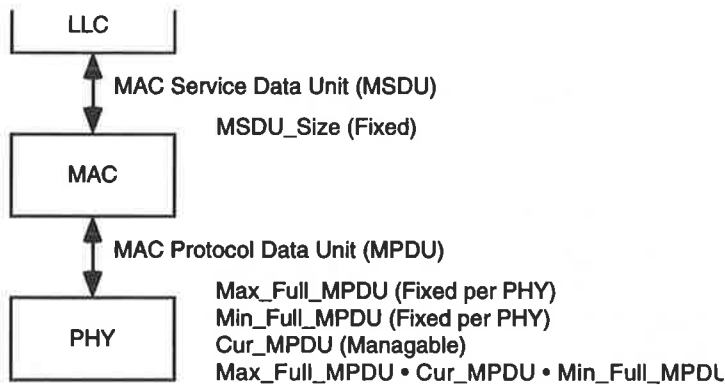


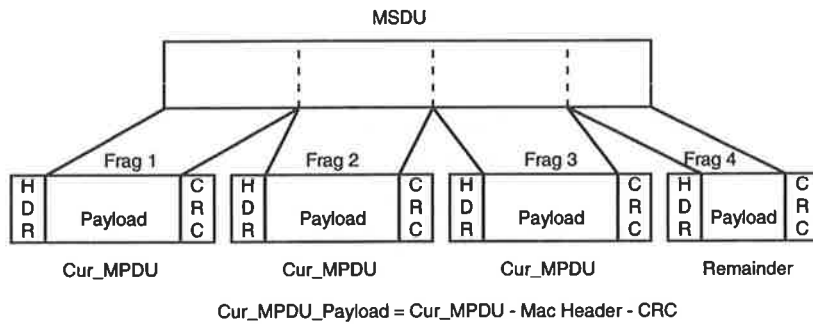
Fragmentation/Reassembly at the MAC Layer

Presented by
Rick White
Motorola
Wireless Data Group

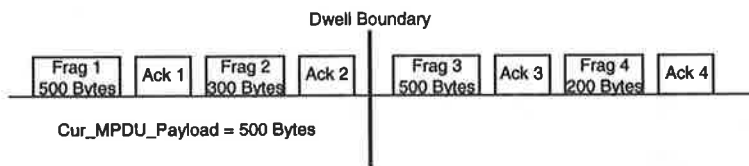
MPDU and MSDU Definitions



Fragmentation of a MSDU

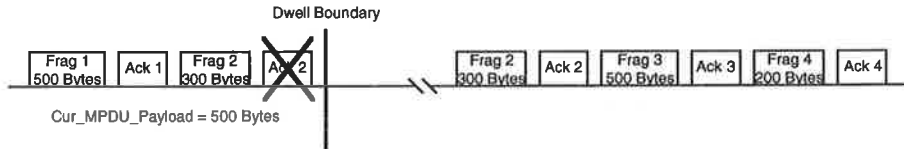


Fragmentation Near a Dwell Boundary



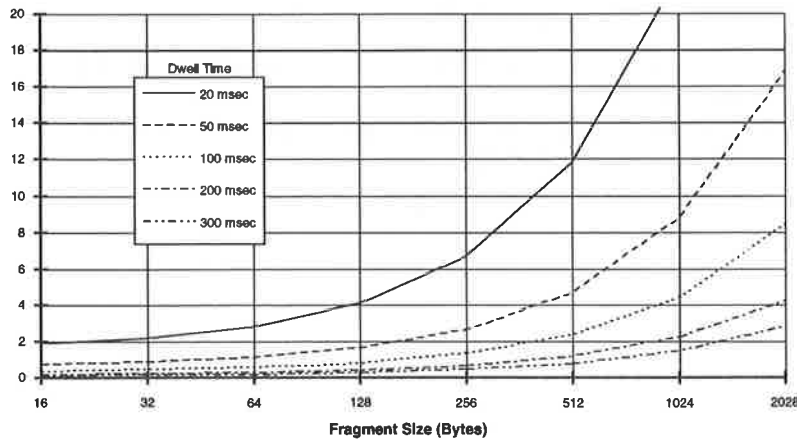
- **1500 Byte MSDU**
- **After Fragment 1, there is only enough time to send a 300 Byte fragment and receive an ACK.**
- **Fragment 3 contends for the channel after the dwell boundary.**

Fragmented MSDU with Missed ACK near Dwell Boundary



- **Fragment 2 reduced to 300 bytes due to impending dwell boundary.**
- **Source Station does not receive ACK from Destination.**
- **Fragment 2 remains 300 bytes when retransmitted.**

Unutilized Bandwidth



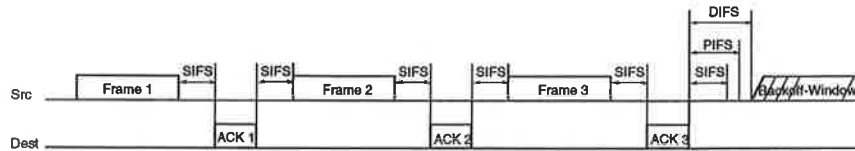
Reassembly

- **Data frame must contain:**
 - **Frame type**
 - **Source Address**
 - **Destination Address**
 - **MPDU ID**
 - **Fragment Number**
 - **Last Fragment Indicator**
- **Fragments sent in order.**
- **Destination Station reassembles MSDU by piecing together fragments in order of increasing Fragment Number.**
- **Last Fragment Indicator denotes last fragment in MSDU.**
- **Duplicate fragments are discarded.**

Transmitter Priority

- **Allows a station to send multiple asynchronous frames without being preempted by another station.**
- **Fairness requires the number of consecutive frames be limited.**
- **Station will only contend for the channel for the first data frame of a MSDU.**
- **Each frame is acknowledged.**

Transmission of a Multiple Fragment MSDU using Transmitter Priority



- The source station transmits a data frame then waits for an acknowledgment.
- The destination will send an acknowledgment after SIFS.
- The SIFS following the acknowledgment is reserved for the source station to send another data frame (if necessary).
- If the source station does not receive an acknowledgment frame, it will attempt to retransmit the data frame at a later time (according to the backoff algorithm).

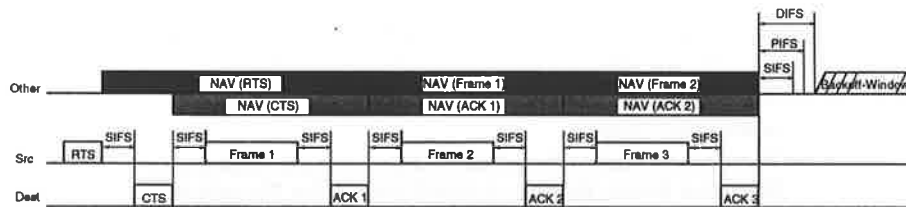
Transmitter Priority Rules

- A station will transmit after the SIFS only under the following conditions (for transmitter priority):
 - The station has just received a frame that requires acknowledging.
 - The source station has received an acknowledgment to a previous frame, has more data frame(s) for the same MSDU to transmit, and there is enough time left in the dwell time to send the next frame & receive an acknowledgment.

Transmitter Priority Guidelines

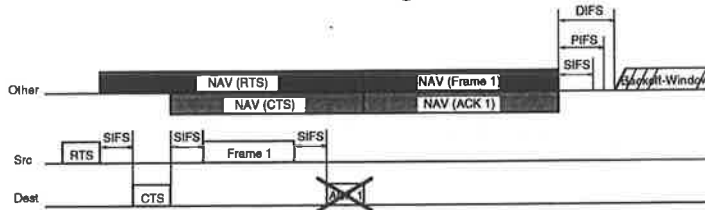
- When a station has transmitted a frame other than a data frame, it does not have priority to transmit on the channel following the acknowledgment for that frame.
- When a MSDU has been successfully delivered, the device does not have priority to transmit on the channel following the last acknowledgment of the last data frame.
- Only unacknowledged data frames need to be retransmitted.

RTS/CTS with Fragmented MSDU



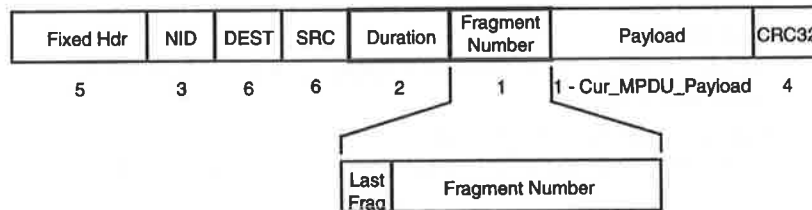
- Each frame contains information that defines duration of the next transmission.
- The RTS will update the NAV to indicate busy until the end of ACK 1. The CTS will also update the NAV to indicate busy until the end of ACK 1.
- Both Frame 1 and ACK 1 will update the NAV to indicate busy until the end of ACK 2. This will continue until the last Frame and ACK which will indicate no update to the NAV.

RTS/CTS with Transmitter Priority and Missed Acknowledgment

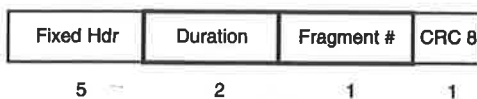


- When an acknowledgment is not received by the source station, the NAV will be marked busy for next frame exchange and is the worst case situation.
- If the acknowledgment is not sent by the destination station, stations that can only hear the destination station will not update their NAV and be free to access the channel.

Data Frame



Acknowledgment Frame



Conclusion

- **Fragmentation compatible with current Foundation**
- **Dynamic nature of fragmentation minimizes unutilized bandwidth.**
- **RTS/CTS provides media reservation on a fragment by fragment basis.**
- **Transmitter Priority provides efficient method of transmitting a fragmented MSDU with minimal delay.**