**United States**

PROPOSALS FOR THE WORK OF THE CONFERENCE

# Agenda item 7

Issue H

*7 to consider possible changes, and other options, in response to Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution* ***86 (Rev.WRC-07)****, in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the geostationary-satellite orbit;*

Resolution **86 (Rev.WRC‑07)** *– Implementation of Resolution 86 (Rev. Marrakesh, 2002) of the Plenipotentiary Conference*

**Agenda item 7(H)**

**Issue H – Modifications to RR Appendix 4 data items to be provided for non-geostationary satellite systems with multiple orbital planes**

**BACKGROUND:**

Issue H relates to the need to ensure that RR Appendix 4 data items sufficiently describe non-geostationary (non-GSO) satellite systems in order for:

– potentially affected administrations to be able to identify the potential impacts of these systems on their own systems and to formulate their comments to the notifying administration and the Radiocommunication Bureau;

– the Radiocommunication Bureau to be able to perform an examination with respect to compliance with the RR Article **22** epfd limits based on the latest version of the algorithm contained in Recommendation ITU-R S.1503; and

– administrations and the Radiocommunication Bureau to understand whether the frequency assignments to a non-GSO satellite system define a single non-GSO system or multiple mutually exclusive configurations and, in the case of the latter, the nature of the mutually exclusive configurations.

**PROPOSALS:**

The following modifications to Appendix 4 Annex 2 are proposed in order to improve the description of non-GSO satellite systems as indicated in the background.

APPENDIX 4 (REV.WRC‑15)

Consolidated list and tables of characteristics for use in the  
application of the procedures of Chapter III

ANNEX 2

Characteristics of satellite networks, earth stations  
or radio astronomy stations2     (Rev.WRC‑12)

Footnotes to Tables A, B, C and D

MOD USA/7H/1

TABLE A

GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,   
EARTH STATION OR RADIO ASTRONOMY STATION     (Rev.WRC‑19)

| **Items in Appendix** | ***A \_ GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK,  EARTH STATION OR RADIO ASTRONOMY STATION*** | **Advance publication of a geostationary- satellite network** | **Advance publication of a non-geostationary-satellite network subject to coordination under Section II  of Article 9** | **Advance publication of a non-geostationary-satellite network not subject to coordination under Section II  of Article 9** | **Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)** | **Notification or coordination of a non-geostationary-satellite network** | **Notification or coordination of an earth station (including notification under  Appendices 30A or 30B)** | **Notice for a satellite network in the broadcasting-satellite service under  Appendix 30 (Articles 4 and 5)** | **Notice for a satellite network  (feeder-link) under Appendix 30A  (Articles 4 and 5)** | **Notice for a satellite network in the fixed- satellite service under Appendix 30B  (Articles 6 and 8)** | **Items in Appendix** | **Radio astronomy** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A.4.b | **For space station(s) onboard non-geostationary satellite(s):** |  |  |  |  |  |  |  |  |  | A.4.b |  |
| A.4.b.1 | the number of orbital planes |  |  | **X** |  | **X** |  |  |  |  | A.4.b.1 |  |
| A.4.b.1.a | Indicator of whether the non-geostationary satellite system represents a “constellation”, where a term “constellation” describes a satellite system, for which the relative distribution of the orbital planes and satellites is defined.  *Note* - Non-geostationary satellite systems in frequency bands subject to the provisions of Nos. **9.12,** **9.12A**, **22.5C**, **22.5D** or **22.5F** are always considered as “constellations”. |  |  | **X** |  | **X** |  |  |  |  | A.4.b.1.a |  |
| A.4.b.1.b | Indicator of whether all the orbital planes identified under A.4.b.1 describe a) single configuration where all frequency assignments to the satellite system will be in use, or b), multiple configurations are mutually exclusive where a sub-set of the frequency assignments to the satellite system will be in use on one of the sub-sets of orbital parameters to be determined at the notification and recording stage of the satellite system  Required only for the:  1) advance publication information of a non-geostationary satellite system representing a constellation (A.4.b.1.a), and  2) coordination request of non-geostationary-satellite systems |  |  | **+** |  | **+** |  |  |  |  | A.4.b.1.b |  |
| A.4.b.1.c | In case the orbital planes identified under A.4.b.1 describe multiple mutually exclusive configurations, identification of the number of sub-sets of orbital characteristics that are mutually exclusive  Required only for the:  1) advance publication information of a non-geostationary satellite system representing a constellation (A.4.b.1.a), and  2) coordination request for non-geostationary-satellite systems |  |  | **+** |  | **+** |  |  |  |  | A.4.b.1.c |  |
| A.4.b.1.d | In case the orbital planes identified under A.4.b.1.b describe multiple mutually exclusive configurations, identification of the orbital planes id numbers that are associated with each of the mutually exclusive configurations  Required only for the:  1) advance publication information of a non-geostationary satellite system representing a constellation (A.4.b.1.a), and  2) coordination request of non-geostationary satellite systems |  |  | **+** |  | **+** |  |  |  |  | A.4.b.1.d |  |
| A.4.b.2 | the reference body code |  | **X** | **X** |  | **X** |  |  |  |  | A.4.b.2 |  |
| A.4.b.3 | **For space stations of a non-geostationary fixed-satellite service system operating in the frequency band 3 400‑4 200 MHz:** |  |  |  |  |  |  |  |  |  | A.4.b.3 |  |
| A.4.b.3.a | the maximum number of space stations (*NN*) in a non-geostationary-satellite system simultaneously transmitting on a co-frequency basis in the fixed-satellite service in the Northern Hemisphere |  |  | **X** |  | **X** |  |  |  |  | A.4.b.3.a |  |
| A.4.b.3.b | the maximum number of space stations (*NS*) in a non-geostationary-satellite system simultaneously transmitting on a co-frequency basis in the fixed-satellite service in the Southern Hemisphere |  |  | **X** |  | **X** |  |  |  |  | A.4.b.3.b |  |
| A.4.b.4 | **For each orbital plane, where the Earth is the reference body:** |  |  |  |  |  |  |  |  |  | A.4.b.4 |  |
| A.4.b.4.a | the angle of inclination (*ij*) of the orbital plane with respect to the Earth’s equatorial plane  (0° ≤ *ij* < 180°) |  |  | **X** |  | **X** |  |  |  |  | A.4.b.4.a |  |
| A.4.b.4.b | the number of satellites in the orbital plane |  |  | **X** |  | **X** |  |  |  |  | A.4.b.4.b |  |
| A.4.b.4.c | the period |  |  | **X** |  | **X** |  |  |  |  | A.4.b.4.c |  |
| A.4.b.4.d | the altitude, in kilometres, of the apogee of the space station |  |  | **X** |  | **X** |  |  |  |  | A.4.b.4.d |  |
| A.4.b.4.e | the altitude, in kilometres, of the perigee of the space station |  |  | **X** |  | **X** |  |  |  |  | A.4.b.4.e |  |
| A.4.b.4.f | the minimum altitude of the space station above the surface of the Earth at which any satellite transmits |  |  | **X** |  | **X** |  |  |  |  | A.4.b.4.f |  |
| A.4.b.4.g | the right ascension of the ascending node (Ω*j*) for the *j*-th orbital plane, measured counter-clockwise in the equatorial plane from the direction of the vernal equinox to the point where the satellite makes its South-to-North crossing of the equatorial plane (0° ≤  Ω*j* < 360°), determined at the reference time indicated in A.4.b.4.k and A.4.b.4.l.  Required only for space stations operating in a frequency band subject to the provisions of Nos. **9.12** **or** **9.12A**  *Note* - All satellites in all orbital planes must use the same reference time. If no reference time is provided in A.4.b.4.k and A.4.b.4.l, it is assumed to be t=0 |  |  |  |  | **+** |  |  |  |  | A.4.b.4.g |  |
| A.4.b.4.h | the initial phase angle (ω*i*) of the *i*-th satellite in its orbital plane at reference time *t* = 0, measured from the point of the ascending node (0° ≤ ω*i* < 360°)  Required only in case of a non-geostationary satellite system representing a “constellation” (A.4.b.1.a), and to be specified in:  1) the Advanced Publication (API), for any frequency assignment not subject to the provisions of Section II of Article **9**  2) the Coordination Request (CR/C), for any frequency assignment subject to the provisions of Nos.  **9.12, 9.12A, 22.5C, 22.5D** or **22.5F**  3) the Notification, in all cases  *Note* - The initial phase angle is the argument of perigee plus the true anomaly |  |  | **+** |  | **+** |  |  |  |  | A.4.b.4.h |  |
| A.4.b.4.i | the argument of perigee (ω*p*), measured in the orbital plane, in the direction of motion, from the ascending node to the perigee (0° ≤ ω*p* < 360°)  Required only for orbits of a “constellation” (A.4.b.1.a) where the altitudes of apogee and perigee (A.4.b.4.d and A.4.b.4.e) are different and to be specified in:  - the Advanced Publication (API), for any frequency assignment not subject to the provisions of Section II of Article **9**  - the Coordination Request (CR/C), for any frequency assignment subject to the provisions of Nos.  **9.12,** **9.12A, 22.5C, 22.5D** or **22.5F**  - the Notification, in all cases |  |  | **+** |  | **+** |  |  |  |  | A.4.b.4.i |  |
| A.4.b.4.j | the longitude of the ascending node (θ*j*) for the *j*-th orbital plane, measured counter-clockwise in the equatorial plane from the Greenwich meridian to the point where the satellite orbit makes its South-to-North crossing of the equatorial plane (0° ≤  θ*j* < 360°)  Required only for orbits of a “constellation” (A.4.b.1.a) and to be specified in:  - the Advanced Publication (API), for any frequency assignment not subject the provisions of Section II of Article **9**  - the Coordination Request (CR/C), for any frequency assignment subject to the provisions of Nos.  **9.12, 9.12A, 22.5C, 22.5D** or **22.5F**  - the Notification, in all cases  *Note* - All satellites in all orbital planes must use the same reference time. If no reference time is provided in A.4.b.4.k and A.4.b.4.l, it is assumed to be t=0 |  |  | **+** |  | **+** |  |  |  |  | A.4.b.4.j |  |
| A.4.b.4.k | the date (day:month:year) at which the satellite is at the location defined by the longitude of the ascending node (θ*j*), (see Note under A.4.b.4.j) |  |  | **O** |  | **O** |  |  |  |  | A.4.b.4.k |  |
| A.4.b.4.l | the time (hours:minutes) at which the satellite is at the location defined by the longitude of the ascending node (θ*j*), (see Note under A.4.b.4.j) |  |  | **O** |  | **O** |  |  |  |  | A.4.b.4.l |  |
| A.4.b.4.m | indicator of whether the space station uses sun-synchronous orbit or not  Required only in frequency bands not subject to the provisions of Nos **9.12** or **9.12A** |  |  | **+** |  | **+** |  |  |  |  | A.4.b.4.m |  |
| A.4.b.4.n | if the space station uses sun-synchronous orbit (A.4.b.4.m), indicator if the space station references the local time of the ascending node (solar local time when the space station is crossing the equator plane in the South-North direction in hours:minutes format) or the descending node (solar local time when the space station is crossing the equator plane in the North-South direction in hours:minutes format) |  |  | **O** |  | **O** |  |  |  |  | A.4.b.4.n |  |
| A.4.b.4.o | if the space station uses sun-synchronous orbit (A.4.b.4.m), the local time of the ascending (or descending, per A.4.b.4.n) node (solar local time when the space station is crossing the equator plane in the South-North (or North-South) direction in hours:minutes format) |  |  | **O** |  | **O** |  |  |  |  | A.4.b.4.o |  |
| A.4.b.5 | **Not used** |  |  |  |  |  |  |  |  |  |  |  |
| A.4.b.6 | **For space stations operating in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F, additional data elements to characterize properly the orbital operation of the non-geostationary-satellite system:** |  |  |  |  |  |  |  |  |  | A.4.b.6 |  |
| A.4.b.6*bis* | **An indicator showing whether the set of operating parameters is provided in A.14.d (extended set of operating parameters) or provided in A.4.b.6.a and A.4.b.7 (limited set of operating parameters)** |  |  |  |  | **X** |  |  |  |  | A.4.b.6*bis* |  |
| A.4.b.6.a | **For each range of latitudes:**  the limited set of operating parameters |  |  |  |  |  |  |  |  |  | A.4.b.6.a |  |
| A.4.b.6.a.1 | the maximum number of non-geostationary satellites transmitting with overlapping frequencies to a given location |  |  |  |  | **+** |  |  |  |  | A.4.b.6.a.1 |  |
| A.4.b.6.a.2 | the associated start of the latitude range |  |  |  |  | **+** |  |  |  |  | A.4.b.6.a.2 |  |
| A.4.b.6.a.3 | the associated end of the latitude range |  |  |  |  | **+** |  |  |  |  | A.4.b.6.a.3 |  |
| A.4.b.6.b | **Not used** |  |  |  |  |  |  |  |  |  | A.4.b.6.b |  |
| A.4.b.6.c | an indicator showing whether the space station uses station-keeping to maintain a repeating  ground track |  |  |  |  | **X** |  |  |  |  | A.4.b.6.c |  |
| A.4.b.6.d | if the space station uses station-keeping to maintain a repeating ground track, the time in seconds that it takes for the constellation to return to its starting position, i.e. such that all satellites are in the same location with respect to the Earth and each other |  |  |  |  | **+** |  |  |  |  | A.4.b.6.d |  |
| A.4.b.6.e | an indicator showing whether the space station should be modelled with a specific precession rate of the ascending node of the orbit instead of the *J*2 term |  |  |  |  | **X** |  |  |  |  | A.4.b.6.e |  |
| A.4.b.6.f | if the space station is to be modelled with a specific precession rate of the ascending node of the orbit instead of the *J*2 term, the precession rate in degrees/day, measured counter-clockwise in the equatorial plane |  |  |  |  | **+** |  |  |  |  | A.4.b.6.f |  |
| A.4.b.6.g | **Not used** |  |  |  |  |  |  |  |  |  | A.4.b.6.g |  |
| A.4.b.6.h | **Not used** |  |  |  |  |  |  |  |  |  | A.4.b.6.h |  |
| A.4.b.6.i | **Not used** |  |  |  |  |  |  |  |  |  | A.4.b.6.i |  |
| A.4.b.6.j | the longitudinal tolerance of the longitude of the ascending node |  |  |  |  | **X** |  |  |  |  | A.4.b.6.j |  |
| A.4.b.7 | **For space stations operating in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F, the data elements to characterize properly the performance of the non-geostationary-satellite system:**  **to be provided, if A.4.b.6*bis* indicates the limited set of operating parameters** |  |  |  |  |  |  |  |  |  | A.4.b.7 |  |
| A.4.b.7.a | the maximum number of non-geostationary satellites receiving simultaneously with overlapping frequencies from the associated earth stations within a given cell |  |  |  |  | **+** |  |  |  |  | A.4.b.7.a |  |
| A.4.b.7.b | the average number of associated earth stations with overlapping frequencies per square kilometre within a cell |  |  |  |  | **+** |  |  |  |  | A.4.b.7.b |  |
| A.4.b.7.c | the average distance, in kilometres, between co‑frequency cells |  |  |  |  | **+** |  |  |  |  | A.4.b.7.c |  |
| A.4.b.7.c*bis* | the minimum elevation angle at which any associated earth station can transmit to or receive from a non-geostationary satellite |  |  |  |  | **+** |  |  |  |  | A.4.b.7.c*bis* |  |
| A.4.b.7.d | For the exclusion zone about the geostationary-satellite orbit: |  |  |  |  |  |  |  |  |  | A.4.b.7.d |  |
| A.4.b.7.d.1 | the type of zone (based on topocentric angle, satellite-based angle for establishing the exclusion zone) |  |  |  |  | **+** |  |  |  |  | A.4.b.7.d.1 |  |
| A.4.b.7.d.2 | if the zone is based on a topocentric angle or a satellite-based angle, the width of the zone, in degrees |  |  |  |  | **+** |  |  |  |  | A.4.b.7.d.2 |  |
| A.4.b.7.d.3 | **Not used** |  |  |  |  |  |  |  |  |  | A.4.b.7.d.3 |  |
| … | … | … | | | | | | | | | … | … |
| **A.14** | **FOR STATIONS OPERATING IN A FREQUENCY BAND SUBJECT TO Nos. 22.5C, 22.5D OR 22.5F: SPECTRUM MASKS** |  | | | | | | | | | **A.14** |  |
| A.14.a | **For each e.i.r.p. mask used by the non-geostationary space station:** |  |  |  |  |  |  |  |  |  | A.14.a |  |
| A.14.a.1 | the mask identification code |  |  |  |  | **X** |  |  |  |  | A.14.a.1 |  |
| A.14.a.2 | the lowest frequency for which the mask is valid |  |  |  |  | **X** |  |  |  |  | A.14.a.2 |  |
| A.14.a.3 | the highest frequency for which the mask is valid |  |  |  |  | **X** |  |  |  |  | A.14.a.3 |  |
| A.14.a.4 | the mask pattern defined in terms of the power in the reference bandwidth for a series of angles measured at the non-geostationary space station between the line to the sub-satellite point and the line to a point on the geostationary arc, together with the bandwidth used |  |  |  |  | **X** |  |  |  |  | A.14.a.4 |  |
| A.14.a.5 | the reference bandwidth used for the mask pattern of A.14.a.4 |  |  |  |  | **X** |  |  |  |  | A.14.a.5 |  |
| A.14.b | **For each associated earth station e.i.r.p. mask:** |  |  |  |  |  |  |  |  |  | A.14.b |  |
| A.14.b.1 | the mask identification code |  |  |  |  | **X** |  |  |  |  | A.14.b.1 |  |
| A.14.b.2 | the lowest frequency for which the mask is valid |  |  |  |  | **X** |  |  |  |  | A.14.b.2 |  |
| A.14.b.3 | the highest frequency for which the mask is valid |  |  |  |  | **X** |  |  |  |  | A.14.b.3 |  |
| A.14.b.4 | **Not used** |  |  |  |  |  |  |  |  |  | A.14.b.4 |  |
| A.14.b.5 | **Not used** |  |  |  |  |  |  |  |  |  | A.14.b.5 |  |
| A.14.b.6 | the mask pattern defined in terms of the power in the reference bandwidth as a function of latitude and the off-axis angle between the non-geostationary earth station boresight line and the line from the non-geostationary earth station to a point on the GSO arc |  |  |  |  | **X** |  |  |  |  | A.14.b.6 |  |
| A.14.b.7 | the reference bandwidth used for the mask pattern of A.14.b.6 |  |  |  |  | **X** |  |  |  |  | A.14.b.7 |  |
| A.14.c | **For each pfd mask used by the non-geostationary space station:**  *Note* – The space station pfd mask is defined by the maximum power flux-density generated by any space station in the interfering non-geostationary-satellite system as seen from any point on the surface of the Earth |  |  |  |  |  |  |  |  |  | A.14.c |  |
| A.14.c.1 | the mask identification code |  |  |  |  | **X** |  |  |  |  | A.14.c.1 |  |
| A.14.c.2 | the lowest frequency for which the mask is valid |  |  |  |  | **X** |  |  |  |  | A.14.c.2 |  |
| A.14.c.3 | the highest frequency for which the mask is valid |  |  |  |  | **X** |  |  |  |  | A.14.c.3 |  |
| A.14.c.4 | the type of mask, among one of the following types: (Earth-based exclusion zone angle, difference in longitude, latitude), (satellite-based exclusion zone angle, difference in longitude, latitude) or (satellite azimuth, satellite elevation, latitude) |  |  |  |  | **X** |  |  |  |  | A.14.c.4 |  |
| A.14.c.5 | the mask pattern of the power flux-density defined in three dimensions |  |  |  |  | **X** |  |  |  |  | A.14.c.5 |  |
| A.14.c.6 | the reference bandwidth used for the mask pattern of A.14.c.5 |  |  |  |  | **X** |  |  |  |  | A.14.c.6 |  |
| A.14.d | **For each set of non-geostationary satellite system operating parameters**  to be provided, if A.4.b.6*bis* indicates the use of an extended set of operating parameters  *Note* – There could be different sets of parameters at different frequency bands, but only one set of operating parameters for any frequency band used by the non-geostationary system |  |  |  |  |  |  |  |  |  | A.14.d |  |
| A.14.d.1 | the parameter set identification code |  |  |  |  | **+** |  |  |  |  | A.14.d.1 |  |
| A.14.d.2 | the lowest frequency for which the mask is valid |  |  |  |  | **+** |  |  |  |  | A.14.d.2 |  |
| A.14.d.3 | the highest frequency for which the mask is valid |  |  |  |  | **+** |  |  |  |  | A.14.d.3 |  |
| A.14.d.4 | minimum limit of the latitude range of non-geostationary earth station locations in degrees North |  |  |  |  | **+** |  |  |  |  | A.14.d.4 |  |
| A.14.d.5 | maximum limit of the latitude range of non-geostationary earth station locations in degrees North |  |  |  |  | **+** |  |  |  |  | A.14.d.5 |  |
| A.14.d.6 | the average number of associated earth stations, per km2, active at the same time |  |  |  |  | **+** |  |  |  |  | A.14.d.6 |  |
| A.14.d.7 | the average distance, in kilometres, between co‑frequency cell or beam footprint centre |  |  |  |  | **+** |  |  |  |  | A.14.d.7 |  |
| A.14.d.8 | the minimum duration, in seconds, during which an earth station will track a non-geostationary satellite without handover for different ranges of latitude |  |  |  |  | **+** |  |  |  |  | A.14.d.8 |  |
| A.14.d.9 | the maximum number of co-frequency tracked non-geostationary satellites for different ranges of latitude |  |  |  |  | **+** |  |  |  |  | A.14.d.9 |  |
| A.14.d.10 | the exclusion zone angle (degrees), i.e. the minimum angle to the geostationary arc at the non-geostationary earth station at which it will operate defined at the earth station given latitude range  *Note –* The exclusion zone angle could vary between non-geostationary system orbit planes. If identification code of orbital plane is not defined then it applies to all orbital planes |  |  |  |  | **+** |  |  |  |  | A.14.d.10 |  |
| A.14.d.11 | the minimum elevation angle (degrees) of the non-geostationary earth station when it is receiving or transmitting within a given latitude (degrees North) and azimuth (degrees from North) range |  |  |  |  | **+** |  |  |  |  | A.14.d.11 |  |