Australian Update

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Outline

- Update on SouthPAN SBAS being developed by the governments of Australia and New Zealand.
- Australian Department of Defence Joint Project 9380 on *Assured PNT in a Contested Environment.*
- Australian Department of Home Affairs – Space Technology recognised as 1 of 11 Critical Infrastructure Sectors.
- Latest developments with some Australian Companies working in PNT ~ including recent Australian Space Agency grants for "PNT in Space"

SouthPAN

ICG-17

16 October 2023

Madrid, Spain

Vincent Rooke, Geoscience Australia

Matt Amos, Land Information New Zealand

SouthPAN Early Open Services

L1 SBAS Open Service

- Delivered on L1 signal
- Augments GPS L1 C/A
- Better than 3m (H) and 4m (V)

DFMC SBAS Open Service

- Delivered on L5 signal
- Augments GPS L1 C/A + L5, and Galileo E1 + E5a
- Better than 1.5m (H) and 2.5m (V)

PPP via SouthPAN

- Delivered on L5 signal
- Augments GPS L1 C/A + L5, and Galileo E1 + E5a
- Better than 0.38m (H) and 0.53m (V), with 80 min convergence

Early Open Services have been available since September 2022 and will improve as SouthPAN is deployed

Full Operating Capability, including Safety-of-Life services, is expected in 2028

More detail is available in the SouthPAN Service Definition Document for Open Services.

Year 1 Review - Programme

- Early Open Services delivered (IOC-95)
- System PDR completed
- Contract awarded to Viasat+Inmarsat for first SouthPAN Geostationary Payload (SGP-01)
- RFT for second payload released

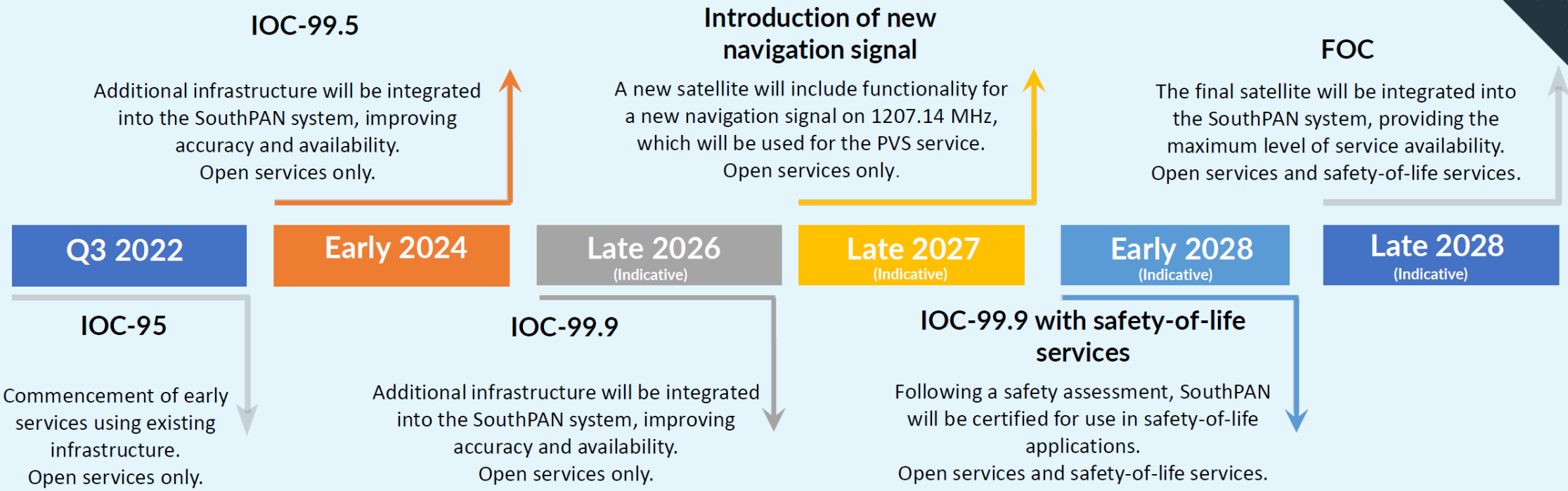
Year 1 Review - Infrastructure

- GNSS Reference Station surveys
- Land acquisition for reference stations
- Uplink Facility works in Uralla and Awarua

Year 1 Review – Service Performance

Service	Metric	Target	Actual
OS-L1-SIS	L1 navigation signal availability (%)	95.000	98.74
OS-L1-SIS	HPE (m) (worst) / VPE (m) (worst)	3.0 / 4.0	2.91 / 3.15
OS-L1-SIS	L1 SBAS open service availability (%)	90.000	98.01
OS-DFMC-SIS	L5 navigation signal availability (%)	95.000	98.75
OS-DFMC-SIS	HPE (m) (worst) / VPE (m) (worst)	1.5 / 2.5	1.36 / 1.95
OS-DFMC-SIS	DFMC SBAS open service availability (%)	90.000	98.04
OS-PVS-SIS	L5 navigation signal availability (%)	95.000	98.75
OS-PVS-SIS	HPE (m) (worst) / VPE (m) (worst)	0.375 / 0.525	0.195 / 0.285
OS-PVS-SIS	Convergence time (min)	80	59
OS-PVS-SIS	PVS open service availability (%)	90.000	97.90

Establishment Timeline



Future Developments (1)

- SGP-01 PDR – Dec 2023
- SGP-02 tender close – Jan 2024
- Early Open Services improve to 99.5% – Feb 2024
- SGP-01 CDR – mid 2024
- SouthPAN CDR – mid 2024

Future Developments (2)

- SouthPAN Data Access Services – Internet delivery coming soon
- SouthPAN 3rd Navigation Channel (L5b)
- SGP-01 operational in 2027
- SGP-02 operational 2028 onwards
- SouthPAN use cases
- Service monitoring website

Further Information

- Contact details
  - clientservices@ga.gov.au
  - southpan@linz.govt.nz

- Websites
  - www.ga.gov.au/southpan
  - www.linz.govt.nz/southpan

Service definition document available on above websites

JP9380 - Assured PNT in a Contested Environment

Australian Government
Department of Defence

- Associated procurement is underway with the RFI for Phase 1 now closed.
- The following points are taken from the RFI documentation…
- *The 2020 Force Structure Plan and the 2023 Defence Strategic Review have validated the need for JP9380. As such, Joint Project JP9380 Phase 1 Assured Positioning Navigation and Timing (A-PNT) was established to assure the Australian Defence Force's (ADF) PNT capabilities through two (2) major scope elements.*
  - *Establishment of an ADF Joint Navigation Warfare (NAVWAR) Centre (ADF JNWC) - Providing PNT expertise to educate and support the ADF; and*
  - *Establishment of an enduring multilayered PNT Strategy – develop and support the resilience of ADF NAVWAR through a multilayered PNT strategy providing an assured capability in contested environments.*

Department of Home Affairs – Critical Infrastructure

Australian Government
Department of Home Affairs

CYBER AND INFRASTRUCTURE SECURITY CENTRE

- The Security of Critical Infrastructure Act 2018 applies to 11 sectors:
- Communications
- Financial services and markets
- Data storage and processing
- Defence
- Higher education and research
- Energy
- Food and grocery
- Healthcare and medical
- Space technology
- Transport
- Water and sewerage

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Department of Home Affairs – Critical Infrastructure

Australian Government
Department of Home Affairs

CYBER AND INFRASTRUCTURE SECURITY CENTRE

- **Space Sector Group** - provides support and guidance to the Trusted Information Sharing Network on the use of space-based systems, technologies and information by Australian critical infrastructure. The group's focus is on current, emerging and future (medium to long-term) issues and trends.
  (The Australian Space Agency provides secretariat support to the Space Sector Group).
- Space-based assets, including:
  - PNT Satellites.
  - Communication Satellites.
  - Earth Observation Satellites.
- Ground-based assets, including:
  - Command Centres.
  - Ground Stations.
  - Deep Space Communication Centres.

Some Australian Companies Working in PNT

Locata Testing by European Commission's Joint Research Centre

Locata

JRC EUROPEAN COMMISSION

Summary of Positioning Test Results

INDOOR POSITIONING

STATIC: **8** millimetres

KINEMATIC: **5** millimetres

OUTDOOR POSITIONING

STATIC: **11** millimetres

KINEMATIC: **10** millimetres

Locata Positioning Type	2D Mean Difference (mm)	2D Standard Deviation (mm)	2D RMSE (mm)	Reference	Number of Points
Average Outdoor Static	11	4	12	Total Station	58
Average Outdoor Kinematic	10	5	11	GNSS (2D difference)	48,701
Average Indoor Static	8	5	10	Total Station	14
Average Indoor Kinematic	5	4	6	Total Station (cross-track)	269

Summary of Timing Test Results

OVER 6 DAYS OF TESTING Internal Time Transfer

MEAN: **261** picoseconds

STD DEV: **49** picoseconds

OVER 6 DAYS OF TESTING External Time Synchronization

MEAN: **218** picoseconds

STD DEV: **565** picoseconds

Locata Time Transfer Type	Mean [ns]	Std Dev [ns]	MTIE [ns]	Peak-to-Peak [ns]	Samples [1 Hz]
Average Internal Time Transfer (over 6 days)	0.261	0.049	0.494	0.434	518,406
Average External Time Transfer (over 6 days)	0.218	0.565	3.062	5.641	518,406

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GRIFFIN — WHY, WHEN & WHAT

WHY:

Significant USA GPS Jamming & Spoofing Events Affecting Aviation – select examples

- **17th Oct 2022 – Dallas Fort Worth Int Airport- 44 hour episode** - closure runway & 40mile airspace closure
- **21st Jan 2021 – Denver Airport 33 Hour episode –** 8000 sqMiles regions effecting WAAS GBAS &ADS-B
- **July 2019 - Sun Valley, Idaho's Friedman Memorial Airport** - anomaly causing erroneous aircraft heading.
- **March 2015 – Sydney Aust Mascot Airport –** Multiple (Qty60) disruptions GBAS CAT-1 approach runway 16R

much more and it's only going to get worse into the future..!!

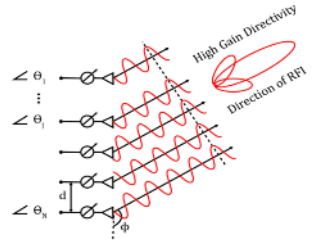
WHEN / HISTORY:

- 1995 AirServices Aust prototype GPS SCAT-1 Instrument Landing Sydney (pre-GBAS) supporting Norfolk & Lord Howe Islands air operations.
- 1998-2007 AirServices prototypes SBAS & GRAS (SBAS hybrid) Aust CAT-1 Vertical Guidance.
- **2008 – AirServices recognising future GPS Jamming & Spoofing (J&S) will compromise SBAS/GBAS/ADS-B/TCAS, launches joint Aust Universities J&S geolocation R&D project.**
- 2010—AirServices withdraws, GPSat Systems assumes project responsibility & continues funding R&D with ongoing Australian Research Council support.
- 2015 to 2024 GPSat Systems continues ongoing R&D investment.

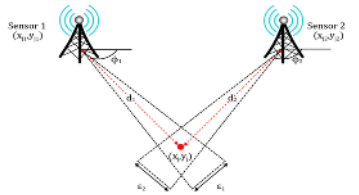
WHAT

— Fused RF Sensor Technologies

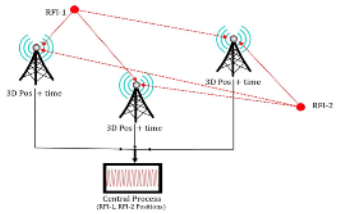
Electronic Phase Beam Form



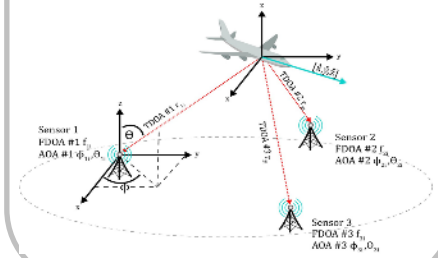
Automatic Beam Steer (MUSIC)



Time Difference Of Arrival



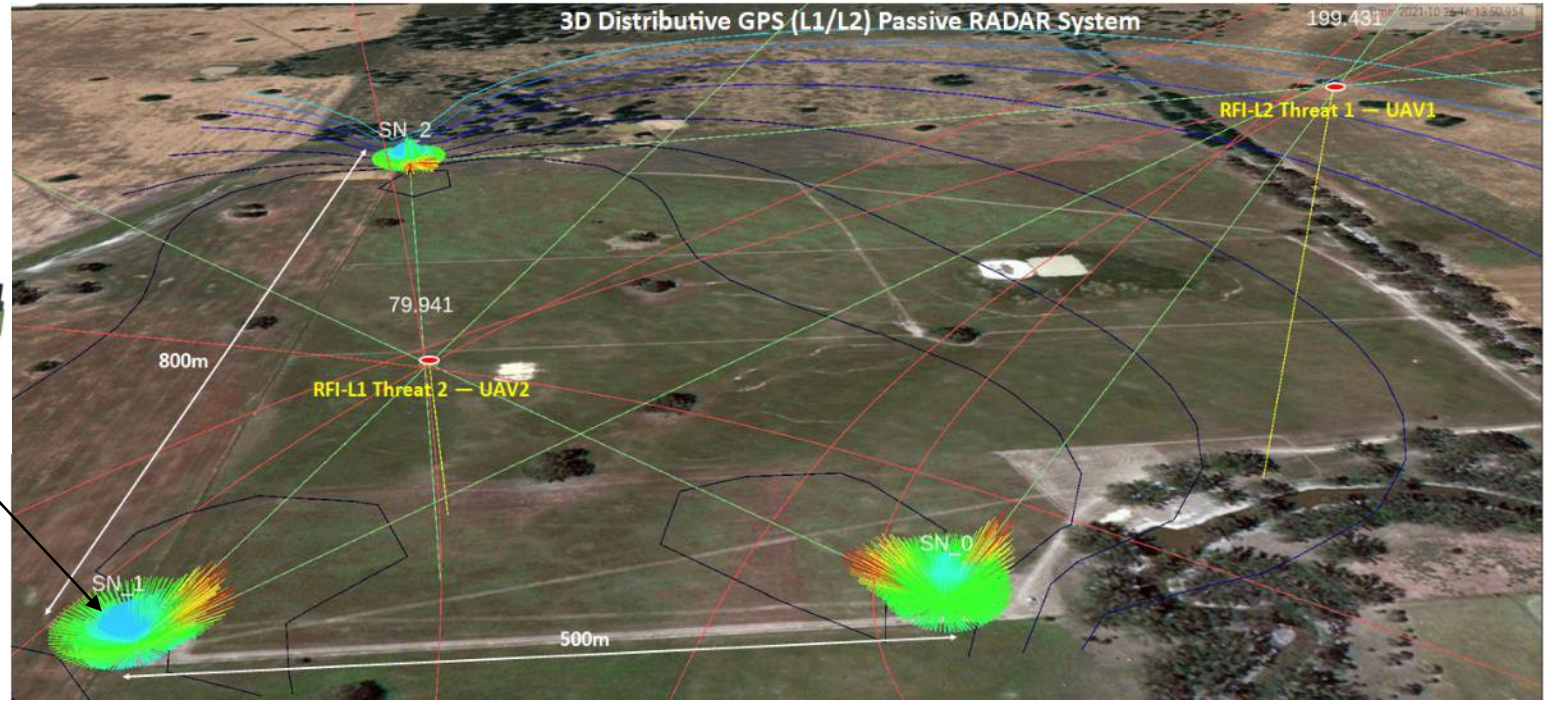
Frequency Difference Of Arrival



GRIFFIN — 3D Distributed GPS (L1/L2) Passive RADAR

- For Mission/ Safety Critical GPS/ GNSS users, regional GBAS, SBAS, etc. other “dual use” infrastructure.
- Delivers REAL TIME 3D REGIONAL (100s sqMiles) GPS (L1/L2) SPECTRUM SITUATIONAL AWARENESS Geospatial interactive 3D Heat Maps—Cesium3D.
- Simultaneously handles multiple Jamming & Spoofing RFI threats in any combination of ground, airborne and space (LEO/MEO) domains.
- Currently TRL7 with extensive 4 weeks testing central Australia (July 23).

GRIFFIN SENSOR ELECTRONICS

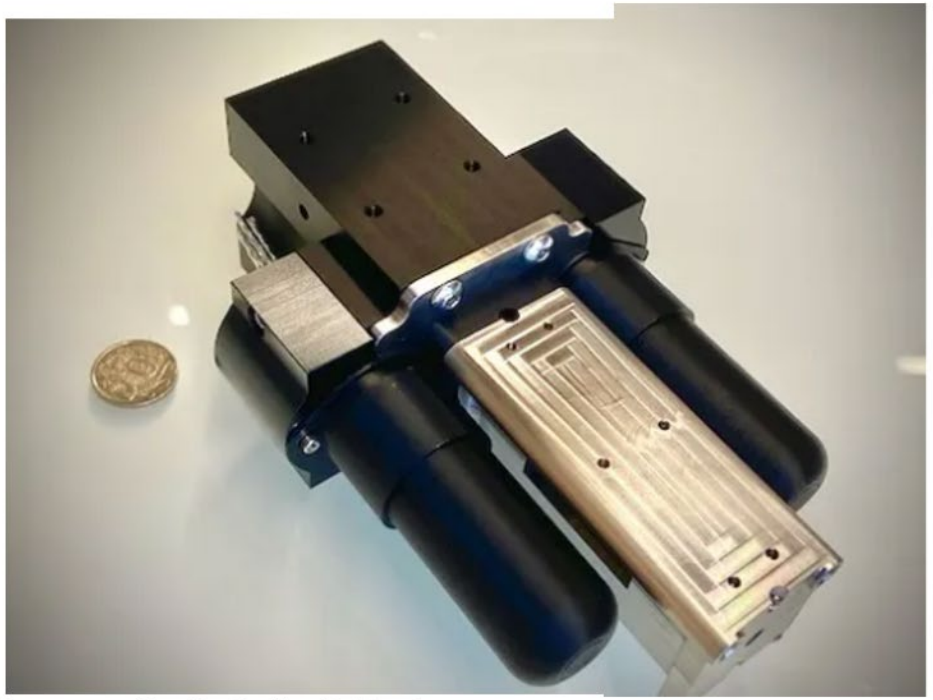


Moon to Mars
Demonstrator Mission Grants

- **$5,272,805** – Consortium led by Advanced Navigation.
- **Project LUNA** (Laser measurement Unit for Navigational Aid) will demonstrate the performance and capability of the mature Australian LiDAV technology, opening doors to integrate the technology to space transportation, infrastructure, and operations service providers. The technology will be given the ultimate demonstration and evaluation, operating on board Intuitive Machines' Nova-C lander, during controlled descent and landing on the lunar surface.

Moon to Mars Demonstrator Mission Grants

- **$3,725,160** – Consortium led by QuantX Labs.
- **The Kairos-1 Mission** will build a next-generation atomic clock and place it in orbit. Kairos-1 will result in Australia launching one of the globe's most complex quantum devices into orbit. We will verify the clock performance and be able to demonstrate its superiority against current space based GNSS clocks. Clocks are key underpinning resource for navigation, timing synchronisation and numerous other space activities – this mission will place Australia and QuantX at the forefront of that.




IGNSS2024
7 - 9 February 2024
Colombo Theatres,
UNSW Sydney