

IEEE P802.15 Wireless Personal Area Networks

Project	IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)	
Title	TG3 Draft D08 to D09 changes	
Date Submitted	[1 December, 2001]	
Source	[James P. K. Gilb] [Mobilian] [12707 High Bluff Dr., Suite 335, San Diego, CA 92130]	Voice: [858-436-2201] Fax: [858-436-2301] E-mail: [gilb@ieee.org]
Re:	[]	
Abstract	[This document is contains the issues and resolutions developed by the TG3 subcommittee at the Rolling Meadows ad-hoc meeting. It also serves to document the addtions made to the draft standard D07 to produce D08.]	
Purpose	[To provide a record of the resolutions of TG3 and the changes to the draft standard D07 to make D08.]	
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Release	The contributor acknowledges and accepts that this contribution becomes the property of IEEE and may be made publicly available by P802.15.	

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1. Changes from “Austin Draft Ammendements,” document 01/496r2

1.1 Make changes identified in document 01/485r4

7.5.11 EPS Configuration Request

MkS Editor note: Eliminate this command from D08

7.5.12 EPS Configuration Response

MkS Editor note: Eliminate this command from D08

7.5.13 EPS PS Configuration command

MkS Editor note: Eliminate this command and replace the Action Commands shown below

Ed. action: The above three commands have been deleted from the Frame Formats clause. The EPS PS configuration command was called the PS PNC configuration command in D08.

7.5.13.1 EPS Action command

This command is found in Figure 1 along with the interpretation of the fields as shown in Figure 2.

7.5.13.2 EPS Action response

This command is found in Figure 1 along with the interpretation of the field as shown in Figure 3.

This is used to create and maintain EPS Sets as well as EPS Set membership. When an EPS Set is confirmed as created, the PNC shall begin keeping the time base specified for that EPS Set.

Octets:2	2	1	1	2	4
Command type	Length (=2 or 8 based on request type)	Request/Response type	EPSSet value	EPSTime	EPSNext

Figure 1 PS PNC configuration command/response

Request type	<u>EPS set value</u>	<u>EPSTime & EPSNext</u>
Release request (0 value)	Value Required	Not present
New request (1 value)	Set to 0	Required
Place me in set request (2 value)	Value Required	Not present
Give me information on the EPS set request (3 value)	Value Required	Not present

Figure 2 Request entries

Reply type	<u>EPS set value</u>	<u>EPSTime & EPSNext</u>
Release confirm (0 value)	Value released	Not present
New confirm (1 value)	New value provided	Not present
Place me in set confirm (2 value)	Value of set place into	Not present
Give me information on the EPS set response (3 value)	Value Required	Part of reply
Failure code Incorrect command length	Set to 0	Not present
Failure code – Already a member	Set to 0	Not present
Failure code – EPS set does not exist	Set to 0	Not present
Failure code – Cannot create new set	Set to 0	Not present
Failure code – Illegal command	Set to 0	Not present

Figure 3 Response entries

PS editor note: Security methods may impact which devices are permitted to use this command. TBD

Ed. action: new commands are listed below:

7.5.5.1 EPS action request command

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The EPS action request command shall be formatted as illustrated in Figure 1. This command is used to create and maintain EPS sets as well as EPSSet membership. When an EPS set is confirmed as created, the PNC shall begin keeping the time base specified for that EPS set.

octets: 2	2	1	1	2	4
Command type	Length (=2 to 8)	Action type	EPSSet value	EPSTime	EPSNext

Figure 1—EPS action request/response command format

The value of the action type determines the length of the command since the EPSTime and EPSNext fields may be left out for certain action types. The valid request types and the corresponding values for EPS set, EPSTime and EPSNext are given in Table 1.

Table 1—EPS action request command entries

Action type	Action type value	EPSSet value	EPSTime and EPSNext
Release request	0	Value required	Not present
New request	1	Set to 0	Required
Place in set	2	Value required	Not present
Information request	3	Value required	Not present
Reserved	4-255		

The EPS set value is a octet that that is assigned by the PNC to a group of DEVs that share the same EPSTime and EPSNext.

The EPSTime has a range of 0 to 65,535 ms. A value of zero indicates that the DEV is waking for each superframe. Depending on the value of superframe duration parameter, values of EPSTime that are less than the current value of superframe duration indicate that the DEV wakes for each superframe. Since the wake time is bounded by superframe beacon location, the beacon start point immediately preceding the completion of EPSTime shall be the wake point.

EPSNext is a beacon number as defined in piconet synchronization parameters element, 7.4.2. EPSNext informs the PNC or DEVs when the next EPSTime will occur. For this command, the value of EPSNext is taken from the EPSSync parameter in the MLME-POWERMGT.request primitive. The current beacon number when that primitive is received by the SME is used to calculate the beacon number for the next EPSTime event and inserts that beacon number as EPSNext when building the EPS configuration request command.

7.5.5.2 EPS action response command

The EPS action request command shall be formatted as illustrated in Figure 1. This command is used to create and maintain EPS Sets as well as EPS Set membership. When an EPSSet is confirmed as created, the PNC shall begin keeping the time base specified for that EPSSet.

The defintions of the EPSSet value, EPSTime and EPSNext fields in the command are the same as for the EPS action request, .

The value of the action type determines the length of the command since the EPSTime and EPSNext fields may be left out for certain action types. The valid action types for an EPS action response and the corresponding values for EPSSet, EPSTime and EPSNext are given in Table 2.

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Table 2—EPS action response command entries

Action type	Action type value	EPSSet value	EPSTime and EPSNext
Release confirm	0	Value released	Not present
New confirm	1	New value provided	Not present
Place in set confirm	2	Value of set place	Not present
Return information on the EPS set response	3	Value required	Part of reply
Incorrect command length	4	Set to 0	Not present
Already a member	5	Set to 0	Not present
EPS set does not exist	6	Set to 0	Not present
Cannot create new set	7	Set to 0	Not present
Illegal command	8	Set to 0	Not present
Reserved	9-255		

7.5.14 DEV to PNC PS information

MkS Editors Note: Keep this command in D07. It is needed to give the PNC information about PS capabilities to the PNC.

MkS Editors Note: D07, Table 63, printed page 80, line 18-19. Fix momentary command entry.

<u>Command type</u> Hex value	<u>Command name</u>
0x0002	Channel time request (<i>enhancement</i>)
0x0003	Channel time grant (<i>enhancement</i>)
0x0015	EPS action request
0x0016	EPS action response
0x0017	DEV to PNC PS information
0x0018	Switch to ACTIVE mode
0x0019	Switch to EPS mode
0x001a	Momentary EPS CTA slot

MkS Editors note: D08 The channel time request block with will have to be modified to add a 1 octet field for "EPS Set". This modification will not be shown in this document.

Ed. action: The command DEV to PNC PS information is retained. The command summary table has been updated and is now cross-linked to the section headings so the words and locations are always current. The CTRB does not yet have the EPS set element since we need a definition for it.

7.5.21.1 Channel time request

MkS Editors note: D08 printed page 101, line 45-48.

Replace paragraph with text below.

EPS status indicates whether the CTA requested is for ACTIVE mode channel time or EPS mode channel time. The PNC shall maintain separate ACTIVE mode type CTAs and EPS mode type CTAs. Values of 0, or 1 are used for making ACTIVE mode channel time requests, and the value of 2 is used for making EPS mode channel time requests.

For a device without EPS capability: A value of 0 shall be used for an ACTIVE mode channel time request. For an EPS capable device, a value of 0 or 1, shall be used for an ACTIVE mode channel time request and a value of 2 shall be used for an EPS mode channel time request.

The difference between using a 0 and a 1 EPS status is the persistence of the CTR. The values 0 and 1 are used to tell the PNC whether it should delete this CTR when the "Switch to EPS mode" command is received by the PNC. A 0 indicates that the PNC shall delete this CTR and de-allocate the associated channel time, and a 1 indicates that the PNC shall retain the CTR, and if possible, return the channel time to the device when the PNC it the device returns to ACTIVE mode from EPS mode.

The EPS status value of 2 is used to create an EPS channel time request. The PNC shall create and retain this EPS CTR based on this request. If possible, the PNC shall provide the requested channel time when the PNC switches the device back to EPS mode from ACTIVE mode.

See section 8.c.m for details about CTA management.

All other values of EPS status are reserved.

MkS Editors note: I have deleted the use of the value 3 in the EPS status field (broadcast/multicast) until a specific reason for this feature is indicated to the MAC group. No one seems to know whyit was put in.

Ed. action: Small re-arrangement of the text, actual text follows:

EPS status indicates whether the CTA requested is for ACTIVE mode channel time or EPS mode channel time. The PNC shall maintain separate ACTIVE mode type CTAs and EPS mode type CTAs. Values of 0, or 1 are used for making ACTIVE mode channel time requests, and the value of 2 is used for making EPS mode channel time requests. All other values of EPS status are reserved. CTA management is discussed in 8.13.3.5.

For a device without EPS capability a value of 0 shall be used for an ACTIVE mode channel time request. For an EPS capable device, a value of 0 or 1, shall be used for an ACTIVE mode channel time request and a value of 2 shall be used for an EPS mode channel time request.

The difference between using a 0 and a 1 EPS status is the persistence of the CTR. The values 0 and 1 are used to tell the PNC whether it should delete this CTR when the "Switch to EPS mode" command is received by the PNC. A 0 indicates that the PNC shall delete this CTR and de-allocate the associated channel time, and a 1 indicates that the PNC shall retain the CTR, and if possible, return the channel time to the DEV when the PNC it the device returns to ACTIVE mode from EPS mode.

The EPS status value of 2 is used to create an EPS channel time request. The PNC shall create and retain this EPS CTR based on this request. If possible, the PNC shall provide the requested channel time when the PNC switches the device back to EPS mode from ACTIVE mode.

7.5.17 Momentary EPS CTA slot command.

MkS Editor's Note: D08 Page 96, line 42-53. Replace txt with the following.

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The structure of the command is indicated in Figure 45 This command instructs the PNC to use the EPS CTR slot size in the EPS CTA of the next WAKE beacon. This substitution is only in effect for one EPS superframe. If the WAKE beacon already has an EPS slot, there is no change to the CTA, and if the EPS CTA scheduled was a null CTA, then the null CTA shall be replaced with a non-zero CTA, the length specified by the EPS CTR for that DEV.

Ed. action: text added as indicated.

7.4.10 Channel time allocation (CTA) element

MkS Editors note: The text does not change until D08 printed page 84, line 31.

Figure 26 shows the structure of the CTA element. This shall be used by the PNC to describe the location of a dynamic or pseudo static time slot for the specified Source AD-AD, Destination AD-AD, and Stream Index field values. The use of the next field, Slot Location, is summarized in Table xxcc. Slot Location is slot start time if there is a time slot in the corresponding superframe, and as the next slot's beacon number (SFN-ext) if the next time slot is in a future superframe. The Beacon-Time bit of the CTA Control field shall be set by the PNC to indicate how the two bytes of the Slot Location field are interpreted. A Beacon-Time of 0 shall cause the Slot Location field to be interpreted as the Slot Start Time.

The slot stop time is Slot Start time of the next GTS slot minus the aSlotGuardTime. The slot stop time is also measured relative to the start of the beacon frame and in the same units. In EPS mode only, the values of Slot Start time and slot stop time may both be identical to indicate a zero length time slot.

A value of 1 shall cause Slot Location to be interpreted as the least significant two bytes of a beacon count corresponding to the superframe in which the next slot will be allocated. Figure 26 shows this Slot Location field as SFN_{ext} in Figure 26. The interpretation of the Slot Location field is the same for devices in ACTIVE mode as it is for devices in EPS mode. For a device is in EPS mode, the SFN_{ext} contains the two least significant bytes of EPSNext.

Figure 26 also shows the CTA Type bit contained in the CTA control field. This bit specifies whether the Source DEV and Destination DEV are in ACTIVE mode, 0, or EPS mode, 1.

The Slot Start time field indicates the start time or end time of the time slot. The value of this field is always measured relative to the start of transmission of the beacon frame sent by the PNC. The resolution of this field is 8 μ s and so the range is [0-524280] μ s.

The third bit in the CTA Control block is Key Change. If this bit is set to 1, this flag indicates that the DEV must update its symmetric keys before continuing peer to peer communication. The security section (x.???) explains this process in detail.

The remaining 5 bits in the CTA block are reserved.

Figure 25-Channel time allocation element

MkS Editors Note: no change to figure 25 and to the associated text.

Ed. action: Lots of changes to format this like the rest of the Frame Formats clause. Actual text for the CTRB is below:

Each CTA element consists of multiple, 6-octet wide CTA blocks, which shall be formatted as illustrated in Figure 2.

octets: 1	1	1	1	2
Source DEV address	Destination DEV address	Stream index	CTA control	Slot Start time or SFNext

Figure 2—Channel time allocation block

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

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

For a child PNC, the source DEV and destination DEV addresses shall both be the AD-AD of the DEV that is the child piconet's PNC.

For a neighbor piconet, the source and destination addresses shall both be the AD-AD assigned by the parent PNC for the neighbor piconet and shall be one of the reserved neighbor piconet addresses, 7.2.3.

The stream index is the number assigned by the PNC that indicates the stream associated with the channel time.

The CTA control field shall be formatted as illustrated in Figure 3..

bits: b0	b1	b2	b3-b7
Time-beacon	CTA type	Key change	Reserved

Figure 3—CTA control block

The time-beacon bit of the CTA Control field shall be set by the PNC to indicate how the two bytes of the slot location field are interpreted. The bit shall be set to 0 if the slot location field to be interpreted as the slot start time. It shall be set to 1 if the slot location field is to be interpreted as the SFNext.

The CTA type specifies whether the source DEV and destination DEV are in ACTIVE mode or EPS mode. The bit shall be set to 0 if they are in ACTIVE mode and shall be set to 1 if they are in EPS mode.

The key change bit is reserved for possible security implementation with TBD meaning.

The slot location field is interpreted as either the slot start time field or the SFNext field, depending on the value of the time-beacon bit. The use of this field is summarized in Table 3.

If the slot location field is to be interpreted as the slot start time, then the field contains the start time of the allocated 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 μ s and so the range is [0-524280] μ s.

The end of each GTS slot is the start time of the next GTS slot minus the guard time indicated in the beacon.

If the slot location field is to be interpreted as the SFNext field, then the field contains the least significant two bytes of a beacon count corresponding to the superframe in which the next AWAKE slot will be allocated.

Clause 8 additions ...

Ed action: Text added by Jay Bain. JPKG moved the definitions to the Definitions clause. New definitions are below:

Table 3—Summary of slot location field usage

Type of activity for destination DEV	Slot location octets	Time-beacon bit value	CTA type bit value
ACTIVE CTA, GTS present in this superframe	Slot start time	0	0
ACTIVE CTA, no GTS in this superframe	Next GTS slot start time	1	0
EPS CTA, AWAKE superframe	Slot start time	0	1
EPS CTA, no GTS, just WAKE	Slot start time = 0	0	1
EPS CTA, Momentary EPS CTA GTS	Slot start time	0	1
EPS CTA, not a WAKE superframe	SFNnext	1	1

1.2 active mode: This mode is the default mode after a device joins the piconet. A device in active mode listens to every beacon.

1.3 active channel time allocation: A type of channel time allocation where the device will be using the allocated time slot in the current superframe.

1.4 awake mode: In this mode, a device that is using enhanced power save mode begins using the previously allocated time slots while still maintaining its enhanced power save mode status.

1.5 enhanced power save: A the power management technique used to reduce the amount of power used by devices in the piconet.

1.6 enhanced power save time: The fundamental operating parameter for enhanced power save mode. It is the nominal time value for the inter-wake periods for enhanced power save devices. The actual wake beacon is the beacon for the superframe when the nominal time is reached.

1.7 enhanced power save next: The beacon number value for the very next wake beacon for an enhanced power save set.

1.8 enhanced power save set: A grouping of devices where at least one member of the group will use enhanced power save mode. A single enhanced power save mode set shares a common timing information with regards to the enhanced power save time and enhanced power save next.

1.9 enhanced power save channel time allocation: A type of channel time allocation element generated to enable a power saving mode by the device.

1.10 reduced power save: The mode of a device that reduces its power level for part and only part of a superframe, excluding the beacon.

1.11 wake beacon: The beacon to which the enhanced power save device will listen. For other beacons, the enhanced power save mode device can be presumed to be unavailable for communications.

1.12 wake superframe: A superframe when the enhanced power save device will listen to the beacon and also be available for sending or receiving operations.

Ed. action: New acronyms were added as well, as shown below:

ACTIVE active mode

ACTIVE CTA		1
	active mode channel time allocation	2
AWAKE	awake mode	3
EPSTime	enhanced power save time	4
EPSNext	enhanced power save next	5
EPS set	enhanced power save set	6
EPS CTA	enhanced power save channel time allocation	7
WAKE	wake mode	8

Ed. action: Some changes to "Overview of CTA management"

8.13.3.5 Overview of CTA Management

The PNC shall create CTA elements in every beacon, after the PNC has allocated their slot time. An EPS CTA is the CTA of a DEV in EPS mode. An ACTIVE CTA is the CTA of a DEV in ACTIVE mode. If a DEV does not have an ACTIVE or EPS slot in a particular superframe, the PNC shall include a CTA with the beacon number of the next ACTIVE or EPS time slot according to the CTA block definitions of 7.4.11.

The constant presence of CTA element allows any member of the network that has missed hearing some number of beacons, to re-synchronize with other members of the piconet after hearing just one beacon. Any DEV may read the CTA mode of a device as well as its slot start time or beacon number value.

In order for a device to determine the duration of the time slot identified in a particular CTA, that same device shall use the Slot Location field of the next contiguous CTA whose Time-Beacon bit is set to 0. This slot location field shall be interpreted as "slot stop time + aSlotGuardTime". The device shall ignore all intermediate CTA blocks that have time-beacon bit set to 1.

When a DEV is in EPS mode the EPS set and the EPS channel time request are used together by the PNC to create the EPS CTAs, and time slots with the correct characteristics and at the correct times.

Figure 84 describes the three sequences of switching CTAs for an EPS DEV that is depicted as DEV B. DEV A may be operating as EPS or ACTIVE for this description. Without loss of generality, the direction of information flow is shown here from DEV A to DEV B.

The first sequence describes the transition of DEV B from ACTIVE mode to EPS mode and the operation of the DEV when it is in EPS mode. DEV A first sends a switch to EPS CTA mode command, 7.5.5.5, to the PNC either in the CAP or an MTS. The PNC then switches both the mode of DEV B and the specification it uses to create CTAs. The CTA specification switches from the DEV B's ACTIVE CTRB to the combination of the DEV B's EPS CTRB and the EPS Set specified therein. The first sequence shows that DEV B previously specified the EPS CTRB using an allocation period field set to 2. The resulting CTAs have a time slot allocated in every other superframe, with a null CTA allocated in the superframes in-between.

The second sequence set describes the operation for the momentary EPS CTA, 7.5.5.6. This command forces an EPS CTA into the next WAKE beacon. It may be issued by a source DEV by sending it in superframe prior to the desired WAKE superframe. The PNC shall create an EPS CTA in the next WAKE superframe with a slot size specified by the original EPS CTR block. It is possible for an EPS DEV to specify that all WAKE times have null slots except when the momentary EPS CTA command is issued. Doing so gives simple direct control over the creation of EPS slots that are still synchronized to the EPS set time base.

The third sequence describes the transition of DEV B from EPS mode back to ACTIVE mode. The switch to ACTIVE mode command, 7.5.5.4, is send by DEV A in the CAP or MTS slot allocated in the superframe before the WAKE superframe. Since this command is sent prior to the WAKE superframe, the PNC is able to switch DEV B to ACTIVE mode and begin using the corresponding CTA elements starting with the next (WAKE) superframe. Since this is the normal WAKE superframe, all devices hearing the beacon will see from the mode bit of the CTA element for DEV B that it is now in ACTIVE mode. The transition is both synchronized and seamless.

1.13 Make changes identified in document 01/488r1

1.14 Make changes identified in document 01/476r3

Ed. note: Draft D08 contains 01/476r0. Text that is new from 01/476r0 is listed below:

New Clause 8.3.4 MTS slot Access

Management Time Slots (MTSs) are identical to GTSs except that the PNC address (zero) is the source or the destination address in the CTA. A PNC can choose to use MTSs instead of the CAP for command frames. When MTSs are used, the PNC shall ensure that sufficient MTSs are allocated to allow for transmission of commands to and from the PNC. There can be as little as a single MTS in a superframe whose ownership changes from superframe to superframe. At the other extreme, there can be one or more uplink and downlink MTS per associated DEV per superframe plus MTSs for association. It is up to the PNC to determine the appropriate number of MTS in a superframe the same way the PNC is responsible for choosing the CAP size if a CAP is used. The PNC determines which DEVs to allocate MTSs to and how often. The PNC determines which DEVs to allocate MTSs to and how often. The PNC shall allocate at least one association MTS every aMTSAssocPeriod.

Ed. Note: add aMTSAssocPeriod with a value of 0.6s.

An open MTS is an MTS where the source address in the CTA for the MTS is the broadcast address. Any DEV associated to the piconet can attempt to send a command frame to the PNC in an open MTS. An MTS with the association address as the SA in the CTA for the MTS is called an association MTS. Any station not currently associated to the piconet can attempt to send an association command to the PNC in an association MTS. Association commands are not permitted in open MTSs. Likewise, only association commands are allowed in association MTSs.

Open MTSs enable the PNC to service a large number of DEVs with low MTS requirements using a minimum number of MTSs. When there are few DEVs in a piconet it will be more efficient to use assigned an MTS to a DEV instead of using open MTS. It is the PNC's responsibility to determine how many and what type of MTSs to use.

The PNC shall assign an uplink MTS within aMTSAssocPeriods of a successful association command in order to support the 1 second connection target.

Ed. action: The above text was merged by Jay Bain with the existing text. The parameter aMTSAssocPeriod was added to the table at the end of clause 8 with a value of 0.6 s. JPKG performed minor changes to formalize the language, actual text is below:

8.4.3.4 Management Time Slots

Management Time Slots (MTSs) are identical to GTSs except that the PNC address is the source or the destination address in the CTA. A PNC may choose to use MTSs instead of the CAP for command frames. When MTSs are used, the PNC shall ensure that sufficient MTSs are allocated to allow for the transmission of commands to and from the PNC. There may be as few as a single MTS in a superframe where the ownership of the MTS changes from superframe to superframe. At the other extreme, there may be one or more uplink and downlink MTSs per associated DEV per superframe plus MTSs for association. The PNC is responsible for determining the appropriate number of MTSs in a superframe in the same way that the PNC is responsible for choosing the CAP size if a CAP is used. The PNC determines which DEVs will be allocated MTSs and how often. The PNC shall allocate at least one association MTS every aMTSAssocPeriod.

An open MTS is one where the source address in the CTA for the MTS is the broadcast address. Any DEV that is associated to the piconet may attempt to send a command frame to the PNC in an open MTS. An MTS with the association address as the SA in the CTA for the MTS is called an association MTS. Any station not currently associated to the piconet may attempt to send an association command to the PNC in an association MTS. Association commands shall not be

sent in open MTSs. Likewise, only association commands shall be sent in association MTSs. Open MTSs enable the PNC to service a large number of DEVs with low MTS requirements by using a minimum number of MTSs. When there are few DEVs in a piconet it would be more efficient to use MTSs assigned to a DEV instead of using an open MTS. It is the PNC's responsibility to determine how many and what type of MTSs to use for each superframe.

The PNC shall assign an uplink MTS within aMTSAssocPeriod of a successful association command in order to support a 1 second connection target.

Clause 8.12.3.5 Additional Traffic to EPS DEVs

Add the following paragraph:

If management time slots are used, the PNC shall assign management time slots for a device in EPS mode during the superframes when the EPS device is scheduled to be awake and the superframe before that.

Ed. action: Text added by Jay Bain, minor edits by JPKG, actual text is below:

If management time slots are used, the PNC shall only assign management time slots for a DEV in EPS mode during superframes when the EPS device is scheduled to be listening to the beacon. The preceding superframe shall have an MTS allocated with the EPS DEV as the source to allow for a Switch to AWAKE CTA mode command, 7.5.5.5, or a Momentary EPS CTA command, 7.5.5.7, to be sent to the PNC.

Clause 7.5.21 Figure 49

Change Reason code to 4 bits. Use 1 bits for GTS type. 3 bits reserved.

Note: Modified stream management command appears below.

Ed. action: JPKG changed as indicated.

Clause 8.3.3.1

Add the following sentence:

There are two types of GTS: dynamic GTS, and pseudo-static GTS. The type of GTS slots are indicated in the stream management command as specified in 7.5.21.

New Clause 8.3.3.1.1 Dynamic Guaranteed Time Slots

The PNC is free to move dynamic GTSS within the superframe on a superframe by superframe basis. This allows the PNC the flexibility to rearrange GTS assignments to optimize the utilization of the slot assignments. The PNC can move a dynamic GTS by simply changing the CTA parameters in the Beacon.

New Clause 8.3.3.1.2 Pseudo-Static Guaranteed Time Slots

Pseudo static GTSS require a stream connection - non-stream GTSS cannot be pseudo-static. Pseudo static GTSS can be moved within the CFP by the PNC, but the PNC shall notify the affected DEVs by sending them acknowledged Channel Time Grant frames with the new CTA. As with dynamic GTSS, the PNC can rearrange pseudo static GTSS so that the GTS assignments can be optimized, but it must use the Channel Time Grant and coordinate the channel time grants with the CTAs in the beacon.

Before a pseudo static GTS is moved, the PNC shall ensure that the new position is unoccupied by another GTS. Then, the PNC sends a directed channel time grant to the receiving DEV so that the receiving DEV is listening to both the old GTS position and the new position. This channel time grant contains both the old and the new CTA. If the old and the new position overlap, the CTA can be one larger CTA.

Next the PNC sends a channel time grant to the transmitting DEV that contains only the new CTA. By moving the receiver first, the PNC ensures that no frames are lost if Channel time requests are corrupted.

Lastly, the PNC sends a channel time grant to the receiving DEV which only contains the new CTA.

Ed. action: Most of the text was already in D08, small changes to D09 made by Jay Bain and corrections to the language by JPKG (an evil "must" was purged).

Modified Clause 8.3.3.2 paragraph 1

(Ed. note: the changes are in the following sentences)

The slot assignments for dynamic GTS may change from superframe to superframe as required by the PNC. Slot assignments for pseudo-static GTS slots require directed channel time grant commands.

Ed. action: Changes made by Jay Bain, small change to the wording by JPKG, actual text below:

The slot assignments for dynamic GTSs may change from superframe to superframe as required by the PNC. Changing the slot assignments for pseudo-static GTSs requires directed channel time grant commands, as described in 8.4.3.1.

Modified Clause 8.3.3.2 paragraph 4

In any superframe there may be one or more DEVs in the piconet that receives the Beacon in error. This may not happen to the same DEV all the time but may happen to different DEVs at different times depending upon their location and type of interference they are subjected to. If a DEV did not receive the ~~CTA information beacon~~ correctly, it shall not access the ~~channel-dynamic GTS~~ during CFP. Stations with pseudo-static GTS(s) are allowed to transmit during these GTS(s) as long as the number of consecutive lost beacons is less than or equal to MaxLostBeacons. A DEV shall stop transmitting in its pseudo-static GTS when the number of consecutive lost beacons exceeds MaxLostBeacons.

Ed. action: Corrections made by Jay Bain, editorial changes by JPKG, actual text is below:

If a DEV did not receive the beacon, it shall not access any dynamic GTSs during the CFP. Stations with pseudo-static GTSs are allowed to transmit during these GTSs as long as the number of consecutive lost beacons is less than or equal to aMaxLostBeacons. A DEV shall stop transmitting in its pseudo-static GTS when the number of consecutive lost beacons exceeds aMaxLostBeacons.

New Clause 3.3.3.3 Private GTS

A private GTS is a GTS where the same DEV is the source and destination. A private GTS is not used for communication in the piconet. Rather, it is used to reserve channel time for some other use. The other use may be for another 802.15.3 piconet, or a different type of network sharing the same channel.

Private GTS slots will usually be pseudo-static GTS slots, so that the slot is periodic for the other use. A DEV requests a private GTS slot by inserting it's own AD-AD in the source and destination address for the stream and channel time request.

Ed. action: Corrections made by Jay Bain, editorial changes by JPKG, actual text is below:

A private GTS is a GTS where the same DEV is both the source and the destination. A private GTS is not used for communication in the piconet. Instead, it is used to reserve channel time for some other use. The other use may be for another 802.15.3 piconet, or a different type of network sharing the same channel.

Private GTSs will usually be pseudo-static GTSs, so that the slot is periodic for the other use. A DEV requests a private GTS by using it's own AD-AD as the originator and target address for the stream management command, 7.5.8.3, or channel time request command, 7.5.8.1.

4) Modified Stream Management Command

Reserved Byte for max Delayed ACK frames in stream Mgt Command (Issue 310) and source/target address field in stream management command (Issue 400). Modified Action Type and Reason Code address Issues

Figure 49 Modified Stream Management Command

Octets: 2	2	2	1	1	1	1	1	1	20
Command type	Length (=30)	Stream request identifier	Originator AD-AD	Target AD-AD	DSAA	Max Frames (delayed ACK)	Reason code/GTS type	reserved	Stream QoS parameters

Note: Reserved field will not be needed if the stream QoS parameters become odd after pending changes.

New Figure Reason code / GTS Type field (after figure 50)

4 bits	1 bits	3 bits
Reason Code	GTS Type	reserved

Replace line 50 and 51 of page 95 with the following:

The Originator AD-AD is the 8 bit address of the originator of the stream management command. The Target AD-AD is the 8 bit address of the target of the stream management command.

Add the following text after line 29, page 96:

Max Frames specifies the maximum number of frames that can be outstanding when the ACK policy for the stream is Delayed ACK.

Ed action: Changed command illustration, new figures and text shown below:

octets: 2	2	1	1	1	1	2	20
Command type	Length (=26)	Stream request identifier	Originator AD-AD	Target AD-AD	Max frames (Del-ACK)	Control Information	Stream QoS parameters

Figure 4—Stream management command format

The originator AD-AD is the allocated address of the DEV that is the originator of the stream management command.

The target AD-AD is the allocated address of the DEV that is the target of the stream management command.

The max frames field specifies the maximum number of frames that can be outstanding when the ACK policy for the stream is Del-ACK.

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The control information field is illustrated in Figure 5.

bits b0:b1	b2:b3	b4:b6	b7	b8:b11	b12	b13-b15
Action Type	ACK Policy	Security	Direction	Reason code	GTS type	Reserved

Figure 5—Control information field in the stream management command

Modify the Action Type description as follows:

- Value of '0' means that this is a request for stream connection. This request is sent from the DEV that originates the stream management request to the PNC.
- Value of '1' means that this is the indication forwarded request frame sent from the PNC to the target of the stream management frame. This command contains the QoS-parameters, except the retransmission window, set by the PNC.
- Value of '2' means that this is a response to the stream connection sent from the target DEV to the PNC. The target DEV can lower the QoS-parameters in the response.
- Value of '3' means that this is a Stream Management confirm forwarded response command for the stream connection. This request is sent by the PNC to the originator DEV to complete the stream connection. It is also sent from the PNC to the originator and target DEV to reject or disconnect a stream.
- Value of "4" means that the frame is sent by one of the DEVs to the PNC to reject or disconnect the stream
- Value of "5" means that the frame is sent by the PNC to one of the DEVs to reject or disconnect the stream

Ed. action: Text updated with editorial changes (JPKG), actual text follows:

- A value of '0' indicates that this is a request for stream connection. This request is sent from the DEV that originates the stream management request to the PNC.
- A value of '1' indicates that this is a forwarded request frame sent from the PNC to the target of the stream. This command contains the QoS-parameters set by the PNC, except for the retransmission window.
- A value of '2' indicates that this is a response to the stream connection. This is sent from the target DEV to the PNC. The target DEV can modify the QoS-parameters to smaller values in the response.
- A value of '3' indicates that this is a confirmation of the acceptance of the stream connection. This request is sent by the PNC to the originator DEV to complete the stream connection.
- A value of "4" indicates that the frame is sent by one of the DEVs to the PNC to reject or disconnect the stream
- A value of "5" indicates that the frame is sent by the PNC to one of the DEVs to reject or disconnect the stream

Modify the reason code as follows:

The reason code is a 4 bit field that is valid in the Stream Management Confirm when a stream connection is being completed, rejected or disconnected. It is also valid in the Stream Management response from the target to the PNC. Otherwise this field is ignored. Valid reason codes are:

- 0 ->Success
- 1 ->invalid stream parameters
- 2 -> non-negotiable stream parameters
- 3 -> system resources unavailable

- 4 -> bandwidth allocation failure
- 5 -> currently disassociating from the piconet
- 6 -> too many streams
- 7 -> lack of required security
- 8 -> unauthorized stream
- 9-> Stream rejected or disconnected by other DEV
- 10-16-> reserved

Add the following text:

GTS type zero signifies that the stream shall use dynamic GTS. GTS type one indicates that the stream shall use pseudo-static GTS.

Ed action: Reason codes and GTS type modified, actual text is below:

The reason code is a 4 bit field that is valid when a stream connection is being completed, rejected or disconnected. It is also valid in the response from the target to the PNC. Otherwise this field shall be ignored. Valid reason codes are:

- 0 -> success
- 1 -> invalid stream parameters
- 2 -> non-negotiable stream parameters
- 3 -> system resources unavailable
- 4 -> insufficient channel time available
- 5 -> currently disassociating from the piconet
- 6 -> too many streams
- 7 -> lack of required security
- 8 -> unauthorized stream
- 9-> Stream rejected or disconnected by other DEV
- 10 -> target unreachable
- 11-16-> reserved

The GTS type bit is set by the requesting DEV and shall be set to 0 for dynamic GTSs and shall be set to 1 for pseudo-static GTSs.

5) DEV GTS Status Information Element

Add new element GTS status information element to the beacon frame with type in every frame.

New Clause 7.4.x DEV GTS Status Information Element

This element is a 256 bit bitmap where each bit corresponds to an AD-AD. The PNC sends the DEV GTS Status element in the Beacon. The purpose of this element is to enable a DEV to know if any GTSs where it is a SA or DA have change since the last Beacon. If any of the GTSs for a given DEV has changed since the last Beacon, the bit corresponding to the AD-AD for that DEV shall be set to a one. If none of the GTSs for that DEV have changed since the last beacon, the bit corresponding to the AD-AD for that DEV shall be set to zero. If a broadcast GTS has changed since the last beacon, the broadcast GTS bit will be set, and not all bits in the bitmap.

Octets:1	1	8	
ElementID	Length=8	lsb	DEV GTS Status bitmap msb

Figure 2 DEV GTS Status Information Element

If a DEV correctly received beacon n, it does not need to process the CTAs in beacon n+1 if its DEV GTS Status bit and the broadcast GTS status bit in beacon n+1 is set to zero. If its DEV GTS Status bit is set to one or the broadcast GTS status bit, the DEV shall process the CTAs in that beacon.

Ed. action, add element and update information element table. New section for the information element is below:

7.4.13 DEV GTS status

The DEV GTS status element, illustrated in Figure 29, is a 256 bit bitmap where each bit corresponds to an AD-AD. The DEV GTS status element may only be sent by the PNC in the beacon. The purpose of this information element is to enable a DEV to know if any GTSs where it is either the SA or DA have changed since the last beacon. If any of the GTSs for a given DEV has changed since the last beacon, the bit corresponding to the AD-AD for that DEV shall be set to a one. If none of the GTSs for that DEV have changed since the last beacon, the bit corresponding to the AD-AD for that DEV shall be set to zero. If a broadcast GTS has changed since the last beacon, only the broadcast GTS bit shall be set, and not all bits in the bitmap

octets: 1	1	8
Element ID	Reserved	(lsb) DEV GTS status bitmap (msb)

Figure 6—DEV GTS status information element

If a DEV correctly received beacon n, it does not need to process the CTAs in beacon n+1 if it's DEV GTS status bit and the broadcast GTS status bit in beacon n+1 are set to zero. If either it's DEV GTS status bit or the broadcast GTS status bit is set to one, then the DEV needs to process the CTAs in that beacon.

1.15 Make changes identified in document 01/503r0

1.16 Make changes identified in document 01/328r4 with caveat to add CTRB parameter of desired maximum GTS.

Definitions;

- f_D = bits per second of delivered data.
- N_B = bits of source buffer available to store the data to be communicated.
- N_{MPDU} = bits of the data portion of one packet of data.
- N_{OH} = Equivalent bits of overhead of one packet of data including: actual MAC header bits, slot guard times, PHY or PLCP overhead, etc., everything-but-data, etc. It simplifies the explanation to express this as an equivalent number of bits.

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- N_E = Channel (PHY) encoding, bits per symbol
- f_S = Channel symbol rate, symbols per second.
- T_{BCN} = Beacon Period

Octets: 1	1	1	1	2	2	2	2
Target Address	EPS status	EPS Set	Stream index	Allocation Period	Minimum GTS Time	Desired GTS Time	Maximum Allocation Delay

- CTRB field that exists in draft D0.8
- CTRB field proposed in this proposal
- CTRB field proposed in document 01/485

Allocation period

- a) $T_{AP} = N_B / f_D$
- b) This is how often the N_B buffer must be sent to get the desired delivered data rate f_D .
- c) This is the size of the source buffer divided by the desired data rate.
- d) We need to send N_P packets over the network in order to transmit one buffer:
- e) $N_P = N_B / N_{MPDU}$ Assume an integer for simplicity.
- f) $N_T = N_{MPDU} + N_{OH}$, the total number of bits that would have to be sent over the network to cover both the data and the overhead.

Minimum GTS time

- a) T_{GTS} is the total time requested for GTS allocated in order to send one buffer of data.
- b) $T_{GTS} = (N_P N_T / N_E f_S)$.
- c) For the sending N_P packets of equivalent size, $N_T = (N_{MPDU} + N_{OH})$ with a PHY encoding of N_E bits per symbol and a PHY symbol rate of f_S .
- d) $1/(N_E f_S)$ is a constant as long as the symbol rate and encoding method is unchanged.
- e) From before: $N_P = N_B / N_{MPDU}$
- f) Stating the obvious: N_T and N_P will also be constants if the transmit packet size and the transmit buffer size both remain constant.

Desired GTS time, i.e. GTS time per allocation period

- a) T_{DMG} defines the maximum amount of GTS time per allocation period that a DEV is capable of using. $T_{DMG} > T_{GTS}$
- b) If there is unused bandwidth, the extra channel bandwidth can be divided up among DEVs based on what they can actually use.
- c) Allows channel utilization to be maximized.

Maximum allocation delay

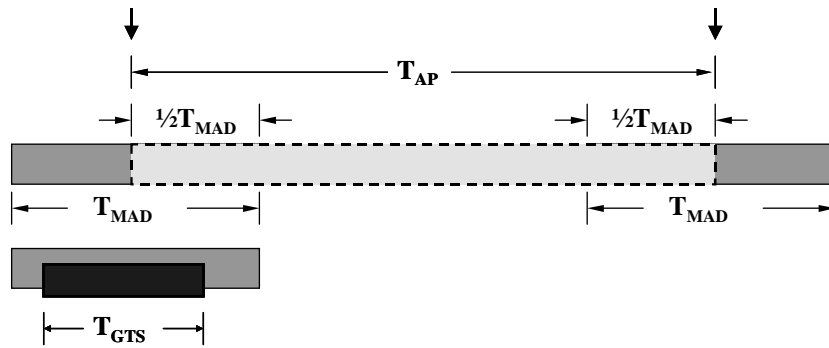
- a) T_{MAD} defines an allowable time jitter to the allocation of time slots by the piconet coordinator, PNC.
- b) The maximum allocation delay starts before the end of the allocation period, but does not affect the PNC's reference timing of the T_{AP} period. It allows some variability in position of the GTS slot(s).

Requirements for Data Rate Only QoS

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- a) The transmit buffer is large enough to accept GTS slots anywhere in the superframe. 1
- b) The amount of bandwidth only depends on the data rate required f_D , the data rate available, and the amount of overhead. 2
- c) $T_{AP} / T_{GTS} = (f_D / f_S) / (N_T / N_E N_{MPDU})$ 3
- d) Define $T_{MAD} = 0xFFFF$, which will be a special value indicating “anywhere in CFP”. 4

The T_{GTS} (blue) time is the total amount of slot time that must be allocated by the PNC within the T_{MAD} (green) time centered around the start of the T_{AP} interval (vertical arrows).



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Ed. action: Change the CTRB to match the figure. The new figure and new text are below:

octets: 1	1	1	2	2	2	2
Target AD-AD	EPS status	Stream index	Allocation period	Minimum GTS time	Desired GTS time	Maximum allocation delay

Figure 7—Channel time request block for a particular stream

The allocation period is the block of time that the DEV is using to calculate the other parameters in this block. The resolution of this field is 1 ms and so the range of this field is [0-65535] ms.

The minimum GTS time is the minimum duration of the time that is acceptable at the requesting DEV in any time slot. The resolution of this field is 8 ms and so the range of this field is [0-524280] μ s.

The desired GTS time is the amount of time that the DEV would prefer to have allocated. The resolution of this field is 8 ms and so the range of this field is [0-524280] μ s.

The maximum allocation delay defines the allowable time jitter in the allocation of the GTSs with respect to the allocation period. The value 0xFFFF indicates that the DEV has no jitter requirements for the GTS. The resolution of the channel time field is 8 ms and so the range of requested time is [0-524272] μ s.

The relationship of the allocation period, minimum GTS time, desired GTS time and maximum allocation delay is discussed in 8.4.3.3.

New section added to clause 8, is 8.4.3.3, text follows;

8.4.3.3 QoS considerations for channel time allocation

The DEV needs to map its QoS requirements into the parameters of the channel time request block, Figure 57. This sub-clause describes one way to map the DEVs requirements into the CTRB parameters. A compliant DEV may use another method to determine what values of the CTRB are required to fulfill its throughput and QoS requirements. In this sub-clause, the following terms are used:

- f_D = Bits/s of delivered data.
- N_B = Number of bits of source buffer available to store the data to be communicated.
- N_{MPDU} = Number of bits in the data portion of one packet of data.
- N_{OH} = Equivalent bits of overhead of one packet of data including: actual MAC header bits, slot guard times, PHY overhead, etc. (i.e. everything but the data). It simplifies the explanation to express this as an equivalent number of bits.
- N_E = Channel (PHY) encoding in bits/symbol
- f_S = Channel symbol rate in symbols/s.
- T_{BCN} = Beacon period in seconds.
- T_{AP} = The allocation period, in seconds.
- T_{GTS} is the total time, in seconds, requested for GTS allocated in order to send one buffer of data.
- T_{MAD} , defines an allowable time jitter to the allocation of time slots by the piconet coordinator, PNC.

The allocation period, is a time reference that the DEV uses in calculating the other parameters. In general, the allocation period is how often the N_B buffer must be sent to get the desired delivered data rate f_D , i.e. $T_{AP} = N_B/f_D$. In order to transmit the buffer, the DEV needs to send N_P packets over the network, where each packet is $N_T = N_{MPDU} + N_{OH}$ bits in length.

The minimum GTS time is then be calculated using $T_{GTS} = (N_P N_T / N_E f_S)$. The desired GTS time should not be more than the maximum amount of GTS time per allocation period that a DEV is capable of using. If there is unused band-

width in the piconet, the PNC could choose to allocate the extra channel bandwidth among the DEVs based on what they can actually use. This allows channel utilization to be maximized.

The maximum allocation delay starts before the end of the allocation period, but does not affect the PNC's reference timing of the T_{AP} period. This allows some variability in position of the GTS(s). The DEV determines this time based on the jitter requirements of the data stream that it needs to send. Figure ?? illustrates the position of T_{MAD} within T_{AP} . The T_{GTS} time is the total amount of slot time that needs to be allocated within the T_{MAD} time centered around the start of the T_{AP} interval.

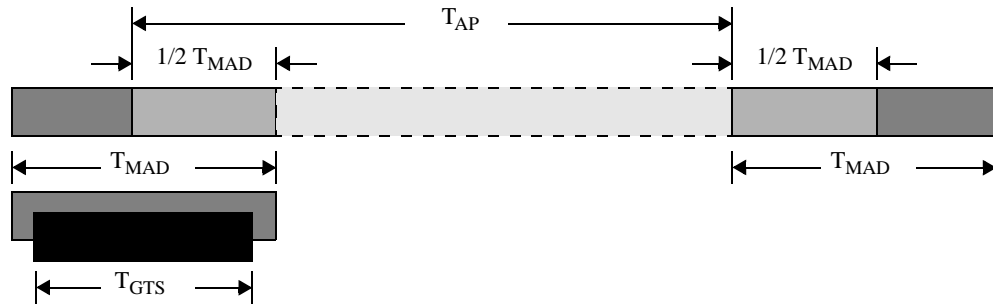


Figure 8—Illustration of the position of T_{MAD} within T_{AP}

Based on the requirements for T_{MAD} within T_{AP} , the PNC has many possible ways to allocate the GTSs required by the DEV, as illustrated in .

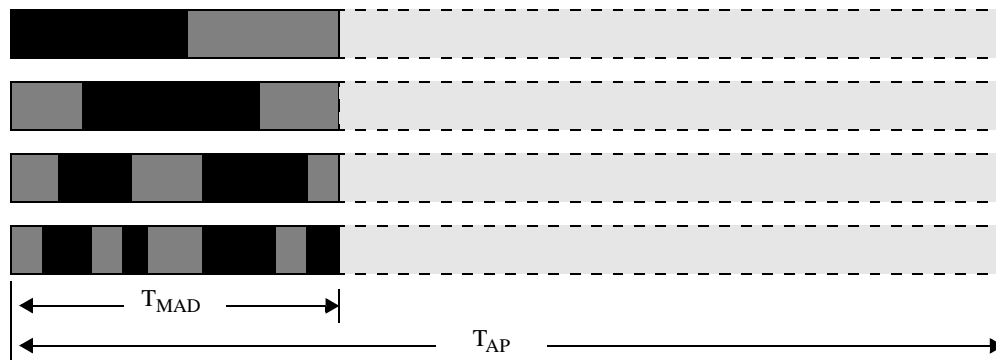


Figure 9—Possible GTS allocations that meet T_{MAD} requirements

For streams with only data rate requirements for QoS, the transmit buffer needs to be large enough to accept GTS slots anywhere in the superframe. The amount of bandwidth only depends on the data rate required, f_D , the data rate available, and the amount of overhead. In this case, $T_{AP} / T_{GTS} = (f_D / f_S) / (N_T / N_E N_{MPDU})$ and the value of T_{MAD} is set to 0xFFFF, which is the special value indicating "anywhere in CFP", 7.5.8.1.

1.17 Make changes identified in document 01/517r2

1.18 Make changes identified in document 01/502r1

1.19 Make changes identified in document 01/410r0

Ed. action: Changes made by Allen Heberling, in D09. New MLMEs include: MLME-CHANNEL-STATUS, MLME-CHANGE-CHANNEL, MLME-PROBE-PNC, MLME-DEV-INFO and MLME-STREAM-CTA.

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1.20 Make changes identified in document 01/469r3

Ed. action: All changes from r2 are in D08, new information in r3 is editorial, i.e. it is in MLMEs and MSCs that reflect what is in the normative text but do not provide new technical information. All edits and updates performed by Allen Heberling.

1.21 Make changes identified in document 01/530r2

1.22 Items in 01/374r12, entered into D09 and noted in the minutes.

Ed. action: Changes already made at Austin meeting, notes on changes are included in 01/374r12.

1.23 Change the MLME commands to reflect the frame formats and information described in clause 7 and 8.

1.24 Change backoff algorithm to use PHY dependent parameters rather than numeric times. Use 802.11 as a model to write this.

1.25 Update neighbor piconet information to reflect changes in 01/481r4

Ed. note: 01/481r3 was included in D08. The changes from r3 to r4 of the document were:

Rev 40

- 1) Removed the neighbor association request command (see rev 1) and added text to the (normal association request format to accommodate the neighbor association.
- 2) Removed the neighbor channel time request from figure def.
- 3) Modified table 63 to remove the neighbor association request and the neighbor channel time request.

Ed. action: Removed the extra commands as noted with new text for the association request. Note that the text is changed based on item 16 below. Made changes to 8.2.6 in the first paragraph to reflect the new usage of the association request command. Actual text is below:

8.2.6 Neighbor piconet

If after following the scan procedure in 8.2.1, no channels are available, then a neighbor alternate coordinator (i.e. an AC from a different system), may attempt to start a neighbor piconet within an existing piconet. To start a neighbor piconet, the neighbor AC shall send an association request, defined in 7.5.2.1, using the association address, 7.2.3, as the source address of the frame. The neighbor PNC bit in the capability field shall be set as indicated in 7.4.3 when the association request command is sent.

1.26 Add mapping of supported data rates from 5 bits to 8 bits by adding 3 binary 0's as the MSB.

Ed. action: Added the following text to the PHY clause, last paragraph of the clause:

The encoding of the supported PHY data rates into an octet number is accomplished by adding bits b5-b7, all set to zero, to the encoding given in Table 102. Bit b0 is the lsb while bit 7 is the msb. Thus a DEV that supports 11, 22 and 33 Mb/s would have a capability information element 01000 (lsb to msb) and an octet encoding of 0x2.

1.27 Move supported data rates field in figure 19, 7.4.3, to be bits b0-b4. Add bit b10 to be neighbor piconet bit. Text for neighbor piconet bit is: "The neighbor piconet bit shall be set to 1 if the DEV is intending to be a neighbor PNC in the current piconet and shall be set to 0 otherwise." Change "is set to" to be "shall set to" in 7.4.3. Change 01/481r4 to use neighbor piconet bit instead of 0 capability field to identify and neighbor association request.

Ed. action: Changed as indicated, figure and text follows:

bits: b0-b5	b6-b9	b10	b11	b12	b13	b14	b15
Supported data rates	Reserved	Neighbor PNC	PSAVE	PSRC	SEC	PNC-Des-Mode	AC

Figure 10—Capability field format

The supported data rates element is a PHY dependent mapping of the optional data rates to a 5 bit field that indicates which of the optional data rates are supported by a DEV. For the 2.4 GHz PHY, this mapping is defined in Table 102.

The neighbor piconet bit shall be set to 1 if the DEV is intends to be a neighbor PNC, 8.2.6, in the current piconet and shall be set to 0 otherwise.

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

The PSRC field shall be set to 1 if the DEV is receiving power from the AC (alternating current) mains and shall be set to 0 otherwise.

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

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

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

1.28 Change "is shown in figure xx" to be "shall be formatted as illustrated in figure xx" for frame formats, information elements, command types and field format figures in clause 7.

Ed. action: Changed as indicated in clause 7 for all frame format figures.

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2. Editorial changes

- 7.4.12 MAX CTAs element, reformat to match the previous sub-clauses in 7.4 and move the functional description to clause 8.
- Check the PNC handover process to make sure that we state that the current PNC checks the DEV-info table to find the most qualified AC to become the new PNC.
- 7.3.1 Add xref to the channel change element and the CTA element in table 58 verify the use of the correct terminology. Also, change the Device ID entry to be device identifier element with description "IEEE 802 address of the PNC, xref 7.4.1" Change to piconet synchronization element and xref in notes.
- 7.3.1 Add text that says that the beacon elements can occur in any order and that DEVs shall ignore information elements other than the ones defined.
- 7.4.6 Add pad byte for word alignment and text for how to handle the pad byte.
- 7.4.3 Fix the TBD in the PHY table mapping by adding the appropriate section to the PHY and the xref to it in 7.4.3.
- 7.4.2 Fix length parameter for piconet sychronization parameter.
- 7.3.3 and 7.3.4, define the SA and DA for the command and data frames.
- 7.5.1, 7.5.2, 7.5.3, Make notes that the PNC selection commands, and the association commands are never sent with other commands. Or perhaps better is to say that a command can only be piggy-backed with commands that are sent with the same SA and DA pair.
- 7.2.1.9 Note that the beacon shall not have the SEC bit set (perhaps this is true of the command frames?).
- 7.5.2 ATP definitions disagrees with 8.2.5 definition of ATP. Did we fix this since Schaumburg.

Ed. action: ATP is now consistent in the document, changes were made in Austin and all issues related to this were closed.

- 7.5.17 (D06) add xref to stream identifier element to the appropriate information element (stream ID)
- Page 104, change aa to a

Ed. action: Fixed in D09

- 7.5.21 Fix QoS paramters length in table 49, fix table sizing for table 51
- 7.5.21 Need to get a good definition for Max Burst Size
- Figure 27, change length of the individual elements to be 7 instead of 6.
- 8.8 The acronyms TPC and DCS are mentioned, but are not defined. It should be DFS rather than DCS. Perhaps delete this sentence.

Ed. action: TPC was added to the acronym list in D08, DCS was added in D09 as "dynamic channel selection.

- Change format of annex A CS-SAP parameters to match the format in the layer management clause.
- MA-UNITDATA.request supports 3 types of ServiceClass:
 - for asynchronous: reorderable and strictly ordered
 - for stream based: only reorderable multicast.
 However, the MA-UNITDATA.indication indicates only two possible classes:
 - reorderable and strictly ordered.
 Shouldn't reorderable multicast be an option?
- What about adding "channel sucks right now" to the MA-UNITDATA-STATUS.indication as a potential error code? (Actually, we would add something like "undeliverable, possibly due to poor channel conditions")