

# Long TTI Size in the IEEE 802.16m

## IEEE 802.16 Presentation Submission Template (Rev. 9)

Document Number:

IEEE C802.16m-09/0536

Date Submitted:

2009-03-02

Source:

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Venue:

“802.16m AWD”

IEEE 802.16m-09/0012, “Call for Contributions on Project 802.16m Amendment Working Document (AWD) Content”

– Call for Comments on Amendment Working Document.

Base Contribution:

None

Purpose:

To be discussed and adopted by TGM for the 802.16m amendment

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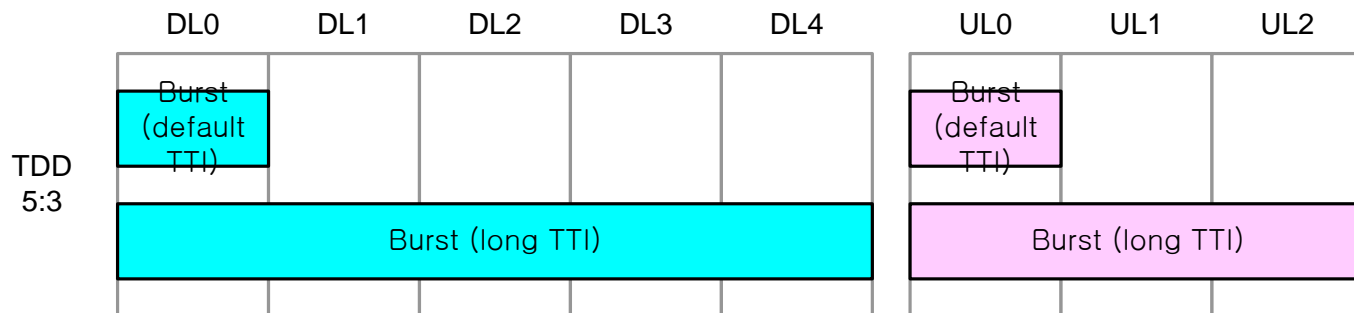
# Long TTI Size in the IEEE 802.16m

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March 2009

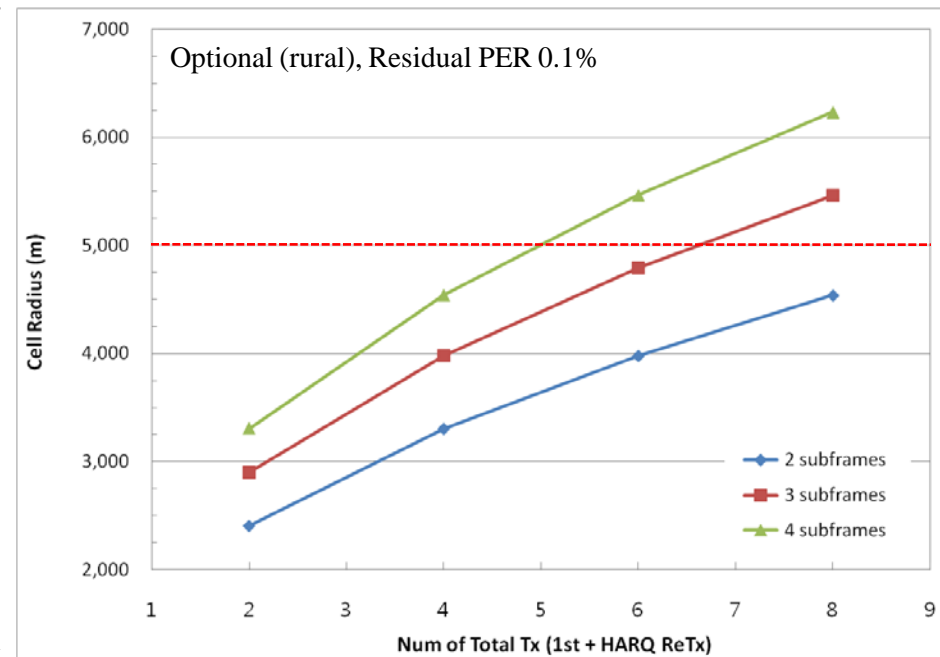
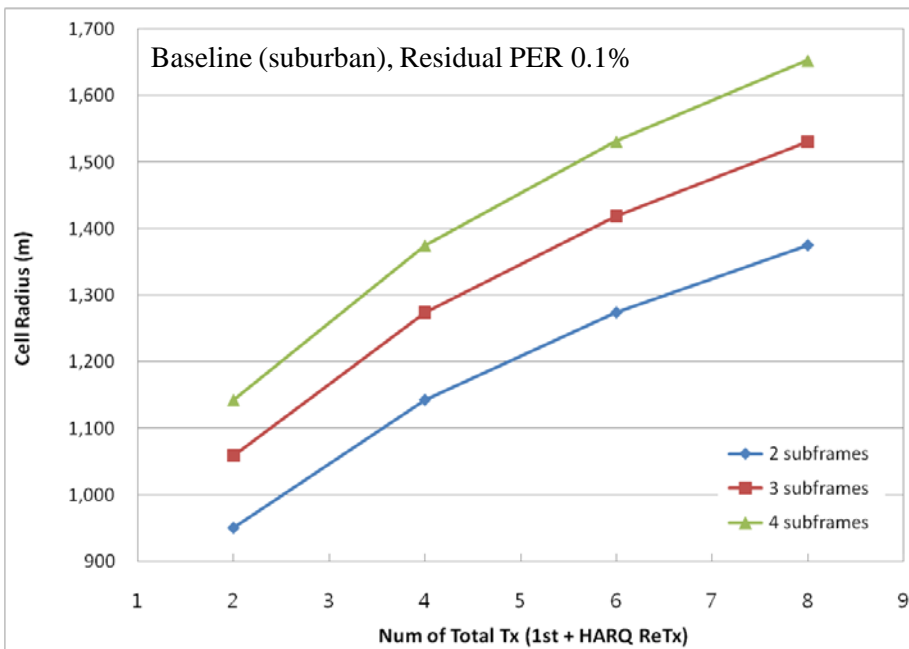
# Long TTI Support in 802.16m

- Default TTI size in the current SDD = 1 subframe
- Motivation of a long TTI
  - To improve Link budget (particularly, in UL)
  - Longer time duration for the band AMC operation (particular, in DL)
  - A large packet transmission w/o fragmentation (particularly, in DL)
- Proposal in this contribution
  - TTI size = 1 subframe (default) or  $N$  subframe (long)  $\Rightarrow$  **2 options only**
  - Long TTI in FDD: 4 subframe for both DL and UL
  - Long TTI in TDD: the whole DL(UL) subframes for DL (UL)



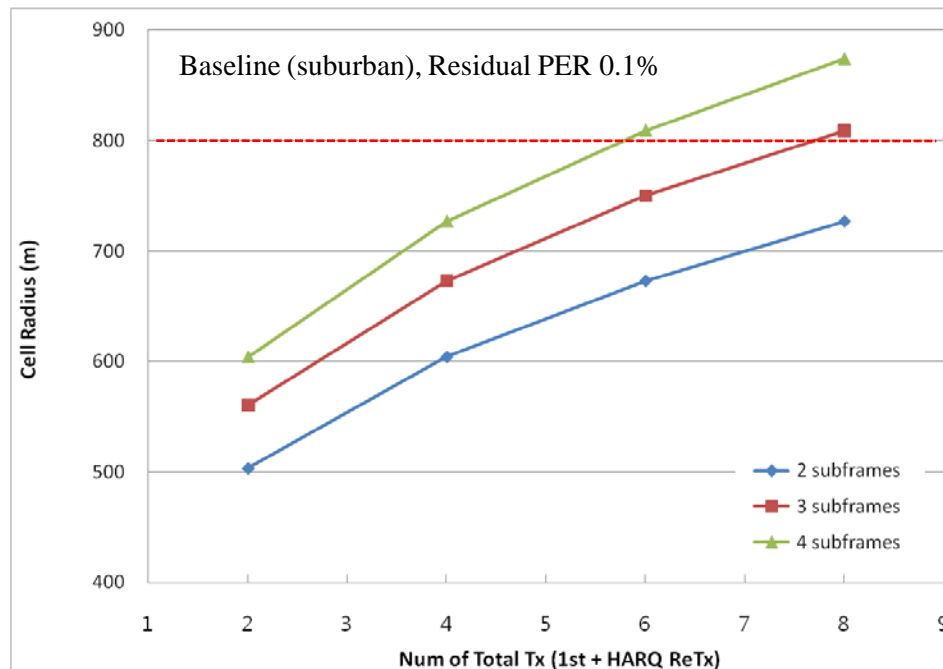
# Link Budget in Uplink

- Assumption for link budget calculation
  - Packet size = 48 byte (VoIP, MOB\_MSHO-REQ, ...), QPSK  $\frac{1}{2}$   $\Rightarrow$  need 4 RB
  - So, 4 subframes TTI  $\rightarrow$  need 1 SubCH, 2 subframes TTI  $\rightarrow$  need 2SubCHs, 3 subframes TTI  $\rightarrow$  need approximately 1.33SubCHs on the freq domain.
- Observation in Case1 (Isolated Cell)
  - To meet the **SRD requirement of 5km** in rural, TTI should be equal to or larger than **3 subframes**



# Link Budget in Uplink (cont'd)

- Observation in Case2 (Multi-cell)
  - Include other cell interference :  $(I+N)/N \approx I/N = 10\text{dB}$
  - To support a cell with over **800m radius** in the baseline environment (ISD=1.5km), TTI should be equal to or larger than **3 subframes**
  - ❖ 4 subframes is more desirable for the long TTI



# Long TTI Tx in Downlink

## ① Band AMC operation

- Longer time duration is more efficient than more subCHs, for a low speed mobile.
- Note: coherence time of low speed MS (3km/h)  $\gg$  1 frame (5ms)

## ② Large packet transmission

- A survey shows that a long packet in the Internet traffic ...
  - 1500 byte: about 18% of total Internet traffic
- Number of the required subframes to transmit 1500 byte packet

	16QAM $\frac{1}{2}$	QPSK $\frac{1}{2}$	QPSK $\frac{1}{4}$
1500 bytes	1.3	2.6	5.2

- Note: total data tones per subframe:  $48 \times 96 = 4608$
  - In order to transmit 1500 bytes (QPSK  $\frac{1}{2}$ ) without fragmentation, a TTI longer than 2 subframes is needed
- ❖ Considered the observations above and a balance between DL and UL, we propose 4 subframes for the long TTI size in DL.

# Concluding Remarks

- Proposed Long TTI size
  - One size for long TTI
  - FDD: 4 subframes for both DL and UL
  - TDD: The whole DL (UL) subframes for DL (UL)
- Rationale
  - Improve a UL link budget
  - Increase the efficiency of the band selection operation
  - A large packet transmission without fragmentation
- This long TTI transmission shall be considered in design of ...
  - A-MAP relevance and HARQ timing
  - An indication of TTI size in A-MAP IE

# Proposed Text for Inclusion into AWD

***[Remedy 1: Insert the following text into line 34 on the page 7, in Section 3]***

----- Text Start -----

**3.xx transmission time interval (TTI):** The duration of the transmission of the physical layer encoded packet over the radio air interface and is equal to an integer number of subframes. The default TTI is 1 subframe.

----- Text End -----

***[Remedy 2: Insert the following text into line 55 on the page 14, in Section 15.3.3.1]***

----- Text Start -----

A data burst shall occupy either one subframe (i.e. the default TTI transmission) or contiguous multiple subframes (i.e. the long TTI transmission). The long TTI in FDD shall be 4 subframes for both DL and UL. The long TTI in TDD shall be the whole DL (UL) subframes for DL (UL) in a frame.

----- Text End -----



# Appendix: UL link budget table

Baseline (suburban), Residual PER ≤ 0.1%, TTI = 4subframes

Parameter	unit	UL: TTI = 4subframes				Equation
		4 times Tx	6 times Tx	8 times Tx	Note	
MS Tx Power	mW	200.0	200.0	200.0		
	dBm	23.0	23.0	23.0		A
MS Cable Loss	dB	0.0	0.0	0.0		B
Body Loss	dB	0.0	0.0	0.0		C
MS Tx Antenna Gain	dBi	0.0	0.0	0.0		D
<b>TX EIRP</b>	dBm	<b>23.0</b>	<b>23.0</b>	<b>23.0</b>		$E = A - B - C + D$
BS RX Antenna Gain	dBi	17.0	17.0	17.0		F
BS Cable Loss	dB	2.0	2.0	2.0		G
BS Noise Figure	dB	5.0	5.0	5.0		H
Thermal Noise Density	dBm/Hz	-174.0	-174.0	-174.0		I
Interference Density	dBm/Hz	-159.0	-159.0	-159.0	I/N = 10dB	J
<b>Total Noise Interference Density</b>	dBm/Hz	<b>-158.6</b>	<b>-158.6</b>	<b>-158.6</b>		$K = 10 \log(10^{(H+I)}/10 + 10^{J/10})$
<b>Occupied Bandwidth</b>	kHz	<b>196.9</b>	<b>196.9</b>	<b>196.9</b>	<b>1 SubCH (18 tones)</b>	
	Hz-dB	<b>52.9</b>	<b>52.9</b>	<b>52.9</b>		L
Required SNR (long-term)	dB	6.7	6.7	6.7	0.1% PER, PED-B	M
HARQ Gain	Max TX num	4.0	6.0	8.0	Combining Gain = 3 dB	
	dB	6.0	7.8	9.0		Z
<b>BS receiver sensitivity</b>	dBm	<b>-105.0</b>	<b>-106.7</b>	<b>-108.0</b>		$N = M + K + L - Z$
Log-normal Fade Margin	dB	8.0	8.0	8.0		O
Penetration Loss	dB	10.0	10.0	10.0		P
<b>Maximum Path Loss</b>	dB	<b>125.0</b>	<b>126.7</b>	<b>128.0</b>		$Q = E - N + F - G - O - P$
<b>Coverage</b>						
- Maximum Range	m	<b>727</b>	<b>809</b>	<b>874</b>	EVM Baseline	$R = (10^{((Q-130.19)/37.6)}) * 1000$
- Coverage Efficiency	km <sup>2</sup> /site	<b>0.528</b>	<b>0.655</b>	<b>0.763</b>		$S = (R/1000)^2$