UNITED STATES OF AMERICA

DRAFT PROPOSAL FOR WRC-12

AGENDA ITEM 7: to consider possible changes in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference: "Advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks", in accordance with Resolution 86 (Rev.WRC-07)

ISSUE: Coordination Arc Applicable to FSS Geostationary Satellite Networks in Certain Congested Portions of the 4/6 GHz and 10/11/12/14 GHz Frequency Bands

BACKGROUND: In certain portions of the 6/4 GHz band[1] as well as of the 10/11/12/14 GHz band[2], a new GSO FSS satellite network is likely required to effect coordination with a large number of other satellite networks with orbital separations in the range of 2º to 4º or even with less than 2º separation. The need to co-exist and ensure appropriate protection to all these satellite networks implies that coexistence with and protection of satellite networks with larger separation angles will automatically result and coordination with such networks is actually unnecessary.

One of the consequences of this situation is that many of the coordinations triggered by the current coordination arcs of 10º (6/4 GHz) and 9º (10/11/12/14 GHz) are never conducted because neither of the parties involved feels an actual need for it to be done. The burden of having to conduct coordination with satellite networks which are closer to the incoming network is already heavy enough to discourage operators and administrations to devote scarce resources to conduct coordination exercises that are clearly unnecessary.

Satellite networks in 6/4 GHz and 10/11/12/14 GHz

To assess the number of coordinations likely to be triggered in the 6/4 GHz band, a query to the ITU BR SNS database identified the satellite networks with frequency assignments in the range 3 700-4 200 MHz[3]. Satellite networks including this frequency range are found in 498 distinct orbital locations, some of them separated by only 0.1º. In most of these orbital locations there are multiple satellite networks, often filed by different administrations.

This means that the average orbital separation between neighbouring orbital locations with filings in the 3 700-4 200 MHz band is about 0.72º[4]. Moreover, within the current coordination arc of ±10º a

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1 3 400-4 200 MHz (space-to-Earth), 5 725-5 850 MHz (Earth-to-space) in Region 1, 5 850-6 725 MHz (Earth-to-space), 7 025-7 075 MHz (space-to-Earth) and (Earth-to-space).

2 10.95-11.2 GHz (space-to-Earth), 11.45-11.7 GHz (space-to-Earth), 11.7-12.2 GHz (space-to-Earth) in Region 2, 12.2-12.5 GHz (space-to-Earth) in Region 3, 12.5-12.75 GHz (space-to-Earth) in Regions 1 and 3, 12.7-12.75 GHz (Earth-to-space) in Region 2, and 13.75-14.5 GHz (Earth-to-space)

3 Query was conducted in early February 2010.

4 Note that the average orbital separation between any two satellite networks is smaller than that because the separation of 0º between collocated satellite networks was not included in the computation of this average value.

new satellite network will on average have to coordinate with satellite networks at about 28 other orbital locations and many of these locations will include networks from multiple administrations.

Similarly, a query of the SNS for the band 14-14.5 GHz reveals that there are 527 distinct orbital locations with satellite networks with frequency assignments within this range[5]. This means that the average orbital separation between neighbouring orbital locations with filings in the 14-14.5 GHz band is about 0.68º[6].

Therefore, within the current coordination arc of ±9º a new satellite network will on average have to coordinate with satellite networks at about 26 other orbital locations and many of these locations will include networks from multiple administrations.

In view of the assessment described above, it is concluded that the coordination arc of ±10º for satellite networks using the 6/4 GHz band is excessive. If the coordination arc is reduced to ±5º any new satellite network will on average still have to coordinate with satellite networks at 14 other orbital locations and coordination with satellite networks outside the 5º arc becomes unnecessary. Any constraints that may have to be imposed on the new comer in order to protect networks outside ±5º will already have been imposed by the significant number of networks within ±5º.

Similarly, it is concluded from the above that the coordination arc of ±9º for satellite networks using the 10/11/12/14 GHz band is also excessive. If the coordination arc is reduced to ±4º any new satellite network will on average still have to coordinate with satellite networks at 12 other orbital locations and coordination with satellite networks outside the 4º arc becomes unnecessary. Again, protection of the satellite networks within ±4º of the new satellite network ensure that satellite networks outside ±4º will also be protected.

Although the reasoning above was based on average values, a closer look at the distribution of satellite networks along the geostationary orbit reveals that the values of the orbital interval between adjacent satellite networks are limited to a small range. Actually, both for 6/4 GHz and 10/11/12/14 GHz, more than 90% of these orbital intervals do not exceed 1º. This means that adoption of the ±5º arc for satellite networks using the 6/4 GHz or of the ±4º arc for satellite networks using the 10/11/12/14 GHz band will still require that any new satellite network coordinate with several other satellite networks.

For satellite networks using the band 3 700-4 200 MHz the distribution of orbital spacing between adjacent orbital locations is shown in Table 1. It is concluded from Table 1 that almost 59% of these orbital intervals are 0.5º or less and more than 90% of the intervals are 1º or less.

The maximum orbital spacing is 4º which occurs only once, between 150ºW and 154ºW. Even in this extreme situation, a hypothetical satellite network at 152ºW would have to coordinate with satellite networks from five different administrations with satellite networks at 147.6ºW, 148ºW, 150ºW, 154ºW, 155ºW and 156ºW. Coordination constraints imposed on the new satellite network by satellite networks at these six orbital locations would provide adequate protection to satellite networks outside the ±5º coordination arc.

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5 See 3 above.

6 See 4 above.

TABLE 1

Distribution of the orbital separation (δ) between adjacent orbital locations with satellite networks including the frequency range 3 700-4 200 MHz

Orbital Separation (δ)	Number of Occurrences	Percentage (%)
0< δ<0.5	124	24.91
0.5	169	33.94
0.5< δ<1.0	36	7.23
1.0	121	24.30
1.0< δ<1.5	6	1.20
1.5	6	1.20
1.5< δ<2.0	3	0.60
2.0	27	5.42
2.5	4	0.80
3.0	1	0.20
4.0	1	0.20
Total Number of Intervals	498	100

For satellite networks using the band 14-14.5 GHz the distribution of orbital spacing between adjacent orbital locations is shown in Table 2. It is concluded from Table 2 that about 59% of these orbital intervals are 0.5º or less and more than 92% of the intervals are 1º or less.

The maximum orbital spacing is 3º which occurs only once, between 140ºW and 143ºW. Even in this extreme situation, a hypothetical satellite network at 141.5ºW would have to coordinate with satellite networks from six different administrations with satellite networks at 138ºW, 139ºW, 140ºW, 143ºW and 144ºW. Coordination constraints imposed on the new satellite network by satellite networks at these five orbital locations would provide adequate protection to satellite networks outside the ±4º coordination arc.

The distributions in Tables 1 and 2 are quite similar as many satellite networks include both the 6/4 GHz and the 10/11/12/14 GHz frequency ranges. For both distributions the mode is the interval of 0.5º while intervals of 1º and the aggregate of those of less than 0.5º have about the same frequency of occurrence.

TABLE 2

Distribution of the orbital separation (δ) between adjacent orbital locations with satellite networks including the frequency range 14-14.5 GHz

Orbital separation (δ)	Number of occurrences	Percentage (%)
0< δ<0.5	136	25.81
0.5	177	33.59
0.5< δ<1.0	44	8.35
1.0	131	24.86
1.0< δ<1.5	5	0.95
1.5	5	0.95
1.5< δ<2.0	2	0.34
2.0	25	4.74
2.5	1	0.19
3.0	1	0.19
Total Number of Intervals	527	100

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Satellites Currently in Orbit Using Frequencies in 6/4 GHz and 10/11/12/14 GHz

In order to further corroborate the above assessment, based on satellite networks filed with the ITU, a similar assessment based on satellites currently in orbit was conducted. This assessment concluded that that the number of geostationary satellites currently in orbit which utilize the frequencies 3 700-4 200 MHz is168. Table 3 shows the distribution of the orbital separation between satellites currently in orbit using the band 3 700-4 200 MHz.

It can be concluded that the average orbital separation between two satellites currently in orbit using the frequencies 3 700-4 200 MHz is about 2.16°. Based on the number of filed satellite networks, as discussed above, it was concluded that, for a 5° coordination arc, on the average a newly filed network would have to coordinate with satellite networks in 14 other orbital locations. It is now concluded that the average number of satellites currently in orbit involved in these coordinations would be approximately 4.6.

It has been noted that the distribution of satellites currently in orbit is significantly non-uniform over the 360° geostationary arc. In the arc 139 °W to 180 °E the average orbital separation becomes about 1.92°[7] while there are only two satellites in the interval (139 °W-180 °W). The largest arc without a satellite using the frequencies 3 700-4 200 MHz extends from 139 °W to 167 °W. Therefore, for a 5° coordination arc a hypothetical filing at, for instance, 153 °W would have to coordinate with several satellite networks but at the moment none of these networks would be associated with a satellite already in orbit. Although reducing the coordination arc from 10° to 5°

[7] In the arc 139° W to 180° E a new filing would have to coordinate with networks that on average would be associated with approximately 5.2 satellites currently in orbit involved.

would lead to more occurrences of such a situation, it is also true that not having to coordinate with a network associated with a satellite in orbit would currently occur for any filing between 149 °W and 157 °W[8].

TABLE 3

Distribution of the orbital separation (δ) between adjacent satellites that include the frequency range 3 700-4 200 MHz (coverage overlapping was not taken into account;frequency overlapping may be total or partial)

Orbital separation (δ°)	Number of occurrences	Percentage (%)
$0 \leq \delta \leq 0.5$	32	19.16
$0.5 < \delta \leq 1.0$	19	11.38
$1.0 < \delta \leq 1.5$	15	8.98
$1.5 < \delta \leq 2.0$	43	25.75
$2.0 < \delta \leq 3.0$	35	20.96
$3.0 < \delta \leq 4.0$	13	7.78
$4.0 < \delta \leq 5.0$	3	1.80
$\Delta > 5.0$	7	4.19
Total number of intervals	167	100

Similarly, an assessment of geostationary satellites currently in orbit which utilize the frequencies 14.0-14.5 GHz led to a total of 194 satellites. Table 4 shows the distribution of the orbital separation between satellites currently in orbit using the band 14.0-14.5 GHz.

It can be concluded that the average orbital separation between two satellites currently in orbit using the frequencies 14.0-14.5 GHz is about 1.87°. Based on the number of filed satellite networks, as discussed above, it was concluded that, for a 4° coordination arc, on the average a newly filed network would have to coordinate with satellite networks in 12 other orbital locations. It is now concluded that the average number of satellites currently in orbit involved in these coordinations would be approximately 4.3.

It has been noted that the distribution of satellites currently in orbit is significantly non-uniform over the 360° geostationary arc. In the arc 129 °W to 180 °E the average orbital separation becomes about 1.62° while there are only two satellites in the interval (139 °W-180 °W). The largest arc without a satellite using the frequencies 14.0-14.5 GHz extends from 129 °W to 167 °W. Therefore, for a 4° coordination arc a hypothetical filing at, for instance, 148° W would have to coordinate with several satellite networks but at the moment none of these networks would be associated with a satellite already in orbit. Although reducing the coordination arc from 9° to 4° would lead to more occurrences of such a situation, it is also true that not having to coordinate with a network

[8] These assertions are being made discarding the possibility that a satellite network outside the coordination arc could request to be included in the coordination based on the $\Delta T/T$ criterion.

associated with a satellite in orbit would currently occur for any filing between 138 °W and 158 °W[9].

TABLE 4

Distribution of the orbital separation (δ) between adjacent satellites that include the frequencyrange 14.0-14.5 GHz (coverage overlapping was not taken into account; frequency overlapping may be total or partial)

Orbital separation (δ°)	Number of occurrences	Percentage (%)
$0 \leq \delta \leq 0.5$	52	26.94
$0.5 < \delta \leq 1.0$	16	8.29
$1.0 < \delta \leq 1.5$	19	9.84
$1.5 < \delta \leq 2.0$	49	25.39
$2.0 < \delta \leq 3.0$	39	20.20
$3.0 < \delta \leq 4.0$	14	7.25
$4.0 < \delta \leq 5.0$	1	0.52
$\delta > 5.0$	3	1.55
Total number of intervals	193	100

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Finally, it is noted that the proposed reduction in the size of the coordination arc will eliminate coordination requirements that are often either not fulfilled[10] or carried out as a mere formality. Satellite networks in 6/4 GHz which are more than 5º apart or in the 10/11/12/14 GHz which are more than 4º are already significantly constrained by other closer by satellite networks. Therefore, coordination between satellite networks that are far apart will either confirm the constraints imposed by closer networks or will lead to lighter constraints that are not applicable as they will be overcome by the former constraints.

U.S. PROPOSAL: In view of the above the United States proposes that the coordination arc applicable to FSS geostationary satellite networks in certain congested portions of the 4/6 GHz and 10/11/12/14 GHz frequency bands be reduced from 10º to 5º in 4/6 GHz and 9º to 4º in 10/11/12/14 GHz. In order to implement this proposal, Table 5.1 in Appendix 5 of the Radio Regulations should be modified as shown in Annex 1.

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9 These assertions are being made discarding the possibility that a satellite network outside the coordination arc request to be included in the coordination based on the ΔT/T criterion.

10 Recording is possible through the application of RR No.11.32A or No.11.41.

Annex 1
TABLE 5-1 (WRC-07)
Technical conditions for coordination
(see Article **9**)

Reference of Article 9	**Case**	**Frequency bands (and Region) of the service for which coordination is sought**	**Threshold/condition**	**Calculation method**	**Remarks**
No. **9.7** GSO/GSO	A station in a satellite network using the geostationary-satellite orbit (GSO), in any space radiocommunication service, in a frequency band and in a Region where this service is not subject to a Plan, in respect of any other satellite network using that orbit, in any space radio-communication service in a frequency band and in a Region where this service is not subject to a Plan, with the exception of the coordination between earth stations operating in the opposite direction of transmission	1) 3 400-4 200 MHz 5 725-5 850 MHz (Region 1) and 5 850-6 725 MHz 7 025-7 075 MHz 2) 10.95-11.2 GHz 11.45-11.7 GHz 11.7-12.2 GHz (Region 2) 12.2-12.5 GHz (Region 3) 12.5-12.75 GHz (Regions 1 and 3) 12.7-12.75 GHz (Region 2) and 13.75-14.5 GHz	i) Bandwidth overlap, and ii) any network in the fixed-satellite service (FSS) and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of ±5° of the nominal orbital position of a proposed network in the FSS i) Bandwidth overlap, and ii) any network in the FSS or broadcasting-satellite service (BSS), not subject to a Plan, and any associated space operation functions (see No. **1.23**) with a space station within an orbital arc of ±4° of the nominal orbital position of a proposed network in the FSS or BSS, not subject to a Plan		With respect to the space services listed in the threshold/condition column in the bands in 1), 2), 3), 4), 5), 6), 7) and 8), an administration may request, pursuant to No. **9.41**, to be included in requests for coordination, indicating the networks for which the value of $\Delta T/T$ calculated by the method in § 2.2.1.2 and 3.2 of Appendix **8** exceeds 6%. When the Bureau, on request by an affected administration, studies this information pursuant to No. **9.42**, the calculation method given in § 2.2.1.2 and 3.2 of Appendix **8** shall be used

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