|  |  |  |
| --- | --- | --- |
| U.S. Radiocommunications Sector  Fact Sheet | | |
| **Working Party:** ITU-R WP 5B | **Document No:** USWP5B29-04R1 | |
| **Ref:** 5B/531 Annex 1 on AI 1.6 | **Date:** May 11, 2022 | |
| **Document Title:** Working Document towards Draft CPM Text for WRC-23 Agenda Item 1.6 | | |
| **Author(s)/Contributors(s):**  Chris Tourigny  FAA Spectrum Engineering Services  Michael Tran  MITRE  Nader Damavandi  Space Exploration Technologies  Damon Ladson  Harris, Wiltshire & Grannis  Donald Jansky  Joseph Cramer  Boeing | | Phone: 202-267-3071  Email: chris.tourigny@faa.gov  Phone: 703-983-1295  Email: mtran@mitre.org  Phone: 310-219-7854  Email: nader.damavandi@spacex.com  Phone: (202) 730-1315  Email: [dladson@hwglaw.com](mailto:dladson@hwglaw.com)  Phone: 202-415-1834  Email: don@jansky-barmat.com  Phone: 703-465-3486  Email: joseph.cramer@boeing.com |
| **Purpose/Objective:** This contribution provides updates to the Working Document towards Draft CPM Text for WRC-23 Agenda Item 1.6 to facilitate the introduction of sub-orbital vehicles (SoV). | | |
| **Abstract:** Pursuant to Resolution 772 (WRC-19), this contribution provides some regulatory provisions as well as to address 2 editor’s notes to the WD-Draft CPM Text for WRC-23 AI 1.6 to facilitate the introduction of sub-orbital vehicles. | | |

|  |  |
| --- | --- |
| **Radiocommunication Study Groups** |  |
|  |  |
|  |  |
| Source: Document 5B/531 – Annex 1  Subject: WRC-23 AI 1.6 Draft CPM Text | **Document 5B/** |
| **11 July 2022** |
| **English only** |
| United States of America | |
| working document towards draft cpm text for WRC-23 agenda item 1.6 | |
|  | |

**Introduction**

Pursuant to Resolution 772 (WRC-19), this contribution provides some regulatory provisions to the WD-Draft CPM Text for WRC-23 AI 1.6 to facilitate the introduction of sub-orbital vehicles

Attachment: 1

ATTACHMENT

working document towards draft cpm text for wrc-23 agenda item 1.6

CHAPTER 2

Aeronautical and maritime issues

(Agenda items 1.6, 1.7, 1.8, 1.9, 1.10, 1.11)

Agenda item 1.6

**(WP 5B[[1]](#footnote-1)\* /** **WP 3M, WP 4A, WP 4C, WP 7B, WP 7D)**

*1.6 to consider, in accordance with Resolution* ***772 (WRC-19)****, regulatory provisions to facilitate radiocommunications for sub-orbital vehicles;*

Resolution **772 (WRC-19)** – *Consideration of regulatory provisions to facilitate the introduction of sub-orbital vehicles.*

# 2/1.6/1 Executive summary

To address this agenda item, the ITU-R undertook studies pursuant to Resolution **772 (WRC-19)**. In particular, the ITU-R is invited to study the spectrum needs for stations on board sub-orbital vehicles, any appropriate modification to the Radio Regulations, excluding any new allocations or changes to the existing allocations in RR Article **5**, and to identify whether there is a need for access to additional spectrum. [Three/Four] Methods are proposed to address this agenda item:

Method A

No change to the Radio Regulations (RR).

Method B

A new WRC Resolution containing the provisions to operate radiocommunications for sub-orbital vehicles.

There are 3 alternative approaches to this Method.

Method C

A Modification of RR Article **4**.

[Method D

No Change to RR Article **4**.]

[Some other Administrations propose not to change RR Article **4** due to the fact that: a) the understanding of this agenda item is not to change any Article of the RR, and b) that such modification is complying with the objectives and purposes of Article **4** of the RR since there is no similar course of action in that Article in this regard.]

# 2/1.6/2 Background

In Report ITU-R M.2477, suborbital flight is described as “The intentional flight of a vehicle expected to reach the upper atmosphere with a portion of its flight path that may occur in space without completing a full orbit around the Earth before returning back to the surface of the Earth.” A suborbital vehicle is described as “a vehicle executing suborbital flight.”

WRC-23 agenda item 1.6 is intended, among other aspects, to safely integrate suborbital vehicles into the same airspace as conventional aircraft during their transition to and from space to minimize the airspace disruption.

In addition, sub-orbital vehicles are intended to operate at higher altitudes than conventional aircraft during short periods of time without reaching an orbit and at potentially flying at speeds up to several times the speed of sound.

# 2/1.6/3 Summary and Analysis of the results of ITU-R studies

Radio stations operating onboard suborbital vehicles are expected to operate in frequency bands currently allocated for certain terrestrial and space services, while not changing the interference environment and conditions for coexistence with existing applications of the same service and on other radiocommunication services.

The following three paragraphs summarize the different interpretations of the ITU-R radio regulations which leads to different Approaches within Method B and Sections 4 and 5.

The suborbital vehicle may be physically located within the major portion of Earth’s atmosphere or in space for a brief period of time.  Referring to the definitions of *terrestrial stations* in RR No. **1.62**, *earth stations* in RR No. **1.63**, and *space stations* in RR No. **1.64**, it can be seen that a station on a suborbital vehicle would meet the definition of its associated station type in different parts of the flight. This leads to a difficulty for the stations on the suborbital vehicle which operate as terrestrial and/or Earth stations. Indeed, contrary to space stations (see RR Article **1.64**) for which the intention “to go beyond, or has been beyond, the major portion of the Earth's atmosphere” allow their use in all phases of a suborbital flight with a part occurring in space, the terrestrial and Earth stations would have to remain in the major part of the Earth’s atmosphere to comply with the Radio Regulations.

Review of the RR provisions revealed there were no difficulties with the existing RR Article 5 allocations when a station onboard suborbital vehicle goes beyond or is intended to go beyonda major portion of the Earth’s atmosphere, based on the space radiocommunication service in which the station operates.

The classification of a suborbital vehicle as a *space station* would however introduce an inconsistency with the RR Article **5** allocations in certain frequency bands. If a station on board suborbital vehicle is considered as a *space station*, this station would consequently require the use of space-to-space, space-to-Earth or Earth-to-space directions of an appropriate space service allocation. However, the relevant space service allocation and directions of the space services to be used for suborbital vehicles do not always exist in the current Table of Frequency Allocations.

Further, a *terrestrial station* is defined as, “a station effecting *terrestrial radiocommunication,*” which is a station effecting [RR No. **1.7**][see also RR No. **1.62**] “any radiocommunication other than *space radiocommunication* or *radio astronomy*.” The suborbital vehicle terrestrial applications do not become space or radio astronomy applications just because of a change in the location of the vehicle. As per RR No. **1.61**, each station shall be classified by the service in which it operates permanently or temporarily. Therefore, while the suborbital vehicle is physically located beyond the Earth’s atmosphere for a brief period of time, the physical location of the suborbital vehicle on which the stations are located does not change the need for, or purpose of the use of specific radiocommunication services.

Studies in Report ITU-R M.2477 show that some suborbital vehicle operations may require making unavailable large areas of international and national airspace during their transition to and from space. This results in airspace disruptions, extra travel time, re-routing flight paths, additional aircraft fuel consumption, etc. The studies also show the technical capability of some current aircraft avionics systems to be operated onboard suborbital vehicles, to facilitate the safe integration of suborbital vehicles into the same airspace as conventional aircraft during their transition to and from space to minimize the airspace disruption. The report also identified several existing radiocommunications services that are envisaged for use by stations onboard suborbital vehicles including:

a) ARNS for surveillance and navigation;

b) AMS, including AM(R)S, for VHF voice and data communications and ADS-B surveillance;

c) AMSS, including AMS(R)S, for voice and data communications and surveillance ADS-B and ADS-C;

d) MSS, including AMS(R)S, for communications and telemetry, tracking and command (TT&C) applications;

e) Aeronautical radiodetermination service (not a specifically defined service in the RR) for surveillance;

f) RNSS for navigation with GNSS systems in 1 164-1 215 MHz and 1 559-1 610 MHz, and

g) Space operation service (SOS) for TT&C.

Report ITU-R also provides, “Furthermore, it is envisaged that for the purpose of flight under aeronautical regulation in upper atmosphere, the station on board sub-orbital vehicles may also be considered as a terrestrial station or an earth station even if a part of the flight occurs in space.”. The term “aeronautical regulation” in the context of this report is the spectrum regulation of aeronautical services applied to sub-orbital vehicles travelling in the upper atmosphere.

The use of existing aircraft avionics systems by suborbital vehicles can be supported by the existing RR Article **5** provisions without modification.

# 2/1.6/4 Methods to satisfy the agenda item

[This section should contain the brief description of the Method or Methods to satisfy the agenda item as per section A2.4 of Annex 2 to Resolution [ITU-R 2-8](http://www.itu.int/pub/R-RES-R.2-8-2019)]

## 2/1.6/4.1 Method A: No change (NOC)

This method NOC covers the case in which the assessment of suborbital vehicles operating relative to the current regulatory conditions under the Radio Regulations are sufficient to address their requirements or that no regulatory provisions could be agreed.

## 2/1.6/4.2 Method B: A new WRC Resolution containing the provisions to operate radiocommunications for sub-orbital vehicles.

There are 3 alternative approaches to this Method. All three approaches propose to suppress Resolution **772 (WRC-19)**:

### 2/1.6/4.2.1 Alternative Approach B1

This approach is for a draft new WRC-23 Resolution to specify that stations on-board suborbital vehicles may be terrestrial stations (RR No. **1.62**) and earth stations (RR No. **1.63**) and can be used in all phases of flight within their respective service allocations. The stations shall not impose any new constraints on applications of the same service and other radiocommunication services that are allocated on a primary basis.

### 2/1.6/4.2.2 Alternative Approach B2

This approach proposes to:

– include the definition of sub-orbital vehicle in the *resolves* part of a draft new WRC-23 Resolution;

– allow stations on board sub-orbital vehicles to operate as terrestrial stations or as earth stations [even when a portion of its flight path that may occur in space] while ensuring the protection and not imposing any additional constraint on other services or applications operated in the same service than conventional aircraft;

Or

– consider the use of space services or to add directions of existing space allocation for the following systems operated in the associated frequency band that are necessary for the operation of suborbital vehicles:

a) VHF voice in the frequency band 119.975-136 MHz;

b) VHF data communications in the frequency band [TBD];

c) ADS-B in the frequency band 1 090 MHz;

d) GNSS systems in the frequency bands 1 164-1 215 MHz and 1 559-1 610 MHz;

e) voice and data communications via satellite in the frequency band [TBD];

f) TT&C applications in the frequency band xxx;

g) [TBD].

– require that the stations of the suborbital vehicles for the phases of their flight occurring or requiring preparation for integration in airspace shared with other aircraft, shall use for the safety radiocommunication purpose the same radiocommunication services and the same frequency bands as the ones for conventional aircraft;

– allow the use of relevant radiocommunication services during all phases of flight for types of suborbital vehicles that fly in non-shared airspace or for non-safety of life purposes.

This method on suborbital vehicles does not impact the radiocommunications of conventional satellite launchers.]

### 2/1.6/4.2.3 Alternative Approach B3

This approach proposes a draft new WRC-23 Resolution based on the following elements:

– To include a definition of stations on a suborbital vehicle which includes operation when in space and includes space launch vehicles.

– To identify the specific services in which sub-orbital vehicles may operate (AM(R)S, MSS, RNSS) and to clarify that stations on suborbital vehicles may operate as aircraft stations or earth stations in those services, for all parts of a flight.

– To require the operation of stations on suborbital vehicles in the above services under the same conditions as those for conventional stations.

– To exclude the operation of systems in the space operation service from the scope of the Resolution.

## 2/1.6/4.3 Method C: Modification to Article 4 of the Radio Regulations: Assignment and use of frequencies

This method is for a modification to Article **4** of the Radio Regulations to specify that stations on-board suborbital vehicles may be terrestrial stations (RR No. **1.62**) and earth stations (RR No. **1.63**) and can be used in all phases of flight, within their respective service allocations. The stations shall not impose any new constraints on applications of the same service and other radiocommunication services that are allocated on a primary basis.

# 2/1.6/5 Regulatory and procedural considerations

2/1.6/5.1 For Method A: No Change

NOC

2/1.6/5.2 For Method B: New WRC-23 Resolution

There are 3 alternative approaches to Method B.

2/1.6/5.2.1 For Method B, alternative Approach B1

ADD

DRAFT NEW RESOLUTION [A16] (WRC-23)

Radiocommunication services for use by stations onboard suborbital vehicles

The World Radiocommunication Conference ([Abu Dhabi or Dubai], 2023),

considering

*a)* that sub-orbital vehicles operate at higher altitudes than conventional aircraft, with a sub-orbital trajectory;

*b)* that sub-orbital vehicles operate through the lower levels of the atmosphere, where they may operate in the same airspace as conventional aircraft;

*c)* that sub-orbital vehicles may perform various missions (e.g. conducting scientific research or providing transportation) and then return to the Earth’s surface without completing a full orbital flight around the Earth;

*d)* that stations on board sub-orbital vehicles have a need for voice/data communications, navigation, surveillance, and telemetry, tracking and command (TT&C);

*e)* that sub-orbital vehicles must be safely accommodated into airspace used by conventional aircraft during certain phases of flight;

*f)* that there is a need to ensure that equipment installed on sub-orbital vehicles can communicate with air traffic management systems and relevant ground control facilities,

recognizing

*a)* that some sub-orbital flights could reach altitudes for a brief period of time in space without sufficient energy to sustain persistent orbit;

*b)* that there is no internationally agreed legal demarcation between the Earth’s atmosphere and the space domain;

*c)* that Report ITU-R M.2477 describes sub-orbital flight as an intentional flight of a vehicle expected to reach the upper atmosphere with a portion of its flight path that may occur in space without completing a full orbit around the Earth before returning back to the surface of the Earth;

*d)* that Report ITU-R M.2477 describes a sub-orbital vehicle as a vehicle executing sub-orbital flight;

*e)* that stations on-board sub-orbital vehicles may use systems operating under space and/or terrestrial services;

*f)* that Annex 10 to the Convention on International Civil Aviation contains Standards and Recommended Practices (SARPs) for aeronautical radionavigation and radiocommunication systems used by international civil aviation;

*g)* that most space launch systems may include components or items not reaching orbital trajectories, but some of these components or items may be developed as reusable items operating on sub-orbital trajectories,

noting

*a)* that Report ITU-R M.2477 provides information on radiocommunications for sub-orbital vehicles, including a description of the flight trajectory, categories of sub-orbital vehicles, technical studies related to possible avionics systems used by sub-orbital vehicles, and service allocations of those systems;

*b)* that the provisions of No. **4.10** may apply to certain aspects of sub-orbital vehicle operations;

*c)* that the development of compatibility criteria between International Civil Aviation Organization (ICAO) standardized aeronautical systems is the responsibility of ICAO,

resolves

that stations on-board suborbital vehicles may be terrestrial stations (No. **1.62**) and earth stations (No. **1.63**) and can be used in all phases of flight, within their respective service allocations. The stations shall not impose any new constraints on applications of the same service and other radiocommunication services that are allocated on a primary basis,

instructs the Secretary-General

to bring this Resolution to the attention of ICAO,

invites the International Civil Aviation Organization

to take into account this Resolution and relevant portions of Report ITU-R M.2477 in the course of developing SARPs for ICAO systems that may be used by sub-orbital vehicles.

**Reasons:** This action will clarify that stations on-board suborbital vehicles may be terrestrial stations (RR No. **1.62**) and earth stations (RR No. **1.63**) and can be used in all phases of flight, within their respective service allocations. The stations shall not impose any new constraints on applications of the same service and other radiocommunication services that are allocated on a primary basis.

2/1.6/5.2.2 For Method B, alternative Approach B2

ADD

DRAFT NEW RESOLUTION [B16] (WRC‑23)

Regulatory provisions to facilitate   
the operation of sub-orbital vehicles

The World Radiocommunication Conference ([Abu Dhabi or Dubai], 2023),

considering

*a)* that sub-orbital vehicles are intended to operate at higher altitudes than conventional aircraft, with a sub-orbital trajectory;

*b)* that sub-orbital vehicles are flying during a short period of time (up to 2 hours for a long range legacy aircraft) in the higher altitudes without reaching an orbit due to insufficient energy/velocity;

*c)* that such sub-orbital vehicles are also developed to fly through the lower levels of the atmosphere, where they are expected to operate in the same airspace as conventional aircraft;

*d)* that stations on board sub-orbital vehicles are needed for voice/data communications, navigation, surveillance and telemetry, tracking and command (TT&C);

*e)* that sub-orbital vehicles must be safely accommodated into airspace used by conventional aircraft during certain phases of flight;

*f)* that there is a need to ensure that equipment installed on such vehicles can communicate with air traffic management systems and, or relevant ground control facilities;

*g)* that vehicles evolving at very high velocity may generate a plasma sheath that may envelop all or most of the vehicle;

*h)* that the plasma-sheath attenuation prevents the use of links with terrestrial stations on the ground,

recognizing

*a)* that there is no internationally agreed demarcation between the Earth’s atmosphere and the space domain;

*b)* that Annex 10 to the Convention on International Civil Aviation contains Standards and Recommended Practices for aeronautical radionavigation and radiocommunication systems used by international civil aviation;

*c)* that conventional space launch systems are not covered by this Resolution. However, some stages of space launch systems are not reaching an orbital trajectory, and these components or items may be considered as suborbital objects,

noting

*a)* Question ITU‑R 259/5, on operational and radio regulatory aspects for planes operating in the upper level of the atmosphere;

*b)* that Report ITU‑R M.2477 provides information on the understanding of radiocommunications for sub-orbital vehicles for WRC-19, including a description of the flight trajectory, categories of sub-orbital vehicles, technical studies related to possible avionics systems used by sub-orbital vehicles, and service allocations of those systems;

*c)* that the development of conditions of coexistence between International Civil Aviation Organization (ICAO) standardized aeronautical systems is the responsibility of ICAO,

resolves

1 that a suborbital flight is defined as an intentional flight of a vehicle expected to reach the upper atmosphere [with a portion of its flight path that may occur in space] without completing a full orbit around the Earth before returning back to the surface of the Earth;

**[**

2 that stations on board sub-orbital vehicles shall be operated as terrestrial stations or as earth stations independently of the altitude as sub-orbital vehicle shall not reach an orbital trajectory in accordance with *resolves* 1, thus it is considered that sub-orbital vehicles remain below the major portion of the Earth's atmosphere in regards with No. **1.64** under derogation allowed by No. **4.4**;

**OR**

2 that stations on board sub-orbital vehicles shall operate when the part of the flight occurs in space:

a) for VHF voice in the frequency band 119.975-136 MHz under the AMS(R)S allocation [and data communications in the frequency band 119.975-137 MHz];

b) for ADS-B transmitter in the frequency band 1 090 MHz under new directions space-to-space and space-to-Earth of the AMS(R)S;

c) for GNSS systems in 1 164-1 215 MHz and 1 559-1 610 MHz under regular RNSS;

d) for voice and data communications and for TT&C applications under MSS in the frequency band xxx eventually under new direction space-to-space;

e) [TBD], ]

3 that the stations on board sub-orbital vehicles shall not create more constraints on existing applications of the same service and on other radiocommunication services that are allocated on a primary basis in the same and adjacent frequency bands, than when the stations operated for the same purpose on board an aircraft in airspace under international or national aviation regulation or on board a satellite launcher in segregated airspace before reaching space;

4 that the stations on board suborbital vehicles for the phases of their flight occurring or requiring preparation for integration in airspace shared with other aircraft, shall use for the safety radiocommunication purpose the same frequency bands and the same radiocommunication services as those required to support safe operation of aviation in airspace under international or national aviation regulation;

5 that stations on board suborbital vehicles may use for purposes not requiring safety by International Civil Aviation Organization (ICAO), other frequency bands while operated in relevant radiocommunication services than those identified in *resolves* 4*,*

instructs the Secretary-General

to bring this Resolution to the attention of the United Nations Committee on the Peaceful Uses of Outer Space and ICAO and other international and regional organizations concerned.

2/1.6/5.2.3 For Method B, alternative Approach B3

ADD

Draft NEW Resolution [C16] (WRC-23)

Regulatory provisions for the operation of radiocommunications   
on sub-orbital vehicles

The World Radiocommunication Conference ([Abu Dhabi or Dubai], 2023),

considering

*a)* that sub-orbital vehicles are being developed to operate at higher altitudes than conventional aircraft, with a sub-orbital trajectory;

*b)* that some types of sub-orbital vehicles are also being developed to fly through the lower levels of the atmosphere, where they are expected to operate in the same airspace as conventional aircraft;

*c)* that sub-orbital vehicles may perform various missions (e.g., conducting scientific research or providing transportation) and then return to the Earth’s surface without completing a full orbital flight around the Earth;

*d)* that stations on board sub-orbital vehicles have a need for voice/data communications, navigation, surveillance and telemetry, tracking and command (TT&C);

*e)* that sub-orbital vehicles must be safely accommodated into airspace used by conventional aircraft during certain phases of flight;

*f)* that there is a need to ensure that equipment installed on sub-orbital vehicles can communicate with air traffic management systems and relevant ground control facilities;

*g)* that vehicles operating at the boundary of space and the atmosphere or re-entering the atmosphere may generate a plasma sheath that may envelop all or most of the vehicle;

*h)* that the plasma-sheath attenuation does not allow for radiocommunications directly to either ground or space stations,

recognizing

*a)* that there is no internationally agreed demarcation between the Earth’s atmosphere and the space domain;

*b)* that, for the purpose of this Resolution, a sub-orbital vehicle is a vehicle expected to reach the upper atmosphere and may reach space in portions of its flight, without completing a full orbit around the Earth, before returning back to the surface of the Earth, and which may or may not be reusable;

*c)* that Annex 10 to the Convention on International Civil Aviation contains Standards and Recommended Practices for aeronautical radionavigation and radiocommunication systems used by international civil aviation;

*d)* that some space launch systems operate as part of the space operation service, under a radiocommunication regulatory framework separate from this Resolution;

*e)* that other space launch systems, not operating in the space operation service, would fall within the scope of this Resolution,

noting

*a)* that the provisions of No. **4.10** may apply to certain aspects of these operations;

*b)* that the development of compatibility criteria between International Civil Aviation Organization (ICAO) standardized aeronautical systems is the responsibility of ICAO,

resolves

1 that stations on sub-orbital vehicles may operate in all stages of flight in the aeronautical mobile (R) service, the mobile-satellite service, or in the radionavigation-satellite service   
*[Note: other services may need to be added];*

2 that, when operating in the aeronautical mobile (R) service, stations on sub-orbital vehicles are subject to the same technical and regulatory conditions as aircraft stations operating in the applicable bands and shall cause no more interference than conventional aircraft stations;

3 that, when operating in the mobile-satellite service or in the radionavigation-satellite service, stations onboard sub-orbital vehicles are subject to the same technical and regulatory conditions as earth stations operating in the applicable bands and shall cause no more interference than conventional earth stations,

instructs the Director of the Radiocommunication Bureau

to bring this Resolution to the attention of the relevant ITU-R Study Groups,

instructs the Secretary-General

to bring this Resolution to the attention of the United Nations Committee on the Peaceful Uses of Outer Space and ICAO and other international and regional organizations concerned.

2/1.6/5.2.4 For the three alternative approaches of Method B

SUP

RESOLUTION 772 (WRC‑19)

Consideration of regulatory provisions to facilitate   
the introduction of sub-orbital vehicles

2/1.6/5.3 For Method C: Modification to RR Article 4

ARTICLE 4

Assignment and use of frequencies

ADD

4.XXStations on-board suborbital vehicles may be terrestrial stations (No. **1.62**) and earth stations (No. **1.63**) and can be used in all phases of flight, within their respective service allocations. The stations shall not impose any new constraints on applications of the same service and other radiocommunication services that are allocated on a primary basis.     (WRC-23)

SUP

RESOLUTION 772 (WRC‑19)

Consideration of regulatory provisions to facilitate   
the introduction of sub-orbital vehicles

[2/1.6/5.4 For Method D: No Method C

No Change to Article **4** of the Radio Regulations]

Annex

Figure 1

Examples of the operational concepts of a suborbital flight.

Chart

Description automatically generated

1. [↑](#footnote-ref-1)