Conference Preparatory Meeting for WRC-15
Geneva, 23 March - 2 April 2015

INTERNATIONAL TELECOMMUNICATION UNION

PLENARY MEETING

Subject: Document CPM15-2/TEMP/22

Document CPM15-2/218-E
31 March 2015
Original: English

Working Group 4.1

PROPOSED TEXT FOR THE CPM REPORT

AGENDA ITEM 1.8

(**WP 4A** / **WP 4C, WP 5A, WP 5B, WP 5C**, (WP 7A), (WP 7B), (WP 7C), (WP 7D))

1.8 *to review the provisions relating to earth stations located on board vessels (ESVs), based on studies conducted in accordance with Resolution **909 (WRC-12)**;*

Resolution **909 (WRC-12)**: *Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz*

4.1/1.8/1 Executive summary

WRC-12 decided to review the provisions relating to 5 925-6 425 MHz (C band) and 14-14.5 GHz (Ku band) earth stations on board vessels (ESVs) in preparation for WRC-15. Studies were conducted by ITU-R to consider possible modifications to Resolution **902 (WRC-03)**. To this effect, WRC-12 established WRC-15 agenda item 1.8 together with Resolution **909 (WRC-12)**.

WRC-15 agenda item 1.8 calls for a review of the existing provisions relating to ESVs, based on studies conducted in accordance with Resolution **909 (WRC-12)**. In particular, it considers the need to review and possibly revise limitations and restrictions contained in Resolution **902 (WRC-03)** to reflect current ESV technologies and technical characteristics that are being used or planned to be used, while ensuring the continued protection of other services to which the frequency bands 5 925-6 425 MHz and 14-14.5 GHz are allocated.

Recommendation ITU-R S.1587-2 describes the current technologies and technical characteristics that are being used or planned to be used for ESVs communicating with fixed-satellite service (FSS) satellites in the frequency bands 5 925-6 425 MHz and 14-14.5 GHz.

Resolution **902 (WRC-03)** had set separation distances from the low-water mark as the relevant parameter to protect terrestrial services from unacceptable interference. In C band and to a lesser extent in Ku band, the fixed service (FS) is implemented in many countries for their infrastructure terrestrial telecommunication services, including IMT backhauls, or to connect remote coastal stations (offshore oil platforms). The studies conducted in response to this agenda item have focused on these separation distances to assess the impact on terrestrial services from a potential modification of the current regulatory regime.

One study proposes to update the regulatory protection distances from low-water mark from the point of view of an increased number of operational ESVs when compared to the scenario considered in 2003, and proposes to increase the regulatory protection distance for C band while

maintaining the maximum ESV transmitted e.i.r.p. densities unchanged with respect to the levels contained in Resolution **902 (WRC-03)**.

A second study proposes to update the current regulatory regime by establishing a discrete set of different regulatory protection distances for different maximum values of e.i.r.p. densities transmitted by ESVs in the C and Ku bands. Because of the smaller C band ESV antenna diameter found in Recommendation ITU-R S.1587-2 when compared to the minimum diameter prescribed in Resolution **902 (WRC-03)**, this study also takes into account an increase in the number of operational C band ESVs when compared to the scenario considered in 2003.

A third study proposes to update the regulatory protection distances by taking into account the statistical information on maritime traffic in certain regions and the probability of frequency overlapping between ESV and the FSR and also such study takes into account the new ESV systems employing transmission techniques requiring lower e.i.r.p. densities. This study therefore proposes different regulatory protection distances based on different sets of maximum values of e.i.r.p. densities towards the horizon transmitted by ESVs in the C and Ku bands.

4.1/1.8/2 Background

Consideration of ESVs in the ITU started in 1997 when WRC-97 placed ESVs on the WRC-2000 agenda (agenda item 1.8) in its Resolution **721 (WRC-97)**.

At WRC-03 diverging views were expressed on the appropriateness of allowing an earth station on board a vessel, which is a maritime mobile earth station, to operate in the fixed-satellite service, with different classes of stations. However, under the prevailing circumstances, the Conference decided to authorize earth stations on board vessels to operate in the fixed-satellite service, adopted Resolution **902 (WRC-03)**, and introduced footnotes RR Nos. **5.457A**, **5.457B**, **5.506A** and **5.506B**.

In particular, Resolution **902 (WRC-03)** limits the use of ESVs to distances of at least 125 km "from the low-water mark as officially recognized by the coastal State" for Ku band and 300 km for C band for operation "without the prior agreement of any administration".

These two distances together with their associated antenna diameters were agreed as results of intensive discussions due to the fact that some administrations were of a strong view that those quoted distances were not sufficient to adequately protect the terrestrial services, whereas other administrations were of the strong view that the proposed measures were sufficient to adequately protect terrestrial services.

While ESV licensing is available in a handful of countries, most simply adhere to the existing Resolution **902 (WRC-03)** coordination requirements. Moreover, the circulation of ESVs within limits defined by Resolution **902 (WRC-03)** requires appropriate administrative and procedural arrangements between the ESV operators, licensing administrations and potentially affected coastal countries to ensure the protection of FS stations.

Since that time, the use of these earth stations on ships has increased but no studies updating the ESV deployment scenario considered in 2003 are available.

However, it should be noted that, for the 14 GHz band, Recommendation ITU-R SF.1650-1 uses the number of ferry arrivals of the Dover port in 1999. The number is approximately 24 000 and the Recommendation derives the number of vessel passes per day multiplying it by the probability of the frequency overlap. This means the Recommendation assumes that all the ferries are equipped with ESV terminals operating in the 14 GHz band.

During the 2007-2012 ITU-R study cycle, an input document called attention to the assumptions used in Recommendations ITU-R S.1587-1 and ITU-R SF.1650-1 to develop Resolution **902 (WRC-03)** considering that they are no longer representative of all current ESV technologies. For

example, some of the typical ESVs in the frequency band 5 925-6 425 MHz may operate today with e.i.r.p. density levels that are more than 20 dB lower than those used in Recommendation ITU-R SF.1650-1. As a consequence, ESV operations at lower power could coordinate more easily with the terrestrial administration if they operate inside the 300 km and 125 km in C and Ku bands, respectively, or even be allowed to operate at smaller distances without the need to coordinate. It is worth noting that the use of spread spectrum will lead to a decrease in spectral efficiency (transmission rate/bandwidth). Meanwhile, lower e.i.r.p. density levels of the ESV transmission would consequently restrict its information rate per ESV terminal within the same bandwidth.

The frequency bands referred to in Resolution **909 (WRC-12)** are, in some countries, extensively used for medium- and long-distance backhaul for cellular networks, and their use is likely to further grow. These terrestrial services also provide the backbone of infrastructure in developing countries including terrestrial stations that are near coastlines and point towards the sea for broadband communications to remote communities or offshore oil platforms.

4.1/1.8/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

Relevant ITU-R Recommendations: ITU-R S.1587-1, ITU-R S.1587-2, ITU-R SF.1650-1, ITU-R P.620-6, ITU-R P.452-14.

These Recommendations contain information on the characteristics, frequency bands, guidance and example methods for use with ESVs operating at 4/6 GHz and 11/14 GHz to provide protection to the FS. It can be however noted that these Recommendations may not cover all characteristics of terrestrial stations currently operating in the terrestrial services.

Recommendation ITU-R S.1587-2 provides a description of technical characteristics of existing and planned ESVs that operate in the bands 5 925-6 425 MHz and 14-14.5 GHz in FSS networks.

Recommendation ITU-R SF.1650-1 recommends distances beyond which in motion ESVs are assumed not to cause unacceptable interference to the FS. For the band 5 925-6 425 MHz, the distance is 300 km and for the 14-14.5 GHz band, the distance is 125 km based, among others, on the assumption of a moving vessel (10 knots).

Recommendation ITU-R P.620-6 provides propagation data for use in the calculation of a coordination area and sets out a straightforward method for the assessment of the propagation factors concerned in the determination of coordination distances in the frequency range 100 MHz to 105 GHz.

Recommendation ITU-R P.452-14 contains a prediction method for the evaluation of interference between stations on the surface of the Earth at frequencies from about 0.1 GHz to 50 GHz, accounting for both clear-air and hydrometeor scattering interference mechanisms.

4.1/1.8/3.1 Study based on increasing the number of passes of ships in the C and Ku bands

The minimum distance of 300 km at C band (for an antenna diameter of 2.4 m) and 125 km at Ku band (for an antenna diameter of 1.2 m) from the low-water mark as officially recognized by the coastal State, beyond which ESVs can operate without the prior agreement of any administration as mentioned in Resolution **902 (WRC-03)**, had been calculated in the 2000-2003 timeframe based on assumptions and technical parameters prevailing at that time.

It was considered that parameters used in previous studies should be reviewed to take into account potential increase in the number of passes of ships. In view of the fact that the number of ESVs in the 6 GHz and 14 GHz bands have increased in recent years, the calculations have been carried out, according to new assumptions as tabulated in Table 4.1/1.8/3-1.

TABLE 4.1/1.8/3-1

Number of vessel passes across the beam of the fixed service receiver (FSR)

Frequency band	Number of vessels
6 GHz band	1 vessel every third day; 1, 3, **4** and **6** vessels every day
14 GHz band	3, 6 and **8** vessels every day

In order to take into account the prevailing situation (numbers of ship passes and etc.) these calculations have been reviewed and the results obtained are reflected in the paragraphs below.

The calculations provided are based on the methodology using the propagation model described in Recommendation ITU-R P.620-6 and also the iterative method for determining the minimum distance presented in Recommendation ITU-R SF.1650-1.

Using the new assumptions of the maximum numbers of vessels with 36° discrimination angle and keeping the same limitations as those mentioned in Resolution **902 (WRC-03)** including maximum e.i.r.p. density levels towards the horizon of 17 dBW/MHz for C band and 12.5 dBW/MHz for Ku band, the results show almost 345 km as the increased protection distance for C band and approximately 125 km as the retained protection distance for Ku band, which has been mentioned in Resolution **902 (WRC-03)**.

It means that, increasing the number of the passing vessels, off-shore distance in the C band should be increased but in the Ku band it could be retained.

Protection distance calculations in the 6 GHz band using Recommendation ITU-R P.452-14 have been made for the fixed stations with the altitudes of 120 m and 1035 m above the sea level. In the first case, the fixed station with the altitude of 120 m above the sea level and distance of zero from the shore and in the second case the fixed station with the altitude of 1 035 m above the sea level and distance of 25 km from the shore have been considered. Since in the most cases the fixed stations are located on the mountains with high altitude, therefore in the second case, the fixed stations with the altitude of 1 035 m above the sea level and distance of 25 km from the shore have been taken into account.

Using the parameter values described above and based on the methodology specified in Recommendation ITU-R SF.1650-1 and using the propagation model described in Recommendation ITU-R. P.452-14, the results show that almost the same conclusion is reached for C band (about 345 km), as using the propagation model described in Recommendation ITU-R P.620-6. Therefore, it is confirmed that the off-shore distance of 300 km for C band in uplink directions should be increased. To this effect, it is necessary to examine and remedy the assumptions again in Recommendation ITU-R SF.1650-1 and review, as appropriate, during this study period.

4.1/1.8/3.2 Study establishing different protection distances for different maximum e.i.r.p. density levels, which yields shorter protection distances for e.i.r.p. density levels lower than those currently allowed by Resolution 902 (WRC-03)

This study follows the same methodology described in Recommendation ITU-R SF.1650-1 and the propagation model described in Recommendation ITU-R P.452-14, and also takes into account different values of uplink transmitted power density for ESVs employing state of the art technologies and technical characteristics and, for the 6 GHz band, a doubling in the number of passes of ships when compared with the number assumed by WRC-03. The latter assumption results from the proposed reduction of the 6 GHz ESV minimum antenna diameter from 2.4 to 1.2 m, with the consequent potential increase in aggregate interference into terrestrial services.

This study also considers, for the 14 GHz band, different values of uplink ESV transmitted power density and the deployment scenario of ESVs implicitly assumed by WRC-03 when establishing the protection environment for the FS, including the number of passing vessels used during the studies carried out before WRC-03. Based on updated maritime traffic statistics, this number is still valid today and equivalent to that of about 11.2 passes per year of ESV transmitting within the FSR channel bandwidth with the ESV antenna pointing to the FSR with a 10° discrimination angle[25].

Based on the results of this study, the separation distances shown in Tables 4.1/1.8/3-2 and 4.1/1.8/3-3 are proposed to replace the single distances currently found in Resolution **902 (WRC-03)** for the 6 GHz and 14 GHz frequency bands:

TABLE 4.1/1.8/3-2

Minimum distances versus maximum e.i.r.p. transmitted toward the horizon – C Band

Maximum e.i.r.p. transmitted toward the horizon (dBW in 11.2 MHz)	Minimum distance from low-water mark* (km)
20.8	323
10.8	227
0.8	130
–9.2	64

* Low-water mark as officially recognized by the coastal State.

TABLE 4.1/1.8/3-3

Minimum distances versus maximum e.i.r.p. transmitted toward the horizon – Ku band

Maximum e.i.r.p. transmitted toward the horizon (dBW in 14 MHz)	Minimum distance from low-water mark*(km)
16.3	125
6.3	85
–3.7	29

* Low-water mark as officially recognized by the coastal State.

The protection distances associated with the above maximum e.i.r.p. levels transmitted toward the horizon were derived using the methodology described in Recommendation ITU-R SF.1650-1 and the propagation model described in Recommendation ITU-R P.452-14. However, use of Recommendation ITU-R P.620-6 would modify the values derived by this study.

The lower e.i.r.p. spectral density levels indicated in the above Tables are compatible with the parameters provided for low power density ESV systems reflected in Recommendation ITU-R S.1587-2 depending on the ESV antenna discrimination angle towards the horizon. Lower e.i.r.p. density levels may be achieved through spreading of the ESV transmitted carrier in bandwidths larger than 11.2 MHz for the C band and 14 MHz for the Ku band, in which case the probability of frequency overlap between the ESV transmission and the FSR will increase, with a

[25] The highest value of f_{ESV} for which results of the methodology described in Recommendation ITU-R SF.1650-1 are presented in Annex 1 of that Recommendation corresponds to 2 190 passes per year, and the maximum discrimination angle assumed in that Recommendation is 36º.

corresponding effect on the protection distances. Quantification of that effect requires knowledge of the extent to which these cases will occur.

There is an argument for having lower e.i.r.p. density levels through spreading of the ESV transmitted carrier in bandwidths larger than 11.2 MHz for the C band and 14 MHz for the Ku band. However, it should be noted that not all ESV deployed use such spread spectrum technique.

4.1/1.8/3.3 Establishment of different protection distances for different maximum e.i.r.p. density levels accounting for the statistical information on maritime traffic and the probability of frequency overlapping

This study assumed that establishing the protecting distances for the FS needs taking into account the statistical information on maritime traffic and the probability of frequency overlapping between ESV and FSR. In this study separation distances for FSRs are defined taking into account the probability of frequency overlapping for two scenarios:

1 ESV operation in any place within the entire 500 MHz frequency band in the C and Ku bands

2 ESV operation only in one satellite 36 MHz transponder. In that case the probability of frequency overlapping between ESVs and FSRs is much higher.

The study showed that the second scenario led to greater protection distances and therefore protection distances presented in Tables 4.1/1.8/3-4 and 4.1/1.8/3-5 are based on the second scenario. Also the protection distances associated with values of ESV e.i.r.p. spectral density toward the horizon were found to provide the same level of interference protection for terrestrial stations as that afforded by the values in Resolution **902 (WRC-03)**.

TABLE 4.1/1.8/3-4

Minimum distances for FSR versus maximum e.i.r.p.$_{ESV}$ transmitted toward the horizon – C Band

Maximum e.i.r.p.$_{ESV}$ transmitted toward the horizon (dBW in 11.2 MHz)	Minimum distance from low-water mark*(km)
20.8	328
10.8	233
0.8	134
–9.2	57

* Low-water mark as officially recognized by the coastal State.

TABLE 4.1/1.8/3-5

Minimum distances for FSR versus maximum e.i.r.p.$_{ESV}$ transmitted toward the horizon – Ku Band

Maximum e.i.r.p.$_{ESV}$ transmitted towards the horizon (dBW in 14 MHz)	Minimum distance from low-water mark* (km)
16.3	125
6.3	97
–3.7	43

* Low-water mark as officially recognized by the coastal State.

The lower e.i.r.p. spectral density levels indicated in the above Tables are compatible with the parameters provided for low power density ESV systems reflected in Recommendation

ITU-R S.1587-2 depending on the ESV antenna discrimination angle towards the horizon. Lower e.i.r.p. density levels may be achieved through spreading of the ESV transmitted carrier in bandwidths larger than 11.2 MHz for the C band and 14 MHz for the Ku band, in which case the probability of frequency overlap between the ESV transmission and the FSR will increase, with a corresponding effect on the protection distances. Quantification of that effect requires knowledge of the extent to which these cases will occur.

4.1/1.8/4 Analysis of the results of studies

Consideration needs to be given to new modulation methods and lower e.i.r.p. values highlighted by operators in current ESV operations which could lead to the use of reduced diameter of antennas, and consequently, to a significant increase in the number of ESVs. In order to review the possibility of implementing revised criteria it is necessary to review the full results of previous studies to determine the extent to which the assumptions and statistics leading to the distance criteria and antenna size are applicable to the technologies being deployed today taking into account new modulation methods, which may operate with lower e.i.r.p. density levels, volume of maritime traffic in international waters and the cumulative effect of the total number of vessels which the terrestrial services would encounter on the shores of the coastal country. In so doing, it may also be necessary to repeat some of the historical studies in their entirety to take into account changed circumstances.

Such studies would enable administrations to better understand the potential for relaxing the current restrictions applying to ESVs enabling an informed decision about the future of Resolution **902 (WRC-03)** taking into account the critical importance of the bands under reference for public telecommunication services and broadband communications to remote rural communities and communications to offshore oil platforms in developing countries.

Studies that considered ESV deployment scenarios where the number of ESVs is larger than that considered by WRC-03 have concluded that, for the maximum levels of e.i.r.p. density transmitted toward the horizon, the protection distances should be increased for the 6 GHz frequency band.

Finally, studies that also considered levels of e.i.r.p. density transmitted toward the horizon lower than those considered by WRC-03 concluded that, for these cases, the protection distances could be decreased.

The results of studies carried out in sections 4.1/1.8/3.1, 4.1/1.8/3.2 and 4.1/1.8/3.3 are summarized below (for more information in details, see the relevant mentioned sections above).

Based on the results of the study described in section 4.1/1.8/3.1, the calculation of the off-shore distance values from the baseline for protection of the FS, based on the methodology using the propagation model described in Recommendation ITU-R P.620-6 and Recommendation ITU-R P.452-14 and also the iterative method for determining the minimum distance presented in Recommendation ITU-R SF.1650-1 with the new assumptions on the number of vessels in the 6 GHz and 14 GHz bands shows that the protection distance increases to almost 345 km for the C band but it could be reached to approximately 125 km for the Ku band.

Based on the results of the study described in section 4.1/1.8/3.2, the distances shown in Tables 4.1/1.8/3-2 and 4.1/1.8/3-3 associated with the values of ESV e.i.r.p. spectral density toward the horizon produce the same level of interference protection as that afforded by the values in Resolution **902 (WRC-03)**. In addition, the study in section 4.1/1.8/3.2 took into account the statistical information on maritime traffic and the probability of frequency overlap between ESV and FSR.

Based on the results of the study described in section 4.1/1.8/3.3, the distances shown in Tables 4.1/1.8/3-4 and 4.1/1.8/3-5 associated with the values of ESV e.i.r.p. density toward the horizon produce the same level of interference protection as that afforded by the values in Resolution **902**

(WRC-03). In addition, the study in section 4.1/1.8/3.3 takes into account the real statistical information on maritime traffic in particular provided in the documents CPM15-2/47 and CPM15-2/37 and the probability of frequency overlapping between ESV and FSR.

It is worth mentioning that, in discussions dealing with ESV use of advance technologies such as spread spectrum technology, some administrations raised the following questions which they believe are still required to be clarified as appropriate before proceeding further or making any conclusions: How many ESVs operating with parameters in line with Recommendation ITU-R SF.1650-1 and Recommendation ITU-R S.1587-2 are deployed today and how many are foreseen to be deployed in the future; how many ESVs with significantly reduced e.i.r.p. (up to 20 dB) are operating today and how many are foreseen to be deployed in the future; what are the technical characteristics of the corresponding satellite networks with which these low e.i.r.p. ESVs are communicating; and what is the overall link performance and what is the service availability of such links; has any of these low e.i.r.p. ESVs been notified to the BR reflected in the BR publication; what were the conclusions of the BR; can statistics on the ESVs and their status be formally provided with sufficient evidence; are these low e.i.r.p. ESVs understood to communicate with the corresponding space station within the typical characteristics contained in the coordinated satellite networks as recorded with the ITU-R; what is the status of an ESV operating under characteristics of a typical earth station (E/S) pertaining to a given satellite network if the E/S drastically reduces the e.i.r.p. up to 20 dB compared to that of the typical E/S associated with the satellite network; could such a drastic e.i.r.p. reduction make the ESV more sensitive to interference from other satellites than what was agreed during the coordination; and would this imply that such an ESV would accept the increased interference?

Some other administrations have the following views concerning the above questions:

As ESVs are not required to be notified and are not entitled to claim protection against interference, BR databases do not provide meaningful information about their numbers.

The level of protection received by ESV terminals is that level afforded indirectly by the coordination of the typical FSS earth stations filed for the respective satellite network. The reduced levels of e.i.r.p. radiated by some ESV terminals, if not within the envelope of those filed for typical FSS earth stations, will be associated with lower values of C/N, and consequently the type of modulation and coding for use with the ESVs will have to be suited for operation with these C/N levels. However, it is not unusual to find in satellite filings differences between maximum and minimum power levels as high as 30 dB for the same frequency assignment.

In several parts in the studies in the above sections (4.1/1.8/3.2 and 4.1/1.8/3.3), references are made to technical characteristics of ESVs communicating with FSS satellites in the C and Ku bands. In this connection, it is worth to mention that most of these references are related to ESV systems 4 and 5 (for Ku and C band, respectively) of Recommendation ITU-R S.1587-2 in which the antenna diameters are 1.2 m and 60 cm, respectively, whereas other ESV systems contained in the above mentioned Recommendation use antenna diameters of 2.4 m and 1.2 m for C and Ku bands, respectively.

In view of the above, ESV systems 4 and 5 in Recommendation ITU-R S.1587-2 are not representative of all ESV systems used in the current studies. However, some administrations are of the view that, although it is recognized that ESV systems 4 and 5 in Recommendation ITU-R S.1587-2 are not representative of all ESV systems used in the studies undertaken in response to this agenda item, the regulatory solutions proposed in response to this agenda item are not exclusive to these systems, but cover all types of EVS systems described in that Recommendation.

4.1/1.8/4.1 Several concerns on the studies

4.1/1.8/4.1.1 Some administrations are of the view that:

– Any modification to the distance would be detrimental to the operation of terrestrial services of coastal administrations in particular when these terrestrial services are the only telecommunications infrastructure of these countries,

– The shorter protection distances for those cases of ESV transmitting power levels lower than the maximum levels currently allowed by Resolution **902 (WRC-03)** would be possible provided that the relevant e.i.r.p. density could be permanently monitored by the terrestrial administrations in order that the shorter distances were not violated. This would be an almost impractical tasks for terrestrial administrations, in particular those of developing countries.

– Reduction of protection distance for ESV operator is counter balanced by increasing workload for coastal administrations using terrestrial services.

– There is no mechanism to verify that compliance with minimum protection distances ensured by the ESV licensing administrations is established and the applicable regulatory procedures referred to are unknown to the coastal administrations.

– There is no evidence how the ESV licensing administration and service providers to ensure that the operational provisions and technical limitations of the Resolution are met, and if not what will happen? For the earth stations which are not notified there is no mechanism to take any action by the Bureau or by coastal administration to verify if the operational provisions and technical limitations of the Resolution are met.

– Network Operation Centre which monitors the registered ESV stations is an entity under the control of FSS operators and the coastal administrations has no direct control over this centre.

– Should the e.i.r.p. of the earth station be reduced by 20 dB and that earth station claimed to be operated within the envelope characteristics of the typical earth station coordinated, notified and recorded in the MIFR, then the overall link would change and in addition to that the interference environment towards the satellite in the vicinity of the FSS used for that purpose would be drastically modified.

– Since the date of the revision of Recommendation ITU-R SF.1650-1 (2003-2005), the number of ESVs has considerably increased and the protection distance in C band from the coastline would have to be increased. Moreover, if the minimum regulatory diameter of the antennas of these ESVs is reduced, then the number of ESVs is likely to increase compared with the numbers assumed in Recommendation ITU-R SF.1650-1.

– Any flexibility in applying the provisions of Resolution **902 (WRC-03)** (e.g. e.i.r.p. as a function of distance from coastline) would make the task of administrations extremely difficult and harder for checking the right application of regulations due to the fact that these administrations need to continuously and dynamically verify the e.i.r.p. of each of very many ESVs to ensure that the terrestrial stations are properly protected. Such course of action would impose additional burden to the developing countries, in particular, when processing interference report analysis or when supervising conformance of ESV characteristics and operational aspects with the applicable regulatory procedures. It is worth to mention that the above-mentioned terrestrial services/stations are the backbone of telecommunication/ICT infrastructure and thus need to be fully protected.

– In addition to concerns expressed by some countries in 2003 on the appropriateness of allowing the implementation of ESVs links in FSS frequency bands, such relaxation in

the current regulations, could adversely impact the availability of the FS links, and provided new increased separation distance values to ensure protection of FS coastal stations, considering an increase of number of ships passes as a consequence of antenna size reduction.

– Considering Annex 1 to Resolution **902 (WRC-03)** (paragraph 6) which states that "the ESV systems shall include means of identification and mechanisms to immediately cease emissions, whenever the station does not operate in compliance with the provisions...", it is recalled that such interference management system is difficult to operate and to act in order to immediately cease or reduce the interference to the acceptable level taking into account that the costal administrations responsible for terrestrial services would need to continually monitor the interference environment in order to report occurrence of such interference. Moreover, it is not clear how quickly and to which entity the interference would be reported and how quickly that report will be taken into account by the control centre and how quickly the control centre will advise the ESV operator to cease or reduce interference to acceptable level. In summary, the whole process is merely hypothetic and un-implementable.

– It should be emphasized that use of different e.i.r.p. density resulting different protection distance would considerably put burden to the coastal administration responsible for terrestrial service. Consequently any claim that reduction of protection distance reduces regulatory burden to the costal administrations is not valid.

– With respect to proponent of the method C's assertion that there is no evidence indicating that the ESV deployment scenario considered by WRC-03 for the 14 GHz is no longer valid today, the fact is that there is no evidence indicating the opposite situation either.

The above administrations in discussing studies dealing with reduction of protection distances as result of use of advance technologies such as spread spectrum technology and use of dynamic power density control of the ESV raised the following questions:

1. How the terrestrial administrations should react on the need for coordination without precise knowledge that which ESV operates on what e.i.r.p. density and what antenna elevation angle?
2. Moreover, even if, that administration is received information on the exact e.i.r.p. power density and exact antenna elevation angle, how that administration should be ensured that such announced e.i.r.p. power density and antenna elevation angle would be respected operation during the actual operation of the ESV?
3. How the terrestrial administrations should react in regard with the coordination requirement of the ESV with respect to its terrestrial services of numerous ESV each with different e.i.r.p. density and eventually different antenna elevation angles?
4. How the terrestrial administrations should react in regard with the required off-shore distance arising from the cumulative effects of a) different earth stations mounted on board given vessels and b) the cumulative effects of different earth stations mounted on board given vessels and different earth stations mounted on board other vessels?
5. How the terrestrial administrations should react on the required off-shore distance arising from the pass of different ESVs consisting of a) a ship having either one or several earth stations on its board with different e.i.r.p. and different eventual antenna elevation angles and b) various ships each either one or several earth stations with different e.i.r.p. density and different angles on each day.

6. How the terrestrial administrations should react on circumstances in which some ESVs continue to operate under the current environment as prescribed in Resolution **902 (WRC-03)** and some other ESVs operate under the new operational environment (different e.i.r.p. density and different eventual antenna elevation angle as outlined above)? However, other administrations are of the view that this issue is proposed to be addressed in the new *resolves* 2 and 3 of Resolution **902** according to Method C.

7. The burden, compared to the current single distance requirement, on that terrestrial administration, in particular those of developing and least developed countries, to take into account the variety of cases mentioned above to ensure that its terrestrial services are duly protected.

8. The issue of reduction of e.i.r.p. density of the ESV resulting from advances in technology, if really implementable, is an interesting issue which should not be limited and deployed for ESV only. On the contrary, it should be deployed and / or used for all FSS earth stations. In fact, if such advance in technology is available and used in all type of FSS earth stations, this could contribute to the efficient rational economical use of the orbital spectrum resources as highlighted in Article 44 of the Constitution.

   In view of the above, ITU-R needs first to examine the applicability and implementation of advance technology, such as use of spread spectrum and use of lower e.i.r.p. density mentioned in some studies under WRC-15 agenda item 1.8 in the use orbit spectrum utilization in other space service, if such technique is practical, valid and implementable in these other services. No information is yet officially available on such use. Consequently, any claim that this technique is only available for ESV seems to undermine the fact and reality in saying that only such technique in only available to ESV and not to other services.

9. Based on the studies for different off-shore distances, using maximum e.i.r.p., question raised is that how the terrestrial administration measures the e.i.r.p. density of current monitoring of the e.i.r.p. density?

4.1/1.8/4.1.2 Some other administrations are of the view that:

– It is possible to reduce the protection distances for these cases of ESVs transmitting lower power levels than the maximum levels currently allowed by Resolution **902 (WRC-03)** and still protect the terrestrial services of coastal administrations to the same level currently afforded by Resolution **902 (WRC-03)** for ESVs transmitting maximum power levels.

– Except for the C band, where possible reduced minimum ESV transmit antenna diameters may give rise to a larger number of ESVs, the deployment scenario taken into account by WRC-03 in the derivation of Resolution **902 (WRC-03)** is still valid today and should be used in responding to WRC-15 agenda item 1.8. It should be noted that Resolution **902 (WRC-03)** already envisages for Ku band antenna diameters as small as 60 cm under certain assumptions and conditions.

– Concerning the Resolution **902 (WRC-03)** requirement that "the ESV systems shall include means of identification and mechanisms to immediately cease emissions, whenever the station does not operate in compliance with the provisions...", the proponents of an appropriate relaxation in ESV regulations are confident in the ability and desire for operators to apply RR provisions, as is the current practice for protecting other primary services. It must be recalled that typical ESV network structure includes a Network Operation Centre which monitors the registered stations, with the view to implement the appropriate regulations as well as to ensure an efficient use of the

satellite spectral resource while allowing ship stations to benefit from this transmit power reduction by extending the operational area where prior agreement of coastal administrations is not required.

– Reducing the protection distances for operation of ESVs transmitting low e.i.r.p density levels will in fact alleviate administrations workload associated with coordination with ESV operators willing to offer access to broadband services since the number of cases of required coordination will be reduced.

– Licensing administrations should ensure compliance of ESV operations under their responsibility with the applicable regulatory provisions, so as to not burden coastal administrations with the need to monitor such compliance. In fact, compliance with minimum protection distances ensured by the ESV licensing administrations is already a feature of the current Resolution **902 (WRC-03)** regulatory regime, and makes it unnecessary for terrestrial administrations to monitor whether vessels within the protection distances are equipped with ESVs in operation and the associated e.i.r.p density level transmitted to toward their coast.

– The answer to question 1 in section 4.1/1.8/4.1.1 lies on the fact that Resolution **902 (WRC-03)** already requires the ESV licensing administration and service providers to ensure that the operational provisions and technical limitations of the Resolution are met. If coordination is needed, the information required to conduct the coordination process, such as precise e.i.r.p. density and elevation angle, will be provided by the administration licensing the ESV, in accordance with *encourages concerned administrations* in Resolution **902 (WRC-03)**.

– The answer to question 2 in section 4.1/1.8/4.1.1 lies on the fact that, in accordance with items 1 and 2 of Annex 1 of Resolution **902 (WRC-03)**, enforcement of the provisions and technical limitations, including conditions agreed during coordination, are to be ensured by the ESV licensing administration and ESV service providers.

– The answer to question 3 in section 4.1/1.8/4.1.1 lies on the fact that the methodology used in the derivation of the protection distances takes into account multiple passes of ESVs transmitting the maximum allowed e.i.r.p. density toward the horizon, and therefore the derived protection for terrestrial services cater for the aggregate effect of multiple worst-case transmitting ESVs. ESVs operating with power levels and elevation angles such that the e.i.r.p. density toward the coast is smaller than the maximum value assumed in the derivation of protection distances can only improve the interference scenario.

– The answer to question 4 in section 4.1/1.8/4.1.1 lies on the fact that the derivation of protection distances was made for the 6 and 14 GHz independently, which does not prevent the same vessel from being equipped with terminals operating in both frequency bands. As to multiple ESVs operating on the same vessel in the same frequency band, this situation would only arise if the service provider used several different satellite networks for service to the same vessel, which is highly unlikely for this type of service. The issue of aggregation of interference from multiple ESVs was addressed in the paragraph above.

– The answer to question 5 in section 4.1/1.8/4.1.1 lies on the fact that the regulatory regime applies to the operation of individual ESVs and not to the vessels. Consequently, each ESV is or is not allowed to operate in accordance with the terms of Resolution **902 (WRC-03)** and with the terms of agreements reached between the ESV licensing administration/service providers and the potentially affected administrations.

– Question 6 in section 4.1/1.8/4.1.1 is proposed to be addressed in the new *resolves* 2 and 3 of Resolution **902** according to Method C.

– The answer to question 7 in section 4.1/1.8/4.1.1 lies on the fact that, once ESVs operating with e.i.r.p. density levels lower than the maximum levels currently prescribed by Resolution **902 (WRC-03)** are allowed to come closer to the coast before they need to coordinate, the total number of requests to coordinate will necessarily be smaller than it would be the case if all ESVs, regardless of their potential to cause interference, were required to coordinate if they were to operate within the current protection distances. Consequently, the proposed new regulatory regime can only decrease the administrative burden of administrations, which is one of the advantages of Methods C and D.

– The answer to question 9 in section 4.1/1.8/4.1.1 lies on the fact that it should be up to the licensing administration to ensure that the ESVs under its responsibility conform to the international regulations and implement mechanisms to avoid their infringement. Monitoring of ESV transmitted power levels should not be required of administrations in whose territory terrestrial facilities are deployed just as no requirement exists for potentially affected administrations to monitor the transmit power levels filed for earth stations or agreed as a result of intersystem coordination of potentially affecting satellite networks.

4.1/1.8/4.2 Other considerations

i) Smaller antenna diameters down to 1.2 m are now being considered for ESVs in the 6 GHz band (i.e. current minimum restriction is 2.4 m) and 60 cm for the 14 GHz band. This is likely to significantly increase the number and type of vessel that can utilize 6 GHz ESVs and therefore the number of likely passes across the main beam of the FS receiver which are being considered in the studies. In addition, 6 GHz ESVs could be installed on smaller vessels which may have different travelling routes so could create different interference geometries/scenarios with respect to FS. Of particular concern would be where vessel could travel in a straight line in perpendicular to a coast line for a reasonable length of time, i.e. vessel could be in the main beam of FS receiver that is pointing towards the sea for much longer.

Concerning this point, some administrations are of the view that, in general, there are two possible different interference scenarios with respect to the FS:

Scenario 1: ESV passes in parallel to a coast line.

Scenario 2: ESV passes in perpendicular to a coast line.

The first scenario was addressed in Recommendation ITU-R SF.1650-1 where the results of the protection distances were determined, namely, 300 km and 125 km, in the C and Ku bands, respectively.

On this base, Resolution **902 (WRC-03)** was developed with detailed regulatory and operational provisions for ESVs transmitting in the C and Ku bands.

The second scenario may be controlled by long-term protection requirements which are to be treated based on the concept of the “Fractional Degradation in Performance” (FDP) and Recommendation ITU-R F.1494. Using of this concept will give much larger separation distances for the ESVs, but this problem is out of the scope of Resolution **909 (WRC-12)** for modifications to Resolution **902 (WRC-03)**.

Some administrations believe that at this study period it is necessary to solve the problem put by Resolution **909 (WRC-12)**, namely, to modify Resolution **902 (WRC-03)** based on the results of the short-term separation distances (this is the first scenario). To solve the problem on the second

scenario it will take a great deal of time and effort, including the detailed development of regulatory, operational provisions and technical limitations (it is the problem for the next study period: 2015-2019 years).

Some other administrations believe that the concerns raised above are not valid because for the 14 GHz frequency band, vessels of sizes compatible with ESV terminals with antenna diameters as small as 1.2 m, and even 60 cm, were considered by WRC-03 when determining the geometry of the traveling route used in the derivation of protection distances. It was based on these assumptions that the traveling routes were established and used in the derivation of the protection distances found in Recommendation ITU-R SF.1650-1 and Resolution **902 (WRC-03)**, and therefore the proposed change in 6 GHz antenna diameter should not impact the traveling routes assumed in the current studies.

ii) According to the information received from the Radiocommunication Bureau (BR), since 2003 when the ESV concept was adopted, no single ESV has been notified to the BR under RR Article **11**. Consequently, no information about the technical and operational characteristics of these stations is available. However, in practice, many ESVs are currently operating without any information on their characteristics in order to know whether they are within the envelope of the specific or typical earth stations of the satellite networks under which and to which they are operating.

On the other hand, some administrations are of the view that this should not be a reason for concern because:

a) Resolution **902 (WRC-03)** requires the ESV licensing administration and service providers to ensure that the operational provisions and technical limitations of the Resolution are met. If coordination is needed, the information required to conduct the coordination process, such as precise e.i.r.p. density and elevation angle, will be provided by the administration licensing the ESV, in accordance with *encourages concerned administrations* in Resolution **902 (WRC-03)**; and

b) It is up to the licensing administration to ensure that the ESVs under their responsibility conform to the international regulations, implement mechanisms to avoid their infringement and conform to the conditions agreed in the coordination of ESVs with coastal administrations.

4.1/1.8/4.3 Views on the ESV regulatory framework

Two views with respect to the ESV regulatory frameworks were proposed, as follows:

View 1:

Some administrations are of the view that in dealing with the operation of ESV either in application of Resolution **902 (WRC-03)** or a modified version of that or a new Resolution on the matter, ESV operator/administration needs to provide all information, where required, to the terrestrial administration in order to enable that administration to verify to whether the 300 km distance in C band and 125 km distance in Ku band have been properly respected. If this detailed information is not provided, how the minimum distance is established since such distance is directly related to the e.i.r.p. and other characteristics. Lack of such information does not allow the coastal administration to determine whether the coordination is or is not required.

View 2:

Some other administrations believe that the current regulatory framework where the ESV operators only provide detailed information on the ESV transmissions if they intend to operate within the

regulatory distances is working and in practice today, and therefore there is no need to change that aspect of the regulations.

"Transitional arrangement"

Due to the fact that many if not all ESVs would continue to operate using criteria contained in Resolution **902 (WRC-03)** and some may be deployed using improved characteristics such as digital modulation, it is necessary to establish transitional arrangements to be used by coastal administrations using terrestrial services to clarify how to deal with these ESVs operating with a combination of old and new characteristics.

This issue is further elaborated and reflected in the modification to Resolution **902 (WRC-03)** as proposed in Methods C and D.

4.1/1.8/5 Method(s) to satisfy the agenda item

4.1/1.8/5.1 Method A: No change to the Radio Regulations

Proponents of this method believe that in fact, any reduction in antenna size and reduction of distance between the vessels and shore would adversely impact the deployment of terrestrial services of countries for which these services constitute their infrastructure backbone telecommunication services.

Advantages:

- No additional text to the RR and no modification to Resolution **902 (WRC-03)**.
- Retention of the limits as currently specified in Resolution **902 (WRC-03)** for operation of ESVs.
- Straightforward and simple criteria currently used by administrations in carrying out their tasks with respect to the operation of the ESVs and monitoring the application of appropriate regulations.
- The authority of administrations involved in coordination of their terrestrial services with ESVs is appropriately preserved.
- Coastal administrations do not need to continuously monitor different values of e.i.r.p. density and also do not need to have any information on the type of modulation used taking into account administrative and other burdens that may be imposed due to the use of different e.i.r.p and different modulation technique.

Disadvantages:

- Technological advances referred to in Resolution **909** (**WRC-12**) such as new modulation technologies would not be considered.

4.1/1.8/5.2 Method B: Increasing off-shore protection distance in the C band

Proponents of this method believe that the number of passes of ships has significantly increased. This would have direct impact on distance from shore/coast. By increasing the number of vessels, the protection distance increases to almost 345 km in the C band but it could be reached to approximately 125 km for the Ku band. These figures are proposed based on the increasing number of vessels and the current maximum ESV e.i.r.p density levels contained in Resolution **902 (WRC-03)**.

Advantages:

- By increasing the protective off-shore distance in the C band to the above mentioned value and using old and new operational ESVs simultaneously, the FS would be better protected without any interference.
- Simple modification of the protective off-shore distance value in Resolution **902 (WRC-03)**.
- No additional text to be added to the RR.
- Straightforward and simple criteria currently used by administrations in carrying out their tasks with respect to the operation of the ESVs and monitoring the application of appropriate regulations.
- The authority of administrations involved in coordination of their terrestrial services with ESV is appropriately preserved.

Disadvantages:

- Single distances will impose unnecessary administrative burden to ESVs transmitting lower power levels than those considered by WRC-03 and reflected in Resolution **902 (WRC-03)**.
- May over protect FS if assumption of a denser deployment of ESVs with respect to that of WRC-03 is not confirmed.
- Technological advances referred to in Resolution **909** (**WRC-12**) such as new modulation technologies would not be considered.

4.1/1.8/5.3 Method C: Establishment of different protection distances for different maximum e.i.r.p. density levels, with shorter protection distances for e.i.r.p. density levels lower than those currently allowed by Resolution 902 (WRC-03)

Method C proposes the adoption of distances associated with maximum values of ESV e.i.r.p. spectral density towards the horizon according to the values mentioned above (see section 4.1/1.8/3.2).

Recent statistics in maritime traffic in certain regions have confirmed that the ESV deployment scenario considered by WRC-03 for the 14 GHz band is still valid today. Consequently the number of ESV passes assumed by WRC-03 for the 14 GHz band can be maintained. However, since the minimum ESV antenna diameter considered for the 6 GHz band nowadays is 1.2 m instead of the 2.4 m diameter provided in Resolution **902 (WRC-03)**, the effect of increased frequency of ESV passes needs to be taken into account for the 6 GHz band. On that basis, the level of protection against interference afforded by Resolution **902 (WRC-03)** to the FS can be used to derive different protection distances for ESVs transmitting lower e.i.r.p. density levels toward the horizon, in accordance with the current ESV technologies being deployed (e.g. use of spread spectrum modulation) or planned to be used, while still adequately protecting terrestrial services to the same level afforded by Resolution **902 (WRC-03)** today.

Advantages:

- Expands the areas wherein ESVs transmitting lower power levels afforded by current technologies can operate without the need to seek agreement from potentially affected administrations.
- Reduces administrative burden of having to coordinate ESVs which have no potential for causing unacceptable interference to terrestrial services.
- Straightforward and simple criteria to be used by administrations to determine the need to coordinate the operation of the ESVs.

– The authority of administrations involved in the coordination of ESVs with their terrestrial services would be appropriately preserved.

Disadvantages:

– Different distances, associated with different values of ESV e.i.r.p. spectral density toward the horizon and taking into account the cumulative effect of the total number of passing vessels, could impose additional technical, regulatory and administrative burden for the deployment of FS and MS in countries for which these services constitute their infra-structure backbone telecommunication services.

– Add complexity to the regulatory provisions given the additional granularity of the off-shore distances specified under this Method.

– Coastal administrations which implement a permanent monitoring process will be imposed additional burden due to the fact that they have no direct control over ESV network operation centres. If the ESV e.i.r.p. density is reduced, there is also no assurance for these administrations to practically observe such e.i.r.p. density levels as mentioned in the above tables when the earth station is operating.

4.1/1.8/5.4 Method D: Establishment of different protection distances for different maximum e.i.r.p. density levels accounting for the statistical information on maritime traffic and the probability of frequency overlapping

Method D proposes the adoption of the distances associated with values of maximum ESV e.i.r.p. spectral density toward the horizon according to the values mentioned above (see section 4.1/1.8/3.3).

Proponents of this method believe that the levels of protection against interference afforded by Resolution **902 (WRC-03)** to the FS can be used to derive different protection distances for ESVs transmitting lower e.i.r.p. density levels toward the horizon, in accordance with the current ESV technologies being deployed (e.g. use of spread spectrum modulation) or planned to be used, while still adequately protecting terrestrial services to the same level afforded by Resolution **902 (WRC-03**) today. Furthermore, proponents of this method also consider that real statistics in particular provided in the documents CPM15-2/47 and CPM15-2/37 should be taken into account while obtaining required distances for FSR protection and even if different protection distances for ESVs transmitting lower e.i.r.p. density levels toward the horizon could be derived, the fundamental rules in Resolution **902 (WRC-03**) are still valid.

It is noted that the advantages and disadvantages of this method are same as the advantages and disadvantages of the Method C.

4.1/1.8/5.5 Method E: Review of the regulatory regime governing operation of ESVs

Method E proposes to review the regulatory regime governing the operation of ESVs to conform to the principles and objectives of the RR. Proponents of this method noted that several administrations at WRC-03 argued that an earth station on board vessel is a maritime mobile satellite earth station which, from a regulatory point of view, is incompatible with the operation within a fixed-satellite service in which the class of station of the space station is different from the class of station of the earth station.

Authorization given at WRC-03 for ESV to communicate with a fixed satellite space station was against the very principle of the definition of the fixed-satellite service in Article 1 of the Radio Regulations. For that reason several administrations introduced a footnote in which they considered such operation would only be possible if the ESV operate under maritime mobile-satellite service and not fixed-satellite service.

4.1/1.8/6 Regulatory and procedural considerations

4.1/1.8/6.1 Method A

No changes to the Radio Regulations.

SUP

RESOLUTION 909 (WRC-12)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

4.1/1.8/6.2 Method B

A proposed text of a revised Resolution **902 (WRC-03)** incorporating the proposals under Method B is provided below.

MOD

RESOLUTION 902 (REV.WRC-~~03~~15)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

The World Radiocommunication Conference (Geneva, 20~~03~~15),

considering

a) that there is a demand for global wideband satellite communication services on vessels;

b) that the technology exists that enables earth stations on board vessels (ESVs) to use fixed-satellite service (FSS) networks operating in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz;

c) that ESVs are currently operating through FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz under No. **4.4**;

d) that ESVs have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

e) that, with respect to the bands considered in this Resolution, global coverage is only available in the band 5 925-6 425 MHz and that only a limited number of geostationary FSS systems can provide such global coverage;

f) that, without special regulatory provisions, ESVs could place a heavy coordination burden on some administrations, especially those in developing countries;

g) that, in order to ensure the protection and future growth of other services, ESVs need to operate under certain technical and operational limitations;

h) that, within ITU-R studies, based on agreed technical assumptions, minimum distances from the low-water mark as officially recognized by the coastal State have been calculated, beyond which an ESV will not have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

i) that, in order to limit the interference into other networks in the FSS, it is necessary to establish maximum off-axis e.i.r.p. density limits on ESV emissions;

j) that establishing a minimum antenna diameter for ESVs has an impact on the number of ESVs that will ultimately be deployed, hence it will reduce interference into the fixed service,

noting

a) that ESVs may be assigned frequencies to operate in FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz pursuant to No. **4.4** and shall not claim protection from, nor cause interference to, other services having allocations in these bands;

b) that the regulatory procedures of Article **9** apply for ESVs operating at specified fixed points,

resolves

that ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands shall operate under the regulatory and operational provisions contained in Annex 1 and the technical limitations in Annex 2 of this Resolution,

encourages concerned administrations

to cooperate with administrations which license ESVs while seeking agreement under the above-mentioned provisions, taking into consideration the provisions of Recommendation **37 (WRC-03)**,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of the International Maritime Organization (IMO).

ANNEX 1 TO RESOLUTION 902 (REV.WRC-~~03~~15)

Regulatory and operational provisions for ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands

1 The administration that issues the licence for the use of ESVs in these bands (licensing administration) shall ensure that such stations follow the provisions of this Annex and thus do not present any potential to cause unacceptable interference to the services of other concerned administrations.

2 ESV service providers shall comply with the technical limitations listed in Annex 2 and, when operating within the minimum distances as identified in item 4 below, with the additional limitations agreed by the licensing and other concerned administrations.

3 In the 3 700-4 200 MHz band and 10.7-12.75 GHz range, ESVs in motion shall not claim protection from transmissions of terrestrial services operating in accordance with the Radio Regulations.

4 The minimum distances from the low-water mark as officially recognized by the coastal State beyond which ESVs can operate without the prior agreement of any administration are ~~300~~345 km in the 5 925-6 425 MHz band and 125 km in the 14-14.5 GHz band, taking into account the technical limitations in Annex 2. Any transmissions from ESVs within the minimum distances shall be subject to the prior agreement of the concerned administration(s).

5 The potentially concerned administrations referred to in the previous item 4 are those where fixed or mobile services are allocated on a primary basis in the Table of Frequency Allocations of the Radio Regulations:

Frequency bands	Potentially concerned administrations
5 925-6 425 MHz	All three Regions
14-14.25 GHz	Countries listed in No. **5.505**, except those listed in No. **5.506B**
14.25-14.3 GHz	Countries listed in Nos. **5.505**~~,~~ and **5.508** ~~and **5.509**,~~ except those listed in No. **5.506B**
14.3-14.4 GHz	Regions 1 and 3, except countries listed in No. **5.506B**
14.4-14.5 GHz	All three Regions, except countries listed in No. **5.506B**

6 The ESV system shall include means of identification and mechanisms to immediately cease emissions, whenever the station does not operate in compliance with the provisions of items 2 and 4 above.

7 Cessation of emissions as referred to in item 6 above shall be implemented in such a way that the corresponding mechanisms cannot be bypassed on board the vessel, except under the provisions of No. **4.9**.

8 ESVs shall be equipped so as to:

– enable the licensing administration under the provisions of Article **18** to verify earth station performance; and

– enable the cessation of ESV emissions immediately upon request by an administration whose services may be affected.

9 Each licence-holder shall provide a point of contact to the administration with which agreements have been reached for the purpose of reporting unacceptable interference caused by the ESV.

10 When ESVs operating beyond the territorial sea but within the minimum distance (as referred to in item 4 above) fail to comply with the terms required by the concerned administration pursuant to items 2 and 4, then that administration may:

– request the ESV to comply with such terms or cease operation immediately; or

– request the licensing administration to require such compliance or immediate cessation of the operation.

ANNEX 2 TO RESOLUTION 902 (REV.WRC-~~03~~15)

Technical limitations applicable to ESVs transmitting in the bands 5 925-6 425 MHz and 14-14.5 GHz

	5 925-6 425 MHz	**14-14.5 GHz**
Minimum diameter of ESV antenna	2.4 m	1.2 m[1]
Tracking accuracy of ESV antenna	±0.2° (peak)	±0.2° (peak)
Maximum ESV e.i.r.p. spectral density toward the horizon	17 dB(W/MHz)	12.5 dB(W/MHz)
Maximum ESV e.i.r.p. towards the horizon	20.8 dBW	16.3 dBW
Maximum off-axis e.i.r.p. density[2]	See below	See below

[1] ~~While operations within the minimum distances are subject to specific agreement with concerned administrations, licensing administrations may authorize the deployment of smaller antenna sizes down to 0.6 m at 14 GHz provided that the interference to the terrestrial services is no greater than that which would be caused with an antenna size of 1.2 m, taking into account Recommendation ITU-R SF.1650.~~ In any case, the use of smaller antenna size shall be in compliance with the tracking accuracy of ESV antenna, maximum ESV e.i.r.p. spectral density toward the horizon, maximum ESV e.i.r.p. towards the horizon and maximum off-axis e.i.r.p. density limits in the Table above and the protection requirements of the FSS intersystem coordination agreements.

[2] In any case, the e.i.r.p. off-axis limits shall be compliant with the FSS intersystem coordination agreements that may agree to more stringent off-axis e.i.r.p. levels.

Off-axis limits

For earth stations on board vessels operating in the 5 925-6 425 MHz band, at any angle φ specified below, off the main-lobe axis of an earth-station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

5 925-6 425 MHz

Angle off-axis			*Maximum e.i.r.p. per 4 kHz band*
2.5°	≤ φ ≤	7°	(32 − 25 log φ) dB(W/4 kHz)
7°	< φ ≤	9.2°	11 dB(W/4 kHz)
9.2°	< φ ≤	48°	(35 − 25 log φ) dB(W/4 kHz)
48°	< φ ≤	180°	−7 dB(W/4 kHz)

For ESV operating in the 14-14.5 GHz band, at any angle φ specified below, off the main-lobe axis of an earth station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

14-14.5 GHz

Angle off-axis			*Maximum e.i.r.p. per 40 kHz band*
2°	≤ φ ≤	7°	(33 − 25 log φ) dB(W/40 kHz)
7°	< φ ≤	9.2°	12 dB(W/40 kHz)
9.2°	< φ ≤	48°	(36 − 25 log φ) dB(W/40 kHz)
48°	< φ ≤	180°	−6 dB(W/40 kHz)

SUP

RESOLUTION 909 (WRC-12)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

4.1/1.8/6.3 Method C

A proposed text of a revised Resolution **902 (WRC-03)** incorporating the proposals under Method C is provided below.

MOD

RESOLUTION 902 (REV.WRC-~~03~~15)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

The World Radiocommunication Conference (Geneva, 20~~03~~15),

considering

a) that there is a demand for global wideband satellite communication services on vessels;

b) that the technology exists that enables earth stations on board vessels (ESVs) to use fixed-satellite service (FSS) networks operating in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz;

c) that ESVs are currently operating through FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz under No. **4.4**;

d) that ESVs have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

e) that, with respect to the bands considered in this Resolution, global coverage is only available in the band 5 925-6 425 MHz and that only a limited number of geostationary FSS systems can provide such global coverage;

f) that, without special regulatory provisions, ESVs could place a heavy coordination burden on some administrations, especially those in developing countries;

g) that, in order to ensure the protection and future growth of other services, ESVs need to operate under certain technical and operational limitations;

h) that, within ITU-R studies, based on agreed technical assumptions, minimum distances from the low-water mark as officially recognized by the coastal State have been calculated, beyond which an ESV will not have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

i) that, in order to limit the interference into other networks in the FSS, it is necessary to establish maximum off-axis e.i.r.p. density limits on ESV emissions;

j) that establishing a minimum antenna diameter for ESVs has an impact on the number of ESVs that will ultimately be deployed, hence it will reduce interference into the fixed service,

noting

a) that ESVs may be assigned frequencies to operate in FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz pursuant to No. **4.4** and shall not claim protection from, nor cause interference to, other services having allocations in these bands;

b) that the regulatory procedures of Article **9** apply for ESVs operating at specified fixed points,

resolves

1 that ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands shall operate under the regulatory and operational provisions contained in Annex 1 and the technical limitations in Annex 2 of this Resolution~~,~~;

2 that ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances established in this Resolution are shorter than those contained in Resolution **902 (WRC-03)** shall operate in accordance with the regulatory conditions established in this Resolution from the date it comes into force;

3 that ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances established in this Resolution are larger than those contained in Resolution **902 (WRC-03)** shall have one year from the date this Resolution comes into force to conform to the conditions established herein,

encourages concerned administrations

to cooperate with administrations which license ESVs while seeking agreement under the above-mentioned provisions, taking into consideration the provisions of Recommendation **37 (WRC-03)**,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of the International Maritime Organization (IMO).

ANNEX 1 TO RESOLUTION 902 (REV.WRC-~~03~~15)

Regulatory and operational provisions for ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands

1 The administration that issues the licence for the use of ESVs in these bands (licensing administration) shall ensure that such stations follow the provisions of this Annex and thus do not present any potential to cause unacceptable interference to the services of other concerned administrations.

2 ESV service providers shall comply with the technical limitations listed in Annex 2 and, when operating within the minimum distances as identified in item 4 below, with the additional limitations agreed by the licensing and other concerned administrations.

3 In the 3 700-4 200 MHz band and 10.7-12.75 GHz range, ESVs in motion shall not claim protection from transmissions of terrestrial services operating in accordance with the Radio Regulations.

4 The minimum distances from the low-water mark as officially recognized by the coastal State beyond which ESVs can operate without the prior agreement of any administration are ~~300 km~~given in Table 1 for the 5 925-6 425 MHz band and ~~125 km~~ in Table 2 for the 14-14.5 GHz band, taking into account the technical limitations in Annex 2. Any transmissions from ESVs within the minimum distances shall be subject to the prior agreement of the concerned administration(s).

5 The potentially concerned administrations referred to in the previous item 4 are those where fixed or mobile services are allocated on a primary basis in the Table of Frequency Allocations of the Radio Regulations:

Frequency bands	**Potentially concerned administrations**
5 925-6 425 MHz	All three Regions
14-14.25 GHz	Countries listed in No. **5.505**, except those listed in No. **5.506B**
14.25-14.3 GHz	Countries listed in Nos. **5.505**~~,~~ and **5.508** ~~and 5.509,~~ except those listed in No. **5.506B**
14.3-14.4 GHz	Regions 1 and 3, except countries listed in No. **5.506B**
14.4-14.5 GHz	All three Regions, except countries listed in No. **5.506B**

6 The ESV system shall include means of identification and mechanisms to immediately cease emissions, whenever the station does not operate in compliance with the provisions of items 2 and 4 above.

7 Cessation of emissions as referred to in item 6 above shall be implemented in such a way that the corresponding mechanisms cannot be bypassed on board the vessel, except under the provisions of No. **4.9**.

8 ESVs shall be equipped so as to:

– enable the licensing administration under the provisions of Article **18** to verify earth station performance; and

– enable the cessation of ESV emissions immediately upon request by an administration whose services may be affected.

9 Each licence-holder shall provide a point of contact to the administration with which agreements have been reached for the purpose of reporting unacceptable interference caused by the ESV.

10 When ESVs operating beyond the territorial sea but within the minimum distance (as referred to in item 4 above) fail to comply with the terms required by the concerned administration pursuant to items 2 and 4, then that administration may:

– request the ESV to comply with such terms or cease operation immediately; or

– request the licensing administration to require such compliance or immediate cessation of the operation.

TABLE 1

Values for the 5 925-6 425 MHz band ESVs

Maximum e.i.r.p. transmitted toward the horizon (dBW in 11.2 MHz)	Minimum distance from low-water mark* (km)
20.8	323
10.8	227
0.8	130
–9.2	64

* Low-water mark as officially recognized by the coastal State.

TABLE 2

Values for the 14-14.5 GHz band ESVs

Maximum e.i.r.p. transmitted toward the horizon (dBW in 14 MHz)	Minimum distance from low-water mark* (km)
16.3	125
6.3	85
–3.7	29

* Low-water mark as officially recognized by the coastal State.

ANNEX 2 TO RESOLUTION 902 (REV.WRC-~~03~~15)

Technical limitations applicable to ESVs transmitting in the bands 5 925-6 425 MHz and 14-14.5 GHz

	5 925-6 425 MHz	14-14.5 GHz
Minimum diameter of ESV antenna	~~2.4~~1.2 m	~~1.2 m~~[1] 60 cm
Tracking accuracy of ESV antenna	±0.2° (peak)	±0.2° (peak)
Maximum ESV e.i.r.p. spectral density toward the horizon	17 dB(W/MHz)	12.5 dB(W/MHz)
Maximum ESV e.i.r.p. towards the horizon	20.8 dBW	16.3 dBW
Maximum off-axis e.i.r.p. density[~~2~~1]	See below	See below

~~[1] While operations within the minimum distances are subject to specific agreement with concerned administrations, licensing administrations may authorize the deployment of smaller antenna sizes down to 0.6 m at 14 GHz provided that the interference to the terrestrial services is no greater than that which would be caused with an antenna size of 1.2 m, taking into account Recommendation ITU-R SF.1650. In any case, the use of smaller antenna size shall be in compliance with the tracking accuracy of ESV antenna, maximum ESV e.i.r.p. spectral density toward the horizon, maximum ESV e.i.r.p. towards the horizon and maximum off-axis e.i.r.p. density limits in the Table above and the protection requirements of the FSS intersystem coordination agreements.~~

[~~2~~1] In any case, the e.i.r.p. off-axis limits shall be compliant with the FSS intersystem coordination agreements that may agree to more stringent off-axis e.i.r.p. levels.

Off-axis limits

For earth stations on board vessels operating in the 5 925-6 425 MHz band, at any angle φ specified below, off the main-lobe axis of an earth-station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

5 925-6 425 MHz

Angle off-axis				*Maximum e.i.r.p. per 4 kHz band*
2.5°	≤ φ ≤	7°		(32 − 25 log φ) dB(W/4 kHz)
7°	< φ ≤	9.2°		11 dB(W/4 kHz)
9.2°	< φ ≤	48°		(35 − 25 log φ) dB(W/4 kHz)
48°	< φ ≤	180°		−7 dB(W/4 kHz)

For ESV operating in the 14-14.5 GHz band, at any angle φ specified below, off the main-lobe axis of an earth station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

14-14.5 GHz

Angle off-axis				*Maximum e.i.r.p. per 40 kHz band*
2°	≤ φ ≤	7°		(33 − 25 log φ) dB(W/40 kHz)
7°	< φ ≤	9.2°		12 dB(W/40 kHz)
9.2°	< φ ≤	48°		(36 − 25 log φ) dB(W/40 kHz)
48°	< φ ≤	180°		−6 dB(W/40 kHz)

SUP

RESOLUTION 909 (WRC-12)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

4.1/1.8/6.4 Method D

A proposed text of a revised Resolution **902 (WRC-03)** incorporating the proposals under Method D is provided below.

MOD

RESOLUTION 902 (REV.WRC-~~03~~15)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

The World Radiocommunication Conference (Geneva, 20~~03~~15),

considering

a) that there is a demand for global wideband satellite communication services on vessels;

b) that the technology exists that enables earth stations on board vessels (ESVs) to use fixed-satellite service (FSS) networks operating in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz;

c) that ESVs are currently operating through FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz under No. **4.4**;

d) that ESVs have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

e) that, with respect to the bands considered in this Resolution, global coverage is only available in the band 5 925-6 425 MHz and that only a limited number of geostationary FSS systems can provide such global coverage;

f) that, without special regulatory provisions, ESVs could place a heavy coordination burden on some administrations, especially those in developing countries;

g) that, in order to ensure the protection and future growth of other services, ESVs need to operate under certain technical and operational limitations;

h) that, within ITU-R studies, based on agreed technical assumptions, minimum distances from the low-water mark as officially recognized by the coastal State have been calculated, beyond which an ESV will not have the potential to cause unacceptable interference to other services in the bands 5 925-6 425 MHz and 14-14.5 GHz;

i) that, in order to limit the interference into other networks in the FSS, it is necessary to establish maximum off-axis e.i.r.p. density limits on ESV emissions;

j) that establishing a minimum antenna diameter for ESVs has an impact on the number of ESVs that will ultimately be deployed, hence it will reduce interference into the fixed service,

noting

a) that ESVs may be assigned frequencies to operate in FSS networks in the bands 3 700-4 200 MHz, 5 925-6 425 MHz, 10.7-12.75 GHz and 14-14.5 GHz pursuant to No. **4.4** and shall not claim protection from, nor cause interference to, other services having allocations in these bands;

b) that the regulatory procedures of Article **9** apply for ESVs operating at specified fixed points,

resolves

1 that ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands shall operate under the regulatory and operational provisions contained in Annex 1 and the technical limitations in Annex 2 of this Resolution~~,~~;

2 that ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances established in this Resolution are shorter than those contained in Resolution **902 (WRC-03)** shall operate in accordance with the regulatory conditions established in this Resolution from the date it comes into force;

3 that ESVs transmitting maximum e.i.r.p. spectral density levels such that the required protection distances established in this Resolution are larger than those contained in Resolution **902 (WRC-03)** shall have one year from the date this Resolution comes into force to conform to the conditions established herein,

encourages concerned administrations

to cooperate with administrations which license ESVs while seeking agreement under the above-mentioned provisions, taking into consideration the provisions of Recommendation **37 (WRC-03)**,

instructs the Secretary-General

to bring this Resolution to the attention of the Secretary-General of the International Maritime Organization (IMO).

ANNEX 1 TO RESOLUTION 902 (REV.WRC-~~03~~15)

Regulatory and operational provisions for ESVs transmitting in the 5 925-6 425 MHz and 14-14.5 GHz bands

1 The administration that issues the licence for the use of ESVs in these bands (licensing administration) shall ensure that such stations follow the provisions of this Annex and thus do not present any potential to cause unacceptable interference to the services of other concerned administrations.

2 ESV service providers shall comply with the technical limitations listed in Annex 2 and, when operating within the minimum distances as identified in item 4 below, with the additional limitations agreed by the licensing and other concerned administrations.

3 In the 3 700-4 200 MHz band and 10.7-12.75 GHz range, ESVs in motion shall not claim protection from transmissions of terrestrial services operating in accordance with the Radio Regulations.

4 The minimum distances from the low-water mark as officially recognized by the coastal State beyond which ESVs can operate without the prior agreement of any administration are ~~300 km~~given in Table 1 for the 5 925-6 425 MHz band and ~~125 km~~ in Table 2 for the 14-14.5 GHz band, taking into account the technical limitations in Annex 2. Any transmissions from ESVs within the minimum distances shall be subject to the prior agreement of the concerned administration(s).

5 The potentially concerned administrations referred to in the previous item 4 are those where fixed or mobile services are allocated on a primary basis in the Table of Frequency Allocations of the Radio Regulations:

Frequency bands	Potentially concerned administrations
5 925-6 425 MHz	All three Regions
14-14.25 GHz	Countries listed in No. **5.505**, except those listed in No. **5.506B**
14.25-14.3 GHz	Countries listed in Nos. **5.505**~~,~~ and **5.508** ~~and 5.509,~~ except those listed in No. **5.506B**
14.3-14.4 GHz	Regions 1 and 3, except countries listed in No. **5.506B**
14.4-14.5 GHz	All three Regions, except countries listed in No. **5.506B**

6 The ESV system shall include means of identification and mechanisms to immediately cease emissions, whenever the station does not operate in compliance with the provisions of items 2 and 4 above.

7 Cessation of emissions as referred to in item 6 above shall be implemented in such a way that the corresponding mechanisms cannot be bypassed on board the vessel, except under the provisions of No. **4.9**.

8 ESVs shall be equipped so as to:

– enable the licensing administration under the provisions of Article **18** to verify earth station performance; and

– enable the cessation of ESV emissions immediately upon request by an administration whose services may be affected.

9 Each licence-holder shall provide a point of contact to the administration with which agreements have been reached for the purpose of reporting unacceptable interference caused by the ESV.

10 When ESVs operating beyond the territorial sea but within the minimum distance (as referred to in item 4 above) fail to comply with the terms required by the concerned administration pursuant to items 2 and 4, then that administration may:

– request the ESV to comply with such terms or cease operation immediately; or

– request the licensing administration to require such compliance or immediate cessation of the operation.

TABLE 1

Values for the 5 925-6 425 MHz band ESVs

Maximum e.i.r.p.$_{ESV}$ transmitted toward the horizon (dBW in 11.2 MHz)	**Minimum distance from low-water mark* (km)**
20.8	328
10.8	233
0.8	134
–9.2	57

* Low-water mark as officially recognized by the coastal State.

TABLE 2

Values for the 14-14.5 GHz band ESVs

Maximum e.i.r.p.$_{ESV}$ transmitted toward the horizon (dBW in 14 MHz)	**Minimum distance from low-water mark* (km)**
16.3	125
6.3	97
–3.7	43

* Low-water mark as officially recognized by the coastal State.

ANNEX 2 TO RESOLUTION 902 (REV.WRC-~~03~~15)

Technical limitations applicable to ESVs transmitting in the bands 5 925-6 425 MHz and 14-14.5 GHz

	5 925-6 425 MHz	14-14.5 GHz
Minimum diameter of ESV antenna	~~2.4~~1.2 m	~~1.2 m~~[1]60 cm
Tracking accuracy of ESV antenna	±0.2° (peak)	±0.2° (peak)
Maximum ESV e.i.r.p. spectral density toward the horizon	17 dB(W/MHz)	12.5 dB(W/MHz)
Maximum ESV e.i.r.p. towards the horizon	20.8 dBW	16.3 dBW
Maximum off-axis e.i.r.p. density~~2~~[1]	See below	See below

~~[1] While operations within the minimum distances are subject to specific agreement with concerned administrations, licensing administrations may authorize the deployment of smaller antenna sizes down to 0.6 m at 14 GHz provided that the interference to the terrestrial services is no greater than that which would be caused with an antenna size of 1.2 m, taking into account Recommendation ITU-R SF.1650. In any case, the use of smaller antenna size shall be in compliance with the tracking accuracy of ESV antenna, maximum ESV e.i.r.p. spectral density toward the horizon, maximum ESV e.i.r.p. towards the horizon and maximum off-axis e.i.r.p. density limits in the Table above and the protection requirements of the FSS intersystem coordination agreements.~~

~~2~~[1] In any case, the e.i.r.p. off-axis limits shall be compliant with the FSS intersystem coordination agreements that may agree to more stringent off-axis e.i.r.p. levels.

Off-axis limits

For earth stations on board vessels operating in the 5 925-6 425 MHz band, at any angle φ specified below, off the main-lobe axis of an earth-station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

5 925-6 425 MHz

Angle off-axis			*Maximum e.i.r.p. per 4 kHz band*
2.5°	≤ φ ≤	7°	(32 − 25 log φ) dB(W/4 kHz)
7°	< φ ≤	9.2°	11 dB(W/4 kHz)
9.2°	< φ ≤	48°	(35 − 25 log φ) dB(W/4 kHz)
48°	< φ ≤	180°	−7 dB(W/4 kHz)

For ESV operating in the 14-14.5 GHz band, at any angle φ specified below, off the main-lobe axis of an earth station antenna, the maximum e.i.r.p. in any direction within 3° of the GSO shall not exceed the following values:

14-14.5 GHz

Angle off-axis			*Maximum e.i.r.p. per 40 kHz band*
2°	≤ φ ≤	7°	(33 − 25 log φ) dB(W/40 kHz)
7°	< φ ≤	9.2°	12 dB(W/40 kHz)
9.2°	< φ ≤	48°	(36 − 25 log φ) dB(W/40 kHz)
48°	< φ ≤	180°	−6 dB(W/40 kHz)

SUP

RESOLUTION 909 (WRC-12)

Provisions relating to earth stations located on board vessels which operate in fixed-satellite service networks in the uplink bands 5 925-6 425 MHz and 14-14.5 GHz

_____