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| **U.S. Radiocommunications Sector****Fact Sheet** |
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| **Purpose/Objective:** This contribution initiates regulatory, operational, and technical studies to respond to Resolution **772** (**WRC-19**). |
| **Abstract:** Resolution **772** (**WRC-19**), in preparation for Agenda Item 1.6 (WRC-23), invites the ITU-R 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 Article **5**, and to identify whether there is a need for access to additional spectrum that should be addressed after WRC-23 by a future competent conference. This contribution initiates those studies to support the agenda item. |

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| **Radiocommunication Study Groups** |  |
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| Regulatory, operational, and technical studies of radiocommunications for suborbital vehicles |

Introduction

Resolution **772** (**WRC-19**), in preparation for agenda item 1.6 (**WRC-23**), invites the ITU-R 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 Article **5**, and to identify whether there is a need for access to additional spectrum that should be addressed after WRC-23 by a future competent conference. The United States offers this contribution to initiate those studies to support the agenda item.

**Attachment**: 1

ATTACHMENT

wd-pdn report ITU-r m.[SUBORBITAL studies]

Regulatory, operational, and technical studies of radiocommunications
for suborbital vehicles

# 1 Introduction

Resolution **772** (**WRC-19**), in preparation for agenda item 1.6 (WRC-23), invites the ITU-R:

1 to study spectrum needs for communications between stations on board sub-orbital vehicles and terrestrial/space stations providing functions such as, *inter alia*, voice/data communications, navigation, surveillance and TT&C;

2 to study appropriate modification, if any, to the Radio Regulations, excluding any new allocations or changes to the existing allocations in Article **5**, to accommodate stations on board sub-orbital vehicles, whilst avoiding any impact on conventional space launch systems with the following objectives:

– to determine the status of stations on sub-orbital vehicles, and study corresponding regulatory provisions to determine which existing radiocommunication services can be used by stations on sub-orbital vehicles, if necessary;

– to determine the technical and regulatory conditions to allow some stations on board sub-orbital vehicles to operate under the aeronautical regulation and to be considered as earth stations or terrestrial stations even if a part of the flight occurs in space;

– to facilitate radiocommunications that support aviation to safely integrate sub-orbital vehicles into the airspace and be interoperable with international civil aviation;

– to define the relevant technical characteristics and protection criteria relevant for the studies to be undertaken in accordance with the bullet point below;

– to conduct sharing and compatibility studies with incumbent services that are allocated on a primary basis in the same and adjacent frequency bands in order to avoid harmful interference to other radiocommunication services and to existing applications of the same service in which stations on board sub-orbital vehicles operate, having regard to the sub-orbital flight application scenarios.

3 to identify, as a result of the studies above, whether there is a need for access to additional spectrum that should be addressed after WRC-23 by a future competent conference.

This report will be organized into sections as outlining in Resolution **772 (WRC-19)** for agenda item 1.6 (WRC-23):

• Section 2: Relevant ITU-R Recommendations and Reports.

• Section 3: To study spectrum needs for communications between stations on board sub‑orbital vehicles and terrestrial/space stations.

• Section 4: To study appropriate modification, if any, to the Radio Regulations, excluding any new allocations or changes to the existing allocations in Article **5,** to accommodate stations on-board sub-orbital vehicles.

• Section 5: Summary of studies.

# 2 Relevant ITU-R Recommendations and Reports

Report ITU-R M.2477-0 (09/2019) – Radiocommunications for suborbital vehicles

# 3 Spectrum needs for communications between stations on-board sub‑orbital vehicles and terrestrial/space stations

Currently, there are a variety of technical solutions to achieve suborbital flight. Launch modes include horizontal and vertical, landing modes include horizontal landing and vertical landing, recovery modes include self-controlled return and parachute recovery, and thrust modes include rocket power and combined power. Suborbital flights can be implemented by different combinations of the above modes. Figure 1 shows examples of the operational concepts of a suborbital flight.

Figure 1

**Examples of the operational concepts of suborbital flight**



With the rapid development of the various suborbital flight concepts in recent years, such as hypersonic flight and reusable carrier rocket technology, suborbital flight has become an operational reality, which supports a wide range of fields including education, transportation, tourism, and scientific research. Current research and development aims to enable suborbital vehicles to be capable of carrying several thousand kilograms of cargo and passengers by 2035 and up to 6000 flights per year by 2045.

There are spectrum needs for radiocommunications between stations on-board sub-orbital vehicles and terrestrial/space stations providing functions such as, *inter alia*, voice/data communications, navigation, surveillance and TT&C.

## 3.1 Communications

It is envisioned that the crewed sub-orbital vehicles to establish and maintain bidirectional audio communications with their ground-based mission control center during full duration of their flight through either direct communication with Earth or through relay satellites or space stations. Such audio communication is considered critical for crews commanding the vehicle with ability to perform manual controls and piloting of the vehicle. These communication links are similar to the communication commonly established by airplanes using Internationally Standardized systems. It is noted that the passenger communication, if on-board these sub-orbital vehicles, may not be considered safety of life.

A unique aspect of sub-orbital vehicles communication requirement is the ability to maintain the link throughout various phases of flight including atmospheric re-entry where radio communication with vehicle experiences significant attenuation due to plasma effects caused by extreme heating and ionization of air around the vehicle.

## 3.2 Telemetry, tracking and command (TT&C)

Telemetry, Radio telemetry and Space telemetry are defined in RR No. **1.131, 1.132, and 1.133.**  Radio telemetry for sub-orbital vehicles provide information about the status of vehicle and its subsystems. It is envisioned that the real-time telemetry is transmitted to ground stations, relay satellites, or space stations over radio frequency links. Additionally, crewed and un-crewed sub-orbital vehicles will require transmitting real-time high definition digital videos from multiple feeds carrying critical visual information about the vehicle status to ground terminals directly or through relay satellites or space stations.

Telecommand and Space telecommand are defined in RR No. **1.134, and 1.135.**  The use of radiocommunication for telecommand in order to initiate, modify or terminate functions of equipment on sub-orbital vehicles is required for safe operation of these vehicles.

Space tracking is defined in RR No. **1.136.** It is envisioned that sub-orbital vehicle will rely on dedicated radio frequency links to perform necessary navigation throughout its trajectory by means of radiodetermination. Such tracking is expected to be performed through either ground station terminals or relay satellites or space stations.

Similar to the communications link mentioned in Section 3.1, a unique aspect of sub-orbital vehicles TT&C links requirement is the ability to maintain the link throughout various phases of flight including atmospheric re-entry where radio communication with vehicle experiences significant attenuation due to plasma effects caused by extreme heating and ionization of air around the vehicle.

## 3.3 Surveillance

[To be added]

## 3.4 Navigation

[To be added]

# 4 Appropriate modification, if any, to the Radio Regulations, excluding any new allocations or changes to the existing allocations in Article 5, to accommodate stations on-board sub-orbital vehicles

4.1 The status of stations on sub-orbital vehicles

[This section will consider the status of stations on sub-orbital vehicles and study corresponding regulatory provisions to determine which existing radiocommunication services can be used by stations on sub-orbital vehicles.]

There are several existing radiocommunications services that can be used by stations on-board suborbital vehicles. These services include, but may not necessarily be limited to:

[TBD]

4.2 Technical and regulatory conditions that allow some stations on board sub-orbital vehicles to operate under the aeronautical regulation

[This section will study the technical and regulatory conditions to allow some stations on board sub‑orbital vehicles to operate under the aeronautical regulation and to be considered as earth stations or terrestrial stations even if a part of the flight occurs in space.]

4.3 Potential modifications to the Radio Regulations, in accordance with *invites 2*, Resolution **772** (**WRC-19**), that facilitate radiocommunications that support aviation to safely integrate sub-orbital vehicles into the airspace and be interoperable with international civil aviation

At this time sub-orbital flight radiocommunications has been carried out using the existing regulatory provisions of the Radio Regulations. These have been recognized in Report M.2477. They include both terrestrial and space services as provided for in Article 5. Further they have been carried out under the exiting definitions of these services in Article 1.

Resolution 772 (WRC-19) has indicated the need to study any appropriate modifications to the Radio Regulations that “facilitate radiocommunications that support aviation to safely integrate sub-orbital vehicles into the airspace”. There are several options for achieving this objective:

1. Make No Changes to the RR- this option recognizes the exiting experience, but provides no unique identification of sub-orbital use of spectrum.
2. A Resolution (WRC-23)-in this option a new Resolution would appropriately recognize the services used by sub-orbital vehicles.
3. Modify Article 4- this Article, “Assignment and Use of Frequencies” contains statements relating to unique spectrum applications through description of their use of the RR.
4. Modification of other parts of the RR- in this option other Articles of the RR could be modified to accommodate sub-orbital vehicle use of spectrum.

4.4 Sharing and compatibility studies

4.4.1 Technical characteristics and protection criteria relevant for the following studies

[to be determined]

4.4.2 Sharing and compatibility studies

[This section will contain sharing and compatibility studies with incumbent services that are allocated on a primary basis in the same and adjacent frequency bands in order to avoid harmful interference to other radiocommunication services and to existing applications of the same service in which stations on board sub-orbital vehicles operate, having regard to the sub-orbital flight application scenarios.]

# 5 Summary of studies

[To be added]

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