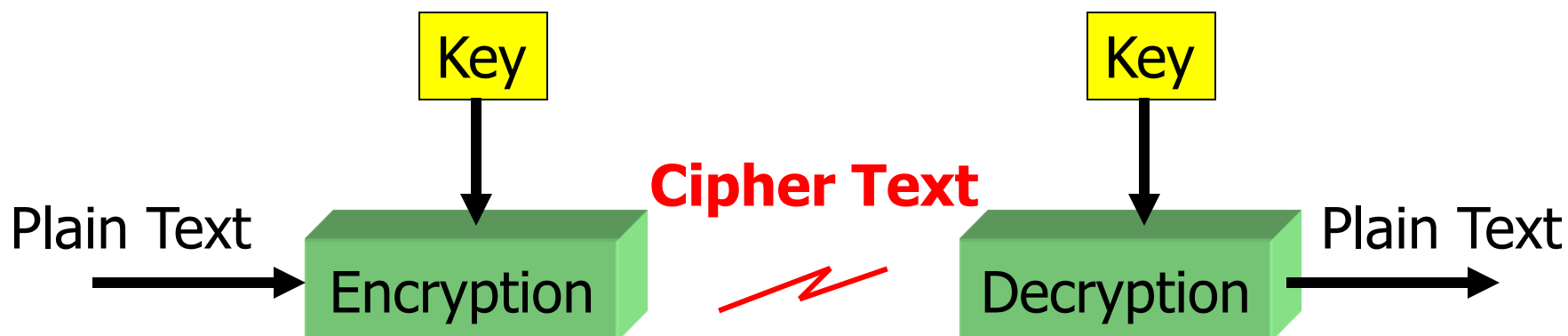
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- Prevent unauthorized access
- Open system authentication
  - send authen. with ID → get back if recognize
- Shared key authentication
  - Secret shared key (through secure channel)
  - Authen. through shared key
  - Required Wireless Equivalent Privacy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



# Privacy

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





# Association

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



# Reassociation

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



# 802.11 State Diagram

