

# PNT & GEODESY IN UK

An overview of PNT and Geodesy activity in the UK

Presented to the *Expert Consultation on Strengthening the Global Geodesy Supply Chain* workshop at UN-GGCE, Bonn, Apr 2024

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# UK geodetic responsibilities

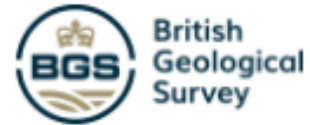
UK does not have a single “Geodetic Agency”

Ordnance Survey (OS)



+

British Geological Survey (BGS)



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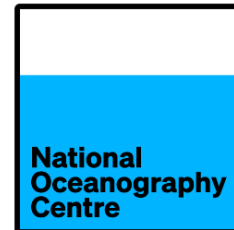
United Kingdom Hydrographic Office (UKHO)



UK Hydrographic  
Office

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National Oceanography Centre (NOC)



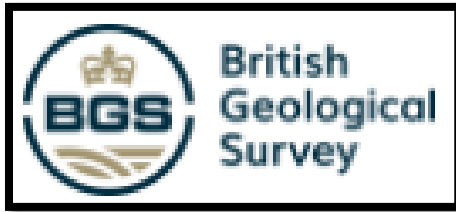
# UK geodetic responsibilities



Ordnance Survey are the national mapping agency and are responsible for “geodesy to support national mapping”:

- Maintain access to national coordinate and height reference systems via a 115 station CORS network
- Contribute some CORS data to European Permanent Network (EPN) and subsequently some of these contribute to ITRS
- Primary focus of CORS is national mapping and supporting survey operations, NOT “global geodesy”

# UK geodetic responsibilities



British Geological Survey (BGS) are responsible for geology, gravity, magnetic field etc....

Funding for GB's primary geodetic site, the Space Geodesy Facility (SGF) comes mostly via BGS. SGF run SLR, IGS stations and absolute gravity observations



# UK geodetic responsibilities



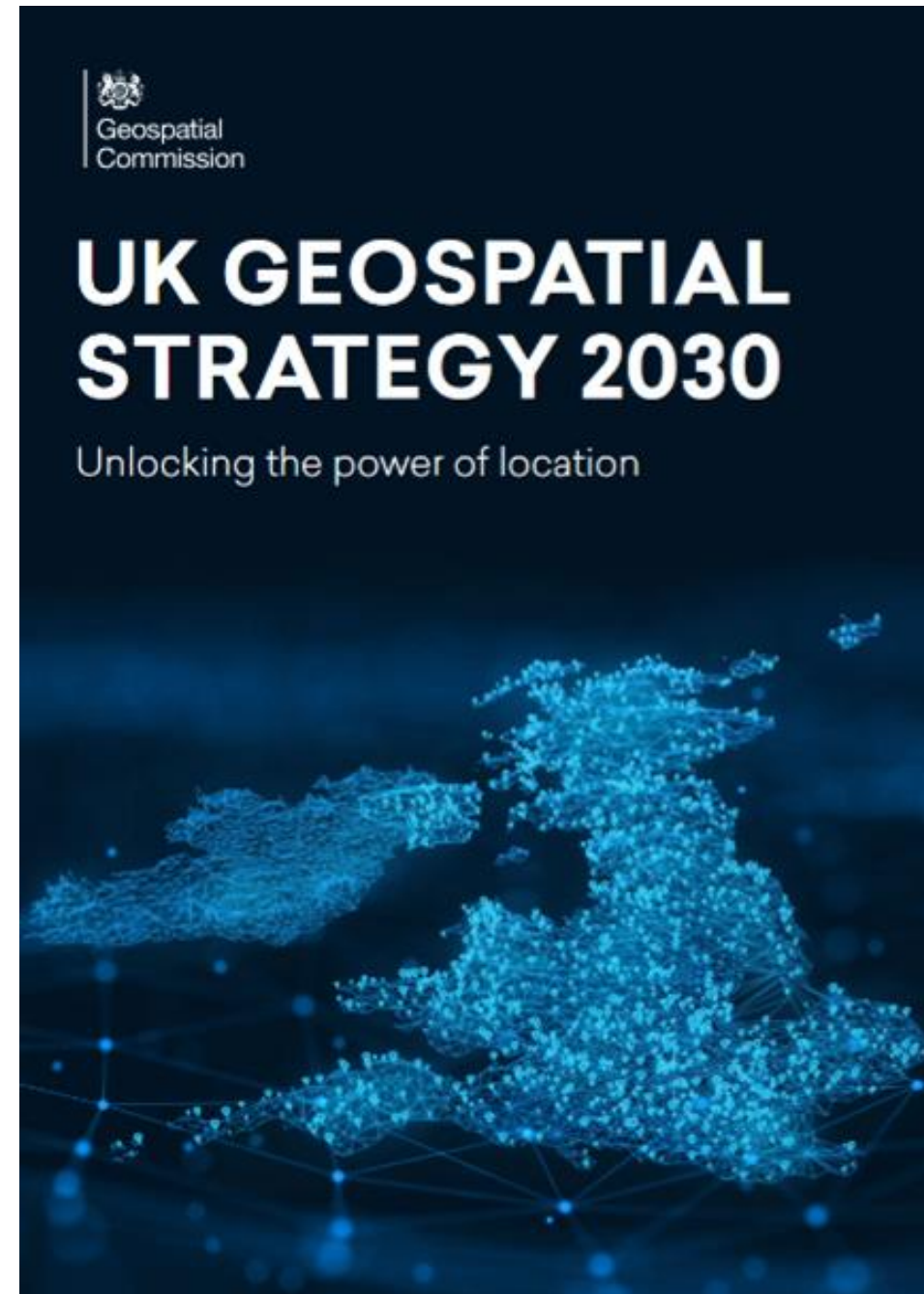
United Kingdom Hydrographic Office (UKHO) is responsible for charts and tides



National Oceanography Centre monitor sea level.

# Geospatial Commission

- Based in the Department of Science, Innovation, and Technology (DSIT)
- Responsible for setting the UK's geospatial strategy and coordinating public sector geospatial activity.
- Mandate and budget to drive and deliver changes by working in partnership with others.
- Provide strategic oversight of the geospatial ecosystem in the UK, setting geospatial strategy, policy and standards.
- Hold the budget for the public sector's largest investment in location data, the Public Sector Geospatial Agreement (PSGA)



# Geospatial Commission

**UK Geospatial Strategy 2030: Government's plan to unlock the power of location data and technologies across the UK economy**

## **GC strategy: 3 key missions**

### **Mission 1**

**Embrace enabling technologies to accelerate geospatial innovation**

- Analytics
  - Remote sensing and automated feature extraction
  - Research and development programmes
- + Earth Observation**  
**+ PNT**

### **Mission 2**

**Drive greater use of geospatial applications and insights across the economy**

- Data to support public sector decision making
  - New data provided in new ways
  - Broaden geospatial adoption
- + NUAR**  
**+ Geovation**

### **Mission 3**

**Build confidence in the future geospatial ecosystem**

- International engagement (e.g. UN-GGIM)
  - Support geography education
  - Invest in early career and advanced geospatial skills
- + Partnerships – AGI, RGS, GCP**  
**+ Graduates and apprenticeships**

# National PNT Office

- Based in the Department of Science, Innovation, and Technology (DSIT)
- Overseen by cross-Government Programme Board from CNI lead departments
- Scientific and technical expertise from Independent Expert Group
- Goal to improve PNT resilience and drive growth through:
  - PNT policy and coordination internationally and with industry
  - Spending review bids
  - Manage PNT delivery programmes
  - Parliamentary and industry engagement

## PNT Resilience

PNT (Positioning, Navigation and Timing), is a technology vital to the functioning of Critical National Infrastructure and underpins many everyday activities in modern society.

### Why PNT matters

PNT underpins the safe operation of Critical National Infrastructure and many everyday activities in modern society including:

- Our travel - cars, trains and planes
- Our personal navigation - maps on mobile phones
- Our telecommunications - phones and TV
- Our finances - touch payments and mobile banking
- Our computers and internet
- Our emergency services - ambulance, police and fire

### Why PNT is at risk

The UK's PNT is almost completely provided through Global Navigation Satellite Systems (GNSS), primarily the US Global Positioning System (GPS), which is operated by the US Space Force.

There are many potential major disruptions to GNSS provided PNT, including hazards like severe space weather and catastrophic technical failure, and threats like cyber and physical attacks.

### What is PNT?

- Positioning, the ability to determine location and orientation.
- Navigation, the ability to determine current and desired position.
- Timing, the ability to acquire and maintain accurate and precise time from a standard anywhere in the world.

### What will HMG do?

Strengthen the resilience of the PNT services on which our Critical National Infrastructure and economy depend by scoping a new Government Policy Framework for Greater PNT Resilience.

### Government Policy Framework for Greater PNT Resilience will scope the proposals below

- National PNT Office
- Next Generation PNT
- PNT Crisis Plan
- PNT Growth Policy
- National Timing Centre
- PNT Skills
- MoD Time
- Satellite Based Augmentation System (SBAS)
- Enhanced Long Range Navigation (eLORAN)
- Infrastructure Resilience

HM Government



# National PNT Office

**Core Strategy: Our strategy to achieve our PNT policy objectives has two core elements.**

**PNT Policy Objectives: Our Government PNT policy objectives are as follows.**

**Policy Objective 1: Ensure CNI will continue to function using alternative PNT, in the event of PNT provided by GNSS is lost.**

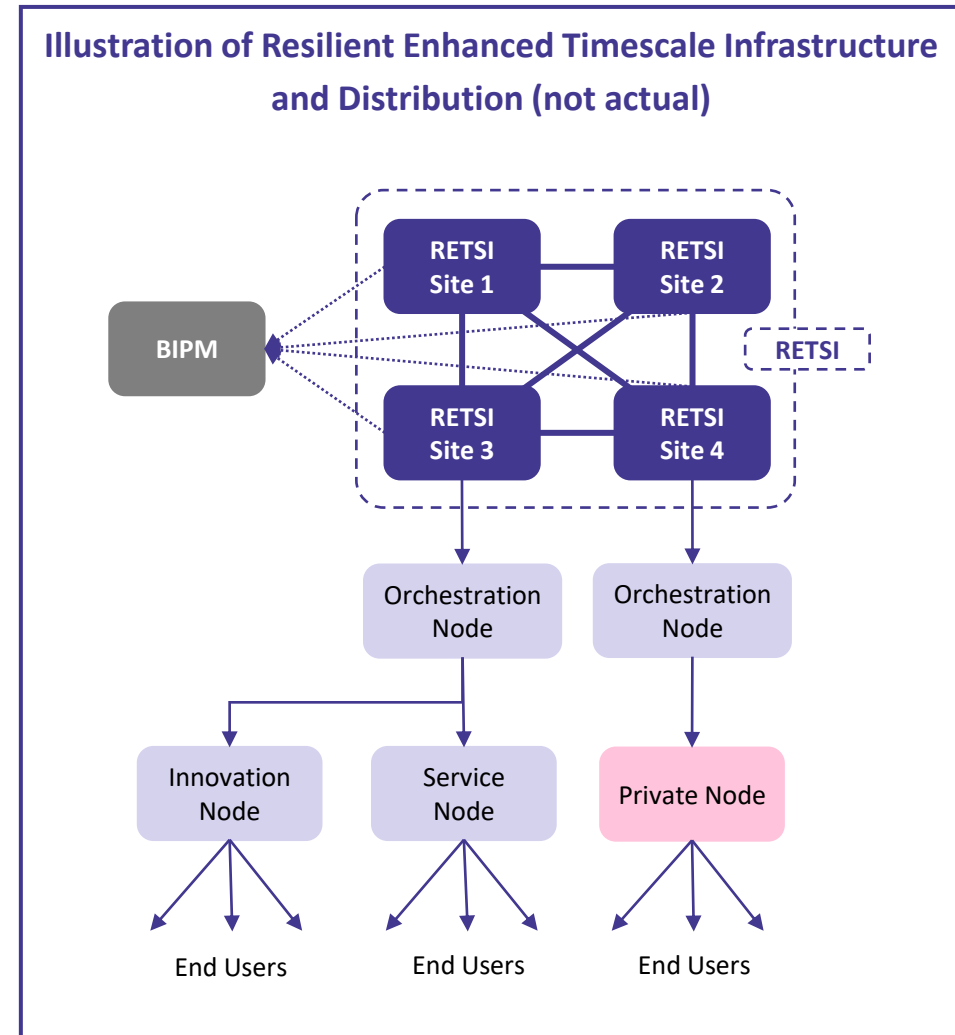
Minimise the resilience risk of losing GNSS provided PNT by providing terrestrial, resilient, independent, and high-quality Timing at relatively low cost through a fully funded and operational National Timing Centre (NTC), and an integrated eLORAN system to transmit timing and provide back-up basic Position and Navigation. Supported by the rollout of Resilient GNSS Receiver Chips to CNI.

**Policy Objective 2: Ensure UK businesses have access to high performing PNT systems to enable productivity driven economic growth.**

Increase UK productivity driven economic growth by providing high accuracy Positioning for autonomous and precision applications through deploying a space-based augmentation system and using R&D (including the European Space Agency's *Navigation Innovation Support Programme*) to spur innovation and technology adoption underpinned by tried and tested standards.

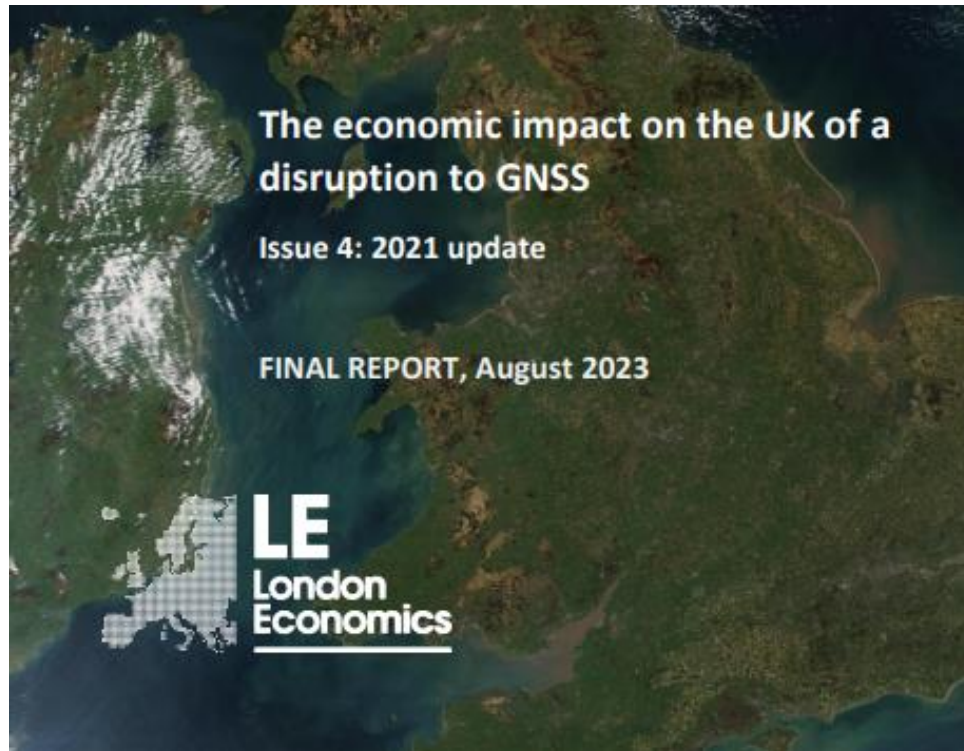
# National Timing Centre

- Delivered by UK National Physical Laboratory.
- Provides resilient, terrestrial, sovereign, and high-quality timing for the UK.
- Timing and eLORAN back-up Positioning.
- Resilient Enhanced Time Scale Infrastructure (RETSI) - 4 linked sites and clocks.
- RETSI sites geographically distributed and physically and cyber secure sites, linked by mesh network of secure optical fibre cable.
- Since 2020 R&D Programme has proven technology and now been extended with an additional £14m until March 2025.
- Business Case for NTC Delivery Programme starts 2025, including RETSI, Optical Clocks for RETSI and Assured Components etc...



# Efforts to understand the importance of GNSS in UK

2021 – extensive assessment of the value of GNSS to the UK economy. £13.6bn per annum



2018 – "Blackett Report" exploring the UK's dependency on GNSS



# GNSS threats and vulnerabilities across GB

As identified in the 2018 Blackett review, GNSS faces a wide variety of threats and vulnerabilities, all of which impact our ability to provide geospatial services.

Significant work is ongoing to monitor, raise awareness and understanding of scale of the problem and impact. We experience thousands of GNSS interference across GB every week.

## Example GNSS threats and vulnerabilities:



Global satellite navigation constellations broadcast very weak signals (60W light bulb from space), this makes disruption easy to achieve.



Space weather causes continuous errors, but on a bad day can damage satellites, even damaging power networks on Earth.



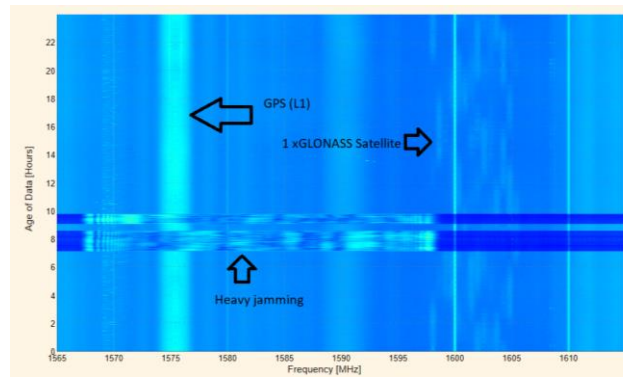
Cyber threats exist due to the connected requirements for receivers.



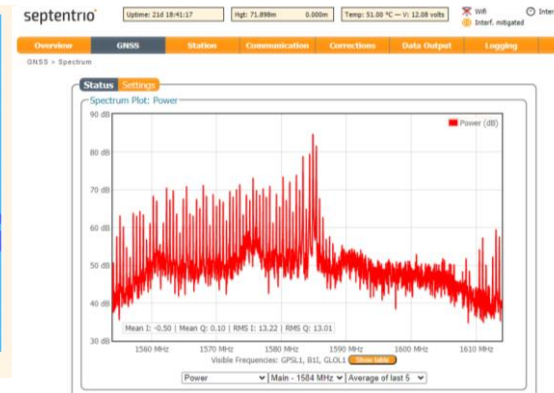
Intentional and non-intentional interference are the biggest and most consistent threats to GNSS.



Criminal activity is diverse, but aims to disrupt GNSS and other radio based services across the nation.



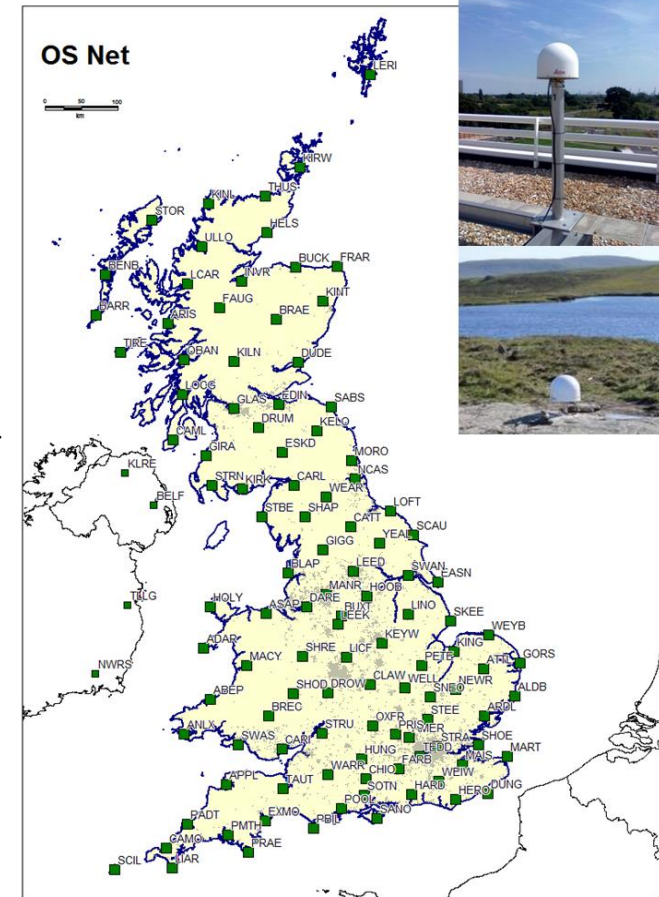
OS Net Trimble web GUI- typical intentional jammer



OS Net Septentrio web GUI- typical intentional jammer



Possible OS Net interference monitoring example



OS Net station distribution

# PNT Crisis Plan



## Crisis Plan

**Activated if GNSS provided PNT is lost.**

Focused on providing an alert service.

Plan being developed to include mitigation measures the UK can take in a crisis.



## OS Net

Ordnance Survey has OS Net that has 115 stations and a GNSS monitoring and alerting capability.

Possible upgrades being considered to enhance CNI status.



## UK SpOC

Enable UK Space Operation Centre to monitor GNSS interference that would affect UK PNT services.

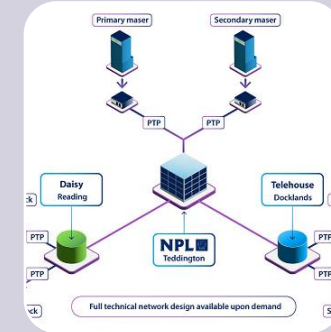
This will be in coordination any upgrades to OS Net and other sources.



## TWSTFT

A new Two-Way Satellite Time and Frequency Transfer capability will transfer UTC(NPL) from Teddington to Anthon.

This is anticipated sometime during early 2025.



## NTP Servers

An upgrade to NPL's Network Time Protocol Servers will provide further resilience.

This is anticipated sometime during 2024 or early 2025.

# Current UK examples of threats to the supply chain

SGF provide globally critical observation data through SLR, IGS stations and absolute gravity.

For 40+ years the Ministry of Defence (MoD) has contributed funding to run SGF. This funding has just been pulled with less than one month's notice.

Newcastle University runs the long term IGS station MORP00GBR. Funding relies on the university's "commercial activities" so is always at risk. They used to run an IGS Analysis Centre – funding for this no longer possible due to changes in research grant criteria.

After an almost 70 year history of teaching geomatics/surveying the undergrad course is now closed. Reason is mostly lack of demand from students.