IEEE P802.11
Wireless Access Method and Physical Layer Specifications

Title: Proposed Revisions to the MAC Frame Formats.

Authors:

Wim Diepstraten
AT&T WCND
Nieuwegein The Netherlands
Tel: (31)-3402-97482
Fax: (31)-3402-97555
Email: Wim.Diepstraten@utrecht.ncr.com

Michael Fischer
Digital Ocean
San Antonio Texas
Tel: 210-614-4096
Fax: 210-614-8192
MFischer@digocean.com

Abstract:
This submission contains the proposed changes for section 4.1 of the draft standard. It is to replace the current section 4.1 in the B3 draft. The paper is a copy of the B3 draft with the necessary changes included.
The section numbering should be adapted to reflect the correct sections in the draft.

Changes introduced:

The changes implemented in this paper involve the redefinition of the Frame Formats and the definition of the different fields.
In addition it includes a change in the FC field to implement the "Final" bit indicating a Final Fragment.
This is currently listed as occupying the reserved bit. However subsequent submissions will address the alternative approach to combine the More bit into the Power Management bits, so that again a reserved bit will be available.

0.1. MAC Frame Formats

Each frame shall consist of the following basic components:

1) A *MAC Header*, which includes control information, addressing, sequencing, fragmentation identification and duration.
2) A variable length *Frame Body*,that may contain information specific to various frame *types*.
3) An IEEE 32-bit CRC.

0.1.1. General Frame Format

The MAC frame format comprises a set of fields that shall occur in a fixed order in all frames. Some fields may be absent from some frame types.

Figure 4-1 depicts the general MAC frame format and field order. The format of the MAC header for each of the frame types is defined subsequently. Subsequent sections define each of the fields of the MAC header. A frame is an ordered octet string. The order of transmission of the octets of a frame shall be from left to right.

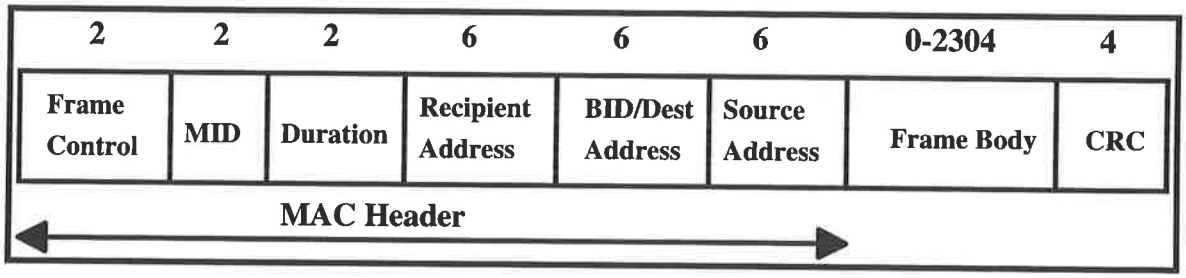

Figure 4-1: MAC Frame Format

0.1.2. Frame Fields

0.1.2.1. Frame Control Field

The Frame Control field shall consist of the following subfields: Protocol Version, Type, Subtype, To AP, From AP, More, Retry, Elements Present, Power Management. The remaining subfields in the Frame Control field are reserved. All reserved bits and fields shall be sent as '0'. Reserved bits and fields shall be ignored on reception.

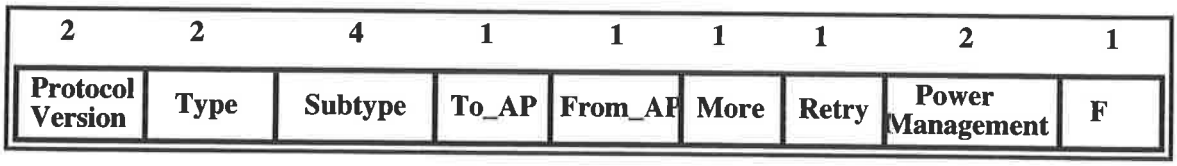

Figure 4-2: Frame Control Field

0.1.2.1.1. Protocol Version

This two bit field shall be invariant in size and placement across all revisions of the 802.11 standard. The values shall be assigned sequentially starting with the value zero. The revision level shall be incremented only when a fundamental incompatibility exists between a lower revision and the current standard. A device that receives a frame with a higher revision level than it can understand shall discard the frame.

0.1.2.1.2. Type and Subtype

The Type and Subtype fields shall identify the function and interpretation of a frame. There are three frame types: control, data and management. Each of the frame types may have several subtypes. The table below lists the valid combination of Type and Subtype.

Type Value	Type Description	Subtype Value	Subtype Description
00	Management	0000	Association Request
00	Management	0001	Association Response
00	Management	0010	Reassociation Request
00	Management	0011	Reassociation Response
00	Management	0100	Probe Request
00	Management	0101	Probe Response
00	Management	0110	Privacy Request
00	Management	0111	Privacy Response
00	Management	1000	Beacon
00	Management	1001	ATIM
00	Management	1010	Disassociation
00	Management	1011	Authentication
00	Management	1100-1111	Reserved
01	Control	0000-1010	Reserved
01	Control	1011	RTS
01	Control	1100	CTS
01	Control	1101	ACK
01	Control	1110	CF End
01	Control	1111	Poll
10	Data	0000	Asynchronous Data
10	Data	0001-1111	Reserved
11	Contention Free	0000	Data
11	Contention Free	0001	Data + ACK
11	Contention Free	0010-1111	Reserved

Table 4-1: Valid Type/Subtype Combinations

0.1.2.1.3. To AP

This one bit field shall indicate that the frame is destined for the access point in an infrastructure network. This bit shall be transmitted as a one when the frame is destined for the access point, either directly to the AP's destination address or to another station via the distribution system services provided by the AP. It shall be transmitted as a zero, otherwise.

0.1.2.1.4. From AP

This one bit field shall indicate that the frame is from the access point in an infrastructure network. This bit shall be transmitted as a one when the frame is sent from the access point. It shall be transmitted as a zero, otherwise.

0.1.2.1.5. More

This one bit field shall indicate that the AP holds additional frames buffered for the station identified by the destination address of the frame. This bit shall only be set by an AP when a frame is being transmitted to a destination address for which there are additional frames buffered.. A station shall always transmit this bit as a zero.

0.1.2.1.6. Retry

This one bit field shall indicate that the frame is a retransmission of an earlier frame. A station may use this indication to aid in the process of eliminating duplicate frames.

0.1.2.1.7. Power Management

This two bit field shall indicate the power management state in which the station will be after the completion of the transmission of the frame. The values for this field are given in table 4-2.

Value	Description
00	CAM - Continuous Active Mode
01	PSP - Power Save, Polling
10	PSNP - Power Save, No Polling
11	TAM, Temporary Active Mode

Table 4-2: Power Management Values

0.1.2.1.8. Elements Present

If a frame's "Elements Present" control field is 1, then the frame body shall include one or more "elements". Certain frame types require that specific elements be present. These are defined in Section 4.2.

F (Last Fragment)

The F bit will indicate that this MPDU is the "Final or only" fragment of the MSDU.

MID Field:

The MID field consist of two subfields as indicated by figure 4.3. It consist of a 12 bit Dialog Token (DT) field, and a 4 bit Fragment Number field.

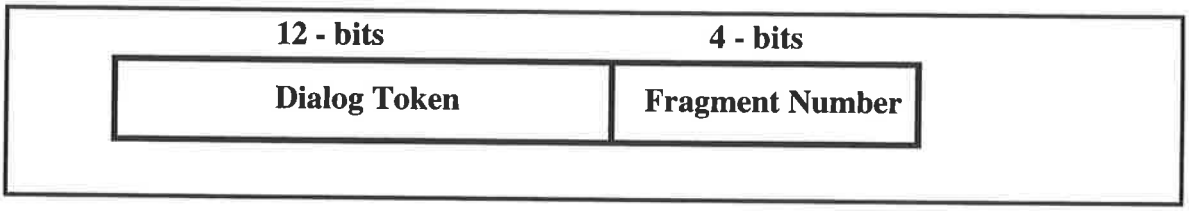

Figure 4-3: MID Field

Dialog Token

The Dialog token field is a 12 bit sequence number. It is generated per MSDU using a modulo 4096 addition with an odd increment value that is generated per individual station. The resulting sequence is a unique sequence per station with a repetition length of 4096.

The Dialog Token value shall be incremented with the aDTcount value for the initial transmission of an RTS, and a subsequent value shall be generated for the initial transmission of an MSDU. The same Dialog Token value shall be used for fragments of the same MSDU. The Dialog Token value shall not be incremented for retransmissions of the same MSDU or its fragments.

0.1.2.2. Fragment Number

The Fragment Number is a 4-bit field.. The format of this field is shown in figure 4-4. The initial value of the fragment number shall be zero for the initial fragment being transmitted. It shall be incremented for the transmission of subsequent fragments after successfull transmission of the previous fragment.

0.1.2.3. Address Fields

There are three address fields in the MAC frame format, that can be filled by four different addresses, Recipient address, BSS Identifier, Destination Address and Source Address. Some frames may omit some of the address fields.

0.1.2.3.1. Address Representation

Each Address field shall contain a 48-bit address as defined in section 5.2 of IEEE Std 802-1990.

0.1.2.3.2. Address Designation

A MAC Sublayer address is of one of two types:

1) Individual Address. The address associated with a particular station on the network.
2) Group Address. A Multidestination address, associated with one or more stations on a given network. There are two kinds of Group Addresses:
   a) Multicast-Group Address. An address associated by higher-level convention with a group of logically related stations.
   b) Broadcast Address. A distinguished, predefined multicast address that always denotes the set of all stations on a given local area network. All 1's in the Destination Address field shall be predefined to be the Broadcast address. This group shall be predefined for each communication medium to consist of all stations actively connected to that medium; it shall be used to broadcast to all the active stations on that medium. All stations shall be able to recognize the Broadcast Address. It is not necessary that a station be capable of generating the broadcast address.

The address space shall also be partitioned into locally administered and globally administered addresses. The nature of a body and the procedures by which it administers these global (U) addresses is beyond the scope of this standard. (Please refer to the IEEE Standard Overview and Architecture, IEEE Std 802-1990, ISBN 1-55937-052-1)

Recipient Address

The Recipient address is the address of the intended receiving station. It shall be the Final Destination Address of the MSDU if the recipient is a Station (To_AP=0). It shall be the address of the AP station if the frame is transferred to the AP (To_AP=1).

0.1.2.3.3. BSS Identifier

The BSS Identifier (BSSID) shall be a 48-bit field of the same format as an IEEE 802 MAC address. This field shall uniquely identify each BSS in an infrastructure LAN. The value of this field, in an infrastructure LAN, shall be the MAC address of the access point of the BSS. The mechanisms used to ensure the uniqueness of MAC addresses also create unique BSS Identifiers. The Individual/Group bit of the address shall be transmitted as zero.

In an ad hoc LAN, this field shall be transmitted with the BSS ID of the ad hoc network. This field shall be a locally administered multicast-group address. The value of this field shall be chosen by the station that establishes the ad hoc LAN. Measures shall be taken in the selection of the value of this field to differentiate it from other ad hoc LANS in the vicinity.

0.1.2.3.4. Destination Address

The Destination Address (DA) field shall identifiy the destination addressee(s) for which the frame is intended.

0.1.2.3.5. Source Address

The Source Address (SA) field identifies the station from which the frame was initiated. The Individual/Group bit shall always be transmitted as a zero.

0.1.2.4. Duration

The Duration field is a 16-bit field. It shall be used to distribute a value that shall update the Network Allocation Vector in stations receiving the frame.

0.1.2.5. Frame Body

The Frame Body is a variable length field that may vary from zero to 2304 bytes. Information specific to individual frame types and subtypes shall be placed in the Frame Body.

0.1.2.6. CRC

The CRC shall be 4 octets in length. Data encoding shall start with the version field.

The encoding shall be defined by the following generating polynomial.

$G(x) = x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$

Mathematically, the cyclic redundancy check (CRC) value corresponding to a given frame is defined by the following procedure:

(1) The first 32 bits of the frame are complemented.

(2) The n bits of the frame are then considered to be the coefficients of a polynomial M(x) of degree n-1. The first bit encoded corresponds to the x^{n-1} term and the last bit of data encoded corresponds to the x^0 term.

(3) M(x) is multiplied by x^{32} and divided by G(x), producing a remainder R(x) of degree <31.

(4) The coefficients of R(x) are considered to be a 32 bit sequence.

(5) The bit sequence is complemented and the result is the CRC.

0.2. Format of Individual Frame Types

0.2.1. Control Frames

0.2.1.1. RTS Frame Format

The frame format for an RTS frame is shown in Figure 4-xx.

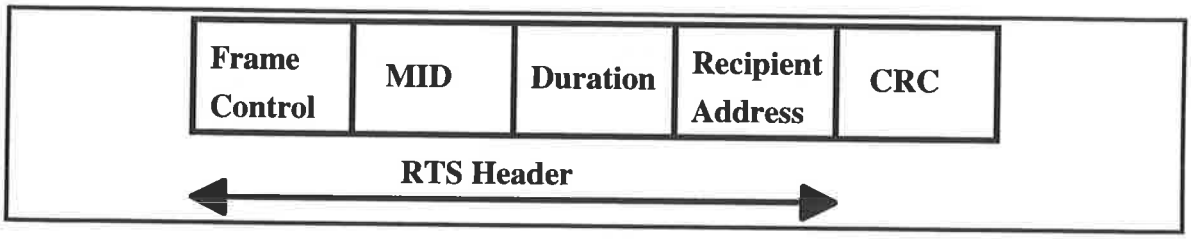

Figure 4-xx: RTS Frame

The recipient address of this frame shall be the immediate station receiving the frame. In an infrastructure LAN, the recipient address shall be the address of the AP with which the station is associated. In an ad hoc LAN, the recipient address shall be the destination of the subsequent data or management frame. A new MID shall be generated for the transmission of each RTS frame.

0.2.1.2. CTS Frame Format

The frame format for an CTS frame is shown in Figure 4-xx.

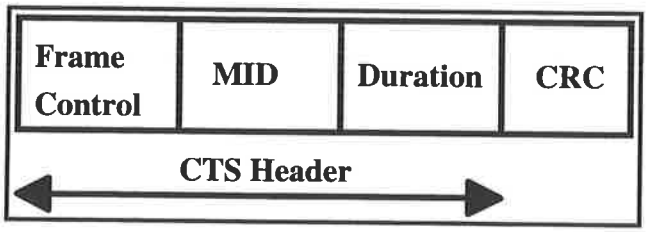

Figure 4-xx: CTS Frame

The MID field of the CTS frame shall be taken from the MID field of the RTS frame to which the CTS is a response.

0.2.1.3. ACK Frame Format

The frame format for the ACK frame is shown in Figure 4-xx.

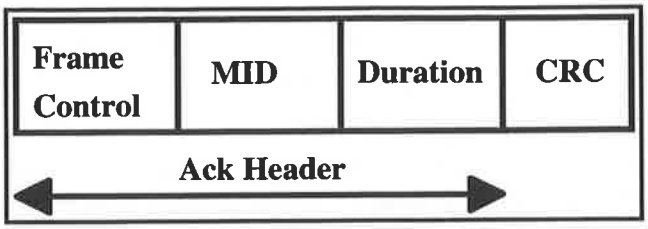

Figure 4-xx: ACK Frame

The MID field of the ACK frame shall be copied from the MID field of the immediate data or management frame.

0.2.1.4. Poll Frame Format

The frame format for the Poll frame is shown in Figure 4-xx.

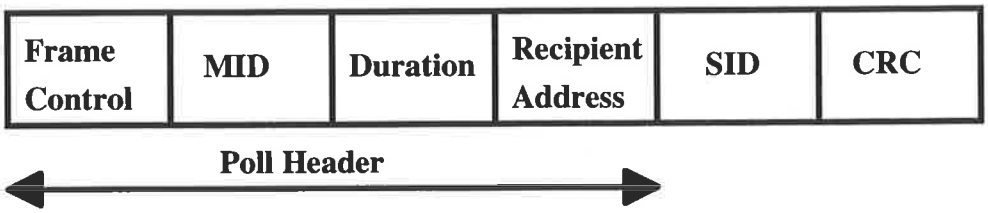

Figure 4-xx: Poll Frame

The Recipient address shall be the address of the AP The SID shall be the value assigned by the AP in the Associate Response frame.

0.2.2. Data Frames

0.2.2.1. DATA Frame Format

The frame format for a Data frame is independent of subtype and is shown in Figure 4-xx.

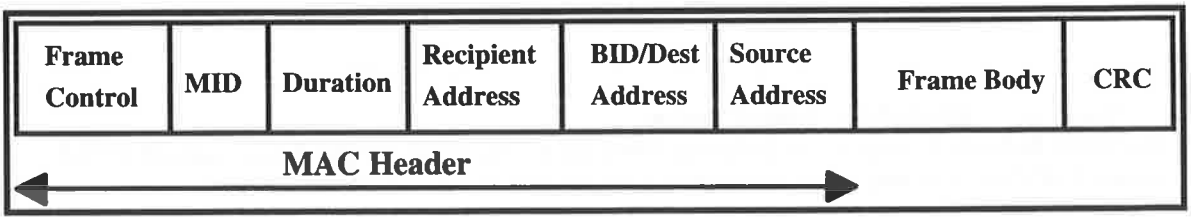

Figure 4-xx: DATA Frame

The Recipient address is the address of the intended receiving station. It shall be the Final Destination Address of the MSDU if the recipient is a Station (To_AP=0). It shall be the address of the AP station if the frame is transferred to the AP (To_AP=1).

The BID/Dest Address field of the Data frame shall be dependent on whether the frame is transmitted to a station (To_AP=0), or to an AP (To_AP=1). It shall be the Destination Address when the frame is transmitted to the AP. It shall be the BSSIdentifier when the frame is transmitted to a station.

The BID or BSS Identifier of the Data frame shall be determined as follows:

1) If the station is an AP or is a member of an infrastructure LAN, the BSS Identifier shall be the address of the AP.
2) If the station is a member of an ad hoc LAN, the BSS Identifier shall be the BSS ID of the ad hoc LAN.

The Source Address shall be the address of the station transmitting the frame.

The Frame Body shall be the MSDU or a fragment thereof.

0.2.3. Management Frames

The frame format for a Management frame is independent of subtype and is shown in Figure 4-xx.

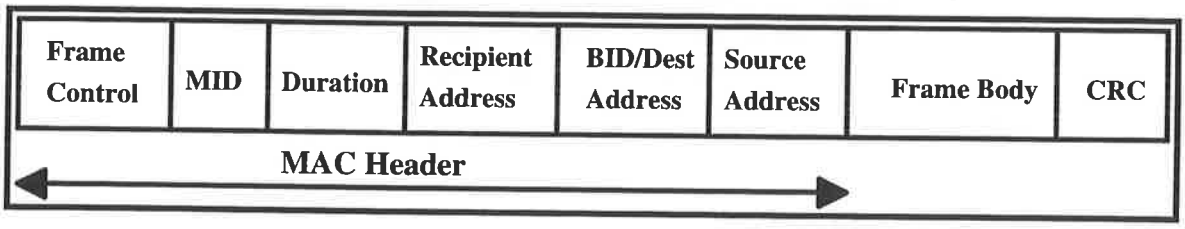

Figure 4-xx: Management Frame Format

The address fields for Management frames shall not vary by frame subtype.

The Recipient address is the address of the intended receiving station. It shall be the Final Destination Address of the MSDU if the recipient is a Station (To_AP=0). It shall be the address of the AP station if the frame is transferred to the AP (To_AP=1).

The BID/Dest Address field of the Data frame shall be dependent on whether the frame is transmitted to a station (To_AP=0), or to an AP (To_AP=1). It shall be the Destination Address when the frame is transmitted to the AP. It shall be the BSSIdentifier when the frame is transmitted to a station.

The BSS Identifier of the Management frame shall be determined as follows:

1) If the station is an AP or is in an infrastructure LAN, the BSS Identifier shall be the address of the AP.
2) If the station is in an ad hoc LAN, the BSS Identifier shall be the the the BSS ID of the ad hoc LAN.

The Source Address shall be the address of the station transmitting the frame.

0.2.3.1. BEACON Frame Format

The Frame Body shall comprise the following information: time stamp, weight, beacon interval, DTIM period, DTIM count, channel sync information, ESS ID, TIM and broadcast indicator.

0.2.3.2. ATIM Frame Format

The Frame Body shall be null.

0.2.3.3. Disassociation Frame Format

The Frame Body of this frame is null.

0.2.3.4. Association Request Frame Format

The Frame Body shall consist of the privacy algorithm number.

0.2.3.5. Association Response Frame Format

The Frame Body shall consist of a status value, an error indication and the station ID assigned (SID).

0.2.3.6. Reassociation Request Frame Format

The Frame Body shall consist of the current AP address and the privacy algorithm number.

0.2.3.7. Reassociation Response Frame Format

The Frame Body shall consist of a status value, an error indication and the station ID (SID) assigned.

0.2.3.8. Probe Request Frame Format

The Frame Body shall be null.

0.2.3.9. Probe Response Frame Format

The Frame Body shall consist of time stamp, weight, beacon interval, DTIM period, DTIM count, channel sync information and ESS ID.

0.2.3.10. Privacy Request Frame Format

The Frame body of this frame shall consist of a supported algorithm list.

0.2.3.11. Privacy Response Frame Format

The Frame body of this frame shall consist of status value, an error indication and a privacy algorithm number.

0.2.3.12. Authentication Frame Format

The Frame Body of the Authentication frame shall comprise a transaction sequence and additional information dependent upon the value of the transaction sequence. If the transaction sequence is 1, the remainder of the Frame Body shall comprise the supported algorithm list. If the transaction sequence is 2, the remainder of the Frame Body shall comprise a status value, an error indication, an identity assertion and the selected authentication algorithm number. If the transaction sequence is 3, the remainder of the Frame Body shall comprise an identity challenge and an identity assertion. If the transaction sequence is 4, the remainder of the Frame Body shall comprise a challenge response and an identiy challenge. If the transaction sequence is 5, the remainder of the Frame Body shall comprise, a challenge result and a challenge response. If the transaction sequence is 6, the remainder of the frame body shall comprise a challenge result.