Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/1(**
Title	**Proposed Revision to Section B.3 (SC PHY Link Budget Analysis)**
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Re:	Proposal to revise Section B.3 of document IEEE P802.16a/D1-2001 with provided text.
Abstract	The Link budget given in Tables 265 and 266 are being revised in Section B.3 of document IEEE P802.16a/D1-2001. This contribution simplifies and provides more accurate and comprehensive link budget results.
Purpose	Incorporate provided text as revision of Section B.3 of document IEEE P802.16a/D1-2001.
Notice	
Release	
Patent Policy and Procedures	

Revision of SC PHY Link Budget Analysis

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Introduction:

The objective of this contribution is to present a typical link budget for single carrier systems with parameters close to a feasible scenario for Uplink and Downlink transmission and reception. In the existing Appendix B.3, there are two link budget tables with some redundant information that are being reworked carefully to reflect more accurate and comprehensive link budget data. Therefore, we propose to replace Section B.3 of the existing document with the following section.

B.3: SC PHY LINK Budget Analysis

This annex is informative only.

A complete link budget analysis was performed by combining various channel bandwidths and QAM constellations with the channel models found in [B64]. Two examples of the path loss versus propagation radius for Category C of the propagation model in [B64], assuming a 30 m and 80 m BS antenna and 6.5 m SS antenna, are shown in Figures 248a and 248b.

For reference, an example set of parameters that fully specify model categories A, B, and C in [B64] are listed in Table 264.

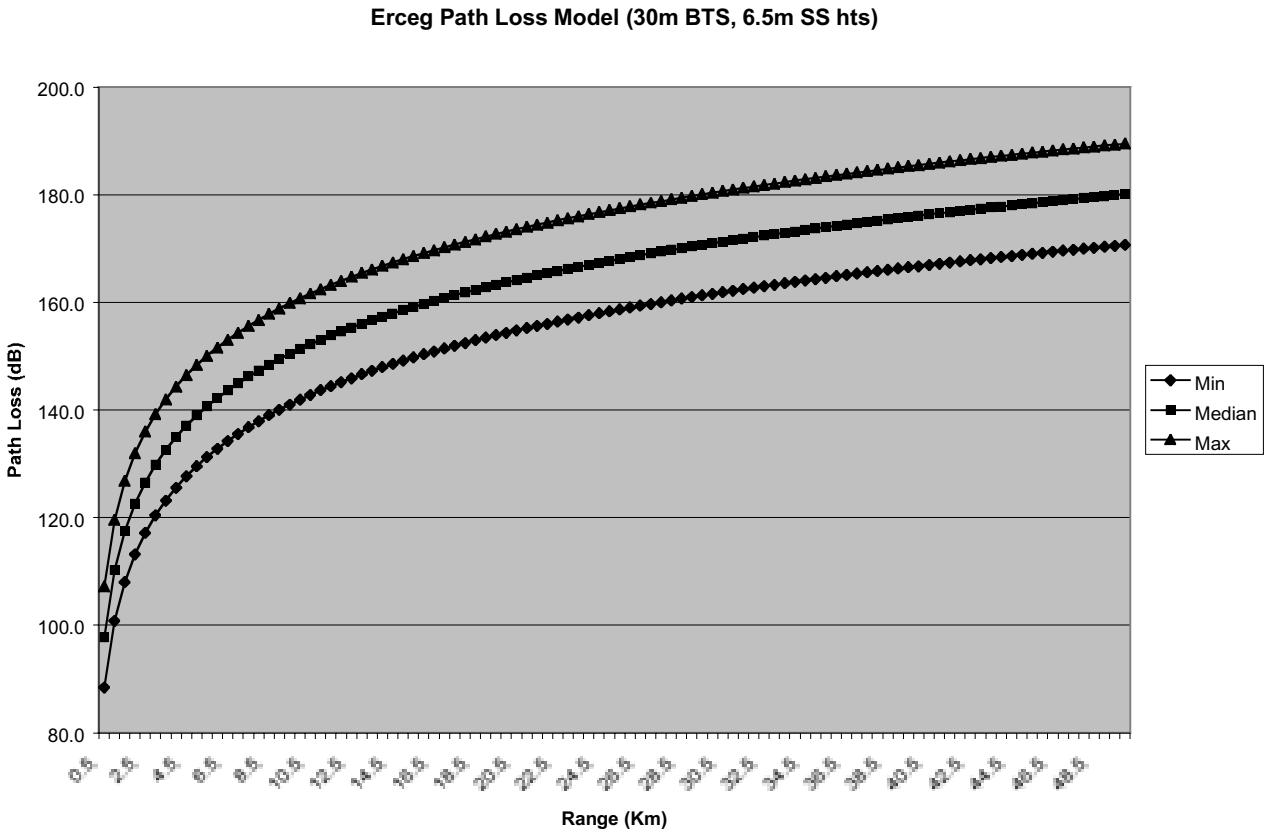

Figure 248a Path Loss Model for 30 m Base Station antenna height.

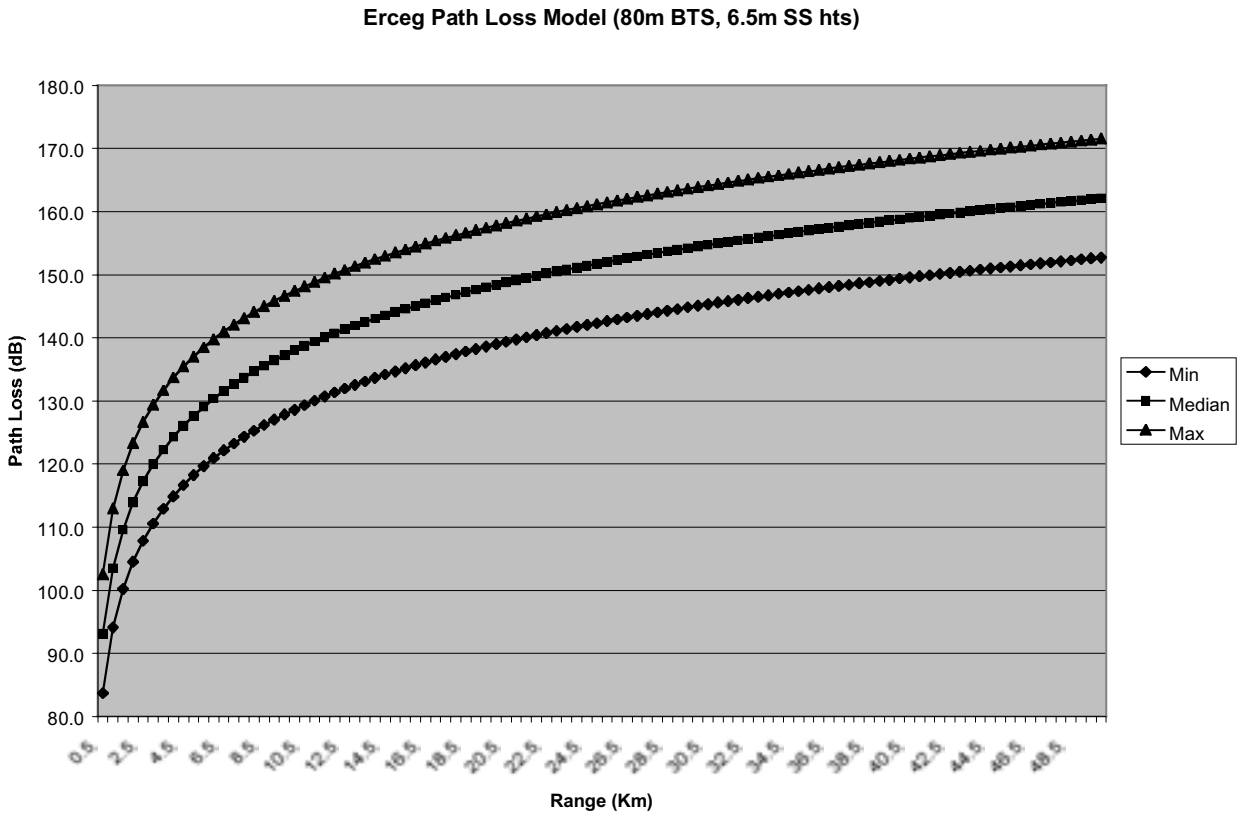

Figure 248b Path Loss Model for 80 m Base Station antenna height.

Table 264 Sample set of parameters for A, B, and C channel model categories

Parameters	Category		
	C	B	A
	Flat, few trees	Intermediate	Hilly, heavy trees
a	3.6	4	4.6
b	0.005	0.0065	0.0075
c	20	17.1	12.6
°			
Channel frequency (GHz)	3.5		
Wavelength _ (m)	0.085714		
Receiver antenna height h= (m)	6.5		
(hb is the height of the base station antenna in m) hb=	30		
Gama =(a —b hb +c /hb) Gama =	4.116667	4.375	4.795
A =20 log10 (4 „ d0 /_)(_ being the wavelength in m)	83.32313		
s= (dB)	9.4		
PL =A + 10 Gama log10 (d/d0) + DPl + DPh ± s for d >d0,			
4/3 Earth Line of Sight= (km)	32.5		

Using the parameter settings for Category C of Table 264, **median** path losses are being generated for NLOS conditions. Evaluating these path loss figures as a function of distance, the minimum path length necessary to reliably deliver QPSK and 16QAM, on both UL (1.5 MHz channel) and DL (6 MHz channel), were computed.

Tables 265 and 266 capture the results of these calculations, for a typical SC system. The results presented here are link budget for two SC systems with 30 m and 80 m BTS antenna heights and for BTS coverage of 7 Km. In addition, similar results are presented in Table 267 for the SC system with 30 m BTS antenna height and for a 3.5 Km coverage. For comparison purposes, corresponding link budget results for LOS scenarios are also provided.

These results assume that SC system have the same CINR requirements for QPSK and 16-QAM at their receivers.

Table 265 Typical Link Budget for SC system with 16QAM Downlink (6 MHz) and QPSK Uplink (1.5 MHz) with Base Station antenna height=30 m and 7 km coverage.

	Single Carrier Systems (NLOS)		Single Carrier Systems (LOS)	
Bandwidth	**6.0** MHz		**6.0** MHz	
Modulation type / Target SNR with FEC gain	**16QAM** 14 dB		**16QAM** 14 dB	
Downstream				
EIRP (BTS)	43.0 dBm	20 w	43.0 dBm	20 w
Antenna Gain	13.0 dB		13.0 dB	
Back off	10.0 dB		10.0 dB	
Nominal 1 dB compression point	40.0 dBm	**10 w**	40.0 dBm	**10 w**
Path distance for targeted SNR	**7.0 km**		**7.0 km**	
Associated Path Loss (from 802.16.3c-29r1)	-150.5 dB		-120.2 dB	
Receive Antenna gain	18.0 dB		18.0 dB	
Power at Input to Receiver	-89.5 dBm		-59.2 dBm	
Receiver Noise Figure	5.0 dB		5.0 dB	
Equivalent Noise Power in channel BW	-101.2 dBm		-101.2 dBm	
SNR, Calculated	**11.7 dB**		**42.0 dB**	
Bandwidth	**1.5** MHz		**1.5** MHz	
Modulation type / Target SNR with FEC gain	**QPSK** 12 dB		**QPSK** 12 dB	
EIRP (SS)	34.0 dBm	3 w	34.0 dBm	3 w
Antenna Gain	13.0 dB		13.0 dB	
Back off	5.0 dB		5.0 dB	
Nominal 1 dB compression point	26.0 dBm	**0.40 w**	26.0 dBm	**0.40 w**
Path distance for targeted SNR	**7.0 km**		**7.0 km**	
Associated Path Loss (from 802.16.3c-29)	-150.5 dB		-120.2 dB	
Receive Antenna gain	18.0 dB		18.0 dB	
Power at Input to Receiver	-98.5 dBm		-68.2 dBm	
Receiver Noise Figure	4.0 dB		4.0 dB	
Equivalent Noise Power in channel BW	-108.2 dBm		-108.2 dBm	
SNR, Calculated	**9.7 dB**		**40.0 dB**	

Table 266 Typical Link Budget for SC system with 16QAM Downlink (6 MHz) and QPSK Uplink with Base Station antenna height=80 m and 7 km coverage.

	Single Carrier Systems (NLOS)		Single Carrier Systems (LOS)	
Bandwidth	**6.0** MHz		**6.0** MHz	
Modulation type / Target SNR with FEC gain	**16QAM** 14 dB		**16QAM** 14 dB	
Downstream				
EIRP (BTS)	43.0 dBm	20 w	43.0 dBm	20 w
Antenna Gain	13.0 dB		13.0 dB	
Back off	10.0 dB		10.0 dB	
Nominal 1 dB compression point	40.0 dBm	**10 w**	40.0 dBm	**10 w**
Path distance for targeted SNR	**7.0 km**		**7.0 km**	
Associated Path Loss (from 802.16.3c-29r1)	-138.2 dB		-120.2 dB	
Receive Antenna gain	18.0 dB		18.0 dB	
Power at Input to Receiver	-77.2 dBm		-59.2 dBm	
Receiver Noise Figure	5.0 dB		5.0 dB	
Equivalent Noise Power in channel BW	-101.2 dBm		-101.2 dBm	
SNR, Calculated	**24.0 dB**		**42.0 dB**	
Bandwidth	**1.5** MHz		**1.5** MHz	
Modulation type / Target SNR with FEC gain	**QPSK** 12 dB		**QPSK** 12 dB	
EIRP (SS)	34.0 dBm	3 w	34.0 dBm	3 w
Antenna Gain	13.0 dB		13.0 dB	
Back off	5.0 dB		5.0 dB	
Nominal 1 dB compression point	26.0 dBm	**0.40 w**	26.0 dBm	**0.40 w**
Path distance for targeted SNR	**7.0 km**		**7.0 km**	
Associated Path Loss (from 802.16.3c-29)	-138.2 dB		-120.2 dB	
Receive Antenna gain	18.0 dB		18.0 dB	
Power at Input to Receiver	-86.2 dBm		-68.2 dBm	
Receiver Noise Figure	4.0 dB		4.0 dB	
Equivalent Noise Power in channel BW	-108.2 dBm		-108.2 dBm	
SNR, Calculated	**22.0 dB**		**40.0 dB**	

Table 267 Typical Link Budget for SC system with 16QAM Downlink and QPSK Uplink with Base Station antenna height=30 meters and for 3.5 km coverage.

	Single Carrier Systems (NLOS)		Single Carrier Systems (LOS)	
Bandwidth	**6.0** MHz		**6.0** MHz	
Modulation type / Target SNR with FEC gain	**16QAM** 14 dB		**16QAM** 14 dB	
Downstream				
EIRP (BTS)	43.0 dBm	20 w	43.0 dBm	20 w
Antenna Gain	13.0 dB		13.0 dB	
Back off	10.0 dB		10.0 dB	
Nominal 1 dB compression point	40.0 dBm	**10 w**	40.0 dBm	**10 w**
Path distance for targeted SNR	**3.5 km**		**3.5 km**	
Associated Path Loss (from 802.16.3c-29r1)	-138.1 dB		-114.2 dB	
Receive Antenna gain	18.0 dB		18.0 dB	
Power at Input to Receiver	-77.1 dBm		-53.2 dBm	
Receiver Noise Figure	5.0 dB		5.0 dB	
Equivalent Noise Power in channel BW	-101.2 dBm		-101.2 dBm	
SNR, Calculated	**24.1 dB**		**48.0 dB**	
Bandwidth	**1.5** MHz		**1.5** MHz	
Modulation type / Target SNR with FEC gain	**QPSK** 12 dB		**QPSK** 12 dB	
EIRP (SS)	34.0 dBm	3 w	34.0 dBm	3 w
Antenna Gain	13.0 dB		13.0 dB	
Back off	5.0 dB		5.0 dB	
Nominal 1 dB compression point	26.0 dBm	**0.40 w**	26.0 dBm	**0.40 w**
Path distance for targeted SNR	**3.5 km**		**3.5 km**	
Associated Path Loss (from 802.16.3c-29)	-138.1 dB		-114.2 dB	
Receive Antenna gain	18.0 dB		18.0 dB	
Power at Input to Receiver	-86.1 dBm		-62.2 dBm	
Receiver Noise Figure	4.0 dB		4.0 dB	
Equivalent Noise Power in channel BW	-108.2 dBm		-108.2 dBm	
SNR, Calculated	**22.1 dB**		**46.0 dB**	

Note1. The target SNR is assumed for the case of applying Concatenated Reed-Solomon and Convolutional coding or Turbo coding ($\geq$ 6.0 dB Gain at 10^{-6}).

Note2. Antenna gain in the above two tables include **-1.5 dB** RF loss.

Note 3: All above-mentioned link budget results do not include Frequency Domain Equalization gain.