**IEEE P802.15**

**Wireless Personal Area Networks**

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| Re: | TG8 draft text for Channel Scanning for 802.15.8 | |
| Abstract | This is the work in progress text of the MAC component for IEEE 802.15.8 group for PAC. | |
| Purpose | This document provides the details of draft text to IEEE 802.15.8 | |
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# [This is draft text for subclause of Channel Scanning for TG8]

# MAC Layer

## MPDU Format

## Channel Scanning

### General Description

All PDs shall be capable of performing passive scan, energy detection (ED) and active scans across a specified list of channels. The next higher layer should submit a scan request for a particular channel page containing a list of channels chosen only from the channels specified by *phyChannelsSupported* for that particular channel page.

A PD is instructed to begin a channel scan through the MLME-SCAN.request primitive, as described in P.x.y.1. Channels are scanned first starting from the name-TBD channel and then in order from the lowest channel number to the highest, if applicable. For the duration of the scan, the PD shall suspend transmissions, if applicable, and shall only accept frames received over the PHY data service that are relevant to the scan being performed. For UWB PHYs, each preamble code appropriate to the specified channel is scanned. Upon the conclusion of the scan, the PD may begin transmission if applicable. The results of the scan shall be returned via the MLME-SCAN.confirm primitive as described in P.x.y.2.

### ED Channel Scan

An ED scan allows a PD to obtain a measure of the peak energy in each requested channel. This could be used by a prospective PD to select a channel on which to operate prior to starting a new group. During an ED scan, the MAC sublayer shall discard all frames received over the PHY data service.

An ED scan over a specified set of channels is requested using the MLME-SCAN.request primitive with the

ScanType parameter set to indicate an ED scan. For each channel, the MLME shall first switch to the channel, by setting *phyCurrentChannel* and *phyCurrentPage* accordingly, and then repeatedly perform an ED measurement for [*aBaseSuperframeDuration* × (2*n* + 1)], where *n* is the value of the ScanDuration parameter in the MLME-SCAN.request primitive. The maximum ED measurement obtained during this period shall be noted before moving on to the next channel in the channel list. A PD shall be able to store at least one channel ED measurement.

The ED scan shall terminate when either the number of channel ED measurements stored equals the implementation-specified maximum or energy has been measured on each of the specified channels.

### Active and Passive Channel Scan

An active or passive channel scan allows a PD to locate any other PD within its radio communications range. A PD in an active scan transmits to extract any other intended PD. A PD in a passive scan detects the intended channels. A message sequence chart for active scan is illustrated in Figure xx1 and for passive scan in Figure xx2.



Fig. xx1 Active scan message sequence chart

During an active or a passive scan, the MAC sublayer shall discard all frames received over the PHY data service that are not related to scan. If a scan related frame is received that contains the address of the scanning PD in its list of pending addresses, the scanning PD shall not attempt to extract the pending data.



Fig. xx2 Passive scan message sequence chart

An active or a passive scan over a specified set of channels is requested using the MLME-SCAN.request primitive with the ScanType parameter set to indicate an active or a passive scan. For each channel, the PD shall first switch to the channel, by setting *phyCurrentChannel* and *phyCurrentPage* accordingly. For an active scan, the PD shall send a scan request command. For UWB PHYs, the scan process shall be repeated for each mandatory preamble code, setting the *phyCurrentCode* appropriately. Upon successful transmission of the scan request command for an active scan or after switching to the channel for a passive scan, the PD shall enable its receiver for at most [*aBaseSuperframeDuration* × (2*n* + 1)], where *n* is the value of the ScanDuration parameter. During this time, the PD shall reject all non-scan-related frames and record the information contained in the received scan frames in a group descriptor structure, as TBD, including the channel information and, if required, the preamble code.

If a scan frame is received when *macAutoRequest* is set to TRUE, the list of group descriptor structures shall be stored by the MAC sublayer until the scan is complete; at this time, the list shall be sent to the next higher layer in the GroupDescriptorList parameter of the MLME-SCAN.confirm primitive. A PD shall be able to store at least one group descriptor. A scan frame shall be assumed to be unique if it contains both a group ID and a source address that has not been seen before during the scan of the current channel.

If a scan frame is received when *macAutoRequest* is set to FALSE, each recorded group descriptor is sent to the next higher layer in a separate MLME-Group-NOTIFY. indication primitive as described in P.x.z.1. A received scan frame containing one or more octets of payload shall also cause the group descriptor to be sent to the next higher layer via the MLME-Group-NOTIFY. indication primitive. Once the scan with *macAutoRequest* set to FALSE is complete, the MLME-SCAN.confirm shall be issued to the next higher layer with a null GroupDescriptorList.

For UWB PHYs, the scan request is repeated for each preamble code.

If a protected scan frame is received, i.e., the Security Enabled field is set to one, the PD shall attempt to unsecure the scan frame using the unsecuring process described TBD.

The security-related elements of the group descriptor, as TBD, shall be set to the corresponding parameters returned by the unsecuring process. The SecurityStatus element of the group descriptor shall be set to SUCCESS if the status from the unsecuring process is SUCCESS and set to one of the other status codes indicating an error in the security processing otherwise.

The information from the unsecured frame shall be recorded in the group descriptor even if the status from the unsecuring process indicated an error.

If *macAutoRequest* is set to TRUE, the active scan on a particular channel shall terminate when the number of PDs found equals the implementation-specified limit or the channel has been scanned for the full time. If *macAutoRequest* is set to FALSE, the active scan on a particular channel shall terminate when the channel has been scanned for the full time. If a channel was not scanned for the full time, it shall be considered to be unscanned.

If *macAutoRequest* is set to TRUE, the entire scan procedure shall terminate when the number of group descriptors stored equals the implementation-specified maximum or every channel in the set of available channels has been scanned. If *macAutoRequest* is set to FALSE, the entire scan procedure shall only terminate when every channel in the set of available channels has been scanned.

## Synchronization Procedure

## Discovery

## Peering

## Communication Period

P.x.y.1 MLME-SCAN.request

The MLME-SCAN.request primitive is used to initiate a channel scan over a given list of channels.

The semantics of this primitive are:

MLME-SCAN.request (

ScanType,

ScanChannels,

ScanDuration,

ChannelPage,

)

The primitive parameters are defined in Table xy1.

Table xy1 **MLME-SCAN.request parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Descriptions** |
| ScanType | Enumeration | ED, ACTIVE, PASSIVE | Indicates the type of scan performed, as described in 5.2. |
| ScanChannels | List of integers | Any list of valid channel numbers | The channel numbers to be scanned. |
| ScanDuration | Integer | 0-14 | A value used to calculate the length of time to spend scanning each channel for ED, active, and passive scans.  The time spent scanning each channel is [*aBaseSuperframeDuration* × (2*n* +1)], where *n* is the value of the ScanDuration parameter. |
| ChannelPage | Integer | Any valid channel page | The channel page on which to perform the scan. |

When the MLME receives this primitive, it begins the appropriate scan procedure, as defined in 5.2.

P.x.y.2 MLME-SCAN.confim

The MLME-SCAN.confirm primitive reports the result of the channel scan request.

The semantics of this primitive are:

MLME-SCAN.confirm (

Status,

ScanType,

ChannelPage,

UnscannedChannels,

ResultListSize,

EnergyDetectList,

GroupDescriptorList,

DetectedCategory

UWBEnergyDetectList

)

The primitive parameters are defined in Table xy2.

If the requested scan was successful, the status parameter will be set to SUCCESS.

If the MLME receives the MLME-SCAN.request primitive while performing a previously initiated scan operation, the MLME will not perform the scan and the status parameter will be set to SCAN\_IN\_PROGRESS.

Table xy2 **MLME-SCAN.confirm parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Descriptions** |
| Status | Enumeration | SUCCESS, LIMIT\_REACHED,  SCAN\_IN\_PROGRESS,  COUNTER\_ERROR,  FRAME\_TOO\_LONG,  UNAVAILABLE\_KEY,  UNSUPPORTED\_SECURITY,  INVALID\_PARAMETER | The status of the scan request. |
| ScanType | Integer | 0x00–0x03 | Indicates the type of scan performed:  0x00 = ED scan.  0x01 = active scan.  0x02 = passive scan. |
| ChannelPage | Integer | Any valid channel page | The channel page on which the scan was performed. |
| UnscannedChannels | List of integers | Any list of valid channels | A list of the channels given in the request which were not scanned. This parameter is not valid for ED scans. |
| ResultListSize | Integer | Implementation specific | The number of elements returned in the appropriate result lists. |
| EnergyDetectList | List of integers | 0x00–0xff for each integer | The list of energy measurements, one for each channel searched during an ED scan. This parameter is null for active and passive scans. |
| GroupDescriptorList | Set of group descriptor values | TBD | The list of group descriptors, one for each scan found during an active or passive scan if *macAutoRequest* is set to TRUE. This parameter is null for ED scan or when *macAutoRequest*  is set to FALSE during an active or passive scan. |
| DetectedCategory | Integer | 0x00–0xff | Categorization of energy detected in channel with the following values:  0: Category detection is not supported  1: UWB PHY detected  2: Non-UWB PHY signal source detected  3–25: Reserved for future use |
| UWBEnergy DetectList | List of Integers | 0x00–0xff for each element of the list | For UWB PHYs, the list of energy measurements taken. The total number of measurements is indicated by ResultListSize. This parameter is null for active and passive scans. It is also null for non-UWB PHYs. |

If, during an active scan, the MLME is unable to transmit a scan request command on a channel specified by the ScanChannels parameter due to a channel access failure, the channel will appear in the list of unscanned channels returned by the MLME-SCAN.confirm primitive. If the MLME was able to send a scan request command on at least one of the channels but no scan frames or response frames were found, the MLME SCAN.confirm primitive will contain a null set of group descriptor values, regardless of the value of *macAutoRequest*.

If the MLME-SCAN.request primitive requested an active, or a passive scan, the EnergyDetectList and UWBEnergyDetectList parameters will be null. If the MLME-SCAN.request primitive requested an ED scan, the GroupDescriptionList parameter will be null.

If, during an ED, active, or passive scan, the implementation-specified maximum of group descriptors is reached thus terminating the scan procedure, the MAC sublayer will issue the MLME-SCAN.confirm primitive with a status of LIMIT\_REACHED.

If the MLME-SCAN.request primitive requested an ED and the PHY type is UWB, as indicated by the *phyChannelPage*, then the UWBEnergyDetectList contains the results for the UWB channels scanned, and the EnergyDetectList and GroupDescriptorList are null. The UWB scan is fully described in 5.2.

P.x.z.1 MLME-SCAN-NOTIFY.indication

The MLME-SCAN-NOTIFY.indication primitive is used to send parameters contained within a scan frame received by the MAC sublayer to the next higher layer when either *macAutoRequest* is set to FALSE or when the scan frame contains one or more octets of payload. The primitive also sends a measure of the LQI and the time the scan frame was received.

The semantics of this primitive are:

MLME-SCAN-NOTIFY.indication (

SSN,

GroupDescriptor,

PendAddrSpec,

AddrList,

sduLength,

sdu

)

The primitive parameters are defined in Table xz1.

The elements of the GroupDescriptor type are TBD.

Table xz1 **MLME-BEACON-NOTIFY.indication parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Valid range** | **Descriptions** |
| SSN | Integer | 0x00–0xff | The scan sequence number. |
| GroupDescriptor | GroupDescriptor value | TBD | The GroupDescriptor for the received scan frame. |
| PendAddrSpec | Bitmap | TBD | The scan pending address specification. |
| AddrList | List of PD addresses | --- | The list of addresses of the PDs for which the scan source has data. |
| sduLength | Integer | 0 – *aMaxScanPayloadLength* | The number of octets contained in the scan payload of the scan frame received by the MAC sublayer. |
| Sdu | Set of octets | --- | The set of octets comprising the scan payload to be transferred from the MAC  sublayer entity to the next higher layer. |