Long TTI Size in the IEEE 802.16m

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None

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

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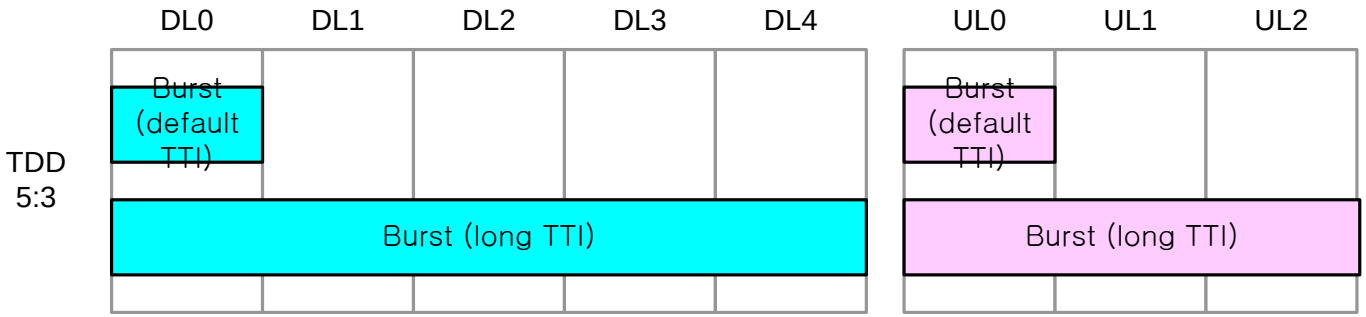
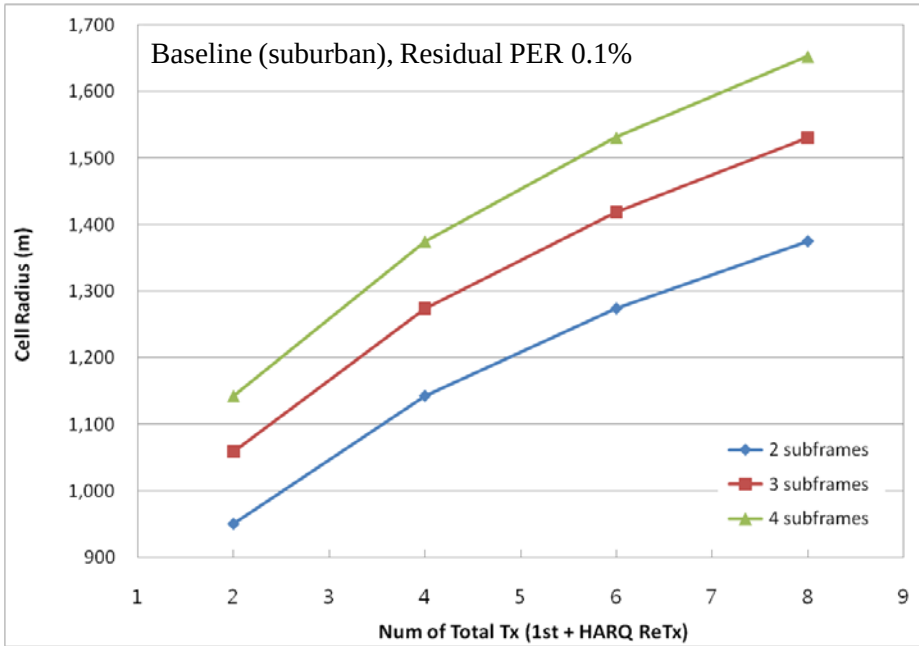
Long TTI Support in 802.16m

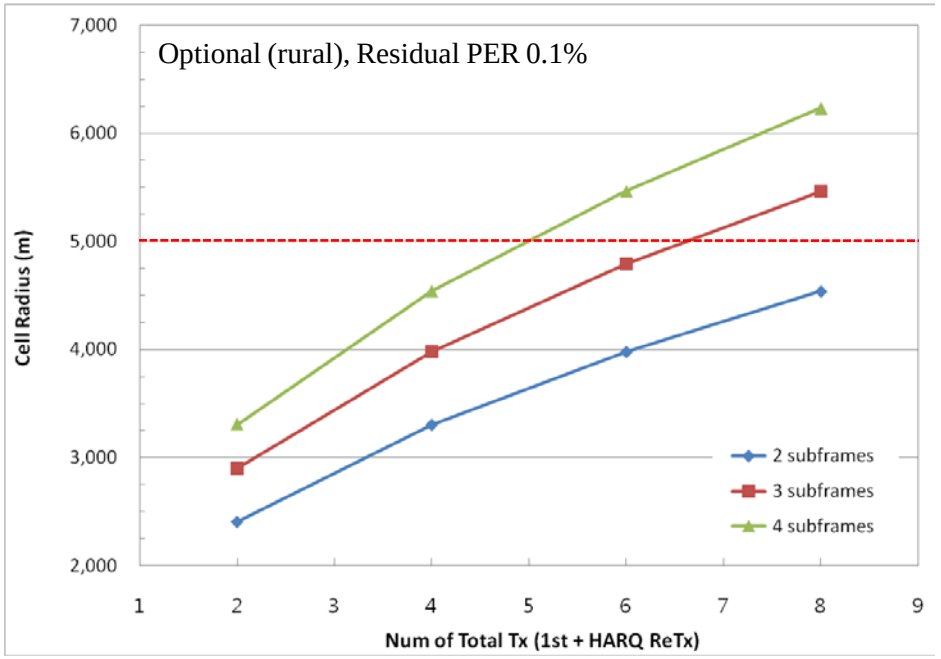
- Default TTI size in the current SDD = 1 subframe
- Motivation of a long TTI
  - To improve Link budget (particularly, in UL)
  - Longer time duration for the band AMC operation (particular, in DL)
  - A large packet transmission w/o fragmentation (particularly, in DL)
- Proposal in this contribution
  - 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

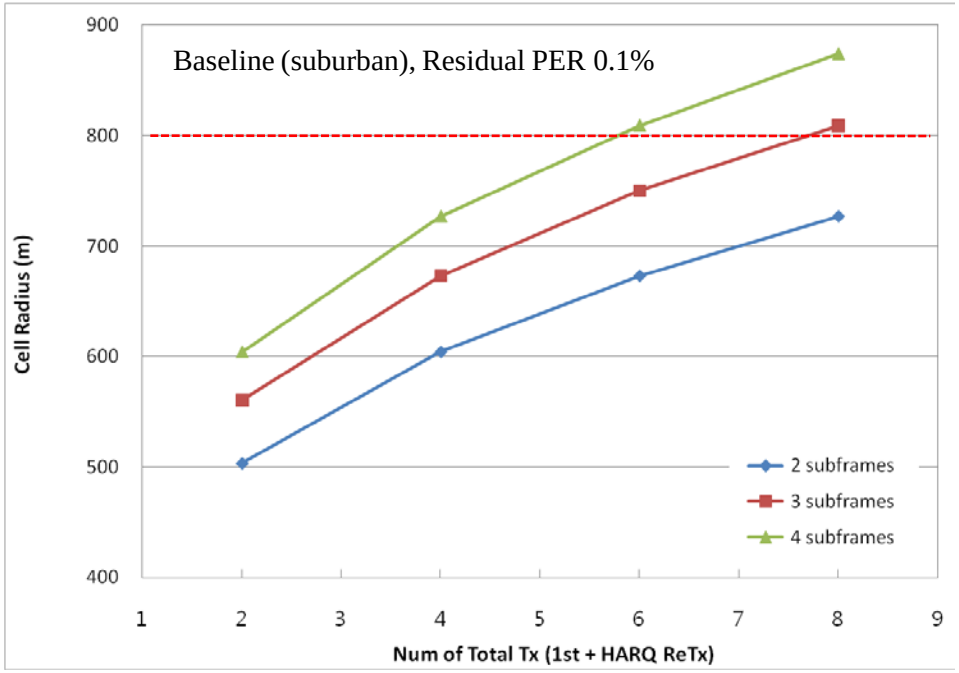
- Assumption for link budget calculation
  - Packet size = 48 byte (VoIP, MOB_MSHO-REQ, …), QPSK ½ ⇒ need 4 RB
  - So, 4 subframes TTI → need 1 SubCH, 2 subframes TTI → need 2SubCHs,
    3 subframes TTI → need approximately 1.33SubCHs on the freq domain.
- Observation in Case1 (Isolated Cell)
  - To 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 ~= I/N = 10dB
  - 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) >> 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 ½	QPSK ½	QPSK ¼
1500 bytes	1.3	2.6	5.2

  - Note: total data tones per subframe: 48*96 = 4608
  - In order to transmit 1500 bytes (QPSK ½) 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
TX EIRP	dBm	23.0	23.0	23.0		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
Total Noise Interference Density	dBm/Hz	-158.6	-158.6	-158.6		K=10 log(10^(H+I)/10 + 10^J/10)
Occupied Bandwidth	kHz	196.9	196.9	196.9	1 SubCH (18 tones)	
	Hz-dB	52.9	52.9	52.9		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
BS receiver sensitivity	dBm	-105.0	-106.7	-108.0		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
Maximum Path Loss	dB	125.0	126.7	128.0		Q = E-N+F-G-O-P
Coverage						
- Maximum Range	m	727	809	874	EVM Baseline	R = (10^((Q-130.19)/37.6))*1000
- Coverage Efficiency	km2/site	0.528	0.655	0.763		S = (R/1000)^2