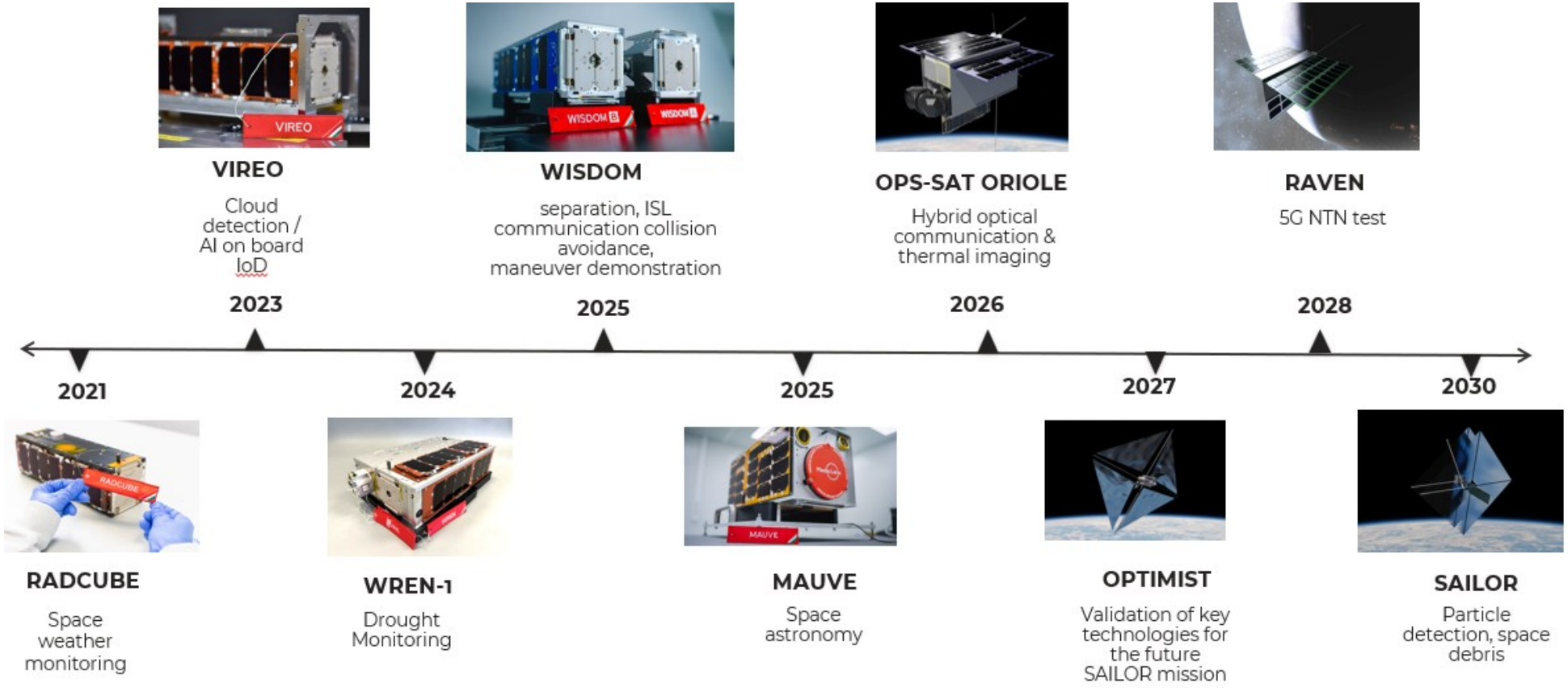
Host-independent Orbital Whereabout Locator with Dual-Channel GNSS receiver-based attitude information

Clean Space Days 2026

29 June 2026

We are part of the story — and part of the solution



C3S develops and operates compact, high-reliability satellite systems, with a strong focus on resilient and sustainable small-satellite operations.

Zero Debris starts with trusted state knowledge

Around **40,000 objects** are currently tracked by space surveillance networks.

About **11,000 active payloads** are now in orbit

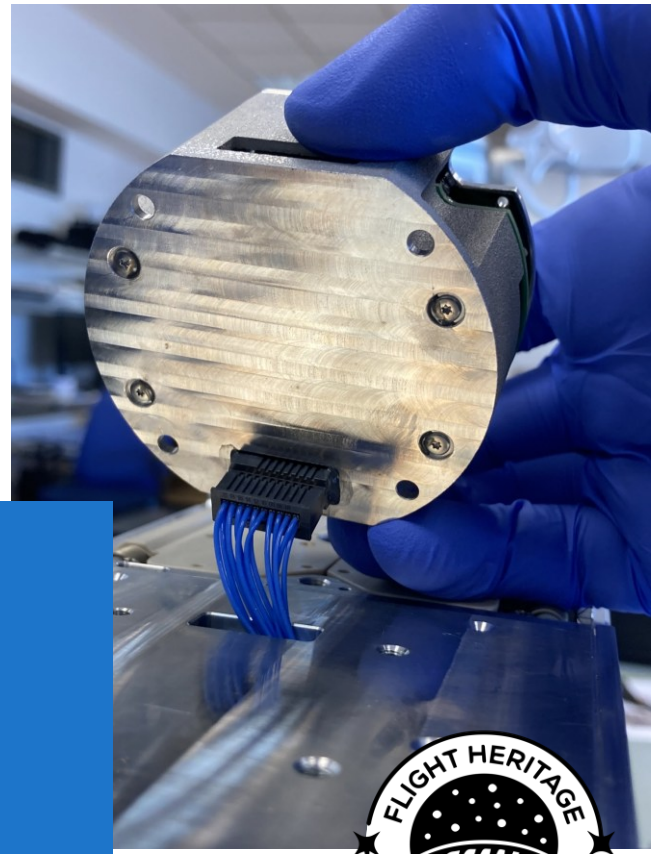
The estimated number of debris objects larger than 1 cm is above **1.2 million**.

Space traffic management requires satellites to remain identifiable, trackable and state-assessable throughout the mission lifecycle.

This is especially important during early mission, degraded operation, collision avoidance and end-of-life scenarios.

Zero Debris is not only about avoiding debris creation — it starts with knowing where the spacecraft is, what state it is in, and whether it can safely manoeuvre.

OWL-1 A compact “satellite-in-satellite” tracking layer



Flight-proven VHF beacon and GNSS-based tracking unit designed for CubeSat missions and early mission phases.

Transmits satellite identification, position and key telemetry.

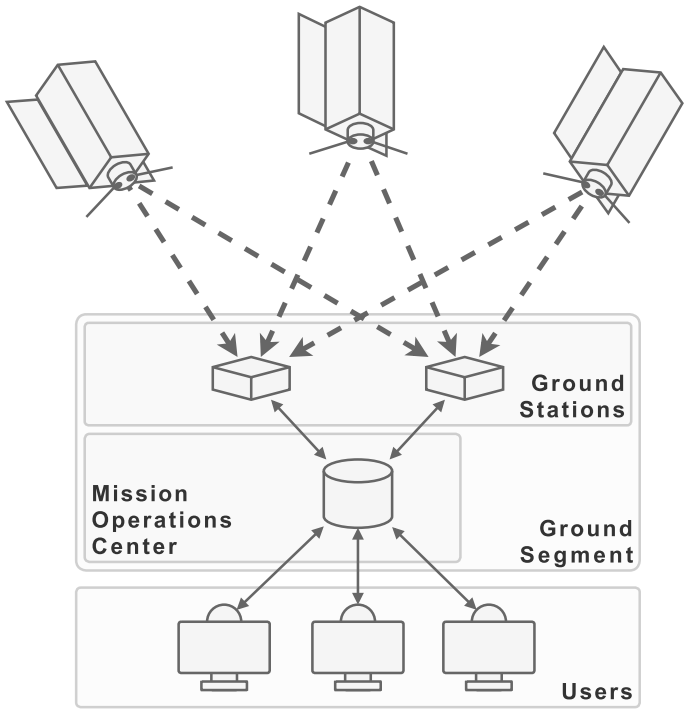
Operates independently from the host satellite for a limited time using its own battery.

Provides useful onboard measurements such as angular velocity, temperature, voltage and optional radiation data

Can provide GNSS and onboard measurement data to the host satellite via optional interface

OWL 1 established the core concept: independent identification, GNSS tracking and telemetry transmission for CubeSat missions.

OWL-1 architecture



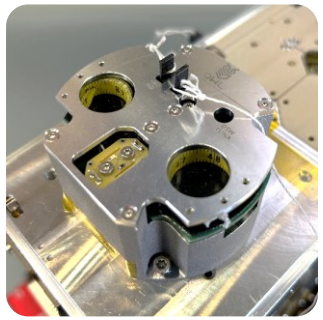
Space Segment:

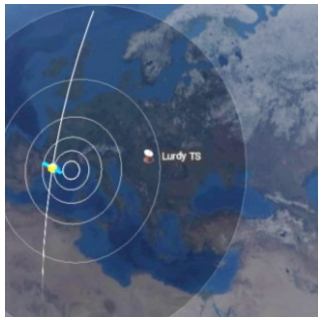
Key Subsystems:

- **OWL-EPS:** Manages power, charging from the host satellite, and provides about one day of battery operation.
- **OWL-COM:** Handles RF communication using a V-dipole antenna and LoRa modulation for long-range communication with low-power ground antennas.
- **OWL-OBC:** Collects data from GNSS, TID sensor, and IMU, and generates beacon frames.
- **OWL-WDT:** Protects against software failures and ensures system recovery after faults.

Ground Segment:

Includes omnidirectional VHF ground stations that receive signals from the OWL and transmit data to the Mission Operations Center (MOC), which processes the data and provides orbit determination services for satellite operators.

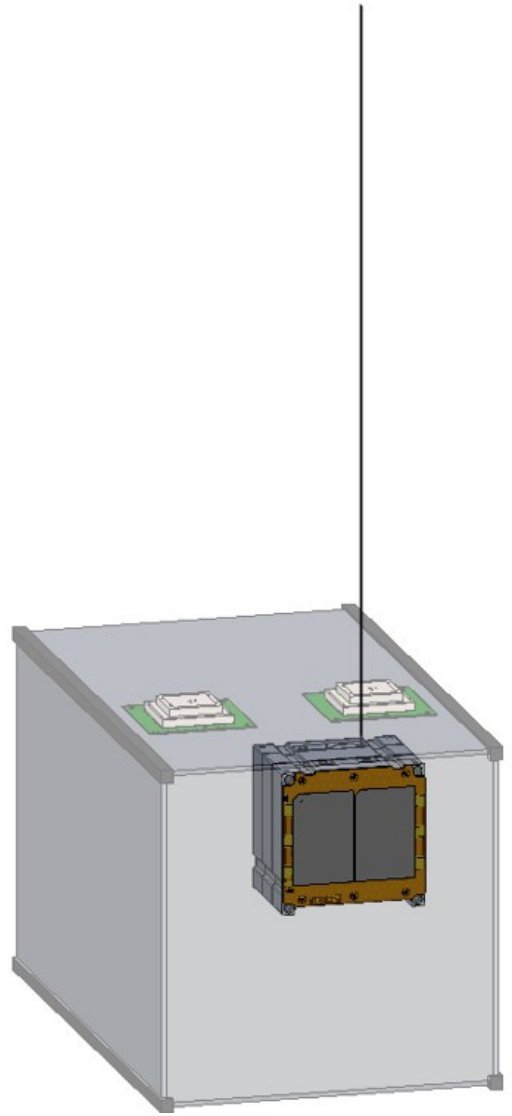




OWL evolution

OWL 2 preserves the original beacon and tracking function, but adds sensing, estimation and power autonomy.

Capability	OWL 1	OWL 1.5 / WISDOM	OWL 2
Core function	Beacon + GNSS tracking	Beacon/tracking + ISL	Navigation telemetry subsystem
Main use	Identification and location	Extended communication concept	STM, CAM readiness and disposal support
Communication	VHF to ground	VHF + ISL	VHF + ISL
GNSS	multi-constellation GNSS	multi-constellation GNSS	Dual-antenna, multi-constellation GNSS
Sensors	GNSS, IMU, basic telemetry, TID	GNSS, IMU, basic telemetry, TID	GNSS, IMU, magnetometer, optional TID
Estimation	GNSS, IMU, basic telemetry	GNSS, IMU, basic telemetry	EKF-enhanced PVT and attitude/rate telemetry
Power autonomy	Battery-limited	Battery-limited	Dedicated solar-cell / body-mounted solar input possible
Platform scope	CubeSat-focused	Mission-specific evolution	CubeSats and larger satellite platforms
Zero Debris relevance	Basic tracking	Improved communication path	Independent state knowledge for CAM and degraded scenarios



Dual-GNSS and EKF-based state estimation Turning raw sensor data into trusted state knowledge

Dual-antenna GNSS provides independent position and velocity data and supports attitude-related information

IMU captures short-term dynamics, angular motion and tumbling behaviour

Magnetometer adds an additional attitude reference

Onboard EKF fuses GNSS, IMU and magnetometer data into a robust spacecraft state estimate

Outputs support **PVT, attitude/rate telemetry, estimator health and CAM readiness assessment.** OWL 2 gives the operator an independent view of where the satellite is, how it is oriented, and whether it is stable enough to perform a collision avoidance manoeuvre. This is particularly valuable if the primary AOCS telemetry is degraded or cannot be fully trusted.

OWL 2 turns tracking data into trusted state knowledge for safe manoeuvre decisions.

Collision avoidance manoeuvres require trusted state knowledge

When a conjunction assessment indicates a potential collision risk, the operator needs to know more than the satellite's orbital position.

Before activating a thruster, the operator must assess:

- where the satellite is pointing,
- whether the spacecraft is stable or tumbling,
- whether the attitude state is compatible with the planned burn direction,
- whether the manoeuvre can be safely executed,
- whether the post-manoeuvre trajectory can be verified.

OWL 2 provides independent PVT, attitude and angular-rate telemetry to support CAM readiness assessment, especially when the primary AOCS telemetry is degraded, unavailable or not fully trusted.

The same telemetry layer also supports disposal assurance by preserving tracking and attitude/rate information in degraded scenarios.

Thank you for your attention!

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