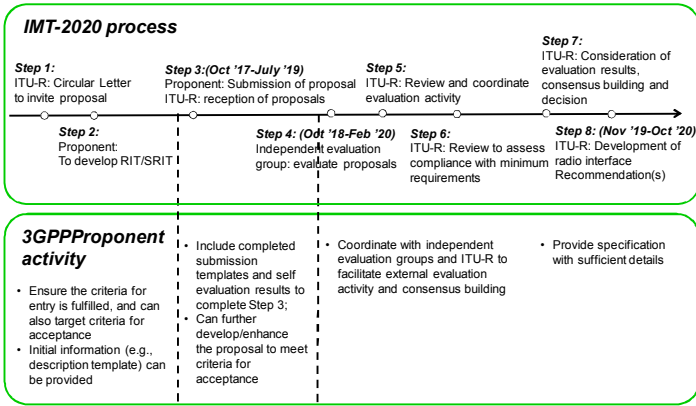


WiSE 模擬器應用於 IMT-2020 5G 之系統效能評估

WiSE Simulator for IMT-2020 5G Evaluation

➤ Introduction to ITU-R evaluation

➤ IMT-2020 process and 3GPP potential proponent activity



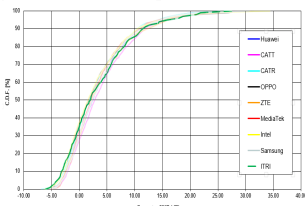
➤ Evaluation method and related test environments

Related Usage scenario	Sub-items	Evaluation method	Related test environment(s)				
			Indoor Hotspot	Dense Urban	Rural	Urban Macro	Urban Macro
eMBB	Peak data rate	Analytical		Y			
	Peak spectral efficiency	Analytical		Y			
	User experienced data rate	For single layer: Analytical For multi-layer: SLS*		Y			
	5th percentile user spectral efficiency	SLS	Y	Y	Y		
	Average spectral efficiency	SLS	Y	Y	Y		
	Area traffic capacity	Analytical	Y				
eMBB, URLLC	Energy efficiency	Inspection		Y			
	Mobility	LLS* + SLS	Y	Y	Y		
	User plane latency	Analytical		Y		Y	
URLLC	Control plane latency	Analytical		Y		Y	
	Mobility interruption time	Analytical		Y		Y	
mMTC	Reliability	LLS+SLS				Y	
General	Connection density	Opt 1: LLS + SLS Opt 2: Full SLS					Y
	Bandwidth and Scalability	Inspection		Y			

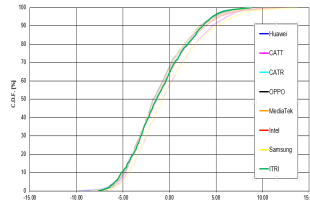
➤ Calibration for 3GPP self evaluation

➤ Indoor Hotspot

■ 12TRPs Config. A Model A

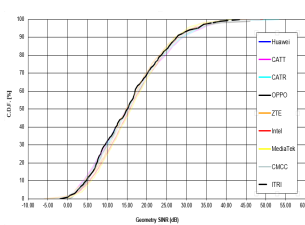


■ 36TRPs Config. A Model A

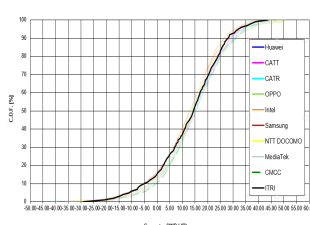


➤ Dense Urban

■ Config. A Model A

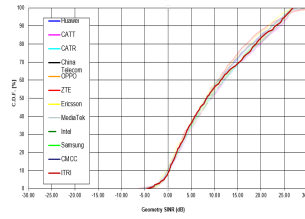


■ Config. B

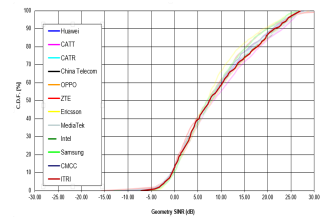


➤ Rural

■ Config. A Model A



■ Config. B Model A



➤ Average spectral efficiency

$$SE_{avg} = \frac{\sum_{i=1}^N R_i(T)}{T \cdot W \cdot M}$$

- ✓ SE_{avg} : average spectral efficiency
- ✓ $R_i(T)$: the number of correctly received bits by/from user i (N users and M TRxPs)
- ✓ W : channel bandwidth
- ✓ T : the time over which the data bits are received

Test Environment(DL)	TRP Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	UE Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	SE_{avg}	ITU Requirement
Dense Urban – eMBB Config A	For 4T: (8, 8, 2, 1, 1; 2, 1)	For 4R: (1, 2, 2, 1, 1; 1, 2)	14.105	7.8
	For 32T: (8, 8, 2, 1, 1; 2, 8)	For 4R: (1, 2, 2, 1, 1; 1, 2)	10.584	

Test Environment(UL)	TRP Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	UE Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	SE_{avg}	ITU Requirement
Dense Urban – eMBB Config A	For 4R: (8, 8, 2, 1, 1; 2, 1)	For 4T: (1, 2, 2, 1, 1; 1, 2)	9.29	5.4
	For 16R: (8, 8, 2, 1, 1; 1, 8)	For 2T: (1, 1, 2, 1, 1; 1, 1)	8.026	

Test Environment(DL)	TRP Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	UE Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	SE_{avg}	ITU Requirement
Rural – eMBB Config. A	For 8T: (8, 4, 2, 1, 1; 1, 4)	For 2R: (1, 1, 2, 1, 1; 1, 1)	7.287	3.3
Rural – eMBB Config. B	For 16T: (8, 8, 2, 1, 1; 1, 8)	For 4R: (1, 2, 2, 1, 1; 1, 2)	10.212	
Rural – eMBB Config. C	For 32T: (8, 8, 2, 1, 1; 2, 8)	For 4R: (1, 2, 2, 1, 1; 1, 2)	10.760	
Rural – eMBB Config. C	For 8T: (8, 4, 2, 1, 1; 1, 4)	For 4R: (1, 2, 2, 1, 1; 1, 2)	11.732	

Test Environment(UL)	TRP Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	UE Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	SE_{avg}	ITU Requirement
Rural – eMBB Config. A	For 8R: (8, 4, 2, 1, 1; 1, 4)	For 2T: (1, 1, 2, 1, 1; 1, 1)	8.715	1.6
	For 8R: (8, 4, 2, 1, 1; 1, 4)	For 1T: (1, 1, 1, 1, 1; 1, 1)	5.378	
Rural – eMBB Config. B	For 16R: (8, 8, 2, 1, 1; 1, 8)	For 4T: (1, 2, 2, 1, 1; 1, 2)	9.614	
Rural – eMBB Config. B	For 32R: (8, 8, 2, 1, 1; 2, 8)	For 1T: (1, 1, 1, 1, 1; 1, 1)	5.093	
Rural – eMBB Config. C	For 8R: (8, 4, 2, 1, 1; 1, 4)	For 4T: (1, 2, 2, 1, 1; 1, 2)	8.995	
Rural – eMBB Config. C	For 8R: (8, 4, 2, 1, 1; 1, 4)	For 1T: (1, 1, 1, 1, 1; 1, 1)	4.749	

➤ 5th percentile user spectral efficiency

$$r_i = \frac{R_i(T_i)}{T_i \cdot W}$$

- ✓ r_i : the (normalized) user throughput of user i
- ✓ T_i : active session time for user i
- ✓ $R_i(T_i)$: the number of correctly received bits of user i
- ✓ W : channel bandwidth

Test Environment(DL)	TRP Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	UE Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	SE_{user}	ITU Requirement
Dense Urban – eMBB Config A	For 4T: (8, 8, 2, 1, 1; 2, 1)	For 4R: (1, 2, 2, 1, 1; 1, 2)	0.395	0.225
	For 32T: (8, 8, 2, 1, 1; 2, 8)	For 4R: (1, 2, 2, 1, 1; 1, 2)	0.202	

Test Environment(UL)	TRP Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	UE Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	SE_{user}	ITU Requirement
Dense Urban – eMBB Config A	For 4R: (8, 8, 2, 1, 1; 2, 1)	For 4T: (1, 2, 2, 1, 1; 1, 2)	0.189	0.15
	For 16R: (8, 8, 2, 1, 1; 1, 8)	For 2T: (1, 1, 2, 1, 1; 1, 1)	0.042	

Test Environment(DL)	TRP Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	UE Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	SE_{user}	ITU Requirement
Rural – eMBB Config. A	For 8T: (8, 4, 2, 1, 1; 1, 4)	For 2R: (1, 1, 2, 1, 1; 1, 1)	0.142	0.12
Rural – eMBB Config. B	For 16T: (8, 8, 2, 1, 1; 1, 8)	For 4R: (1, 2, 2, 1, 1; 1, 2)	0.159	
Rural – eMBB Config. B	For 32T: (8, 8, 2, 1, 1; 2, 8)	For 4R: (1, 2, 2, 1, 1; 1, 2)	0.221	
Rural – eMBB Config. C	For 8T: (8, 4, 2, 1, 1; 1, 4)	For 4R: (1, 2, 2, 1, 1; 1, 2)	0.329	

Test Environment(UL)	TRP Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	UE Antenna configuration (M, N, P, Mq, Ng, Mp, Np)	SE_{user}	ITU Requirement
Rural – eMBB Config. A	For 8R: (8, 4, 2, 1, 1; 1, 4)	For 2T: (1, 1, 2, 1, 1; 1, 1)	0.052	0.045
	For 8R: (8, 4, 2, 1, 1; 1, 4)	For 1T: (1, 1, 1, 1, 1; 1, 1)	0.058	
Rural – eMBB Config. B	For 16R: (8, 8, 2, 1, 1; 1, 8)	For 4T: (1, 2, 2, 1, 1; 1, 2)	0.015	
Rural – eMBB Config. B	For 32R: (8, 8, 2, 1, 1; 2, 8)	For 1T: (1, 1, 1, 1, 1; 1, 1)	0.063	
Rural – eMBB Config. C	For 8R: (8, 4, 2, 1, 1; 1, 4)	For 4T: (1, 2, 2, 1, 1; 1, 2)	0.045	
Rural – eMBB Config. C	For 8R: (8, 4, 2, 1, 1; 1, 4)	For 1T: (1, 1, 1, 1, 1; 1, 1)	0.081	