

Introduction to 802.11 MAC

10/14/05

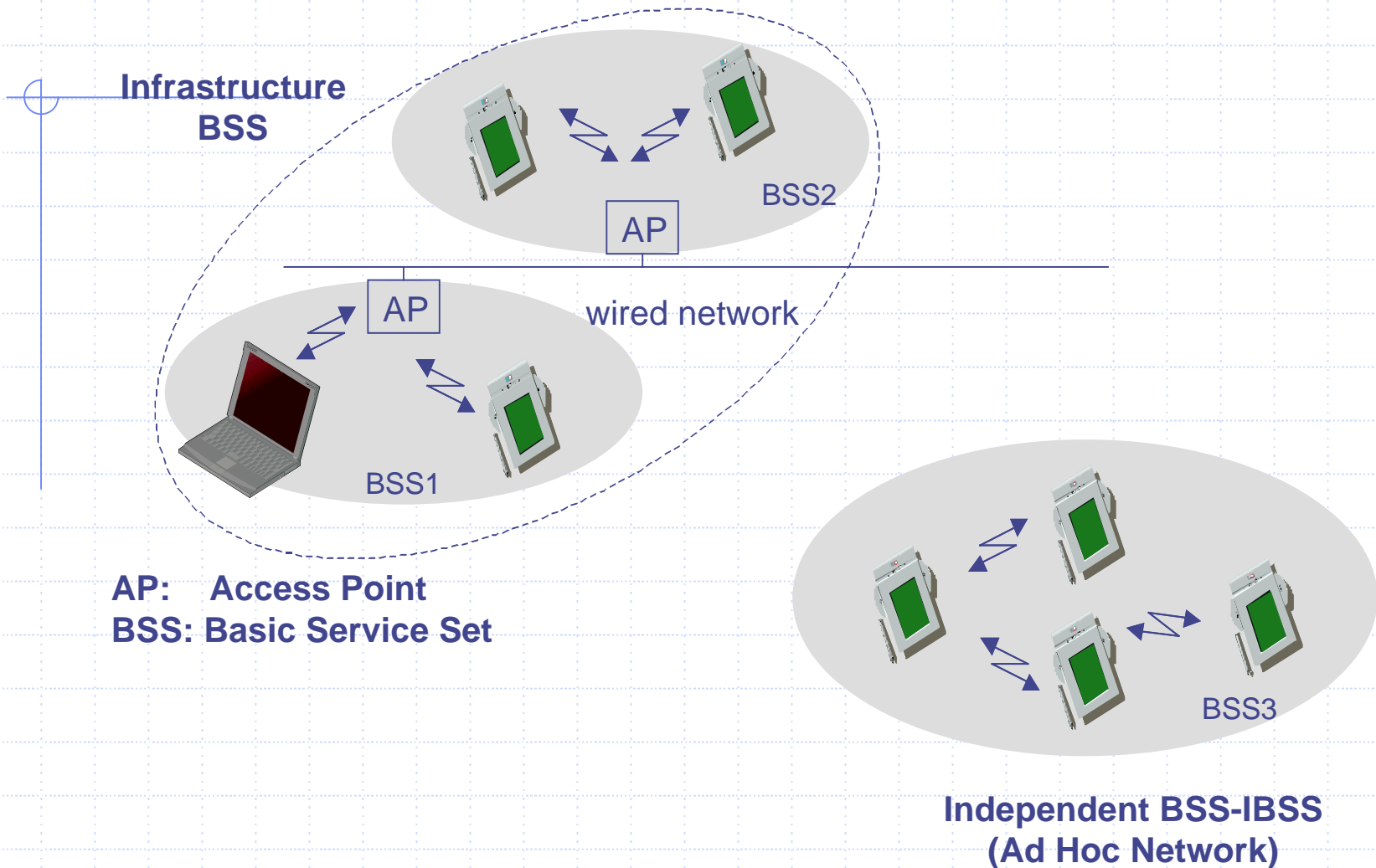
Outline

- ◆ 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

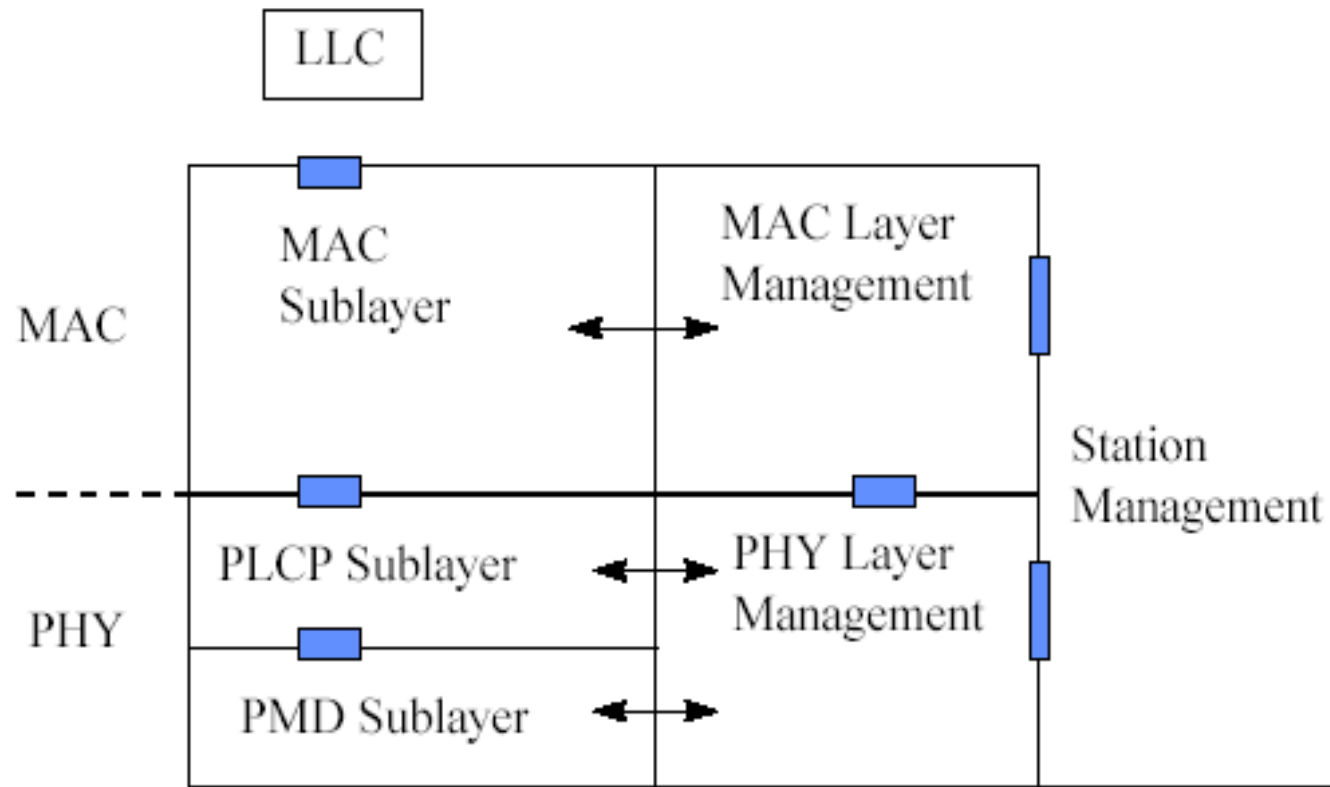
◆ PHY Management

- 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

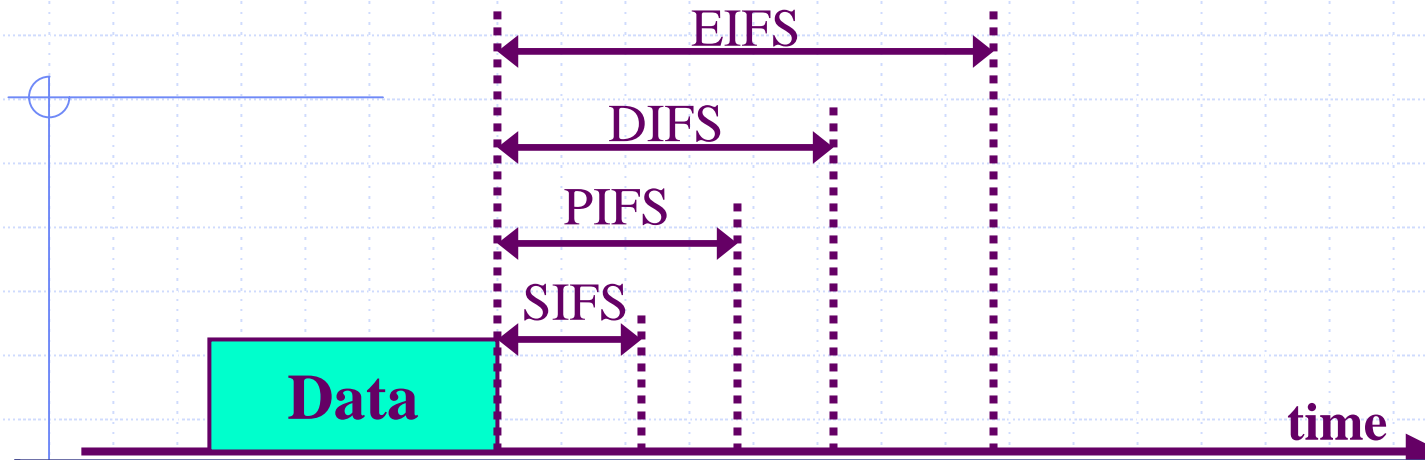
Medium Access Control (CSMA/CA)

- ◆ 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)

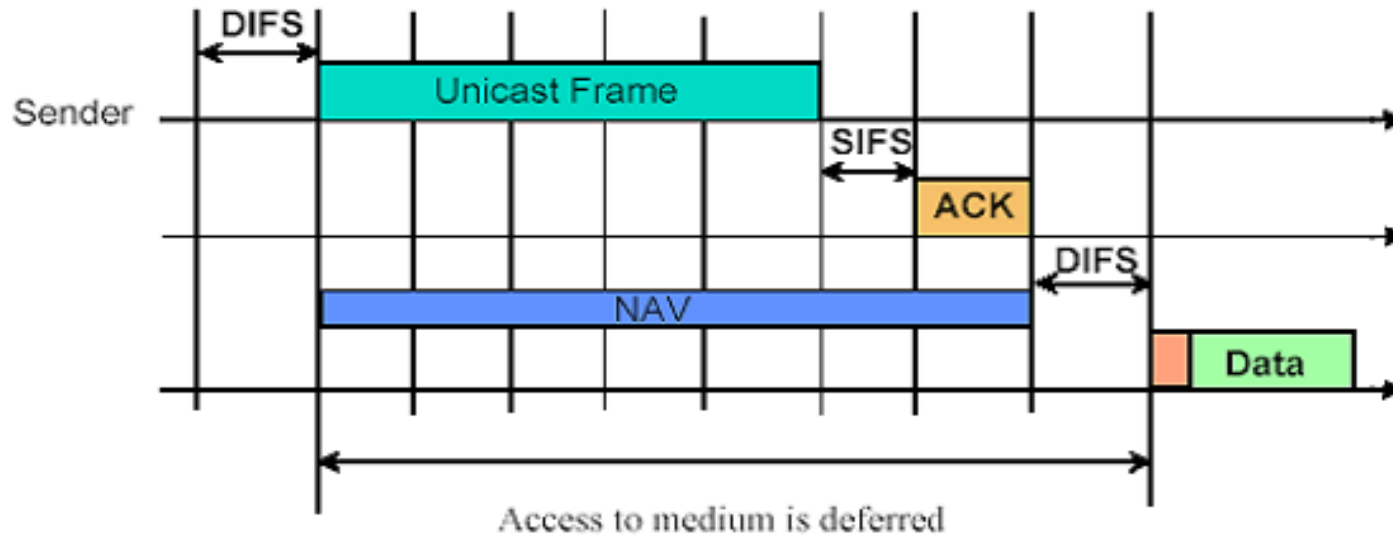
- ◆ Two carrier sensing mechanisms are defined
 - Physical carrier sensing
 - ◆ Depending upon the PHY layer, it senses the availability of the carrier frequency
 - Virtual carrier sensing
 - ◆ Logical carrier sensing at the MAC layer
 - ◆ Every packet (with some exceptions) announces the duration for 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



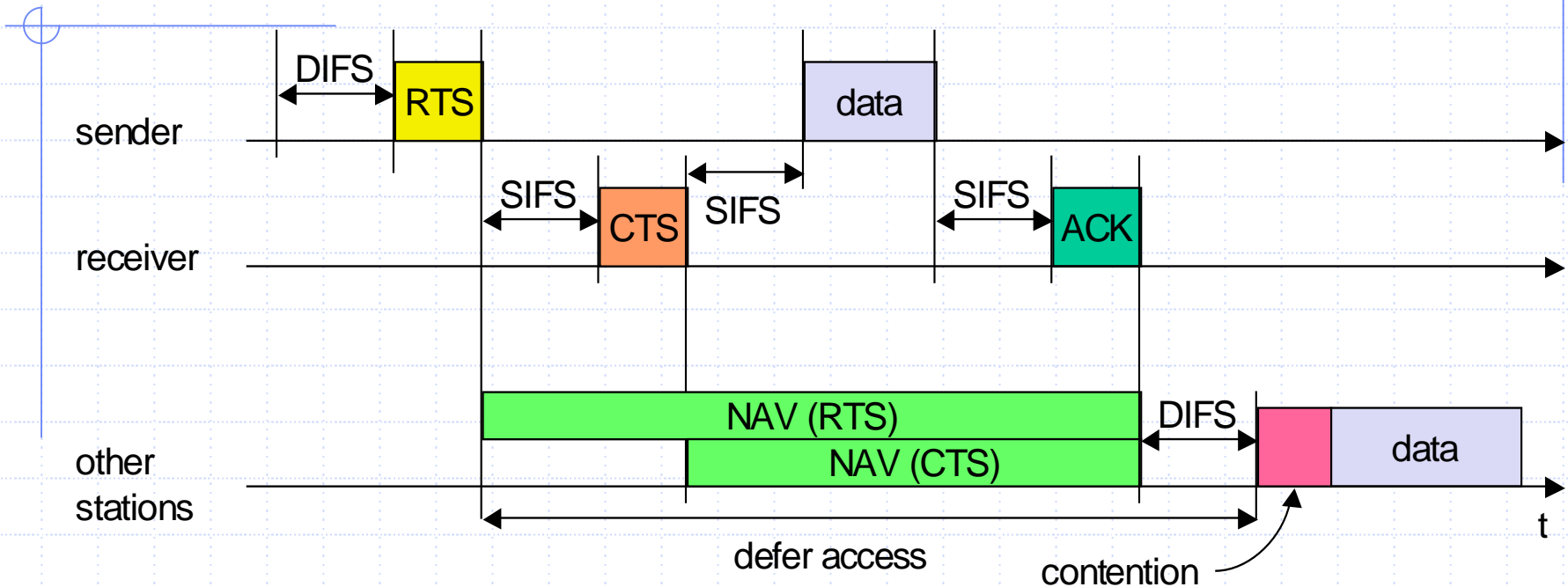
IFS	Interframe Spacing		
SIFS	Short IFS	Highest Priority	ACK,CTS, Poll Messages and Poll Responses, CF-End
PIFS	PCF IFS	2 nd priority	PCF Operation Mode (Beacon, Retransmitted Poll Messages)
DIFS	DCF IFS	3 rd priority	DCF Operation Mode (back-off, RTS)
EIFS	Extended IFS	Lowest priority	After detection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

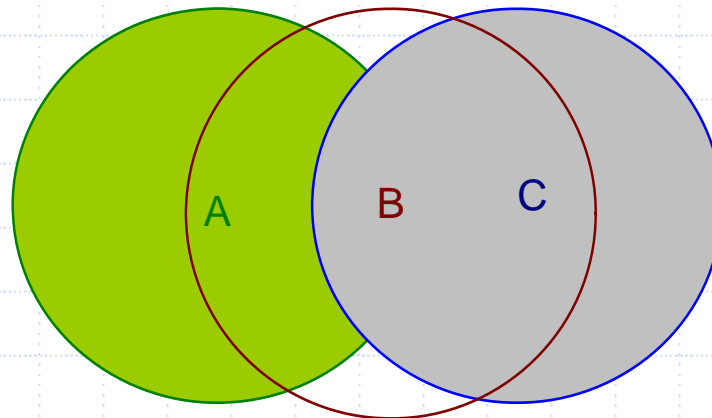


- ◆ Used only for unicast packets
 - ◆ Sender send RTS with reservation parameter after waiting for DIFS
 - ◆ Receiver acknowledge via CTS after SIFS (if ready to receive)
 - ◆ sender can now send data at once, acknowledgement via ACK
 - ◆ other stations save medium reservations distributed via RTS and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

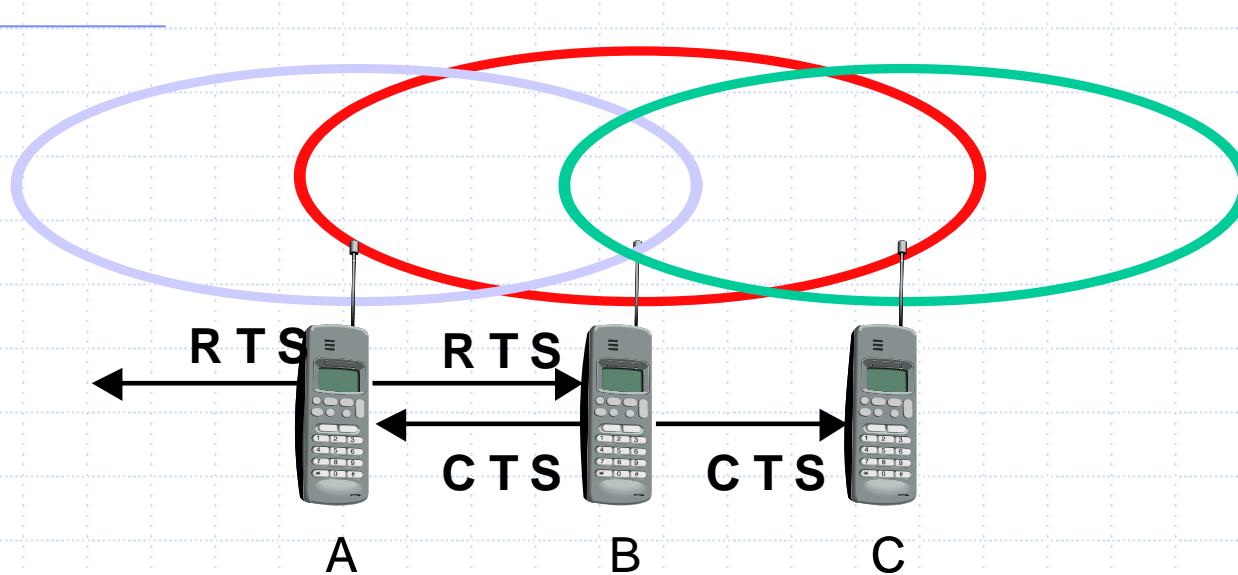
Hidden node problem

◆ 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

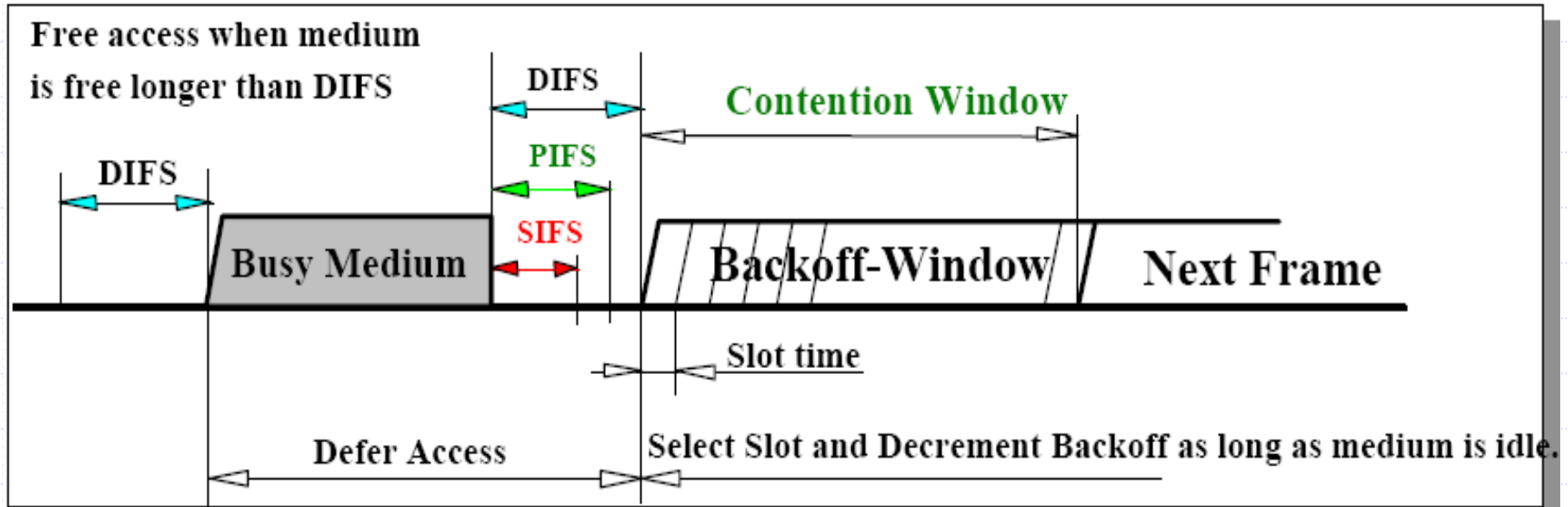


Hidden node problem(contd.)



- ◆ 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”