

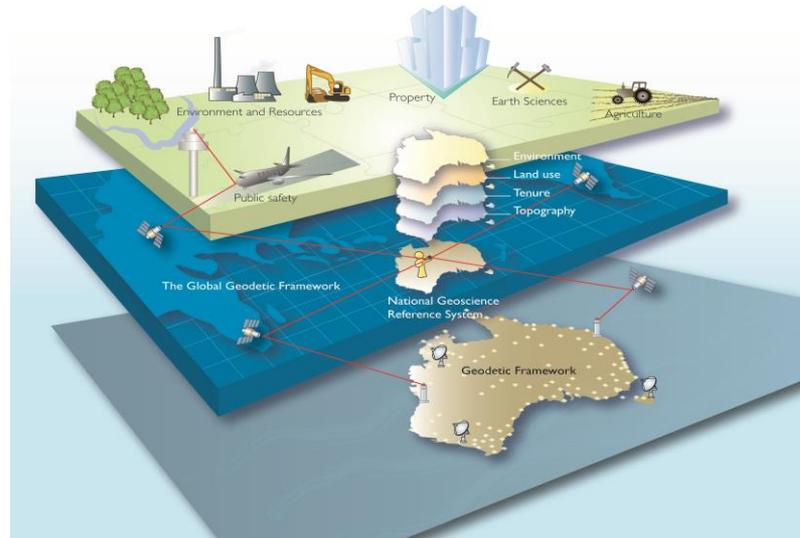


Australian Government PNT Activities

Grant Hausler, Geoscience Australia

31 October 2015

US National Space-Based
PNT Advisory Board
Boulder, Colorado



A Multi-GNSS Future

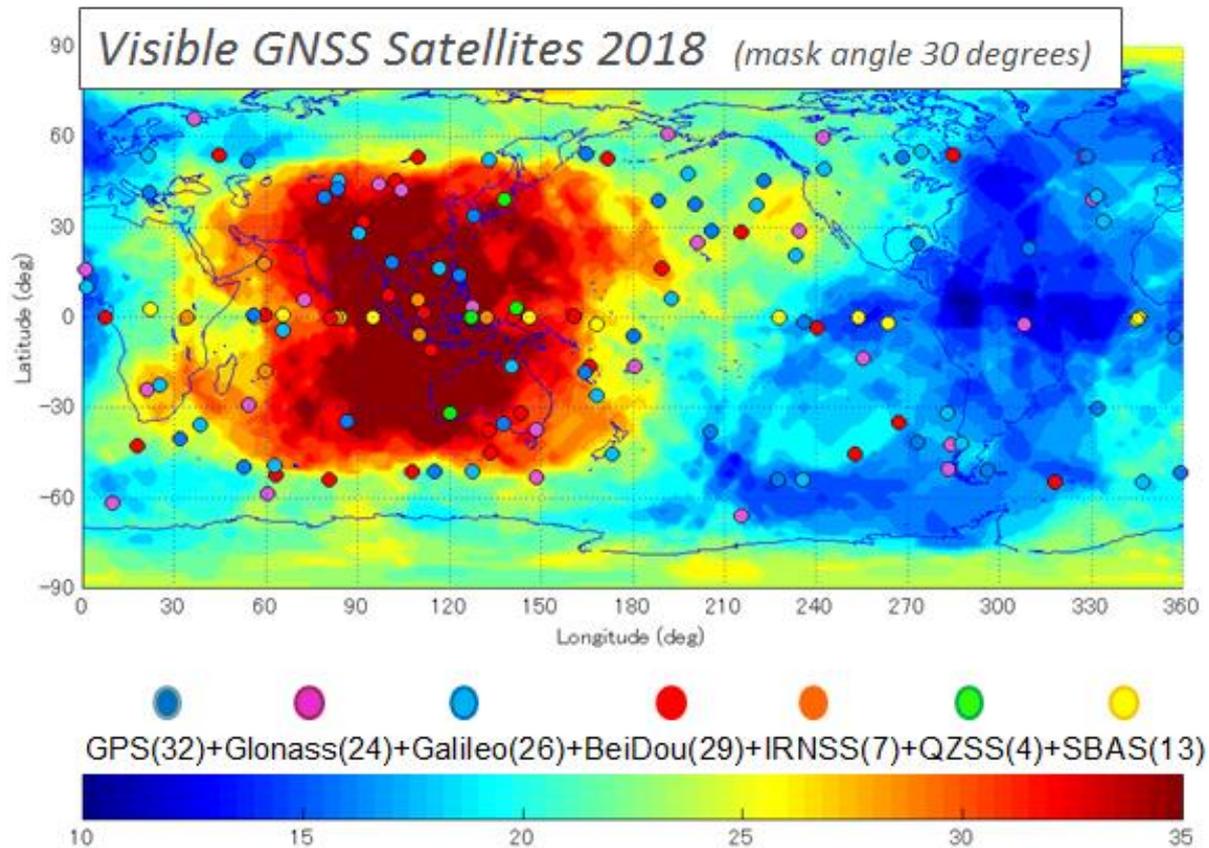


Figure courtesy Prof Chris Rizos, UNSW

**POSITION NAVIGATION
AND TIMING**

Geoscience Australia

SATELLITE COMMUNICATIONS

Department of Communications and the Arts

EARTH OBSERVATION

*Bureau of Meteorology
Geoscience Australia
CSIRO*

SPACE WEATHER

Bureau of Meteorology

*A safe and
secure Australia*

*Access to
information
and services*

*Better
environmental
management*

COORDINATION

*Department of
Industry, Innovation
and Science*

*Improved
productivity*

*A smarter
workforce*

SPECTRUM MANAGEMENT

*Department of Communications and the Arts
Australian Communications
and Media Authority*

INTERNATIONAL ENGAGEMENT

*Department of Foreign Affairs and Trade
Department of Industry, Innovation and Science*

SPACE SCIENCE

CSIRO

State of Space Report 2015

A consolidated summary of civilian space-related activities being conducted by Commonwealth Government agencies represented on the Australian Government Space Coordination Committee (SCC)

The SCC provides a forum for information sharing between Australian Government agencies on civilian space activities

Agencies represented on the SCC include:

- Australian Communications and Media Authority
- Attorney-General's Department
- Bureau of Meteorology
- Commonwealth Scientific and Industrial Research Organisation
- Department of Communications
- Department of Defence
- Department of the Environment
- Department of Foreign Affairs and Trade
- Department of Industry and Science
- Department of Infrastructure and Regional Development
- Geoscience Australia



<http://www.industry.gov.au/industry/IndustrySectors/space/Publications/Pages/The-State-of-Space-Report.aspx>

Background: Australian Space Activities

Senate Enquiry (*Lost in Space? Setting a new direction for Australia's space science and industry sector*) – 2008 (Standing Committee on Economics)

Australian Government Response to Enquiry:

- Established Space Policy Unit in 2009 (now the Space Coordination Office)
- Established Space Industry Innovation Council 2009

Principles of a National Space Industry Policy 2011

Satellite Utilisation Policy 2013

- Position, Navigation & Timing
- Earth Observations from Space
- Satellite Communications, including Broadband

Space Coordination Committee and Working Groups



<http://www.industry.gov.au/industry/IndustrySectors/space/Publications/Pages/Australias-Satellite-Utilisation-Policy.aspx>

Australian Government Positioning, Navigation & Timing Working Group (PNT-WG)

Chaired by Geoscience Australia

Reports to the Space Coordination Committee (SCC)

Draws together key Australian Government agencies involved in PNT to advise the SCC on the status and future of positioning in Australia

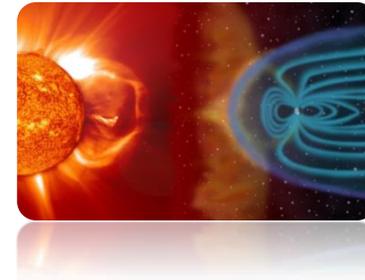
Quarterly meetings with industry presentations

Key discussion points from 2014 / 2015 include:

- National coordination
- Spectrum management
- Capability assessment
- International engagement
- Hosting of GNSS ground infrastructure
- Planning for the NPI
- Critical Infrastructure



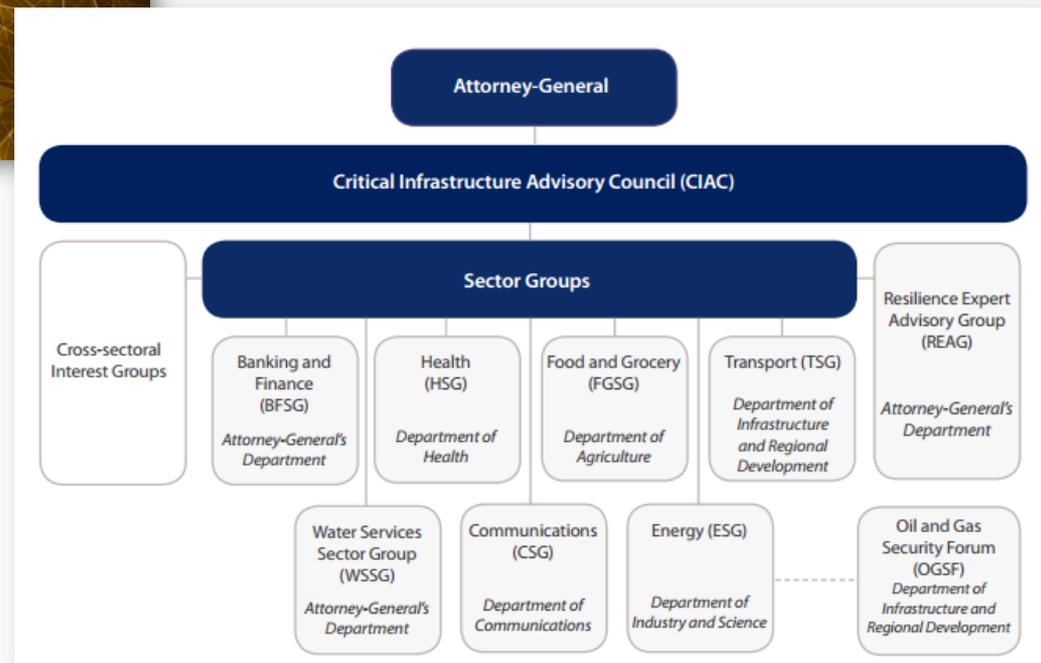
Critical Infrastructure



The Space Community of Interest (CoI) is a cross-sectoral interest group within the Attorney General's Trusted Information Sharing Network (TISN)

The Space CoI is analysing risks associated with Australia's dependencies on space-based assets

<http://www.tisn.gov.au/Documents/CriticalInfrastructureResilienceStrategyPlan.PDF>



National Positioning Infrastructure Advisory Board



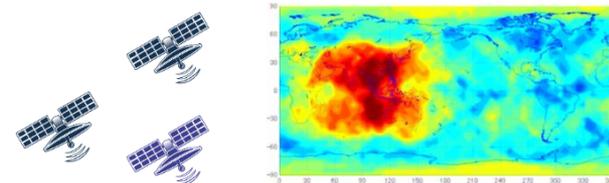
Australian Government
Geoscience Australia

Established December 2014 to advise Geoscience Australia on developing and implementing the NPI

Comprises 10 members representing key user groups across Australia and New Zealand:

- Land/Maritime Transport
- Aviation
- Engineering/Construction
- Agriculture
- Surveying/Mapping
- Device Manufacturers

Technical Working Groups (TWG) will address priority issues, including infrastructure management and performance standards



IGNSS Conference 2015 – NPI Workshop

NPI Advisory Board Presentations ([available online](#)):

Gary Johnston – NPI: Background & Current Progress

John Dawson – Infrastructure Management & Operations

Paul Harcombe – Jurisdictional Updates on Positioning Infrastructure & Services across Australia

Stuart Ballingall – Enabling Connected & Automated Vehicles

Tim Neale – High Accuracy Positioning in Agricultural Industries

Rod MacLeod – A GNSS Receiver Manufacturer’s Perspective

Ian Mallet – The Transition to Satellite Based Communications, Navigation, Surveillance (CNS)

Graeme Blick – New Zealand National Positioning Infrastructure

Nick Lemon – GNSS for Maritime Operations

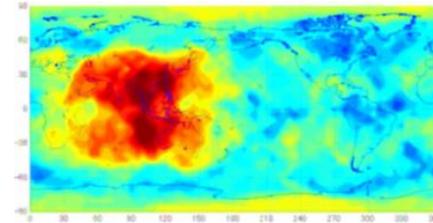
Dr Suelynn Choy – PNT Research: High Precision GNSS Positioning

Martin Nix – Construction & Spatial Applications

Matt Higgins – US Position, Navigation and Timing Advisory Board



Spectrum Management



The Space Community of Interest identifies spectrum as a potential vulnerability

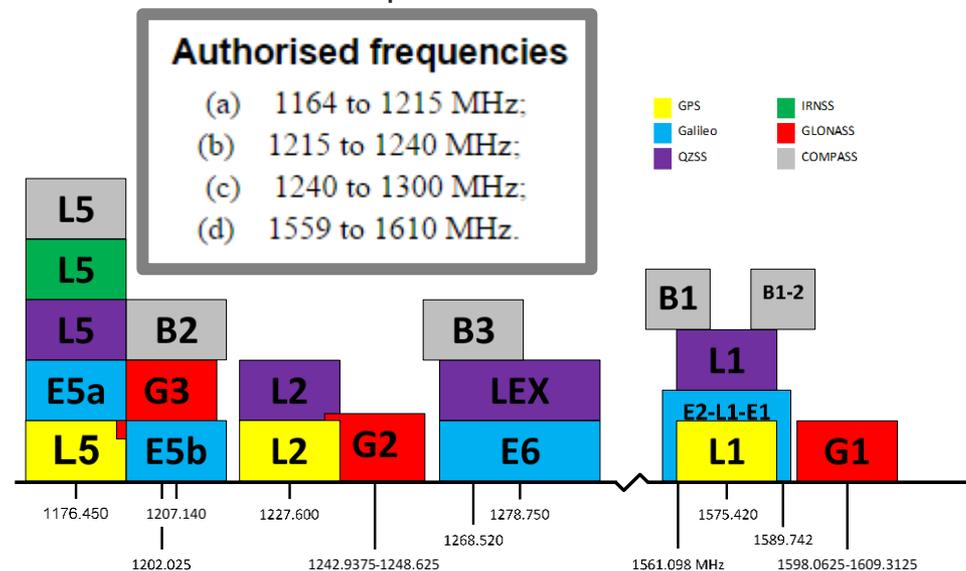
The Australian Communications and Media Authority (ACMA) is the regulatory authority for spectrum management in Australia

The PNT Working Group and NPI Advisory Board consult with government and industry on spectrum and related PNT issues

In September 2015 the ACMA made a new Class License: the **Radionavigation Satellite Service (RNSS) Class License 2015** to better facilitate the use of GNSS frequencies in Australia

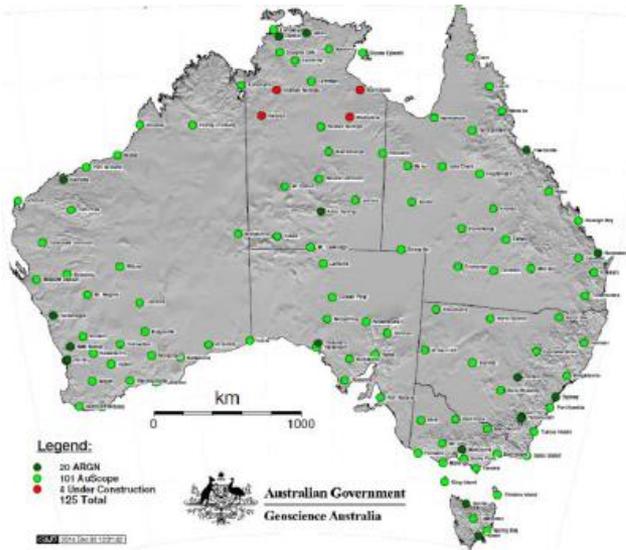


<http://acma.gov.au/theACMA/Consultations/Consultations/Current/remaking-the-communication-with-space-object-class-licence>



Australian Collaboration on GNSS Infrastructure

Australia

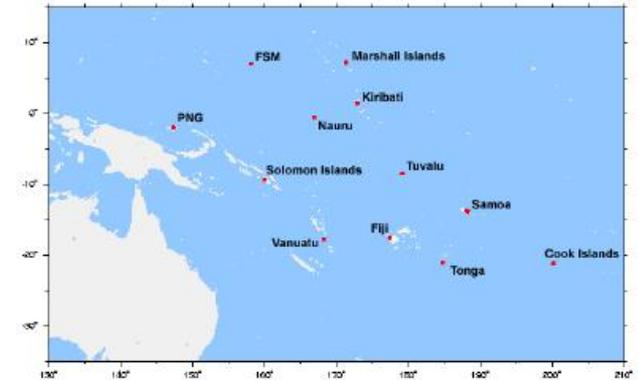


Australia-Japan



JAXA QZSS Master Station
Mount Stromlo, Canberra

Australia-Pacific



Australia-China



Government (Commonwealth/State/Territory) and Industry CORS Infrastrucure

June 2015

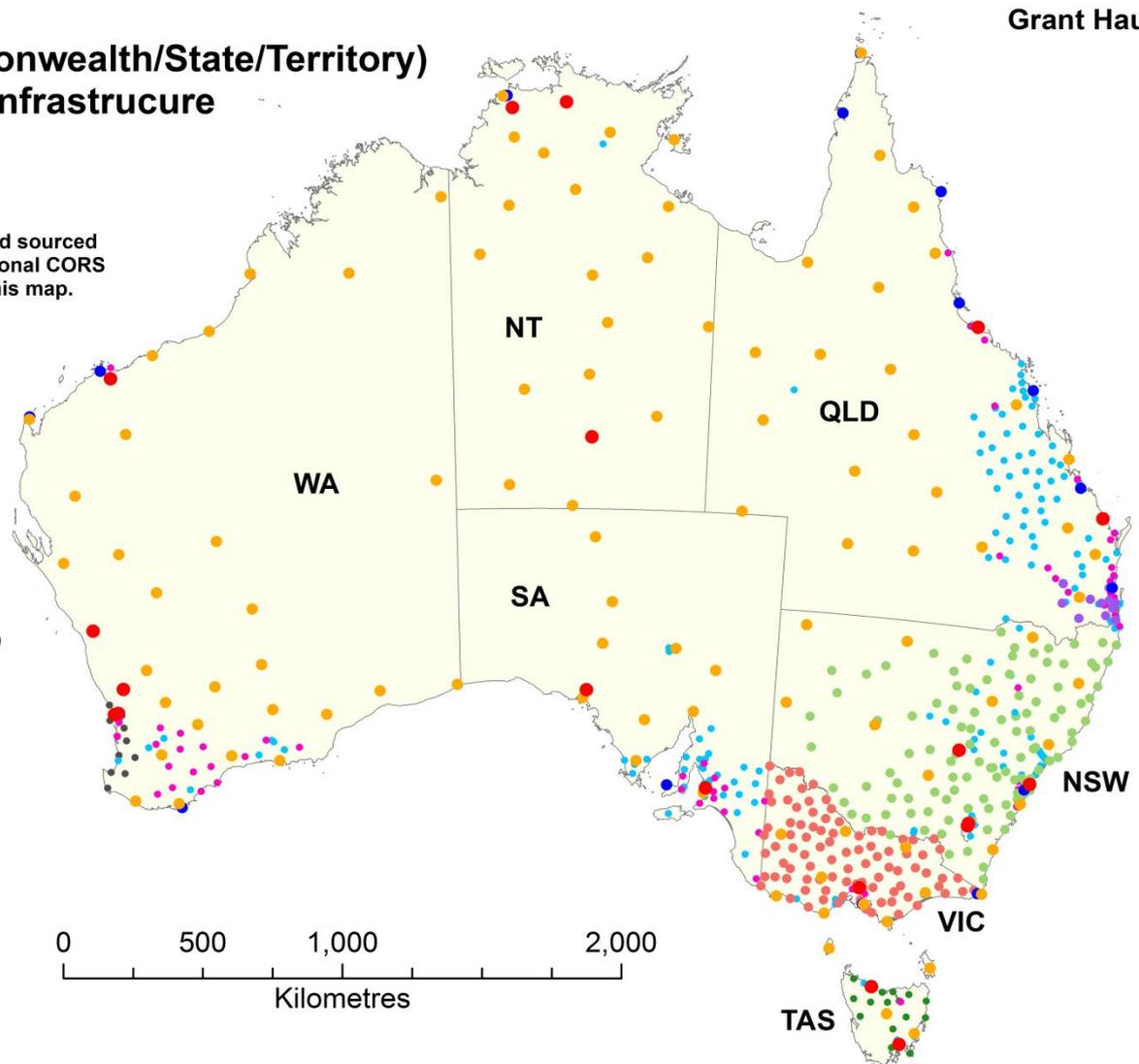
*Location details are approximate and sourced from public datasets meaning additional CORS may exist that are not displayed on this map.

Government

- ARGN (Comm)
- AuScope (Comm/State/Territory)
- AMSA (Comm)
- CORSnet NSW
- DNRM QLD
- DSE GPSnet VIC

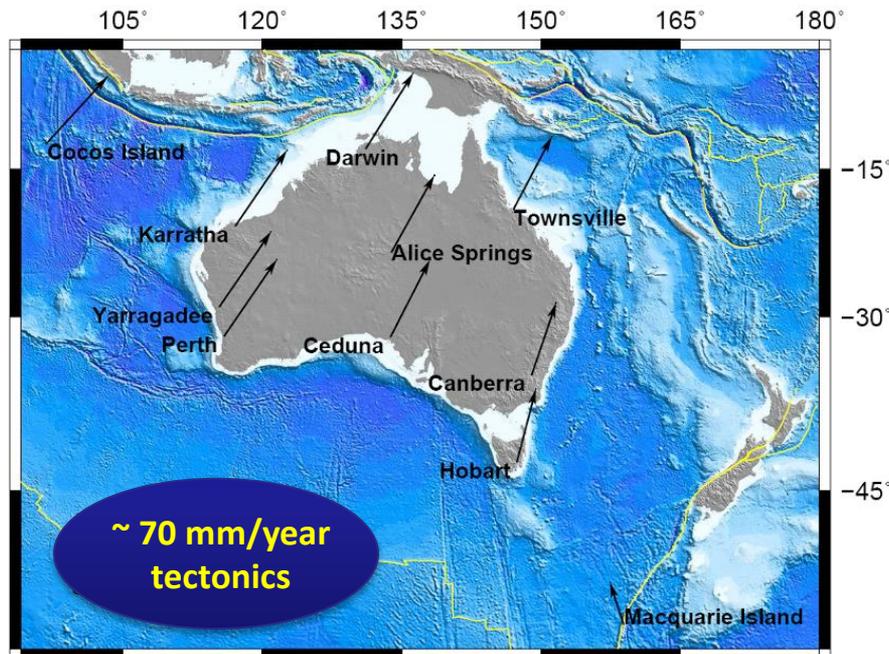
Industry

- AllDayRTK
- Trimble/OmniSTAR
- RTKnetwest
- SmartNet



National Coordinate Framework

- Difference between the Geocentric Datum of Australia 1994 (**GDA94**) and the Global Geodetic Reference Frame (**GGRF**) will exceed **1.8 metres** by 2020



Issue: Next-generation positioning services linked to the GGRF will have a positional uncertainty of 5 cm, leading to datum inconsistencies

Proposal: Datum Modernisation is needed to align with the GGRF through time



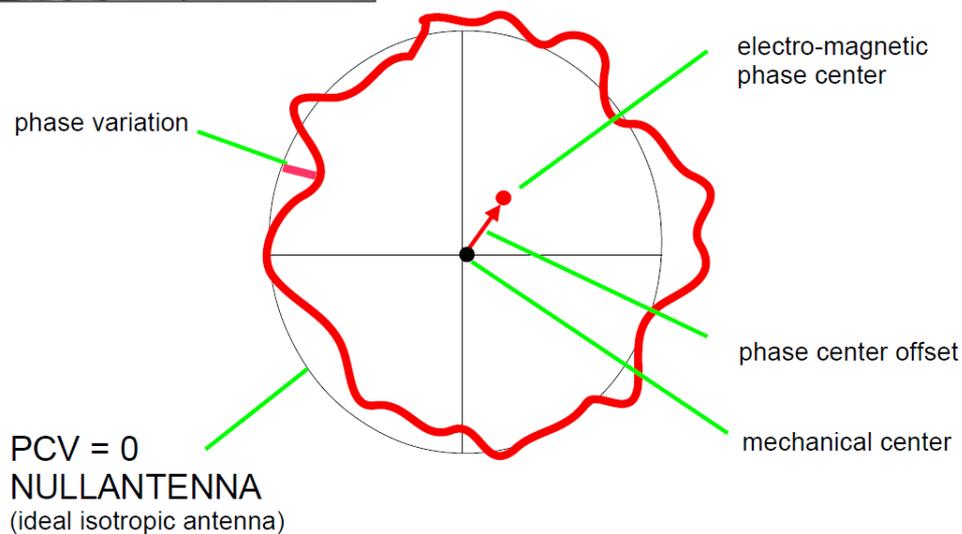
GGRF – see the United Nations resolution on the ‘*GGRF for Sustainable Development*’

<http://www.unggfrf.org>

Dancing Robots



We use robots to calibrate our equipment.





Legal Traceability of Position



National Measurement Act 1960

Act No. 64 of 1960 as amended

Expert Evidence on GNSS Performance

EXPERT CERTIFICATE

Section 177, Ev

GPS Status and Performance

12. On 23 September 2013 there were no GPS advisories notifying of service outages issued by the U.S. GPS Operations Centre.
13. An analysis of archived data collected by Geoscience Australia from its Australian Regional GPS Network (ARGN) indicated that the GPS was operating normally on 23 September 2013 across the Australian landmass and its maritime jurisdictions.
14. Using archived tracking data from the ARGN it was determined that no anomalous atmospheric conditions impacting the GPS were observed on 23 September 2013 across the Australian landmass and its maritime jurisdictions.
15. Using archived tracking data from the ARGN it was determined that in the geographic region (i.e. latitude 18.08295 South and longitude 146.77928 East) and period of interest (i.e. 23 September 2013) the number of GPS satellites visible (i.e. above the horizon) would have been always between 8 and 14.
16. Position Dilution of Precision, or PDOP, is a measure of the effect of satellite geometry (i.e. where the visible satellites are located in the sky) on positioning uncertainty. In the geographic region of interest on 23 September 2013, PDOP values were always less than 2, which indicated high quality positioning would have been achieved.

Value of standard of measurement:

Station (4 character ID): QUAB

South Latitude and its uncertainty of value:

$$28^{\circ} 46' 23.25290'' \pm 0.008 \text{ m}$$

East Longitude and its uncertainty of value:

$$114^{\circ} 36' 46.47413'' \pm 0.008 \text{ m}$$

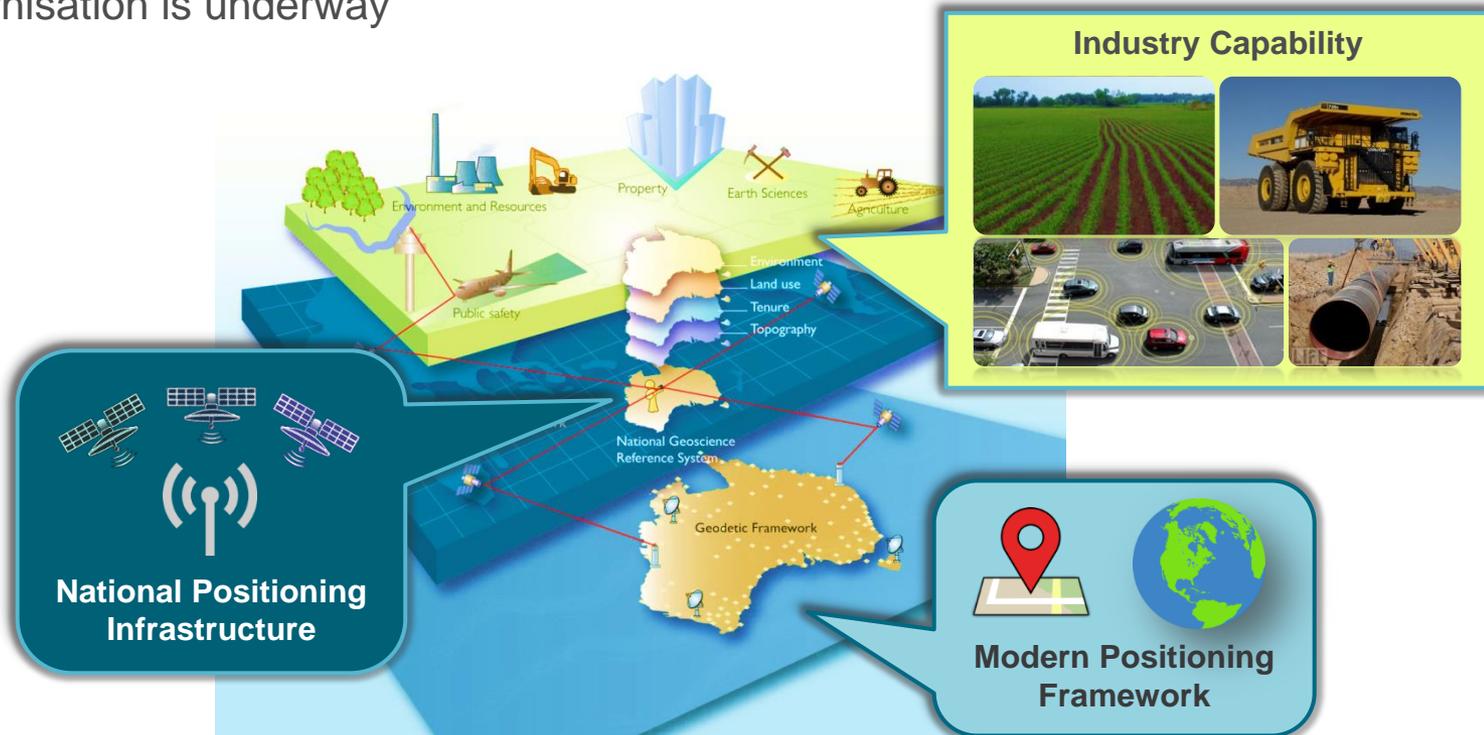
Elevation above Ellipsoid and its uncertainty of value:

$$-14.6538 \pm 0.019 \text{ m}$$

Geocentric Datum of Australia (GDA94) coordinates referred to the GRS80 ellipsoid being in the ITRF92 reference frame at the epoch 1994. The uncertainties are calculated in accordance with the principles of the ISO Guide to the Expression of Uncertainty in Measurement (1995), with an interval estimated to have a confidence level of 95% at the time of verification. The combined standard uncertainty was converted to an expanded uncertainty using a coverage factor, k , of 2.

Conclusions

- National coordination is underway
- Multi-GNSS is driving upstream and downstream capability development
- Capability assessments will inform investment and the NPI design
- Datum modernisation is underway
- International standards are important
- Terrestrial and satellite communications are needed
- Complementary PNT technologies are being explored



GNSS Futures

IGS Workshop
15–19 February 2016
Sydney, NSW, Australia



IGS

