Locata: A New Constellation for High Accuracy Outdoor & Indoor Positioning

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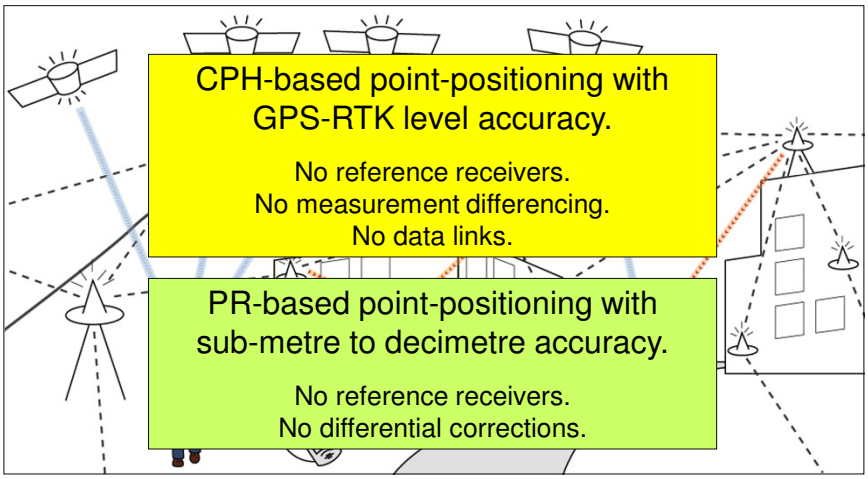
Introductory Remarks

- GNSS signals can be obstructed outdoors leading to loss of availability, *& are vulnerable to RFI*.
- GNSS signals are attenuated indoors, *& cannot give levels of accuracy similar to outdoors*.
- APNT systems such as *Locata* can address availability issues *both outdoors & indoors*, for land and air applications.
- New directional antenna technology recently developed by *Locata* gives us hope to address multipath & RFI issues.

Locata Positioning Concept



Locata receiver can use signals from *LocataNet*.
Integrated Locata & GNSS receiver possible for certain applications.
But once a *LocataNet* is established it can operate independently of GNSS.

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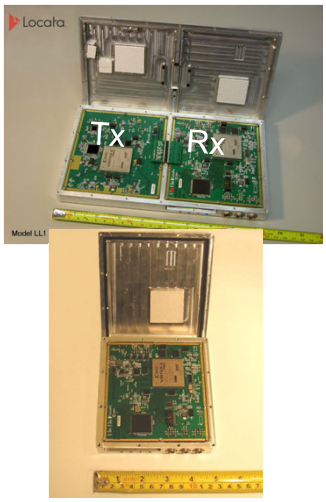
Current System

- Signal Structure
  - Licence-free ISM frequency band (2.4GHz)
  - Dual-frequency carriers
  - Bespoke CDMA PRN codes - *ICD to be released Sept 2011*
  - Precise TDMA pulsing - *for near-far problem*
  - >1 Watt output power - *range of over 10's km*
- *LocataLite*
  - Time-synchronised transceiver network
  - Dual Tx antennas
  - Prototype has modular board design based on FPGA & DDS technology
  - Uses low-cost clock (TCXO), shared by receiver section
- *Locata Receiver*
  - CPH or PR single point-positioning
  - CPH AR at known point or OTF
  - Real-time positioning at 10Hz



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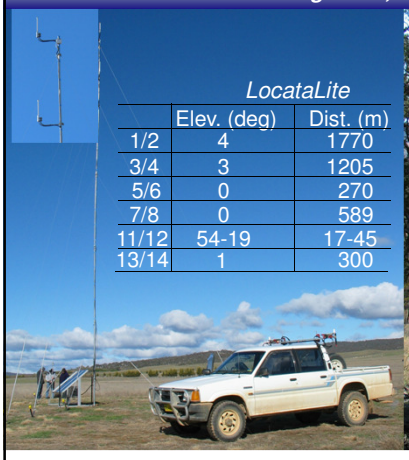
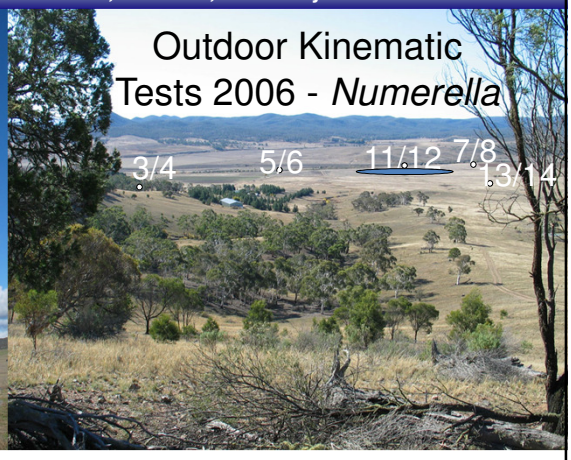


LocataLite

	Elev. (deg)	Dist. (m)
1/2	4	1770
3/4	3	1205
5/6	0	270
7/8	0	589
11/12	54-19	17-45
13/14	1	300



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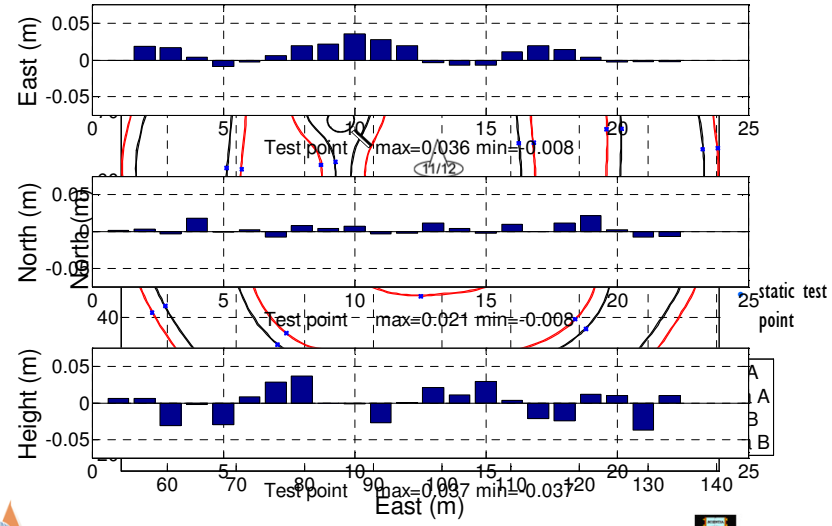
Trajectory GPS-RTK vs. *Locata*



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More than just an engineering curiosity…

- when it has to be right

Leica Geosystems

Press Release

For immediate release
(Brisbane, Australia. 19 January 2011)

Leica Geosystems Launch Terrestrial GPS Augmentation Network

Delivering total positioning coverage across site, Leica's GPS Augmentation technology ensures optimal fleet productivity

Mining fleet management specialists Leica Geosystems have launched their GPS Augmentation Network, incorporating exclusive technology developed by Locata Corporation. The innovative terrestrial network ensures 24/7 positioning coverage in adverse GPS situations.

Open cut mines can present challenges for satellite based positioning as the pit becomes deeper, and on sites where the walls are steep. The positioning signals transmitted from satellites can become obstructed by the pit walls, reducing GPS availability and accuracy. The angle of 'sky view' is further reduced where machinery is in close proximity to the pit walls. Leica's GPS augmentation network fills holes in coverage and ensures consistent and accurate positioning is always available.

Under an exclusive technology partnership with Locata, Leica's Jigsaw360 is the first fleet management system with the ability to replicate the GPS satellite constellation from the ground. This ground breaking technology enables a level of control and flexibility which is not possible from the standard satellite GPS network.

Leica Geosystems LocataLite positioned at the pit rim

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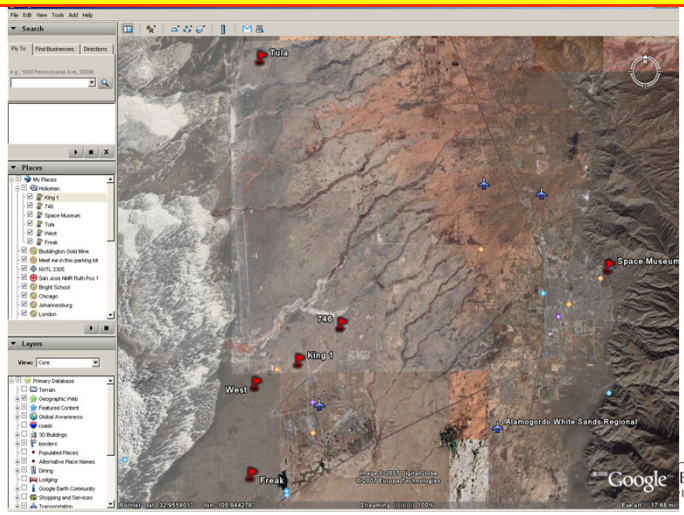
USAF - Holloman AFB – First Tests

First large "test" LocataNet set-up in 2008

Covered ~52km x 15km…. USAF new "Truth Reference System"



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Locata…Backup to GPS

"Wide-Area" **APNT**

- ☑ Sole-source USAF contract
- ☑ Cover 2,500 sq. miles
- ☑ GPS *completely* jammed
- ☑ HP position: < 10 cm

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USAF – White Sands Missile Range

Sole-source contract to cover > 2,500 sq. miles White Sands

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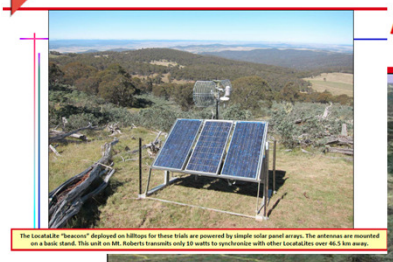
Recent Aircraft Trials in Australia

First Wide-Area APNT Trials – Australia May 2011



The LocataLite "beacons" deployed on hilltops for these trials are powered by simple solar panel arrays. The antennas are mounted on a basic stand. This unit on Mt. Roberts transmits only 10 watts to synchronize with other LocataLites over 46.5 km away.

APNT Trials – Australia May 2011

Distances
A to B = 44.6 km
A to C = 46.5 km
B to C = 31.9 km
C to D = 48.3 km

This temporary 6-transmitter LocataNet covers >1,500 sq km around the Snowy Mountains Airport, NSW Australia

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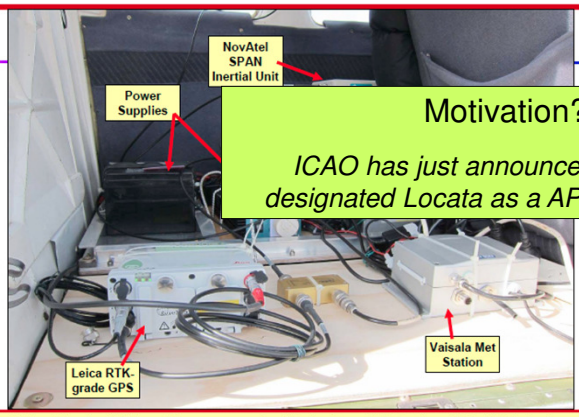

A view of the aircraft high-precision measurement and "truth reference" electronics against which the Locata position solution results will be compared. Results will be published in industry papers in the second half of 2011.

Motivation?

ICAO has just announced that it has designated Locata as a APNT candidate.

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Recent Indoor Testing

- Indoor experiments conducted in a metal shed at Numerella (30m × 15m) in late-2010.

- Severe multipath environment for signals.

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TimeTenna

- Uses an array of antenna elements & SW-controlled directional beams.
- Takes advantage of *Locata's* proprietary signal structure and time synchronisation.
- Dynamically tracks *only* direct line-of-sight ranging signals.

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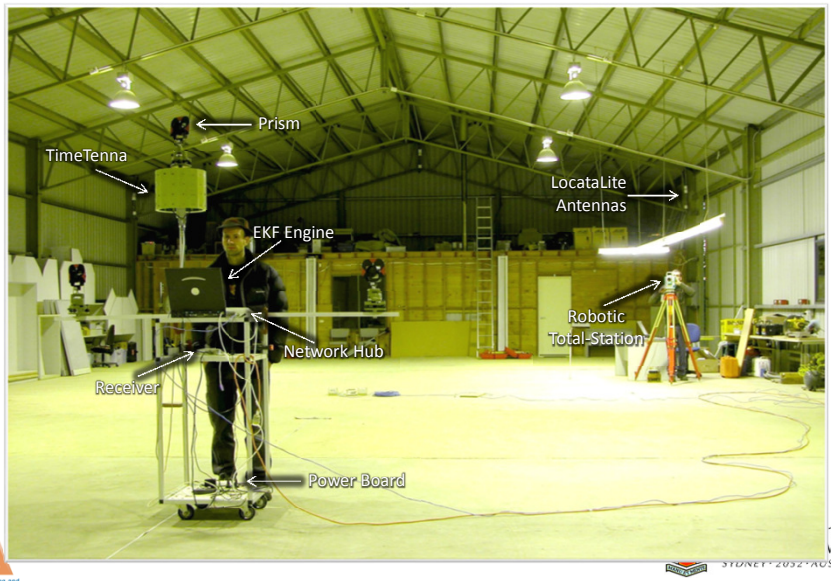
Indoor Test Setup



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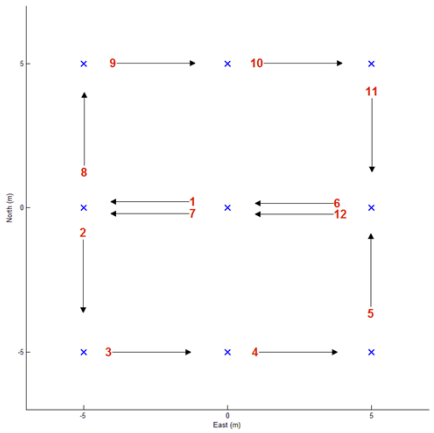
Static Test

- Receiver moved between adjacent marked points.
- Static for at least one minute per point.



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Static Results

- RTS solutions considered as 'truth'.
- Nav Engine: (mostly) better than 2cm accuracy
- EKF-based: better than 3cm accuracy (except at initialisation startup).
- *Remarkable results given the test conditions!*

Point Index	Nav Error Distance (mm)	EKF Error Distance (mm)
1	7.0	633.0
2	19.7	287.9
3	12.8	7.1
4	7.1	12.2
5	2.9	6.5
6	5.2	23.5
7	9.3	24.7
8	0.7	16.9
9	42.6	0.3
10	18.5	5.5
11	12.1	21.0
12	8.7	23.0
13	8.5	16.3

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Kinematic Test

- Receiver started on initial known point.
- Moved continuously in a random pattern.
- The EKF-based solution converges after some initial movement.
- A *visual* inspection of the results confirms relative accuracy performance.

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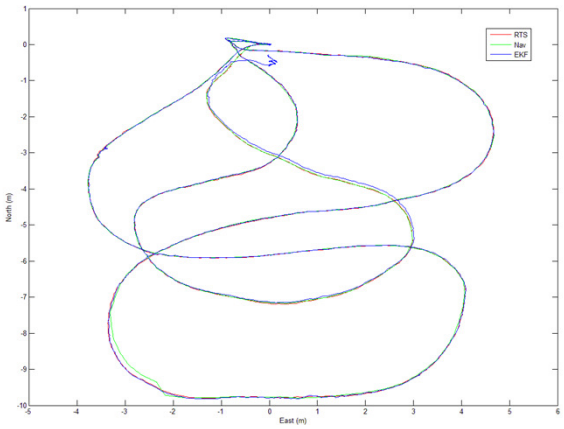
Kinematic Results



- *Majority of the trajectory errors were less than 3cm*

Concluding Remarks

- *Locata* deployed at open-cut mine sites for several years to augment GNSS where availability is poor.
- *Leica Geosystems* integrated GNSS/*Locata* mine positioning products recently announced.
- Further *Locata*-only & GNSS/*Locata* real world tests underway, including airborne positioning.
- First indoor tests of *Locata's* new prototype antenna successfully demonstrated multipath mitigation.
- Robust cm-level indoor positioning accuracy for industrial applications is closer to reality.
- Watch for further news in the coming months…*can Locata be considered a new PNT "constellation"? An APNT system?*

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THANK YOU FOR YOUR ATTENTION

ANY QUESTIONS ?

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