

Positioning Technology Improvement Enabled by the Multi-Constellation New GNSS Signals

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What is iNsight?



- *Innovative Navigation using new GNSS SIGNALS with Hybridised Technologies*
- **Objective:** To address the major scientific and technical barriers to the full exploitation of the new signals from modernized and new GNSSs
- Unique at researching various aspects in the GNSS navigation technology simultaneously, based on close collaboration between universities and industry
- A 4-year project starting from late 2009
- Flagship research collaboration project within UK GNSS community

Who are we? - Universities



**Imperial College
London**



University of Westminster



The University of
Nottingham

UNITED KINGDOM • CHINA • MALAYSIA

- 4 Professors in GNSS area
- 10 Research Staff + a group of PhD students
- Funded with ~£2.76M by UK Engineering and Physical Science Research Council

Who are we? – Industry & Government



The industrial & government agency partners

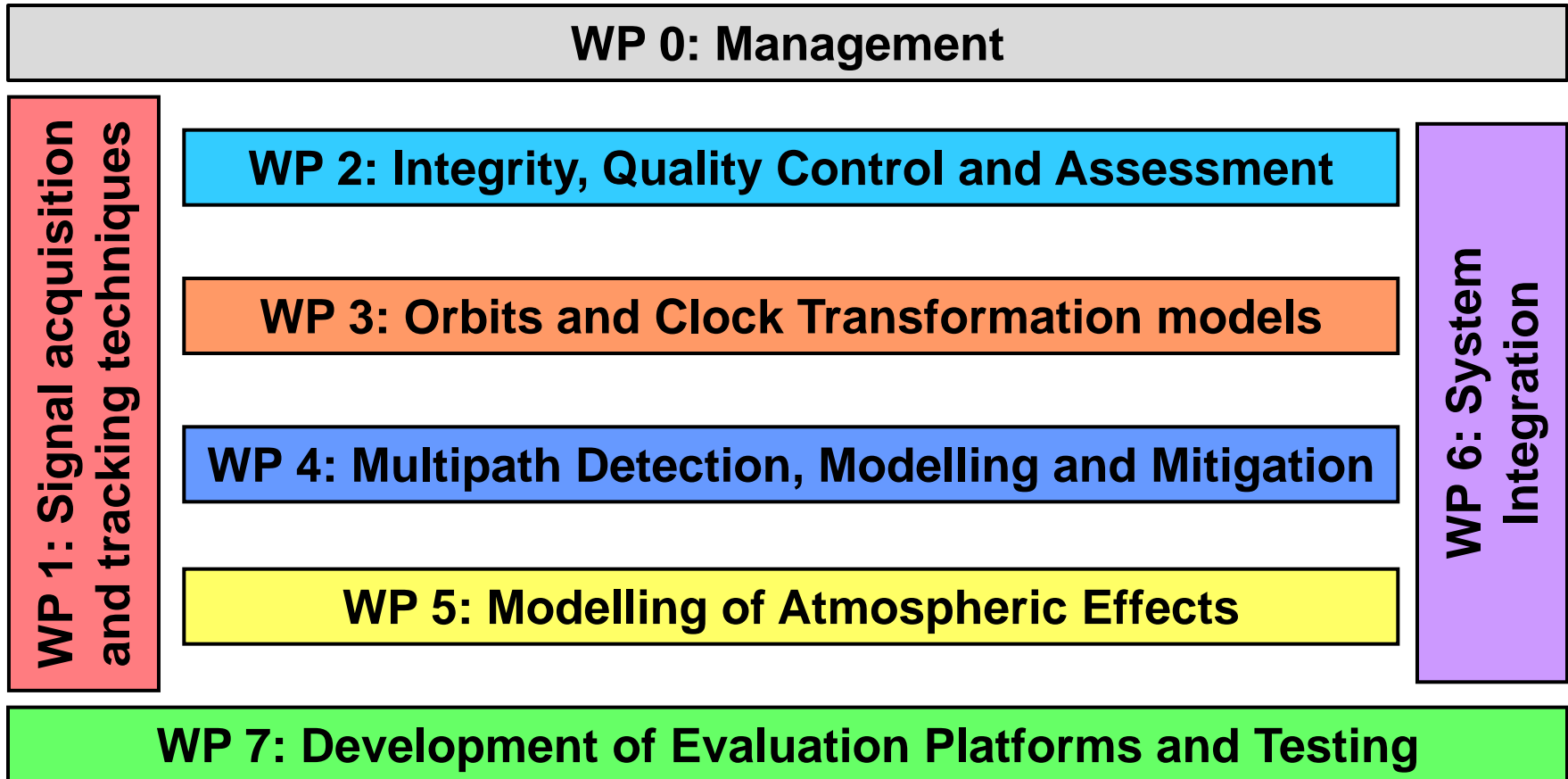


- Civil Aviation Authority
- EADS Astrium
- Leica Geosystems
- Nottingham Scientific Limited
- Ordnance Survey
- QinetiQ
- ST Microelectronics
- Thales Research & Technology



industrial and government agency partners contributing expertise, knowledge and facilities worth >£2M

Project Architecture



WP1 : Signal Acquisition and Tracking



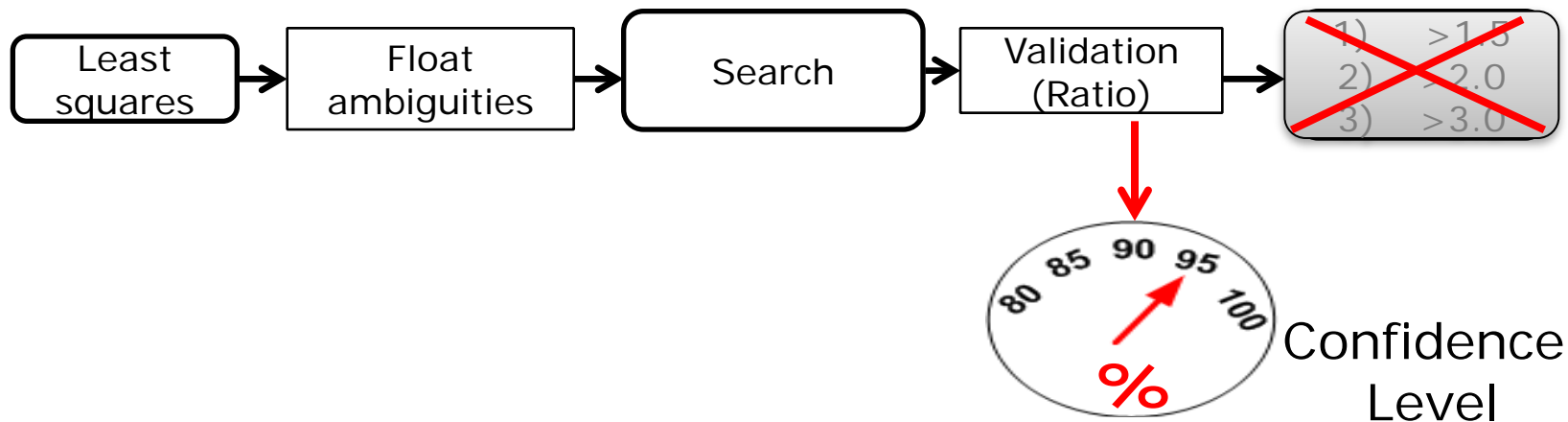
- A novel front-end architecture capable of processing all GNSS signals
- Fully compatible with SDR-based receivers and ready to interface with high speed processing devices (FPGA, DSP)
- Next generation of GNSS receivers :
 - Better measurement accuracy
 - Robustness against multipath
 - Ionosphere estimation capabilities
 - More stable clock
 - Programmable correction spacing and PLL
 - Inter-freq delay calibration



WP2 : Integrity, Quality Control and Assessment



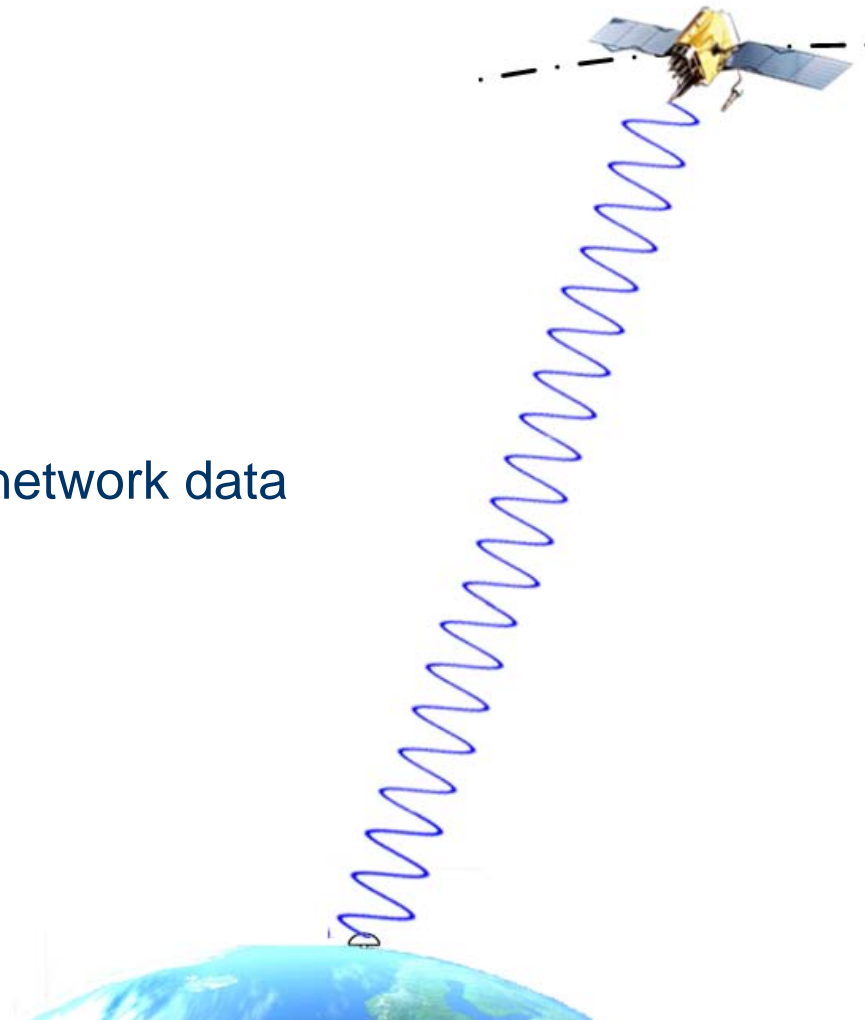
- Capture, characterise and model failure modes
- Specify and develop new Carrier Phase RAIM (CRAIM)
- Develop new ambiguity resolution & validation methods
- Incorporate ambiguity validation into a end-to-end CRAIM concept



WP3 : Orbits and Clock Transformation Models



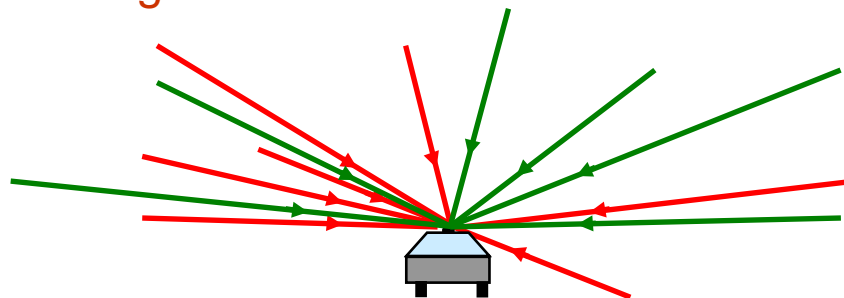
- GNSS inter-frame modeling to a common reference frame
 - spatial transformation
 - timescale transformation
- Enhanced satellite clock modeling
- Perform multi-constellations global network data modeling and parameter estimation



WP4 : Multipath Mitigation



- Dual-polarization antennas
 - Different polarizations (RHCP/LHCP) for direct and singly reflected signals
 - C/N0 difference between two polarizations are measured
- Multi-constellation GNSS multipath mitigation using consistency checking
 - Exploring signal selection and different combination of satellites
 - Multi-epoch filter-based approaches for signal time variation modelling



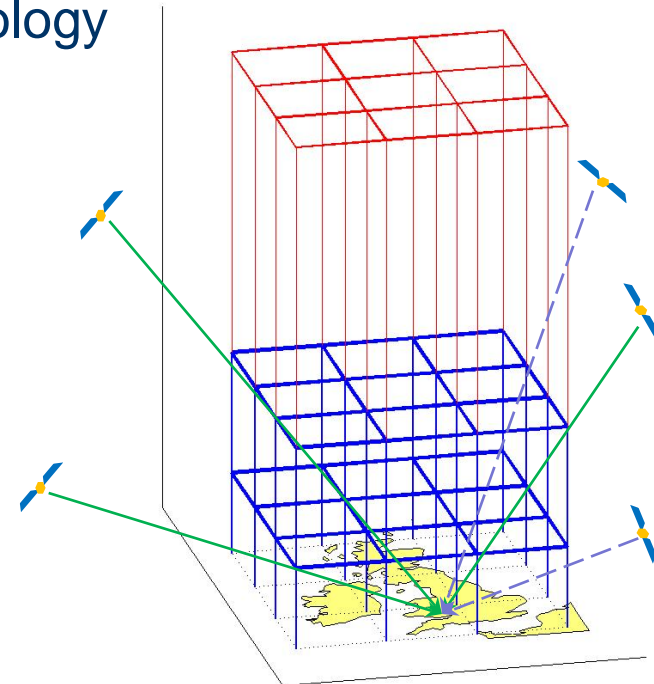
Multipath-free

Multipath-contaminated

WP5 : Tropospheric Effects



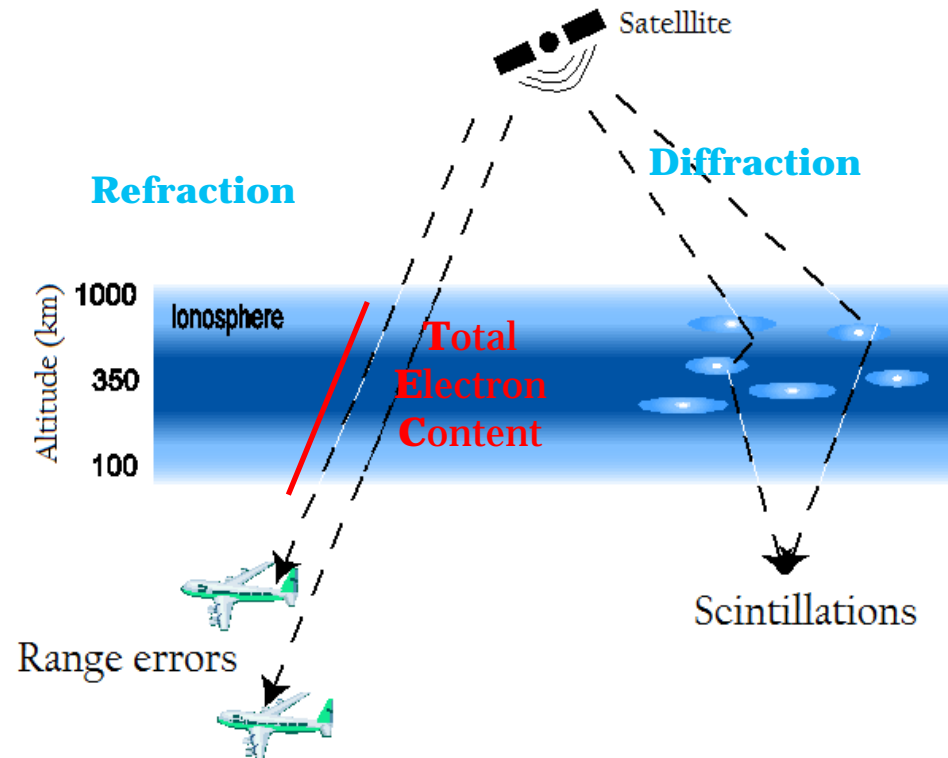
- Integration with Numerical Weather Modeling
 - Monitoring and forecast the weather related parameter changes, using the UK Met Office Unified Model (North America and Europe mesoscale Model)
 - Using signals from multiple constellations, and observed in a network of reference stations, to further estimation water vapor spatial distribution
- Improvement for high-accuracy positioning technology
 - PPP convergence time
 - NRTK interpolation



WP5 : Ionospheric Effects

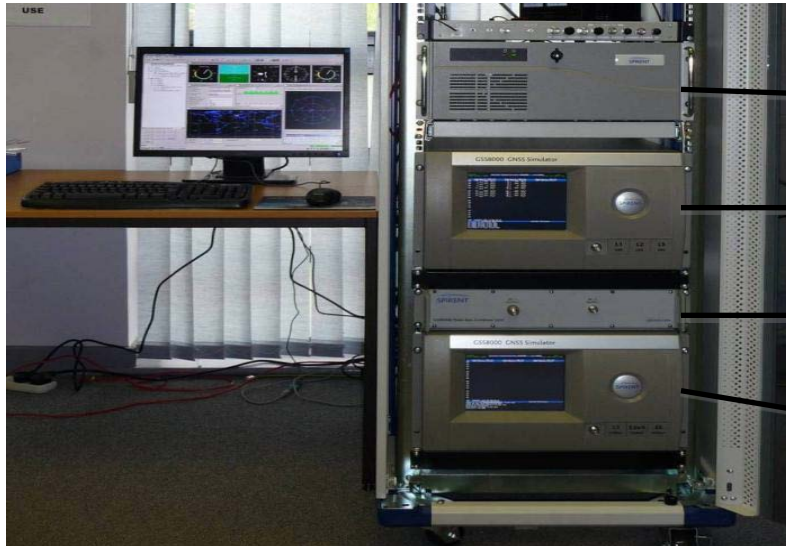


- Monitoring, modeling and mitigating the ionospheric effects
 - New triple frequency linear combinations: model the 2nd and 3rd order term
 - Estimation of the receiver signal tracking performance during scintillation : can help mitigate the effects of scintillation in GNSS positioning
- GNSS modernization
 - Contribution of the new signals to counter the ionospheric effects in the GNSS applications



- Research themes
 - Optimized processing of multi-constellation GNSS
 - Inter-system bias modeling, stochastic properties, outlier detection
 - PPP research
 - Effect of multi-constellations on PPP convergence
 - Effect of multi-constellations with ambiguity resolution
 - Receiver integration
 - Aiding multi-constellation GNSS with INS

Evaluation and Testing



SimGen PC

GPS (L1, L2, L5)

Combiner Unit

Galileo (L1, E5a/b, E6)



- As a GNSS research user group, we are keen to push forward the GNSS technology frontiers, paving the way for next generation GNSS applications
- Highlight the use of new signals in modernized / new constellations, and maximize the possible performance enhancement through simultaneous research on various tech aspects
- Looking forward to keeping track of the latest system development trends from the service providers, in the early stage of these developments, and discuss/demonstrate their possible influence
- Build links with international peer researchers and application developers



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THANK YOU !

www.insight-gnss.org

