Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Flexibility for Delivery	)	IB Docket No. 01-185
Of Communications by	)	
Mobile Satellite Service Providers	)	
In the 2 GHz Band, the L-Band, and the	)	
1.6/2.4 GHz Band	)	
	)	
Amendment of Section 2.106 of the Commission's	)	ET Docket No. 95-18
Rules to Allocate Spectrum at 2 GHz for Use	)	
By the Mobile-Satellite Service	)	

FURTHER TECHNICAL COMMENTS OF
THE CELLULAR TELECOMMUNICATIONS & INTERNET ASSOCIATION

The Cellular Telecommunications & Internet Association ("CTIA")[1/] respectfully submits these comments and the attached technical analysis in response to the Public Notice released March 6, 2002 in the above-captioned proceeding.[2/] The Public Notice invites additional technical comment on certain issues raised in the original Notice of Proposed Rulemaking in this proceeding,[3/] in particular whether the operations of mobile satellite services

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1/ CTIA is the international organization of the wireless communications industry for both wireless carriers and manufacturers. Membership in the association covers all Commercial Mobile Radio Service ("CMRS") providers and manufacturers, including cellular, broadband PCS, and ESMR, as well as providers and manufacturers of wireless data services and products.

2/ In the Matter of Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Band; Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum at 2 GHz for Use by the Mobile-Satellite Service, IB Docket No. 01-185, ET Docket No. 95-18, Public Notice, DA 02-554 (rel. March 6, 2002) ("Public Notice").

3/ In the Matter of Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Band; Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum at 2 GHz for Use by the Mobile-Satellite

("MSS") in the 2 GHz band, L-band, and Big LEO band can be "severed" from terrestrial operations in those bands. As the attached technical analysis (Appendix A) describes in more detail, the 2 GHz band can clearly be segmented into separate frequency bands for terrestrial and satellite services, and indeed *must* be segmented even to provide the so-called "integrated MSS Ancillary Terrestrial Component (ATC)" service proposed by New ICO Global Communications ("New ICO").

There is therefore no reason for the Commission to undermine its existing auction process by giving away valuable terrestrial licenses to MSS operators, especially when those operators could easily provide terrestrial services in urban areas by purchasing PCS or cellular licenses or signing agreements with existing CMRS carriers. If the Commission does decide to authorize terrestrial services in the 2 GHz MSS bands, it should segment the band, give all interested entities the opportunity to compete for authorizations to use the terrestrial segments, and award those authorizations using competitive bidding.

DISCUSSION

Question 1. From a purely technical point of view, can the operations of mobile satellite services (MSS) in the 2 GHz band, L-band and Big LEO band be "severed" from terrestrial operations in each band? In other words, is it technically feasible for one operator to provide terrestrial services and another operator to provide satellite services in the same MSS band? If not, why not?

New ICO has yet to choose a single ATC design for consideration, which makes it difficult for either the Commission or other interested parties to assess the spectrum efficiency implications of their ATC proposal. New ICO has not even decided upon such basics as a choice of modulation/coding or frequency sharing mode ("Forward Band," "Reverse Band," "Downlink Duplex," "Uplink Duplex"). Any serious consideration of possible co-frequency co-coverage

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Service, IB Docket No. 01-185, ET Docket No. 95-18, Notice of Proposed Rulemaking, FCC 01-

frequency sharing between satellite and terrestrial services requires some bounds upon the range of emission characteristics, direction of transmission, and other system design basics. The most straightforward way to maintain a wide range of system design possibilities for the terrestrial and satellite systems is for them to use separate frequency band segments.

Even New ICO, which opposes the proposal to separately authorize terrestrial services in the MSS bands in question, admits that segmenting the spectrum in question into separate frequency bands "will technically work, quite easily."[4/] Indeed, New ICO's own proposal confirms that its terrestrial and mobile satellite services will operate on separate, "non-overlapping" frequencies in order to mitigate the potential interference between the two services.[5/] Our technical review of New ICO's proposal for terrestrial - satellite sharing of the 2 GHz band is shown in Appendix A. It demonstrates that the amount of permissible frequency reuse is very small and that most of the terrestrial and satellite traffic will need to be supported on separate non-overlapping frequencies.

New ICO's opposition to segmenting the 2 GHz band in order to separately authorize terrestrial operations clearly is not based on technical infeasibility, but on the fact that such an approach would not be "economically viable" for New ICO,[6/] i.e. it would not promote the

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225 (rel. Aug. 17, 2001) ("Notice").

4/ Letter from Cheryl A. Tritt, Counsel to ICO Global Communications (Holdings) Ltd., to William F. Caton, Acting Secretary, FCC, March 8, 2002, Exh. B at 14 ("March 8, 2002 New ICO Letter").

5/ Letter from Lawrence H. Williams, New ICO Global Communications (Holdings) Ltd., to Chairman Michael Powell, March 8, 2001, App. B at 6-7.

6/ March 8, 2002 New ICO Letter, Exh. B at 14.

commercial viability of New ICO's MSS service. But the Commission's duty is to serve the broader public interest, not to "save companies."[7]

Question 2. How would severing the operations affect domestic and foreign satellite operations?

Segmenting the 2 GHz band would not have any different effect on domestic and foreign satellite operations than if the band were not segmented. Under either proposal, terrestrial operators will have to coordinate with other systems using the band both domestically and internationally. The introduction of a separate terrestrial mobile service into the 2 GHz band would be consistent with the ITU Table of Allocations, because Mobile Service (MS) enjoys primary status along with MSS and Fixed Service (FS).

Question 3. How would severing the operations affect terrestrial operations?

The challenges of introducing terrestrial operations will be the same whether the 2 GHz band is separately authorized or existing MSS operators are authorized to provide terrestrial services in the band. Under either proposal, licensees in the MSS bands would have to engineer their systems so as not to interfere with terrestrial operations in adjacent bands and coordinate with adjacent licensees. Coordination would be similar to the process that is currently used to coordinate between adjacent Commercial Mobile Radio Service ("CMRS") licensees. Coordination with incumbent FS systems will also be the same under either proposal. If the new terrestrial mobile system introduces interference to a FS system, there may be a need for FS link relocation provisions similar to those in Part 24.239 of the FCC Rules.

New ICO claims that one of the benefits of its ATC proposal will be "[a] rich suite of services (telephony and data), available and working seamlessly across both platforms."[8/] But

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[7/] Brian Hammond, Rescuing Struggling Companies Isn't FCC's Role, Powell Says, TR Daily, Feb. 20, 2002.

these same user capabilities can be offered by terrestrial systems if the band is segmented. The few shortcomings of present day roaming compatibility standards are being addressed in industry standard groups and should be widely deployed in the same time frame as the planned 2 GHz MSS systems. Portability of a wide range of services between different operators is already widespread within the GSM/TDMA and CDMA families of PCS systems. Under the 3G standards, a mobile user with a multi-mode cellphone will have the technical capability to roam from system to system and still access a wide range of both voice and data services.

Question 4. How would severing the operations affect service to remote and rural areas?

The effect on service to remote and rural areas will be approximately the same whether the MSS bands are segmented and separately authorized or existing MSS operators are authorized to provide terrestrial services in the band as part of an integrated satellite-terrestrial system. In fact, using separate frequencies to provide satellite service to remote and rural areas would reduce interference from urban terrestrial systems in the same region (within the same satellite beam coverage) and improve the quality of service to those areas. By contrast, if an integrated satellite-terrestrial system is used to provide service to remote and rural areas, the terrestrial service may occasionally be provided on overlapping frequencies, which may produce interference into the satellite links.

Under either approach, it will be necessary to provide some separate bandwidth for terrestrial services. However, because customers are more likely to use the terrestrial service than the satellite service, there should be sufficient spectrum available for MSS offerings to rural users and the grade of satellite service to remote and rural areas should not be adversely affected despite the use of some of the MSS bandwidth by the terrestrial system. In other words, severing

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[8/] March 8, 2002 New ICO Letter, Exh. B at 14.

satellite and terrestrial operations within the MSS band will not reduce the prospects for service in remote and rural areas.

Question 5. How would severing the operations affect service to urban areas?

Under either proposal, additional spectrum will become available to provide terrestrial services in urban areas. If only MSS operators are authorized to provide terrestrial services, however, only they will be able to utilize this spectrum, regardless of whether they would put it to its best use. Such a limitation would preclude the public from realizing the full value of this scarce resource and ensuring that it is put to its most innovative, efficient use. As Chairman Powell has explained previously, unnecessarily restricting eligibility "smothers the development of innovative uses of the band, employing different business models and technology. . . . It is the auction process and the market that should pick the winning and losing business models for the provision of spectrum-based services."[9/]

By contrast, if the MSS bands are segmented and the licenses to provide terrestrial service awarded by competitive bidding, the spectrum will go to those who place the highest value on it and will put it to the best use. CMRS operators may bid for the spectrum to augment existing networks in urban areas and provide new and improved services to customers, or new entrants may use the spectrum to provide innovative services targeted for currently underserved segments of the market. And nothing would preclude the MSS operators from bidding for and obtaining such licenses at auction if their proposed terrestrial service is truly the best and highest use of the spectrum.

Question 6. How would the technical requirements for separate services differ from the technical requirements for integrated MSS ATC?

9/ Separate Statement of Commissioner Michael Powell, Dissenting in Part, Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules, 15 FCC Rcd 5299 (2000).

The technical requirements for separate services and "integrated" MSS services are likely to differ in the degree to which subscriber mobility management and network operations management are centralized.

With regard to subscriber mobility management, a subscriber to a separate MSS system with a dual-mode mobile terminal would be capable of using a separate terrestrial system under normal intersystem roaming provisions. If the terrestrial and satellite operations are separate but offer comparable services, then use of industry standard roaming protocols would ensure that a subscriber using a dual-mode handset can switch from one system to the other and still access the same range of services. The exact same type of roaming occurs today between independent terrestrial systems. Because industry standard roaming protocols are important to the growth of the terrestrial industry as a whole, greatly improved roaming "service portability" can be expected in the same time frame as the deployment of the 2 GHz MSS systems.

The provisions for supporting the "back office" functions associated with subscriber roaming between different systems (e.g., billing) are already quite mature within the industry. GSM systems, for example, are bound together not only by their common radio technology, but also by the GSM MOU Association's agreement to support roaming between different GSM mobile systems, domestically and internationally.

If the satellite and terrestrial services are provided by a single integrated system, the subscribers would be within their "home area" whether they were using the satellite or the terrestrial part of the integrated system. From an operator's point of view, such an integrated satellite-terrestrial system would be more attractive because it would minimize the need to account for roaming settlements. However, the operational differences between remaining within the "home area" or roaming on an independent system would be imperceptible to the subscriber in nearly all cases. While commercial arrangements between independent system operators may result in usage charges that are higher than those that might be charged by an integrated satellite-terrestrial operator, roaming rates have been declining steadily in recent years, as the Commission's Sixth Competition Report documents.[10/]

Other than intersystem interworking between Visitor Location Registers and Home Location Registers, separate satellite and terrestrial services would probably operate with independent network management systems and manage their respective bandwidth resources independently. By contrast, an MSS operator authorized to provide both satellite and terrestrial services would probably centralize certain functions like that of the Home Location Register and Authentication Center. The operator probably would also link the network management systems of the operator's two networks together to centralize the collection of traffic and performance data, as well as the dissemination of network configuration instructions, including frequency plans.

Question 7. How would severing the operations affect adjacent channel operations (both satellite and terrestrial)?

An MSS operator authorized to provide terrestrial service must take steps to ensure that its terrestrial operations do not interfere with its satellite operations or those of other MSS operators. Segmenting and separately authorizing terrestrial service in the MSS bands would not change this basic requirement to protect the operations of licensees in adjacent channels, whether satellite or terrestrial. Under either proposal, adequate guardbands between the terrestrial and satellite segments of the MSS band will be necessary, and both satellite and terrestrial operators will have to coordinate with adjacent licensees. In order to maximize the usefulness of the band

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[10/] In the Matter of Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with segments in the case of separated satellite and terrestrial operations, a contiguous block of terrestrial bandwidth for each direction would be desirable. As suggested by others, the limitations on satellite link emissions should comply with Part 25.202(f) of the FCC's rules, while the terrestrial link emissions should comply with Part 24.238.

Question 8. What requirements are necessary for an integrated MSS ATC system to avoid adjacent channel and/or adjacent band interference?

As described above, the operator of an integrated MSS ATC system must avoid interference between the terrestrial and satellite components of its own system. The best way to reduce the potential for such disruptive interference in a given area is to use separate channels. An operator also must avoid causing interference from its terrestrial component into incumbent FS systems operating in the 2 GHz MSS downlink allocation. Unless the frequencies used for the terrestrial base station are adequately separated from those used in nearby FS links, the operator may need to pay to modify any affected FS systems.

The major concern with other systems operating in adjacent channels or bands would be protecting mobile user terminals from possible strong signal overload by adjacent channel or adjacent band signals from nearby transmitters. In order to reduce the susceptibility of the mobile user terminals to overload from nearby terrestrial stations, the specification for receiver front end overload will need to be sufficiently high. The normal industry standards for broadband PCS receivers should suffice for dual-mode satellite-terrestrial receivers because this standard protects against overload when the user is in close proximity to PCS base stations and incumbent FS transmitters operating in adjacent bands.

Question 9. How do the technical requirements that integrated MSS ATC systems must observe to avoid creating harmful interference differ from those that freestanding terrestrial mobile systems would have to observe?

Respect to Commercial Mobile Services; Sixth Report at 30 (rel. July 17, 2001)

As noted in the answers to Questions 7 and 8, integrated and freestanding terrestrial systems would have to observe similar technical requirements to avoid creating harmful interference. The same sort of out-of-band emission limits that are currently required between adjacent PCS frequency blocks would be required in either case. The criteria in section 24.238 of the FCC's rules could be applied in the case of separate operators using adjacent frequency blocks. Like the integrated provider, the terrestrial operator may also have to cover the cost of modifying affected FS systems in cases where frequencies needed for the terrestrial base station cannot be selected so as to be adequately separated from those used in a particular FS link.

CONCLUSION

For the reasons set forth above, the Commission should segment the band and award authorizations to provide terrestrial services using competitive bidding open to all parties.

Respectfully submitted,

CELLULAR TELECOMMUNICATIONS
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March 22, 2002

CERTIFICATE OF SERVICE

I, Margo Adams, hereby certify that on this 22nd day of March 2002, I caused copies of the foregoing "Further Technical Comments of the Cellular Telecommunications & Internet Association" to be sent to the following by either first class mail, postage prepaid, or hand delivery (*):

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APPENDIX A

Terrestrial and Satellite Sharing of 2 GHz MSS Allocations

1.0 INTRODUCTION

Earlier IMT-2000 spectrum use studies concluded that: "‥, it is clear that co-coverage, co-frequency sharing between the terrestrial and satellite components of IMT-2000 is not feasible."[i]

New ICO is asserting that co-coverage co-frequency sharing between its proposed Ancillary Terrestrial Component (ATC) and its satellite system is feasible and has submitted some illustrative interference calculations to demonstrate that serious interference can be avoided with a variety of "mitigation techniques." This section presents a review of those calculations and the practical measures needed to avoid serious interference.

Primary emphasis is placed upon the alternative called "Forward Band Sharing" in the New ICO filings, since this is most consistent with conclusions of IMT-2000 studies to date (i.e., that user terminals should transmit toward the base stations using lower band frequencies and receive from the base stations that transmit in the higher frequency band).[ii]

2.0 Downlink Interference Considerations with "Forward Band Sharing"

There are two interference cases to evaluate associated with "Forward Band" sharing of the satellite downlink frequencies :

(a) Terrestrial Base Station Transmissions Interfering with Satellite Reception by User Terminals (in Satellite Mode) as shown in Figure 2.1.

(b) Satellite Downlink Transmissions Interfering with Terrestrial Signal Reception by User Terminals (in ATC Mode) as shown in Figure 2.2.

2.1 Terrestrial (ATC) Base Station Interference to Satellite Users

If a terrestrial base station transmits on a satellite downlink frequency, the satellite user attempting to receive on that frequency will suffer interference if the user is too close to the base station. This case is illustrated in Figure 2.1.

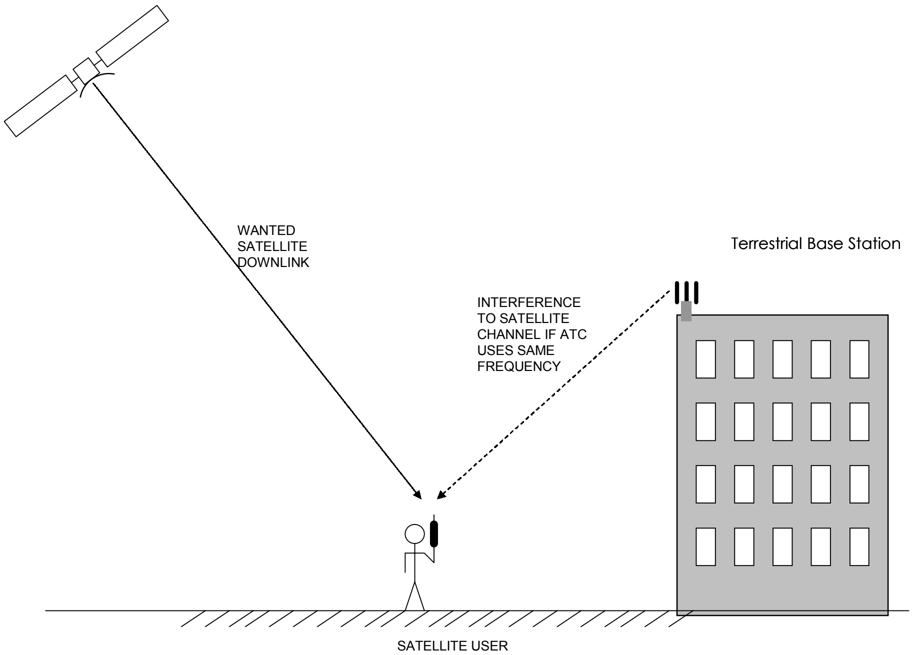

Figure 2.1 Terrestrial Base Station Interfering with Satellite Downlink

Knowledge of the mobile user's location can be used to avoid interference. If the satellite user is in or anywhere near the ATC service area, a satellite frequency that does not overlap the terrestrial channel must be selected for a user's satellite call. As a practical matter for a non-geostationary satellite system with spot beams moving over the earth's surface (i.e., like ICO), **this frequency must come from a non-overlapping band dedicated to satellite use.**

The interference assumptions presented in the March 2001 New ICO filing[iii] can be used to deduce the required distance from the ATC base station to avoid unacceptable interference and are listed in the following table.

Table 2.1 – ATC Base Into User Terminal (UT) Receiving Satellite Downlink

Satellite signal flux spectral density at earth's surface	-169.7	$dBW/Hz/m^2$
Min. Carrier to Interference	18	dB
Max. allowable interference	-187.7	$dBW/Hz/m^2$
ATC Base EIRP Spectral Density	-33.4	dBW/Hz
Required Spreading Loss [$10 \log(4\pi d^2)$] + Additional Loss	154.3	dB
$10\log(4\pi/\lambda^2)$ at 2200 MHz	28.3	dB
Required Free Space Loss + Additional Loss	182.6	dB
ATC Base (40m high) to Sat. User (2m high) Grazing Horizon Distance	32	km
Free Space Loss at this distance	129.4	dB
Additional Loss needed	53.2	dB

The March 2001 New ICO filing suggests that an only slightly greater distance than the grazing horizon distance will suffice to ensure that the interference criterion is satisfied. However, if one allows for the need for additional loss (beyond that of free space), the variability of path loss and the lack of precision in the user location measurement, one sees that the required distance would be considerably greater than the grazing distance. For example, using NTIA's "Irregular Terrain Model"[iv] and reasonable assumptions, one sees that the average required distance is likely to be more that 67 km.[v]

In any case, it is clear that an exclusion area around each base station needs to be defined, within which users are only assigned channels from a band that is separate from the terrestrial band(s) used by the base station.

2.2 Satellite Downlink Interference to ATC User Terminal Reception

Co-channel co-coverage satellite downlinks can cause unacceptable interference into a terrestrial ATC channel. This case is illustrated in Figure 2.2 .

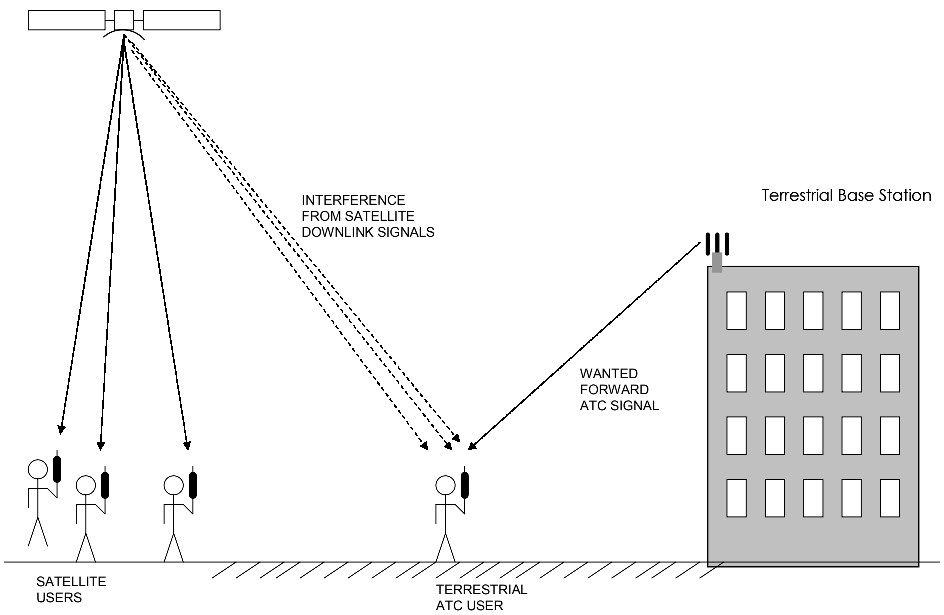

Figure 2.2 Satellite Downlink Interfering with Terrestrial ATC Forward Channel

The cdma2000 system used as an example by New ICO will tolerate interference from a few satellite downlink channels. If a certain level of interference is anticipated, the ATC cell size can be reduced accordingly to provide a higher receive signal strength for the ATC users to compensate for the higher total noise with interference.

The interference assumptions presented in the March 2001 New ICO filing [vi] can be used to deduce the percentage decrease in ATC cell radius to maintain the same receive carrier to total noise ratio in the user terminal (UT) as follows:

Table 2.2 – Satellite Downlink Into UT Receiving ATC Forward Channel

Noise in UT receiver bandwidth (1.1 MHz, ATC mode)	-135	dBW
Satellite EIRP per 25 kHz channel	33.6	dBW
Free space path loss (subsatellite, 10,390 km)	179.6	dB
UT antenna gain toward satellite	0	dBi
Interference from single satellite channel	-146	dBW
Interference to Noise Ratio	-11	dB
Required carrier level/original carrier level (power ratio)	1.08	
% decrease in cell radius needed (assuming $1/r^2$ rolloff) to compensate for single interfering channel	3.7	%
Interference from 3 satellite channels	-141.2	dBW
Interference to Noise Ratio	-6.2	dB
Required carrier level/original carrier level (power ratio)	1.24	
% decrease in cell radius needed	10.2	%

These co-coverage interference calculations (cdma2000 for the ATC) show that only three active 25 kHz ICO satellite downlink Time Division Multiple Access (TDMA) carriers can share (overlap) the ATC channel, if the required cell size reduction is to be no more than 10%. This is one half the channel capacity of the overlapping ICO frequency block, which is 150 kHz wide and could otherwise support six TDMA carriers, each with six channels.

If there were no constraints due to possible interference into the ATC channel, the 1250 kHz wide band would be usable for 48 satellite TDMA carriers instead of just 3 satellite TDMA carriers. In other words, each 1250 kHz wide band used for the example ATC limits the usefulness of that spectrum for satellite links to only 6% of its usefulness without ATC.

Since a single satellite spot beam will cover a large area, it will illuminate a good number of urban areas in which ATC service areas might be established. To facilitate planning, the number of frequency band segments used for ATC would need to be restricted if there is to be enough bandwidth left for assigning non-overlapping satellite channels.
With the "Satellite Oriented Frequency Assignment" plan[vii] described in ICO's original 1997 filing, the beams are fixed with respect to the satellite so that the beam footprints are constantly moving over a user as each satellite passes over. There are 16 possible frequency blocks that might be used for a call to a given location (2 per satellite, which corresponds, to 4 per each of 2 orbit planes). The blocks are different in order to avoid interference between overlapping beams of the (up to 4) satellites that may be within view of a user simultaneously. Capacity limitations (due to ATC sharing) in some blocks but not in others will make seamless beam-to-beam satellite call handoffs very problematic in times of heavy traffic.

It should also be noted that there would need to be at least one block or sub-block that does not overlap any ATC band segment to support satellite users who are within or near to an ATC service area, but cannot access the ATC for some reason.

To summarize, the drastic limitation in usable satellite capacity in frequency bands that overlap ATC channels means that most of the satellite downlink bandwidth will need to come from separated non-overlapping frequency bands. **In fact, there is little efficiency loss if the frequency bands used for the terrestrial service are segregated from the those used for the satellite service.**

3.0 Uplink Interference Considerations with "Forward Band" Sharing

There are two interference cases to evaluate associated with "Forward Band" sharing of the satellite uplink frequencies:

(a) User Terminal Transmissions (in Satellite Mode) Interfering with ATC Base Station Reception as shown in Figure 3.1.

(b) User Terminal Transmissions (in ATC Mode) Interfering with Satellite Uplink Channels as shown in Figure 3.2.

3.1 Transmitting UT (Sat. Mode) Interfering with ATC Base Station Reception

If a user terminal in satellite mode transmits on a frequency that overlaps an ATC base station channel, the ATC base station may suffer interference if that user is too close to the base station. This case is illustrated in Figure 3.1.

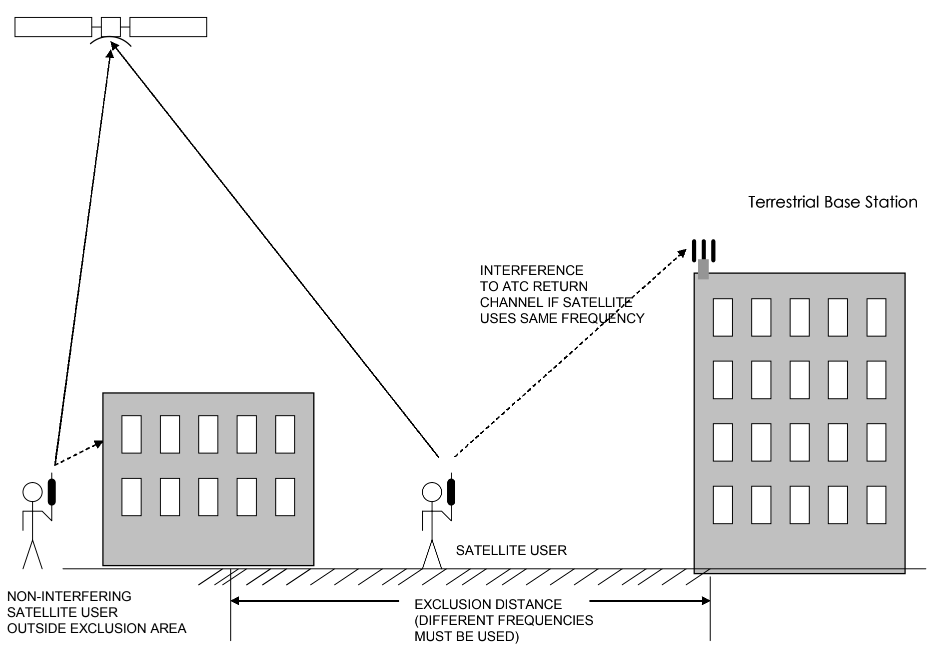

Figure 3.1 Satellite User Interfering with Terrestrial ATC Base Station Return Link

Knowledge of the satellite user's location can used to avoid interference. If the satellite user is in or anywhere near the ATC service area, a satellite frequency that does not overlap the terrestrial channel would be selected for a user's satellite call. **This frequency must come from a segmented band dedicated to satellite use that is not reused by the ATC.**

The interference assumptions presented in the March 2001 New ICO filing[viii] can be used to deduce the required distance from the ATC base station to avoid unacceptable interference and are listed in the following table.

Table 3.1 – UT Satellite Uplink Transmission Into ATC Base Return Channel

ATC Base Station Receiver Noise in 1.1 MHz	-139	dBW
Interfer. to Noise (I/N) for 10% cell radius decrease	-6	dB
Max. allowable interference in 1.1 MHz	-145	dBW
Satellite User Terminal Peak Burst EIRP	7	dBW
ATC Base Station Receive Antenna Gain	17	dBi
Required (Satellite UT to ATC Base) Path Loss	169	dB
ATC Base (40m high) to Sat. User (2m high) Grazing Horizon Distance	32	km
Free Space Loss at this distance	128.6	dB
Additional loss needed (if only one interfering satellite UT)	40.4	dB
Additional loss needed (if 10 interfering satellite UT's at same distance are active)	50.4	dB

The March 2001 New ICO filing suggests that an only slightly greater distance than the grazing horizon distance (32 km for the example) will suffice to ensure that the interference criterion is satisfied. However, if one allows for the need for additional loss (beyond that of free space), the variability of path loss and the lack of precision in the user location measurement, one sees that the required distance would be considerably greater than the grazing distance.

In any case, it is clear that an exclusion area around each base station needs to be defined, within which users are only assigned channels from a band that is separate from the terrestrial band(s) used by the base station.

3.2 User Terminal (in ATC Mode) Interference to Satellite Uplink Reception

Interference to a satellite uplink will occur if the terrestrial system uses the same frequency as the satellite uplink for the area in which the terrestrial system is located. This case is illustrated in Figure 3.2.

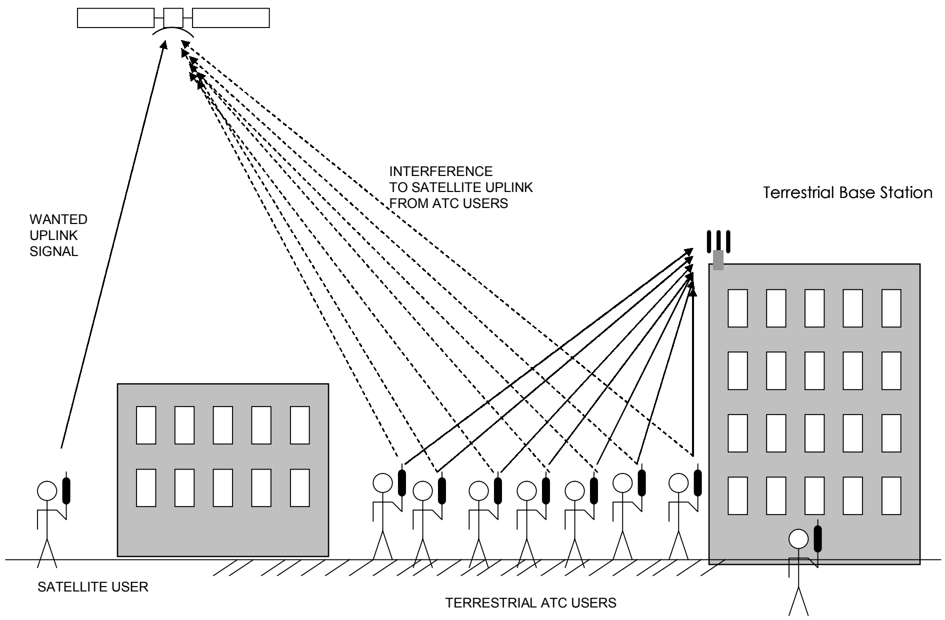

Figure 3.2 Interference from Terrestrial Users into Satellite Uplink Channel

If more than a few user terminals (in the ATC mode) transmit on an ATC frequency that overlaps an in-use satellite uplink channel, the satellite channel will suffer unacceptable interference. This will occur if those simultaneously transmitting ATC users are within the coverage of the satellite spot beam receiving the particular uplink frequency. The severity of the interference will depend upon how many ATC users seen by the satellite spot beam are simultaneously operating on an ATC channel that overlaps the satellite uplink frequency.

The interference assumptions presented in the March 2001 New ICO filing[ix] can be used to illustrate the implications of an ATC channel overlapping an active satellite uplink channel as follows:

Table 3.2 – ATC User Terminal Into Satellite Uplink

User Terminal (Satellite Mode) EIRP	7	dBW
User Terminal (Satellite Mode) EIRP Spectral Density	-37	dBW/Hz
Effective EIRP Spectral Density with 8 dB fade	-45	dBW/Hz
Terrestrial User Terminal (ATC Mode) EIRP	-10	dBW
ATC User Terminal EIRP Spectral Density (1.1 MHz)	-70.4	dBW/Hz
Carrier to Interference (C/I) with single ATC user terminal	25.4	dB
Required C/I from all ATC user terminals within spot beam using overlapping ATC channel	18	dB
Carrier to Interference (C/I) with 32 transmitting ATC UT's	10.4	dB
Max. No. of ATC transmitters in spot beam on same frequency	5	UT's

The above table shows that only a few ATC mobile users can transmit on an overlapping frequency if the satellite interference criterion is to be satisfied. Since the satellite beam footprint is relatively large (~ 400 miles diameter), a much larger number of ATC mobile users than five are likely to be within the beam transmitting on the same ATC frequency. Consequently, reuse of the ATC user-to-base channel frequency by satellite uplink channels is not viable for any reasonably sized ATC build-out. Instead, there will be a need to separate some bandwidth out of the MSS allocation for the ATC implementation, leaving less bandwidth available for satellite links.

New ICO suggested in its comments[x] that the carrier to interference (C/I) criterion be relaxed to 12.8 dB, so the maximum number of active ATC transmitters on the same frequency in the same beam may be eighteen instead of only five. However, the revised C/I value (12.8 dB) is approximately the same as the uplink carrier to noise without interference (13.2 dB) and would reduce the uplink fade margin by an approximate factor of two. Lowering the C/I criterion as proposed by New ICO is not consistent with the normal practice of limiting interference to be substantially lower than thermal noise.

New ICO goes on to calculate the number of simultaneous voice calls that might be supported by applying various statistical assumptions to the ATC usage factors. However, New ICO makes the overly optimistic assumption that the victim satellite link user is unfaded and that the user terminal is transmitting at full power. Furthermore, the statistics assume an ATC cdma2000 "typical" mobile transmitter power level of 100 mW as a starting point, rather than the more appropriate maximum level of 250 mW,[xi] leading to results that are optimistic by an additional 4 dB (factor of 2.5). This combination of revised assumptions does not appear to be realistic, nor is the calculated number of simultaneous users in an uplink beam given New ICO's October 2001 comments. The 5.5 simultaneous users implied in New ICO's original March 2001 filing is probably much closer to a realistic estimate.

The only realistic conclusion is that **the limited amount of permissible uplink frequency reuse will necessitate the segregation of dedicated ATC bandwidth**. Given that each return ATC channel would most likely be paired with a forward ATC channel, the need for band segmentation of the MSS downlink would also lead to segmentation of the uplink allocation.

4.0 Conditions for Satellite & ATC Sharing of the 2 GHz MSS Bands

The claim that ".. the ATC concept only works if it is fully integrated with the MSS network and under the constant control of a single MSS operator"[xii] is not necessarily true.

As shown in the previous sections, a good portion, if not all of the terrestrial bandwidth will need to be separate from the satellite bandwidth. Operations in the separate spectrum segments can be under the control of two separate operators.

Even with separate operators, it is technically possible to shift some band segments from terrestrial to satellite use, or vice versa. However, the benefits of "dynamic sharing of spectrum" between the terrestrial and satellite networks are somewhat questionable. Improvement in spectrum utilization can only occur if the busy periods of the ATC service within a satellite beam do not coincide with the busy periods for satellite service within the same beam. There is little reason to believe that this would be the case, so the benefits of such "dynamic sharing" are likely to be nonexistent. In other words, little will be lost in efficiency by simply separating and fixing the band segments for terrestrial services from those used for the satellite services.

5.0 CONCLUSIONS

Based upon the earlier observations in this appendix (esp. 2.2 and 3.2) and the fact that uplink and downlink channels normally are assigned in pairs, one concludes that the **most likely frequency management scheme for introducing terrestrial services within the 2 GHz MSS allocation would be a subdivision of the 2 GHz MSS allocation to set aside one or more segments for the terrestrial services.**

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[i] Recommendation ITU-R M.1036-1, Annex 1, Section 2
[ii] Ibid., Annex 2, Section 2.2
[iii] New ICO Filing to FCC (Letter to Chairman Powell), 3/8/2001, Sect. 5.6, p.18
[iv] NTIA, Institute for Telecommunications Sciences, "Irregular Terrain Model Version 1.5.5", executable program is available as a download from NTIA from ftp://elbert.its.bldrdoc.gov/itm/ITMsetup.exe
[v] Ibid, 67 km calculated using Area Mode with following assumptions: 2200 MHz, antenna effective heights of 40 & 2 m, Delta H= 38m, 50% of time, 50% confidence level, Default Values for all other parameters. Requiring higher confidence that the path loss is exceeded would make the exclusion distance even larger than 67 km.
[vi] New ICO Filing to FCC (Letter to Chairman Powell), 3/8/2001, Sect. 5.2, p.14
[vii] ICO Services Limited Letter of Intent, 9/26/1997, Chap. II, Section 7.0, pp. 58-61
[viii] New ICO Filing to FCC (Letter to Chairman Powell), 3/8/2001, Sect. 5.3, p.15
[ix] Ibid, Sect. 5.7, p.19
[x] New ICO Comments, 10/22/2001, Appendix A, p. A-1 (FCC Docket 01-185)
[xi] Report of the Industry Association Group on Identification of Spectrum for 3G Services (TIA, CTIA, PCIA), 2/22/01, Attachment I, Table 1
[xii] New ICO Filing to FCC (Letter to Chairman Powell), 3/8/2001, Section III, p. 9