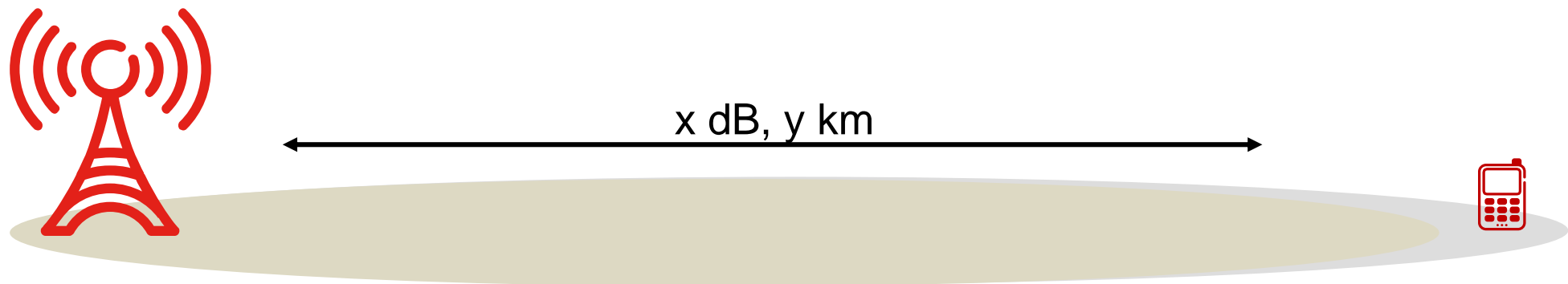# IMT-2020 submission templates: Link budget template

Asbjörn Grövlen
Ericsson

Link budget – what is it?

- Assess the maximum supported path loss and range
  - Downlink and uplink
  - Data and control
  - Five test environments: indoor hotspot eMBB, dense urban eMBB, rural eMBB, urban macro mMTC, urban macro URLLC

x dB, y km

Guidelines from the ITU

- Methodology and tables provided in M.2111, 5.2.3.3

- One table per test environment
  - Indoor hotspot, dense urban, rural, urban macro mMTC, urban macro URLLC

- Some parameters given by the ITU

- Some parameters provided by proponent
  - Assumptions
  - Simulation results

TABLE 1

Link budget template for Indoor Hotspot-eMBB

Item	Downlink	Uplink
System configuration		
Carrier frequency (GHz)	4 or 30 or 70	4 or 30 or 70
BS antenna heights (m)	3	3
UE antenna heights (m)	1.5	1.5
Cell area reliability[(1)] (%) (Please specify how it is calculated.)		
Transmission bit rate for control channel (bit/s)		
Transmission bit rate for data channel (bit/s)		

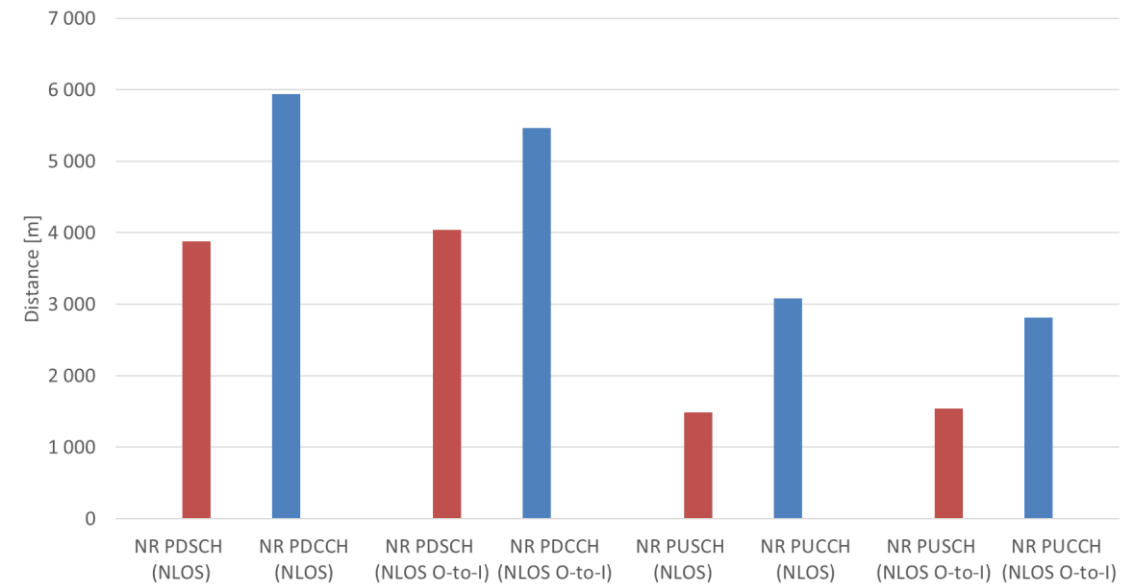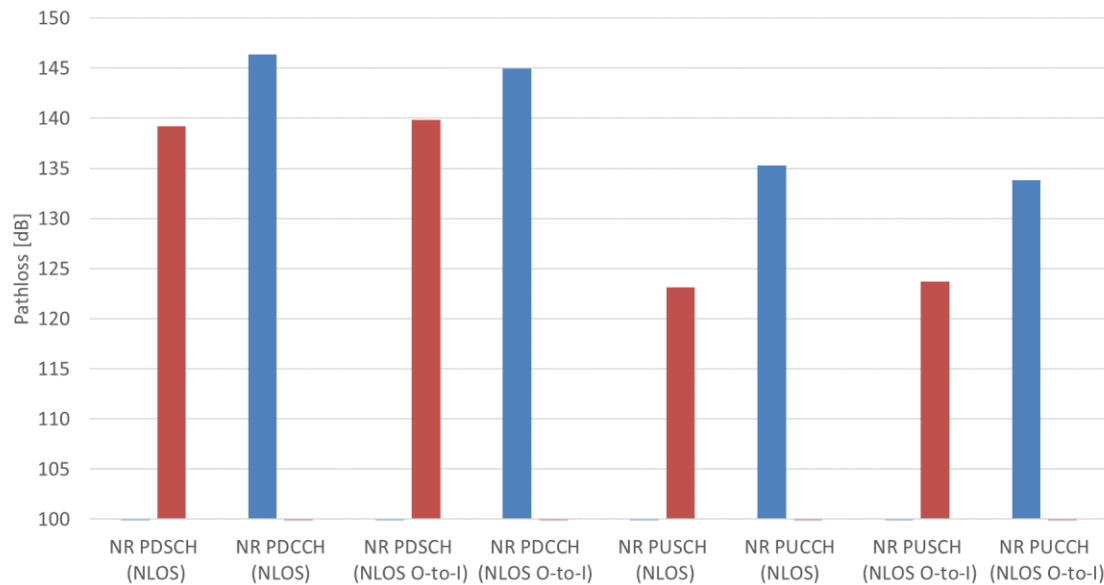| Item		
= (90) + (11) − (22b) dB		
Calculation of available pathloss		
(24) Lognormal shadow fading std deviation (dB)		
(25) Shadow fading margin (function of the cell area reliability and (24)) (dB)		
(26) BS selection/macro-diversity gain (dB)		
(27) Penetration margin (dB)		
(28) Other gains (dB) (if any please specify)		
(29a) Available path loss for control channel = (23a) − (25) + (26) − (27) + (28) − (12) dB		
(29b) Available path loss for data channel = (23b) − (25) + (26) − (27) + (28) − (12) dB		
Range/coverage efficiency calculation		
(30a) Maximum range for control channel (based on (29a) and according to the system configuration section of the link budget) (m)		
(30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m)		
(31a) Coverage Area for control channel = $(\pi \ (30a)^2)$ (m²/site)		
(31b) Coverage Area for data channel = $(\pi \ (30b)^2)$ (m²/site)		

Assumptions from 3GPP

- NR and LTE

- Data represented by PDSCH and PUSCH

- Control represented by PDCCH (indicating downlink and uplink resource allocation, modulation and coding) and PUCCH (used for ACK/NACK, scheduling requests, channel quality indication)

- For NR TDD, a DDDSU pattern is assumed for downlink and a DSUUD pattern for uplink

- Power levels, bandwidths, noise figures, antenna configurations aligned with test environment configurations

- Shadow fading and interference margins assumptions
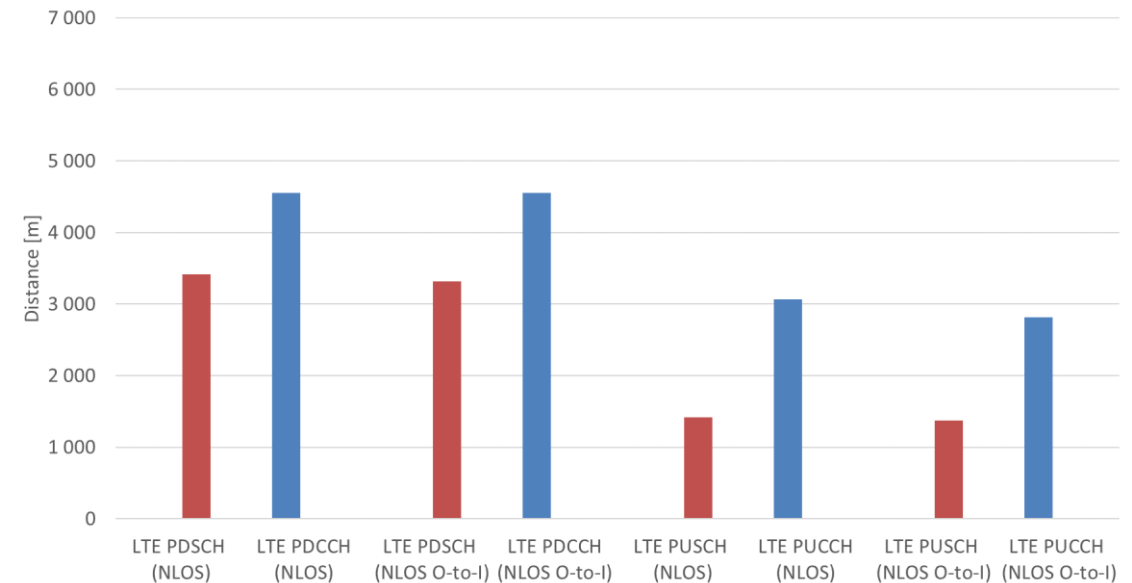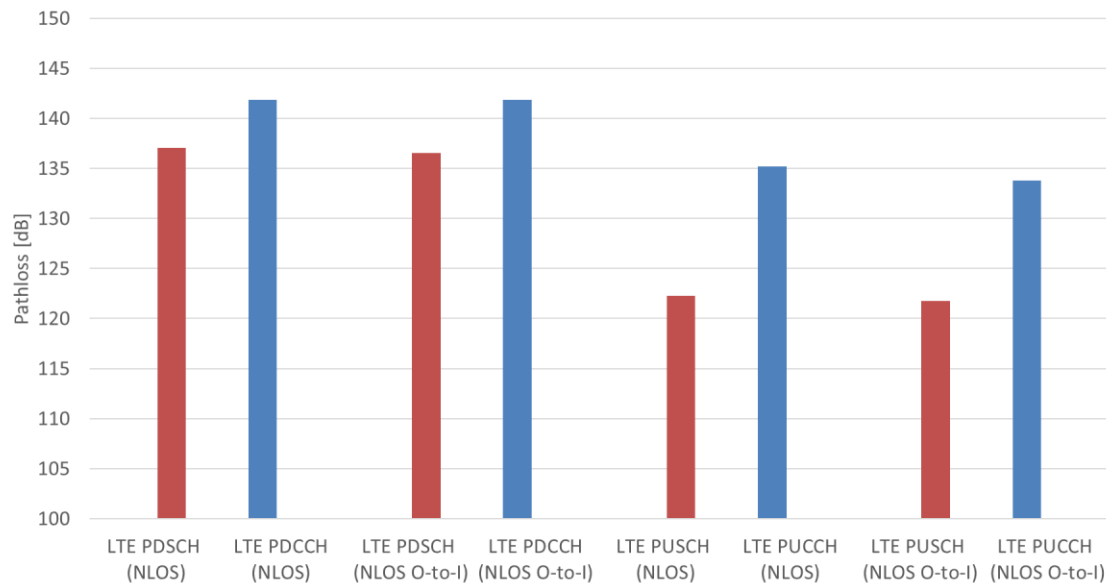
- Link performance simulated

- Link: RP-182097

Preliminary results from 3GPP

- Full results provided in RP-182097

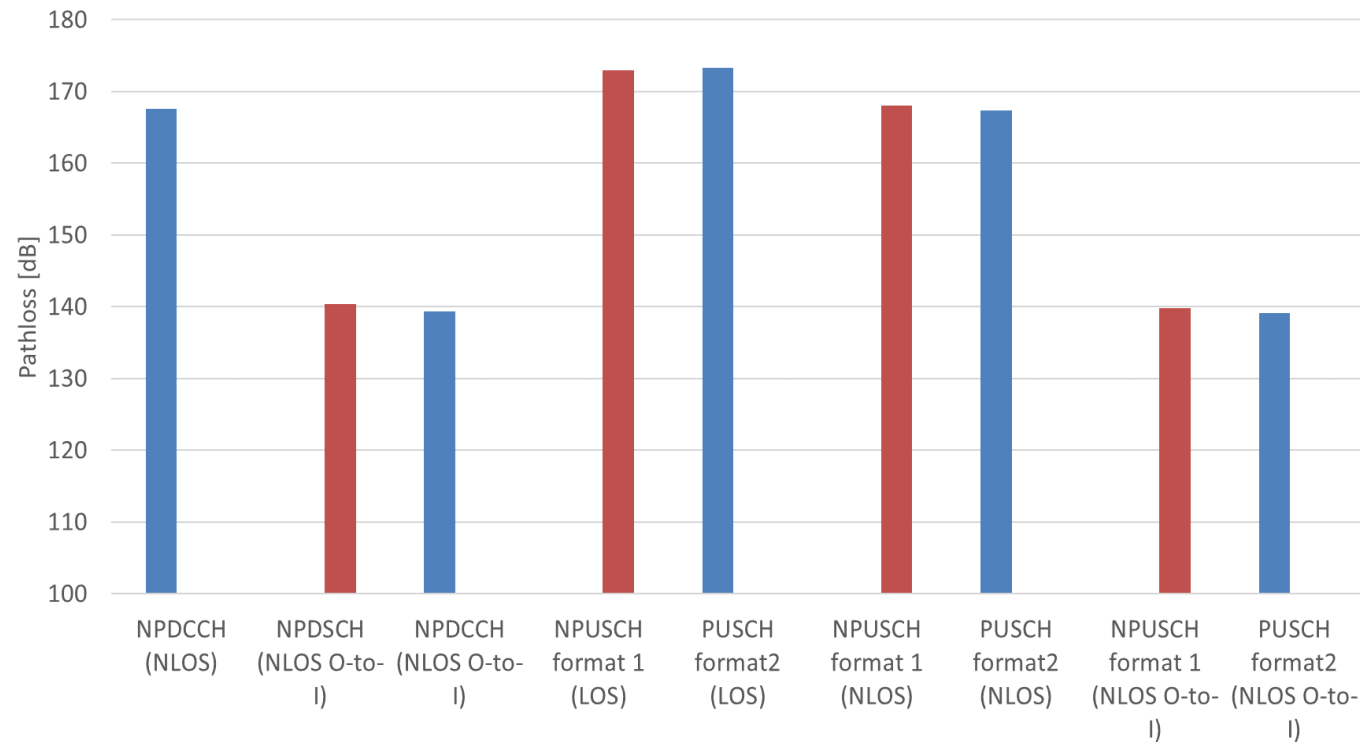- Example, NR FDD 700MHz, rural, channel model A, 6Mbps DL, 0.5Mbps UL

Preliminary results from 3GPP

- Full results provided in RP-182097

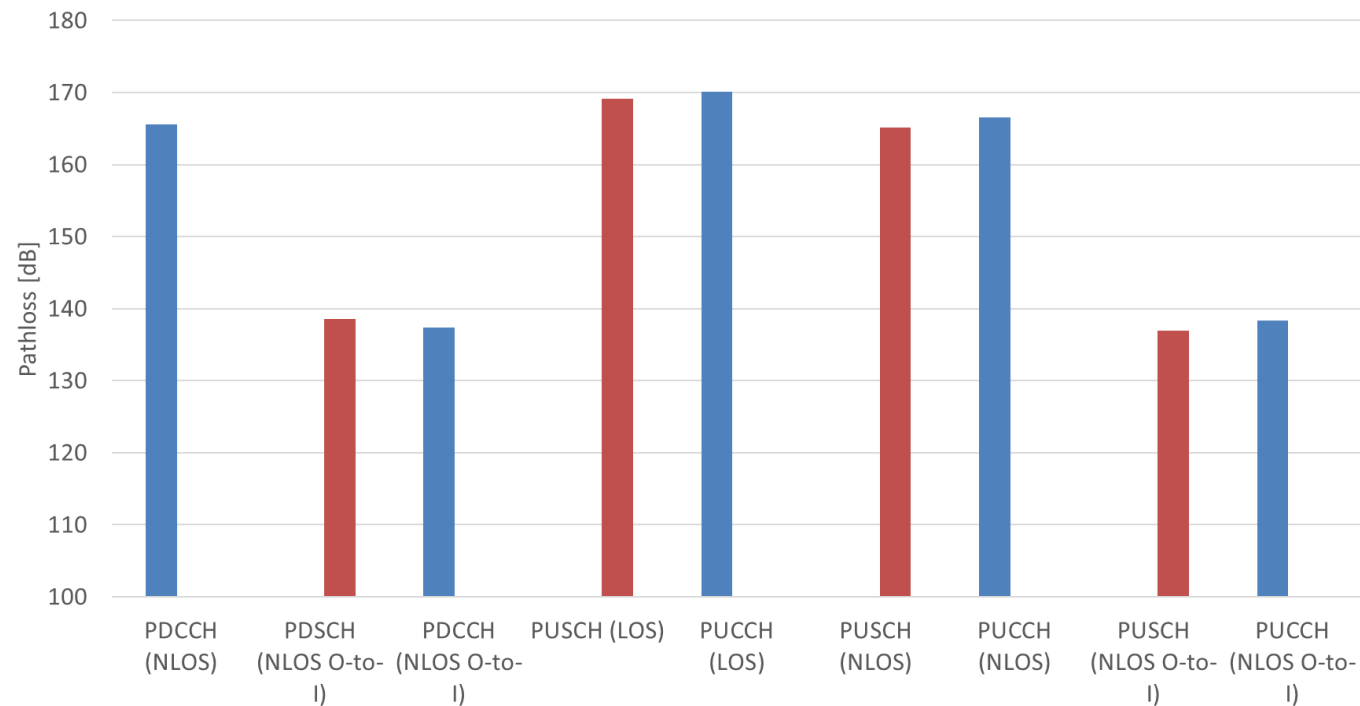- Example, LTE FDD 700MHz, rural, channel model A, 6Mbps DL, 0.5Mbps UL

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Preliminary results from 3GPP

- Full results provided in RP-182097

- Example, NB-IoT Uma-mMTC

Preliminary results from 3GPP

- Full results provided in RP-182097

- Example, eMTC, Uma-mMTC

What to do for the evaluation groups?

- Verify that parameters are aligned with ITU guidelines

- Verify that margins for fading and interference etc. are reasonable

- Verify link performance