

**Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)**

**Submission Title:** [IEEE802.15.4k LECIM Co-existence Study]

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**Re:** []

**Abstract:** [A PHY Proposal for Low Energy Critical Infrastructure Networks Applications]

**Purpose:** [To be considered in IEEE 802.15.4k]

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# IEEE802.15.4k LECIM Coexistence Study

# Outline

- Simulation parameters
- Simulation results

## Major parameters of coexisting 802 systems in the 2400-2483 MHz

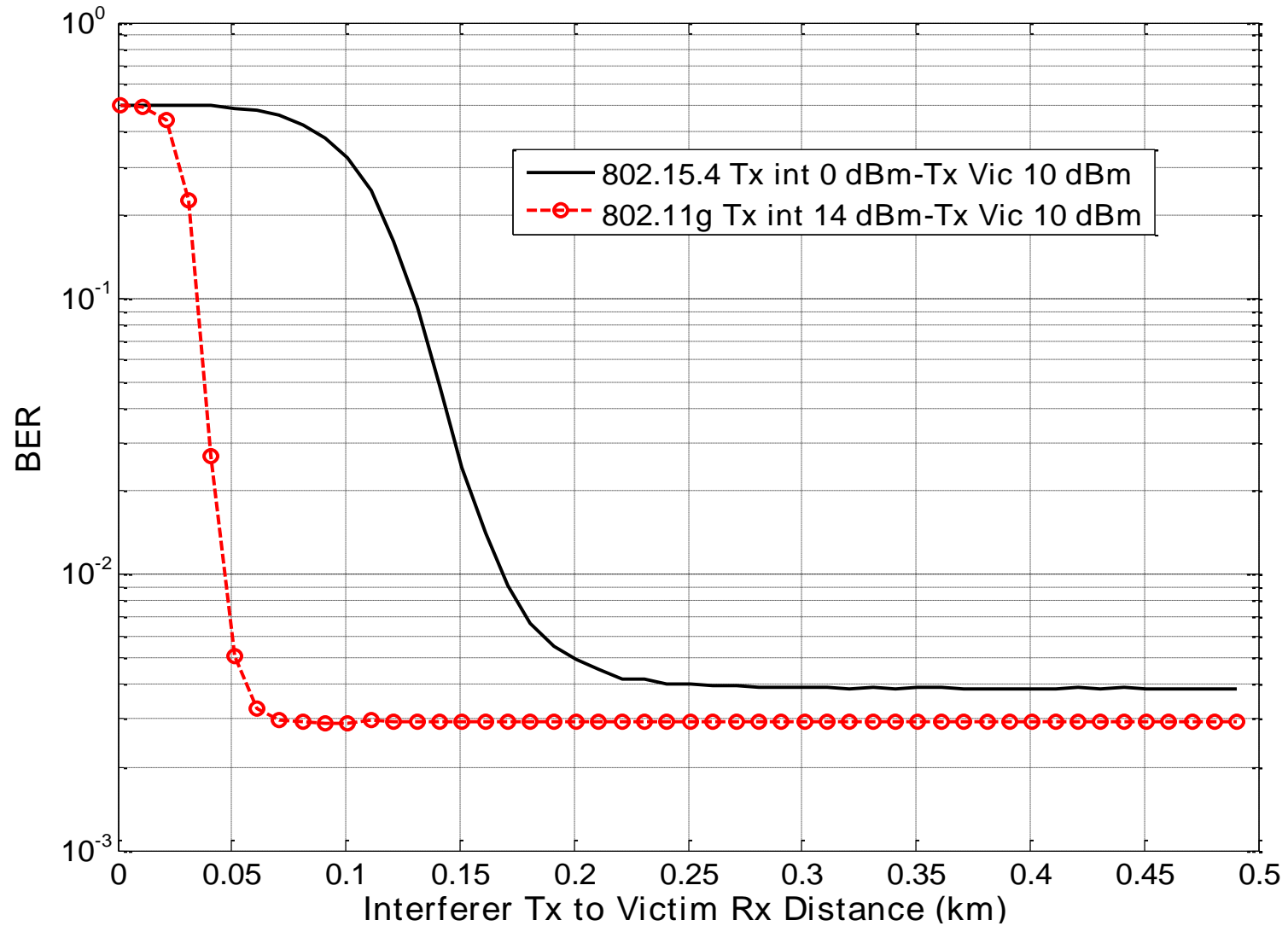
System	PHY Spec	PHY Mode	Channel Bandwidth (MHz)	Transmit Power (dBm)	Receiver Sensitivity (dBm)	Average Frame Length (Octet)
802.11b	DSSS	CCK, 11 Mb/s	22	14	-76	1024
802.11g	OFDM	BPSK, 6 Mb/s	22	14	-88	1000
802.11n	OFDM	QPSK, 18 Mb/s	22	14	-83	4096
802.15.3	FHSS	GFSK, 1 Mb/s	1	0	-70	1024
802.15.4	SC	DQPSK, 22 Mb/s	15	8	-75	1024
802.15.4	DSSS	O-QPSK 2000 kc/s, 250 kb/s	2	0	-85	22
802.15.4f	MSK	MSK, 250 kb/s	0.58-	0	-	-
802.15.4g	MR-FSK	FSK 50 kb/s, h = 1.0	0.2	0	-91	250
	MR-OFDM	QPSK, 100 kb/s OFDM Option 4, MCS3	0.2	0	-103	20
	MR-O-QPSK	QPSK, 2000 kc/s Rate Mode 3	5	0	-90	20

We only consider the impact of interference from [802.15.4](#) and [802.11g](#) systems in the [2400-2483MHz](#) on the 4k system performance.

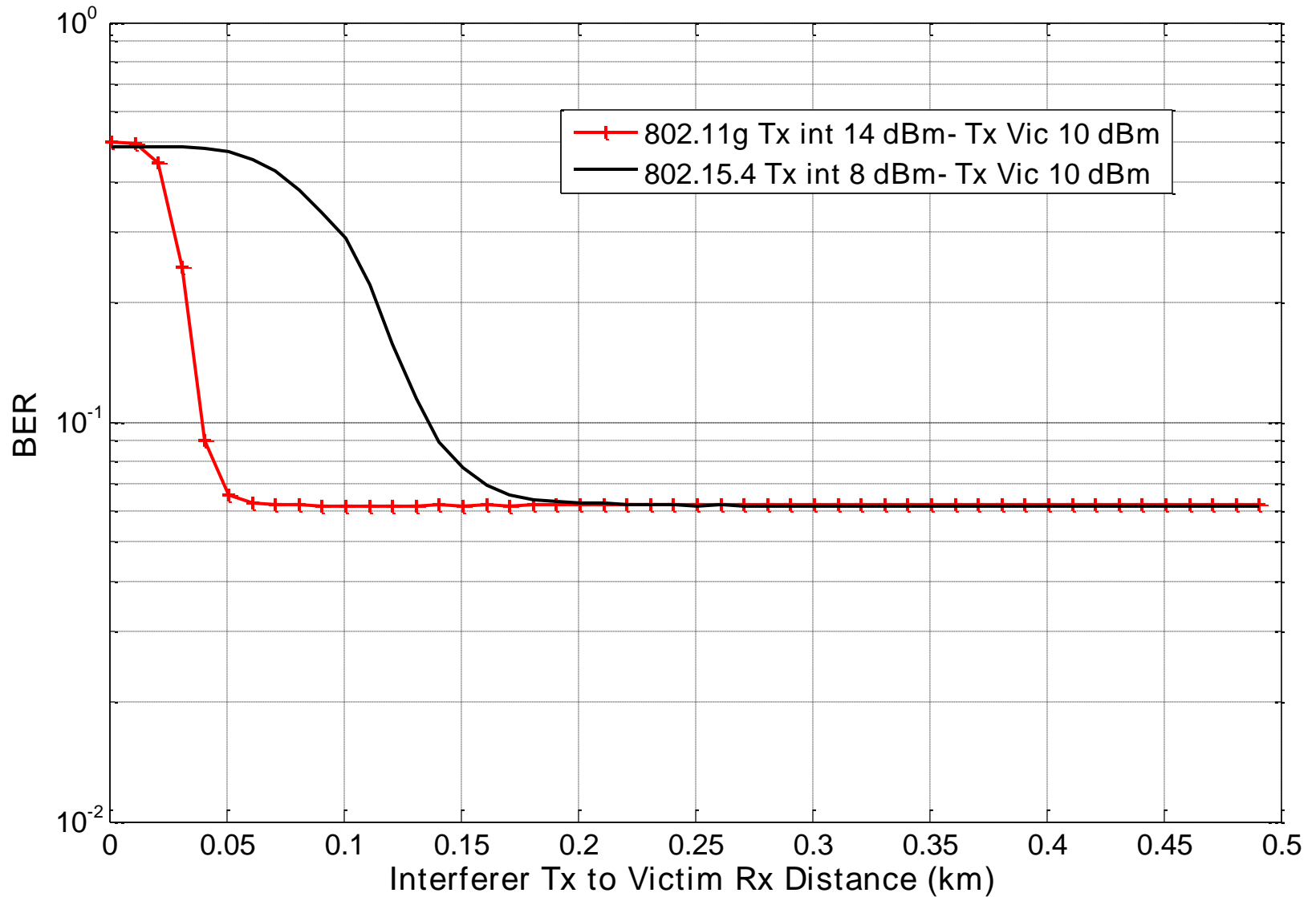
# Simulation parameters

- 802.15.4k (under Hata channel model)
  - Tx antenna high 2m and Rx antenna high 30m
  - Distance 1km
  - Transmit power 10dBm
  - Data rate 19.531kbps
  - SF=128
- Interference 802.15.4
  - Tx antenna high 1m and Rx antenna high 1m
  - Distance to Vic Receiver 1-500m
  - Transmit power 0dBm-8dBm
  - Data rate 250kbps
- Interference 802.11g
  - Tx antenna high 1m and Rx antenna high 1m
  - Distance to Vic Receiver 1-500m
  - Transmit power 14 dBm
  - Data rate 6Mbps

Interferer:802.15.4 and 802.11g; Victim:802.15.4k (SNR=12dB)

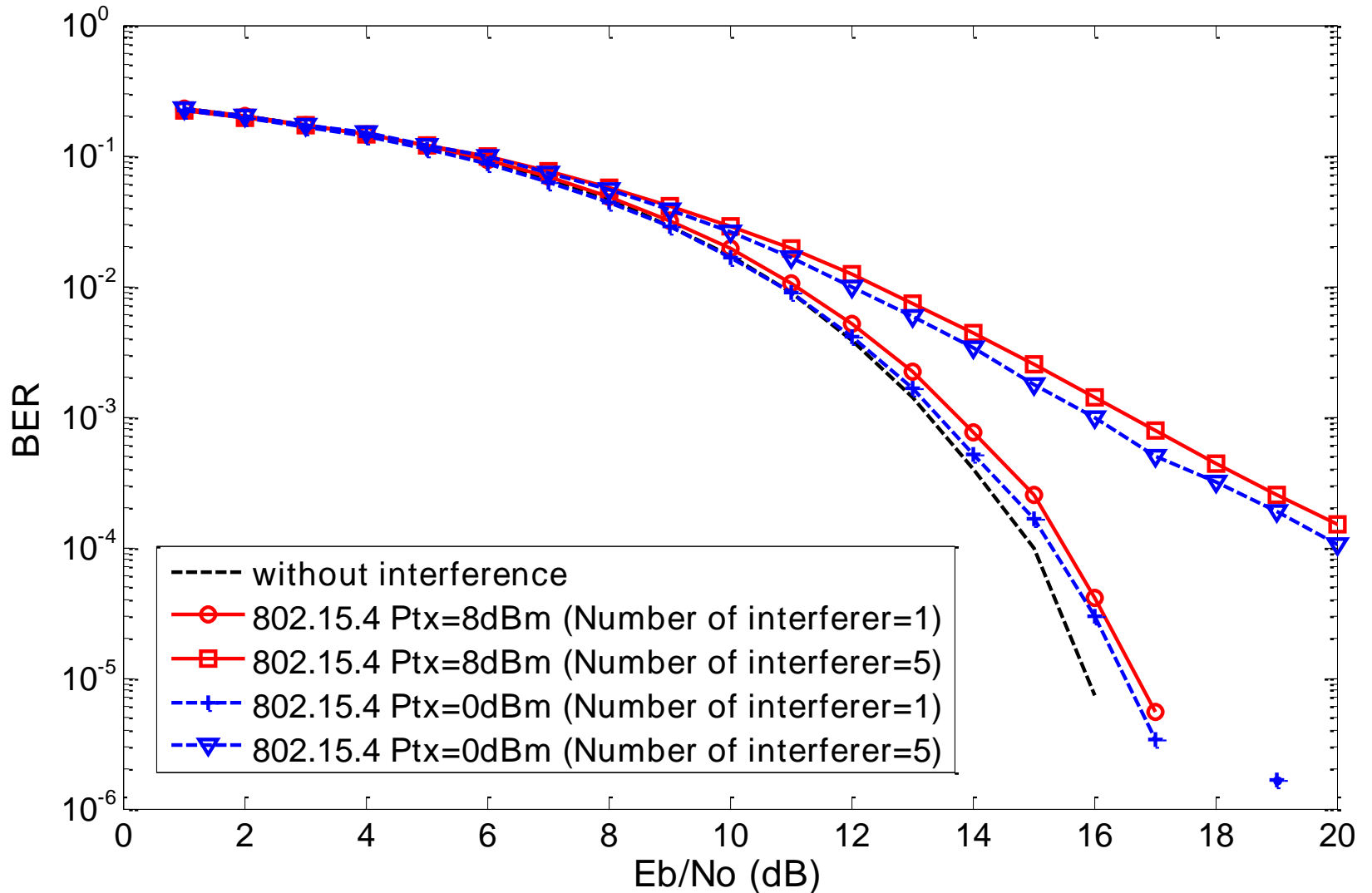


Interferer:802.15.4 and 802.11g; Victim:802.15.4k (SNR=7dB)

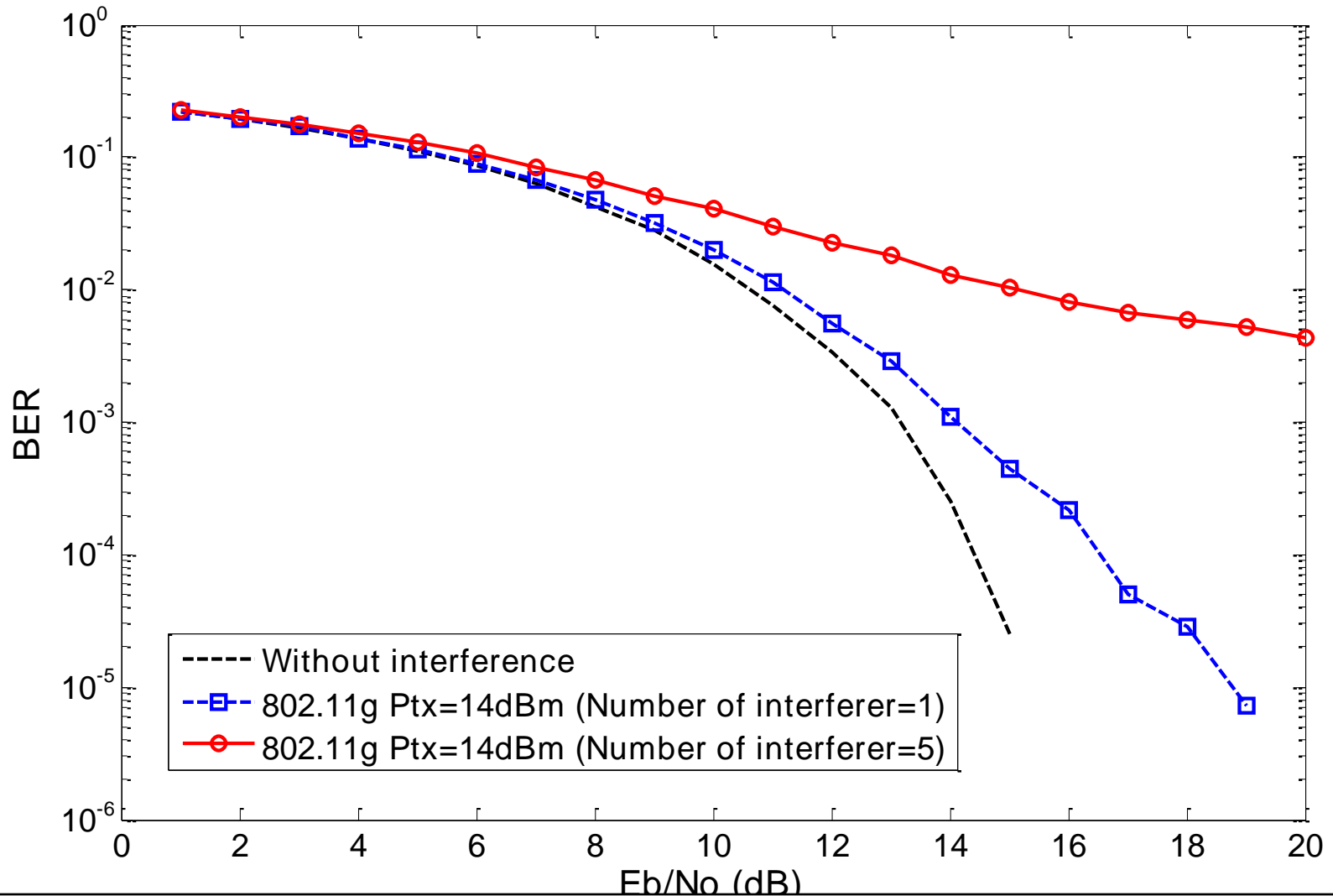




# Interferer:802.15.4; Victim:802.15.4k (distance=200m)



Interferer:802.11g; Victim:802.15.4k (distance=50m)



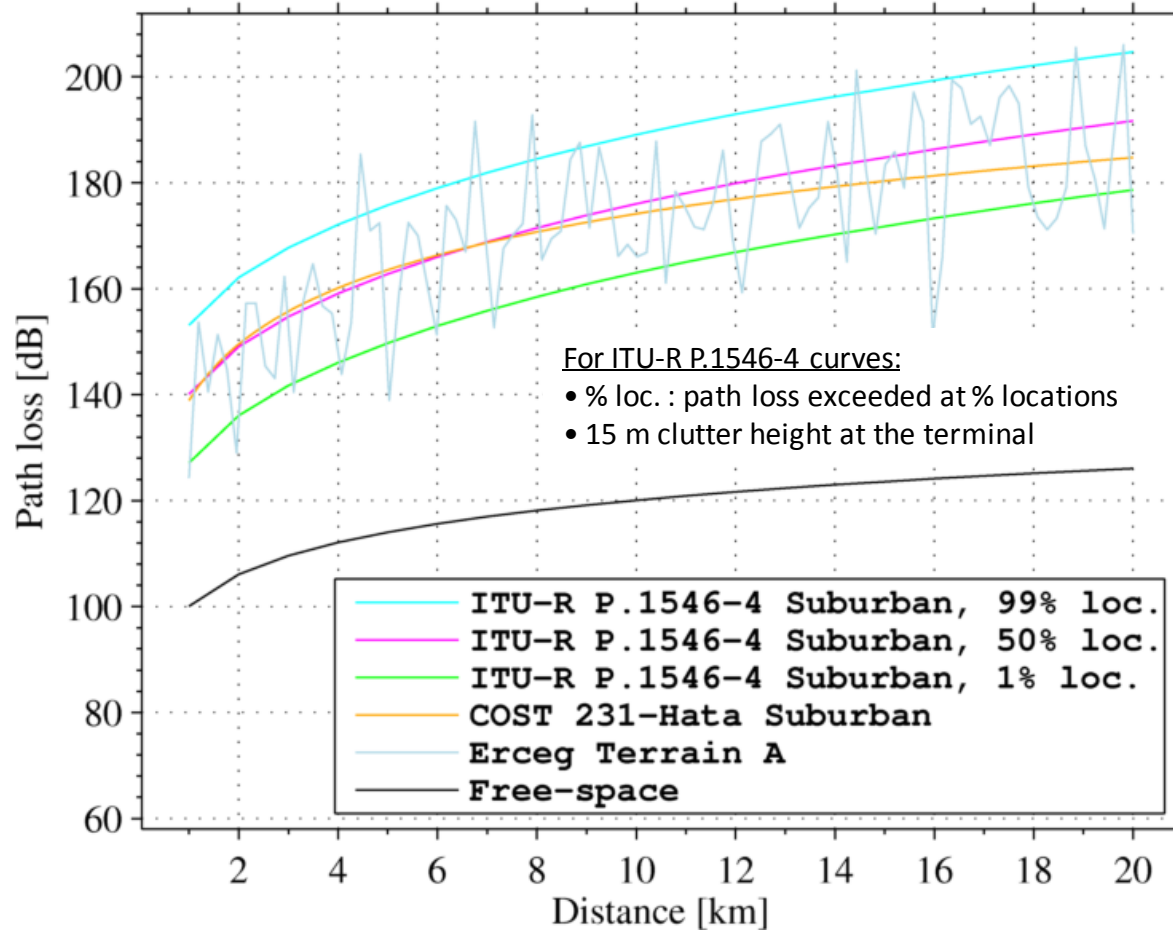
According to [15-11-0571-00-004k-channel-model-comparison-for-802-15-tg4k.pptx](#)

We use the recommended models for the 2.4 GHz band

- Path loss: COST 231-Hata and Erceg

# Path loss comparison at 2.4 GHz

$$f_c = 2400 \text{ MHz} \cdot h_b = 30 \text{ m} \cdot h_m = 2 \text{ m}$$



# Cost 231-Hata Model

- Frequencies: 1500-2400 MHz
- Terrain: Urban, Suburban
- Valid Collector Antenna Height: 30-200m
- Valid Endpoint Antenna Height: 1-10m
- Distance: 1-20 km

$$L = A + B \log_{10}(d) - C$$

$$A = 46.3 + 33.9 \log_{10}(f_c) - 13.82 \log_{10}(h_b) - D$$

$B$  = same as that of Okumura-Hata PL model

$$C = \begin{cases} 0, & \text{mid-urban and suburban with mid-foliage} \\ -3, & \text{large urban} \end{cases}$$

$D$  = same as that of urban (mid/small) of Okumura-Hata PL model

$d$  km T-R distance

$f_c$  MHz carrier frequency

$h_b$  m BS antenna height

# BER Performance

- needs to be corrected doc 15-12-0314-00-004k-tg4k-coexistence-document.pdf
- BER vs distance of victim Rx
- The following figures need to be discussed for results
- Fig 6, 7, 9, 10, 12, 13, 14, 15,16, 19, 20, 21, 22, 23, 25, 26,27,28, 29, 31, 32, 33, 34, 35, 38, 39, 40, 42, 43, 44, 45, 46, 47

Thank You