

Frame Windowing at the MAC Layer

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Windowing

- Windowing is used in most of today's network protocols.
- It allows the transmission of multiple frames with a single acknowledgment.
- It also provides for selective retransmission.
- Windowing also reduces the effect of delay introduced in a network.

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Windowing in a Wireless LAN

- The delay in a wireless LAN is not only due to the lower bits rates of the wireless LAN but also the contention problem.
- The source station will maintain priority of the media while transmitting data frames in the window.
- When used with fragmentation, whole MAC Service Data Units (MSDU) can be fragmented into multiple data frames and sent with minimal delay.
- For a multiple fragment MSDU, the sending device would only have to contend for the channel for the first data frame of each MSDU.
- Windowing has equal benefits for both frequency hopping and direct sequence PHYs.

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Windowing and Fragmentation

- Windowing allows data frames of a fragmented MSDU to be transferred back-to-back without introducing any significant additional delay.
- The transmitting station may use multiple windows to send a fragmented MSDU depending on the maximum size of the window.
- The destination station will send one acknowledgment for each window indicating which data frames were received without error.
- No assumption is made about window size.

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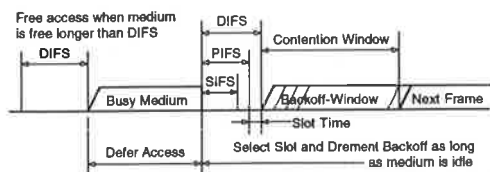
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Foundation CSMA/CA Access Method



- **Short Inter Frame Space (SIFS)**
 - This priority level is used for all immediate response actions.
- **Point Coordination Function Inter Frame Space (PIFS)**
 - This priority level is used by the PCF in the AP to send any of the Contention Free Period (CFP) frames.
- **Distributed Coordination Function Inter Frame Space (DIFS)**
 - This priority level is used by the DCF to transmit Asynchronous frames in the Contention Period.

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Windowing in the Foundation MAC

- **Windowing is used in conjunction with fragmentation to provide a efficient MSDU delivery mechanism.**
- **Once a station has contended for the channel, it can maintain control of the channel until it has sent all of the data frames of a MSDU.**
- **After all frames have been transmitted, the station will relinquish control of the channel.**
- **It is not necessary for a station to transmit all frames in a single window (only requiring one acknowledgment) but the frames can be broken into several windows.**
- **The source station will maintain control of the channel for the entire series of windows.**

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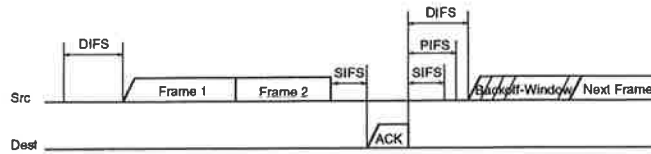
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Multiple Frame Window with ACK



- The source station contends for the channel after the DIFS.
- The source station will transmit the number of data frames specified by *frame_window_size*.
- After the source station has transmitted its last data frame in the window, the destination will see the channel idle for SIFS and transmit an ACK.

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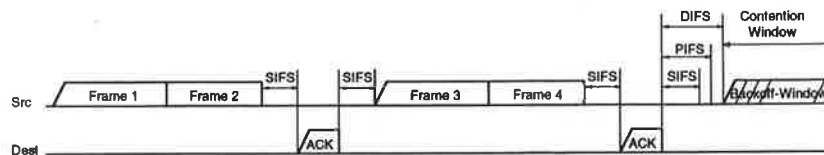
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Multiple Window Operation



- The source station contends for the channel the same as it did for a single window.
- The destination stations transmits the ACK the same as it did for a single window.
- After the ACK, the source station will see the channel idle for SIFS and transmit the data frames of the next window.
- After the source station has transmitted its last data frame in the second window, the destination will see the channel idle for SIFS and transmit an ACK.
- This continues until all data frames of a MSDU have been transmitted.

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Windowing Rules

- A station may transmit immediately following its own transmission when the following conditions are all satisfied:
 - The station has just finished transmitting a data frame of a MSDU.
 - More data frames of the same MSDU require transmission.
 - The number of consecutive data frames that may be transmitted (without waiting for an acknowledgment) has not exceeded the `frame_window_size`.

Windowing Rules (con't)

- A station will transmit after the SIFS under either of the following conditions (for windowing):
 - The station has just received a frame that requires acknowledging and the SIFS is detected idle.
 - The source station has received an acknowledgment to a previous window and has more data frame(s) for the same MSDU to transmit.

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Windowing Guidelines

- **The following guidelines also apply to windowing:**
 - **A transmitting station with permission to transmit following its own transmission need not turn its radio around to sense the channel. The station can simply continue in transmit mode and start transmitting the next frame as soon as the current frame is finished. At the end of the SIFS, other stations will hear a busy channel as required.**
 - **When a station has transmitted a frame other than a data frame, it does not have priority to transmit on the channel following that packet.**
 - **When a MSDU has been successfully delivered, the device does not have priority to transmit on the channel following the last acknowledgment of the last data frame.**
 - **Only unacknowledged data frames need to be retransmitted.**

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Conclusion

- **Windowing can be implemented in the Foundation MAC without changing what already exists, only requires additional definition.**
- **Windowing when used with fragmentation provides an efficient method for delivery of large MSDUs in a wireless environment.**
- **Windowing allows for selective retransmission.**

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Motion

- Move that Issue 20.7 be closed with a recommendation of yes, the MAC will support windowing.

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Motion

- Move that windowing be implemented using the approach defined in paper 94/38 as a foundation.

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