

# Handbook on Satellite Communications and Technologies

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### **1 Introduction**

*This chapter highlights the purpose of the Handbook and provides a brief introduction on concept of a communications satellite.*

- 1.1 Objectives
- 1.2 Vocabulary of key terms used in this Handbook
- 1.3 Basic concept of a communication satellite

### **2 International Telecommunication Union (ITU)**

*This chapter introduces the International Telecommunication Union (ITU) and the Radiocommunication Sector (ITU-R) within the ITU structure, introduces the Radio Regulations and the fundamental principles governing the utilization of spectrum and orbit resource.*

- 2.1 Key roles of the ITU
- 2.2 ITU structure
- 2.3 The Radiocommunication Sector (ITU-R) within the ITU structure
- 2.4 The Radio Regulations (RR)
- 2.5 Principles for utilization of spectrum and orbit resources
- 2.6 ITU's collaboration with other United Nation (UN) organizations, but not limited to, on satellite communications (e.g., ICAO, UNOOSA, COPUOS, IMO, etc.)

### **3 Fixed-Satellite Service (FSS) Concept**

- 3.1 Definition of service
- 3.2 Type of orbits
- 3.3 Type of applications
- 3.4 Frequency allocations
- 3.5 Technical characteristics of space segments
- 3.6 Role of standards
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- 4.2 Type of orbits
- 4.3 Type of applications
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- 4.6 Role of standards
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## **6 Radiodetermination-satellite service (RDSS)**

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- 6.2 Type of orbits
- 6.3 Type of applications
- 6.4 Frequency allocations
- 6.5 Technical characteristics of space segment
- 6.6 Role of standards
- 6.7 Trends and evolution of RDSS services

## **7 Regulatory considerations**

*This chapter describes relevant ITU radio regulatory procedures related to FSS, BSS, MSS and RDSS satellites services. It briefly delineates the ITU regulatory procedures for satellite services, along with various ITU filing processes, associated examinations of filings and thereafter the subsequent implementation of bringing into use of frequency assignments.*

- 7.1 Regulatory procedures for ITU filing process and coordination  
*(including but not limited to, determination of whether a satellite network is subject to or not subject to coordination, filing processes and associated examinations of filings and thereafter bringing into use of frequency assignments).*
- 7.2 Overview of relevant Radio Regulations provisions for coexistence and sharing of space services and other services
- 7.3 Key ITU-R Recommendations
- 7.4 BR software used for filing space notices to the Bureau
- 7.5 Role of Administrations  
*(focusing on Administration role and procedures in facilitating FSS/BSS/MSS/RDSS satellite services e.g., in bilateral and multilateral meetings).*
- 7.6 Relevant regulatory considerations of international space law

## **8 Space Segment Subsystems - Design and technology**

*This chapter describes the space segment subsystems of the communications satellite in FSS, BSS, MSS and RDSS.*

- 8.1 Payload subsystems
  - 8.1.4 *Satellite Antenna*
  - 8.1.8 *Transponders/communication channels*

## 8.2 Bus subsystems

8.1.1 *Altitude and orbit control (AOC)*

8.1.2 *Telemetry, tracking and command (T&C)*

8.1.3 *Power*

8.1.5 *Thermal control*

8.1.6 *Propulsion*

8.1.7 *Structures and Mechanisms*

## 8.3 Key comparison of FSS, BSS, MSS and RDSS space segment subsystems design and technology

## 9 Ground Subsystems - Design and technology

*This chapter describes the ground-based elements to provide radio interfaces between the space and ground segments for telemetry, tracking, and command (TT&C), as well as payload data transmission and reception in FSS, BSS, MSS and RDSS.*

### 9.1 Types of earth stations

9.1.1 *Fixed Earth Station and Gateways (for FSS, BSS, MSS, RDSS)*

9.1.2 *User terminals (for FSS, BSS, MSS, RDSS)*

9.1.3 *Telemetry, Tracking and Command (TT&C)*

9.1.4 *Network Management and Control Centers*

*(to also consider outcome of WRC-19 agenda items 1.15 and 1.16 and WRC-23 agenda item 1.5, that is switching facilities and functionalities with respect to response to the cases in which uses in territories of those countries are not authorized)*

### 9.2 Key comparison of FSS, BSS, MSS and RDSS ground subsystems design and technology

## 10 Communication Satellite Link Performance

*This chapter describes the key parameters in link budget calculations of communication satellites*

### 10.1 Link parameters

*(general description of link parameters and how they fit into a link budget)*

10.1.1 *Availability*

10.1.2 *Performance*

### 10.2 Link losses / impairments

*(Including but not limited to, noise, intermodulation, propagation models, noise due to interference, link impairment, etc. Compensation)*

### 10.3 Link margin

### 10.4 Composite link design

## 11 Communication Satellite Reliability

*This chapter describes reliability of satellites as well as launch vehicles, failure rate, probability of survival, mean satellite lifetime, etc.*

### 11.1 Reliability of Spacecraft

11.1.1 *Payload Reliability*

11.1.2 *Bus Reliability*

## 11.2 Reliability of Earth Segment

### 11.2.1 Earth Station Reliability

### 11.2.2 User Terminal Reliability

## 12 The Space Environment

*This chapter describes the six challenges unique to the space environment - gravity, the atmosphere, vacuum, micrometeoroids and debris, radiation, and charged particles.*

## 13 Space Debris Mitigation

*This chapter describes space debris mitigation mechanisms including current space laws and ITU-R Recommendations, without duplication of content with ITU-R Handbook on space sustainability.*

### 13.1 Space Situational Awareness (SSA) and Space Traffic Management (STM)

*(including but not limited to, collision avoidance, SSA and communication between operators)*

### 13.2 Assisted Disposal and Removal (ADR)

*(including but not limited to, trends towards removing satellites at the end of life)*

### 13.3 Current ITU-R Recommendations on space debris mitigation

*(including but not limited to, Resolution ITU-R 74 (RA-23), etc.)*

### 13.4 Roles of ITU, administration and industry players in space debris mitigation

## 14 International Cooperation in Satellite Communications

### 14.1 International intergovernmental satellite organizations

### 14.2 International non-governmental organizations and other forms of international cooperation in satellite communications (e.g., GMPCS MOU)

## ANNEX A - List of abbreviations

## ANNEX B - List of references

### B.1 ITU publications and references

### B.2 External publications and references

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