7. MAC Frame Formats

This clause specifies the format of the MAC frames. All devices shall be able to validate every received frame, either error free or in error, using the frame check sequence (FCS). In addition, every device shall be able to construct a subset of these frame formats for transmission, and to decode another (potentially different) subset of these frame formats upon validation following reception. The particular subsets of these formats that a device shall construct and decode are determined by the functional capabilities supported by that particular device, as declared by them in the capability information specified in 7.4.3.

7.1 Overview

Each MAC frame consists of the following basic components:

a) A MAC header, which comprises frame control, duration, address and sequence number information, and, optionally, traffic category information.
b) A fixed length header check sequence (HCS), which contains the CRC parity bits for frame header that includes the PHY header and the MAC header.
c) A variable length frame body, which contains information specific to the frame type and subtype.
d) A frame check sequence (FCS) which contains an IEEE 32-bit cyclic redundancy code (CRC).

7.1.1 Conventions

The MAC frames in the MAC sublayer are described as a sequence of fields in specific order. Each figure in Clause 7 depicts the fields/subfields as they appear in the MAC frame and in the order in which they are passed to the PHY, from left to right where the leftmost bit is transmitted first in time.

In figures, all bits within fields are numbered, from 0 to k, where the length of the field is k+1 bits. The octet boundaries within a field can be obtained by taking the bit-numbers of the field modulo 8. Octets within numeric fields that are longer than a single octet are depicted in increasing order of significance, from lowest numbered bit to highest numbered bit. The octets in fields longer than a single octet are sent to the PHY in order from the octet containing the lowest numbered bits to the octet containing the highest numbered bits.

Any field containing a CRC is an exception to this convention and is transmitted commencing with the coefficient of the highest-order term.

Values specified in decimal are coded in natural binary unless otherwise stated.

Without further qualification, "reception" by the MAC sublayer implies that the frame contents are valid, and that the protocol version is supported, but implies nothing about frame addressing, nor whether the frame type or other fields in the MAC header are meaningful to the mac entity that has received the frame.

Unless otherwise stated, any reserved field or subfield shall be set to 0 upon transmission and shall be ignored on reception.

Reserved values in non-reserved fields and subfields shall not be transmitted by conformant devices. However, a device conformant to an older revision of this standard may receive frames with what it considers to be reserved values in non-reserved fields and subfields. These fields, along with other fields in the same frame whose interpretation is directly dependent thereon, shall be ignored on reception.

7.2 General frame format

The MAC frame format comprises a set of fields that occur in a fixed order in all frames. The general MAC frame format is illustrated in Figure 3. Each field is defined in 7.1.3. The maximum size of a MAC frame is 2048 octets.

octets: 2	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**0-2030**	**4**
Frame Control	PNID	Destination Address (DA)	Source Address (SA)	Stream ID	Sequence Number	Duration	HCS	Frame Body	FCS
MAC Header									

Figure 3—MAC frame format

7.2.1 Frame fields

7.2.1.1 Frame control field

The Frame Control field consists of the following sub-fields: Protocol Version, ACK policy, Frame Type, Frame Position, Frag-start, Frag-end, retry, Del-Ack request, SECurity and Repeater. The format of the frame control field is illustrated in Figure 4.

bits: 0-1	**2-3**	**4-7**	**8**	**9**	**11**	**12**	**13**	**14**	**15**
Protocol Version	ACK Policy	Frame Type	Frag-Start	Frag-End	Retry	Del-Ack Request	Reserved	SEC	Repeater

Figure 4—Frame control field

7.2.1.1.1 Protocol version field

The Protocol Version field is two bits in length and is invariant in size and placement across all revisions of the 802.15.3 standard. For this revision of the standard the value of the protocol version is 0. All other values are reserved. The revision level will be incremented only when a fundamental incompatibility exists between a new revision and the prior revision of the standard. A device that receives a frame with a higher revision level than it supports will discard the frame without indication to the sending device.

7.2.1.1.2 ACK policy field

The ACK policy field is 2 bits in length and is used to indicate the kind of acknowledgement procedure that the addressed recipient is required to perform. The ACK policy field shall only be set to delayed acknowledgement only in Stream-Data type frames. The ACK policy field shall be set to no acknowledgement in all multicast and broadcast frames. Upon reception of a multicast or broadcast frame, the ACK policy field shall be ignored as those frames are not explicitly acknowledged. The allowed values for the ACK policy field are:

— 0: No acknowledgement: The recipient(s) shall not acknowledge the transmission, and the sender treats the transmission as successful without regard for the actual result. This policy shall be used in all group addressed frames and in those directed frames that do not need any form of acknowledgement.

— 1: Immediate acknowledgement (ACK) required: The addressed recipient returns an ACK frame after an SIFS period, according to the procedures defined in clause 8. This policy shall be used only in directed frames.
— 2: Delayed acknowledgement: The addressed recipient uses the retransmission request command, defined in 7.5.13.1, to convey the acknowledgement. The return command is transmitted during the time scheduled for the recipient of this frame. This policy shall be used only in directed Stream-data type frames.
— 3: Implied acknowledgement: The intended recipient is allowed to send either an imm-ACK or any other frame to the source-DEV of this frame as described in <TBD: 8.6.4>. This policy shall be used only in directed Stream-data type frames in any time slot during CFP by the DEV that has been allocated that time slot. This ack policy shall not be used during CAP.

7.2.1.1.3 Frame type field

The frame type field is four bits in length. Table 36 defines the valid frame type values and their description. The format and the usage of each of the individual frame types is defined in 7.2.

Table 36—Valid frame type values (numeric values in this Table are shown in binary)

Type Value b3 b2 b1 b0	Frame type Description
0000	Beacon
0001	PNC Selection (PNCS)
0010	Association request
0011	Association response
0100	Disassociation request
0101	Immediate Acknowledgement (ACK)
0110	Command
0111	Stream-Data
1000-1111	Reserved

7.2.1.1.4 Frag-start field

The frag-start field is one bit in length and is set to 1 in all stream-data type or command frames, that is the start of the current MSDU/MCDU. It is set to 0 in all other frames.

7.2.1.1.5 Frag-end field

The frag-end field is one bit in length and is set to 1 in all stream-data type or command frames, that is the end of the current MSDU/MCDU. It is set to 0 in all other frames.

7.2.1.1.6 Retry field

The retry field is one bit in length and is set to 1 in any data or management type frame that is a retransmission of an earlier frame. It is set to 0 in all other frames. A receiving device uses this indication to aid in the process of eliminating duplicate frames.

7.2.1.1.7 Del-Ack Request

The Del-Ack REquest is one bit in length and is valid only in the Stream-Data type frames of a stream that is currently employing delayed ack mechanism. When this bit is set, the source device of the stream is requesting the destination device to expidite the delivery of “Retransmission Request” command.

7.2.1.1.8 SEC field

The SEC field is one bit in length. It is set to 1 if the frame body field contains information that is encrypted. When the SEC bit is set to 1, the frame body field contains the encryption fields as defined in <TBD>.

7.2.1.1.9 Repeater field

The repeater is one bit in length and is set to 1 if the frame is being repeated by the PNC as the repeater service between two devices in the same piconet. It is set to 0 in all other frames.

7.2.1.2 Piconet ID (PNID)

The PNID is a unique identificaion for the piconet. The PNID remains constant during the life of the piconet.

7.2.1.3 Address fields

There are two address fields in the MAC frame format and each of these fields is 8 bits in length. These fields are used to indicate the destination address (DA) and the source address (SA). An address for a device is assigned by the NC during the association of the device. The address of a device is unique to an associated device within a piconet. The following addresses are reserved.

- The address value 0 is reserved for the PNC, for cooridnator related transmissions and receptions
- The address value of all-ones (0xFF) is reserved for multicast and broadcast
- The address value of 0xFE is reserved for use by all new clients during their association until a unique address is allocated to each one of those new clients by the PNC.

7.2.1.4 Stream ID

The Stream ID field is 16 bits in length and is used to uniquely identify a data stream. This fiels is valid only in the stream-data type frames. This field is is set to zero, and ignored upon reception, in all other frame types.

bits: 15	14:12	11:0
Stream Type	Priority	Stream Index

Figure 5—Stream ID field

This field contains three subfields, stream type, priority and stream index.

The stream index field is a 12-bit field with the value of zero reserved for non-stream type data. The DEVs use the rest of the values of the stream index as dynamically assigned by the PNC during the setup of the data stream. The PNC allocates a unique value of stream index for each stream in the piconet.

Priority field indicates the priority of the stream and is same as defined in IEEE 802.1D standard.

The stream type shall be set to ‘1’ for streams requiring Isochronous services and shall be set to ‘0’ otherwise.

Any frame that does not belong to an established stream and does not need a stream connection is a non-stream data frame. Any non-stream data frame is transmitted with the stream ID valie of zero.

7.2.1.5 Sequence number field

The sequence number field is a 16-bit value indicating the sequence number of the current MSDU/MCDU.

For stream-data type frames, the devices maintain one modulo-65536 counter associated with the stream ID of each of the data stream that they source. The sequence number for a stream with a given stream ID is assigned from the counter associated with that stream ID.

For all frame types other than stream-data type, the sequence numbers are assigned from a single modulo-65536 counter.

Each sequence number counter is started at 0 and incremented by 1 at the end of frame for which the sequence number is assigned using this counter.

7.2.1.6 Duration

This field in all frames, other than in the response frames (ACK), indicates the time in μs on the channel that the sender is assuming to be occupy from the end of current frame. This field does not include the channel time required for the current frame.

In the frames within a time slot during the CFP, the duration field is set to indicate the remaining time from the end of current frame to the end of the current time slot. If a device decides to terminate its slot before the allocated maximum slot duration, the frames transmitted after such a decision may reflect the new end of the shortened current time slot. In any time slot, once a frame is transmitted with a value in the duration field, the subsequent frames shall not have a value in their duration field to indicate a farther end time than any of the frames previously transmitted in the same slot.

In all the frames transmitted during CAP, the duration field is set to indicate the remaining time in the current burst starting from the end of current frame.

In response frames (ACK), this field is appropriately adjusted to indicate the same end time as indicated by the immediately previous received frame at the sender of this frame. That is, the value of the duration field in response frames shall be equal to the value of the same field in the immediately previous received frame reduced by the total channel time taken by the current response frame including any IFS used before the transmission.

In Beacon frames, this field is always set to zero.

7.2.1.7 Header check sequence

The header check sequence (HCS) is PHY dependent and is generated by the PHY before transmission and checked by the PHY during reception. The HCS for the 2.4 GHz PHY is defined in 11.2.8.

7.2.1.8 Frame body field

The frame body is a variable length field and contains information specific to individual frame types. The minimum frame body is zero octets. The maximum length frame body is 2030 octets, including the security information, if any.

7.2.1.9 FCS field

The FCS field is a 32 bit field that contains a 32-bit CRC. The FCS is calculated over all of the frame body field, which is referred to here as the calculation field.

The FCS is calculated using the following standard generator polynomial of degree 32:

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

The FCS is the one's complement of the sum (modulo 2) of the following:

1) The remainder of $x^k \times (x^{31} + x^{30} + x^{29} + ... + x^2 + x + 1)$ divided (modulo 2) by G(x), where k is the number of bits in the calculation field, and
2) The remainder after multiplication of the contents (treated as a polynomial) of the calculation field by x^{32} and then division by G(x).

The FCS field is transmitted commencing with the coefficient of the highest order term.

As a typical implementation, at the transmitter, the initial remainder of the division is preset to all ones and is then modified by division of the calculation fields by the generator polynomial G(x). The ones complement of this remainder is transmitted, with the high order bit first, as the FCS field.

At the receiver, the initial remainder is preset to all ones and the serial incoming bits of the calculation fields and FCS, when divided by G(x) results in the absence of transmission errors, in a unique non-zero remainder value. The unique remainder value is the polynomial:

$$x^{31} + x^{30} + x^{26} + x^{25} + x^{24} + x^{18} + x^{15} + x^{14} + x^{12} + x^{11} + x^{10} + x^8 + x^6 + x^5 + x^4 + x^3 + x + 1$$

7.3 Format of individual frame types

7.3.1 Frame types

There are seven defined frame types. Frame types defined for appropriate classification of frames that can be transmitted or received at different states of DEV as defined in <TBD. 8.8> before and after the DEV is associated with a piconet. The commands within command frame are defined so that a DEV can perform multiple transactions in one shot with a low overhead of just one frame transaction.

7.3.1.1 Beacon frame format

The contents of beacon frame body are shown in Table 37 below. The individual information elements in the beacon frame are described in 7.4.

The frame control fields of the beacon frame shall be set according to the values in Table 38. The ACK policy, frame position, frag-start, frag-end, retry, Del-Ack request, SEC and Repeater sub-fields in the frame control field of the MAC header of this frame shall be set to zeros and shall be ignored upon reception.

Table 37—Beacon frame body

Information element	Note
Device ID	48 bit IEEE 802 address of the PNC
Piconet synchronization parameters	TSF element and other time duration elements
TPC element	Sets the max TX power level in the piconet
Channel change	During change to new channel
Channel time allocation (CTA)	All the channel time allocation in the current superframe

Table 38—Frame control field settings for beacon frame

Header field	Setting on transmission	Interpretation on reception
ACK Policy	0	Ignored
Frame type	Beacon value in Table 36	Decoded
Frame position	0	Ignored
Frag-start	0	Ignored
Frag-end	0	Ignored
Retry	0	Ignored
Del-Ack Request	0	Ignored
SEC	0	Ignored
Repeater	0	Ignored

The DA in the beacon frame header is broadcast address. The stream ID in beacon frame header is set to 0 and ignored upon reception.

7.3.2 Immediate acknowledgement (ACK) frame format

The immediate ACK frame shall be sent at the same data rate as the frame that it is acknowledging.

The ACK policy, frame position, frag-start, frag-end, retry, Del-Ack request, SEC and Repeater sub-fields in the frame control field of the MAC header of this frame shall be set to zeros and shall be ignored upon reception.

The SA of the ACK frame is copied from the DA field of the immediately previous directed frame that requires immediate acknowledgement. Similarly the DA of the ACK frame is copied from the SA field of the immediately previous directed frame that requires immediate acknowledgement. The stream ID and the stream sequence number fields are also copied from the corresponding fields of the immediately previous directed frame that requires immediate acknowledgement.

7.3.3 PNC selection

The PNC selection frame shall always be sent at the base data rate of the PHY.

The ACK policy shall be set to request immediate acknowledgement when sent as a directed frame. Otherwise the ACK-policy bits shall be set to zero.

The frame position, frag-start, frag-end, retry, Del-Ack request, SEC and Repeater sub-fields in the frame control field of the MAC header of this frame shall be set to zeros and shall be ignored upon reception.

The DA is set to broadcast or a directed address. When sent as a directed frame, the intended recipient shall send an immediate acknowledgement frame if the frame is received correctly. The stream ID and sequence number fields shall be set to zero and shall be ignored upon reception. When sent as a directed frame, the value of the duration field is the sum of SIFS and the total channel time required for the expected immediate acknowledgement frame. When sent as a broadcast frame, the duration field is set to zero.

The frame body of the PNC selection frame is shown in Figure 6. There are three action types defined and they are described in the following sub-clauses. The action types are,

— 0: Alternate PNC Announcement
— 1: Alternate PNC pullout
— 2: New PNC announcement
— 3-255: Reserved.
—

Octets	Field
1	Action Type
1	Reserved
2	Capability
1	Total external connections
1	Active external connections
1	Total system memory
1	Available system memory
1	Maximum PHY transmit power
1	Maximum PHY rate
6	Device ID
2	CSTimeout

Figure 6—PNC selection frame body

The capability field is illustrated in Figure 15 and in 7.4.3. This frame shall not be transmitted with the AC bit in the capability field set to 0.

The total external connections field indicates the total number of connections available at the device that are external to the piconet. The active external connections field indicates the number of currently active connections out of the total number of external connections that are available at the device.

The total system memory field indicates the total memory (in Mbytes) that is present in the system. The avail system memory field indicates the amount of memory (in Mbytes) that is allocated for the WPAN-MAC in the system.

The Max-PHY-transmit-power indicates the free-air transmit power (in TBD) that is possible for the device.

The Max PHY Rate indicates the maximum rate that is achievable by PHY of the device. This field takes the values that are defined in sub-clause 7.4.6.

The device ID is the 48-bit IEEE 802 address of the sender of this frame.

The PNCS-Timeout is the time within which the other devices are expected to participate in the PNC selection process. This time duration is indicated in Kμs. A late joining, new device may extend this time in its frame which shall be adapted by all the currently participating devices.

7.3.3.1 Alternate PNC announcement

The alternate PNC announcement frame shall always be sent at the base data rate of the PHY.

This action type is used by all ACs to announce their capabilities that make them suitable for the responsibilities of PNC in the piconet.

7.3.3.2 Alternate PNC pullout

The alternate PNC pullout frame shall always be sent at the base data rate of the PHY.

An AC uses this action type to pullout of multi-AC announcement session if it has received an announcement from another AC that is better suited as PNC in the piconet. The fields in the PNC selection frame body are compared for elimination of an AC from contest or pulling out of the multi-AC announcement. The comparison order of the fields is listed in Table 39.

7.3.3.3 New PNC announcement

Table 39—Comparison order of fields in AC-announcement command

Order	Information	Note
1	Designated mode bit in capability field	PNC designation is preferred
2	RTC bit in capability field	RTC=1 is preferred
3	SEC bit in capability field	SEC=1 is preferred
4	PS bit in capability field	PS=0 is preferred
5	Storage Type sub-field in capability field	Higher value is preferred
6	Total Ext connections	Higher value is preferred
7	Active Ext connections	Higher value is preferred
8	Total System Memory	Higher value is preferred
9	Avail System Memory	Higher value is preferred
10	Max PHY Range	Higher value is preferred
11	Max PHY Rate	Higher value is preferred
12	Device ID	Higher value is preferred

The new PNC announcement frame shall always be sent at the base data rate of the PHY.

An AC uses this action type to announce itself as the winning PNC in a multi-AC announcement session if it is better suited as PNC in the piconet.

At the end of PNC hand over, the new PNC of the piconet uses the PNC selection frame with this action type to signal the end of PNC hand over.

The CSTimeout in this frame indicated the time offset before which the first beacon from the winning AC shall be expected by the rest of the devices in the channel.

7.3.4 Association request frame format

The association request frame shall always be sent at the base data rate of the PHY.

Only a device that wishes to associate with the PNC of an already existing piconet shall send this frame.

The ACK policy shall always be set to request immediate acknowledgement.

The frame position, frag-start, frag-end, retry, Del-Ack request, SEC and Repeater sub-fields in frame control field of the MAC header in this frame shall be set to zeros and shall be ignored upon reception.

The DA shall always be set to all-zero address, meant to indicate the PNC's address. The SA shall always be set 0xFE to indicate the association-address.

The PNID is set to zero in the association frames from an un-registered device. In all the association frames from a registered device, this field is set to the value of the PNID of the piconet to which the device is already registered.

The structure of the frame body for an association request frame is illustrated in Figure 7.

6	2	1	1	2	0-128
Device ID	Capability	Allocated Device Address (AD-AD)	Reserved	Association timeout period (Kμs)	Challenge/ Response text

Figure 7—Association request/response frame format

The device ID field is the 48-bit IEEE 802 address of the device involved in the association.

The capability field is same as illustrated in Figure 15. This field describes the capabilities of the device.

The allocated device address (AD-AD) is set to 0xFE and ignored upon reception.

The association timeout period (ATP), defined in aAssocTimeoutPeriod, is the timeout during which if the frames from PNC meant for the current device are not received at the device, the device disassociates and tries to associate again. Similarly, if PNC did not receive any frame originating from the current device within this timeout duration, the PNC may disassociate the device and expect the device to associate again. The PNC shall not disassociate the current device for the reason of absence of frames from the device within that timeout period.

Challenge/Response text is used in the authentication process that is described in <TBD>

7.3.5 Association response frame format

The association response frame shall always be sent at the base data rate of the PHY.

Only the PNC of an already existing piconet shall send this frame and shall send the frame only to a device that is currently trying to associate.

The ACK policy shall always be set to zero and shall be ignored upon reception.

The frag-start, frag-end, retry, Del-Ack request, SEC and Repeater sub-fields in frame control field of the MAC header of this frame shall be set to zeros and shall be ignored upon reception.

The SA shall always be set to an all-zero address which is the PNC's address. The DA shall always be set to 0xFE to indicate the association-address. Hence this frame shall not be ACKed.

The structure of the frame body for an association frame is illustrated in Figure 7.

The device ID field is the 48-bit IEEE 802 address of the device involved in the association. When the PNC sends this frame to the device, the PNC uses the field from the previously received association request from that device. Two or more devices trying for association at the same time distinguish the response-command from the PNC by comparing their device ID to the device ID in the response-frame. All DEVs trying to associate comapre their Device-ID with the Device-ID listed in the received assocaiation response frame. If there is a match, the DEV assumes the AD-AD as its address for all its future communications.

The capability field describes the capabilities of the PNC and is the same as illustrated in Figure 15.

The allocated device address (AD-AD) field is filled with the address allocated to the device. The address shall be in the valid range of addresses. The device shall start using that address as its address in the piconet in all its future communications until it is disassociated and hence required to associate again. If this field contains the association-address (0xFE), the device is not allowed to associate for the reason mentioned in the reason code.

The valid reason codes are:

- 0 -> Already serving maximum number of devices
- 1 -> Lack of available bandwidth to serve the device
- 2 -> Channel is severe to serve the device
- 3 -> PNC is turning off with no AC in the piconet
- 4 -> Device wishes to disassociate
- 5 -> Channel change is in progress
- 6 -> PNC hand over is in progress
- 7 -> Device Authentication failed
- 8-255 -> reserved

The association timeout period (ATP) is the finalized value of the ATP. This value may be different from that requested by the device in its association request frame if the PNC can not support the value of the ATP requested.

The challenge/response text is used in the authentication process that is described in <TBD>

7.3.6 Disassociation request

The disassociation request frame shall always be sent at the base data rate of the PHY.

Either the PNC or an associated device can send the disassociation request command. The structure of the command is illustrated in Figure 8.

6	**1**	**1**
Device ID	Reason Code	Reserved

Figure 8—Disassociation request command format

The device ID is the 48 bit IEEE 802 address of the device that is being disassociated.

The valid reason codes are:

- 0 -> Device state has expired (Need to re-associate)
- 1 -> Channel is severe to serve the device
- 2 -> Device is overshooting its allocated channel time
- 3 -> PNC is turning off with no AC in the piconet
- 4 -> Device wishes to disassociate
- 5-255 -> reserved

7.3.7 Command frame format

The command frame shall always be sent at the base data rate of the PHY.

The command frame shall only be sent in either in a slot that is allocated for coordintor-device communication or during the CAP.

The command frame body consists of one or more command blocks as shown in Figure 9. Each command block consists of a 2-octet command type field, a 2-octet length field and a variable length command payload as shown in Figure 10. The command types are described in sub-clause 7.5.

Octets: 14	**(2+2+L_1)**	**(2+2+L_2)**	**-----**	**(2+2+L_n)**	**4**
MAC frame header	Command block-1	Command block-2	……..	Command block-n	FCS

Figure 9—Command frame format

Command block		
Octets: 2	**2**	**L_x**
Command type	Length (= L_x)	Command payload

Figure 10—Command block format

The stream ID in the command frame header is set to 0 and ignored upon reception.

The command blocks shall always start on a 2-octet boundary within the frame body. While encoding, if the command payload is not aligned to 2-octet boundary, an extra octet with an all-zero value shall be placed after the last valid octet of Command payload to achieve the 2-octet alignment. However, the length field shall contain only the number of valid octets and hence shall exclude the stuffed octet from its count. While decoding, the length field is used to know the number of octets that belong to the payload of the command. If the value of the length field is an odd number, then the octet following the last valid octet of the payload shall be ignored before considering the next command block.

A command data unit (MCDU) may also be fragmented and transmitted in fragments. This is described in <8.5>.

During the CAP, a directed command frame with null payload requiring immediate ACK serves as the request by the sending DEV to send more frames. The ACK frame sent as response to such command frame serves as acceptance of that request.

7.3.8 Stream-data frame format

The frame format of Data frame is as shown in Figure 11.

Octets: 14	**0 or <TBD>**	**0 to <TBD>**	**4**
MAC frame header	Encryption information	Variable length data	FCS

Figure 11—Stream-data frame format

7.4 Information elements

The information elements are listed in Table 40. Individual elements are described in the following sub-clauses.

Table 40—Information elements

Element ID	Element
0	Device ID
1	Piconet synchronization parameters
2	Capability Information
3	Maximum supported time slots
4	Channel change
5	Supported Rates
6	Security parameters
7	PS Parameters
8	Transmit Power Control
9	Channel Time Allocation
10-255	Reserved

The format of an information element is shown in Figure 12. The first octet is the information element ID and the second octet is the length (L_n) of the payload of the information element in octets. The following L_n octets are the payload for the information element. These elements can appear in any order in the frames that are allowed include more than one of these elements.

The information elements shall always start on a 2-octet boundary within frame body. While encoding, if the information element is not aligned to a 2-octet boundary, an extra octet with an all-zero value shall be placed after the last valid octet of that information element to achieve the 2-octet alignment. However, the length field in the information element shall contain only the number of valid octets and hence shall exclude the stuffed octet from its count. While decoding, the length field is used to know the number of octets that belong to the information element. If the value of the length field is an odd number, then the octet following the last valid octet of the payload shall be ignored before considering the next information element.

octets: 1	**1**	**L_n**
Element ID	Length (=L_n)	Data

Figure 12—information element format

7.4.1 Device identifier element

The format of the device identifier element is shown in Figure 13.

octets: 1	1	6
Element ID	Length (=6)	Device ID

Figure 13—Device identifier element

The device ID is the 48-bit (6 octets) IEEE 802 address of the device that is sending the frame.

7.4.2 Piconet synchronization parameters element

The format of piconet synchronization parameter element is shown in Table 41

Table 41—Piconet synchronization parameters elements

Octet	Description
1	Element ID
1	Length (=24)
8	Time stamp (TSF value in microsec)
2	Superframe duration (in 8 microsecond resolution)
2	CFP duration (in 8 microsecond resolution)
2	Guaranteed start time for CFP (in 8 microsecond resolution)
2	MaxBurstDuration in CAP

The time stamp is the local TSF timer value at the time of transmission of first bit of the Time-stamp field.

The superframe duration is the duration of the current superframe. The resolution of this field is 8 microseconds which gives a range of [0-524280] microseconds.

The CFP duration is the time allocated to the CFP within the superframe. The resolution of this field is 8 microseconds which gives a the range of [0-524280] microseconds. The duration of the CAP is computed as the difference between the superframe duration and the CFP duration. The same value is used as the time offset for the start of the CFP from the start of beacon transmission.

The guaranteed start time for the CFP is the start time of the CFP within the current superframe. The resolution of this field is 8 microseconds and so the range is [0-524280] microseconds.

The MaxBurstDuration in the CAP is the duration of the longest allowed burst during the CAP of the current superframe. The resolution of this field is 8 microseconds and so the range is [0-524280] microseconds.

When a device sends this element in one of its frames, for all the fields except for the time stamp, it sends the same values as it last received from the PNC. The time stamp is always the local TSF timer value at the time of transmission of first bit of the time-stamp field.

7.4.3 Capability information

The capability information element is shown in Figure 14 and the capability field is illustrated in Figure 15. The bits in the capability field shall not change during after association of the DEV until it disassociates from the piconet. For PNC, the bits in the capability field shall not change during the period when it remains PNC of the current piconet.

Octets: 1	**1**	**2**
Element ID	Length (=2)	Capability field

Figure 14—Capability information element format

2-octets					
bits: b0	**b1**	**b2**	**b3**	**b4**	**b5-b15**
Des-Mode	AC	RTC	SEC	PS	Reserved

Figure 15—Capability field format

The Des-Mode is the designated mode of the device as currently set. This bit is set to 1 if the device is in the PNC mode. Otherwise this bit is set to 0.

The AC bit is set to 1 if the device is capable of being a PNC in the piconet. Otherwise AC bit is set to 0.

The RTC bit is set to 1 if the device is supporting real time stream. Otherwise RTC bit is set to 0.

The SEC bit is set to 1 if the device is capable of supporting encryption for its data streams. Otherwise SEC bit is set to 0.

The PS bit is set to 1 if the device is planning to use “sleep state” as part of power management. Otherwise the PS bit is set to 0. The PNC shall always set this bit to 0 in its capability field.

7.4.4 Maximum supported time slots

The maximum supported time slots element is illustrated in Figure 18.

Octets: 1	**1**	**1**	**1**
Element ID	Length (=2)	Reserved	Max number of time slots supported

Figure 16—Maximum supported time slots element

The Max number of time slots supported indicates the maximum number of time slots that can be allocated to the DEV that is sending this element in any superframe.

7.4.5 Channel change element

The channel change element is illustrated in Figure 17.

Octets: 1	1	1	1
Element ID	Length (=2)	New Channel Index	Channel Change Time-out (in Kμs)

Figure 17—Channel change element

The new channel index indicates the channel to which the PNC is intending to move the piconet over to. The values of this field are PHY dependent. For the 2.4 GHz PHY, the valid channels are defined in 11.2.3

The channel change timeout is the time within which the devices shall expect beacon from PNC in the new channel. This time duration is indicated in Kμs.

7.4.6 Supported rates element

The Supported Rates element specifies the rates in the Operational Rate Set as described in the <TBD 11.x.y.z> and are conveyed to MAC through MLME.Associate.request and MLME.StartPiconetRequest primitives. The information field is encoded as 1 to 8 octets where each octet describes a single supported rate.

Octets: 1	1	(1 – 8)
Element ID	Length (=1 – 8)	Supported Rates

Figure 18—Supported rates element

7.4.7 Security parameters element

<TBD>

7.4.8 Transmit power control (TPC) element

The TPC element is illustrated in Figure 19.

Octets: 1	1	1	1
Element ID	Length (=2)	Flag	TX power level

Figure 19—Transmit power control (TPC) element

The flag is one bit information with rest of the bits in the field being reserved. When the flag is received as ‘0’, it indicates that the source-DEV is providing its tx power level corresponding to the transmission to the intended recipient (dest-DEV) of this information element. When the flag is received as ‘1’, it indicates that the source-DEV is requesting the dest-DEV to set the tx power level to the indicated level for all transmissions from the dest-DEV intended for the source-DEV. In Beacons, the flag shall always be set to ‘1’.

The TX power level indicates either the tx power level at source-DEV or requested tx power level at the dest-DEV depending on the value of the flag. When received in Beacon the TX power limit sets the global

max level, and not the actual level, for all transmissions within the piconet. Hence the TX Power level in received in Beacon define the maximum EIRP for all DEVs in the pconet.

Upon reception of this element in probe information command, a DEV must use a TX power setting at the specified level when sending frames to the source-DEV of the frame containing this TPC element.

7.4.9 Channel time allocation (CTA) element

The channel time allocation (CTA) element is illustrated in Figure 20. Since the length parameter supports only 255 octets of payload allowed in any one information element, the PNC may split the CTA information into more than one information element entry in the Beacon. The receiving device shall assemble all the CTA elements in a received Beacon frame before its analysis. The PNC shall place the CTA-blocks in the increasing order of their allocated channel time to ease their reassembly.

Octets: 1	**1**	**12**	**12**	**-----**	**12**
Element ID	Length = (n * 12)	CTA block-1	CTA block-2	……..	CTA block-n

Figure 20—Channel time allocation element

The CTA element consists of multiple, 12-octet wide CTA blocks, and shall be arranged in an increasing order of their start time. The CTA block is illustrated in Figure 21.

Octets: 1	**1**	**2**	**2**
Source DEV address	Destination DEV address	Slot Start time (in 8 microsecond resolution)	Time slot duration (in 8 microsecond resolution)

Figure 21—Channel time allocation block

The source DEV-address indicates the device to whom the channel time is being allocated.

The destination DEV-address indicates the device to whom the source-device can send the frames to. If this is a broadcast address, then the source-device shall send send broadcast frames only during that time slot.

The slot start time in the CTA block indicates the start time of the slot. The value of this field is always an offset from the start of superframe and hence the start of transmission of beacon frame from the PNC. The resolution of this field is 8 microseconds and so the range is [0-524280] microseconds.

In all CTA blocks, the time slot duration field indicates the maximum time for which the device is allowed to transmit in this slot. The resolution of this field is 8 microseconds and so the range is [0-524280] microseconds.

7.5 Command types

The command types are listed in Table 47. The individual commands are described in the following subclauses. No command frame shall be transmitted to or by an unassociated device within a piconet. The commands are categorized as management commands and control commands. The most significant bit of the command type is set to ‘0’ for control commands and the same is set to ‘1’ to indicate that it is a control command. For ease of parsing at the receive DEV, the transmitting DEV shall arrange the commands in any command frame such that all control command appear first followed by management commands.

Table 42—Command types

Command type (Hex value)	Command
0x0000	Reserved
0x0001	Remain Quiet
0x0002	Retransmission Request
0x0003	Retransmission Sequence Resync
0x0004-0x7FFF	Reserved
0x8000	Channel Time Request
0x8001	Probe Information
0x8002	Repeater Service Request
0x8003	Repeater Service Grant
0x8004	Repeater Service Reject
0x8005	Channel Status Request
0x8006	Channel status response
0x8007	Sleep state request
0x8008	Sleep state permit
0x8009	Sleep state reject
0x800A	Active state indication
0x800B	Coordination Handover
0x800C	Device Information Request
0x800D	Device Information Response
0x800E	Stream Management
0x800F-0xFFFF	Reserved

7.5.1 Channel time

This group of commands is used for the request and grant of time slots within the CFP.

7.5.1.1 Channel time request

The channel time request command structure is illustrated in Figure 22. Each block of 10 octets corresponds to channel time requested for a particular latency. The format of channel time request block for a given latency is illustrated in Figure 23.

Octets: 2	**2**	**6**	**6**	**-----**	**6**
Command Type	Length (n * 6)	Channel time request block for Stream-1	Channel time request block for Stream-2	……..	Channel time request block for Stream-n

Figure 22—Channel time request command format

Octets: 2	**1**	**1**	**2**
Stream ID	Duration between time-slots (Kμs)	Minimum requested channel time in a time slot	Requested Channel time per time slot

Figure 23—Channel time request block for a particular stream

The Stream ID indicates the stream for which the channel time is being requested. This field is defined in 7.2.1.4.

The Duration between transmissions indicates the requested frequency of time slots that needs to be allocated for the DEV. The resolution of this field is Kμs.

The Minimum requested channel time is the minimum duration of the time that is acceptable at the requesting DEV for in any time slot. If the allocated time slot is smaller the time indicated in this field, the PNC may not allocate that time-slot at all for the DEV. The resolution of this field is 32 microsec. Hence the range of this field is [0-8160] microseconds.

The Requested channel time is the time required at the DEV in every time slot for transmission of the indicated stream. Hence this field represents the time required for the given latency and not necessarily for the entire superframe. The resolution of the channel time field is 8 microseconds and so the range of requested time is [0-524280] microseconds.

7.5.1.2 Channel time grant

When present in a directed command frame, this command lists all the channel time slots granted to the addressed device. When present in a broadcast command frame, this command may have channel time slots allocated for more than one device in the piconet. The payload of the command may have more than one CTA element (which are defined in 7.4.9). The recipient device(s) are expected to assemble the contents of

all the elements in the order of their occurrence in the received frames before using the information contained in them.

Octets: 2	2	variable
Command Type	Length	CTA element(s)

Figure 24—Channel time grant command format

The channel time allocations that have been announced in the immediately preceding beacon at the beginning of the CFP shall not be changed using this command. However, the PNC may use this command to reannounce the same allocations that were already announced in the immediately preceding beacon. The slot-start times in all the CTA elements in this command shall be with reference to the time at the start of the transmission of the immediately preceding beacon at the PNC.

7.5.2 Probe information command

The probe information command is used both to request information about a device and as a response to the information request. This command can be exchanged between any two devices in the piconet. The individual elements used in this frame are described in 7.4. The stream ID in the probe request frame header is set to 0 and ignored upon reception.

octets: 2	2	2	Variable
Command Type	Length	Information Request	Information elements

Figure 25—Probe Information command format

The least significant 15 bits of the information request field is a bitmap to indicate the information requested of the destination of device. The sender sets a value of ‘1’ in a bit to request the information element that corresponds to the bit position. Otherwise the sender sets the bit to ‘0’. The bit position for an information element is same as the value of the element-ID for that information element. That is, the bit position of ‘n’ in “Information Request” field corresponds the Information element whose element ID is ‘n’. An all-zero value in this field means that the source device is not expecting any probe information from the destination device, but is providing the information about itself to the destination device in the elements following this field.

The most significant bit of information request field indicates that the rest of the bits in the field are not bit maps, instead they are binary coded to indicate the element ID of the information element that is being requested by the sender of this command from its intended recipient.

The information elements field is a list of information elements described in 7.5.12. The elements themselves can be placed in any order and all the elements need not be present.

7.5.3 Repeater service

This group of commands is used to request, grant or reject the repeater service from the PNC.

7.5.3.1 Repeater services request

The repeater services request shall only be sent by an associated device on the piconet and shall not be sent by the PNC. The structure of the command is illustrated in Figure 26.

octets: 2	2	6	10	10	-----	10
Command Type	Length (6 + (n * 10))	Destination Device ID	Channel time for latency-1	Channel time for latency-2	……..	Channel time for latency-n

Figure 26—Repeater services request/grant command format

The destination device ID is the 48-bit IEEE 802 address of the device associated with the link for which the sender of this command is requesting repeater service by the PNC. If the destination device ID is a broadcast address, the request is for all links from/to the sender of the command. The format of channel time for a given latency is illustrated in Figure 23. The list of channel times includes all the link(s) originating from the sender of this command to the device(s) indicated by destination device ID.

7.5.3.2 Repeater service grant

The repeater service grant command shall be sent only by the PNC. The command structure is illustrated in Figure 26.

The destination device ID is that of the second device that is associated with the link for which the repeater service is granted. The format of channel time for a given latency is illustrated in Figure 23. The channel time fields indicate the total channel time for an indicated latency that has been allocated by the PNC for repeater service. If the device sends more frames than those that can be accommodated in this allocated channel time, the extra frames are buffered and repeated whenever the channel time next becomes available.

7.5.3.3 Repeater service reject

Either the PNC or the device that originally requested repeater-service can send the repeater service reject command. The structure of the command is illustrated in Figure 27.

octets: 2	2	6	1	1
Command Type	Length (=8)	Destination Device ID	Reason Code	Reserved

Figure 27—Repeater service reject command format

When PNC sends this command, the repeater service is being terminated between the DA of the frame containing this command and the device indicated in the destination device ID field.

When a member DEV sends this command, the repeater service is being rejected for the link between the SA and DA of the frame containing this frame. The destination device ID field contains the IEEE 48-bit address of the DA.

The reason codes are same as those defined in 7.1.1.

7.5.4 Remain Quiet

Only the PNC shall send the remain quiet command. The structure of the command is illustrated in Figure 28.

octets: 2	2	1	1
Command Type	Length (=2)	Quiet Time (in Kμs)	piconet Status

Figure 28—Remain Quiet command format

The quiet time indicates the time duration during which the devices in the piconet shall be quiet waiting for a beacon from the PNC.

The piconet status field values are,

— 0 -> No change
— 1 -> Channel change is in progress
— 2 -> PNC hand over is in progress
— 3-255 -> reserved

7.5.5 Channel Status Request

The structure of the command is illustrated in Figure 29. This command can be sent by any DEV in the piconet to its peer-DEV in the piconet, incluidng the PNC to request the current channel condition as experienced at the requested DEV.

octets: 2	2
Command Type	Length (= 0)

Figure 29—Channel status request command format

7.5.6 Channel Status Response

The structure of the command is illustrated in Figure 30. This command is sent by peer-DEV to the device that is requesting the channel status to let the requesting DEV know the current channel condition at this peer-DEV.

octets: 2	2	2	2	2	2	2
Command Type	Length (=10)	Measurement Window Size (in Kμs)	Tx Frames Count	Rx Frames Count	Rx Error Frames Count	Rx Frames Loss Count

Figure 30—Channel status response command format

The Measurement window size is the time duration, in Kμs, during which the measurements were carried out.

The Tx frames count is the total number of frames that were transmitted by the sender of this command.

The Rx frames count is the total number of frames that were received by the sender of this command. Only the directed frames intended for this device are included.

The Rx error frames count is the total number of frames that were received in error by the sender of this command. A frame is considered to have been received in error if the header passes the HCS calculation but the frame body fails the FCS calculation.

The Rx Frame Loss Count is the total number of frames that were detected as not having received at the first attempt of their transmission. Only the expected, but not received, directed frames intended for this device are included. Loss of frame(s) for a given Stream-ID is detected when the stream sequence number in a received frame corresponding to that stream is not one more than the sequence number indicated in the last received frame corresponding to the same stream. The difference between the new stream sequence number and the last stream sequence number received reduced by one gives the number of frames lost. These numbers are accumulated for all streams at a device and sent as receive frame loss count. The frames received with retry bit set are excluded from this calculation as it is not possible to determine the number of attempts made by the sending device before the frame is succesfully received by the destination device.

7.5.7 Sleep time request

A DEV that is associated with a PNC indicating its intention to use sleep state during the association state shall use this command to obtain permission to enter sleep state.The command structure is illustrated in Figure 31.

octets: 2	**2**	**2**
Command Type	Length (= 2)	Requested sleep state duration (in TU)

Figure 31—Sleep time request command format

The requested sleep state duration is the length of time that the PNC is being requested to buffer the frames for the requesting DEV.

7.5.8 Sleep time permit

PNC shall use this command to permit a requesting DEV to enter sleep state. The requesting DEV shall enter the sleep state only after it has succesfully acknowledged this command from the PNC. The command structure is illustrated in Figure 32.

octets: 2	**2**	**2**
Command Type	Length (= 2)	Max sleep state duration (in TU)

Figure 32—Sleep time permit command format

The max sleep state duration is the length of time that the PNC is agreeing to buffer the frames for the requesting DEV.

7.5.9 Sleep time reject

PNC shall use this command to reject a requesting DEV to enter sleep state. The requesting DEV shall not enter the sleep state if it receives this command from the PNC. The command structure is illustrated in Figure 33.

octets: 2	2	1	1
Command Type	Length (= 2)	reserved	Reason code

Figure 33—Sleep time reject command format

The max sleep state duration is the length of time that the PNC is agreeing to buffer the frames for the requesting DEV.

- 0 -> No resources available
- 1 -> Channel change is in progress
- 2 -> PNC hand over is in progress
- 3 -> Pending buffered frames from previous sleep state
- 4-> Unknown reason
- 5-255-> Reserved

7.5.10 Active state indication

A DEV that was permitted to enter sleep state by the PNC uses this command to indicate its intention to be back in active state. After succesfully acknowledging this frame, the PNC shall stop buffering frames for the requesting DEV and start delivering the currently buffered frames to this DEV. The command structure is illustrated in Figure 34.

octets: 2	2
Command Type	Length (= 0)

Figure 34—Active state indication command format

7.5.11 Coordination handover

The PNC shall use this command to hand over its responsibility to an associated device that is capable of being a PNC. The command structure is illustrated in Figure 35.

octets: 2	2	2	2	6	6	2
Command Type	Length (= 18)	Number of devices	Superframe duration	PNC Device ID	AC Device ID	Hand over timeout

Figure 35—Coordination handover command format

The number of devices field indicates the total number of devices that are currently associated with the PNC.

The superframe duration is defined in sub-clause 7.4.2.

The PNC device ID is the device ID of the current PNC of the piconet.

The AC device ID is the device ID of the AC that is chosen to be the new PNC of the piconet.

The hand over timeout is the time by which the new PNC is expected to obtain the device information from the current PNC and start the beaconing process. The resolution of this field is 8 microseconds and as a range of [0-524280] microseconds. The indicated timeout shall be with reference to the start of transmission of immediately previous beacon from the current PNC.

The beacons from the current PNC stop at the end of the transfer of device information.

7.5.12 Device information

This group of commands is used to request and provide information about any or all of the currently associated devices.

7.5.12.1 Device information request

Only a DEV shall send the device information request command. The structure of the command is illustrated in Figure 36.

octets: 2	**2**	**6**	**6**
Command Type	Length (=2)	Requester Device ID	Queried Device ID

Figure 36—Device information request command format

The requester device ID is the device ID of the device that is requesting the information. The allocated address for this device is SA of the command frame in which this command is received.

The queried device ID is the device ID of the device whose information is being requested from the PNC. If this field has a broadcast address, then the device is requesting the entire list at the PNC.

7.5.12.2 Device information Response

Only a PNC sends the device information response command. This command may be sent either as a response to the device information request by a member DEV or it can be sent unsolicited. This command can be sent in a directed command frame to a member DEV or it can be sent in a broadcast command frame meant for all member DEVs in the piconet.

Octets: 2	**2**	**2**	**Variable**	**Variable**	**-----**	**Variable**
Command Type	Length	Number of records (= m)	Record for device-1	Record for device-2	……..	Record for device-m

Figure 37—Device information response command format

The record field is illustrated in Figure 34.

Octets: 1	1	6	2	2	10	10	-----	10
Allocated Device Address (AD-AD)	Reserved	Device ID	Capability field	Number of Tx slots (= n)	Requested channel time for latency-1	Requested channel time for latency-2	……..	Requested channel time for latency-n

Figure 38—Format of a Record in device information response command

The allocated device address (AD-AD) is the address assigned to the device. This field is an all-zero value for the record corresponding to the PNC.

The device ID is for the device whose allocations are indicted in the following fields.

The capability field is illustrated in Figure 15 and defined in 7.4.3.

The number of Tx-slots is the number of allocated transmission slots for the device within each superframe.

The requested channel time for a given latency is illustrated in Figure 23.

7.5.13 Retransmission

This group of commands is used in the retransmission process for frames in connected streams.

7.5.13.1 Retransmission request

Only the device that is receiving a unicast stream addressed to it shall send a retransmission request command. The command structure is illustrated in Figure 39.

Octets: 2	2	10	10	-----	10
Command Type	Length= 8 * m	Record for stream-1	Record for stream-2	……..	Record for stream-m

Figure 39—Retransmission Request command format

The record for a stream is illustrated in Figure 40.

octets: 2	2	2	4
stream ID	Start Sequence Number	End Sequence Number	Rx-status bitmap

Figure 40—Format of a Record in Retransmission Request command

The stream ID is a 2-octet field that identifies stream of the MPDU(s) being acknowledged by this record. There may be more than one record with the same stream ID in a given retransmission request command frame, if more than 32 frames from that stream require acknowledgement and/or negative acknowledgement.

The start sequence number is a 2-octet field that contains the sequence number of the first frame reported in the “Rx-status bitmap”.

The end sequence number is a 2-octet field that contains the sequence number of the last frame reported in the “Rx-status bitmap”.

The Rx-status bitmap is a 4-octet field in which each bit indicates the reception status of an frame within the specified stream. Rx-status bitmap bit number 0 indicates the reception status of the frame with the sequence number contained in the start sequence number field and subsequent bits indicate the reception status of frames with the next 31 sequentially ascending sequence numbers. Rx-status bitmap bits set to 1 indicate frames that have been received successfully, whereas bits set to 0 indicate frames that have not yet been successfully received (and which may have not been sent).

7.5.13.2 Retransmission sequence resync

Only the device that is transmitting a unicast stream addressed to some other device in the piconet shall send a retransmission sequence resync command. The command structure is illustrated in Figure 41.

octets: 2	**2**	**4**	**4**	**-----**	**4**
Command Type	Length = 4 * m	Record for stream-1	Record for stream-2	……..	Record for stream-m

Figure 41—Retransmission sequence resync command format

The record for a stream is illustrated in Figure 42.

octets: 2	**2**
stream ID	Resync Sequence Number

Figure 42—Format of a Record in Retransmission Sequence Resync command

The stream ID is a 2-octet field that identifies stream that is being resynchronized between the sending and receiving devices.

The start sequence number is a 2-octet field that contains the sequence number of the first frame that shall be expected after this command frame.

7.5.14 Stream Management

The stream management command is used for setting up, tearing down and negotiating parameters of a stream in the piconet. This command may be used by the devices that are involved in transmitting/receiving a unicast stream and by the PNC of the piconet.

Octets: 2	**2**	**2**	**1**	**1**	**1**	**1**	**20**
Command type	Length (=22)	Stream request identifier	DA for the stream	DSAA	Reserved	Reason Code	Stream QoS parameters

Figure 43—Stream Management command format

The stream request identifier is a 2-octet field containing the unique identifier that is generated by the device that originates the stream connection request (see the Action Type below). This chosen identifier is always

used in conjunction with the allocated address of the requester. This identifier shall remain constant in the entire frame exchange sequence regarding the connection of the intended stream.

The DA is the allocated address of the destination device of the stream that is being connected. This field is valid only when this command is exchanged between the source device for the stream and the PNC.

The DSAA field is illustrated in Figure 44.

Bits: b7	b6:b4	b3:b2	b1:b0
Direction	Security	Ack-Policy	Action Type

Figure 44—DSAA field in the stream management command

The action type is a 2-bit field with the following values.

- Value of ‘0’ means that this is a request for stream connection. This request is sent from one device to another to start a stream. This is also sent from the device that sources the stream to the PNC.
- Value of ‘1’ means that this is the decision for QoS-parameters, except the retransmission window, by the PNC. Hence only the PNC shall be able to send this action type.
- Value of ‘2’ means that this is an acceptance of the stream connection. This is sent to the originator from the second device that is involved in the stream connection. This is also exchanged between the device that sources the stream and the PNC.
- Value of ‘3’ means that this is rejection/disconnection of the stream connection. This request is sent by source/destination to the destination/source device to reject/disconnect a stream. This is also exchanged between the device that sources the stream and the PNC to disconnect a stream.

The security is a 3-bit field <TBD>

The direction field value of ‘1’ means that the stream is being transmitted from the device that sent the command. The value of ‘0’ means that the stream is being received.

The reason code is valid when a stream connection is being rejected with the action type in DSAA field set to stream rejection/disconnection. Otherwise this field is ignored. Valid reason codes are:

- 0 -> invalid stream parameters
- 1 -> non-negotiable stream parameters
- 2 -> system resources unavailable
- 3 -> bandwidth allocation failure
- 4 -> currently disassociating from the piconet
- 5 -> too many streams
- 6 -> lack of required security
- 7 -> unauthorized stream
- 8-255 reserved

The stream QoS parameters for the stream that is being established is illustrated in Figure 45.

octets: 6	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**
Channel time Request Block	Max Tx-Delay variation (Kμs)	Reserved	Mini-mum Rate (KOctets/sec)	Peak Rate (KOc-tets/sec)	Average Rate (KOc-tets/sec)	Max burst size (Octets)	Average frame size (Octets)	Max ReTX duration (Kμs)	Receive window size (K Octets)

Figure 45—Stream QoS parameters in Stream Management command

The Channel time request block is defined in 7.5.1.1. The stream ID in Channel time request block cntains the index of the stream as issued by the PNC. The stream ID is set to zero in all of the stream management commands meant for a stream whose index is not yet issued by the PNC. The priority field in Stream-ID field contained in channel time request block is set by the original requestor and shall remain the same in all the stream management commands related to the same stream.

The max Tx-delay variation is a 1-octet field indicating the maximum transmit delay that is tolerated, in Kμs.

The minimum rate" is a 2-octet field indicating the minimum data rate, in kilo octets per second.

The peak rate is a 2-octet field indicating the maximum data rate, in kilo octets per second.

The average rate is a 2-octet field indicating the average data rate, in kilo octets per second.

The max burst size is a 2-octet field indicating the maximum burst size, in octets.

The average frame size is a 2-octet field indicating the average size of the frame, in octets.

The max ReTX duration is a 1-octet field indicating the time, in Kμs, over which the retransmission of the frame is not needed. The value '0' in this field means no retransmission is required and all-one value indicates that retransmission shall continue indefinitely to attempt to provide completely reliable transmission of the stream.

The receive window size is a 1-octet field indicating the size of the receive buffer, in kilo octets. The receive-window in the command from a source device is always a request to the destination device. The destination device makes the final decision on the receive window.