FIELD TESTING OF 5G BASED HIGH-ACCURACY POSITIONING USING RTK AND PPP-RTK

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Session A4: Land-Based Applications

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CONTEXT

5G Precise Positioning Testbed Project

- Project Sponsored through a government grant under The Australian 5G Innovation Initiative
- Development and demonstration of 5G precise positioning capabilities through collaboration with Technical and Demo Partners
- This project aims to improve the accessibility of precise positioning using 5G
- Key objectives include:
    - Overcoming interoperability barriers
    - Proof of concept integration with user devices
    - Demonstration of 3GPP standards in real-world use cases
    - Evaluating the economic benefits

Project Sponsor

Australian Government
Department of Infrastructure, Transport, Regional Development, Communications and the Arts

Technical partners

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ERICSSON
OPTUS
FRONTIER SI

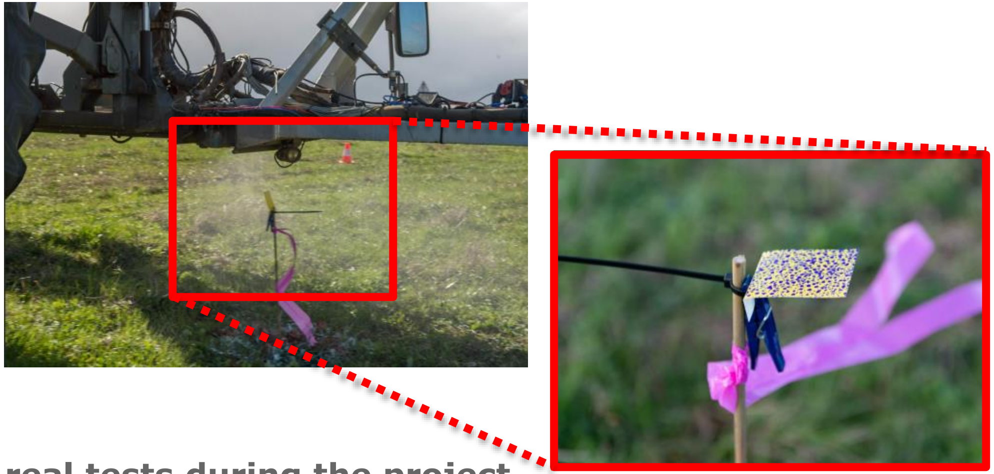
Demonstration partners

Position Partners
KONDININ GROUP
Platfarm

CONTEXT

Agriculture use cases tested in the project:

- Vineyard management – e.g., precise spraying, pruning, harvesting
- Precise broadacre crop spraying

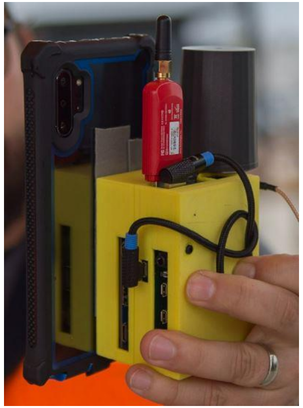


Photos taken by Dan Woodrow (Frontier SI) in real tests during the project

CONTEXT

Other use cases tested in the project

- Augmented Reality for construction
  - Integration of Digital Twin data and precise position in augmented reality capable device
- Drone delivery
  - Simulation of drone delivery of medical supplies
  - Integration with UTM systems

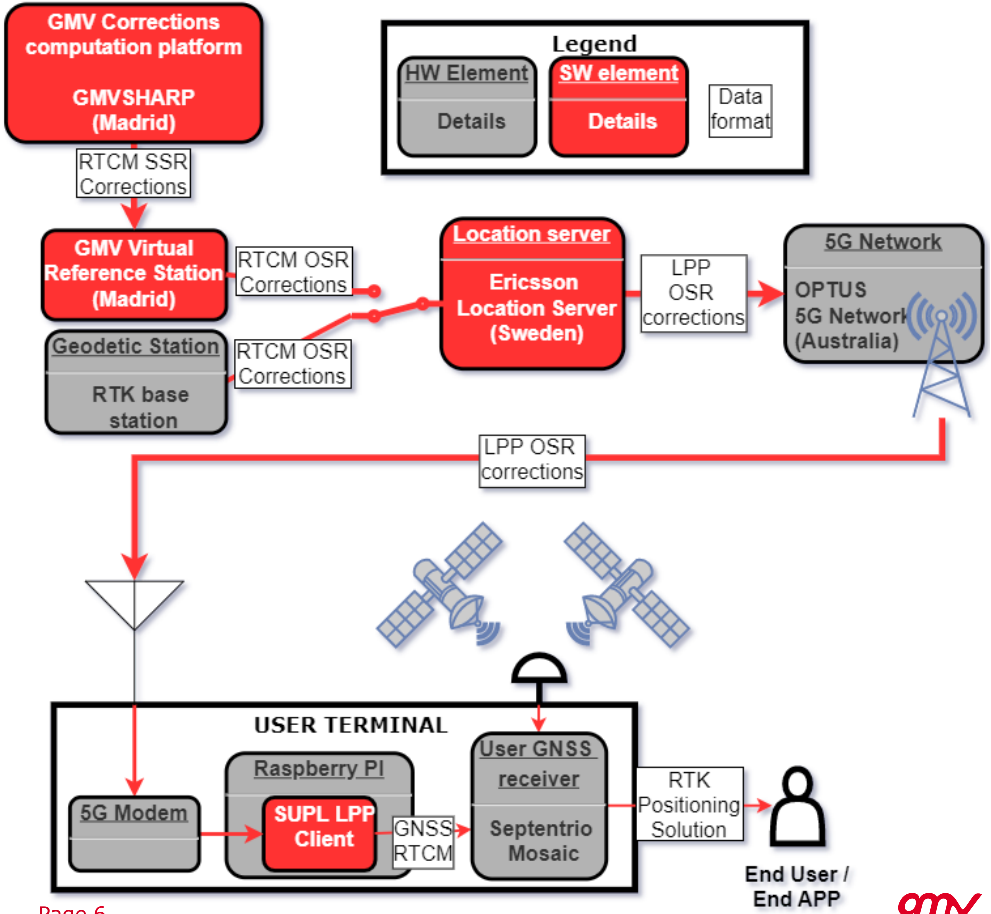


Photos taken by Dan Woodrow (Frontier SI) in real tests during the project

TECHNICAL APPROACH AND ARCHITECTURE

Based on transmission of GNSS corrections through 5G network

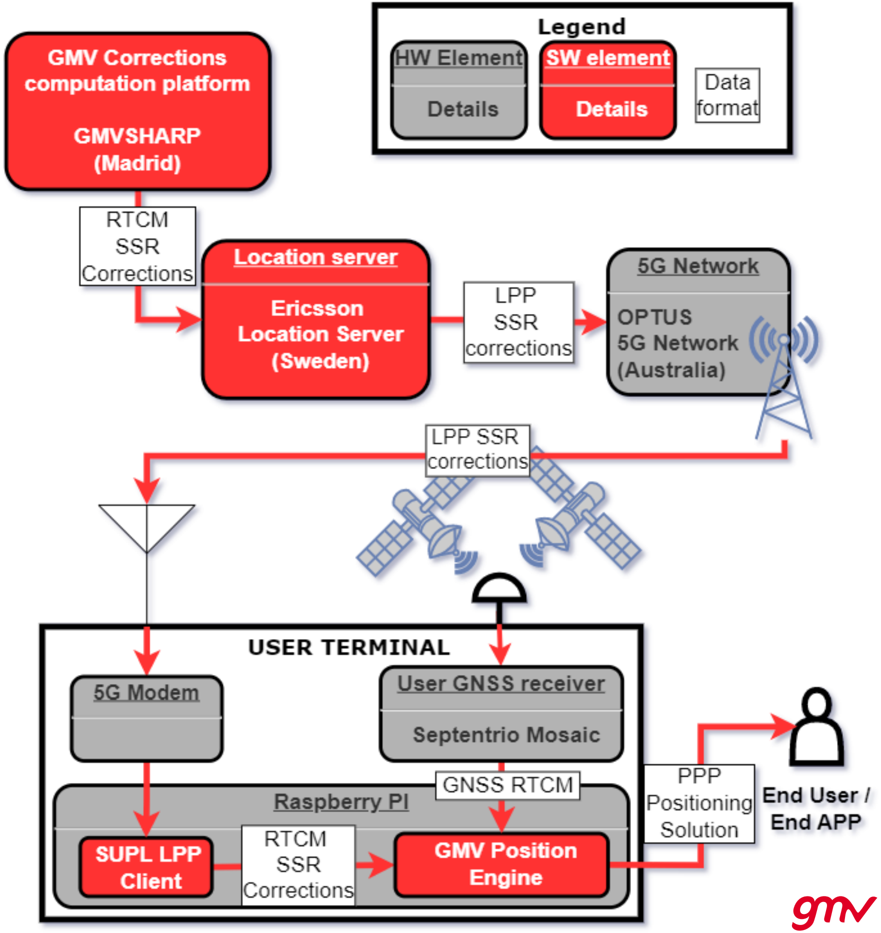
- LTE Positioning Protocol (3GPP release 16)
- COTS components from partners
  - Integration effort for getting synergies
  - GMV: Correction service + Position Engine
  - Ericcson: Location Server + LPP Client
  - Optus: 5G Network
- Incremental approach for the integration
  - Phase 1: OSR corrections
  - Phase 2: SSR (orbit + clocks + code biases corrections)
  - Phase 3: SSR + SSR Ionospheric corrections



TECHNICAL APPROACH AND ARCHITECTURE

Phase 2 and Phase 3 architectures

- SSR corrections are mapped to equivalent LPP messages in the Location Server
- LPP client in the user terminal send the request messages to the Location server.
- LPP client transforms the LPP corrections to RTCM SSR
- Phase 2: SSR without ionospheric corrections:
  - GNSS-SSR-OrbitCorrections
  - GNSS-SSR-ClockCorrections
  - GNSS-SSR-CodeBias
- Phase 3: SSR with ionospheric corrections + IAR
  - GNSS-SSR-CorrectionPoints
  - GNSS-SSR-STEC-Correction
  - GNSS-SSR-GriddedCorrection
  - GNSS-SSR-PhaseBias



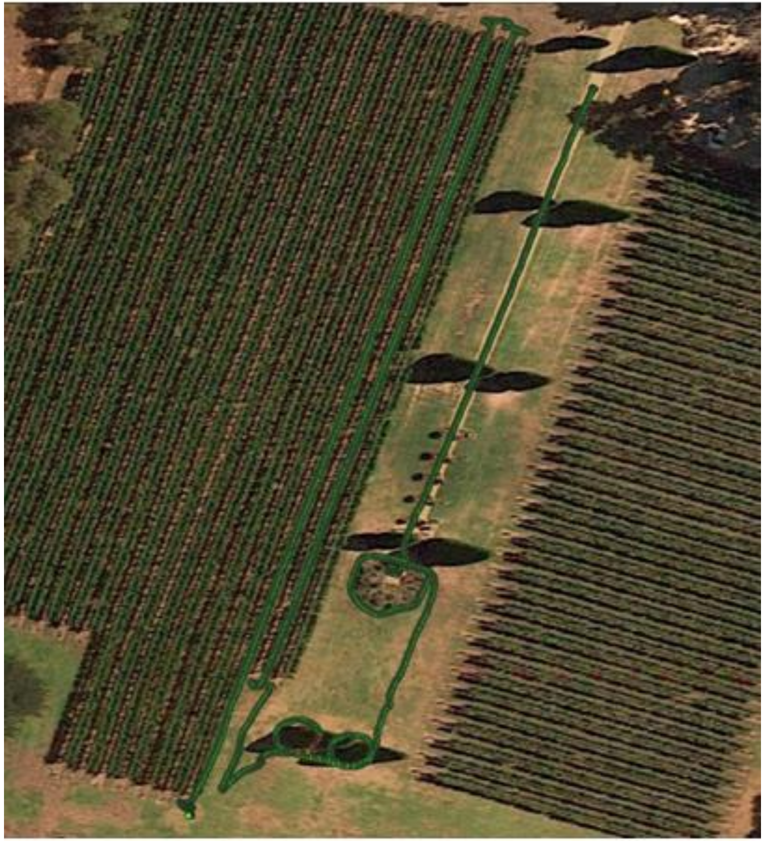
PERFORMANCE OF TESTING SETUP

Results from Phase 1: OSR approach

- Test in a vineyard placed south of Melbourne. Walking tests (user terminal in hand and antenna on ~2m pole) and tests with user terminal installed in a small tractor

- GNSS setup: Mosaic x5 and Antenna Tallysman TW7972

- Several runs in the roads of the vineyard and between the crops rows

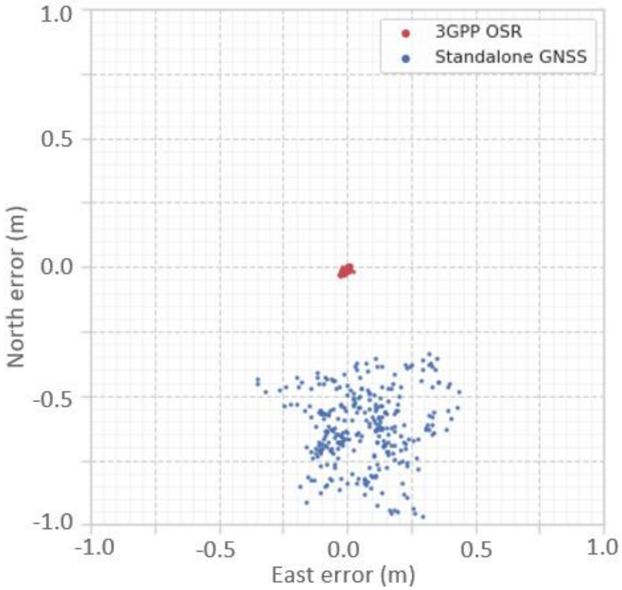


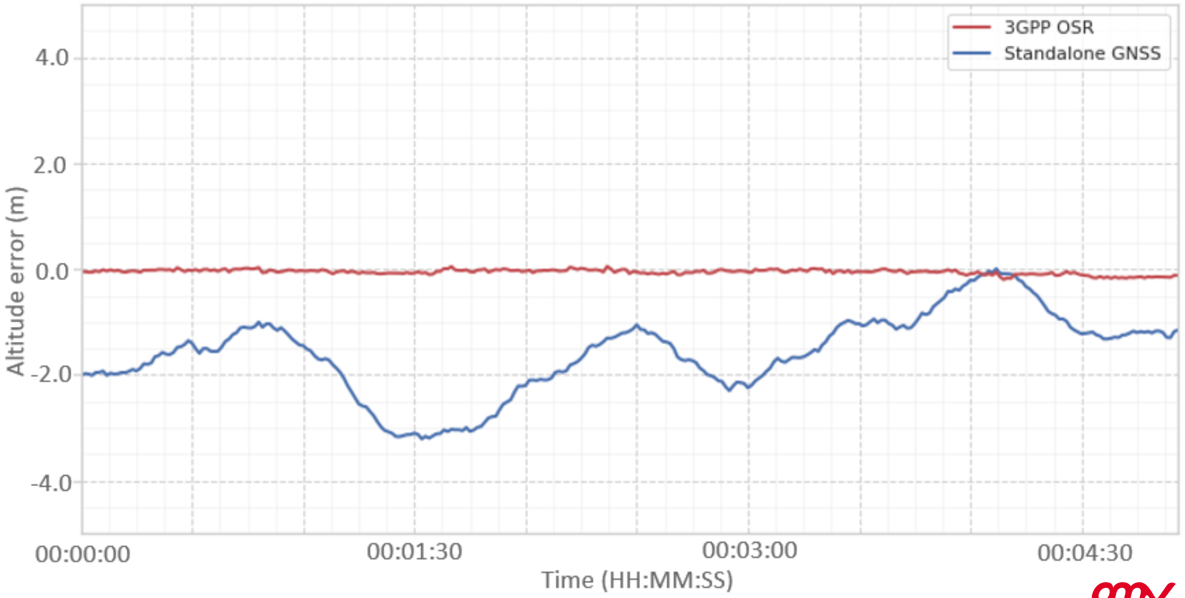
PERFORMANCE OF TESTING SETUP

Results from Phase 1: OSR approach

- Centimeter accuracy obtained in several runs.

	Horizontal Error (m)		Vertical Error (m)	
	RMS	STD	RMS	STD
Run 1 - 3GPP OSR	0.02	0.02	0.05	0.02
Run 2 - 3GPP OSR	0.04	0.03	0.07	0.05
Run 1 - Standalone GNSS	0.63	0.53	0.68	0.43
Run 2 - Standalone GNSS	1.32	0.42	1.76	0.76

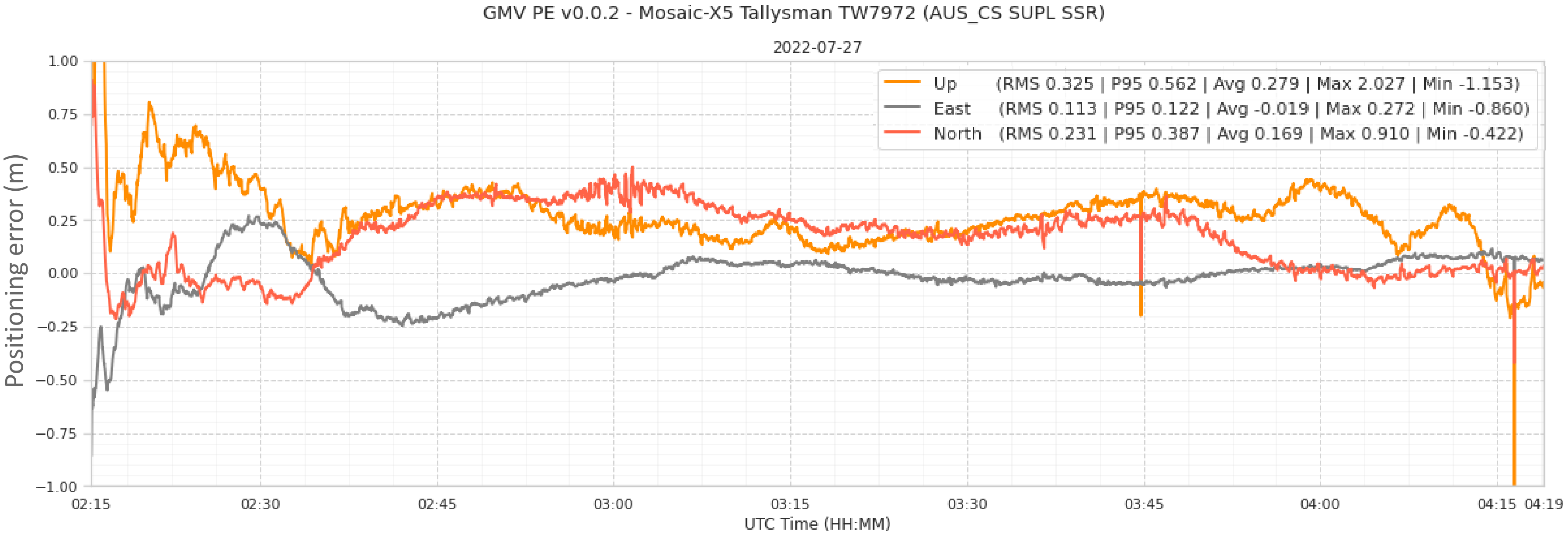




PERFORMANCE OF TESTING SETUP

Results from Phase 2: SSR approach (no ionospheric corrections + no IAR)

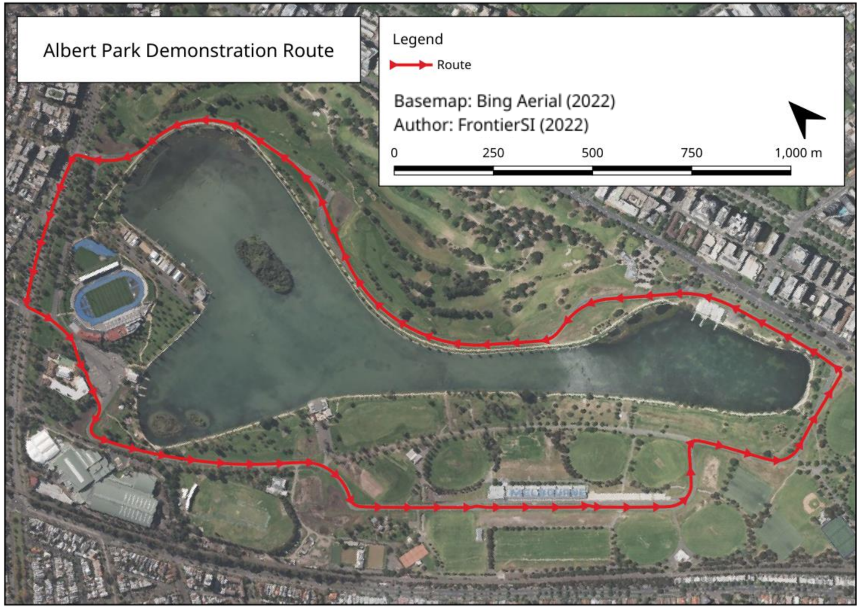
- Static tests in open sky for checking the integration
- Full performance is not reached with this approach yet, but still useful for integration or some users



PERFORMANCE OF TESTING SETUP

Results from Phase 3: SSR approach (ionospheric corrections + IAR = Fast convergence and HA)

- Full potential of SSR solution with fast performance and high accuracy has been reached with this approach
- Several rounds of kinematic tests have been performed in the surroundings of Albert Park in Melbourne comparing OSR, SSR and GNSS standalone solutions

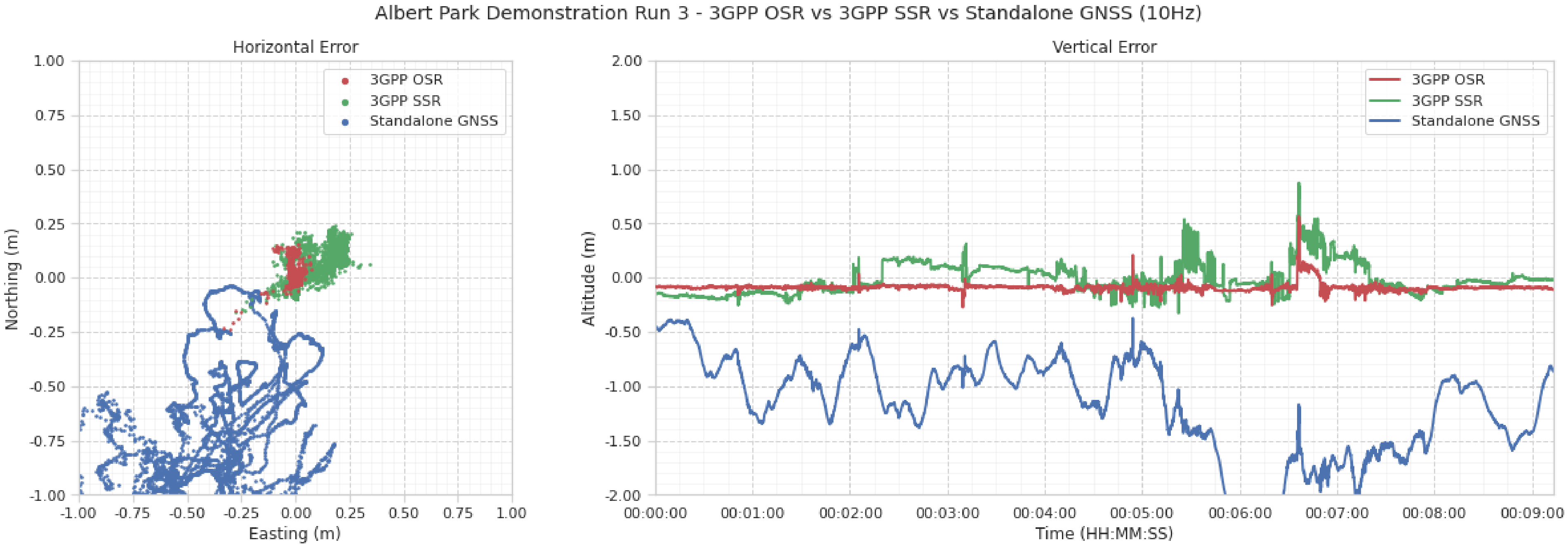


- Open Sky + sub urban environment (not many buildings but tree corridors in some parts of the circuit)

PERFORMANCE OF TESTING SETUP

Results from Phase 3: SSR approach (ionospheric corrections + IAR = Fast convergence and HA)

- Full potential of SSR solution with fast performance and high accuracy has been reached with this approach



PERFORMANCE OF TESTING SETUP

Results from Phase 3: SSR approach (ionospheric corrections + IAR = Fast convergence and HA)

Remarks:

- Reference station for OSR was located near the circuit (2 km). Optimal conditions for OSR
- Several runs obtaining the 3 solutions at the same time.
- 10 Hz output rate for all the runs and solutions

	Horizontal Error (m)		Vertical Error (m)	
	RMS	STD	RMS	STD
Albert Park Run 1 - 3GPP OSR (10Hz)	0.02	0.02	0.12	0.05
Albert Park Run 2 - 3GPP OSR (10Hz)	0.02	0.02	0.10	0.03
Albert Park Run 3 - 3GPP OSR (10Hz)	0.03	0.03	0.10	0.04
Albert Park Run 1 - 3GPP SSR (10Hz)	0.09	0.08	0.23	0.18
Albert Park Run 2 - 3GPP SSR (10Hz)	0.10	0.08	0.23	0.15
Albert Park Run 3 - 3GPP SSR (10Hz)	0.16	0.12	0.14	0.14
Albert Park Run 1 - Standalone GNSS (10Hz)	0.77	0.84	0.45	0.38
Albert Park Run 2 - Standalone GNSS (10Hz)	1.34	1.39	0.52	0.51
Albert Park Run 3 - Standalone GNSS (10Hz)	0.91	1.00	1.27	0.46

CONCLUSIONS

- Concept of delivering high accuracy GNSS corrections through 5G using the LPP standard has been proved in real-world scenarios and use cases
- OSR and SSR approaches have been tested and both approaches could be used for high accuracy solutions. The usage of one approach or another could be assessed for each use case.
  - SSR: higher scalability and lower cost for mass market adoption
  - OSR: higher accuracy when conditions are optimal but higher cost for covering big regions or mass market
- First step for future development in this area and boost R&D of new products and services

Thank you!

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