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Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	**Text and Table for Draft 802.16m Evaluation Methodology: Link Budget Template**	
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Re:	IEEE 802.16m-07/039r1– Call for Comments on Draft 802.16m Evaluation Methodology Document	
Abstract	This document contains proposed text for the draft evaluation methodology for IEEE 802.16m technical proposals.	
Purpose	For discussion and approval by TGm	
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Text and Table for Draft 802.16m Evaluation Methodology:

Link Budget Template

Text Proposal

----------*Start of the text*----------

[Add the following references after the line#13 of the page 15 in C802.16m-07/037]

[1]. ITU-R recommendation M.1225, 'Guidelines for evaluation of radio transmission technologies for IMT-2000' (1997)

[2]. IEEE 802.16 Evaluation Methodology Document, IEEE C802.16m-07/080r3, August 28, 2007, IEEE 802.16 Broadband Wireless Access Working Group.

[3]. Mobile WiMAX – Part 1: A Technical Overview and Performance Evaluation, WiMAX Forum , February 21, 2006

[4]. ITU-R 'Additional technical details supporting IP-OFDMA as an IMT-2000 terrestrial radio interface', Revision 1 to Document 8F/1079-E, Radiocommunication Study Groups, January 10,2007.

[5]. http://www.wimaxforum.org/technology/WiMAX_IMT_2000/

[6]. 8F/1079r1: Section 2.3.4 on Link Budget

[7]. 8F/1347: Clarifications Regarding OFDMA TDD WMAN Link Budget

----------*End of the text*----------

----------Start of the text----------

[Add text and Table: after line 32 of the page #116 in C802.16m-07/037]

13.1.1.1.1. Link Budget Template

The link budget template, as shown in **Table 1**, is adopted from ITU-R recommendation M 1225 [1] with additions and modifications of some entries in the table to reflect possible system operations and characteristics might be exploited or considered in 802.16m system but are not considered in the M.1225 document [2-7].

The gains or margins parameters that are not in the entries of M.1225 link budget template but are considered in **Table 1** are:

13.1.1.1.1.1 Pilot boosting loss

It is the attenuation of data sub-carriers to offset the power boosting of the pilot carriers.

13.1.1.1.1.2 Penetration margin

In the indoor transmission environment, or outdoor to indoor transmission, the penetration margin is the loss due to the signal transmits through the building or through the floors.

13.1.1.1.1.3 Coding gain

The gain is realized due to the channel coding by using repetition diversity technique.

This gain should not be double counted, for example, if this coding gain is already included in the Req. S/(N+I) entry then it should not be included here.

13.1.1.1.1.4 Occupied bandwidth by data burst

A partial number of available sub-channels are allocated for the data burst in the transmission, and consequently it has associated sub-channelization gain due to the total available power is concentrated on the allocated sub-channels. The occupied bandwidth by data burst is the product of the sub-channel bandwidth and the number of sub-channels allocated for the data burst.

We also need to pay particular attentions to the following entries in the table:

13.1.1.1.1.5 Required S/ (N+I)

This is the required signal to noise plus interference ratio required to meet certain system performance requirement, such as the Packet Error Rate (PER). In this requirement specification it usually identifies the S/(N+I) required with certain modulation technique and FEC coding method exploited, e.g. the S/(N+I) required with QPSK 1/2 modulation and coding techniques to meet the 10^-3 PER.

13.1.1.1.1.6 Log-normal and fast fading margin

The log-normal fade margin is defined at the cell boundary for isolated cells. This is the margin required to provide specified coverage availability over the individual cells.
When fast fading effect is not included in the Required S/(N+I) entry, it can be added the fast fading model on top of the log-normal shadowing fading model as described. This parameter is modified from the parameter considered in M1225 [1] which is considered only the log-normal margin.

13.1.1.1.1.7 Other gain

Other gain or margin not listed or considered in the table can be included in this column, such as the Cyclic Shift Transmit Diversity (CSTD) gain if it is used but not considered in the Required S/(N+I) entry.
Hybrid Automatic Repeat reQuest (HARQ) is also a gain that can be included in this entry if this technique is used, and if this gain is not already considered in the Required S/(N+I) entry..

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Table 1 Link Budget Template		
Item	Downlink	Uplink
Test Environment /Test Service		
Multipath channel class	A, B	A, B
Mobile speed	km/h	km/h
Data burst rate	Bits/s	Bits/s
Sub-channel bandwidth	Hz	Hz
Number of Sub-channels used (by data burst)		
(a) Maximum transmitter power per data burst	dBm	dBm
(b) Cable, connector, and combiner losses (enumerate sources)	dB	dB
(c) Transmitter antenna gain	dBi	dBi
(d) **Transmitter EIRP = (a – b + c)**	dBm	dBm
(e) Receiver antenna gain	dBi	dBi
(f) Cable and connector losses	dB	dB
(g) Receiver noise figure	dB	dB
(h) Thermal noise density (H) (linear units)	–174 dBm/Hz 3.98×10^{-18} mW/Hz	–174 dBm/Hz 3.98×10^{-18} mW/Hz
(i) Receiver interference density (I) (linear units)	dBm/Hz mW/Hz	dBm/Hz mW/Hz
(j) **Total effective noise plus interference density = 10 log ($10^{((g + h)/10)}$ + I)**	dBm/Hz	dBm/Hz
(k) Occupied bandwidth per data burst (10 log (BW)) = 10 log (number of sub-channels x sub-channel bandwidth)	dB(Hz)	dB(Hz)
(l) Required S/(N+I)	dB	dB
(m) **Receiver sensitivity = (j + k + l)**	dB	dB
(n) Hand-off gain	dB	dB
(o) Explicit diversity gain	dB	dB
(p) Other gain	dB	dB
(q) Log-normal & fast fade margins	dB	dB
(r) Pilot boosting loss	dB	dB
(s) Penetration margin	dB	dB
(t) Coding gain	dB	dB
(u) **Maximum path loss = {d – m + e – f + n + o + p - q - r – s + t }**	dB	dB
(v) Maximum range	m	m
(w) Coverage Efficiency	sq m/site	sq m/site

2 ----------*End of the text*----------

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