IEEE P802.15
Wireless Personal Area Networks

Project	IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)
Title	**JCS Proposed Changes**
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Re:	[]
Abstract	[This document contains a list or proposed changes to IEEE Std 802.15.3.]
Purpose	[The purpose of this document is to propose changes to IEEE Std 802.15.3 to improve compatibility, performance and clarity in the standard.]
Notice	
Release	

1. Introduction

This document proposes various changes to IEEE Std 802.15.

2. Amendment Items

2.1. Imm-ACK Frame used in place of Command Response

2.1.1. Issue

The developers of the 802.15.3 standard made the decision to use Imm-ACK frames in the place of Response command frames for certain message exchange sequences. This was done when the Response command would not contain any payload data or when the scenario was considered “fire and forget”.

The problem with this logic is a Response command frame, even if it has no command payload data, indicates to the source device that the Request command was received AND processed. An Imm-ACK frame can only ever indicate that the Request command was received because it is unlikely the Request command could ever be processed fast enough to generate the Imm-ACK 10 microseconds after the Request command was received. If a scenario is a “fire and forget” situation, then no confirmation is needed.

2.1.2. Suggested Changes

Changes presented in 04/202r0.

2.2. PNC must support all possible stream indexes

2.2.1. Issue

The standard should clarify that the PNC must support all 256 possible stream indexes. This is necessary because one manufacture may do so and a PNC from another vendor must be able to accept a handover from this first PNC, including active stream information.

2.2.2. Suggested Changes

7.2.5 Stream Index

DEVs use other values of the stream index as dynamically assigned by the PNC during the setup of the data stream, as described in 7.5.6.1. The PNC allocates a unique stream index value for each isochronous stream in the piconet. <u>Although each DEV has a maximum number of isochronous streams that it can support at one time, each DEV in a piconet shall support all possible stream index values.</u>

2.3. DEV Use of CTA

2.3.1. Issue

The standard currently indicates that a DEV can send a frame to any destination DEV in any CTA assigned to it. The standard should clarify that, in the case of isochronous stream data, a stream between the source and destination DEV must exist. Or, in other words, clarify that a DEV cannot send a frame to a destination DEV using a stream index that the destination DEV is not aware of.

2.3.2. Suggested Changes

8.4.3.2 Channel time allocation (CTA) and channel time usage

When a source DEV has a frame of any type for a destination DEV, the source DEV may send it during any CTA for that source DEV and destination DEV pair or to use the CAP to communicate that frame. The source DEV may also send a frame to a destination DEV in any CTA assigned to that source even if the destination DEV is different ~~that~~ than that indicated in the CTA block, provided the source DEV has determined that the destination DEV will be receiving in that CTA, as described in 7.4.11. All stream data sent between a source DEV and destination DEV pair shall use a stream index for an established stream from the source DEV to the destination DEV.

2.4. Adjustable Xmit Power in CTA

2.4.1. Issue

The standard should clarify that the transmit power used between two devs in a CTA is not restricted by the Max Tx Power broadcast in the beacon.

2.4.2. Suggested Changes

8.11.2 Transmit power control

Two independent forms of transmit power control (TPC) are available for 802.15.3 systems, a maximum power for the CAP, the beacon and directed MCTAs, and adjustable power in a CTA. The goal of TPC in the CAP is to prevent one DEV from having better access to the medium in the CAP due to a higher transmit power level. Adjustable transmitter power in the CTA is intended to support reduced power usage as well as reducing the overall interference levels generated by the piconet.

2.5. Conflicting ACKPolicy's

2.5.1. Issue

The standard should clarify that the ACKPolicy field in a MAC-ISOCH-DATA.request for a stream overrides the ACKPolicy specified in a MLME-CREATE-STREAM.request for the stream.

2.5.2. Suggested Changes

6.6.4.2 Effect of receipt (MAC-ISOCH-DATA.request)

The MAC upon receiving this primitive uses the received parameters to format an appropriate MPDU which is then sent to the PHY-SAP for transfer over the wireless medium to a peer MAC entity or entities. The ACKPolicy value received with this primitive takes precedence over the ACKPolicy value received when the stream was created using the MLME-CREATE-STREAM.request primitive.

2.6. PNC Allocation of Stream Indexes

2.6.1. Issue

The PNC allocates a unique stream index value for each isochronous stream in the piconet. The current requirement is that the PNC assign an unused value other than the asynchronous stream index to a new stream. There is no other requirement on how a stream index should be assigned. For example, if the PNC has assigned stream indexes 0x01, 0x02 and 0x03, and stream 0x01 is terminated, the PNC may use stream index 0x01 for the next stream created.

An amendment is proposed where the PNC would be required to "cycle through" all available unused stream indexes before re-assigning a stream index that was already assigned.

Because this is a radio system, commands between devices can be lost for various reasons. Therefore, it is reasonable to expect that at times DEVs is the system may not have consistent information about which streams are currently active in the system. If the PNC is allowed to immediately reuse a stream index, it is possible that the stream index could be used before all DEVs in the piconet are aware that the previous stream with that same stream index has been terminated. This could lead to many unforeseen problems.

If the PNC cycled through all available stream indexes, it is significantly less likely that the PNC would ever reassign a stream index very shortly after the termination of a previous stream with the same stream index.

2.6.2. Suggested Changes

8.5.1.1 Isochronous stream creation

The PNC upon receiving the Channel Time Request command from the originating DEV shall respond with a Channel Time Response command, as described in 7.5.6.2, to the originating DEV with the following Channel Time Response command field values if the requested channel time is available:

— The Stream Index field is set to an unused value ~~other than the asynchronous stream index~~ to indicate that the isochronous stream has been allocated channel time. Stream indexes shall be assigned in sequence (increasing order) by the PNC except when the PNC can only reuse a Stream Index that was freed up after the termination of a stream.

2.7. Stream Index 0xFF

2.7.1. Issue

Currently, stream indexes 0x01 through 0xFC plus stream 0xFF are available to the PNC for assignment to isochronous streams. Stream indexes, 0x00, 0xFD and 0xFE are currently special stream indexes reserved for special purposes. In an implementation, it would be more practical to have a single contiguous range of stream indexes of 0x01-0xFC available for allocation to isochronous streams. Therefore, an amendment is recommended to reserve stream index 0xFF for future use.

2.7.2. Suggested Changes

7.2.5 Stream Index

The Stream Index field reserved values are:

— 0x00 reserved for asynchronous data.
— 0xFD reserved for MCTA traffic.
— 0xFE reserved for unassigned streams
— 0xFF reserved for future use.

2.8. Interframe Spacing Requirements

2.8.1. Issue

The standard should clarify when a specified inter-frame spacing is to be considered a “minimum” value and when a specified inter-frame spacing is to be considered an exact value. For example, the SIFS between a data frame and a corresponding ack frame needs to be 10us in order to prevent the sender of the data from resending the data. However, the SIFS between the ack frame and the next data frame sent is a minimum value. For example, the source of the data may not have another data frame to send until 20us after the ack was received. Clarify MIFS is a minimum value (with limits within an extended beacon) and that RIFS is a minimum value.

2.8.2. Suggested Changes

8.4.1 Interframe space (IFS):

There are four IFSs that are defined; the minimum interframe space (MIFS), the short interframe space (SIFS), the backoff interframe space (BIFS) and the retransmission interframe space (RIFS). The actual values of the MIFS, SIFS, BIFS and RIFS are PHY dependent. For the 2.4 GHz PHY they are listed in 11.2.7.1.

~~All Imm-ACK frames and Dly-ACK frames shall start transmission over the medium a SIFS duration after the end of the transmission of the previous frame which requested the ACK. A MIFS duration shall be allowed in the CTA between a frame and the next successive frame transmitted over the medium if the first frame either had the ACK Policy field set to either no-ACK or Dly-ACK.~~

All Imm-ACK frames and Dly-ACK frames shall start transmission over the medium a SIFS after the end of the transmission of the previous frame which requested the ACK. The IFS between all received Imm-ACK frames and Dly-ACK frames and the next successive frame transmitted over the medium shall be no less than a SIFS. The IFS in a CTA between a frame and the next successive frame transmitted over the medium if the first frame had the ACK Policy field set to either no-ACK or Dly-ACK shall be no less than a MIFS.

During the CTAP, all DEVs shall use an IFS no less than a RIFS for retransmissions. During the CAP, however, the retransmissions shall follow the CAP rules described in 8.4.2. The rules for acknowledgement and retransmissions are described in 8.8. The interframe space requirement for the beacon is ensured by the location of the CTAs which is determined by the PNC, as described in 8.4.3.6.

8.6.2 Beacon generation

If the PNC determines that the beacon frame is too large or if it is going to split the information in the beacon frame, it may send one or more Announce commands with the SrcID set to the PNCID and the DestID set to the BcstId following the beacon. This is called an extended beacon. Unless it is specified otherwise, the term beacon applies to both the beacon frame and the Announce commands that make up the extended beacon. The IFS between the beacon frame, the first Announce command, and any additional Announce commands shall be less than a SIFS and no less than a MIFS. ~~The first Announce command shall be sent one MIFS following the beacon~~

~~with any additional Announce commands following one MIFS after the the prior Announce command.~~

8.8.4 Retransmissions

< text omitted >

During CTAs within the CTAP when an Imm-ACK or Dly-ACK is expected~~,~~ but is not received ~~during a RIFS~~, the source DEV ~~shall~~ may start the retransmission of the frame (or new frame if the failed frame's retransmission limit has been met) ~~after the end of RIFS~~ a RIFS after the end of the previous frame as long as there is enough channel time remaining in the CTA for the entire frame exchange.

11.2.7.4 Time between successive transmissions

The minimum time between successive transmissions shall be pPHYMIFSTime, including the power-up ramp specified in 11.5.7.

2.9. MSDU Number for New Stream

2.9.1. Issue

The standard should clarify what the first MSDU number is when a new stream is started. This has an impact on the requirements for duplicate detection. Is the MSDU number always reset to zero, or does the MSDU number continue from the last time the stream index was assigned?

2.9.2. Suggested Changes

7.2.4.1 MSDU number

The MSDU Number field indicates the sequence number of the current MSDU or command frame.

For data frames, each DEV shall maintain one modulo-512 counter for each of its isochronous streams, and one for its asynchronous data traffic. The MSDU numbers for all command frames shall be assigned from a single modulo-512 counter.

Each MSDU number counter shall be set to zero when the DEV is initialized. The MSDU number counter for an isochronous stream shall be set to zero when the stream index for the isochronous stream is set as described in <.8.5.1.1>.

8.5.1.1 Isochronous stream creation

< text omiited >

The PNC upon receiving the Channel Time Request command from the originating DEV shall respond with a Channel Time Response command, as described in 7.5.6.2, to the originating DEV with the following Channel Time Response command field values if the requested channel time is available:

— The Stream Index field is set to an unused value other than the asynchronous stream index to indicate that the isochronous stream has been allocated channel time.

2.10. IEs Unchanged Bit

2.10.1. Issue

In many situations, channel time allocations from superframe to superframe will remain unchanged. However, currently, a DEV is required to decode and process all channel time allocation IEs for each beacon frame received.

An amendment is proposed where a new bit is defined in the MAC header for beacon frames that indicates when the IEs for a particular beacon frame are unchanged from the previous beacon transmitted. If a DEV receives a beacon frame with this bit set, and the DEV correctly received the previous beacon frame, the DEV can skip decode and processing of the IEs in the current beacon.

2.10.2. Suggested Changes

7.3.1.1 Non-secure beacon frame

<Define b7 of Figure 13 – Piconet mode field as "IEs Unchanged">

The SEC Mode field indicates the current security settings in the piconet as defined in 9.2. The field is encoded as illustrated in Table 41:

<Table 41>

<u>The IEs Unchanged bit shall be set to one if the number, type, and contents of the IEs in the beacon payload are exactly the same as the previously transmitted beacon.</u>

8.6.2 Beacon generation

If the PNC determines that the beacon frame is too large or if it is going to split the information in the beacon frame, it may send one or more Announce commands with the SrcID set to the PNCID and the DestID set to the BcstId following the beacon. This is called an extended beacon. Unless it is specified otherwise, the term beacon applies to both the beacon frame and the Announce commands that make up the extended beacon. The first Announce command shall be sent one MIFS following the beacon with any additional Announce commands following one MIFS after the the prior Announce command. If the PNC sends some of the beacon information in the broadcast Announce commands, it shall set the More Data bit to indicate 'more

data' in the Frame Control field of the beacon frame and in all but the last Announce command frame used to
communicate the IEs. The CAP or the CTAP, if the CAP isn't present, begins after the last Announce command that is part of the extended beacon. The PNC shall send CTA IEs, BSID IE, and the Parent Piconet IE, if present, only in the beacon frame and not in any of the broadcast Announce commands. The Announce commands are sent to the BcstID and so the ACK Policy field shall be set to no-ACK in these frames.

If all the IEs contained in the beacon frame and any Announce commands of an extended beacon are identical to the IEs transmitted in the previous beacon the PNC shall set the IEs Unchanged bit in the Piconet Mode field of the Piconet Synchronization Parameters field as defined in <7.3.1.1>.

The PNC shall transmit the beacon such that the time between beacons is the superframe duration with an error of no more than pPHYClockAccuracy times the superframe duration. The PNC changes the super-frame position or duration using the procedures indicated in 8.10.1 and 8.10.2, respectively.

8.6.3 Beacon reception

All of the DEVs that are associated shall use the beacon start time, CAP end time and the CTA IEs contained in the beacon to start their transmissions. The superframe duration and the CAP end time in the beacon, as described in 7.3.1, are used to accurately mark the beginning and the end of the CTAP. A lost beacon is defined as one for which the FCS is not valid or when a DEV has not received a beacon at the expected time.

If a DEV receives a beacon frame with the IEs Unchanged bit set in the Piconet Mode field of the Piconet Synchronization Parameters field, and if the DEV has correctly received the previously transmitted beacon, the DEV may assume that the IEs contained in the beacon frame and any Announce commands that make up the beacon are identical to the IEs received in the previous beacon. If the IEs Unchanged bit is not set, or if the previous beacon (beacon frame and any Announce commands) was not correctly received, then the DEV shall consider that the IEs in the current beacon contain new information.

2.11. Clause 7.4.16, Piconet Services IE

2.11.1. Issue

The minimum length value is listed as 2. This does not match the fields in the IE or the fact that Clause 8.3.2 discusses sending Piconet Services IEs with a length of both 0 and 1.

2.11.2. Suggested Changes

Figure 47—Piconet services information element format

Length (=~~2~~0 to 131)

2.12. Probe Request Index

2.12.1. Issue

There seems be a major flaw with Probe in that the Request Index field is for the CTA Status IE, yet a DEV is not allowed to request this IE.

2.12.2. Suggested Changes

Table 51—Rules for requesting IEs in a Probe Request command

< In the “CTA status” row, under the column “Dev allowed to request?”, change “Shall not request” to “May request”. >

Table 52—Rules for responding to IE requests in a Probe Request command

< In the “CTA status” row, under the column “PNC receives request from DEV” change “Shall ignore” to “Shall respond”. >

2.13. PNC Allocation of DEVIDs

2.13.1. Issue

The PNC allocates a unique DEVID value for each associated DEV in the piconet. The current requirement is that the PNC assign any unused DEVID. The only other restriction is stated in clause 8.3.1:

“the PNC shall not reuse the same DEVID of that DEV until at least two times the ATP duration for that DEV has passed.”

Because this is a radio system, commands between devices can be lost for various reasons. Therefore, it is reasonable to expect that at times DEVs is the system may not have consistent information about which DEVs are currently associated in the system. If the PNC is allowed to reuse a DEVID relatively quickly, it is possible that the DEVID could be reused before all DEVs in the piconet are aware that the previous DEV with the same DEVID has been disassociation. This could lead to many unforeseen problems.

An amendment is proposed where the PNC would be required to “cycle through” all available DEVIDs before re-assigning a DEVID that was previously assigned.

2.13.2. Suggested Changes

Clause 8.3.1:

The device IDs (DEVIDs) shall be assigned in sequence (increasing order) by the PNC except when the PNC ~~wishes to~~ can only reuse a DEVID that was freed up after a DEV has left the piconet.

2.14. Randomize First DEVID Assigned by PNC

2.14.1. Issue

From clause 8.3.1:

“The device IDs (DEVIDs) shall be assigned in sequence (increasing order) by the PNC except when PNC wishes to use a DEVID that was freed up after a DEV has left the piconet.”

If all PNCs allocate DEVIDs starting with DEVID 0x01, then this increases the likelihood of confusion in the case where piconets overlap. This is especially true during a point in to time where two piconets are using the same PNID (before one of the PNCs changes its PNID). Allowing a PNC to randomize the starting DEVID would significantly decrease the likelihood of DEVID reuse between overlapping piconets.

2.14.2. Suggested Changes

Clause 8.3.1:

The device IDs (DEVIDs) shall be assigned in sequence (increasing order) by the PNC except when the PNC ~~wishes to~~ can only reuse a DEVID that was freed up after a DEV has left the piconet. The first DEVID assigned may be randomly selected by the PNC.

2.15. Max Frames Field of Dly-ACK Frame

2.15.1. Issue

The standard should clarify the definition of the Max Frames field in the Dly-ACK frame because it could be interpreted in two different ways.

Interpretation #1: The maximum number of frames a source DEV can send before it requests a Dly-ACK from the destination DEV. For example, if Max Frames is six, the source DEV can always send six frames in each Dly-ACK burst, including both retransmitted frames and new frames.

Interpretation #2: The maximum number of frames the destination DEV can store, implying that the source DEV can never attempt to send more frames than the destination DEV can store considering the fact that the destination DEV must send received frames to higher layers in order. In other words, after sending the first six frames, the next transmission will be one to six frames depending on which frames were received correctly at the destination. For example, if the first of the original six frames was not received correctly, the next transmission could only contain one frame, because 5 receive buffers are occupied with frames 2 through 6. If the 3rd frame of the original six was not received correctly, the next transmission could contain at most four frames (a retransmission of the original 3rd frame plus 3 new frames).

2.15.2. Suggested Changes

8.8.3 Delayed acknowledgement

If the destination DEV accepts the use of Dly-ACK, it shall respond with a Dly-ACK frame, acknowledging the received data frame and setting the Max Burst field to a value representing the maximum number of pMaxFrameBodySize MPDUs the source DEV may send in one burst. Because the receiver buffer requirement is equal to Max Burst field times pMaxFrameBodySize, the source may send as many smaller frames as will fit in the receive buffer window, up to a maximum of Max Frames, as provided in the Dly-ACK frame, as described in 7.3.2.2. The destination DEV may change the Max Burst and Max Frames values in each Dly-ACK frame. The MPDUs ACKed field shall be set to one and the MPDU ID field shall contain the information for the frame that was sent to negotiate the Dly-ACK.