Slide 1

GNSS, CORS and Positioning Infrastructure: Business and the Future

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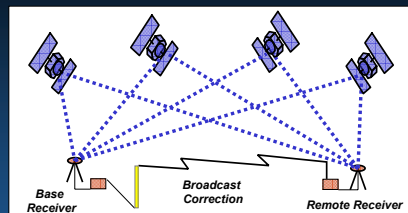*Member UN International Committee on GNSS*

FIG Regional Conference Costa Rica November 2007

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Slide 2

Presentation Outline

- Approaches to Centimetre Accuracy Positioning;
- Economic Benefits from centimetre accuracy applications;
- Business Models for delivering CORS Infrastructure;
- Some Comments on the Future.

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Approaches to Centimetre Accuracy GNSS

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Traditional Techniques for Centimetre Positioning with GPS

Base Receiver   *Broadcast Correction*   *Remote Receiver*

- *Process 2 datasets in PC for Centimetre accuracy*
- *If Surveyor sets up their own GPS Base Receiver and their own radio for each Survey, "Real Time GPS Surveying" – on a Survey by Survey basis.*

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RTK from CORS Networks

- "RTK Networks" can deliver centimetre accuracy in real-time using survey quality GNSS receivers and mobile phone communications;
- Note that the reference stations, communications and data processing can be separate components of the overall infrastructure;
- Better reference station coverage and more reliable communications improve productivity;
- In the Queensland surveying market, productivity improvements of 30-50% for surveyors using the SunPOZ precise positioning service.

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Economic Benefits of GNSS

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Economic Benefits from GNSS

- Time for survey control for photogrammetric mapping from 4 months down to 1 week;
- Rail track survey costs reduced by 80% through GNSS based automation.

Economic Benefits from GNSS

- *BUT*… Surveying is no longer the major market for centimetre accuracy;
- Guiding heavy machinery used in Agriculture, Maritime, Mining and Construction;
- *"Machine Guidance"*

Leica Geosystems

Economic Benefits from GNSS

- GNSS machine control in the form of auto-steer is widely used in the grain, cotton, sugar and horticultural sectors of Queensland agriculture;
- Using auto-steer for control traffic farming can reduce input costs of fuel, seed, fertilizer, herbicide and time by 10-20%;
- An estimated 15% of grain growers in Australia use GNSS for machine guidance and 9% for auto-steer;
- Start up costs and lack of CORS Infrastructure are seen as major impediments to further uptake of the machine guidance approach.

Economic Benefits from GNSS

- In civil engineering, machine guidance is delivering significant increases in productivity and improved on-site safety;
- Using GNSS machine guidance and other innovative techniques the Port of Brisbane Motorway was completed six months ahead of schedule (30% reduction in time required), with a 10% reduction in total project costs, 10% reduction in traffic management costs and 40% reduction in lost time injuries.

Economic Benefits from GNSS

- Accurate guidance of Shipping in Ports can bring significant benefits;
- By introducing GNSS pilotage systems 4 fewer buoys were required at a Queensland coal port with a cost saving of A$4 Million (USD 3.6M).

Economic Benefits from GNSS

- 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.

GNSS in Mining

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GNSS in Mining

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*Business Models
for Delivering
CORS Infrastructure*

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The CORS Network Business

Specify Own Operate Deliver

Role of Government ?

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The CORS Network Business

Specify Own Operate Deliver

Government *Partner*

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The CORS Network Business

Specify Own Operate Deliver

Government
Market Segment 1

Government *Partner*
Market Segment 2

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The CORS Network Business

Specify → Own → Operate → Deliver

Government → Partner 2 → Partner 3

Partner 1

The CORS Network Business

The CORS Network Business

The CORS Network Business

The CORS Network Business

Specify → Own → Operate → Deliver

?

Major New R&D Project

"Delivering precise positioning services in regional areas"

Major New R&D Project
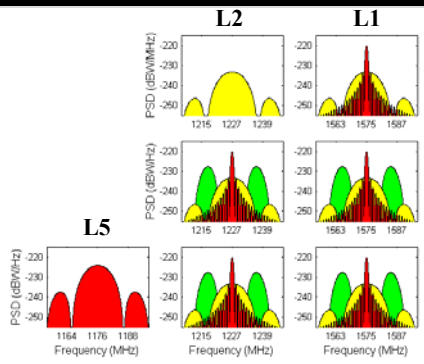
- Underlying Motivation:
  - Existing networks elsewhere tend to be in areas of *thick infrastructure* (eg for communications);
  - Germany has SAPOS at ~60km Density;
  - Queensland has 5 times the area and 1/20th of the population of Germany;
  - So the per capita Cost in Qld is 100 times more than Germany;
  - So… We need to do it differently…
- Two parts to Project
  - Business Issues *(Matt Higgins - NRW)*
  - Technical Issues *(Yanming Feng - QUT)*

Some Comments on the Future

GPS Signal Modernization
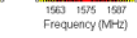
Block IIA/IIR
Present Signals

Block IIR-M
2nd Civil Signal and M-code

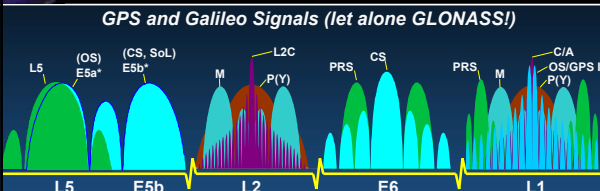Block IIF + Block III
3rd Civil Signal
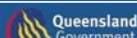
More Satellites

- USA: Global Positioning System (GPS) + (WAAS)
- Russian Federation: Global Navigation Satellite System (GLONASS) + (SDCM)
- European Satellite Navigation System (Galileo) + (EGNOS)
- China: Compass/BeiDou Navigation Satellite System (CNSS)
- India: Indian Regional Navigation Satellite System (IRNSS) + (GAGAN)
- Japan: Quasi-Zenith Satellite System (QZSS) and MTSAT (Multi-functional Transport Satellite) + (MSAS)

GPS (1973)
GLONASS (1976)
GALILEO (1999)

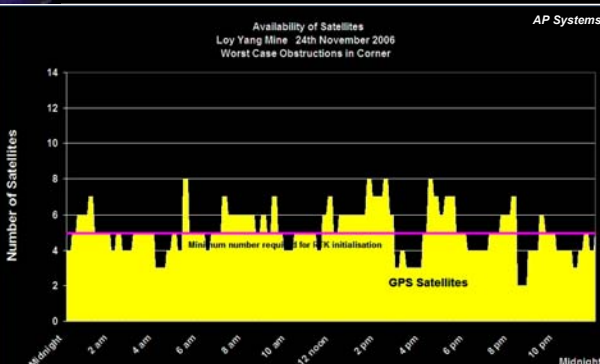## More Signals

GPS and Galileo Signals (let alone GLONASS!)

| L5 (1176.45 MHz) | E5b (1217.14 MHz) | L2 (1227.6 MHz) | E6 (1278.75 MHz) | L1 (1575.42 MHz) |

- **Coded signals should make carrier phase tracking simpler and cheaper but which signals will be most useful and what receivers will be for sale?**
- **With state-of-the-art technology for generating and processing multiple signals, will differential carrier smoothed ranging deliver centimetre accuracy?**

Value of Extra Satellites

AP Systems

Availability of Satellites
Loy Yang Mine 24th November 2006
Worst Case Obstructions in Corner

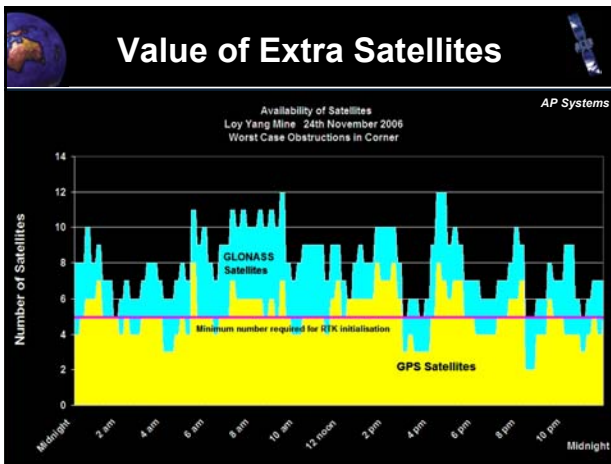## Value of Extra Satellites

AP Systems

Ubiquitous Positioning

Combining GNSS with pseudolites, WiFi, RFID, cellular phone triangulation, etc

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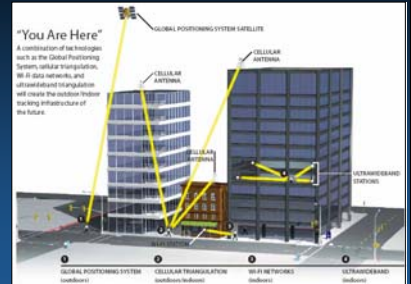
Conclusion

- Approaches to Centimetre Accuracy Positioning are moving from Stand-Alone Reference Stations to a true Infrastructure;
- Economic Benefits are moving from Surveying into Machine Guidance for Agriculture, Construction, Mining etc;
- Business Models for delivering CORS Infrastructure should be standards based but need to be tailored to the physical, organisational and economic conditions for a given area;
- Challenge is to provide an infrastructure that is both economically viable and technically flexible to serve users of current and coming generations of GNSS and that extend to supporting truly ubiquitous positioning;
- FIG is interested in helping address these issues.

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