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Re:	Call for comments, maintenance task group
Abstract	
Purpose	
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Corrections to CINR and RSSI measurements in OFDMA PHY

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1 Problem Statement

There are several problems with the description of CINR and RSSI measurements and reporting:

1. The text does not specify to what the CINR measurement relates. Measurements on the preamble, on pilots, and even on data subcarriers of different zones, will result in totally different values due to varying boosting levels, cell loading, and reuse factor. Further, when adaptive beamforming is employed, CINR measurements will vary greatly depending on the subchannel used for measurement (due to different beamforming on different subchannels).

   The BS should specify the unique zone (by means of zone type and PRBS_ID in order to differentiate between multiple zones), and subset of major groups (for PUSC reuse-1 zone) on which the SS shall measure CINR. Specifying the subset of major groups is important for sub-sectorized reuse-1 deployments.

2. The text states that CINR is measured on "messages". It is not clear to which "messages" the text refers, as the SS is not required to decode or be aware of all messages in the frame.

3. Further, the time scale of the message time indices is not defined; as a result, the averaging parameter has no meaning.

4. It is not clear whether the averaging factor alpha applies to measurements reported through CQICH. We think that separate averaging factors should be specified for REP-RSP and for CQICH, for the following reason: While CQICH periodic reports continue, a BS may request a one-time CINR measurement through REP-RSP that relates to a different zone and for a different purpose. This implies that the averaging factor specified for the REP-RSP should not affect the averaging factor used for periodic CQICH measurements.

   In addition, the averaging factor is limited to the range 1/32…1/2 which does not permit instantaneous CINR measurement (important for H-ARQ schemes).

5. CINR estimates derived for CQICH should be kept distinct from reports triggered by REP-REQ/RSP. For example, we would want the ability to configure the CQICH to periodically report CINR on a specific zone, while triggering a one-time measurement on a different zone.

6. It is not stated to what portion of the signal the RSSI measurement should relate. The text should specify that the RSSI measurement should reflect the RSSI in the first zone.

7. The absolute accuracy of +/-2dB is too relaxed. Reuse-1 systems that operate in low SNR regions require tighter CINR tracking. The absolute accuracy requirement should be reduced to at most +/-1dB.

2 Detailed Text Changes

[Add the following text the end of section 6.3.2.2.6]

When the feedback type is '00', and no CINR type parameters were provided by a previous CQICH IE, the reported CINR estimate shall correspond to the first zone in the frame. Otherwise, the CINR type parameters provided by a previous CQICH IE shall be used.

[Modify section 6.3.17.4, page 32, beginning line 22, as follows]

6.3.~~17.4~~.18 ~~CQICH Operations~~ CINR Report Operation

[Add the following text before the 1st paragraph]

This section applies to OFDMA mode only. SS transmits CINR reports using the REP-RSP MAC message or the fast-feedback (CQICH) channel.

6.3.18.1 CINR report with REP-RSP MAC message

The REP-RSP message shall be sent by the SS in response to a REP-REQ message from the BS to report DL CINR estimation. The REP-REQ indicates the CINR type configuration, which includes the zone for which the CINR is to be estimated. The zone is identified by its type (PUSC with 'use all SC=0', PUSC with 'use all SC=1', FUSC, Optional FUSC, Band AMC, Safety channel), and PRBS ID. The BS shall not request a CINR report on a zone type that is not supported by the SS. For PUSC with 'use all SC=1', the SS may be instructed to report CINR estimate for only a subset of the major groups. See section 8.4.11 for details.

The SS may send a REP-RSP message in an unsolicited fashion. In such a case, the reported CINR shall correspond to the CINR type be as instructed in the latest REP-REQ message sent by the BS.

[All existing text within 6.3.17.4 should go under the following title (6.3.18.2)]

6.3.18.2 CINR report with Fast Feedback (CQICH) channel

[Modify the first paragraph following 6.3.17.4 as follows]

This section describes the operation scenarios and requirements of CQICH fast-feedback.~~, which is designed for H-ARQ enabled SS. After an SS turns on its power, the only appropriate subchannels that can be allocated to the MSS are normal subchannels. To determine the M/C level of normal subchannels, the average CINR measurement is enough for the BS to determine the M/C levels of uplink and downlink.~~ As soon as the BS and the SS know the capabilities of both entities modulation and coding, the BS may allocate a CQICH subchannel using a CQICH IE (CQICH Allocation IE or CQICH Control IE). The first CQICH IE sent to the SS shall indicate the CINR type configuration, which includes the zone for which the CINR is to be estimated. The zone is identified by its type (PUSC with 'use all SC=0', PUSC with 'use all SC=1', FUSC, Optional FUSC, Band AMC, Safety channel), and PRBS ID. The BS shall not request a CINR report on a zone type that is not supported by the SS. For PUSC, the SS may be instructed to report CINR estimate for only a subset of the major groups. Only a subsequent CQICH IE may update the CINR type configuration. See sections 8.4.5.4.12 and 8.4.11 for details. ~~Then, the MSS reports the average CINR of the BS preamble. From then on, the BS is able to determine the M/C level.~~ The CINR measurement encoding and quantization onto the Fast-Feedback channel is defined in section 8.4.5.4.10. ~~A CINR measurement is quantized into 16 levels and encoded into 4 information bits.~~

[Add the following entries to table 300, immediately following the 'Duration' entry]

Syntax	Size	Notes
…		
CINR type included	1 bit	
If (CINR type included == 1) {		
Zone type	3 bits	The type of zone over which CINR is to be reported 0b 000 – PUSC with 'use all SC = 0' 0b 001 – PUSC with 'use all SC = 1' 0b 010 – FUSC 0b 011 – Optional FUSC 0b 100 – Band AMC differential report 0b 101 – Safety Channel region 0b 110 – AAS zone 0b 111 – Reserved
Zone PRBS_ID	2 bits	The PRBS_ID of the zone over which CINR is to be reported
If (Zone type == PUSC with 'use all SC = 1') {		
PUSC Major group config indication	1 bit	If '0' then CINR report may refer to any subchannel in the PUSC zone.
If (Major group config indication == 1) {		
PUSC Major group bitmap	6 bits	Reported CINR shall only be estimated for the subchannels of PUSC major groups for which the corresponding bit is set. Bit #*k* refers to major group *k*.
}		
}		
}		
Averaging parameter included	1 bit	
If (Averaging parameter included == 1) {		
Averaging parameter	4 bits	Averaging parameter α_{avg} used for deriving CINR estimates reported through CQICH.
}		

[Add the following text to page 85, line 47]

CINR type included
Indicates whether an update to the CQI configuration exists in the IE. A value of '0' indicates that the SS shall perform CINR measurements using the latest received CQI configuration.

[Add the following text at the end of section 8.4.11.2]

The message time index is incremented every frame. The reported RSSI value shall be an estimate of the total received power over the subcarriers belonging to the segment's clusters in the first zone of the frame.

[Modify the text in section 8.4.11.3 as follows]

When CINR measurements are mandated by the BS, an SS shall obtain a CINR measurement (implementation-specific). From a succession of these measurements, the SS shall derive and update estimates of the mean and/or the standard deviation of the CINR, and report them via REP-RSP messages and/or report the estimate of the mean of the CINR via the fast-feedback channel (CQICH).

Mean and standard deviation statistics for CINR shall be reported in units of dB. To prepare such reports, statistics shall be quantized in 1 dB increments, ranging from a minimum of –10 dB (encoded 0x00) to a maximum of 53 dB (encoded 0x3F). Values outside this range shall be assigned the closest extreme value within the scale.

The method used to estimate the CINR of a single message is left to individual implementation, but the relative and absolute accuracy of a CINR measurement derived from a single message shall be ± ~~1~~ ½ dB and ± ~~2~~ 1 dB, respectively. The specified accuracy shall apply to the range of CINR values starting from 3 dB below SNR of the most robust rate, to 10 dB above the SNR of the least robust rate. See Table 336. In addition, the range over which these single-packet measurements are measured should extend 3 dB on each side beyond the –10 dB to 53 dB limits for the final reported, averaged statistics.

The reported CINR shall be an estimate of the CINR over the data subcarriers of the zone on which CINR reporting was instructed by the CQICH IE or by the REP-RSP message. The CINR value shall refer to non-boosted data subcarriers. When repetition code is applied it is considered part of the coding, and the CINR value doesn't include the SNR improvement resulting from repetition. If the BS instructs CINR reporting on an AAS zone, then the SS shall report the estimate of the CINR on data subcarriers of slots allocated it.

The reported value should be computed such that the SS reporting CINR value higher or equal to a C/N value appearing in table 332 (Normalized C/N per modulation) is able to demodulate data in the respective modulation and coding rate in a flat AWGN channel with the same average SNR per subcarrier with BER 10^{-6}. For example, a SS reporting CINR=6dB should be able to decode QPSK rate 1/2 in a flat channel with SNR=6dB per subcarrier.

[Add the following text at the end of section 8.4.11.3]
The message time index is incremented every frame. The SS shall maintain separate message time index counters and mean CINR estimates for REP-RSP-based reports and for Fast-

Feedback-based reports. When the CINR type is changed, the SS shall reset the corresponding message time index to zero.

Unless specified otherwise, the default averaging parameter (α_{avg}) is ¼. When the averaging parameter (α_{avg}) is given to a SS through REP-REQ, this value shall only be used for deriving CINR estimates reported through REP-RSP, and can further only be changed through another REP-REQ message. When the averaging parameter is given to a SS through the CQICH_Alloc_IE, this value shall only be used for deriving CINR estimates through Fast-Feedback channel (CQICH), and can further only be changed through another CQICH_Alloc_IE.

[Modify the 2nd table in section 11.11 (REP-REQ) as follows]

11.11 REP-REQ management message encodings

Report type	1.1	1	Bit #0 =1 Include DFS Basic report Bit #1 =1 Include CINR report Bit #2 =1 Include RSSI report Bit #3–6 α_{avg} \ in multiples of 1/~~32~~ 16 (range ~~[1/32, 16/32]~~ [1/16,16/16]) Bit #7 =1 Include current transmit power report
Channel number	1.2	1	Physical channel number (see 8.5.1) to be reported on. (license-exempt bands only)
~~Channel~~ CINR type request	1.3	~~1~~ 2	~~00 = Normal subchannel,~~ ~~01 = Band AMC Channel,~~ ~~10 = Safety Channel,~~ ~~11 = Reserved,~~ Bit #0 = 1: Report the CINR estimate for PUSC zone with 'use all SC=0' Bit #1 = 1: Report the CINR estimate for PUSC zone with 'use all SC=1' Bit #2 = 1: Report the CINR estimate for FUSC Bit #3 = 1: Report the CINR estimate for Optional FUSC Bit #4 = 1: Report the differential CINR estimate for band AMC Bit #5 = 1: Report the CINR estimate for Safety Channel region Bit #6 = 1: Report the CINR estimate for AAS zone Bit #7: Reserved (shall be set to 0) Bits #8-9: PRBS_ID of the zone for which CINR should be estimated. Ignored for Safety Channel. Bits #10-15: When bit #1 is '1', reported CINR shall only be estimated for the subchannels of PUSC major groups for which the corresponding bit is set. Bit #*(k+10)* refers to major group *k*. Ignored if bit #1 is '0'.

[Modify the 3rd table in section 11.12 (REP-RSP) as follows]

REP-REQ CINR ~~Channel~~ Type request	Name	Type	Length	Value
~~Channel type=00~~	~~Normal subchannel Report~~	~~2.1~~	~~1~~	~~First 5 bits for the CINR measurement report and the rest for don't care~~
~~Channel type=01~~	~~Band AMC Report~~	~~2.2~~	~~5~~	~~First 12 bits for the band indicating bitmap and Next 25 bits for CINR reports (5 bits per each band)~~
~~Channel type=10~~	~~Safety Channel Report~~	~~2.3~~	~~5~~	~~The first 20 bits for the reported bin indices and the next 20 bits for CINR reports (5bits for each bin)~~

Bit #0 = 1	PUSC zone with 'use all SC=0'	2.1	1	Bit #0-4: CINR estimate for PUSC zone with 'use all SC=0' and PRBS_ID indicated by 'CINR type request' bits #8-9. Bit #5-7: reserved
Bit #1 = 1	PUSC zone with 'use all SC=1'	2.2	1	Bit #0-4: CINR estimate for PUSC zone with 'use all SC=1' and PRBS_ID indicated by 'CINR type request' bits #8-9. CINR reported corresponds to a subset of major groups as specified in 'CINR type request' bits #10-15. Bit #5-7: reserved
Bit #2 = 1	FUSC zone	2.3	1	Bit #0-4: CINR estimate for FUSC zone with PRBS_ID indicated by 'CINR type request' bits #8-9 Bit #5-7: reserved
Bit #3 = 1	Optional FUSC zone	2.4	1	Bit #0~4: CINR estimate for Optional FUSC with PRBS_ID indicated by 'CINR type request' bits #8-9zone and PRBS_ID indicated by 'CINR type request' bits #8-9.
Bit #4 = 1	Differential report for Band AMC	2.5	5	CINR estimate for Band AMC zone with PRBS_ID indicated by 'CINR type request' bits #8-9. First 12 bits for the band indicating bitmap and Next 25 bits for CINR reports (5 bits per each band). Bit#37-39: reserved.
Bit #5 = 1	Safety channel	2.6	5	The first 20 bits for the reported bin indices and the next 20 bits for CINR reports (5 bits for each bin).

[Add the following text at the end of section 11.12]

For the type 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, the following 5 bit CINR measurement encoding shall be used:

$$Payload\ bits = \begin{cases} 0, & CINR \le -3dB \\ n, & (n-4) < CINR \le (n-3), \quad 0 < n < 31 \\ 31, & CINR > 27 \end{cases}$$