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Title	**OLPC Mode 1 Control Channel SINR Targets (Section 15.3.9.4.1)**
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Abstract	In Mode 1 UL OLPC, the text as written has several problems: 1) SINR_min as currently applied varies with the number of receive antennas and thus requires a larger range of expression; 2) SINR_min can be violated in some cases; 3) the equation contains no maximum SINR limit; 4) control transmissions use the same target as data transmissions, which is likely not what was intended. This submission discusses these problems and proposes solutions.
Purpose	Discuss and adopt
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OLPC Mode 1 Control Channel SINR Targets (Section 15.3.9.4.1)

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1. Introduction

Section 15.3.9.4.1, UL Open-loop Power Control, contains this equation:

$$SINR_{Target} = \begin{cases} 10\log 10\left(max\left(10^{\wedge}\left(\frac{SINR_{MIN}(dB)}{10}\right), \gamma_{IoT} \times SINR_{DL} - \alpha\right)\right) - \beta \times 10\log 10(TNS), & OLPC\ Mode\ 1 \\ C/N, & OLPC\ Mode\ 2 \end{cases}$$

(273)

As discussed in submission C802.16m-09/2534, the Mode-1 line of this equation may be written more simply (with errors corrected) as:

$$SINR_{T\arg et} = \max[SINR_{MIN}, \gamma_{IoT} \times SINR_{DL} - db(\alpha)] - \beta \times db(TNS)$$

where
$$db(x) \equiv 10\log_{10}(x)\ \text{and}\ \ undb(x) \equiv 10^{x/10}.$$

We will use this notation in the presentation that follows since it is relatively easy to understand.

2. Application of SINR_min

To save signalling bits, it is desirable to keep the required range of $SINR_{MIN}$ as small as possible. In the equation as currently written, $SINR_{MIN}$ is compared (in the max[]) to a term that contains $-db(\alpha)$. This expands the required range of $SINR_{MIN}$ by 12 dB since $db(\alpha)$ can vary from 0 to 12. This problem can be addressed by modifying the equation as follows:

$$SINR_{T\arg et} = \max[SINR_{MIN} - db(\alpha), \gamma_{IoT} \times SINR_{DL} - db(\alpha)] - \beta \times db(TNS)$$

We may now interpret $SINR_{MIN}$ as a post-combine limit; this reduces its range since a post-combine SINR limit follows more-or-less directly from the sensitivity of the desired minimum MCS but does not depend on the number of receive antennas.

However, this equation is still not correct because the $\beta \times db(TNS)$ term is outside the max[]; consequently this term can reduce the target below the limit set by $SINR_{MIN}$, defeating the purpose of the limit. The fix is to pull the term inside the max[], leading to:

$$SINR_{T\arg et} = \max[SINR_{MIN} - db(\alpha), \gamma_{IoT} \times SINR_{DL} - db(\alpha) - \beta \times db(TNS)]$$

or equivalently,

$$SINR_{T\arg et} = \max\left[SINR_{MIN}, \gamma_{IoT} \times SINR_{DL} - \beta \times db(TNS)\right] - db(\alpha)$$

This makes sense; everything inside the max[] can now be viewed as a post-combine SINR, and the correction factor $-db(\alpha)$ outside the max[] converts that post-combine value to a pre-combine target.

3. Maximum SINR limit

The Mode-1 equation does not contain an upper limit on the SINR target. An upper limit would be desirable, both to control interference and to prevent overloading the ABS receiver. It is easy to add such a limit to the equation, as follows:

$$SINR_{T\arg et} = \min\left[SINR_{MAX}, \max\left[SINR_{MIN}, \gamma_{IoT} \times SINR_{DL} - \beta \times db(TNS)\right]\right] - db(\alpha)$$

4. Control transmissions in Mode 1

Clearly the intent of Mode 1 is to modulate the $SINR_{T\arg et}$ for data transmissions as a function of DL SINR.

However, it is not correct to also modulate the SINR target for control transmissions (ACK/NACK, CQI, P/S-FBCH, etc.). Each type of control signalling will have a relatively fixed CINR requirement. In Mode 1, the C/N targets for control transmission should be taken from Table 896.

5. Proposed Text Changes

 [Modify the first case in equation 273 on p.512 to read]

$\min\left[SINR_{MAX}, \max\left[SINR_{MIN}, \gamma_{IoT} \times SINR_{DL} - \beta \times db(TNS)\right]\right] - db(\alpha)$, OLPC Mode 1 data transmission

[Modify the second case in equation 273 on p.512 to read]

C/N, OLPC Mode 2 or OLPC Mode 1 control transmission

[Insert under line 50 on p.512 the definition]

$$db(x) \equiv 10\log_{10}(x)$$

[Add below line 53 on p.512]

$SINR_{MAX}$ is the SINR requirement for the maximum rate expected by the ABS. It has TBD bits to represent the values {TBD}.

[Modify line 4 on p. 513 as shown]

aggregated number of streams. ~~In case of control channel transmission, this value shall be set to one.~~