6^{th} National Preparatory Workshop for WRC-23

Aeronautical and Maritime Issues

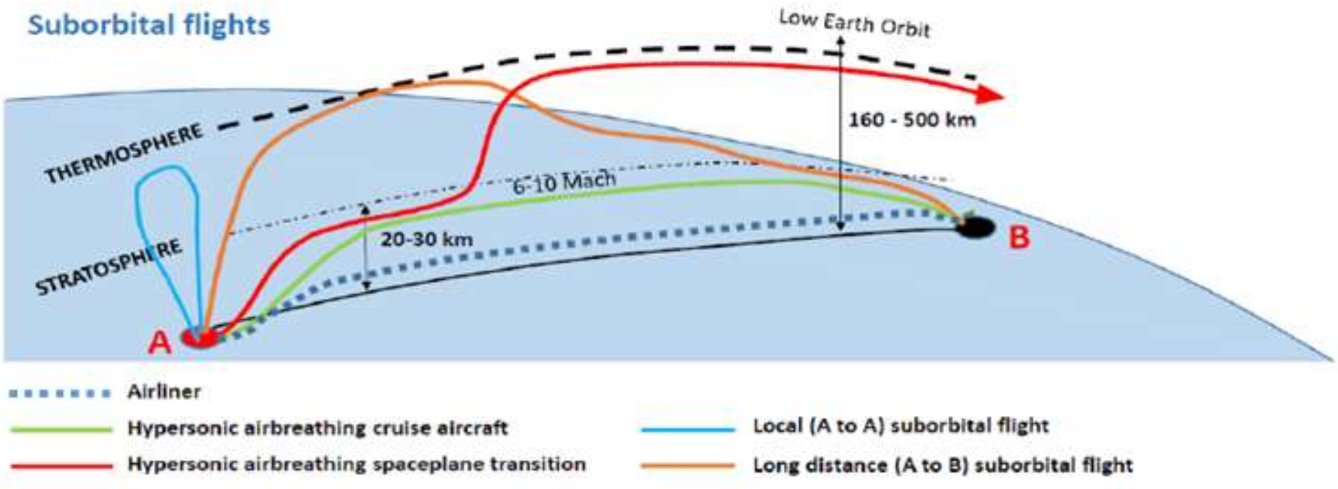
Agenda Items 1.6, 1.7,1.8,1.9,1.10,1.11

Making suborbital flights a reality

A sub-orbital flight is 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. The aircraft used for such flights is called a “sub-orbital” vehicle.

AGENDA ITEM 1.6: –

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



Towards Space Travel

- These vehicles are intended to perform various missions, such as deploying satellites, conducting scientific research, or carrying passengers and cargo, and then returning to the Earth's surface.
- As one example, such vehicles could lead to hypersonic travel from Europe to Australia in 90 minutes, down from the current 24 hours.

- Several companies are working to provide commercially viable travel for passengers to experience, at least for a few moments, the sensation of weightlessness and being in space. As the vehicle free-falls back to Earth, those onboard will experience the feeling of zero gravity.
- Flying in a sub-orbital vehicle will allow passengers a view of both space and the curvature of the Earth.

Key Issues

- Classification of sub-orbital vehicles as terrestrial or space service. Difference in the regulatory procedure for each as they are different in nature and in application.
- No internationally agreed demarcation between the earth's atmosphere and the space domain, nor between sovereign airspace and outer space.
- Need to be safely integrated into the airspace used by conventional aircraft and minimize disruption during the transition to and from controlled airspace.
- Sub-orbital vehicles are intended to achieve altitudes and velocities that are much higher than conventional aircraft and hence do not always perform as an aircraft.
- Also, the way that on-board terrestrial or satellite systems operate may not necessarily be consistent with the definitions in the RR.

Methods Proposed

Method A : No change to the Radio Regulations (RR).

Method B: A new World Radiocommunication Conference (WRC) Resolution containing the provisions to operate radiocommunications for sub-orbital vehicles without any change to RR Article 5. There are four alternative approaches to this method.

The view was raised at The CPM-23/2 that Method B with its different Approaches / Alternatives are not to be considered at this stage unless all problems, difficulties, inconsistencies and ambiguities are properly addressed and fully responded.

Method C: This method provides for the revision of Resolution 772 (WRC-19) in order to clarify the list of possible interference scenarios, including scenarios for the use of ground/earth stations on board a sub-orbital vehicle in a section of its flight path passing in outer space, as well as the completion of compatibility studies provided for in “resolves 2” of this Resolution. .

Enhancing communications in oceanic and remote areas

Current technologies for long-range communications, such as high frequency (HF) and conventional satellite links, may not provide the level of performance needed to safely support close aircraft-to-aircraft separation in a similar way as terrestrial VHF communications. The satellite-based technology will overcome these constraints in oceanic and remote areas, where deploying VHF terrestrial infrastructure is unpractical.

AGENDA ITEM 1.7: To consider a new aeronautical mobile-satellite (R) service (AMS(R)S) allocation in accordance with Resolution 428 (WRC-19) for both the Earth-to-space and space-to-Earth directions of aeronautical VHF communications in all or part of the frequency band 117.975-137 MHz, while preventing any undue constraints on existing VHF systems operating in the AM(R)S, the ARNS, and in adjacent frequency bands

The Agenda Item proposes the following:

- ✓ Satellite-based voice and datalink services could be integrated into the existing ground infrastructure using current operational procedures, without any modification in current avionics.
- ✓ Satellite-based voice and data services could coexist with current terrestrial aeronautical services.
- ✓ Satellite-based voice and digital data services can also coexist with adjacent band services and without adverse impact to those services

The main benefits of the space-based VHF concept for air traffic management are:

- the use of the same operational procedures for air traffic controllers in continental and oceanic areas
- important gains in safety for aircraft operation in oceanic and remote continental areas
- a significant increase in communication capacity in oceanic and remote areas
- no additional training for air traffic controllers, as operation is the same as in aeronautical terrestrial VHF communications
- no additional avionics required in aircraft
- significant reduction in fuel combustion and therefore fewer carbon dioxide (CO_2) emissions owing to optimized and efficient routes

Methods Proposed

Method A: NOC

Method B: This method proposes to add a new allocation to the AMS(R)Sin the frequency band 117.975-137 MHz, or part thereof, limited to non-geostationary satellite systems and to internationally standardized aeronautical systems.

This has four alternatives

Method B1: proposes the addition of pfd limit on AMS(R)S space stations unwanted emissions falling above 137 MHz, in order to ensure protection of adjacent band services. Also proposes coordination for co-existence between AMS(R)S and other primary in-band services

Method B2: proposes that systems operating under an allocation to the AMS(R)S be subject to the application of regulatory and technical measures to ensure compatibility with existing systems

Method B3: allocation in 117.975-136.8 MHz with application of coordination procedure

Method B4: allocation in 117.975-136 MHz with application of coordination procedure. Also, use limited to systems that operate and are planned in accordance with recognized international aeronautical standards.

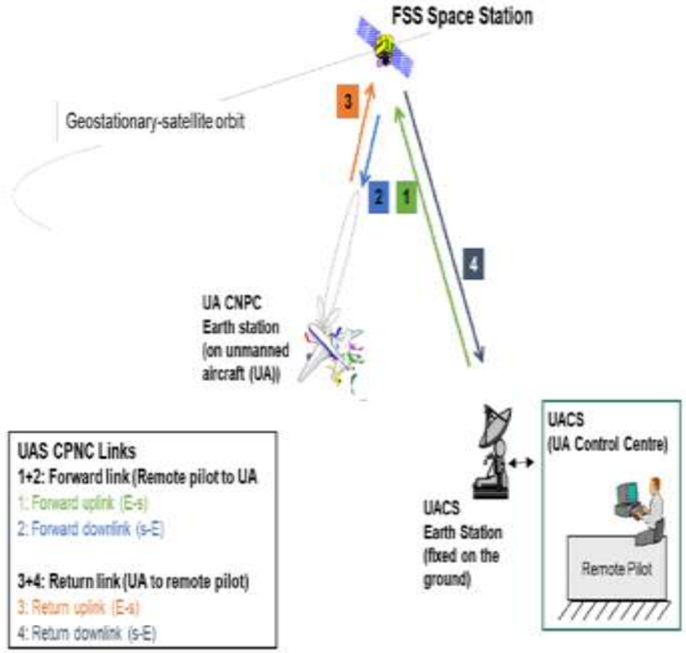
Controlling unmanned aircraft through links on regular communication satellites

Unmanned Aircraft (UA): Aircraft that are piloted remotely through the established communication link

Control and non-payload communications (CNPC)

- Telecommand (forward) control messages and telemetry (return) data relevant
- ATC Relay communication
- Sense and avoid data

UA Control Station (UACS): Facility from which the UA is controlled remotely



Links 1 and 4 are at fixed specific location and consistent with regular FSS operation. Links 2 and 3 involve mobile earth stations and require additional consideration

Key Considerations for UAS-CNPC Operation

<u>For downlink (space-to- Earth)</u>
10.95-11.2 GHz
11.45-11.7 GHz
11.7-12.2 GHz in Region 2
12.2-12.5 GHz in Region 3
12.5-12.75 GHz in Regions 1 and 3
19.7-20.2 GHz

<u>For uplink (Earth –to-space)</u>
14-14.47 GHz
29.5-30.0 GHz

- UAS CNPC operation is seen as under FSS which has a primary status in the frequency bands under consideration
- The notifying administration has limited information related to the coordination of its satellite network and operator of the satellite on which CNPC link operates has full information related to technical performance
- To ensure safety of flight of the UA, ensure interference free operation.
- No additional status to be granted
- No adverse effect during regular satellite coordination processes of future FSS Networks.
- No impact on terrestrial services/stations
- Responsibilities of Member States to be defined.

Methods Proposed

Method A: Suppress RR No. 5.484B together with Resolution 155(Rev. WRC-19) and Resolution 171(WRC-19)

- Contradiction between safety nature of the operation of UAS and the non-safety status of the fixed-satellite service
- FSS bands are heavily congested and interference is a regular occurrence
- Communication link of the UAS CNPC via FSS is not robust

Method B has several alternatives which intend to revise Resolution 155 (Rev. WRC-19)

B1	B2
• Clearly separate responsibilities of ICAO and ITU • Consider how to ensure safety of flight • Remove the ambiguities in Resolution 155 • Avoid adverse effect to terrestrial stations • Maintain the existing procedure for the FSS network coordination • Provide process to treat cases of interference	• Continued safety of other airspace users is ensured • Assignments and use of frequency consistent with 4.10 • The frequencies shall not be used before the issue of safety of life is resolved • No special regulatory status on the satellite network

Method B has several alternatives which intend to revise Resolution 155 (Rev. WRC-19) to

- Clearly separate responsibilities of ICAO and ITU
- Ensure that UAS CNPC operate in accordance to ICAO
- Confirm that RR No. 4.10 shall not apply or create responsibility of administrations
- Not impose additional constraints on terrestrial systems
- Maintain existing procedure for coordination
- No impact on relevant existing agreements reached during FSS coordination or in future
- Ensure protection of current systems
- Provide a process to treat cases of interference caused by UA Earth station

B3

Global communication coverage for aircrafts

HF is the only terrestrial service with means of providing ubiquitous global communication coverage for aircraft, and is still the long-range system required by many aviation regulators for the provision of safety and regularity of flight communications in oceanic, polar and remote areas.

Access to the various frequency bands in the range 2 850-22 000 kHz assigned to the aeronautical mobile (route) service (AM(R)S) is therefore essential. Since the last substantive review of Appendix **27** at the 1979 World Administrative Radio Conference, use of HF by aviation has continued to evolve and grow, especially with the introduction of HF datalink in the 1990s; now used by many airlines.

AGENDA ITEM 1.9 :To review Appendix **27** of the Radio Regulations and consider appropriate regulatory actions and updates based on ITU-R studies, in order to accommodate digital technologies for commercial aviation safety-of-life applications in existing HF bands allocated to the aeronautical mobile (route) service and ensure coexistence of current HF systems alongside modernized HF systems

Methods Proposed

Method A: No change (NOC)

Method B: inclusion into RR Appendix 27, the relevant part of the Rules of Procedure, and explicit recognition of the aggregation of single channels for wideband digital communications.

- Operational capacity limited by the number of 3 kHz channels available in the HF band. However, the development of advanced digital techniques, including new waveforms, allows the aggregation of independent 3 kHz channels (either contiguous or non-contiguous) into wideband links.
- This opens the possibly for simultaneous transmission of voice and data, thus improving capacity, connectivity, and quality of HF communication systems.
- This will provide aircraft with additional capabilities and to improve the reliability, availability and continuity of communications especially when used in conjunction with existing L-band aviation SATCOM systems.
- With the availability of advanced digital technologies and the demonstrated capabilities of aeronautical wideband HF, including contiguous or non-contiguous channel aggregation, faster data rates and digital voice communications are possible.

Aircrafts as Platforms for varied applications

- With development in technology, aircraft as platforms can be used for payload applications such as fire and border surveillance, air quality and environment monitoring, video surveillance, terrain mapping, and imagery such as film-making.
- As a result, the number of aircraft equipped with sensors and the demand for associated communication links to offload large amounts of data has also grown and is expected to continue to grow. Those communication links, whilst not associated with aeronautical safety, can be mission critical in providing data or sensor control for the application that they are supporting.
- Wideband line-of-sight data links operate in the AM(OR)S and are not related to safety of life.

AGENDA ITEM 1.10: To conduct studies on spectrum needs, coexistence with radiocommunication services and regulatory measures for possible new allocations for the aeronautical mobile service for the use of non-safety aeronautical mobile applications

Objective

The objective of this agenda item is to assess spectrum requirements for new non-safety aeronautical mobile service applications and seek:

- possible new primary allocations to the aeronautical mobile service in frequency band 15.4-15.7 GHz for such non-safety aeronautical applications, and
- possible revision of the “except aeronautical mobile” in the frequency band 22-22.21 GHz, already allocated on a primary basis to the mobile, except aeronautical mobile, service.

Methods Proposed

Method A: No Change

Method B: New primary aeronautical mobile (off-route)service (AM(OR)S allocation in the frequency band 15.4-15.7 GHz

Method C: Remove the exception of AM (OR)S in the frequency band 22-22.21 GHz

Method D: Combination of Methods B and C

Method E: Combination of Methods B and C with 10 MHz guardbands

15.35-15.4	EARTH EXPLORATION-SATELLITE (passive) RADIO ASTRONOMY SPACE RESEARCH (passive)
15.4-15.43	RADIOLOCATION AERONAUTICAL RADIONAVIGATION
15.43-15.63	FIXED-SATELLITE (Earth-to-space)
15.63-15.7	RADIOLOCATION AERONAUTICAL RADIONAVIGATION
15.7-16.6	FIXED MOBILE RADIOLOCATION
21.4-22	FIXED MOBILE BROADCASTING-SATELLITE
22-22.21	FIXED MOBILE except aeronautical mobile
22.21-22.5	EARTH EXPLORATION-SATELLITE (passive) FIXED MOBILE except aeronautical mobile RADIO ASTRONOMY SPACE RESEARCH (passive)

Supporting Effective Maritime Communication

- ❖ Need for faster, more reliable and more efficient radiocommunication systems and services, both between ships and with shore stations.
- ❖ IMO sets global standards for radiocommunications in shipping through the International Convention for the Safety of Life at Sea (SOLAS), adopted in 1974.
- ❖ GMDSS outlines the requirements for shipborne radio equipment and systems and ensures that a ship in distress at sea will always be heard and responded to, regardless of its location.
- ❖ In addition to the distress and safety aspects, radiocommunications have also become an integral part of commercial shipping operations.
- ❖ Today, there is an intensified demand from the maritime industry for greater connectivity and higher data capacity to support all maritime operations.

Objective

AGENDA ITEM 1.11: to consider possible regulatory actions to support the modernization of the Global Maritime Distress and Safety System and the implementation of e-navigation

<u>Issue A: Modernization of GMDSS</u>

- Deletion of narrow-band-direct-printing (NBDP) for distress and safety communications
- Introduction of a new automatic connection system (ACS) in all MF and HF bands
- Introduction of the NAVDAT frequencies in MF and HF
- Implement Automatic Identification system search and rescue transmitter (AIS-SART) as locating equipment
- Frequency band 1645.5-1646.5 MHz no longer used by EPIRBs

<u>Issue B: E-Navigation</u>

The VHF data Exchange System (VDES) and NAVDAT systems would support e-navigation by means of enabling broadcasting and exchange of digital files. From a spectrum regulatory point of view, the requirements for e-navigation are thus covered.

Introduction of additional satellite systems into the GMDSS

- IMO has recognized one additional GSO MSS system (BEIDOU) to provide satellite communication within GMDSS.
- This uses primary MSS allocations within the frequency bands 1 610-1 626.5 MHz (Earth-to-space) and 2 483.5-2 500 MHz (space-to-Earth).
- The primary MSS allocations in those bands are also used by other non-GSO MSS systems and further coordination is required.

GMDSS Systems	**Frequency of Operation (in MHz)**	**ITU Coordination Status**
INMARSAT	Earth to space: 1530-1544 space to Earth: 1626.5-1645.5	Recorded in Master International Frequency Register with favourable finding
Iridium	Earth to space: 1621.35-1626.5 space to Earth: 1621.35-1626.5	-Do-
Beidou (Proposed)	Earth to space: 1610-1626.5 space to Earth: 2483.5-2500	Recorded with unfavourable findings and operating on NIB/NPB

Methods Proposed

Method C1: No change to the RR except suppression of resolves 3, Resolution 361 (Rev.WRC-19)

Method C2: Identify spectrum for GMDSS if the candidate GSO MSS system/network has been completely coordinated in accordance with Articles 9 and 11 of the Radio Regulations and recorded in the MIFR in accordance with RR No. 11.37.

- Coordination is an outstanding implementation issue that needs to be effected before the commencement of GMDSS services. There are two options associated with the method in relation to the applicability of RR No. 4.10 to GMDSS.

Method C3: Support the requirement of safety of life aspects by the GMDSS and implement applicable provisions of the Radio Regulations, including applicability of RR No. 4.10 to the specific frequency bands used by the additional MSS system for GMDSS. This method proposes an associated new Resolution.

Method C4: Identify spectrum for GMDSS if the candidate GSO MSS system/network has been completely coordinated in accordance with Articles 9 and 11 of the Radio Regulations and recorded in the MIFR in accordance with RR No. 11.37.

- Coordination is an outstanding implementation issue that needs to be effected before the commencement of GMDSS services.
- Apply RR No. 4.10 to the concrete frequency bands used by the new MSS system for GMDSS.

THANK YOU