

Introduction of the Small Satellite Handbook

The launch of the first artificial Earth “small” satellite, Sputnik 1, triggered the space race in 1957. In the decades that followed, there was the development of increasingly larger satellites in order to provide reliable services from space over extended periods of time. Since then, with the increasing demand of radio-frequency spectrum and satellite-orbit usages and sustained growth of technological breakthroughs and innovation of space communication along with the booming capabilities in satellite manufacturing, a dramatic rise in the development of small satellites and systems has been witnessed, especially over the last ten years. The small satellite industry is experiencing an era of unprecedented change.

The term “small satellite”, including minisatellite, microsatellite, CubeSat, nanosatellite (nanosat), picosatellite (picosat), femtosatellite (femtosat) and others, is becoming increasingly common and widespread, even though there is currently no legal or regulatory definition of this term.

In the field of small satellites, the technical and capital barriers to entry are often low, and small satellite development can be more affordable and rapid for various entities (start-ups, universities, research institutions, etc.) due to their lower cost, simpler design, flexible launching requirements and modular payload configurations. The development of small satellites is an evolution in the overall satellite industry, which provides opportunities for greater and easier access to, and use of, space services by all countries.

Governments and private enterprises are developing small satellite projects to promote not only the traditional satellite applications in data communications, Earth exploration, space research, monitoring of ground environment including climate change and global warming, space environment monitoring, satellite navigation and positioning, education, agriculture, forestry, disaster recovery, scientific experiments, testing innovative technologies, national defence, but also the development of multi-satellite fleets (constellation) for the satellite internet access, and further enabling integration with 5G, the Internet of Things (IoT), smart cities, business intelligence, and many other areas in completing various difficult tasks in space. The vast range of possible diverse applications stems from a number of small satellite characteristics that can be summarised as follows:

- Rapid build/launch cycle,
- Affordable projects with low capital investment and operating costs,
- Modular and standardized design (e.g. CubeSats standard),
- Lower latency due to lower orbits,
- Seamless coverage to all areas of the world when used in LEO constellations,
- Easy to expand, update, renew, augment and replenish the satellite fleet.

In recent years, small satellites have been steadily launched, which gradually proved the feasibility of small satellite constellations. The small satellite industry has seen an incredible surge in the number of small satellites launched over the last few years. Small satellites with advanced technology, artificial intelligence (AI), and machine learning in the future are likely to bring new features to the field of satellite communications.

The use of small satellite technology is also becoming an increasingly powerful tool with multi-missions, functions, capabilities, which can be fundamental to support those that need seamless services on a worldwide basis. This trend in the adoption of small satellite technology,

while “democratizing” space for all nations irrespective of their economic status, also play a role in helping these nations achieve the sustainable development goals (SDGs).

In view of the diverse usages of small satellites, this field may attract new entrants lacking knowledge of, or experience with, the ITU and the ITU Radio Regulations and related procedures. An ITU-R handbook addressing various elements including regulations, procedures, and key information of small satellites as well as other similar short-duration mission satellites in similar applicable situations, would be useful to administrations, satellite operators, manufacturers and service providers interested in operating or utilizing such small satellites.

It is noted that there already exists a training mechanism in ITU for various areas. Training programs on radio communication have been organized and conducted on a regular basis, including the biennial ITU World Radiocommunication Seminar and thematic regional workshops. However, these seminars and workshops rarely target specifically the application of the Radio Regulations in the research, launch and application of small satellites.

Studies had been carried out under ITU-R Working Party 7B in response to Question ITU-R 254/7 and Reports, such as ITU-R SA.2312, ITU-R SA.2348 and ITU-R SA.2426, have been generated focusing on the characteristics and spectrum requirements, as well as practice situation for notifying nano and pico-satellites. However, it has been expressed that a more detailed guidance on the regulatory environment and procedures for new operators and service providers in this field is needed.

In view of the above, this stand-alone Handbook, separate from the more general Satellite Handbook or MSS Handbook, has been generated by the ITU-R to effectively promote development of small satellites and better serve the needs of Member States and the whole satellite industry.