

ATIS Wireless Technologies and Systems Committee (WTSC) IMT-2020 Evaluation Group

Summary of the Interim Report

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Advancing ICT Industry Transformation

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Evaluation Process



TEs/TPRs evaluated via **Simulation: NR**

Test environment	Evaluation configuration	TPRs to simulate	ATIS WTSC Evaluation Group
Indoor Hotspot - eMBB	Config. A (4 GHz)	<ul style="list-style-type: none"> Cell/User Spectral Efficiency (SE), (Area Traffic Capacity, derived from cell SE) Mobility 	✓
	Config. B (30 GHz)		✓
	Config. C (70 GHz)		
Dense Urban - eMBB	Config. A (4 GHz)	<ul style="list-style-type: none"> Cell/User Spectral Efficiency (User data rate is derived from user SE) Mobility 	✓
	Config. B (30 GHz)		✓
	Config. C (4, 30 GHz)	<ul style="list-style-type: none"> Cell/User SE and User Data Rate 	✓
Rural - eMBB	Config. A (1732 m, 700 MHz)	<ul style="list-style-type: none"> Cell/User Spectral Efficiency 	✓
	Config. B (1732 m, 4 GHz)	<ul style="list-style-type: none"> Mobility (incl. High-Speed train) 	✓
	Config. C (LMLC, 6000 m, 700 MHz)	<ul style="list-style-type: none"> Cell Spectral Efficiency only 	✓
Urban Macro - mMTC	Config. A (500 m, 700 MHz)	<ul style="list-style-type: none"> Connection Density 	✓
	Config. B (1732 m, 700 MHz)		✓
Urban Macro - URLLC	Config. A (4 GHz)	<ul style="list-style-type: none"> Reliability 	✓
	Config. B (700 MHz)		✓

TEs/TPRs evaluated via **Simulation: LTE (eMTC/NB-IOT)**

Test environment	Evaluation configuration	TPRs to simulate	ATIS WTSC Evaluation Group
Indoor Hotspot - eMBB	Config. A (4 GHz)	<ul style="list-style-type: none"> Cell/User Spectral Efficiency (SE), (Area Traffic Capacity, derived from cell SE) Mobility 	
	Config. B (30 GHz)		
	Config. C (70 GHz)		
Dense Urban - eMBB	Config. A (4 GHz)	<ul style="list-style-type: none"> Cell/User Spectral Efficiency (User data rate is derived from user SE) Mobility 	
	Config. B (30 GHz)		
	Config. C (4, 30 GHz)	<ul style="list-style-type: none"> Cell/User SE and User Data Rate 	
Rural - eMBB	Config. A (1732 m, 700 MHz)	<ul style="list-style-type: none"> Cell/User Spectral Efficiency 	
	Config. B (1732 m, 4 GHz)	<ul style="list-style-type: none"> Mobility (incl. High-Speed train) 	
	Config. C (LMLC, 6000 m, 700 MHz)	<ul style="list-style-type: none"> Cell Spectral Efficiency only 	
Urban Macro - mMTC	Config. A (500 m, 700 MHz)	<ul style="list-style-type: none"> Connection Density 	✓
	Config. B (1732 m, 700 MHz)		
Urban Macro - URLLC	Config. A (4 GHz)	<ul style="list-style-type: none"> Reliability 	
	Config. B (700 MHz)		

TPRs evaluated via **Analysis**

TPR/KPI	Usage scenario (TE independent)	ATIS WTSC Evaluation Group	
		NR	LTE
Peak spectral efficiency	eMBB	✓	
Peak data rate	eMBB	✓	
Mobility interruption time	eMBB & URLLC	✓	
Control Plane Latency	eMBB & URLLC	✓	
User Plane Latency	eMBB & URLLC	✓	

TPRs/Requirements evaluated via **Inspection**

TPR (General)	ATIS WTSC Evaluation Group	
	NR	LTE
Bandwidth	✓	✓
Energy efficiency	✓	✓
Other Requirements		
Support of wide range of services	✓	✓
Supported spectrum band(s)/range(s)	✓	✓

Other tasks - **Link Budgets** (Characteristics Template)

Test environment	ATIS WTSC Evaluation Group	
	NR	LTE
Indoor Hotspot - eMBB	✓	✓
Dense Urban - eMBB	✓	✓
Rural - eMBB	✓	✓
Urban Macro - mMTC	✓	✓
Urban Macro - URLLC	✓	✓



Evaluation Results



NR eMBB SE Evaluation Results

eMBB Cell/Average Spectral Efficiency

TPR	Test environment	Eval. configuration	DL/UL	IMT-2020 Target	3GPP Self-eval. Results (NR RIT) FINAL	ATI S IEG results					
						A	B (*)	C (*)	D	E (*)	F
						TDD (CM B)	FDD/TDD, ... (CM A)	FDD (CM A)	TDD (CM B)	FDD/TDD, ... (CM A/B)	FDD/TDD (DL only)
Average spectral efficiency (bit/s/Hz/TRxP)	Indoor Hotspot	A (4 GHz)	DL	9	8.77~16.88		14.01	9.8		13.5	
			UL	6.75	6.95~15.17		8.18	7.4		9.44	
		B (30 GHz)	DL	9	8.5~19.91	13.37	10.31		14.8	11.6	
			UL	6.75	6.9~11.44	6.9	9.08		10.54	7.04	
	Dense Urban	A (4 GHz)	DL	7.8	7.87~22.33	11.06	16.49	9.2	12.99	16.1	11.6
			UL	5.4	5.51~22.48	5.76	10.31	6.8	7.53	7.04	
	Rural	A (700 MHz)	DL	3.3	5.04~17.37	6.78	17.01			9.22	12
			UL	1.6	3.75~15.55	4.37	10.7			4.76	
		B (4 GHz)	DL	3.3	5.96~21.11	10.63	20.05	9.7	18.5	15.35	9.62
			UL	1.6	2.7~21.3	9.610	11.66	9.0	11.1	5.73	
		C (LMLC)	DL	3.3	3.9~19.29		14.08	5.4	6.4	8.83	
			UL	1.6	3.31~10.59		7.28	4.8	4.99	4.03	

(*) When multiple options/results are provided (e.g. FDD/TDD, CM A/B, SU-MU/MIMO, Tx/Rx config.), only the best values (highest DL) are reported above => details in Annex

NR eMBB SE Evaluation Results

eMBB User (5%-ile) Spectral Efficiency

TPR	Test environment	Eval. Configuration	DL/UL	IMT-2020 Target	3GPP Self-eval. Results (NR RIT) FINAL	ATI S IEG results					
						A	B (*)	C (*)	D	E (*)	F
						TDD (CM B)	FDD/TDD, ... (CM A)	FDD (CM A)	TDD (CM B)	FDD/TDD, ... (CM A/B)	FDD/TDD (DL only)
User spectral efficiency (5 th -ile) (bit/s/Hz)	Indoor Hotspot	A (4 GHz)	DL	0.3	0.31~0.59		0.45	0.35		0.32	
			UL	0.21	0.27~0.63		0.36	0.4		0.59	
		B (30 GHz)	DL	0.3	0.31~1.18	0.54	0.41		0.37	0.31	
			UL	0.21	0.30~0.43	0.3	0.53		0.323	0.4	
	Dense Urban	A (4 GHz)	DL	0.225	0.23~0.81	0.37	0.6	0.33	0.315	0.49	0.32
			UL	0.15	0.16~0.60	0.18	0.3	0.28	0.169	0.36	
	Rural	A (700 MHz)	DL	0.12	0.13~0.57	0.14	0.52			0.22	0.5
			UL	0.045	0.09~0.63	0.23	0.44			0.1	
		B (4 GHz)	DL	0.12	0.12~2.11	0.13	0.52	0.27	0.453	0.38	0.29
			UL	0.045	0.02~0.34	0.12	0.25	0.12	0.076	0.18	
		C (LMLC)	DL	Not defined	-		0.47	0.18	-	0.22	
			UL	Not defined	-		0.23	0.12	-	0.6	

(*) When multiple options/results are provided (e.g. FDD/TDD, CM A/B, SU-MU/MIMO, Tx/Rx config.), only the best values (highest DL) are reported above => details in Annex

User Experienced Data Rate

Evaluation results for User data rate, in eMBB Dense Urban, at 4GHz

According to ITU-R M.2410, the user-experienced data-rate is to be evaluated in the eMBB Dense Urban test environment. The target values are:

- Downlink: 100 Mbit/s
- Uplink: 50 Mbit/s

Bandwidth, W	User experienced data rate, R_{user} [Mbits/s]	
	Downlink	Uplink
317 MHz	100	53.7
640 MHz	202	108
1 GHz	315	169

Mobility

- IMT-2020 requirements for spectral efficiency and residual BLER are met in FDD and TDD with the Indoor Hotspot - eMBB, Dense Urban - eMBB, and Rural - eMBB test environments.
- Observations:
 - Using the pre-processing SINR with MU-MIMO transmission does not properly account for interference experienced with MU-MIMO.
 - Use the post-processing SINR distribution as the interface between the system and link simulations for evaluating the mobility performance.
 - The Indoor Hotspot - eMBB, Dense Urban - eMBB, and Rural - eMBB test environments have post-processing SINR 50th percentile values of 8.65 dB (Indoor, 10 km/h), 6.51 dB (Dense Urban, 30 km/h), 5.58 dB (Rural, 120 km/h), and 3.07 dB (Rural, 500 km/h)

Latency

Control Plane

- NR FDD can fulfill the target CP latency
 - The worst-case CP latency in NR Rel-15 FDD is estimated to $9\text{TTI}+6\text{ms}$ at 15/30kHz SCS and $14\text{TTI}+6\text{ms}$ at 120kHz SCS
- NR FDD can fulfill the target CP latency
 - The worst-case CP latency in NR Rel-15 TDD with alternating UL-DL pattern is estimated to $14\text{TTI}+6\text{ms}$ for 15/30kHz SCS and $20\text{TTI}+6\text{ms}$ for 120kHz SCS

Latency

User Plane

- NR FDD can fulfill the 4 ms UP latency target with 15kHz SCS
- NR FDD can fulfill the 1 ms UP latency target with 15kHz SCS, mini-slots, and UL configured grants
- NR FDD can fulfill the 1ms UP latency target with 15kHz SCS, mini-slots, and UL configured grants
- NR TDD can fulfil the 4ms UP latency target with 15 kHz SCS, mini-slot and configured UL grants
- NR TDD can fulfil the 1ms UP latency target with 120 kHz SCS, mini-slots and configured UL grants



High Level Evaluation Results



Observation

- ATIS WTSC Evaluation Group notes that in accordance with Report ITU.R. M.2411 there are certain submission guidelines, some of which are related to the provision of voluntary supplementary material:

“.....

5.2 Submission guidelines and templates

5.2.1 Submission guidelines

Submission of the ITU-R requested information and **voluntary supplementary information addressing the description template and compliance template on the candidate RITs or SRITs** by proponents in the form of completed templates shown in § 5.2.2 can be made electronically or by other means to the ITU-R.

5.2.2 Templates for submission

Templates required for submission of IMT-2020 candidate RITs or SRITs are divided into two categories: an RIT/SRIT description template and RIT/SRIT compliance templates. Each set of responses:

- a) must complete the RIT/SRIT description template and RIT/SRIT compliance templates – this is information developed in a template format in order to provide a common base of information across the submissions and therefore follows a defined format, asks certain questions, and proposes the responses be provided in a suggested format to the questions determined by ITU-R; and
- b) **may include voluntary supplementary information – this is additional information deemed relevant by the proponent to provide further understanding of the submission.** This information may be formatted as desired by the proponent.

.....”

Conclusion

SRIT SUBMISSION FROM 3GPP PROPONENT ([IMT-2020/13](#))

- ATIS WTSC IMT-2020 IEG has reviewed the 3GPP Proponent submissions in Documents [5D/1215](#) and [5D/1216](#).
- ATIS WTSC IMT-2020 IEG has not identified any deficiencies or technology issues which impact the submission, and the ability of WP 5D to have the submission move forward in the IMT-2020 process.

Conclusion

RIT SUBMISSION FROM 3GPP PROPONENT ([IMT-2020/14](#))

- ATIS WTSC IMT-2020 IEG has reviewed the 3GPP Proponent submissions in Documents [5D/1215](#) and [5D/1217](#).
- ATIS WTSC IMT-2020 IEG has not identified any deficiencies or technology issues which impact the submission, and the ability of WP 5D to have the submission move forward in the IMT-2020 process.

Conclusion

RIT SUBMISSION FROM CHINA ([IMT-2020/15](#))

WP 5D has agreed (see Document [IMT-2020/24](#)) this submission is technically identical to 3GPP submission.

Conclusion

RIT SUBMISSION FROM KOREA ([IMT-2020/16](#))

WP 5D has agreed (see Document [IMT-2020/25](#)) this submission is technically identical to 3GPP submission.

Conclusion

SRIT SUBMISSION FROM ETSI (TC DECT), DECT FORUM ([IMT-2020/17](#))

- ATIS WTSC IMT-2020 IEG has reviewed the ETSI (TC DECT), DECT FORUM submission in Documents [5D/1230](#), [5D/1253](#), and [5D/1299](#).
- The proposed SRIT consists of two component RITs:
 - DECT-2020 NR RIT
 - 3GPP 5G CANDIDATE FOR INCLUSION IN IMT-2020: SUBMISSION 2 FOR IMT-2020 (RIT)
- ATIS WTSC IMT-2020 IEG has not evaluated the “DECT-2020 NR RIT” component RIT.
- The 3GPP component RIT in ([IMT-2020/17](#)) is identical to The “3GPP 5G CANDIDATE FOR INCLUSION IN IMT-2020: SUBMISSION 2 FOR IMT-2020 (RIT)” ; as such, it should follow the same disposition.

Conclusion

SRIT SUBMISSION FROM ETSI (TC DECT), DECT FORUM ([IMT-2020/17](#))

- ATIS WTSC Evaluation Group duly notes that ETSI/DECT Forum has provided supplementary material, in particular, in Document 5D/[1299P1](#) - Annex A: mMTC self evaluation details; Sec. A.1: System simulations for mMTC :
“We present following simulation results: results based on ITU-R evaluation configuration and in addition the results based on DECT configuration (operating at 1900 MHz with a BS antenna height of 5 m).”
- It is noted that this supplementary information, while interesting, does not provide material that is relevant and pertinent to the IMT-2020 evaluation and does not “provide further understanding of the submission” because this supplementary information in general, in the parametric values or other assumptions and analysis utilized, does not align with that specified in Report ITU-R M.2412 for a specific scenario being assessed.

Conclusion

SRIT SUBMISSION FROM ETSI (TC DECT), DECT FORUM ([IMT-2020/17](#))

- With respect to the supplementary material:
 - ATIS WTSC Evaluation Group has not considered the indicated supplementary materials in the IMT-2020 evaluation as it is not directly relevant to the formal IMT-2020 evaluation.
 - ATIS WTSC Evaluation Group holds the view that the proposed technology operating under the specific technical provisions stated in the supplementary material provides no indication or validation of the suitability of the proposed technology with regard to meeting the IMT-2020 performance requirements.
 - ATIS WTSC Evaluation Group therefore offers no endorsement of this supplementary information in the context of IMT-2020 suitability.

Conclusion

RIT SUBMISSION FROM TSDSI ([IMT-2020/19](#))

- ATIS WTSC IMT-2020 IEG has reviewed submission in Document [5D/1231](#) and [5D/1301](#).
- ATIS WTSC IMT-2020 IEG notes that a large portion of the submission is identical to the unmodified 3GPP specific portions of the submission; as such, it should follow the same disposition.
- ATIS WTSC Evaluation Group duly notes that TSDSI has provided supplementary material, in particular, in Document 5D/[1301](#) Section 20: Coverage Enhancement with Pi/2 BPSK and Spectrum Shaping.
- It is noted that this supplementary information, while interesting, does not provide material that is relevant and pertinent to the IMT-2020 evaluation and does not “provide further understanding of the submission” because this supplementary information in general, in the parametric values or other assumptions and analysis utilized, does not align with that specified in Report ITU-R M.2412 for a specific scenario being assessed.

Conclusion

RIT SUBMISSION FROM TSDSI ([IMT-2020/19](#))

- With respect to the supplementary material:
 - ATIS WTSC Evaluation Group has not considered the indicated supplementary materials in the IMT-2020 evaluation as it is not directly relevant to the formal IMT-2020 evaluation.
 - ATIS WTSC Evaluation Group holds the view that the proposed technology operating under the specific technical provisions stated in the supplementary material provides no indication or validation of the suitability of the proposed technology with regard to meeting the IMT-2020 performance requirements.
 - ATIS WTSC Evaluation Group therefore offers no endorsement of this supplementary information in the context of IMT-2020 suitability.

Reference

For additional information, please visit:

ATIS | www.atis.org

ATIS WTSC | www.atis.org/wtsc

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