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GNSS and the convergence of Geodesy and the Cadastre in Australia

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At the time of English settlement in Australia there were…

- No physically defined boundaries other than natural features (i.e. no fences, roads, walls …)
- No existing survey control. Consequently, land granted could only be defined by
  - "Metes and Bounds" or measurements and limits of the boundary lines,
  - Relating a land parcel with respect to a recognisable feature, or, after some time,
  - Relating a land parcel to an existing parcel

Problems with Early Land Surveys

- Crown Land was granted (freehold or leasehold) by the Governor to free settlers or emancipated convicts
- But descriptions of the land granted by the Governor often ambiguous.
- Techniques of land measurement in early 1800's very rudimentary
- Land was sometimes transacted (eg sold) before it was marked on the ground!

All of the above shaped the way the laws for boundary definition evolved.

Early Land Survey Instruments

Gunter's Chain

Compass - Bearings only good to +/- 2 degrees

Meanwhile….

- … as the cadastre spread in a fairly unstructured manner for over 40 years, Governor Darling recognised the importance of a trigonometrical survey.
- Map of Nineteen Counties (1834) by Sir Thomas Mitchell was the first geodetic survey in NSW.
- Followed by:
  - Accurate map of Sydney, 1854
  - Trig survey in Albury (500km south of Sydney), 1859
  - One third of NSW surveyed by 1895 with 2700 points.

Primary motivation for trig surveys was land administration

A national geodetic network in Australia

- The Australian Geodetic Datum 1966 (AGD66) provided a national framework
  - Minimised N – geoid/ellipsoid separation
  - Not geocentric
  - AMG66 map grid coordinates derived from UTM projection
  - ISG coords in NSW - 2° zones to reduce scale factor
- AGD84 was a readjustment using new Transit Doppler observations - still not geocentric
- GDA94 – Geocentric Datum of Australia implemented in 2000 to accord with GPS techniques
  - UTM projection provides MGA coords

Convergence of Geodesy and the Cadastre

- Surveyors have described themselves as either Cadastral or Geodetic
  - Cadastral work "from the part to the whole"
    - Fitting in with surrounding tenure as per the original intention of the first surveyor
  - Geodetic work "from the whole to the part"
- Public sector has nudged private surveyors (predominantly cadastral) toward convergence
  - Online survey mark searching with coordinates
  - Requirements to connect surveys to geodetic control

The influence of AUSPOS

- AUSPOS is a service offered by Geoscience Australia to provide 2cm accurate coordinates for surveyors using static GNSS for survey control (6 hrs of dual freq data)
- AUSPOS uses scientific software
  - Send file to service, receive report in 15 mins
- AUSPOS uses the local IGS stations and computes ITRF, WGS84, GDA94 and MGA.
- Can be used anywhere on Earth.

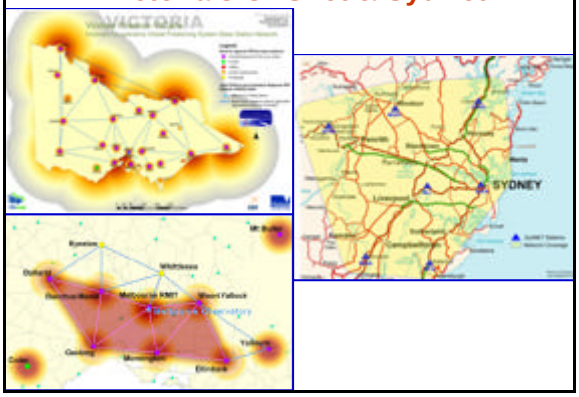
Issues with AUSPOS

- GDA coordinates locked in time → derived from ITRF using geodynamic modelling
- Coordinates do not always accord with published MGA coordinates due to distortions in existing geodetic network
  - AUSPOS exposes network distortions
- GNSS techniques provide direct connection to the datum → requires a new accuracy standard
  - Class and order replaced by class and Local Uncertainty
  - Positional Uncertainty relates to a connection to GDA

CORS networks in Australia

- First network in Victoria developed since 1994
  - VicPos – sub-metre across Victoria
  - MelbPos – 2cm across Melbourne
- SydNet - 9 stations across Sydney Basin
- SunPoz – 5 stations in SE Queensland
  - Trimble GPSnet proprietary service
- GPSnetwork – Perth – 5 stations across Perth
  - First privately owned network in Australia

Victoria's GPSnet & SydNet



Implications for CORS networks

- Full network RTK requires at least 2cm coordinate accuracy for algorithms to function
  - Homogeneous geodetic network required for CORS overlay
- Challenge existing survey regulations
  - Accuracy restricted to length measures
- Ultimately CORS will relieve pressure on ground mark infrastructure
  - Costly maintenance for public sector
- GNSS manufacturers providing integrated surveying designed for CORS networks
  - Combination of total station and GPS

Implications for Surveyors

- Survey regulations are being rewritten to accommodate GNSS techniques
  - Length requirements are relaxed or coordinate measures included
- Legal traceability of position not length is addressed
- Coordinate based methods are encouraged
- Connections to geodetic control required on cadastral surveys

Future services for Cadastral Surveyors

- AUSPOS – Provides MGA coords anywhere in the Australia
  - Requires 6 hrs of dual freq static data for 2cm accuracy
- CORS networks – GPSnet, SunPoz, SydNet, GPSnet Perth
  - No base station needed
  - MGA coords
  - Data is free (SydNet) or inexpensive
- Impact of new GNSS signals – Modernised GPS (L2C), revitalised Glonass, Galileo, QZSS
  - Up to 80 satellites
  - Faster initialisation and more reliable
  - No survey planning required, even for RTK
- Coordinate based methods give rise to electronic plan lodgement, digital registration and support the DCDB

Concluding remarks

- From divergent origins, the cadastre and geodetic network are converging largely due to GPS/GNSS techniques.
- The global AUSPOS service exposed distortions in the geodetic infrastructure.
- CORS networks have provided further impetus to merge the cadastre and geodetic network.
- Convergence opens the way for many other services such as e-plan, digital registration and a high accuracy DCDB.
- Surveyors should embrace this opportunity to provide value added services, both surveying and spatial, to clients that were never previously possible