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Volunteering for the future – Geospatial excellence for a better living



# GISCAD-OV: Galileo High Accuracy Service: a contribution of Surveyors to GNSS

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# GISCAD-OV

**Galileo Improved Services for Cadastral Augmentation Development On-field Validation**

**GISCAD-OV** involves the whole value chain of the Cadastral domain. Its main scope is to design, develop and validate an innovative and cost-effective high accuracy service for Cadastral Surveying applications, based on European GNSS Galileo signals.

https://giscad-ov.eu/

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# PROJECT ID-CARD

- **Duration: 42 months (started in December 2019) – Budget: 3,23 MEUR**

- **CLGE part of the budget (9,1%) : 293,535.00 EUR** – ***Reimbursement rate 100%***

  Personnel costs: 162,500 EUR – Other costs (travels): 37,800 EUR – Indirect costs: 50,075 EUR

- **GEOWEB SPA** (IT) acting as Project Coordinator together with 13 partners from 3 categories:

| | |
|---|---|
| 1. Service Providers: | TERIA (FR), GEOFLEX (FR), SOGEI (IT), GEO++ (DE), NOVATEL (CA), TELESPAZIO (IT) |
| 2. Prof. Associations of Surveyors: | CLGE |
| 3. Academic and research institutes: | VUGTK (CZ), UNIPD (IT), York University (CA), Delft University of Technology (NL), Roma Tre University (IT) |

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## GISCAD-OV

**GNSS measurements are largely used in Cadastral surveying and mapping**

But cadastral surveying operations using GNSS are limited by several factors such as:

- the cost of the Augmentation service;
- the cost of professional GNSS receivers;
- the not easy-to-use services;
- and the lack of customer care and supporting services.

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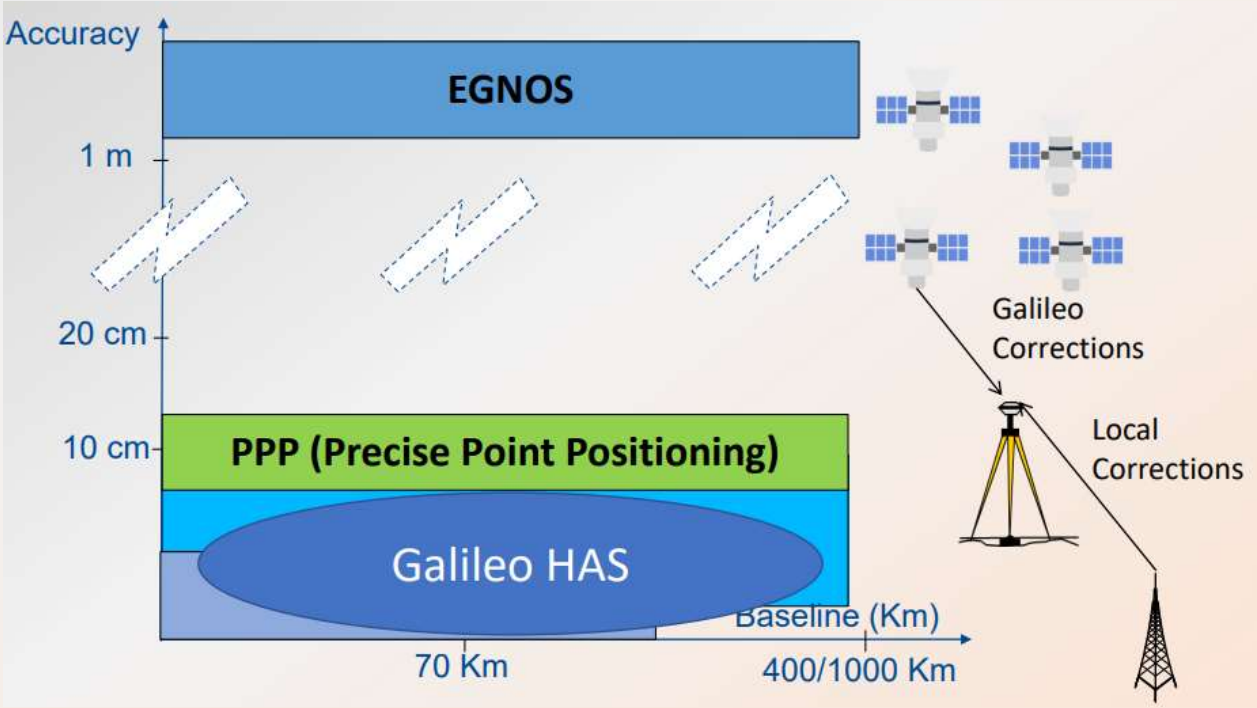
# GISCAD-OV Scope & Objective

To design, develop and validate an innovative and cost-effective High Accuracy Service for Cadastral and Property Surveying applications

- based on GPS and **Galileo High Accuracy Services (HAS)**;
- and advanced techniques of Precise Point Positioning-Ambiguity Resolution quick convergence (PPP-AR).



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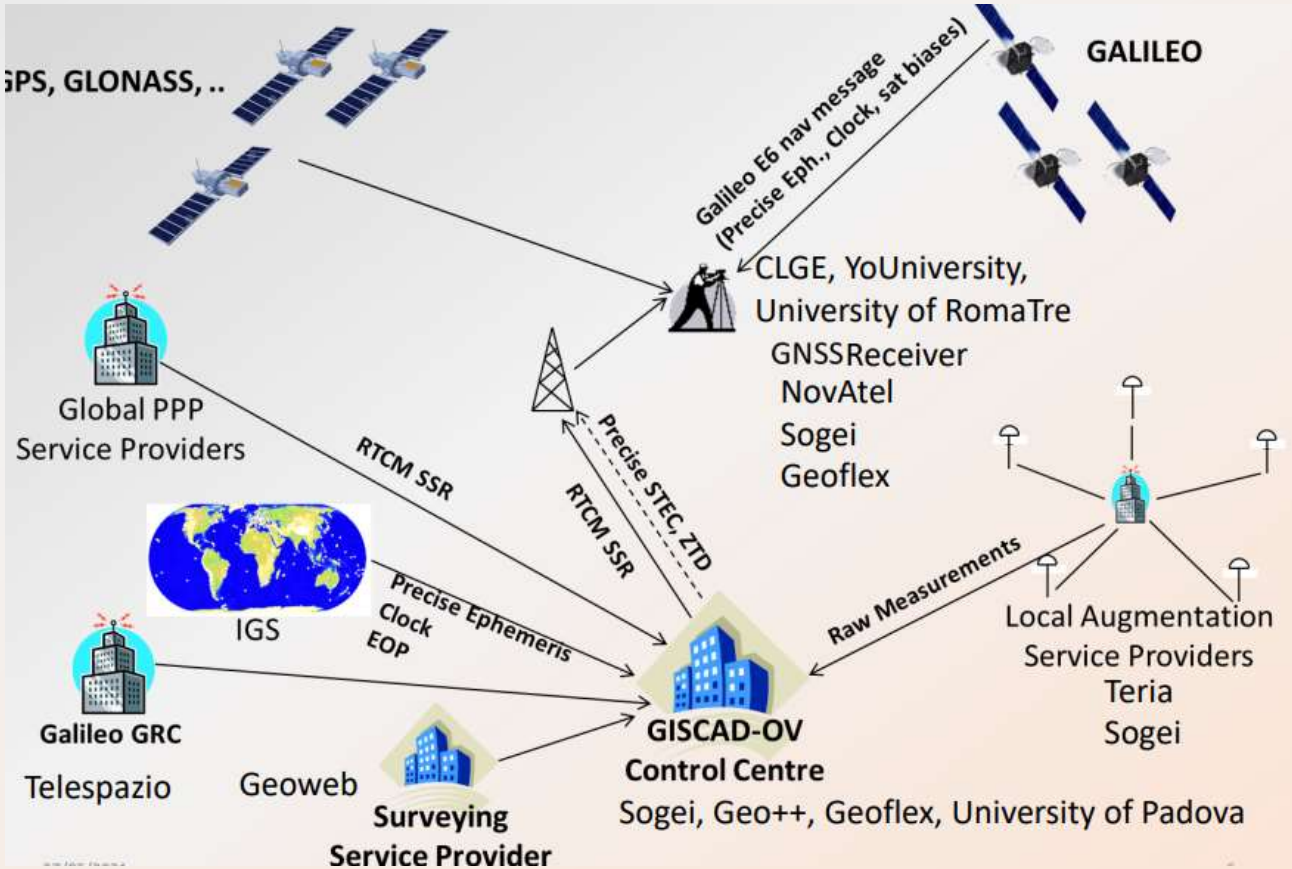
# GISCAD-OV Scope & Objective

The project aims to set up a **GISCAD-OV Service Operator Centre:**

- able to fully integrate the existing Augmentation and National infrastructures,
- for improving Cadastral operations efficiency and effectiveness,
- reducing Cadastral procedures' time

…for the benefit of its many users, including **surveyors**, and ultimately **for the good of all European citizens**.



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# Development of GISCAD-OV services

- GISCAD-OV is a test bed for global High Accuracy Services, covering the transition from RTK/NRTK services to Galileo HAS;
- Galileo HAS will allow achieving High Accuracy with corrections coming only from the constellation's satellites **for free** through the following basic service:
  - 1st Phase (2022): corrections for achieving 20 cm accuracy in a few minutes (feasibility was demonstrated during test campaign in 2021);
  - 2nd Phase (2023): provide corrections for higher accuracy in a reduced convergence time.

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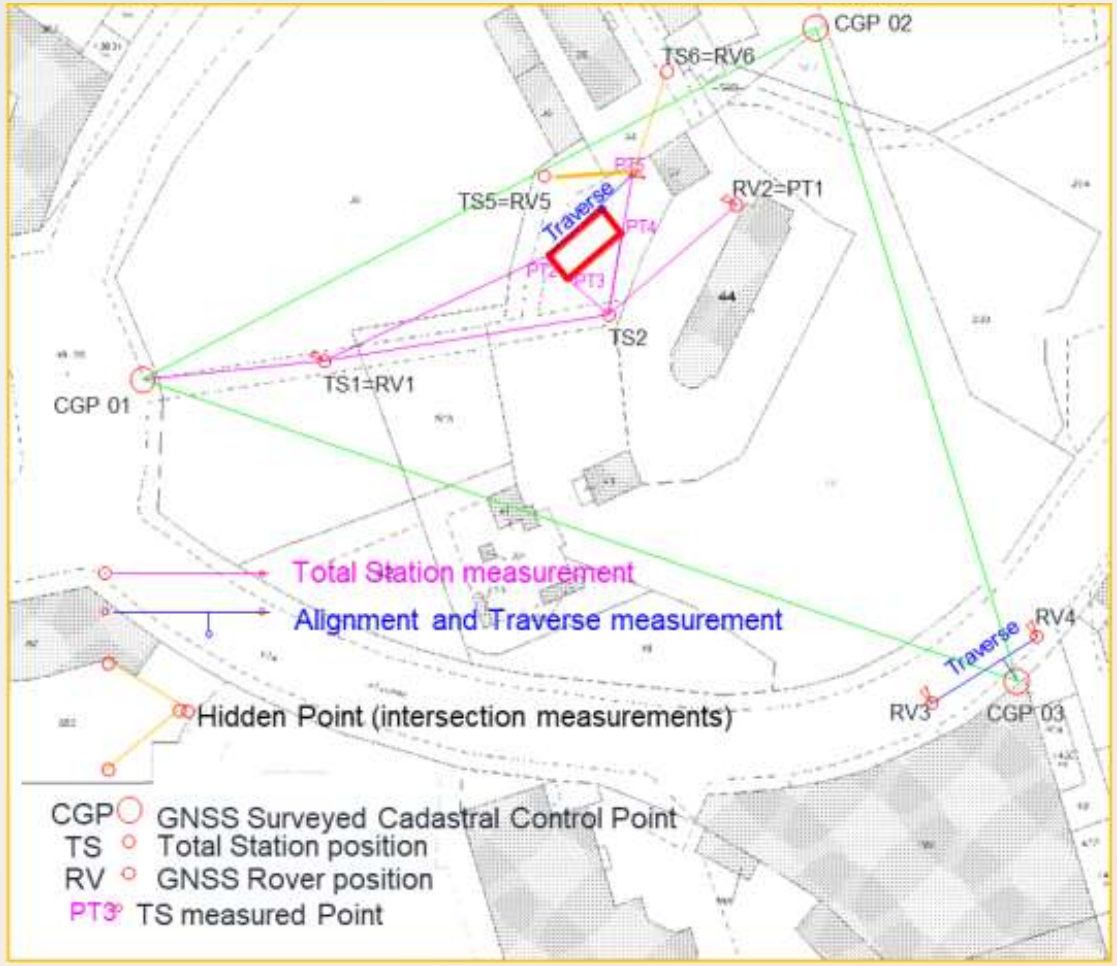
# Development of GISCAD-OV services

- A Real-time Galileo HAS Testing campaign through a prototype receiver equipment (Commercial and Software receiver);
- Testing PPP-RTK services for Cadastral Surveying, evaluating the integration of Galileo HAS data streams;
- Simulating Phase 2 Galileo HAS services for Cadastral Surveying through PPP-RTK.



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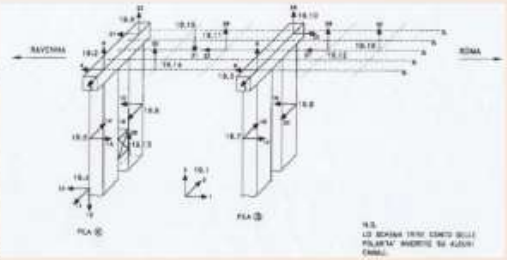
# Development of GISCAD-OV services

## Infrastructural Monitoring (University of Roma Tre)

- Integration of Galileo HAS, High Accuracy GNSS and accelerometers for Infrastructural Monitoring
- Infrastructure Dynamic Monitoring
- Test on one or two possible sites

Steel frame
(rooftop of a SOGEI Building)
Validation test

CESI Viaduct (along route E45)
(San Gemini, Central Italy)
Operational Test



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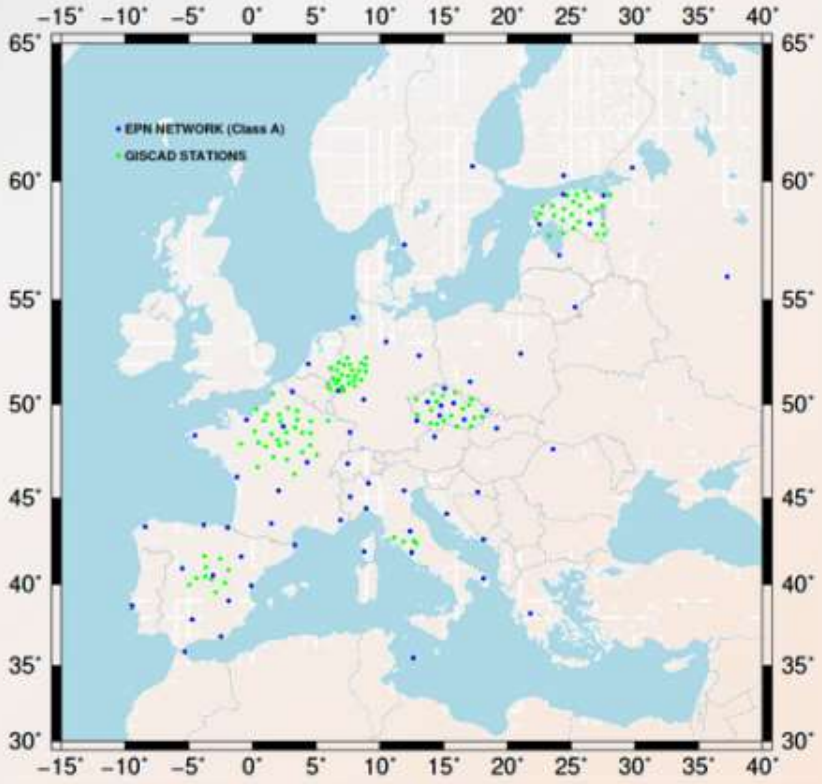
# Development of GISCAD-OV services

## Reference Framework Determination (University of Padova)

- European Reference Station files collection
- Weekly geodetic solution (IGb14 and ETRF2000 )
- Global to National Reference Framework transformation parameters derivation
- INSPIRE Directive Compliance



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# Pilot Implementation

- Cadastral or property survey's following national regulation in 7 pilot countries;
- Test different scenarios and environments;
- Support of Local surveyors;
- Surveying standard and data collection procedure;
- Survey Results recording in a standard format;
- Monitoring of the Galileo HAS availability in the test zones;
- Monitoring of the ionospheric conditions;
- Test report.

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# Task 4.2: Pilot Implementation

Real Cadastral Surveys in each of the Pilot Countries

On-Field Validation in the following Countries:

1. Italy
2. France
3. Spain
4. Germany
5. Croatia
6. Czech Republic
7. Estonia

Comparison between current techniques and GISCAD-OV proposed solution

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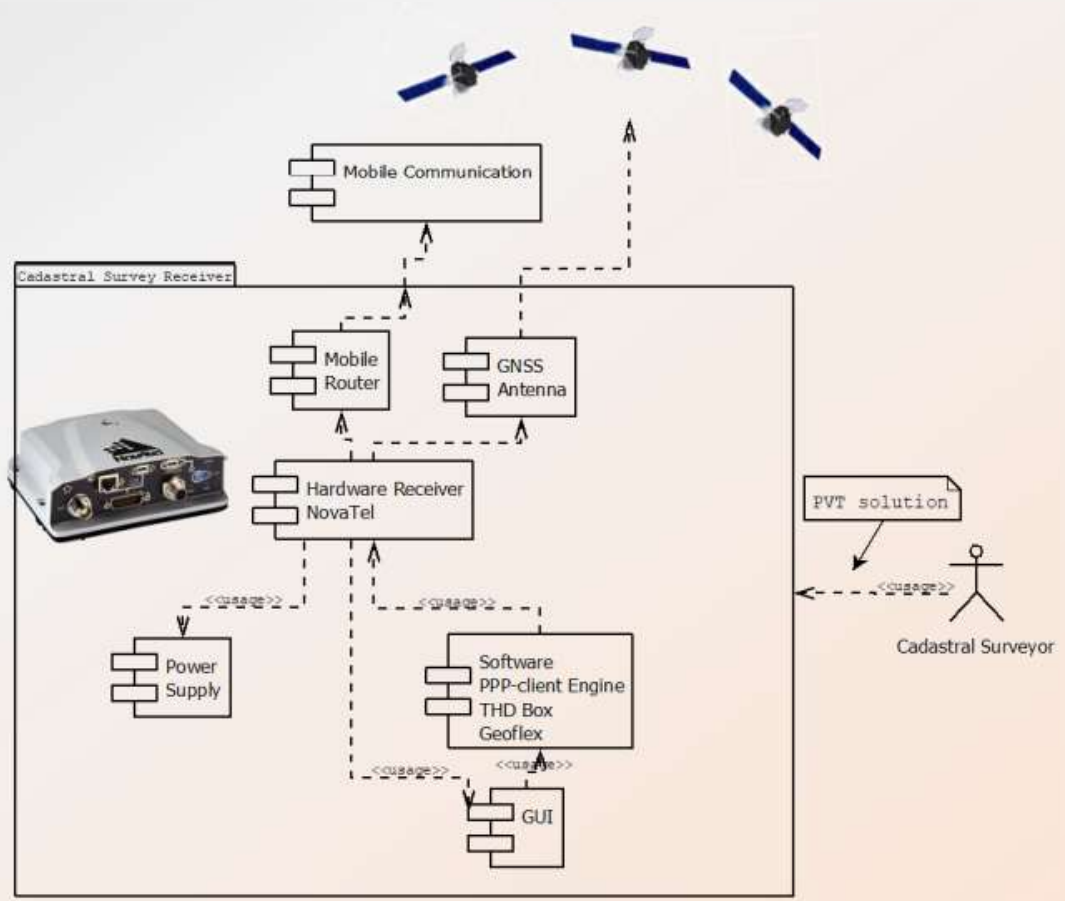
# September 2021 – Availability of the Galileo HAS Test signal

- Development finalization of GISCAD-OV solution;
- Material testing;
- Integration and Test of the System and Service Architecture;
- Field test with Cadastral Pilot Project Execution in Italy and France.



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# Main achievements and first results

- The surveys carried out led to the following main results:

- Multi-constellation PPP-RTK Surveying: accuracy better than 2 cm, fixing time: instantaneous;
- Pure Galileo HAS: accuracy better than 20 cm in 15 min convergence time;

- Furthermore, an infrastructural monitoring campaign was held on a bridge in the centre of Italy, in collaboration with the Italian Civil Protection.

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# First results from France

| | | |
|---|---|---|
| 0,052 | 0,0141 | 0,062 |
| 0,049 | 0,0148 | 0,045 |
| 0,036 | -0,0129 | 0,055 |
| 0,005 | 0,002 | 0,016 |
| 0,028 | -0,0059 | 0,005 |

| Point | Company | E | N | H* | δE | δN | δH |
|---|---|---|---|---|---|---|---|
| RKN.1005 | **Geodetic reference point** | **1644005,733** | **8155563,546** | **86,206** | | | |
| survey ma | Surveyors RTK | 1644005,701 | 8155563,531 | 86,188 | 0,032 | 0,015 | 0,018 |
| | GISCAD PPP-RTK | 1644005,689 | 8155563,530 | 86,106 | 0,044 | 0,016 | 0,100 |
| | | | | | | | |
| | | | | | | | |
| RKN.1175 | **Geodetic reference point** | **1643905,666** | **8155612,716** | **86,774** | | | |
| survey ma | Surveyors RTK | 1643905,648 | 8155612,700 | 86,768 | 0,018 | 0,016 | 0,006 |
| | GISCAD-OV PPP-RTK | 1643905,635 | 8155612,707 | 86,701 | 0,031 | 0,009 | 0,073 |
| | GISCAD-OV Galileo HAS | 1643905,718 | 8155612,857 | 86,686 | -0,052 | -0,141 | 0,088 |
| | | | | | | | |
| AF.117 | **Geodetic reference point** | **1642882,976** | **8153093,553** | **88,311** | | | |
| survey ma | Surveyors RTK | 1642882,965 | 8153093,548 | 88,311 | 0,011 | 0,004 | 0,000 |
| | GISCAD-OV PPP-RTK | 1642882,972 | 8153093,538 | 88,278 | 0,004 | 0,015 | 0,033 |
| | | | | | | | |
| | | | | | | | |

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# March & April 2022 – Availability of the Galileo HAS Test signal

- Material testing;
- Test of the System and Service Architecture;
- Field test with Cadastral Pilot Project Execution in Italy and Spain.

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# First results from ITALY and SPAIN

| Point | Company | X | Y | Z | ΔX | ΔY | ΔZ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| AUD7 | **Geodetic reference point** | **4868527,0627** | **-304633,7050** | **4096282,8109** | | | |
| CDP | Surveyors RTK | 4868527,072 | -304633,714 | 4096282,783 | -0,009 | 0,009 | 0,028 |
| urban | GISCAD PPP-RTK | 4868527,056 | -304633,735 | 4096282,810 | 0,007 | 0,030 | 0,001 |
| | GISCAD-OV Galileo HAS | | | | 4868527,063 | -304633,705 | 4096282,811 |
| | Cadastre | | | | | | |
| | | | | | | | |
| RUS1 | **Geodetic reference point** | **4868139,6943** | **-303277,3353** | **4096824,2618** | | | |
| RP | Surveyors RTK | 4868139,689 | -303277,351 | 4096824,253 | 0,005 | 0,016 | 0,009 |
| rural | GISCAD PPP-RTK | 4868139,733 | -303277,360 | 4096824,291 | -0,039 | 0,025 | -0,029 |
| | GISCAD-OV Galileo HAS | | | | 4868139,694 | -303277,335 | 4096824,262 |
| | Cadastre | | | | | | |
| | | | | | | | |
| 0039 | **Geodetic reference point** | **4868387,4239** | **-303770,1000** | **4096500,4799** | | | |
| RP | Surveyors RTK | 4868387,406 | -303770,109 | 4096500,486 | 0,018 | 0,009 | -0,006 |
| suburban | GISCAD PPP-RTK | 4868387,442 | -303770,102 | 4096500,480 | -0,018 | 0,002 | 0,000 |
| | GISCAD-OV Galileo HAS | | | | 4868387,424 | -303770,100 | 4096500,480 |
| | Cadastre | | | | | | |




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# Next activities

- **Next HAS continuous broadcast window**

Field operations in the 4 remaining countries (plus a repetition in France) will be held **in September 2022 onwards** with the now available continuous broadcast of the HAS signal.

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# Czech Republic

- 5 sites in 4 locations.
- Support from 2 Professional Surveyors
- Observations on 38 points and 15 HAS observations
- 4 National level triangulation points

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# Outcomes

## Expected Project Impacts for all Project's stakeholders

- For the Surveyors: improved availability in urban areas, one-time terminal configuration, opportunities of new markets due to HAS availability, etc.;
- For National Mapping and Cadastral Agencies;
- For the Services providers;
- For Receivers' manufacturers.

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# Outcomes

***What new applications could result from GISCAD-OV solution, for the benefit of final users as for the European customers and citizens?***

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# Markets Applications

## GEOMATICS

Geomatics is the segment with the most stringent accuracy requirements, but for certain applications dm-level is sufficient:

- GIS/MAPPING
- CADASTRE IN RURAL AREAS (LAND CONSOLIDATION)
- HYDROGRAPHIC SURVEY
- OFFSHORE EXPLORATION

The performance offered by the HAS through E6b is expected to give a new boost to GIS applications, further supporting the creation of new services thanks to free access to high accuracy, from lane marking to utilities and points of interest connected to extended reality applications.

## AVIATION

GNSS's role is becoming more and more prominent, since automated drone functions are becoming increasingly accessible and a HAS service with 20 cm positioning accuracy can be relevant for the applications below. New airport surface management systems will also benefit from increased accuracy:

- DRONES: POSITIONING SYSTEM (URBAN)
- DRONES: NAVIGATION SYSTEM (URBAN)
- DRONES: GEO-AWARENESS SYSTEM
- AIRPORT – INTEGRATED SURFACE MANAGEMENT SYSTEMS

Specialised functions such as "return to home" or flight planning are now available even in budget models, and for new emerging applications such as parcel delivery using drones with beyond line-of-sight, etc. the accuracy provided by HAS is desirable.

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# Markets Applications

## CONSUMER SOLUTIONS

The addition of free high-accuracy positioning with dm-level precision can benefit the following applications in consumer solutions:

- LBS
- GAMING
- HEALTH
- AR FOR LEISURE
- COMMERCIAL (GEO-MARKETING AND ADVERTISING)
- AR PROFESSIONAL
- ROBOTICS - HIGH GNSS USE

For smartphones, HAS may enable a wealth of new apps, such as augmented reality. Robotics is widely reported to be one of the fastest growing market sectors, driven by the developing capability of robots to navigate complex environments thanks to local sensors such as LIDAR that are critical to understanding the robot's immediate surrounding but also, with the inclusion of GNSS sensors, necessary for open environment navigation.

## AGRICULTURE

There is a wide range of precision farming applications for certain type of crops that can benefit from dm-level accuracy such as:

- GUIDANCE
- VRA-LOW APPLICATIONS
- FARM MACHINERY POSITIONING
- SITE-SPECIFIC DATA ANALYSIS APPLICATIONS

These applications can be used for farming activities such as soil condition monitoring, cultivation, spraying, seeding and fertilising, etc. Also, HAS can be relevant for Common Agricultural Policy (CAP) applications, e.g. a geo-tagged photo app with 9 million EU farmers as potential users.

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***Thank you for your attention***

***Questions ?***