Source: Document 5D/

Subject: WRC-27 agenda item 1.7

Document XX/-E
Date 20xx
Original: English

IAFI

1 Introduction

Working Party (WP) 5D is the responsible group for WRC-27, agenda item 1.7 in accordance with Resolution **256 (WRC-23)**, see the results of CPM27-1 in CA/270. The 47th meeting of WP 5D developed the following documents in relation to sharing and compatibility studies for WRC-27, agenda item 1.7:

– **Main part –** Annex 4.9 to Document 5D/413-E

– **Annex 1 (4 400-4 800 MHz) -** Annex 4.10 to Document 5D/413-E

– **Annex 2: (7 125-8 400 MHz) -** Annex 4.11 to Document 5D/413-E

– **Annex 3 (14.8-15.35 GHz) -** Annex 4.12 to Document 5D/413-E

2 Discussion

This input contribution proposes edits to Annex 1 (4 400-4 800 MHz) and Annex 2 (7 125 -8 400 MHz). The edits aim to streamline the text and make some formatting edits.

The 47th meeting of WP 5D also discussed the final status of Annex 2 (7 125-8 400 MHz) and if it should be an ITU-R Report or supporting material annexed to the Chair's Report and added the following editor's note:

[Editor's note: A decision is needed later in the study cycle on if this document is supporting material annexed to the chair's report only or if it becomes an ITU-R Report. If this document is to become an ITU-R Report it is important that all supporting material (i.e. Main Part and all Annexes) become ITU-R Report(s) as a package. This could be facilitated through all material being combined into a single ITU-R Report.]

In the previous study cycle, supporting material has only been annexed to the Chair's Report and did not become a ITU-R Report (see Annexes 4.9 - 4.24, 5D/1776 from the 2019 -2023 study cycle). It is suggested that WP 5D converts this Annex 2 (7 125-8 400 MHz) into an ITU-R Report so that it becomes an important reference material during the WRC-27. Further, it is proposed that all supporting material (i.e. Main Part and all Annexes) become ITU-R Report(s) as a package, perhaps within a single ITU-R Report. This is to avoid having a different status for the various parts / Annexes where some become ITU-R Reports, and some remain annexed to the Chair's Report only.

2 Proposal

Working Party 5D consider and discuss the proposed edits in the Attachment below.

Attachment: 1

Source: Document 5D/TEMP/160

Subject: WRC-27 agenda item 1.7

Annex 4.9 to
Document 5D/413-E
16 October 2024
English only

Annex 4.9 to Working Party 5D Chair's Report

[DOCUMENT ON SHARING AND COMPATIBILITY STUDIES OF IMT SYSTEMS IN THE FREQUENCY BANDS 4 400-4 800 MHZ, 7 125-8 400 MHZ AND 14.8-15.35 GHZ IN RELATION TO WRC-27 AGENDA ITEM 1.7] / [WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT NEW REPORT ON SHARING AND COMPATIBILITY STUDIES IN RELATION TO WRC-27 AGENDA ITEM 1.7 / SUPPORTING MATERIAL FOR WRC-27 AGENDA ITEM 1.7] – MAIN PART

[Editor's note: A decision is needed later in the study cycle on if this document is supporting material annexed to the chair's report only or if it becomes an ITU-R Report. If this document is to become an ITU-R Report it is important that all supporting material (i.e. Main Part and all Annexes) become ITU-R Report(s) as a package. This could be facilitated through all material being combined into a single ITU-R Report.]

1 Introduction

This document includes the sharing and compatibility studies between IMT systems in the frequency bands 4 400-4 800 MHz, 7 125-8 400 MHz, and 14.8-15.35 GHz with existing service/application(s).

It is intended to respond to resolves to invite the ITU Radiocommunication Sector to complete in time for the 2027 world radiocommunication conference 2 of Resolution **256 (WRC-23)** under WRC-27 agenda item 1.7.

2 Propagation models and technical and operational characteristics

This section provides the reference to specific parameters used in the studies included within this document, as developed in WP 5D and provided by the contributing groups to WRC-27 agenda item 1.7.

[Editor's note: the table below needs to be reviewed based on inputs from contributing groups, updating the list of services for which information was provided.]

WP 5D/	Source	Services/Applications/Models
77 (Annex 4.8)	WP 5D	International Mobile Telecommunications (IMT)
160	WPs 3K/3M	Propagation models
118	WP 4A	Fixed-satellite service (FSS) / RR Appendix **30B** including detailed information provided by the BR in Document 5D/254R1 Broadcasting-satellite service (BSS)
108	WP 4C	Mobile-satellite service (MSS) Maritime mobile-satellite service (MMSS)
	WP 5A	Land mobile service excluding IMT (LMS) Amateur service Amateur-satellite service
127	WP 5B	Maritime mobile service (MMS) Aeronautical mobile service (AMS) Aeronautical mobile (R) service (AM(R)S) Radiodetermination service Aeronautical radionavigation service (ARNS)
129	WP 5C	Fixed service (FS)
92, 403	WP 7B	Space operation service (SOS) Space research service (SRS) Earth exploration-satellite service (EESS) Meteorological-satellite service (MetSat)
87	WP 7C	Earth exploration-satellite service (passive) (EESS (passive))
404	WP 7D	Radio astronomy service (RAS)

3 Sharing and compatibility studies

The sharing and compatibility studies are contained in the Annexes to this document.

Annex 1: Sharing and compatibility studies of IMT systems in the frequency band 4 400-4 800 MHz

Annex 2: Sharing and compatibility studies of IMT systems in the frequency band 7 125-8 400 MHz

Annex 3: Sharing and compatibility studies of IMT systems in the frequency band 14.8-15.35 GHz

4 Abbreviations and acronyms

[Editor's note: need to review all parts of the document to add additional acronyms as needed.]

3GPP Third generation partnership project

AAS Advanced antenna system

EESS Earth exploration-satellite service

FSS Fixed-satellite service

Source: Document 5D/TEMP/140

Subject: Subject: WRC-27 agenda item 1.7

Annex 4.10 to
Document 5D/413-E

16 October 2024

English only

Annex 4.10 to Working Party 5D Chair's Report

ANNEX 1 – SHARING AND COMPATIBILITY STUDIES BETWEEN SERVICES TO WHICH THE BAND IS CURRENTLY ALLOCATED AND IMT SYSTEMS IN THE FREQUENCY BAND 4 400-4 800 MHz UNDER WRC-27 AGENDA ITEM 1.7

IMT	International Mobile Telecommunications
IMT-2020	International Mobile Telecommunications (IMT) for 2020 and beyond
LEO	Low-Earth orbit
MetSat	Meteorological-satellite service
MSS	Mobile-satellite service
OOB	Out-of-band
PFD	Power flux-density
RAS	Radio astronomy service
RR	Radio Regulations
SOS	Space operation service
SRS	Space research service

1 Introduction

This document includes the sharing and compatibility studies between IMT systems in the frequency band 4 400-4 800 MHz with existing service/application(s) to which the frequency band is allocated on a primary basis, and also with primary services in adjacent bands.

2 Allocation information in the frequency band 4 400-4 800 MHz

For allocation details, please refer to the ITU Radio Regulations (RR) (Table of Frequency Allocations, and associated footnotes) and corresponding Rules of Procedure. The relevant services to which the frequency band is allocated on a primary basis within the frequency range 4 400-4 800 MHz, and also services allocated on a primary basis in adjacent bands, are:

Table 1

RR allocations in 4 400-4 800 MHz and adjacent bands

Allocation to services

Region 1	Region 2	Region 3
4 200-4 400	AERONAUTICAL MOBILE (R) 5.436 AERONAUTICAL RADIONAVIGATION 5.438 5.437 5.439 5.440	
4 400-4 500	FIXED MOBILE 5.440A	
4 500-4 800	FIXED FIXED-SATELLITE (space-to-Earth) 5.441 MOBILE 5.440A	
4 800-4 990	FIXED MOBILE 5.440A 5.441A 5.441B 5.442 Radio astronomy 5.443 5.149 5.339	

3 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 5D SWG Characteristics.]

[Editor's note: Further discussion is needed at the next WP 5D meeting in February 2025 to finalize the treatment of reverse study analysis of existing services into IMT. Additional elements of this discussion are included in Annex 4 of the document on sharing and compatibility studies under WRC-27 agenda item 1.7.]

4 Propagation models for sharing and compatibility studies in the frequency band 4 400-4 800 MHz

[Editor's note: This section 4 is proposed to be kept at this position to ensure consistency of the different studies and may later be considered for deletion from this part, as the propagation models are included in the Attachment of the respective service listed in section 5.]

4.1 Recommendations applicable for all sharing geometries

– ITU-R P.2108 – Prediction of clutter loss.

– ITU-R P.2109 – Prediction of building entry loss.

4.2 Recommendations applicable for sharing between stations on the surface of the Earth

– ITU-R P.452 – Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz.

– ITU-R P.1812 – A path-specific propagation prediction method for point-to-area terrestrial services in the frequency range 30 MHz to about 6 GHz.

– ITU-R P.2001 – A general purpose wide-range terrestrial propagation model in the frequency range 30 MHz to 50 GHz.

– ITU-R P.1411 – Propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz.

– ITU-R P.1238 – Propagation data and prediction methods for the planning of indoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 450 GHz.

4.3 Recommendations applicable for sharing between airborne stations and stations on the Earth's surface

– ITU-R P.528 – A propagation prediction method for aeronautical mobile and radionavigation services using the VHF, UHF and SHF bands.

5 Sharing and compatibility studies

[Editor's note: Additional discussions are required on whether studies with LMS are needed, depending on the information provided by the contributing groups.]

The sharing and compatibility studies are contained in the attachments to this document:

Attachment 1: Sharing between the fixed service and IMT operating in the frequency band 4 400-4 800 MHz.

Attachment 2: Sharing between the aeronautical mobile service and IMT operating in the frequency band 4 400-4 800 MHz.

Attachment 3: Sharing between the maritime mobile service and IMT operating in the frequency band 4 400-4 800 MHz.

Attachment 4: Sharing between the fixed satellite service (space-to-Earth) (RR No. 5.441) in Allotments in the RR Appendix 30B Plan, assignments in the RR Appendix 30B List, conversions of an allotment into an assignment, Article 7 requests transferred to Article 6 of RR Appendix 30B, submissions in accordance with Resolution 170 (Rev.WRC-23) and submissions for additional system under Article 6 of RR Appendix 30B operating in the frequency band 4 500-4 800 MHz and IMT operating in the frequency band 4 400-4 800 MHz.

Attachment 5: Compatibility of the aeronautical mobile (R) service (RR No. 5.436) operating in the frequency band 4 200-4 400 MHz and IMT operating in the frequency band 4 400-4 800 MHz

Attachment 6: Compatibility of the aeronautical radionavigation service (RR No. 5.438) operating in the frequency band 4 200-4 400 MHz and IMT operating in the frequency band 4 400-4 800 MHz

ATTACHMENT 1

Sharing between the fixed service and IMT operating in the frequency band 4 400-4 800 MHz

[Editor's note: The studies provided have not been discussed and will need to be carefully examined and updated once service parameters are finalized.]

A1.1 Technical/operational characteristics and protection criteria of fixed service operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 5C.]

A1.2 Technical analysis

A1.2.1 Study A [CHN]

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A1.2.1.1 Technical characteristics

[Editor's note: This section the specific parameters and protection criteria used in the included study/studies, as provided by the contributing groups to WP 5D.]

A1.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

The IMT system characteristics as described in the Chair's Report of ITU 5D #46 (Annex 4.9, Document 5D/242) are utilized for the study. The IMT system operates at a centre frequency of 4 600 MHz with a 100 MHz bandwidth.

Tables A1-1 and A1-2 summarize the deployment and AAS characteristics in the 4 400-4 800 MHz frequency band for urban and suburban macro scenario.

Table A1-1

Deployment-related parameters for bands 4 400-4 800 MHz

	Urban/suburban macro
Cell radius / Deployment density	Typical cell radius 0.4 km urban / 0.8 km suburban (10 BSs/km2 urban / 2.4 BSs/km2 suburban (Note 1))
Antenna height	20 m urban / 25 m suburban
Sectorization	3 sectors
Frequency reuse	1
Below rooftop base station antenna deployment (Note 2)	Urban: 50% Suburban: 0%
Typical channel bandwidth	100 MHz
Network loading factor (base station load probability X%)	50%

	Urban/suburban macro
TDD / FDD	TDD
BS TDD activity factor	75%
Note 1: “1 BS” = 1 sector in 3-sector cell. Note 2: This “below rooftop” parameter is provided for IMT BS deployments to describe the environment surrounding the BS, including the clutter. It relates to outdoor scenarios with different BS heights. From a propagation perspective, line-of-sight (LOS) or non-line-of-sight (NLOS) condition is a more appropriate concept to compute the additional clutter loss in urban, suburban and rural scenarios. In addition, in some cases, LOS conditions can also be associated with a clutter loss. This is particularly true for ground paths or, in general, paths that pass close to one or more obstacles. Even if there is visual LOS, the radio waves may experience a loss due to the intrusion of the clutter. If there are multiple such clutter objects at different distances along the path, then the loss can be higher. Still, it is recommended for now that the LOS probability be considered to determine clutter loss instead of above/below rooftop ratio in this table.	

Table A1-2

Beamforming antenna characteristics for IMT in 4400 - 4800 MHz

		Macro suburban	Macro urban
1			
1.1	Antenna pattern		
1.2	Element gain (dBi) (Note 2)	6.4	6.4
1.3	Horizontal/vertical 3 dB beam width of single element (degree)	90º for H 65º for V	90º for H 65º for V
1.4	Horizontal/vertical front-to-back ratio (dB)	30 for both H/V	30 for both H/V
1.5	Antenna polarization	Linear ±45º polarized sub-array	Linear ±45º polarized sub-array
1.6	Antenna array configuration (Row × Column) (Note 4)	4 × 8	4 × 8
1.7	Horizontal/Vertical radiating sub-array or element spacing (Note 5)	0.5 of wavelength for H, 2.1 of wavelength for V	0.5 of wavelength for H, 2.1 of wavelength for V

1.7a	Number of element rows in sub-array	3	3
1.7b	Vertical element separation in sub-array ($d_{v,sub}$)	0.7 of wavelength for V	0.7 of wavelength for V
1.7c	Pre-set sub-array down-tilt (degrees) (Note 6)	3	3
1.8	Array Ohmic loss (dB) (Note 2)	2	2
1.9	Conducted power (before Ohmic loss) per sub-array or element (dBm) (Note 3)	28	28
1.10	Base station horizontal coverage range (degrees) (Note 9)	+/–60	+/–60
1.11	Base station vertical coverage range (degrees) (Note 1) (Note 9)	90-100	90-100
1.12	Mechanical down-tilt (degrees) (Note 8)	6	6
1.13	Maximum base station output power/sector (e.i.r.p.) (dBm) (Note 7)	72.2	72.2

Note 1: The vertical coverage range is given in global coordinate system, i.e., 90° being at the horizon. This range includes the mechanical down-tilt given in row 1.12.

Note 2: The element gain in row 1.2 includes the loss given in row 1.8 and is per polarization.

Note 3: Conducted power values are per polarization. The conducted power per sub-array assumes 4 × 8 sub-arrays and 2 polarizations for the rural, suburban and urban macro cases; the conducted power per element assumes 8 × 8 elements and 2 polarizations for the small cell outdoor/micro urban case.

Note 4: 4 × 8 means there are 4 rows and 8 columns of radiating sub-arrays for rural, macro suburban and macro urban cases. 8 × 8 means there are 8 rows and 8 columns of radiating elements for the small cell outdoor/micro urban case.

Note 5: For the case of 3 elements per sub-array, vertical sub-array spacing will be 2.1 wavelengths.

Note 6: The pre-set sub array down-tilt is a fixed design parameter for a base station. It is envisaged as a passive fixed (non-varying) electrical tilt within the sub-array elements.

Note 7: The maximum base station e.i.r.p per sector is calculated as total power (including power from two orthogonal polarizations).

Note 8: Mechanical down-tilt is handled by a coordinate system transformation described in 3GPP TR 36.814 section A.2.1.6.2.

Note 9: θ_{etilt} and φ_{escan} is the BS array antenna beam steering direction used in Table 3 about Extended AAS model, they should be set so that the beam steering direction is within the vertical and horizontal coverage ranges in row 1.11 and row 1.10, respectively.

A1.2.1.1.2 Technical/operational characteristics and protection criteria of fixed service operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of fixed service provided by other expert group for sharing/interference analyses used in the study.]

The technical and operational characteristics and protection criteria of the fixed service (FS) are based on the reply liaison statement from WP 5C (Doc. 5D/129), with reference to Recommendations ITU-R F.758-7 and F.2086-0. The parameters of the fixed service (FS) utilized in this study refer to the parameters of frequency range 4.4-5.0 GHz in Table 8 of the latest revision to Recommendation ITU-R P.758-7, see Table A1-3 for details.

TABLE A1-3

Parameter	Value	Note
Maximum antenna gain(dBi)	22.5	From Recommendation ITU-R F.758
Feeder loss(dB)	3	From Recommendation ITU-R F.758
Antenna pattern	F.1245	
Elevation angle (degrees)	−0.2	From Recommendation ITU-R F.2086
Link length (km)	41	From Recommendation ITU-R F.2086
Antenna Height(m)	39	From Recommendation ITU-R F.2086
Receiver noise figure (dB)	6.5	From Recommendation ITU-R F.758
Receiver noise power density typical (=NRX) (dBW/MHz)	−137.5	From Recommendation ITU-R F.758

Working Party 5C provides guidance on interference criteria in section 4 of Annex 1 of Recommendation ITU-R F.758-7. According to Recommendation ITU-R F.758-7, that performance and availability degradation may be affected by both long-term and short-term interference, therefore, this study adopts long-term and short-term protection criteria to evaluate the coexistence conditions respectively. I/N values for long-term interference is -10 dB, not to be exceeded for more than 20% of the time.

A1.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

Recommendation ITU-R P.452-17 with smooth earth profile between the IMT BSs and the FS station and the random time percentage is used in Monte Carlo simulations in this study.

A1.2.1.2 Methodology

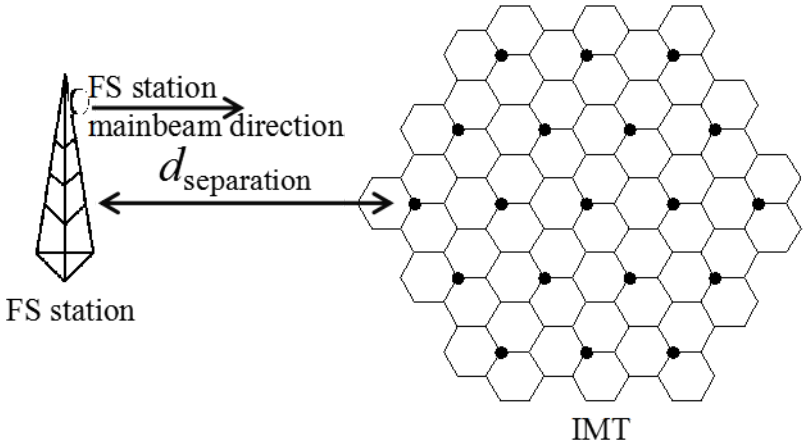
[Editor's note: This section provides the methodology used in this study.]

This section outlines the methodology for calculating the aggregate interference from IMT (International Mobile Telecommunications) base stations to a fixed service (FS) station. Monte Carlo simulation method is used in this study. The specific steps undertaken are outlined below:

Step 1: generate FS station, IMT base stations and UEs. The IMT base stations are generated in a hexagon grid with 19 sites, and each site has 3 sectors, the separation distance is the distance from FS station and the nearest IMT BS. Illustration of the coexistence scenario were shown below in Figure A1-1, the main lobe of the FS station pointing towards the IMT networks in azimuth.

Figure A1-1

The deployment of the FS station and the IMT network



Step 2: calculate the interference power density In from each BS/UE as:

dBm/MHz (1)

where:

P: the transmit power density of a BS/UE (dBm/MHz)

Gt : antenna gain of the BS in the direction of the FS station (dBi)

LP: propagation loss between the BS/UE and the FS station(dB)

Gr: antenna gain of the FS station in the direction of the BS/UE (dBi)

Lpolar: polarization loss (dB)

Lfeeder: feeder loss (dB).

Step 3: The aggregate interference power density from multiple BSs/UEs is calculated as below:

(2)

where:

Iagg: the aggregate interference power density (dBm/MHz)

n: index of the BS/UE

FTDD: the TDD factor.

Step 4: calculated I/N.

Noise power density at FS station receiver (NRX) has been given in Table 2. I/N can be calculated as:

$$I/N = Iagg - NRX$$

Step 5: repeat step 1~4, then generate the CDF curve, and compare with the protection criteria.

A1.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

The simulation results are shown in the table below. Based on past experience, interference from IMT UEs is significantly lower than that from IMT BSs, thus the UE interference can be considered negligible. Hence, this study focuses exclusively on interference emanating from IMT BS. Figure A1-2 shows I/N CDF.

Figure A1-2

I/N CDF for urban macro scenario with long-term protection criteria

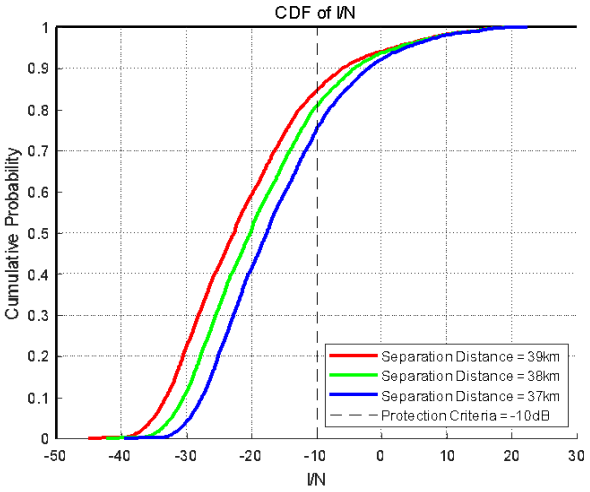


Table A1-3

Simulation results of separation distance

	Separation distance(km)	
	Urban macro	Suburban macro
Long-term interference	38	[TBD]
Short-term interference	[TBD]	[TBD]

A1.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

[TBD]

A1.2.2 Study B

A1.2.2.1 Technical characteristics

A1.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

A1.2.2.1.2 Technical/ operational characteristics and protection criteria of [service type z] operating in the frequency band 4 400-4 800 MHz

A1.2.2.1.3 Propagation models used in the studies

A1.2.2.2 Methodology

A1.2.2.3 Study results

A1.2.2.4 Summary and analysis of the results of Study B

A1.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 4 400-4 800 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 2

Sharing between the aeronautical mobile service and IMT operating in the frequency band 4 400-4 800 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the aeronautical mobile service and IMT operating in the frequency band 4 400-4 800 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above.]

A2.1 Technical/operational characteristics and protection criteria of aeronautical mobile service operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 5B. Noting that additional consideration is needed on whether studies with MS will be required.]

A2.2 Technical Analysis

A2.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A2.2.1.1 Technical characteristics

A2.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A2.2.1.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A2.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A2.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A2.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A2.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A2.2.2 Study B

A2.2.2.1 Technical characteristics

A2.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

A2.2.2.1.2 Technical/ operational characteristics and protection criteria of [service type z] operating in the frequency band 4 400-4 800 MHz

A2.2.2.1.3 Propagation models used in the studies

A2.2.2.2 Methodology

A2.2.2.3 Study results

A2.2.2.4 Summary and analysis of the results of Study B

A2.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 4 400-4 800 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 3

Sharing between the maritime mobile service and IMT operating in the frequency band 4 400-4 800 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the maritime mobile service and IMT operating in the frequency band 4 400-4 800 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above. In the case of studies related to Appendix 30B, an alternative format to provide the information of studies may need to be considered.]

A3.1 Technical/operational characteristics and protection criteria of aeronautical mobile service operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 5B. Noting that additional consideration is needed on whether studies with MS will be required.]

A3.2 Technical Analysis

A3.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A3.2.1.1 Technical characteristics

A3.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A3.2.1.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A3.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A3.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A3.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A3.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A3.2.2 Study B

A3.2.2.1 Technical characteristics

A3.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

A3.2.2.1.2 Technical/ operational characteristics and protection criteria of [service type z] operating in the frequency band 4 400-4 800 MHz

A3.2.2.1.3 Propagation models used in the studies

A3.2.2.2 Methodology

A3.2.2.3 Study results

A3.2.2.4 Summary and analysis of the results of Study B

A3.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 4 400-4 800 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 4

Sharing between the fixed satellite service (space-to-Earth) (RR No. 5.441) in Allotments in the RR Appendix 30B Plan, assignments in the RR Appendix 30B List, conversions of an allotment into an assignment, Article 7 requests transferred to Article 6 of RR Appendix 30B, submissions in accordance with Resolution 170 (Rev.WRC-23) and submissions for additional system under Article 6 of RR Appendix 30B operating in the frequency band 4 500-4 800 MHz and IMT operating in the frequency band 4 400-4 800 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the fixed satellite service (space-to-Earth) (Appendix 30B) operating in the frequency band 4 500-4 800 MHz and IMT operating in the frequency band 4 400-4 800 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above. In the case of studies related to Appendix 30B, an alternative format to provide the information of studies may need to be considered.]

A4.1 Technical/operational characteristics and protection criteria of fixed satellite service (space-to-Earth) (Appendix 30B) operating in the frequency band 4 500-4 800 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 4A.]

A4.2 Technical Analysis

A4.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A4.2.1.1 Technical characteristics

A4.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A4.2.1.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A4.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A4.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A4.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A4.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A4.2.2 Study B

A4.2.2.1 Technical characteristics

A4.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

A4.2.2.1.2 Technical/ operational characteristics and protection criteria of [service type z] operating in the frequency band 4 400-4 800 MHz

A4.2.2.1.3 Propagation models used in the studies

A4.2.2.2 Methodology

A4.2.2.3 Study results

A4.2.2.4 Summary and analysis of the results of Study B

A4.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 4 400-4 800 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 5

Compatibility of the aeronautical mobile (R) service (RR No. 5.436) operating in the frequency band 4 200-4 400 MHz and IMT operating in the
frequency band 4 400-4 800 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the aeronautical mobile (R) service (RR No. 5.436) operating in the frequency band 4 200-4 400 MHz and IMT operating in the frequency band 4 400-4 800 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above. In the case of studies related to Appendix 30B, an alternative format to provide the information of studies may need to be considered.]

A5.1 Technical/operational characteristics and protection criteria of aeronautical mobile (R) service (RR No. 5.436) operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 5B.]

A5.2 Technical Analysis

A5.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A5.2.1.1 Technical characteristics

A5.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A5.2.1.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A5.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A5.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A5.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A5.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A5.2.2 Study B

A5.2.2.1 Technical characteristics

A5.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

A5.2.2.1.2 Technical/ operational characteristics and protection criteria of [service type z] operating in the frequency band 4 400-4 800 MHz

A5.2.2.1.3 Propagation models used in the studies

A5.2.2.2 Methodology

A5.2.2.3 Study results

A5.2.2.4 Summary and analysis of the results of Study B

A5.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 4 400-4 800 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 6

Compatibility of the aeronautical radionavigation service (RR No. 5.438) operating in the frequency band 4 200-4 400 MHz and IMT operating in the
frequency band 4 400-4 800 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the aeronautical radionavigation service (RR No. 5.438) operating in the frequency band 4 200-4 400 MHz and IMT operating in the frequency band 4 400-4 800 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above. In the case of studies related to Appendix 30B, an alternative format to provide the information of studies may need to be considered.]

A6.1 Technical/operational characteristics and protection criteria of aeronautical radionavigation service (RR No. 5.438) operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 5B.]

A6.2 Technical Analysis

A6.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A6.2.1.1 Technical characteristics

A6.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A6.2.1.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 4 400-4 800 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A6.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A6.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A6.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A6.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A6.2.2 Study B

A6.2.2.1 Technical characteristics

A6.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 4 400-4 800 MHz

A6.2.2.1.2 Technical/ operational characteristics and protection criteria of [service type z] operating in the frequency band 4 400-4 800 MHz

A6.2.2.1.3 Propagation models used in the studies

A6.2.2.2 Methodology

A6.2.2.3 Study results

A6.2.2.4 Summary and analysis of the results of Study B

A6.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 4 400-4 800 MHz, or in adjacent band as appropriate, from IMT systems.]

Table (IMT ANd Service XX in A-B MHz frequency range)

Overview of the sharing and compatibility studies

[Editor's note: Descriptive text and notes of the table. Rows to be added or deleted based on the decision of WP 5D.]

	Parameters from expert WPs	Study A	Study …
Methodology			
Single-entry or Multiple-entry (aggregated)			
Statistical, or Statistical and Deterministic			
Technical and operational characteristics of IMT systems			
Deployment scenario			
IMT stations			
Method to deploy multiple IMT stations for the aggregated interference analysis over a relatively large area (as applicable to scenarios for the studies)			
Number of IMT base stations (BS)			
Network loading factor for BS and UE (%)			
TDD activity factor (%)			
UE power control			
UE body loss (dB)			
IMT antenna pattern			
BS antenna mechanical downtilt			
UE antenna pointing (if beamforming)			
UE distribution			
User equipment density for terminals that are transmitting simultaneously			
Technical and operational characteristics (of incumbent service)			

	Parameters from expert WPs	Study A	Study …
Propagation model/losses			
Basic transmission loss			
Clutter loss			
Building entry loss			
Cross-polarization loss (dB)			
Results of studies			
Does the study result consider both BS and UEs?			
Results summary			

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Subject: WRC-27 agenda item 1.7

Annex 4.11 to
Document 5D/413-E

16 October 2024

English only

Annex 4.11 to Working Party 5D Chair's Report

ANNEX 2 – SHARING AND COMPATIBILITY STUDIES BETWEEN SERVICES TO WHICH THE BAND IS CURRENTLY ALLOCATED AND IMT SYSTEMS IN THE FREQUENCY BAND 7 125-8 400 MHZ UNDER WRC-27 AGENDA ITEM 1.7

1 Introduction

This document includes the sharing and compatibility studies between IMT systems in the frequency band 7 125-8 400 MHz with existing service/application(s) to which the frequency band is allocated on a primary basis, and also with primary services in adjacent bands.

2 Allocation information in the frequency band 7 125-8 400 MHz

For allocation details, please refer to the ITU Radio Regulations (RR) (Table of Frequency Allocations, and associated footnotes) and corresponding Rules of Procedure. The relevant services to which the frequency band is allocated on a primary basis within the frequency range 7 125-8 400 MHz, and also services allocated on a primary basis in adjacent bands, are:

Table 1

RR allocations in 7 125-8 400 MHz and adjacent bands

Allocation to services		
Region 1	Region 2	Region 3
7 075-7 145 FIXED MOBILE 5.457E 5.457F 5.458 5.459		
7 145-7 190 FIXED MOBILE SPACE RESEARCH (deep space) (Earth-to-space) 5.458 5.459		

7 190-7 235	EARTH EXPLORATION-SATELLITE (Earth-to-space) 5.460A 5.460B FIXED MOBILE SPACE RESEARCH (Earth-to-space) 5.460 5.458 5.459
7 235-7 250	EARTH EXPLORATION-SATELLITE (Earth-to-space) 5.460A FIXED MOBILE 5.458
7 250-7 300	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE 5.461
7 300-7 375	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile 5.461
7 375-7 450	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile MARITIME MOBILE-SATELLITE (space-to-Earth) 5.461AA 5.461AB 5.461AC
7 450-7 550	FIXED FIXED-SATELLITE (space-to-Earth) METEOROLOGICAL-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile MARITIME MOBILE-SATELLITE (space-to-Earth) 5.461AA 5.461AB 5.461A 5.461AC
7 550-7 750	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile MARITIME MOBILE-SATELLITE (space-to-Earth) 5.461AA 5.461AB 5.461AC

7 750-7 900	FIXED METEOROLOGICAL-SATELLITE (space-to-Earth) 5.461B MOBILE except aeronautical mobile
7 900-8 025	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.461
8 025-8 175	EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A
8 175-8 215	EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A
8 215-8 400	EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.463 5.462A
8 400-8 500	FIXED MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) 5.465 5.466

3 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

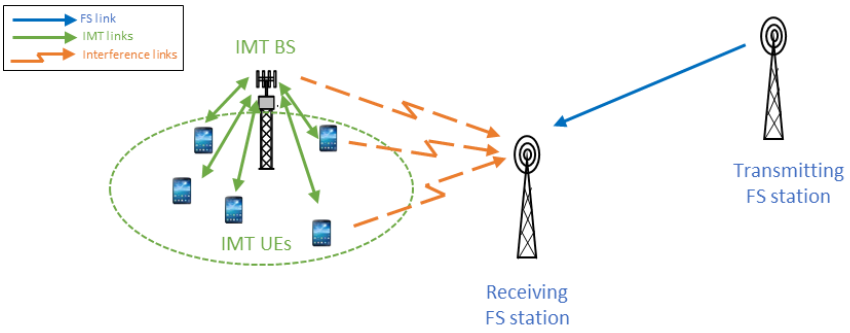
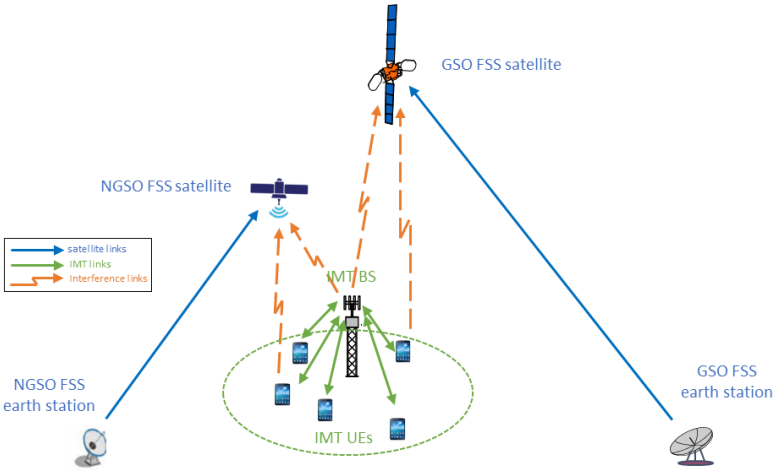
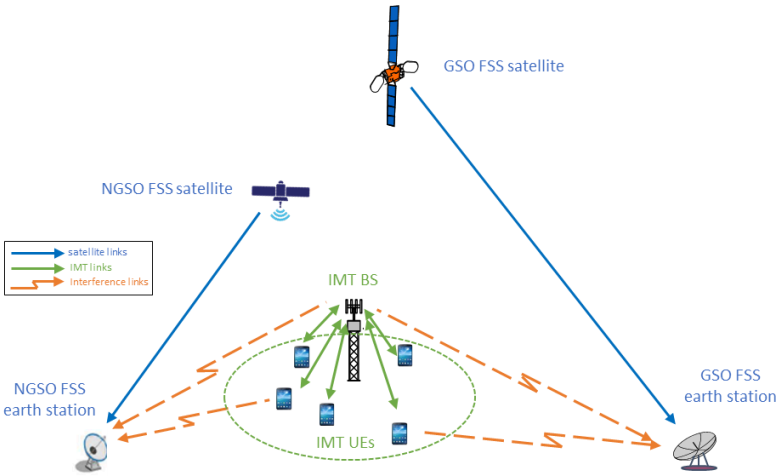
[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 5D SWG Characteristics.]

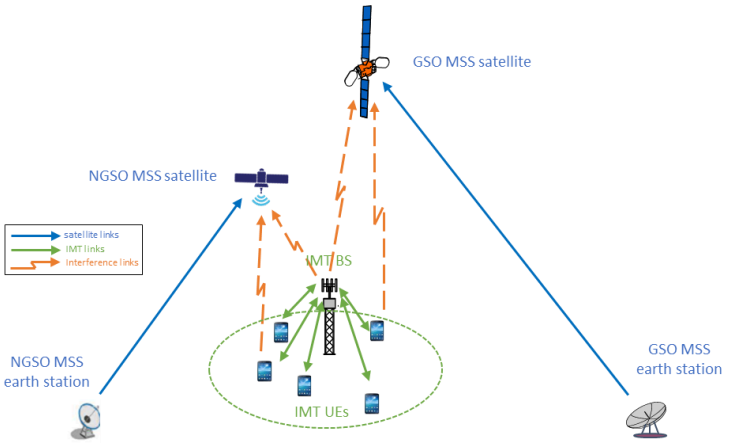
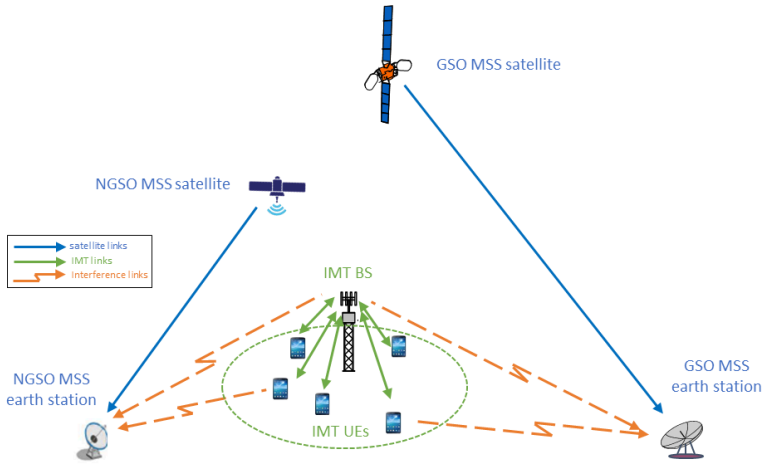
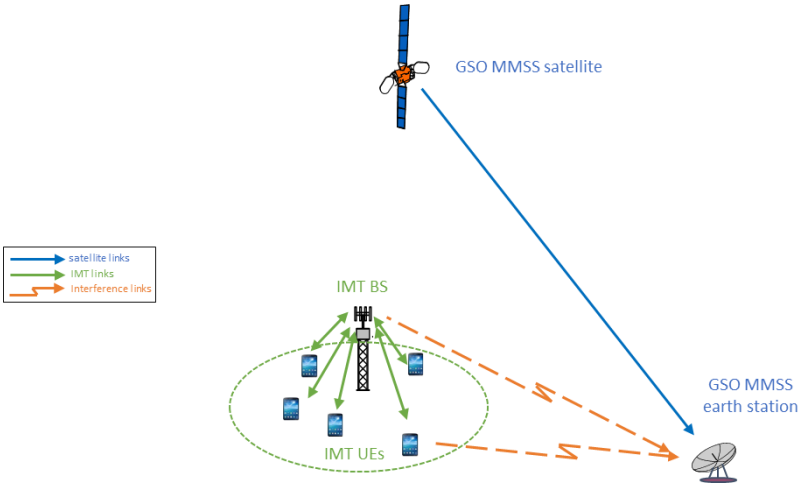
[Editor's note: Further discussion is needed at the next WP 5D meeting in February 2025 to finalize the treatment of reverse study analysis of existing services into IMT. Additional elements of this discussion are included in Annex 4 of the document on sharing and compatibility studies under WRC-27 agenda item 1.7.]

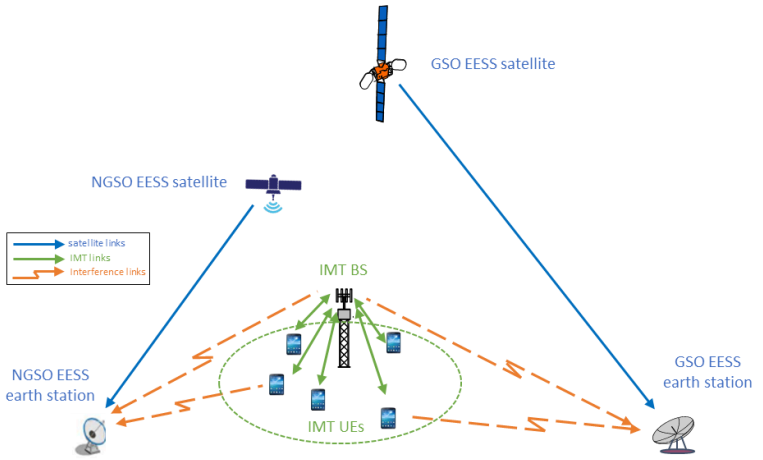
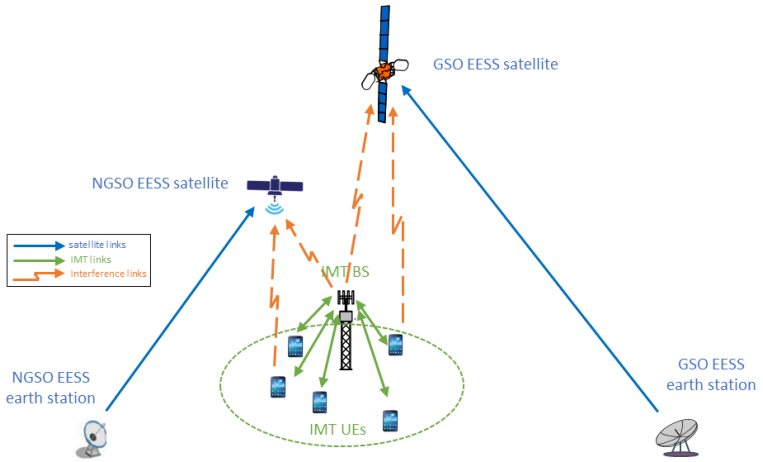
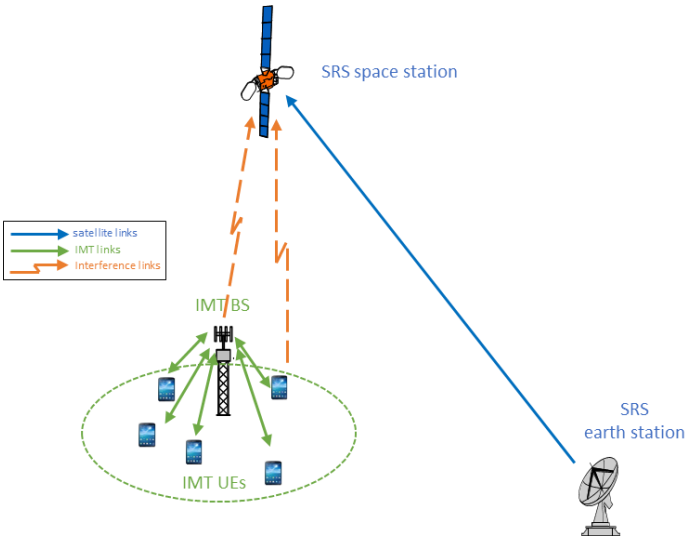
4 Potential interference scenarios to be considered

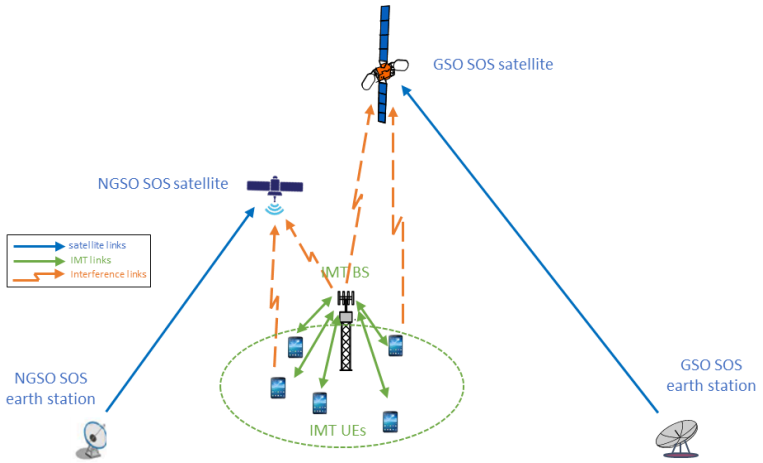
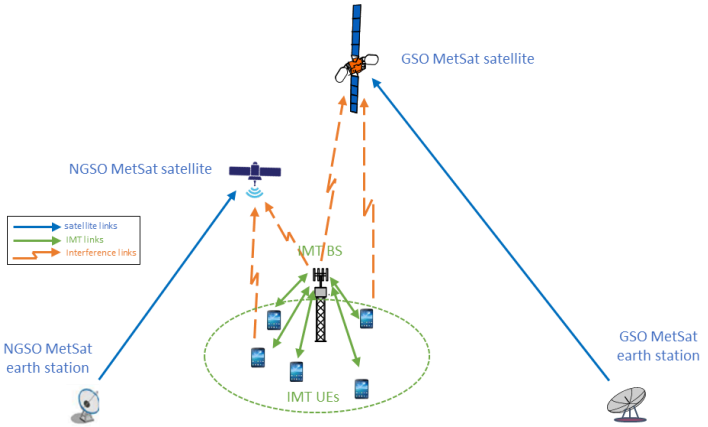
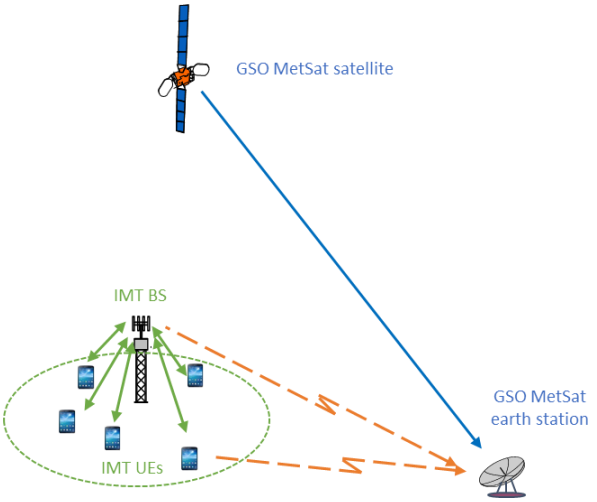
[Editor's note: The elements in this section are for information and require future discussion, as well as have not been fully reviewed nor agreed. This section may be considered for deletion at a later stage. Additional elements from the discussion are contained in the chair's report.]

4.1 Interference from IMT transmitters into receivers of other services

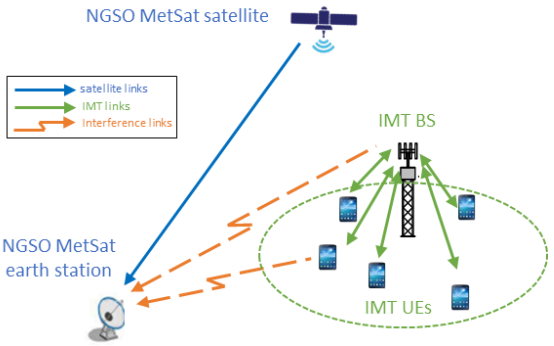
Interference Scenario	Figures
IMT transmitters □ FS receivers	
IMT transmitters □ FSS space stations	
IMT transmitters □ FSS earth stations	

Interference Scenario	Figures
IMT transmitters □ MSS space stations	
IMT transmitters □ MSS earth stations	
IMT transmitters □ MMSS earth stations	

Interference Scenario	Figures
IMT transmitters □ EESS earth stations	
IMT transmitters □ EESS space stations	
IMT transmitters □ SRS space stations	

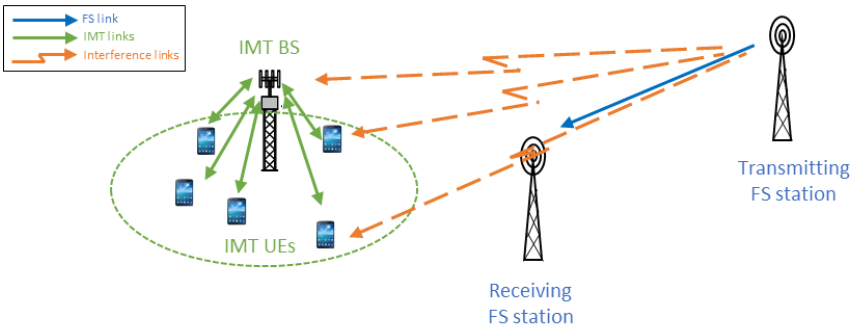
Interference Scenario	Figures
IMT transmitters □ SOS space stations	
IMT transmitters □ MetSat space stations	
IMT transmitters □ MetSat earth stations	For 7 450-7 550MHz band  For 7 750-7 900MHz band

Interference Scenario	Figures

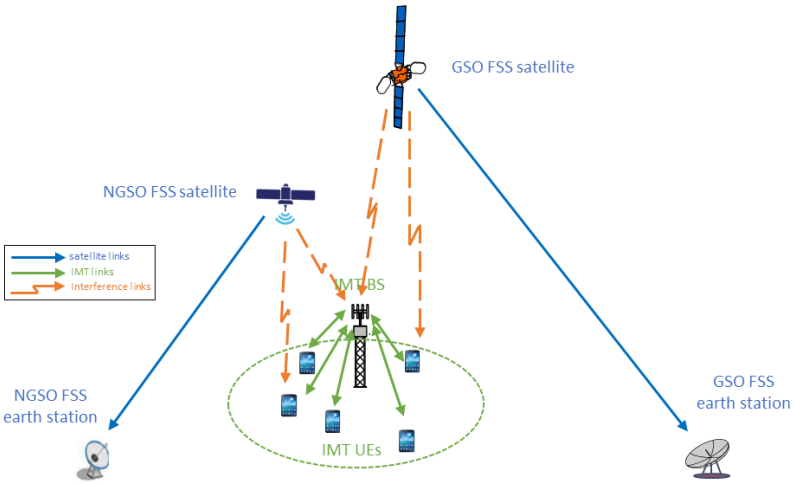


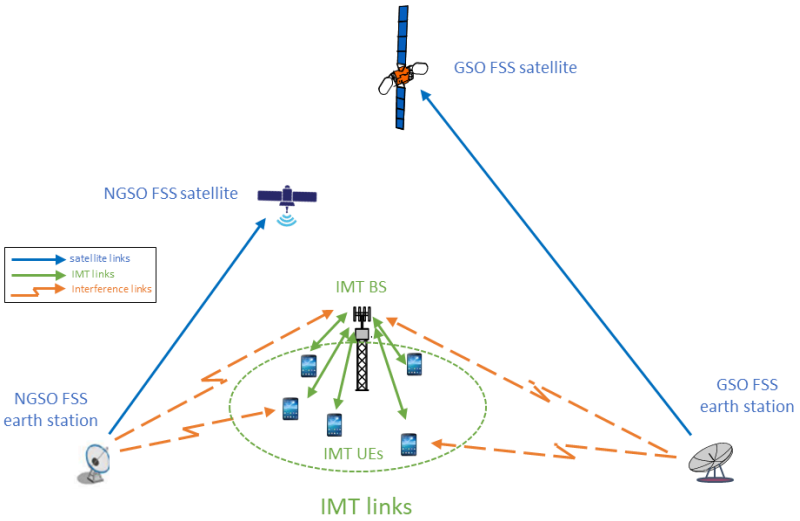
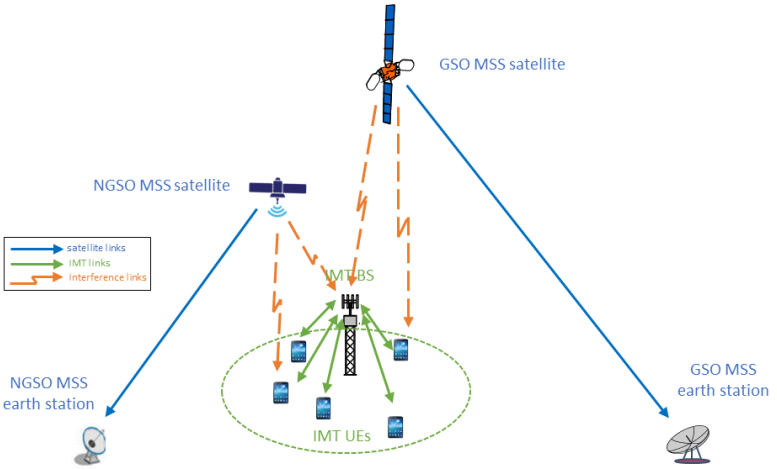
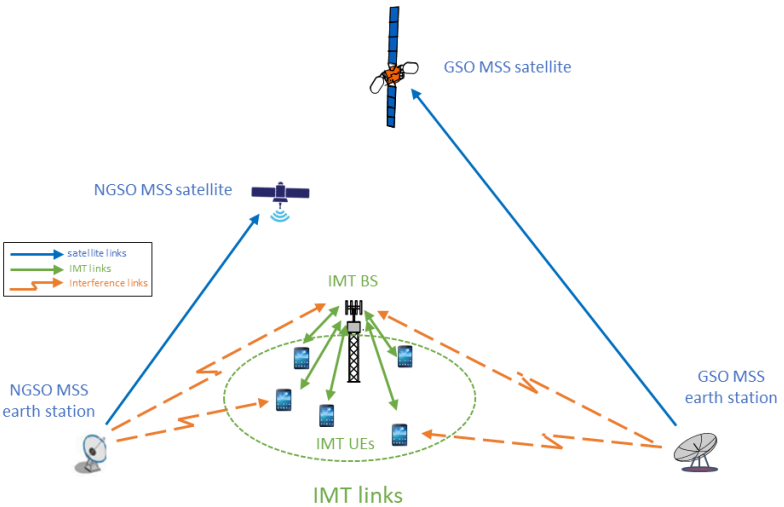
[4.2 Interference from transmitters of other services into IMT receivers

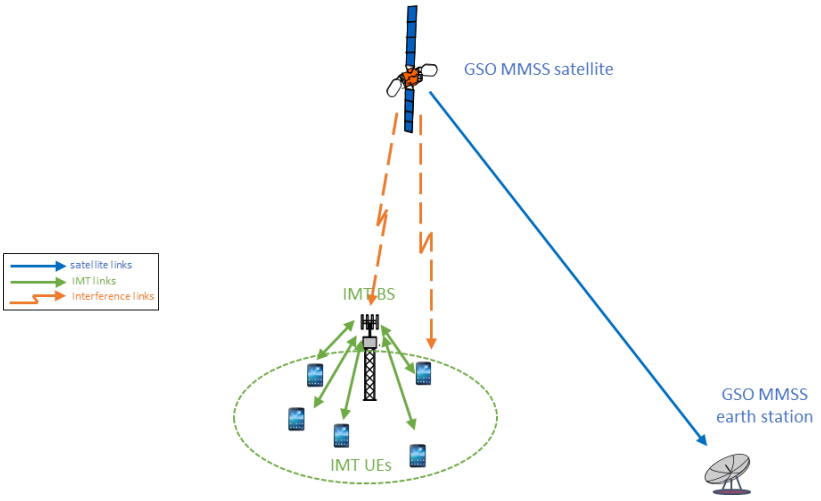
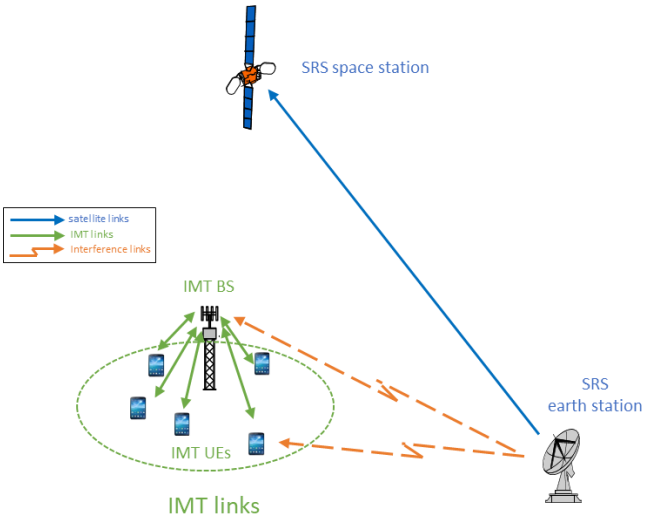
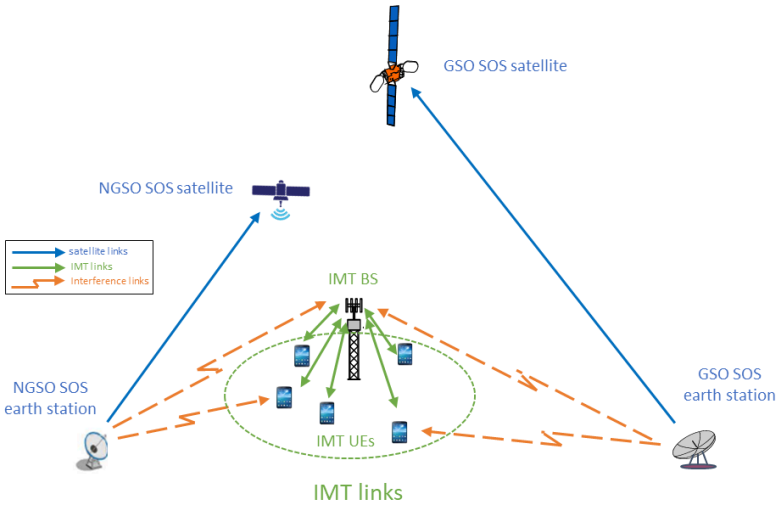
Interference Scenario	Figures
FS transmitters □ IMT receiver	

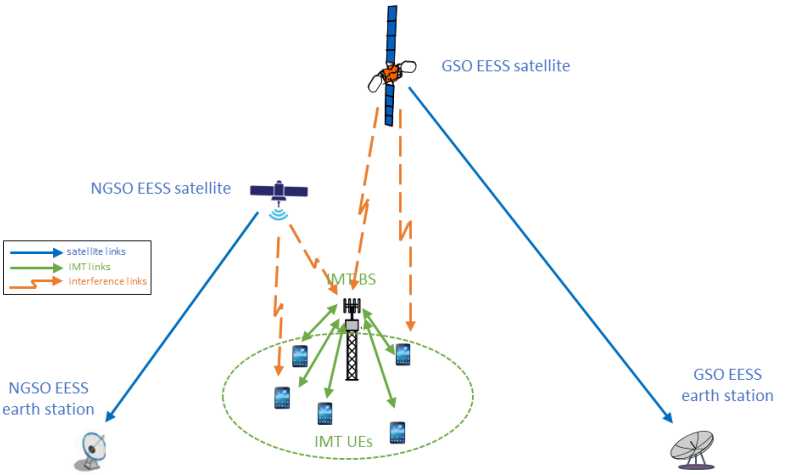
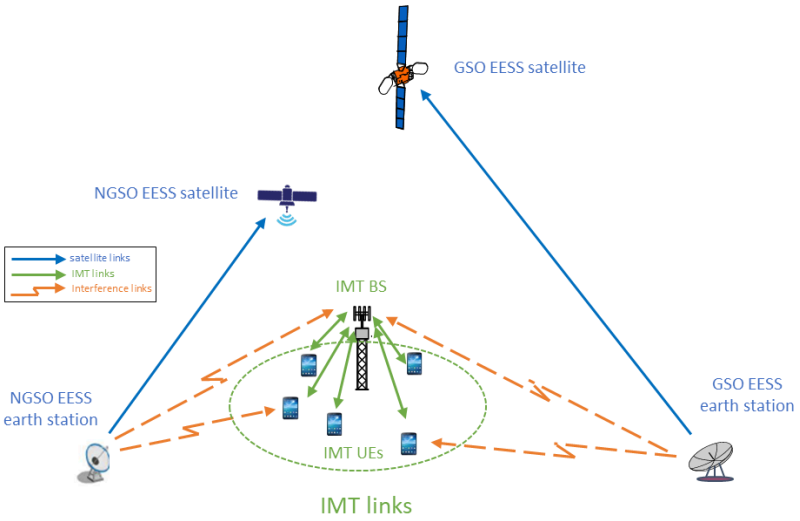
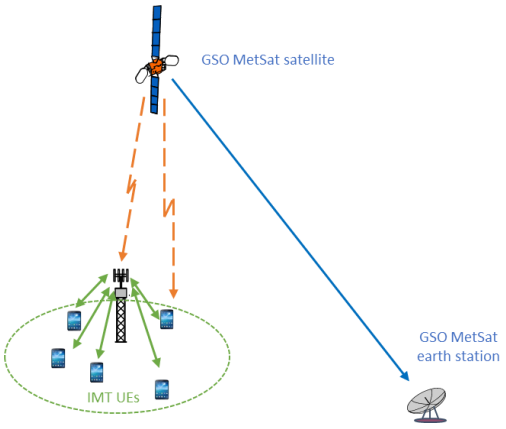


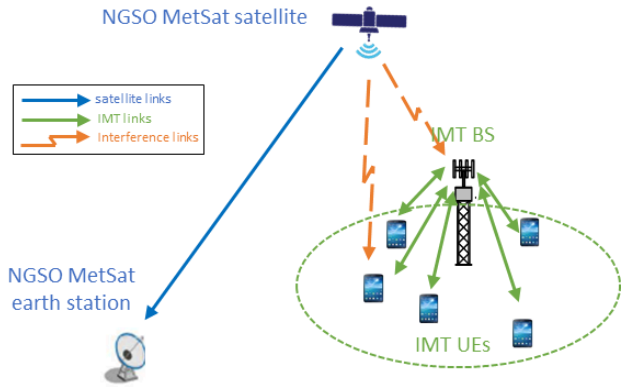
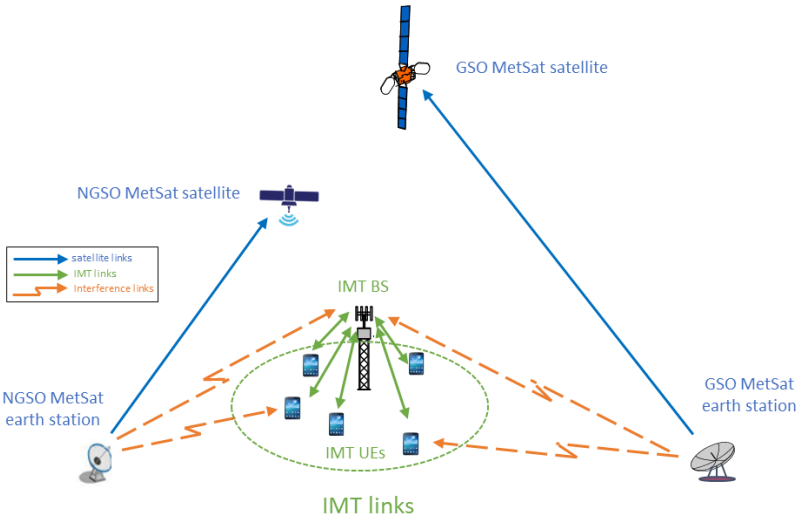
FSS space stations □ IMT receivers NOTE 1	



Interference Scenario	Figures
FSS earth stations □ IMT receivers NOTE 2	
MSS space stations □ IMT receivers NOTE 3	
MSS earth stations □ IMT receivers NOTE 4	

Interference Scenario	Figures
MMSS space stations □ IMT receivers NOTE 5	
SRS earth stations □ IMT receivers	
SOS earth stations □ IMT receivers NOTE 6	

Interference Scenario	Figures
EESS space stations □ IMT receivers NOTE 7	
EESS earth stations □ IMT receivers	
MetSat space stations □ IMT receivers NOTE 8	For the 7 450-7 550MHz band  For the 7 750-7 900MHz band

Interference Scenario	Figures
MetSat earth stations □ IMT receivers	 

NOTE 1: Transmitting FSS space stations comply with pfd limits contained in Table 21-4 of RR Article 21 which are intended for the protection of terrestrial services. It is to be noted that those limits can be exceeded in some parts of FSS service area pending the agreement of the concerned administration(s).

NOTE 2: Transmitting FSS Earth stations comply with eirp limits contained in RR Article 21 Section III and IV which are intended for the protection of terrestrial services.

NOTE 3: Transmitting MSS space stations comply with pfd limits contained in Table 21-4 of RR Article 21 which are intended for the protection of terrestrial services. It is to be noted that those limits can be exceeded in some parts of MSS service area pending the agreement of the concerned administration(s).

NOTE 4: Transmitting MSS Earth stations comply with eirp limits contained in RR Article 21 Section III and IV which are intended for the protection of terrestrial services.

NOTE 5: Transmitting MMSS space stations comply with pfd limits contained in Table 21-4 of RR Article 21 which are intended for the protection of terrestrial services. It is to be noted that those limits can be exceeded in some parts of MMSS service area pending the agreement of the concerned administration(s).

NOTE 6: Transmitting SOS Earth stations comply with eirp limits contained in RR Article 21 Section III and IV which are intended for the protection of terrestrial services.

NOTE 7: Transmitting EESS space stations comply with pfd limits contained in Table 21-4 of RR Article 21 which are intended for the protection of terrestrial services. It is to be noted that those limits can be exceeded in some parts of EESS service area pending the agreement of the concerned administration(s).

NOTE 8: Transmitting MetSat space stations comply with pfd limits contained in Table 21-4 of RR Article 21 which are intended for the protection of terrestrial services.

]

5 Propagation models for sharing and compatibility studies in the 7 125-8 400 MHz frequency band

[Editor's note: This section 5 is proposed to be kept at this position to ensure consistency of the different studies and may later be considered for deletion from this part, as the propagation models are included in the Attachment of the respective service listed in section 6.]

5.1 Recommendations applicable for all sharing geometries

– ITU-R P.2108 – Prediction of clutter loss

– ITU-R P.2109 – Prediction of building entry loss

5.2 Recommendations applicable for sharing between stations on the surface of the Earth

– ITU-R P.452 – Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz

– ITU-R P.1812 – A path-specific propagation prediction method for point-to-area terrestrial services in the frequency range 30 MHz to about 6 GHz

– ITU-R P.2001 – A general purpose wide-range terrestrial propagation model in the frequency range 30 MHz to 50 GHz

– ITU-R P.1411 – Propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz

– ITU-R P.1238 – Propagation data and prediction methods for the planning of indoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 450 GHz.

5.3 Recommendations applicable for sharing between airborne stations and stations on the Earth's surface

– ITU-R P.528 – A propagation prediction method for aeronautical mobile and radionavigation services using the VHF, UHF and SHF bands

5.4 Recommendations applicable for sharing between stations in space and stations on the Earth's surface

– ITU-R P.619 – Propagation data required for the evaluation of interference between stations in space and those on the surface of the Earth

6 Sharing and compatibility studies

[Editor's note: Additional discussions are required on whether studies with EESS (7 190-7 250 MHz), MS, and MMSS are needed, also taking into consideration the information provided by the contributing groups. The discussion should also consider that:

In the frequency band 7 375-7 750 MHz, MMSS earth stations shall not claim protection from stations in the fixed and mobile services as per RR No. 5.461AB. Based on this, some indicate that

studies with MMSS downlink in this band are not required for IMT systems, as they are part of the mobile services. Others indicate that these studies would still be relevant considering the possible changes in the condition of the use of the band.

Similarly, in the frequency band 7 190-7 250 MHz, EESS (E-s) space stations shall not claim protection from stations in the fixed and mobile services as per RR No. 5.460A. Based on this, some indicate that studies with EESS (E-s) in this band are not required for IMT systems, as they are part of the mobile services. Others indicate that these studies would still be relevant considering the possible changes in the condition of the use of the band.

Regarding MS, comments were made that studies with other LMS applications are not required.]

The sharing and compatibility studies are contained in the attachments to this document:

Attachment 1: Sharing between the fixed service and IMT operating in the frequency band 7 125-8 400 MHz

Attachment 2: Sharing between the [space research service (deep space) / space research service] (Earth-to-space) in the frequency band 7 145-[7 190 / 7 235] MHz and IMT operating in the frequency band 7 125-8 400 MHz

Attachment 3: Sharing between the space operation service (Earth-to-space) (see No. 5.459) in the frequency bands 7 100-7 155 MHz and 7 190-7 250 MHz and IMT operating in the frequency band 7 125-8 400 MHz

Attachment 4: Sharing between the fixed satellite service (space-to-Earth) in the frequency band 7 250-7 750 MHz and IMT operating in the frequency band 7 125-8 400 MHz

Attachment 5: Sharing between the fixed satellite service (Earth-to-space) in the frequency band 7 900-8 400 MHz and IMT operating in the frequency band 7 125-8 400 MHz

Attachment 6: Sharing between the mobile satellite service (space-to-Earth) (see No. 5.461) in the frequency band 7 250-7 375 MHz and IMT operating in the frequency band 7 125-8 400 MHz

Attachment 7: Sharing between the mobile satellite service (Earth-to-space) in the frequency band 7 900-8 025 MHz and IMT operating in the frequency band 7 125-8 400 MHz

Attachment 8: Sharing between the meteorological satellite service (space-to-Earth) in the frequency bands 7 450-7 550 MHz and 7 750-7 900 MHz and IMT operating in the frequency band 7 125-8 400 MHz

Attachment 9: Sharing between the meteorological satellite service (Earth-to-space) in the frequency band 8 175-8 215 MHz and IMT operating in the frequency band 7 125-8 400 MHz

Attachment 10: Sharing between the Earth exploration satellite service (space-to-Earth) in the frequency band 8 025-8 400 MHz and IMT operating in the frequency band 7 125-8 400 MHz

Attachment 11: Compatibility of the space research service (space-to-Earth) operating in the frequency band 8 400-8 500 MHz and IMT operating in the frequency band 8 215-8 400 MHz

[Attachment 12: Sharing between the Earth exploration satellite service (Earth-to-space) operating in the frequency band 7 190-7 250 MHz and IMT operating in the frequency band 7 125-8 400 MHz]

[Attachment 13: Sharing between the maritime mobile satellite service (space-to-Earth) operating in the frequency band 7 375-7 750 MHz and IMT operating in the frequency band 7 125-8 400 MHz]

attachment 1

Sharing between the fixed service and IMT operating
in the frequency band 7 125-8 400 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the fixed service and IMT operating in the frequency band 7 125-8 400 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above.]

A1.1 Technical/operational characteristics and protection criteria of fixed service operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 5C.]

A1.2 Technical Analysis

A1.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A1.2.1.1 Technical characteristics

A1.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A1.2.1.1.2 Technical/ operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A1.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG 3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A1.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A1.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A1.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A1.2.2 Study B

A1.2.2.1 Technical characteristics

A1.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

A1.2.2.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

A1.2.2.1.3 Propagation models in the studies

A1.2.2.2 Methodology

A1.2.2.3 Study results

A1.2.2.4 Summary and analysis of the results of Study B

A1.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the Section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 7 125-8 400 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 2

Sharing between the [space research service (deep space) / space research service] (Earth-to-space) in the frequency band 7 145-[7 190 / 7 235] MHz and IMT operating in the frequency band 7 125-8 400 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the [space research service (deep space) / space research service] (Earth-to-space) in the frequency band 7 145-[7 190 / 7 235] MHz and IMT operating in the frequency band 7 125-8 400 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above.]

A2.1 Technical/operational characteristics and protection criteria of [space research service (deep space) / space research service] (Earth-to-space) operating in the frequency band 7 145-[7 190 / 7 235] MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 7B.]

A2.2 Technical Analysis

A2.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A2.2.1.1 Technical characteristics

A2.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A2.2.1.1.2 Technical/ operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A2.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG 3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A2.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A2.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A2.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A2.2.2 Study B

A2.2.2.1 Technical characteristics

A2.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

A2.2.2.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

A2.2.2.1.3 Propagation models in the studies

A2.2.2.2 Methodology

A2.2.2.3 Study results

A2.2.2.4 Summary and analysis of the results of Study B

A2.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the Section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 7 125-8 400 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 3

Sharing between the space operation service (Earth-to-space) (see No. 5.459) in the frequency bands 7 100-7 155 MHz and 7 190-7 250 MHz and IMT operating in the frequency band 7 125-8 400 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the space operation service (Earth-to-space) (see No. 5.459) in the frequency bands 7 100-7 155 MHz and 7 190-7 250 MHz and IMT operating in the frequency band 7 125-8 400 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above.]

A3.1 Technical/operational characteristics and protection criteria of space operation service (Earth-to-space) (see No. 5.459) operating in the frequency bands 7 100-7 155 MHz and 7 190-7 250 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 7B.]

A3.2 Technical Analysis

A3.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A3.2.1.1 Technical characteristics

A3.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A3.2.1.1.2 Technical/ operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A3.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG 3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A3.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A3.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A3.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A3.2.2 Study B

A3.2.2.1 Technical characteristics

A3.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

A3.2.2.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

A3.2.2.1.3 Propagation models in the studies

A3.2.2.2 Methodology

A3.2.2.3 Study results

A3.2.2.4 Summary and analysis of the results of Study B

A3.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the Section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 7 125-8 400 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 4

Sharing between the fixed satellite service (space-to-Earth) in the frequency band 7 250-7 750 MHz and IMT operating in the
frequency band 7 125-8 400 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the fixed satellite service (space-to-Earth) in the frequency band 7 250-7 750 MHz and IMT operating in the frequency band 7 125-8 400 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above.]

A4.1 Technical/operational characteristics and protection criteria of fixed satellite service (space-to-Earth) operating in the frequency band 7 250-7 750 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 4A.]

A4.2 Technical Analysis

A4.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A4.2.1.1 Technical characteristics

A4.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A4.2.1.1.2 Technical/ operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A4.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG 3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A4.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A4.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A4.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A4.2.2 Study B

A4.2.2.1 Technical characteristics

A4.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

A4.2.2.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

A4.2.2.1.3 Propagation models in the studies

A4.2.2.2 Methodology

A4.2.2.3 Study results

A4.2.2.4 Summary and analysis of the results of Study B

A4.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the Section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 7 125-8 400 MHz, or in adjacent band as appropriate, from IMT systems.]

Attachment 5

Sharing between the fixed satellite service (Earth-to-space) in the frequency band 7 900-8 400 MHz and IMT operating in the frequency band 7 125-8 400 MHz

[Editor's note: The studies provided have not been discussed and will need to be carefully examined and updated once service parameters are finalized.]

A5.1 Technical/operational characteristics and protection criteria of fixed satellite service (Earth-to-space) operating in the frequency band 7 900-8 400 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 4A.]

A5.2 Technical Analysis

A5.2.1 Study A [AUS]

A5.2.1.1 Technical characteristics

A5.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

[Editor's note: Parameters are expected to be developed and agreed within 5D to provide the to provide the IMT specification related parameters. The below unpopulated table is taken from the placeholder table for 7 900-8 400 MHz in the 5D chair's report Chapter 4 – Annex 4.9 Working document on characteristics of terrestrial component of IMT for sharing and compatibility studies in preparation for WRC-27.]

TABLE A5-1

IMT specification related parameters in 7 125-8 400 MHz

No.	Parameter	Base station (AAS)	Mobile station
1	Duplex Method		
2	Channel bandwidth (MHz)		
3	Signal bandwidth (MHz)		
4	Transmitter characteristics		
4.1	Power dynamic range (dB)		
4.2	Spectral mask (dB)		
4.3	ACLR (dB)		
4.4	Spurious emissions		
4.5	Maximum/typical output power (dBm)		
5	Receiver characteristics		
5.1	Noise figure (dB)		

No.	Parameter	Base station (AAS)	Mobile station
5.2	Sensitivity (dBm)		
5.3	Blocking response		
5.4	ACS		
5.5	SINR operating range (dB)		

A5.2.1.1.1.1 AAS beamforming characteristics

[Editor's note: Parameters are expected to be developed and agreed within 5D to provide the characteristics of AAS antennas, likely to be used in conjunction with the radiation pattern given in Recommendation ITU-R M.2101-0 (Annex 1 section 5), when generating emissions levels of the IMT base stations. Some parameters are expected to differ among different environments or BS classes that may be considered in this study.

Table one is a placeholder for expected parameters that will need to be documented, taken from the placeholder table for 7 900-8 400 MHz in the 5D chair's report Chapter 4 – Annex 4.9 Working document on characteristics of terrestrial component of IMT for sharing and compatibility studies in preparation for WRC-27.]

Table A5-2

Beamforming antenna characteristics for IMT in 7 125-8 400 MHz

		Macro suburban	Macro urban	Small cell outdoor/ Micro urban	Small cell indoor/ Indoor urban
1	Base station antenna characteristics				
1.1	Antenna pattern				
1.2	Element gain (dBi)				
1.3	Horizontal/vertical 3 dB beamwidth of single element (degree)				
1.4	Horizontal/vertical front-to-back ratio (dB)				
1.5	Antenna polarization				
1.6	Antenna array configuration (Row × Column)				
1.7	Horizontal/Vertical radiating element spacing				

		Macro suburban	Macro urban	Small cell outdoor/ Micro urban	Small cell indoor/ Indoor urban
1.8	Array Ohmic loss (dB)				
1.9	Conducted power (before Ohmic loss) per antenna element (dBm)				
1.10	Base station maximum coverage angle in the horizontal plane (degrees)				
1.11	Base station vertical coverage range (degrees)				
1.12	Mechanical downtilt (degrees)				

A5.2.1.1.1.2 Operational characteristics

A5.2.1.1.1.3 BS deployment characteristics

[Editor's note: Values have been taken from those in the 5D chair's report Chapter 4 – Annex 4.9 Working document on characteristics of terrestrial component of IMT for sharing and compatibility studies in preparation for WRC-27. UEs are not proposed to be included in the study so those characteristics are not included.]

TABLE A5-3

Deployment-related parameters for bands between 7.125 and 8.4 GHz

	Urban/suburban macro	Small cell (outdoor)/Micro cell	Indoor (small cell)
Deployment density (Note 1)	10 BSs/km2 urban / 2.4 BSs/km2 suburban (Note 2, 3)	1-3 per urban macro cell <1 per suburban macro site	Depending on indoor coverage/capacity demand
Antenna height	18 m urban / 20 m suburban	6 m	3 m
Sectorization	3 sectors	Single sector	Single sector
Frequency reuse	1	1	1
Indoor base station deployment	n.a.	n.a.	100%

	Urban/suburban macro	Small cell (outdoor)/Micro cell	Indoor (small cell)
Indoor base station penetration loss	n.a.	n.a.	Rec. ITU-R P.2109
Below rooftop base station antenna deployment (Note 4)	Urban: 65% Suburban: 15%	100%	n.a.
Typical channel bandwidth	100 or 200 MHz	100 or 200 MHz	100 or 200 MHz
Network loading factor (base station load probability X%) (see section 1.1.2.3 below and Rec. ITU-R M.2101 Annex 1, section 3.4.1 and 6)	20%, 50%	20%, 50%	20%, 50%
TDD / FDD	TDD	TDD	TDD
BS TDD activity factor	75%	75%	75%

Note 1: These density values are for small dense areas. See section 1.1.2.2 for densities in larger areas.

Note 2: “1 BS” = 1 sector in 3-sector cell.

Note 3: This value is calculated based on use of same grid as 3-6 GHz. It is expected that the same BS infrastructure will typically be used for networks in both 3-6 GHz and 6-8 GHz. For sharing studies requiring a specific cell size, the following values should be used: 0.3 km for urban and 0.6 km for suburban.

Note 4: This “below rooftop” parameter is provided for IMT BS deployments to describe the environment surrounding the BS, including the clutter. It relates to outdoor scenarios with different BS heights. From a propagation perspective, line-of-sight (LOS) or non-line-of-sight (NLOS) condition is a more appropriate concept to compute the additional clutter loss in urban, suburban and rural scenarios. In addition, in some cases, LOS conditions can also be associated with a clutter loss. This is particularly true for ground paths or, in general, paths that pass close to one or more obstacles. Even if there is visual LOS, the radio waves may experience a loss due to the intrusion of the clutter. If there are multiple such clutter objects at different distances along the path, then the loss can be higher. Still, it is recommended for now that the LOS probability be considered to determine clutter loss instead of above/below rooftop ratio in this table.

NOTE for Table 2:

For the 7.125-8.4 GHz range, contiguous coverage is not expected in this frequency range in rural areas, and any such base stations that may exist in small numbers will be isolated installations at specific locations, and therefore, the rural deployment environment may or may not be included in the sharing and compatibility studies.

If the rural deployment environment is modelled in a sharing study, it should assume the BS density (per sector) of 0.001-0.006 BS per km2 as well as the below rooftop base station antenna deployment of 0%. Other parameters for the rural deployment should be the same as the suburban parameters found in the column for urban/suburban macro for base station in Table 2-1, and for AAS in section 3.3.2 (macro suburban).

Considerations should be given that the above BS density (per sector) values should be applied for the rural areas of the entire coverage area of the interfered system that is under study (e.g., the entire satellite footprint), taking into account the size of this entire coverage area, and the chosen value should be given together with the results of studies. These BS density (per sector) values have been derived for an area of around 100 000-500 000 km2 and some initial analysis subject to further verification showed it could be applicable up to 2 000 000 km2.

For involving IMT deployments over smaller or larger areas, including the case where mixed environments of urban, sub-urban and rural are considered in the satellite footprint, it may not be appropriate to assume that IMT base stations will be deployed at the same density as the above across the whole area, and thus, the deployment density values may need to be adjusted. This adjustment should be explained together with the results of studies.

A5.2.1.1.1.4 Deployment consideration in a relatively large area

For studies involving IMT deployments over wider areas such as the entire visibility of a GSO satellite (i.e. area locations whose elevation angle towards the space station is positive), it has been recognized in previous cycles that IMT base stations will not be deployed at the same high density across the whole area. Consequently, any deployment density values in the Table 2 likely needs to be adjusted with additional parameters:

[Editor's note: In the WRC-23 study cycle this was achieved with options for Ra (%) the ratio of coverage areas to areas of cities/built areas/districts and Rb (%) the ratio of built areas to total area of region in study. This study would implement whatever large area deployment adjustments that are agreed during this cycle, but noting that the WRC-23 cycle Ra/Rb values may remain relevant but work is ongoing in 5D to agree on options.]

A5.2.1.1.1.5 Network loading factor

[Editor's note: 5D is yet to agree on networking loading factors and the study will use whatever is agreed.]

A5.2.1.1.2 Technical/ operational characteristics and protection criteria of FSS (Earth-to-space) operating in the frequency band 7 900-8 400 MHz

A5.2.1.1.2.1 Technical characteristics of FSS space receiver

[Editor's note: To be determined based on information expected to be received from 4A. Table 7 is a placeholder for parameters.]

Table A5-4

FSS satellite characteristics of system

Frequency range	MHz	7 900-8 400
Carrier	Carrier Name	t.b.d.
Noise bandwidth	MHz	t.b.d.
Space station		
Peak receive antenna gain	dBi	t.b.d.
Antenna receive gain pattern and 3dB beamwidth	–	t.b.d.
System receive noise temperature	K	t.b.d.
Satellite height	km	35 840

Earth radius	km	6 378
GSO orbit	°	t.b.d.
Protection criteria		t.b.d.

A5.2.1.1.2.2 FSS satellite antenna radiation pattern and operational characteristics of FSS space receive

[Editor's note: To be determined based on information expected to be received from 4A.]

A5.2.1.1.3 Propagation models used in the study

A5.2.1.1.3.1 Background

[Editor's note: To be determined based on information expected to be received from 3K and 3M.

In the previous cycle, advice from 3K and 3M was that Recommendation ITU-R P.619 should be considered for the evaluation of interference between stations in space and those on the surface of the Earth. That Recommendation provides methodologies to list and calculate individual propagation effects. For this study, the likely most important propagation mechanisms mentioned in Recommendation ITU-R P.619 are listed in Table 8 and are building entry/exit loss for indoor base stations, basic free space loss, atmospheric gaseous loss, clutter loss and beam spreading loss are considered in this study.]

Table A5-6

Propagation loss consideration

Building entry/exit loss	t.b.d, for indoor base stations only
Basic loss	Free space Rec. ITU-R P.525
Beam-spreading loss for propagation through the atmosphere	t.b.d.
Gaseous attenuation	t.b.d.
Clutter loss	t.b.d.

A5.2.1.1.3.2 Clutter loss

[Editor's note: To be determined based on information expected to be received from 3K and 3M.]

A5.2.1.1.3.3 Beam spreading loss

[Editor's note: To be determined based on information expected to be received from 3K and 3M.]

A5.2.1.1.3.4 Losses due to atmospheric gases

[Editor's note: To be determined based on information expected to be received from 3K and 3M.]

A5.2.1.1.3.5 Free Space Loss

Free Space Loss for the Earth-space slant path will be considered for this analysis (using Recommendation ITU-R P.525-4).

A5.2.1.1.3.6 Polarisation loss

[Editor's note: To be determined based on information expected to be received from 3K and 3M.]

Note that, as per 2.1.1, some relevant losses from each IMT BS to the satellite in a specific study cell may be a fixed value to minimise computation time (see 2.1.1).

A5.2.1.1.3.7 Building entry/exit loss

[Editor's note: To be determined based on information expected to be received from 3K and 3M.]

A5.2.1.2 Methodology

A5.2.1.2.1 Division into study cells

Subdivide the simulation area in study cells where various parameters of the multiple BSs could be considered the same, in that the effect of the variation of the parameters within the study cell upon study results would be sufficiently small so that a common value could be used for all BS in the study cell. This would reduce computational effort.

Proposed fixed parameters within a given study cell would be:

– elevation angle to the satellite,

– propagation losses from each BS to the satellite,

– satellite antenna gain towards each BS in the cell,

– BS deployment density factors.

With these parameters fixed in a study cell, this also means that placement of the BSs within the cell is not critical.

The appropriate size of the study cells will be determined after an examination of the effect of fixing these parameters within a study cell upon the aggregate interference. It is proposed that a study cell size would be acceptable if the error due to fixing a normally variable parameter upon the aggregate I/N from an individual study cell was sufficiently small, say 0.1-0.5 dB. It would be expected that the elevation angle to the satellite will be the most sensitive variable.

Radio sites (composed of three sectoral Macro BSs antenna for most BS classes) of the same network are not necessarily oriented in the same azimuthal direction (in particular towards the satellite), consequently, the orientation of each BS antenna should be treated independently of all others.

A5.2.1.2.2 Impact of the IMT User Terminals in the sharing study

Studies in the previous WRC-23 cycle in the 6/7 GHz ranges demonstrated that UEs were not a significant source of interference compared with Macro BS. Consequently, aggregate interference from UEs is not considered in this study.

A5.2.1.2.3 Monte-Carlo simulation approach

This section provides the methodology to calculate the aggregate interference from IMT stations at FSS GSO space station receiver in Monte-Carlo simulations. The aggregate impact is assessed with respect to a specific orbital position of the GSO satellite. This approach can then be used for multiple longitudes of a GSO satellite and multiple pointings of the FSS satellite antenna. The calculation proposed for this analysis is based on the following Steps.

A5.2.1.2.4 Setup of overall study grid and study cells

Step 1: Within the FSS satellite and beam visible area, a land grid map is created with a Step of t.b.d.[1]° in longitude and t.b.d.° in latitude, resulting in splitting the map into Nc t.b.d.°×t.b.d.° study cells.

[1] Study cell size will be determined as per 2.1.1.

Step 2: Remove study cells in ocean areas from study, to reduce computation.

[Editor's note: Other study cells of very low population may also be removed in the study, to reduce computation.]

[Editor's note: Unlike some bands in the WRC-23 cycle under study for IMT, all of the FSS band of 7 900-8 400 MHz is being studied for IMT in all Regions 1,2 and 3. Only bands below 7 900 MHz vary in study between the regions. Consequently, there is no need to remove study cells of any ITU Region from the study.]

A5.2.1.2.5 Initial setup of each applicable study cell

Step 3: Place the relevant number of BS sites in each study cell, with each BS site having the number of sectors relevant to the BS class. The overall BSs (NBSn) simultaneously transmitting in each study cell n (see Step 2) is then NBSn , defined as follows:

$$N_{BS_n} = (BS\ class, density,\ density\ adjustment\ factor\ and\ network\ loading\ factor\ agreed\ parameters\ based\ formula)$$

with:

n index of Step 2 grid (elementary surface grid map)

Randomly orient in azimuth each BS site in each study cell, with the orientation of each BS (individual sector as relevant for the BS class) then determined. i.e., For classes with 3 sectors, each BS will be oriented 120 degrees different from the random BS site orientation.

[Editor's note: the study may consider modelling a reduced number of BS, representative of applicable classes and elevation angles to satellite, then scaling the aggregate interference. This will reduce computational effort.]

A5.2.1.2.6 Calculation of the aggregate interference from IMT Base Stations

Step 4: Three (3) UEs are proposed to be placed randomly within each BS sector BS #i for each study time/event step #j. Steer the beams of each BS to the UEs in the respective sector, as applicable. These UEs are only used for generating beam pointing directions in the study.

[Editor's note: If developed parameters and deployment information in 5D includes UE distribution, this will be considered in the study.]

[Editor's note: the study may consider alternate methods to aggregate interference, such as the use of the averaging of BS azimuth angle described in Appendix 1 of , [229] Proposed modifications of the draft CPM Report to WRC-23 on agenda item 1.2 (6 425-7 025 MHz) in relation to the expected e.i.r.p. of IMT base stations as a function of elevation angle (itu.int).]

Step 5: Compute the BS antenna gain for every BS #i at every time event/step #j towards the FSS satellite. This gain is respectively denoted $G_{BS}(\varphi_{i(j)}, \theta_{i(j)}, \varphi_{scan\ i(j),j}, \theta_{e-tilt\ i(j),j})$. The dependency of the BS #i over the event #j is reflected through the expression $i(j)$. Such an expression is useful to indicate that the physical orientation of every BS antenna towards the satellite $(\varphi_{i(j)}, \theta_{i(j)})$ is fixed over time, while beamforming angles $(\varphi_{scan}, \theta_{e-tilt})$ can vary for the same BS antenna along the event #j because the served UE changes location. i.e., the antenna gain of every BS located within the same study cell is calculated at the same elevation angle towards the space receiver, but with different beam-steering and azimuth positioning.

Step 6: The building exit loss is computed for every BS #i of an applicable indoor class towards the FSS satellite for every time/event step #j. As this may change with each time step, this attenuation

is denoted $BL_{BS,\,i(j)}$ for BS classes/environments where the calculation of building exit loss is applicable. Note that building exit loss, where relevant, may be dependent upon relevant variables depending upon the agreed building exit loss method.

Step 7: The clutter loss is computed for every BS #i of an applicable class towards the FSS satellite for every time/event step #j. As this may change with each time step, this attenuation is denoted $CL_{BS,\,i(j)}$ for BS classes/environments where the calculation of clutter is applicable. Note that clutter loss, where relevant, may be dependent upon relevant variables depending upon the agreed clutter method.

Step 8: The free space loss (FSL) and the attenuation due to gases (GL) between the FSS space receiver and IMT base stations are computed for every study cell. These parameters are used for all BSs in the study cell. Because of the dominance of the satellite altitude over the distance between study cells, the variation of the FSL will be small (<2 dB). These values will not change over each time step, however they are none-the-less respectively denoted $FSL_{i(j)}$ and $GL_{i(j)}$ for all BS classes/environments[2]. Note that these losses may be dependent upon relevant variables determined by the agreed propagation models.

Step 9: For a FSS satellite antenna beam pointing to the Nadir, the FSS beam antenna gain towards an active BS antenna #i $G_{Rx}\left(\psi_i\right)$ is computed by calculating the angular discrimination between the FSS Earth-station and the study cell containing the BS ψ_i. In practice, $G_{Rx}(\psi_i)$ can be calculated for every study cell and the ones hosting active BSs are used in the sharing study.

Step 10: The interference from every BS station #i at every event #j is then derived by combining the previous parameters, the net conducted power of the emitter including ohmic losses ($P_{composite\ BS}$), and the polarization loss (PL) (assumed to be 3 dB) as follows:

$$I_{BSi,j}(mW) = \frac{P_{composite\ BS} \times G_{BS}(\varphi_{i(j)}, \theta_{i(j)}, \varphi_{scan\ i(j),j}, \theta_{e-tilt\ i(j),j}) \times G_{Rx}(\psi_{i(j)})}{BL_{BS,\,i(j)} \times CL_{BS,\,i(j)} \times FSL_{i(j)} \times GL_{i(j)} \times PL}$$

Note that $P_{composite\ BS}$ and hence $I_{BSi,j}$ will likely be calculated on a power spectrum density basis for each event/time step and appropriately scaled, to account for overall IMT interfering bandwidth and FSS carrier bandwidth.

Note that this calculation uses linear, not decibel, based values.

Step 11: The aggregate interference received by the FSS space receiver at every event #j can then be determined from the previous step and accounting the TDD factor TF apportionment between BS and UE:

$$I_{agg,\,j} = TF\left(\sum_{i(j)} I_{BS\,i,j}\right) + (1 - TF)\left(\sum_{i(j)} I_{UE\,i,j}\right)$$

As the aggregate interference from UEs is considered negligible compared with the BSs, the aggregate interference is given as follows:

$$I_{agg,\,j} \approx TF\left(\sum_{i(j)} I_{BS\,i,j}\right)$$

A5.2.1.3 Study results

[2] Note that any BS operating in the same study cell is subject to the same FSL and GL even though its BS class may be different.

T.b.d. Complementary cumulative distribution function (CCDF) of Iagg/N values, displayed in dB, figures to be included for the proposed cases.

A5.2.1.4 Summary and analysis of the results of Study A

T.b.d. Conclusions concerning relevant Iagg/N thresholds will be made.

A5.2.2 Study B

A5.2.2.1 Technical characteristics

A5.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

A5.2.2.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

A5.2.2.1.3 Propagation models in the studies

A5.2.2.2 Methodology

A5.2.2.3 Study results

A5.2.2.4 Summary and analysis of the results of Study B

A5.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the Section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 7 125-8 400 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 6

Sharing between the mobile satellite service (space-to-Earth) (see No. 5.461) in the frequency band 7 250-7 375 MHz and IMT operating
in the frequency band 7 125-8 400 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the mobile satellite service (space-to-Earth) (see No. 5.461) in the frequency band 7 250-7 375 MHz and IMT operating in the frequency band 7 125-8 400 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above.]

A6.1 Technical/operational characteristics and protection criteria of mobile satellite service (space-to-Earth) (see No. 5.461) operating in the frequency band 7 250-7 375 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 4C.]

A6.2 Technical Analysis

A6.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A6.2.1.1 Technical characteristics

A6.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A6.2.1.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A6.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG 3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A6.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A6.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A6.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A6.2.2 Study B

A6.2.2.1 Technical characteristics

A6.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

A6.2.2.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

A6.2.2.1.3 Propagation models in the studies

A6.2.2.2 Methodology

A6.2.2.3 Study results

A6.2.2.4 Summary and analysis of the results of Study B

A6.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the Section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 7 125-8 400 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 7

Sharing between the mobile satellite service (Earth-to-space) in the frequency band 7 900-8 025 MHz and IMT operating in the frequency band 7 125-8 400 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the mobile satellite service (Earth-to-space) in the frequency band 7 900-8 025 MHz and IMT operating in the frequency band 7 125-8 400 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above.]

A7.1 Technical/operational characteristics and protection criteria of mobile satellite service (Earth-to-space) operating in the frequency band 7 900-8 025 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 4C.]

A7.2 Technical Analysis

A7.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A7.2.1.1 Technical characteristics

A7.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A7.2.1.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A7.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG 3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A7.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A7.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A7.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A7.2.2 Study B

A7.2.2.1 Technical characteristics

A7.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

A7.2.2.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

A7.2.2.1.3 Propagation models in the studies

A7.2.2.2 Methodology

A7.2.2.3 Study results

A7.2.2.4 Summary and analysis of the results of Study B

A7.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the Section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 7 125-8 400 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 8

Sharing between the meteorological satellite service (space-to-Earth) in the frequency bands 7 450-7 550 MHz and 7 750-7 900 MHz and IMT operating in the frequency band 7 125-8 400 MHz

[Editor's note: The studies provided have not been discussed and will need to be carefully examined and updated once service parameters are finalized.]

A8.1 Technical/operational characteristics and protection criteria of meteorological satellite service (space-to-Earth) operating in the frequency bands 7 450-7 550 MHz and 7 750-7 900 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 7B.]

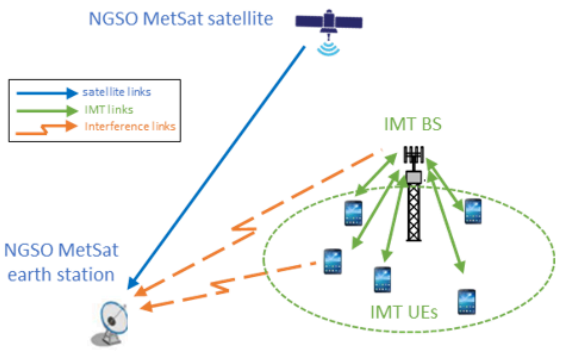
A8.2 Technical Analysis

A8.2.1 Study A [USA]

The sharing scenario between IMT and MetSat (space-to-Earth) in the 7 750-7 900 MHz band is depicted in Figure A8-1.

FIGURE A8-1

Sharing study scenario between IMT and NGSO MetSat (space-to-Earth)



A8.2.1.1 Technical characteristics

A8.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 750-7 900 MHz

A8.2.1.1.2 Technical / operational characteristics and protection criteria of MetSat (space-to-Earth) in the frequency band 7 750-7 900 MHz

[US Note: The technical/operational characteristics and protection criteria in this section will have to be reviewed and revised as necessary upon receiving additional information from contributing groups to WP 5D.]

[US Note: The MetSat interference sharing criteria contained in this section are contained in Recommendation ITU-R SA.1027 and are only appropriate for single entry sharing analyses. This information will have to be reviewed and revised by WP 7B to reflect the requisite aggregate sharing criteria that would be appropriate for statistical interference sharing analysis between MetSat and IMT systems.]

The technical/operational characteristics and protection criteria for MetSat (space-to-Earth) systems, as described Tables A.6-1 – A.6-X, are parameters provided by WP 7B to WP 5D for

NGSO and GSO systems. Table A.6-1 lists parameters for two NGSO MetSat systems that are analysed in Study A.

TABLE A8-1

Non-GSO MetSat systems, space-to-Earth link, high-rate data

Parameter	Value and unit	
Satellite(s)	JPSS-1*	JPSS-2 (and 3, 4)
Orbital altitude	824 km	824 km
Inclination angle	98.7 degrees	98.7 degrees
Orbit type	Sun-synchronous	Sun-synchronous
Local time of ascending node (LTAN)	13:25:00	13:25:00
Center frequency	7 812 MHz	7 812 MHz
Necessary bandwidth	30 MHz	50 MHz
Satellite transmit power	9.6 dBW	11.7 dBW
Satellite antenna maximum gain	9.4 dBi	6 dBi
Satellite antenna pattern	Isoflux	Isoflux
Satellite antenna polarization	RHCP	RHCP
Ground station maximum antenna gain	44.9 dBi	44.9 dBi
Ground station antenna beamwidth	0.8 degrees	0.8 degrees
Ground station antenna pattern	Rec. ITU-R S.465-6	Rec. ITU-R S.465-6
Ground station antenna polarization	RHCP	RHCP
Ground station minimum elevation	5 degrees	5 degrees
Ground station receiver noise temperature	343 K	343 K

* This satellite is also represented as “Satellite C” in Report ITU-R SA.2488-0. However, the parameters in this table provide refined characteristics.

The sharing criteria for the 7 750-7 900 MHz band between a terrestrial signal path and MetSat earth stations using spacecraft in low-Earth orbit is defined in Recommendation ITU-R SA.1027-6 for a minimum elevation angle of 5 and is summarized in Table A8-2.

TABLE A8-2

Sharing criteria for Meteorological-satellite earth stations using spacecraft in low-Earth orbit

(see Notes 1, 2, 3 and 4)

Frequency band (MHz)	Interfering signal power (dBW) in the reference bandwidth to be exceeded no more than 20% of the time	Interfering signal power (dBW) in the reference bandwidth to be exceeded no more than p% of the time
	Interfering signal path	Interfering signal path

	Terrestrial	Terrestrial
7 750-7 900	–148 dBW per 10 MHz	–127 dBW per 10 MHz p = 0.0016

NOTE 1 – The single entry interfering signal power thresholds in the above table are the permissible levels of interfering signal power that fall within the specified reference bandwidth. Accordingly, the total power in interfering signals that are narrower than the reference bandwidth should be considered in frequency sharing analyses. In cases where the interfering signal bandwidth exceeds the reference bandwidth or does not fully overlap the passband of a specific receiver under study, the available frequency dependent rejection should be applied in conjunction with the specified permissible interference levels.

NOTE 2 – In deriving the above sharing criteria from permissible total levels of interfering signal power, no allowance has been made for interference from spurious emissions.

NOTE 3 – Both the long-term (20% of the time) and short-term (< p% of the time) sharing criteria must be met in order for interference to be at or below permissible levels.

NOTE 4 – Sharing criteria specified for terrestrial signal paths are applicable to transmitting stations in terrestrial services and transmitting earth stations.

A8.2.1.1.3 Propagation models used in the study

A8.2.1.2 Methodology

A8.2.1.3 Study results

A8.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A8.2.2 Study B

A8.2.2.1 Technical characteristics

A8.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

A8.2.2.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

A8.2.2.1.3 Propagation models in the studies

A8.2.2.2 Methodology

A8.2.2.3 Study results

A8.2.2.4 Summary and analysis of the results of Study B

A8.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the Section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any

other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 7 125-8 400 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 9

Sharing between the meteorological satellite service (Earth-to-space)
in the frequency band 8 175-8 215 MHz and IMT operating
in the frequency band 7 125-8 400 MHz

[Editor's note: This Attachment contains sharing and compatibility studies of the meteorological satellite service (Earth-to-space) in the frequency band 8 175-8 215 MHz and IMT operating in the frequency band 7 125-8 400 MHz. Note that the technical characteristics are provided from the inputs listed section 2 in the main body of the document, with the relevant information summarized in sections 3 and 4 above.]

A9.1 Technical/operational characteristics and protection criteria of meteorological satellite service (Earth-to-space) operating in the frequency band 8 175-8 215 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 7B.]

A9.2 Technical Analysis

A9.2.1 Study A

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A9.2.1.1 Technical characteristics

A9.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A9.2.1.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of [service type z] provided by other expert group for sharing/interference analyses used in the study.]

A9.2.1.1.3 Propagation models used in the study

[Editor's note: This section provides specific propagation models for sharing/interference analyses used in the study in accordance with guidance from SG 3 and its WPs (5D/160 and 5D/[TBD]). For each model, values used for model parameters are to be clearly stated.]

A9.2.1.2 Methodology

[Editor's note: This section provides the methodology used in this study.]

A9.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A9.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A9.2.2 Study B

A9.2.2.1 Technical characteristics

A9.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

A9.2.2.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

A9.2.2.1.3 Propagation models in the studies

A9.2.2.2 Methodology

A9.2.2.3 Study results

A9.2.2.4 Summary and analysis of the results of Study B

A9.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the Section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 7 125-8 400 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 10

Sharing between the Earth exploration satellite service (space-to-Earth)
in the frequency band 8 025-8 400 MHz and IMT operating
in the frequency band 7 125-8 400 MHz

[Editor's note: The studies provided have not been discussed and will need to be carefully examined and updated once service parameters are finalized.]

A10.1 Technical/operational characteristics and protection criteria of Earth exploration satellite service (space-to-Earth) operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 7B.]

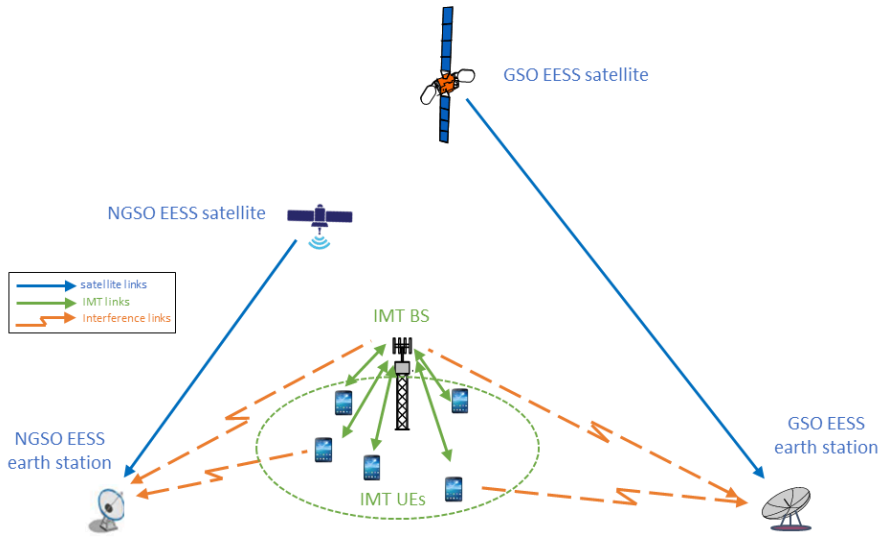
A10.2 Technical Analysis

A10.2.1 Study A [USA]

The sharing scenario between IMT and EESS (space-to-Earth) in the 8 025-8 400 MHz band is illustrated in Figure A10-1.

FIGURE A10-1

Sharing study scenario between IMT and EESS (space-to-Earth)



A10.2.1.1 Technical Characteristics

A10.2.1.1.1Technical and operational characteristics of IMT systems operating in the frequency band 8 025-8 400 MHz

A10.2.1.1.2Technical/operational characteristics and protection criteria of EESS (space-to-Earth) in the frequency band 8 025-8 400 MHz

[US Note: The technical/operational characteristics and protection criteria in this section will have to be reviewed and revised, as necessary, upon receiving additional information from contributing groups to WP 5D.]

[US Note: The EESS interference sharing criteria contained in this section are contained in Recommendation ITU-R SA.1027 and are only appropriate for single entry sharing analyses. This information will have to be reviewed and revised by WP 7B to reflect the requisite aggregate sharing criteria that would be appropriate for statistical interference sharing analysis between EESS and IMT systems.]

The technical and operational characteristics of EESS (space-to-Earth) systems in Tables A10-1 – A10-X are parameters provided by WP 7B to WP 5D for NGSO and GSO systems that are analysed in Study A.

TABLE A10-1

Non-GSO EESS systems, space-to-Earth link, payload science data

Parameter	Value and unit	
Satellite(s)	JASON-CS A (and B)*	OceanSat-3 (EOS-6)
Orbital altitude	1 336 km	738 km
Inclination angle	66 degrees	98.3 degrees
Orbit type	Non sun-synchronous	Sun-synchronous
Local time of ascending node (LTAN)		0:00:00
Centre frequency	8 090 MHz	8 275 MHz
Necessary bandwidth	120 MHz	160 MHz
Satellite transmit power	16.2 dBW	13 dBW
Satellite antenna maximum gain	6 dBi	5 dBi
Satellite antenna pattern	ND-SPACE	
Satellite antenna polarization	RHCP	
Ground station maximum antenna gain	58.6 dBi	57.8 dBi
Ground station antenna beamwidth	0.2 degrees	0.2 degrees
Ground station antenna pattern	Rec. ITU-R S.465-6	Rec. ITU-R S.465-6
Ground station antenna polarization	RHCP	
Ground station minimum elevation	5 degrees	5 degrees
Ground station receiver noise temperature	120 K	121 K

* This satellite is also represented as “Satellite X” in Report ITU-R SA.2488-0. However, the parameters in this table offer additional details (e.g., earth station antenna gain toward satellite).

TABLE A.9-2

GSO EESS system, space-to-Earth link, raw sensor data

Parameter	Value and unit
Satellite	GOES-R series*
Orbit type	Geostationary
Centre frequency	8 220 MHz
Necessary bandwidth	130 MHz

Satellite transmit power	10 dBW
Satellite antenna maximum gain	35.9 dBi
Satellite antenna beamwidth	3.1 degrees
Satellite antenna polarization	Mixed
Ground station maximum antenna gain	61 dBi
Ground station antenna beamwidth	0.15 degrees
Ground station antenna pattern	Rec. ITU-R S.465-6
Ground station antenna polarization	Mixed
Ground station antenna pointing angle	Fixed pointing
Ground station receiver noise temperature	150 K

* This satellite is also represented as ‘Satellite R’ in Report ITU-R SA.2488-0. However, the parameters in this table provide refined characteristics.

The criteria for sharing between a terrestrial signal path and EESS earth stations using spacecraft in low-Earth orbit are defined in Recommendation ITU-R SA.1027-6 for a minimum elevation angle of 5º, as summarized in Table A.9-3. Additionally, the protection criteria for EESS earth stations using spacecraft in geostationary orbit is defined in Recommendation ITU-R SA.514-3 and is described in Table A.9-4.

TABLE A10-3

Sharing criteria for Earth exploration-satellite earth stations using spacecraft in low-Earth orbit

(see Notes 1, 2, 3 and 4)

Frequency band (MHz)	Interfering signal power (dBW) in the reference bandwidth to be exceeded no more than 20% of the time	Interfering signal power (dBW) in the reference bandwidth to be exceeded no more than p% of the time
	Interfering signal path	Interfering signal path
	Terrestrial	Terrestrial
8 025-8 400	–150 dBW per 10 MHz	–133 dBW per 10 MHz p = 0.0050

NOTE 1 – The single entry interfering signal power thresholds in the above table are the permissible levels of interfering signal power that fall within the specified reference bandwidth. Accordingly, the total power in interfering signals that are narrower than the reference bandwidth should be considered in frequency sharing analyses. In cases where the interfering signal bandwidth exceeds the reference bandwidth or does not fully overlap the passband of a specific receiver under study, the available frequency dependent rejection should be applied in conjunction with the specified permissible interference levels.

NOTE 2 – In deriving the above sharing criteria from permissible total levels of interfering signal power, no allowance has been made for interference from spurious emissions.

NOTE 3 – Both the long-term (20% of the time) and short-term (< p% of the time) sharing criteria must be met in order for interference to be at or below permissible levels.

NOTE 4 – Sharing criteria specified for terrestrial signal paths are applicable to transmitting stations in terrestrial services and transmitting earth stations.

TABLE A10-4

Protection criteria for Earth exploration-satellite earth stations using spacecraft in geostationary orbit

Frequency Band (GHz)	Link Type	Protection Criteria
1-10	space-to-Earth	The power spectral density of noise-like interference or the total power of CW-type interference in any single band or in all sets of bands shall not exceed –154 dB(W/MHz) at the receiver input for more than 1% of the time.

A10.2.1.1.3Propagation models used in the study

A10.2.1.2 Methodology

A10.2.1.3 Study results

A10.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study for both the protection of incumbent services (in band and adjacent bands) and without imposing additional regulatory or technical constraints on those incumbent services.]

A10.2.2 Study B

A10.2.2.1 Technical characteristics

A10.2.2.1.1Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

A10.2.2.1.2Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

A10.2.2.1.3Propagation models in the studies

A10.2.2.2 Methodology

A10.2.2.3 Study results

A10.2.2.4 Summary and analysis of the results of Study B

A10.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the Section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical

constraints on existing service/application(s) operating in the band 7 125-8 400 MHz, or in adjacent band as appropriate, from IMT systems.]

attachment 11

Compatibility of the space research service (space-to-Earth) operating
in the frequency band 8 400-8 500 MHz and IMT operating
in the frequency band 8 215-8 400 MHz

[Editor's note: The studies provided have not been discussed and will need to be carefully examined and updated once service parameters are finalized.]

A11.1 Technical/operational characteristics and protection criteria of space research service (space-to-Earth) operating in the frequency band 8 400-8 500 MHz

[Editor's note: This section provides the technical characteristics for sharing and compatibility studies from WP 7B.]

A11.2 Technical Analysis

A11.2.1 Study A [USA]

[Editor's note: The chapter structure of each study depends on the input contribution of the ITU members. The following chapter structure in each study can be used as a reference.]

A11.2.1.1 Technical characteristics

A11.2.1.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

[Editor's note: This section provides specific characteristics of IMT systems provided by WP 5D for sharing/interference analyses used in the study.]

A11.2.1.1.2 Technical/operational characteristics and protection criteria of SRS (deep space) operating in the frequency band 8 400-8 450 MHz

For deep space SRS earth stations, this study considers a minimum elevation is 5 degrees.

The SRS antenna gain towards the horizon is determined using the minimum pointing elevation angle for the azimuth considered and the relevant antenna pattern.

The antenna pattern given in Rec. ITU-R SA. 509 can be used to determine the SRS receiver antenna gain.

A11.2.1.1.2.1 Protection criteria

For SRS (deep space) systems operating in the 8 400-8 450 MHz band, Recommendation ITU-R SA.1157 gives the protection level (I0) as −221 dBW in a reference bandwidth of 1 Hz. The calculation of interference that may result from atmospheric and precipitation effects should be based on weather statistics that apply for 0.001% of the time.

A11.2.1.1.3 Propagation models used in the study

Working Party 3 provided the guidance to use Recommendation ITU-R P.452. The propagation allowance based on the interference protection criteria is listed Recommendation ITU-R SA.1157 as 0.1% for unmanned or 0.001% for manned mission. Since most of SRS earth stations can support both manned and unmanned missions, the value of 0.001% should be used.

A11.2.1.2 Methodology

This methodology considers the bounding case to determine the distances at which the IMT base stations could cause interference at levels that could exceed the SRS protection criteria. This methodology is applicable for the protection of SRS (deep-space) in the 8400-8450 MHz (space-to-Earth) band when proposed IMT base stations are operating in-band and in adjacent band to SRS (deep space) receiving stations.

The interference received by an SRS earth station from a transmitting IMT base station at a given azimuth angle is expressed by the following equation:

$$I_r(d,p) = P_t + G_t(\theta_t) + G_r(\theta_r) - L_x - L(d,p)$$

where:

d : separation distance (km) between the transmitter and the receiver;

p: exceedance time probability to be used in propagation loss calculation;

Ir : interference power (dBW) received in the SRS reference bandwidth at the input of the SRS/EESS earth station antenna;

*P*t: total IMT transmit power (dBW) in the IMT reference bandwidth at the antenna port – note that specifying Pt and Gt separately is equivalent to specifying only the e.i.r.p of IMT transmitters towards SRS receiver;

*G*t: IMT transmitter antenna gain (dB) towards the horizon for the given azimuth;

θt: horizon separation angle of the IMT transmitter antenna. The IMT base station antenna beam is assumed to be steered to point in the azimuth direction of the SRS earth station with the lowest 0-degree horizon separation angle resulting in the highest transmit e.i.r.p. towards the SRS earth station;

Gr: receiver antenna gain (dB) towards the physical horizon of the SRS earth station for a given azimuth with the minimum elevation angle;

θr: horizon separation angle of the SRS receiver antenna. It is the difference between the minimum pointing elevation angle and the physical horizon angle.

Lx: coupling losses (dB) between the IMT transmit spectrum in the IMT reference bandwidth and SRS/EESS receiver in the EESS reference bandwidth due to polarization loss, frequency separation, interference spectrum overlaps, and spectrum roll-offs;

L: propagation loss (dB) calculated for a time probability of *p* when the separation distance between the transmitter and the receiver is d km. Note that WPs 3K and 3M provided a reply liaison statement to WP 5D (Doc. 5D/160, Doc. 7B/57) with guidance on the propagation models to be used for sharing between stations on the surface of the Earth.

For SRS missions, the Earth station main beam pointing rates are dependent upon target spacecraft orbits and trajectories. Thus separation distances around SRS earth stations are necessary to ensure scientific mission needs to mitigate interference geometry involving the SRS earth station antenna pointing towards the azimuth of the IMT station at its minimum elevation angle.

The coordination distance (dmax) required to ensure adequate separation between the terrestrial service transmitters and the SRS earth station receivers can be determined by the following:

$$d_{max} = max\{d : I_r(d,p) \geq I_0\}$$

where I0 is the protection level of the SRS earth station, p is the exceedance time percentage used in calculating the propagation losses, and d (in km) is the separation distance between the transmitter and the receiver. With this definition, the interference received from an IMT base station would satisfy the protection level of the SRS earth station for all separation distances d ≥ dmax along the given azimuth. Calculation of dmax for each azimuth direction around an SRS/EESS earth station would ensure that no additional or regulatory constraints.

A11.2.1.3 Study results

[Editor's note: This section provides the sharing and compatibility study results of this study.]

A11.2.1.4 Summary and analysis of the results of Study A

[Editor's note: This section provides the summary and analysis of the results of this study.]

A11.2.2 Study B

A11.2.2.1 Technical characteristics

A11.2.2.1.1 Technical and operational characteristics of IMT systems operating in the frequency band 7 125-8 400 MHz

A11.2.2.1.2 Technical/operational characteristics and protection criteria of [service type z] operating in the frequency band 7 125-8 400 MHz

A11.2.2.1.3 Propagation models in the studies

A11.2.2.2 Methodology

A11.2.2.3 Study results

A11.2.2.4 Summary and analysis of the results of Study B

A11.3 Summary and analysis of the results of studies

[Editor's note: This section provides the summary and analysis of the results of studies. The text here can be used in the Section 1/1.7/3 "Summary and analysis of the results of ITU-R studies" of draft CPM text.]

[Editor's note: This section should include concise text with summary and analysis of the results of studies. It may contain a summary table listing possible distance and/or frequency separation, or any other mitigation techniques, needed to protect, without imposing additional regulatory or technical constraints on existing service/application(s) operating in the band 7 125-8 400 MHz, or in adjacent band as appropriate, from IMT systems.]

Table (IMT ANd Service XX in A-B MHz frequency range)

Overview of the sharing and compatibility studies

[Editor's note: Descriptive text and notes of the table. Rows to be added or deleted based on the decision of WP 5D.]

	Parameters from expert WPs	Study A	Study …
Methodology			
Single-entry or Multiple-entry (aggregated)			
Statistical, or Statistical and Deterministic			
Technical and operational characteristics of IMT systems			
Deployment scenario			
IMT stations			
Method to deploy multiple IMT stations for the aggregated interference analysis over a relatively large area (as applicable to scenarios for the studies)			
Number of IMT base stations (BS)			
Network loading factor for BS and UE (%)			
TDD activity factor (%)			
UE power control			
UE body loss (dB)			
IMT antenna pattern			
BS antenna mechanical downtilt			
UE antenna pointing (if beamforming)			
UE distribution			
User equipment density for terminals that are transmitting simultaneously			
Technical and operational characteristics (of incumbent service)			

	Parameters from expert WPs	Study A	Study …
Propagation model/losses			
Basic transmission loss			
Clutter loss			
Building entry loss			
Cross-polarization loss (dB)			
Results of studies			
Does the study result consider both BS and UEs?			
Results summary			