Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	|	
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Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 MHz Bands and 14.0-14.5 GHz/11.7-12.2 GHz Bands	|	IB Docket No. 02-10

COMMENTS OF THE FIXED WIRELESS COMMUNICATIONS COALITION

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Pursuant to Section 1.415 of the Commission's Rules, the Fixed Wireless Communications Coalition (FWCC) files these Comments in response to the Notice in the above-captioned docket.[1]

A. Summary

The Commission proposes to allow satellite earth station stations mounted on vessels (ESVs) to operate in two bands shared with the fixed service (FS): C-band at 3700-4200 and 5925-6425 MHz, and Ku-band at 14.0-14.5 and 11.7-12.2 GHz. The proposal requires that ESVs not cause harmful interference to, claim protection from, or otherwise constrain FS operation.

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[1] *Use of Satellite Earth Stations on Board Vessels*, 18 FCC Rcd 25248 (2003) (Notice). The FWCC is a coalition of companies, associations, and individuals interested in the Fixed Service -- *i.e.*, in terrestrial fixed microwave communications. Our membership includes manufacturers of microwave equipment, licensees of terrestrial fixed microwave systems and their associations, and communications service providers and their associations. The membership also includes railroads, public utilities, petroleum and pipeline entities, public safety agencies, and/or their respective associations, landline and wireless, local, and interexchange carriers, and telecommunications attorneys and engineers. Our members build, install, and use both licensed and unlicensed point-to-point, point-to-multipoint, and other fixed wireless systems, in frequency bands from 900 MHz to 95 GHz.

The FWCC has no objection to ESVs operating on Ku-band frequencies. In C-band, we similarly have no objection to ESVs receiving on the 3700-4200 MHz downlink segment, so long as they do not claim protection from FS transmitters. Our concerns center on 5925-6425 MHz, where ESV uplinks to satellites threaten interference to FS receivers.

The FS uses the 5925-6425 MHz band to carry vitally important safety and infrastructure services. Applications include public safety communications (such as dispatching police and fire vehicles), coordinating the movement of railroad trains, controlling natural gas and oil pipelines, regulating the electric grid, and backhauling wireless telephone traffic, among many others. The band is congested and getting worse, due not only to needed expansion, but also because FS links are being relocated there from other bands -- in many cases to accommodate new satellite services.

Many applications at 5925-6425 MHz require 99.999% (or better) availability. This standard limits outages from all sources to a total of just five minutes or less per year. Because these facilities operate disproportionately in coastal areas, they are directly at risk of interference from ESVs. Just one ESV interference incident per year would violate the 99.999% criterion and cause more service disruption than all other causes combined.

FS links and earth stations are able to coexist on shared frequencies through the process of frequency coordination, which requires a later-arriving facility in either service to choose its location, frequency, and power so as to avoid interfering with pre-existing facilities. These calculations depend on, among other things, a precise knowledge of just where each facility is located. The process becomes much more difficult -- and the results, much more uncertain -- when coordinating a facility that will move while in operation.

The surest way to avoid ESV interference into critical FS operations is to prohibit ESVs from using C-band frequencies within 300 km of the U.S. coastline. Otherwise the following measures become necessary:

1. All ESV routes must be frequency coordinated in advance. ESVs will have to suspend transmission on any route segments where they cannot coordinate.

2. Each ESV must be tied to a shipboard GPS finder with software set to shut down the ESV if the vessel departs from the frequency-coordinated route, or enters a segment that could not be coordinated, or drops below the coordinated speed.

3. FS operators need real-time access to ESV vessel itineraries, frequency, bandwidth, and satellites, and access to a 24/7 point of contact capable of shutting down ESV transmissions if necessary. ESV operators should have to retain this information for one year and make historical data available on 72 hours' notice.

4. ESV coordination must be limited to bandwidth for which the ESV operator can demonstrate actual need, not to exceed 36 MHz in each direction on each of two satellites per operator, and to the azimuths and elevations for those individual satellites (which will vary with vessel location).

5. ESV license terms must be limited to two years.

6. ESV operation must be limited to ships of 5,000 gross tons or larger to ensure vessels are restricted to deep draft channels.

We acknowledge these measures will entail costs for ESV operators, and may hinder ESVs from providing all the services they may wish to offer. Nonetheless, as the sole economic beneficiaries of their own operations, ESV proponents can reasonably be asked to bear the financial costs of protecting the FS. And some service limitations may be an unavoidable result of the industry's decision to operate in the already-congested C-band frequencies.

B. Introduction

This proceeding proposes to allow satellite earth stations on board moving vessels to use the 3700-4200 and 5925-6425 MHz bands.[2] In principle, these bands are shared "coequally" between fixed satellite service earth stations (FSS) and the terrestrial microwave Fixed Service (FS).[3] In practice, however, the satellite-terrestrial sharing is far from coequal. Satellite earth station operators have an overwhelming preference in access to spectrum.[4] This has made it chronically difficult for the FS to coordinate the links it needs for essential infrastructure services.

The introduction of moving earth stations will make the situation in the 5925-6425 MHz uplink band vastly more difficult. Interference from vessel-mounted earth stations threatens interference into FS receivers. Beyond the normal land-based interference exposure, the difficulty of ESV/FS frequency coordination is exacerbated by the ESV's exposed location and lack of any close-in blockage.

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[2] Notice at paras. 43-46. The proposal also encompasses Ku-band at 14.0-14.5 and 11.7-12.2 GHz.

[3] 47 C.F.R. § 25.202(a)(1) Note 1.

[4] The earth stations' preference takes two forms. First, the Commission routinely licenses an earth station for the entire allocated band, without regard to any actual need for bandwidth, and with no loading requirements, while point-to-point terrestrial operations are limited to frequencies actually needed, 47 C.F.R. Secs. 101.109(b), 101.103(c), and additionally are subject to stringent requirements for spectrum efficiency and loading. 47 C.F.R. Secs. 101.141(a)(3) & note 3 in table. Second, earth stations are routinely licensed for a wide range of azimuths and elevations, and can deny coordination to terrestrial operators on that basis.

The 5925-6425 MHz is band is extremely important, not only for existing terrestrial FS applications, but for future growth as well. The Commission identified this band as the primary relocation band for FS licensees who were displaced by PCS licensees in the 1.9 GHz band, and who will be displaced by Mobile Satellite Service operators and "3G" licensees in the 2.1 GHz band.[5] As it considers rules for ESV use of the band, the Commission should address not only the prevention of interference to current terrestrial FS users, but also the future availability of the band for migration and relocation from former FS spectrum in the 1.9 GHz and 2.1 GHz bands.

In general, sharing of the 6 GHz band among FS users themselves works well because of prior frequency coordination based on the geography and operational characteristics of the respective systems. Subject to the inequities noted above, the same is true of sharing between terrestrial FS users, on the one hand, and FSS earth stations, on the other. In both FS/FS and FS/FSS sharing scenarios, the potential interfering station is in a fixed position at a known location. This certainty enables licensees, frequency coordinators, equipment manufacturers, and system designers to rely on a combination of geographic and spectral separation, along with operational characteristics (such as close-in shielding, terrain blockage, etc.) to achieve efficient use of the band for both FSS and FS, with minimum likelihood of interference to either. In the event interference does occur, it is a relatively easy matter to pinpoint the offending source and correct the problem.

All of this changes with the introduction of an in-motion transmitter, such as an ESV. The difficulty of prior coordination is multiplied by any uncertainty in the route of the ESV. And

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5 *See Redevelopment of Spectrum*, 8 FCC Rcd 6495, 6506 (1993); *Creating New Technology Bands for Emerging Technology*, OET Publication TS 92-1 (released January, 1992); *Introduction of New Advanced Wireless Services*, 17 FCC Rcd 23193 at paras. 27-33 (2002).

if interference does occur, the transient nature of the moving vessel makes the task of tracking down and confirming the source almost impossible. An ESV could cause interference sufficient to disrupt a vital FS communications link, only to move on and never be traceable as the source of the interference. Indeed, the Commission's first authorization of ESV operations recognized that "the mobile nature of [ESV] stations makes it extremely difficult to prevent harmful interference and to identify the interference source."[6] That has not changed.

C. Proposals

The Commission proposes to allow ESV operation both in C-band (3700-4200 and 5925-6425 MHz) and Ku-band (14.0-14.5 and 11.7-12.2 GHz).

The FWCC does not oppose Ku-band operation.

The Commission proposes two modes of operation in C-band: non-coordinated and coordinated. In either mode,

> we propose that ESV operations in this band shall not cause harmful interference to, claim protection from, or otherwise impose constraints on the operation or development of other radio services operating in the bands.[7]

Both modes would be limited to vessels of 300 gross tons or larger.

1. Non-coordinated operation

Under this approach, an ESV could operate within 300 km of the U.S. coastline without prior frequency coordination under the following conditions:

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[6] *Crescomm Transmission Services, Inc.*, 11 FCC Rcd 10944 at para. 11 (IB and OET, 1996).

[7] Notice at para. 45.

- ESV operators must provide an accurate list of the vessels carrying ESVs.[8]
- Each vessel must be equipped with real-time tracking and identification, including frequency, bandwidth, and satellites ESVs are using; and an itinerary for each vessel operating an ESV.[9]
- FS licensees must have real-time access to a secure database containing the above information.[10]
- The ESV operator must provide a 24/7 point of contact for FS operators.[11]
- The ESV hub operator must be capable of terminating service to or from any associated ESVs that fail to comply with Commission rules (presumably including the rules against interfering with the FS).[12]
- ESV has no protection against future FS operations.[13]
- The ESV license term is limited to two years.[14]

2. Coordinated operation

As an alternative Commission proposal, an ESV could operate under prior frequency coordination. In contrast to a fixed earth station, which is coordinated at a particular location, an ESV would be coordinated over a route, such as the ocean channel into a port. Each ESV would be limited to 36 MHz of uplink spectrum and 36 MHz of downlink spectrum on each of two

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8 Notice at para. 65.

9 Notice at paras. 64-66.

10 Notice at para. 64, 66.

11 Notice at para. 65.

12 Notice at para. 66.

13 Notice at para. 64.

14 Notice at para. 68.

satellites.[15] The ESV operator would have to retain vessel tracking data for 90 days and make it available to Commission or frequency coordinator on 72 hours' notice.[16] The license term would be 15 years.[17]

In this mode, as well as uncoordinated operation, ESVs could neither interfere with nor claim protection from FS stations.[18]

D. Protecting the Fixed Service

1. General principles

Many FWCC members operate 6 GHz FS links in port cities and coastal locations. These include state and local law enforcement agencies; electric, gas and water utilities; railroads; pipeline and petroleum exploration companies; and providers of wireless telephone services. Their 6 GHz links support such applications as remote control of railroad switches and signals, interconnecting mobile radio base stations used for dispatching emergency vehicles (police, fire, ambulance, etc.), control of pipeline valves and electric utility circuit breakers; and carrying backhaul traffic on cellular and PCS systems.

These are critical infrastructure services that warrant the highest degree of protection. At considerable expense, most systems installed today are engineered to achieve 99.999% availability -- equivalent to no more than five minutes outage per year due to all causes combined. Some critical services or route segments are engineered to meet 99.9999%

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[15] Notice at para. 69.

[16] Notice at para. 70.

[17] Notice at para. 70.

[18] Notice at para. 45.

availability (maximum 30 seconds outage per year), or even better. These systems take into account of all known sources of interference, including fixed earth stations, at the time the system is designed.

The FS links are licensed incumbents fulfilling functions vital to the nation's economy, public safety, and homeland security, and as such are entitled to full protection from ESVs. Just one episode of ESV interference per year would not only violate the 99.999% criterion, but typically would trigger more outage than all other causes put together. It is both unfair and unwise to allow the introduction of new, unanticipated sources of interference that threaten the integrity of FS operations. While we have no objection to ESV operation that does not diminish FS reliability, the burden of achieving that protection falls entirely on the ESV operators, who will be the sole economic beneficiaries of additional uses of the band.

2. No C-band operation within 300 km of the U.S. coastline

The most certain way to protect C-band FS operation from ESVs is to prohibit ESV C-band operation within 300 km of the U.S. coastline. The Commission agrees.[19] We have no objection to Ku-band operation anywhere, or to C-band operation far out at sea.

We understand this option is not the ESV operators' first choice. If Ku-band coverage is not available everywhere on the high seas,[20] ESVs would need dual-band facilities, which obviously would be more expensive than C-band equipment alone. But we think this is a cost the ESV operators can reasonably be asked to bear. Some satellite interests also state (without

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[19] Notice at para. 29.

[20] *See* Notice at para. 61.

support) that C-band operation is needed to carry the desired volume of voice, data, and video,[21] and argue that operating outside C-band would incur additional costs.[22] Even if true, the assertion simply pits the business interests of the ESV operators against the infrastructure services carried on the FS links.[23] If it turns out the ESV operators must scale back their commercial offerings in order to avoid interfering with FS in C-band, that too is a reasonable demand on ESV. A new service seeking to piggyback on heavily used spectrum may have to manage with less bandwidth than it considers optimal.

3. No non-coordinated ESV operation

The non-coordinated option is not acceptable to the FWCC, even with the proposed conditions set out in the Notice.[24] As a practical matter, this would place on FS operators the full burden of identifying and documenting ESVs as the source of harmful interference. (The difficulties of doing so are described in the Appendix.) This is an unreasonable burden, considering that the potential interference comes from an application that is supposed to be operating on a non-interference basis. The lack of any bandwidth limitation would make

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[21] Notice at para. 61. *See* Comments of Maritime Telecommunications Network, Inc. at 11 (filed May 10, 2002).

[22] Comments of Maritime Telecommunications Network, Inc. at 10.

[23] MTN says, "to prohibit or restrict ESV access to C-band would . . . render more than $25 million in capital investments obsolete." *Id.* As noted, we have no objection to MTN's continued use of its C-band equipment more than 300 km offshore, where Ku-band coverage may be inadequate. In any event, MTN made its capital investment with nothing more in hand than waivers and a Special Temporary Authority, Notice at para. 8, both of which were expressly made subject to revocation and/or non-renewal. Having made the investment in spite of that uncertainty and at its own risk, MTN cannot now cite the investment as a ground for permanent authority.

[24] *See* Notice at paras. 64-68.

interference all the more likely.[25] At best, the proposal might allow FS operators to identify a source of interference *after the interference occurs*. That may be adequate for a service that can tolerate occasional disruptions without adverse consequences. It is not acceptable for links handling critical safety services.

4. Coordinated operation with appropriate protections

If the Commission allows ESV operation in C-band, then it must require prior frequency coordination. With coordination, however, comes the possibility that coordination may not always be successful. Especially when close to port or in coastwise operations near population centers, ESVs may encounter route segments on which they will have to cease transmission.

Even then, however, frequency coordination can be only one part of the answer. Successful frequency coordination depends critically on knowing the precise location of a potentially interfering source. This presents no problem in the case of a conventional fixed earth station, whose location is surveyed and does not change after that. But the situation is very different for an ESV. There, frequency coordination is based not on any actual location of the earth station, but instead on its planned route. But there is no assurance the vessel will invariably adhere to that route. There can be any number of reasons why either a military or civilian vessel might depart from its originally planned route, and FS operators are entitled to know that none of these will cause interference.

To attain a reasonable level of protection for the FS, we propose several conditions in addition to frequency coordination.

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[25] *Compare* Notice at para. 69.

First, each ESV must be equipped with a GPS finder linked to software that is programmed to cease transmission automatically if the vessel leaves the frequency-coordinated route, or enters a segment of the route that could not be successfully coordinated, or drops below the coordinated speed. The longer the ESV program is in operation, the more likely it becomes that those in charge of a ship will lose track of the coordination agreements, thus necessitating an automatic cut-off. The controlling software can be located either on the vessel or at the ESV hub.

Second, the Commission should apply the protections proposed for non-coordinated operation, including real-time access to information on ESV vessels, itineraries, frequency, bandwidth, and satellites, and access to a 24/7 point of contact capable of shutting down ESV transmissions if necessary. Moreover, an FS operator experiencing interference should not have to sort through the ship records, but should be able to ask the designated ESV contact about ESV use of a particular frequency on a particular azimuth from a particular location, and request termination of that source if necessary. In addition, the ESV operators should be required to retain vessel tracking and identification data (including time of day, frequency, bandwidth, and satellites in use) for one year and make historical data available to the Commission, frequency coordinator, or FS licensee on 72 hours' notice.

Third, ESV coordination should be limited as to amount of spectrum and number of satellites.[26] The limits proposed for non-coordinated operation -- 36 MHz of uplink spectrum and 36 MHz of downlink spectrum on each of two satellites per ESV -- may add up to a lot of spectrum, considering there are likely to be at least two providers and possibly more transmitting

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[26] *See* Notice at para. 69.

near major ports. We suggest that coordinated ESV spectrum be limited to that for which the ESV operator can demonstrate actual need,[27] not to exceed 36 MHz in each direction on each of two satellites per operator.

Fourth, the rules should make clear that ESV coordination is not for the entire geostationary arc, as is customary for fixed earth stations, but is limited to the azimuths and resulting elevations that correspond to the two (maximum) satellites specified by the ESV operator. Although these azimuths and elevations will vary somewhat with vessel location, this limitation will facilitate FS coordination with minimal burden on ESV operators.

Finally, we think a 15-year license term is excessive for an application in which a small mis-step is capable of causing serious interference to critical operations.[28] We propose a two-year term, with renewal on a case-by-case basis.[29] We do not expect FS operators will object to renewal where the ESV licensee has respected the conditions above.

Vessel size. Allowing ESVs on vessels of 300 gross tons or larger risks proliferation in large numbers on relatively small ships capable of travel far into inland waterways.[30] ESV services offered to date have been available only on large vessels, so the 300 gross ton criterion would amount to a major expansion. Noting that cruise ships are generally in the range 10,000-100,000 gross tons, we propose restricting ESVs to ships of 5,000 gross tons or larger. This

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[27] This is the same standard applicable to all FS operations. *See* 47 C.F.R. Secs. 101.103(c), 101.141(a)(3) & note 3 in table.

[28] Notice at para. 70.

[29] *Compare* Notice at para. 68.

[30] Notice at para. 54.

should give ESV operators continuing access to their present markets, yet reasonably limit their operation to deep draft vessels that operate in coastal waters or major waterways.

5. Interference criteria[31]

The unsuccessful effort by the National Spectrum Managers Association (NSMA) to develop ESV/FS interference criteria[32] was focused on finding a single interference criterion that would be effective in all cases. But it may well be that no single interference criterion can protect FS receivers from ESVs in all circumstances.

The coordination methodology developed in ITU-R WP 4-9S represents a further development of the NSMA work. That approach, as described in Recommendation ITU-R SF.1649, extends the critical contour point methodology considered by NSMA and tests the results of separate calculations against short-term and long-term interference criteria. The Recommendation suggests the short-term interference criteria used in Recommendation ITU-R SF.1650, but this is similar to the short-term criteria given in Appendix 7 of the Radio Regulations, Recommendation ITU-R SM.1448, and Recommendation ITU-R SF.1006. For the consideration of long-term interference, Recommendation ITU-R SF.1649 uses a calculation that is equivalent to the Fractional Degradation of Performance (FDP) calculation developed in Recommendation ITU-R F.1108, rather than the calculation usually used for transmitting fixed Earth stations operating to GSO satellites. It refers to Recommendation ITU-R SF.1006 for a long-term interference criterion.

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31 See also the Appendix.

32 *See* Notice at paras. 12, 71.

The FDP approach has been widely used in determining long-term interference in cases where the interference power to an FS receiver varies widely over time. A recent example of the U.S. use of FDP is in TIA TSB-86, where it is used as the basis for examining interference into an FS receiver from constellations of NGSO satellites near 2200 MHz. The Satellite and Fixed Microwave Sections of TIA along with the NSMA developed TSB-86 jointly. It may be the best approach here.

ESVs should be required to meet both short-term and long-term interference criteria. The short-term interference criteria protect an FS receiver from the high power interference levels that can result when an ESV passes through the main beam of the receiving antenna. Where there is no main-beam passage, but the main-beam axis of the receiving antenna is close to a portion of the ESV operating contour, elevated interference power levels may be present for several hours. Even though the maximum interference power level may not exceed the critical short-term interference power level, the accumulated time over many passes in a month may lead to degraded performance, particularly when modest levels of fading of the desired signal occur simultaneously with the ESV's producing elevated levels. A long-term interference criterion along with an appropriate calculation methodology, as provided in Recommendation ITU-R SF.1649, is needed for this assessment.

The interference criterion of TSB 10F was developed to account for long-term interference from a small number of stationary sources of interference. It is not readily adaptable for the consideration of long-term interference from mobile sources. As noted above, an FDP methodology was used in the development of TSB 86 rather than the criterion of TSB 10F.

Coordination distance. The Notice asks whether 100 km is an adequate coordination distance.[33] It is entirely possible that harmful interference may be caused by ESV operations at distances greater than 100 km. If the coordination distance were set at 100 km, it would be impossible to confirm the occurrence of these interference events because of the large distance to the interfering ESV and lack of any information as to ESV operations beyond the coordination distance.

CONCLUSION

The FWCC appreciates the benefits that ESV operation would bring to vessel operators and the sea-going public. We think these benefits can be achieved while still protecting critical FS systems from interference. The burden of that protection must fall on the ESV industry as the sole economic beneficiaries of ESV operation.

Respectfully submitted,

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[33] Notice at para. 75.

APPENDIX

Identification of Harmful Interference

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The ESV NPRM (FCC 03-286) has described possible processes for resolving cases of harmful interference. The FWCC has commented previously on the difficulty of identifying harmful interference from moving sources of interference. But the problem is even more serious than has been described previously. Since this NPRM has also raised the issue of long-term and short-term interference criteria, it appears that the stage is set for a comprehensive discussion of the problems of identifying harmful interference. The point is that interference that is readily identified as harmful is much more severe than the permissible interference levels that are used as allowances in fixed service designs to assure that systems meet the desired design objectives. If harmful interference becomes widespread, or appears to be becoming widespread, the ability of the fixed service to provide radiocommunication services of acceptable quality will be severely compromised.

Short-term interference is interference that is of high enough power that it exceeds allowable limits for a permissible fraction of time when the desired signal to the receiver is at its nominal, unfaded, power level. That is, the interference will cause the fixed service to make errors even when there is no fading of the desired signal to the receiver. In the case of ESVs the interference power may exceed this level only when the ESV is in a particular portion of its operating route and when propagation conditions lead to enhanced power on the interference propagation path. If the enhancement needed to exceed the permissible level is sufficiently large, the ESV will meet the short-term interference criterion based on the percentage of time.

Long-term interference is interference that can cause performance defects when the desired signal is faded to a power level at which that performance defect would not be experienced in the absence of interference. It is usually evaluated under nominal propagation conditions for the interfering signal. Thus, it is regarded as a degradation of fade margin. In cases where the interference is time invariant, its permissible power level, as given by an interference criterion, is easily calculated. In cases where the interference is time varying because of motion of the interfering transmitter, determining the effect can be quite difficult since both motion and the propagation conditions on the desired-signal path determine the effect of the received interference power. In frequency bands where multipath fading is the predominant cause of performance defects, the use of an average value of the interference power is appropriate for determining the effect of the interference. This approach is referred to as the FDP approach.

In a static situation the occurrence of a performance defect in a receiver depends on the relative values of the received signal power, the received interference power and the effective system noise power all referred to the same point. In general, an interference power that is 20 dB below the desired signal power would be sufficiently strong to put a fixed service receiver, which was using high level complexity digital modulation, into a continuously errored state. Yet such an interference power is almost impossible to detect since the sum of the desired signal power and the interference power is only 1 percent greater than the power of the signal without interference. As a consequence the interference power can only be measured by turning down the desired signal and monitoring the radio channel or by using the observed error performance as an indicator of possible harmful interference. It does not appear that either of these options is a viable alternative.

Turning down the link and using it for interference monitoring instead of service is expensive and undesirable. The monitoring requires an investment in personnel, equipment and time. At the same time it is necessary to monitor the propagation on the desired signal path to be able to assess the effect of long-term interference. Any test must extend over weeks or perhaps months in order to characterize the propagation statistics of the desired signal and to characterize the interference signal which has variability due both to motion and to propagation anomalies.

The detection of harmful interference through performance monitoring likewise presents difficulties. Under interference-free conditions a fixed service link may exhibit performance defects for some small percentage of time. In the presence of interference, performance defect events may become more severe (longer duration) than they would have been without interference, and events can occur that would have not occurred in the absence of interference. It is the latter type of event that would serve as the more definitive indicator of interference, but it is not possible to distinguish it from an interference-free performance defect.

The only way to identify an interference event is to establish the correspondence between performance defect events and the presence of an ESV on some portion of an operating contour. In general the correspondence will not be complete. Sometimes performance defect events will occur when no ESV is near (an interference-free event), and sometimes an ESV will be present and no performance defect will occur (favorable propagation conditions). In only the most severe interference situations would performance defects always occur concurrently with the operation of an ESV nearby.

If it was established that an ESV had been present during half of the performance defects observed in a receiver, one could reasonably assume that the interference had more than doubled the performance defect time of the FS system. Such a performance degradation would significantly exceed the performance degradation that a service would accept from any source either in the same service or from a co-primary service. This raises the question of what fraction of performance degradation events must be observed in time-coincidence with the presence of an ESV in order to validate a decision that harmful interference was present. Alternatively, how many "frivolous" complaints need to be investigated to reliably establish that harmful interference is not present.

From the preceding discussion it appears that interference from the light usage of a waterway by a small number of ESVs is unlikely to be recognized even if it exceeded the usual interference criteria. Over time as more vessels use ESVs and operate more frequently on a waterway, the possibility of identifying interference from performance degradations increases. By the time that a fixed service operator has a 50 percent chance of identifying an interference event on a hop, the time duration of performance defects of the hop will have more than doubled, compared to an interference-free operation.

The interference resolution process proposed in paragraph 67 of the ESV NPRM for uncoordinated operation of ESVs in the 6 GHz band does not offer much value to the fixed service. By the time ESV usage had reached a point that a fixed service operator could make a case that harmful interference was occurring, the performance of the particular link would be significantly degraded. Attempts to limit the number of complaints would only serve to further reduce the value of the proposed process. The uncoordinated operation of ESVs in the 6 GHz band should not be permitted. The uncoordinated operation of secondary services has been described as granting the secondary service super-primary status. That appears to be the case here.

The difficulty of identifying interference provides a strong basis for requiring that ESV operations should only be licensed on a frequency-coordinated basis. To allow the fixed service to continue to provide the high-quality services required in modern communications networks such coordination should include the use of both short-term and long-term interference criteria. Such a coordination procedure can be implemented most effectively by reference to the ITU-R Recommendations SF.1649 for methodology and SF.1006 for interference criteria. Furthermore, this solution relieves the FCC of the need to define any special means for dealing with claims of interference.

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