BAR HARBOR ESV INTERFERENCE ANALYSIS
PREPARED FOR O3b

PREPARED BY SKJEI TELECOM
November 27, 2017

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Section 1: ESV Parameters

An interference analysis to determine the interference potential from of a C-band Earth Station onboard Vessel (ESV) has been performed for the Bar Harbor, ME area. The analysis considers a port-side location in Bar Harbor. The Earth Station operating parameters are shown in Table 1 below. Table 2 below lists the breakpoints of the ESV approach route, as shown in Figure 1 below.

Company	O3b	
Site Name, State	Bar Harbor	
Call Sign		
Latitude (NAD83) Main Port (B47)	44.39169444	N
Longitude (NAD83) Main Port (B47)	68.20319444	W
Elevation AMSL (ft/m)Cp	0	
Transmit Frequency Range (MHz)	5925-6425	
	5930.375-5960.025	
	5960.025-5989.675	
Climate Zone		
Range of Satellite Orbital Long. (deg W)	20	72
Range of Azimuths from North (deg)	122.0	185.4
Antenna Centerline (ft/m)	51.0	15.5
Antenna Elevation Angles (deg)	20.3	38.7
Antenna Diameter (m)	2.4	
Equipment Parameters at Center Freq (GHz)		**6.18**
Antenna Gain, Main Beam (dBi)		41.9
15 DB Half Beamwidth (deg)		1.18
3 DB Half Beamwidth (deg)		0.66
Receive Antenna Type		
Transmit Antenna Type		FCC32
Max Transmitter Power (dbW/4KHz)		-16.3
Max EIRP Main Beam (dbW/4KHz)		51.0
Modulation / Emission Designator		**1M40G7W**
Coordination Parameters		
6 GHz Max Interference Power Long Term (dBW/4kHz) (20%)	-154	
6 GHz Max Interference Power Short Term (dBW/4kHz) (.0025%)	-131	
6 GHz Max Interference Power In Motion (dBW/4kHz) (1%)	-145	

TABLE 1 – EARTH STATION ON VESSEL DATA SHEET

Break Pt	Latitude	Longitude
Port	442330.1	681211.5
Bp1	442336.1	681158.7
Bp2	442340.1	681146.2
Bp3	442347.1	681047.4
Bp4	442259.1	680931.8
Bp5	442046.3	680809.3
Bp6	441659.5	680651
Bp7	441415.3	680442.6
SE:	440924.6	680508.6
NE:	441305.4	675507.1

TABLE 2 - ESV ROUTE BREAK POINTS

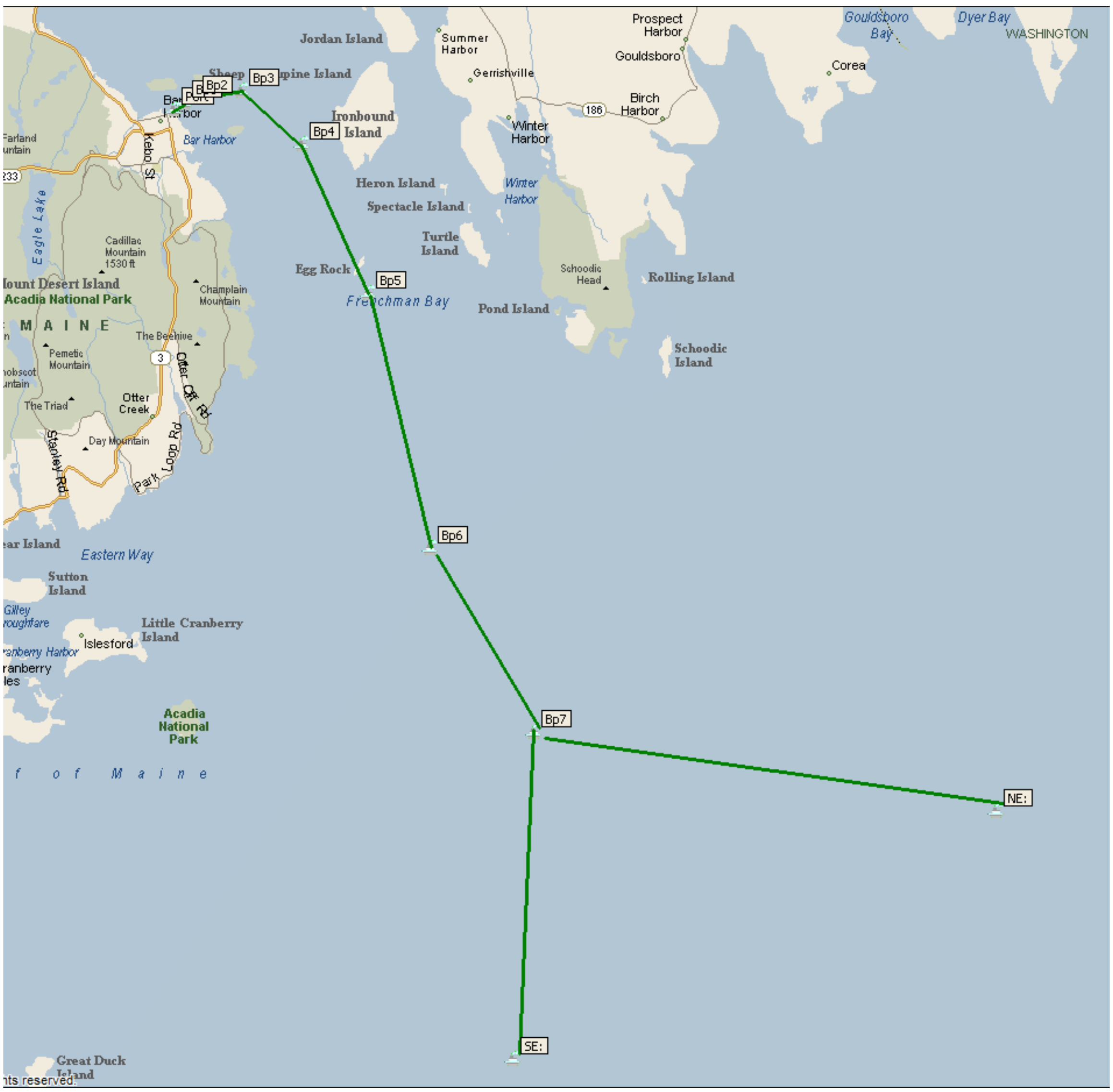

FIGURE 1 - ESV ROUTE

Section 2: The Critical Contour Point Technique

The critical contour point (CCP) technique has been developed to assist in the determination of interference from an ESV. The technique involves calculating the interference from all points along the route of the ESV and determining which point produces the worst case interference into a victim microwave receiver. The worst case interference level is then calculated for this point. If the calculated interference exceeds the maximum long-term permissible level of interference, which is shown in Table 1 above, then the licensed or coordinated receive frequencies for that site must be avoided in order to preclude interference.

The following section is excerpted from ITU-R SF 1649, which describes the CCP in more detail:

For any interference exposure of a particular FS receiver from an ESV terminal on a moving ship, there are three position-related variables in the calculation:

- Propagation loss exceeded for all but a percentage of time. This loss depends on the length of the interference path, the radio-climatic zones and may include the effects of any blockage that may exist on the interference path;
- FS receiver antenna gain; and
- ESV antenna horizon gain.

For every point within the operating contour as defined by the deep-draft channel (see Fig. 2), each of these three factors can be readily determined.

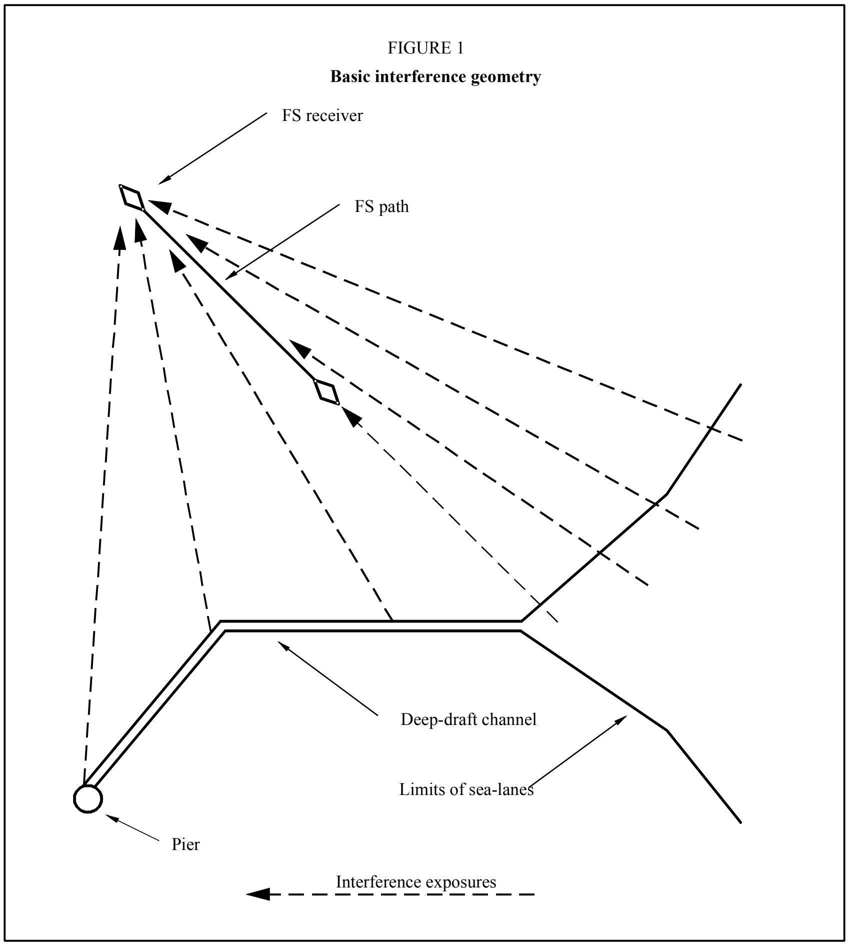

FIGURE 2 – BASIC INTERFERENCE GEOMETRY

For the purpose of evaluating the potential interference the operating contour is approximated by a set of straight-line segments. The identification of the CCPs depends on the position and alignment of the FS path with respect to the operating contour, and several cases need to be distinguished. In those cases where the azimuth of the main beam axis of the FS antenna does not intersect with any portion of the operating area of the ESV, the critical contour points are the points along the operating contour where the contour changes direction or reaches the off-shore limit beyond which coordination is not required. In those cases where the azimuth of the main beam axis of the FS antenna intersects the operating contour it is necessary to augment and/or modify the number of CCPs. In any event, the same CCPs should be used to consider both the long-term and the short-term interference to any FS station under consideration. Interference from in-motion ESV operations to any FS receiver within the area where the potential interference from the ESV needs to be evaluated is assessed by consideration of the operation at each of the CCPs for each receiver using propagation

loss models such as those given in recommendation ITU-R P.452. The goal of this assessment is the identification of frequencies that can be used for in-motion ESV operations without causing unacceptable levels of interference to FS stations.
For the identification of the CCPs with respect to a specific FS receiver, the following three cases need to be distinguished:

Case 1: in this case the main beam axis of the FS receiving antenna does not intersect any portion of the operating contour. The only CCPs required for this case are the points where the operating contour of the ESV changes direction.

Case 2: in this case, the main beam of the FS antenna (within 10 db of the maximum antenna gain) lies entirely within one segment of the operating contour. The points on the operating contour where the antenna gain is 10 db below the maximum, determine two additional CCPs. The segment of the operating contour between these two CCPs contains the natural intersection point (nip), the point where the main beam axis of the FS antenna intersects the operating contour. The nip is always taken as a CCP.

Case 3: in this case, the nip is close enough to one of the points where the operating contour changes direction that the main beam of the FS antenna extends over more than one segment of the operating contour. This case is most likely to arise when the nip is close to one of the points where the operating contour of the ESV changes direction. The intersection of the operating contour with the antenna 10 db points determine two additional CCPs as in case 2; however, in this case the original point within the main beam does not need to be considered as a CCP.

A further possibility: if there is a point on the operating contour of an ESV from which the maximum horizon gain of the ESV antenna is directed toward a FS receiver, that point on the contour may be identified as an additional CCP for that FS receiver regardless of which of the three cases applies.

The CCP always represents the worst-case interference scenario and the associated exclusion zone mitigates all interference into an FS receiver for the ESV route.

Once the CCP is determine an interference zone where the ESV transmissions into the victim receiver will exceed the maximum permissible interference criteria is developed based upon the receive antenna pattern of the terrestrial station. Within these zones the interfered spectrum must be avoided. The interference zones are detailed in the attached ESV Interference Analysis excel workbook.

SECTION 3 – INTERFERENCE RESULTS

Table 3 below list the interference cases calculated for the ESV port(s) and route, including worst case interference margin. Table 4 provides a high level summary for each case CCP, including the CCP coordinates, interference margin, victim receive location, and affected licensee.

Site	Bar Harbor																			
	Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Into 1																				
Case #	Margin(dB)																			
464	25.7											Y	Y							
Into 2																				
Case #	Margin(dB)																			
465	30.5		Y	Y	Y	Y	Y		Y	Y										
653	21.8						Y	Y	Y											
507	20.2					Y	Y	Y												
490	19.8											Y	Y							
486	17.1					Y	Y	Y												
461	8.1											Y	Y		Y	Y	Y			

Summary of Cases		
Channel Spectrum (MHz)		# Cases
1	5925-5929.0	0
2	5930.375-5960.025	1
3	5960.025-5989.675	1
4	5989.675-6019.325	1
5	6019.325-6048.975	3
6	6048.975-6078.625	4
7	6078.625-6108.275	3
8	6108.275-6137.925	2
9	6137.925-6167.575	1
10	6168.86-6181.0	0
11	6182.415-6212.065	3
12	6212.065-6241.715	3
13	6241.715-6271.365	0
14	6271.365-6301.015	1
15	6301.015-6330.665	1
16	6330.665-6360.315	1
17	6360.315-6389.965	0
18	6389.965-6419.615	0
19	6421-6425	0

TABLE 3 – SUMMARY OF ESV ROUTE INTERFERENCE FREQUENCY ANALYSIS CASES

Interference Zones			Bar Harbor		
Into 1					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin (dB)	Victim Rx Site	Licensee
464	44.16487	68.1011142	25.7	STONINGTON	Island Telephone Company
Into 2					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin (dB)	Victim Rx Site	Licensee
465	44.38771	68.16611944	30.5	SWANS ISLAND	Island Telephone Company
653	44.39169	67.91861528	21.8	CLIFTON	Maine RSA #4 Limited Partnership
507	44.15853	68.08898619	20.2	JEFFERSON	Maine RSA #1 Inc.
490	44.21816	68.20319415	19.8	BANGOR-CELL	Maine RSA #4 Limited Partnership
486	44.2772	68.1094763	17.1	I95 PITTSFLD	Maine RSA #1 Inc.
461	44.39484	68.19307105	8.1	MILBRIDGE	Maine RSA #4 Limited Partnership

TABLE 4 – SUMMARY OF ESV ROUTE INTERFERENCE CASES

Summary of Results

Table 3 shows that there are seven cases affecting spectrum throughout the 6 GHz band. There are several segments of the spectrum which result in zero cases throughout the passage of the ESV route and into the port see the summary table below:

Summary of Cases		
Channel Spectrum (MHz)		# Cases
1	5925-5929.0	0
2	5930.375-5960.025	1
3	5960.025-5989.675	1
4	5989.675-6019.325	1
5	6019.325-6048.975	3
6	6048.975-6078.625	4
7	6078.625-6108.275	3
8	6108.275-6137.925	2
9	6137.925-6167.575	1
10	6168.86-6181.0	0
11	6182.415-6212.065	3
12	6212.065-6241.715	3
13	6241.715-6271.365	0
14	6271.365-6301.015	1
15	6301.015-6330.665	1
16	6330.665-6360.315	1
17	6360.315-6389.965	0
18	6389.965-6419.615	0
19	6421-6425	0

There are also several spectrum segments with only 1 case, where muting would be required during operation in the exclusion zone.

CAPE LIBERTY ESV INTERFERENCE ANALYSIS
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Section 1: ESV Parameters

An interference analysis to determine the interference potential from of a C-band Earth Station onboard Vessel (ESV) has been performed for the Cape Liberty, NJ area. The analysis considers a port-side location in Cape Liberty. The Earth Station operating parameters are shown in Table 1 below. Table 2 below lists the breakpoints of the ESV approach route, as shown in Figure 1 below.

Company	O3b	
Site Name, State	Cape Liberty	
Call Sign		
Latitude (NAD83) Main Port (B47)	40.66511111	N
Longitude (NAD83) Main Port (B47)	74.07261111	W
Elevation AMSL (ft/m)	0	
Transmit Frequency Range (MHz)		
	5925-6425	
Climate Zone		
Range of Satellite Orbital Long. (deg W)	20	72
Range of Azimuths from North (deg)	115.3	176.8
Antenna Centerline (ft/m)	51.0	15.5
Antenna Elevation Angles (deg)	18.2	42.9
Antenna Diameter (m)	2.4	
Equipment Parameters at Center Freq (GHz)		**6.18**
Antenna Gain, Main Beam (dBi)		41.9
15 DB Half Beamwidth (deg)		1.18
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Receive Antenna Type		
Transmit Antenna Type		FCC32
Max Transmitter Power (dBW/4KHz)		-16.3
Max EIRP Main Beam (dBW/4KHz)		51.0
Modulation / Emission Designator		**1M40G7W**
Coordination Parameters		
6 GHz Max Interference Power Long Term (dBW/4kHz) (20%)	-154	
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TABLE 1 – EARTH STATION ON VESSEL DATA SHEET

Site	Latitude	Longitude
Port	403954.4	740421.4
BP1	403936.2	740258.4
Bp2	403742.9	740312.4
Bp3	403602	740217.7
Bp4	403116.2	740105.7
Bp5	402647	734906
Bp6	400919.9	725928.8
NE	402302	722649.1
SE	394940.8	730022.6

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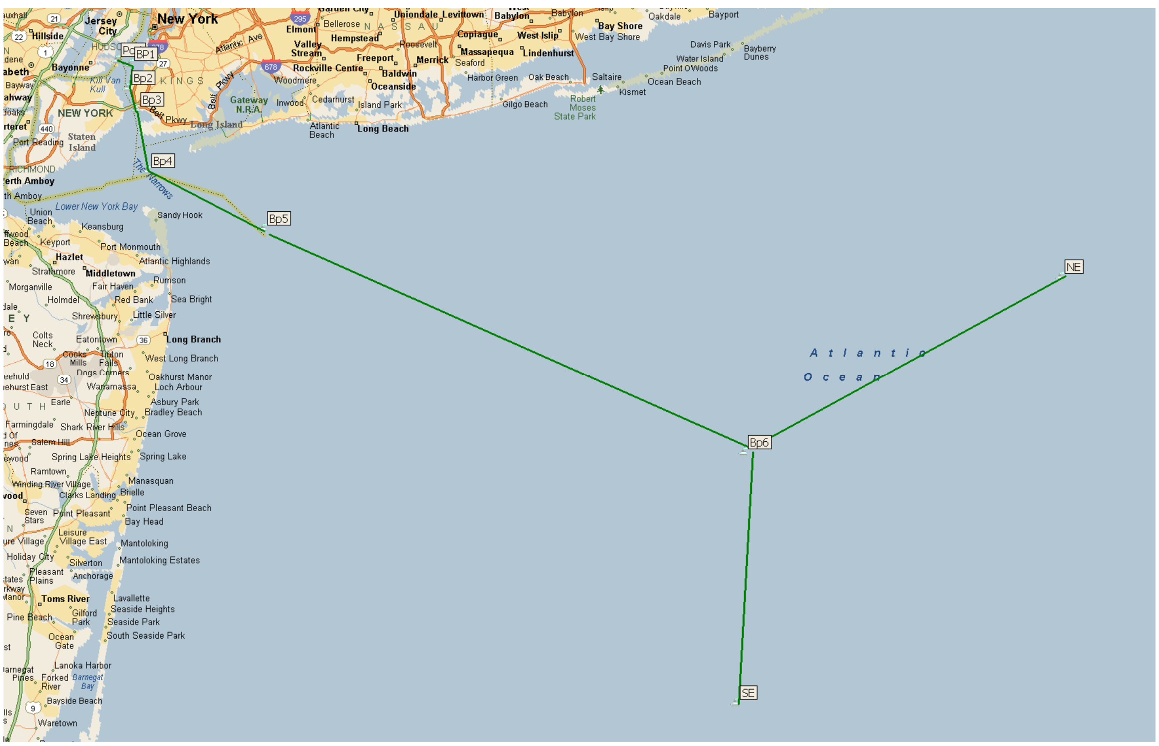

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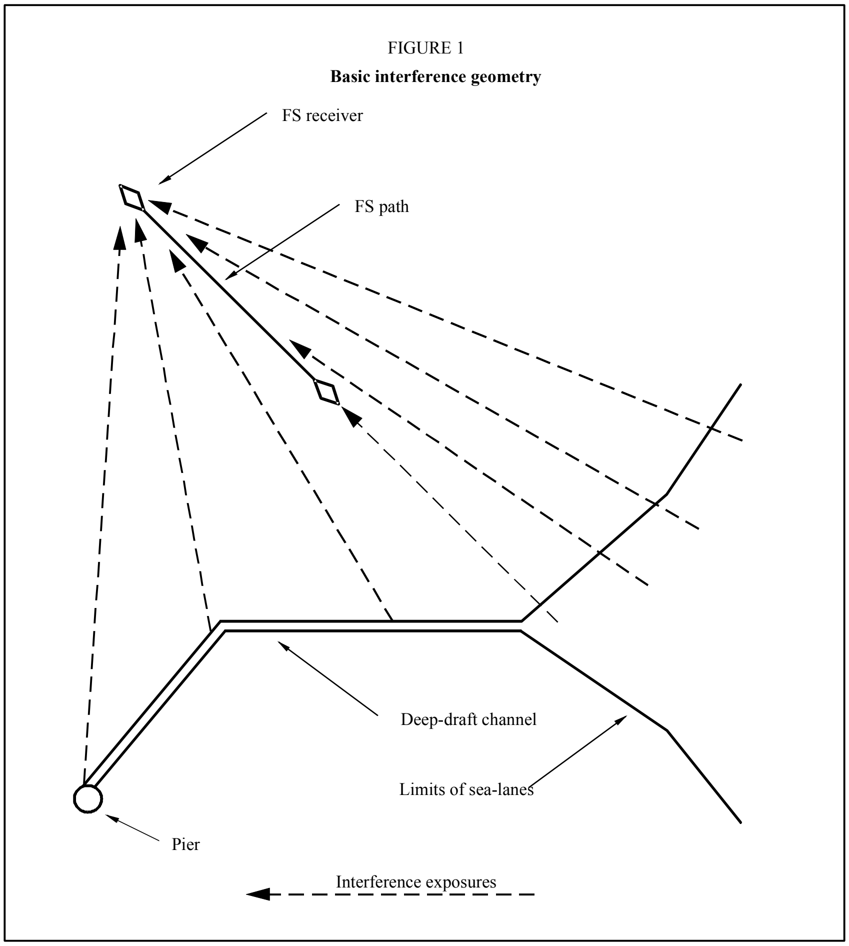

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Table 3 below list the interference cases calculated for the ESV port(s) and route, including worst case interference margin. Table 4 provides a high level summary for each case CCP, including the CCP coordinates, interference margin, victim receive location, and affected licensee.

Site	Cape Liberty																			
	Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Into 1																				
Case #	Margin (dB)																			
197	45.1											Y	Y							
1607	38.9											Y	Y							
204	37.6													Y	Y	Y				
1608	36.3						Y	Y	Y											
157	29.5				Y	Y	Y													
597	28.8												Y	Y	Y					
205	28.5								Y											
1549	28.3															Y	Y	Y		
685	28.1		Y	Y																
961	28.0								Y	Y										
807	27.5												Y	Y	Y					
561	26.5					Y	Y	Y												
262	26.1																Y	Y	Y	
1377	25.5							Y	Y	Y										
1388	25.0		Y	Y																
859	24.7					Y	Y	Y												
860	24.7					Y	Y	Y												
861	24.7					Y	Y	Y												
656	24.7				Y	Y	Y													
252	24.4											Y	Y							
1693	24.2			Y	Y	Y														
581	23.8					Y	Y	Y												
218	23.6											Y	Y	Y						
764	23.4													Y	Y	Y				
959	22.8											Y	Y							
824	22.3		Y	Y	Y															
156	22.2		Y	Y	Y															
1344	21.9												Y	Y	Y					
1435	21.9																Y	Y	Y	
1436	21.9																Y	Y	Y	
1590	21.6																Y	Y	Y	
994	21.4											Y	Y	Y						
1671	21.4											Y	Y	Y						
681	21.4											Y	Y							
1617	21.3														Y	Y	Y			
562	20.4																Y	Y	Y	
1379	20.2												Y	Y	Y					
270	20.2														Y	Y	Y			

877	19.4														Y	Y	Y			
1411	19.4														Y	Y	Y			
1293	19.3											Y	Y							
251	18.6		Y	Y	Y															
144	18.2					Y	Y	Y												
408	17.9				Y	Y	Y													
990	17.7											Y	Y	Y						
198	17.3															Y	Y	Y		
1290	16.6						Y	Y	Y											
754	16.3																	Y	Y	
1669	15.5														Y	Y	Y			
321	15.2						Y	Y	Y	Y										
1496	15.1											Y	Y							
133	9.1															Y	Y	Y		
203	8.9											Y	Y	Y						
1134	6.0													Y	Y		Y	Y	Y	
1759	5.2		Y	Y																
75	3.1						Y	Y	Y											
199	3.0																		Y	
7	2.4						Y	Y	Y											
269	2.2		Y	Y																
69	1.7							Y	Y	Y										
345	1.6						Y	Y	Y											
567	1.1						Y	Y	Y											
Into 2	Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Case #	Margin (dB)																			
158	43.6													Y	Y	Y				
204	42.4				Y	Y	Y													
961	41.4																	Y	Y	
197	41.4		Y	Y																
1608	40.7															Y	Y	Y		
778	40.4											Y	Y							
198	39.2						Y	Y	Y											
1381	34.8																Y	Y	Y	
1606	34.8																Y	Y	Y	
203	34.3		Y	Y	Y															
857	33.1				Y	Y	Y													
845	32.8		Y	Y																
250	32.5		Y	Y																
960	31.4																	Y	Y	
320	31.1												Y	Y	Y					
130	30.9		Y			Y	Y	Y	Y	Y										
632	30.9		Y							Y										

572	29.4						Y	Y	Y											
682	28.8						Y	Y	Y											
1451	28.7											Y	Y	Y						
217	28.0		Y	Y																
1126	27.9								Y	Y										
1127	27.9								Y	Y										
115	27.9		Y							Y										
1605	26.9		Y	Y	Y															
1077	26.4														Y	Y	Y	Y		
1078	26.4																Y	Y	Y	Y
199	25.8									Y										
1047	25.0															Y	Y	Y		
1048	25.0				Y	Y	Y													
59	25.0								Y	Y										
1073	25.0								Y	Y										
1112	25.0				Y	Y	Y													
1113	25.0				Y	Y	Y													
1199	25.0								Y	Y										
604	24.9											Y	Y							
268	24.8													Y	Y	Y				
1076	24.7											Y	Y	Y						
1140	24.7												Y	Y	Y	Y				
113	24.6											Y						Y	Y	
128	24.6											Y	Y	Y	Y		Y	Y		
265	24.6											Y	Y							
12	23.2			Y	Y															
684	22.9							Y	Y	Y										
692	22.0		Y	Y	Y				Y	Y										
266	21.6			Y	Y	Y														
277	21.6											Y	Y							
1203	21.6						Y	Y	Y											
1204	21.6						Y	Y	Y											
1205	21.6					Y	Y	Y												
1206	21.6					Y	Y	Y												
1246	21.6					Y	Y	Y												
1247	21.6					Y	Y	Y												
1248	21.6						Y	Y	Y											
1249	21.6						Y	Y	Y											
1531	21.6						Y	Y	Y											
1532	21.6					Y	Y	Y												
1718	21.6						Y	Y	Y											
1719	21.6						Y	Y	Y											
1726	21.6					Y	Y	Y												
1727	21.6					Y	Y	Y												
1380	20.8							Y	Y	Y										

1300	20.5															Y	Y	Y		
1450	20.5											Y	Y	Y						
200	20.4													Y	Y	Y				
683	19.4																Y	Y	Y	
366	19.2						Y	Y	Y											
78	19.1		Y	Y																
1594	18.4		Y	Y	Y															
719	17.3													Y	Y	Y				
1033	17.1		Y	Y																
1034	17.1			Y	Y	Y														
1534	17.1													Y	Y	Y				
1535	17.1													Y	Y	Y				
1536	17.1													Y	Y	Y				
1537	17.1																	Y	Y	
1538	17.1																	Y	Y	
1539	17.1																	Y	Y	
1268	16.0													Y	Y	Y				
1269	16.0													Y	Y	Y				
1533	16.0													Y	Y	Y				
1640	16.0													Y	Y	Y				
1641	16.0													Y	Y	Y				
1642	16.0													Y	Y	Y				
111	6.4		Y	Y	Y			Y	Y	Y										
206	5.9			Y	Y	Y														
1623	5.5		Y	Y	Y															
851	5.1						Y	Y	Y											
93	4.9											Y	Y	Y						
1035	4.9														Y	Y	Y			
1036	4.9																Y	Y	Y	
69	4.9																Y	Y	Y	
987	4.8													Y	Y	Y				
979	4.6						Y	Y												
1400	4.6												Y	Y	Y					
1401	4.6												Y	Y	Y					
1567	4.6																			
1717	2.9												Y	Y	Y	Y	Y			
962	1.0						Y	Y	Y											
1383	0.9																	Y	Y	
202	0.5			Y	Y	Y														
849	0.3					Y	Y	Y												

Summary of Results		
Channel Spectrum (MHz)		# Cases Above 15 dB
1	5925-5929.0	0
2	5930.375-5960.025	18
3	5960.025-5989.675	19
4	5989.675-6019.325	19
5	6019.325-6048.975	25
6	6048.975-6078.625	36
7	6078.625-6108.275	31
8	6108.275-6137.925	26
9	6137.925-6167.575	15
10	6168.86-6181.0	0
11	6182.415-6212.065	20
12	6212.065-6241.715	25
13	6241.715-6271.365	29
14	6271.365-6301.015	28
15	6301.015-6330.665	27
16	6330.665-6360.315	21
17	6360.315-6389.965	23
18	6389.965-6419.615	16
19	6421-6425	0

TABLE 3 – SUMMARY OF ESV ROUTE INTERFERENCE FREQUENCY ANALYSIS CASES

Interference Zones			Cape Liberty		
Into 1					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin (dB)	Victim Rx Site	Licensee
197	40.6327987	74.05292328	45.1	FDNY WTR TNK	City of New York
1607	40.6402758	74.04041037	38.9	PSAC 1	New York City Police Department
204	40.6615223	74.06795697	37.6	LIB PLAZA	City of New York
1608	40.6471398	74.05115188	36.3	BUG	New York City Police Department
157	40.6600558	74.04955583	29.5	ELMHURST	New York City Police Department
597	40.6580673	74.0498016	28.8	WEST ORANGE	Coralinks
205	40.6474479	74.05111381	28.5	IS34	City of New York
1549	40.6381952	74.03771429	28.3	PSAC 2	New York City Police Department
685	40.3979602	73.95062652	28.1	DISTRICT 10	Monmouth, County of
961	40.6407881	74.05193653	28.0	ELMHURST	New York City Police Department
807	40.6580673	74.0498016	27.5	WEST ORANGE	Coralinks
561	40.5109059	74.01261215	26.5	FC1224038	Wireless Internetwork LLC
262	40.6015576	74.0387952	26.1	BOUND BROOK	Texas Eastern Communications, LLC
1377	40.5546099	74.02666996	25.5	WARRENVILLE	Wireless Internetwork LLC
1388	40.5546099	74.02666996	25.0	1045121	Webline Holdings LLC
859	40.5700718	74.03056533	24.7	ASR1054661	Wireless Internetwork LLC
860	40.5700718	74.03056533	24.7	ASR1054661	Wireless Internetwork LLC
861	40.5700718	74.03056533	24.7	ASR1054661	Wireless Internetwork LLC
656	40.570029	74.03055453	24.7	ASR1054661	Wireless Internetwork LLC
252	40.539804	73.91049911	24.4	MASSAPEQUA	Nassau County Police Department
1693	40.571493	74.03092345	24.2	ATC88090	xWave Engineering LLC
581	40.4958655	74.00434473	23.8	ASR1224038	Wireless Internetwork LLC
218	40.3454294	73.6608038	23.6	NUMC	Nassau County Police Department
764	40.6093955	74.04304288	23.4	DISTRICT 10	Monmouth, County of
959	40.526825	73.89375934	22.8	NCB	New York City Police Department

824	40.6651116	74.07261312	22.3	839175	Qoncept Holdings LLC
156	40.6651116	74.07261312	22.2	ELMHURST	New York City Police Department
1344	40.4785835	73.99485013	21.9	CCI806079	Blueline Communications
1435	40.4785835	73.99485013	21.9	CCI806079	Blueline Communications
1436	40.4785835	73.99485013	21.9	CCI806079	Blueline Communications
1590	40.4057249	73.95488061	21.6	MATAWAN	FELHC, Inc.
994	40.4785835	73.99485013	21.4	806079	Webline Holdings LLC
1671	40.4785835	73.99485013	21.4	806079	Webline Holdings LLC
681	40.3738963	73.9374493	21.4	MILLSTONE	Monmouth, County of
1617	40.4660918	73.98799063	21.3	CCI806079	xWave Engineering LLC
562	40.5390385	74.02274888	20.4	GLEN GARDNER	Jefferson Microwave, LLC
1379	40.6078518	74.04220616	20.2	MILLSTONE	Monmouth, County of
270	40.471269	73.13799092	20.2	OYSTER BAY	Nassau County Police Department
877	40.5388447	74.02270008	19.4	NJ033	Webline Holdings LLC
1411	40.5388447	74.02270008	19.4	NJ033	Webline Holdings LLC
1293	40.6565585	74.06151885	19.3	RAMAPO	New Jersey, State of -NJ Transit
251	40.2751874	73.57109385	18.6	FARMINGDALE	Nassau County Police Department
144	40.5897165	73.97496411	18.2	BLUE HILL PL	Orange and Rockland Utilities, Inc.
408	40.4120194	73.95833	17.9	TOMS RIVER	New Jersey, State of -NJ Transit
990	40.5343745	73.90349521	17.7	MAHOPAC1	New York Communications Co., Inc
198	40.587271	73.97180232	17.3	CI HOSP	City of New York
1290	40.6359786	74.05253058	16.6	CHERRYVILLE	New Jersey, State of -NJ Transit
754	40.5878801	74.03505409	16.3	SITE 73	SW Networks
1669	40.4660918	73.98799063	15.5	CCI806079	xWave Engineering LLC
321	40.6651116	74.07261312	15.2	QUEENS COLLE	City of New York
1496	40.6221215	74.04994181	15.1	MT FREEDOM	FELHC, Inc.
133	40.6597504	74.06565862	9.1	TRENTON	PSEG Services Corporation
203	40.5856675	73.96972923	8.9	CI HOSP	City of New York
1134	40.6597504	74.06565862	6.0	TRENTON	PSEG Services Corporation

1759	40.6651116	74.07261312	5.2	WURTSBORO	Orange County Dept of Emergency Services
75	40.1585778	73.81999599	3.1	WEST CREEK	Atlantic City Electric Company
199	40.6600558	74.04955583	3.0	US PARK POL	City of New York
7	40.5068142	73.06045229	2.4	BAYVILLE	Nassau County Police Department
269	40.4812703	73.11619405	2.2	BAYVILLE	Nassau County Police Department
69	40.6651116	74.07261312	1.7	EMPIRE STATE	Consolidated Edison Company of New York
345	40.5747545	74.03174541	1.6	CAMELBACK MT	Monroe County Control Center (PA)
567	40.1942221	73.83938339	1.1	HAMILTON	New Jersey State Police
Into 2					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin (dB)	Victim Rx Site	Licensee
158	40.6402758	74.04041037	43.6	PSAC 1	New York City Police Department
204	40.6615223	74.06795697	42.4	STATEN IS CO	City of New York
961	40.6407881	74.05193653	41.4	TODT HILL	New York City Police Department
197	40.6380321	74.03750298	41.4	BKLYN CO	City of New York
1608	40.6471398	74.05115188	40.7	TODT HILL	New York City Police Department
778	40.6402758	74.04041037	40.4	PSAC 1	New York City Police Department
198	40.582395	73.96549896	39.2	BKLYN CO	City of New York
1381	40.6592573	74.04965453	34.8	QES	New York City Police Department
1606	40.6592573	74.04965453	34.8	QES	New York City Police Department
203	40.5835637	73.96700961	34.3	QUEENS CO	City of New York
857	40.6600558	74.04955583	33.1	ELMHURST	New York City Police Department
845	40.6077421	73.99828041	32.8	ISLAND PARK	Nassau County Police Department
250	40.5989174	73.98686323	32.5	ISLAND PARK	Nassau County Police Department
960	40.6381952	74.03771429	31.4	PSAC 2	New York City Police Department
320	40.5844153	73.96811044	31.1	QUEENS COLLE	City of New York
130	40.2013679	73.84327273	30.9	FREEHOLD	New Cingular Wireless PCS LLC - NJ
632	40.2013679	73.84327273	30.9	FREEHOLD	New Cingular Wireless PCS LLC - NJ

572	40.6625116	74.06924015	29.4	ASR1049007	Wireless Internetwork LLC
682	40.350584	73.92469341	28.8	ALLENWOOD	Monmouth, County of
1451	40.4766928	73.82919104	28.7	HQ	New York City Police Department
217	40.5365658	73.90632177	28.0	MINEOLA	Nassau County Police Department
1126	40.5675498	74.02992983	27.9	BRIDGEWATER	New Line Networks, LLC
1127	40.5675498	74.02992983	27.9	BRIDGEWATER	New Line Networks, LLC
115	40.4072915	73.95573905	27.9	TOMS RIVER	Direct Broadcast Services, Inc.
1605	40.6651116	74.07261312	26.9	ELMHURST	New York City Police Department
1077	40.4725652	73.99154501	26.4	BAYARD ST	Middlesex, County of
1078	40.4725652	73.99154501	26.4	BAYARD ST	Middlesex, County of
199	40.3495401	73.66606234	25.8	BKLYN CO	City of New York
1047	40.5704689	74.03066538	25.0	BRIDGEWATER	New Line Networks, LLC
1048	40.5700879	74.03056938	25.0	BRIDGEWATER	New Line Networks, LLC
59	40.5675498	74.02992983	25.0	BRIDGEWATER	New Line Networks, LLC
1073	40.5675498	74.02992983	25.0	BRIDGEWATER	New Line Networks, LLC
1112	40.5675498	74.02992983	25.0	BRIDGEWATER	New Line Networks, LLC
1113	40.5675498	74.02992983	25.0	BRIDGEWATER	New Line Networks, LLC
1199	40.5675498	74.02992983	25.0	BRIDGEWATER	New Line Networks, LLC
604	40.3318218	73.44029379	24.9	ELMONT	Nassau County Police Department
268	40.6233169	74.01844156	24.8	MATINECOCK	Nassau County Police Department
1076	40.5998522	73.98807249	24.7	ARCHIVES	Middlesex, County of
1140	40.5998522	73.98807249	24.7	ARCHIVES	Middlesex, County of
113	40.3290124	73.91289855	24.6	HOPEWELL	New Cingular Wireless PCS LLC - NJ
128	40.3290124	73.91289855	24.6	HOPEWELL	New Cingular Wireless PCS LLC - NJ
265	40.3768552	73.70102893	24.6	EAST HILLS	Nassau County Police Department
12	40.6340266	74.05277164	23.2	YARDS CREEK	FELHC, Inc.
684	40.4730302	73.99180035	22.9	DISTRICT 7	Monmouth, County of
692	40.2850989	73.88891289	22.0	NJY0771	Uniti Fiber PEG, LLC
266	40.2950169	73.51958571	21.6	GLEN COVE	Nassau County Police Department
277	40.6600558	74.04955583	21.6	MOMBASHA	Orange and Rockland Utilities, Inc.

1203	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1204	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1205	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1206	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1246	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1247	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1248	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1249	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1531	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1532	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1718	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1719	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1726	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1727	40.5546099	74.02666996	21.6	WARREN	New Line Networks, LLC
1380	40.5018362	73.86155691	20.8	WBLI TX SITE	Cox Radio Inc
1300	40.4553507	73.17265136	20.5	ONE WTC	Port Authority of New York & New Jersey
1450	40.4373739	73.21174684	20.5	REN BLDG	New York City Police Department
200	40.4779952	73.12333345	20.4	4 TIMES	City of New York
683	39.9112328	73.11062771	19.4	MILLSTONE	Monmouth, County of
366	40.4149628	73.95994322	19.2	YARDS CREEK	County of Warren, NJ
78	40.6651116	74.07261312	19.1	RYE HDQ	Consolidated Edison Company of New York
1594	40.618245	74.01187468	18.4	YARDS CREEK	FELHC, Inc.
719	40.6600558	74.04955583	17.3	NETCONG SBA	Morris, County of
1033	40.4075291	73.74034525	17.1	YAPHANK	Suffolk County Police Department
1034	40.4075291	73.74034525	17.1	YAPHANK	Suffolk County Police Department
1534	40.5388447	74.02270008	17.1	HTC A2900073	New Line Networks, LLC
1535	40.5388447	74.02270008	17.1	HTC A2900073	New Line Networks, LLC
1536	40.5388447	74.02270008	17.1	HTC A2900073	New Line Networks, LLC
1537	40.5388447	74.02270008	17.1	HTC A2900073	New Line Networks, LLC

1538	40.5388447	74.02270008	17.1	HTC A2900073	New Line Networks, LLC
1539	40.5388447	74.02270008	17.1	HTC A2900073	New Line Networks, LLC
1268	40.5388447	74.02270008	16.0	HTC A2	ECW Wireless, LLC
1269	40.5388447	74.02270008	16.0	HTC A2	ECW Wireless, LLC
1533	40.5388447	74.02270008	16.0	HTC A2	ECW Wireless, LLC
1640	40.5388447	74.02270008	16.0	HTC A2	ECW Wireless, LLC
1641	40.5388447	74.02270008	16.0	HTC A2	ECW Wireless, LLC
1642	40.5388447	74.02270008	16.0	HTC A2	ECW Wireless, LLC
111	40.1871953	73.75070178	6.4	BASS RIVER	Direct Broadcast Services, Inc.
206	40.6651116	74.07261312	5.9	QUEENS CO	City of New York
1623	40.5771437	74.03234757	5.5	CAMELBACK	Monroe County Control Center (PA)
851	40.6651116	74.07261312	5.1	CLIP	NeXXCom Wireless LLC
93	40.5224984	73.88818124	4.9	SUFFOLK HILL	Suffolk County Police Department
1035	40.5224984	73.88818124	4.9	SUFFOLK HILL	Suffolk County Police Department
1036	40.5224984	73.88818124	4.9	SUFFOLK HILL	Suffolk County Police Department
69	40.6651116	74.07261312	4.9	ARTHUR KILL	Consolidated Edison Company of New York
987	40.261713	73.87615333	4.8	WESTAMPTON	County of Burlington, Public Safety Cntr
979	40.6436731	74.05158015	4.6	FLORENCE	County of Burlington, Public Safety Cntr
1400	40.1554956	73.81832058	4.6	ASR1046886	Rendezvous Communications LLC
1401	40.1554956	73.81832058	4.6	ASR1046886	Rendezvous Communications LLC
1567	40.343527	73.41503317	4.6	PUTNAM VLY	Westchester, County of
1717	40.6443634	74.05149296	2.9	NST	Hammarlund Research LLC
962	40.6651116	74.07261312	1.0	ELMHURST	New York City Police Department
1383	40.6651116	74.07261312	0.9	CCI WIND GAP	New Line Networks, LLC
202	40.6651116	74.07261312	0.5	FDNY LIC SHP	City of New York
849	40.6651116	74.07261312	0.3	CLIF	NeXXCom Wireless LLC

TABLE 4 – SUMMARY OF ESV ROUTE INTERFERENCE CASES

Summary of Results

Table 3 shows that there are numerous cases affecting spectrum throughout the 6 GHz band. The only segment of the spectrum which result in zero cases throughout the passage of the ESV route and into the port are channels 1, 10, and 19 (the low, mid, and high band edges) as detailed below:

Summary of Results		
Channel Spectrum (MHz)		# Cases Above 15 dB
1	5925-5929.0	0
2	5930.375-5960.025	18
3	5960.025-5989.675	19
4	5989.675-6019.325	19
5	6019.325-6048.975	25
6	6048.975-6078.625	36
7	6078.625-6108.275	31
8	6108.275-6137.925	26
9	6137.925-6167.575	15
10	6168.86-6181.0	0
11	6182.415-6212.065	20
12	6212.065-6241.715	25
13	6241.715-6271.365	29
14	6271.365-6301.015	28
15	6301.015-6330.665	27
16	6330.665-6360.315	21
17	6360.315-6389.965	23
18	6389.965-6419.615	16
19	6421-6425	0

The next two segments of spectrum with the lowest # cases are channels 9 and 18. Per FCC 25.221(a)(8) only 36 MHz per satellite on up to two satellites is permitted for C-band ESV operation. If the band edges are not available then other spectrum must be identified and operation of the ESV must be muted while within the CCP exclusion zone.

HALIFAX ESV INTERFERENCE ANALYSIS
PREPARED FOR O3b

PREPARED BY SKJEI TELECOM
November 27, 2017

TABLE OF CONTENTS

Section 1: ESV Parameters

An interference analysis to determine the interference potential from of a C-band Earth Station onboard Vessel (ESV) has been performed for the Halifax, NS area. The analysis considers a port-side location in Halifax. The Earth Station operating parameters are shown in Table 1 below. Table 2 below lists the breakpoints of the ESV approach route, as shown in Figure 1 below.

Company	O3b	
Site Name, State	Halifax	
Call Sign		
Latitude (NAD83) Main Port (B47)	44.64011111	N
Longitude (NAD83) Main Port (B47)	63.56538889	W
Elevation AMSL (ft/m)	0	
Transmit Frequency Range (MHz)	5925-6425	
Climate Zone		
Range of Satellite Orbital Long. (deg W)	20	72
Range of Azimuths from North (deg)	126.5	191.9
Antenna Centerline (ft/m)	51.0	15.5
Antenna Elevation Angles (deg)	23.0	37.9
Antenna Diameter (m)	2.4	
Equipment Parameters at Center Freq (GHz)		6.18
Antenna Gain, Main Beam (dBi)		41.9
15 DB Half Beamwidth (deg)		1.18
3 DB Half Beamwidth (deg)		0.66
Receive Antenna Type		
Transmit Antenna Type		FCC32
Max Transmitter Power (dBW/4KHz)		-16.3
Max EIRP Main Beam (dBW/4KHz)		51.0
Modulation / Emission Designator		1M40G7W
Coordination Parameters		
6 GHz Max Interference Power Long Term (dBW/4kHz) (20%)	-154	
6 GHz Max Interference Power Short Term (dBW/4kHz) (.0025%)	-131	
6 GHz Max Interference Power In Motion (dBW/4kHz) (1%)	-145	

TABLE 1 – EARTH STATION ON VESSEL DATA SHEET

Break Pt	Latitude	Longitude
Port	443824.4	633355.4
Bp1	443803.3	633339.5
Bp2	443742.1	633302.8
Bp3	443655.3	633258.7
Bp4	443555.5	633258.7
Bp5	443252.3	632948
Bp6	442839.2	632104.5
Bp7	442529.8	632410.1
Bp8	443000.7	631530.1

TABLE 2 - ESV ROUTE BREAK POINTS

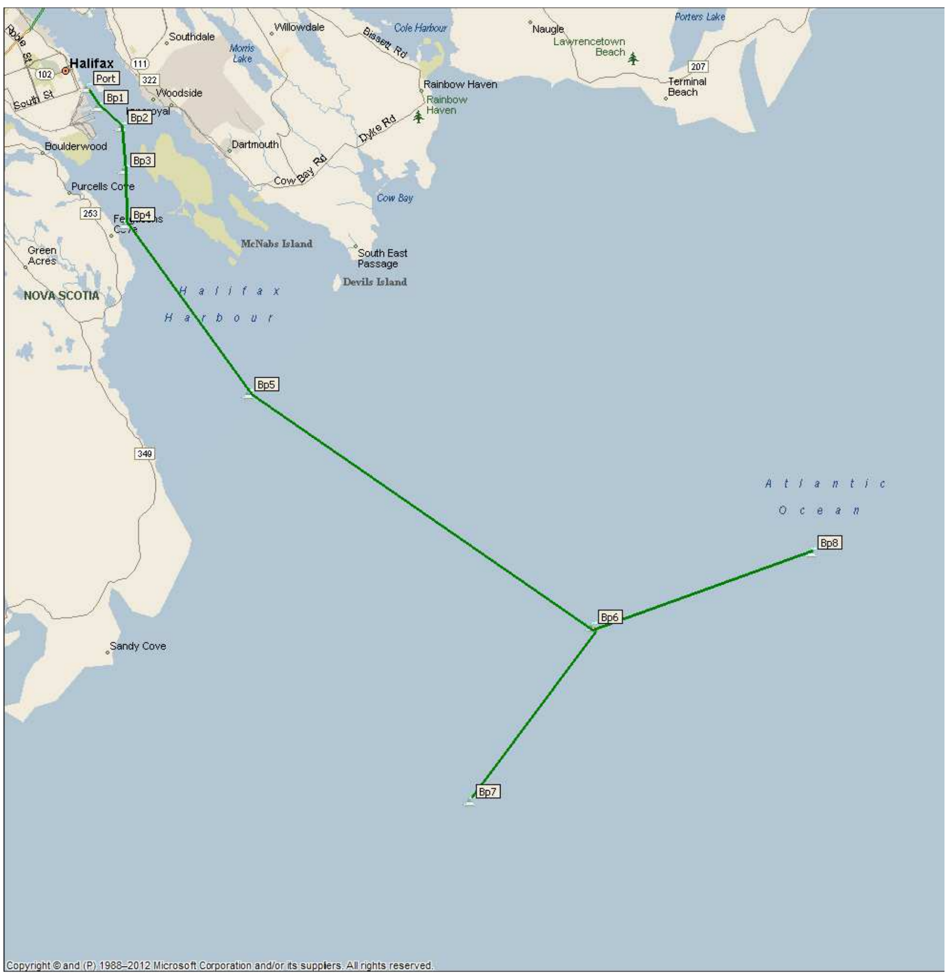

FIGURE 1 - ESV ROUTE

Section 2: The Critical Contour Point Technique

The critical contour point (CCP) technique has been developed to assist in the determination of interference from an ESV. The technique involves calculating the interference from all points along the route of the ESV and determining which point produces the worst case interference into a victim microwave receiver. The worst case interference level is then calculated for this point. If the calculated interference exceeds the maximum long-term permissible level of interference, which is shown in Table 1 above, then the licensed or coordinated receive frequencies for that site must be avoided in order to preclude interference.

The following section is excerpted from ITU-R SF 1649, which describes the CCP in more detail:

For any interference exposure of a particular FS receiver from an ESV terminal on a moving ship, there are three position-related variables in the calculation:

- Propagation loss exceeded for all but a percentage of time. This loss depends on the length of the interference path, the radio-climatic zones and may include the effects of any blockage that may exist on the interference path;
- FS receiver antenna gain; and
- ESV antenna horizon gain.

For every point within the operating contour as defined by the deep-draft channel (see Fig. 2), each of these three factors can be readily determined.

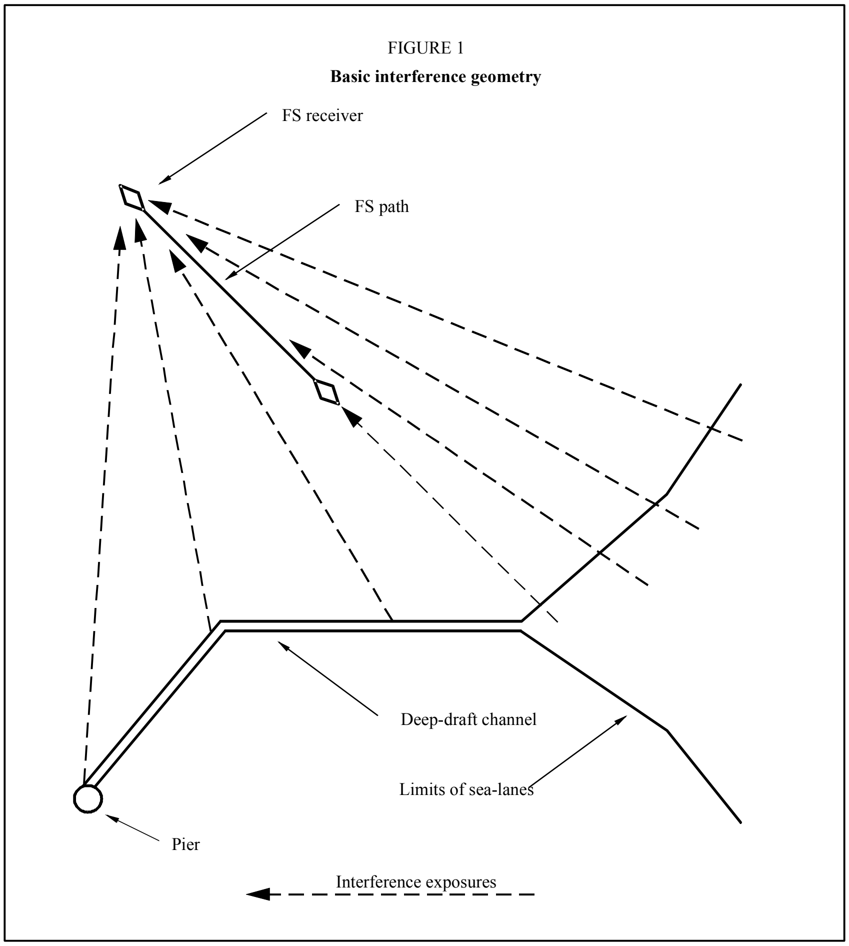

FIGURE 2 – BASIC INTERFERENCE GEOMETRY

For the purpose of evaluating the potential interference the operating contour is approximated by a set of straight-line segments. The identification of the CCPs depends on the position and alignment of the FS path with respect to the operating contour, and several cases need to be distinguished. In those cases where the azimuth of the main beam axis of the FS antenna does not intersect with any portion of the operating area of the ESV, the critical contour points are the points along the operating contour where the contour changes direction or reaches the off-shore limit beyond which coordination is not required. In those cases where the azimuth of the main beam axis of the FS antenna intersects the operating contour it is necessary to augment and/or modify the number of CCPs. In any event, the same CCPs should be used to consider both the long-term and the short-term interference to any FS station under consideration. Interference from in-motion ESV operations to any FS receiver within the area where the potential interference from the ESV needs to be evaluated is assessed by consideration of the operation at each of the CCPs for each receiver using propagation

loss models such as those given in recommendation ITU-R P.452. The goal of this assessment is the identification of frequencies that can be used for in-motion ESV operations without causing unacceptable levels of interference to FS stations.
For the identification of the CCPs with respect to a specific FS receiver, the following three cases need to be distinguished:

Case 1: in this case the main beam axis of the FS receiving antenna does not intersect any portion of the operating contour. The only CCPs required for this case are the points where the operating contour of the ESV changes direction.

Case 2: in this case, the main beam of the FS antenna (within 10 db of the maximum antenna gain) lies entirely within one segment of the operating contour. The points on the operating contour where the antenna gain is 10 db below the maximum, determine two additional CCPs. The segment of the operating contour between these two CCPs contains the natural intersection point (nip), the point where the main beam axis of the FS antenna intersects the operating contour. The nip is always taken as a CCP.

Case 3: in this case, the nip is close enough to one of the points where the operating contour changes direction that the main beam of the FS antenna extends over more than one segment of the operating contour. This case is most likely to arise when the nip is close to one of the points where the operating contour of the ESV changes direction. The intersection of the operating contour with the antenna 10 db points determine two additional CCPs as in case 2; however, in this case the original point within the main beam does not need to be considered as a CCP.

A further possibility: if there is a point on the operating contour of an ESV from which the maximum horizon gain of the ESV antenna is directed toward a FS receiver, that point on the contour may be identified as an additional CCP for that FS receiver regardless of which of the three cases applies.

The CCP always represents the worst-case interference scenario and the associated exclusion zone mitigates all interference into an FS receiver for the ESV route.

Once the CCP is determine an interference zone where the ESV transmissions into the victim receiver will exceed the maximum permissible interference criteria is developed based upon the receive antenna pattern of the terrestrial station. Within these zones the interfered spectrum must be avoided. The interference zones are detailed in the attached ESV Interference Analysis excel workbook.

SECTION 3 – INTERFERENCE RESULTS

Table 3 below list the interference cases calculated for the ESV port(s) and route, including worst case interference margin. Table 4 provides a high level summary for each case CCP, including the CCP coordinates, interference margin, victim receive location, and affected licensee.

Site	Halifax																			
	Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Into 1																				
Case #	Margin(dB)																			
Into 2																				
Case #	Margin(dB)																			
1265	10.2											Y	Y							

Summary of Cases		
Channel Spectrum (MHz)		# Cases
1	5925-5929.0	0
2	5930.375-5960.025	0
3	5960.025-5989.675	0
4	5989.675-6019.325	0
5	6019.325-6048.975	0
6	6048.975-6078.625	0
7	6078.625-6108.275	0
8	6108.275-6137.925	0
9	6137.925-6167.575	0
10	6168.86-6181.0	0
11	6182.415-6212.065	1
12	6212.065-6241.715	1
13	6241.715-6271.365	0
14	6271.365-6301.015	0
15	6301.015-6330.665	0
16	6330.665-6360.315	0
17	6360.315-6389.965	0
18	6389.965-6419.615	0
19	6421-6425	0

TABLE 3 – SUMMARY OF ESV ROUTE INTERFERENCE FREQUENCY ANALYSIS CASES

Interference Zones			St John		
Into 1					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin (dB)	Victim Rx Site	Licensee
Into 2					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin (dB)	Victim Rx Site	Licensee
1265	44.42493	63.40279496	10.2	THUNDERHILL	Sullivan County DPW

TABLE 4 – SUMMARY OF ESV ROUTE INTERFERENCE CASES

Summary of Results

Table 3 shows that there is only one case affecting spectrum throughout the 6 GHz band. Most of the spectrum has zero cases throughout the passage of the ESV route and into the port see the summary table below:

Summary of Cases		
Channel Spectrum (MHz)		# Cases
1	5925-5929.0	0
2	5930.375-5960.025	0
3	5960.025-5989.675	0
4	5989.675-6019.325	0
5	6019.325-6048.975	0
6	6048.975-6078.625	0
7	6078.625-6108.275	0
8	6108.275-6137.925	0
9	6137.925-6167.575	0
10	6168.86-6181.0	0
11	6182.415-6212.065	1
12	6212.065-6241.715	1
13	6241.715-6271.365	0
14	6271.365-6301.015	0
15	6301.015-6330.665	0
16	6330.665-6360.315	0
17	6360.315-6389.965	0
18	6389.965-6419.615	0
19	6421-6425	0

NEWPORT ESV INTERFERENCE ANALYSIS
PREPARED FOR O3b

PREPARED BY SKJEI TELECOM
November 27, 2017

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Section 1: ESV Parameters

An interference analysis to determine the interference potential from of a C-band Earth Station onboard Vessel (ESV) has been performed for the Newport, RI area. The analysis considers a port-side location in Newport. The Earth Station operating parameters are shown in Table 1 below. Table 2 below lists the breakpoints of the ESV approach route, as shown in Figure 1 below.

Company	O3b	
Site Name, State	Newport	
Call Sign		
Latitude (NAD83) Main Port (B47)	41.48741667	N
Longitude (NAD83) Main Port (B47)	71.32147222	W
Elevation AMSL (ft/m)	0	
Transmit Frequency Range (MHz)	5925-6425	
Climate Zone		
Range of Satellite Orbital Long. (deg W)	20	72
Range of Azimuths from North (deg)	117.9	181.0
Antenna Centerline (ft/m)	51.0	15.5
Antenna Elevation Angles (deg)	19.7	42.1
Antenna Diameter (m)	2.4	
Equipment Parameters at Center Freq (GHz)		6.18
Antenna Gain, Main Beam (dBi)		41.9
15 DB Half Beamwidth (deg)		1.18
3 DB Half Beamwidth (deg)		0.66
Receive Antenna Type		
Transmit Antenna Type		FCC32
Max Transmitter Power (dbW/4KHz)		-16.3
Max EIRP Main Beam (dBW/4KHz)		51.0
Modulation / Emission Designator		1M40G7W
Coordination Parameters		
6 GHz Max Interference Power Long Term (dBW/4kHz) (20%)	-154	
6 GHz Max Interference Power Short Term (dBW/4kHz) (.0025%)	-131	
6 GHz Max Interference Power In Motion (dBW/4kHz) (1%)	-145	

TABLE 1 – EARTH STATION ON VESSEL DATA SHEET

Break Pt	Latitude	Longitude
Port	412914.7	711917.3
BP1	412850.4	711926.4

BP2	412859.3	711959.6
BP3	412854.6	712051
BP4	412748.1	712221
BP5	412634.2	712254.1
BP6	412446.5	712229.6
BP7	412032.7	712007.6
BP8	410303.2	710649.5
SE:	403234.3	712154.8
NE:	404510.3	701435.6

TABLE 2 - ESV ROUTE BREAK POINTS

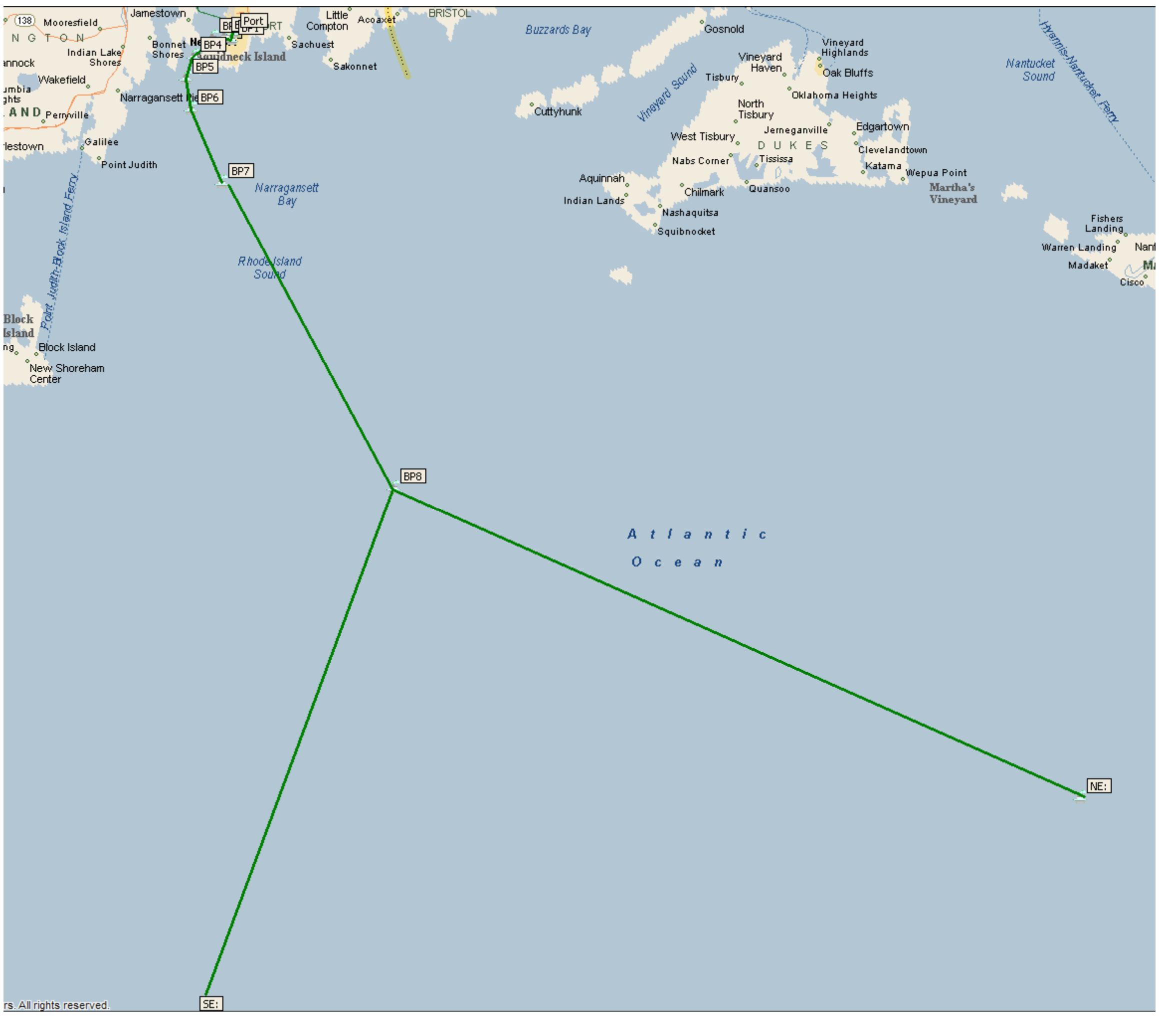

FIGURE 1 - ESV ROUTE

Section 2: The Critical Contour Point Technique

The critical contour point (CCP) technique has been developed to assist in the determination of interference from an ESV. The technique involves calculating the interference from all points along the route of the ESV and determining which point produces the worst case interference into a victim microwave receiver. The worst case interference level is then calculated for this point. If the calculated interference exceeds the maximum long-term permissible level of interference, which is shown in Table 1 above, then the licensed or coordinated receive frequencies for that site must be avoided in order to preclude interference.

The following section is excerpted from ITU-R SF 1649, which describes the CCP in more detail:

For any interference exposure of a particular FS receiver from an ESV terminal on a moving ship, there are three position-related variables in the calculation:

- Propagation loss exceeded for all but a percentage of time. This loss depends on the length of the interference path, the radio-climatic zones and may include the effects of any blockage that may exist on the interference path;
- FS receiver antenna gain; and
- ESV antenna horizon gain.

For every point within the operating contour as defined by the deep-draft channel (see Fig. 2), each of these three factors can be readily determined.

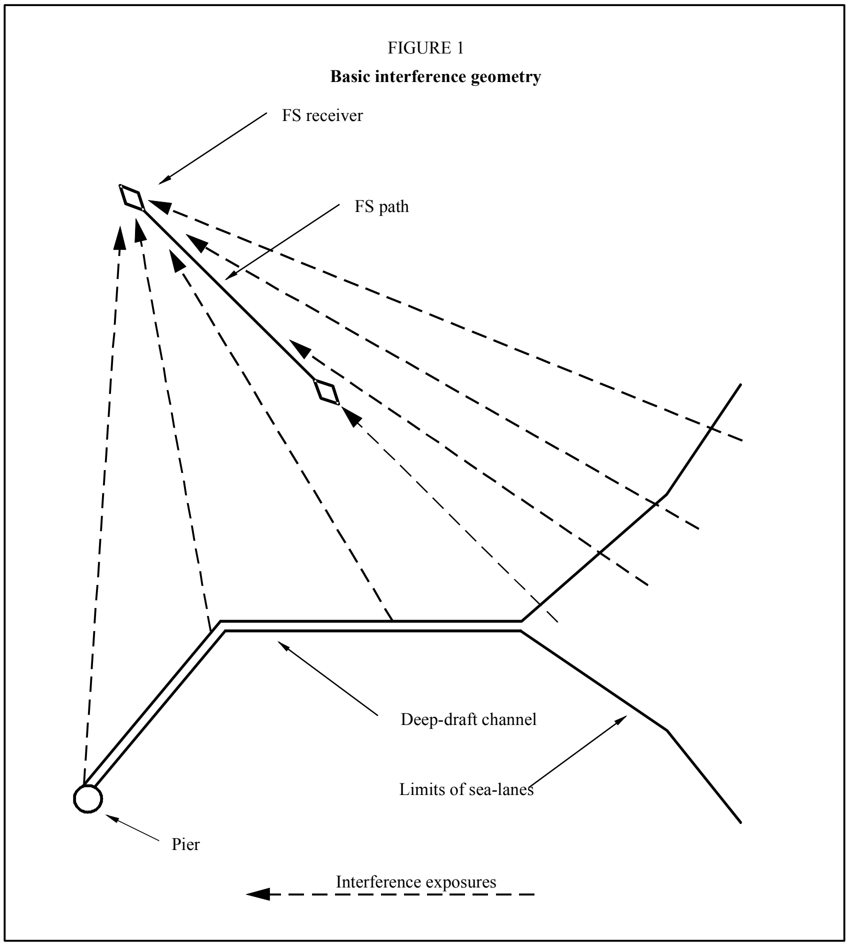

FIGURE 2 – BASIC INTERFERENCE GEOMETRY

For the purpose of evaluating the potential interference the operating contour is approximated by a set of straight-line segments. The identification of the CCPs depends on the position and alignment of the FS path with respect to the operating contour, and several cases need to be distinguished. In those cases where the azimuth of the main beam axis of the FS antenna does not intersect with any portion of the operating area of the ESV, the critical contour points are the points along the operating contour where the contour changes direction or reaches the off-shore limit beyond which coordination is not required. In those cases where the azimuth of the main beam axis of the FS antenna intersects the operating contour it is necessary to augment and/or modify the number of CCPs. In any event, the same CCPs should be used to consider both the long-term and the short-term interference to any FS station under consideration. Interference from in-motion ESV operations to any FS receiver within the area where the potential interference from the ESV needs to be evaluated is assessed by consideration of the operation at each of the CCPs for each receiver using propagation

loss models such as those given in recommendation ITU-R P.452. The goal of this assessment is the identification of frequencies that can be used for in-motion ESV operations without causing unacceptable levels of interference to FS stations.
For the identification of the CCPs with respect to a specific FS receiver, the following three cases need to be distinguished:

Case 1: in this case the main beam axis of the FS receiving antenna does not intersect any portion of the operating contour. The only CCPs required for this case are the points where the operating contour of the ESV changes direction.

Case 2: in this case, the main beam of the FS antenna (within 10 db of the maximum antenna gain) lies entirely within one segment of the operating contour. The points on the operating contour where the antenna gain is 10 db below the maximum, determine two additional CCPs. The segment of the operating contour between these two CCPs contains the natural intersection point (nip), the point where the main beam axis of the FS antenna intersects the operating contour. The nip is always taken as a CCP.

Case 3: in this case, the nip is close enough to one of the points where the operating contour changes direction that the main beam of the FS antenna extends over more than one segment of the operating contour. This case is most likely to arise when the nip is close to one of the points where the operating contour of the ESV changes direction. The intersection of the operating contour with the antenna 10 db points determine two additional CCPs as in case 2; however, in this case the original point within the main beam does not need to be considered as a CCP.

A further possibility: if there is a point on the operating contour of an ESV from which the maximum horizon gain of the ESV antenna is directed toward a FS receiver, that point on the contour may be identified as an additional CCP for that FS receiver regardless of which of the three cases applies.

The CCP always represents the worst-case interference scenario and the associated exclusion zone mitigates all interference into an FS receiver for the ESV route.

Once the CCP is determine an interference zone where the ESV transmissions into the victim receiver will exceed the maximum permissible interference criteria is developed based upon the receive antenna pattern of the terrestrial station. Within these zones the interfered spectrum must be avoided. The interference zones are detailed in the attached ESV Interference Analysis excel workbook.

SECTION 3 – INTERFERENCE RESULTS

Table 3 below list the interference cases calculated for the ESV port(s) and route, including worst case interference margin. Table 4 provides a high level summary for each case CCP, including the CCP coordinates, interference margin, victim receive location, and affected licensee.

Site	Newport																			
	Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Into 1																				
Case #	Margin(dB)																			
290	22.6													Y	Y	Y				
766	3.7											Y							Y	
1677	1.9				Y	Y	Y													
Into 2																				
Case #	Margin(dB)																			
245	22.8		Y	Y																
5	22.7				Y	Y	Y	Y	Y	Y										
247	18.3												Y	Y	Y					
6	17.7		Y	Y		Y	Y	Y	Y	Y										
1081	5.2				Y	Y	Y													
1677	4.9													Y	Y	Y				

Summary of Cases		
Channel Spectrum (MHz)		# Cases
1	5925-5929.0	0
2	5930.375-5960.025	2
3	5960.025-5989.675	2
4	5989.675-6019.325	3
5	6019.325-6048.975	4
6	6048.975-6078.625	4
7	6078.625-6108.275	2
8	6108.275-6137.925	2
9	6137.925-6167.575	2
10	6168.86-6181.0	0
11	6182.415-6212.065	1
12	6212.065-6241.715	1
13	6241.715-6271.365	3
14	6271.365-6301.015	3
15	6301.015-6330.665	2
16	6330.665-6360.315	0
17	6360.315-6389.965	0
18	6389.965-6419.615	1
19	6421-6425	0

TABLE 3 – SUMMARY OF ESV ROUTE INTERFERENCE FREQUENCY ANALYSIS CASES

Interference Zones			Newport		
Into 1					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin (dB)	Victim Rx Site	Licensee
290	41.47175	71.36115	22.6	LINCOLN	State of Rhode Island
766	40.98874	70.58528	3.7	FALMOUTH RX	Verizon New England Inc.
1677	41.48742	71.32147	1.9	PORTSMOUTH	State of Rhode Island
Into 2					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin (dB)	Victim Rx Site	Licensee
245	41.34573	71.11044	22.8	TAUNTON	Industrial Tower and Wireless, LLC
5	41.34573	71.11044	22.7	TAUNTON	Industrial Tower and Wireless, LLC
247	41.22978	70.93885	18.3	FOXBORO	Industrial Tower and Wireless, LLC
6	41.29333	71.03278	17.7	QUINCY	Industrial Tower and Wireless, LLC
1081	40.76996	71.25331	5.2	TROOP E	Connecticut, State of
1677	41.48742	71.32147	4.9	N KINGSTOWN	State of Rhode Island

TABLE 4 – SUMMARY OF ESV ROUTE INTERFERENCE CASES

Summary of Results

Table 3 shows that there are nine cases affecting spectrum throughout the 6 GHz band. There are several segments of the spectrum which result in zero cases throughout the passage of the ESV route and into the port see the summary table below:

Summary of Cases		
Channel Spectrum (MHz)		# Cases
1	5925-5929.0	0
2	5930.375-5960.025	2
3	5960.025-5989.675	2
4	5989.675-6019.325	3
5	6019.325-6048.975	4
6	6048.975-6078.625	4
7	6078.625-6108.275	2
8	6108.275-6137.925	2
9	6137.925-6167.575	2
10	6168.86-6181.0	0
11	6182.415-6212.065	1
12	6212.065-6241.715	1
13	6241.715-6271.365	3
14	6271.365-6301.015	3
15	6301.015-6330.665	2
16	6330.665-6360.315	0
17	6360.315-6389.965	0
18	6389.965-6419.615	1
19	6421-6425	0

There are also several spectrum segments with only 1 case, where muting would be required during operation in the exclusion zone.

PORT EVERGLADES ESV INTERFERENCE ANALYSIS
PREPARED FOR O3b

PREPARED BY SKJEI TELECOM
November 28, 2017

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Section 1: ESV Parameters

An interference analysis to determine the interference potential from of a C-band Earth Station onboard Vessel (ESV) has been performed for the Port Everglades, FL area. The analysis considers a port-side location in Port everglades. The Earth Station operating parameters are shown in Table 1 below. Table 2 below lists the breakpoints of the ESV approach route, as shown in Figure 1 below.

Company	O3b	
Site Name, State	Port Everglades	
Call Sign		
Latitude (NAD83) Main Port (B47)	26.09944	N
Longitude (NAD83) Main Port (B47)	-80.1197	W
Elevation AMSL (ft/m)	0	
Transmit Frequency Range (MHz)	5925-6425	
Climate Zone		
Range of Satellite Orbital Long. (deg W)	20	72
Range of Azimuths from North (deg)	94.5	129.7
Antenna Centerline (ft/m)	51.0	15.5
Antenna Elevation Angles (deg)	-17.4	-57.2
Antenna Diameter (m)	2.4	
Equipment Parameters at Center Freq (GHz)		**6.18**
Antenna Gain, Main Beam (dBi)		41.9
15 DB Half Beamwidth (deg)		1.18
3 DB Half Beamwidth (deg)		0.66
Receive Antenna Type		
Transmit Antenna Type		FCC32
Max Transmitter Power (dBW/4KHz)		-16.3
Max EIRP Main Beam (dBW/4KHz)		51.0
Modulation / Emission Designator		**1M40G7W**
Coordination Parameters		
6 GHz Max Interference Power Long Term (dBW/4kHz) (20%)	-154	
6 GHz Max Interference Power Short Term (dBW/4kHz) (.0025%)	-131	
6 GHz Max Interference Power In Motion (dBW/4kHz) (1%)	-145	

TABLE 1 – EARTH STATION ON VESSEL DATA SHEET

Break Pt	Latitude	Longitude
1	261330.000	790517.880
17	261000.010	800000.000
2	260537.790	800445.840
3	260537.210	800643.920
4	260531.810	800701.920
5	260525.800	800654.720
B6	260521.590	800654.000
14	260512.010	800649.680
P2	260409.010	800657.960
B7	260506.610	800651.480
B8	260522.200	800658.680
B9	260510.790	800701.920
B10	260522.200	800710.920
B12	260540.810	800714.880
B11	260548.010	800712.000
P1	260557.980	800710.920
13	260537.210	800700.120

TABLE 2 - ESV ROUTE BREAK POINTS

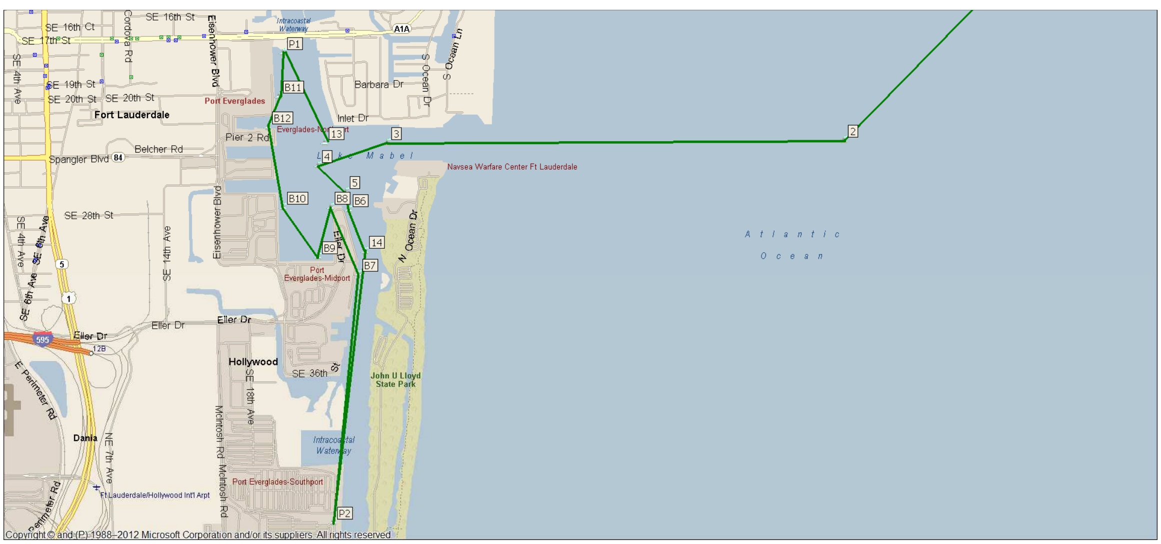

FIGURE 1 - ESV ROUTE

Section 2: The Critical Contour Point Technique

The critical contour point (CCP) technique has been developed to assist in the determination of interference from an ESV. The technique involves calculating the interference from all points along the route of the ESV and determining which point produces the worst case interference into a victim microwave receiver. The worst case interference level is then calculated for this point. If the calculated interference exceeds the maximum long-term permissible level of interference, which is shown in Table 1 above, then the licensed or coordinated receive frequencies for that site must be avoided in order to preclude interference.

The following section is excerpted from ITU-R SF 1649, which describes the CCP in more detail:

For any interference exposure of a particular FS receiver from an ESV terminal on a moving ship, there are three position-related variables in the calculation:

- Propagation loss exceeded for all but a percentage of time. This loss depends on the length of the interference path, the radio-climatic zones and may include the effects of any blockage that may exist on the interference path;
- FS receiver antenna gain; and
- ESV antenna horizon gain.

For every point within the operating contour as defined by the deep-draft channel (see Fig. 2), each of these three factors can be readily determined.

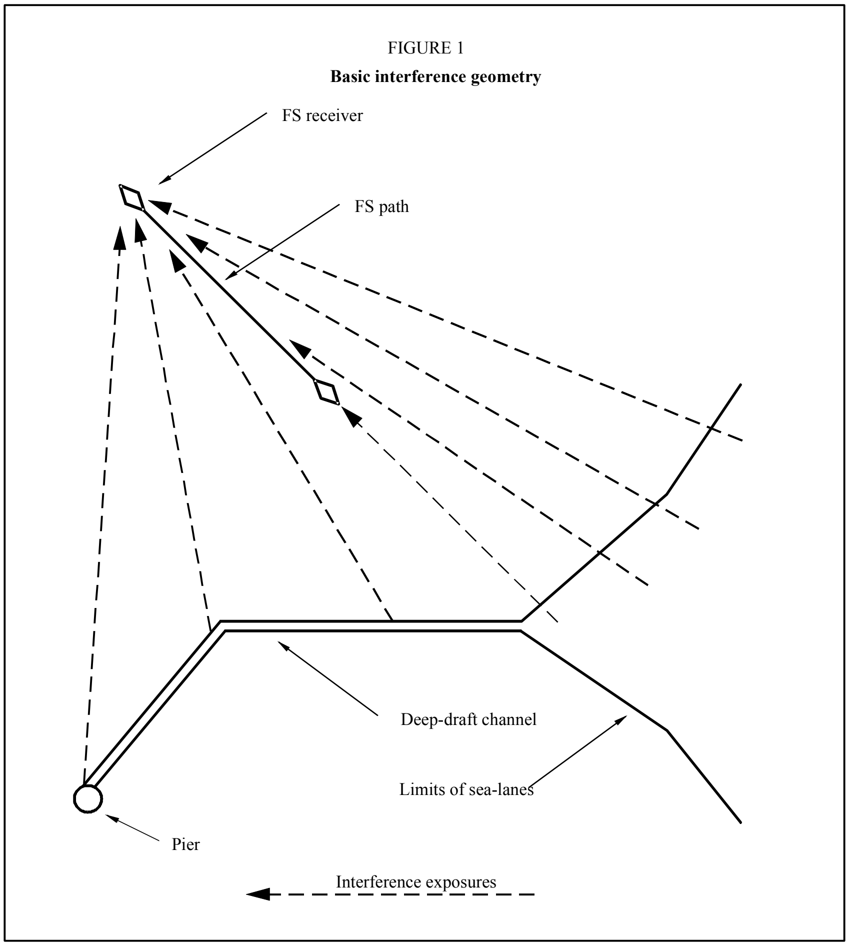

FIGURE 2 – BASIC INTERFERENCE GEOMETRY

For the purpose of evaluating the potential interference the operating contour is approximated by a set of straight-line segments. The identification of the CCPs depends on the position and alignment of the FS path with respect to the operating contour, and several cases need to be distinguished. In those cases where the azimuth of the main beam axis of the FS antenna does not intersect with any portion of the operating area of the ESV, the critical contour points are the points along the operating contour where the contour changes direction or reaches the off-shore limit beyond which coordination is not required. In those cases where the azimuth of the main beam axis of the FS antenna intersects the operating contour it is necessary to augment and/or modify the number of CCPs. In any event, the same CCPs should be used to consider both the long-term and the short-term interference to any FS station under consideration. Interference from in-motion ESV operations to any FS receiver within the area where the potential interference from the ESV needs to be evaluated is assessed by consideration of the operation at each of the CCPs for each receiver using propagation

loss models such as those given in recommendation ITU-R P.452. The goal of this assessment is the identification of frequencies that can be used for in-motion ESV operations without causing unacceptable levels of interference to FS stations.
For the identification of the CCPs with respect to a specific FS receiver, the following three cases need to be distinguished:

Case 1: in this case the main beam axis of the FS receiving antenna does not intersect any portion of the operating contour. The only CCPs required for this case are the points where the operating contour of the ESV changes direction.

Case 2: in this case, the main beam of the FS antenna (within 10 db of the maximum antenna gain) lies entirely within one segment of the operating contour. The points on the operating contour where the antenna gain is 10 db below the maximum, determine two additional CCPs. The segment of the operating contour between these two CCPs contains the natural intersection point (nip), the point where the main beam axis of the FS antenna intersects the operating contour. The nip is always taken as a CCP.

Case 3: in this case, the nip is close enough to one of the points where the operating contour changes direction that the main beam of the FS antenna extends over more than one segment of the operating contour. This case is most likely to arise when the nip is close to one of the points where the operating contour of the ESV changes direction. The intersection of the operating contour with the antenna 10 db points determine two additional CCPs as in case 2; however, in this case the original point within the main beam does not need to be considered as a CCP.

A further possibility: if there is a point on the operating contour of an ESV from which the maximum horizon gain of the ESV antenna is directed toward a FS receiver, that point on the contour may be identified as an additional CCP for that FS receiver regardless of which of the three cases applies.

The CCP always represents the worst-case interference scenario and the associated exclusion zone mitigates all interference into an FS receiver for the ESV route.

Once the CCP is determine an interference zone where the ESV transmissions into the victim receiver will exceed the maximum permissible interference criteria is developed based upon the receive antenna pattern of the terrestrial station. Within these zones the interfered spectrum must be avoided. The interference zones are detailed in the attached ESV Interference Analysis excel workbook.

SECTION 3 – INTERFERENCE RESULTS

Table 3 below list the interference cases calculated for the ESV port(s) and route, including worst case interference margin. Table 4 provides a high level summary for each case CCP, including the CCP coordinates, interference margin, victim receive location, and affected licensee.

Site	Port Everglades																			
	Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Into 1																				
Case #	Margin(dB)																			
168	26.0						Y	Y	Y											
22	1.8									Y										
Into 2																				
Case #	Margin(dB)																			
387	24.9		Y	Y	Y															
319	21.5																	Y	Y	
315	20.5												Y	Y	Y					
348	13.2							Y	Y	Y	Y									
351	7.3					Y	Y	Y												
372	6.2		Y																	
391	5.8			Y	Y	Y														

Summary of Cases		
Channel Spectrum (MHz)		# Cases
1	5925-5929.0	0
2	5930.375-5960.025	2
3	5960.025-5989.675	2
4	5989.675-6019.325	2
5	6019.325-6048.975	2
6	6048.975-6078.625	2
7	6078.625-6108.275	3
8	6108.275-6137.925	2
9	6137.925-6167.575	2
10	6168.86-6181.0	1
11	6182.415-6212.065	0
12	6212.065-6241.715	1
13	6241.715-6271.365	1
14	6271.365-6301.015	1
15	6301.015-6330.665	0
16	6330.665-6360.315	0
17	6360.315-6389.965	1
18	6389.965-6419.615	1
19	6421-6425	0

TABLE 3 – SUMMARY OF ESV ROUTE INTERFERENCE FREQUENCY ANALYSIS CASES

Interference Zones			Port Everglades		
Into 1					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin (dB)	Victim Rx Site	Licensee
168	26.09363	80.10393282	26.0	CAB	Miami-Dade County
22	26.16895	79.96557462	1.8	NEW EOC	Palm Beach, County of
Into 2					
Case #	CCP Lat	CCP Long	Margin(dB)	site2	company1
387	26.16895	79.96557462	24.9	NEW EOC	Palm Beach, County of
319	26.10387	80.06855595	21.5	MIDTOWN1	HiQ Data Corporation
315	26.09709	80.11869814	20.5	6NC1111M	T-Mobile License LLC
348	26.19358	79.59045556	13.2	MET2	Computer Office Solutions, Inc.
351	26.19534	79.56311927	7.3	C-18 NPB	South Florida Water Management District
372	26.18218	79.76592954	6.2	SWEETWATER	Olympic Wireless, LLC
391	26.1433	80.02560026	5.8	JUPITER	Palm Beach, County of

TABLE 4 – SUMMARY OF ESV ROUTE INTERFERENCE CASES

Summary of Results

Table 3 shows that there are nine cases affecting spectrum throughout the 6 GHz band. There are several segments of the spectrum which have zero cases throughout the passage of the ESV route and into the port see the summary table below:

Summary of Cases		
Channel Spectrum (MHz)		# Cases
1	5925-5929.0	0
2	5930.375-5960.025	2
3	5960.025-5989.675	2
4	5989.675-6019.325	2
5	6019.325-6048.975	2
6	6048.975-6078.625	2
7	6078.625-6108.275	3
8	6108.275-6137.925	2
9	6137.925-6167.575	2
10	6168.86-6181.0	1
11	6182.415-6212.065	0
12	6212.065-6241.715	1
13	6241.715-6271.365	1
14	6271.365-6301.015	1
15	6301.015-6330.665	0
16	6330.665-6360.315	0
17	6360.315-6389.965	1
18	6389.965-6419.615	1
19	6421-6425	0

SAN JUAN ESV INTERFERENCE ANALYSIS
PREPARED FOR O3b

PREPARED BY SKJEI TELECOM
November 29, 2017

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Section 1: ESV Parameters

An interference analysis to determine the interference potential from of a C-band Earth Station onboard Vessel (ESV) has been performed for the San Juan, PR area. The analysis considers a port-side location in San Juan. The Earth Station operating parameters are shown in Table 1 below. Table 2 below lists the breakpoints of the ESV approach route, as shown in Figure 1 below.

Company	O3b	
Site Name, State	San Juan	
Call Sign		
Latitude (NAD83) Main Port (B47)	18.4622	N
Longitude (NAD83) Main Port (B47)	-66.1102	W
Elevation AMSL (ft/m)	0	
Transmit Frequency Range (MHz)	5925-6425	
Climate Zone		
Range of Satellite Orbital Long. (deg W)	20	72
Range of Azimuths from North (deg)	268.8	109.4
Antenna Centerline (ft/m)	51.0	15.5
Antenna Elevation Angles (deg)	-5.0	-50.4
Antenna Diameter (m)	2.4	
Equipment Parameters at Center Freq (GHz)		6.18
Antenna Gain, Main Beam (dBi)		41.9
15 DB Half Beamwidth (deg)		1.18
3 DB Half Beamwidth (deg)		0.66
Receive Antenna Type		
Transmit Antenna Type		FCC32
Max Transmitter Power (dBW/4KHz)		-16.3
Max EIRP Main Beam (dBW/4KHz)		51.0
Modulation / Emission Designator		1M40G7W
Coordination Parameters		
6 GHz Max Interference Power Long Term (dBW/4kHz) (20%)	-154	
6 GHz Max Interference Power Short Term (dBW/4kHz) (.0025%)	-131	
6 GHz Max Interference Power In Motion (dBW/4kHz) (1%)	-145	

TABLE 1 – EARTH STATION ON VESSEL DATA SHEET

Break Pt	Latitude	Longitude	Break Pt	Latitude	Longitude
SH1	19.97478	-67.05431	ST4	18.31667	-65.11833
SH2	18.75333	-66.58333	ST5	18.27167	-65.03667
SH3	18.80333	-66.5	ST6	18.26333	-64.99167
SH4	18.66667	-66.31667	ST7	18.30617	-64.98333
SH5	18.4695	-66.12833	ST8	18.3	-64.96333
SH6	18.4555	-66.11417	ST9	18.31667	-64.96433
SH7	18.45	-66.1095	ST10	18.32217	-64.95967
SH8	18.46117	-66.10567	ST11	18.32783	-64.953
SH9	18.4595	-66.09883	ST12	18.33117	-64.95283
SH10	18.45917	-66.09617	ST13	18.33183	-64.95283
SH11	18.4605	-66.10033	ST14-P	18.332	-64.953
SH12	18.46133	-66.10667	ST15	18.33267	-64.95283
SH13	18.46283	-66.10967	ST16	18.33183	-64.95033
SH14	18.46	-66.1085	ST17	18.33233	-64.94633
SH15	18.45917	-66.1105	ST18	18.33133	-64.94217
SH16-P1	18.4622	-66.1102	ST19	18.33017	-64.9405
SH17	18.4625	-66.11033	ST20	18.3195	-64.93633
SH18	18.4625	-66.11367	ST21	18.30367	-64.941
SH19	18.46017	-66.11233	ST22	18.28633	-64.94617
SH20	18.45817	-66.11117	ST23	18.328	-64.92867
SH21	18.46017	-66.11367	ST24	18.33117	-64.92933
SH22	18.46233	-66.114	ST25	18.3315	-64.92783
SH23	18.45733	-66.11467	ST26-P	18.3343	-64.9205
SH24	18.4575	-66.118	ST27	18.334	-64.9205
SH25	18.463	-66.12467	ST28	18.33283	-64.92283
SH26	18.46667	-66.12733	ST29	18.33133	-64.92467
SH27	18.4695	-66.12833	ST30	18.31667	-64.92533
SH28	18.48333	-66.128	ST31	18.29717	-64.92467
SH29	18.51667	-66.12667	ST32	18.25	-64.925
SH30	18.555	-66.08333	ST33	18.17	-64.88167
SH31	18.565	-65.91667	ST34	18.14333	-64.70167
ST1	18.615	-65.83333	ST35	18.29167	-64.56
ST2	18.635	-65.5	ST36	18.11333	-64.5
ST3	18.42667	-65.175	ST37	17.985	-64.5

TABLE 2 - ESV ROUTE BREAK POINTS


Atlantic Ocean
Palo Seco
San Juan
Paseo Covadonga
Calle Comercio
Paseo de la Princesa
La Fortaleza
Parque del Nuevo Milenio
Palmas

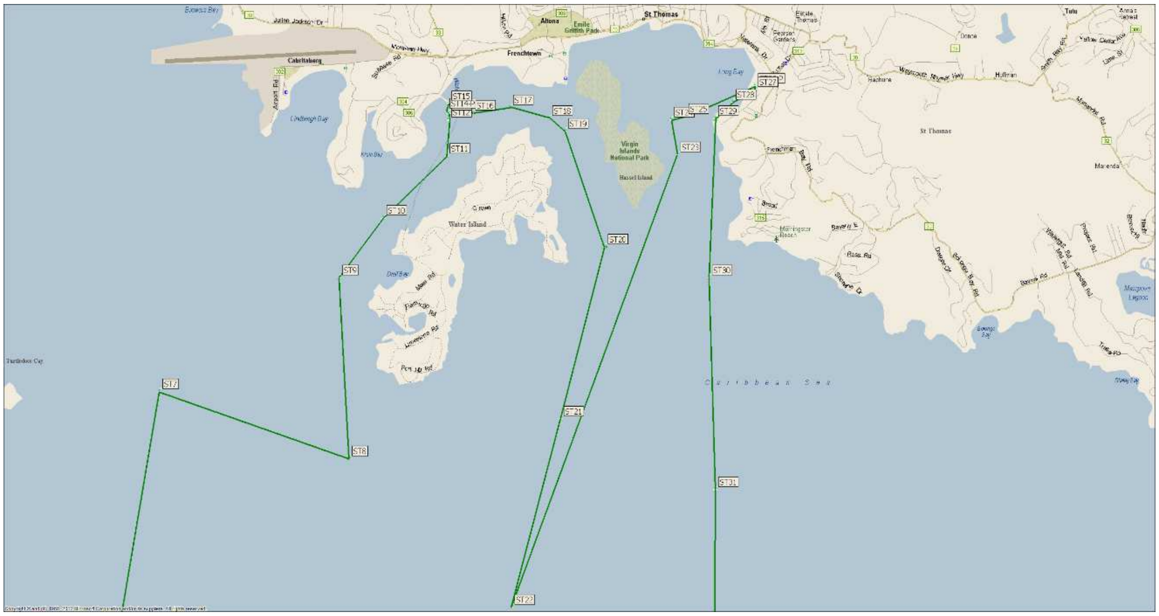

FIGURE 1 - ESV ROUTE

Section 2: The Critical Contour Point Technique

The critical contour point (CCP) technique has been developed to assist in the determination of interference from an ESV. The technique involves calculating the interference from all points along the route of the ESV and determining which point produces the worst case interference into a victim microwave receiver. The worst case interference level is then calculated for this point. If the calculated interference exceeds the maximum long-term permissible level of interference, which is shown in Table 1 above, then the licensed or coordinated receive frequencies for that site must be avoided in order to preclude interference.

The following section is excerpted from ITU-R SF 1649, which describes the CCP in more detail:

For any interference exposure of a particular FS receiver from an ESV terminal on a moving ship, there are three position-related variables in the calculation:

- Propagation loss exceeded for all but a percentage of time. This loss depends on the length of the interference path, the radio-climatic zones and may include the effects of any blockage that may exist on the interference path;
- FS receiver antenna gain; and
- ESV antenna horizon gain.

For every point within the operating contour as defined by the deep-draft channel (see Fig. 2), each of these three factors can be readily determined.

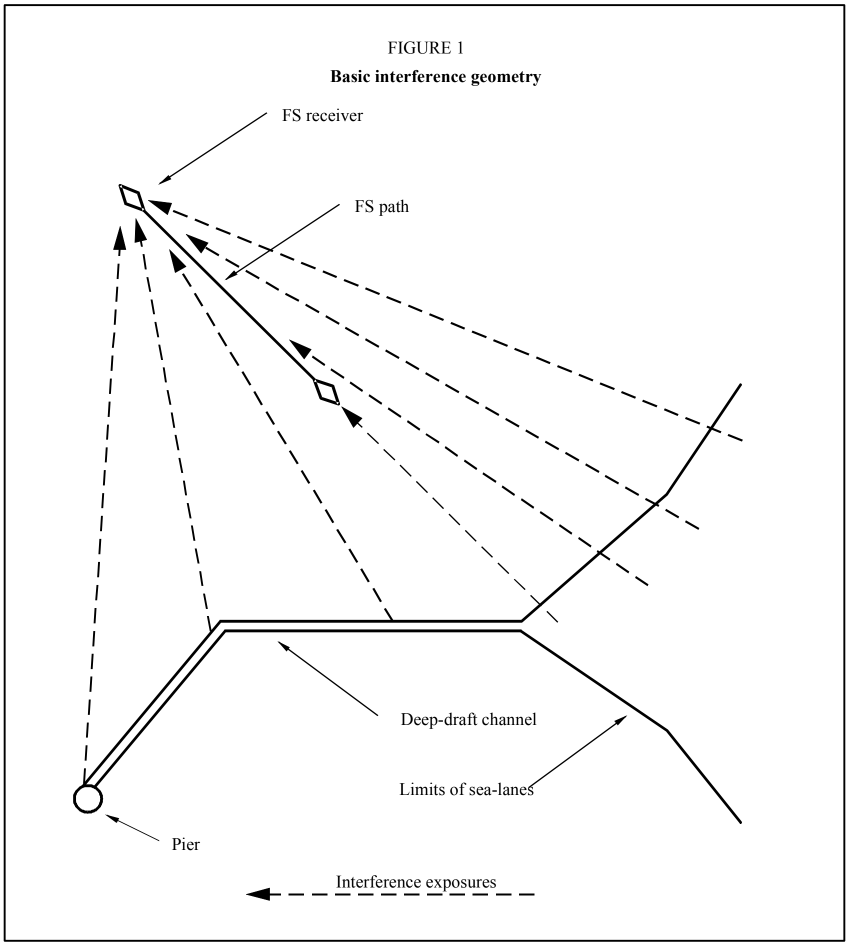

FIGURE 2 – BASIC INTERFERENCE GEOMETRY

For the purpose of evaluating the potential interference the operating contour is approximated by a set of straight-line segments. The identification of the CCPs depends on the position and alignment of the FS path with respect to the operating contour, and several cases need to be distinguished. In those cases where the azimuth of the main beam axis of the FS antenna does not intersect with any portion of the operating area of the ESV, the critical contour points are the points along the operating contour where the contour changes direction or reaches the off-shore limit beyond which coordination is not required. In those cases where the azimuth of the main beam axis of the FS antenna intersects the operating contour it is necessary to augment and/or modify the number of CCPs. In any event, the same CCPs should be used to consider both the long-term and the short-term interference to any FS station under consideration. Interference from in-motion ESV operations to any FS receiver within the area where the potential interference from the ESV needs to be evaluated is assessed by consideration of the operation at each of the CCPs for each receiver using propagation

loss models such as those given in recommendation ITU-R P.452. The goal of this assessment is the identification of frequencies that can be used for in-motion ESV operations without causing unacceptable levels of interference to FS stations.
For the identification of the CCPs with respect to a specific FS receiver, the following three cases need to be distinguished:

Case 1: in this case the main beam axis of the FS receiving antenna does not intersect any portion of the operating contour. The only CCPs required for this case are the points where the operating contour of the ESV changes direction.

Case 2: in this case, the main beam of the FS antenna (within 10 db of the maximum antenna gain) lies entirely within one segment of the operating contour. The points on the operating contour where the antenna gain is 10 db below the maximum, determine two additional CCPs. The segment of the operating contour between these two CCPs contains the natural intersection point (nip), the point where the main beam axis of the FS antenna intersects the operating contour. The nip is always taken as a CCP.

Case 3: in this case, the nip is close enough to one of the points where the operating contour changes direction that the main beam of the FS antenna extends over more than one segment of the operating contour. This case is most likely to arise when the nip is close to one of the points where the operating contour of the ESV changes direction. The intersection of the operating contour with the antenna 10 db points determine two additional CCPs as in case 2; however, in this case the original point within the main beam does not need to be considered as a CCP.

A further possibility: if there is a point on the operating contour of an ESV from which the maximum horizon gain of the ESV antenna is directed toward a FS receiver, that point on the contour may be identified as an additional CCP for that FS receiver regardless of which of the three cases applies.

The CCP always represents the worst-case interference scenario and the associated exclusion zone mitigates all interference into an FS receiver for the ESV route.

Once the CCP is determine an interference zone where the ESV transmissions into the victim receiver will exceed the maximum permissible interference criteria is developed based upon the receive antenna pattern of the terrestrial station. Within these zones the interfered spectrum must be avoided. The interference zones are detailed in the attached ESV Interference Analysis excel workbook.

SECTION 3 – INTERFERENCE RESULTS

Table 3 below list the interference cases calculated for the ESV port(s) and route, including worst case interference margin. Table 4 provides a high level summary for each case CCP, including the CCP coordinates, interference margin, victim receive location, and affected licensee.

Site	San Juan																			
	Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Into1																				
Case	Margin (dB)																			
248	40.0			Y	Y	Y														
249	31.7														Y	Y	Y			
252	31.7											Y	Y							
446	31.4														Y	Y		Y	Y	
38	29.9			Y	Y	Y														
138	29.2															Y	Y	Y	Y	
8	27.7		Y	Y																
40	27.2			Y	Y	Y														
368	27.0													Y	Y	Y				
382	25.9														Y	Y		Y	Y	
383	25.9														Y	Y		Y	Y	
247	25.9																			
233	25.8						Y	Y	Y											
400	24.7						Y	Y	Y											
260	24.7					Y	Y	Y												
32	24.6		Y	Y	Y															
413	24.6																			
392	24.4																			
77	23.6		Y	Y	Y	Y	Y	Y	Y											
39	23.1							Y	Y	Y										
86	22.3		Y	Y	Y	Y	Y													
159	22.0															Y	Y	Y		
328	21.8												Y	Y	Y					
455	20.8																			
254	20.8						Y	Y	Y	Y										
460	20.4		Y	Y	Y															
465	20.4		Y	Y	Y															
18	20.0		Y	Y																
308	19.9		Y	Y	Y	Y	Y													
222	19.7		Y	Y																
397	19.4														Y	Y	Y			
72	19.2		Y	Y																
76	19.1		Y							Y										
307	19.0								Y	Y										
357	18.7												Y	Y	Y					
358	18.7																Y	Y	Y	
27	18.4		Y	Y	Y	Y	Y	Y	Y											
81	18.1		Y	Y				Y	Y	Y										
210	18.0		Y	Y		Y	Y													

360	17.8				Y	Y	Y	Y	Y	Y										
364	16.8								Y	Y										
45	16.6						Y	Y	Y											
114	16.5					Y	Y	Y												
298	14.7		Y	Y	Y															
304	11.5																			
14	7.0							Y	Y	Y										
184	4.0																	Y	Y	
16	3.6											Y	Y	Y	Y	Y	Y	Y	Y	
51	3.6											Y	Y	Y	Y	Y				
349	3.1																			
157	2.8		Y	Y	Y															
98	2.7													Y	Y	Y	Y			
69	2.7		Y	Y	Y															
202	1.7																			
Into2																				
Case	Margin (dB)																			
249	40.2					Y	Y	Y												
252	40.2		Y	Y																
446	40.2					Y	Y		Y	Y										
165	39.5				Y	Y	Y		Y	Y										
382	34.7					Y	Y		Y	Y										
383	34.7					Y	Y		Y	Y										
54	33.8												Y	Y	Y	Y	Y	Y		
248	31.9												Y	Y	Y					
160	31.5											Y	Y							
329	30.7					Y	Y	Y												
118	30.7														Y	Y	Y			
70	30.4																	Y	Y	
204	29.9																			
457	28.8		Y	Y																
464	28.8		Y	Y																
199	28.4																			
28	28.2											Y	Y	Y	Y	Y	Y	Y	Y	
257	27.9																Y	Y	Y	
205	27.7																			
447	27.5						Y	Y	Y											
462	27.5						Y	Y	Y											
361	27.1		Y	Y	Y															
206	26.7																			
472	26.6															Y	Y	Y		
33	25.9				Y	Y	Y													
245	25.5												Y	Y	Y					

246	25.5											Y	Y	Y						
436	25.5												Y	Y	Y					
437	25.5											Y	Y	Y						
209	25.4																			
449	25.0		Y	Y	Y															
144	24.5														Y	Y	Y			
67	24.4													Y	Y	Y				
139	24.2											Y	Y					Y	Y	
69	24.0											Y	Y	Y						
4	23.8																	Y	Y	
53	23.8																Y	Y		
471	23.6					Y	Y	Y	Y	Y										
255	23.5											Y	Y	Y	Y	Y				
208	23.3				Y	Y	Y													
448	23.1														Y	Y			Y	
258	22.4													Y	Y	Y	Y			
399	22.4											Y	Y							
346	21.7								Y	Y										
212	21.4						Y	Y	Y											
37	21.4															Y	Y	Y		
95	20.8						Y	Y	Y											
30	20.3																	Y	Y	
181	20.2		Y	Y																
332	20.1												Y	Y	Y					
452	19.8														Y	Y	Y	Y	Y	
451	19.8																Y	Y	Y	
453	19.8														Y	Y	Y			
242	19.3																			
330	19.3						Y	Y	Y											
287	18.3		Y			Y	Y	Y	Y	Y										
201	17.8																			
421	17.0																Y	Y	Y	
450	17.0					Y	Y	Y												
422	16.1											Y	Y	Y						
298	10.1																Y	Y	Y	
88	7.0																Y	Y	Y	
239	5.5																			
159	4.8						Y	Y	Y											
41	0.2		Y	Y	Y	Y	Y	Y	Y	Y										

Summary of Cases	
Channel Spectrum (MHz)	# Cases

1	5925-5929.0	0
2	5930.375-5960.025	25
3	5960.025-5989.675	26
4	5989.675-6019.325	20
5	6019.325-6048.975	23
6	6048.975-6078.625	30
7	6078.625-6108.275	24
8	6108.275-6137.925	26
9	6137.925-6167.575	16
10	6168.86-6181.0	0
11	6182.415-6212.065	12
12	6212.065-6241.715	19
13	6241.715-6271.365	19
14	6271.365-6301.015	25
15	6301.015-6330.665	23
16	6330.665-6360.315	22
17	6360.315-6389.965	23
18	6389.965-6419.615	19
19	6421-6425	0

TABLE 3 – SUMMARY OF ESV ROUTE INTERFERENCE FREQUENCY ANALYSIS CASES

Interference Zones			San Juan		
Into 1					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin(dB)	Victim Rx Site	Licensee
248	18.29466	65.08053043	40.0	PR59XC205	Sprintcom, Inc
249	18.29466	65.08053043	31.7	176 ISABELLA	Sprintcom, Inc. Puerto Rico
252	18.29466	65.08053043	31.7	176 ISABELLA	Sprintcom, Inc. Puerto Rico
446	18.29466	65.08053043	31.4	176 ISABELLA	Sprintcom, Inc. Puerto Rico
38	18.60704	66.26042086	29.9	CEDRO ABAJO	Puerto Rico Telephone Company, Inc.
138	18.55489	66.08293143	29.2	LA SANTA	Puerto Rico Electric Power Authority
8	18.45232	66.11221545	27.7	MARAVILLAS	Puerto Rico Telephone Company, Inc.
40	18.56378	65.91955653	27.2	TORRECILLAS	Puerto Rico Telephone Company, Inc.
368	18.5773	66.23201857	27.0	MOROVIS PRTC	Neptunomedia, Inc.
382	18.29466	65.08053043	25.9	176 ISABELLA	Sprintcom, Inc. Puerto Rico
383	18.29466	65.08053043	25.9	176 ISABELLA	Sprintcom, Inc. Puerto Rico
247	18.44253	65.20126609	25.9	176 ISABELLA	Sprintcom, Inc. Puerto Rico
233	18.34279	65.13209386	25.8	CEIBA	AT&T Mobility Puerto Rico
400	18.62017	65.74235699	24.7	YABUCAO	Puerto Rico Electric Power Authority
260	18.36163	65.14179227	24.7	SUSANNABERG	AT&T Mobility Virgin Islands, Inc.
32	18.56319	65.93039945	24.6	LA MESA	PR Wireless, Inc.
413	18.52496	66.18206243	24.6	ORCOVIS CR	PR Wireless, Inc.
392	18.44517	65.20537878	24.4	VIEQUES 1	PR Wireless, Inc.
77	18.71697	66.38515935	23.6	JAYUYA	Puerto Rico Telephone Company, Inc.
39	18.62076	65.7320027	23.1	CEDRO ABAJO	Puerto Rico Telephone Company, Inc.
86	18.76183	66.58117357	22.3	EL GATO	Puerto Rico Electric Power Authority
159	18.61812	65.77788573	22.0	EL GATO	Puerto Rico Electric Power Authority
328	18.77327	66.55830139	21.8	GURABO	Neptunomedia, Inc.

455	18.59992	65.44653984	20.8	COROZAL	Olympic Wireless, LLC
254	18.397	65.15999677	20.8	LPI011	Iniciativa Tecnologica Centro Oriental
460	18.76316	66.57851308	20.4	PR00096A	T-Mobile Puerto Rico LLC
465	18.76316	66.57851308	20.4	PR00096A	T-Mobile Puerto Rico LLC
18	18.40285	65.16300889	20.0	LA MESA	PR Wireless, Inc.
308	18.42679	65.17679771	19.9	VIEQUES PILO	Puerto Rico Telephone Company, Inc.
222	18.56863	65.39769485	19.7	PANDURA	Neptunomedia, Inc.
397	18.39294	65.15790834	19.4	EL YUNQUE	Puerto Rico Electric Power Authority
72	18.57094	66.22594538	19.2	INDIERA	Puerto Rico Commomwealth
76	18.62217	65.70733776	19.1	JAYUYA	Puerto Rico Telephone Company, Inc.
307	18.31294	65.11367656	19.0	FAJARDO	Aeronet Wireless Broadband LLC
357	18.78947	66.48239873	18.7	CERRO PUNTA	PR Wireless, Inc.
358	18.78947	66.48239873	18.7	CERRO PUNTA	PR Wireless, Inc.
27	18.63343	65.50859766	18.4	JAYUYA	Puerto Rico Telephone Company, Inc.
81	18.6248	65.66137722	18.1	MONTE JAYUYA	Puerto Rico Telephone Company, Inc.
210	18.60874	65.46031003	18.0	PR70XC332	Sprintcom, Inc. Puerto Rico
360	18.63218	65.53083927	17.8	AWILDA	PR Wireless, Inc.
364	18.61813	65.77779993	16.8	OSN-PINAS	Osnet Wireless Corporation
45	18.40285	65.16300889	16.6	LA MESA	PR Wireless, Inc.
114	18.66304	66.31394384	16.5	ATALAYA	Puerto Rico Commonwealth of State Police
298	18.30005	64.97164999	14.7	CROWN MTN	Broadband VI, LLC
304	18.26723	65.02003654	11.5	LA SANTA	PREPA Networks, LLC.
14	18.61261	65.46634487	7.0	MONTE JAYUYA	Evertec, Inc.
184	18.26189	64.99127716	4.0	COLLORES	PR Wireless, Inc.
16	18.29858	64.96292509	3.6	CROWN MTN	Virgin Islands Telephone Corporation
51	18.29858	64.96292509	3.6	CROWN MTN	Virgin Islands Telephone Corporation
349	18.75246	66.59989491	3.1	ORCOVIS CR	PR Wireless, Inc.

157	18.59308	66.2470881	2.8	ISABELA PLAN	Puerto Rico Electric Power Authority
98	18.4489	66.10930915	2.7	EL YUNQUE	Puerto Rico Electric Power Authority
69	18.4489	66.10930915	2.7	MINILLAS	Puerto Rico Commomwealth
202	18.26455	65.00559733	1.7	SANTA ANA	PR Wireless, Inc.
Into 2					
Case #	CCP Lat	CCP Long	Margin(dB)	Victim Rx Site	Licensee
249	18.29466	65.08053043	40.2	PR59XC205	Sprintcom, Inc. Puerto Rico
252	18.29466	65.08053043	40.2	PR59XC205	Sprintcom, Inc. Puerto Rico
446	18.29466	65.08053043	40.2	PR59XC205	Sprintcom, Inc. Puerto Rico
165	18.30084	64.97630791	39.5	CROWN MTN	University of The Virgin Islands
382	18.29466	65.08053043	34.7	PR59XC205	Sprintcom, Inc. Puerto Rico
383	18.29466	65.08053043	34.7	PR59XC205	Sprintcom, Inc. Puerto Rico
54	18.37771	65.15006827	33.8	BETHANY	Virgin Islands Telephone Corporation
248	18.29466	65.08053043	31.9	176 ISABELLA	Sprintcom, Inc
160	18.55511	66.07880842	31.5	MONACILLOS	Puerto Rico Electric Power Authority
329	18.4656	66.12530098	30.7	NARANJITO	Neptunomedia, Inc.
118	18.4489	66.10930915	30.7	HATO NUEVO	Puerto Rico Commonwealth of State Police
70	18.45103	66.10857901	30.4	YUNQUE	Puerto Rico Commomwealth
204	18.4489	66.10930915	29.9	FAJARDO LOW	PR Wireless, Inc.
457	18.53948	66.19591533	28.8	PR00579A	T-Mobile Puerto Rico LLC
464	18.53948	66.19591533	28.8	PR00579A	T-Mobile Puerto Rico LLC
199	18.61926	65.75820411	28.4	TRANSCARIBE	PR Wireless, Inc.
28	18.62001	65.74515457	28.2	HUMACAO	Puerto Rico Telephone Company, Inc.
257	18.31248	65.11283354	27.9	BORDEAUX	AT&T Mobility Virgin Islands, Inc.
205	18.47294	66.12809229	27.7	CONQUISTADOR	PR Wireless, Inc.
447	18.53765	66.11114898	27.5	PR000117A	T-Mobile License LLC
462	18.53765	66.11114898	27.5	PR000117A	T-Mobile License LLC
361	18.56319	65.93039945	27.1	LA MESA	PR Wireless, Inc.
206	18.62016	65.74239922	26.7	CHUPACALLOS	PR Wireless, Inc.

472	18.62381	65.67876349	26.6	CIEBA	AT&T Corp.
33	18.42795	65.17859294	25.9	EL YUNQUE	Puerto Rico Telephone Company, Inc.
245	18.56148	65.96211417	25.5	176 ISABELLA	Sprintcom, Inc. Puerto Rico
246	18.56148	65.96211417	25.5	176 ISABELLA	Sprintcom, Inc. Puerto Rico
436	18.56148	65.96211417	25.5	176 ISABELLA	Sprintcom, Inc. Puerto Rico
437	18.56148	65.96211417	25.5	176 ISABELLA	Sprintcom, Inc. Puerto Rico
209	18.76885	66.4547269	25.4	FLORIDA	PR Wireless, Inc.
449	18.45475	66.10730084	25.0	CC FAJARDO	Aeronet Wireless Broadband LLC
144	18.31339	65.1144949	24.5	CHALWELL	Choice Communications, LLC (VI)
67	18.55546	66.07247054	24.4	LA SANTA	Puerto Rico Commomwealth
139	18.55959	65.99695467	24.2	LA SANTA	Puerto Rico Electric Power Authority
69	18.56395	65.91642956	24.0	NARANJITO	Puerto Rico Commomwealth
4	18.4525	66.11236696	23.8	VIEQUES	Puerto Rico Telephone Company, Inc.
53	18.4525	66.11236696	23.8	VIEQUES	Puerto Rico Telephone Company, Inc.
471	18.53994	65.35295653	23.6	HUMACAO NORT	AT&T Corp.
255	18.55428	66.09401584	23.5	HUM014	Iniciativa Tecnologica Centro Oriental
208	18.61343	65.85045723	23.3	PRTC PINAS	Neptunomedia, Inc.
448	18.56162	65.95955058	23.1	JAJOME	AT&T Mobility Puerto Rico
258	18.55239	66.10088989	22.4	VIEQUES BC	AT&T Mobility Puerto Rico
399	18.56606	65.91361671	22.4	VIEQUES	Puerto Rico Electric Power Authority
346	18.4489	66.10930915	21.7	PRT VB	Aeronet Wireless Broadband LLC
212	18.46558	66.12714158	21.4	MONTE DEL ES	Critical Hub Networks, Inc.
37	18.78947	66.48239873	21.4	CERRO PUNTA	PR Wireless, Inc.
95	18.60966	65.46174937	20.8	CAGUAS HIMA	Neptunomedia, Inc.
30	18.63218	65.53083927	20.3	AWILDA	PR Wireless, Inc.
181	18.51476	65.31370753	20.2	SANTA JUANA	Neptunomedia, Inc.
332	18.61821	65.77632878	20.1	OROCOVIS	Neptunomedia, Inc.
452	18.62874	65.59194342	19.8	AIBONITO	AT&T Mobility Puerto Rico
451	18.5625	65.94317169	19.8	TORRECILLAS	Aeronet Wireless Broadband LLC
453	18.5625	65.94317169	19.8	TORRECILLAS	Aeronet Wireless Broadband LLC

242	18.55601	65.37800746	19.3	COCACOLA 104	PR Wireless, Inc.
330	18.80249	66.49987381	19.3	MONTE DEL ES	Neptunomedia, Inc.
287	18.55872	66.01286789	18.3	VIEQUES PILO	Puerto Rico Telephone Company, Inc.
201	18.49947	65.28988861	17.8	BARRANQUITAS	PR Wireless, Inc.
421	18.88341	66.64823531	17.0	RONCADOR	Osnet Wireless Corporation
450	18.77128	66.56229168	17.0	COLLORES	Aeronet Wireless Broadband LLC
422	18.4489	66.10930915	16.1	NET-MAESTRO	Osnet Wireless Corporation
298	18.29858	64.96292509	10.1	LTL PRINCESS	Broadband VI, LLC
88	18.60636	65.45658702	7.0	CERRO PUNTA	Puerto Rico Electric Power Authority
239	18.45707	66.11097889	5.5	SANTA ISABEL	PR Wireless, Inc.
159	18.4489	66.10930915	4.8	SANTURCER	Puerto Rico Electric Power Authority
41	18.4489	66.10930915	0.2	EL YUNQUE	Puerto Rico Telephone Company, Inc.

TABLE 4 – SUMMARY OF ESV ROUTE INTERFERENCE CASES

Summary of Results

Table 3 shows that there are numerous cases affecting spectrum throughout the 6 GHz band. There are three segments of the spectrum which have zero cases throughout the passage of the ESV route and into the port see the summary table below, these represent the band edges which have no overlap to typical Fixed Service microwave plans (the so-called 4% solution since approximately 20 MHz of the 500 MHz band is available:

Summary of Cases		
Channel Spectrum (MHz)		# Cases
1	5925-5929.0	0
2	5930.375-5960.025	25
3	5960.025-5989.675	26
4	5989.675-6019.325	20
5	6019.325-6048.975	23
6	6048.975-6078.625	30
7	6078.625-6108.275	24
8	6108.275-6137.925	26
9	6137.925-6167.575	16
10	6168.86-6181.0	0
11	6182.415-6212.065	12
12	6212.065-6241.715	19
13	6241.715-6271.365	19
14	6271.365-6301.015	25
15	6301.015-6330.665	23
16	6330.665-6360.315	22
17	6360.315-6389.965	23
18	6389.965-6419.615	19
19	6421-6425	0

Most of the remainder of the band is encumbered by numerous cases.

ST JOHN ESV INTERFERENCE ANALYSIS
PREPARED FOR O3b

PREPARED BY SKJEI TELECOM
November 27, 2017

TABLE OF CONTENTS

Section 1: ESV Parameters

An interference analysis to determine the interference potential from of a C-band Earth Station onboard Vessel (ESV) has been performed for the St John, NS area. The analysis considers a port-side location in St. John. The Earth Station operating parameters are shown in Table 1 below. Table 2 below lists the breakpoints of the ESV approach route, as shown in Figure 1 below.

Company	O3b	
Site Name, State	St. John	
Call Sign		
Latitude (NAD83) Main Port (B47)	45.27222222	N
Longitude (NAD83) Main Port (B47)	66.06566667	W
Elevation AMSL (ft/m)	0	
Transmit Frequency Range (MHz)	5925-6425	
Climate Zone		
Range of Satellite Orbital Long. (deg W)	20	72
Range of Azimuths from North (deg)	124.4	188.3
Antenna Centerline (ft/m)	51.0	15.5
Antenna Elevation Angles (deg)	21.1	37.5
Antenna Diameter (m)	2.4	
Equipment Parameters at Center Freq (GHz)		6.18
Antenna Gain, Main Beam (dBi)		41.9
15 DB Half Beamwidth (deg)		1.18
3 DB Half Beamwidth (deg)		0.66
Receive Antenna Type		
Transmit Antenna Type		FCC32
Max Transmitter Power (dBW/4KHz)		-16.3
Max EIRP Main Beam (dBW/4KHz)		51.0
Modulation / Emission Designator		1M40G7W
Coordination Parameters		
6 GHz Max Interference Power Long Term (dBW/4kHz) (20%)	-154	
6 GHz Max Interference Power Short Term (dBW/4kHz) (.0025%)	-131	
6 GHz Max Interference Power In Motion (dBW/4kHz) (1%)	-145	

TABLE 1 – EARTH STATION ON VESSEL DATA SHEET

Break Pt	Latitude	Longitude
Port	451620	660356.4
Bp1	451614.8	660350.8
Bp2	451609.8	660347.2
Bp3	451602.8	660344.6
Bp4	451556.4	660349.8
Bp5	451541.7	660334.3
Bp6	451514	660300.7
Bp7	451417.4	660133.9
Bp8	451249.9	660249.9
Bp9	445656.5	655858.9
Bp10	443005.5	663334.8
Bp11	434059.9	674533.9
Bp12	421618.2	663755.9
Bp13	412102.3	675310.2
Bp14	424648.2	641932.8

TABLE 2 - ESV ROUTE BREAK POINTS

Bp2
Bp9
Bp10
Bp11
Bp12
Bp13
Bp14
NEW BRUNSWICK
NOVA SCOTIA
CANADA
STATES
Bay of Fundy
Atlantic Ocean
Gulf of Maine
Halifax

FIGURE 1 - ESV ROUTE

Section 2: The Critical Contour Point Technique

The critical contour point (CCP) technique has been developed to assist in the determination of interference from an ESV. The technique involves calculating the interference from all points along the route of the ESV and determining which point produces the worst case interference into a victim microwave receiver. The worst case interference level is then calculated for this point. If the calculated interference exceeds the maximum long-term permissible level of interference, which is shown in Table 1 above, then the licensed or coordinated receive frequencies for that site must be avoided in order to preclude interference.

The following section is excerpted from ITU-R SF 1649, which describes the CCP in more detail:

For any interference exposure of a particular FS receiver from an ESV terminal on a moving ship, there are three position-related variables in the calculation:

– Propagation loss exceeded for all but a percentage of time. This loss depends on the length of the interference path, the radio-climatic zones and may include the effects of any blockage that may exist on the interference path;
– FS receiver antenna gain; and
– ESV antenna horizon gain.

For every point within the operating contour as defined by the deep-draft channel (see Fig. 2), each of these three factors can be readily determined.

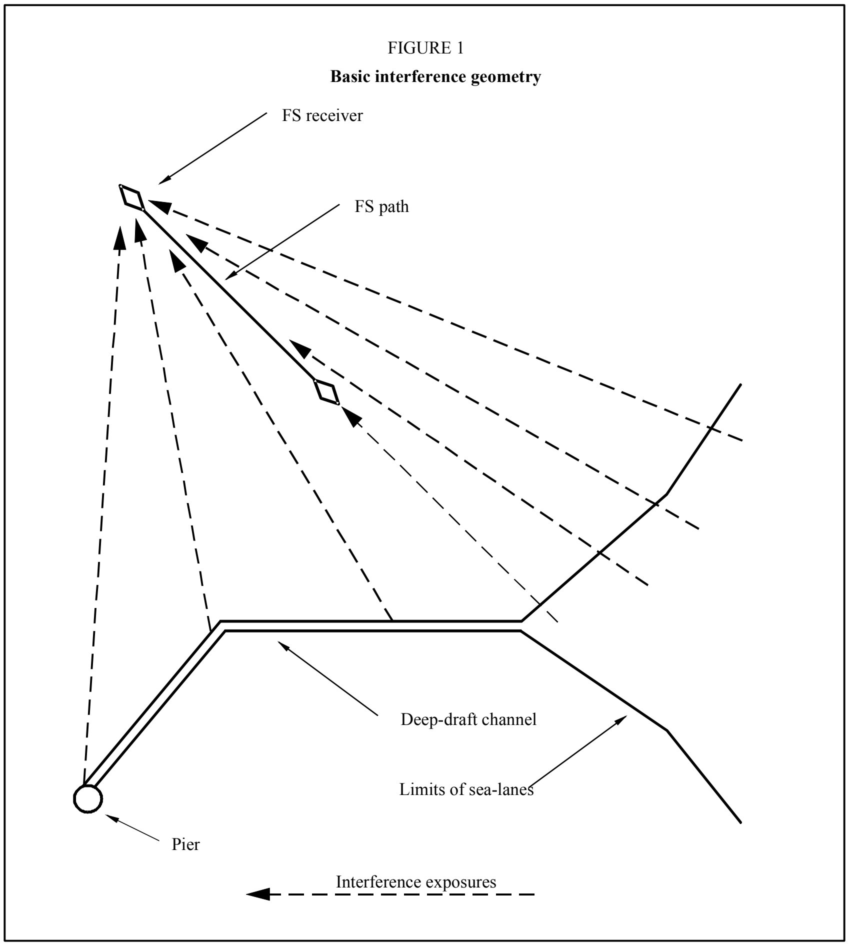

FIGURE 2 – BASIC INTERFERENCE GEOMETRY

For the purpose of evaluating the potential interference the operating contour is approximated by a set of straight-line segments. The identification of the CCPs depends on the position and alignment of the FS path with respect to the operating contour, and several cases need to be distinguished. In those cases where the azimuth of the main beam axis of the FS antenna does not intersect with any portion of the operating area of the ESV, the critical contour points are the points along the operating contour where the contour changes direction or reaches the off-shore limit beyond which coordination is not required. In those cases where the azimuth of the main beam axis of the FS antenna intersects the operating contour it is necessary to augment and/or modify the number of CCPs. In any event, the same CCPs should be used to consider both the long-term and the short-term interference to any FS station under consideration. Interference from in-motion ESV operations to any FS receiver within the area where the potential interference from the ESV needs to be evaluated is assessed by consideration of the operation at each of the CCPs for each receiver using propagation

loss models such as those given in recommendation ITU-R P.452. The goal of this assessment is the identification of frequencies that can be used for in-motion ESV operations without causing unacceptable levels of interference to FS stations.
For the identification of the CCPs with respect to a specific FS receiver, the following three cases need to be distinguished:

Case 1: in this case the main beam axis of the FS receiving antenna does not intersect any portion of the operating contour. The only CCPs required for this case are the points where the operating contour of the ESV changes direction.

Case 2: in this case, the main beam of the FS antenna (within 10 db of the maximum antenna gain) lies entirely within one segment of the operating contour. The points on the operating contour where the antenna gain is 10 db below the maximum, determine two additional CCPs. The segment of the operating contour between these two CCPs contains the natural intersection point (nip), the point where the main beam axis of the FS antenna intersects the operating contour. The nip is always taken as a CCP.

Case 3: in this case, the nip is close enough to one of the points where the operating contour changes direction that the main beam of the FS antenna extends over more than one segment of the operating contour. This case is most likely to arise when the nip is close to one of the points where the operating contour of the ESV changes direction. The intersection of the operating contour with the antenna 10 db points determine two additional CCPs as in case 2; however, in this case the original point within the main beam does not need to be considered as a CCP.

A further possibility: if there is a point on the operating contour of an ESV from which the maximum horizon gain of the ESV antenna is directed toward a FS receiver, that point on the contour may be identified as an additional CCP for that FS receiver regardless of which of the three cases applies.

The CCP always represents the worst-case interference scenario and the associated exclusion zone mitigates all interference into an FS receiver for the ESV route.

Once the CCP is determine an interference zone where the ESV transmissions into the victim receiver will exceed the maximum permissible interference criteria is developed based upon the receive antenna pattern of the terrestrial station. Within these zones the interfered spectrum must be avoided. The interference zones are detailed in the attached ESV Interference Analysis excel workbook.

SECTION 3 – INTERFERENCE RESULTS

Table 3 below list the interference cases calculated for the ESV port(s) and route, including worst case interference margin. Table 4 provides a high level summary for each case CCP, including the CCP coordinates, interference margin, victim receive location, and affected licensee.

Site	St Johns																			
	Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Into 1																				
Case #	Margin(dB)																			
1795	23.6															Y	Y	Y		
Into 2																				
Case #	Margin(dB)																			
463	12.2						Y	Y	Y											
908	6.9		Y	Y																

Summary of Cases		
Channel Spectrum (MHz)		# Cases
1	5925-5929.0	0
2	5930.375-5960.025	1
3	5960.025-5989.675	1
4	5989.675-6019.325	0
5	6019.325-6048.975	0
6	6048.975-6078.625	1
7	6078.625-6108.275	1
8	6108.275-6137.925	1
9	6137.925-6167.575	0
10	6168.86-6181.0	0
11	6182.415-6212.065	0
12	6212.065-6241.715	0
13	6241.715-6271.365	0
14	6271.365-6301.015	0
15	6301.015-6330.665	1
16	6330.665-6360.315	1
17	6360.315-6389.965	1
18	6389.965-6419.615	0
19	6421-6425	0

TABLE 3 – SUMMARY OF ESV ROUTE INTERFERENCE FREQUENCY ANALYSIS CASES

Interference Zones			St John		
Into 1					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin (dB)	Victim Rx Site	Licensee
1795	44.77718	65.70670879	23.6	BRIDGETOWN N	Rogers Communications Partnership
Into 2					
Case #	CCP Latitude (dec.deg)	CCP Longitude (dec.deg.)	Margin (dB)	Victim Rx Site	Licensee
463	43.48967	67.60100664	12.2	SWANS ISLAND	Island Telephone Company
908	44.02896	67.25880651	6.9	CALAIS	Maine RSA #4 Limited Partnership

TABLE 4 – SUMMARY OF ESV ROUTE INTERFERENCE CASES

Summary of Results

Table 3 shows that there are only three cases affecting spectrum throughout the 6 GHz band. A great deal of the spectrum has zero cases throughout the passage of the ESV route and into the port see the summary table below:

Summary of Cases		
Channel Spectrum (MHz)		# Cases
1	5925-5929.0	0
2	5930.375-5960.025	1
3	5960.025-5989.675	1
4	5989.675-6019.325	0
5	6019.325-6048.975	0
6	6048.975-6078.625	1
7	6078.625-6108.275	1
8	6108.275-6137.925	1
9	6137.925-6167.575	0
10	6168.86-6181.0	0
11	6182.415-6212.065	0
12	6212.065-6241.715	0
13	6241.715-6271.365	0
14	6271.365-6301.015	0
15	6301.015-6330.665	1
16	6330.665-6360.315	1
17	6360.315-6389.965	1
18	6389.965-6419.615	0
19	6421-6425	0

There are also several spectrum segments with only 1 case, where muting would be required during operation in the exclusion zone.