

METEOSAT THIRD GENERATION Programme Status

4th meeting IRS MAG

MTG System Manager – R. Perin

18/10/2017



Meteosat Third Generation: Mission overview

- **Imagery missions:**

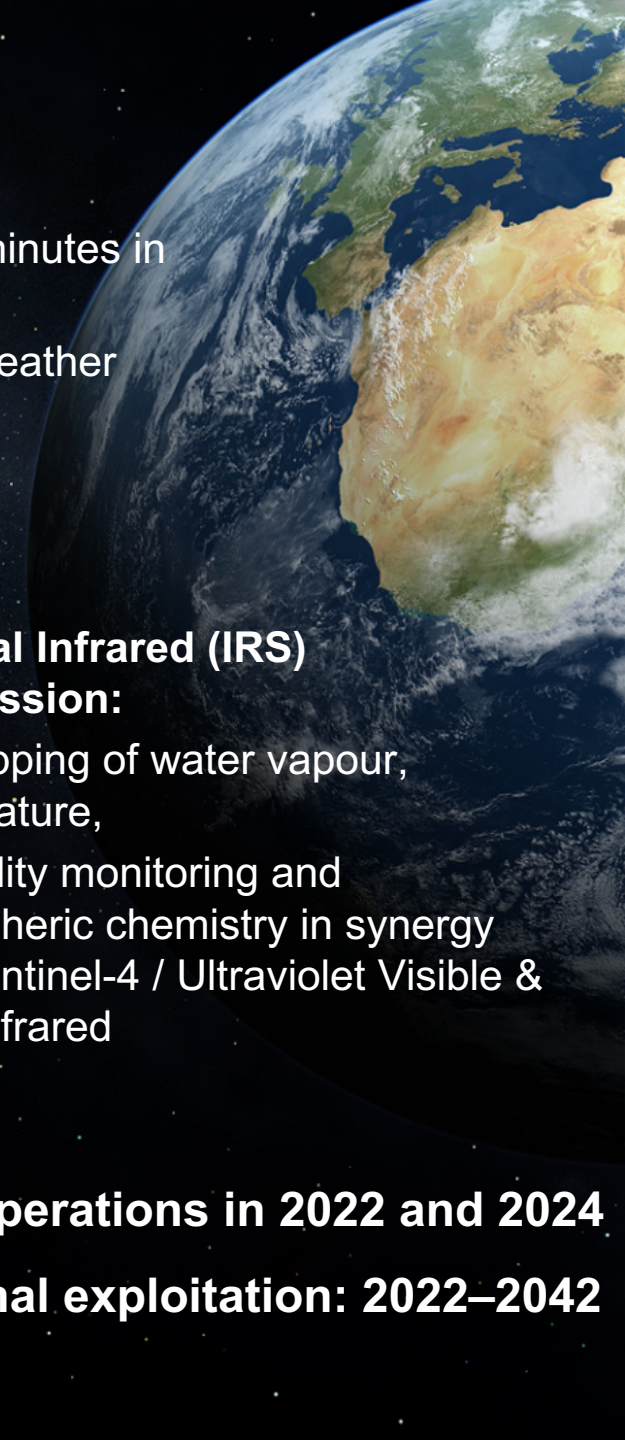
1. Full disk imagery every 10 minutes in 16 spectral bands
2. Fast imaging of European weather every 2.5 minutes
3. Lightning Imager (LI)

- **Hyperspectral Infrared (IRS) Sounding mission:**

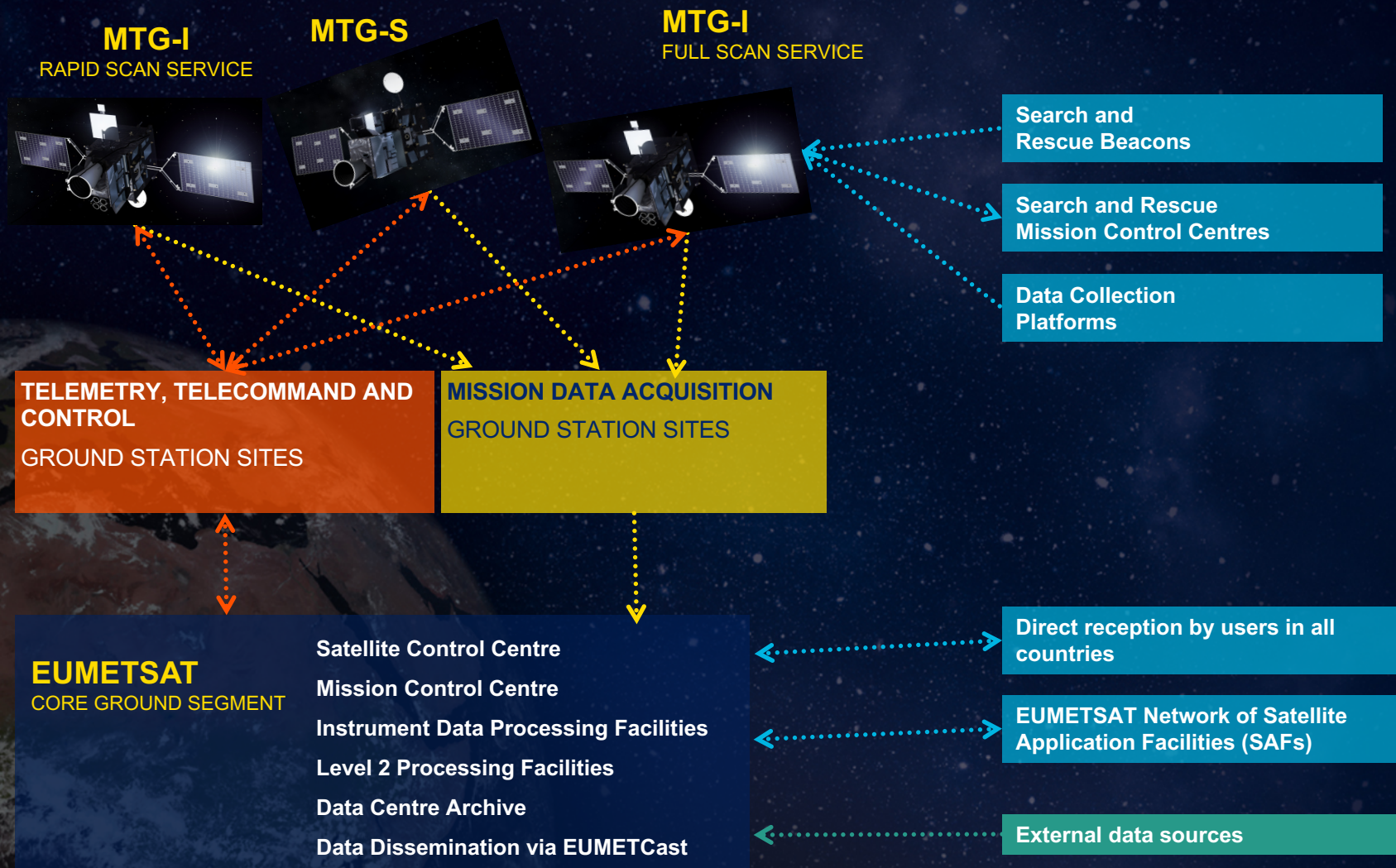
1. 3D mapping of water vapour, temperature,
2. Air quality monitoring and atmospheric chemistry in synergy with Sentinel-4 / Ultraviolet Visible & Near-infrared

- **Start of operations in 2022 and 2024**

- **Operational exploitation: 2022–2042**



MTG Programme – Overall system configuration



Twin satellite concept – based on 3-axis platforms:

4 geostationary imaging satellites (MTG-I)

2 geostationary sounding satellites (MTG-S)

**Lightning
Imager (LI)**

Established through a cooperation
between:



esa



EUMETSAT

**Sentinel-4
Ultra-Violet, Visible &
Near-Infrared (UVN)**

InfraRed Sounder (IRS)

Data Collection & GEOSAR (D&G)

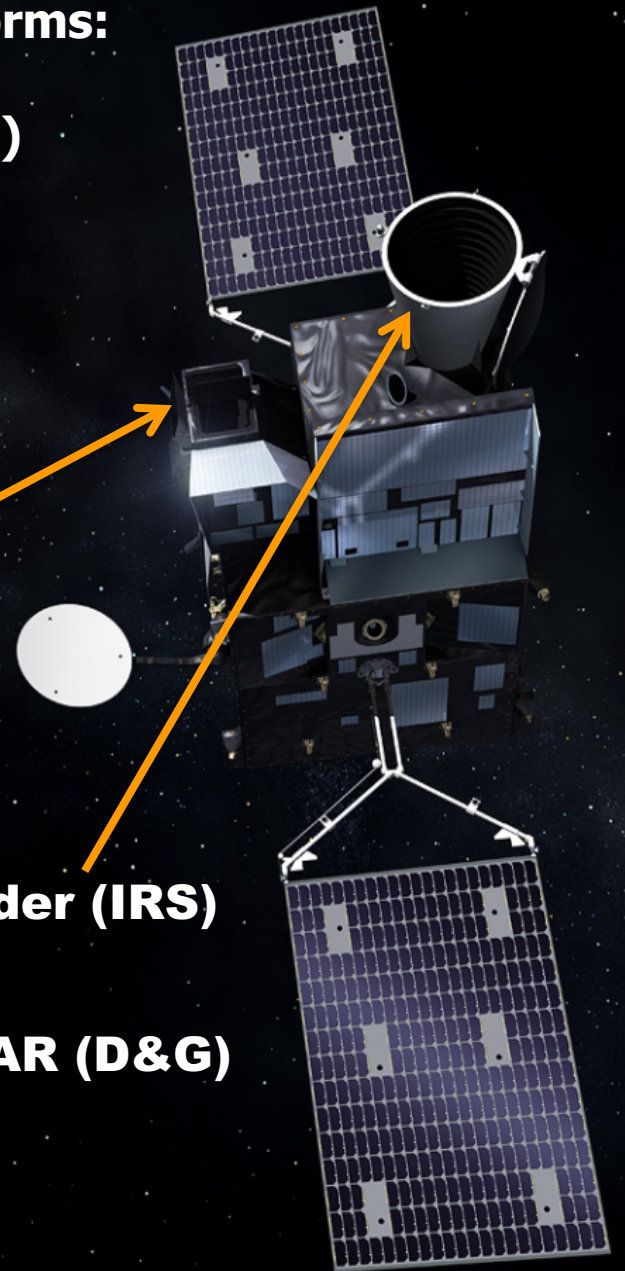
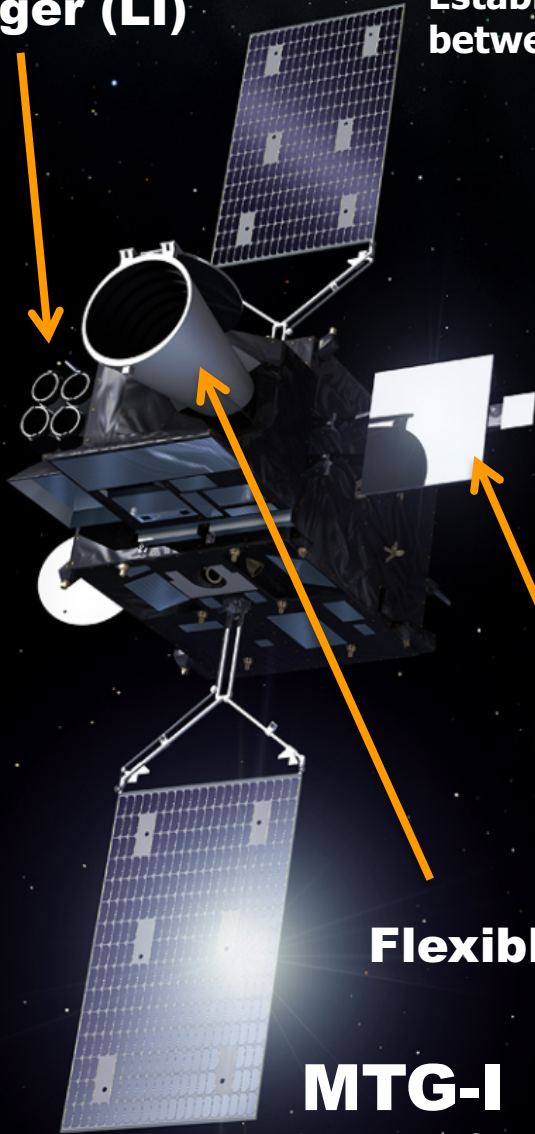
Flexible Combined Imager (FCI)

MTG-I

20 years of operational service

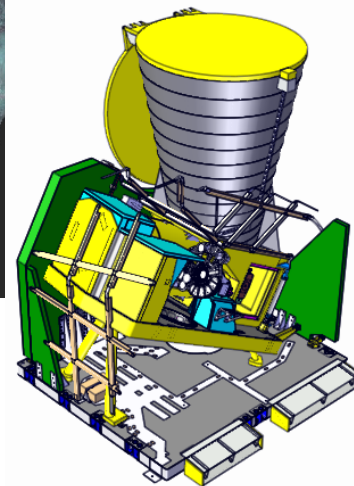
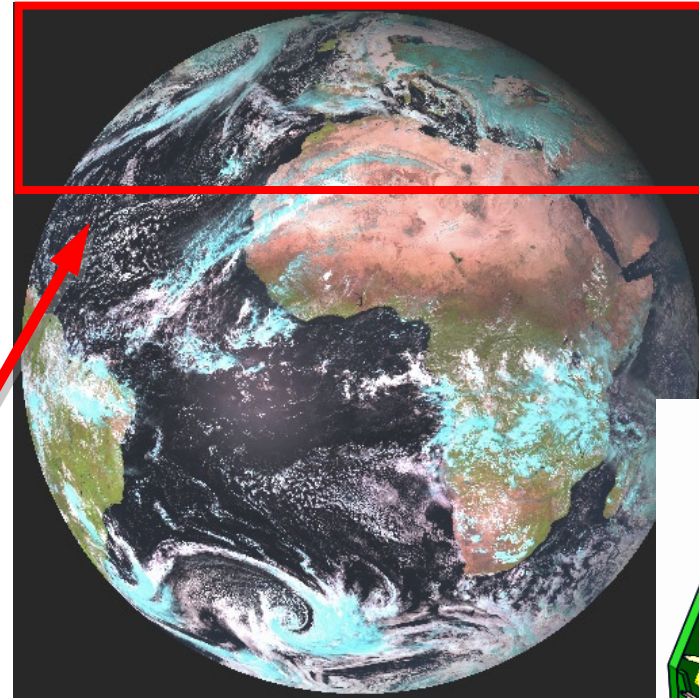
MTG-S

15,5 years of operational service

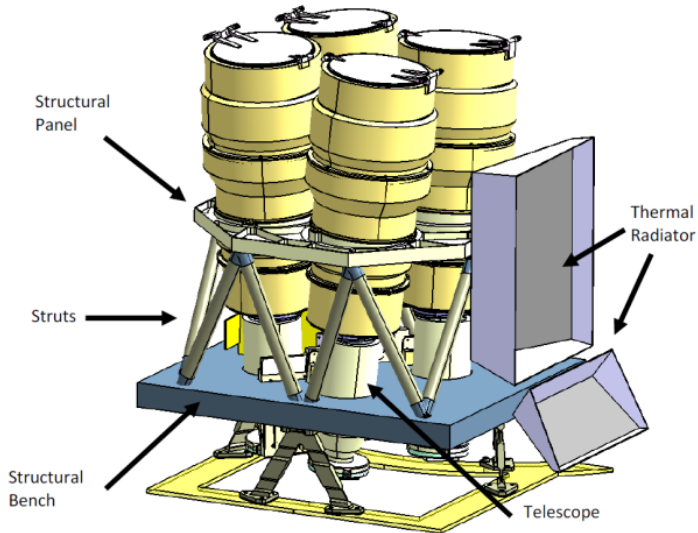


The Flexible Combined Imager (FCI) on MTG-I

- FCI will continue the **Full Disc Scanning Service (FDSS)** and **Rapid Scanning Service (RSS)** currently provided by the MSG SEVIRI instruments.
- **Full Disc High Spectral resolution Imagery (FDHSI)** and **High Resolution Fast Imagery (HRFI)** mission requirements are established for FDSS and RSS respectively.
- Full Disk Scan Service (FCI-FDSS):
 - global scales: Full Disk; @ 10 min Repeat Cycle
 - 16 channels at spatial resolution:
 - 1.0 km for the 8 solar channels;
 - 2.0 km for the 8 thermal channels.
- Rapid Scan Service (FCI-RSS):
 - local scales: 1/4th of Full Disk; @ 2.5 min Repeat Cycle
 - 4 channels at high spatial resolution:
 - 0.5 km for the 2 solar channels;
 - 1.0 km for the 2 thermal channels.



Lightning Imager (LI) Instrument on MTG-I

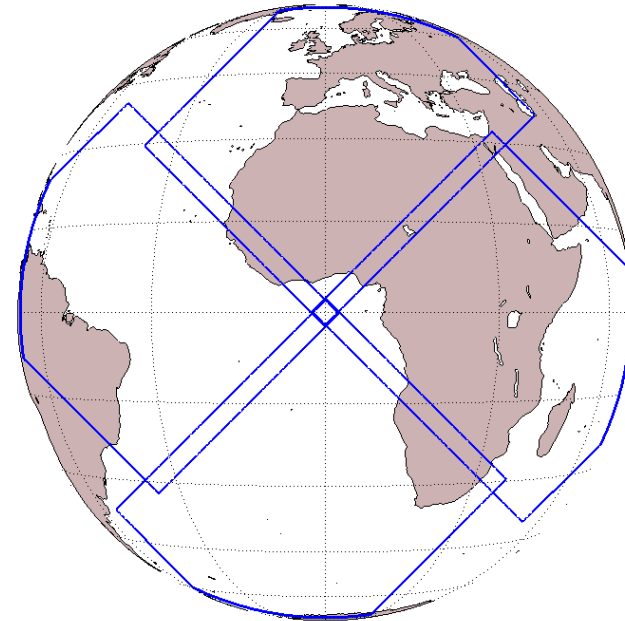


LI Main characteristics:

- Measurements at 777.4 nm
- Coverage close to “visible disc”
- Continuous measurements of (lightning) triggered events
- Spatial resolution ~ 4.5 km at SSP
- Integration time per frame 1 ms
- Background subtraction & event detection in on-board electronics

The baseline for the LI is a 4-Optical Chain solution:

- 4 identical optical channels with CMOS back-thinned backside illuminated detectors
- 1170 x 1000 pixels per camera

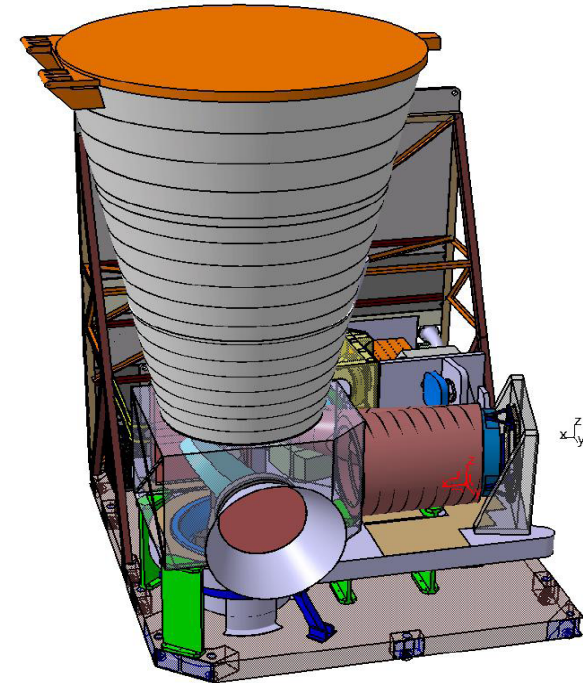


End-users (Level 2) will not see the “detector structure”

MTG-IRS Instrument Characteristics

- The InfraRed Sounder (IRS) is based on
 - an imaging interferometer with a hyperspectral resolution of 0.625 cm^{-1} ,
 - 2 detector arrays with each 160×160 detectors,
 - taking measurements in two bands:
 - the Long-Wave InfraRed (LWIR, $700\text{--}1210 \text{ cm}^{-1}$ or $14.3\text{--}8.3 \text{ }\mu\text{m}$) with 800 spectral channels and
 - the Mid-Wave InfraRed (MWIR, $1600\text{--}2175 \text{ cm}^{-1}$ or $6.25\text{--}4.6 \text{ }\mu\text{m}$) with 900 spectral channels,
 - with a spatial resolution of 4 km,
 - with a basic repeat cycle of 60 min.

The IRS will provide e.g. highly resolved vertical structures of humidity, temperature (+ boundary layer temperature profile), ozone, and wind.....



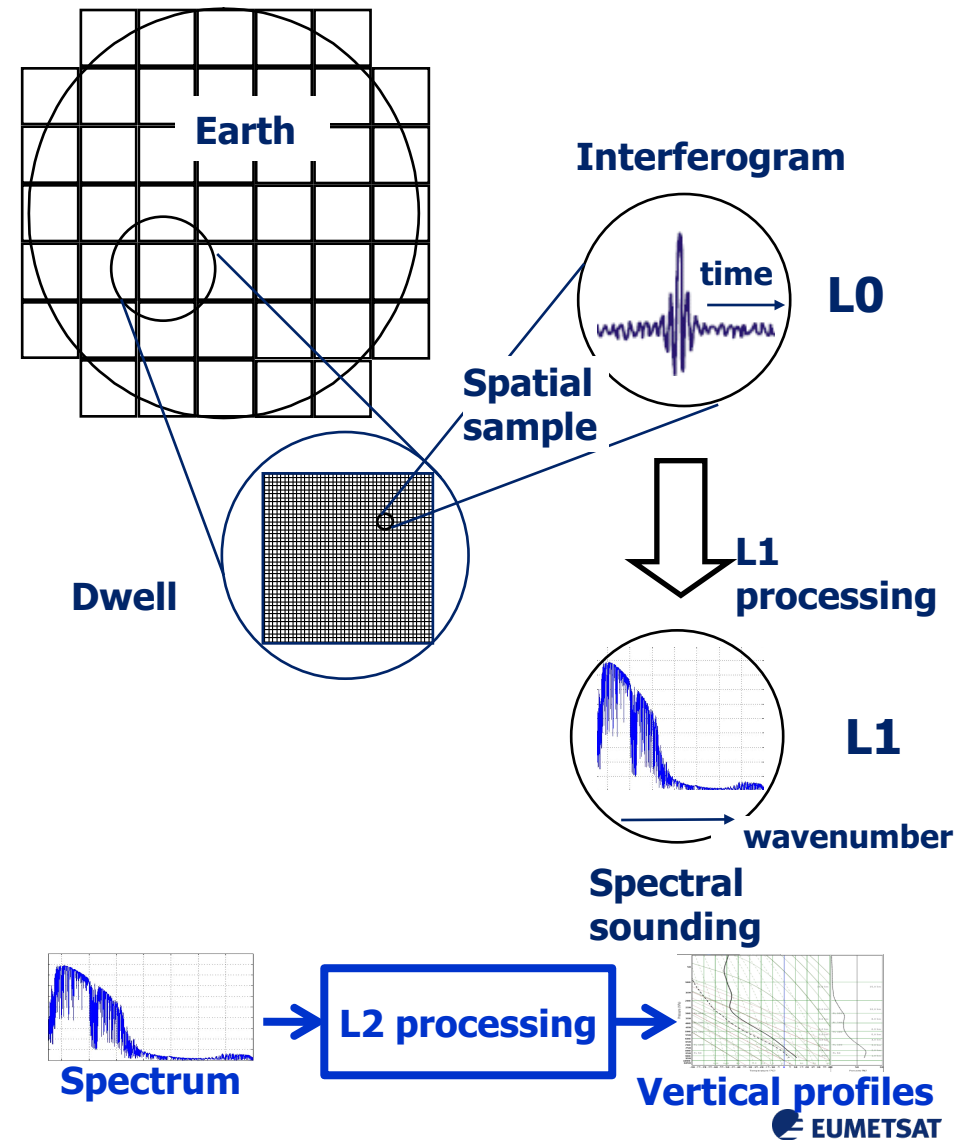
Volume: $1.4 \times 1.6 \times 2.2 \text{ m}^3$

Mass: 400 kg

Power: 750 W

MTG-IRS: Working Principle

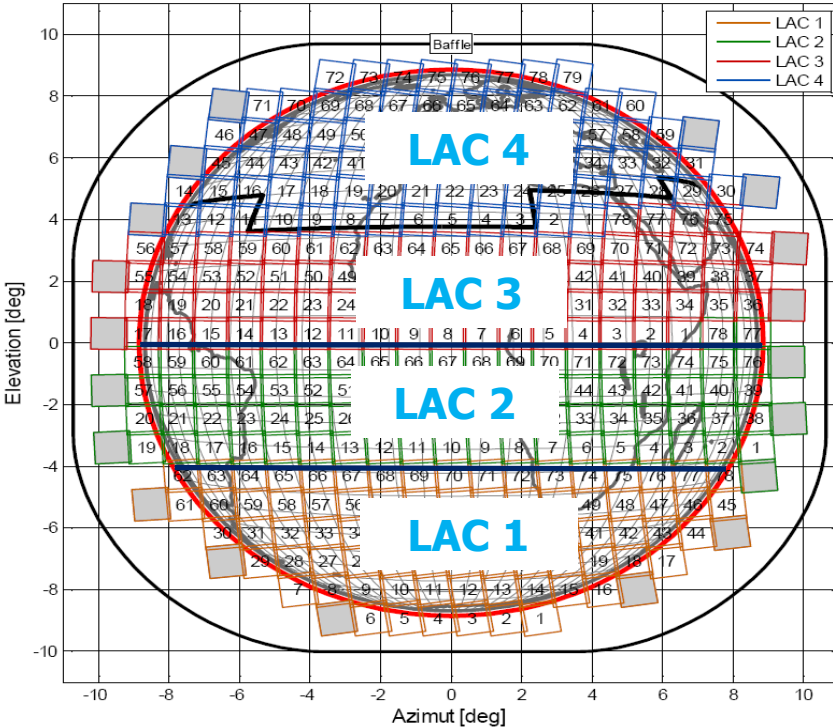
- The instrument works in step-&-stare mode, with the Earth disc covered through a sequence of contiguous square sub-images (dwells).
- With the current design, each dwell is taken in 10s and covers about 640 x 640 km² (at nadir) with 160 x 160 spatial samples.
- Within a single dwell, a set of interferograms, one per spatial sample, is produced.
- A spectral sounding is the result of the Fourier transformation of an interferogram from a single spatial sample
- L2 processing generates IRS L2 products



InfraRed Sounder (IRS) on MTG-S

- MTG-IRS Concept: Every 30 Minutes Europe
 - 4 Local Area Coverage (LAC) zones, South to North, with LAC4 covering Europe;

78 LAC1 + 78 LAC2 + 78 LAC3 + 79 LAC4 = 313 Dwells

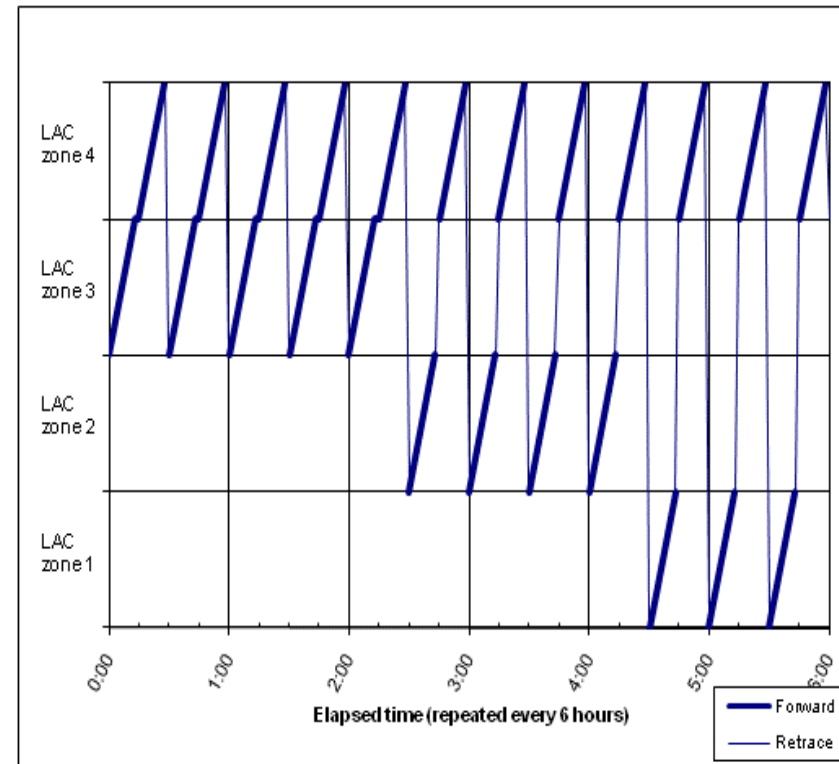


LAC 4: every 30 min

**LAC 3: every 4h:00 min
5 times every 30 min**

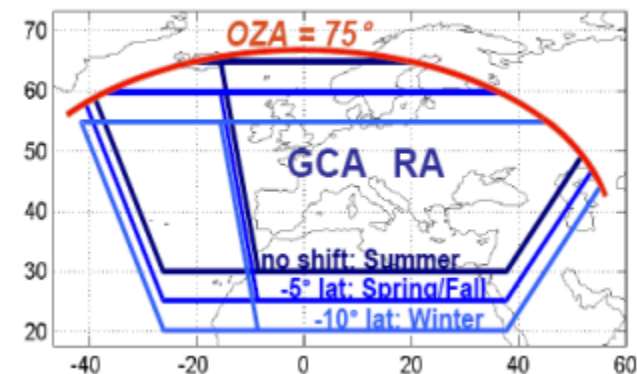
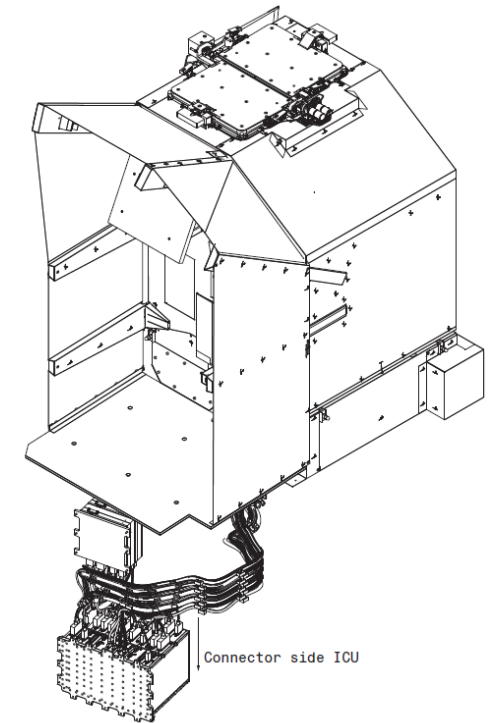
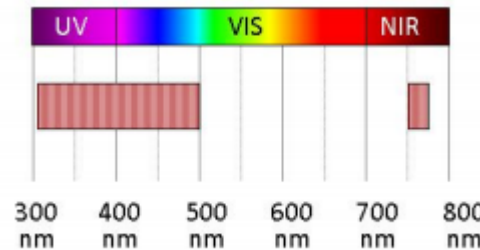
**LAC 2: every 4h:30 min
4 times every 30 min**

**LAC 1: every 5h:00 min
3 times every 30 min**



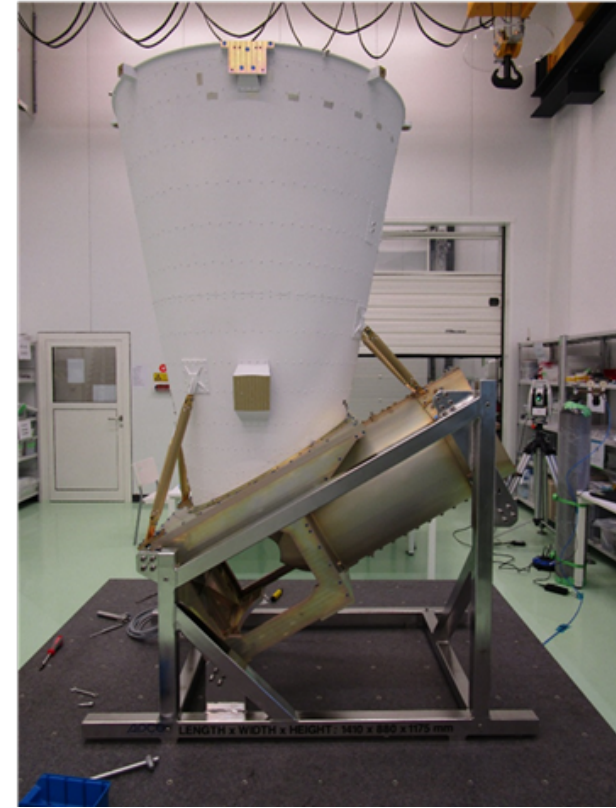
The Ultraviolet, Visible & Near-Infrared (UVN) on MTG-S

- The second instrument aboard MTG-S, the Ultraviolet Visible Near-infrared (UVN) spectrometer.
- The UVN covers the need for continuous monitoring of atmospheric composition.
- Focus on air quality with the main data products being O_3 , NO_2 , SO_2 , HCHO, and aerosol optical depth.
- The UVN spectrometer is based on
 - a hyperspectral spectrometer,
 - covering a spectral range from:
 - 305 nm to 500 nm @ spectral resolution of 0.5 nm
 - 750 nm to 775 nm @ spectral resolution of 0.12 nm
 - Spatial sampling at 45° North: 8 x 8 km²
 - Temporal resolution: 60 min.

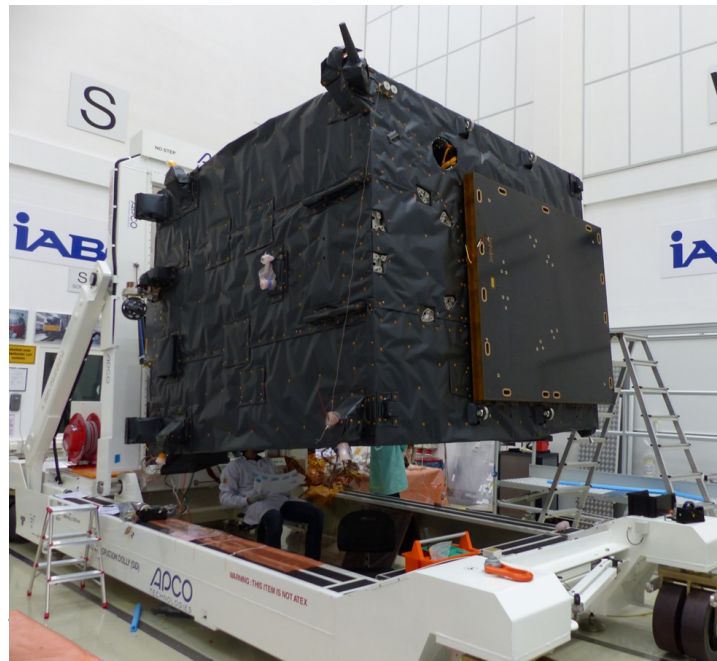


Satellite and Instruments Status

- Passing the Intermediate Design Check Point (IDCP) for MTG-I and MTG-S satellites
- Satellite Platform Critical Design Review on-going
- Moving from the design phase to Assembly, Integration and Test (AIT)
 - Hardware is being build (STM, SM, EM, PFM)
 - Engineering models for Satellite Platform components and Instruments becoming available



**FCI & IRS Instrument
External Baffle Assembly**



**Platform before the
Thermal Vacuum (TVAC)
Test at IABG in Munich**

Programme Status

- System Implementation Review Part#1 passed in Q4/2016 with the focus on the Imager Mission and to give the go-ahead for the start of the Ground Segment System Integration

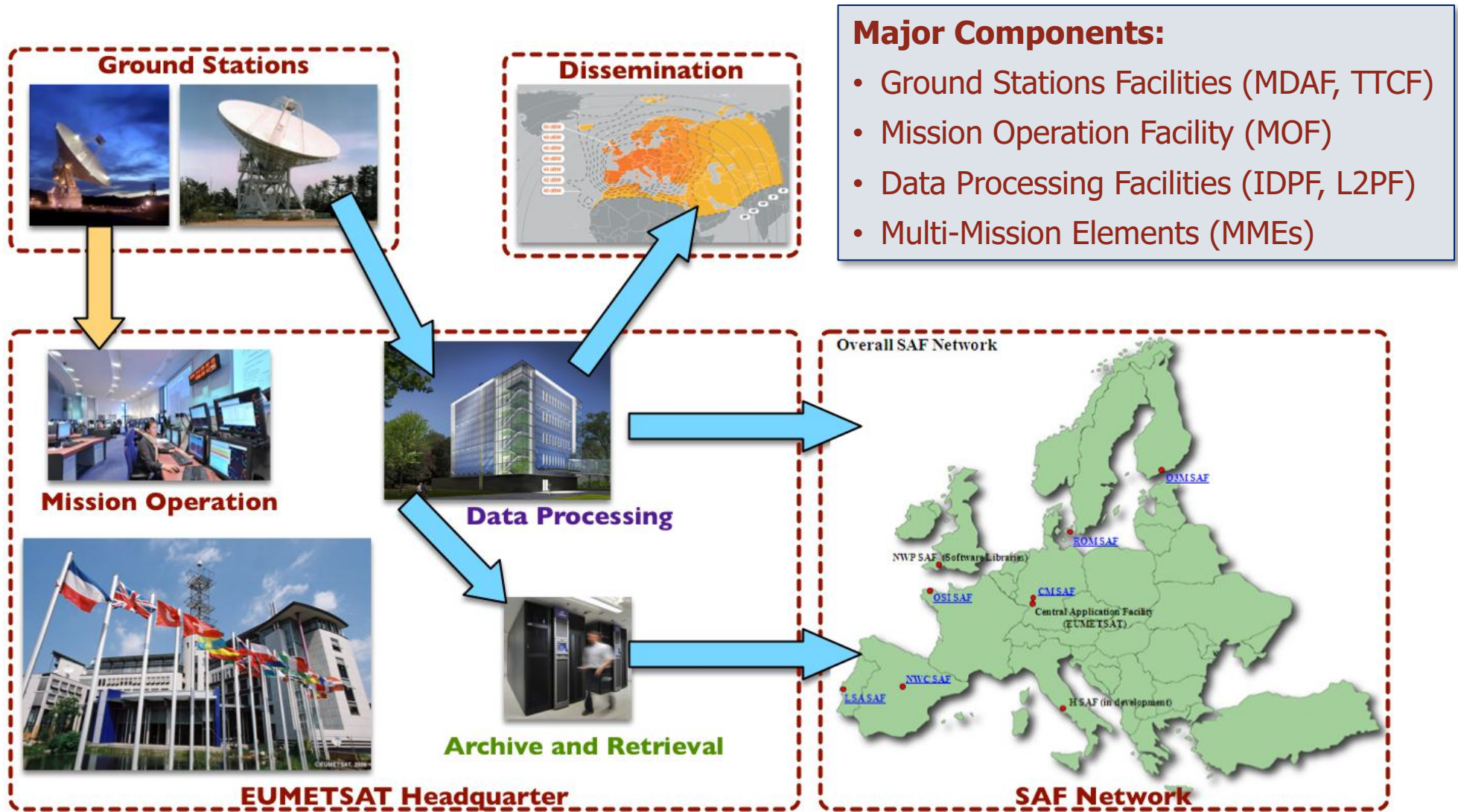
Planning of the System Development Milestones

- System Implementation Review (Part#2): Feb 2018
- MTG-I System Critical Design Review: Jun 2019
- MTG-S System Critical Design Review: Jun 2021
- Flight Acceptance Review MTG-I1: Dec 2020
- **Flight Acceptance Review MTG-S1: Aug 2022**

Tentative launch planning

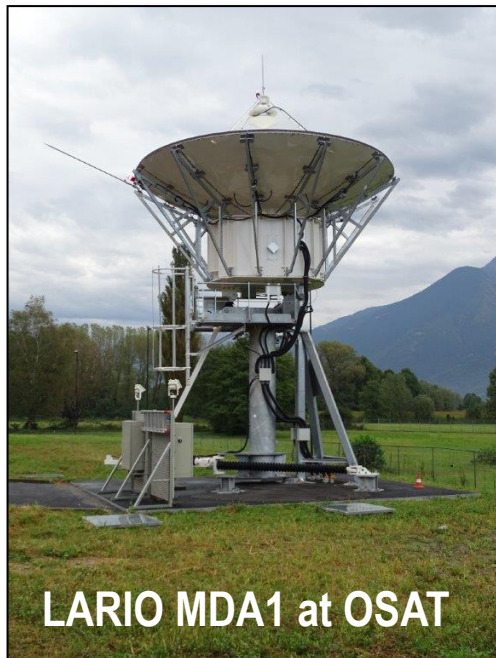
- MTG-I1: Q3 2021
- MTG-S1: Q1 2023**
- MTG-I2: Q1 2025
- MTG-I3: Q3 2029
- MTG-S2: Q3 2031
- MTG-I4: Q1 2033

Overview of the MTG Ground Segment



Status of Other Ground Segment Facility Procurements

- **Contracts Already Awarded (Prime Contractor)**
 - ✓ Mission Operations Facility (GMV) – past CDR, second version delivered
 - ✓ Instrument Data Processing Facility for MTG-I (TAS-F) – CDR planned mid 2018
 - ✓ Level 2 Processing Facility (Thales Services) – CDR planned mid 2018
 - ✓ TTCF Ground Stations (Telespazio) – Preliminary Acceptance Review early 2018
 - ✓ MDAF Ground Stations (Telespazio) – Preliminary Acceptance Review running



Ground Segment Status

- **Ground Segment integration and verification has started for the M&C and MTG-I data acquisition chains**
- **The GS development logic focuses first on MTG-I and Common elements**
- **Design checks and GS versions are then introduced for the MTG-S specific aspects**
- **Planning of the Major GS Development Milestones**
 - **GS CDR Part 1 : Q3 2017**
 - **GS CDR Part 2 : Q4 2018**
 - **GS Version 1 (MTG-I) : Q4 2019**
 - **GS Version 1.1 (Launch version) : Q3 2020**
 - **GS CDR-S : Q4 2020**
 - **GS Version 2 (MTG-S) : Q2 2022**

Overview of the Instrument Data Processing Facility for MTG-S

- **The purpose of the Instrument Data Processing Facility for MTG-S (IDPF-S) is to generate Level-1b datasets for IRS and UVN (geo-located, radiometrically and spectrally corrected samples)**
- **The input data streams are provided by the Mission Data Acquisition Facility (MDAF). Telemetry packets are received by the Level-0 processor which also splits the constant streams into individual data chunks for processing**
- **Data chunks are provided to the L2PF and to MMEs for further processing, archived and some are disseminated to end-users (e.g. IRS Principal Components)**
- **Chunks, including some intermediate results, are transferred to off-line for inspection and analysis**

IRS chain development status

➤ IRS instrument

- **IRS Critical Design Review** : **Jan 2019**
- **IRS proto-flight model (PFM)** : **early 2021**
- **MTG-S Flight Acceptance Review** : **August 2022**

➤ IRS data processing development status

Level 1

- **IDPF-S ITT published in May 2017 (IRS level 1 processing facility)**
- **Kick-off meeting with selected contractor possibly early 2018**

Level 2

- **L2PF phase 2 anticipated to implement IRS L2 in the current L2PF contract**
- **Preparation to be initiated soon in EUMETSAT (GEO and RSP)**
- **Kick-off meeting expected late 2018**

Expectation from MTG programme side

- The IRS processing chain development is running and a robust chain is to be developed, verified and validated at the time of the launch of MTG-S1 satellite
- As this is a new mission, new ideas are welcome but requirements and expectation from users have to be fulfilled as well
- In support of this development, studies, prototyping, reference processor, generation of test data and tools development are in place
- Experts meetings as IRS-MAG are seen useful to progress in the definition of the algorithms and technical baseline to be implemented.