



**Report ITU-R M.2279
(10/2013)**

Outcome of the evaluation, consensus building and decision of the IMT-Advanced satellite process (Steps 4 to 7), including characteristics of IMT-Advanced satellite radio interfaces

**M Series
Mobile, radiodetermination, amateur
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Foreword

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Note: This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.

Electronic Publication
Geneva, 2013

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(2013)

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1 Introduction

International Mobile Telecommunications-Advanced (IMT-Advanced) systems are mobile service systems that include the new capabilities of IMT that go beyond those of IMT-2000. Such systems provide access to a wide range of telecommunication services, including advanced mobile services supported by mobile and fixed networks, which are increasingly packet-based.

IMT-Advanced systems support low to high mobility applications and a wide range of data rates in accordance with user and service demands in multiple user environments. IMT-Advanced also has capabilities for high-quality multimedia applications within a wide range of services and platforms anywhere, providing a significant improvement in performance and quality of service.

The key features of IMT-Advanced are:

- a high degree of commonality of functionality worldwide while retaining the flexibility to support a wide range of services and applications in a cost efficient manner;
- compatibility of services within IMT and with fixed networks;
- capability of interworking with other radio access systems;
- high-quality mobile services;
- user equipment suitable for worldwide use;
- user-friendly applications, service and equipment;
- worldwide roaming capability;
- enhanced peak data rates (i.e. wideband) to support advanced services and applications.

These features enable IMT-Advanced to address evolving user needs.

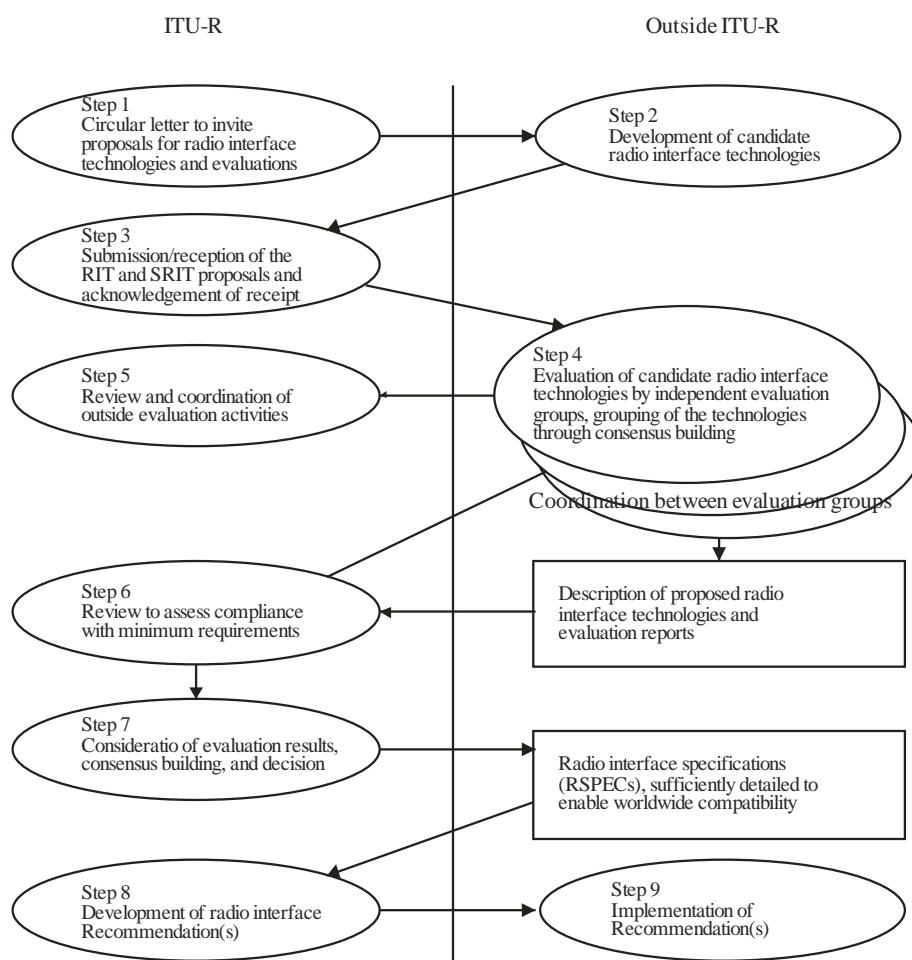
The capabilities of IMT-Advanced systems are being continuously enhanced in line with user trends and technology developments.

The satellite component of IMT-Advanced will be an integral part of the future IMT infrastructure with the optimized service delivery.

Circular Letter 4/LCCE/102 was sent on November 2010 to invite the submission of proposals for candidate radio interface technologies for the satellite component of IMT-Advanced. The Radiocommunication Bureau established an “IMT-Advanced-Satellite” webpage (<http://www.itu.int/ITU-R/go/rsg4-imt-adv-sat/>) to facilitate the development of proposals and the work of the Evaluation Groups.

The submission and evaluation process for the IMT-Advanced satellite radio interface Recommendation is included in Document IMT-ADV-SAT/2(Rev.2) and is illustrated in Fig. A2-2, reproduced below for easy reference in understanding the steps of the IMT-Advanced satellite process. The requirements, evaluation criteria and submission templates for the development of the IMT-Advanced satellite radio interface are included in Report ITU-R M.2176. The requirements related to the technical performance for IMT-Advanced satellite radio interface(s) as well as the guidelines for the evaluation of satellite radio interface technologies for IMT-Advanced are also included in Report ITU-R M.2176.

FIGURE A2-2

IMT-Advanced satellite component radio interface development process

Report M.2279-01

2 Scope

This Report is the record of the work performed after receipt of the proposals for the IMT-Advanced satellite candidate RITs, including the evaluation activity and the consensus building. This Report contains the outcome and conclusions of Steps 4-7 of the IMT-Advanced satellite process. These steps correspond to:

- Step 4: Evaluation of candidate RITs or SRITs by Evaluation Groups.
- Step 5: Review and coordination of outside evaluation activities.
- Step 6: Review to assess compliance with minimum requirements.
- Step 7: Consideration of evaluation results, consensus building and decision.

The details of these steps are provided in Document IMT-ADV-SAT/2(Rev.2)¹.

This Report also states the decisions reached by ITU-R on each of the candidate proposals and provides the technical characteristics of the RITs and SRITs for the satellite component of IMT-Advanced.

¹ IMT-ADV-SAT documents referred to in this Report are found on the ITU-R web page: “IMT-Advanced-Satellite submission and evaluation process (<http://www.itu.int/ITU-R/go/rsg4-imt-adv-sat/>)”.

Note that the actual specifications of the agreed IMT-Advanced satellite radio interfaces are contained in Recommendation ITU-R M.2047.

3 Related text references

Recommendation ITU-R M.1224	Vocabulary of Terms for International Mobile Telecommunications (IMT)
Recommendation ITU-R M.1645	Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000
Recommendation ITU-R M.1822	Framework for services supported by IMT
Recommendation ITU-R M.1850	Detailed specifications of the radio interfaces for the satellite component of International Mobile Telecommunications-2000 (IMT-2000)
Recommendation ITU-R M.2047	Detailed specifications of the satellite radio interfaces of International Mobile Telecommunications-Advanced (IMT-Advanced)
Report ITU-R M.2038	Technology trends
Report ITU-R M.2072	World mobile telecommunication market forecast
Report ITU-R M.2078	Estimated spectrum bandwidth requirements for the future development of IMT-2000 and IMT-Advanced
Report ITU-R M.2176	Vision and requirements for the satellite radio interface(s) of IMT-Advanced
Resolution ITU-R 56-1	Naming for International Mobile Telecommunications
Resolution ITU-R 57-1	Principles for the process of development of IMT-Advanced
Document IMT-ADV-SAT/2(Rev.2)	Submission and evaluation process and consensus building for satellite radio interface technology proposals of IMT-Advanced.

3.1 List of acronyms and abbreviations

CDF	Cumulative distribution function
HARQ	Hybrid automatic repeat request
IMT	International Mobile Telecommunications
RIT	Radio interface technology
S-RAN	Satellite radio access network
SRIT	Set of radio interface technologies
TD	Transmission delay
UE	User equipment

4 Summary of submissions

Following the guidelines of the IMT-Advanced satellite process, the candidate technology submissions provided to the ITU-R in May 2012 were reviewed and the following were

acknowledged as “complete” candidate technology submissions as per § 4 of Report ITU-R M.2176:

- Document IMT-ADV-SAT/4(Rev.1) – Acknowledgement of candidate submission from Republic of Korea under Step 3 of the satellite IMT-Advanced process (SAT-OFDM).
- Document IMT-ADV-SAT/3(Rev.1) – Acknowledgement of candidate submission from China (People’s Republic of) under Step 3 of the satellite IMT-Advanced process (BMSat).

For convenience, these submissions are included in Annex 1.

5 Conclusion for Steps 4 to 7

5.1 Results of Step 4, “Evaluation of candidate RITs or SRITs by Evaluation Groups” and Step 5, “Review and coordination of outside evaluation activities”

Under Step 4 of the IMT-Advanced satellite process, the candidate RITs were evaluated by Independent Evaluation Groups that were registered in the ITU-R. In this step the candidate RITs were assessed based on Report ITU-R M.2176.

In Step 5, the ITU-R monitored the progress of the evaluation activities, and provided appropriate responses to problems or requests for guidance to facilitate consensus building. To this end, ITU-R convened correspondence activities between the thirtieth and thirty-third meetings of Working Party 4B (i.e. from May 2011 to September 2012) and coordinated discussions between proponents and Independent Evaluation Groups, and among Independent Evaluation Groups.

A total of three Independent Evaluation Groups were registered in the ITU-R. Two evaluation reports from the Independent Evaluation Groups were submitted and discussed in ITU-R under Steps 4 and 5. These evaluation reports from the respective Independent Evaluation Groups are included in Annex 2.

5.1.1 Summary of the evaluations received for SAT-OFDM

Under Steps 4 and 5 of the IMT-Advanced satellite process, the ITU-R coordinated the activities of the three Evaluation Groups and received one full evaluation report on the SAT-OFDM technology. The Independent Evaluation Group, Telecommunications Technology Association (TTA) Project Group 707 (PG707) from Korea (Republic of), utilized the defined ITU-R evaluation methodology and criteria established in Report ITU-R M.2176. It developed additional assessment aspects as provided in the IMT-Advanced satellite process. The ITU-R concluded that TTA PG707 had fulfilled its role in the process and that the inclusion of views from organizations external to the ITU-R working by invitation under the guidelines of Resolution ITU-R 9 had been useful to the work on the satellite component of IMT-Advanced and had contributed to the success of the IMT-Advanced satellite process.

The received evaluation report indicated that TTA PG707 was of the opinion that the candidate RIT proposed in Document IMT-ADV-SAT/4(Rev.1) met the minimum requirements of the required test environment.

The ITU-R views of the relevant evaluation report from TTA PG707 for the SAT-OFDM technology is included in Annex 2.

- Document IMT-ADV-SAT/6 – Evaluation Report on the proposed candidate IMT-Advanced satellite radio interface technology based on the SAT-OFDM (submission in Document IMT-ADV-SAT/4(Rev.1)).

5.1.2 Summary of the evaluations received for BMSat

Under Steps 4 and 5 of the IMT-Advanced satellite process, the ITU-R received one evaluation report on the BMSat technology. This report is proposed by the Chinese Evaluation Group (ChEG) and is included in Annex 2.

- Document IMT-ADV-SAT/5(Rev.1) – Evaluation of IMT-Advanced satellite candidate technology submissions in Document IMT-ADV-SAT/3(Rev.1) by ChEG.

ChEG utilized the defined ITU-R evaluation methodology and criteria established in Report ITU-R M.2176. The ITU-R coordinated the activities of ChEG with TTA PG707 to discuss and reach consensus on parameter assumption, calibration, evaluation methodologies and other issues which are related to evaluation tasks. ChEG also developed additional assessment aspects, e.g. specific characteristics evaluation for BMSat. The ITU-R concluded that ChEG had fulfilled its role in the process and that the inclusion of views from organizations external to the ITU-R working by invitation under the guidelines of Resolution ITU-R 9 had been useful to the work on the satellite component of IMT-Advanced and had contributed to the success of the IMT-Advanced satellite process.

The received evaluation report from ChEG indicated that ChEG was of the opinion that:

- the candidate RIT proposed in Document IMT-ADV-SAT/3(Rev.1) met the minimum requirements of mandatory open area test environments;
- the candidate RIT proposed in Document IMT-ADV-SAT/3(Rev.1) had good performance in other test environments, including urban area, suburban area, intermediate tree-shadowed area and heavy tree-shadowed area;
- the specific designs in the candidate RIT proposed in Document IMT-ADV-SAT/3(Rev.1) largely improved the system performance.

5.1.3 Review and coordination outside evaluation activities

Under Step 6 of the IMT-Advanced satellite process, the Chinese Evaluation Group (ChEG) and Telecommunications Technology Association (TTA) Project Group 707 (PG707) from Korea (Republic of), had a discussion meeting at the Vision Hotel, in Beijing, China (People's Republic of), on 30 August 2012, in order to build consensus on the evaluation reports.

During this meeting, the following agenda was discussed in relation to the IMT-Advanced satellite process:

- Introduction of ChEG and TTA PG707 evaluations on IMT-Advanced satellite candidate RITs and discussion.
- Discussion of ITU-R inputs/outputs on evaluation of IMT-Advanced satellite candidate RITs.
- Introduction of input documents on ITU-R IMT-Advanced satellite Recommendations to the thirty-third meeting of ITU-R WP 4B, from China (People's Republic of) and Korea (Republic of), and discussion.

As a result of the meeting, the following decisions were made:

- During the discussion on the evaluation results, it was discovered that the channel model parameters specified in Report ITU-R M.2176 contained typo errors, and the urgency of revising the Report was understood. It was determined to ask the WP 4B Chairman to submit an input document on the revision of the Report at the thirty-third meeting of ITU-R WP 4B.
- Development of Report ITU-R M.2279 – Outcome of the evaluation, consensus building and decision of the IMT-Advanced satellite process (Steps 4 to 7), including characteristics of IMT-Advanced satellite radio interfaces.
- Use a template of recommendation on detailed specifications of the radio interfaces for the satellite component of IMT-Advanced as proposed by China (People’s Republic of).

5.2 Results of Step 6, “Review to assess compliance with minimum requirements”

Under Step 6 of the IMT-Advanced satellite process, an assessment of each proposal was made as to whether it met a version of the minimum technical requirements and evaluation criteria of the IMT-Advanced satellite process in force, as described in Report ITU-R M.2176. The evaluation methodology and the version of the minimum technical requirements used are described in Report ITU-R M.2176.

In this step, the evaluated proposal for an RIT/SRIT is assessed as a qualifying RIT, if any one of the following is met:

- an RIT meets the minimum requirements of at least one test environment;
- an RIT may meet the minimum requirements of all required test environments.

Such a qualified RIT will go forward for further consideration under Step 7.

Based on a review of the evaluations carried out by the Independent Evaluation Groups as well as the self-evaluations from the proponents, the conclusions of the ITU-R for Step 6 are presented in the following subsections. Each candidate technology submission is separately addressed for compliance with regard to services, spectrum and technical performance and for confirmation as a qualifying RIT:

- Section 5.2.1 – Candidate submission from Korea (Republic of) (Doc. IMT-ADV-SAT/4(Rev.1)).
- Section 5.2.2 – Candidate submission from China (People’s Republic of) (Doc. IMT-ADV-SAT/3(Rev.1)).

5.2.1 Candidate submission from Korea (Republic of) (Doc. IMT-ADV-SAT/4(Rev.1))

The ITU-R summary review of the candidate technology submission from Korea (Republic of) is presented below. The individual detailed analysis of compliance for each of the defined items in Report ITU-R M.2176 is included in the tables in Annex 3.

Compliance related to services

The SAT-OFDM technology proposed by Korea (Republic of) (Doc. IMT-ADV-SAT/4(Rev.1)) meets the minimum requirements for services.

Compliance related to spectrum

The SAT-OFDM technology proposed by Korea (Republic of) (Doc. IMT-ADV-SAT/4(Rev.1)) meets the minimum requirements for spectrum.

Compliance related to technical performance

The SAT-OFDM technology proposed by Korea (Republic of) (Doc. IMT-ADV-SAT/4(Rev.1)) meets the minimum requirements for technical performance.

Assessment of the candidate technology proposal as a qualifying RIT/SRIT

ITU-R confirms that the RIT of the candidate technology submission in Document IMT-ADV-SAT/4(Rev.1) meets the minimum requirements of the mandatory open area test environment.

5.2.2 Candidate submission from China (People's Republic of) (Doc. IMT-ADV-SAT/3(Rev.1))

The ITU-R summary review of the candidate technology submission from China (People's Republic of) is presented below. The individual detailed analysis of compliance for each of the defined items in Report ITU-R M.2176 is included in the tables in Annex 3.

Compliance related to services

The technology proposed by China (People's Republic of) (Doc. IMT-ADV-SAT/3(Rev.1)) meets the minimum requirements for services.

Compliance related to spectrum

The technology proposed by China (People's Republic of) (Doc. IMT-ADV-SAT/3(Rev.1)) meets the minimum requirements for spectrum.

Compliance related to technical performance

The technology proposed by China (People's Republic of) (Doc. IMT-ADV-SAT/3(Rev.1)) meets the minimum requirements for technical performance.

Assessment of the candidate technology proposal as a qualifying RIT/SRIT

ITU-R confirms that the RIT of the candidate technology submission in Document IMT-ADV-SAT/3(Rev.1) meets the minimum requirements of the mandatory open area test environment.

5.3 Results of Step 7, "Consideration of evaluation results, consensus building and decision"

5.3.1 Consideration of evaluation results

Each of the two candidate technology submissions, as acknowledged and listed below (and their respective RIT), has individually satisfied in the mandatory open area test environment the requirements of Step 7 of the IMT-Advanced satellite process. Therefore, each of these submissions for candidate technology of the satellite component of IMT-Advanced has the opportunity to proceed to Step 8.

- Document IMT-ADV-SAT/4(Rev.1) – Acknowledgement of candidate submission from Korea (Republic of) under Step 3 of the satellite IMT-Advanced process (SAT-OFDM).
- Document IMT-ADV-SAT/3(Rev.1) – Acknowledgement of candidate submission from China (People's Republic of) under Step 3 of the satellite IMT-Advanced process (BMSat).

5.3.2 Consensus building and decision

In consideration of the IMT-Advanced satellite process for Steps 4 through 7, the following conclusions have been reached in ITU-R:

- Both “SAT-OFDM” and “BMSat” technologies are acknowledged to individually satisfy the requirements of Resolution ITU-R 57-1, *resolves 6e*) and *6f*), for the required number of test environments. These requirements are specified in Report ITU-R M.2176.
- Consequently, both “SAT-OFDM” and “BMSat” technologies are accepted for inclusion in the standardization phase of the IMT-Advanced satellite process and should proceed to Step 8.

6 Characteristics of the satellite radio interface technologies of IMT-Advanced and basis of the specifications for Step 8

In Step 8, an IMT-Advanced satellite radio interface Recommendation is developed within the ITU-R, on the basis of the results of Step 7, sufficiently detailed to enable worldwide compatibility of operation and equipment, including roaming.

6.1 Characteristics of the satellite radio interface technologies for IMT-Advanced

The SAT-OFDM satellite radio interface for IMT-Advanced is based on the technology specified in Document IMT-ADV-SAT/4(Rev.1).

The BMSat satellite radio interface for IMT-Advanced is based on the technology specified in Document IMT-ADV-SAT/3(Rev.1).

6.2 Detailed specifications of the satellite radio interface technologies for IMT-Advanced in Step 8

Under Step 8 of the IMT-Advanced satellite process, the detailed technical specifications of the satellite radio interface technologies for IMT-Advanced are provided in Recommendation ITU-R M.2047.

6.2.1 For SAT-OFDM

Based on the consensus views in § 5.3, SAT-OFDM is accepted in Step 8. The basis for specifying the SAT-OFDM technology in Step 8 is Document IMT-ADV-SAT/4(Rev.1).

6.2.2 For BMSat

Based on the consensus views in § 5.3, BMSat is accepted in Step 8. The basis for specifying the BMSat technology in Step 8 is Document IMT-ADV-SAT/3(Rev.1).

Annex 1

Submission of candidate technologies

Document IMT-ADV-SAT/4(Rev.1) – Acknowledgement of candidate submission from Korea (Republic of) under Step 3 of the satellite IMT-Advanced process (SAT-OFDM).



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Document IMT-ADV-SAT/3(Rev.1) – Acknowledgement of candidate submission from China (People's Republic of) under Step 3 of the satellite IMT-Advanced process (BMSat).



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Annex 2

Summary and details of Evaluation Reports from Independent Evaluation Groups

Document IMT-ADV-SAT/5(Rev.1) – Evaluation of IMT-Advanced satellite candidate technology submissions in Document IMT-ADV-SAT/3(Rev.1) by ChEG.



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Document IMT-ADV-SAT/6 – Evaluation Report on the proposed candidate IMT-Advanced satellite radio interface technology based on the SAT-OFDM (submission in Document IMT-ADV-SAT/4(Rev.1)).



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Annex 3

Detailed compliance template summaries²

1 Candidate submission from Korea (Republic of) (Doc. IMT-ADV-SAT/4(Rev.1))

Summary of assessment of compliance for services (Reference section of Report ITU-R M.2176: 8.2.5.1)	ITU-R confirmation that the requirement is met by the candidate technology proposal
Support of a wide range of services	Yes

Summary of assessment of compliance for spectrum (Reference section of Report ITU-R M.2176: 8.2.5.2)	ITU-R confirmation that the requirement is met by the candidate technology proposal
Spectrum bands – Is the proposal able to utilize at least one band identified for IMT?	Yes

Summary of assessment of compliance for technical performance (Reference section of Report ITU-R M.2176: 8.2.5.3)					ITU-R confirmation that the requirement is met by the candidate technology proposal
Minimum technical requirements items	Category		Required value	Value³	
	Test environment	Downlink or uplink			
Beam spectral efficiency (bit/s/Hz/beam)	Open	Downlink	1.1	1.526	Yes
		Uplink	0.7	1.525	
Peak spectral efficiency (bit/s/Hz)	–	Downlink	2.5	6.06	Yes
		Uplink	1.25	2.88	
Bandwidth	–	Up to and including (MHz)	30	100	Yes
		Scalability	N/A	1.4, 3, 5, 10, 15, 20	
Beam edge user spectral efficiency (bit/s/Hz) ⁴	Open	Downlink	0.04	1.526	Yes
		Uplink	0.015	1.525	
Control plane latency (ms)	N/A	N/A	N/A	50+6TD 9.5+3TD	N/A
User plane latency (ms)	N/A	N/A	N/A	5+2TD+p×n	

² Reference: Report ITU-R M.2176.

³ Detailed values for other test environments and different UE types could be referred to Document IMT-ADV-SAT/4(Rev.1).

⁴ Beam edge user spectral efficiency values of 1.525/1.526 bit/s/Hz for uplink/downlink were calculated as the 5% point of the cumulative distribution function (CDF) of the user throughput divided by the user channel bandwidth. When we assume that spectral efficiency is the user throughput divided by the beam bandwidth, they could be estimated into 0.061/0.061 bit/s/Hz.

Summary of assessment of compliance for technical performance (Reference section of Report ITU-R M.2176: 8.2.5.3)					ITU-R confirmation that the requirement is met by the candidate technology proposal
Minimum technical requirements items	Category		Required value	Value ³	
	Test environment	Downlink or uplink			
Mobility	Open	N/A	Stationary, pedestrian, vehicular high speed vehicular, aeronautical	Stationary, pedestrian, vehicular high speed vehicular, aeronautical	Yes
Intra-frequency handover interruption time (ms)	N/A	N/A	N/A	19.5+2TD	N/A
Inter-frequency handover interruption time within spectrum band (ms)	N/A	N/A	N/A	19.5+2TD	
Inter-frequency handover interruption time between spectrum band (ms)	N/A	N/A	N/A	19.5+2TD	
Intersystem handover	N/A	N/A	N/A	support	
Number of supported VoIP users (active users/beam/MHz)	Open	N/A	30	88	Yes

N/A: Not Applicable.

TD: Transmission delay between S-RAN and UE.

p: The error probability of the first HARQ retransmission.

n: The number of HARQ processes.

2 Candidate submission from China (People's Republic of) (Doc. IMT-ADV-SAT/3(Rev.1))

Summary of assessment of compliance for services (Reference section of Report ITU-R M.2176: 8.2.5.1)	ITU-R confirmation that the requirement is met by the candidate technology proposal
Support of a wide range of services	Yes
Summary of assessment of compliance for spectrum (Reference section of Report ITU-R M.2176: 8.2.5.2)	ITU-R confirmation that the requirement is met by the candidate technology proposal
Spectrum bands – Is the proposal able to utilize at least one band identified for IMT?	Yes

Summary of assessment of compliance for technical performance (Reference section of Report ITU-R M.2176: 8.2.5.3)					ITU-R confirmation that the requirement is met by the candidate technology proposal	
Minimum technical requirements items	Category		Required value	Value		
	Test environment	Downlink or uplink				
Beam spectral efficiency (bit/s/Hz/beam)	Urban	Downlink	N/A	0.6221/0.6221/0.6221/ 0.8567/0.9037/ 1.2678	N/A	
		Uplink	N/A	0.0177/0.0702/0.4271/ 0.5729/1.0220/ 1.0971		
	Suburban	Downlink	N/A	0.7798/0.7798/0.7798/ 1.0907/1.1545/ 1.4923	N/A	
		Uplink	N/A	0.0167/0.0744/0.5188/ 0.7201/1.3506/ 1.4586		
	Open	Downlink	1.1	0.8662/0.8662/0.8662/ 1.1760/1.2296/ 1.5620	Yes	
		Uplink	0.7	0.0299/0.1235/0.6464/ 0.8590/1.4635/ 1.5365		
	Intermediate tree-shadowed	Downlink	N/A	0.7217/0.7217/0.7217/ 0.9813/1.0400/ 1.4346	N/A	
		Uplink	N/A	0.0199/0.0778/0.4659/ 0.6355/1.1893/ 1.3385		
	Heavy tree-shadowed	Downlink	N/A	0.1281/0.1281/0.1281/ 0.3460/0.4079/ 1.1297	N/A	
		Uplink	N/A	0.0026/0.0049/0.0186/ 0.0313/0.3204/ 0.7227		
	Peak spectral efficiency (bit/s/Hz)	-	Downlink	2.5	2.73	Yes
			Uplink	1.25	2.63	

Summary of assessment of compliance for technical performance (Reference section of Report ITU-R M.2176: 8.2.5.3)					ITU-R confirmation that the requirement is met by the candidate technology proposal	
Minimum technical requirements items	Category		Required value	Value		
	Test environment	Downlink or uplink				
Bandwidth	–	Up to and including (MHz)	30	100	Yes	
		Scalability	N/A	1.4/3/5/10/15/20		
Beam edge user spectral efficiency (bit/s/Hz) ⁵	Urban	Downlink	N/A	0.0018/0.0018/0.0018/ 0.0026/0.0030/ 0.0425	N/A	
		Uplink	N/A	0.0003/0.0007/0.0043/ 0.0035/0.0016/ 0.0034		
	Suburban	Downlink	N/A	0.0324/0.0324/0.0324/ 0.0465/0.0535/ 0.0893	N/A	
		Uplink	N/A	0.0002/0.0006/0.0209/ 0.0142/0.0416/ 0.0754		
	Open	Downlink	0.04	0.0609/0.0609/0.0609/ 0.0877/0.0930/ 0.1201	Yes	
		Uplink	0.015	0.0002/0.0009/0.0331/ 0.0568/0.1043/ 0.1089		
	Intermediate tree-shadowed	Downlink	N/A	0.0079/0.0079/0.0079/ 0.0281/0.0338/ 0.0949	N/A	
		Uplink	N/A	0.0002/0.0009/0.0023/ 0.0019/0.0229/ 0.0627		
	Heavy tree-shadowed	Downlink	N/A	0.0006/0.0006/0.0006/ 0.0113/0.0210/ 0.0901	N/A	
		Uplink	N/A	0.0001/0.0001/0.0001/ 0.0003/0.0063/ 0.0418		
	Control plane latency (ms)	N/A	N/A	N/A	50+6x ⁶	N/A

⁵ Beam edge user spectral efficiency is defined as the 5% point of the cumulative distribution function (CDF) of the normalized user throughput. The normalized user throughput is calculated as $\gamma_i = \chi_i / (T_i \cdot \omega)$, where χ_i denotes the number of correctly received bits of user i , T_i denotes the active session time for user i , and ω denotes the channel bandwidth.

⁶ “x” is the transmission delay between the UE and satellite gateway, and “50+6x” is the “Idle to Connected” latency.

Summary of assessment of compliance for technical performance (Reference section of Report ITU-R M.2176: 8.2.5.3)					ITU-R confirmation that the requirement is met by the candidate technology proposal
Minimum technical requirements items	Category		Required value	Value	
	Test environment	Downlink or uplink			
User plane latency (ms)	N/A	N/A	N/A	$5+y_1+y_2^7$	
Mobility	Urban	N/A	N/A		N/A
	Suburban	N/A	N/A		
	Open	N/A	Stationary, pedestrian, vehicular high speed vehicular, aeronautical	Stationary, pedestrian, vehicular high speed vehicular, aeronautical	Yes
	Intermediate tree-shadowed	N/A	N/A		N/A
	Heavy tree-shadowed	N/A	N/A		
Intra-frequency handover interruption time (ms)	N/A	N/A	N/A	$12+2x$	N/A
Inter-frequency handover interruption time within spectrum band (ms)	N/A	N/A	N/A	$12+2x$	
Inter-frequency handover interruption time between spectrum band (ms)	N/A	N/A	N/A	$12+2x$	
Intersystem handover	N/A	N/A	N/A		
Number of supported VoIP users (active users/beam/MHz)	Urban	N/A	N/A	0/0/5/8/50	N/A
	Suburban	N/A	N/A	0/5/19/24/36/ 54	
	Open	N/A	30	5/13/30/44/ 48/55	Yes
	Intermediate tree-shadowed	N/A	N/A	0/0/6/10/14/49	N/A
	Heavy tree-shadowed	N/A	N/A	0/0/0/6/9/34	

⁷ “y1” is the transmission delay between the UE and satellite, and “y2” is the transmission delay between the satellite gateway and satellite.