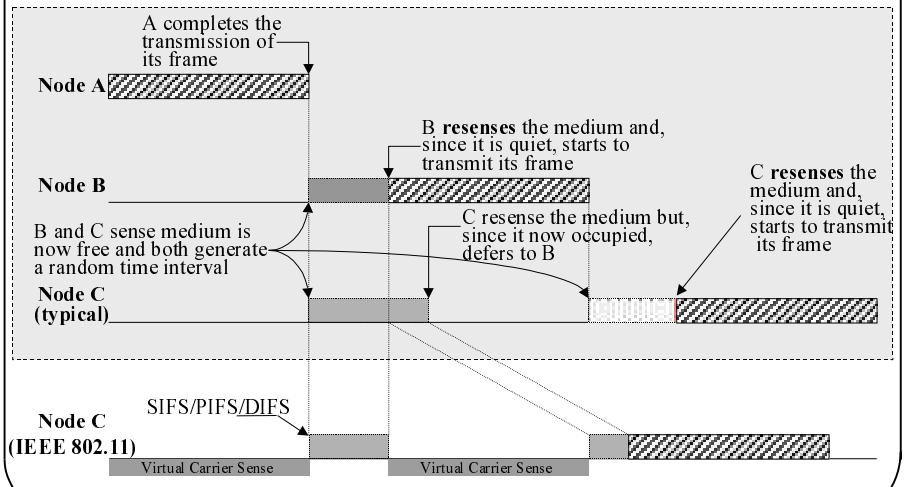
2. DCF in Ad Hoc Network

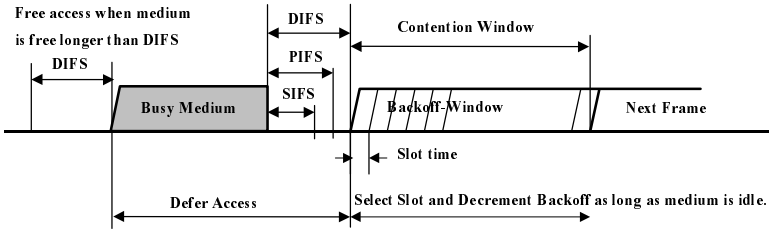
- Based on an enhanced CSMA/CA Algorithm
  - Typical CSMA/CA scheme
  - IEEE 802.11 CSMA/CA scheme
- RTS/CTS Mechanism
- ACK-Level Acknowledge
- Retransmission Procedure
- Fragmentation and Defragmentation

Typical CSMA/CA scheme



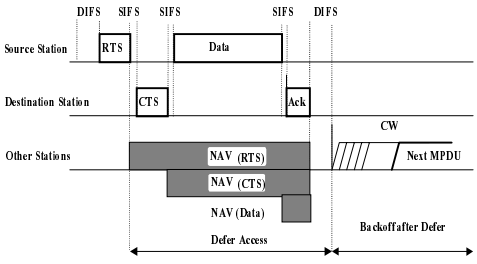
IEEE 802.11 CSMA/CA Algorithm

- Virtual carrier sense
  - Net Allocation Vector (NAV)
- Random Back-off Algorithm with exponentially increasing back-off windows
- IFS Scheme to prioritize transmitted frames

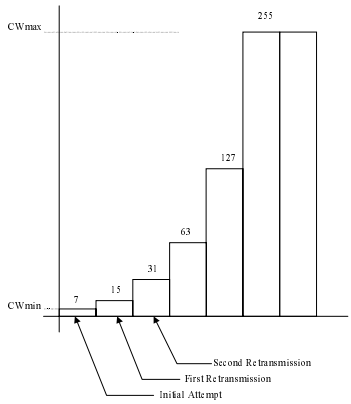


NAV Update and Contention Window

(a) NAV update



(b) Contention window



Back-off Algorithm

- The back-off procedure shall be invoked whenever a station desires to transfer and finds medium busy
- Constantly sense the medium when performing back-off procedure
  - Decrease the back-off timer by *aSlotTime* when medium is sensed *free;*
  - Stop the back-off timer when medium is sensed *busy*
- When multiple STAs enter the back-off procedure, the one selecting the *smallest back-off time* will win the channel.

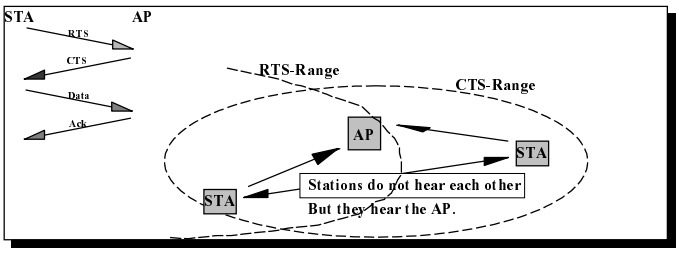
Back-off Time = INT (CW × Random( )) × SlotTime

RTS/CTS Mechanism

- Increase the Traffic Throughput
- Avoid the *Hidden Node Effect*
- Duration field in RTS and CTS frames distribute Medium Reservation information which is stored in NAV
- Controlled by a ***RTS_Threshold*** parameter associated with each station

Hidden Node Problem?

- **Transmitters contending for the medium may not *"Hear each other"* as shown below.**



- **Separate Control frame exchange (RTS / CTS) between transmitter and receiver will *Reserve the Medium* for subsequent data access.**

ACK-Level Acknowledge

- An ACK shall be transmitted whenever Destination STA receives a valid unicast frame.
- After transmitting a MPDU which requires an ACK shall wait for a ***ACKTimeout*** interval to receive ACK.

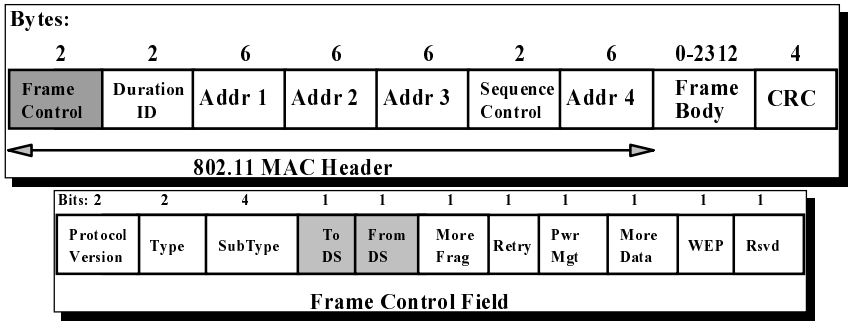
Retransmission Procedure

- Error Recovery shall be attempted by retransmissions and retry shall continue until either ***successful*** transmission is reported or ***retry limit*** is reached.
- There are two retry limits specified, ***Short Retry Limit*** for short data frame and ***Long Retry Limit*** for long data frame.

Fragmentation and Defragmentation

- When a station transmits an MSDU, the SequenceNumber shall remain the same, while the Fragment Number starts at zero and increases by one for each fragment of the MSDU.
- The header of each fragmentation contains the following information that is used by destination STA to reassemble the MSDU
  - Frame type
  - Source Address
  - Destination Address
  - Sequence Control Field
  - More fragment indicator

MAC Frame Format



- MAC Header format differs per Type:
  - Control Frames (several fields are omitted)
  - Management Frames
  - Data Frames