



PanGeo Alliance: The calibration of a multi-mission Constellation



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- **The PanGeo Alliance**
- **Cal/Val Management System**
- **Current status**

1 The PanGeo Alliance



- **The first alliance among Earth Observation satellite operators or worldwide distributors**
- **Following the model of airline alliances, provides to the customer**
 - **A common interface to access all the platforms**
 - **Uniform service level**
 - **Quality assurance**
 - **Common product format**
- **The founding members of the PanGeo Alliance:**
 - **Dauria Aerospace Group (Russia/US)**
 - **EIAST (United Arab Emirates)**
 - **Elecnor Deimos (Spain)**
 - **BSEI (China)**



北京天目创新科技有限公司
Beijing Space Eye Innovation Technology Co., Ltd.

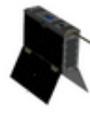
The PanGeo Alliance



9 satellites now >20 to be launched	Medium Resolution 1 satellite in orbit >8 to be launched	High Resolution 3 satellites in orbit >10 to be launched			Very High Resolution 2 satellites in orbit 1 to be launched			AIS 3 satellites in orbit	
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Deimos 1
Elecnor
Deimos



Perseus 0
Dauria



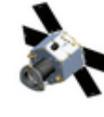
Auriga
Dauria



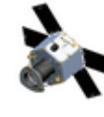
DubaitSat1
EIAST



TH-1-01/02
Beijing Space
Eye Innovation



Deimos 2
Elecnor
Deimos



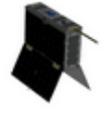
DubaitSat2
EIAST



KhalifaSat
EIAST



Dauria DX
Dauria



Perseus M 1-2
Dauria

Country	Spain	US/Russia	US/Russia	UAE	China	Spain	UAE	UAE	US/Russia	US/Russia
Type	Optical MR	Optical MR	Optical HR	Optical HR	Optical HR	Optical VHR	Optical VHR	Optical VHR	AIS	AIS
Launch	2009	2015	2017	2009	2010/2012	2014	2013	2017	2014	2014
Local Time AN	10:30	10:30	10:30	10:30	10:30	10:30	22:00	22:00	10:30	10:30
Lifetime	10 years	>5 years	>5 years	>5 years	7 years	7 years	7 years	7 years	>5 years	>5 years
Agility	-	± 25°	± 25°	± 45°	± 30°	± 45°	± 45°	± 45°	-	-
Spatial Resolution	20m	20m	2.5m	2.5m	2.0m	0.75m	1.0m	0.70m	-	-
Spectral Bands	3	3	5	Pan + 4	Pan + 4	Pan + 4	Pan + 4	Pan + 4	-	-
Swath	650km	220km	25km	20km	60km	12/24km	12km	16km	-	-



- **6 EO satellites operative**

- Dubaisat 1
- Dubaisat 2
- TH 1.1
- TH 1.2
- Deimos-1
- Deimos-2

- All optical & push-broom
- Swath ranging from 12km to 650km
- Nadir-pointing & agile platforms
- From 3 MS to 4+Pan bands
- GSD ranging from 1m to 22m
- Other major differences: Orbit, radiometric resolution, etc.

None with on-board calibration equipment.

An semi-automated Cal/Val system is being developed to deal with the current and upcoming sensors calibration.

2 Cal/Val management system



- **Supervised calibration and validation system for optical sensors**
- **Modular for inputs**
- **Input harmonization**
- **Human supervision**
- **Modular for tools**
- **Sensors database**
- **Datasets database (Built-in catalogue)**
- **Outputs**
 - **Anomaly detection**
 - **Calibration parameters**
 - **Quality assessment reports**
 - **R&D data**



- Development already started
- Input modules
- Tools (developed for Deimos-1 and Deimos-2)
- Built-in catalogue

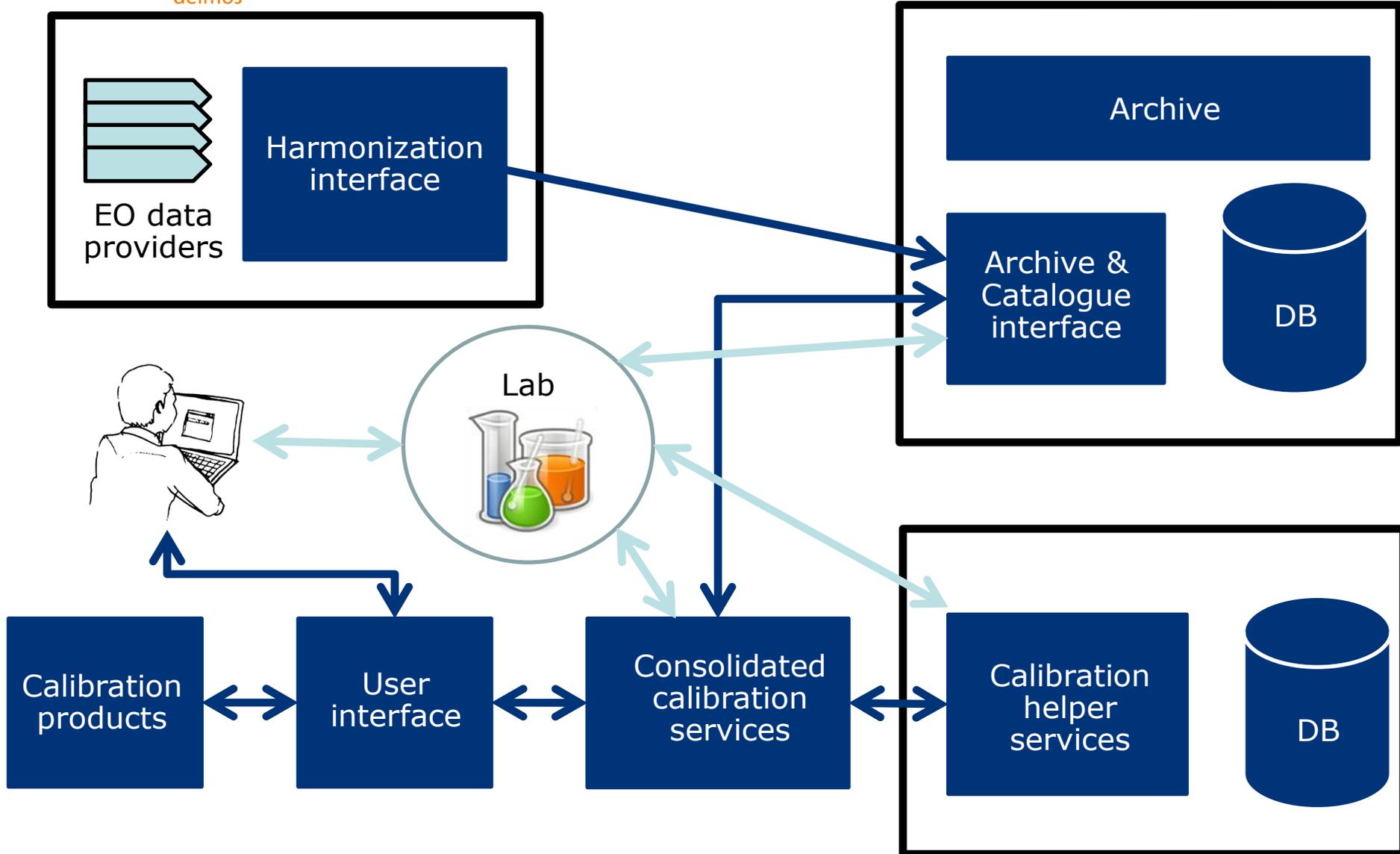
The screenshot displays the Cal/Val management system interface. It is divided into several sections:

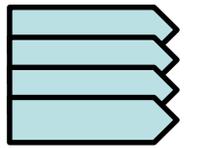
- TASKS | MONITOR**: A header section containing filter and search controls.
- Acquisition Date**: Fields for Start Date (2014-06-20) and End Date (2015-04-29).
- Geographical Area**: Radio buttons for Place name, Shape File / KML, Geographical coordinates, and Scene ID.
- Other Criteria**: Dropdown menus for Cloudiness (Level: LOR), Version (All), and Products (All). Includes a Roll range (0 to To) and Search/Clear all buttons.
- Instructions**: A note about longitude and latitude decimal format.
- Map**: A topographic map of Turkey with a red vertical bar highlighting a region near Ankara.
- Image Information**: A list of found images (30 total) with columns for Info, Image - Tile, and View. Each entry includes acquisition date, area, version, roll/pitch/yaw, and action buttons like 'Allow', 'Edit Products', 'Processable', and 'Calibration T'.

Cal/Val management system

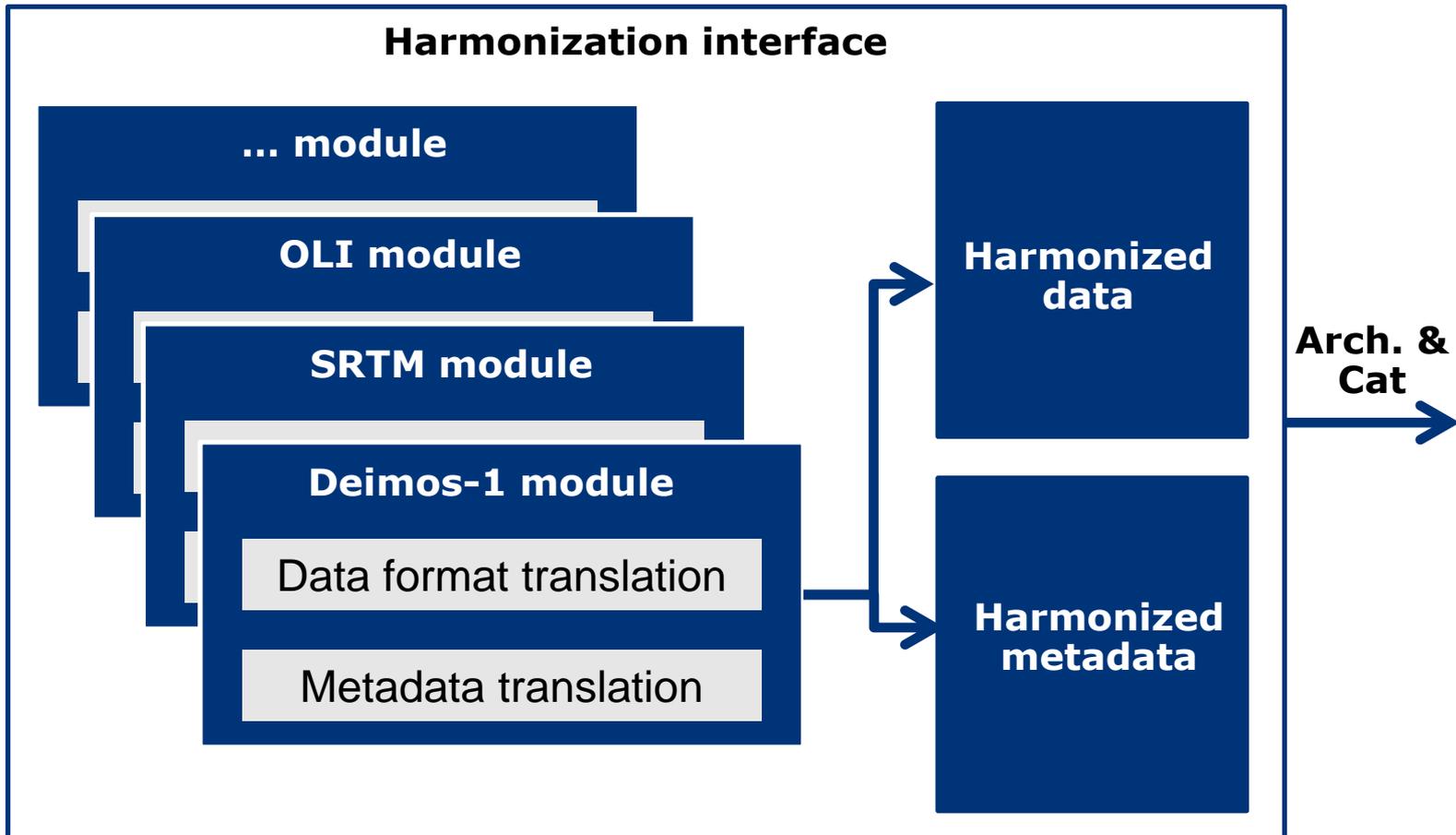


Design





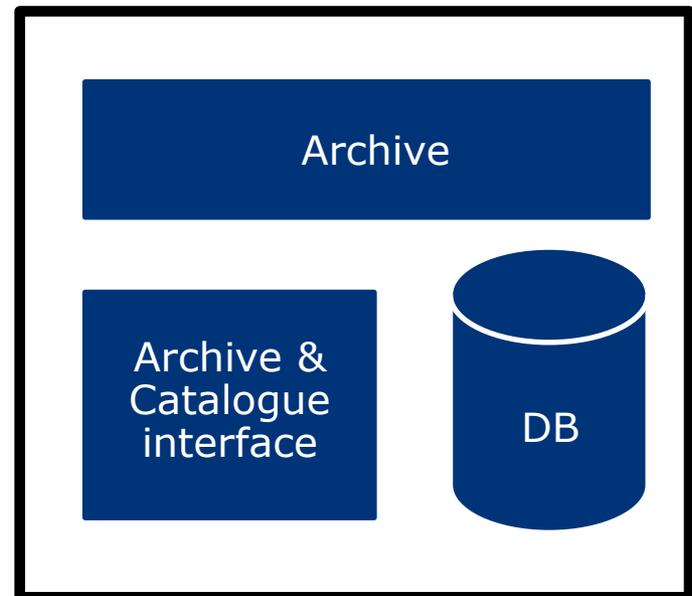
EO data providers



- **Data: JPEG2000, lossless compression**
- **Metadata: Custom, but ISO19115 compliant**

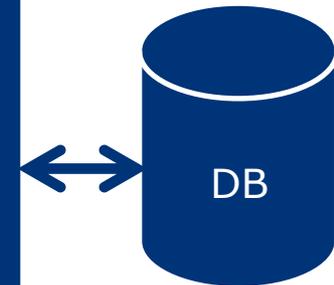
Archive and catalogue

- **Despite the calibration archive and catalogue are not mission critical, they are integrated in the ground segment, so they are highly available and fault-tolerant**
- **The database is GIS-enabled**
- **The interface provides**
 - **Harmonized data ingestion**
 - **WMS, WFS and CSW**
 - **Extended features like on-the fly cropping and statistics calculation**



Calibration helper services

- **Sensor characteristics** (bands, spectral responses, and other specificities)
- **Calibration parameters database**
- **Cal/Val AoIs** (PICS, Instrumented, MTF, etc)
- **Sun-ground-sensor geometry**
 - Simple azimuth/elevation calculation
 - ...
 - Sun-ground-sensor viewing geometry considering the ground slope according to a DEM
- **Other helper utilities**
 - CRS transformation
 - Twoline database and orbit propagator
 - GCPs → RPCs
 - Quaternions ↔ RPY
 - Exo-atmospheric solar irradiance model database
 - Etc.

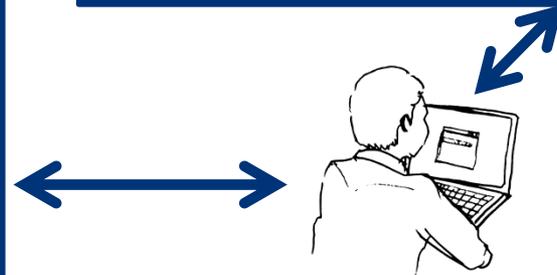


Consolidated calibration services

- Radiometric models
- TOA Radiance and reflectance calculation
- Atmospheric correction
- Stripping measurement
- Dark signal measurement
- SNR measurement
- Artifacts detection
- Calibration parameters calculation
- Trend analysis
- Report generation

Calibration products

- Calibration parameters
- Anomaly detection
- Calibration reports
- Quality assessment reports
- R&D data



Even the simplest calculations have been implemented to avoid manual errors



- **Calibration data currently integrated in Cal/Val Archive & Catalogue**
 - **Landsat-5/TM**
 - **Landsat-7/ETM+**
 - **Landsat-8/OLI**
 - **EO1 / Hyperion**
 - **Deimos-1**
 - **Deimos-2**

- **Platforms participating in PanGeo Cal/Val activities (ESA's CSCDA-DW)**
 - **Dubaisat-2 (EIAST)**
 - **TH-1-01, TH-2-02 (BSEI)**
 - **Deimos-1, Deimos-2 (ELECINOR-Deimos)**

Thank you!

Any questions?

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