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Wireless RANs

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| Local Cell Management |
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Abstract

This contribution provides resolutions to the Loca Cell management issues brought up in section 1.H of DCN 22-14/82r0.

R0: initial version of this contribution

R1: Second version, some minor edits

R2: Update to “PDU Type” field

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# Introduction

In Sections 1.H and 1.E of DCN 22-14/82r0, issues regarding how the topology and membership of local cells should be managed are brought up. Local cells are the grouping of S-CPEs that are attached through a distributed A-CPE. Local cell management involves making sure the A-BS and a distributed A-CPE have a “common” picture of which S-CPEs are attached through that distributed A-CPE. Local cell(s) management does not apply to centralized A-CPEs and S-CPEs attached through centralized A-CPEs.

# 1. Local Cell Recommendations in DCN 22-14/82r0

Recommendations section 1.H in DCN 22-14/82r0 is as follows:

***“1.H.1 Update 7.7.25.1 to define it as a “Local Cell Update Indication (LCU-IND)” message sent from distributed R-CPE to MR-BS to give the MR-BS only a list of SIDs of CPEs currently attached through the distributed R-CPE. Update 7.7.25.2 to define it as a “Local Cell Update Acknowledgement (LCU-ACK)” message sent from MR-BS to R-CPE or to acknowledge reception for the LCU-IND or from R-CPE to MR-BS to acknowledge reception for the “Local Cell Update Command (LCU-CMD)” (See 1.H.2)”***

***“1.H.2 Update 7.7.26.1 to define it as a “Container Message (CON-MSG)” message sent from either MR-BS or R-CPE to the other. Inside of this message will be a list of messages. For each message, the SID of the recipient, the purpose (or message type), size of message, and message conents (full MAC PDU) shall be provided. Update 7.7.26.2 to define it as “Container Acknowledgement (CON-ACK)”. CON-ACK will be used to acknowledge reception of CON-MSG by recipient.”***

***“1.H.3 The LCU-IND message would be sent from distributed R-CPE to MR-BS whenever an S-CPE has done one of the following: completed the full network entry process (ranging, basic capability negotiation, authentication, registration), or it has been de-registered.”***

***“1.H.4 If R-CPE receives a container message from MR-BS and sees a REG-RSP or DREG-CMD intended for an S-CPE, it will unpack the message from CON-MSG, forward it to S-CPE, and then send LCU-IND to MR-BS.”***

***“1.H.5 When considering defining message types that can be sent from MR-BS and forwarded through a distributed R-CPE, specifc types should be outline for DREG-CMD with action code 0x05/0x04 or 0x03/0x01. We do this because when the action code in DREG-CMD is 0x05/0x0x4 that should be a trigger for distributed R-CPE to send LCU-IND message. Action code of 0x01/0x03 is not fully derigstering the device, therefore it should trigger local cell update.”***

***“1.H.6 If a message being orginiated at MR-BS and bundled in container message to be forwarded by R-CPE, is a message that is being sent on the Primary Management FID, and is being sent to a S-CPE that has completed initial network entry (including authencation); it is recommended that the message shall be encrypted/authenticated. The same goes for messages originated by S-CPE and bundled by R-CPE for transmission to MR-BS.”***

***“1.H.7 Due to security consideration it is recommended that we forbid distributed R-CPE from originating a DREG-CMD itself, this will only be allowed for ranging and basic capabilities.”***

***“1.H.8 If distributed R-CPE receives container message that includes a RNG-CMD intended for a S-CPE in it’s cell, it will forward that RNG-CMD to the S-CPE.”***

# 2. Local Cell Management Section

Text to resolve recommendations 1.H.3 - 1.H.5, 1.H.7, and 1.H.8 from DCN 22-14/82r0 is provided below.

***Add a new subsection 7.14.3.11.1 “Local Cell Management” with the following text***

***<Start of modification>***

**7.14.3.11.1 Local Cell Management on Relay Network**

A local cell is the grouping of S-CPEs attached to the A-BS through a particular distributed A-CPE. When a S-CPE completes registration or de-registration at the distributed scheduling A-CPE, the A-CPE must update the A-BS with any changes to the current membership of the local cell. This is is necessary for the A-BS to be able to have a complete picture of the topology of the network.

In order to determine if a local cell update is required, the distributed scheduling A-CPE watches for Container Messages or stand-along management messages coming from the A-BS. For each MAC PDU encapsulated in a Container Message (CON-MSG), the “PDU Type” subfield (see 7.7.26.1) indicates the purpose of the message encapsulated by the MAC PDU being sent to an S-CPE. The “PDU Type” field in the CON-MSG, is 3 bits, and shall be handled has follows:

* PDU Type = 000, REG-RSP:
	+ A-BS is sending REG-RSP to S-CPE, thereby S-CPE will complete registration upon receiving MAC PDU containing this message (as forwarded by A-CPE).
	+ In this case the A-CPE shall send the LCU-IND message to A-BS to update local cell membership
* PDU Type = 001, DREG-CMD w/ Action Code = 0x04 or 0x05:
	+ A-BS has asked S-CPE to either terminate operation & shutdown (Action Code = 0x04) or reinitialize on another operating channel (Action Code = 0x05). In either case the S-CPE is ceasing operation because it’s being fully de-registered
	+ In this case the A-CPE shall send the LCU-IND message to A-BS to update local cell membership
* PDU Type = 010, DREG-CMD w/Action Code = 0x01, 0x02, 0x03:
	+ A-BS has asked S-CPE to only listen for transmission on Basic/Primary Management/Secondary Management FID (Action Code = 0x02), temporarily suspend operation (Action Code = 0x01), or resume operation (Action Code = 0x03).
	+ In this case the A-CPE shall not send the LCU-IND message to A-BS
* PDU Type = 011, Any Other PDU:
	+ A-BS is sending any othe non-regisration or de-regisration message or generatl MAC PDU to S-CPE
	+ In this case the A-CPE shall not send the LCU-IND message to A-BS

The “PDU Type” field shall be set to 011 when the A-CPE sends a CON-MSG in the US to the A-BS.

Given the rules for processing the “PDU Type” field in the CON-MSG, it is clear that the A-CPE shall not be capable of originating REG-RSP and DREG-CMD messages to be sent to a S-CPE itself.

Regarding other local cell operations, the A-CPE shall be capable of originating messages related to ranging (i.e. RNG-CMD) and basic capability negotiation (i.e. CBC-RSP) with the S-CPE locally in the access zone.

***<End of modification>***

# 3. MAC PDU handling

Text that resolves recommendation 1.H.6 is provided in DCN 22-14/109r1.

# 4. Local Cell MAC Management Messages

Recommendation section 1.H.1 in DCN 22-14/82r0 proposes introduction of the following MAC maangemnt messages related to Local Cell management:

* LCU-IND: “Local Cell Update Indication”, sent by A-CPE to A-BS to update member list of S-CPEs (e.g. identified by their SID) attached through the A-CPE
* LCU-ACK: “Local Cell Updated Acknowledgement”, sent by A-BS to A-CPE to acknowledge reception of LCU-IND message sent by A-CPE
* LCU-CMD: “Local Cell Update Command”, unclear definition. Originally meant to be used by A-BS to force a topology change.

At this time, definitions of the LCU-IND and LCU-ACK messages have been provided in other contributions.

Original comment suggestion recommending the addition of the LCU-CMD is to be ignored. Upon further review the LCU-CMD is not necessary, so it does not need to be implemented.

7.7.25.1 Local Cell Update Indication (LCU-IND)

The format of a Local Cell Update Indication message is shown in Table A1. This message shall be transmitted by a distributed scheduling A-CPEs to the A-BS at the update of local cell information.

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| **Local Cell Update IND message format** |
| **Syntax** | **Size** | **Note** |
| LCU\_IND\_Message \_Format() { |  |  |
| Management Message Type = 41 | 8 bits | Local Cell Update Indication |
| Number of CPEs: n | 8 bits | The number of CPEs, which are attached by a distributed scheduling A-CPE |
| For (i=1; i<= n; i++){ | Variable |  |
| SID | **13 bits** | SID of CPEwhich requires local cell update |
| } |  |  |
| } |  |  |

7.7.25.2 Local Cell Update Acknowledgement (LCU-ACK)

The format of a Local Cell Update Acknowledgement message is shown in Table B1. This message shall be transmitted by an A-BS to a distributed scheduling A-CPEs for the acknowledgement of reception of local cell updateindication.

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| --- |
| **Local Cell Update ACK message format** |
| **Syntax** | **Size** | **Note** |
| LCU\_ACK\_Format() { |  |  |
| Management Message Type = 42 | 8 bits |  |
| Confirmation Code | 2 bits | 0: success1: unknown message2: failed3: reserved |
| } |  |  |

# 5. Container Message updated

Recommendation section 1.H.2 in DCN 22-14/82r0 proposes a reformatting of the Container Message (see 7.7.26.x) format. One additional modification should be considered for the Container Message format, and that is addition of the “PDU Type” field mentioned in Section 2 of this contribution.

The purpose for introducing this field is two-fold:

* REG-REQ/RSP are exchanged on the Primary Management FID
* DREG-CMD is sent on the Basic or the Primary Management FID

Messages sent on the Primary Management FID may or may not be encrypted. They would be encrypted if they are exchanged between the A-BS and S-CPE, if they are exchanged after the CPE has completed initial authentication or re-authentication. Such is the case for the REG-REQ/RSP, as registration messages are exchanged after the S-CPE has been authenticated. The DREG-CMD can also be sent on the Primary Management FID to a S-CPE that has already been in operation for a while, e.g. one that has completed initial or re-authentication. Messages sent on the Basic FID are not encrypted. A DREG-CMD that is sent to S-CPEs on the Basic FID, is usually done prior to S-CPE authentication and registration.

If a MAC management message is being sent to a S-CPE on the Primary Management FID and being encapsulated in a CON-MSG, the encapsulated MAC PDU containg the MAC management message would be encrypted. It would then be impossible for the A-CPE if a REG-RSP or DREG-CMD is being passed to a S-CPE. Then only exception to this is a DREG-CMD being sent on the Basic FID, then the A-CPE could parse the MAC PDU encapsulating this DREG-CMD that was bundled in the CON-MSG.

To allow the A-CPE to know when a REG-RSP or DREG-CMD is being passed, the introduction of the “PDU Type” for each encapsulated MAC PDU is suggested. The rules for setting this field are given in the new proposed text in Section 2 of this contribution.

***Add a field called “PDU Type”, two bits in length after “SID” field in CON-MSG. The field can take on the values as described in Section 2 of this contribution a new subsection 7.14.3.11.1 “Local Cell Management” with the following text***

7.7.26.1 Container Message

The format of a Container message is shown in Table A1. A container message is used to convey MAC PDUs between the A-CPE and the A-BS.

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| **Container message format** |
| **Syntax** | **Size** | **Note** |
| Container\_Message \_Format() { |  |  |
| Management Message Type = 43 | 8 bits |  |
| Number of ContainedMAC PDUs: n | 8 bits | The number of contained MAC PDUs |
| For (i=1; i<= n; i++){ | Variable |  |
| SID | 13 bits | SID of A-CPE which sent the container message |
| MAC PDU Type | 3 bits | 000 : REG-RSP001: DREG-CMD w/ Action Code = 0x04 or 0x05010: DREG-CMD w/Action Code = 0x01, 0x02, 0x03011: Any Other PDU100-111:Reserved |
| MAC PDU | Variable |  |
| } |  |  |
| } |  |  |

7.7.26.2 Container ACK Message

The format of a Container ACK message is shown in Table B1. A container ACK message is used for acknowledgment of reception of a container message.

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| **Container ACK message format** |
| **Syntax** | **Size** | **Note** |
| Container\_ACKMessage \_Format() { |  |  |
| Management Message Type = 44 | 8 bits |  |
| Confirmation Code | 2 bits | 0: success1: unknown message2: failed3: reserved |
| } |  |  |

**References:**

[1] IEEE P802.22b™/D2.0 Draft Standard for Wireless Regional Area Networks Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: Policies and procedures for operation in the TV Bands - Amendment: Enhancement for broadband services and monitoring applications, April 2014.

[2] IEEE Standard for Information Technology—Telecommunications and information exchange between systems Wireless Regional Area Networks (WRAN)— Specific requirements, Part 22: Cognitive Wireless RAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Policies and Procedures for Operation in the TV Bands, IEEE Std. 802.22-2011, ISBN 978-0-7381-6724-4

[3] Pyo, Chang-woo, “802.22b Letter Ballot 2 Comment database”, DCN 22-14/74r3, <https://mentor.ieee.org/802.22/dcn/14/22-14-0074-03-000b-802-22b-letter-ballot-2-comment-database.xlsx>

[4] Reddy, Ranga, “Security Recommendations for TGb”, DCN 22-14/82r0, <https://mentor.ieee.org/802.22/dcn/14/22-14-0082-00-000b-security-recommendations-for-tgb.docx>

[5] Reddy, Ranga, “MAC PDU Construction and Subheader Management”, DCN 22-14/109r0, <https://mentor.ieee.org/802.22/dcn/14/22-14-0109-00-000b-mac-pdu-construction-subheader-management.docx>