ICARUS: INTEGRATED COMMON ALTITUDE REFERENCE SYSTEM FOR U-SPACE

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Why ICARUS ?

“If something works, why break it?

Barometric altimetry has been the preferred way to ensure vertical separation for almost 100 years in manned aviation, and it works!

Why ICARUS ?

The short answer is:

If something has been working for almost 100 years, maybe it is time to revisit it

Why ICARUS ?

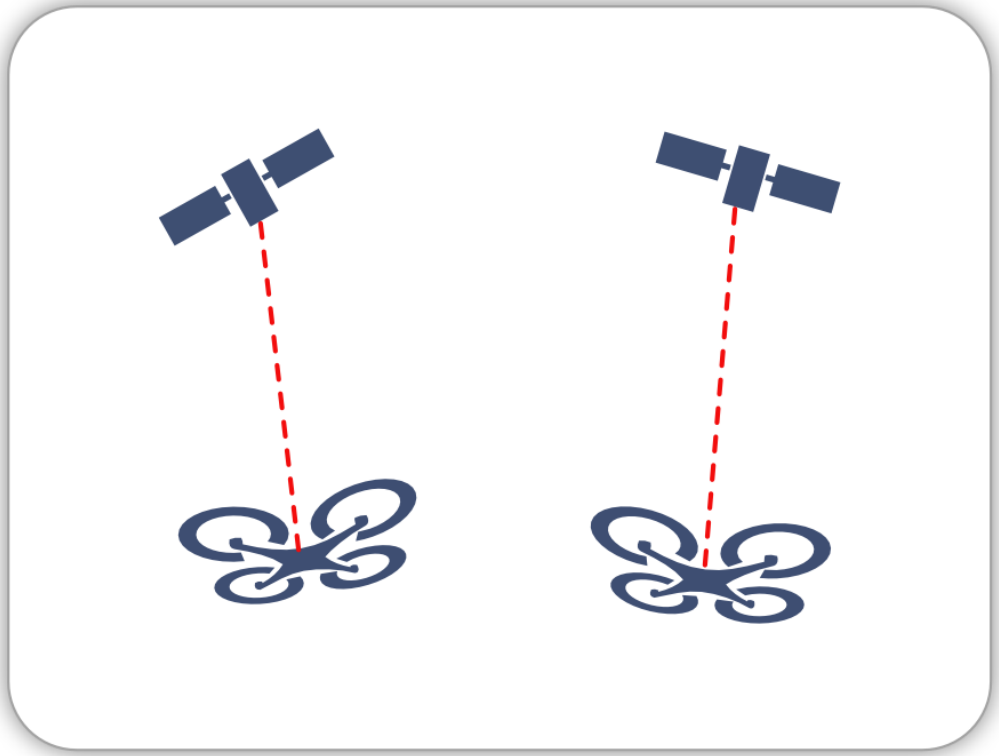
- Drone traffic vertical separation requires more precise height measurements
- Barometric measurements are not reliable at VLL, especially over cities
- ICARUS work will enhance vertical separation and enable high density operations

What is ICARUS?

ICARUS is a U3 U-space service, providing:

- **UAS-UAS: Common altitude reference at VLL**
  - Performance based navigation approach
  - Sources: DFMC GNSS receivers and UAS barometers
  - Technical requirements and error budgets
- **UAS-Ground: Obstacle awareness at VLL**
  - Sources: DTM/DSM/DEM models
  - Error budget for terrain models and WGS-84 datum
- **UAS-Manned: Common altitude flight reference**
  - WGS-84 vs QNH dynamic offset calculation (translation service)
  - Communication mechanisms and avionics integration

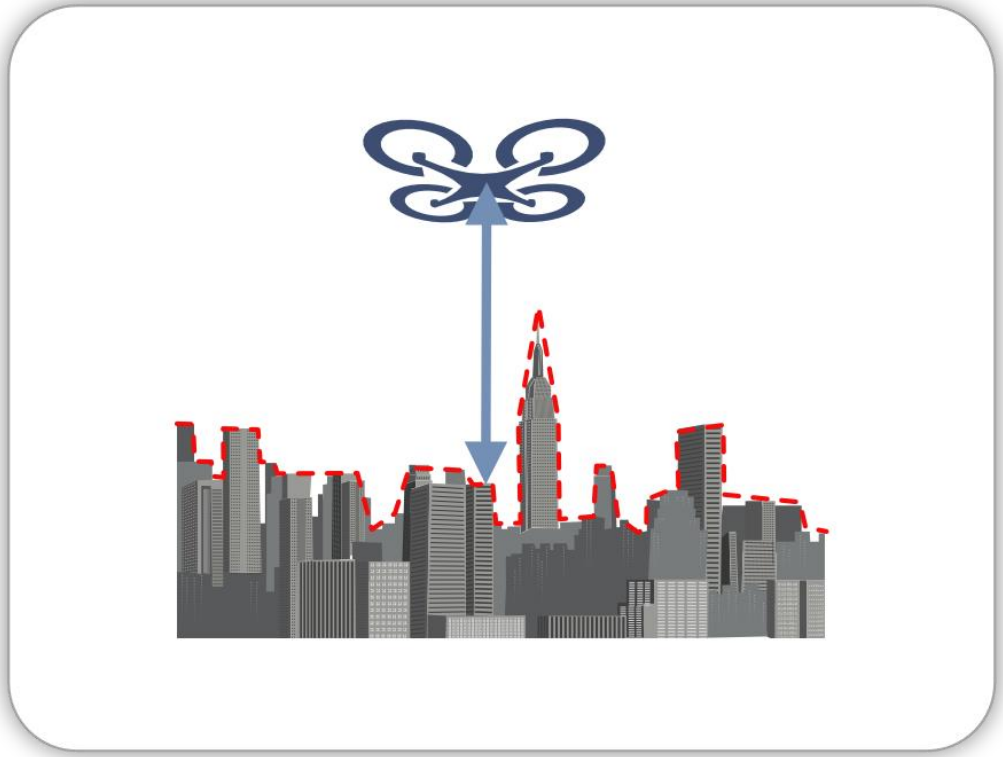
UAS-UAS: Common reference at VLL



Objective #1

Define the technical requirements for high accuracy GNSS-based altitude measurement for drones, allowing a reliable and accurate common vertical reference (UAS-UAS)

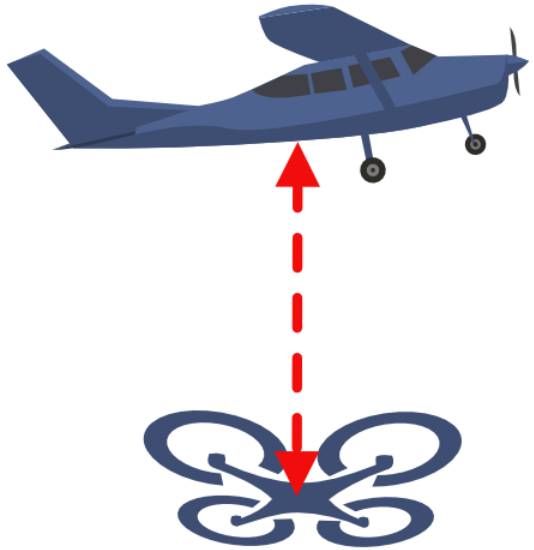
UAS-Ground: Obstacle awareness



Objective #2

Investigate the vertical accuracy and resolutions achievable by the actual DTM/DSM services for ground obstacle and terrain profile, with respect to the geodetic WGS-84 datum

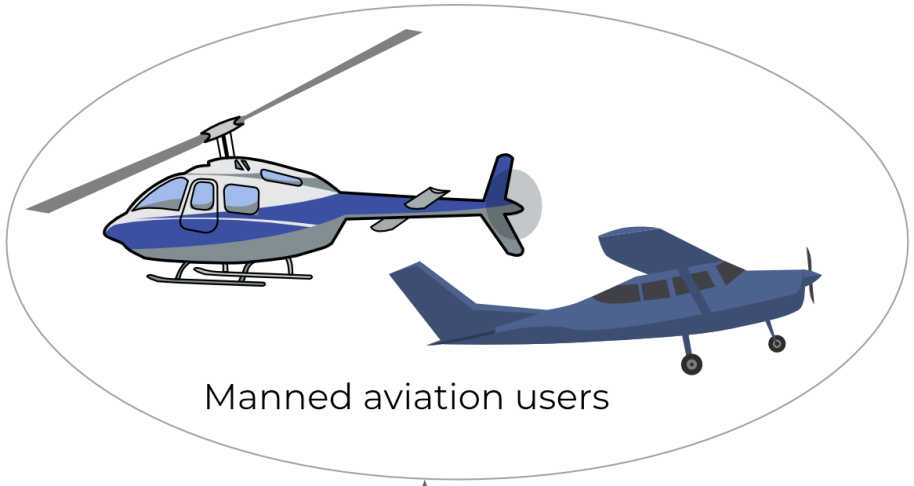
UAS-Manned: Common reference



Objective #3

Design a tailored U-space service for altitude translation between geometric to barometric altitude for UAS and manned aircrafts

ICARUS architecture



GNSS sources

GIS sources

Weather sources

ICARUS

Input processing

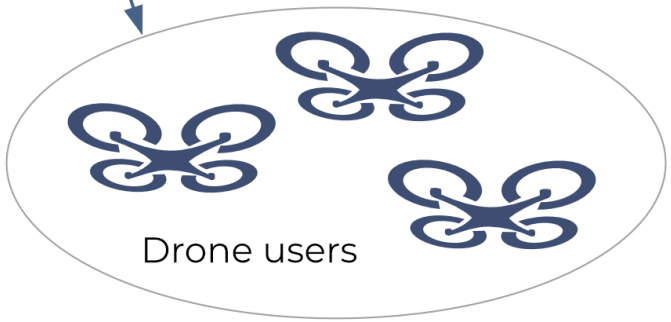
ICARUS API

Vertical conversion service

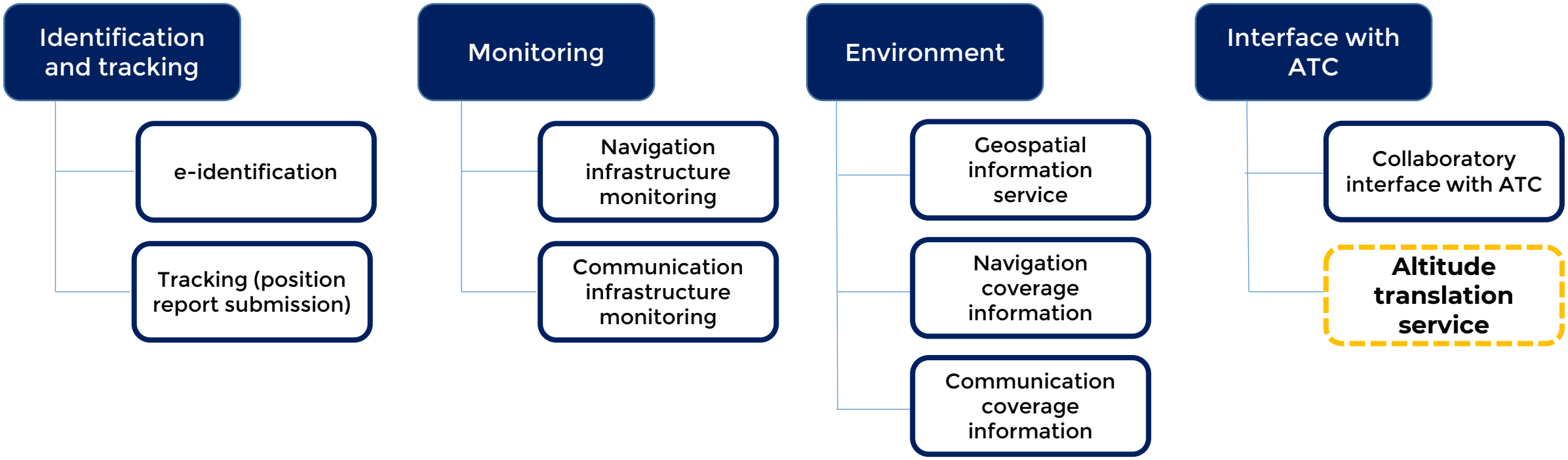
Vertical alert and information service

U-space service providers

ATM

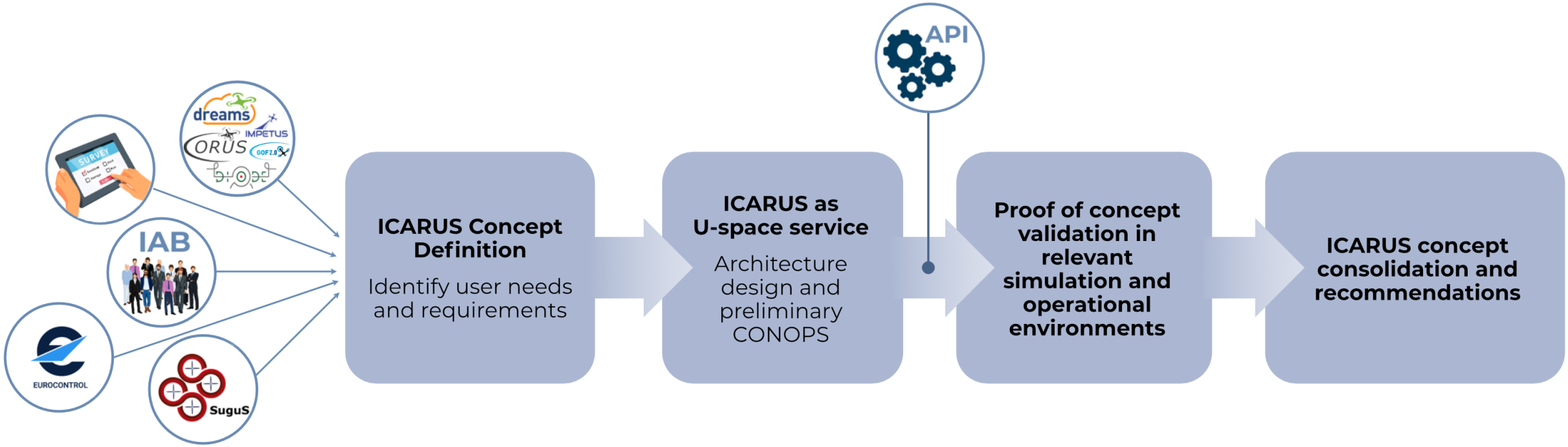


ICARUS as a U3 service



ICARUS will interact with many existing and planned U-space services and introduces a new U3 service

Methodology



Five relevant use cases

	Industrial ski-lift inspection	Spare parts delivery to offshore platform	Industrial power line inspection	Bio sample delivery	Airport-vertiport passenger transport
Scenario	Mountains / Rural	Above the sea	Rural / Suburban	Urban / Suburban	Airport /Rural / Suburban / Urban
Population density	None to low	None to low	Low	Medium to high	Medium to high
Conflicting traffic	None	Ultralight and GA in neigh. airspace	UAS / Helicopter / Other leisure GA	Other UAS / HEMS	Commercial flights / Other UAS
Airspace	X only Adjacent: G	Y only Adjacent: G	Y only Adjacent: G	Zu only (CTR) Adjacent: G	ATZ (Za), CTR, Zu Adjacent: G
Altitude data	WGS-84 Home points	UAS : WGS-84 Ultralight: WGS-84 GA: QNH	UAS: WGS-84 Ultralight: WGS-84 GA: QNH	UAS: WGS-84 HEMS: QNH / ADS-B	Taxi UAS: QFE (or QNH) in ATZ, WGS-84 inside GAMZ

Summary and ICARUS future

- ICARUS solves new challenges imposed by planned operations of UAS in VLL airspace using a completely novel approach
- While providing a safe backwards compatible interface with existing manned aviation procedures and systems
- It will be tested initially by UAS traffic, taking advantage of its enhanced functionality to support high density operations
- When proved successful, it might also be used by manned aviation (possibly extending its scope beyond VLL)
- ICARUS paves the way for introducing new paradigms into manned aviation, using drones as the experimental medium

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Thank you very much for your attention!

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