Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of

Amendment of Parts 2 and 25 of the Commission's Rules to Facilitate the Use of Earth Stations in Motion Communicating with Geostationary Orbit Space Stations in Frequency Bands Allocated to the Fixed Satellite Service	IB Docket No. 17-95

Reply Comments of Global Mobile Suppliers Association

The Global Mobile Suppliers Association (GSA)[1] represents the leading suppliers in the mobile industry and is progressively supporting mobile broadband development based on a harmonized and standards-based approaches. GSA promotes the 3GPP technology roadmap – 3G; 4G; 5G including NB-IoT, VoLTE, LTE-V, LTE-U, LTE Broadcast, mobile device availability and features, etc. and represents companies across the worldwide mobile ecosystem engaged in the supply of infrastructure, semiconductors, test equipment, devices, applications and mobile support services. The GSA Executive Board comprises of Ericsson, Huawei, Intel, Nokia, Qualcomm Incorporated and Samsung covering close to 100% of all mobile network infrastructure deployments.

In our comments filed in the above proceedings (July 31, 2017), we pointed to an analysis GSA has been undertaking to assess potential impact of ESIM stations in adjacent band to the bands operated by the mobile service. In this reply comment filing, we include the full analysis and make specific request that the results from this analysis should represent the basis for the FCC's solution framework for operation of ESIM in the United States in the frequency range 28.35-28.6 GHz.

Compatibility between Earth Stations in Motion Operating in the Frequency Range 28.35-28.6 GHz and Stations in the Mobile Service Operating in Adjacent Frequency Bands

Introduction

This study provides an analysis of the potential interference from earth stations in motion (ESIM) operating in the frequency range 28.35-28.6 GHz into Mobile Service (MS) stations operating in adjacent frequency bands. Three types of ESIM are considered: air, sea, and land

[1] GSA: Global mobile Suppliers Association. Website http://www.gsacom.com.

based. For the air case, two deployment scenarios are considered: an aircraft airborne (at 10, 5, or 1 km altitude) and the aircraft parked at the gate. Similarly for the sea case, the ship is either at sea (10, 5, or 1 km from the shore) or docked at the pier. Two deployment scenarios are also considered for the land case: ESIM on a road outside the dense urban area (called "Inter-city") at 1 km and 50 m distances, and an ESIM within the dense urban area (called "Intra-city") at a distance of 20 m. The deployment scenario are summarized in Table 1.

Table 1
Analysis Scenarios

ESIM Type	ESIM Deployment	ESIM Location
Air	Airborne	Altitude = 10 km
		Altitude = 5 km
		Altitude = 1 km
	Parked	Distance = 100 m
Sea	At sea	Distance = 10 km
		Distance = 5 km
		Distance = 1 km
	Docked	Distance = 100 m
Land	Inter-city	Distance = 1 km
		Distance = 50 m
	Intra-city	Distance = 20 m

ESIM Deployment Conditions and Scenarios

For the case of air-based ESIM for which antennas are mounted on the aircraft fuselage tracking the satellite, corresponding IMT deployments are those in urban/suburban hotspots, especially in areas near the airports, as well as deployments at the airports. IMT deployments at the airports could be those of a hotspot nature inside airport terminals, as well as use of IMT by airport facilities to provide connectivity to various outdoor stations for purposes such as video monitoring, data transfer, surveillance, etc.

While in the air, interference from ESIM to IMT would be affected by factors including distance, altitude, fuselage shadowing, and satellite position. While parked at the gate or during taxiing, interference from ESIM to IMT would be affected by factors including distance, building entry loss (for the case of indoor stations), high likelihood of Line of Sight (LOS) propagation (for outdoor stations), clutter loss, IMT stations at potentially higher heights than the ESIM antenna (small or no fuselage shadowing). Aggregation of ESIM interference in and around airports could also be a factor to consider.

For the case of sea-based ESIM for which antennas are mounted on a mast tracking the satellite, corresponding IMT deployments are those in urban/suburban hotspots, especially in areas near the piers or marinas, as well as deployments at the pier/shipyard to provide IMT connectivity among various facilities for purposes such as video monitoring, data transfer, surveillance, etc. While at sea, interference from ESIM to IMT would be affected by factors including distance over water, enhanced propagation over water, local urban/suburban clutter, and high likelihood of LOS propagation to shipyard/pier/marina facilities. While docked, interference from ESIM to IMT would be affected by factors including distance, urban/suburban clutter (for outdoor hotspots), IMT stations potentially at higher heights than the ESIM antenna, and high likelihood of LOS propagation to shipyard/pier/marina facilities. Aggregation of ESIM interference in and around shipyards and marinas could also be a factor to consider.

For the case of land-based ESIM in which antennas are mounted on the roof of moving vehicles such as trucks and trains, corresponding IMT deployments include indoor and outdoor hotspots in urban/suburban areas, especially those near highways, as well as V2X (Vehicle to Vehicle, Vehicle to Infrastructure, Vehicle to Cloud, etc.) on highways and roads in urban/suburban/rural areas. For the case of ESIM passing through urban/suburban areas (intra-city), interference from ESIM to IMT would be affected by factors including distance, urban/suburban clutter (for outdoor hotspots), building entry loss (for indoor deployments), IMT stations at higher heights than ESIM antennas, and high likelihood of LOS propagation (for both hotspots and V2X). For the case of ESIM passing through highways outside city centers (inter-city), interference from ESIM to IMT would be affected by factors including distance, likelihood of propagation without much clutter at the ESIM end, local urban/suburban clutter at the IMT end for nearby cities, and high likelihood of LOS propagation (for the case of V2X). Aggregation of interference from ESIM interference for both hotspots and V2X cases could also be a factor to consider as it could be significant.

Methodology

The interference-to-noise (I/N) ratio into an MS receive station from an ESIM transmit station is computed. This I/N level is then compared with the MS protection requirement to determine the amount of frequency dependent rejection (FDR), if any, that would be necessary to protect the MS receive station.

This analysis considers a variety of the three types of ESIM and mobile system deployment scenarios. It focuses on coexistence scenarios where ESIMs could potentially produce a considerable amount of interference into the mobile system stations.

Interference levels are calculated as follows:

$$I/N = ED_{ESIM}(\theta_{ESIM}) - FL_{ESIM} - PL + G_{MS}(\theta_{MS}) - FL_{MS} - N_0 - PD$$

where:

I/N	= Interference-to-noise ratio, dB
$ED_{ESIM}(\theta_{ESIM})$	= ESIM transmit station signal off-axis eirp density in the direction of the MS receive station, dBW/Hz
FL_{ESIM}	= ESIM transmit station feeder loss, dB
PL	= Propagation loss, dB
$G_{MS}(\theta_{MS})$	= MS receive station antenna gain in direction of the ESIM transmit station, dBi
FL_{MS}	= MS receive station feeder loss, dB
N_0	= MS receive station noise power density, dBW/Hz
PD	= Polarization discrimination, dB

This study does not account for the time-varying aspects of the ESIM.

Assumptions:

Due to a lack of information on the proposed ESIM operation in the record, this study used the following assumptions
:

- The ESIM transmit station and MS receive station are within line of sight (LoS) of each other.
- The ESIM transmit station antenna and the MS receive station antenna are pointing toward each other (in azimuth).
- Height and elevation angle vary by scenario, as shown in Table 2 and 4.
- Clutter loss is negligible or not present (due to possibility of ESIM operation in areas where mobile system is deployed in immediate adjacency to ESIM or in open areas such as along highways).
- Building entry loss is not present(due to possibility of ESIM operation adjacent to outdoor mobile system deployments).
- ESIM ACLR is computed using rule part 25-202(f) based on the off-axis EIRP from the NPRM and the antenna roll-off from Rec ITU-R S.465..

Some of these assumptions are worst-case scenarios. However, the study could be refined if and when more information on operational aspects of ESIM become available from ESIM operators.

System Characteristics

System characteristics for representative earth station in motion systems are shown in Tables 2 and 3.

Table 2
ESIM Characteristics

Parameter	Land	Sea	Air	
			Airborne	Parked
ESIM Earth Station				
Height	3 m	10, 40 m	10, 5, 1 km	8 m
Minimum elevation angle	10 deg	10 deg	10 deg	10 deg
Transmitter				
Frequency	28.5 GHz	28.5 GHz	28.5 GHz	28.5 GHz
Off-axis EIRP	Table 3	Table 3	Table 3	Table 3
Signal bandwidth	100 MHz	100 MHz	100 MHz	100 MHz
Feed loss	0 dB	0 dB	0 dB	0 dB
ACLR				
50 - 100 % of bandwidth	25 dB	25 dB	25 dB	25 dB
100 - 250 % of bandwidth	35 dB	35 dB	35 dB	35 dB
> 250 % of bandwidth	46.5 dB	46.5 dB	46.5 dB	46.5 dB

Table 3
ESIM Off-axis EIRP Density limits
(https://www.ecfr.gov)

Maximum EIRP (dBW in 1 MHz)	Angle
$35.5 - 25\log(\theta)$	$3.5° \le \theta \le 7°$
14.4	$7° < \theta \le 9.2°$
$38.5 - 25\log(\theta)$	$9.2° < \theta \le 19.1°$
6.5	$19.1° < \theta \le 180°$

Characteristics of Mobile Service base and user equipment stations are shown in Table 4.

Table 4
Mobile Service Station Characteristics

Parameter	Base Station	User Equipment
Receiver		
Height	20 m	1.5 m
Pointing type	Fixed	Fixed
Azimuth angle	Varies	Varies
Elevation angle	-10 deg	0 deg
Gain pattern	Array	Array
Element gain	5 dBi	5 dBi
Element horizontal 3 dB beamwidth	80 deg	80 deg
Element front-to-back ratio	30 dB	30 dB
Element vertical sidelobe attenuation	30 dB	30 dB
Element vertical 3 dB beamwidth	65 deg	65 deg
Array elements (row x column)	16 x 16	4 x 4
Array horizontal element spacing	0.5	0.5
Array vertical element spacing	0.5	0.5
Channel bandwidth	100 MHz	100 MHz
Noise figure	6.5 dB	8.5 dB
Feed loss	2.5 dB	2.5 dB
I/N requirement	-6.0 dB	-6.0 dB
ACS		
1st adjacent	24 dB	23 dB
2nd adjacent	34 dB	33 dB
> 2nd adjacent	44 dB	43 dB

Propagation

The propagation models assumed for this study vary depending on the ESIM type and deployment scenario. These include Free Space Loss (FSL), Recommendation ITU-R P.676-11 for atmospheric attenuation, Recommendation ITU-R P.452-16 for terrestrial paths, and Recommendation ITU-R P.1411 (LoS) for short distances within a dense urban area. Table 5 summarizes the propagation parameters used in this study.

Table 5

Propagation Models

Parameter	Airborne		Sea		Land	
	Airborne	Parked	At sea	Docked	Intra-city	Inter-city
Propagation						
Model	FSL + P.676	FSL	P.452-16	FSL	P.452-16	P.1411 (LoS)
Percentage of time basic loss is not exceeded	n/a	n/a	20%	n/a	20%	n/a
Propagation zone	n/a	n/a	3	n/a	2	n/a
Clutter loss model	None	None	None	None	None	None
Fuselage loss	Figure 1	Figure 1	n/a	n/a	n/a	n/a
Polarization discrimination						
MS wrt ESIM	3 dB		3 dB		3 dB	

Figure 1
Fuselage Loss

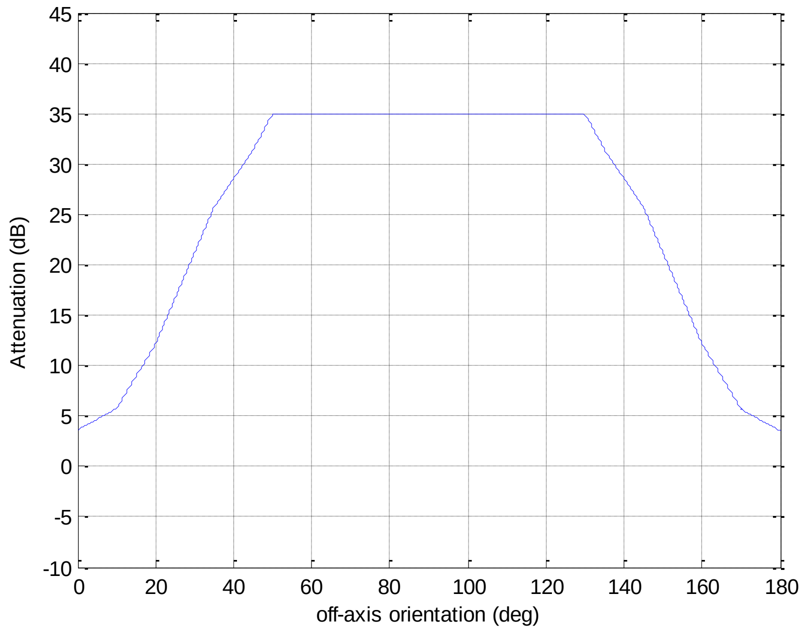


Figure 1 presents the effect of the airplane fuselage in shadowing transmissions towards the ground as provided by Recommendation ITU-R M.2221.

Results of Interference Calculations

I/N levels are computed for certain separation distances between ESIM and mobile system stations in accordance to the deployment scenarios considered for both single-entry and aggregate conditions. For the aggregate case, an assumed number of additional ESIM transmit stations are located at some off-axis angle in azimuth relative to the MS receive station antenna pointing direction. The I/N value is then compared with the MS receive station protection requirement to determine the amount of frequency-dependent rejection (FDR) necessary to protect the MS receive station. The results are shown in Tables 6A and 6B.

Table 6A

Results of I/N Calculation

Single entry

ESIM Type	ESIM Deployment	Number of ESIM	Propagation Model	MS pointing azimuth	ESIM Location	I/N (dB)	
						Base station	User Equipment
Air	Airborne	1	FSL + P.676	0 deg	Height = 10 km	-18.3	-15.5
					Height = 5 km	-12.2	-9.4
					Height = 1 km	1.9	4.6
	Parked	1	FSL	0 deg	Distance = 100 m	79.5	49.6
Sea 10 m	At sea	1	P.452 Zone 3	0 deg	Distance = 10 km	19.9	18.7
					Distance = 5 km	26.4	25.2
					Distance = 1 km	40.6	39.0
	Docked	1	FSL	0 deg	Distance = 100 m	74.3	54.8
Sea 40 m	At sea	1	P.452 Zone 3	0 deg	Distance = 10 km	19.8	18.7
					Distance = 5 km	26.1	24.9
					Distance = 1 km	38.8	37.3
	Docked	1	FSL	0 deg	Distance = 100 m	36.1	41.9
Land	Inter-city	1	P.452 Zone 2 (eMBB)	0 deg	Distance = 1 km	40.0	39.5
			FSL (V2X)	0 deg	Distance = 50 m	64.9	63.9
	Intra-city	1	P.1411 (LoS)	0 deg	Distance = 20 m	38.1	37.6

Aggregate

ESIM Type	ESIM Deployment	Number of Additional ESIM	Propagation Model	MS pointing azimuth	ESIM Location	I/N (dB)	
						Base station	User Equipment
Air	Airborne	2	FSL + P.676	5 deg	Height = 10 km	-17.2	-11.0
					Height = 5 km	-11.1	-5.0
					Height = 1 km	3.0	9.0
	Parked	3	FSL	10 deg	Distance = 100 m	80.0	54.3
Sea 10 m	At sea	2	P.452 Zone 3	10 deg	Distance = 10 km	20.3	22.3
					Distance = 5 km	26.7	28.9
					Distance = 1 km	40.9	42.6
	Docked	2	FSL	45 deg	Distance = 100 m	74.4	55.1
Sea 40 m	At sea	2	P.452 Zone 3	10 deg	Distance = 10 km	20.2	22.3
					Distance = 5 km	26.5	28.5
					Distance = 1 km	39.2	40.9
	Docked	2	FSL	45 deg	Distance = 100 m	36.3	42.1
Land	Inter-city	3	P.452 Zone 2 (eMBB)	5 deg	Distance = 1 km	41.5	45.2
			FSL (V2X)	20 deg	Distance = 50 m	65.1	65.4
	Intra-city	3	P.1411 (LoS)	45 deg	Distance = 20 m	38.1	38.0

Table 6B

Results of Required Frequency Dependent Rejection Calculations (dB)

Single entry

ESIM Type	ESIM Deployment	Number of ESIM	Propagation Model	MS pointing azimuth	ESIM Location	Required FDR (dB)	
						Base station	User Equipment
Air	Airborne	1	FSL + P.676	0 deg	Height = 10 km	0.0	0.0
					Height = 5 km	0.0	0.0
					Height = 1 km	7.9	10.6
	Parked	1	FSL	0 deg	Distance = 100 m	85.5	55.6
Sea 10 m	At sea	1	P.452 Zone 3	0 deg	Distance = 10 km	25.9	24.7
					Distance = 5 km	32.4	31.2
					Distance = 1 km	46.6	45.0
	Docked	1	FSL	0 deg	Distance = 100 m	80.3	60.8
Sea 40 m	At sea	1	P.452 Zone 3	0 deg	Distance = 10 km	25.8	24.7
					Distance = 5 km	32.1	30.9
					Distance = 1 km	44.8	43.3
	Docked	1	FSL	0 deg	Distance = 100 m	42.1	47.9
Land	Inter-city	1	P.452 Zone 2 (eMBB)	0 deg	Distance = 1 km	46.0	45.5
			FSL (V2X)	0 deg	Distance = 50 m	70.9	69.9
	Intra-city	1	P.1411 (LoS)	0 deg	Distance = 20 m	44.1	43.6

Aggregate

ESIM Type	ESIM Deployment	Number of Additional ESIM	Propagation Model	MS pointing azimuth	ESIM Location	Required FDR (dB)	
						Base station	User Equipment
Air	Airborne	2	FSL + P.676	5 deg	Height = 10 km	0.0	0.0
					Height = 5 km	0.0	1.0
					Height = 1 km	9.0	15.0
	Parked	3	FSL	10 deg	Distance = 100 m	86.0	60.3
Sea 10 m	At sea	2	P.452 Zone 3	10 deg	Distance = 10 km	26.3	28.3
					Distance = 5 km	32.7	34.9
					Distance = 1 km	46.9	48.6
	Docked	2	FSL	45 deg	Distance = 100 m	80.4	61.1
Sea 40 m	At sea	2	P.452 Zone 3	10 deg	Distance = 10 km	26.2	28.3
					Distance = 5 km	32.5	34.5
					Distance = 1 km	45.2	46.9
	Docked	2	FSL	45 deg	Distance = 100 m	42.3	48.1
Land	Inter-city	3	P.452 Zone 2 (eMBB)	5 deg	Distance = 1 km	47.5	51.2
			FSL (V2X)	20 deg	Distance = 50 m	71.1	71.4
	Intra-city	3	P.1411 (LoS)	45 deg	Distance = 20 m	44.1	44.0

Frequency Separation Calculations

Frequency dependent rejection (FDR) is dependent on the characteristics of the interfering signal and the wanted receiver filter. Therefore, FDR is used to calculate the amount of additional isolation needed between the two systems in order to protect the victim receivers. FDR is calculated from the following equation:

$$FDR(\Delta f) = 10\log_{10}\left[\frac{\int_{-\infty}^{+\infty} S(f)df}{\int_{-\infty}^{+\infty} S(f)F(f+\Delta f)df}\right]$$

where:

FDR	= Frequency dependent rejection, dB
S	= Power spectral density of the interfering signal, W/Hz
F	= Frequency response of the wanted receiver, relative power fraction
f	= Frequency, Hz
Δf	= Frequency offset, Hz

The interfering signal, S, is modeled as a flat spectrum within the signal bandwidth and a specified adjacent channel leakage ratio (ACLR) curve outside the signal bandwidth. Similarly, the wanted receiver filter response, F, is modeled as a flat response within the receive signal bandwidth and a specified adjacent channel selectivity (ACS) curve outside the signal bandwidth. The following figures show the interfering signal, FSS receiver frequency response, and resulting FDR for the airborne ESIM interference scenario. FDR results for the other scenarios considered here are omitted for brevity.

Figure 2 – Frequency Dependent Rejection
ESIM Air Earth Station into MS Base Station

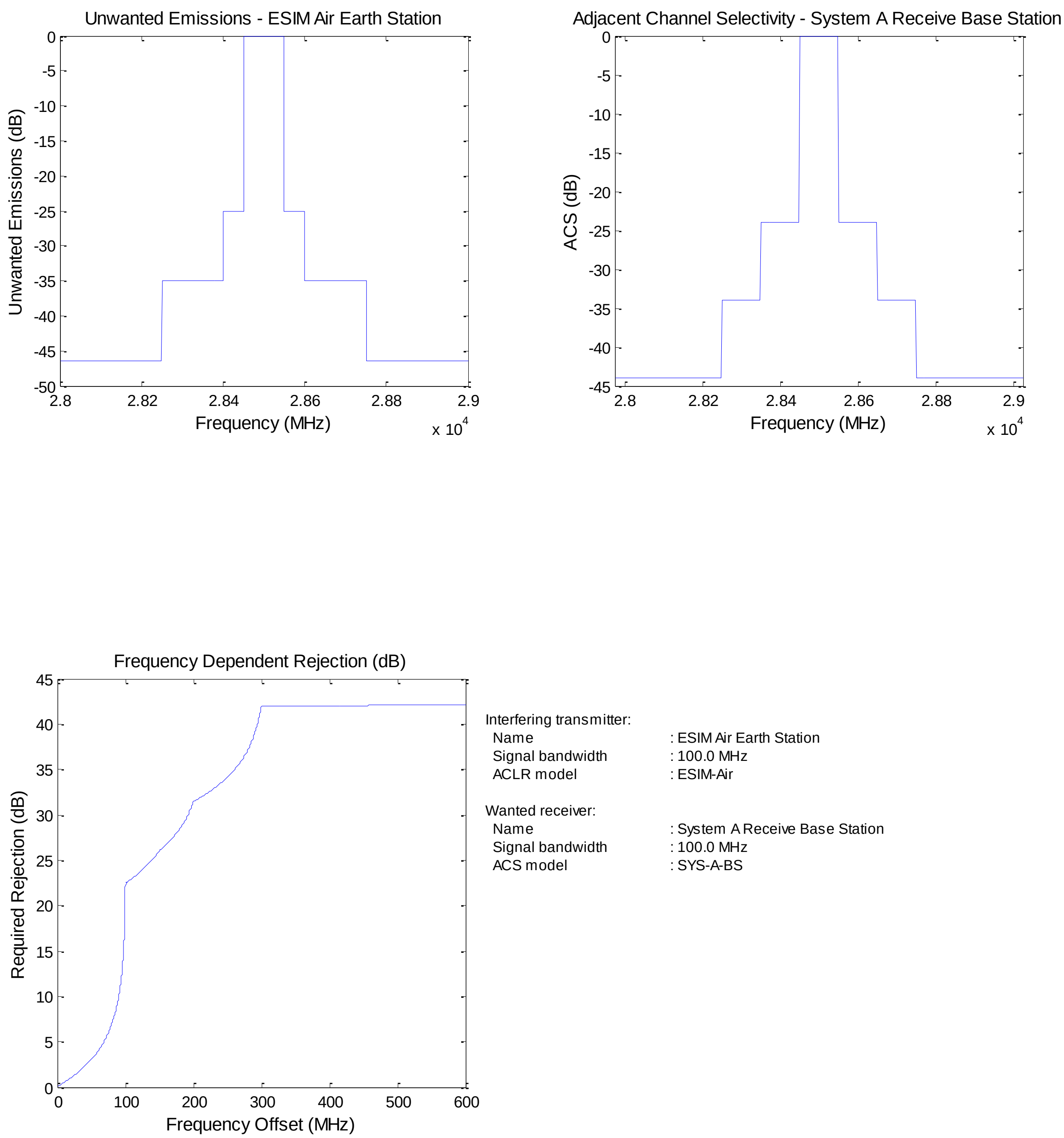
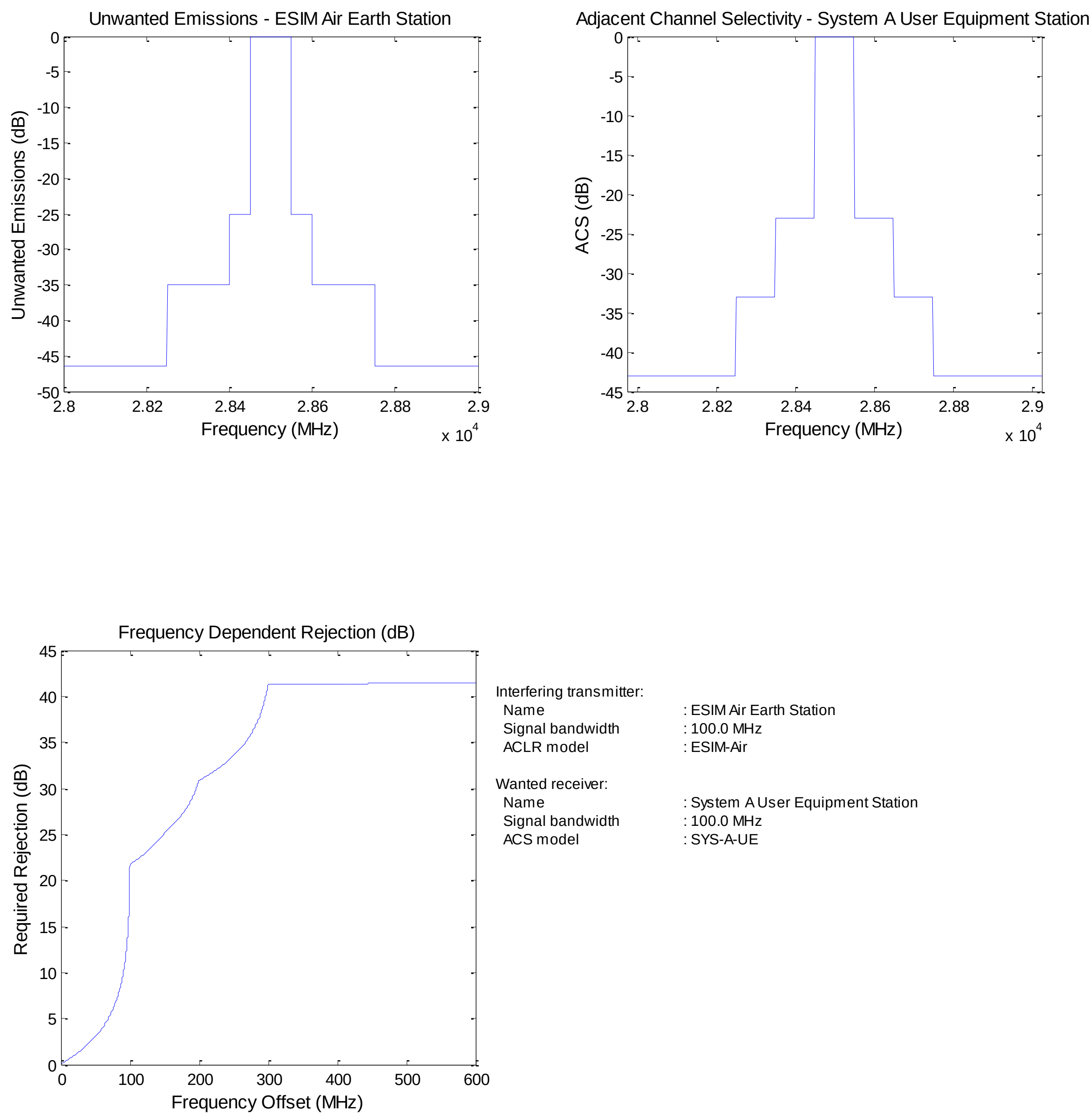


Figure 3 – Frequency Dependent Rejection
ESIM Air Earth Station into MS User Equipment Station



The interference levels and FDR curves computed above are combined to derive the frequency separation (center-to-center, using 100 MHz channels) necessary to meet the stated protection requirement. Table 7 provides results for selected separation distances for the various interference scenarios and deployment environments considered here.

Table 7

Results of Required Frequency Separation Calculations (MHz)

Single entry

ESIM Type	ESIM Deployment	Number of ESIM	Propagation Model	MS pointing azimuth	ESIM Location	Frequency Separation (MHz)	
						Base station	User Equipment
Air	Airborne	1	FSL + P.676	0 deg	Height = 10 km	0.0	0.0
					Height = 5 km	0.0	0.0
					Height = 1 km	84.2	91.9
	Parked	1	FSL	0 deg	Distance = 100 m	Inf	Inf
Sea 10 m	At sea	1	P.452 Zone 3	0 deg	Distance = 10 km	149.0	145.6
					Distance = 5 km	221.3	209.6
					Distance = 1 km	Inf	Inf
	Docked	1	FSL	0 deg	Distance = 100 m	Inf	Inf
Sea 40 m	At sea	1	P.452 Zone 3	0 deg	Distance = 10 km	147.9	145.3
					Distance = 5 km	216.2	200.8
					Distance = 1 km	Inf	Inf
	Docked	1	FSL	0 deg	Distance = 100 m	Inf	Inf
Land	Inter-city	1	P.452 Zone 2 (eMBB)	0 deg	Distance = 1 km	Inf	Inf
			FSL (V2X)	0 deg	Distance = 50 m	Inf	Inf
	Intra-city	1	P.1411 (LoS)	0 deg	Distance = 20 m	Inf	Inf

Aggregate

ESIM Type	ESIM Deployment	Number of Additional ESIM	Propagation Model	MS pointing azimuth	ESIM Location	Frequency Separation (MHz)	
						Base station	User Equipment
Air	Airborne	2	FSL + P.676	5 deg	Height = 10 km	0.0	0.0
					Height = 5 km	0.0	21.2
					Height = 1 km	87.8	97.6
	Parked	3	FSL	10 deg	Distance = 100 m	Inf	Inf
Sea 10 m	At sea	2	P.452 Zone 3	10 deg	Distance = 10 km	154.1	185.5
					Distance = 5 km	228.4	266.0
					Distance = 1 km	Inf	Inf
	Docked	2	FSL	45 deg	Distance = 100 m	Inf	Inf
Sea 40 m	At sea	2	P.452 Zone 3	10 deg	Distance = 10 km	152.3	185.3
					Distance = 5 km	223.9	262.2
					Distance = 1 km	Inf	Inf
	Docked	2	FSL	45 deg	Distance = 100 m	Inf	Inf
Land	Inter-city	3	P.452 Zone 2 (eMBB)	5 deg	Distance = 1 km	Inf	Inf
			FSL (V2X)	20 deg	Distance = 50 m	Inf	Inf
	Intra-city	3	P.1411 (LoS)	45 deg	Distance = 20 m	Inf	Inf

In the above table, entries with “inf” (i.e. infinite frequency separation) represent the cases where no additional guard-band could reduce interference below the acceptable level under the assumed out of band conditions (ACLR of ESIM). This is related to the ACLR having a fixed final value (at >250% bandwidth), but the impact could potentially be improved if the Federal Communications Commission were to specify a sloped, frequency-dependent terminal value, assuming ESIM equipment could met that sloped value.

As noted previously, the above analysis assumes the ESIM and MS are pointing towards each other in azimuth, which is a plausible deployment scenario and leads to the interference issues for certain scenarios. We performed limited scenario analysis to determine the impact of non-aligned (in azimuth) ESIM and mobile stations on the frequency separation required, in order to determine if implementing coordination requirements on azimuth pointing angles could resolve some harmful interference issues. Early results indicate this may be a viable coordination parameter in cases where coordination is the preferred resolution, at least for mobile base stations. Further study is needed on additional scenarios (*i.e.* the minimum necessary azimuth angle offset will vary by scenario) as well as the mechanism to ensure azimuth offset is maintained on moving or static air and sea vessels, .

Conclusions

This study provides an analysis of potential interference from earth stations in motion (ESIMs) operating in the frequency range 28.35-28.6 GHz, into Mobile Service stations operating in adjacent frequency bands for a variety of ESIM and mobile system deployment scenarios. It focuses on coexistence scenarios where ESIM could potentially produce a considerable amount of interference into the mobile system stations.

Results are presented as the level of frequency dependent rejection necessary to protect the MS stations for a variety of ESIM types and deployment scenarios. The results show that the interference levels in the airborne case are within the MS station protection requirement except when the aircraft is at a low altitude or on the ground. The required FDR for the case of the aircraft parked at the gate is 86 dB for the MS base station and 56 dB for the MS user equipment for assumed separation distances. However, the fixed final value of the ACLR at >250% bandwidth results in no frequency separation value being adequate to protect the mobile station. This was also the case for shipborne ESIMs at a distance of 1km and 100m.

Comparing the aggregate results with the single entry values shows that the interference is dominated by the single ESIM transmit station that is most in-line with the MS receive station antenna pointing direction.

The most problematic case is the land-based ESIM case since the ESIM and MS terminals could be in close proximity to one another and pointing directly at each other. Compounding the problem, the density of mobile stations for coordination purposes can be much higher for these scenarios, compared to the sea and air-based ESIMs. It is not immediately clear that there is a non-burdensome coordination method for resolving the harmful interference issues between land-based ESIMs and terrestrial mobile, even when considering the ESIM is on an adjacent channel.

Due to a lack of information on the proposed ESIM operation in the record, this study used the assumptions described above. Some of these assumptions are worst-case scenarios. However, the study could be refined if and when more information on operational aspects of ESIM become available from ESIM operators. In many of the assumed scenarios, the interference may potentially be mitigated through one of several means. These include implementation of a coordination process between the ESIM and MS system operators, or the use of frequency separation (guard bands) that may vary in size based on the scenario, or for some cases, enforcing certain minimum geographical separation (for instance by allowing operation only at cruising altitudes for certain air-based ESIMs, or a set distance out at sea for sea-based ESIM, etc.).

As there is not enough information in the record on proposed ESIM deployment scenarios, other scenarios were not studied. If sufficient information is made available in the future, additional analysis can be performed. Until such time, it is our view that the results from these scenarios should represent the basis for the FCC's solution framework. Furthermore, any solution framework developed by the Commission should permit flexibility for operators to choose the preferred mitigation method on a case by case basis, since the considerations for the best solution could vary by location.

Respectfully Submitted,

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