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| Re: | Call for Technical Comments and Contributions regarding IEEE Project P802.16j; See 802.16j-07/007r2 |
| Abstract | This contribution describes an optional method to extend the range of the RS - MR-BS link by sending a compact DCD/UCD message on the access channel in the AAS Relay Zone. |
| Purpose | This document provides a proposal for a new DCD/UCD message to be considered for incorporation into the 802.16j amendment. |
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# A Compact DCD/UCD Message to Extend the Range of RS Nodes using the AAS Relay Zone

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This document describes an enhanced method, applicable to RS nodes, for receiving the DCD and UCD broadcast messages. This method is only applicable to MR-BS nodes and RS nodes capable of communicating in the optional AAS Relay Zone. This method provides range extension for edge-of-cell RS nodes that cannot receive standard broadcast messages without the additional system gain provided by adaptive array system (AAS) processing.

## *Background*

An MR-BS can communicate with RS nodes at a greater range, or higher MCS level or some combination of increased range and MCS if adaptive beamforming is used. However, edge-of-cell RS nodes may not be able to receive the DCD and UCD messages reliably since they are sent without the benefits of beamforming gain. If the DCD and UCD messages are not received, initial ranging and network entry is not possible.

Section 8.4.4.7.2.3 of IEEE 802.16j-06/026r4 describes the overall strategy for edge-of-cell RS nodes and is repeated here:

"Most AAS-RS receive broadcast messages such as the DCD and UCD in the access zone using standard allocations pointed to by standard MAP IEs while edge-of-cell RS nodes receive DCD and UCD messages in the AAS Relay Zone Access Channel via allocations pointed to by IEs contained in the R-MAP received in the access channel".

This contribution further describes the messaging and signaling used by edge-of-cell RS nodes in AAS Relay Zone Access Channel

## *Proposed Solution*

The proposed solution sends a "Compact AAS DCD/UCD" message in the AAS Access Channel which is just sufficient to enable initial ranging. The message is sent with the

benefit of repetitions and frequency diversity and possibly scatter-casting or cyclic delay diversity for reliable reception. The entire message may be transmitted in one or two frames for most TDD relay frame structures using the well known modulation QPSK rate ½ with CC FEC encoding. High levels of data repetition or the use of scatter-casting requires a compact message to increase the probability of network entry.

Successful receipt of the Compact AAS DCD/UCD message enables initial ranging over allocations in the Access Channel with the full benefit of MR-BS beamforming. Thereafter, the full DCD and UCD messages may be received with the benefit of MR-BS beamforming gain.

## *Detailed Solution*

The RS and MR-BS shall perform the following actions:

The RS detects the preamble marking the start of Compact AAS DCD/UCD message in the AAS Access channel. This preamble is called the Forward Link Access (FLA) preamble (see C80216j-07_412r1).

The RS processes the AAS FCH (see C80216j-07_412r1) to determine the message length and repetitions.

The RS receives and processes the Compact AAS DCD/UCD message checking the CRC32 for integrity. The modulation is the well known QPSK rate ½ with CC FEC.

The RS performs initial ranging in using the Range Request and Range Response messaging received in the Access Channel. The initial ranging access codewords are codewords 2000 - 2015 defined in section 8.4.4.7.2.3 and are selected by the base color code. Base color code 0 selects codewords 2000-2003, Base color code 1 selects codewords 2004-2007, Base color code 2 selects codewords 2008-2011, and Base color code 3 selects codewords 2012-2015. Within the set, the codeword is randomly selected by the RS.

The RS requests the full DCD and UCD messages with beamforming gain using the assign access codeword as training. The DCD message contains the revisit rate (in frames) of the Compact AAS DCD/UCD message.

The RS monitors the change count in the Access Channel and if the change count is greater than the saved change count, it processes the message and requests the full DCD and UCD messages with beamforming gain using the assign access codeword as training.

The Compact AAS DCD/UCD message with MAC encapsulation is shown in Table 1. Note its compact length compared to the standard DCD and UCD as it has been optimized for initial ranging only.

Table 1 Compact AAS DCD/UCD PDU Construction

| Compact AAS DCD/UCD PDU | bits | bytes |
|---|---|---|
| | | |
| Generic MAC Header | 48 | 6 |
| DCD MAC Message Format | | |
| Management Message Type=? | 8 | 1 |
| DCD Configuration Change Count | 8 | 1 |
| UCD Configuration Change Count | 8 | 1 |
| Compact AAS DCD TLV Encoded information for the overall channel | | 22 |
| Compact AAS UCD TLV Encoded information for the overall channel | | 8 |
| Reserve | | 1 |
| total size ----------> | | 34 |
| CRC | 32 | 4 |
| Total MAC PDU Size ----------> | | 44 |

## *Proposed Text Changes*

Add section 6.3.2.3.62

The Compact AAS DCD/UCD message for the AAS Relay Zone is given in Table xx1. Tables xx2 and xx3 define the required TLV fields. To reduce message length, the length field has been suppressed.

Table xx1 Compact AAS DCD/UCD Message Format

| Syntax | Size | Notes |
|---|---|---|
| Compact AAS DCD/UCD() { | | |
| Mac Management Type=1 | 1 Byte | |
| DCD Configuration Count | 1 Byte | |
| UCD Configuration Count | 1 Byte | |
| DCD TLV Encoded information for the overall channel | 22 Bytes | |
| UCD TLV Encoded information for the overall channel | 8 Bytes | |
| Reserve | 1 Byte | |
| | | |
| } | 34 Bytes | Totals |
| | | |

Table xx2 Compact AAS DCD Contents

| | Compact DCD Contents (TLVs) | Type | Bytes | | Bytes |
|---|---|---|---|---|---|
| Type | Description | | TLV-size | Req'd for Ranging | TV-size |
| 2 | BS EIRP | 2 | 4 | y | 3 |
| 7 | TTG in PSs | 7 | 4 | y | 3 |
| 8 | RTG in PSs | 8 | 3 | y | 2 |
| 9 | $EIRxP_{IR,max}$ | 9 | 4 | y | 3 |
| 13 | Base station ID | 13 | 8 | y | 7 |
| 148 | MAC version | 148 | 3 | y | 2 |
| | Basestation color code | | 3 | y | 2 |
| | Totals-----> | | 29 | | 22 |

Table xx3 Compact AAS UCD Contents

| | Compact UCD Contents (TLVs) | bytes | bytes | | |
|---|---|---|---|---|---|
| Type | Description | V-size | TLV-size | Req'd for Ranging | TV-size |
| 198 | Initial ranging backoff start | 1 | 3 | y | 2 |
| 199 | Initial ranging backoff end | 1 | 3 | y | 2 |
| 200 | Bandwidth request backoff start | 1 | 3 | y | 2 |
| 201 | Bandwidth request backoff end | 1 | 3 | y | 2 |
| 202 | Uplink burst profile for multiple FEC types | 1 | 3 | | |
| | Totals-----> | | 15 | | 8 |

## *Initial Ranging for Edge-of-Cell RS Nodes*

*Add a subsection 8.4.4.7.2.3.*1

Initial ranging for edge-of-cell RS Nodes begins with reception of the "Compact AAS DCD/UCD" message in the AAS Access Channel which is sufficient to enable initial ranging. The message is sent with the benefit of repetitions and frequency diversity and possibly scatter-casting or cyclic delay diversity for reliable reception. The entire message may be transmitted in one or two frames for most TDD relay frame structures using the well known modulation QPSK rate ½ with CC FEC encoding. High levels of data repetition or the use of scatter-casting requires a compact message to increase the probability of network entry. The RS procedure may be defined as follows:

Detect the preamble marking the start of Compact AAS DCD/UCD message in the AAS Access channel. This preamble is called the Forward Link Access (FLA) preamble.

Process the AAS FCH to determine the message length and repetitions

Receive and process the Compact AAS DCD/UCD message checking the CRC32 for integrity. The modulation is the well known QPSK rate ½ with CC FEC.

Perform initial ranging in using the Range Request and Range Response messaging received in the Access Channel. The initial ranging access codewords are codewords 2000 - 2015 defined in section 8.4.4.7.2.3 and are selected by the base color code. Base color code 0 selects codewords 2000-2003, Base color code 1 selects codewords 2004-2007, Base color code 2 selects codewords 2008-2011, and Base color code 3 selects codewords 2012-2015. Within the set, the codeword is randomly selected.

Request the full DCD and UCD messages with beamforming gain using the assign access codeword as training. The DCD message contains the revisit rate (in frames) of the Compact AAS DCD/UCD message.

Monitor the change count in the Access Channel and if the change count is greater than the saved change count, process the message and request the full DCD and UCD messages with beamforming gain using the assign access codeword as training.