**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) |
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| Date Submitted |  |
| Source | Refik Çağlar Kızılırmak Nazarbayev UniversityKai Lennert BoberFraunhofer HHITunçer BaykaşKadir Has UniversityMurat UysalÖzyeğin University | Voice: [ ]Fax: [ ]E-mail: [ ] |
| Re: |  |
| Abstract |  |
| Purpose | Comment resolution |
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**Legend:**

* Arial size 13 indicates subsections for individual comments
* Red underlined text needs to be adapted during the comment implementation (e.g. because it is a reference).
* ***Bold italic text*** is an instruction to the editor to implement the text

***REVISION HISTORY:***

New *Relayed Device Configuration Request* and *Relayed Device Configuration Response* elements are added.

MCS ID information to be used for relayed frames is included in the *Relay Configuration Response*, *Relayed Device Configuration Request* and *Relayed Device Configuration Response* elements.

*Relay Control* field is added in Data Frame and Control Frame formats.

***DESCRIPTION:***

Step by step relaying mechanism is summarized below as reference.

**STEP 1:** Relay sends *Association Request* element and receives *Association Response* element.

**STEP 2:** Relay obtains GTS (*GTS Descriptor* elements or *GTS Descriptor List* element.)

This allocation is required for relay to transmit *Reachable Address* element to coordinator.

**STEP 3:** Relay sends *Reachable Address* element to coordinator

**STEP 4:** Coordinator sends *Relay Configuration Request* to relay device

This is required for relay device to know which devices it will serve

**STEP 5:** Relay device sends *Relay Configuration Response* to coordinator

Relay device confirms the list of devices that it will serve

It will only forward the frames that are destined to those devices

**STEP 6:** Coordinator sends *Relay Configuration Request* to device

This is required for devices to use relay. They will set *Relayed Frame* bit to 1.

**STEP 7:** Device sends *Relay Configuration Response* to coordinator

Device confirms that it will use relaying by setting *Relayed Frame* bit to 1.

**STEP 8:** Relay device request additional GTS.

GTSs for the relay link in the superframe after the ones allocated for the direct link by *macRelayingOffset*.

Device does not request additional GTS since its receiver is enabled all the time.

***DRAFT-AMENDING TEXT:***

***Add the following definitions under 3.1:***

**relay device:** A non-coordinator device that is used to forward data from a coordinator to a device and from a device to a coordinator.”

**relayed device:** A non-coordinator device whose frames are being relayed by a relay device.

**relay link:** A relay link is an indirect connection between a device and the coordinator through a relay device.

***Remove the following sentence in P30L9:***

“Relay device is a non-coordinator device and is used to forward data from a coordinator to a device and from a device to a coordinator.”

***Insert the following sentence after P38L37****:*

GTS for relay devices shall not overlap with GTS allocated to other devices.

***Insert the following subclauses****:*

5.10 Relaying

5.10.1 Determining potential relay configurations

A relay device shall indicate *capRelay* during the association as described in 5.3.4.3. After receiving an *Association Response* element indicating successful association and confirming the use of *capRelay,* the relay device starts listening to its environment and collecting the transmitter addresses of observed MPDUs.

*NOTE--Due to the nature of wireless communications, a device in the OWPAN will be able to receive and decode transmissions from all other devices complying with this standard that are in the same coverage area.*

Figure x depicts the setup and operation of relaying.

The relay device shall periodically transmit a *Reachable Address* element to the coordinator. The periodicity is implementation-specific. Fig. x shows the periodic message exchange between the relay device and coordinator.

Upon receiving a *Reachable Address* element, the coordinator shall decide whether to use relaying for communication with the devices in the *Reachable Address* element. The coordinator may activate the relaying for a certain device as described in 5.10.2. The coordinator may deactivate the relaying for a certain device at any time. The coordinator should deactivate the relaying for a certain device when it was previously reachable by the relay device and determined permanently not reachable anymore.

In the presence of multiple relay devices in the environment, coordinator may choose more than one relay for a device.



**Fig. x** Relay activation chart for relaying operation

5.10.2 Activating a relay link

Once the coordinator decides which devices will be served by the relay device, it shall send *Relay Configuration Request* element, as described in 6.6.29, to the intended relay device with the *Relay Active* field set to one and the *Relay Link Address* field set to the address of the device intended to have the relay link.

Upon receiving the *Relay Configuration Request* from the coordinator, the intended relay device shall answer with a *Relay Configuration Response*. It shall set the *Status* field to SUCCESS if the request was accepted and DENIED otherwise. The intended relay device shall include the usable MCS ID for transmissions from the intended relayed device to the relay device in the *Relay Configuration Response* element.

Upon receiving a *Relay Configuration Response* element with *Status* set to SUCCESS from the intended relay device, the coordinator shall transmit *Relayed Device Configuration Request* element to the intended relayed device.

Upon receiving the *Relayed Device Configuration Request* from the coordinator, the intended relayed device shall answer with a *Relayed Device Configuration Response*. It shall set the *Status* field to SUCCESS if the request was accepted and DENIED otherwise. The intended relayed device shall include the usable MCS ID for transmissions from the intended relay device to the relayed device in the *Relayed Configuration Response* element. The frame containing the *Relayed Device Configuration Response* element shall have the *Relayed Frame* field set to one. The intended relay device shall thus decode the frame and if the Status field is SUCCESS, shall store the MCS to use for future relayed transmissions to the intended relayed device.

If the coordinator receives a *Relayed Device Configuration Response* element with *Status* other than SUCCESS from the intended relayed device, the coordinator shall undo the configuration of the relay device as described in 5.10.3.

5.10.3 Deactivating a relay link

To deactivate a relay link, the coordinator shall transmit the same *Relay Configuration Request* and *Relayed Configuration Request* elements to the active relay device and the relayed device. Those elements shall have the *Relay Active* field set to zero and the *Relay Link Address* set to the device that was intended to have a relay link.

If the relay device or a device for which relaying is active leaves the OWPAN as described in 5.5.7, the coordinator shall deactivate the relaying in the remaining relay device or relayed device only.

A relayed device should deactivate a relay link when it notices that an active relay device is not reachable by the configured MCS anymore. A relay device should deactivate a relay link when it notices that a relayed device is not reachable by the configured MCS anymore.

5.10.4 Relaying frames

The relay device obtains GTS for relayed transmissions like any other device as described in 5.3.4.

The frames that will be relayed shall be sent with *Relayed Frame* field set to one as described in 6.2.2. The frames, either sent from coordinator to device or from device to coordinator, are also received by the relay device. The relay device accepts and stores the frames with *Relayed Frame* field set to one. If the frame is valid, its MAC sublayer then relays the frame as it is. The MCS to use for relayed frames shall be the one configured at relay link activation as described in 5.10.2.

ACK frames are also relayed like other frames. Relay device does not acknowledge any frame sent to it.

A frame with a destination address equal to the broadcast address shall be handled and shall also be relayed.

If the *capFullDuplex* was agreed during association with the device, the relay device may perform relaying simultaneously to both directions without self-interference due to the directive nature of light propagation.

7.5 Capabilities

Add the row to the Table 37 MAC Capabilities

|  |  |  |  |
| --- | --- | --- | --- |
| Name | ID | Description | Required Capabilities |
| capRelayedDevice | X | The device supports relaying procedure |  |
| capRelayDevice | X | The device supports acting as a relay. |  |

6.6.28 Reachable Address element

The format of the Reachable Address element is shown in

|  |  |  |  |
| --- | --- | --- | --- |
| **1 Octet** | **6 Octets** | **…** | **6 Octets** |
| Address Count(N) | ReachableAddress 1 |  | ReachableAddress N |

Fig X – Reachable Address element

**Address Count**: The Address Count field is an integer representing the number of addresses in the Reachable Addresses field.

**Reachable Addresses 1 … N:** These fields contain one or more MAC addresses of reachable, i.e. observed, devices.

***Insert the following new subclause:***

6.6.29 Relay Configuration Request element

The format *Relay Configuration Request* element is depicted in Figure X.

|  |  |  |
| --- | --- | --- |
| **Bit 0** | **Bits 1-7** | **6 Octets** |
| Relay Active | reserved | Device Address |

Figure X – Relay Configuration Request Element

**Relay Active:** The *Relay Active* field is set to one to indicate that relaying is active. The *Relay Active* field is set to zero to indicate that relaying is not active.

**Device Address:** The *Device Address* field contains the address of the devices that may become a relayed device. In case the element is sent to the intended relayed device, the field shall contain the address of the intended relay device.

6.6.30 Relay Configuration Response element

The format *Relay Configuration Response* element is depicted in Figure X.

|  |  |  |
| --- | --- | --- |
| **1 Octet** | **6 Octets** | **1 Octet** |
| Status Code | DeviceAddress | MCS ID |

Figure X – Relay Configuration Response Element

**Status Code:** The status code indicates the result of the preceding relay configuration request. Status codes are listed in Table X.

**MCS ID:** The MCS ID indicates the MCS ID to use for relayed frames.

**Table X Status codes of the Relay Configuration Response element**

|  |  |
| --- | --- |
| **Value** | **Description** |
| 0 | reserved |
| 1 | DENIED  |
| 2 | SUCCESS |
| 3-255 | reserved |

**MCS ID:** The MCS ID indicates the MCS ID to use for relayed frames.

**Device Address:** This field shall contain the value from the *Device Address* field from the corresponding *Relay Configuration Request* element.

6.6.31 Relayed Device Configuration Request element

The format *Relayed Device Configuration Request* element is depicted in Figure X.

|  |  |  |  |
| --- | --- | --- | --- |
| **Bit 0** | **Bits 1-7** | **6 Octets** | **1 Octet** |
| Relay Active | reserved | Device Address | MCSID |

Figure X – Relayed Device Configuration Request Element

**Relay Active:** The *Relay Active* field is set to one to indicate that relaying is active. The *Relay Active* field is set to zero to indicate that relaying is not active.

**Device Address:** The *Device Address* field contains the address of the devices that may become a relayed device. In case the element is sent to the intended relayed device, the field shall contain the address of the intended relay device.

**MCS ID:** The *MCS ID* field contains the MCS to be used for relayed frames.

6.6.32 Relayed Device Configuration Response element

The format *Relayed Device Configuration Response* element is depicted in Figure X.

|  |  |  |
| --- | --- | --- |
| **1 Octet** | **6 Octets** | **1 Octet** |
| Status Code | DeviceAddress | MCS ID |

Figure X – Relayed Device Configuration Response Element

**Status Code:** The status code indicates the result of the preceding relay configuration request. Status codes are listed in Table X.

**Table X Status codes of the Relay Configuration Response element**

|  |  |
| --- | --- |
| **Value** | **Description** |
| 0 | reserved |
| 1 | DENIED  |
| 2 | SUCCESS |
| 3-255 | reserved |

**MCS ID:** The MCS ID indicates the MCS ID to use for relayed frames.

**Device Address:** This field shall contain the value from the *Device Address* field from the corresponding *Relay Configuration Request* element.

***Append the following rows to Table 12***

|  |  |  |
| --- | --- | --- |
| ID | Element | Subclause |
| 17 | Reachable Address element | 6.6.28 |
| 18 | Relay Configuration Request element | 6.6.29 |
| 19 | Relay Configuration Response element | 6.6.30 |
| 20 | Relayed Device ConfigurationRequest element | 6.6.31 |
| 21 | Relayed Device ConfigurationResponse element | 6.6.32 |

6.2.2 Frame Control Field

***Change Bit10 Field name from “reserved” to “Relayed Frame”***

***Add the following paragraph:***

**Relayed Frame:** This field shall be set to one if relayed link is used and set to zero otherwise.

<Possibly add the relay control field when this bit is one>

**6.3 Data Frames**

***Add the Relay Control Field. This field will be used if the Relayed Frame bit (bit10 in Frame Control field) is set to one.***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 Octets | 0/2 Octets | 2/6 Octets | 2/6 Octets | 0/6 Octets | 2 Octets | 0/6 Octet | variable | 4 Octets |
| FrameControl | PollACK | Receiver Address | TransmitterAddress | Auxiliary Address | SequenceControl | RelayControl  | MSDU / A-MSDU | FCS |
| MAC Frame Header (MHR) | Payload |

**Relay Control:** This field contains the MAC address of the relay device if the data frame is exchanged through a relay link between coordinator and relayed device. Otherwise, the field does not exist

**6.5 Control Frames**

***Add the Relay Control Field. This field will be used if the Relayed Frame bit (bit10 in Frame Control field) is set to one.***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 2 Octets | 0/2 Octets | 2/6 Octets | 2/6 Octets | 6 Octets | 0/6 Octet | variable | 4 Octets |
| FrameControl | ACKInformation | Receiver Address | TransmitterAddress | Auxiliary Address | RelayControl  | ControlInformation | FCS |
| MAC Frame Header (MHR) | Payload |

**Relay Control:** This field contains the MAC address of the relay device if the data frame is exchanged through a relay link between coordinator and relayed device. Otherwise, the field does not exist.

**4.7.2.4 Data transfer through a relay device**

***Add the following paragraph at the end.***

Relaying functionality is supported only for beacon enabled multiple access mode.

When multiple OFEs are used by the coordinator, relaying functionality is not supported.