

# Introduction to 802.11 MAC

10/14/05

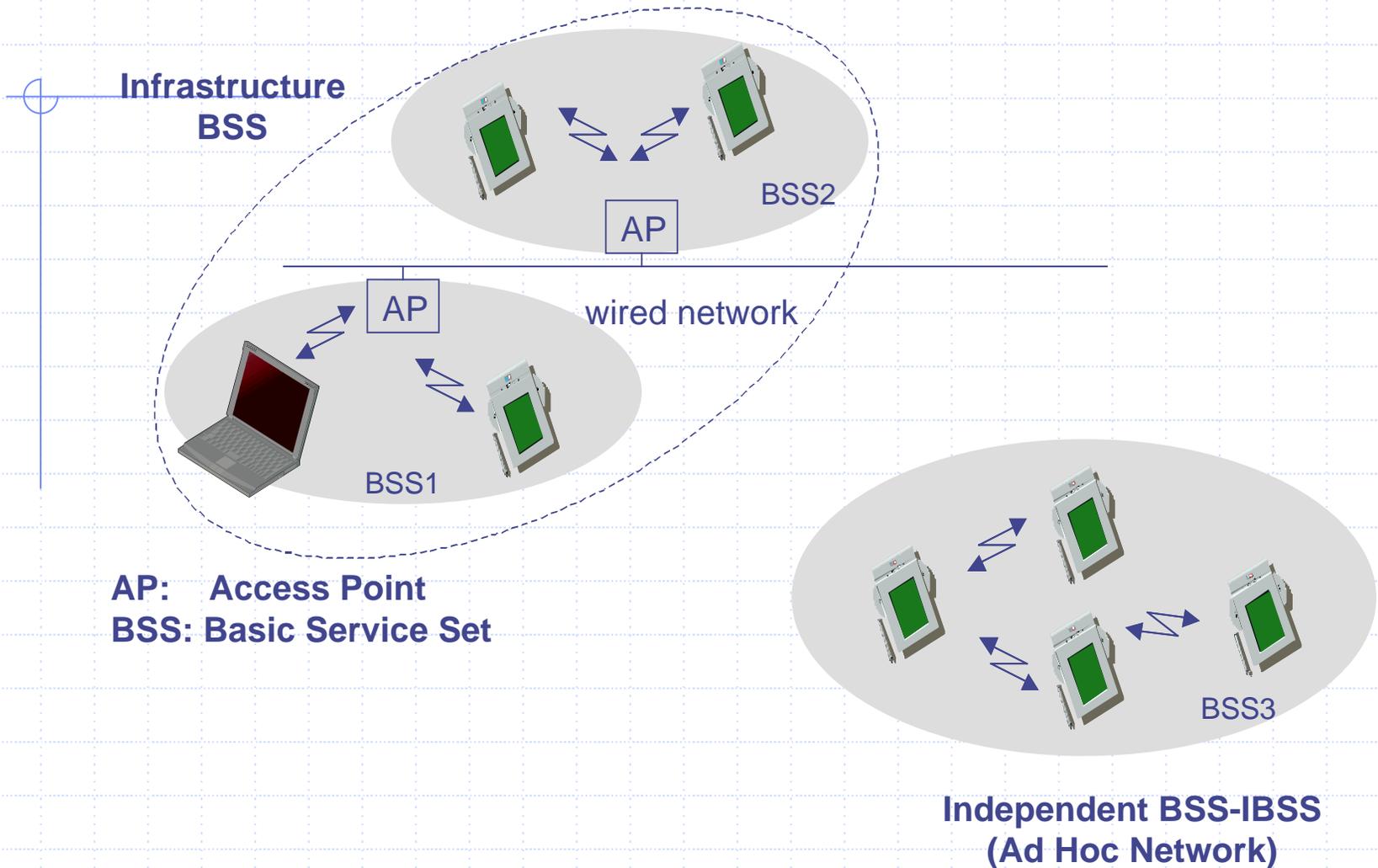
# Outline

- ◆ 802.11 overview
- ◆ 802.11 layers and MAC entity
- ◆ Medium access control(CSMA/CA)
  - Carrier Sensing (CS)
  - Collision Avoidance (CA)
  - Hidden node problem
- ◆ Other topics

# What is 802.11?

- ◆ Standard for wireless local area networks (wireless LANs)
- ◆ Intended for home or office use
- ◆ Standard specifications for the MAC and PHY layer
- ◆ Other sub-standards have been/are being developed for the MAC, PHY, and management functions
- ◆ Extension of the Ethernet (802.3) standard to wireless domain
  - Ethernet: CSMA/CD
  - WLAN: CSMA/CA

# Examples of 802.11 wireless LAN



**BSS: group of stations using the same frequency**

# 802.11 layers and functions

## ◆ MAC sublayer

- access mechanisms, fragmentation, encryption

## ◆ MAC Management

- roaming, MIB, power management

## ◆ PLCP sublayer

- clear channel assessment signal (carrier sense)

## ◆ PMD sublayer

- modulation, coding

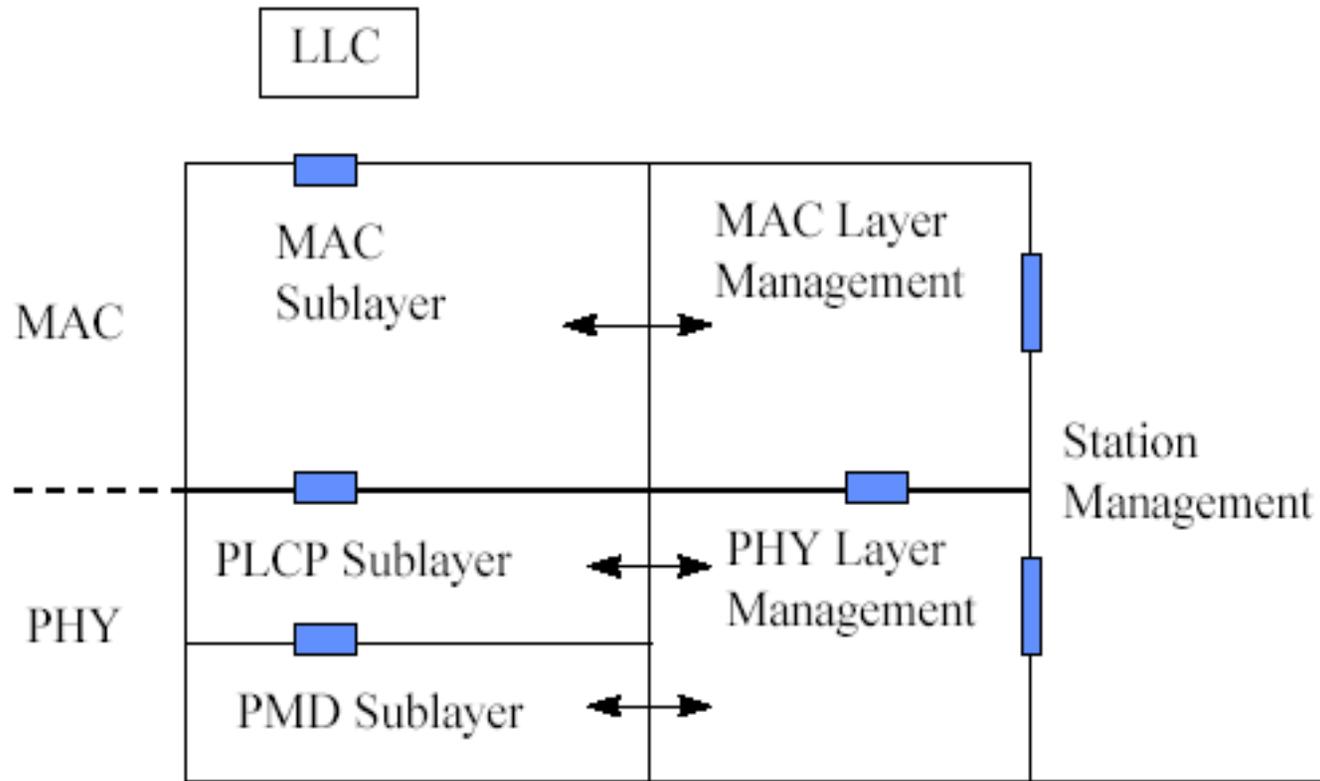
## ◆ PHY Management

- channel selection, Management Information Base(MIB)

## ◆ Station Management

- coordination of all management functions

# 802.11 MAC and PHY Entity



LLC : Logical Link Control

PLCP : Physical Layer Convergence Protocol

PMD : Physical Medium Dependent Sublayer

# Medium Access Control

## ◆ Why not CSMA/CD?

- Collision detection is difficult in radio environment (signal strength decrease, nodes out of radio range)
- Stations may interfere from other LANs (BSS)
- Hidden node problem

## ◆ Distributed Coordination Function (DCF)

- No central coordination
- For asynchronous data service
- CSMA/CA

## ◆ Point Coordination Function (PCF)

- For time-bounded data service
- Access Point (AP) serves as the coordinator

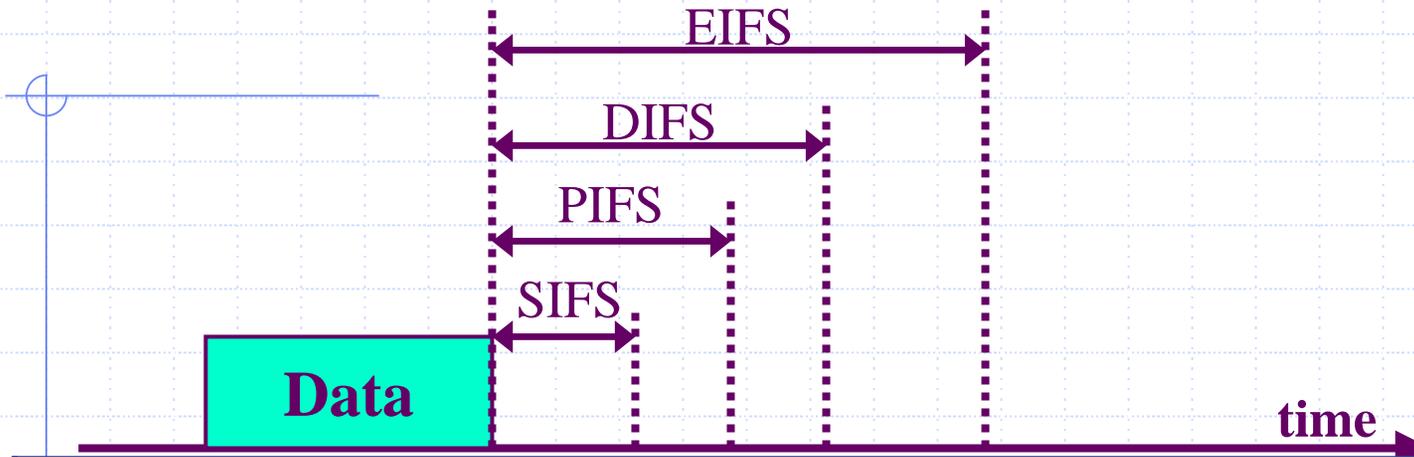
# Medium Access Control (CSMA/CA)

- ◆ Carrier sensing: Listen before talking
- ◆ Handshaking to infer collisions
  - DATA-ACK packets
- ◆ Collision Avoidance
  - RTS-CTS-DATA-ACK to request medium
  - Duration information in each packet
  - Random back off after collision is detected
  - Net Allocation Vector (NAV) to reserve bandwidth
  - Hidden nodes use CTS duration information

# Carrier Sensing(CS)

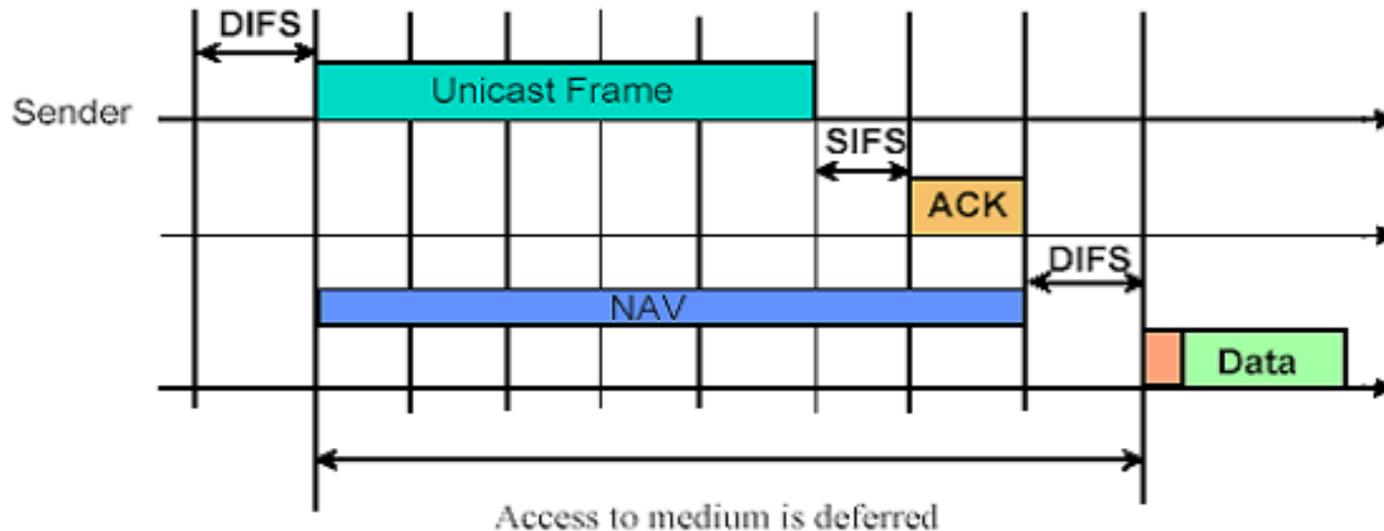
- ◆ Two carrier sensing mechanisms are defined
  - Physical carrier sensing
    - ◆ Depending upon the PHY layer, it senses the availability of the carrier frequency
  - Virtual carrier sensing
    - ◆ Logical carrier sensing at the MAC layer
    - ◆ Every packet (with some exceptions) announces the duration for which the current transmission will hold the channel – Network Allocation Vector (NAV)
    - ◆ All stations monitoring the channel read the MAC header, which contains the NAV. They all “back off” for NAV microseconds before starting the contention for the next transmission

# Medium Access Priorities



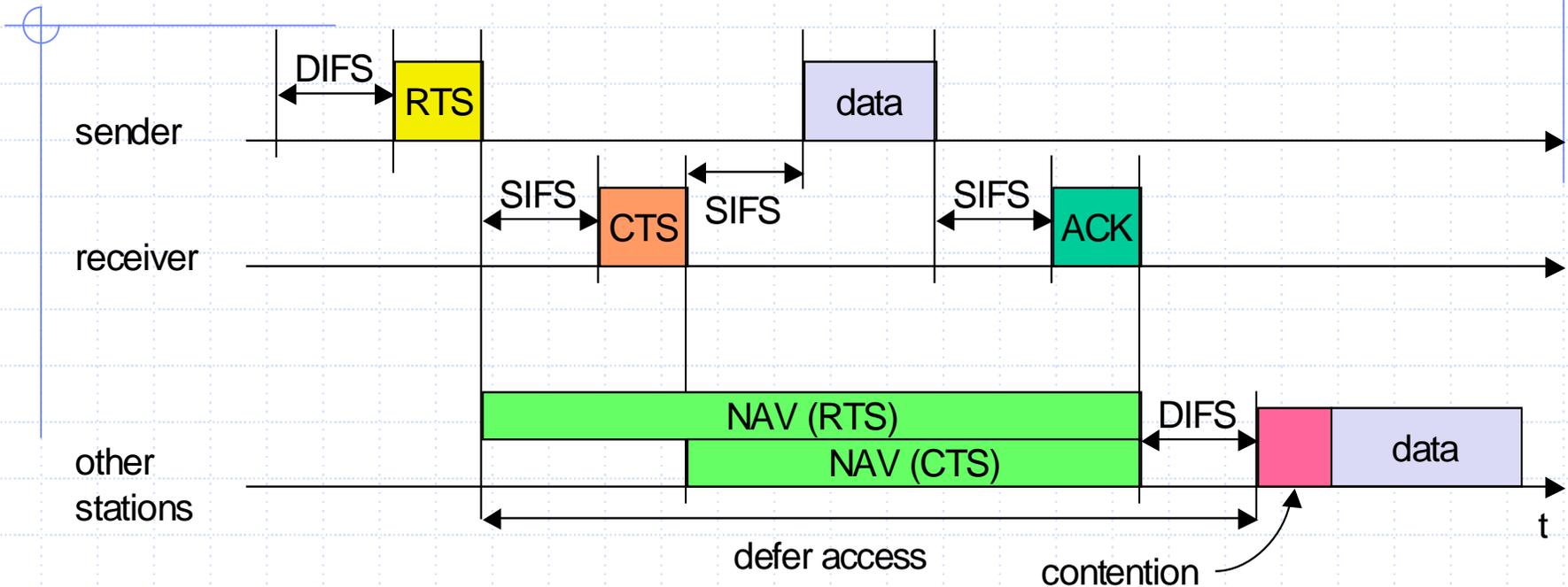
<b>IFS</b>	Interframe Spacing		
<b>SIFS</b>	Short IFS	Highest Priority	ACK,CTS, Poll Messages and Poll Responses, CF-End
<b>PIFS</b>	PCF IFS	2 <sup>nd</sup> priority	PCF Operation Mode (Beacon, Retransmitted Poll Messages)
<b>DIFS</b>	DCF IFS	3 <sup>rd</sup> priority	DCF Operation Mode (back-off, RTS)
<b>EIFS</b>	Extended IFS	Lowest priority	After detection of erroneous frame

# Virtual Carrier Sensing



- ◆ Every unicast frame contains NAV value, indicating time in us the transmission will take including the time for ACK
- ◆ All other monitoring stations will next sense the medium after NAV and the subsequent DIFS

# Collision Avoidance (CA): RTS & CTS

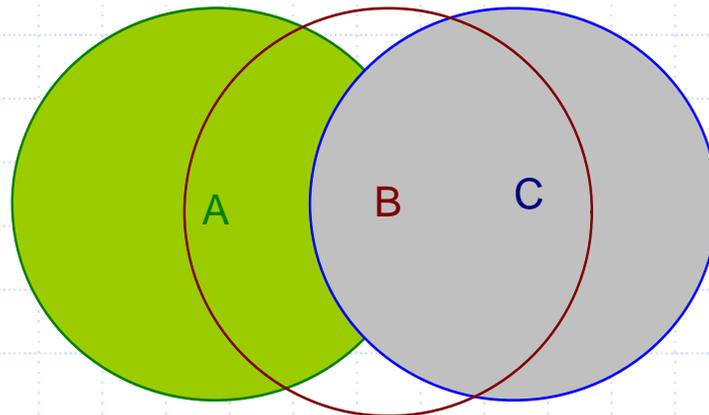


- ◆ Used only for unicast packets
  - ◆ Sender send RTS with reservation parameter after waiting for DIFS
  - ◆ Receiver acknowledge via CTS after SIFS (if ready to receive)
  - ◆ sender can now send data at once, acknowledgement via ACK
  - ◆ other stations save medium reservations distributed via RTS and CTS

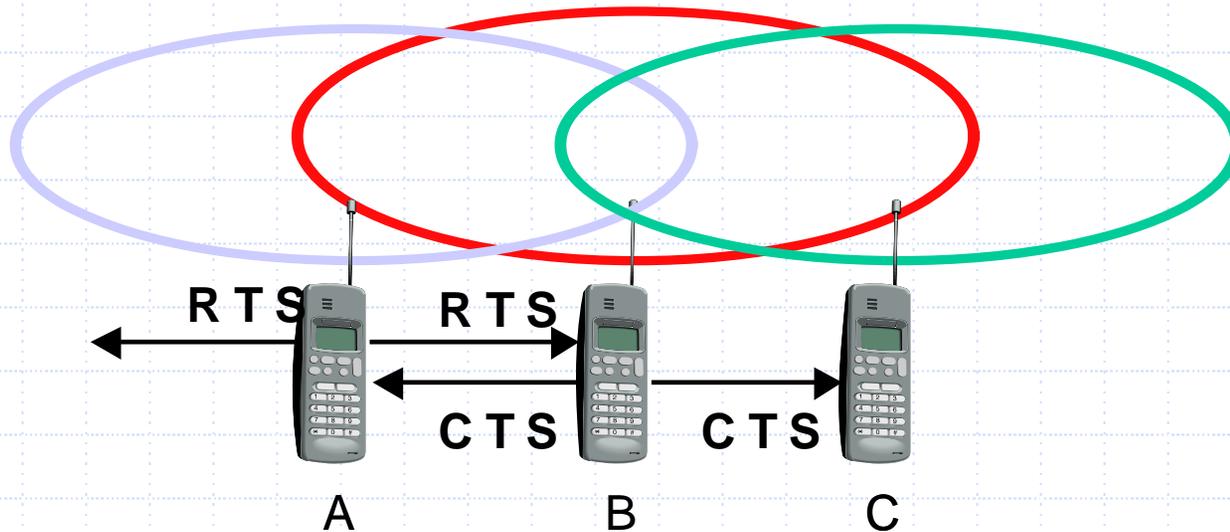
# Hidden node problem

## ◆ Hidden terminals

- A sends to B, C cannot receive A
- C wants to send to B, C senses a “free” medium (CS fails)
- collision at B, A cannot receive the collision (CD fails)
- A is “hidden” for C

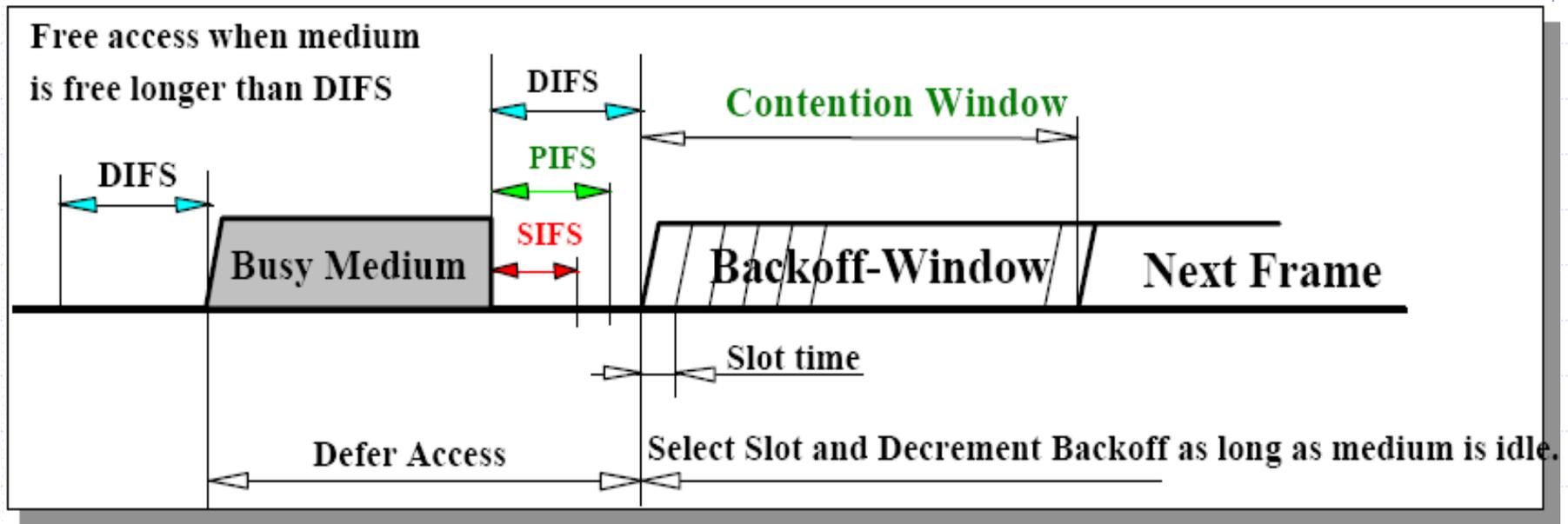


# Hidden node problem(contd.)



- ◆ A and C want to send to B
- ◆ A sends RTS first
- ◆ C waits after receiving CTS from B

# 802.11 DCF : Basic Access Method CSMA/CA in Detail



- Stations wait for medium to become free
- Random back-off after a defer period to avoid collisions
- Exponential back-off window increases for retransmissions
- back-off timer elapses only when medium is idle
- Implement different fixed priority levels
  - ◆ Allows immediate responses and PCF co-existence

# Other topics not covered

- ◆ Optional Point Coordination Function(PCF)
  - Time-bounded service
- ◆ Synchronization, fragmentation
- ◆ Error correction
- ◆ Encryption, roaming, power saving
- ◆ Reference: “80211 standards-1999version”