

# LPWAN: Great CLOSING

## Long Range Tests at High Altitudes (from Texas Instrument)

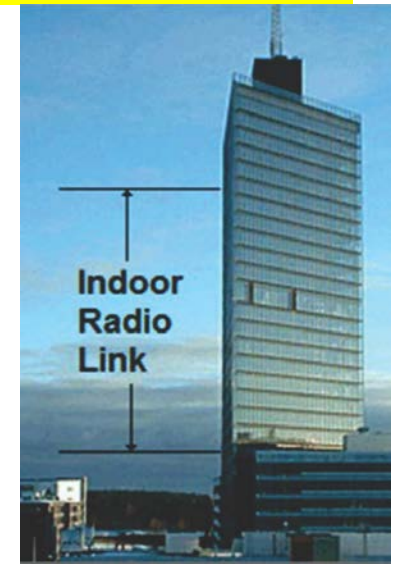
**Test Setup:** antenna Positioning: H1 = 1000 m, 91 m for **114 km outdoor with no lost data packets**

- CC1120 CC1190 at 868 MHz, 32 MHz TCXO, LRM, Tx=27 dBm and kit antennas
- GFSK, Rx BW:12.5 kHz for freq. compensation and 7.8 kHz for packet reception
- Location: Table Mountain, Cape Town, South Africa
- LNA = 0x03, ext. data filter on, Symbol Rate =0,6 kbps, Freq. Deviation = 1,5[kHz], FB2PLL =[yes]
- **Link Budget** = Tx=27 + antenna Tx=2.1 + antenna Rx=2.1 – (Rx=-126.5) = **158 dB**

## High Rise Building Range Test (from Texas Instrument)

**Test Setup:** Tx unit placed **at floor 26** in the stairway

- CC1120 at 470 MHz, 32 MHz TCXO, LRM, Tx=14 dBm and kit antennas
- GFSK, Rx BW:12.5 kHz for freq. compensation and 7.8 kHz for packet reception
- Data could be received **12 to 16 floors below** the Tx unit. 26 -16 = **10 floors\*3=30 meters indoor**
- LNA = 0x03, ext. data filter on, Symbol Rate =0,6 kbps, Freq. Deviation = 1,5[kHz], FB2PLL =[yes]
- **Link Budget** = Tx=14 + antenna Tx=2.1 + antenna Rx=2.1 – (Rx=-125) = **143 dB**



Firm	Protocol	Floor number	Budget	Freq.	1	2	3	4	5	6	7	8	9	Retransmit	10	11	12	13	14	15	16	17	18	Retransmit	19	20	
					Atten. per floor (12 cm concrete)									Fading dB	Atten. per floor (12 cm concrete)									Fading dB	etc.		
DJV-COM	Dmesh	114 dB	434MHz	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	atten -108	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	atten -108	-12	-12
STRIJ	NB-FI	164 dB	868MHz	-15	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -135	-15	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -270	-15	-15
Semtech	LoRa	150 dB	868MHz	-15	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -135	-15	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -270	-15	-15
Sigfox	UNB	155 dB	868MHz	-15	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -135	-15	-15	-15	-15	-15	-15	-15	-15	-15	-15	atten -270	-15	-15
Ingenu	RPMA	162 dB	2400MHz	-19	-19	-19	-19	-19	-19	-19	-19	-19	-19	atten -171	-19	-19	-19	-19	-19	-19	-19	-19	-19	-19	atten -342	-19	-19

This table is simply showing how the resulting effective link budget and penetration capabilities differ effecting the signal behavior in the multistory building. You can see, that attenuation per one floor is differ for different frequencies 434MHz – 12dB, 868MHz – 15dB and 2400MHz – 19dB for the concrete wall 12 cm.

You can see, if transmitter set at ground floor, data could be received for Ingenu (RPMA) only up to 9 floor, for the Semtech (LoRa) – up to 10 floor, for Sigfox (UNB) up to 11 floor, for WAVIoT (STRIJ – NB-FI) up to 12 floor and for the DJV-COM (DMesh) – first level up to 9 floor, but DMesh is the multi-level retransmission technology with up to 30 level of retransmission, so second level will be up to 18 floor, the third level will be up to 27 floor and etc.. Theoretically DMesh technology can retransmit data up to 9 floor x 30 levels = 270 floor.