The Data Processing Concept and Performance Requirements for the Meteosat Third Generation Programme

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EUMETSAT

Agenda

- Who we are
- Current and future missions
- MTG payload missions
- MTG GS overview
- Processing load estimate
- Next steps

Who we are

EUMETSAT is an independent intergovernmental organisation founded in 1986 to establish, maintain, and exploit European systems of operational meteorological satellites and is governed by a Council representing 26 Member States. The Headquarters of EUMETSAT are located in Darmstadt, Germany.

Existing Satellite Programmes

- The initial system of EUMETSAT, the Meteosat Operational Programme (MOP), was developed by the European Space Agency and continued by EUMETSAT.
- An extension to this system, the Meteosat Transition Programme (MTP) has been in place since November 1995.
- The first second generation of Meteosat satellites has been launched in August 2002.
- In addition to these geostationary satellite systems, EUMETSAT has developed a Low Earth Orbiting System, the EUMETSAT Polar System (EPS). The first EPS satellite has been launched in October 2006.

Future Satellite Programmes

- The Meteosat Third Generation (MTG) with a launch date in 2017. MTG flies four payload missions
- The Post-EPS system with a launch date in 2019. Currently there are 19 proposed payload missions

=> The remaining part of the presentation will focus on the MTG Programme only

MTG Payload Missions

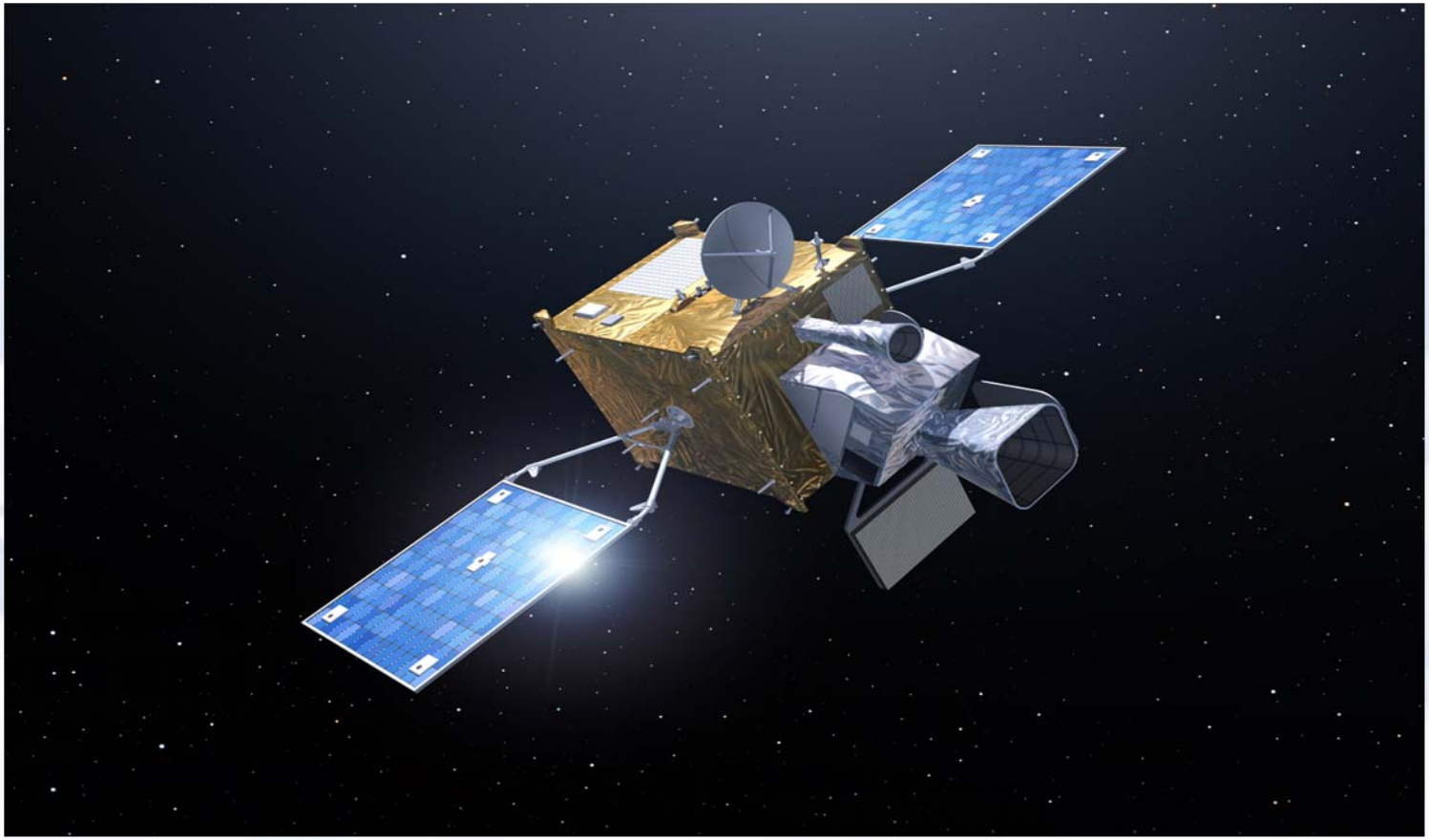
Three distinct imagery missions dedicated to operational meteorology and climate, with emphasis on now-casting (NWC) and very short range forecasting (VSRF):

- The High Resolution Fast Imagery (HRFI) mission;
- The Full Disk High Spectral resolution Imagery (FDHSI) mission;
- The Lightning Imagery (LI) mission;

Two sounding missions:

- The Infrared Sounding (IRS) mission focussed on operational meteorology and climate, with some relevance to atmospheric chemistry;
- The UV/Near-Infrared sounding (UVN) mission dedicated to atmospheric chemistry and climate (the UVN is a GMES mission, but flown on the MTG-S platform)

Artistic view of MTG-I satellite



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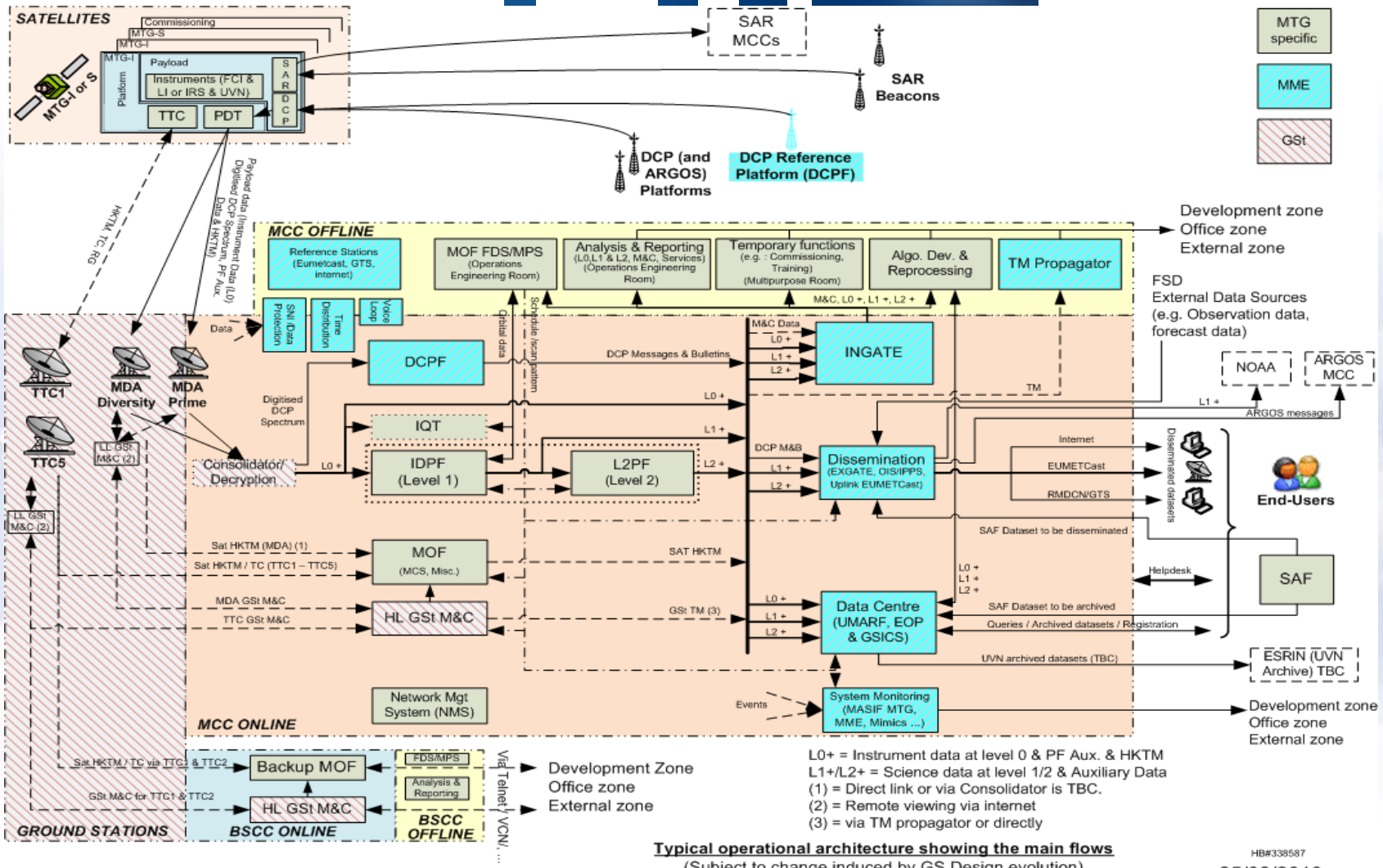
GS Operational architecture overview



Typical operational architecture showing the main flows
(Subject to change induced by GS Design evolution)

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MTG Data Processing Scope

The MTG Data Processing will generate Level 1 data:

	coverage	# of spatial samples	# of bit	# of channels	Data rate - Mbps
FDHSI-L1C	Full disk	8 channels at 5568x5568 8 channels at 11136x11136	12	16+1	24.8
HRFI -L1C	LAC	2 channels 5568x5568 2 channels at 11136x11136	12	4	24.8
IRS –L1B	Full disk	2784x2784	16	1752	60.3
LI – L1B	Nearly full disk	400 events/sec	16	1	0.3
UVN – L1B	LAC	TBD	TBD	TBD	TBD

Subsequent Level 2 processing will generate about 2 dozen Level 2 products at DAY-1

MTG Data Processing Estimate

Logic to derive processing estimates:

- Choose processing reference system (MTSAT for FCI and IASI for IRS)
- Specifying a reference performance measure: SpecFP_rate2006
- Determine SpecFP_rate2006 of reference systems
- Determine scale factor for processing needs from reference system to MTG
- Multiply scale factor with reference SpecFP_rate2006 – the result is the required MTG processing power expressed in SpecFP_rate2006 units
- Assuming a SpecFP_rate2006 value for a “standard” machine results in the required number of standard machines

MTG Processing Estimate

Processing loads are not evenly distributed:

	L0/L1	L2	combined
MTG-I	13	3	16
IRS	186	1414	1600
UVN	26	n/a	26
Total	225	1417	1642

Number of parallel cores with SpecFP_rate2006 = 10 necessary for each instrument level.

Based on SpecFP_rate2006 of 80 for a standard machine => 200

MTG Data Processing Estimate

MTG Data Processing HW needs casted onto IBM p575 HW:

- Choose “standard” machine to be IBM p575, 4.7 GHz with 32 cores. It has a peak SpecFP_rate2006 performance of 839. Five of these machines have been purchased for an EPS GS up-grade.

- The total estimate for the MTG data processing needs amounts to 20 IBM p575 (about 3.8 MEU)!

- If the IRS L2 product is excluded from the MTG processing load, only 3 machines are required for the job.

MTGData Processing Drivers

Processing Performance drivers:

⇒ 85% of all processing needs originate from the IRS processing!

Or more …, because the IASI L2 processing taken as a reference is only processing 250 channels (out of 8461 channels) and

The maximum number of iterations has been limited to 5, but the original specification was for a maximum number of 20.

⇒ An optimal IRS Level 2 processing could require about 30 times more resources!

In addition, the GS has to accommodate 3 processing chains + reprocessing.

MTG Data Processing Needs

MTG HW alternatives:

- The Tesla S1070 from NVIDIA consists of 4 GPU (Graphical Processing Unit) with a total of 960 cores (1.3 – 1.44 GHz). The peak SP-floating point performance is stated with 3.73-4.14 TFlops compared with about 600 GFlops (peak) for the IBM p575, 4.7 GHz with 32 cores.

- GPUs have been shown to be applicable to general purpose application. For example, it has been applied to an FTS L0 processing in the Gloria project.

- The Tesla is only a fraction (1/30) of the price of the IBM p575, 4.7 GHz with 32 cores.

- Nvida is bringing an updated GPU architecture (Fermi) to the market these days.

Next steps

- We are about to kick-off a Phase B study for the definition of a preliminary data processing architecture
- A further study has is about to be launched to prototype Radiative Transfer code on a GPU architecture
- Code and algorithm optimization (e.g. LUT to replace calculations)
- Selective processing (clear-sky only, 1:9 sample, etc.)