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FEDERAL COMMUNICATIONS COMMISSION
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BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, DC 20554

In re	)	
	)	
Application of	)	FCC File No. 0100-EX-RR-1999
Maritime Telecommunications	)	
Network, Inc. For Renewal of	)	
Experimental Authorization,	)	
Call Sign K12XEE	)	
	)	

REPLY TO OPPOSITION

The Association of American Railroads ("AAR") and Consortium Digital Microwave System ("CDMS"), by their attorneys, hereby reply to the "Opposition to Petition to Deny" filed in the above-captioned proceeding on April 6, 1999, by Maritime Telecommunications Network, Inc. ("MTN").

I. BACKGROUND

MTN operates 45 Shipboard Earth Stations ("SESs") under Call Sign K12XEE as a successor-in-interest to Crescomm Transmission Services, Inc. ("Crescomm"). Experimental authorization was previously granted to Crescomm, pursuant to delegated authority, in 1996.[1/] On January 22, 1999, MTN filed an application for renewal of its experimental authorization to operate the SESs in the C Band.

CDMS and AAR's members operate point-to-point microwave communications systems in the same frequency bands in which MTN conducts its secondary SES operations. AAR and CDMS depend on their service for operational efficiency and

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1/ Crescomm Transmission Services, Inc., 11 FCC Rcd 10944 (OET, IB 1996) (hereinafter "Crescomm Order").

safety, which is compromised by harmful interference. In this regard, AAR and CDMS filed a joint Petition to Deny the Application ("Petition") on March 24, 1999. MTN filed an Opposition, to which AAR and CDMS now reply, on April 6, 1999. The Opposition stated that (1) claims of interference in the 5925 to 6425 MHz band are unsupported; (2) continued experimental authorization is necessary to resolve any interference issues; and (3) a 100 km frequency coordination distance is an appropriate interim standard.

MTN's Opposition is noteworthy for its numerous admissions that crucial topics for establishing proper interference objectives for MTN's operations are still under discussion and have not achieved consensus, either domestically or internationally. If MTN's Opposition and its experimental operations to date show anything, it is that (1) conducting on-the-air operations has not enhanced the ability of the interested groups to reach conclusions on the proper interference criteria to be used when introducing mobile operations into an existing Fixed Service environment; (2) the issues are far more complex and difficult than anyone imagined three years ago when the experimental authorization was issued to MTN's predecessor; and (3) experimental operations should cease pending resolution of these admittedly complex and difficult sharing and interference issues.

II. MTN'S OPPOSITION MISSES THE ESSENTIAL POINT REGARDING MTN'S FAILURE TO PROVIDE NECESSARY INFORMATION

In their Petition, AAR and CDMS demonstrated that MTN had failed to meet its obligation to cooperate in establishing interference assessment and prevention procedures. In its Opposition, MTN creates and attacks a straw man by seeking dismissal of the AAR/CDMS Petition on grounds that the Petition lacks support for claims of interference. In fact, the Petition does not contain allegations of specific cases of interference because neither AAR's members nor CDMS could obtain from MTN sufficient advance information to determine whether the certain interference events were attributable to MTN's operations. Indeed, the point of the Petition was that there is a critical information gap of MTN's own making, caused by MTN's refusal to provide the necessary information to ascertain the source of interference, as demonstrated in the exchange of correspondence between AAR's counsel and MTN's counsel attached to the Petition. Throughout its Opposition, MTN attempts to obscure the real issue: MTN has failed to abide by its obligation to cooperate in establishing interference assessment and prevention procedures as required in the Order granting the waiver of the Table of Frequency Allocations.[2/] Despite MTN's allegation to the contrary, the AAR/CDMS Petition is not procedurally infirm due to a lack of affidavits by persons with personal knowledge. In fact, the Petition contained several attached documents incorporated by reference, including the affidavits of two individuals with personal knowledge of the facts.[3/] In addition to these affidavits, the Petition included copies of the above-mentioned correspondence between counsel, previously on file with the Commission -- documents of which the Commission may take official notice.

[2/] Crescomm Order at 10949 (conditioning grant upon requirement "that the MSS applicants cooperate in establishing interference assessment and prevention procedures").

[3/] See Affidavits of Mssrs. Berne Life and Roger Sullivan.

III. MTN's OFFER TO ENGAGE IN "EXPERIMENTATION" IS TOO LITTLE, TOO LATE

While MTN has recently expressed an interest in working with AAR and CDMS on joint experiments, this gesture is belated. The tests and experiments that are required would necessitate the collection of data over an extended period of time -- an entire year -- in order to assess properly both short-term and long-term interference. To expose the Fixed-Service licensees to this type of potential harm for yet another experimental license term would be an unreasonable imposition and potentially quite dangerous to safety-related Fixed-Service communications systems in the 6GHz band. This is especially so in light of the lack of consensus among the parties regarding protection of digital FS links. In this regard, MTN admits in its Opposition that there is not yet any agreement between it and the FS community regarding key aspects of the interference relationship between SES and FS operation. For example, MTN admits that the parties have not yet agreed on protection standards for the digital equipment that the newer microwave systems presently utilize, nor has any agreement been reached concerning the unique characteristics of transmissions over water at 6 GHz for purposes of establishing a coordination standard. MTN's admission that these complex interference questions (which are "the subject of numerous on-going meetings, papers, reports, discussions, and correspondence"[4/]) are not yet answered stands as compelling testimony that further SES operations should not be continued unless and until these issues are resolved.

[4/] MTN Opposition at 10, 12, (footnote omitted).

MTN's offer to engage in further "experimentation" is particularly hollow in light of the manner in which it is conducting its operations. Notwithstanding that it holds merely an experimental license pursuant to a waiver, MTN is behaving in the marketplace as though it holds a permanent license. MTN's experimental authorization and waiver are subject to certain terms and conditions with which MTN has failed to comply. Section 5.93 of the Commission's rules, 47 C.F.R. § 5.93, provides in pertinent part:

> Unless otherwise stated in the instrument of authorization, licenses granted for the purpose of limited market studies pursuant to § 5.3(j) of this part are subject to the following conditions . . . (b) The licensee is responsible for informing anyone participating in the experiment that the service or device is granted under an experimental authorization and is strictly temporary.

MTN routinely holds its SES operations out to the public as a regular commercial service.[5] In so doing, MTN has failed to comply with the explicit requirements of Section 5.93 governing limited market studies. In other words, rather than conducting its operations as a bona fide experiment for the purpose of advancing the art and science of radio technology, MTN is offering nothing but garden-variety Fixed Satellite Service on a mobile platform on a commercial basis as though pursuant to a permanent license.

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[5] The SES service offering is described in a series of Company Press Releases available on the Internet. See Company Press Releases, dated March 1, 1999; April 1, 1999; and April 13, 1999 (appended hereto as Attachments 1, 2, and 3, respectively).

IV. MTN HAS NOT PROVEN THAT THE 100 km COORDINATION DISTANCE PROVIDES ADEQUATE INTERFERENCE PROTECTION TO THE FIXED SERVICE

In addition to obscuring the real issue, MTN asks the Commission to take its word that interference has not been caused by MTN's "experimental" SES operations. The MTN Opposition casts vague aspersions about the nature and source of the interference received by AAR and CDMS by stating that the interference "probably would not have been caused by a 'nearby' [SES] station."[6/] While MTN has attached a copy of Micronet's letter[7/] which purports to "clear" a certain prior coordination involving CDMS, the letter does not identify which of the many CDMS platforms were subject to the prior coordination notice. MTN did not include the corresponding prior coordination notice, so it is quite likely that only one or a very few of the CDMS platforms were subject to prior coordination based on the arbitrary 100 km coordination distance requirement.[8/] The Micronet letter applies only to the CDMS fixed-service facilities subject to prior coordination -- not to all of the CDMS 6 GHz microwave facilities. Therefore, the Micronet letter proves nothing of relevance and does not lend the slightest support to MTN's naked claim that interference with CDMS was impossible during the experimental SES operations in the Gulf of Mexico.

6/ MTN Opposition at 7 (emphasis added).

7/ Letter from Stacey Cato, Micronet Communications, Inc., to Tom Detrick, EK Wireless (March 31, 1997) (Attachment C to MTN Opposition).

8/ As indicated in the Petition and in the attached Engineering Statement of Edwin F. Morris, dated March 24, 1999 ("Morris Engineering Statement"), the 100 km coordination distance is inadequate to ensure interference protection to Fixed-Service stations in the 6 GHz band.

The MTN Opposition blithely asserts that MTN's application for renewal of the initial experimental license granted to its predecessor, Crescomm, is not the appropriate forum for review of the conditions of the license, e.g., the 100 km coordination distance.[9] However, the Commission's authority to review the terms and conditions of a license at renewal time is well established. Not only may the Commission deny a license renewal where it finds that a licensee has failed to abide by the terms and conditions of a license as in the case of MTN's experimental license, the Commission may impose new or additional terms and conditions on a renewed license.[10]

Furthermore, the MTN Opposition mischaracterizes the coordination distance adopted by the Commission in the Crescomm Order as being the product of prior notice and comment.[11] The current coordination distance of 100 km was never the subject public notice and comment as MTN states. Indeed, it was adopted in a novel way in the Crescomm Order -- apparently, but not explicitly, applying the ITU-R default minimum distance -- without discussion of further distance calculation requirements.[12]

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[9] MTN Opposition at 3

[10] In fact, Section 5.83 of the Commissions Rules, 47 C.F.R. § 5.83 expressly states that a license in the Experimental Radio Services is "subject to change or cancellation by the Commission at any time . . . ." (emphasis added). In the commercial broadcast context, conditions such as short-term renewal are often imposed when there is an issue of compliance with FCC operating requirements. See, e.g., Applications of Certain Broadcast Stations Serving Communities in the State of South Carolina, 5 FCC Rcd 1704 (1990).

[11] MTN Opposition at 3.

[12] Crescomm Order at 10949.

The Commission has before it now engineering statements from two qualified sources casting serious doubt upon the adequacy of the current 100 km coordination distance on several grounds. First, MTN's own expert acknowledged the interference potential of FSS/FS frequency sharing and stated "the coordination distance around a satellite earth station, however, is not a single number or standard set of numbers, as has been the case with microwave systems, nor is earth station coordination distance a parameter that has been set by industry practice and agreement." See Engineering Statement of Daniel J. Collins, dated April 5, 1999 ("Collins Engineering Statement"). The Collins Engineering Statement correctly states that the ITU-R 100 km distance is nothing more than a "default minimum" distance, but fails to provide or opine upon the correct minimum coordination distance for protecting FS receivers in the 5925 to 6425 MHz band from interference from MTN's SES operations.[13]

Second, the Morris Engineering Statement attached to the AAR/CDMS Petition indicates that the coordination distance of 100 km is inadequate to protect FS stations pursuant to Section 101.105 of the FCC's rules. The 100 km distance is inconsistent with the coordination distances currently applicable to the Fixed-Service use of the 5925 to 6425 MHz band, i.e., 400 km around the boresight of a fixed-service antenna, and 200 km at all other azimuths. Moreover, these fixed-service coordination distances: (1) are based on propagation characteristics assuming land-based stations which may afford terrain shielding that is not present in operations over water; and (2) do not take into account the characteristics of digital microwave systems such as

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[13] Id. at 4.

automatic transmitter power control which are now in use by many Fixed-Service licensees. Finally, the 100 km distance fails to take account of the potential for ducting and fading known to occur in 6 GHz transmissions over water, which may result in increases in the reception of undesired signals and decreases in the reception of desired signals.[14]

Furthermore, subsequent to the filing of the Petition, the United States tendered a paper entitled "*Determination of Coordination Ara for Earth Stations Located on Board Vessels Operating in the Fixed-Satellite Service in the Bands 3700-4200 MHz (Space-to-Earth) and 5925-6425 MHz (Earth-to-Space)*" in ITU Working Party 4-9S, authored by MTN's consultants and other proponents of permanent SES authorization in the 6 GHz band. This paper contained an analytical example from which the conclusion was drawn that 165 km, not 100 km, is an appropriate coordination distance.[15]

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[14] See Morris Engineering Statement.

[15] "Therefore, any administration operating ESVs [SESs] fitting the description used herein which limits its Earth-to-space transmission operations to areas at sea beyond 165 km of the coastline is not required to perform frequency coordinations with FS administrations ashore. If, on the other hand, the ESV administration intends to approach the coastline within distances which are less than 165 km while transmitting, then the ESV administration will be required to conduct detailed frequency coordinations with FS administrations ashore. These results are preliminary and will require further confirmation." Radiocommunication Study Groups, Preliminary Draft New Recommendation–ESV-1, USWP4-9S-31 (Rev. 4), at 15 (Geneva, April 1999) (emphasis added) (appended hereto as Attachment 4).

V. CONCLUSION

MTN accuses the petitioners of seeking to impede efficient, shared use of the 6 GHz band.[16] That is an untoward and unjustified accusation. AAR and CDMS, and other members of the Fixed Service community, have no objection to shared use of the band as long as their operations are protected from harmful interference. Indeed, this willingness to share is exemplified by the coexistence of the FS and FSS in the 6 GHz band. If the SES proponents and FS operators can reach agreement on the proper protection standards, then petitioners will have no objection whatsoever to sharing the band. The problem here is that MTN has commenced widespread commercial operations pursuant to an "experimental" license prior to any consensus having been reached regarding extremely important protection criteria, including those pertaining to protection of digital receivers, the adequacy of the 100 km coordination distance for "off shore" operations, and appropriate criteria for close-in, in-motion operations.[17] In light of the difficult sharing issues here (which, by MTN's own admission, are extremely complex and are yet to be developed), Petitioners respectfully submit that the MTN "experiment" should be halted until such time resolution of these complex issues has

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16/ MTN Opposition at 13.

17/ It is important to note, in this regard, that the Commission has not in the past, proposed sharing for dissimilar services, i.e., fixed and mobile.

been achieved. Accordingly, MTN's application for renewal of its "experimental" authority should be denied.

Respectfully submitted,

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April 20, 1999

Attachments (4)

ATTACHMENT 1

Monday March 1, 4:46 pm Eastern Time

Company Press Release

MTN and Digital Seas International Form Alliance to Provide Internet Services to Cruise Line Industry

MIAMI--(BUSINESS WIRE)--March 1, 1999--Imagine being able to check your E-mail in the middle of the Atlantic Ocean or cruising the Internet from the convenience of your cruise ship cabin. Many Internet services are now being offered through new technology developed by Maritime Telecommunications Network (MTN), a subsidiary of ICG Satellite Services Inc., and Digital Seas International (DSI).

Passengers and ship personnel can visit the 24-hour Internet Cafe for quick and easy access to many services, including Internet access to check hometown news, stock market updates, and the ability to send or receive E-mail. Other services, for example, video conferencing, electronic white boards and company E-mail, provide major corporations with on-board capabilities never before available. ``The computer and on-line services offered by DSI are revolutionizing the way cruise lines will do business in the future," said Glenn Farrington, president of Digital Seas International.

About Digital Seas International

The world leader in cruise ship solutions, DSI is bringing the Digital Age to the cruise industry. A privately held company with offices in New York, Alabama and soon Florida, DSI was founded to allow the cruising industry to tap into what has become the communication medium of the future, the computer and on-line industry. With this in mind the Digital Seas Internet Cafe was born, a computer room on board where passengers can stay wired while at sea. The earth is mostly water: somebody has to wire it! Visit Digital Seas' web site, www.digitalseas.com for more information about the company.

About Maritime Telecommunications Network

Maritime Telecommunications Network, Inc. (MTN) is the leading provider of C-Band voice, fax and data communications to the cruise industry, the U.S. Navy, and to offshore oil and gas platforms around the world. MTN also provides ship-to-shore live video and radio broadcast capabilities in C- or Ku-Band. Through its Earth Station in Holmdel, N.J., it also offers international satellite voice and data services. ICG Satellite Services, Inc. is a division of ICG Communications, Inc., which is headquartered in Englewood, Colo. (Nasdaq:ICGX - news). Further information is available on ICG's web site located athttp://www.icgcomm.com.

Contact:

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Media Contact:
ICG Satellite Services Inc., Miami
Nancy Price, Belkis Castro
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ATTACHMENT 2

Thursday April 1, 9:27 am Eastern Time

Company Press Release

MTN Takes Part In Princess Cruise Lines' Love Boat National Holiday

MIAMI--(BUSINESS WIRE)--April 1, 1999--For the 9th year Maritime Telecommunications Network, Inc., (MTN), a subsidiary of ICG Satellite Services, Inc. has provided enhanced communication services and all of the satellite links needed for Princess Cruise Line's annual Valentine's voyage.

``The seven-day cruise provided plenty of excitement and fun, and MTN was there to cover it all," says Brad Briggs, Vice-President of Sales and Marketing of MTN.

MTN stepped up its satellite voice, fax and data communications system to offer both live video, radio and high-speed Internet access capabilities to over 15 television stations on board the Grand Princess. Additionally, MTN provided 24 hour per day C-Band Video uplink, dedicated coordination phones, IFB's and satellite delivered data services. With a four-person crew, MTN assumed round the clock personalized services to the production crews of ``PERRI PRODUCTIONS" of Marina Del Ray, Ca. executive producers of all LIVE and taped segments transmitted from the ship.

This year's Valentine's voyage sailed on February 8th-14th.

About Maritime Telecommunication Network

Maritime Telecommunications Network, Inc. is the leading provider of C-Band voice, fax and data communications to the cruise industry, the U.S. Navy, and to offshore oil and gas platforms around the world. MTN also provides ship-to-shore live video and radio broadcast capabilities in C- or Ku-Band. Through its Earth Station in Holmdel, N.J., it also offers international satellite voice and data services. ICG Satellite Services, Inc. is a division of ICG Communications, Inc., which is headquartered in Englewood, CO. (Nasdaq:ICGX - news).

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Related News Categories: computers, leisure/travel, telecom

ATTACHMENT 3

Tuesday April 13, 9:08 am Eastern Time

Company Press Release

Maritime Telecommunication Network Provides Unisys Corporation's ``Top Producers'' With Floating Office On Board Carnival's MS Destiny

MIAMI--(BUSINESS WIRE)--April 13, 1999--Unisys Corporation is committed to their customers. Indeed, it is that strong commitment to good customer relations, which Unisys has successfully instilled in their top sales people, that was the driving force behind the one-week cruise on board Carnival's MS Destiny. Mixing business with pleasure, Unisys converted the card room and lounge on board the MS Destiny into an International Communications Center.

Maritime Telecommunication Network, (MTN) a subsidiary of ICG Communications, Inc., was there for the seven-day trip providing a unilateral T-1 connection. Unisys Information Technology Group engineered and supported a virtual private network (VPN) via the Global Internet, which kept Unisys' employees in touch with their offices, homes and customers worldwide. ``With MTN's help we were able to provide an essential and cost effect service to over 900 Unisys' sales personnel, executives and spouses," said Tom Costello, vice president, Special Events for Unisys.

MTN provided eighteen telephone, fax and modem lines and kept the circuits alive from 8:00 a.m. to 5:00 p.m. for daily Unisys usage. ``With the state-of-the-art technology available today, more and more corporations will find conducting business at sea to be the norm in years to come," said Richard Hadsall, vice president of operations of MTN.

About Unisys

Unisys (NYSE:UIS - news) is more than 33,000 employees helping customers in 100 countries apply information technology to solve their business problems. Unisys solutions are based on a broad portfolio of global information services including systems integration, outsourcing, ``repeatable" application solutions, consulting, network integration, remote network management, and multivendor maintenance and support, coupled with enterprise-class servers and associated middleware, software and storage. Headquartered in Blue Bell, Pennsylvania, in the Greater Philadelphia area, Unisys had 1998 annual revenue of $7.2 billion. Access the Unisys home page on the World Wide Web - http://www.unisys.com - for further information.

About Maritime Telecommunications Network

Maritime Telecommunications Network, Inc. (MTN) is the leading provider of C-Band voice, fax and data communications to the cruise industry, the U.S. Navy, and to offshore oil and gas platforms around the world. MTN also provides ship-to-shore live video and radio broadcast capabilities in C- or Ku-Band. Through its Earth Station in Holmdel, N.J., it also offers international satellite voice and data services. MTN and its parent company, ICG Satellite Services, Inc., are divisions of ICG Communications, Inc., which is headquartered in Englewood, CO. (Nasdaq:ICGX - news). Further

Radiocommunication Study Groups
Geneva, April 1999

US WP 4-9S-31(Rev. 4)
March 30 1999

PRELIMINARY DRAFT NEW RECOMMENDATION – ESV-1

DETERMINATION OF COORDINATION AREA FOR EARTH STATIONS LOCATED ON BOARD VESSELS** OPERATING IN THE FIXED-SATELLITE SERVICE IN THE BANDS 3700 - 4200 MHz (SPACE-TO-EARTH) AND 5925 - 6425 MHz (EARTH-TO-SPACE)

(Questions ITU-R [Doc. 4/13 (or 9/24)]/4 and [Doc. 9/23 (or 4/12)]/9)

The ITU Radiocommunication Assembly,

considering

a) that the technology exists which permits the use of FSS earth stations on board vessels in the allocations 3700 - 4200 MHz (space-to-Earth) and 5925 - 6425 MHz (Earth-to-space);

b) that developmental operations using such earth stations on board vessels have been conducted for several years;

c) that operations require considerably less than the full bandwidth in these FSS allocations and only a portion of the visible geostationary arc;

d) that to ensure the future growth of the FS the vessel earth station must operate with certain operational constraints;

e) that there are three situations in which frequency coordination with vessels having FSS earth stations need to be considered:

i) a distance from the nearest point of land beyond which no coordination is necessary;

ii) when the vessel is in motion within the distance described in i) above and the nearest point of land between the vessel earth station and an FS station; and

iii) when the vessel is stationary (in port or moored).

** Throughout this attachment the term "vessels" is used to describe all ships whose operation near to shore is restricted to operation within designated sea-lanes and channels, or stationary vessels.

recommends

1 that when a vessel with an ESV earth station operating in the band 5925-6425 MHz is further than [XXX km] from land, no coordination between it and the FS is required. Annex 1 defines the basis for [XXX km], and the ESV E.S. operating constraints.

2 that for earth stations on vessels, in motion, operating within [XXX km] of land the composite coordination area should be determined using the method indicated in Annex 2;

3 that for the composite coordination area determined in 2 above, the method in Draft New Recommendation ESV-2 may be used by administrations for guidance in assessing the interference potential between the indicated type of earth station and fixed stations in the same band;

4 that the coordination area of an ESV earth station on a stationary vessel (docked in port or moored at sea) is determined according to the methods specified in Recommendation ITU-R IS.847.

NOTE - The proposed Recommendation is related to agenda item 1.8 of WRC-2000. It is intended to address the technical provisions necessary to enable earth stations located on board vessels to operate in fixed-satellite services networks in the bands 3700 - 4200 MHz and 5925 - 6425 MHz with regard to their coordination with other services. Its use will be determined by the results of WRC-2000.

Annex 1
DETERMINATION OF DISTANCE BEYOND WHICH NO COORDINATION IS NECESSARY

1. Introduction

The purpose of this Annex is to determine the distance XXX indicated in Recommends 1. It is proposed to use a single distance world-wide, subject to constraints on the parameters characterizing ESV operations, which is based on the methodology and examples presented in sections 2 and 3 of this Annex. The methodology may require further development, and the results of the calculations presented herein need further confirmation.

The operation of earth stations aboard vessels (ESVs) which transmit in the 5.925-6.425 GHz band creates the possibility of interference with receivers of the terrestrial fixed service (FS) when the ESV is sufficiently close to a potential victim FS receiver (FSR). However, for any particular situation, there is clearly a distance out to sea, d_{sea}, beyond which the possibility of interference from the ESV is negligible.

A number of parameters determine d_{sea}, among which are

- the heights of the ESV and FSR antennas,
- the distance of the potentially affected FSR from the coastline,
- the gain of the FSR antenna in the direction of the ESV,
- the effective isotropic radiated power (EIRP) of the ESV in the direction of the FSR,
    - the ESV transmitter power,
    - the horizon gain of the ESV antenna in the azimuthal direction of the FSR,
- radiometeorological conditions, and
- the FSR permissible level of interference.

It is recognized that there could be a great deal of variability in the values of some of these parameters. However, from the perspective of ease of use, there is merit in being able to specify a single distance beyond which no coordination would be necessary given, say, a complete characterization of the ESV and the potentially affected FSR. (Note: Table 1 in Annex 1 of Recommendation ITU-R IS.847 provides the appropriate FS parameters for the determination of coordination areas. It is useful to note that the permissible level of interference in Table 1 (of Annex 1 of Rec. ITU-R IS.847) for analog systems in this band, namely –131 dBW/4kHz, leads to a larger coordination area and it is employed for that purpose in this Annex.) Then, if an ESV with suitably constrained operating parameters remains at least d_{sea} km out to sea from the coastline, no coordination between the administration operating the ESV and administrations operating FSRs ashore would be necessary. It is recognized that while such an approach has the merit of simplicity, it may, in some cases, be overly conservative.

This annex proposes a framework for developing a worst case interference scenario which would yield a single, conservative value of d_{sea}, given a complete characterization of the ESV. Section 2 outlines the methodology and the Section 3 illustrates the methodology by applying it to an example ESV.

2. Methodology

This section proposes a process for setting up a worst case interference scenario for which d_{sea} can be calculated through an iterative procedure. The process is based on the premise that the minimum permissible basic transmission loss is determined by the characteristics of the ESV, the characteristics of the potentially affected FSR and the applicable interference objective(s). The procedure employs the techniques of Recommendation ITU-R P.452-8 to calculate the basic transmission loss, $L_b(p)$ (where p is defined in Table 1 herein) as a function of the great-circle distance, d, between the ESV (at sea) and an FSR which is placed in a worst case location and orientation with respect to receiving interference from the ESV.

In calculating $L_b(p)$, all of the individual interference propagation mechanisms which can arise are considered, including:

- line-of-sight (LOS),
- LOS with sub-path diffraction,
- troposcatter,
- diffraction, and
- ducting.

At each value of d, the path losses associated with the individual interference propagation mechanisms are combined to calculate $L_b(p)$ according to the prescription given in Rec. ITU-R P.452-8 as discussed in greater detail below. This is repeated for increasing values of d until the value of $L_b(p)$ exceeds the minimum permissible basic transmission loss for p percent of the time. If the calculated distance is less than 100 km, the distance, d_{sea}, defaults to 100 km, the minimum coordination distance.

Considering that $L_b(p)$ increases more rapidly over land than over water, a reasonable worst case interference situation for the FSR would locate it at the coastline with the main beam of its antenna pointed out to sea, directly at the ESV[1]. This is not an unrealistic situation because many FS microwave links

[1] It is recognised that it may be possible to construct alternative worst case interference scenarios.

involve over-water hops (e.g., inter-island service). With regard to the ESV, the worst case interference situation maximizes its horizon EIRP in the direction of the FSR. The ESV maximum horizon EIRP is based on the maximum transmit power, minimum operational elevation angle and the minimum antenna size. Furthermore, it is assumed that the ESV antenna azimuth angle is such that it is pointed along the bearing from the ESV to the FSR. Additional characteristics of the worst case scenario can include the following.

- Worst month statistics are used for radiometeorological data.
- No clutter loss is included in path loss calculations.

These assumptions are made in the calculations presented herein.

Table 1 and Table 2, respectively, summarize the basic input data, and list the sources of the radiometeorological data used in the examples presented in this annex. In order to take into account a range of radiometeorological climates, three regions were selected for consideration based on their maximum monthly mean values of ΔN. These are listed in Table 3 and it should be noted that they are among the areas with the largest maximum monthly mean values of ΔN in the world.

Table 1 Basic input data and values used herein (after Table 1 of Rec. ITU-R P.452-8).

Parameter	Preferred resolution	Description	Values Used Herein
f	0.01	Frequency (GHz)	6.00
p	0.001	Required time percentage for which the calculated minimum basic transmission loss is not exceeded	0.0025
φ_t, φ_r	0.001	Latitude of station (degrees)	See Table 3 herein.
ψ_t, ψ_r	0.001	Longitude of station (degrees)	See Table 3 herein.
h_{tg}, h_{rg}	1	Antenna center height above ground level (m)	ESV: 40 FSR: 300
h_{ts}, h_{rs}	1	Antenna center height above mean sea level (m)	ESV: 40 FSR: 300
G_t, G_r	0.1	Antenna gain in the direction of the horizon along the great-circle interference path (dBi)	ESV: +4.0 FSR: +43.0

Table 2 **Radiometeorological data and values used herein (section 3.2.1 of Rec. ITU-R P.452-8).**

Parameter	Description	Values Used Herein
ΔN (N-units/km)	Average radio-refractive index lapse-rate in lowest 1 km of atmosphere.	Max. monthly mean values per Figure 5 of Rec. ITU-R P.452-8.
β_0 (%)	Time percentage for which $\Delta N > 100$ N-units/km in the lowest 100 m of atmosphere at the path center.	Strong function of path center latitude φ. See Figure 1 herein.
N_0 (N-units)	Sea-level surface refractivity, used only by troposcatter model.	Regional values from Figure 6 of Rec. ITU-R P.452-8.

The point incidence of anomalous propagation, $\beta_0(\%)$, for the path center location is determined using equations (2) through (4) of Section 3.2.1 of Annex 1 of Rec. ITU-R P.452-8. Here, under the assumption that the FSR is at the coastline, the propagation path is entirely over water. Therefore, d_{tm} (longest continuous land (inland + coastal) section of the great-circle path (km)) and d_{lm} (longest continuous inland section of the great-circle path (km)) of Rec. ITU-R P.452-8 are both zero. As a consequence β_0 depends only on φ and this dependence is shown in Figure 1 herein.

The median effective Earth's radius factor k_{50} is determined for the path using:

$$k_{50} = \frac{157}{157 - \Delta N}$$

where the values of ΔN used here are given in Table 3, as are the corresponding values of k_{50}. Assuming a true Earth radius of 6371 km, the median value of effective Earth radius a_e is determined from:

$$a_e = 6371 \cdot k_{50} \text{ (km)}.$$

It should be noted that the values of k_{50} shown in Table 3 were used in all calculations in this Annex with one exception. As discussed in section 4.3 of

Table 3 **Some coastal-region maximum monthly mean values of ΔN from Figure 5 of Rec. ITU-R P.452-8. Representative values of φ for indicated locations.**

Regions	ΔN	k_{50}	φ
USA (East Coast, Norfolk, VA)	60	1.62	38.5
USA (West Coast, San Diego, CA)	70	1.80	33.5
India	85	2.18	10.0

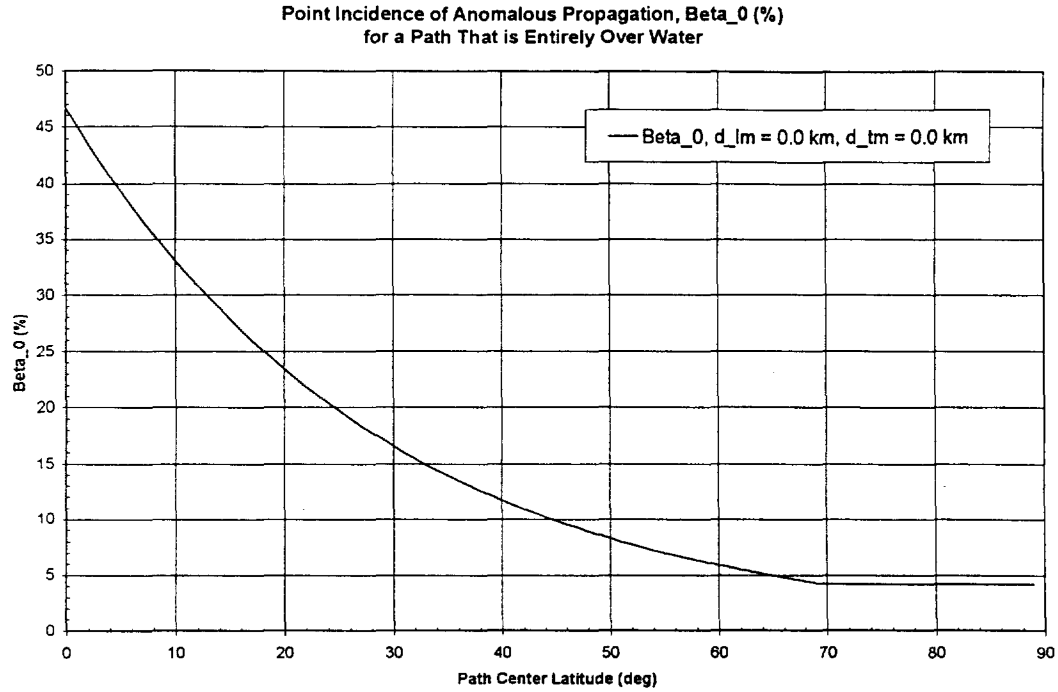

Figure 1 Point incidence of anomalous propagation, $\beta_0(\%)$, for a path that is entirely over water as a function of the path center latitude. Note that $\beta_0 > 4\%$.

Rec. ITU-R P.452-8, the *relative* values of β_0 and *p* have an effect on the value of *k* which is appropriate for use in the calculation of the individual path loss due to diffraction. Specifically, if $p < \beta_0$ as it clearly is here[2], then $k = 3$ is the appropriate value to use in the calculation of the individual path loss due to diffraction. (See section 4.3 of Rec. ITU-R P.452-8.)

As mentioned above, for each value of *d*, in order to select the proper equation (from Table 5 of Rec. ITU-R P.452-8) for combining the individual transmission losses, it is necessary to determine if the radio path is trans-horizon. To do so, it is necessary to have agreed-upon typical terminal heights and Table 4 proposes some values which are used herein. When the FSR is placed at the coastline, the test for a trans-horizon path given in Section 4.1 of Appendix 2 of Annex 1 of Rec. ITU-R P.452-8 is easily applied. Using the notation of P.452-8, the elevation angle, θ_1, to the first "terrain" point, a point on the sea surface which is at a range of 22.6 km from the ESV in the direction of the FSR, is given by

$$\theta_1 = -\frac{40}{22.6} - \frac{22.6 \times 10^3}{2a_e} \text{ mrad}$$

---

[2] $p = 0.0025\%$ and $\beta_0 > 4\%$

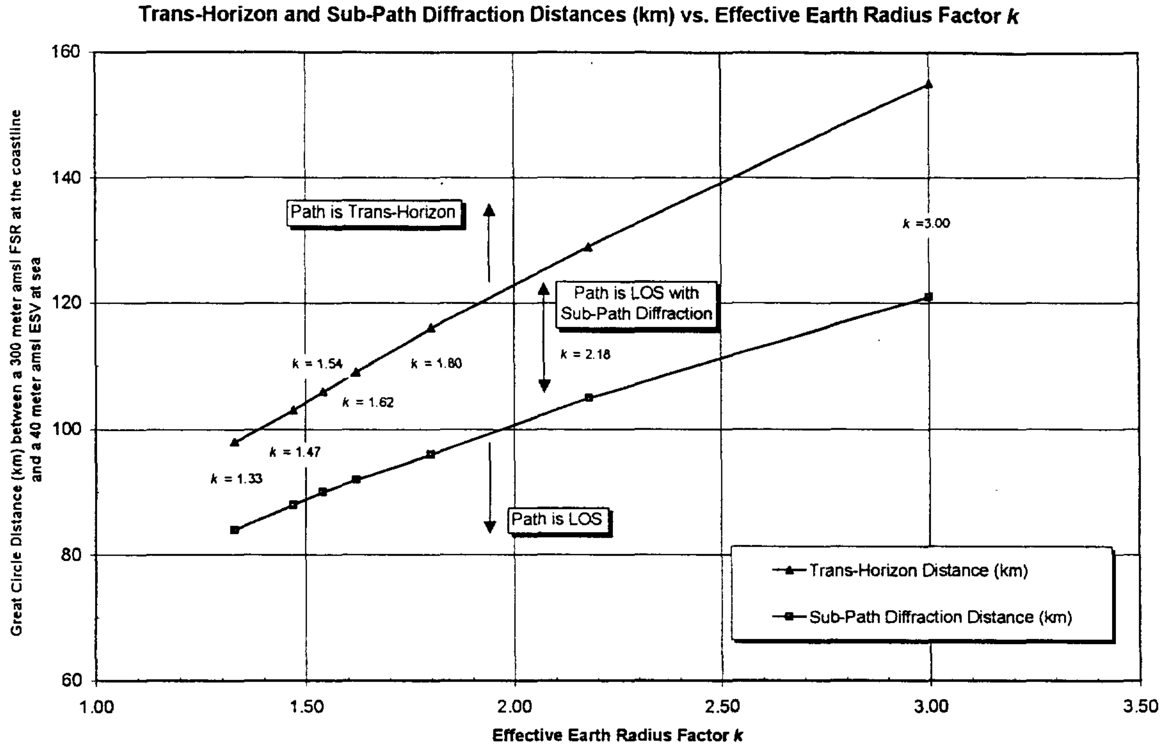

Figure 2 The regions in which a propagation path between a 300 meter AMSL FSR located at the coastline, and a 40 meter AMSL ESV at sea, is classified by Rec. ITU-R P.452-8 as "trans-horizon," "line-of-sight (LOS) with sub-path diffraction," and "LOS" versus the effective Earth radius factor *k*.

for the ESV antenna height given in Table 4. The test for a trans-horizon path compares θ_1 to θ_{td} which, for the ESV and FSR antenna heights in Table 4, is given by

$$\theta_{td} = \frac{260}{d} - \frac{d \times 10^3}{2a_e} \text{ mrad.}$$

(θ_{td} is a monotonically decreasing function of d.) The path is considered trans-horizon if $\theta_1 > \theta_{td}$. If the path is not trans-horizon, then an additional test is performed to determine if the path is line-of-sight (LOS) with sub-path diffraction. Figure 2 shows the regions in which a propagation path between the ESV at sea

Table 4 ESV and FSR antenna heights and corresponding horizon distances.

	Antenna Height (meters AMSL)	Physical Horizon (km)	Radio Horizon (km), $k = 2.18$	Radio Horizon (km), $k = 3.00$
ESV	40	22.6	33.4	39.1
FSR	300	61.8	91.4	107.2
	Sums:	84.4	124.8	146.3

and the FSR at the coastline is classified by Rec. ITU-R P.452-8 as "trans-horizon," "LOS with sub-path diffraction," and "LOS" versus the effective Earth radius factor *k* for the ESV and FSR antenna heights in Table 4.

3. Example Determination of d_{sea}

This section presents an example determination of d_{sea} using the ESV and FSR characterizations summarized in Table 5. The ESV horizon gain of 4 dBi in the direction of the FSR is representative of what would be obtained if a 2.4 meter diameter ESV antenna were pointed as follows:

- Elevation angle to satellite: 10 degrees.
- Bearing to satellite = Bearing to FSR.

Figures 3 through 5 plot the basic transmission loss $L_b(p)$ versus the great circle distance, d, of the ESV from the FSR at the coastline. In addition to $L_b(p)$, each figure plots the individual transmission loss associated with each of the following propagation mechanisms: line-of-sight (LOS), LOS with sub-path diffraction, troposcatter, diffraction and ducting. (To facilitate reproduction of the results, the data associated with each plot is tabulated in 0.) As might be expected, $L_b(p)$ initially follows the LOS curve, then the LOS with sub-path diffraction curve, and ends up following the ducting curve as d increases into the trans-horizon region. It should be noted that increasing (decreasing) the

- ESV transmitter power density,
- ESV antenna gain in the direction of the FSR, or
- FSR antenna gain in the direction of the ESV

by X dB would increase (decrease) the value of $L_{b\min}(p)$ by X dB but leave the transmission loss curves unchanged. Increasing (decreasing) the interference objective by X dB would decrease (increase) the value of $L_{b\min}(p)$ by X dB, also leaving the transmission loss curves unchanged. However, changing the height of either the ESV or FSR antenna would necessitate the recalculation of the transmission loss curves.

Table 5 Example ESV and FSR characterizations. The ESV characteristics are worst case with respect to the potential for interference with the FS. The FSR characteristics are from Rec. ITU-R IS.847.

ESV Antenna Diameter	2.4	meters
ESV Antenna Elevation Angle	10	degrees
Power density at ESV antenna input flange	-7.0	dBW/4kHz
ESV antenna gain in direction of FSR	4.0	dBi
ESV EIRP density in direction of FSR	-3.0	dBW/4kHz
FSR antenna gain in direction of ESV	43.0	dBi
Interference power density at output flange of FSR antenna with zero transmission loss	40.0	dBW/4kHz
Permissible level of Interference	-131.0	dBW/4kHz
Required minimum basic transmission loss	171.0	dB

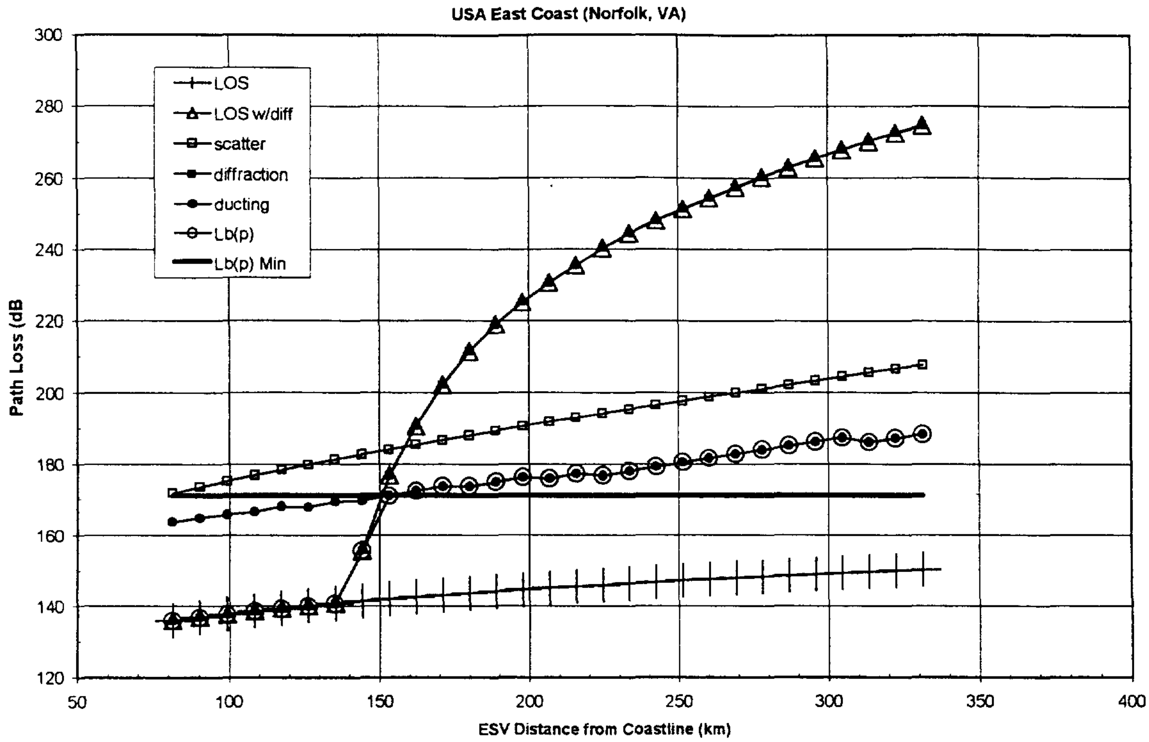

Figure 3 Path loss associated with the indicated propagation mechanisms versus ESV distance from the coastline for Norfolk, VA (USA). The heavy horizontal line indicates the 171 dB minimum permissible basic transmission loss which is consistent with a permissible level of interference of –131 dBW/4kHz. The condition $L_b(p) > L_{b\min}(p)$ is satisfied at a great circle distance $153 < d < 162$ km.

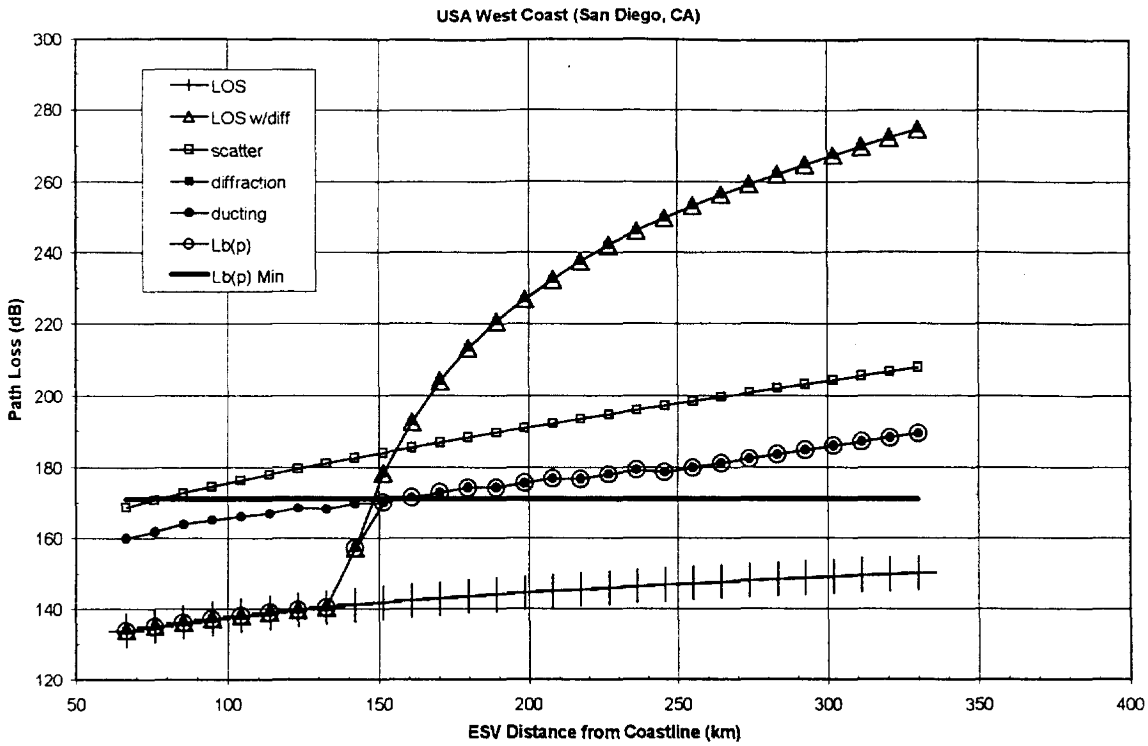

Figure 4 Path loss associated with the indicated propagation mechanisms versus ESV distance from the coastline for San Diego, CA (USA). The heavy horizontal line indicates the 171 dB minimum permissible basic transmission loss which is consistent with a permissible level of interference of –131 dBW/4kHz. The condition $L_b(p) > L_{b\min}(p)$ is satisfied at a great circle distance $152 < d < 161$ km.

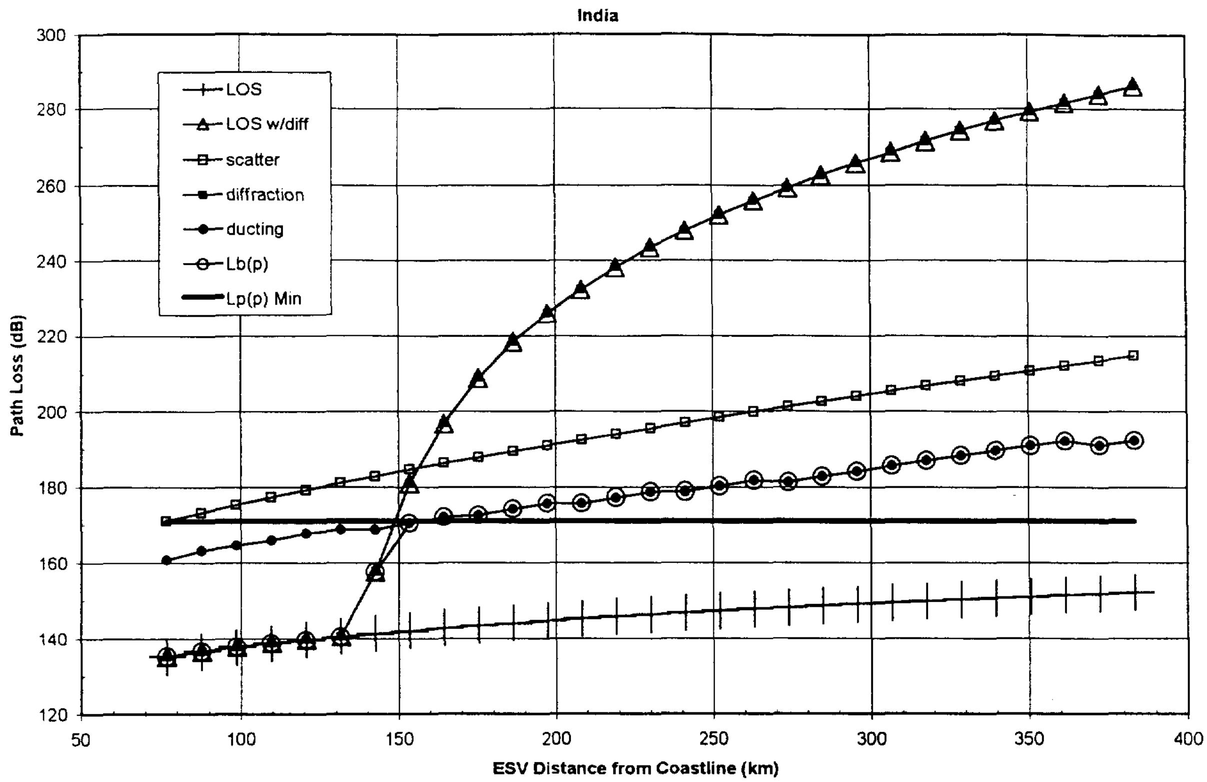

Figure 5 Path loss associated with the indicated propagation mechanisms versus ESV distance from the coastline for Southern India. The heavy horizontal line indicates the 171 dB minimum permissible basic transmission loss which is consistent with a permissible level of interference of –131 dBW/4kHz. The condition $L_b(p) > L_{b\min}(p)$ is satisfied at a great circle distance $154 < d < 164$ km.

4. Conclusions Which Could Be Drawn from the Example

The minimum required basic transmission loss of 171 dB is exceeded at distances which are less than 165 km in each of the regions examined. These regions were selected for examination because they have radioclimatic conditions which result in the lowest over-water transmission losses in the world. Furthermore, the placement and orientation of the FSR, and the orientation of the ESV with respect to the horizon and with respect to the FSR, provided for the highest amount of interference coupling. Therefore, from these results it can be concluded that

- if an ESV which fits the description used herein remains at least 165 km from the coastline,
- then an interference level greater than the permissible level of –131 dBW/4kHz would be induced in FSRs no more than 0.0025% of the time.

Therefore, any administration operating ESVs fitting the description used herein which limits its Earth-to-space transmission operations to areas at sea beyond 165 km of the coastline is not required to perform frequency coordinations with FS administrations ashore. If, on the other hand, the ESV administration intends to approach the coastline within distances which are less than 165 km while transmitting, then the ESV administration will be required to conduct detailed frequency coordinations with FS administrations ashore.

These results are preliminary and will require further confirmation. Appendix A provides details of the results to facilitate their confirmation.

APPENDIX A Data Tables

This appendix provides the data sets which are graphed in Figures 3-5.

Table 6 Data associated with Figure 3, Norfolk, VA. FSR position: 38.5N, 76.0W.

ESV Position		*d* (km)	Path Losses Associated With Individual Mechanisms (dB)					PathType	$L_b(p)$ (dB)
Longitude (deg W)	Latitude (deg N)		LOS	LOS w/diff	Scatter	Diffraction	Ducting		
75.1	38.5	81.3	135.8	135.8	171.8	135.8	163.7	LOS	135.8
75.0	38.5	90.3	136.8	136.8	173.6	136.8	164.9	LOS	136.8
74.9	38.5	99.3	137.7	137.7	175.3	137.7	165.8	LOS w/diff	137.7
74.8	38.5	108.3	138.6	138.6	176.9	138.5	166.6	Trans	138.5
74.7	38.5	117.2	139.3	139.3	178.4	139.3	168.1	Trans	139.3
74.6	38.5	126.2	140.1	140.1	179.9	140.0	167.9	Trans	140.0
74.5	38.5	135.2	140.7	140.7	181.4	140.7	169.4	Trans	140.7
74.4	38.5	144.2	141.4	155.7	182.8	155.7	169.7	Trans	155.7
74.3	38.5	153.1	142.0	176.8	184.1	176.7	171.1	Trans	171.0
74.2	38.5	162.1	142.6	190.7	185.5	190.6	172.5	Trans	172.5
74.1	38.5	171.0	143.1	202.3	186.8	202.2	173.8	Trans	173.8
74.0	38.5	180.0	143.6	211.5	188.1	211.4	173.8	Trans	173.8
73.9	38.5	188.9	144.2	218.9	189.3	218.9	175.1	Trans	175.1
73.8	38.5	197.9	144.6	225.2	190.6	225.1	176.3	Trans	176.3
73.7	38.5	206.8	145.1	230.6	191.8	230.5	176.0	Trans	176.0
73.6	38.5	215.7	145.6	235.4	193.0	235.3	177.4	Trans	177.4
73.5	38.5	224.7	146.0	240.2	194.2	240.1	176.8	Trans	176.8
73.4	38.5	233.6	146.4	244.2	195.4	244.2	178.1	Trans	178.1
73.3	38.5	242.5	146.8	247.9	196.6	247.9	179.3	Trans	179.3
73.2	38.5	251.4	147.2	251.3	197.8	251.3	180.5	Trans	180.5
73.1	38.5	260.3	147.6	254.5	198.9	254.5	181.7	Trans	181.7
73.0	38.5	269.2	148.0	257.5	200.0	257.4	182.9	Trans	182.9
72.9	38.5	278.1	148.3	260.3	201.2	260.2	184.0	Trans	184.0
72.8	38.5	287.0	148.7	263.0	202.3	262.9	185.1	Trans	185.1
72.7	38.5	295.9	149.0	265.5	203.4	265.4	186.2	Trans	186.2
72.6	38.5	304.7	149.4	267.9	204.5	267.9	187.3	Trans	187.3
72.5	38.5	313.6	149.7	270.3	205.6	270.2	186.1	Trans	186.1
72.4	38.5	322.5	150.0	272.5	206.7	272.4	187.2	Trans	187.2
72.3	38.5	331.3	150.3	274.6	207.8	274.6	188.4	Trans	188.4

Table 7 Data associated with Figure 4, San Diego, CA. FSR position: 33.5N, 117.7W.

ESV Position		*d* (km)	Path Losses Associated With Individual Mechanisms (dB)					PathType	$L_b(p)$ (dB)
Longitude (deg W)	Latitude (deg N)		LOS	LOS w/diff	Scatter	Diffraction	Ducting		
118.4	33.5	66.4	134.0	134.0	168.8	133.9	160.1	LOS	134.0
118.5	33.5	75.9	135.2	135.2	170.8	135.2	161.9	LOS	135.2
118.6	33.5	85.3	136.3	136.3	172.8	136.3	164.0	LOS	136.3
118.7	33.5	94.8	137.3	137.3	174.6	137.3	165.1	LOS	137.3
118.8	33.5	104.3	138.2	138.2	176.3	138.2	166.1	LOS w/diff	138.2
118.9	33.5	113.7	139.0	139.0	178.0	139.1	166.9	Trans	139.1
119.0	33.5	123.2	139.8	139.8	179.6	139.8	168.5	Trans	139.8
119.1	33.5	132.6	140.6	140.6	181.1	140.6	168.2	Trans	140.6
119.2	33.5	142.1	141.2	157.4	182.6	157.4	169.8	Trans	157.4
119.3	33.5	151.5	141.9	178.3	184.1	178.3	170.1	Trans	170.0
119.4	33.5	160.9	142.5	192.5	185.5	192.5	171.6	Trans	171.5
119.5	33.5	170.4	143.1	204.1	186.9	204.2	172.9	Trans	172.9
119.6	33.5	179.8	143.6	213.3	188.3	213.3	174.3	Trans	174.3
119.7	33.5	189.2	144.2	220.7	189.6	220.7	174.3	Trans	174.3
119.8	33.5	198.6	144.7	226.9	190.9	226.9	175.6	Trans	175.6
119.9	33.5	208.0	145.2	232.3	192.2	232.3	176.9	Trans	176.9
120.0	33.5	217.5	145.6	237.5	193.5	237.5	176.7	Trans	176.7
120.1	33.5	226.9	146.1	242.0	194.8	242.0	178.0	Trans	178.0
120.2	33.5	236.3	146.5	246.0	196.0	246.0	179.3	Trans	179.3
120.3	33.5	245.7	147.0	249.7	197.3	249.7	178.6	Trans	178.6
120.4	33.5	255.1	147.4	253.2	198.5	253.2	179.9	Trans	179.9
120.5	33.5	264.5	147.8	256.4	199.7	256.4	181.2	Trans	181.2
120.6	33.5	273.8	148.2	259.4	200.9	259.4	182.4	Trans	182.4
120.7	33.5	283.2	148.5	262.2	202.1	262.2	183.6	Trans	183.6
120.8	33.5	292.6	148.9	264.9	203.3	264.9	184.8	Trans	184.8
120.9	33.5	302.0	149.3	267.5	204.5	267.5	186.0	Trans	186.0
121.0	33.5	311.4	149.6	270.0	205.7	270.0	187.1	Trans	187.1
121.1	33.5	320.7	150.0	272.3	206.8	272.3	188.3	Trans	188.3
121.2	33.5	330.1	150.3	274.6	208.0	274.6	189.4	Trans	189.4

Table 8 Data associated with Figure 5 , India. FSR position: 10.0N, 282.0W.

ESV Position		*d* (km)	Path Losses Associated With Individual Mechanisms (dB)					PathType	$L_b(p)$ (dB)
Longitude (deg W)	Latitude (deg N)		LOS	LOS w/diff	Scatter	Diffraction	Ducting		
281.3	10.0	76.7	135.3	135.3	171.2	135.3	160.8	LOS	135.3
281.2	10.0	87.7	136.6	136.6	173.4	136.5	163.3	LOS	136.6
281.1	10.0	98.7	137.7	137.7	175.5	137.7	164.7	LOS	137.7
281.0	10.0	109.6	138.7	138.7	177.5	138.7	166.0	LOS w/diff	138.7
280.9	10.0	120.6	139.6	139.6	179.4	139.6	167.8	LOS w/diff	139.6
280.8	10.0	131.6	140.5	140.5	181.2	140.5	168.8	Trans	140.5
280.7	10.0	142.5	141.3	157.6	182.9	157.6	168.8	Trans	157.6
280.6	10.0	153.5	142.0	180.9	184.6	180.9	170.5	Trans	170.5
280.5	10.0	164.4	142.7	196.8	186.3	196.8	172.2	Trans	172.2
280.4	10.0	175.4	143.4	209.0	187.9	209.0	172.7	Trans	172.7
280.3	10.0	186.3	144.0	218.4	189.5	218.4	174.3	Trans	174.3
280.2	10.0	197.3	144.6	225.9	191.1	225.9	175.8	Trans	175.8
280.1	10.0	208.3	145.2	232.3	192.6	232.3	175.9	Trans	175.9
280.0	10.0	219.2	145.7	238.2	194.1	238.2	177.4	Trans	177.4
279.9	10.0	230.2	146.2	243.3	195.6	243.3	178.9	Trans	178.9
279.8	10.0	241.1	146.8	247.9	197.1	247.9	178.9	Trans	178.9
279.7	10.0	252.1	147.2	252.0	198.5	252.0	180.4	Trans	180.4
279.6	10.0	263.0	147.7	255.8	200.0	255.8	181.8	Trans	181.8
279.5	10.0	274.0	148.2	259.4	201.4	259.4	181.4	Trans	181.4
279.4	10.0	285.0	148.6	262.7	202.8	262.7	182.8	Trans	182.8
279.3	10.0	295.9	149.0	265.8	204.2	265.8	184.2	Trans	184.2
279.2	10.0	306.9	149.5	268.8	205.6	268.8	185.6	Trans	185.6
279.1	10.0	317.8	149.9	271.6	206.9	271.6	187.0	Trans	187.0
279.0	10.0	328.8	150.3	274.2	208.3	274.2	188.3	Trans	188.3
278.9	10.0	339.7	150.6	276.8	209.6	276.8	189.7	Trans	189.7
278.8	10.0	350.7	151.0	279.3	211.0	279.3	191.0	Trans	191.0
278.7	10.0	361.6	151.4	281.7	212.3	281.7	192.2	Trans	192.2
278.6	10.0	372.6	151.7	284.0	213.6	284.0	191.0	Trans	191.0
278.5	10.0	383.5	152.1	286.2	214.9	286.2	192.4	Trans	192.4

ANNEX 2

Composite coordination area for earth stations on board vessels in motion near shore

Definition of ESV Coordination Area Within XXX Km of Land

1 Introduction

Earth stations on vessels (ESVs), which transmit in the band 5 925 - 6 425 MHz, are potential sources of interference for stations in the fixed service operating in the same band. [Similarly, ESVs are susceptible to interference from transmissions by stations in the fixed service operating in the band 3 700 - 4 200 MHz.] This annex describes methods that may be used by administrations to determine the appropriate coordination areas for ESVs where their operation is permitted inside XXX km of land the value XXX km is described in Annex 1. The potential for interference within the coordination area can be evaluated using Rec. ITU-R ESV-2.

The potential interference effects from ESVs can be avoided through frequency coordination within the coordination area by examining potential interference to receivers operating in the same frequency band located within the area. The use of particular frequencies may need to be avoided where the predicted worst-case interference to FS operations on such frequencies exceeds the interference criteria specified in Rec. ITU-R ESV-2.

2 ESV operation within [XXX km] of land

When vessels equipped with earth stations operating in the bands 3 700 - 4 200 MHz (space-to-Earth) and 5 925 - 6 425 MHz (Earth-to-space) are operating within [XXX km] of land, determination of coordination area is a critical step in the process to ensure that unacceptable interference does not occur. Determination of a coordination area requires knowledge of the limits of the position of the vessel as it approaches land, enters a port or harbour, and proceeds to the vessel's final stationary point at the dock or at anchor. Similar limitations must be defined for the ESV operations as the vessel leaves its stationary position in the port and proceeds to the open sea.

Maritime law and the laws of administrations define the requirements for vessel motion within the sea-lanes and port channels. A vessel larger than 300 gt must stay within the area known as the sea lanes as it approaches a port. Once inside a port or harbour, the vessel must follow the port channels to its final stationary position at the dock or mooring at a pre-designated stopping point. The sea lanes and port channels are clearly marked on the water with buoys and other aids to navigation defined under international maritime law. They are also clearly designated on maritime charts published by local and international regulatory authorities.

Once within the sea lanes leading to a port or harbour and the channels within that port, a vessel may not go outside the marked areas, nor may it stop or anchor at any point except as directed by the local authorities. These limitations on vessel motion within [XXX km] of land define the extremes of position for all larger vessels, including those equipped with ESVs. These extremes of position (that is, the government-mandated limits of permissible vessel motion) define the "operating contour" for all larger vessels operating in a particular port or harbour.

The information defining the maximum vessel operating area within a sea lane or port channel is readily available from published maps, charts and regulatory authorities. Identification of this mandatory operating contour, which cannot be violated by an ESV-equipped vessel, provides the basis for defining the coordination area and determining the potential for interference within [XXX km] of land.

3 Determination of coordination area

The determination of coordination area is progressed in two stages. The first is the determination of a set of auxiliary coordination areas. The second is the development of a composite coordination area from these auxiliary coordination areas.

3.1 Determination of auxiliary coordination areas

After determining the operating contour for a vessel operating within [XXX km] of land, the next step is to determine the coordination area for a representative set of positions in or on the operating contour. These are the auxiliary coordination areas. These auxiliary coordination areas are developed by determining the required coordination distance at a set of azimuth angles. The coordination distance is the distance from an earth station beyond which interference to or from a terrestrial station may be considered to be negligible.

Coordination distance can be computed using the minimum permissible transmission loss methodology contained in several ITU-R recommendations, including Rec. ITU-R P.452. The determination of coordination distance is based on the premise that the attenuation of an unwanted signal is a monotonically increasing function of distance. Since this may not be true when Rec. ITU-R P.452 is employed for this purpose, special conditions for its application may need to be developed.

The calculation of an accurate coordination distance requires specific information about the operating characteristics of the ESV and the azimuth and elevation of the antenna for the satellite(s) to be used in that particular port. The operating parameters of the earth station do not change significantly as the vessel moves from beyond the [XXX km] limit to a stationary position within the port or harbour and, therefore, a single set of parameters may be used to compute the minimum possible transmission loss for the entire operating contour within a specific port. However, the percentage of the path that is over water varies from 100% over water when the vessel is at the full coordination distance from the port to almost entirely over land when it is docked in the harbour. As the percentage of land in the path increases, the coordination distance will decrease.

3.2 Determination of the composite coordination area

The coordination area for an earth station on board a vessel (ESV) operated in-motion within [XXX km] from the nearest land can be determined using, for example, the procedures given in Rec. ITU-R P.452 and a knowledge of the operating contour for that specific port. In addition, it is necessary to identify a set of break points along the operating contour representing the limits of vessel position and where the sea-lanes and port channels change direction. The coordination distance is then computed for all azimuths around these break points to determine the coordination area for a specific break point. These are the circled numbers in Figure 1.

The coordination areas computed for each break point can be drawn on a chart containing the relevant operating contour or generated by a computerized graphical information system using the same principles. Figure 1 shows an example of such a coordination area.

In Figure 1 the operating contour is represented by the funnel-shaped figure that leads from the open ocean into the harbour. The break points of the operating contour are numbered in a systematic fashion as shown in Figure 1. The operating contour starts at the minimum distance from shore where interference to fixed service systems may be considered to be negligible. This would include islands, man-made offshore structures and peninsulas, if applicable. If the coastline is highly irregular (i.e., with deviations greater than 10 km within [XXX km] of the entrance to the port), then a series of straight line segments may be used, each one drawn at [XXX km] from the nearest point of land. This distance is indicated as XXX km in Figure 1 and it may be determined as described in Annex 1.

It will often be the case that the XXX km is greater than the distance from the shore to the last sea-lane marker, called the outer marker. Beyond the outer marker ships may proceed in any direction that may be safely navigated.

Therefore, in such cases the operating contour must be extended from the outer marker to the [XXX km] limit in such a fashion as to include all possible routes that ships with ESV's can and will use. Moreover, the limits of the operating contour thus extended must be clearly marked on the chart so that the limits of the area considered in the coordination procedure are easily understood.

Figure 1 gives an example of this procedure. In this figure break points numbered 2 and 9 are the outer markers of the sea-lanes. The operating contour has been extended to break points numbered 1 and 10. The crosshatched area outside the limits of the operating contour indicates that the use of the ESV has not been examined for potential interference in this area. Therefore, the ESV may not be used if the ship uses an approach route to the port that is outside of the indicated operating contour.

As mentioned previously, the numbered points along the operating contour are the break points where the individual coordination areas have been calculated. Two such example coordination areas are shown at break points number 2 and 4. In both cases the coordination area is larger along the boresight of the antenna pointing towards the satellite(s) to be used by the ESV. At break point number 2 the coordination area is mostly over water and, therefore, it is larger than the coordination area at break point number 4 where the coordination paths are mostly over land. The extremes of the individual coordination areas are then joined to form a composite coordination area for the ESV as it moves from beyond the XXX km limit to the stationary position in the harbour. (Where multiple paths exist from the port to the open sea, select the points that enclose the greatest area (i.e., the points that are the greatest distance from the channels and sea lanes in the direction of land) so as to be sure to include the full coordination distance for any possible position of the vessel within the operating contour.)

The area enclosed by this boundary and the outer boundary line is the composite coordination area of an ESV for a specific port or harbour.

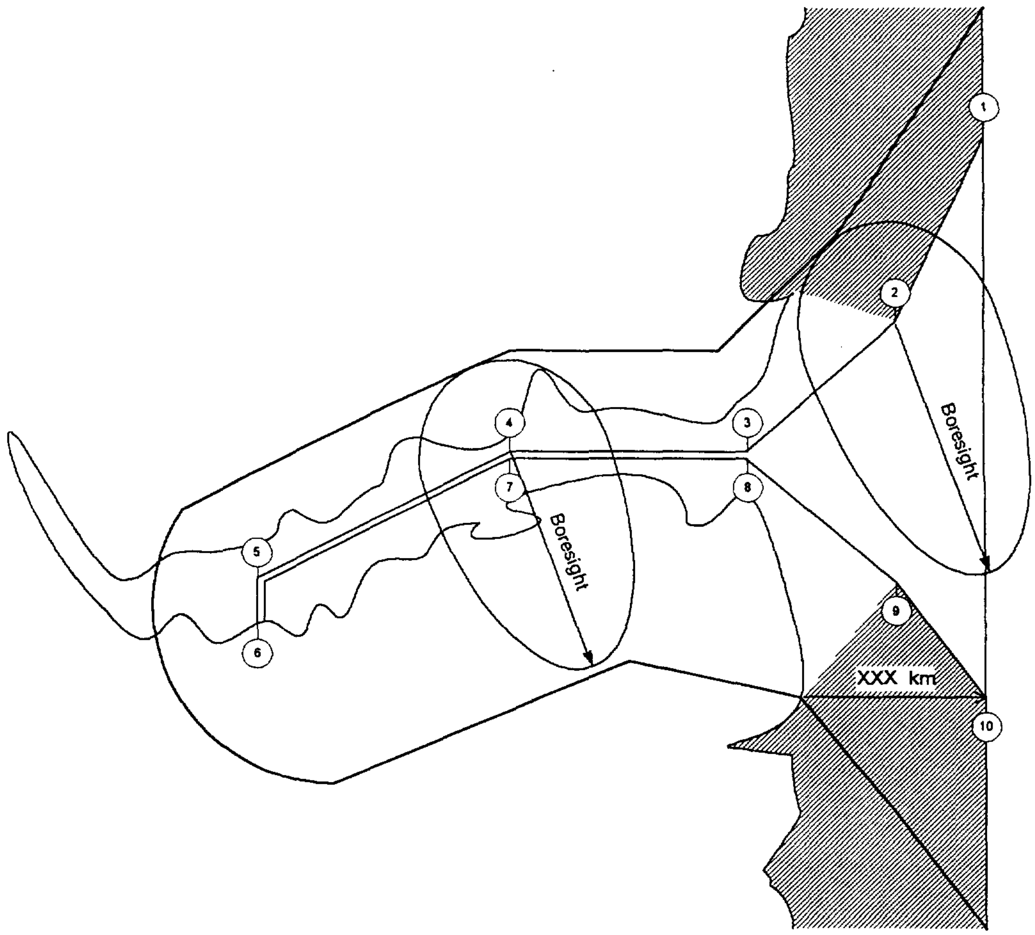

FIGURE 1

Example composite coordination area

CERTIFICATE OF SERVICE

The undersigned hereby certifies that on this 20th day of April, 1999, I caused copies of the foregoing document to be served by first class mail, postage prepaid to the following:

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