

Space42 Space Situational Awareness for Geostationary Satellites

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Space42, Purpose, Vision

Space42 is a G42 company, part of a leading AI and cloud computing group with a strong portfolio of tech companies and global partnerships

SPACE42

A UAE-BASED, AI-POWERED SPACETECH COMPANY WITH GLOBAL REACH

Our Purpose

We pioneer beyond today, for humanity to experience a better tomorrow

Our Vision

Enlighten the Earth from space

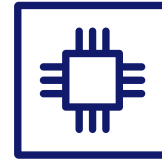


SPACE42

TWO BUSINESS UNITS

Space Services

Business unit mainly covering Yahsat's satellite communications business



Smart Solutions

Business unit mainly covering Bayanat's geospatial analytics business

Expertise

Satellite communication
(SatCom) services



Geospatial data acquisition
and management

SatCom satellite and ground
station operations and
management



AI driven multi-
intelligence leveraging
geospatial data

Earth observation satellite and
ground station operations and
management



Smart Autonomous
Mobility

Translating Vision Into Reality

Core pillars and sectorial priority will secure future growth, with longer-term uplift from key enablers



Core Pillars

- 1 Become preferred partner for premium geospatial data**
Build tier-1 sovereign multi-sensor EO assets and capabilities
- 2 Become leader in GeoInt AI platform and services**
Deliver actionable insights to global customers
- 3 Become a global NTN leader**
Lead the NTN revolution with IoT and D2D
- 4 Enhance leadership position in secure connectivity solutions**
Provide multi-path and multi-orbital critical connectivity solutions

Verticalized solutions



Government
Solutions



Public Services



Critical
Infrastructure
& Asset
Management



Autonomous
Mobility

Sectorial Priority



Telco



Sustainability

Enabling Pillars

Drive in-country space
value chain development

5

Strengthen core and
adjacent R&D for sustained
innovation

6

Embrace and adopt AI
technologies across
organization

7

Space42 Operates Across the Full Value Chain

From Orbit to Ground

- **Integrated capabilities**

Combines SatCom, geospatial analytics, and AI via two core units to deliver scalable, dual-use solutions

- **Expanding orbital infrastructure**

Operates six GEO satellites, with AI Yah 4 and 5 scheduled for launch in 2027 and 2028

- **Sovereign SAR constellation**

3 Foresight Satellites are live and deployed under the national EO program. Additional 2 in the pipeline

- **High-altitude platform stations (HAPS)**

Tested across three continents, the system extends reach and resilience for EO and connectivity missions

- **Industrial capability building**

Advances sovereign production with in-country manufacturing and local tech development

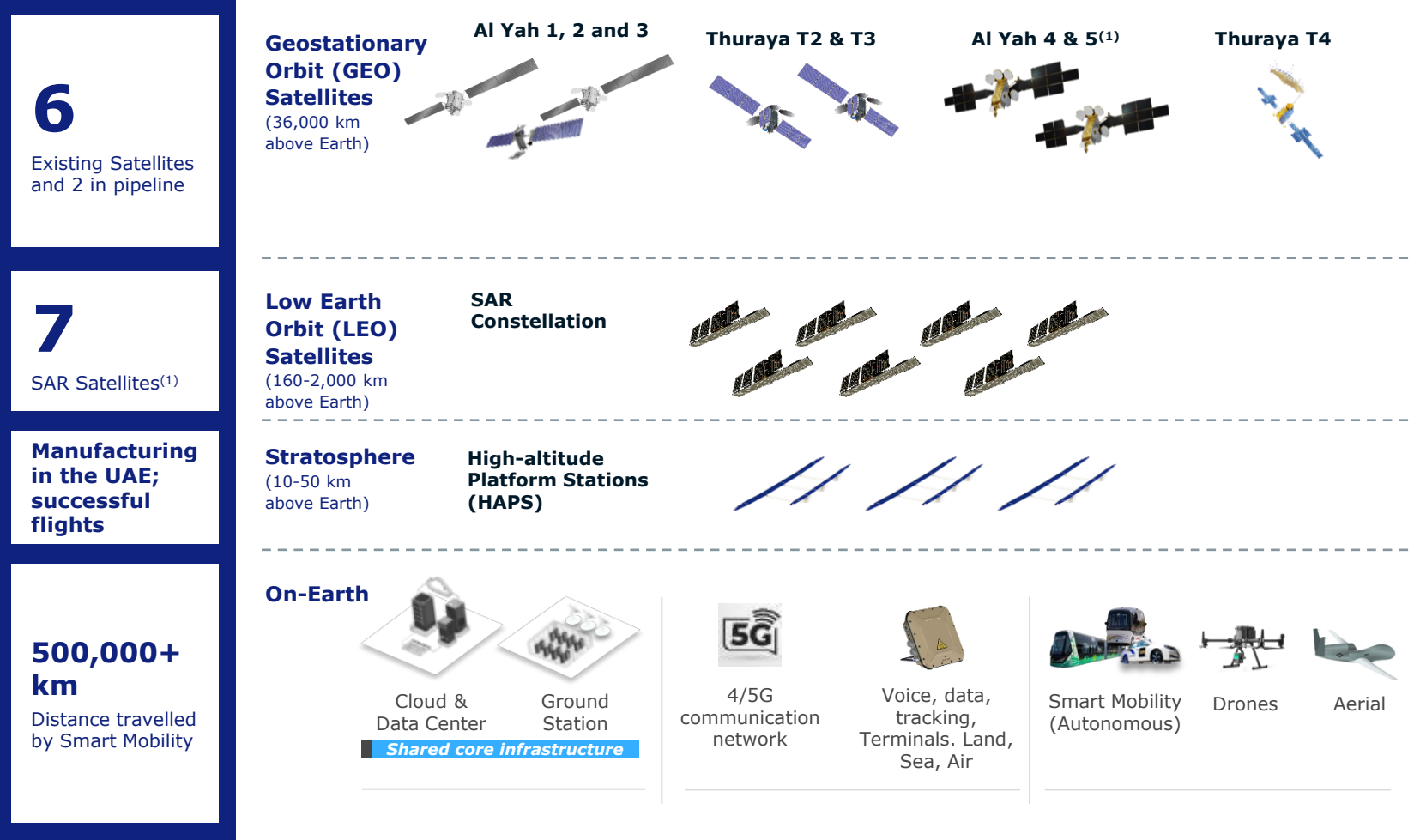
- **Enabling smart mobility**

Enables future mobility and smart cities through geospatial and autonomous systems integration



Space42 Assets Cover the Entire Value Chain

From Orbit to Space





Space42 Objective

- **Space42 aims to demonstrate that:**
 - GEO debris close encounters can be identified well in advance.
 - Potential conjunctions can be assessed systematically.
 - Avoidance actions can be integrated into routine operations.
 - Lifetime and fuel penalties are essentially negligible.



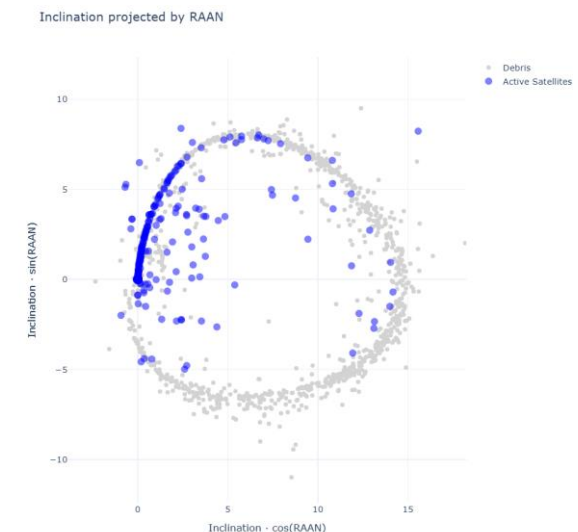
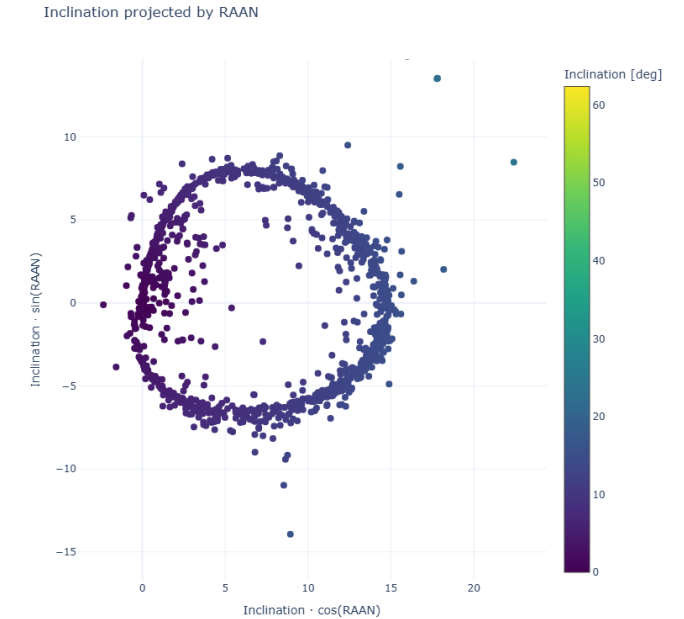
Objects of concern

Object categories

- Three categories of objects must be considered:
 - Controlled Satellites
 - Managed through station-keeping deadbands
 - Operator coordination when necessary
 - Major contributor to false-positive conjunction warnings, especially in case of adjacent satellites
 - Geosynchronous Debris
 - Primary focus of this presentation
 - Non-Geosynchronous Debris
 - Difficult to predict accurately
 - Dependence on SSA providers CDMs
 - Examples include Briz-M and Block-DM upper stages

GEO Debris Key Observation

- Most objects with inclination below 5° are operational spacecraft or disposal orbit objects.
- Most debris objects have inclinations greater than 5° .
- Debris crossing the GEO belt:
 - Remains within $\pm 0.1^\circ$ latitude of the equator for less than 10 minutes.
 - High relative North-South velocity. Crossing speed is approximately 15 km/minute.
 - Close encounters occur only near orbital node crossings.
 - Maximum of two crossings per day.
- Radial separation becomes the dominant parameter.
- **Operational focus:**
 - Monitor conditions where radial separation becomes small.





Space42 Early Warning Process

- **Space42 routinely identify potential encounters earlier (more than 14days in advance):**
 - **Process:**
 - Download GEO TLE catalogue
 - Filter objects using Space42 TLE processing tools
 - From the filtered list, obtain SP catalogue orbit for the debris as more accurate orbit
 - Import debris orbits into Flight Dynamics software
 - Generate refined encounter predictions against actual Satellite ephemeris
 - Monitor encounter consistency over time
 - **Outcome:**
 - Early identification of objects requiring detailed investigation.

TLE Catalogue → Filtering → FD Analysis → Possible Encounter

Identifying potential encounters

- **Indicators of a significant event:**
 - Repeated close radial separation
 - Moderate tangential separation
 - Consistent encounter predictions across multiple TLE updates
 - Multiple encounters involving the same object
- **Key Message:** These patterns distinguish genuine conjunctions from inaccurate TLE.



Close Encounter Refinement

Conjunction re-assessment

- **When a potential conjunction is identified:**
 - Submit Space42 ephemeris to SpaceTrack with pre-planned manoeuvres
 - Receive refined conjunction assessments
 - Continue providing updated ephemerides with actual manoeuvres
 - Monitor evolution of conjunction parameters

Roles of TLEs

Screening Tool

- **TLEs are not suitable for precise conjunction assessment. However, TLEs are extremely valuable for:**
 - Situational awareness
 - Early warning
 - Trend monitoring
 - Identifying possible encounters
- **Key Message:**
 - TLEs are a screening tool, not an encounter analysis tool.

Operational Experience

TCA predictions

- SSA providers occasionally predicts close encounters without the knowledge of upcoming manoeuvres or stationkeeping cycle durations.
- Hence, predicted encounter TCA dates may be incorrect in some of the CDMs.
- For such case, Space42 uses an avoidance planner tool where the upcoming nominal manoeuvre cycle can be forecasted, and re-assessment of the close encounter would be completed.
 - TCA better estimated

A vertical blue bar on the left side of the slide, featuring a partial view of a satellite in space.

Typical Avoidance Philosophy

- Avoid unnecessary manoeuvres.
- Integrate avoidance into routine station-keeping activities.
 - Make manoeuvre timing adjustments where possible.
- **Key Message:**
 - Most GEO debris avoidance actions can be achieved with minimal operational impact
 - Collision avoidance does not significantly require extra propellant.



SDA Benefits

- Improved efficiency
 - Provides Conjunction Data Message results from different SSA providers, in a single platform.
- GEO Relocation support more accurate with operators' ephemerides
 - Improved coordination during drift operations
 - Early identification of potential conflicts
 - Reduced operational risk, especially close to the relocation stop manoeuvres
- Operator to Operator coordination
 - Direct communication pathways
 - Rapid clarification of concerns
 - Manoeuvre coordination when required
- LEO mission support
 - As recently added SAR Satellites in LEO, Satellite Operator ephemeris will minimize the false positive conjunctions