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| Re: | Working Group Letter Ballot Recirc #28b, Technical Comments and Contributions regarding IEEE Project P802.16j; Draft Amendment P802.16j/D3. | |
| Abstract | This contribution describes the Direct Signaling Private Map message transmitted in the AAS Relay Zone to accomplish bandwidth grant, physical link adjustment and fast HARQ feedback. | |
| Purpose | This document provides the necessary messaging to properly accomplish bandwidth grant and HARQ control within the AAS Relay Zone for Direct Signaling mode of operation. | |
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Private Map Message and CQICH Direct Signaling in the AAS Relay Zone

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This document provides the necessary messaging to properly accomplish bandwidth grant and HARQ control within the AAS Relay Zone for Direct Signaling mode of operation.

Background

Direct Signaling operation within the relay zone provides a bandwidth request mechanism that can scale with an M-fold increase in the number of users afforded by multi-user beamforming.

Section 8.4.4.7.2.3 of Draft Amendment P802.16j/D3 describes the AAS Relay Zone but does not detail the messaging required for managing private map bandwidth grant, range/frequency/power adjustment and CQICH signaling.

Proposed Solution

The proposed solution is to describe the bandwidth grant, link adjustment mechanism and CQICH signaling as well as the required Direct Signaling Access Messages to accomplish it within the AAS Relay Zone.

Detailed Solution

Overview

The AAS-DS Private Map structure provides information for supporting bandwidth grant. AAS-DS Resource allocation utilizes the follow definitions:

- 1) Partition – a partition of frequency within the carrier channel. AAS-DS partitions utilize AMC slots and are therefore comprised of 1 or 2 bins as defined by the AMC subchannel permutation (1 bin x 6 symbols or 2 bins x 3 symbols). The partition is the smallest unit of allocation granularity within a burst for the AAS Relay Zone. Partitions are numbered with an index in ascending order based on frequency (starting with an index of 0). A partition allocation is a coupled resource allocation which is granted in both the DL subframe and UL subframe for each frame of allocation.

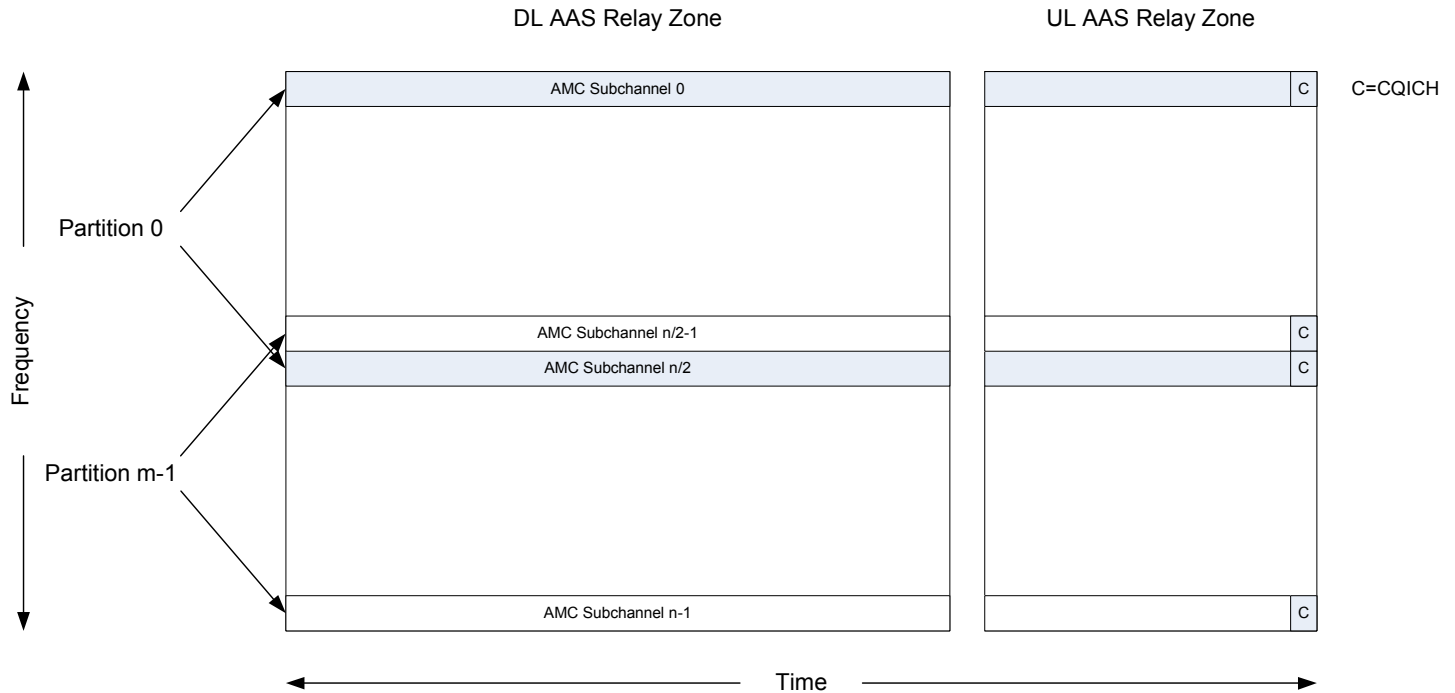


Figure xxx: Partition Definition

- 2) Burst – a burst is the unit resource allocation within the AAS zone. A burst is comprised of 1 to 8 partitions. The AAS zone can support 1 to 4 bursts per user. Bursts are defined to be HARQ enabled or disabled within the partition control structure described in the Private Map Message section.
- 3) Partition Control actions
 - a) Probe – a training preamble that allows the BS to unobtrusively determine interference characteristics between the probing users and current active users within a single partition of frequency.
 - b) Open – an allocation grant of the partition resource
 - c) Close – a de-allocation of the partition resource
 - d) Maintain – maintain the allocation of partition resource (used to maintain synchronization of partition resource allocation between the BS and RS since the partition controls are all delta state related.).

The initial ranging message sequence for an entering RS shows the migration from the Access partition utilizing the DLA for bandwidth grant and physical layer control to a traffic partition as part of a burst allocation where the PMAP is then used for bandwidth grant and physical layer control. The initial ranging message sequence for an RS entering the network in the AAS Relay zone is as follows:

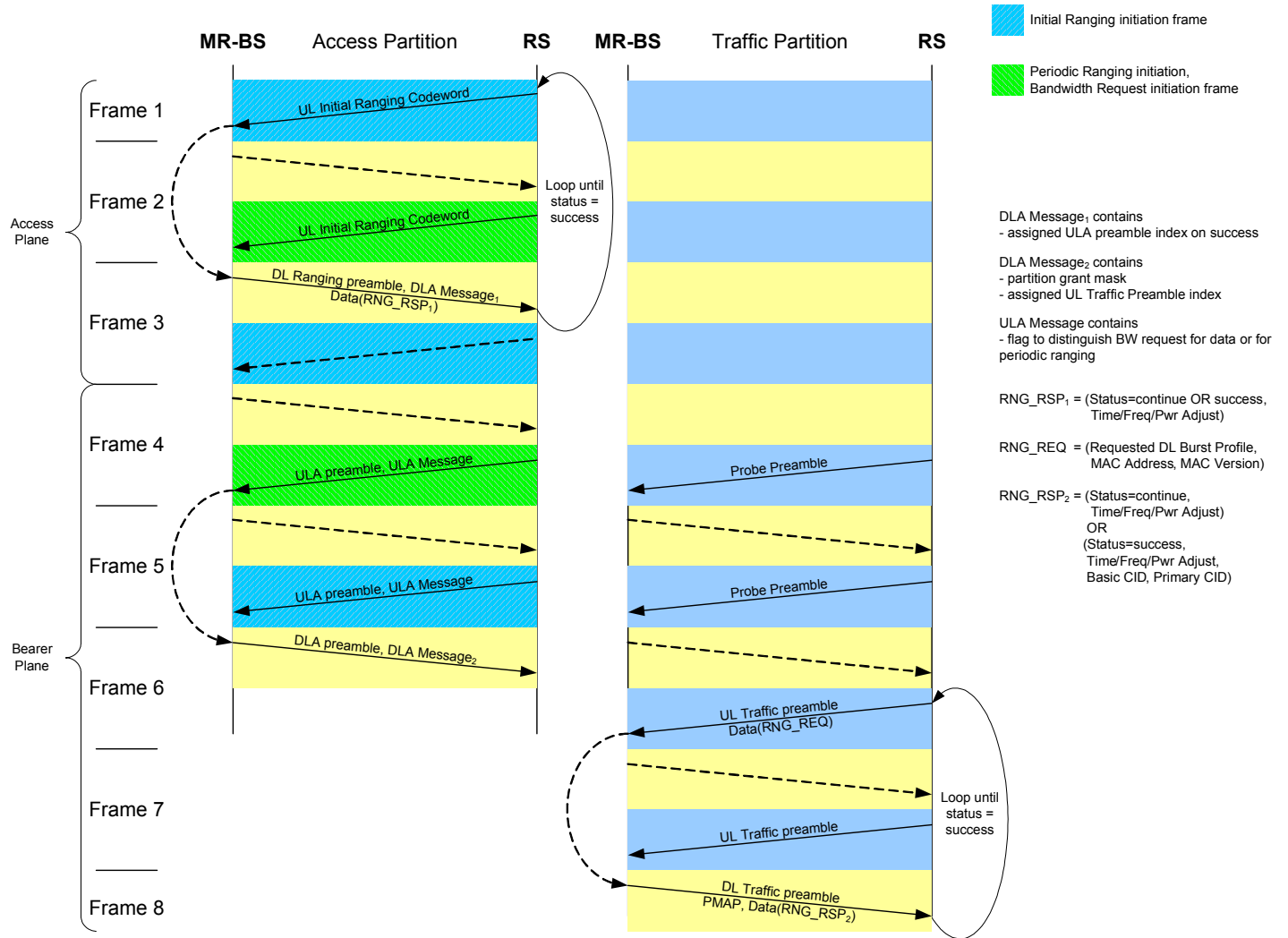


Figure xxx: Initial Ranging Message Sequence in AAS Relay Zone

Private MAP (PMAP)

The PMAP is used to grant bandwidth and provide HARQ control signaling on a burst basis. It is always transmitted as QPSK 1/2 rate and is anchored within the burst (it is transmitted as the first AMC slot within the lowest numbered partition of a burst). The following table defines the AAS_PMAP Message structure:

Table 1: AAS_PMAP Message Structure

| PMAP Component | Bits | Reps | Slot | Comment |
|--------------------------|------|------|------|---|
| AAS_PMAP Message { | | | | |
| PB_Ctl_0_Partition_Id | 5 | 1 | | Partition id for control_0 structure |
| PB_Ctl_0_Burst_Id | 2 | 1 | | Burst id for control_0 structure |
| UL_HARQ_Ack/Nack | 1 | 1 | | 1=Ack, 0=Nack |
| PB_Ctl_1_Partition_Id | 5 | 1 | | Partition id for control_1 structure |
| PB_Ctl_1_Burst_Id | 2 | 1 | | Burst id for control_1 structure |
| DL_HARQ_re-tx_indication | 1 | 1 | | 0=new frame, 1=frame n-2 retransmission |
| PB_Ctl_2_Partition_Id | 5 | 1 | | Partition id for control_2 structure |
| DIUC | 3 | 1 | | DL MCS level |
| PB_Ctl_2_Burst_Id | 2 | 1 | | Burst id for control_2 structure |

| | | | |
|---------------------------|----|---|-----------------------------------|
| UIUC Offset | 2 | 1 | UL MCS offset from the DIUC index |
| UL Range Adjust | 2 | 1 | Range Adjustment encode |
| UL Frequency Adjust | 2 | 1 | Frequency Adjustment encode |
| UL Partition Power Adjust | 8 | 1 | 1 bit per partition (CVSD) |
| CRC | 8 | 1 | CRC-8 |
| } | | | |
| Total PMAP Bits | 96 | 2 | |

1) **Partition/Burst Control** (7 bit encode) – The partition/burst control encode is described in Table 2 below:

Table 2: Partition/Burst Control encode¹

| 5 bit value | 2 bit encode value | Description |
|-------------|-----------------------|--|
| 0-23 | 0-3 (burst index) | Probe, Open or Maintain (p,o,m) the partition indexed by the 5 bit value in the burst indexed by the 2 bit encode value. |
| 24 | 0-3 (partition index) | Close Partition in the 4 partition range 0-3 indexed by the 2 bit encode value |
| 25 | 0-3 (partition index) | Close Partition in the 4 partition range 4-7 indexed by the 2 bit encode value |
| 26 | 0-3 (partition index) | Close Partition in the 4 partition range 8-11 indexed by the 2 bit encode value |
| 27 | 0-3 (partition index) | Close Partition in the 4 partition range 12-15 indexed by the 2 bit encode value |
| 28 | 0-3 (partition index) | Close Partition in the 4 partition range 16-19 indexed by the 2 bit encode value |
| 29 | 0-3 (partition index) | Close Partition in the 4 partition range 20-23 indexed by the 2 bit encode value |
| 30 | 0-3 (burst index) | Close all partitions in burst using 2 bit encode as burst number |
| 31 | 0-3 | 0: Fast power control for MCS increase (affects all partitions in current burst) 1-3: <i>Reserved</i> |

A special encode for value 31 is used when there is an UL MCS increase. In this case there must be power increase step sizes of approximately 1.8 dB to ensure we can increase power over 3dB within two frames.

2) **UL Time (Range) Adjust** (2 bit encode) - There will be a configurable delta (d_t) for the time adjustment. A step size of $d_t = 0.714$ us is proposed. 0.714 us corresponds to 4 samples at a 5.6 MHz sample rate. In 802.16, 4 samples corresponds to a “PS”. The frequency adjustment encode is described in Table 3 below:

Table 3: UL Range (Time) Adjustment Encoding

| Encoded bits | Time Delay @ BS | SS UL Adjustment |
|--------------|-------------------|------------------|
| 00 | $t_e < -\delta_t$ | Delay |

| | | |
|----|--------------------------|---------|
| 01 | $-\delta_t \leq t_e < 0$ | Delay |
| 10 | $0 \leq t_e < \delta_t$ | Advance |
| 11 | $\delta_t \leq t_e$ | Advance |

- 3) **UL Frequency Adjust** (2 bit encode) – There will be a configurable delta (d_f) for the frequency adjustment. The frequency adjustment encode is described in Table 4 below:

Table 4: UL Frequency Adjustment Encoding

| Encoded bits | Frequency Error @ BS | SS UL Adjustment |
|--------------|----------------------|--------------------|
| 00 | $f_e < -d_f$ | increase frequency |
| 01 | $-d_f \leq f_e < 0$ | increase frequency |
| 10 | $0 \leq f_e < d_f$ | decrease frequency |
| 11 | $d_f \leq f_e$ | decrease frequency |

- 4) **UL Power Adjust** (8 bit encode) – The power adjust is a 1-bit CVSD encode per available partition in a burst.

CQICH Signaling

The CQICH is always allocated as the last symbol of a frame for any partition that is allocated to an RS. There is no need for an allocation IE or control IE to allocate resources, or manage configuration. The configuration is implicit according to the sections below.

CQICH mapper and demodulator

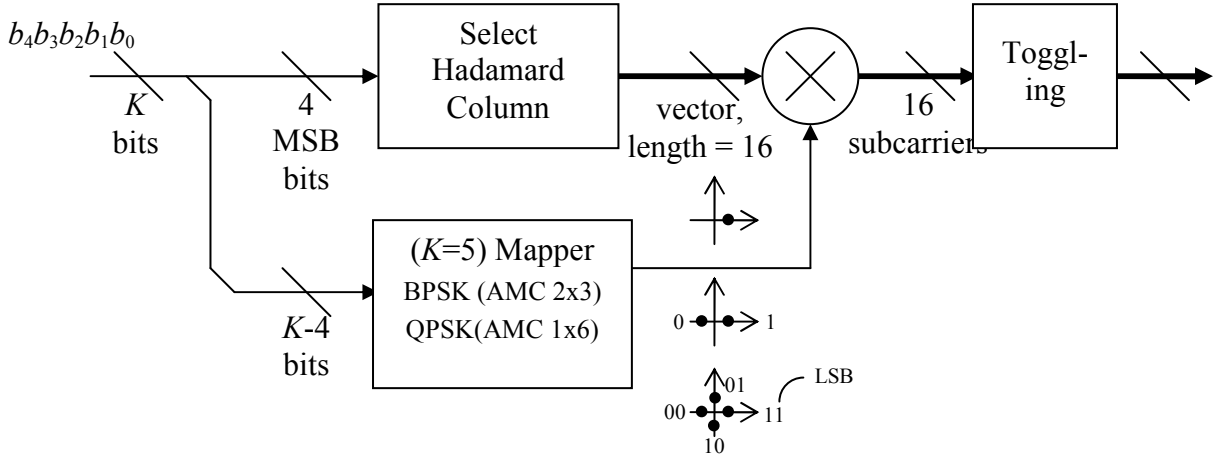


Figure 1. Block diagram of CQICH mapper

We will use $K = 5$ bits. The constellation is BPSK for AMC permutation 2x3 and QPSK for AMC permutation 1x6. The constellation amplitude is unity; no boosting. b_4 is the MSB.

The toggling vector is applied per partition, which is described as:

$$CQICH_Toggle_Vector = [111-1111-1-1-11-111-11]$$

in which the k-th element(from the leftmost) corresponds to the k-th bit (from the lowest subcarrier) of the coded CQICH sequence.

The Hadamard matrix is as follows. The CQICH mapper's 4-bit input value defines which of the column vectors will be selected.

| | | | | | | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 |
| 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 |
| 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 |
| 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 |
| 1 | -1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | 1 |
| 1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 |
| 1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 |
| 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 |
| 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 |
| 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 |
| 1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 |
| 1 | 1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | -1 | -1 |
| 1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 |

UL Tx headroom report

This field describes the difference between the maximum permissible power and the current RS UL transmit power. The current UL transmit power is for all of the partitions and is the greater one of the two antennas.

For a burst with only one partition

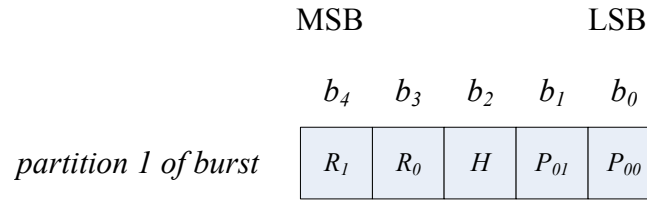


Figure 2. CQICH bit allocation of 1 partition sub-burst

Note: P_{ij} is defined as power control for each partition, and subscript i denotes partition index, and subscript j denotes power control bit index; H is defined as HARQ acknowledge bit; and R_m is defined as headroom report bits.

Table 5. For a burst with only 1 partition

| $R_1 R_0$ | Description |
|-----------|--|
| 00 | There is no headroom and this partition is the most expensive partition (MEP) among all open partitions |
| 01 | There is no headroom and this partition is not the MEP among all open partitions taking into account partitions in other bursts. |
| 10 | There is enough headroom to open 1 additional partition or increase the MCS |
| 11 | There is enough headroom to open 2 partitions or increase the MCS |

If multiple bursts are open, only one partition in one of the bursts will be indicated as the MEP if the RS is out of headroom.

In a multiple bursts case, the recommendation for each burst can be implemented simultaneously by the BS. For example, if burst 0 says OK to add 2 partitions, and burst 1 says OK to add 1 partition, the BS may choose to add 0 to 3 partitions.

H is the DL HARQ bit; 1=ACK, 0=NACK.

For a burst with two partitions

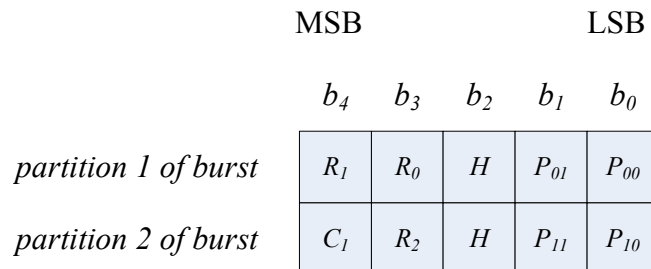


Figure 3. CQICH bit allocation for 2 partition sub-burst

Table 6. For a burst with 2 to 4 partitions

| $R_2R_1R_0$ | Description |
|-------------|--|
| 000 | There is no headroom, and 1 st partition in the burst is the MEP |
| 001 | There is no headroom, and 2 nd partition in the burst is the MEP |
| 010 | There is no headroom, and 3 rd partition in the burst is the MEP |
| 011 | There is no headroom, and 4 th partition in the burst is the MEP |
| 100 | Not enough headroom to increase MCS nor open new partition, and no partition in the burst is the MEP |
| 101 | Enough headroom to open 1 partition |
| 110 | Enough headroom to open 2 partitions |
| 111 | Enough headroom to increase MCS of the burst |

Bit C_1 is used for even parity check across the CQICH bits, except the HARQ bit of the 2nd partition, of the 2 partitions, such as:

$$R_0 \oplus R_1 \oplus R_2 \oplus H \oplus P_{00} \oplus P_{01} \oplus P_{10} \oplus P_{11} \oplus C_1 = 0 \quad (1)$$

At the base station, if the parity check fails or either of the HARQ bits on two partitions are equal to NACK, we assume a NACK was transmitted. During transmission, the HARQ bit of the second partition is identical to the HARQ bit of the first partition.

When there are two partitions are open, the two partitions can be placed in either one burst or two bursts. Here we recommend using one burst with two partitions. By doing this, we can reduce the PMAP overhead, and add parity check and HARQ bit repetition.

For a burst with 3 partitions

| | MSB | | | LSB | |
|-----------------------------|-------|-------|-------|----------|----------|
| | b_4 | b_3 | b_2 | b_1 | b_0 |
| <i>partition 1 of burst</i> | C_0 | R_0 | H | P_{01} | P_{00} |
| <i>partition 2 of burst</i> | C_1 | R_1 | H | P_{11} | P_{10} |
| <i>partition 3 of burst</i> | C_2 | R_2 | H | P_{21} | P_{20} |

Figure 4. CQICH bit allocation for 3 partition sub-burst

Bit C_i is used for even parity check across the CQICH bits on each partition, such as:

$$R_i \oplus H \oplus P_{i0} \oplus P_{i1} \oplus C_i = 0 \quad (2)$$

At base station, we assume that a HARQ NACK was transmitted if any of the following conditions are true:

- No partition passes parity check.
- At least one partition passes parity check, and the number of partitions with a NACK is more than or equal to the number of partition with an ACK.

This rule also applies to a burst with more than 3 partitions.

For a burst with 4 partitions

| | MSB | | LSB | | |
|-----------------------------|-------|-------|-------|----------|----------|
| | b_4 | b_3 | b_2 | b_1 | b_0 |
| <i>partition 1 of burst</i> | C_0 | R_0 | H | P_{01} | P_{00} |
| <i>partition 2 of burst</i> | C_1 | R_1 | H | P_{11} | P_{10} |
| <i>partition 3 of burst</i> | C_2 | R_2 | H | P_{21} | P_{20} |
| <i>partition 4 of burst</i> | C_3 | 1 | H | P_{31} | P_{30} |

Figure 5. CQICH bit allocation for a 4 partition sub-burst.

The parity check bit for the first 3 partitions are defined as in (2).

The parity check bits for the 4th partition is defined as:

$$C_i \oplus 1 \oplus H \oplus P_{i1} \oplus P_{i0} = 0 \quad (3)$$

For a burst with more than 4 partitions

| | MSB | | LSB | | |
|-----------------------------|-------|-------|-------|----------|----------|
| | b_4 | b_3 | b_2 | b_1 | b_0 |
| <i>partition 1 of burst</i> | C_0 | R_0 | H | P_{01} | P_{00} |
| <i>partition 2 of burst</i> | C_1 | R_1 | H | P_{11} | P_{10} |
| <i>partition 3 of burst</i> | C_2 | R_2 | H | P_{21} | P_{20} |
| <i>partition 4 of burst</i> | C_3 | R_3 | H | P_{31} | P_{30} |
| <i>partition m of burst</i> | C_m | 1 | H | P_{m1} | P_{m0} |

Figure 6. CQICH bit allocation for a sub-burst with more than 4 partitions (m=5, 6, 7, 8)

The parity check bit for the first 4 partitions are defined as in (2).

The parity check bit for other partitions are defined as in (3).

Table 7. For a burst with 5 to 8 partitions

| $R_3R_2R_1R_0$ | Description |
|----------------|---|
| 0000 | There is no headroom, and 1 st partition of the burst is the MEP |
| 0001 | There is no headroom, and 2 nd partition of the burst is the MEP |
| 0010 | There is no headroom, and 3 rd partition of the burst is the MEP |
| 0011 | There is no headroom, and 4 th partition of the burst is the MEP |
| 0100 | There is no headroom, and 5 th partition of the burst is the MEP |
| 0101 | There is no headroom, and 6 th partition of the burst is the MEP |
| 0110 | There is no headroom, and 7 th partition of the burst is the MEP |
| 0111 | There is no headroom, and 8 th partition of the burst is the MEP |
| 1000 | There is no enough headroom to increase MCS nor open a new partition. |
| 1001 | Enough headroom to open 1 partition |
| 1010 | Enough headroom to open 2 partitions |
| 1011 | Enough headroom to increase MCS of the burst |
| 11xx | Not defined |

Definition of power control bits

There are two power control bits in each CQICH. The definition is given in Table 8.

Table 8. DL Power Control Step Sizes

| P_1P_0 | DL_Power_Control | $e = \text{measured_snr} - \text{target_snr}$ (mW/mW) |
|----------|----------------------------|--|
| 0 0 | Increase TX power a lot | $e < -G_{2a}$ |
| 0 1 | Increase TX power a little | $-G_{2a} \leq e < 0$ |
| 1 0 | Decrease TX power a little | $0 \leq e < G_{2a}$ |
| 1 1 | Decrease TX power a lot | $G_{2a} \leq e$ |

The value of G_{2a} is determined by SNR measurement jitter.

Proposed Text Changes

Insert the following subclause 8.4.4.7.3.2.3.6:

8.4.4.7.2.3.6 AAS Relay Zone Messaging

The AAS-DS Private Map structure provides information for supporting bandwidth grant. AAS-DS Resource allocation utilizes the follow definitions:

- 1) Partition – a partition of frequency within the carrier channel. AAS-DS partitions utilize AMC slots and are therefore comprised of 1 or 2 bins as defined by the AMC subchannel permutation (1 bin x 6 symbols or 2 bins x 3 symbols). The partition is the smallest unit of allocation granularity within a burst for the AAS Relay Zone. Partitions are numbered with an index in ascending order based on frequency (starting with an index of 0). A partition allocation is a coupled resource allocation which is granted in both the DL subframe and UL subframe for each frame of allocation.

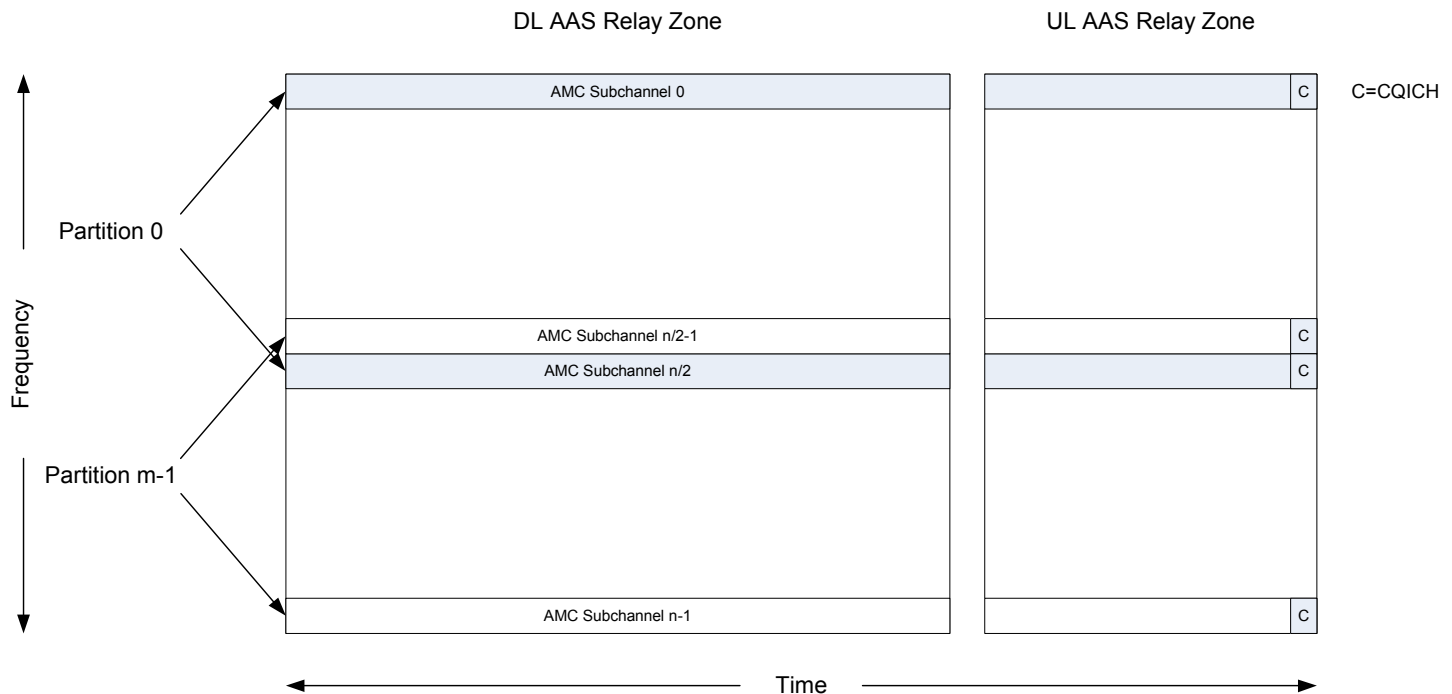


Figure xxx: Partition Definition

- 2) Burst – a burst is the unit resource allocation within the AAS zone. A burst is comprised of 1 to 8 partitions. The AAS zone can support 1 to 4 bursts per user. Bursts are defined to be HARQ enabled or disabled within the partition control structure described on section x.x.x.x.x.
- 3) Partition Control actions
 - a) Probe – a training preamble that allows the BS to unobtrusively determine interference characteristics between the probing users and current active users within a single partition of frequency.
 - b) Open – an allocation grant of the partition resource
 - c) Close – a de-allocation of the partition resource
 - d) Maintain – maintain the allocation of partition resource (used to maintain synchronization of partition resource allocation between the BS and RS since the partition controls are all delta state related.).

The initial ranging message sequence for an entering RS shows the migration from the Access partition utilizing the DLA for bandwidth grant and physical layer control to a traffic partition as part of a burst

allocation where the PMAP is then used for bandwidth grant and physical layer control. The initial ranging message sequence for an RS entering the network in the AAS Relay zone is as follows:

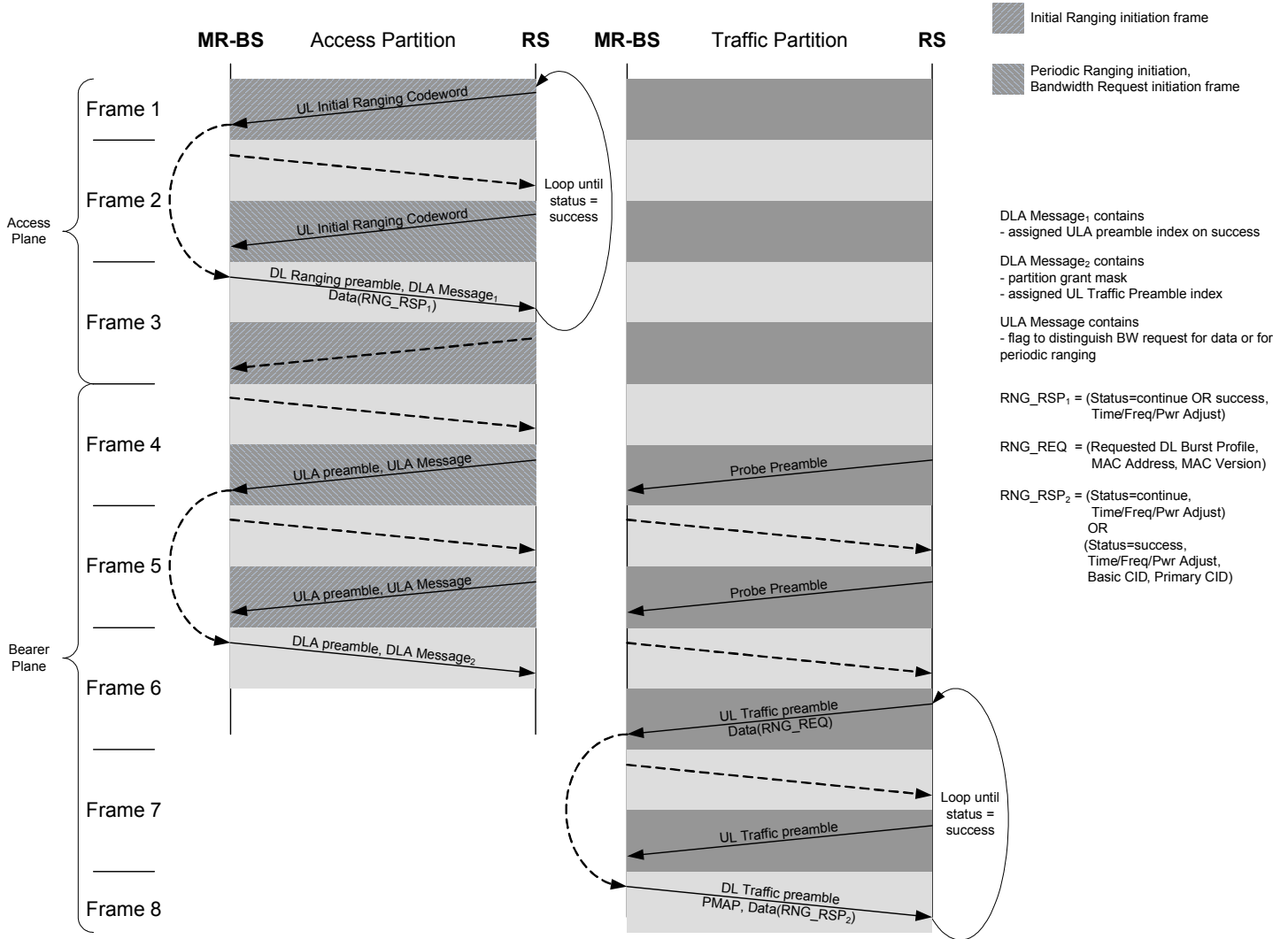


Figure xxx: Initial Ranging Message Sequence in AAS Relay Zone

8.4.4.7.2.3.6.1 Private MAP (PMAP) Message

The DLA provides code word assignments during initial ranging and provides bandwidth grant, codeword assignment, supportable MCS for UL/DL, and range(time)/frequency/power adjustment during the bandwidth grant exchange.

Insert Table 2xx (.16e)/Table 3xx (Rev2) as indicated:

Table xxx – AAS_PMAP Message

| Syntax | Size | Notes |
|------------------------------|--------|--------------------------------------|
| AAS_PMAP() { | | |
| PB Ctl 0 Partition Id | 5 bits | Partition id for control_0 structure |
| PB Ctl 0 Burst Id | 2 bits | Burst id for control_0 structure |
| UL HARQ Ack/Nack | 1 bit | 1=Ack, 0=Nack |
| PB Ctl 1 Partition Id | 5 bits | Partition id for control_1 structure |
| PB Ctl 1 Burst Id | 2 bits | Burst id for control_1 structure |

| | | |
|----------------------------------|--------|---|
| DL HARQ re-tx indication | 1 bit | 0=new frame, 1=frame n-2 retransmission |
| PB Ctl 2 Partition Id | 5 bits | Partition id for control_2 structure |
| DIUC | 3 bits | DL MCS level |
| PB Ctl 2 Burst Id | 2 bits | Burst id for control_2 structure |
| UIUC Offset | 2 bits | UL MCS offset from the DIUC index |
| UL Range Adjust | 2 bits | Range Adjustment encode |
| UL Frequency Adjust | 2 bits | Frequency Adjustment encode |
| UL Partition Power Adjust | 8 bits | 1 bit per partition (CVSD) |
| CRC | 8 bits | CRC-8 |
| } | | |

Insert the following parameter descriptions following Table 2xx (.16e)/Table 3xx (Rev2) as indicated:

Partition_Ctl_0_Partition_Id

5 bit Partition Id encode portion for the first of three partition control structures (Partition_Ctl_0) described in table xxx

Partition_Ctl_0_Burst_Id

2 bit Burst Id encode portion for the first of three partition control structures (Partition_Ctl_0) described in table xxx

UL HARQ Ack/Nack

Indicates whether frame n-2 UL was received successfully or not (1=Ack, 0=Nack)

Partition_Ctl_1_Partition_Id

5 bit Partition Id encode portion for the second of three partition control structures (Partition_Ctl_1) described in table xxx

Partition_Ctl_1_Burst_Id

2 bit Burst Id encode portion for the second of three partition control structures (Partition_Ctl_1) described in table xxx

DL HARQ re-tx indication

Indicates whether this DL burst is a retransmission or not. (0=new frame, 1=frame n-2 retransmission)

Partition_Ctl_2_Partition_Id

5 bit Partition Id encode portion for the third of three partition control structures (Partition_Ctl_2) described in table xxx

DIUC

DIUC

Partition_Ctl_2_Burst_Id

2 bit Burst Id encode portion for the third of three partition control structures (Partition_Ctl_2) described in table xxx

UIUC Offset

Offset from the DIUC

UL Range Adjust

Range Adjustment.

UL Frequency Adjust

Frequency adjustment

UL Partition Power Adjust

Power adjustment for the bearer partitions (up to 6 described in the partition grant control)

8.4.4.7.2.3.6.2 CQICH Signaling

The CQICH is always allocated as the last symbol of a frame for any partition that is allocated to an RS. There is no need for an allocation IE or control IE to allocate resources, or manage configuration. The configuration is implicit according to the sections below.

8.4.4.7.2.3.6.2.1 CQICH mapper

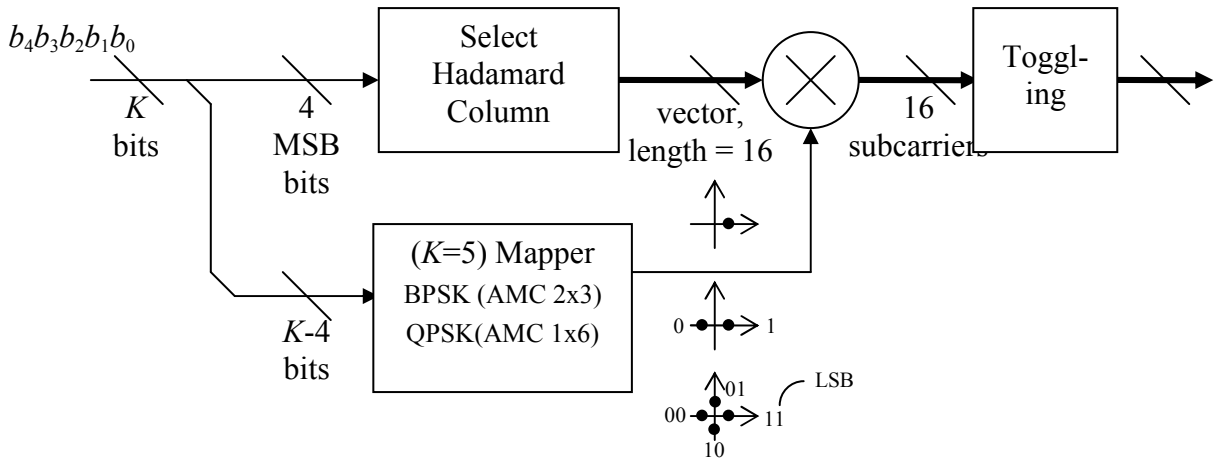


Figure xxx. Block diagram of CQICH mapper

We will use $K = 5$ bits. The constellation is BPSK for AMC permutation 2x3 and QPSK for AMC permutation 1x6. The constellation amplitude is unity; no boosting. b_4 is the MSB.

The toggling vector is applied per partition, which is described as:

$$CQICH_Toggle_Vector = [111-1111-1-1-11-111-11]$$

in which the k-th element(from the leftmost) corresponds to the k-th bit (from the lowest subcarrier) of the coded CQICH sequence.

The Hadamard matrix is as follows. The CQICH mapper's 4-bit input value defines which of the column vectors will be selected.

| | | | | | | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 |
| 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 |
| 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 |
| 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 |
| 1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 |
| 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 |
| 1 | -1 | -1 | 1 | -1 | 1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| 1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 |
| 1 | 1 | -1 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 |
| 1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 |
| 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 |
| 1 | -1 | 1 | -1 | -1 | 1 | -1 | 1 | -1 | 1 | -1 | 1 | 1 | -1 | 1 | -1 |
| 1 | 1 | -1 | -1 | -1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | 1 | 1 | -1 | -1 |
| 1 | -1 | -1 | 1 | -1 | 1 | 1 | -1 | -1 | 1 | 1 | -1 | 1 | -1 | -1 | 1 |

8.4.4.7.2.3.6.2.2 UL Tx headroom report

This field describes the difference between the maximum permissible power and the current RS UL transmit power. The current UL transmit power is for all of the partitions and is the greater one of the two antennas.

8.4.4.7.2.3.6.2.2.1 For a Burst with only one partition

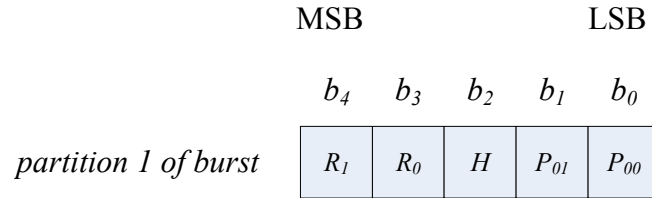


Figure xxx. CQICH bit allocation of 1 partition sub-burst

Note: P_{ij} is defined as power control for each partition, and subscript i denotes partition index, and subscript j denotes power control bit index; H is defined as HARQ acknowledge bit; and R_m is defined as headroom report bits.

Table xxx. For a burst with only 1 partition

| $R_1 R_0$ | Description |
|-----------|--|
| 00 | There is no headroom and this partition is the most expensive partition (MEP) among all open partitions |
| 01 | There is no headroom and this partition is not the MEP among all open partitions taking into account partitions in other bursts. |
| 10 | There is enough headroom to open 1 additional partition or increase the MCS |
| 11 | There is enough headroom to open 2 partitions or increase the MCS |

If multiple bursts are open, only one partition in one of the bursts will be indicated as the MEP if the RS is out of headroom.

In a multiple bursts case, the recommendation for each burst can be implemented simultaneously by the BS. For example, if burst 0 says OK to add 2 partitions, and burst 1 says OK to add 1 partition, the BS may choose to add 0 to 3 partitions.

H is the DL HARQ bit; 1=ACK, 0=NACK.

8.4.4.7.2.3.6.2.2.2 For a burst with two partitions

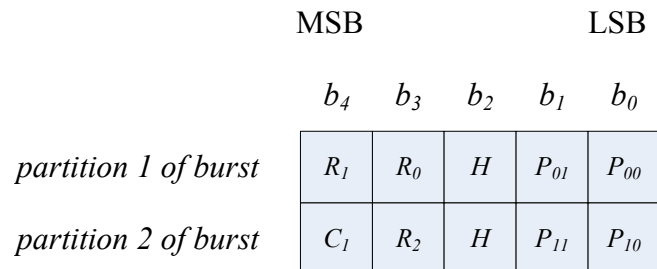


Figure xxx. CQICH bit allocation for 2 partition sub-burst

Table xxx. For a burst with 2 to 4 partitions

| $R_2 R_1 R_0$ | Description |
|---------------|---|
| 000 | There is no headroom, and 1 st partition in the burst is the MEP |
| 001 | There is no headroom, and 2 nd partition in the burst is the MEP |

| | |
|-----|--|
| 010 | There is no headroom, and 3 rd partition in the burst is the MEP |
| 011 | There is no headroom, and 4 th partition in the burst is the MEP |
| 100 | Not enough headroom to increase MCS nor open new partition, and no partition in the burst is the MEP |
| 101 | Enough headroom to open 1 partition |
| 110 | Enough headroom to open 2 partitions |
| 111 | Enough headroom to increase MCS of the burst |

Bit C_1 is used for even parity check across the CQICH bits, except the HARQ bit of the 2nd partition, of the 2 partitions, such as:

$$R_0 \oplus R_1 \oplus R_2 \oplus H \oplus P_{00} \oplus P_{01} \oplus P_{10} \oplus P_{11} \oplus C_1 = 0 \quad (4)$$

At the base station, if the parity check fails or either of the HARQ bits on two partitions are equal to NACK, we assume a NACK was transmitted. During transmission, the HARQ bit of the second partition is identical to the HARQ bit of the first partition.

When there are two partitions are open, the two partitions can be placed in either one burst or two bursts. Here we recommend using one burst with two partitions. By doing this, we can reduce the PMAP overhead, and add parity check and HARQ bit repetition.

8.4.4.7.2.3.6.2.2.3 For a burst with 3 partitions

| | MSB | | LSB | | |
|-----------------------------|-------|-------|-------|----------|----------|
| | b_4 | b_3 | b_2 | b_1 | b_0 |
| <i>partition 1 of burst</i> | C_0 | R_0 | H | P_{01} | P_{00} |
| <i>partition 2 of burst</i> | C_1 | R_1 | H | P_{11} | P_{10} |
| <i>partition 3 of burst</i> | C_2 | R_2 | H | P_{21} | P_{20} |

Figure 7. CQICH bit allocation for 3 partition sub-burst

Bit C_i is used for even parity check across the CQICH bits on each partition, such as:

$$R_i \oplus H \oplus P_{i0} \oplus P_{i1} \oplus C_i = 0 \quad (5)$$

At base station, we assume that a HARQ NACK was transmitted if any of the following conditions are true:

- No partition passes parity check.
- At least one partition passes parity check, and the number of partitions with a NACK is more than or equal to the number of partition with an ACK.

This rule also applies to a burst with more than 3 partitions.

8.4.4.7.2.3.6.2.2.4 For a burst with 4 partitions

| | MSB | | LSB | | |
|-----------------------------|-------|-------|-------|----------|----------|
| | b_4 | b_3 | b_2 | b_1 | b_0 |
| <i>partition 1 of burst</i> | C_0 | R_0 | H | P_{01} | P_{00} |
| <i>partition 2 of burst</i> | C_1 | R_1 | H | P_{11} | P_{10} |
| <i>partition 3 of burst</i> | C_2 | R_2 | H | P_{21} | P_{20} |
| <i>partition 4 of burst</i> | C_3 | 1 | H | P_{31} | P_{30} |

Figure xxx. CQICH bit allocation for a 4 partition sub-burst.

The parity check bit for the first 3 partitions are defined as in (2).

The parity check bits for the 4th partition is defined as:

$$C_i \oplus 1 \oplus H \oplus P_{i1} \oplus P_{i0} = 0 \quad (6)$$

8.4.4.7.2.3.6.2.2.5 For a burst with more than 4 partitions

| | MSB | | LSB | | |
|-----------------------------|-------|-------|-------|----------|----------|
| | b_4 | b_3 | b_2 | b_1 | b_0 |
| <i>partition 1 of burst</i> | C_0 | R_0 | H | P_{01} | P_{00} |
| <i>partition 2 of burst</i> | C_1 | R_1 | H | P_{11} | P_{10} |
| <i>partition 3 of burst</i> | C_2 | R_2 | H | P_{21} | P_{20} |
| <i>partition 4 of burst</i> | C_3 | R_3 | H | P_{31} | P_{30} |
| <i>partition m of burst</i> | C_m | 1 | H | P_{m1} | P_{m0} |

Figure xxx. CQICH bit allocation for a sub-burst with more than 4 partitions (m=5, 6, 7, 8)

The parity check bit for the first 4 partitions are defined as in (2).

The parity check bit for other partitions are defined as in (3).

Table xxx. For a burst with 5 to 8 partitions

| $R_3R_2R_1R_0$ | Description |
|----------------|---|
| 0000 | There is no headroom, and 1 st partition of the burst is the MEP |
| 0001 | There is no headroom, and 2 nd partition of the burst is the MEP |
| 0010 | There is no headroom, and 3 rd partition of the burst is the MEP |
| 0011 | There is no headroom, and 4 th partition of the burst is the MEP |
| 0100 | There is no headroom, and 5 th partition of the burst is the MEP |
| 0101 | There is no headroom, and 6 th partition of the burst is the MEP |
| 0110 | There is no headroom, and 7 th partition of the burst is the MEP |
| 0111 | There is no headroom, and 8 th partition of the burst is the MEP |
| 1000 | There is no enough headroom to increase MCS nor open a new partition. |
| 1001 | Enough headroom to open 1 partition |
| 1010 | Enough headroom to open 2 partitions |
| 1011 | Enough headroom to increase MCS of the burst |
| 11xx | Not defined |

8.4.4.7.2.3.6.2.3 Definition of power control bits

There are two power control bits in each CQICH. The definition is given in Table 8 below.

Table xxx DL Power Control Step Sizes

| P_1P_0 | DL_Power_Control | $e = \text{measured_snr} - \text{target_snr}$ (mW/mW) |
|----------|----------------------------|--|
| 0 0 | Increase TX power a lot | $e < -G_{2a}$ |
| 0 1 | Increase TX power a little | $-G_{2a} \leq e < 0$ |
| 1 0 | Decrease TX power a little | $0 \leq e < G_{2a}$ |
| 1 1 | Decrease TX power a lot | $G_{2a} \leq e$ |

The value of G_{2a} is determined by SNR measurement jitter.