



New strategies in GNSS technology for accurate and scalable applications

project presentation

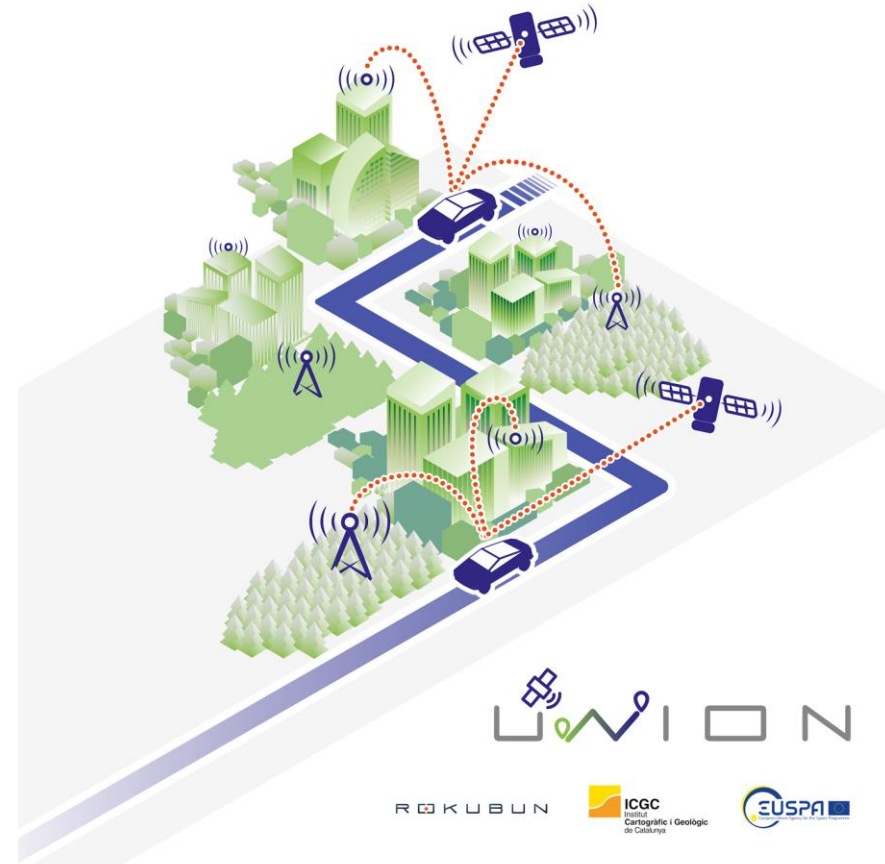
R K U B U N
Innovative Navigation Solutions

ICGC
Institut
Cartogràfic i Geològic
de Catalunya

What is UNION?

“UNION is a satellite positioning engine for accurate and real-time navigation for mass-market devices such as smartphones and vehicles.”

<https://union-navigation.eu>



Main objectives

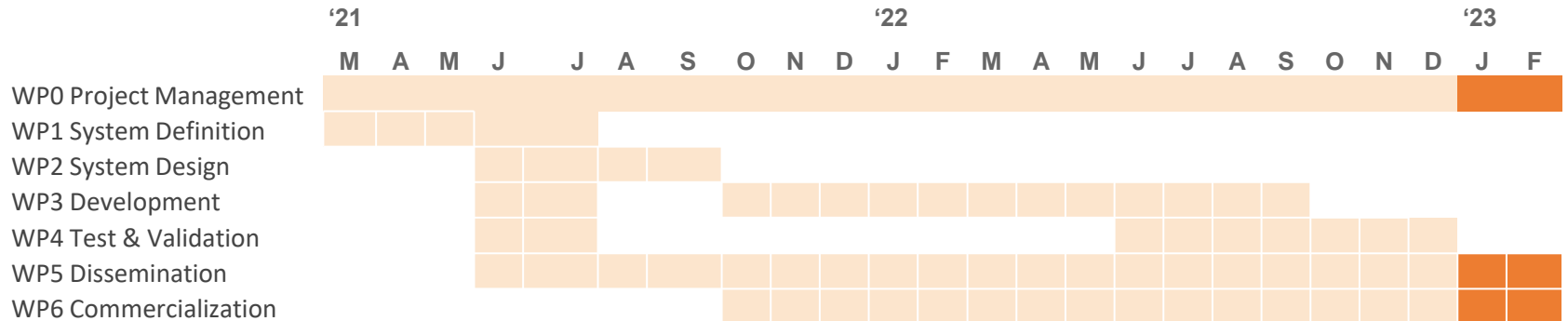
- Development of a positioning engine that is flexible to process new signals and systems (UUPE)
- Decimetric accuracy in mass-market devices (e.g. automotive, LBS)
- Overcome scalability limitations of positioning technologies such as RTK → Permanent VRS

UNION, as a precise positioning solution, will improve:

- **Continuity**, especially in navigation sessions spanning hundreds of kilometres.
- **Accuracy**. UNION will represent a major breakthrough in mass-market oriented navigation solutions, reaching meter-level accuracy in smartphones and lane-level navigation in road applications.
- **Availability** of precise navigation any time in broad geographical areas.

Main project figures

- Two partners (ICGC + Rokubun)
- Two year duration
- Total budget of ~430k€



Milestones

KO SRR PDR CDR MTR TRR DRR FR

Undifferenced and Uncombined Processing Engine (UUPE)

- State-of-the-art
 - PPP uses combined data (ionosphere free combination)
 - RTK uses differenced data (double differences)
- When number of signals and systems increase, which combination to use? which difference to make? → Problem in bookkeeping and scalability
- New approach to use data that is processed as-is (no combination, no differentiation)
 - Those parameters that were removed in PPP (ionosphere) and RTK (biases) are now estimated instead
- Techniques that were proposed at an academic level, UNION brings it to the market, with real case applications

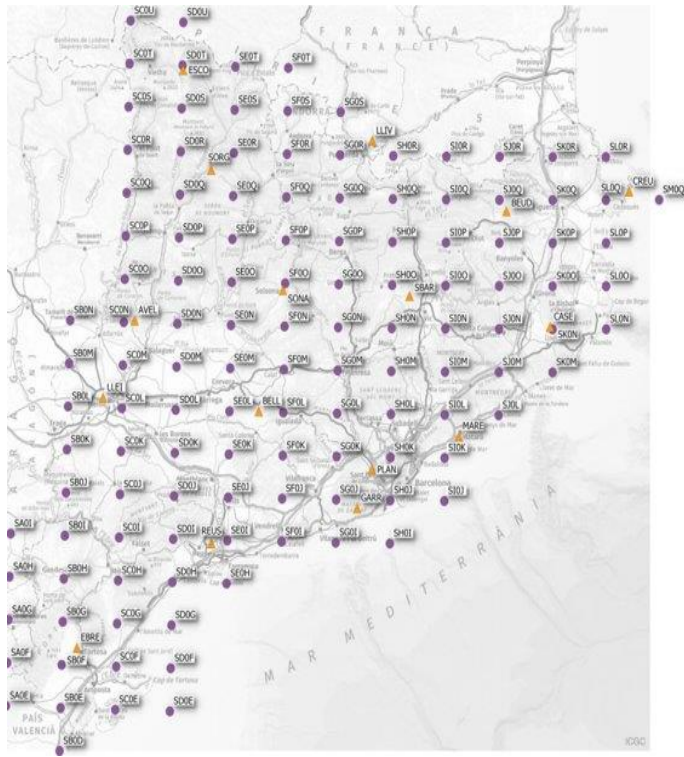
Permanent Virtual Reference Stations (P-VRS)

Positioning techniques such as RTK use data from reference stations to achieve up to cm accuracy:



Virtual Reference Stations are not scalable (due to its bi-directional nature)

Permanent Virtual Reference Stations remove bi-directional requirement → scalable!



More details in ICGC presentation

Permanent Virtual Reference Stations (P-VRS)

Users access UNION P-VRS through its NTRIP caster: <https://caster.rokubun.cat>

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caster.rokubun.cat - Chromium
caster.rokubun.cat
Not secure | caster.rokubun.cat

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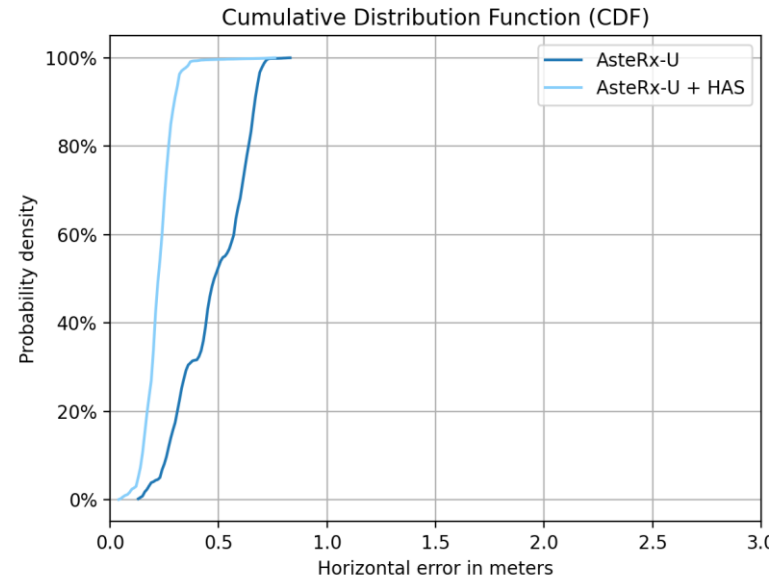
Galileo HAS

In addition, Rokubun has implemented, within UUPE, a Galileo HAS engine (i.e. SSR corrections) to improve UUPE solution.

Also:

- Rokubun has participated in EUSPA's validation campaign for the Galileo HAS correction
- In addition, it performs a **relay of HAS corrections** from Galileo E6 to RTCM3 compliant format so that is available to non-E6 receivers (e.g. smartphones). Publicly available at this mountpoint:

https://caster.rokubun.cat/ROK1_HAS



Galileo HAS (caster relay)

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caster.rokubun.cat - Chromium
caster.rokubun.cat
Not secure | caster.rokubun.cat

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Portability to multiple platforms

Thanks to the low level implementation of UUPE, it has been embedded in various platforms

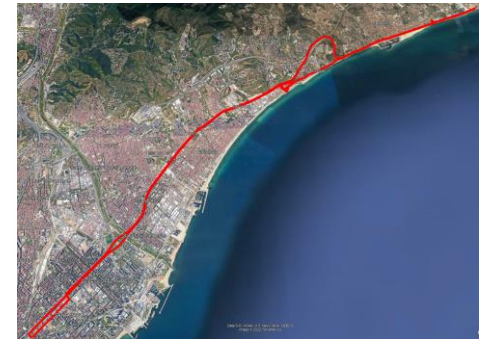
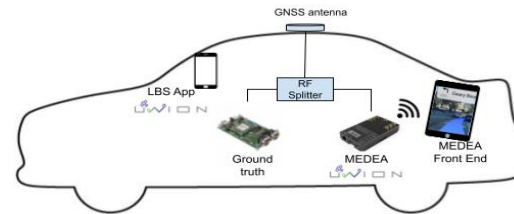
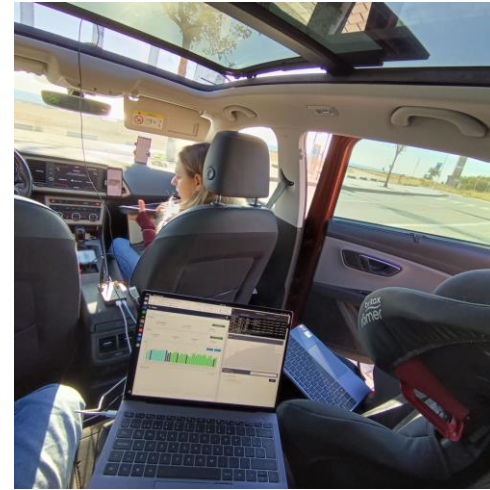
- Laptops and Desktops
- Rokubun MEDEA Receiver (based on ARM technology)
- Android smartphones



Test and validation campaign

Multiple scenarios covered, long duration and range automotive tests performed

Bicycle and urban scenarios covered



Dissemination

- Infographics generated
- Conferences presented
- Paper submitted at ION GNSS 2022



CORS Networks

by Rokubun, ICGC
November 15, 2022



R O K U B U N



October 10, 2022 Leave a comment

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Is High-Precision GNSS Coming to Your Smartphone?



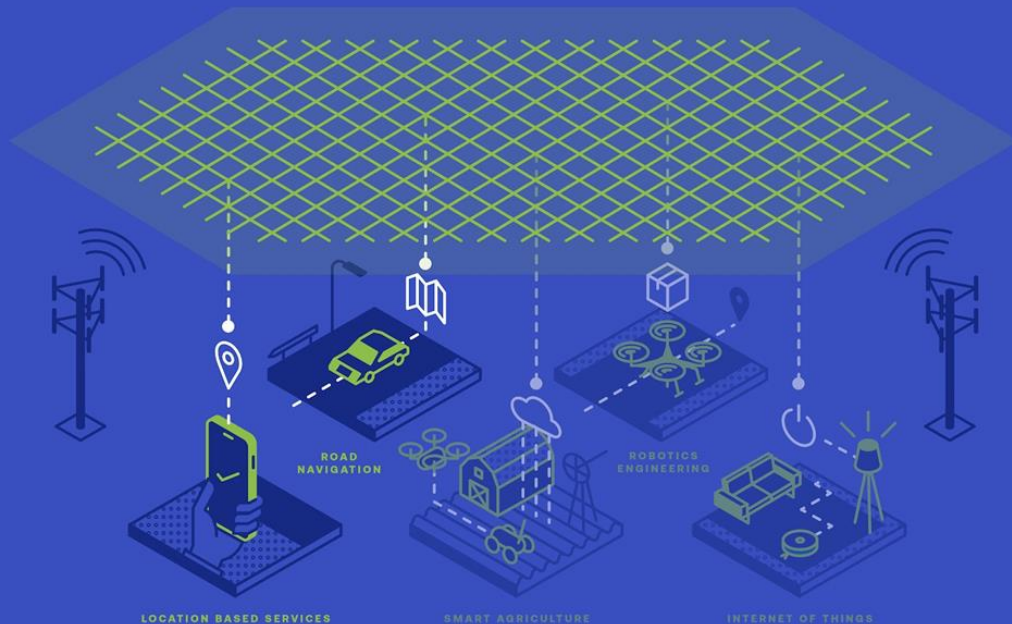
UNION Infographics

Do you know what UNION technology does? How to use it? What are the use cases?

We believe that an image is worth a thousand words. That is why we have developed an infographic to show the possibilities regarding how to use our navigation engine and the benefits you can get from it.

Open our infographic and see some possible use cases for the technology!

Open it



How does it work?

UNION is a satellite positioning technology that provides accurate and real-time navigation for mass-market devices such as smartphones and vehicles. It is a platform-agnostic technology that can achieve an accuracy of less than a meter. UNION generates a new set of GNSS receiver technologies:

- A Location Stack based on undifferentiated and uncombined processing of GNSS measurements and data sources. The location stack blends PPP (Precise Point Positioning) and RTK (Real Time Kinematics) in a self-configured combination depending on the available input data.
- The creation and operation of a permanent network of Virtual Reference Stations (VRS) enables a high area coverage, ensuring service scalability.
 - Galileo HAS (High Accuracy Service) corrections for all: Rebroadcast (via Internet) of the HAS messages found in Galileo E6 so that non-E6 receivers can benefit from it.

The technology is developed in the framework of the UNION project, an R&D European project funded by the EU Agency for the Space Programme (EUSPA) and performed by ROKUBUN and the Cartographic and Geological Institute of Catalonia (ICGC). The outcome is a navigation software library with an API that can be easily embedded in a smartphone app or a car navigation system.

TO LEARN MORE ABOUT IT, VISIT: WWW.UNION-NAVIGATION.EU



Technology Scenario

The UNION project aims to generate and operate a network of Permanent VRS that densifies the current real GNSS CORS network. Then, the user can connect to this network and select the closest GNSS reference station(s) (real or virtual) to get a correction stream for navigation. Thanks to this technique, there is no need to generate an ad-hoc VRS for every user, which is not scalable to a massive number of simultaneous users, and the Permanent VRS guarantees a precise navigation corrections service in a wide-area territory.

Its benefits



ACCURACY

Below one meter accuracy

UNION delivers sub-meter-level accuracy for navigation applications by optimally configuring itself depending on the available data in the device. UNION supports Precise Point Positioning (PPP) or differential techniques such as Real Time Kinematics (RTK) and offers a high degree of flexibility in the processing strategy: single rover with single- or multi-base receivers, parallel multi-rover, etc.



AVAILABILITY

Keep position on harsh environments

In case of a partial or total loss of satellite signal (due to tunnels, viaducts, urban canyons, canopies, etc.), the navigation solution needs a rapid convergence back to nominal performance, which becomes a significant challenge to PPP-only techniques. UNION technology solves this problem by combining PPP and RTK techniques depending on the available data.



ROBUSTNESS

Protect from attacks

The multi-navigation, multi-frequency and multi-constellation technology nature of UNION offers an extra layer of position robustness that will allow on-the-fly position cross-check with alternative navigation systems. Besides, incorporating a Fault Detection and Exclusion (FDE) layer to detect and discard potential harmful data.



PLATFORM AGNOSTICISM

Run in any platform

UNION has been conceived to be platform independent and easily integrated in any navigation device. UNION is especially suited for mass-market or premium mass-market navigation equipment, optimizing the performance and providing accurate navigation at an affordable cost. UNION has been validated in platforms as different as automotive navigation OBDs or Android smartphones.

ROKUBUN



THE EUROPEAN UNION
EUROPEAN SPACE AGENCY
EUROPEAN SPACE INFRASTRUCTURE PROGRAM

Commercialization

- UUPE → Spear (commercial name)
- Rokubun is preparing a **white-paper** to disseminate to the industry. Its contents are performance benchmarks of the engine through different scenarios and receivers
- Leads have been contacted and Rokubun is currently in talks with:
 - Chip manufacturers
 - System integrators
- Collaboration Agreement on-going with an initial integration and benchmarking of SPEAR as the positioning engine of an automotive navigation On-board Unit (OBU)



Thank you!

Any questions?

More info at:

<https://union-navigation.eu>

