Positioning Infrastructures for Sustainable Land Governance

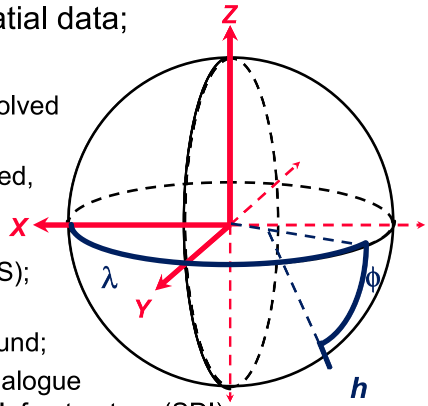
Matt Higgins
Principal Survey Advisor, Queensland Government, Australia
Vice President, International Federation of Surveyors (FIG)

Presentation Outline

- The Evolution towards Positioning Infrastructure;
- Geodetic Datum and its Traditional Role;
- An outline of the concept of Positioning Infrastructure;
- The 3 Roles of Positioning Infrastructure;
  - Continuing the Role of Geodetic Datum;
  - Monitoring Global Processes;
  - Enabling Real-Time Positioning;
- Trends from Positioning Infrastructure and their benefit for Land Governance in Developing Countries

The Traditional Geodetic Datum

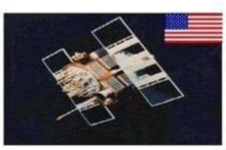
- Enables description of position as latitude, longitude and height and underpins all geo-spatial data;
- Characteristics:
  - Coverage - initially local but has evolved to national and continental;
  - Measurement – initially ground based, labor intensive, now more efficient using GPS and other Global Navigation Satellite Systems (GNSS);
  - Outcome – published positions on permanent survey marks in the ground;
  - Data management - initially very analogue but now a key part of Spatial Data Infrastructure (SDI).

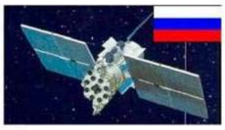


Roles for the Geodetic Datum

- Typical General Roles:
  - Control of topographic mapping and hydrographic charts;
  - Control for engineering, topographic and hydrographic surveys;
  - Support to SDI and underpinning many geospatial data sets;
- Role in Land Administration Systems to Date:
  - Support for Cadastral Surveying ranging from minimal to integral in the case of “coordinated cadastre”.
  - Control for small to medium scale cadastral mapping;
  - Recent trends more cost effective cadastral surveys enabled by GPS and its ability to easily work directly in the Geodetic Datum.

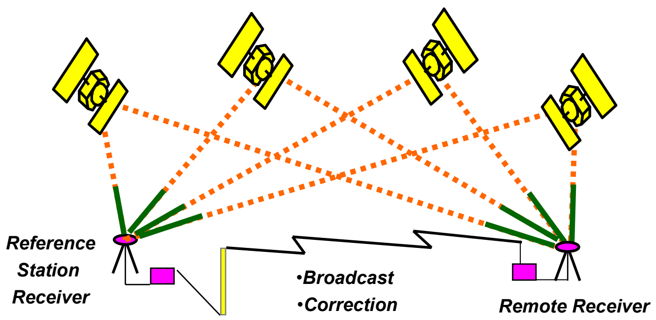
Positioning Infrastructure





- Positioning Infrastructure is based on Global Navigation Satellite Systems (GNSS);
- Next 5 years moving from 1 to 4 Global systems:
  - USA: Global Positioning System (GPS) - Now;
  - Russian Federation: GLONASS – by 2009;
  - European Satellite Navigation System (Galileo) – by 2013;
  - China: Compass – by 2013;
- Plus at least 2 Regional Systems
  - India: Indian Regional Navigation Satellite System (IRNSS);
  - Japan: Quasi-Zenith Satellite System (QZSS).

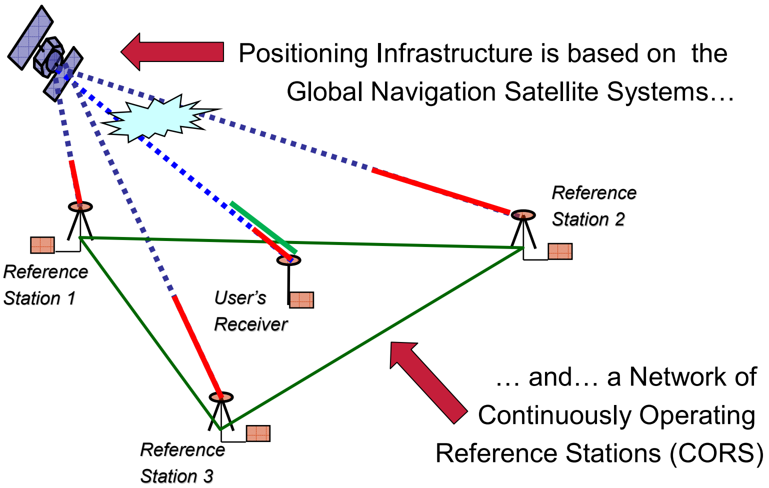
Improving Satellite Positioning



If User has access to GNSS Reference Receiver(s) and Communications…

"Real Time Precise Positioning"

Continuously Operating Reference Stations (CORS)



Positioning Infrastructure

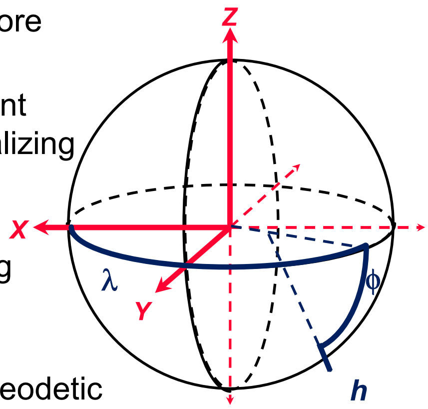
- Network of Continuously Operating Reference Stations placed at a spacing of 70km across coverage area;
- Feeding data to a Control Centre that processes data, computes corrections and sends them to the users' receiver;
- Requires state of the art communications for gathering data from Reference Stations and delivering corrections to users;
- Better coverage reliability improve productivity;
- Best practice approaches need two way communications which allows precise location based services – "virtual wrench";
- Many countries have national coverage;
- Australian state of Victoria has committed funds to achieve statewide coverage;
- Figure shows SunPOZ service in South East Queensland.

Roles of Positioning Infrastructure

1. Continuation of the traditional role of a Geodetic Datum in support of surveying and mapping activities;
2. As a stable reference frame for precise measurement and monitoring of global processes such as sea level rise and plate tectonics;
3. Extension to a true infrastructure that underpins the explosion in industrial and mass market use of positioning technology.

1. Continuing Geodetic Datum Role

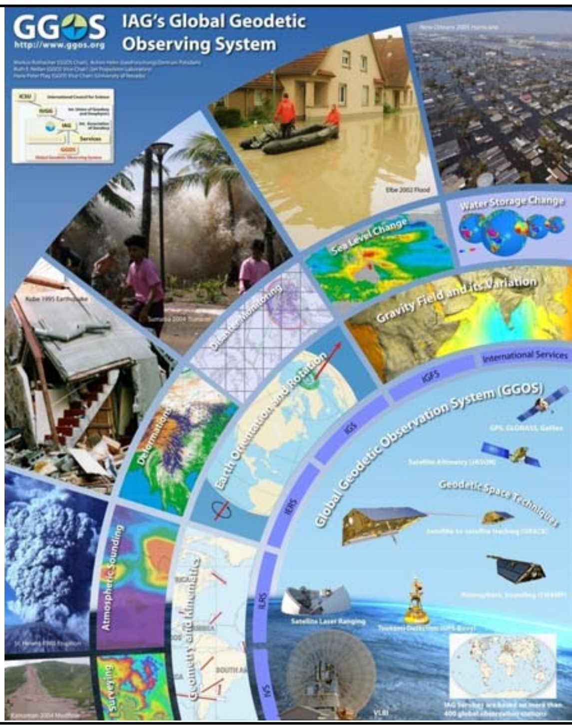
- Support beyond the traditional users to more and more spatially aware and more and more spatially enabled users;
- CORS complementing Permanent Survey Marks as a means of realizing and delivering geodetic datum;
- Increasing accuracy to stay ahead of increasingly demanding users;
- CORS networks enable rapid establishment of a high quality geodetic datum ~ especially relevant for developing countries, which can leap-frog to state of the art infrastructure.



2. Monitoring of Global Processes

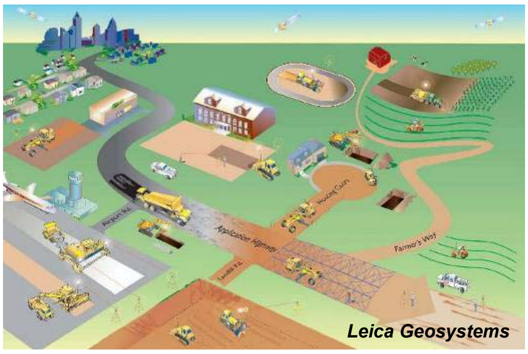
- Stable reference frame for measuring and monitoring change on a global scale:
  - Sea level due to global warming;
  - Atmosphere ~ short and long term;
  - Planet's overall water storage;
  - Ground cover ~ desertification or deforestation;
  - Earth's crust as motion, uplift or deformation and including plate tectonics;
  - Applying change detection to disaster monitoring and management.

2. Monitoring of Global Processes



3. Enabling Real-Time Positioning

- Surveying is no longer the major market for real-time precise positioning (centimetre accuracy);
- Main interest is guiding heavy machinery used in Agriculture, Construction and Mining;
- *"Machine Guidance"*



Leica Geosystems

Economic Benefits – Agriculture

- GNSS machine guidance can be applied widely in the grain, cotton, sugar and horticultural sectors of agriculture;
- Using "control traffic farming" can significantly reduce input costs;
- Condamine study findings:
  - Annual Yields up 10%;
  - Fuel and oil costs reduced 52%;
  - Labour costs reduced 67%;
  - Crop gross margin up by ($110);
- An estimated 10-15% of grain growers in Australia use GNSS for machine guidance;
- Increasing uptake requires better reference station infrastructure.

IGNSS 2008

Economic Benefits - Construction

- In civil engineering, machine guidance is delivering significant increases in productivity and improved on-site safety;
- Using GNSS machine guidance on Port of Brisbane Motorway contributed to significant savings:
  - Completed six months ahead of schedule (30% time reduction);
  - 10% reduction in total project costs;
  - 10% reduction in traffic management costs;
  - 40% reduction in lost time injuries.

Lorimer 2007

Economic Benefits - Mining

- In open cut Mining, precise GNSS is used for a variety of tasks including surveying, grading, dozing, drilling, collision avoidance and fleet management;
- Productivity increases are as much as 30% by adopting GNSS.

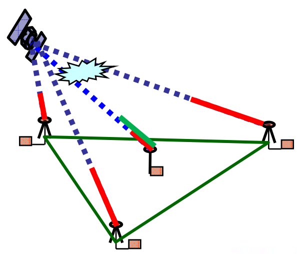
•Lorimer 2007

Benefit Across Australia

- Recent study by Allen Consulting found productivity gains with potential cumulative benefit $73 to $134 billion over next 20 years - in agriculture, construction and mining alone;
  - Relevant for World Bank, given that the development of rural infrastructure constitutes a substantial and growing component of Bank activities (World Bank, 2009).
- Significant environmental benefits from various sources, including reduced carbon footprint through greatly improved fuel efficiency.

Ad-hoc vs Infrastructure

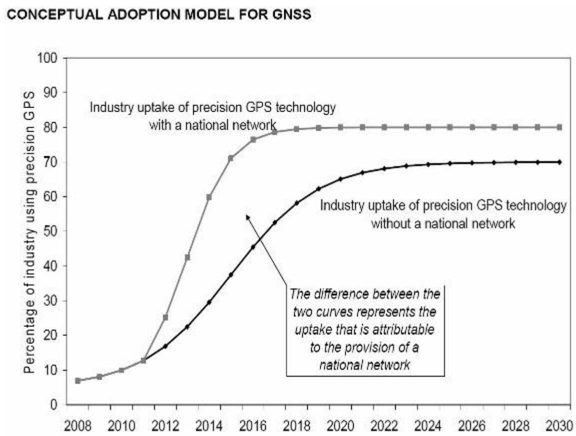
- Those benefits flow even with inefficient ad-hoc approach from most users running their own reference stations;
- Problems include:
  - Duplication and waste on unnecessary reference stations;
  - Lack of adherence to standards - coordinate systems, quality and data communications;
  - Lack of interoperability between equipment;
  - Steep learning curve = early adopters but limited take up across industries.



Need to move from
ad-hoc to ***infrastructure.***

The Value of Infrastructure

- The Allen Consulting study also found that a coordinated roll-out of national network of reference stations (an infrastructure approach rather than solely market forces) would increase total uptake and rate of uptake;
- Additional cumulative benefit $32 to $58 billion (gross) to 2030.



(Allen Consulting 2008 - Available at www.crcsi.com.au – Click on Publications)

Conclusion

- Trends from Positioning Infrastructure and their benefit for Land Governance in Developing Countries:
  - Much broader spatial enablement across society;
  - Ubiquitous positioning linked to real-time processes;
  - Efficient construction and maintenance of hard infrastructures such as water, transport, energy and telecommunications;
  - Precision agriculture increasing profits and yield and decreasing fuel, chemical and water use ~ contributing to reducing hunger and poverty, responding to climate change and improving environmental sustainability;
  - Measuring, monitoring and managing global change and natural disasters to improve long term decision-making associated with Land Governance.

XXIV FIG International Congress 2010

Sydney Convention & Exhibition Centre

www.fig2010.com

11 – 16 April 2010

We look forward to welcoming you to Sydney in 2010