The IRIDE Programme: Overview of the System, Constellations and Services

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The IRIDE System and its objectives

A constellation of constellations, comprising several sensing technologies: radar, optical, multispectral & hyperspectral, complementing existing systems and contributing with increased resolution and improved revisit.

Set up an operational EO system to fulfil Institutional services’ needs expressed by Italian public Users, within the tight schedule imposed by the PNRR.

Enhance existing Italian and European systems, focusing on observations over Italy.

Develop a geospatial-based services market at National/European level, strengthening national capabilities and promoting the competitiveness of Italian companies.

Complement existing Italian and European systems.

Progressively involve local administrations and private customers in the use of geospatial information (space economy).
IRIDE Project Implementation Timeline

- Implementation Approach
- Team Setup
- Architecture Definition
- Procurement
- Upstream Development
- Downstr. Development
- Services
- Development and Deployment

PNRR MILESTONES

M1C2-22

M1C2-24 / M1C2-25
IRIDE Project Budget

**Budget ~ 1.1 B€**

- **800 M€** EU RRF (to be committed in 15 months)
- **300 M€** National Complementary Fund

**System**

- **Upstream** (satellite constellation)
- **Downstream** (FOS, PDGS, marketplace)
- **Services** (8 to PA, by National Users Forum)

**Milestone M1C2-22**: All contracts assigned by 31 March 2023

**MILESTONE ACHIEVED**

**Milestone M1C2-24/25**: Deliver the whole system to the Italian Government authorities (or to the Entity formally designated by those authorities) no later than 30 June 2026 in an “Operation-Ready” status
IRIDE System Definition Strategy

IRIDE System Iterative Approach, due to Schedule Constraints

- Users’ needs
- System spec
- “Available” assets

Iterative and progressive definition of the constellation

Users’ Forum regularly consulted

Providers Consultation
IRIDE System Implementation Drivers

**Inclusive**
Architecture Definition - Technological Solutions
User Forum, Companies (LSI & SME), Academia, Research Centres

**Distributed**
Variety of Companies & Company Types
Modular, Scalable Architecture

**Resilient**
No reliance on single solution nor on a single supplier
Staggered development
Strict development checkpoints

**Multiplier**
Value past investments (ASI, Difesa, commercial, self-funded initiatives)
IRIDE Complements and enhance existing systems’ capabilities
IRIDE System Constituents

Upstream
- Radar Microwave (SAR)
- HyperSpectral / VIS-SWIR
- MultiSpectral (HR)
- Optical VHR

Launch Services
- FOS
- PDGS
- Central Mission Control & Planning

Downstream
- IRIDE Services Development
- LPA Uptake Initiative

Services
- CyberItaly

Marketplace
IRIDE System Architecture

Constellation 1  Constellation 2  Constellation 3  Constellation z

Flight Operations Segment 1  2  x  Performance Infos Orbit Files

Payload Data Orbit Files  Acquisition & Calibration Requests  Performance Infos Calibration Requests

Central Mission Planning and Management

Requests  Background mission infos  Requests’ status infos

Payload Data Ground Segment  Processing Requests

Products

Marketplace

Data  Applications  Cyber Italy (Digital Twin)

Marketplace Platform

Marketplace Dashboard

Services

Hydro-climate  Water resources  Monitoring of land cover and use  Security Services

Emergency Services  Coast & Marine Monitoring  Air Quality  Ground motion

Third party Data, Services and Applications

Downstream Element

Service Element

Upstream Element

IRIDE Ext Element

Auxiliary Data Providers

External Entities

Third Party Data Serv. and Applications  Data and Infos (e.g. in-situ, meteo, etc.)

National Missions  Other Platf(e.g. Copernicus DIASs)

Users

Commercial users  Scientific users  Institutional users

Auxiliary Data

External Data

Applications

Requests

Constellation 1  Constellation z

Flight Operations Segment 1  2  x

Orbit Files  Calibration Requests

Constellation 1  Constellation 2  Constellation 3  Constellation z

Constellation 3

Constellation 2
The MarketPlace

Integrates **State-Of-The-Art technologies & Open Standards.**

**No vendor lock-in**, since it does not make use of any Background Intellectual Propriety Rights or Third Party solutions.

**Natively interoperable** though standard API interfaces, for future federation with other digital infrastructures.

**Scalable micro-services architecture**, to manage a growing number of users, applications, services and volume of data.

**Tight link to the IRIDE Ground Segment**, granting a reliable and efficient unique access point to all the IRIDE Program resources.

**Ready to onboard IRIDE Services and Digital Twin applications**, providing rich hosting functions, adequate technical guidelines and a Developer Portal.

**Reliable and secure by design**, ensuring Business Continuity with a gold standard Security Operations (SOC).

**Fully complying with Italian and EU regulations** on Security, Data Protection, implementing shutter control

**Natively interoperable** though standard API interfaces, for future federation with other digital infrastructures.
## SAR NIMBUS Constellation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radar Frequency</td>
<td>X-band</td>
</tr>
<tr>
<td>Radar Operative BW</td>
<td>Up to 1000 MHz</td>
</tr>
<tr>
<td>RF Max Peak power</td>
<td>3840 W</td>
</tr>
<tr>
<td>Radar Polarization</td>
<td>Single pol (VV)</td>
</tr>
<tr>
<td>Radar Antenna Length</td>
<td>3.6 m</td>
</tr>
<tr>
<td>Radar Operative Modes</td>
<td>Spotlight, Stripmap, ScanSAR</td>
</tr>
<tr>
<td>Performance Range</td>
<td>15 - 50 deg incidence</td>
</tr>
<tr>
<td>Data Access Range</td>
<td>15 - 50 deg incidence</td>
</tr>
<tr>
<td>Swath</td>
<td>2.5 km (spot); &gt; 23 km (strip); 100 km (scan)</td>
</tr>
<tr>
<td>Ground Resolution</td>
<td>From 0.5 m to 17 m</td>
</tr>
<tr>
<td>Lifetime</td>
<td>5.25 years</td>
</tr>
<tr>
<td>Orbit</td>
<td>SSO nominal 490 km; LTAN from 01:30 up to 10:30, inclined orbit from 44° to SSO</td>
</tr>
</tbody>
</table>
## NOX SAR Constellation: SAR Specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launchers Compatibility</td>
<td>Vega-C, Vega, Ariane 6, PSLV</td>
</tr>
<tr>
<td>Radar Frequency</td>
<td>X-band</td>
</tr>
<tr>
<td>Radar Operative Bandwidth</td>
<td>50-300 MHz</td>
</tr>
<tr>
<td>RF Max Peak power</td>
<td>4096 W</td>
</tr>
<tr>
<td>Radar Polarization</td>
<td>Single pol (VV)</td>
</tr>
<tr>
<td>Radar Antenna Length</td>
<td>3,2 m</td>
</tr>
<tr>
<td>Radar Operative Modes</td>
<td>Spotlight, Stripmap, ScanSAR</td>
</tr>
<tr>
<td>Performance Range</td>
<td>20-40 deg off nadir</td>
</tr>
<tr>
<td>Data Access Range</td>
<td>15-50 deg off nadir</td>
</tr>
<tr>
<td>Swath (Gnd x Az)</td>
<td>From [10 x 10 km] to [80 x 120 km and beyond]</td>
</tr>
<tr>
<td>Ground Resolution</td>
<td>From &lt; 1.5 m to &lt; 6 m</td>
</tr>
<tr>
<td>Max Downlink datarate</td>
<td>&gt; 330 Mbps</td>
</tr>
<tr>
<td>On-board Data Storage (EoL)</td>
<td>n ≤ TR</td>
</tr>
<tr>
<td>Reference Orbit</td>
<td>515 km; LTAN 18:00 ± 1h</td>
</tr>
<tr>
<td>Lifetime</td>
<td>5 years</td>
</tr>
<tr>
<td>Parameter</td>
<td>Specification and Performances</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------</td>
</tr>
<tr>
<td>Launchers Compatibility</td>
<td>Vega C, Falcon-9, others commercial</td>
</tr>
<tr>
<td>Optical Band</td>
<td>Panchromatic band: 450 – 800 nm</td>
</tr>
<tr>
<td></td>
<td>MS band 1 (blue): 450 – 520 nm</td>
</tr>
<tr>
<td></td>
<td>MS band 2 (green): 520 – 590 nm</td>
</tr>
<tr>
<td></td>
<td>MS band 3 (red): 630 – 690 nm</td>
</tr>
<tr>
<td></td>
<td>MS band 4 (VNIR): 770 – 890 nm</td>
</tr>
<tr>
<td>SNR</td>
<td>&gt;80 PAN; &gt; 140-177@ RGB/VNIR; TDI=16</td>
</tr>
<tr>
<td></td>
<td>MTF (end to end) &gt; 0.06@Nyquist</td>
</tr>
<tr>
<td>Ground Sampling Distance @ nadir</td>
<td>&lt; 1 m (PAN) native, &lt; 4 m (RGB-VNIR) native</td>
</tr>
<tr>
<td>Operative Modes</td>
<td>Stripmap, Mosaic, N-Stereo</td>
</tr>
<tr>
<td>Field of regards: maximum off nadir angle</td>
<td>+/- 30 deg</td>
</tr>
<tr>
<td>Stripmap Swath Across-Track</td>
<td>≥ 10.5 Km</td>
</tr>
<tr>
<td>Max strip Along-Track</td>
<td>&lt; 1200 Km (~200 sec acquisition)</td>
</tr>
<tr>
<td>Reference Operational Orbit</td>
<td>Around 460 km</td>
</tr>
<tr>
<td></td>
<td>Indicative LTDN 10:30 – 14:30</td>
</tr>
<tr>
<td>Lifetime</td>
<td>5,25 years</td>
</tr>
</tbody>
</table>
Hyperspectral Constellation (SITAEL-LEONARDO)

**Orbit (SSO)**
- Reference Orbit → Altitude of ~515 [Km]; Indicative LTDN 10:30 - 14:30
- **Payload** → Optical Hyperspectral (Pushbroom)
  - Acquisition Modes → Stripmap; Spotlight;
- **Spectral Range** → between 400 [nm] and 2500 [nm]
- **Spectral Resolution** = 10 [nm] - (> 200 spectral bands)
- greater than 31[m]@519km
- **SNR** = @450nm > 180 ; @600nm > 200 ; @1000nm> 180 ; @1600nm> 140; @2300nm
- **GSD (at the nadir point on the ground track at sea level at the equator)**
  - ~ 5 m@519 km - PAN
  - ~ 21m@519 km - SPOTLIGHT
  - ~ 31 m @519 km – STRIPMAP
- **Swath (Across Track)** = ~ 21 km @519km
- **Payload Duty Cycle** = ~3%
- **(Min/max) Continuous Acquisition**: 4 - 142 [sec] STRIPMAP; 8 - 60 [sec] SPOTLIGHT
High Resolution Multi Spectral#1 (Hawk–Argotec, Officine Stellare)

- **Wet Mass** = 60 [Kg]
- **Orbit** (SSO; LEO): Altitude of 560 km Nominal, LTAN 10:30 – 14:30; **Payload** → Optical Multi-Spectral High Res
- **Spectral Bands**: Red (610-690 [nm]); Green (530-610 [nm]); Blue (440-520 [nm]); NIR (440-520 [nm]); PAN (455-705 [nm])
- **GSD** = 2.66 [m] @560 [Km] → 7.98 [m] for the MS (RGB; NIR) with Binning 3x3; **Swath (Across Track)** = 10.9 [Km] @560 [Km]
- **Strip Length** = Up to 80 [Km]; **PDT User Data Rate (X-Band)** = Up to 225 [Mbps]
- **SNR**: 110.6 (PAN); 54 (MS) @ TDI = 4; 81 (MS) @ TDI = 4 and 3x3 Binning
- **Maximum OFF-Nadir angle** = 13.4°; **Payload Memory Storage** = Up to 240 [GB]
High Resolution Multi Spectral MS#2 (Eaglet 2) – OHB I, OPTEC

**Nominal Mass** = 25 [Kg];  **Orbit (SSO)**; Altitude between 467 [Km] and 525 [Km] (Nominal); Local Time interval 09:30 to 11:30 i and from 12:30 to 14:30. Ascending and descending.

**Payload** → Optical Multi-Spectral High Resolution + AIS

**Spectral Bands** = RGB → Red = (0.55 0.85) [nm]; Green = (0.45 0.65) [nm]; Blue = (0.35 0.55) [nm]

**GSD** = 1.75 [m] @467 [Km];  **SNR= >100**;  **Swath (Across Track)** = 16.3 [Km] @467 [Km]

**Spot Image Size** = (16.3 [Km] x 12.2 [Km]) @467 [Km]

**Strip Image Size** = (16.3 [Km] x 350-400 [Km]) @467[Km]

**PDT User Data Rate (X-Band)** = 100 [Mbps]
Summary and Next Steps

• ~30 individual procurement actions carried out, covering upstream, downstream and services with a wide distribution of development effort across the entire industrial eco-system (~1/4 of the budget to SME’s):

  • **Upstream**: Satellites: 34 (baseline) + 35 (order activated depending on progress)
  • **Downstream**: composed by the Ground Segment, Marketplace and CyberItaly
  • **Services**: National institutional services (8) + complemented by local services (5)
  • **Launch services**: 2 dedicated launches with option for 1 additional launch

• **Next Steps**:

  • Finalization in Q4 2023 of the Mission aspects for each Constellation as closure of the iteration between User Need and Constellations flexibility to move towards the proposed mission ranges (orbit, LTAN, etc)
  • Monitor the evolution of the contracts and support the development of the assets
Thank you!