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May 10, 2002

Via Electronic Filing and Hand Delivery

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
The Portals
445 Twelfth Street, S.W.
Washington, DC 20554

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MAY 10 2002
FEDERAL COMMUNICATIONS COMMISSION
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Re: ***Ex Parte Presentation***:
IB Docket No. 01-185;
Motioent Services Inc. and Mobile Satellite Ventures Subsidiary LLC;
File No. SAT-ASG-20010302-00017 et al.;
TMI Communications and Company, Limited Partnership
File No. SES-ASG-20010116-00099 et al.

Dear Ms. Dortch:

Enclosed on behalf of Inmarsat Ventures plc is a paper entitled "Quantification of Harmful Co-Channel L-Band Uplink Interference into Inmarsat-4 From MSV ATC Uses, Versus MSV Mobile Earth Terminal Uses." This paper quantifies and depicts one aspect of the harmful interference that Inmarsat would suffer if terrestrial use of the L band were authorized.

An original and five copies are enclosed.

Respectfully submitted,

John P. Janka

Enclosure

cc (w/ encl.):

Rick Engelman
Breck Blalock
Trey Hanbury
Paul Locke

No. of Copies rec'd 0+5
List ABCDE

Quantification of Harmful Co-Channel L-Band Uplink Interference into Inmarsat-4 From MSV ATC Uses, Versus MSV Mobile Earth Terminal Uses

Inmarsat Ventures plc

May 9, 2002

IB Docket No. 01-185

Quantification of Harmful Co-Channel L-Band Uplink Interference into Inmarsat-4 From MSV ATC Uses, Versus MSV Mobile Earth Terminal Uses

Inmarsat has previously explained the harmful interference into the Inmarsat network that ATC deployment in the L-band would produce. Communications with any Inmarsat spacecraft that "sees" part of the U.S. would be adversely affected. This includes in-orbit Inmarsat spacecraft at 15.5W, 54W, 98W, 142W, 178E, and 179E, as well as those planned at 143.5E (and other locations).[1]

This paper provides a brief comparative analysis of one aspect of the harmful interference created by ATC use of the L-band, vis-à-vis the impact of continued satellite-only use of the L-band. For the sake of brevity, only one interference case is presented here---co-channel interference into the Inmarsat spacecraft receive antennas from ATC mobile transmitters. The other cases of interference into Inmarsat—harmful adjacent channel interference into Inmarsat spacecraft from ATC mobile transmitters, and harmful adjacent channel interference from ATC base stations into Inmarsat mobile terminals, are addressed in Inmarsat's other filings.[2]

This paper explains why ATC use of the L-band would generate much more interference into the Inmarsat network than continued satellite-only use. Specifically, this paper focuses on the effect of co-channel interference generated by ATC handsets into receivers on the new, state-of-the-art Inmarsat-4 spacecraft. Inmarsat is developing this next-generation system at a cost of over $1.6 Billion, and plans to launch the first Inmarsat-4 spacecraft in 2003. Thus, any ATC interference analysis must take into account the Inmarsat-4 design.

As Inmarsat has demonstrated before, because of the cellular/PCS-like spectrum re-use proposed for MSV's ATC network, there will be many more ATC/terrestrial handsets simultaneously generating interference into the Inmarsat spacecraft than ever would be the case with satellite handsets. In the case of a satellite-only use of the L-band, Inmarsat would have to plan for only one use of a given L-band channel within the >150 mile radius of a next-generation MSV spacecraft spot beam. However, with ATC use, that same area could contain thousands of much smaller ATC "cell sites," each reusing the same channel. Thus, ATC uses would likely produce thousands more co-channel signals that would cause harmful interference into the Inmarsat network.

Finally, this paper depicts how the harmful interference produced by ATC use of the L-band would substantially constrain the ability of Inmarsat to re-use the scarce L-band spectrum in areas near the U.S..

1. Baseline Assumptions About Interference Into Inmarsat-4 Satellite Receive Antennas

In order to quantify the effect of ATC on Inmarsat, it is first important to understand that ATC use in the United States will generate co-channel interference into the

[1] *See* Technical Annex to Inmarsat Comments (filed October 22, 2001); Supplemental Technical Annex to Inmarsat Reply Comments (filed November 13, 2001); Inmarsat Ex Parte Presentation (dated February 21, 2002).

[2] *Id.*

sidelobes of Inmarsat spacecraft receive antennas that are intended to receive signals from geographic areas outside the United States. The level of co-channel interference that Inmarsat will "see" from the United States is a function of the discrimination of the satellite antenna at the given geographical separation, which is fixed by the antenna design, and the constraints of current technology.

In previous analyses, Inmarsat has used a value of 20 dB for the Inmarsat-4 satellite antenna discrimination in the direction of ATC interference. This value is based on an estimate of the antenna discrimination likely to be required for spectrum reuse between the Inmarsat-4 and next-generation MSV spacecraft, as discussed below. Inmarsat will receive ATC interference into those Inmarsat-4 beams that reuse spectrum also used by MSV. Further, since ATC will operate from the same service area as MSV's satellite terminals, the ATC interference will emanate from that same area. Therefore, the satellite antenna discrimination applicable to the agreed reuse between Inmarsat-4 and MSV will also apply to the interference from ATC. As shown below, Inmarsat believes this value will be around 20 dB. MSV, on the other hand, inexplicably has generally used a value of 30 dB, which superficially skews the analysis in MSV's favor. For the reasons described in Section 3, even if MSV's 30 dB value were needed for frequency reuse, ATC deployment still would produce harmful interference into the Inmarsat network.

The current MSV spacecraft and Inmarsat-3 mutually reuse spectrum with around 22 dB of satellite antenna discrimination. The reuse constraints between Inmarsat-4 and the next-generation MSV satellite system will eventually be agreed upon in coordination between Inmarsat and MSV. Inmarsat does not want to prejudge the outcome of these negotiations. However, as Inmarsat showed in its ex-parte presentation dated 21 February 2002, a simple comparison of the interference levels caused by MSV terminals into the Inmarsat-4 satellite indicates that similar antenna isolation levels to the 22 dB used today would also support spectrum reuse between Inmarsat-4 and the next generation MSV system, see Table 1.

Interfering satellite system MES	-	Current MSV	Next-gen. MSV
Victim satellite	-	Inmarsat-3	Inmarsat-4
Victim satellite antenna gain	dBi	27	41
Victim satellite receiver noise temperature	K	700	650
Victim satellite receiver noise spectral density	dBW/Hz	-200.2	-200.5
Victim satellite G/T	dB/K	-1.45	12.9
Maximum interfering MES EIRP	dBW	16.0	5.0
Interfering satellite carrier bandwidth	kHz	6.0	50.0
Interfering MES antenna discrimination	dB	0.0	0.0
Interfering MES EIRP spectral density	dBW/Hz	-21.8	-42.0
Free space loss	dB	188.8	188.8
Satellite receive antenna discrimination	dB	22	21
Power control advantage	dB	0	2
Polarization isolation	dB	0	0
Voice activity factor	dB	0	3
Received interfering signal spectrum density per carrier	dBW/Hz	-205.6	-215.8
$\Delta T/T$ for one carrier	-	28.6%	2.94%
Reuse factor	-	1	10[3]
Total $\Delta T/T$	-	**29%**	**29%**

Table 1: Comparison of interference levels from MSV current and next-generation satellite terminals into Inmarsat-3 and Inmarsat-4 respectively.

In Table 1, the satellite antenna discrimination in the final column was adjusted to produce the same total $\Delta T/T$ value as in the previous column. As reuse between Inmarsat-3 and the current MSV satellite system is possible with 22 dB antenna discrimination, it can be tentatively concluded from this that 21 dB should be sufficient antenna discrimination to enable reuse between Inmarsat-4 and the next-generation MSV satellite system. Thus, Inmarsat has used this analysis as the "baseline" against which to compare the effects of ATC-generated interference[4].

As with any satellite coordination, co-channel spectrum sharing between technically similar satellite networks is much easier to accomplish than sharing between different systems. Given the similarities between Inmarsat-4 and the next-generation MSV system, and the absence on certain feeder link constraints that currently exist on the Inmarsat-3 design, Inmarsat expects to be able to share much more spectrum on a co-channel basis between its Inmarsat-4 design and the next-generation MSV spacecraft. As with any transition to next-generation satellite systems, there will be a period of time where either the new MSV or the new Inmarsat spacecraft will need to co-exist with the older satellite design of its competitor. Any issues arising from the transition to more efficient spot beam spacecraft can be managed on a short-term basis, and do not ultimately limit the potential for more efficient reuse of spectrum by next-generation spot beam satellites.

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[3] See the Attachment for a discussion of the MSV reuse factor.

[4] Table 1 gives a top-level analysis to estimate the antenna discrimination required for reuse - a detailed assessment will have to be performed by Inmarsat and MSV during frequency coordination. In particular, Table 1 only considers one of four relevant satellite network-to-satellite network interference paths; the other three interference paths are: downlink interference from MSV into Inmarsat-4 and uplink and downlink interference from Inmarsat-4 into MSV.

With respect to ATC interference, the critical fact is that once satellite coordination between Inmarsat and MSV has determined the acceptable interference levels from MSV mobile earth terminals into the Inmarsat-4 satellite, additional interference generated by ATC uses will raise the total interference to unacceptable levels. The important question , therefore, is whether the interference caused by an ATC system would be significant in comparison to the interference from MSV's satellite-only operations . As shown below, ATC interference would, in fact, be significant. ATC uses of the L-band would create a permanent, long-term problem that would produce harmful interference into the Inmarsat system, and thereby reduce the capacity of the Inmarsat system.

2. Comparison of uplink interference levels caused by ATC and MSV mobile earth terminals

A comparison between the interference levels caused by the next generation MSV satellite service and the proposed ATC service was presented in the Inmarsat ex-parte presentation to the FCC dated 21 February 2002 and is reproduced below in Table 2.

Interferer		MSV mobile earth terminals	ATC terminals
Inmarsat-4 satellite antenna gain	dBi	41	41
Inmarsat-4 satellite receiver noise temperature	K	650	650
Inmarsat-4 satellite receiver noise spectral density	dBW/Hz	-200.5	-200.5
Inmarsat-4 satellite G/T	dB/K	12.9	12.9
Maximum MSV terminal EIRP	dBW	5	0
MSV carrier bandwidth	kHz	50	200
MSV carrier EIRP spectral density	dBW/Hz	-42.0	-53.0
Free space loss	dB	188.8	188.8
Average shielding	dB	0	3
Average Inmarsat-4 satellite receive antenna discrimination	dB	20	20
Power control advantage	dB	2	2
Variable-rate vocoder advantage	dB	0	0
Polarization isolation	dB	0	1.4
Voice activity factor	dB	3	0
Received interfering signal spectrum density per carrier	dBW/Hz	-214.8	-227.2
ΔT/T for one carrier	-	3.7%	0.2%
Reuse factor	-	10	2000
Total ΔT/T	-	**37%**	**424%**

Table 2: Comparison of interference levels caused by MSV METs and ATC terminals

It is noted from Table 2 that the interference caused by a single MSV satellite carrier is significantly greater than that caused by a single ATC carrier – more than 17 times greater—because of the higher power needed to transmit a signal 22,300 miles into outer space. However, as Table 2 also shows, even though ATC transmitters operate at a lower power, one must factor in the effect of ATC co-channel spectrum reuse--- the larger numbers of ATC cell sites, compared to the number of satellite beams, where co-channel re-use will occur. When that factor is taken into account, this analysis concludes that *the aggregate co-channel interference caused by ATC terminals is more than 11 times greater than that caused by MSV mobile earth terminals.*

This conclusion is based on the ATC reuse factor of 2000 given in MSV's 11 January 2002 ex-parte. In other filings MSV has quoted higher reuse factors, which would lead to even greater levels of ATC interference. A critical distinction between the ATC-generated interference and satellite-generated interference is that there is no limit to the number of times MSV could reuse spectrum in a terrestrial system, whereas there is such a limit on a satellite system

It is significant that the relative level of interference generated by MSV's satellite and terrestrial carriers is independent of the value of the Inmarsat-4 satellite antenna discrimination. Since the interference levels caused by ATC are far greater than those produced by MSV's satellite service, ATC uses would produce harmful co-channel interference into the Inmarsat system.

3. Harmful ATC interference would cause a significant loss of capacity on the Inmarsat system

If MSV were allowed to operate an ATC system, in order to avoid experiencing harmful interference generated by ATC uses, Inmarsat would have to restrict the operation of its system. Specifically, Inmarsat would have to maintain far greater geographic separation from MSV's co-channel use of the L-band to avoid experiencing harmful interference from ATC signals. Thus, Inmarsat would be greatly constrained in its ability to reuse the spectrum that MSV would be using over the United States and adjacent areas. To illustrate this effect, let's assume that a 20 dB satellite antenna discrimination is sufficient to reuse spectrum (without ATC). By way of example, Figure 1 shows the beams of the Inmarsat-4 satellite at the 54W location. The diagonally striped beams are the beams where it is not feasible to achieve an antenna discrimination of at least 20 dB towards the MSV service area, because of insufficient separation from the MSV satellite beams. Thus, these are the only beams in which Inmarsat could not reuse MSV spectrum in the absence of ATC.[5]

If on the other hand ATC uses were authorized, Inmarsat would receive 11.5 times more interference from MSV (see Table 2). This level of interference would clearly be harmful and would have the consequence that Inmarsat would only be able to reuse MSV spectrum in beams that were sufficiently separated to achieve a minimum discrimination of $20+10\log(11.5) = 30.5$ dB. In Figure 1, these beams have been highlighted with a wavy pattern.

The remaining beams in Figure 1 (highlighted with a checkered pattern) are those beams on the Inmarsat 4 spacecraft at 54 W that would support co-frequency sharing with MSV's next-generation spacecraft (assuming that MSV and Inmarsat agreed to reuse spectrum on their satellites with 20 dB of discrimination), but where Inmarsat would no longer be able to reuse MSV spectrum if ATC were allowed, due to the harmful interference produced by ATC uses. Similar results would obtain with respect to other orbital locations where Inmarsat 4 spacecraft might be located.

[5] The satellite antenna discrimination for the Inmarsat-4 beams was calculated using the formula $33-0.33(10-\alpha)^2$, where α is the average off-axis angle from the Inmarsat-4 beam towards the MSV service area (if $\alpha > 10°$, the discrimination is equal to 33 dB). This formula closely approximates the actual antenna gain pattern of the Inmarsat-4 beams.

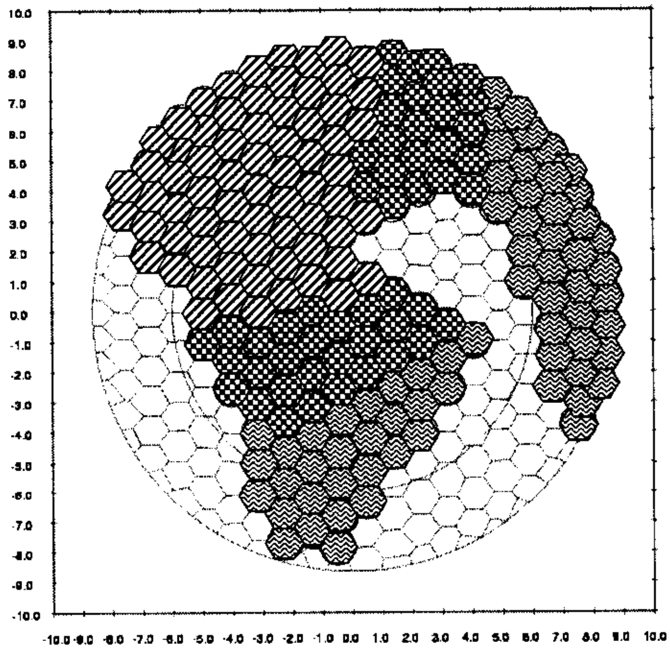
It has to be emphasized that ATC operation also would lead to a significant loss of capacity in the Inmarsat-4 system even if as a result of coordination between Inmarsat and MSV, the agreed required Inmarsat-4 satellite antenna discrimination was different from the 20 dB assumed above. For example, in the very unlikely case that the agreed antenna discrimination requirement was found to be 30.5 dB, then the wavy beams in Figure 1 would represent the beams where Inmarsat could reuse MSV spectrum without ATC. If ATC were introduced in this scenario, Inmarsat would be able to reuse MSV spectrum only in beams where the antenna discrimination towards the MSV service area was at least 30.5+10.5 = 41 dB, since ATC operation would still increase the interference level by the same amount as above. Since the average antenna discrimination towards the MSV service area is less than 41 dB for all the Inmarsat-4 beams, not a single one of the Inmarsat-4 beams would then be able to reuse MSV spectrum.

Inmarsat has just obtained the confidential aspects of the MSV ex parte submissions filed on January 11, 2002 and February 6, 2002, in which MSV has asserted that its proposed next generation satellite/ATC system would have a nominal impact on Inmarsat. MSV's analysis is based on the current configuration of the Inmarsat-3 spacecraft, and it wholly disregards the impact on the Inmarsat-4 design. The Inmarsat-4 design uses state of the art satellite technology, cutting edge spot beam designs, and therefore achieves a much higher level of frequency reuse than ever was possible before. Moreover, the Inmarsat-4 system will not be constrained by the feeder link spectrum limitations present on Inmarsat-3. All of this means that the Inmarsat-4 design supports more co-channel sharing of the L-band, offers a far greater aggregate capacity to end users, and is capable of reusing spectrum over a much wider geographic area, than the Inmarsat-3 system. Thus, ATC deployment in the L-band will have a much greater impact on the Inmarsat-4 system.

In conclusion, MSV has grossly understated both the harmful interference that ATC uses would produce into the Inmarsat system, as well as the significant loss of satellite spectrum reuse that would result from the harmful interference generated by ATC use of the L-band.

Jonas Eneberg
Manager, Spectrum
Inmarsat Limited
9 May 2002

Figure 1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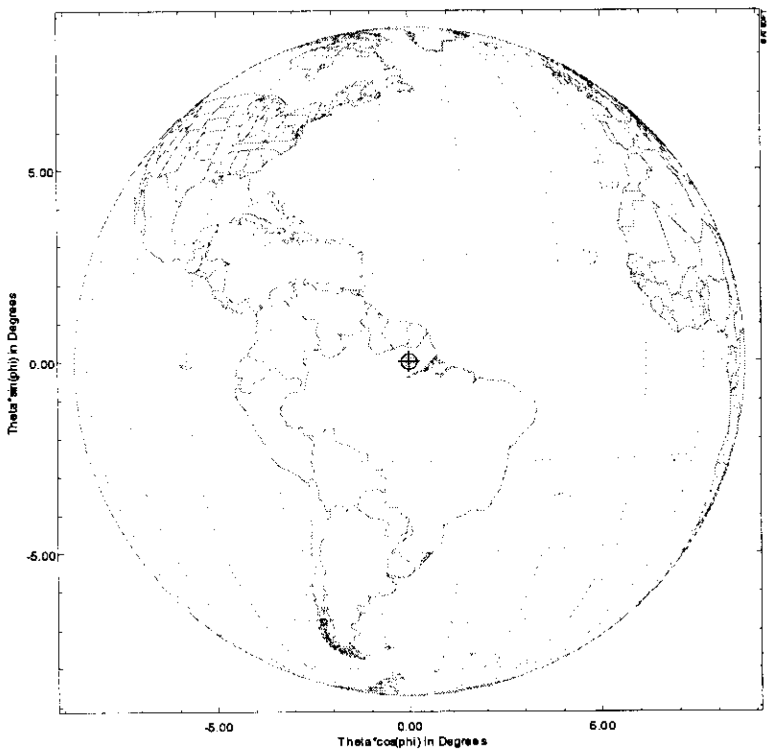
-10.0 -9.0 -8.0 -7.0 -6.0 -5.0 -4.0 -3.0 -2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0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ATTACHMENT

Reuse in the next generation MSV system

MSV states in their filings that the next-generation MSV satellite will reuse the same frequencies 28 times. This number is derived from the fact that the MSV satellite will have up to 200 spot beams (MSV Application, Appendix, Section 1.4, page 5) and will use a 7 cell frequency reuse pattern (200/7 = 28.6). Inmarsat has previously explained that MSV has overstated the level of reuse on its next generation spacecraft, and therefore has overstated the level of interference that Inmarsat can expect to receive from MSV satellite terminals. The following provides a detailed technical analysis of this issue, and concludes that an MSV satellite reuse of at most 10 times is a realistic value, taking into account real world distribution of traffic demand across the United States.

The 28 times reuse claimed by MSV is theoretically possible only in a highly idealized scenario in which all beams that use the same frequencies need exactly the same amount of spectrum. To illustrate, in Figure 1 the beams of the MSV satellite have been numbered according to a seven cell reuse pattern. In order to achieve 28 times reuse, the traffic in all beams labeled "F1" would have to be the same, the traffic in all beams labeled "F2" would have to be the same, and so on.

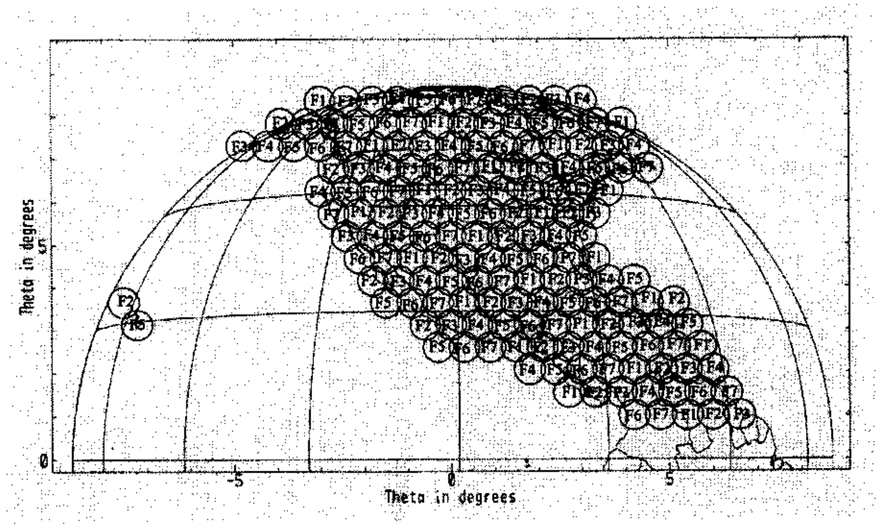

Figure 1: MSV beam pattern with reuse

In the real world, of course, the traffic generated in different beams is not the same. Due to the variation in factors such as population density, terrestrial network coverage, economic prosperity, etc, across the coverage area, traffic demand will vary across the coverage, and different beams therefore will have different spectrum requirements. In order to determine the expected reuse factor for the MSV system, a detailed analysis of all these factors would have to be carried out for the particular coverage area and service offering of the MSV system. Inmarsat has carried out such analyses for the areas to be covered by the Inmarsat-4 system. As mentioned in previous filings, Inmarsat's conclusion is that a reuse factor of **at most** 10 times can be expected for fully loaded conditions. (When the satellite is not fully loaded, the reuse is reduced further.) This estimate is realistic also for the MSV system, since the number of beams is similar (Inmarsat-4 satellite will also have approximately 200 beams). The Inmarsat-4 beams are slightly larger that the MSV beams, and hence the Inmarsat-4 coverage area is larger than that of MSV, but this is not expected to affect significantly the assumptions about traffic demand distribution.

The analysis below calculates a realistic re-use factor for the next-generation MSV system using the same principles that Inmarsat has used to calculate re-use on its own system. The traffic demand data that Inmarsat has gathered for Inmarsat-4 is commercially sensitive and therefore cannot be disclosed here, and any similar data for the MSV system is not known for the same reason. Therefore, a theoretical analysis is provided below to illustrate the principles.

We assume that there are 196 beams on the MSV satellite, making the theoretical maximum reuse 196/7 = 28. Thus, if the traffic was uniformly distributed across the coverage area (if all beams had exactly the same portion of the total traffic), each beam would have 100/196 ≈ 0.51% of the total traffic. However, to model the variation in traffic over the coverage area, we assume that the maximum amount required in any beam is approximately 4 times the average, i.e. 4x0.5 = 2%. This is a reasonable and conservative figure. To distribute the traffic across the 196 beams, we need to use an appropriate statistical distribution. Since we don't know the actual distribution of MSV traffic, the only known properties of this distribution are that the average value is 0.51 and the distribution is limited to the range 0 to 2. A truncated exponential distribution (with $\lambda \approx 1.75$) was chosen. Of course, there are other distributions that meet the same criteria, but it is not believed that these would change the conclusion of this analysis. (Other distributions that were tested gave lower reuse factors than the chosen exponential distribution.) The resulting distribution of spectrum requirements per beam is shown in Figure 2.

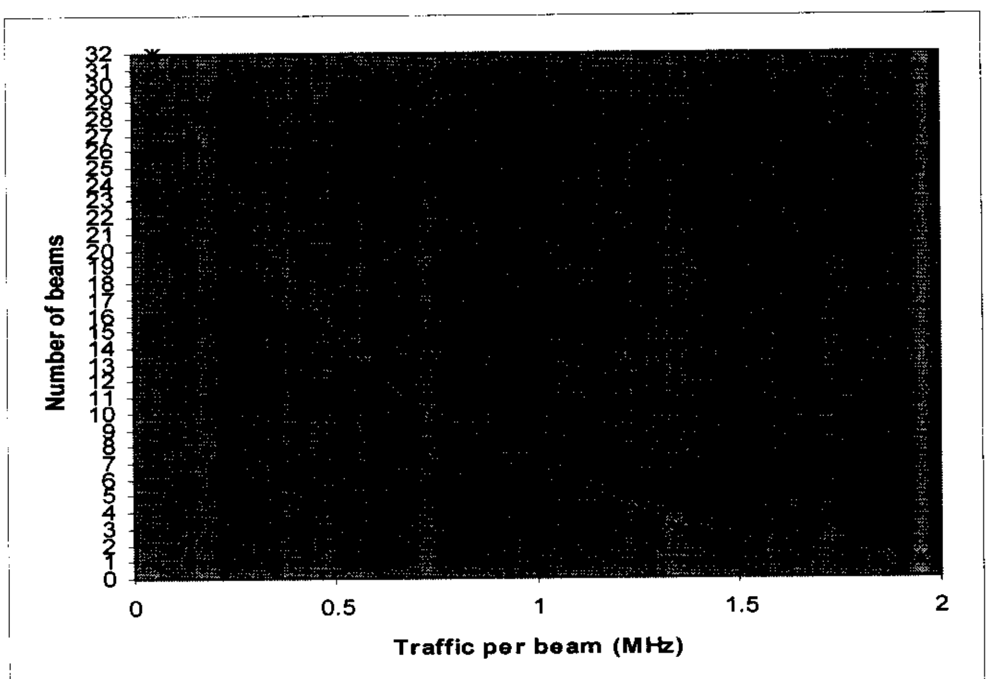

Figure 2: Distribution of spectrum requirements per beam

To calculate the spectrum used in each beam, a simple conversion was used where 1% of the total traffic was converted to 1 MHz of spectrum. Of course, this does not correspond to a real spectrum requirement for the MSV system, but is simply a convenience for calculation purposes. In the present analysis it is not the actual amount of spectrum that is relevant but the number of times spectrum can be reused.

Next, spectrum has to be assigned to the 196 beams of the MSV satellite. This was done by randomly assigning spectrum to beams according to the distribution in Figure 2, i.e. first 32 randomly chosen beams are assigned 0.05 MHz each, next 27 randomly chosen beams are assigned 0.15 MHz each, etc. The assignments are shown in Table 1. Note that in Table 1, all beams with the same reuse number would be reusing the same spectrum. The last column ("Available in reuse") denotes the amount of spectrum that could be used in the beam without requiring any additional spectrum and is the maximum amount used by any beam of the same reuse. Table 2 below summarizes the situation.

Reuse no.	Gross spectrum (MHz)	Net spectrum (MHz)
1	15.3	1.75
2	14.3	1.95
3	13.8	1.85
4	13.5	1.55
5	13.8	1.65
6	14.4	1.45
7	15.1	1.75
	100.2	**12.0**
Reuse factor	(100.2/12.0)	**8.4**

Table 2: Summary and calculation of reuse factor

Thus, in this traffic scenario, the overall reuse of the MSV satellite would be 8.4 times.

Finally, it is noted that the reuse factor obtained for the chosen distribution depends to some extent on the random assignment of spectrum to the 196 beams, in particular to what extent the beams with high amounts of spectrum are in the same reuse or not. Several random assignment orders were generated and it was found that the reuse in all cases was less than 9 times. Thus, in conclusion, using a factor of 10 for interference calculation purposes is a conservative assumption.

Table 1: Spectrum per beam

Beam	Reuse no.	Traffic (MHz)	Available in reuse (MHz)	Beam	Reuse no.	Traffic (MHz)	Available in reuse (MHz)
0	1	0.35	1.75	98	1	0.05	1.75
1	2	0.25	1.95	99	2	0.15	1.95
2	3	0.05	1.85	100	3	1.05	1.85
3	4	0.15	1.55	101	4	0.15	1.55
4	5	0.95	1.65	102	5	0.75	1.65
5	6	0.05	1.45	103	6	1.35	1.45
6	7	0.25	1.75	104	7	0.05	1.75
7	1	0.95	1.75	105	1	1.15	1.75
8	2	1.45	1.95	106	2	0.45	1.95
9	3	0.05	1.85	107	3	0.25	1.85
10	4	0.25	1.55	108	4	0.05	1.55
11	5	0.25	1.65	109	5	0.25	1.65
12	6	0.55	1.45	110	6	0.25	1.45
13	7	1.75	1.75	111	7	0.05	1.75
14	1	1.25	1.75	112	1	1.75	1.75
15	2	0.05	1.95	113	2	0.55	1.95
16	3	0.05	1.85	114	3	0.15	1.85
17	4	0.45	1.55	115	4	1.55	1.55
18	5	0.35	1.65	116	5	1.65	1.65
19	6	0.35	1.45	117	6	0.05	1.45
20	7	1.65	1.75	118	7	0.75	1.75
21	1	0.15	1.75	119	1	0.05	1.75
22	2	0.15	1.95	120	2	0.75	1.95
23	3	0.75	1.85	121	3	0.15	1.85
24	4	0.45	1.55	122	4	0.95	1.55
25	5	0.15	1.65	123	5	0.45	1.65
26	6	0.25	1.45	124	6	0.55	1.45
27	7	0.25	1.75	125	7	0.45	1.75
28	1	0.65	1.75	126	1	1.25	1.75
29	2	1.15	1.95	127	2	0.65	1.95
30	3	0.05	1.85	128	3	0.15	1.85
31	4	0.85	1.55	129	4	0.15	1.55
32	5	0.05	1.65	130	5	0.85	1.65
33	6	0.25	1.45	131	6	0.75	1.45
34	7	0.65	1.75	132	7	0.25	1.75
35	1	0.05	1.75	133	1	0.15	1.75
36	2	0.85	1.95	134	2	0.05	1.95
37	3	0.35	1.85	135	3	0.15	1.85
38	4	0.35	1.55	136	4	0.95	1.55
39	5	0.55	1.65	137	5	0.75	1.65
40	6	0.25	1.45	138	6	1.45	1.45
41	7	1.05	1.75	139	7	0.45	1.75
42	1	0.15	1.75	140	1	0.15	1.75
43	2	0.35	1.95	141	2	1.05	1.95
44	3	0.85	1.85	142	3	1.85	1.85
45	4	0.15	1.55	143	4	0.15	1.55
46	5	0.65	1.65	144	5	0.45	1.65
47	6	0.15	1.45	145	6	1.25	1.45
48	7	0.25	1.75	146	7	0.35	1.75
49	1	0.45	1.75	147	1	0.35	1.75
50	2	0.75	1.95	148	2	0.25	1.95
51	3	0.45	1.85	149	3	0.35	1.85
52	4	0.05	1.55	150	4	0.45	1.55

53	5	1.15	1.65	151	5	0.85	1.65
54	6	0.05	1.45	152	6	0.45	1.45
55	7	0.05	1.75	153	7	1.05	1.75
56	1	0.25	1.75	154	1	0.25	1.75
57	2	1.95	1.95	155	2	0.05	1.95
58	3	0.65	1.85	156	3	0.55	1.85
59	4	1.15	1.55	157	4	0.45	1.55
60	5	0.35	1.65	158	5	0.35	1.65
61	6	0.35	1.45	159	6	0.75	1.45
62	7	0.85	1.75	160	7	0.65	1.75
63	1	0.55	1.75	161	1	0.35	1.75
64	2	0.05	1.95	162	2	0.65	1.95
65	3	0.55	1.85	163	3	0.05	1.85
66	4	0.25	1.55	164	4	0.25	1.55
67	5	0.05	1.65	165	5	0.05	1.65
68	6	1.15	1.45	166	6	0.15	1.45
69	7	0.65	1.75	167	7	0.05	1.75
70	1	0.05	1.75	168	1	0.25	1.75
71	2	0.35	1.95	169	2	0.55	1.95
72	3	1.05	1.85	170	3	0.95	1.85
73	4	0.35	1.55	171	4	0.95	1.55
74	5	0.15	1.65	172	5	0.45	1.65
75	6	0.65	1.45	173	6	0.35	1.45
76	7	0.85	1.75	174	7	0.15	1.75
77	1	0.65	1.75	175	1	0.15	1.75
78	2	0.35	1.95	176	2	0.15	1.95
79	3	1.55	1.85	177	3	0.45	1.85
80	4	0.15	1.55	178	4	0.05	1.55
81	5	0.05	1.65	179	5	0.25	1.65
82	6	1.35	1.45	180	6	0.75	1.45
83	7	0.55	1.75	181	7	0.45	1.75
84	1	1.05	1.75	182	1	1.35	1.75
85	2	0.35	1.95	183	2	0.25	1.95
86	3	0.35	1.85	184	3	0.25	1.85
87	4	0.55	1.55	185	4	0.95	1.55
88	5	0.45	1.65	186	5	0.15	1.65
89	6	0.05	1.45	187	6	0.55	1.45
90	7	1.25	1.75	188	7	0.15	1.75
91	1	0.05	1.75	189	1	1.45	1.75
92	2	0.65	1.95	190	2	0.05	1.95
93	3	0.15	1.85	191	3	0.55	1.85
94	4	0.55	1.55	192	4	0.75	1.55
95	5	0.85	1.65	193	5	0.55	1.65
96	6	0.05	1.45	194	6	0.25	1.45
97	7	0.15	1.75	195	7	0.05	1.75