

## GPS Interference

**Mains syllabus:** GS3 - Science and Technology- developments and their applications and effects in everyday life, disaster management.

### Why in the news?

Recently, GPS interference has emerged as one of the biggest challenges for seafaring vessels and aircraft.

### What is GPS interference?

- **Global Positioning System (GPS)** - It is a *space-based radio-navigation system*, owned by the U.S. Government and operated by the United States Air Force (USAF).
- It can pinpoint a *3 dimensional position to meter-level accuracy* and time to the 10-nanosecond level, worldwide and 24/7.



- **GPS Interference** - It refers to spoofing or jamming, two types of *deliberate cyber-attacks on GPS signals*, which disrupt or deceive vehicles' navigation systems.
- While both are often used synonymously with each other, spoofing and jamming refer to slightly different.

GPS jamming	GPS spoofing
Involves a <b>device (jammer)</b> emitting strong radio signals on GPS frequencies to <i>overpower weaker signals</i> .	Involves a device transmitting signals on the same frequencies used by GPS satellites, <i>blocking the GPS receivers</i> from acquiring or maintaining the right satellite signals.

It disrupts the functioning of GPS systems by <i>rendering receivers unable to determine location or time.</i>	Unlike jamming, which disrupts signals entirely, it <i>deceives the receiver into trusting false data.</i>
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- **Causes** - GPS interference can occur due to various reasons, *not all of them malicious.*
  - Electromagnetic radiation from nearby devices
  - Adverse atmospheric conditions like ionospheric disturbances, solar activity (such as flares)
  - Intentional jamming/spoofing.



## Why is it dangerous?

- **Disrupts military operations** - Spoofing can cause a pilot to *misjudge the aircraft's position*, increasing the chance of collisions with terrain or other aircraft.
  - In 2024, reports indicated up to 700 daily GPS spoofing incidents globally, highlighting the scale of the threat.
- **Interrupts civilian transport** - It can severely disrupt civilian transport by causing navigational errors, leading to *potential collisions, groundings, and traffic chaos.*
- **Disrupts maritime navigation** - It can also lead to *piracy, disastrous events.*
  - Persian Gulf and the Red Sea amid ongoing conflicts are one of the vulnerable regions.

Maritime tech consultancy Windward's Q1 2025 data show a 350% rise in **spoofing incidents in the Red Sea** alone compared to 2024—with some vessels having experienced sudden position jumps of hundreds of nautical miles.

- **Rising conflicts between nations** - If one nation suspects another of GPS interference, it can lead to accusations, *diplomatic tensions, and even retaliatory measures*, potentially escalating the situation.
- **Airspace avoidance** - For aircraft, spoofing is one of the primary risks of being in the airspace of countries in war.
- It forces the nations to immediately avoid these areas as a preventive measure.
  - **For example**, avoiding respective airspace during Russia and Ukraine conflict.
- **Navigation dependence vulnerability** - A mere dependence on GPS navigation is dangerous, if GPS interference happens, leads to *disruptions in daily operations and disasters*.
  - **For instance**, during the 1999 Kargil war and during in 2009 and 2012 Brahmos missile tests - US denied access to GPS.
- **Displays false information** - Leading to collision of ships, aircraft accidents, and civilian vessel crashes etc.

## How it can be prevented?

- **Using alternative navigation systems** - Aircraft experiencing GPS spoofing mid-air can rely on other navigation systems like
  - **Inertial Navigation Systems (INS)** - It uses *gyroscopes and accelerometers* to track the aircraft's current position based on its last known location.
  - **VHF Omnidirectional Range (VOR) and Distance Measuring Equipment (DME)** - It provides ground-based radio navigation, allowing pilots to further cross-check their position.
  - **Instrument Landing Systems (ILS)** - They are critical for precision approaches during landing, are unaffected by GPS spoofing.
- **Enhancing crew training** - Pilots are also encouraged to listen carefully to the control room to pick up any chatter of suspected GPS spoofing and become immediately cautious of the possibility.
- **Employing alert systems** - Involving *sophisticated technology to alert* and take control of the aircraft/ships from auto-pilot mode to the manual mode.
- **Effective Use of terrestrial navigation** - It involves manual position fixing using land-based aids like lighthouses and radars, the immediate alternative to maintain situational awareness.

## What lies ahead?

- *Diversifying navigation systems* can be to mitigate the risks of GPS interference in the future.
- *Multi-constellation Global Navigation Satellite System (GNSS)* systems can be adapted to mitigate against GPS interference.

## Reference

[The Indian Express| GPS Interference Threats](#)

