




# Legal Traceability of GNSS Measurements in Australia

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## Presentation Outline

- Quick Overview of GNSS use in Australia;
- Australia's National Measurement System;
- The Nature of GNSS Measurements;
- The Approach to Legal Traceability of GNSS Measurements in Australia.

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# Australia and Queensland

- Australia is a Federation of States and Territories with legislation at both levels of Government;
- Surveying and Mapping activities are also carried out at both levels of Government.



# GNSS in Queensland

- Combined area of France, Germany, Italy, Spain and Belgium (Almost 4 times Sweden);
- Population 4 Million, Greater Brisbane 1.7M;
- Climate: Tropical to Sub-Tropical;
- Large areas with very sparse population;
- Major Industries are Mining and Agriculture (Becoming reliant on precise GNSS).

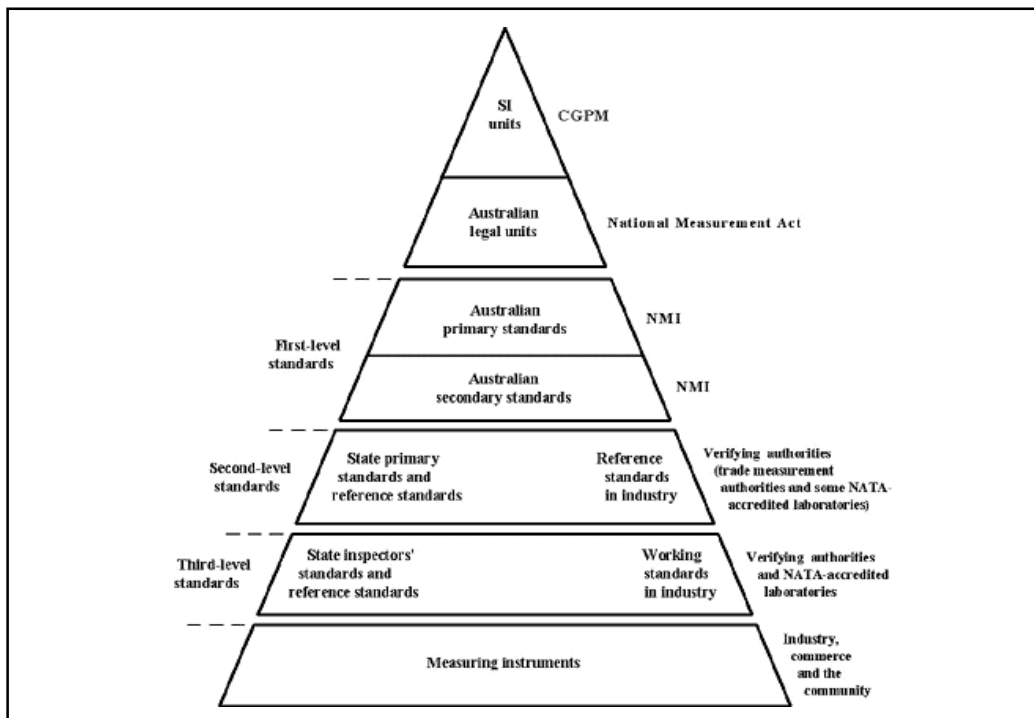




# National Measurement System



- The national measurement system is the infrastructure which ensures a consistent and internationally recognised basis for measurement throughout Australia.
- Both technical and legal/organisational aspects;
- The purpose of the national measurement system is to enable individuals and organisations to make measurements competently and accurately, to demonstrate the validity of such measurements and to coordinate Australia's measurement system with the measurement systems of other countries.







## Legislative Basis (1)


- Section 51(XV) of the Australian Commonwealth Constitution empowered the Federal Government to make laws in respect of weights and measures.
- The Commonwealth has used this power to enact the following legislation:
  - The National Measurement Act 1960 (the Act);
  - The National Measurement Regulations 1999;
  - The National Measurement Guidelines 1999.


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## Legislative Basis (2)


- The Act is the primary legislation empowered to:
  - establish a uniform national system of units and standards of measurement;
  - provide for the uniform use of units and standards throughout Australia;
  - give legal sanction to the national standards of measurement;
  - coordinate the operation of the national measurement system;
  - bring about the sole use of the metric system in Australia;
  - provide for a system of verification of utility meters used for trade.


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## Legislative Basis (3)

- The Act requires that where Australian legal units of measurement have been defined for a **physical quantity**, then measurements of that physical quantity shall only be legal when they are traceable to the Australian primary standards of measurement.
- This traceability typically involves reference to, comparison with, or derivation from an Australian (national) primary or secondary standard or a State primary standard. There is also provision for traceability via a **recognised-value standard** of measurement.


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## Measurements

- It must be remembered that the National Measurement Act is about ensuring:  
**“that measurements are what they claim to be”**
- The question for us then is; what are the problems with GNSS Measurements that could make measurements **not be what they claim to be?**


*(Note: this presentations concentrates on precise positioning with differential phase measurements typically used in Surveying)*



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## Standards and Connection


- There are two main issues for Surveying measurements:
  - What is the Standard for the physical quantity being measured?
  - How can I connect my field measurements to that Standard in a reliable way?


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## The Nature of GNSS Measurements

- GNSS measurements have some unique characteristics in terms of error sources;
- With EDM (for example) most of the reasons why a measurement may be in error are due to instrumental issues – this led to an instrument calibration approach;
- But with GNSS most of the errors are less likely to be due to instrumental and calibration issues and more likely to be due to site dependent errors such as:
  - multi-path;
  - incorrectly modelled atmospheric errors;
  - software incorrectly resolving the so-called phase ambiguity.

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# The Nature of GNSS Measurements




Ensuring that GNSS Surveying measurements are ***what they claim to be*** is as much about ***best practice*** as it is about ***traceability***


**This is a key to our approach in Australia**

**Also we use *position* as the *physical quantity***


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# Value Standard for Position




- The fundamental national GNSS Reference Station network becomes the ***Value Standard for Position***;
- The underlying geodetic networks and secondary Reference Station networks are then linked to that Value Standard;
- Surveyors can then connect:
  - Directly to national GNSS Reference Station network;
  - or;
  - Indirectly via the recognised geodetic network marks or via secondary Reference Station networks.




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## The SunPOZ Service

- Centimetre accuracy in real-time using survey quality GNSS receiver and mobile phone communications;
- 2001 First Pilot Network in the Southern Hemisphere;
- Now an Operational Network;
- Connected directly to the Value Standard for position




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## Galileo Sensor Station Proposal to ESA



- Also:
  - Working with Russian Space Agency on Testing Equipment for future GLONASS Monitoring Stations;
  - Possible Testing of COMPASS Receiver.

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## Best Practice for Surveys and their Connection to the Standard

- No matter how the connection to the standard is performed, best practice guidelines play an important role in ensuring the GNSS Survey measurements are what they claim to be.
- That role for best practice guidelines applies to:
  - the connection to the value standard and;
  - to the measurements in GNSS Survey itself;
- Best practice guidelines outline field procedures, which can be used to minimise the likelihood of errors such as:
  - Site selection to minimise multi-path
  - Dual occupations to identify incorrect ambiguity resolution
- The Guidelines also outline procedures for analysis of the quality of the measurements.

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## Misclosure Analysis for RTK

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