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| U.S. Radiocommunications Sector  Fact Sheet | |
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| **Purpose/Objective:** Initiate the work under WRC-27 Agenda Item 1.13 | |
| **Abstract:** The proposed U.S. contribution aims at getting the work started under WRC-27 Agenda Item 1.13.  An overview of all incumbent services, including adjacent services as appropriate, is provided for the Mobile Service bands between 694-2700 MHz. The document also includes a skeleton of various sections of the Working Document, which will contain orbital and emission characteristics of representative systems and networks for direct communications between space stations and IMT user equipment. | |

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| **Radiocommunication Study Groups** |  |
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| **English only** |
| United States of America | |
| WORKING DOCUMENT [AI 1.13 SHARING AND COMPATIBILITY STUDIES] | |
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Introduction

The proposed U.S. contribution aims at getting the work started under WRC-27 Agenda Item 1.13.

An overview of all incumbent services, including adjacent services as appropriate, is provided for the Mobile Service bands between 694-2700 MHz. The document also includes a skeleton of various sections of the Working Document, which will contain orbital and emission characteristics of representative systems and networks for direct communications between space stations and IMT user equipment.

**Attachment:** 1

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| Attachment 1 |
| WORKING DOCUMENT [AI 1.13 SHARING AND COMPATIBILITY STUDIES] |

1. **Introduction**

Resolution 253 (WRC-23) calls for studies on possible new allocations to the mobile-satellite service for direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage.

Studies on sharing and compatibility between incumbent services, including in adjacent frequency bands are essential to ensure the protection of incumbent services in accordance with the Radio Regulations.

1. **Information on the IMT frequency bands to be studied for Direct-to-device operations and the corresponding incumbent and adjacent-band services**

The following tables were extracted from ITU-R Recommendation M.1036, which deals with the IMT frequency arrangements. The tables for the Earth to Space direction have been included for information only, as there is no need to perform studies for this direction, given that the characteristics of the IMT mobile stations (i.e. user equipment) remain unchanged.

**[Editor's note:** The table for the Earth to Space direction is included for information only. There is no need to perform studies for this direction.**]**

|  |  |
| --- | --- |
| **FDD Frequency arrangements** | **Mobile station transmitter/  Uplink to Satellite  (Earth to Space Direction)  (MHz)** |
| A1 | 824-849 |
| A2 | 880-915 |
| A3 | 832-862 |
| A4 | 698-716 |
| 776-793 |
| A5 | 703-748 |
| A7 | 703-733 |
| A8 | 698-703 |
| A9 | 733-736 |
| A11 | 703-733 |

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| --- | --- | --- | --- |
| **FDD Frequency arrangements** | **Base station transmitter/ Downlink from Satellite (MHz)** | **Incumbent**  **Services** | **Adjacent band**  **Services** |
| A1 | 869-894 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |
| A2 | 925-960 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |
| A3 | 791-821 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |
| A4 | 728-746 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |
| 746-763 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |
| A5 | 758-803 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |
| A7 | 758-788 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |
| A8 | 753-758 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |
| A9 | 788-791 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |
| A10 | 738-758 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |
| A11 | 758-788 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |
| 738-758 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |

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| --- | --- | --- | --- |
| **TDD Frequency arrangements** | **Un-paired arrangement (MHz)** | **Incumbent**  **Services** | **Adjacent band**  **Services** |
| A6 | 698-806 | Fixed  Mobile  Broadcasting | Fixed  Mobile  Broadcasting |

**[Editor's note:** The table for the Earth to Space direction is included for information only. There is no need to perform studies for this direction.**]**

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| --- | --- |
| **FDD Frequency arrangements** | **Mobile station transmitter/  Uplink to Satellite  (Earth to Space Direction)  (MHz)** |
| G2 | 1 427-1 470 |

|  |  |  |  |
| --- | --- | --- | --- |
| **FDD Frequency arrangements** | **Base station transmitter/ Downlink from Satellite (MHz)** | **Incumbent**  **Services** | **Adjacent band**  **Services** |
| G1 | 1 427-1 517 | Space Operations (Earth-to-space)  Fixed  Mobile except aeronautical mobile  Mobile  Broadcasting  Broadcasting-Satellite | Earth Exploration-Satellite (passive)  Radio Astronomy  Space Research (passive)  Fixed  Mobile  Mobile-Satellite |
| G2 | 1 475-1 518 | Space Operations (Earth-to-space)  Fixed  Mobile except aeronautical mobile  Mobile  Broadcasting  Broadcasting-Satellite | Earth Exploration-Satellite (passive)  Radio Astronomy  Space Research (passive)  Fixed  Mobile  Mobile-Satellite |

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| --- | --- | --- | --- |
| **TDD Frequency arrangements** | **Un-paired arrangement (MHz)** | **Incumbent**  **Services** | **Adjacent band**  **Services** |
| G3 | 1 427-1 517 | Space Operations (Earth-to-space)  Fixed  Mobile except aeronautical mobile  Mobile  Broadcasting  Broadcasting-Satellite | Earth Exploration-Satellite (passive)  Radio Astronomy  Space Research (passive)  Fixed  Mobile  Mobile-Satellite |

**[Editor's note:** The table for the Earth to Space direction is included for information only. There is no need to perform studies for this direction.**]**

|  |  |
| --- | --- |
| **FDD Frequency arrangements** | **Mobile station transmitter/  Uplink to Satellite  (Earth to Space Direction)  (MHz)** |
| B1 | 1 920-1 980 |
| B2 | 1 710-1 785 |
| B3 | 1 850-1 920 |
| B4 | 1 710-1 785 |
| 1 920-1 980 |
| B5 | 1 850-1 920 |
| 1 710-1 780 |
| B6 | 1 980-2 010 |
| B7 | 2 000-2 020 |

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| --- | --- | --- | --- |
| **FDD Frequency arrangements** | **Base station transmitter/ Downlink from Satellite (MHz)** | **Incumbent**  **Services** | **Adjacent band**  **Services** |
| B1 | 2 110-2 170 | Fixed  Mobile  Space Research (deep space) (Earth-to-space)  Mobile-Satellite (space-to-Earth) | Space Operation (Earth-to-space) (space-to-space)  Earth Exploration-Satellite (Earth-to-space) (space-to-space)  Fixed  Mobile  Space Research (Earth-to-space) (space-to-space)  Mobile-Satellite (space-to-Earth) |
| B2 | 1 805-1 880 | Fixed  Mobile | Fixed  Mobile |
| B3 | 1 930-2 000 | Fixed  Mobile  Mobile-Satellite (Earth-to-Space) | Fixed  Mobile  Mobile-Satellite (Earth-to-Space) |
| B4 | 1 805-1 880 | Fixed  Mobile | Fixed  Mobile |
| 2 110-2 170 | Fixed  Mobile  Space Research (deep space) (Earth-to-space)  Mobile-Satellite (space-to-Earth) | Space Operation (Earth-to-space) (space-to-space)  Earth Exploration-Satellite (Earth-to-space) (space-to-space)  Fixed  Mobile  Space Research (Earth-to-space) (space-to-space)  Mobile-Satellite (space-to-Earth) |
| B5 | 1 930-2 000 | Fixed  Mobile  Mobile-Satellite (Earth-to-Space) | Fixed  Mobile  Mobile-Satellite (Earth-to-Space) |
| 2 110-2 180 | Fixed  Mobile  Space Research (deep space) (Earth-to-space)  Mobile-Satellite (space-to-Earth) | Space Operation (Earth-to-space) (space-to-space)  Earth Exploration-Satellite (Earth-to-space) (space-to-space)  Fixed  Mobile  Space Research (Earth-to-space) (space-to-space)  Mobile-Satellite (space-to-Earth) |
| B6 | 2 170-2 200 | Fixed  Mobile  Mobile-Satellite (space-to-Earth) | Space Operations (space-to-Earth) (space-to-space)  Earth-Exploration Satellite (space-to-Earth) (space-to-space)  Fixed  Mobile  Space Research (space-to-Earth) (space-to-space) |
| B7 | 2 180-2 200 | Fixed  Mobile  Mobile-Satellite (space-to-Earth) | Space Operations (space-to-Earth) (space-to-space)  Earth-Exploration Satellite (space-to-Earth) (space-to-space)  Fixed  Mobile  Space Research (space-to-Earth) (space-to-space) |

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| --- | --- | --- | --- |
| **TDD Frequency arrangements** | **Un-paired arrangement (MHz)** | **Incumbent**  **Services** | **Adjacent band**  **Services** |
| B1 | 1 880-1 920 | Fixed  Mobile | Fixed  Mobile |
| 2 010-2 025 | Fixed  Mobile  Mobile-Satellite (Earth-to-Space) | Space Operation (Earth-to-space) (space-to-space)  Earth Exploration-Satellite (Earth-to-space) (space-to-space)  Fixed  Mobile  Space Research (Earth-to-space) (space-to-space) |
| B3 | 1 920-1 930 | Fixed  Mobile | Fixed  Mobile |
| B4 | 1 880-1 920 | Fixed  Mobile | Fixed  Mobile |
| 2 010-2 025 | Fixed  Mobile  Mobile-Satellite (Earth-to-Space) | Space Operation (Earth-to-space) (space-to-space)  Earth Exploration-Satellite (Earth-to-space) (space-to-space)  Fixed  Mobile  Space Research (Earth-to-space) (space-to-space) |
| B5 | 1 920-1 930 | Fixed  Mobile | Fixed  Mobile |

|  |  |  |  |
| --- | --- | --- | --- |
| **TDD Frequency arrangements** | **Un-paired arrangement (MHz)** | **Incumbent**  **Services** | **Adjacent band**  **Services** |
| E1 | 2 300-2 400 | Fixed  Mobile  Radiolocation | Fixed  Mobile  Radiolocation |

**[Editor's note:** The table for the Earth to Space direction is included for information only. There is no need to perform studies for this direction.**]**

|  |  |
| --- | --- |
| **FDD Frequency arrangements** | **Mobile station transmitter/  Uplink to Satellite  (Earth to Space Direction)  (MHz)** |
| C1 | 2 500-2 570 |
| C2 | 2 500-2 570 |

|  |  |  |  |
| --- | --- | --- | --- |
| **FDD Frequency arrangements** | **Base station transmitter/ Downlink from Satellite (MHz)** | **Incumbent**  **Services** | **Adjacent band**  **Services** |
| C1 | 2 620-2 690 | Fixed  Fixed Satellite (space-to-  Earth)  Mobile except aeronautical  Mobile-Satellite (space-to-  Earth)  Broadcasting-Satellite | Earth Exploration-Satellite (passive)  Radio Astronomy  Space Research (passive) |
| C2 | 2 620-2 690 | Fixed  Fixed Satellite (space-to-  Earth)  Mobile except aeronautical  Mobile-Satellite (space-to-  Earth)  Broadcasting-Satellite | Earth Exploration-Satellite (passive)  Radio Astronomy  Space Research (passive) |
| 2 570-2 620 | Fixed  Fixed Satellite (space-to-  Earth)  Mobile except aeronautical  Mobile-Satellite (space-to-  Earth)  Broadcasting-Satellite | Fixed  Fixed Satellite (space-to-  Earth)  Mobile except aeronautical  Broadcasting-Satellite |

|  |  |  |  |
| --- | --- | --- | --- |
| **TDD Frequency arrangements** | **Un-paired arrangement (MHz)** | **Incumbent**  **Services** | **Adjacent band**  **Services** |
| C3 | 2500-2690 | Fixed  Fixed Satellite  (Earth-to-space)  (space-to-Earth)  Mobile except aeronautical  Mobile-Satellite (space-to-  Earth)  Broadcasting-Satellite | Fixed  Mobile  Mobile-Satellite (space-to-Earth)  Radiolocation  Radiodetermination-satellite (space-to-Earth)  Earth Exploration-Satellite (passive)  Radio Astronomy  Space Research (passive) |

1. **Detailed list of sharing studies to be conducted**

TBD

1. **Orbit and RF emission characteristics of systems and networks intended to provide direct connectivity between space stations and IMT user equipment**

The following tables summarize orbit configurations of systems and networks intended to provide direct connectivity between space stations and IMT user equipment.

Table X: TBD

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Altitude (km) | Inclination (deg) | # Planes | Sats per plane | RAAN spacing (deg) | Total number of sats |
|  |  |  |  |  |  |

TBD

**4.1 Emissions in the space-to-Earth direction**

This section will contain relevant emission characteristics to conduct sharing studies. Relevant parameters should include, among others:

* Power Flux Density on the ground
* Satellite antenna pattern
* Cell edge definition (relative to cell center)
* TBD

TBD

**4.2 Out-of-band emissions to be used for out-of-band studies**

This section contains relevant information on out-of-band emissions.

TBD

**4.3 Emissions in the Earth-to-space direction**

The intended operations foresee communications to unmodified user equipment. Consequently, the receive/transmit characteristics of the user equipment will remain unchanged with respect to standard terrestrial operations.

As a consequence of the fact that nothing changes, there is no need to conduct any studies of potential interference in the Earth-to-space direction.

**4.4 Modelling of operations and the concept of topology**

This section will contain important assumptions on how to accurately model operations of systems and networks implementing direct-to-device communications.

**4.4.1 Satellite selection mechanism**

TBD

**4.4.2 The “topology” function**

When implementing direct-to-device communications in real-world, operators make use of the “topology” function as a way of managing interference at borders.

This topology function enables direct-to-device operators to dynamically meet applicable cross-border limits without fixed keep-out zones away from borders.

A visual example is offered by the figure below, based on the territory of the United States. The simulated field strength shows how emissions are adapted in cells close to the border with neighboring countries.

A green map of the united states

Description automatically generated

Figure 1: Simulated field strength over the territory of the United States

Modelling topology is fundamental and should be duly taken into account in studies, as this is something satellite systems will implement continuously to manage interference into neighboring countries.

**4 Results of sharing studies**

TBD