

FAQ on Global Navigation Satellite Systems (GNSS) Interference

Q: What is a Global Navigation Satellite System (GNSS)

A: A Global Navigation Satellite System (GNSS) is a constellation of Earth-orbiting satellites¹ that provide positioning, navigation, and timing (PNT) services worldwide². The primary function of a GNSS is to determine the precise location of receivers on Earth's surface or in near-Earth space. The system allows electronic receivers to determine their location within a few meters.

There are currently four GNSSs and two Regional Radio Navigation Satellite Systems (RRNSSs) in operation.

- **The Global Positioning System (GPS)** is a U.S.-owned GNSS that provides users with positioning, navigation, and timing (PNT) services.
- **BeiDou Navigation Satellite System (BDS)** is a global GNSS owned and operated by the People's Republic of China.
- **Galileo** is a global GNSS owned and operated by the European Union.
- **GLONASS (Globalnaya Navigazionnaya Sputnikovaya Sistema)** is a global GNSS owned and operated by the Russian Federation.
- **Indian Regional Navigation Satellite System (IRNSS)** is owned and operated by the Government of India.
- **Quasi-Zenith Satellite System (QZSS)** is a regional navigation satellite system owned by the Government of Japan and operated by QZS System Service Inc. (QSS).

Q: What are the uses of Global Navigation Satellite Systems

A: GNSSs provide users with real-time information about their position on the Earth's surface, including their velocity and time, enabling them to navigate from one point to another efficiently. This is useful in various applications such as road traffic, aviation and maritime navigation, and outdoor activities.

GNSSs provide precise timing signals. These signals are used to synchronize clocks and networks in critical infrastructure, including telecommunications, banking, and power grids.

GNSSs play a crucial role during emergencies supporting search and rescue teams by providing accurate location information for those in distress. Emergency beacons equipped with GNSS receivers can transmit distress signals, allowing search and rescue authorities to locate and assist individuals in distress quickly.

GNSSs play a crucial role in modern aviation, transforming how aircraft navigate, communicate, and operate both in flight and on the ground. They are key to navigation and flight planning, air traffic management including tracking of aircraft.

In the maritime sector, GNSSs provide essential services that enhance safety at sea. They provide precise location information crucial for navigating ships to safely pass through busy sea lanes or open water.

¹ <https://www.unoosa.org/oosa/en/ourwork/psa/gnss/gnss.html>

² <https://emitu.com/glossary>

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GNSS technology is also extensively used in mapping, surveying, and geographic information systems (GIS).

Q: What is GNSS interference?

A: According to the ITU Radio Regulations, interference is any disturbance that alters, degrades, or obstructs the reception of radio navigation satellite signals. This can be intentional or unintentional and may come from various sources. Interference is particularly concerning when it affects the functioning of safety services or disrupts a radiocommunication service operating in accordance with ITU Radio Regulations³.

Interference into GNSSs can significantly reduce the accuracy and reliability of the signals used for positioning, navigation, and timing. Interference can be categorized into several types:

- **Natural Interference:** This includes interference from natural atmospheric phenomena such as solar flares, which can disrupt or degrade GNSS signals as they travel from satellites to receivers on Earth.
- **Multipath Interference:** This occurs when GNSS signals bounce off surfaces such as buildings or mountains before reaching the receiver, leading to errors in calculating the position because the travel time of the signal gets extended.
- **Radio Frequency Interference (RFI):** RFI can come from various sources such as broadcast towers, radar systems, and even personal electronic devices. This type of interference affects the radio bands used by the satellites in a GNSS and can either degrade the signals or completely block them.
- **Jamming:** Deliberate jamming is the intentional broadcasting of radio signals at the same frequencies used by satellites in a GNSS to disrupt their services. It is illegal in many parts of the world and is in contradiction to provisions of the ITU Constitution. It has been used as a tactic in military operations or by individuals to evade tracking.
- **Spoofing:** More sophisticated than jamming, spoofing involves creating fake GNSS signals to mislead GNSS receivers⁴. The receiver thinks it is receiving legitimate signals from GNSS satellites, but it is being deceived into calculating a false position.

Q: How does ITU address issues related to the Global Navigation Satellite Systems (GNSSs)?

A: One of the main mandates of ITU, according to its Constitution and through its Radiocommunication Sector (ITU-R) and Radiocommunication Bureau (BR), is to enable radiocommunication services to operate without receiving or causing harmful radio-frequency interference (RFI).

The ITU's mandate focuses on international spectrum management to ensure that systems that have frequency assignments registered within its Master International Frequency Register (MIFR), which

³ <https://docs.fcc.gov/public/attachments/FCC-23-86A1.pdf>

⁴ https://www.icao.int/APAC/Meetings/2016%20CNS_SG20/WP23_CHN%20AI.%205.3%20-%20%20Interference%20to%20Single%20Frequency%20GNSS%20Rev.pdf



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include Global Navigation Satellite Systems, operate free from harmful interference. This involves, when required by the Radio Regulations, Member States coordinating with other affected administrations on spectrum use and notifying to the BR frequency assignments for the purposes of examination and recording in the MIFR, as well as ITU-R defining technical standards, and recommending practices that enhance compatibility among global telecommunications networks and systems.

When requested by Administrations affected by harmful interference, ITU also assists Member States, as per Article 13.2 of the Radio Regulations, by collecting technical reports to identify the sources and convening the concerned parties to resolve the matter.

Q: What regulatory obligations do Member States have regarding the safeguarding and protection of GNSSs from harmful interference?

A: ITU, as the United Nations specialized agency for Information and Communication Technologies, works on standardizing global radio navigation satellite systems to ensure their reliable and uninterrupted operation worldwide.

ITU treaties, recommendations and guidelines help to mitigate interference by coordinating spectrum use, defining technical standards, and recommending practices that enhance compatibility among global telecommunication networks and systems. This includes managing the frequencies used by Radio satellite navigation systems to minimize the risk of signal disruption due to interference from other electronic devices and services.

The ITU Constitution imposes binding obligations on Member States to manage their radio services under international regulations. Specifically, Article 45 of the ITU Constitution states:

"All stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Member States or of recognized operating agencies, or of other duly authorized operating agencies which carry on a radio service, and which operate in accordance with the provisions of the Radio Regulations."

Additionally, Article 47 emphasizes the collaboration among Member States to prevent the transmission of false or deceptive signals:

"Member States agree to take the steps required to prevent the transmission or circulation of false or deceptive distress, urgency, safety, or identification signals, and to collaborate in locating and identifying stations under their jurisdiction transmitting such signals."

Q: What actions has ITU taken to mitigate interference into the frequencies allocated for GNSSs and RRNSSs

A: The number of cases of harmful interference (including so-called jamming and spoofing) affecting Global Navigation Satellite Services has increased significantly. These have been reported to ITU by several Member States requesting assistance to resolve the matter.

ITU has taken several steps to address the harmful interference, including raising cases of interference at the 2023 World Radiocommunications Conference (WRC-23). For instance, Resolution

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676 (WRC-23) was adopted by consensus to urge administrations to protect GNSSs and RRNSSs from harmful interference in specific frequency bands.

By adopting Resolution 676 (WRC-23) the WRC neither relaxed nor imposed new obligations on Member States, but further clarified how the obligations already imposed by the ITU Constitution apply to the radionavigation-satellite services.

ITU also issued Circular Letter [CR/488](#), summarizing decisions and recommendations concerning the mitigation of harmful interference to the radionavigation-satellite service, which is the frequency allocation used by GNSSs and RRNSSs.

Q: How does ITU function as a multistakeholder forum concerning radionavigation-satellite services?

A: As a membership-driven organization, the ITU provides a forum where Member States collectively evaluate evidence, share studies and practices, and consider the full range of available technologies to make informed decisions. The ITU membership continues to be engaged in discussions regarding the enhancement of radionavigation-satellite service resilience, as well as the exploration and implementation of complementary technologies to ensure the robustness of navigation and communication systems.

The ITU Secretariat fulfils its role by supporting Member States in these deliberations when deciding on the most appropriate course of action and by assisting concerned Administrations, if and as needed, in resolving cases of harmful interference.

For further information you may contact itu-r-communications@itu.int or pressinfo@itu.int

