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# Global Navigation Satellite System (GNSS)

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7 April 2022

# Agenda

- What is GNSS and what are its uses?
- Problems with GNSS
- Liability issues
- International regulation of GNSS
- GNSS in Australia and NZ

# What is GNSS?

***'Constellation of satellites providing signals from space that transmit positioning and timing data to GNSS receivers. The receivers then use this data to determine location'*** - EUSPA (EU Agency for the Space Programme)

Three main elements

(1) The satellites

(2) The master control/monitoring stations

(3) The users

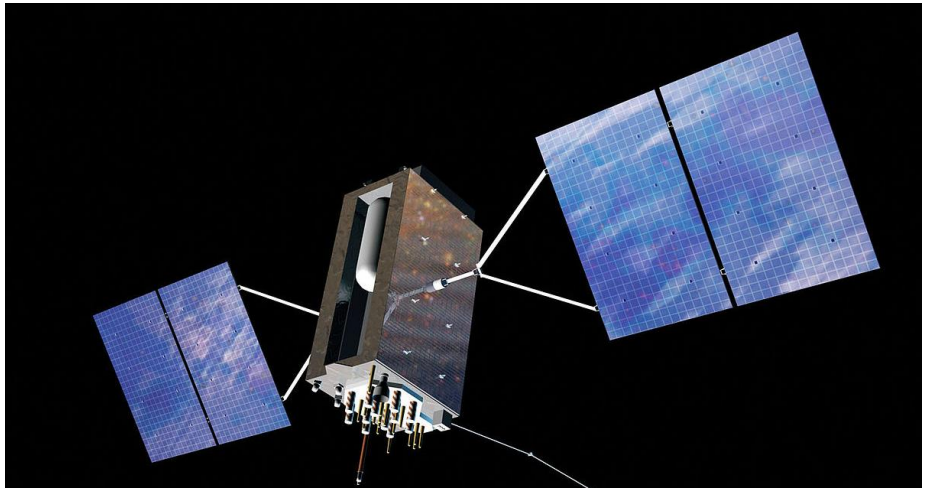

Image source (but cropped):https://www.nationalgeographic.org/photo/gps-satellite/; Quote source: https://www.euspa.europa.eu/european-space/eu-space-programme/what-gnss; NB: images without sources in the presentation are from Clyde & Co's stock images

# GNSS architecture

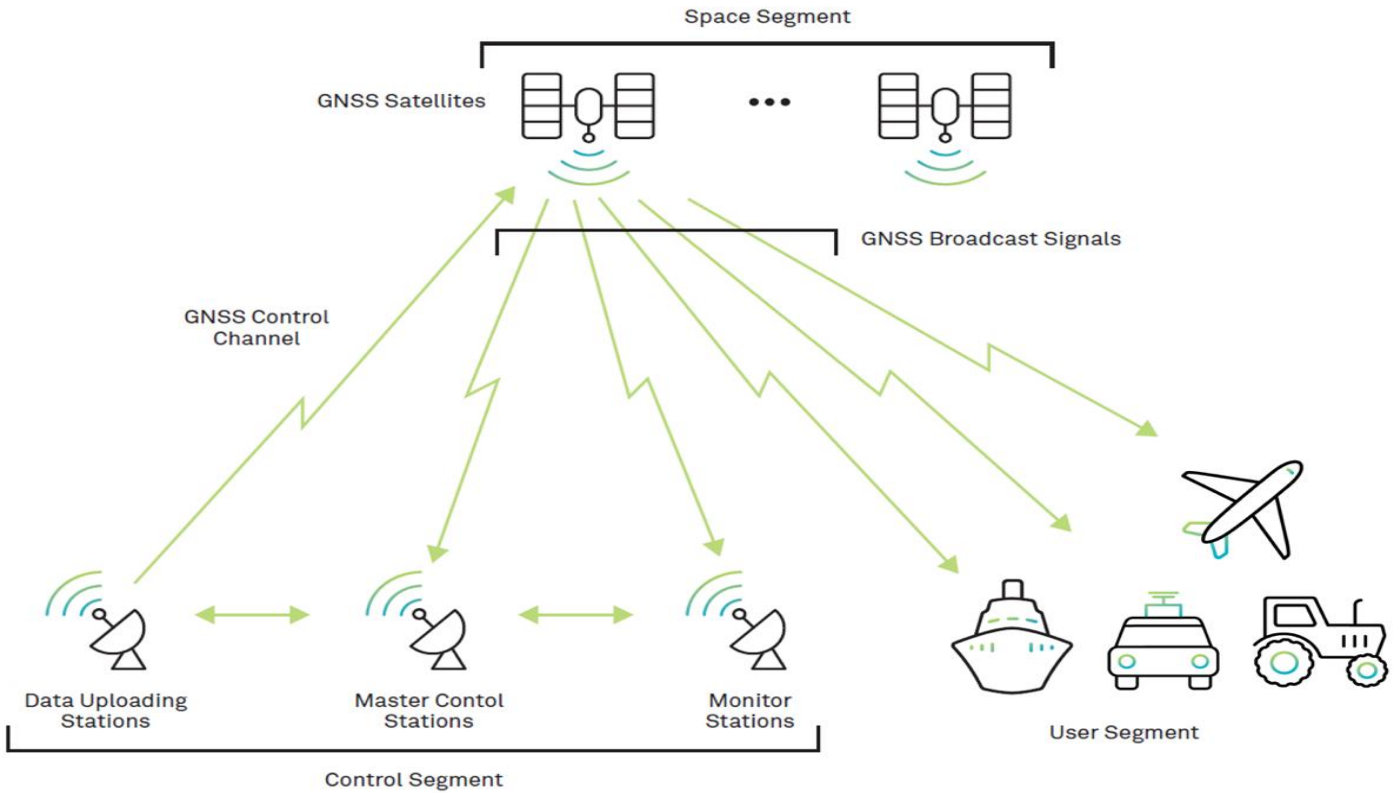


Image source: https://novatel.com/tech-talk/an-introduction-to-gnss/what-are-global-navigation-satellite-systems-gnss

# Examples of GNSS

- Global Positioning System (GPS) (NAVSTAR) (US)*
- Global'naya Navigatsionnaya Sputnikovaya Sistema (GLONASS) (Russia)*
- Galileo (Europe)
- BeiDou Navigation Satellite System/COMPASS (China)
- Regional Navigation Satellite System (IRNSS), also known as Navigation with Indian Consultation (NavIC) (India)
- Quasi-Zenith Satellite System (QZSS) (Japan)

*Note: IRNSS/NavIC and QZSS are only regional*

**Comparing GNSS constellations**

| | Operator | Coverage | Altitude (km) | Satellites in orbit |
|---|---|---|---|---|
| **GPS** | US Space Force (branch of US Armed Forces) | Global | 20,180 | 31 |
| **GLONASS** | Roscosmos (Russian space agency) | Global | 19,130 | 24 |
| **Galileo** | EUSPA (EU Agency for the Space Program) and ESA (European Space Agency) | Global | 23,222 | 26 |
| **BeidDou** | CNSA (China National Space Administration) | Global | 21,528 (MEO satellites)<br>35,786 (GEO and IGSO satellites) | 48 |
| **QZSS** | JAXA (Japanese Aerospace Exploration Agency) | Regional | 32,000 (perigee)<br>40,000 (apogee) | 4 |
| **IRNSS/NavIC** | ISRO (Indian Space Research Organisation) | Regional | 36,000 | 8 |

# What is GNSS used for?

- Telecommunications, land surveying, law enforcement, emergency response, precision agriculture, mining, finance, scientific research etc.

- Used in all forms of transportation: aviation, space stations, maritime, rail, road and mass transit

- Use in aviation:
  - Air navigation services are a major user of GNSS
  - Role in search and rescue

# Problems with GNSS

## GNSS correction services

GNSS can work in tandem with **regional satellite-based augmentation systems (SBAS)**, which 'improves the **accuracy** and **reliability** of GPS information by correcting signal measurement errors and by providing information about the **integrity** of its signals'.

- EUSPA

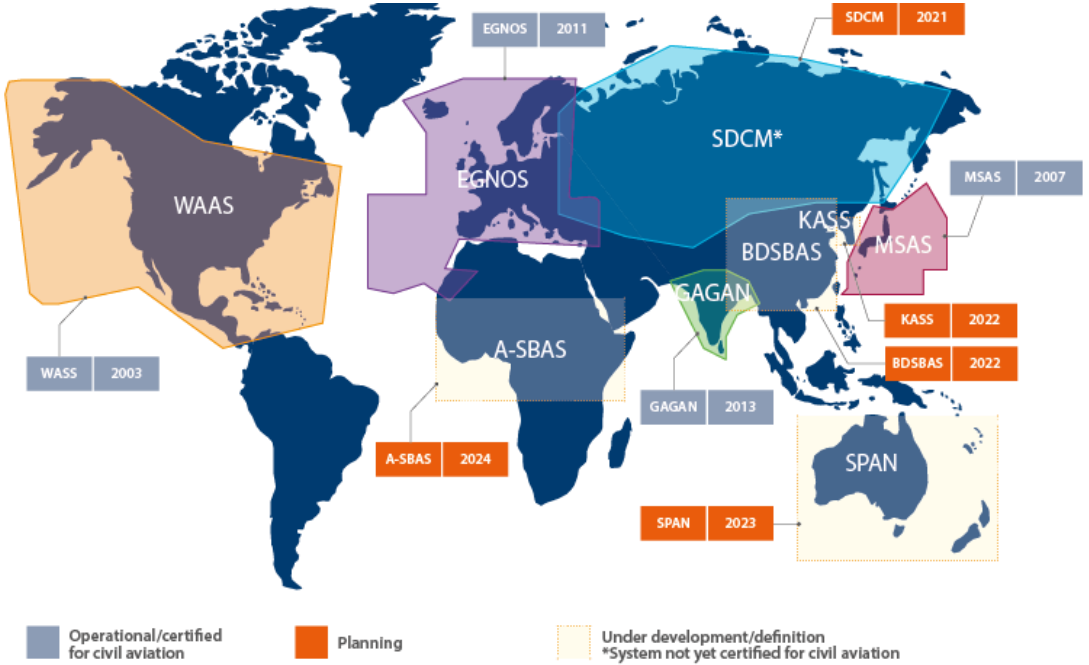


Image source: https://www.euspa.europa.eu/european-space/eu-space-programme/what-sbas; Quote source: https://www.euspa.europa.eu/european-space/eu-space-programme/what-gnss

# Problems with GNSS

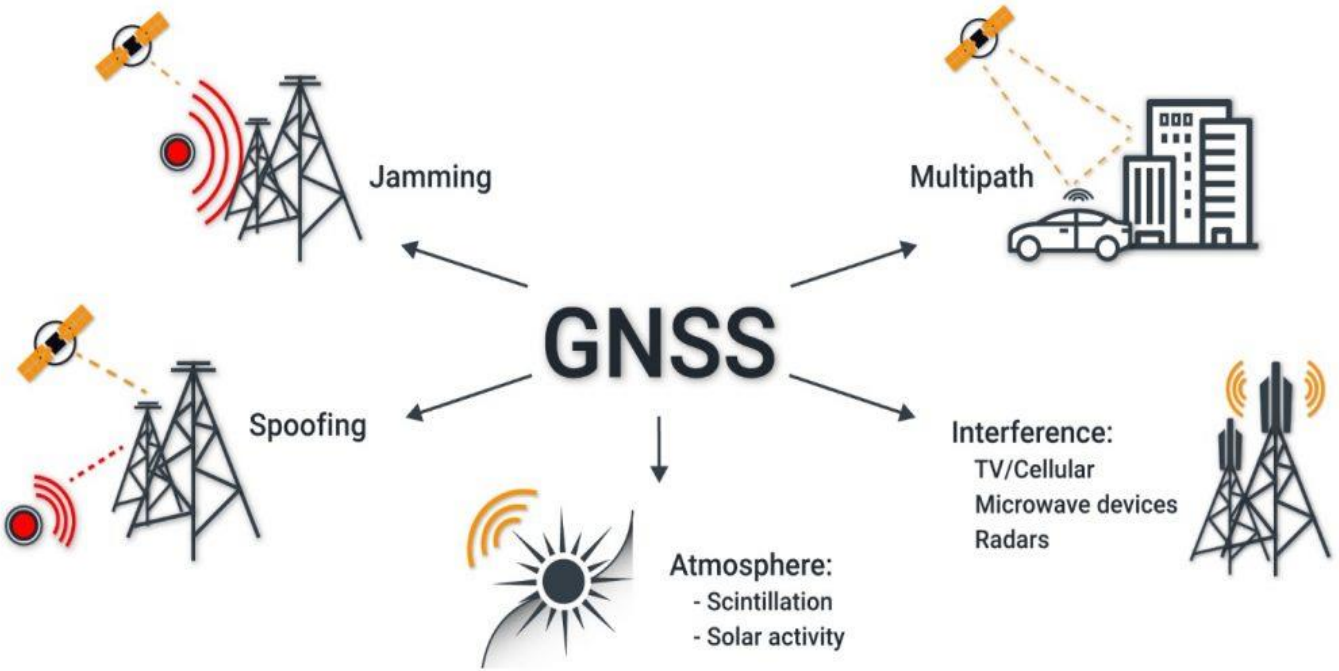


Image source: https://gpspatron.com/gnss-signal-monitoring/

# Liability of service providers?

- No international legal instrument governing liability
- Open access, provided by States
- Multiple jurisdictions and possible parties
- Existing international law

# International regulation of GNSS

International Civil Aviation Organization (ICAO)

International Committee on Global Navigation Satellite Systems (ICG) (under UNOOSA)

International Telecommunications Union (ITU)

International Maritime Organization (IMO)

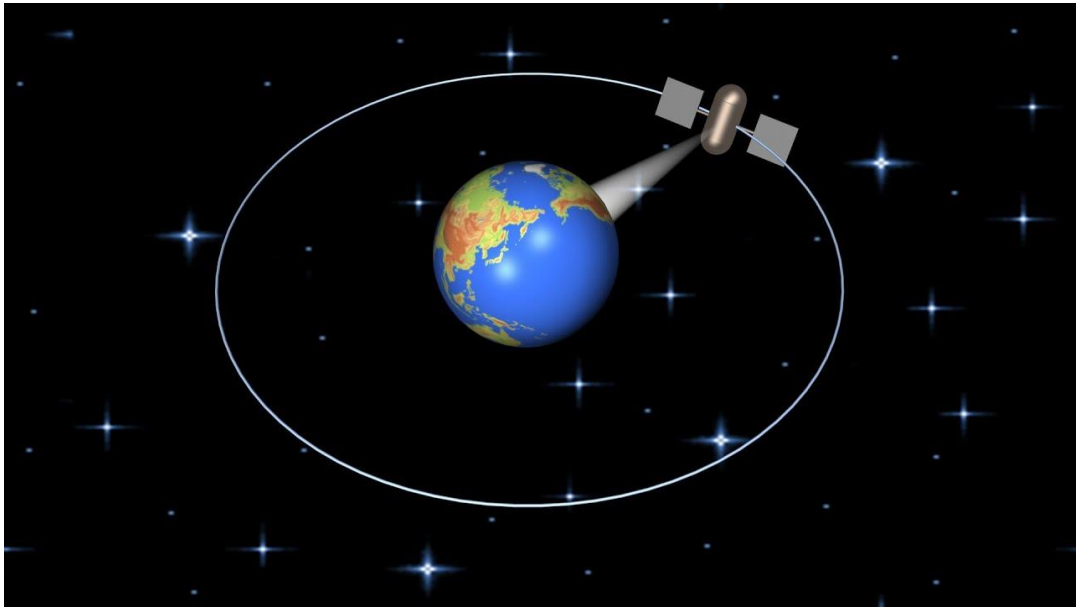

Image source: https://youtu.be/sj7zsGkpZxg

# GNSS in Australia

- Implementation of ICAO's '**Performance-based Navigation**' framework
- **GNSS** mandated as **primary source of navigation** for all aircraft operating under instrument flight rules (IFR)
- Investment in new satellite-based augmentation system – **Southern Positioning Augmentation Network** (SouthPAN)
- **Australia's Civil Space Strategy** – focus on 'position, navigation and timing'

# Recent case law

## *New Zealand Aviation Federation (Inc) v CAA of NZ and the Director of Civil Aviation* [2021] NZHC 2674

The court agreed with the CAA that the words of the relevant regulation:

'impose more than a minimum equipment requirement. Those words require both the carriage of the specified equipment and the ability to access the GBNA on the route being flown. If an operator wishes to fly using GNSS navigation on a route where GBNA is not accessible, it may do so, provided it -

(1) carries the specified equipment, and

(2) complies with the conditions set out in the 2020 Exemption' [104].

An alternate interpretation would be at odd with public safety [101]

Image source: https://airlines.iata.org/news/looking-ahead-in-new-Zealand

# Thank you & any questions

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