MTG End-User Requirements Document [EURD]

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Document Change Record

Issue	*Remarks*
v3C of 30 March 2010	First version approved by Council in the context of the Programme Proposal approval
v4 Draft 15th Aug 2018	Reflects the changes presented to the Delegate Bodies in the first half of 2018. As clarified at that time, the changes related to the instrument performances will be introduced in the issue 5 of the [EURD], after the system CDR has been held. a) The details of the changes to the requirement is provided in the new Annex F with a comparison of the old text vs new text accompanied by an explanation of the change and its rationale. A summary is provided in the change record herebelow. 1) The [EURD] is now accompanied by a unique self-standing document [MTGDIS] defining the data distribution baseline. This allows to update the requirements and the dissemination baseline independently. This is further explained in §1.1. It led to the update of the requirements: MET-08020, MET-08060, DIS-14040, , DIS-14250, the deletion of MET-08040, MET-08080, DIS-14045, DIS-14047, DIS-14260, and the addition of DIS-14048. 2) The internet interface being a re-use of the corporate functionalities, it is now merged into the chapter 6 Data retrieval services. It led to the deletion of DIS-14380, DIS-14390, DIS-14400, DIS-14420, DIS-14440. 3) Reworded but scope unchanged: the wording of some requirements had to be modified for various reasons (e.g. consistency with terminology recalled in Annex C, update of obsolete text, removal of TBC) but the scope is unchanged. It led to the update of the requirements: FCI-02340, IRS-04075, IRS-04140, LI-06120, ARC-12060, DIS-14050, DIS-14220, DIS-14240, USR-18020 and the addition of MET-08090 and Note modification for : DCP-10020, RET-16040 4) Handled by Multi-Mission Element (MME): It led to the update of the requirements: DIS-14020 and the deletion of: DIS-14100, DIS-14140 5) Mission performance clarification: it led to the addition of the requirements: FCI-02230 (MTF performance), IRS-04122 (spectral sampling interval); IRS-04124 (spectral FWHM.), IRS-04230 (integrated energy); IRS-04250 (ASPKE (LAC)), IRS-04255 (ASPKE (dwell)), DIS-14190 (for IRS L2 timeliness). The update of the following requirements: FCI-02320 (removal of TBC), IRS-04020 (spectral channel interval clarification), IRS-04040 (coverage clarification and see below §4.2.1 for new scanning pattern,), IRS-04080 (clarification of missing sounding), IRS-04135 (method for spectral sample spectral response function difference calculation), LI-06020 (coverage clarification), LI-06040 (spectral radiance), LI-06100 (spectral radiance). For IRS-04140, IRS-04160, IRS-04180 and IRS-04200, the associated table 9 has been updated with refined radiometric performance.

	b) Latest version of the Conventions definition and Glossary have been provided in Annex C/D (without tracking) c) Various changes in the descriptive text have been made to bring it in line with the latest terminology used at corporate level or MTG convention & terms as defined in Annex C. For example: • GMES replaced by Copernicus (changes not tracked). • High rate dissemination service replaced by EUMETCast terrestrial • Operational scenario replaced by operational practice. • Introduction of [MTGDIS] instead of the former Annex A and the document [L2HQ] and [L2SAF]. d) new section 1.5 for open issues and assumptions e) IRS Level 1 timeliness: the goal is to have a timeliness better than 15mn but this remains to be confirmed after system CDR and test by EUM on the operational configuration. See Table 17 in §5. f) IRS Level 2 timeliness: the goal is to have a timeliness better than 30mn but this remains to be confirmed after system CDR and test by EUM on the operational configuration. See Table 17 in §5. g) On top of the above, the following changes have been made: • §1.2.1 Instructions, Plans and Arrangements updated (C/S was TBD, [DATAPO-S4] added, preliminary programme proposal [PPP] replaced by [PP], removed Current SAF Strategy EUM/C/52/02/DOC/51 (not used), [TD-15] replacing obsolete TD-04 and EUM, deleted [CGMS_GS] reference replaced by annex C (CONV), [KOP_S4-5] version update for UVN. • §2: Text improvement to make it up to date. • §4.1: Text clarification for the operational practice between FDSS and RSS in line with requirement SYS-00020 • §4.2.1 Deletion of the TBC in table 5 & 6, any deviation to this requirement will be handled as a non-conformance. •§4.2.1 The scanning pattern for the IRS instrument has been modified as per IRS-MAG of October 2017. •§4.3.3 text improvement (albedo -> reflectance at TOA) • § 4.4: Text updated with latest available Sentinel 4 / UVN information. • §4.5 Text improvement to make it up to date. • §4.5.2: update with SAF products timeliness at system level (originating from [L2SAF]). • §4.6: delete the ARGOS part (as being abandoned) • §5 & 5.1 text reworded in line with requirements update (in particular EUMETCast). • §5.1 Table 14 updated. In line with [MTGDIS] introduction, new column “timeliness applies to”, FCI & IRS L2 split in 2 separate rows. Suppression of FSD & MDD not related to MTG, LI is at level 2 only. • §5.4 Deleted, the retrieval of data via internet is now merged into §6 Data Retrieval Services. • §6 Text improvement.

	• §7.2 minor rewording, clear reference to [DATAPO]. • §8: Replaced by a cross reference to EUMETSAT [DATAPO] and the Sentinel-4 [DATAPO-S4] data policies approved separately. • Appendix A: suppression of a TBD (now ADMIN Updated every day) • Appendix B: Level 1 list is now in [MTGDIS]. • Appendix E list of TBD/TBC updated • Appendix F added Editorial changes or changes to ensure coherency with the conventions and terms defined in annex C are not necessarily tracked.
v4.A Draft 10th Sept 2018	Updated to reflect the comments of the STG-SWG and STG-OPSWG of Sept 2018 before submission to STG: •§1.2.2 Deletion of the old (2008) GMES document [KOP_S4] which is not cross referenced in the text. Addition of the date to [KOP_S4-5] •§1.5 open issues: the way forward for the FCI level 2 products for RSS has been clarified. Added "applicability of timeliness for FCI/IRS level 2 products". NOAA is not a Global NWP Centres. •FCI-02055 updated to clarify the wording for the southern boundaries of the LAC 4 in RSS mode (in §4.1.1). •§7.2 "Level 3 products" added in the descriptive text •New appendix F2 to capture the requirement change between the version 4 and 4A. Miscellaneous editorials.
V4B Draft 9th October 2018	§4.1.1 Correction of an editorial related to FCI-02055 (issue 4.1 replaced by version 4.A). Otherwise no change since version 4A. Submitted for approval by Council after review and endorsement by STG #73 on 09th October 2018.
V4C 6th December 2018	Version approved by 90th council in December 2018. Addition of an open issue related to an old definition of "scheduled outage" spotted during FCI-MAG #1.

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1 INTRODUCTION

1.1 Purpose and Scope

The purpose of this document [EURD] is to define the End-User Requirements applicable to the Meteosat Third Generation (MTG) Programme.

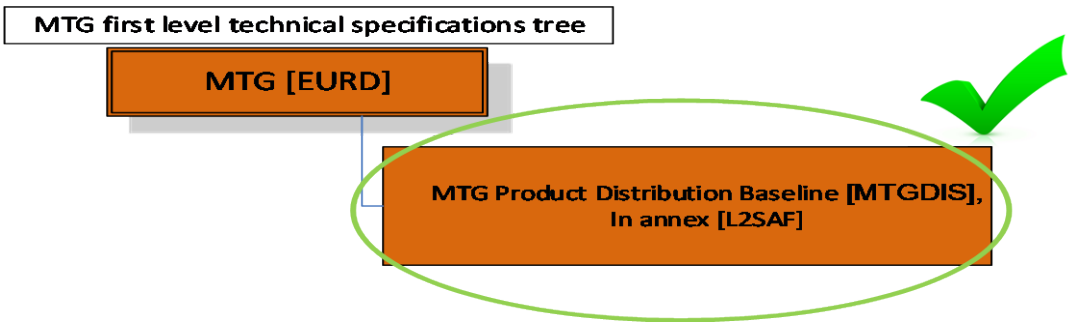
Service requirements expressed in this [EURD] apply at the interface between EUMETSAT and the End Users (excluding networks and service components that are outside the EUMETSAT control).

Requirements in the [EURD] are used for the end-to-end *verification* and *validation* of system functionalities, services, interfaces and operational performance till *commissioning*. Actual performances of the services of the system will be described in the Operational Services Specification after the system has been commissioned.

The essential and In-orbit verifiable End-Users requirements on content, *operational availability*, *timeliness*, etc. are presented for each services provided by the EUMETSAT facilities at its Headquarters as well as in general terms for the EUMETSAT Satellite Application Facilities (SAF) network. The detailed requirements addressing the SAF services are covered separately in SAF-dedicated user and product requirements documentation to be established for each SAF project.

Service delivered by the MTG System will be provided through a cost-effective combination of dedicated and specific new developments and acquisitions and generic, enterprise-like multi-mission infrastructure maintained, sustained, and upgraded by EUMETSAT. Provisions, functions and capabilities made available by the latter will not be detailed in this document.

The "MTG Products Distribution Baseline [MTGDIS]" (EUM/MTG/DOC/17/946090) is an appendix of the [EURD] aiming to define the Level 1 and Level 2 datasets that will be disseminated and archived at EUMETSAT Headquarters as part of the Meteosat Third Generation (MTG) Programme. These are the datasets that will be available to End Users and to SAF for processing. The [L2SAF] document is considered as an annex of [MTGDIS] of relevance for SAF developers.



The requirements affected by the instruments performance will be updated in the issue 5 of the [EURD] foreseen after the CDRs and before the launch. As announced at STG in May 2018.

1.2 Applicable and Reference Documents

1.2.1 Instructions, Plans and Arrangements

The following documents have been used to establish this document.

Doc ID	Title	Reference
[CONVENTION]	EUMETSAT Convention	
[STRATEGY]	EUMETSAT Strategy: 2030	EUM/C/59/06/DOC/28
[DATAPO]	EUMETSAT principles on Data Policy	EUM/C/98/rec IV Date: 3 July 1998
[DATAPO-S4]	COPERNICUS Sentinel Data Policy	ESA/PB-EO(2013)30 of 19 August 2013
[PP]	MTG Programme Proposal	EUM/C/69/10/DOC/02
[EUM_CS]	EUMETSAT - COSPAS-SARSAT Cooperation Arrangement	EUM/LAD/CA/09/0664

1.2.2 Reference Documents

The following documents provide useful information but are not cross-referenced in a requirement.

Doc ID	Title	Reference
[AEG]	Post-MSG User Consultation: Application Expert Groups Position Papers for Nowcasting and NWP Application Users	EUM/C/01/DOC/16 - Annex II
[RSE]	Response of Remote Sensing Experts (RSE) to User Requirements Formulated by Post-MSG Application Expert Groups	EUM/C/01/DOC/16 - Annex III
[SYSCON]	MTG System Concept	EUM/MTG/TEN/07/0042
[L2SAF]	SAF Level 2 Products Generation and Dissemination Baseline for MTG	EUM/PPS/DOC/09/0032
	WMO -Manual on the Global Observing System	WMO - 544
[CGMS02]	CGMS IDCS Users' Guide	CGMS02
[WMO_GTS]	WMO Manual on GTS -Volume I Global Aspects - Volume II: Regional Aspects	306-E
[TD15]	EUMETCast - EUMETSAT's Broadcast System for Environmental Data	EUM/OPS/DOC/06/0118
[WMOcode]	WMO Manual on Codes: Manual on Codes I.1 - A: Alphanumeric Codes Manual on Codes I.2 - Part B/C: Binary Codes	306.I.1.A-6 306.I.2.B.C
[CGMS_35]	CGMS position Report of the 35th Meeting of the Coordination Group for Meteorological Satellites	CGM 35
[KOP_S4-5]	GMES Sentinel 4 and 5 Mission Requirements	EOP-SMA/1507/JL-dr Issue 3 Rev. 1.4 of 31 Jan 2011
[UG04]	EUMETSAT Archive User Guide	UG04
[MOSS]	MSG Operations Service Specification (MOSS)	EUM/OPS-MSG/SPE/00/0011 V 4A July 2007
[TD10]	MSG - Meteorological Data Dissemination Service	EUM TD-10

1.3 Identification of Requirements

The requirement are written in the form:

[EURD] XXX-nnnnn iss: IR

This is the body of the requirement.

Note: may be attached to provide clarification, interpretation, verification method.....

All requirements are uniquely identified according to the following convention:

- 'XXX' represents for information the requirements group identifier (i.e. the service type),

- 'nnnnn' represents the requirement number. This number is unique within this document.

- 'I.R' represents the Issue and Revision of the document when the body of the requirement was last modified, e.g. '3.C' means the requirement has not been modified since the release 3.C of the [EURD]. It is not necessarily updated if only the note is updated or if only a table shared by several requirements is updated. However those changes are also tracked in the Appendix F.

The following requirement groups (i.e. service type) are defined:

SYS = System Level

FCI = FCI data acquisition and generation

IRS = IRS data acquisition and generation

LI = LI data acquisition and generation

UVN = UVN data acquisition and generation

MET = Meteorological/*Level 2 product(s)* generation

DCP = DCP data acquisition and generation

ARC = Archiving and cataloguing

DIS = Near real time dissemination services

RET = Archive retrieval services

USR = User support services

Additionally, notes may be attached to requirements providing clarification, interpretation to the requirement body. Even if this information is a component of the requirement; as such, this information is not to be verified.

1.4 Acronyms and Definitions

A complete list of acronyms is provided in Appendix G.

Words appearing in *italics* have special meaning defined in Appendix F.

1.5 Open Issues and Assumptions

The open issues and assumptions below are those affecting the scope or general content of the document. The open issues and assumptions specific to a given product or recipient are listed in [MTGDIS].

Specific assumptions are written as notes to the relevant requirements.

Specific open issues are identified with a TBD or a TBC and a summary list of TBC/TBDs is provided at the back of this document.

Assumptions and Open Issues related to Services

Service	Open issues / Assumptions
FCI-RSS (L1)	•Assumption: Baseline is the dissemination of the 16 channels at normal resolution (FDHSI) for both FDSS and RSS via EUMETCast satellite. The 4 channels at high resolution (HRFI) for RSS are disseminated via EUMETCast terrestrial. Should all channels be disseminated at both resolutions (16 NR + 4 HR), this would imply doubling the bandwidth for FCI-L1. Increase by 18% if a single normal resolution channel is replaced by the corresponding high resolution channel. Increase by 25% if a single high resolution channel is on top of the corresponding normal resolution channel. •Associated requirements: [MTGDIS] §2.1 and §2.2
FCI-RSS (L2)	•Open issue: "RSS Level 2 products" are not defined. •Assumption: No level 2 products for the RSS service. •Associated requirements: [MTGDIS] §3.2 •Way forward: To select a subset of the FCI-FDSS Level 2 Products (including SAF), after having gained experience in orbit with MTG-I1, and to adapt them for RSS before the launch of MTG-I2.
LI	•Open issue "LI timeliness": The requirement is for 120s but the goal of the users (recalled in LI-MAG of spring 2018) is for 30s. •Assumption: the current design, considered as challenging, is for 60s. •Associated requirements: DIS-14220 and Table 17 of §5.1, [MTGDIS] §3.3 •Way forward: During development phase, the design will be scrutinized. Should there be a risk that one minute is not achievable, the situation will be reported and reconsidered in particular at the CDR. During AIV and Commissioning, reasonable attempts will be made to tune the configuration parameters to try to improve the timeliness to achieve the 30s target (in particular over Europe). If not sufficient, bottleneck will be identified and a further design improvement will be considered taking benefit of technology evolution.
LI	•Assumption "LI accumulation window for accumulated product is 30 seconds". •Associated requirements: [MTGDIS] §3.3 •Way forward: The duration of the accumulation window may vary between 10s and 30s. The situation will be re-assessed after gaining experience with MTG-I1 in orbit and in consultation of LI-MAG.
IRS (L1)	•Open Issue: "IRS Level 1 timeliness". The request of the users through IRS-MAG is to have a timeliness better than 15 min. EUMETSAT analysis showed that it should be feasible and the [EURD] requirement has been modified accordingly. However industry commitment remains at 30mn. •Assumption: Timeliness of 15mn. •Associated requirements: DIS-14180 and Table 17 of §5.1, [MTGDIS] §2.4 •Way forward: The design will be scrutinised through the facility and system CDR and tested by EUM on the operational configuration to confirm feasibility.
IRS (L2)	•Assumption "all LAC to be disseminated", not only LAC 4. The availability of LAC 1, LAC 2, and LAC 3 is not a condition for declaring the readiness to enter routine operations. •Associated requirements: [MTGDIS] §3.4

Service	Open issues / Assumptions
IRS (L2)	•Open Issue: "IRS Level 2 timeliness". The request of the users through IRS-MAG is to have a timeliness better than 30 min. EUMETSAT analysis showed that it should be feasible and the [EURD] requirement has been modified accordingly. However industry commitment remains at 60mn. •Assumption: Timeliness of 30mn. •Associated requirements: DIS-14190 and Table 17 of §5.1, [MTGDIS] §3.4 •Way forward: The design will be scrutinised through the facility and system CDR and tested by EUM on the operational configuration to confirm feasibility
UVN / S4	•Open Issue "Copernicus/UVN data distribution baseline remains to be formally endorsed by the EU commission. •Associated requirements: [MTGDIS] §2.5 and §3.5

Assumptions and Open Issues related to Distribution Mechanisms

Mechanism	Open issues / Assumptions
EUMETCast Europe	•Open Issue "applicability of timeliness for FCI/IRS level 2 product" need to be clarified as it uses a term "chunk" which is not defined •Assumption: As per table 17 in §5.1 •Way forward: Define the term chunk or replace it by a term already defined while checking potential impact on timeliness value, update the table 17 §5.1 accordingly.
EUMETCast Africa	•Open Issue "Dissemination to Africa": The dissemination baseline over Africa will not be finalised before 2020 earliest. •Assumption: An aggregate bitrate of 3.5Mbps is currently assumed which will be revisited depending on the capacities, affordability and priorities. Current baseline considers to disseminate MSG-like L1 spectral channels every 10 minutes with a spatial resolution similar to MSG, plus a Lightning accumulated product (pseudo radar) complemented with some Level 2 products. •Associated requirements: [MTGDIS] §4. •Way forward: Review during the African User Forum at end of September 2020 before being submitted to council decision. •Risk: Additional dissemination cost.
EUMETCast Terrestrial	•Open issue: "EUMETCast terrestrial": This MME functionality may not be fully operational/available for End Users and private companies at the time of MTG-I1 launch. •Assumption: EUMETCast terrestrial is not planned to be used before MTG-S1 commissioning in 2023. •Associated requirements: DIS-14020, USR-18020, Table 17 of §5, [MTGDIS] •Way forward: The situation will be re-assessed at each milestone. Next one is CDR.
Global NWP Centres	•Open Issue "Global NWP Centres, dissemination mechanism". "Global NWP Centres" is not exactly a dissemination mechanism, but a recipient. And there are over 20 global NWP centres designated by WMO. The list of datasets and products to Global NWP Centres is tentative as it has not been discussed/agreed with them. Dedicated communication lines to the global NWP Centres may be needed. •Assumption: For Copernicus/S4, (ECMWF) as defined with ESA. Otherwise, EUMETSAT educated guess. •Associated requirements: [MTGDIS] §2.X.1 & 3.X.1 •Way forward: a) For initial IOC version (after MTG-I1 launch), EUM will use whatever corporate data distribution mechanisms which exist now or will exist before the launch. This includes with current knowledge the mechanism like EUMETCast satellite, EUMETCast terrestrial, internet, GTS/RMDCN complemented by a few point to point links (e.g. ECMWF) regrouped in the document under "Global NWP Centre". b) For MTG-S1 and MTG-I2, any evolution of the corporate data distribution mechanism would benefit to MTG. For example, once the "high-capacity WIS core network" will have

	performance compatible with the MTG needs, it will become part of the MTG baseline.
RMDCN/ GTS	•Open issue "GTS/RMDCN". The list of MTG products to be disseminated by GTS/RMDCN is tentative and subject to change. •Associated requirements: DIS-14250, [MTGDIS] §2.X.1 & 3.X.1 •Way forward: To be discussed in the context of GODEX_NWP (global body representing the NWP data consumption community and the satellite data providers).
Extract of conventions	• TBC and old text (once the *satellite* supplier / design is known) to be corrected in the extract of the convention document related to "scheduled outage" (annex C page 71).

2 METEOSAT THIRD GENERATION MISSION NEED

The mission of the Meteosat Third Generation (MTG) System is to provide continuous high spatial, spectral and temporal resolution observations and geophysical parameters of the Earth / Atmosphere System derived from direct measurements of its emitted and reflected radiation using *satellite* based sensors from the geo-stationary orbit. To fulfil its mission it is required to deploy sustained capabilities to acquire, process and distribute to downstream application users and second tier processing centres environmental data on a broad *spectral range* (from UV to LWIR), covering extensive areas (global and regional), and within a variety of different time scales to continue and enhance the services offered by the Second Generation of the Meteosat System (MSG).

The MTG mission encompasses the following observation missions:

- Flexible Combined Imager (FCI) mission, providing 16 channels with a spatial sampling distance in the range 1-2km (also called Full Disc High Spectral resolution Imagery (FDHSI)); and/or 4 channels with a spatial sampling distance in the range 0.5-1km (also called High spatial Resolution Fast Imagery (HRFI)). It is possible to configure the FCI to scan the earth disc in 10 minutes in support of the Full Disc Scanning Service (FDSS) or a quarter of the disc in 2.5mn in support of the Rapid Scanning Service (RSS). The combination of channels and coverage areas are defined in the list of products. - Implemented by MTG-I
- InfraRed Sounding mission is achieved through the Infrared Sounder (IRS) instrument, providing hyperspectral sounding information in two bands, a Long Wave InfraRed (LWIR: 700-1210 cm-1) and Mid Wave InfraRed (MWIR: 1600-2175 cm-1) band with a spatial sampling distance around 4km at nadir. The earth disc is split in 4 zones of equal size (called LAC for Local Area Coverage), and numbered LAC 1 to LAC 4, from south to north. The scan pattern repeat sequence is arranged to revisit each LAC zone in a manner adapted to the need of the End Users (Europe is revisited more often). - Implemented by MTG-S.
- Lightning Imagery mission is achieved through the Lightning Imager (LI) instrument, detecting continuously over almost the full disc, the lightning discharges taking place in clouds or between cloud and ground with a spatial sampling distance less than 10km at 45 degrees north for the sub-satellite longitude. - Implemented by MTG-I

Moreover, the MTG missions comprise the accommodation of the Copernicus Sentinel-4 (S4) sounding mission, achieved through the Ultraviolet, Visible and Near-infrared (UVN) Instrument, covering Europe every hour taking measurements in three spectral bands (UV: 305 - 400 nm; VIS: 400 - 500 nm, NIR: 750 - 775 nm) with spatial sampling distance around 8km. - Implemented by MTG-S

In addition, the MTG mission makes a major contribution to climate monitoring activities providing high quality radiances, reprocessed level 1 dataset as Fundamental Climate Data Records (FCDRs) supporting generation of Thematic Climate Data Records (TCDRs), providing also stewardship of decadal geostationary data records of the First and Second Generation of Meteosat. - Implemented by reprocessing

The Space Segment of the MTG System consists of a satellites constellation. Three in-orbit satellites are needed to support the complete and total set of missions and functions listed above, the full operational capability (FOC). To span the operational life time of the programme over at least 20 years for the imagery mission and 15.5 years for the sounding

mission, there will be in total 4 satellites dedicated to support the Imagery missions (MTG-I), and 2 satellites to support the sounding missions (MTG-S).

Each *satellite* is specified for a nominal lifetime (including *commissioning*) of ca. 8.5 years, carrying the payload complements or meteorological sensors according to the following split which have been confirmed in the definition and feasibility phase -Phase A- for its detailed design and implementation:

- MTG-I: FCI, LI, DCS and SAR
- MTG-S: IRS + UVN (Copernicus S-4)

This distribution of the payload complement and redundancies gives regard to the novelty nature of the sounding missions (IRS and UVN) and their respective downstream applications using data from geo-stationary systems, balancing the payload mass distribution, power, consumables such as propellant, and data rates making effective use of the same platform.

Complementary to the direct observation missions summarised above and yet essential to satisfy key user needs, the following objectives have also to be fulfilled by the MTG System:

- *Level 1 dataset* generation in the context of above direct observation mission;
- *Level 2 product* extraction;
- Data Collection System (DCS), for collecting and transmitting observations and data from surface, buoy, ship, balloon or airborne Data Collection Platforms (DCP);
- Long term archiving in the *EUMETSAT Data Centre* including *reprocessing* of *instrument data* (*level 0*) and *level 1 datasets*;
- Near Real Time Data Dissemination and Relay services to users
  - *EUMETCast* services (by satellite and terrestrial);
  - RMDCN dissemination service;
  - Search And Rescue (SAR) relay service. Similarly to MSG, the MTG System has the capability to accommodate a GEOSAR transponder, enabling the operations of the mission under the aegis of the COSPAS-SARSAT System.
  - Internet dissemination services;
- *Archived dataset* retrieval services continue to be provided as part of the multi-mission *EUMETSAT Data Centre* services.
- User support services are enhanced to address MTG as well.

The full nominal operational configuration includes a prime *MTG-I satellite* (supporting the FDSS services), a second *MTG-I satellite* (acting as in-orbit hot backup for the prime *MTG-I satellite* and supporting the RSS services) and an *MTG-S satellite*. These three in-orbit satellites are needed to support the complete and total set of missions and functions listed above, also called the full operational capability (FOC).

3 SYSTEM-WIDE REQUIREMENTS

Using the data received from the *satellites*, the following data services are provided within the MTG system:

- FCI data acquisition and generation,
- IR Sounding data acquisition and generation,
- Lightning data acquisition and generation,
- UVN data acquisition and generation,
- *Level 2 product(s)* generation,
- DCP message acquisition, bulletin generation and statistics generation,
- Data Archival in *EUMETSAT Data Centre*.

[EURD] SYS-00020 iss: 3C

The following set of services shall be nominally provided during the operational lifetime of the MTG Programme (at least 20 years), once these services become operational for the first time (i.e. after *commissioning* of *MTG-I1*):

1) FCI Full disc data acquisition and generation (in support of the FDSS)

2) Lightning data acquisition and generation

3) *Level 2 Products* generation

4) *DCP messages* acquisition, *DCP Bulletins* generation and statistics generation

5) Data Archival in the *EUMETSAT Data Centre*

6) Near Real Time data dissemination and Relay;

7) *archived dataset* retrieval services (from the *EUMETSAT Data Centre*)

8) User support

[EURD] SYS-00040 iss: 3C

The following set of services shall be nominally provided during at least 15.5 years once these services become operational for the first time (i.e. after *commissioning* of *MTG-S1*):

1) IR Sounding data acquisition and generation

2) UVN data acquisition and generation

3) Related *Level 2 product(s)* generation

Note: These services are on top of the ones specified to be available after the *commissioning* of MTG-I1.

[EURD] SYS-00060 iss: 3C

The following set of services shall be nominally provided during at least 12.5 years once these services become operational for the first time (after *commissioning* of the *MTG-I2*):

1) FCI *Local Area Coverage* data acquisition and generation (in support of the RSS)

2) Related *Level 2 product(s)* generation

Note 1: MTG Rapid Scanning nominally starts after *commissioning* of *MTG-I2*. Until that time, the Rapid Scanning Service (RSS) is provided by MSG-4.

Note 2: These services are on top of the ones specified to be available after the *commissioning* of MTG- I1.

[EURD] SYS-00080 iss: 3A

The *satellite specified lifetime* shall be 8.5 years.

Note 1: This applies to the MTG-I and MTG-S and includes *commissioning* duration.

Note 2: The *system commissioning* of *MTG-I1* and *MTG-S1* is expected to last 12 months. Any follow-on MTG *satellite* is expected to be commissioned within 6 months.

[EURD] SYS-00100 iss: 3A

The MTG System shall include 4 *satellites* (MTG-I) embarking the Flexible Combined Imager (FCI), the Lightning Imager (LI) , the Data Collection Platform (DCP) receiver and the Search And Rescue (SAR) repeater.

[EURD] SYS-00120 iss: 3A

The MTG System shall include 2 *satellites* (MTG-S) embarking the Infra-Red Sounder (IRS) and the UVN-Copernicus sounder.

[EURD] SYS-00130 iss: 3B

The system shall provide the operational MTG missions (and the related services) when the supporting *satellites* are located within the *nominal longitude range* between 10°W and 10°E.

4 DATA ACQUISITION, GENERATION AND ARCHIVING SERVICES

4.1 FCI Data Acquisition and Generation Services

The MTG Flexible Combined Imager (FCI) generates simultaneously *images* at various spatial resolutions for 16 *spectral channels*, including 4 at high spatial resolution (extension of SEVIRI HRV to 4 channels). A local area scanning is possible with a higher repetition rate (further called rapid scan for consistency with Meteosat first and second Generation). Normal (full disc) and local area scanning can be interleaved on a single *satellite* (e.g. when only one imaging *satellite* is operational in orbit) or conducted in parallel when 2 *satellites* are available in-orbit. These two scanning modes correspond respectively to the Full Disc Scanning Service (FDSS) and Rapid Scanning Service (RSS).

The operational practices for the Full Disc Scanning Service (FDSS), after the launch of MTG-I1, and the Rapid Scanning Service (RSS), after the launch of MTG-I2, are both defined. The capability to perform RSS and interleaved scanning is verified during MTG-I1 commissioning. The potential use of interleaved scanning during routine operations depends on experience in orbit and recommendation of the OPS-WG.

The FCI acquires the *spectral channels* simultaneously by scanning a *detector array* per *spectral channel* in an east/west direction to form a *swath*. The *swaths* are collected moving from south to north to form an *image* per *spectral channel* covering either the *full disc coverage* or the *local area coverage* within the respective *repeat cycle* duration. *Radiance samples* are created from the *detector elements* at specific *spatial sample* locations and are then rectified to a *reference grid*, before dissemination to the End Users as *level 1 datasets*. *Spectral channels* may be sampled at more than one *spatial sampling distance* or *radiometric resolution*, where the *spectral channel* has to fulfil FDHSI and HRFI missions or present data over an extended *radiometric measurement range* for fire detection applications.

4.1.1 FCI Image Acquisition Requirements

[EURD] FCI-02020 iss: 3A

The Flexible Combined Imager (FCI) shall generate simultaneously *images* for the *spectral channels* given in Table 1:

Table 1: Channel specification for the Flexible Combined Imager (FCI)

Spectral Channel	Central Wavelength, *λ0*	Spectral Width, *Δë0*	Spatial Sampling Distance *(SSD)*
VIS 0.4	0.444 µm	0.060 µm	1.0 km
VIS 0.5	0.510 µm	0.040 µm	1.0 km
VIS 0.6	0.640 µm	0.050 µm	1.0 km 0.5 km #1
VIS 0.8	0.865 µm	0.050 µm	1.0 km
VIS 0.9	0.914 µm	0.020 µm	1.0 km
NIR 1.3	1.380 µm	0.030 µm	1.0 km

NIR 1.6	1.610 µm	0.050 µm	1.0 km
NIR 2.2	2.250 µm	0.050 µm	1.0 km 0.5 km #1
IR 3.8 (TIR)	3.800 µm	0.400 µm	2.0 km 1.0 km #1
WV 6.3	6.300 µm	1.000 µm	2.0 km
WV 7.3	7.350 µm	0.500 µm	2.0 km
IR 8.7 (TIR)	8.700 µm	0.400 µm	2.0 km
IR 9.7 (O_3)	9.660 µm	0.300 µm	2.0 km
IR 10.5 (TIR)	10.500 µm	0.700 µm	2.0 km 1.0 km #1
IR 12.3 (TIR)	12.300 µm	0.500 µm	2.0 km
IR 13.3 (CO_2)	13.300 µm	0.600 µm	2.0 km

Note 1: The *spectral channels* VIS 0.6, NIR 2.2, IR 3.8 and IR 10.5 are delivered in both FDHSI sampling and a HRFI sampling configurations, the latter is indicated by #1 in the table.

[EURD] FCI-02040 iss: 3A

The FCI shall be able to generate *images* covering the full Earth disc (called *full disc coverage* (FDC)) and a subset (called *local area coverage* (LAC)) with the *repeat cycle* duration and *coverage* as specified in Table 2.

Table 2: Flexible Combined Imager (FCI)* coverage *versus* repeat cycle *duration

Coverage	**Repeat cycle** *duration*	*Comment*
FDC = 17.70° diameter circle centred at SSP	10 minutes	Corresponds to Full Disc Scanning Service (FCI-FDSS)
LAC = FDC / 4	2.5 minutes	Corresponds to the Rapid Scanning Service (FCI-RSS)

Note 1: The operational practice for the FDSS (based on the FDC alone) is that the acquisition start times are around HH:00, HH:10, HH:20 etc. where HH represents the hours in UTC, as shown in Figure 1.

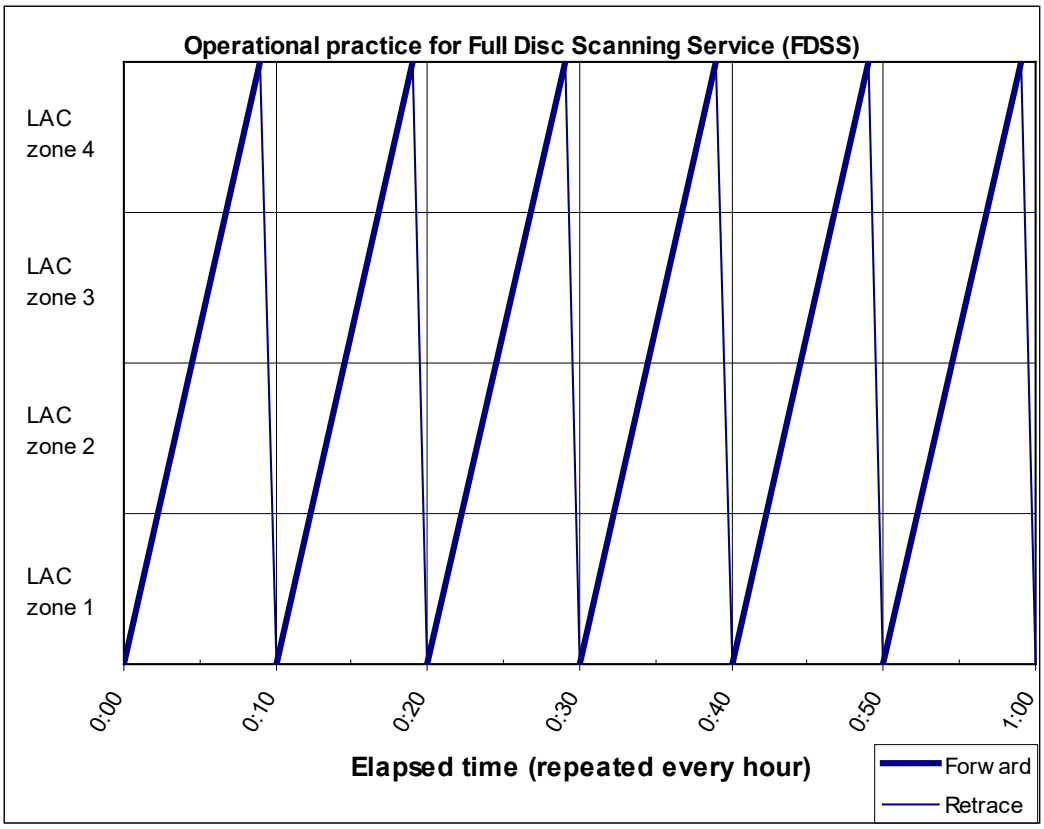


Figure 1: Operational practice for Full Disc Scanning Service (FDSS)

Note 2: The operational practice for the RSS (based on the LAC alone) is to scan Europe, as shown in Figure 2.

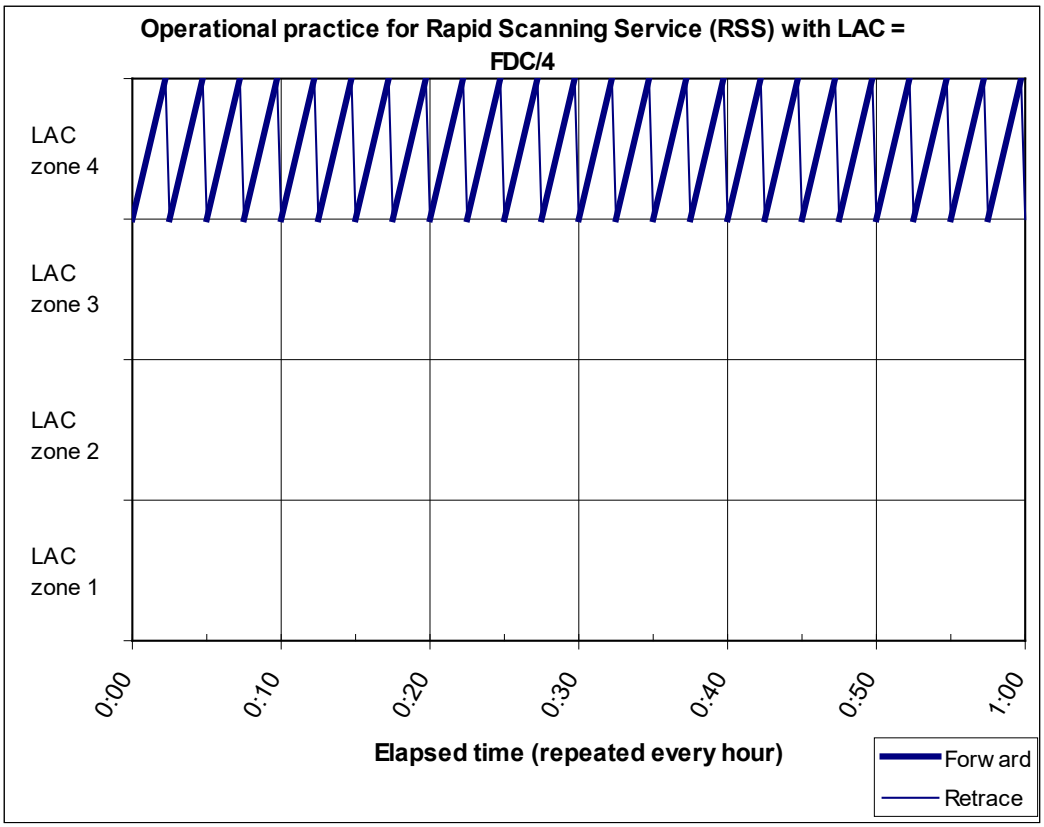


Figure 2: Operational practice for Rapid Scanning Service (RSS)

Note 3: The capability to support simultaneously the FDSS and RSS service using a single satellite is verified during MTG-I1 commissioning. The reference scenario (based on FDC interleaved with LAC) is that the acquisition start times for FDC are around HH:00, HH:15, HH:30, HH:45 and the acquisition start times for LAC are around HH:10, HH:12.5, HH:25, HH:27.5, HH:40, HH:42.5, HH:55, HH:57.5, etc. where HH represents the hours in UTC, as shown in Figure 3.

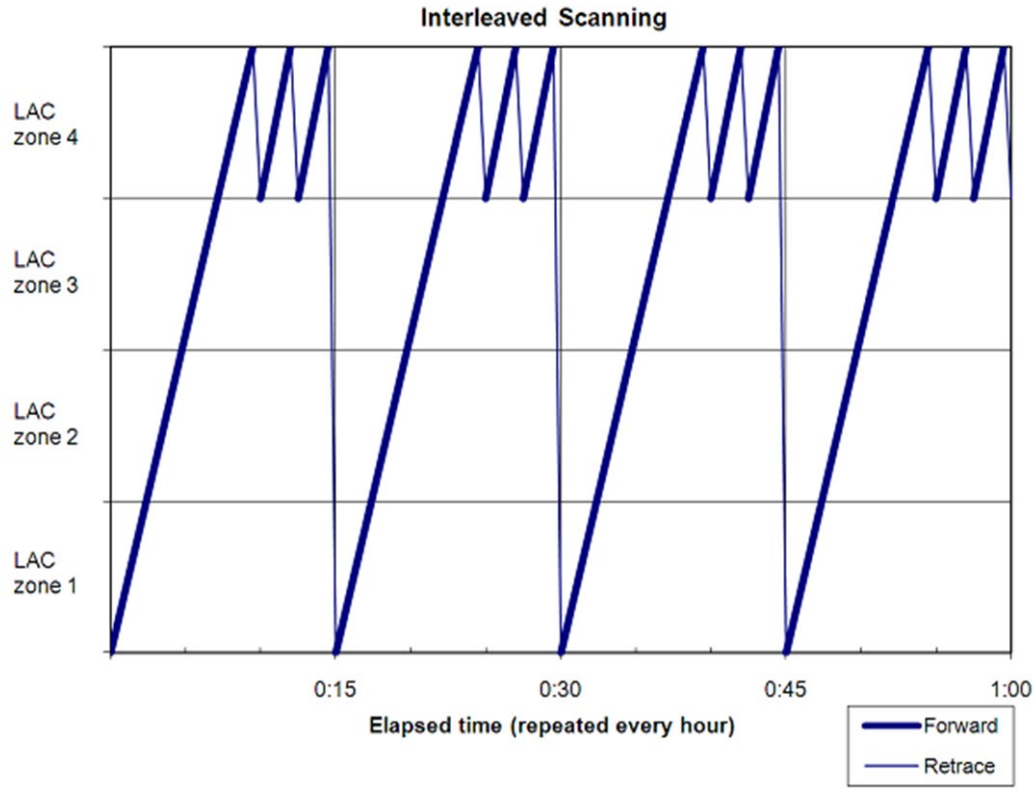


Figure 3: Interleaved Scanning

[EURD] FCI-02050 iss: 3A

The start of the FCI LAC shall be configurable, by ground telecommand, to any position within the FDC, provided that the LAC is fully contained in the FDC.

Note 1: The *LAC zones* are labelled consecutively 1 to 4 starting at the southernmost and ending at northernmost (European) *LAC zone*.

[EURD] FCI-02055 iss: 4.A

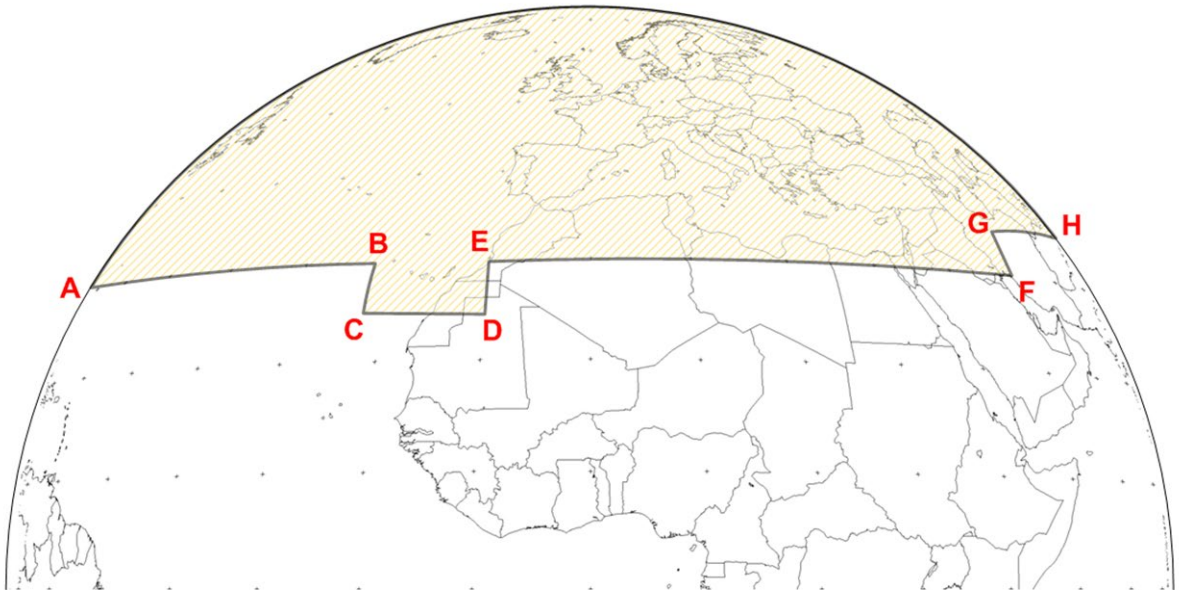
The FCI *image* shall be such that:

When delivering FDSS:

The complete FDC area of *coverage* is available in the acquired *image*;

When delivering RSS:

At least the complete Earth surface visible from *geostationary altitude* at 0° inclination and at the north of the boundary described in Figure 4 is available.



AB	30°N
BC	22°W
CD	25°N
DE	10°W
EF	30°N
FG	50°E
GH	35°N

Note: The diagram indicates the minimum LAC zone 4 *coverage* in terms of latitude and longitude on the earth.

Figure 4: Minimum LAC zone 4* coverage *for FCI

4.1.2 FCI Image Quality Threshold

As defined in [CONV], the *quality threshold* is met when the requirements on *completeness*, *accuracy* and *timeliness* are fulfilled. The percentages of the *images* that meet the *quality threshold* requirements (within *timeliness*) are addressed in the dissemination sections.

[EURD] FCI-02060 iss: 3A

An FCI *image* shall be considered complete if all of the conditions below are met:

a) FCI *image* acquisition requirements are met,

b) Less than 5% of the *radiance samples* in the *image* are declared *missing samples*

[EURD] FCI-02080 iss: 3A

An FCI *image* shall be considered accurate if all of the conditions below are met:

a) FCI *image level 1* spectral requirements are met,

b) FCI *image level 1* radiometric requirements are met,

c) FCI *image level 1* spatial & temporal requirements are met,

d) FCI *image level 1* geometric requirements are met.

4.1.3 FCI Image Level 1 Spectral Requirements

Unless otherwise stated the requirements in this section apply:

- to all *spectral channels*
- to all *spatial samples* in a *repeat cycle*
- to all *repeat cycles* over each MTG-I *satellite specified lifetime*.

[EURD] FCI-02100 iss: 3A

The FCI *spectral response function difference* between any two *spatial samples* of the same *image* shall be less than 0.05 for VIS and NIR *spectral channels* and less than 0.10 for IR *spectral channels* when integrated over three times the *spectral width* and centred on the *central wavelength*.

[EURD] FCI-02120 iss: 3A

The FCI *spectral response function difference* between the actual *spectral response function* and that characterised on-ground shall be less than 0.10 for VIS and NIR *spectral channels* and 0.20 for IR *spectral channels* when integrated over three times the *spectral width* and centred on the *central wavelength*.

4.1.4 FCI Image Level 1 Radiometric Requirements

Unless otherwise stated the requirements in this section apply:

- to all *spectral channels*
- to all signal levels between the minimum and maximum signal
- to all *repeat cycles* over each MTG-I *satellite specified lifetime*.

***Table 3: Radiometric requirements of the FCI* Images**

Spectral Channel	*Min. Signal,* α_{min}	*Max. Signal,* α_{max}	*Ref. Signal,* α_{ref}	**Radiometric Noise** *(SNR)*	**Medium Term Radiometric Stability**	**Long Term Radiometric Stability**	**Radiometric Accuracy**
VIS 0.4	0.01	1.20	0.01	>25	<0.1%	<2%	<5%
VIS 0.5	0.01	1.20	0.01	>25	<0.1%	<2%	<5%
VIS 0.6	0.01	1.20	0.01	>30 >12[#1]	<0.1%	<2%	<5% <10%[#1]
VIS 0.8	0.01	1.20	0.01	>21	<0.1%	<2%	<5%
VIS 0.9	0.01	0.80	0.01	>12	<0.1%	<2%	<5%
NIR 1.3	0.01	0.80	0.01	>40	<0.1%	<2%	<5%
NIR 1.6	0.01	1.00	0.01	>30	<0.1%	<2%	<5%
NIR 2.2	0.01	1.00	0.01	>25 >12[#1]	<0.1%	<2%	<5% <10%[#1]

Spectral Channel	**Min. Signal, Tmin**	**Max. Signal, Tmax**	**Ref. Signal, Tref**	*Radiometric Noise* **(NEdT)**	*Medium Term Radiometric Stability*	*Long Term Radiometric Stability*	*Radiometric Accuracy*
IR 3.8 (TIR)	200K 350K	350K 450K	300K 350-450K[#2]	<0.1K, <0.2K[#1] <1K[#2]	<0.1K <0.2K[#1]	<0.3K	<0.7K < 1K[#1]
WV 6.3	165K	270K	250K	<0.3K	<0.1K	<0.3K	<0.7K
WV 7.3	165K	285K	250K	<0.3K	<0.1K	<0.3K	<0.7K
IR 8.7 (TIR)	165K	330K	300K	<0.1K	<0.1K	<0.3K	<0.7K
IR 9.7 (O_3)	165K	310K	250K	<0.3K	<0.1K	<0.3K	<0.7K
IR 10.5 (TIR)	165K	340K	300K	<0.1K <0.2K[#1]	<0.1K <0.2K[#1]	<0.3K	<0.7K <1K[#1]
IR 12.3 (TIR)	165K	340K	300K	<0.2K	<0.1K	<0.3K	<0.7K
IR 13.3 (CO_2)	165K	300K	270K	<0.2K	<0.1K	<0.3K	<0.7K

Note 1: The channels VIS 0.6, NIR 2.2, IR 3.8 and IR 10.5 are delivered in FDHSI sampling and HRFI sampling configurations. The radiometric requirements for the HRFI sampling configuration are indicated by [#1] in the table.

Note 2: For the IR 3.8 channel the dynamic range has been extended with a reduced *radiometric noise* specification for active fire monitoring and are indicated by [#2] in the table.

[EURD] FCI-02140 iss: 3A

The FCI *radiometric noise* shall be as given in Table 3 with the SNR (or NEdT) requirement scaled, at signal levels α (or T) between the minimum and maximum signal, different from α_{ref} (or T_{ref}), according to the *radiometric scaling function*.

[EURD] FCI-02160 iss: 3C

The FCI *medium term radiometric stability* in the *image* data shall be as per Table 3.

[EURD] FCI-02180 iss: 3C

The FCI *long term radiometric stability* in the *image* data shall be as per Table 3.

[EURD] FCI-02200 iss: 3C

The FCI calibration system shall ensure that the *radiometric accuracy* over *satellite specified lifetime* does not exceed the values provided in Table 3.

4.1.5 FCI Image Level 1 Spatial & Temporal Requirements

Unless otherwise stated the requirements in this section apply:

- to all *spectral channels*
- to all areas in the *coverage* of the *repeat cycle*,

•to all *repeat cycles* over each MTG-I *satellite specified lifetime*,
•separately in N/S and E/W directions.

[EURD] FCI-02220 iss: 3A

The FCI *spatial sampling distance* (SSD) shall be as per Table 1.

[EURD] FCI-02230 iss: 4

The FCI *modulation transfer function* (MTF) for each *spatial sample* shall:

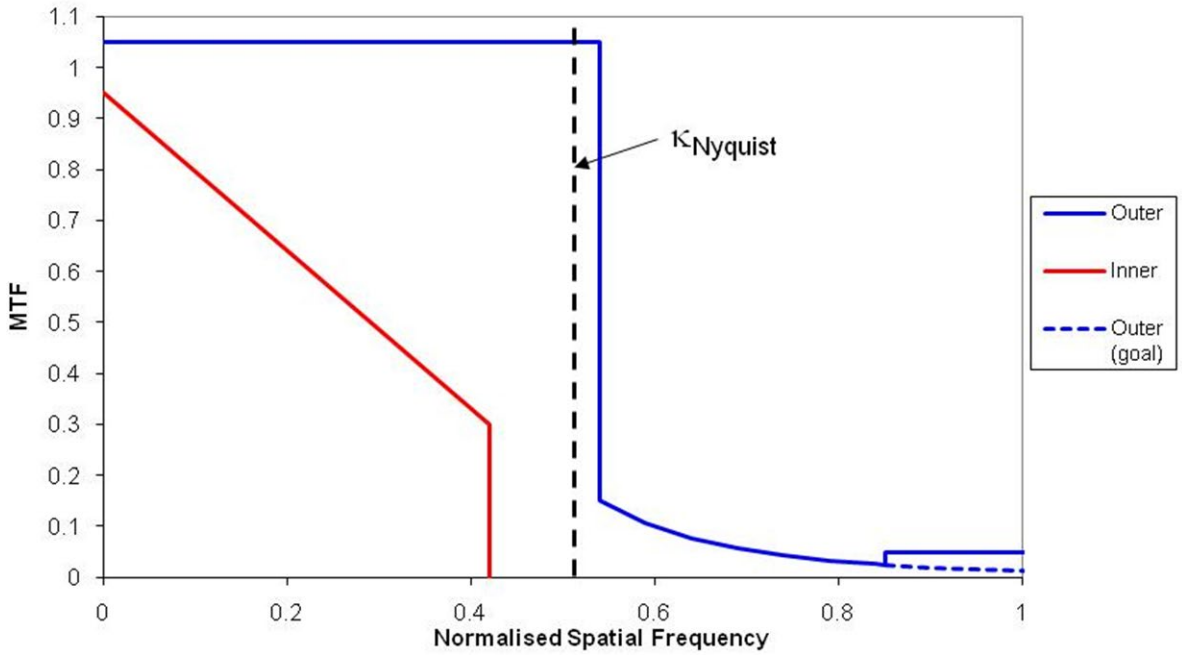
a) For the *spectral channels* VIS 0.6, NIR 2.2, IR 3.8 and IR 10.5 when delivered in the HRFI sampling configuration comply with the values defined in Figure 6.

b) For the *spectral channels* when delivered in the FDHSI sampling configuration comply with the values defined in Figure 5.

Note 1: The aim of the MTF inner template at the point at which the analogue signal is converted to a digital signal is to maximise the sub-Nyquist MTF.

Note 2: On-board and/or on-ground digital processing can be applied to achieve the MTF outer template, in order to minimise the super Nyquist MTF, i.e. minimise *alias noise*, at the specified SSD.

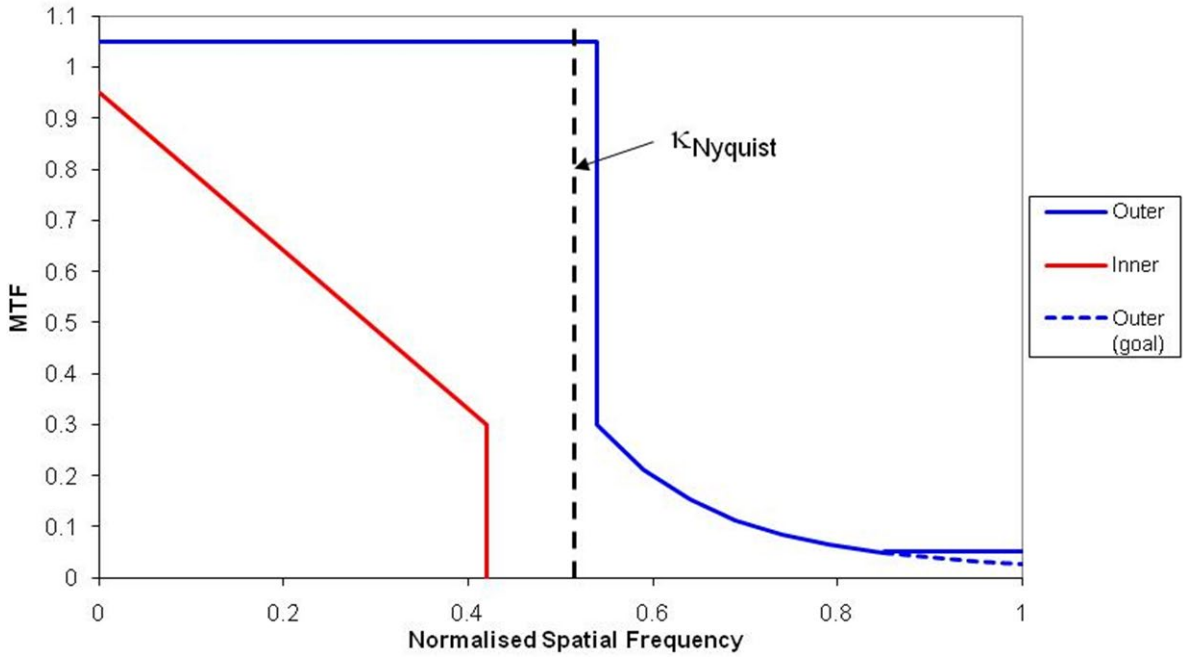
Note 3: Digital OTF manipulation applied to meet the *inter channel co-registration accuracy* and N/S to E/W MTF similarity requirements is allowed provided that the resulting MTF complies with the MTF templates and radiometric requirements are met.



Normalised Spatial Frequency, κ	**Inner MTF Template**	**Outer MTF Template**
0	0.95	1.05
0.42	0.3	-
>0.42	0	-
0.54	-	1.05

0.54<κ=<0.85	-	$0.15/(\kappa/0.54)^4$
0.85<κ<=4 (for SSD= 1km) 0.85<κ<=8 (for SSD=2km)	-	0.05
(goal) 0.85<κ<=4 (for SSD=1km) 0.85<κ<=8 (for SSD=2km)	-	$0.15/(\kappa/0.54)^4$

Figure 5: MTF Template for FDHSI sampling configuration



Normalised Spatial Frequency, κ	**Inner MTF Template**	**Outer MTF Template**
0	0.95	1.05
0.42	0.3	-
>0.42	0	-
0.54	-	1.05
0.54<κ=<0.85	-	$0.3/(\kappa/0.54)^4$
0.85<κ<=2 (SSD=0.5km) 0.85<κ<=4 (SSD=1km)	-	0.05
(goal) 0.85<κ<=2 (SSD=0.5km) 0.85<κ<=4 (SSD=1km)	-	$0.3/(\kappa/0.54)^4$

Figure 6: MTF Template for VIS 0.6, NIR 2.2, IR 3.8 and IR 10.5 in HRFI sampling configuration

4.1.6 FCI Image Level 1 Geometric Requirements

Unless otherwise stated the requirements in this section apply:

- to all *spectral channels*
- to all areas in the *coverage* of the *repeat cycle*,
- to all *repeat cycles* over each MTG-I *satellite specified lifetime*,

•separately in N/S and E/W directions.

Table 4: Geometric Quality Criterion

	Confidence Level	*SSD=0.5 km*	*SSD=1.0 km*	*SSD=2.0 km*
APPKE (500x500 *pixels*)	99.73%	<0.90 km	<1.80 km	<3.60 km
APPKE (*image*)	99.73%	<0.75 km	<1.50 km	<3.00 km
RPPKE (between consecutive *images*)	99.73%	<1.05 km	<1.05 km	<1.05 km

[EURD] FCI-02240 iss: 3A

The absolute value of the FCI *absolute pixel position knowledge error* (APPKE) within a 500 by 500 *pixel imagette* shall be as given in Table 4.

[EURD] FCI-02280 iss: 3A

The absolute value of the FCI *absolute pixel position knowledge error* (APPKE) evaluated over the complete FDC or LAC *image* shall be as given in Table 4.

[EURD] FCI-02300 iss: 3A

The absolute value of the FCI *relative pixel position knowledge error* (RPPKE) shall be as given in Table 4, when evaluated over all *pixels* common between two consecutive FDC or LAC *images* of the same *spectral channel*.

[EURD] FCI-02320 iss: 4

The absolute value of the FCI *relative pixel position knowledge error* (RPPKE) between two *spectral channels* when evaluated over all *pixels* between two FDC or LAC *images* taken in the same *repeat cycle* shall be:

a) For the *spectral channels* as specified in Table 5 at a 68.26% confidence level, when delivered in the HRFI sampling configuration.

b) For the *spectral channels* as specified in Table 6 at a 68.26% confidence level, when delivered in the FDHSI sampling configuration.

Table 5: FCI HRFI* Relative Pixel Position Knowledge Error *between* Spectral channels *(at SSP)

	VIS	*NIR*	*TIR*
VIS		<0.30 km	<1.00 km
NIR			<1.00 km
TIR			<0.68 km

Table 6: FCI FDHSI* Relative Pixel Position Knowledge Error *between* Spectral channels *(at SSP)

	VIS	*NIR*	*TIR*	*WV*	O_3	CO_2
VIS	<0.32 km	<0.40 km	<1.00 km			
NIR		<0.32 km	<1.00 km			
TIR			<0.48 km	<1.60 km	<0.64 km	<0.64 km
WV				<1.92 km		
O_3						<0.84 km
CO_2						

[EURD] FCI-02340 iss: 4

It shall be possible to rectify FCI *images* from a *satellite* to any longitude within +/- 10° from the *sub-satellite point* of that *satellite* according to a *reference grid* and projection defined according to [CONV]

Note: The operational practice is to rectify at 0° if the *satellite* is located close to 0°.

4.2 IRS Data Acquisition and Generation Services

The IRS has no operational predecessors in the geostationary orbit (GEO); pioneering experiments of an imaging infrared spectrometer in GEO are just being made with the first GIIRS instruments on the FY4 Chinese platforms. However, long relevant experience in retrieving geophysical parameters from hyperspectral satellite data has been made for soon two decades from Low Earth Orbits (LEO), starting with AIRS and continued with IASI and CrIS. The development of the IRS Level 2 (L2) product processing chain will capitalise on this very valuable heritage and in particular on IASI operational experience within EUMETSAT.

The IRS acquires a number of *spectral soundings* simultaneously over a *dwell* using a two dimensional *detector array*. The *dwell coverage* is stepped in an east/west direction to form a line of *dwell spectral soundings*, before moving northward to form the next line, covering the *local area coverage* (LAC) within the *repeat cycle* duration. Up to 4 separate *LAC zones* can be defined and the *LAC zones* scanned in any order with maximum sequence length of 96 LACs before repetition of the sequence. The *spectral soundings* are transmitted to the ground as interferograms and transformed to *spectral channels* as part of the ground processing, before dissemination to the End Users as *level 1 datasets*.

4.2.1 IRS Dataset Acquisition Requirements

[EURD] IRS-04020 iss: 4

The IRS shall cover the spectral domain from 680 - 2250 cm^{-1} in two *spectral bands*; a long wave infrared (LWIR) and a medium wave infrared (MWIR) *spectral band* with the characteristics provided in Table 7.

***Table 7: Infra-Red Sounder (IRS)* Spectral Bands**

Spectral Band	*Status*	**Wavenumber** *range*	**Spectral Channel Interval**	**Spatial Sampling Distance***(SSD)*
LWIR	Extended	680-700 cm^{-1}	Better than 0.625 cm^{-1}	4.0 km
	Specified	700-1210 cm^{-1}	Better than 0.625 cm^{-1}	
MWIR	Specified	1600-2175 cm^{-1}	Better than 0.625 cm^{-1}	4.0 km
	Extended	2175-2250 cm^{-1}	Better than 0.625 cm^{-1}	

Note: The LWIR and MWIR *spectral bands* contain specified and extended *wavenumber* ranges. For *spectral channels* lying inside the specified portion of the *spectral band* full compliance is required. No requirements apply to the extended range, except data delivery.

[EURD] IRS-04040 iss: 4

The IRS shall generate a *dataset* covering a subset of the full earth disc (called *local area coverage* (LAC)) with the *repeat cycle* duration and *coverage* as specified in Table 8.

Table 8: IRS* coverage *versus* repeat cycle *duration

Coverage	**Repeat cycle** *duration*	*Comment*
FDC = 17.70° diameter circle centred at SSP	N/A	The FDC *coverage* is the result of the combination of LAC 1, 2, 3, and 4. Restriction of *coverage* to 16.80° diameter circle centred at SSP for LAC 1, 2, and 3 is acceptable.
LAC = FDC/4	15 minutes	

Note 1: The reference pattern for satellite commissioning consists in sequences of quarter of disc scanning, with the complete sequence repeated every 6 hours according to the following patterns: 5 times (LAC3 + LAC4) followed by 4 times (LAC2 + LAC4) followed by 3 times (LAC1 + LAC4).

Note 2: The operational practice is to have only sequences of quarter of disc scanning, with the complete sequence repeated every 6 hours according to the following patterns: 3 times (LAC3 + LAC4) followed by 3 times (LAC2 + LAC4) followed by 3 times again (LAC3 + LAC4) and ultimately 3 times (LAC1 + LAC4 as shown in Figure 7.

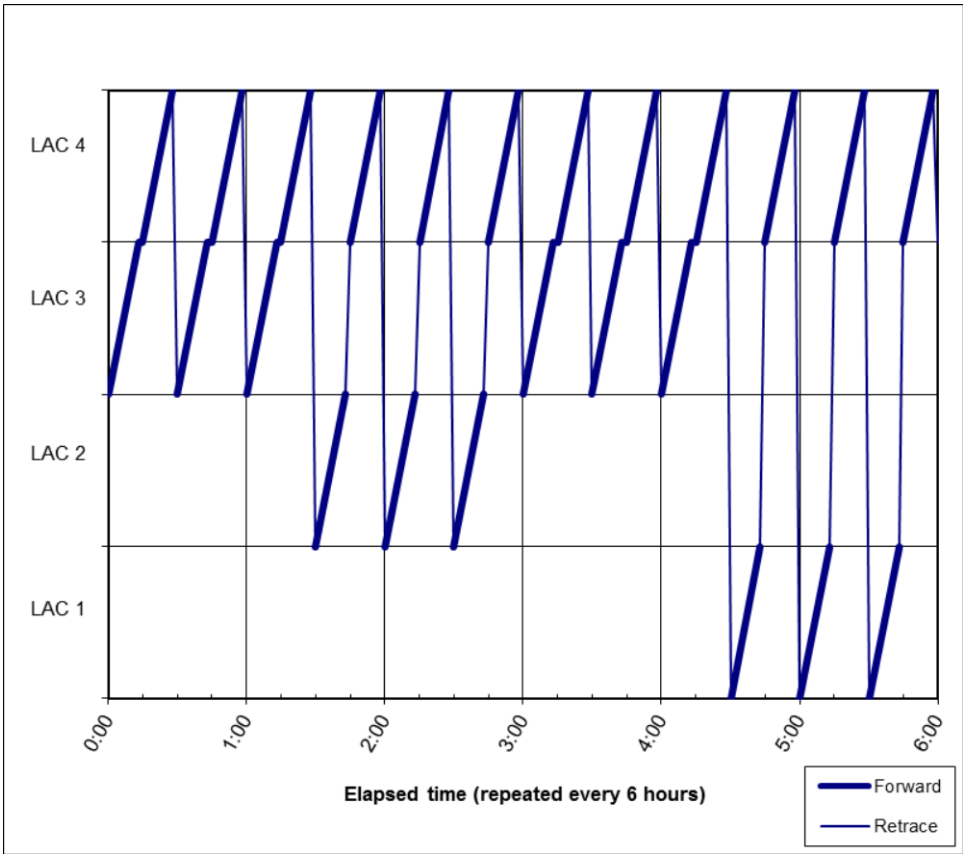


Figure 7: Operational practice for IRS scanning pattern

[EURD] IRS-04060 iss: 3A

The IRS LAC shall be scanned using a regular *dwell* sequence with respect to the *target grid*, with a slow step from geographic south to geographic north and a fast step in the geographic east/west direction.

Note: A *dwell* sequence moving from east to west then from west to east for alternate lines of *dwells* is permitted.

[EURD] IRS-04070 iss: 3A

The IRS shall allow the configuration of 4 *LAC zones*, by ground telecommand, each LAC starting at any position within the FDC, provided that the LAC is fully contained in the FDC.

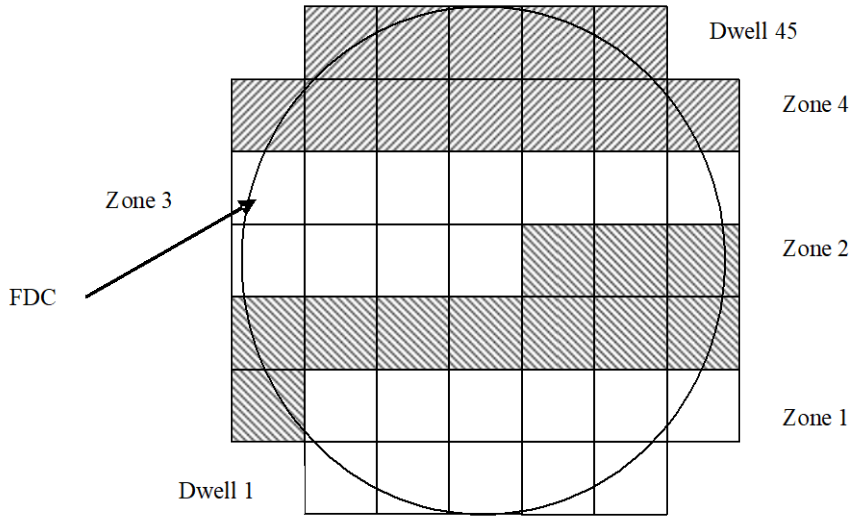
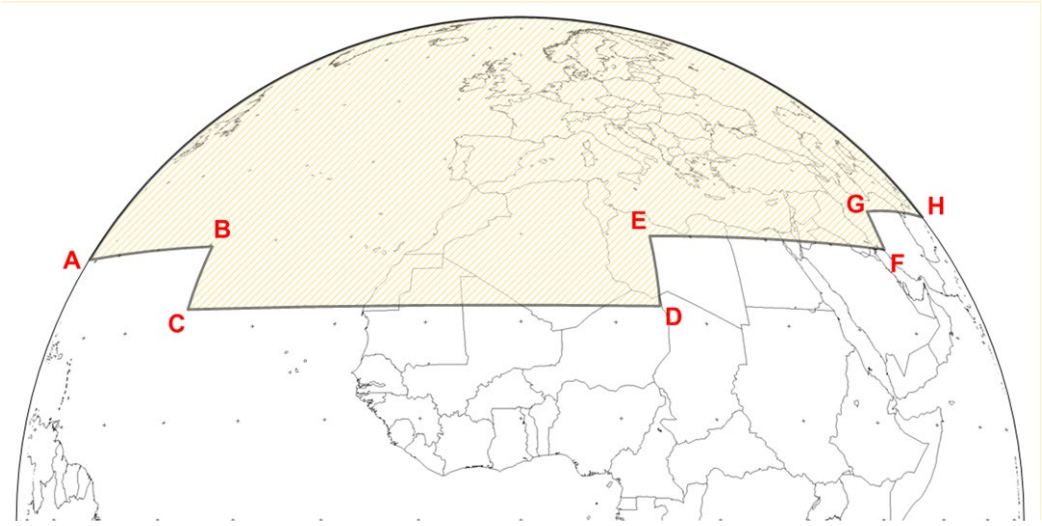


***Figure 8: Example of* LAC zone *definition for a FDC divided by 45* dwells**

[EURD] IRS-04075 iss: 4

The IRS *image* shall be such that:

- For the *LAC zone* 4 in the IRS operational practice the complete Earth surface visible from *geostationary altitude* at 0° inclination and North of the LAC boundary described in Figure 9 is available.



Note: The diagram indicates the mandatory *LAC zone* 4 *coverage* in terms of latitude and longitude on the earth.

AB	30°N
BC	40°W

CD	22°N
DE	15°E
EF	30°N
FG	50°E
GH	35°N

Figure 9: Mandatory LAC zone 4* coverage *for IRS operational practice

4.2.2 IRS Dataset Quality Threshold

As defined in [CONV], the *quality threshold* is met when the requirements on *completeness*, *accuracy* and *timeliness* are fulfilled. The percentages of the *datasets* that meet the *quality threshold* requirements (within *timeliness*) are addressed in the dissemination sections.

[EURD] IRS-04080 iss: 4

The IRS shall provide complete *datasets*. An IRS LAC *dataset* is considered incomplete if any of the conditions below occur:

a) The IRS *dataset* acquisition requirements are not met,

b) More than 5% of the MWIR *spectral soundings* in the LAC are declared *missing soundings*,

c) More than 15% of the LWIR *spectral soundings* in the LAC are declared *missing soundings*,

d) Three or more contiguous *spectral soundings* (in either direction) are declared *missing soundings* and have been declared *missing soundings* for the previous 20 LAC *images*.

where

N=3 and M=0.01 in the definition of *missing sounding*

Note 1: For contiguous *missing sounding* assessment the *spectral soundings* are referenced by *dwell*, *column* and *row* (s,i,j) between LAC *images*.

Note 2: The bullet d) intends to cover satellite detector ("permanent") *failure*. Thus for assessing the satellite performance, the whole requirement applies. For the assessment of the *completeness* of the data delivered to the End-Users, the last bullet d) has to be ignored, if it is due to a transient loss of *dataset* during the transmission.

[EURD] IRS-04100 iss: 3A

An IRS LAC *dataset* shall be considered accurate if all of the conditions below are met:

a) IRS *dataset level 1* spectral requirements are met,

b) IRS *dataset level 1* radiometric requirements are met,

c) IRS *dataset level 1* spatial and temporal requirements are met,

d) IRS *dataset level 1* geometric requirements are met.

4.2.3 IRS Dataset Level 1 Spectral Requirements

Unless otherwise stated the requirements in this section apply:

- to all *spectral channels*
- to all *spatial samples* in a *repeat cycle*
- to all *repeat cycles* over each MTG-S *satellite specified lifetime*.

[EURD] IRS-04120 iss: 3A

The IRS instrument shall be based on an interferometer concept (*Fourier Transform Spectrometer* or FTS type) that converts input spectral *radiances* into interferograms.

[EURD] IRS-04122 iss: 4

The *spectral channel interval* ($\Delta\nu$) for both IRS *spectral bands* LWIR and MWIR shall not exceed the value given in Table 7.

Note: The *spectral channel interval* is given for the resampled *spectral channel* spacing. The actual spectral sampling of the interferogram will be variable across a *dwell coverage* dependent on the *maximum optical path difference* for a *spatial sample*.

[EURD] IRS-04124 iss: 4

The full width half maximum (FWHM) of the IRS *spectral sample spectral response function* (SRF) shall be less than or equal to 0.754 cm^{-1}.

[EURD] IRS-04130 iss: 3A

The IRS *spectral sample* SRF *centroid wavenumber* shall be determined by the *spectral calibration* algorithm such that the *radiometric error* associated to the shift determination does not exceed 50 mK (NEdT@280K) when considering a spatially homogeneous scene and the spectra given by Figure 10.

Note: The requirement applies at a 68.26% confidence level calculated over all *spectral samples* within a *spectral band*, considering the LWIR and MWIR *spectral bands* separately.

[EURD] IRS-04135 iss: 4

The IRS *spectral sample spectral response function difference* between the actual *spectral response function* averaged over one day, and that given by the *SRF Estimation model* shall not exceed a value corresponding to a *radiometric error* of 50 mK (NEdT@280K) when considering a spatially homogeneous scene and the spectra given by Figure 10.

Note: The requirement applies at a 68.26% confidence level calculated over all *spectral samples* within a *spectral band*, considering the LWIR and MWIR *spectral bands* separately. This means that, for every *spectral band*, at least 68.26% of the *spectral channels* of every *spatial sample*) meet the requirement.

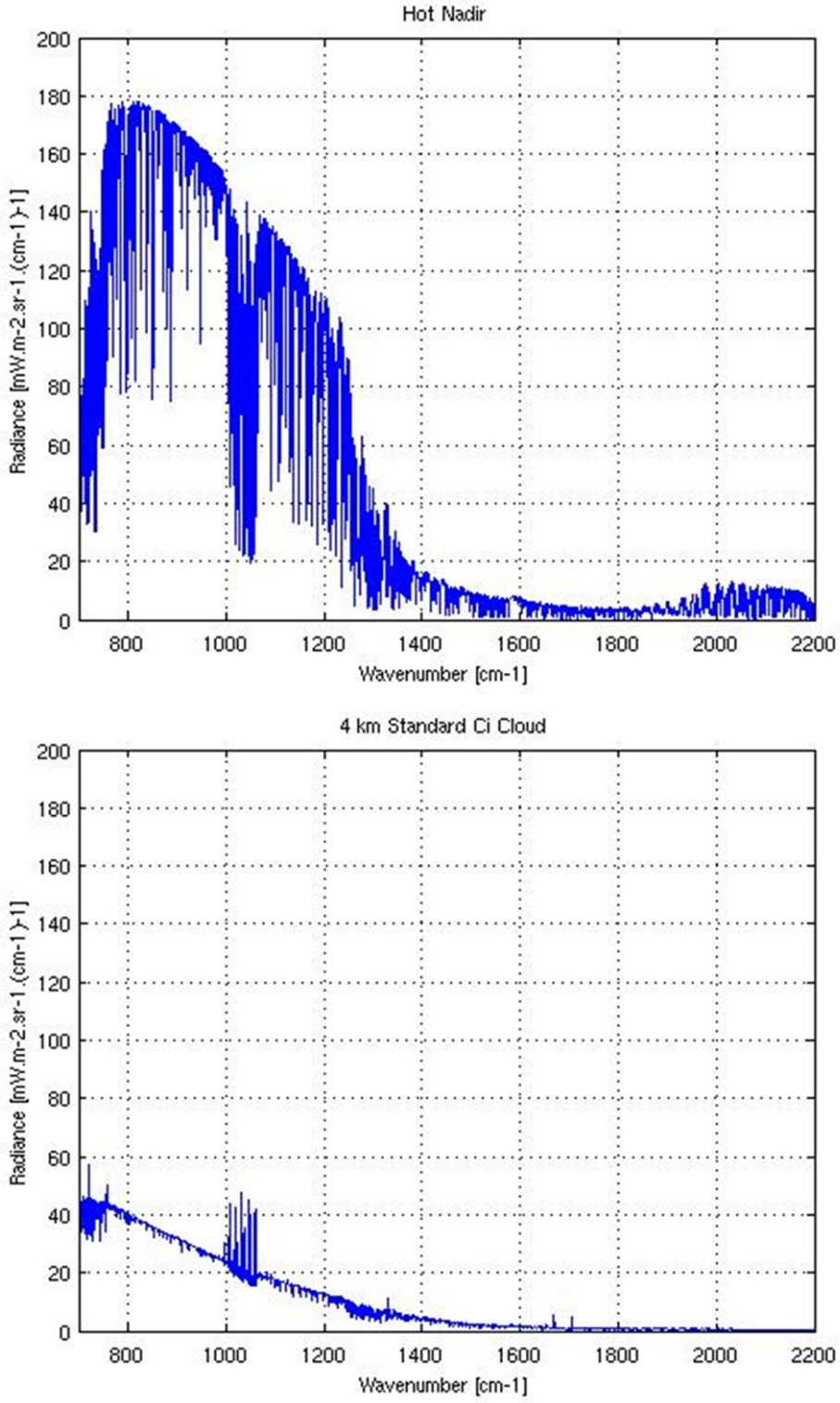


Figure 10: Spectral* radiances *for a hot desert and cold thick cirrus scene

4.2.4 IRS Dataset Level 1 Radiometric Requirements

Unless otherwise stated the requirements in this section apply:

•to all *spectral channels* in the specified *wavenumber* range given in Table 7. The portion of the *spectral bands* lying in the extended *wavenumber* range will be delivered, but no radiometric performance is specified.
•to all signal levels between the minimum and maximum signal levels scaled according to "IRS NEdT scaling rule" defined at signal levels between black body temperatures 200K and 280K according to the *radiometric scaling function* and between black body temperatures 280K to 313K with a scaling factor of 1.
•to all *repeat cycles* over each *MTG-S satellite nominal operational lifetime*.
•to *effective radiances* calculated using a single reference *spectral response function* per *spectral channel* across the complete area of *coverage*, where performance is evaluated after *spectral resampling*, i.e. including *spectral calibration*.

Table 9: Radiometric requirements of the IRS Spectra

LWIR **Wavenumber** *(cm^{-1})*	*Ref. Signal, Tref*	**Radiometric Noise** *(NEdT)*	**Medium Term Radiometric Stability**	**Long Term Radiometric Stability**	**Radiometric Accuracy**
700	280K	<0.5K	<0.1K	<0.3K	<0.5K
714	280K	<0.5K	<0.1K	<0.3K	<0.5K
715	280K	<0.4K	<0.1K	<0.3K	<0.5K
729	280K	<0.4K	<0.1K	<0.3K	<0.5K
730	280K	<0.3K	<0.1K	<0.3K	<0.5K
769	280K	<0.3K	<0.1K	<0.3K	<0.5K
770	280K	<0.2K	<0.1K	<0.3K	<0.5K
1040	280K	<0.2K	<0.1K	<0.3K	<0.5K
1118	280K	<0.224K	<0.1K	<0.3K	<0.5K
1210	280K	<0.35K	<0.1K	<0.3K	<0.5K
MWIR *Wavenumber* **(cm^{-1})**	**Ref. Signal, Tref**	*Radiometric Noise***(NEdT)**	*Medium Term Radiometric Stability*	*Long Term Radiometric Stability*	*Radiometric Accuracy*
1600	280K	<0.224K	<0.1K	<0.3K	<0.5K
1630	280K	<0.2K	<0.1K	<0.3K	<0.5K
1750	280K	<0.2K	<0.1K	<0.3K	<0.5K
1871	280K	<0.269K	<0.1K	<0.3K	<0.5K
1980	280K	<0.4K	<0.1K	<0.3K	<0.5K
2134	280K	<0.757K	<0.1K	<0.3K	<0.5K
2175	280K	<0.906K	<0.1K	<0.3K	<0.5K

[EURD] IRS-04140 iss: 4

The IRS *radiometric noise* shall be as given in Table 9 with the NEdT scaled at signal levels between black body temperatures 200K and 280K according to the *radiometric scaling function* and between black body temperatures 280K to 313K with a scaling factor of 1.

[EURD] IRS-04160 iss: 3A

The IRS *medium term radiometric stability* for a *spectral channel* shall be as per Table 9.

[EURD] IRS-04180 iss: 3A

The IRS *long term radiometric stability* for a *spectral channel* shall be as per Table 9.

[EURD] IRS-04200 iss: 3A

The IRS calibration system shall ensure that the *radiometric accuracy* is as per Table 9.

4.2.5 IRS Dataset Level 1 Spatial and Temporal Requirements

Unless otherwise stated the requirements in this section apply:

- to all *spectral samples* and *spectral channels*
- to all areas in the *coverage* of the *repeat cycle*,
- to all *repeat cycles* over each *MTG-S satellite nominal operational lifetime*,
- separately in N/S and E/W directions.

[EURD] IRS-04220 iss: 3A

The IRS *spatial sampling distance* (SSD) shall be as per Table 7.

[EURD] IRS-04230 iss: 4

For all IRS *spatial samples* of the *spectral channels* in the *wavenumber* range from 900 cm^{-1} to 2175 cm^{-1} the *integrated energy* (IE) shall be: over a square 4x4 km^2 shall be equal to or larger than 67%.

a) over a square 4x4 km^2 equal to or larger than 67%,

b) over a square 12x12 km^2 equal to or larger than 92%.

[EURD] IRS-04240 iss: 3A

The absolute value of the IRS *relative sample position error* (RSPE) between any two *spectral channels* shall meet the requirements in Table 10 when evaluated over a LAC.

Note: In the definition of RSPE r1=r2 for this requirement

***Table 10: IRS* Spectral Channel Relative Sample Position Error**

Channel Group	*Confidence Level*	*RSPE*
Channel to channel (within a *spectral band*)	68.26%	< 0.4 km
Channel to channel (between *spectral bands*)	68.26%	< 0.8 km

4.2.6 IRS Dataset Level 1 Geometric Requirements

Unless otherwise stated the requirements in this section apply:

- to all *spectral channels*
- to all areas in the *coverage* of the *repeat cycle*,
- to all *repeat cycles* over each *MTG-S satellite nominal operational lifetime*,

- separately in N/S and E/W directions.

[EURD] IRS-04250 iss: 4

The absolute value of the IRS *absolute sample position knowledge error* (ASPKE) shall be as given in Table 11 when evaluated over any *LAC zone*.

[EURD] IRS-04255 iss: 4

The absolute value of the IRS *absolute sample position knowledge error* (ASPKE) when evaluated over a single *dwell* shall be as given in Table 11.

[EURD] IRS-04260 iss: 3A

The absolute value of the IRS *relative sample position knowledge error* (RSPKE) shall be as given in Table 11, when evaluated over all *spatial samples* common between two *images* of the same *LAC zone* separated in time by twice the *repeat cycle*.

Note: In the definition of RSPKE k1=k2 for this requirement

Table 11: Geometric Quality Criteria

	Confidence Level	*Value*
ASPKE (*dwell*)	99.73%	<3.32 km
ASPKE (LAC)	99.73%	<2.37 km
RSPKE (between two LAC *images*)	99.73 %	<3.15 km

4.3 Lightning Data Acquisition and Generation Services

The Lightning Imager acquisition and generation has no MSG heritage. It provides a real time lightning location and detection (cloud-to-cloud and cloud-to-ground strokes, with no discrimination between the two types).

The LI is using *detector elements* arranged in a *detector array* covering the earth (no scanning mechanism). The power received by each *detector element* is integrated over the integration period and then compared with the *LI Trigger Threshold*. If the energy exceeds this threshold, it is identified as an *LI Triggered Event*.

The integration period is optimised to meet the Detection Efficiency (DE) and the False Alarm Rate (FAR) requirements, taking into consideration a typical stroke of 0.6 ms duration when observed from above.

During the ground *Level 0* to *Level 1* processing, the *LI triggered events* are filtered to minimise false alarms. In parallel the *LI background radiance images* are processed to improve the geolocation of the flashes.

4.3.1 LI Dataset Acquisition Requirements

[EURD] LI-06020 iss: 4

The Lightning Imager (LI) *coverage* shall contain at least the European territories of all the EUMETSAT member states and at least 84% of the visible earth disc (taken as a circle of 17.54° in diameter centred at SSP) when the *satellite* is within the *nominal longitude range*.

Note: The whole of Turkey is to be taken to lie within Europe for this definition. The *coverage* is to be achieved when the satellite is positioned at 0° longitude, with the requirement SYS-00130 not being applicable for the calculation of the *coverage*.

[EURD] LI-06040 iss: 4

The *LI triggered events* shall be obtained by measuring the *LI lightning spectral radiance* from the strongest lightning emission features within the cloud top optical spectra produced by the neutral oxygen atom lines in the near infrared.

Note: The OI(1) line at 777.4 nm made of three lines of nearly equal intensity with a total separation of 0.34 nm.

4.3.2 LI Dataset Quality Threshold

As defined in [CONV], the *quality threshold* is met when the requirements on *completeness*, *accuracy* and *timeliness* are fulfilled. The percentages of the *datasets* that meet the criteria threshold requirements (within *timeliness*) are addressed in the dissemination sections.

[EURD] LI-06060 iss: 3B

The LI *datasets* collected over 10 minutes shall be considered complete if all of the following requirements are fulfilled:

a) LI *dataset* acquisition requirements,

b) *LI detection efficiency* requirements.

Note: Deleted.

[EURD] LI-06080 iss: 3A

An LI *dataset* shall be considered accurate if all of the following requirements are fulfilled:

a) LI *dataset Level 1* radiometric requirements,

b) LI *dataset Level 1* spatial & temporal requirements,

c) LI *dataset Level 1* geometric requirements.

Note: Radiometric requirements are identified in LI-06100

4.3.3 LI Dataset Level 1 Radiometric Requirements

Unless otherwise stated the requirements in this section apply:

- for all illumination conditions,
- over each MTG-I *satellite specified lifetime*,

•for a 50% cloud cover of the earth,
•for an average cloud *reflectance* at TOA of 80%.

[EURD] LI-06090 iss: 3B

For any *lightning pulse* characterised by:

- a duration longer than 0.6ms, and
- a size larger than a circle of 10km diameter, and
- an energy density higher than 16.7 $mWm^{-2}sr^{-1}$ (day) or 6.7 $mWm^{-2}sr^{-1}$ (night),

the LI shall transmit to the ground:

all the *LI triggered events* with a Detection Efficiency (DE) better than

a) 90% at 45°N latitude, SSP longitude
b) 70% in average over the whole instrument *coverage* area

[EURD] LI-06100 iss: 4

The LI shall provide the *lightning event radiance* measured from the *LI lightning spectral radiance* specified in LI-06040, over the full range from 6.7 to 670 $mWm^{-2}sr^{-1}$, with an error (at 1σ) less than:

a) 10% relative accuracy for *radiances* higher than 70 $mWm^{-2}sr^{-1}$
b) 7 $mWm^{-2}sr^{-1}$ absolute accuracy for *radiances* lower than 70 $mWm^{-2}sr^{-1}$

4.3.4 LI Dataset Level 1 Spatial and Temporal Requirements

[EURD] LI-06120 iss: 4

The LI shall provide a spatial sampling less than or equal to 10km at 45°N for the sub-satellite longitude.

4.3.5 LI Dataset Level 1 Geometric Requirements

[EURD] LI-06140 iss: 3A

The absolute value of the LI *absolute sample position knowledge error* (ASPKE) evaluated over the complete *Full Disc Coverage* (FDC) shall be less than 4 km (112 µrad) at SSP, at a 99.73% confidence level.

4.4 UVN-Copernicus Data Acquisition and Generation Services

Observation of ultraviolet and visible and near-infrared radiation will be provided by MTG through measurements made with a dedicated instrument (UVN *payload*), that will be the GEO part of the Sentinel 4/5 System provided by EC and ESA. The UVN observations are used to measure several trace gas species (O3, NO2, SO2, HCHO, CHOCHO), and gain information on aerosols, clouds and the Earth surface.

The UVN is specified and developed in context of an ESA programme. This section can therefore not contain EUMETSAT requirements on the instrument, but rather reflects the current understanding of expected UVN performance as well as requirements on the ground segment to support its operations. Details on UVN instrument requirements can be found in [KOP_S4-5].

4.4.1 UVN Sounding performances

In its nominal mode, the UVN data acquisition service will provide data over the Geographical *Coverage* Area (GCA) specified in Figure 11. The nominal GCA will comprise the longitude range from 30°W to 45°E at latitude 40°N. The nominal repeat cycle of 1 h will correspond to a longitude range of 55° at 40°N indicated as the Reference Area (RA). The RA is positioned at the easternmost point in the GCA during the morning and is moved westward to follow the solar illumination of the GCA during the day. The scan will be performed from East to West.

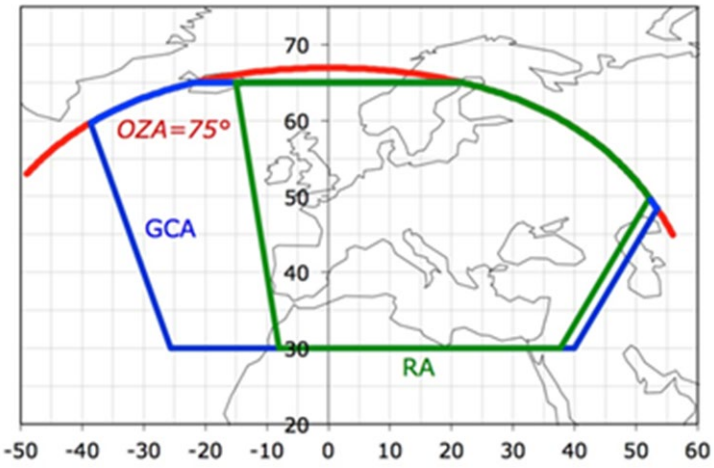


Figure 11: Geographical Coverage Area (blue curve); Reference Area (green curve); OZA=75º (red curve)

4.4.2 UVN Spatial resolution and geometric quality performances

The spatial sampling distance at 45N latitude, 0E longitude of UVN measurements, in both N-S and E-W directions, will be smaller than or equal to 8 km.

4.4.3 UVN Spectral measurements and quality performances

Table 12: Spectral bands and performances for GEO-UVN.

Band ID	*Spectral range [nm]*	*Spectral resolution [nm]*	*Spectral sampling ratio*
UV	305-400	0.5	3
VIS	400-500	0.5	3
NIR	750-775	0.5 (Threshold),	3

		0.2 (Breakthrough) 0.12 (Goal)	

The UVN sounder will cover the spectral bands according to the ranges as specified in Table 12.

The spectral resolution will be smaller than or equal to the values specified in Table 12.

The spectral sampling ratio will be larger than or equal to the values specified in Table 12.

The position of the *spectral channels* centres in Earth spectral radiance mode for all samples acquired between two consecutive solar measurements will not vary by more than 0.01 (UV-VIS) and 0.05 (NIR) of the spectral sampling interval (SSI).

4.4.4 UVN Radiometric performances

The SNR of the spectral channels for (Earth) radiance and reflectance measurements will be larger than or equal to the values specified in Table 13.

Note: this performance estimate applies per spectral resolution element.

Table 13: Radiometric performances (per spectral resolution element) for GEO-UVN.

Wavelength [nm]	*SNR*	
	Threshold	Goal
305	160	200
310	320	400
315	630	700
320	900	
350	1040	
400	1240	1800
450	1440	1800
500	1440	1800
750	250 at 0.5nm 130 at 0.2nm 85 at 0.12nm	1200 at 0.5nm 700 at 0.2nm 566 at 0.12nm

The absolute *radiometric accuracy* of the Earth spectral *radiance* (resp. *reflectance*) in any *spectral channel* of centre λi is smaller than:

- UV-VIS: MAX [2% Sref(λo) , 5% S(λi)] (threshold), MAX [0.5% Sref(λo) , 2% S(λi)] (goal).
- NIR: MAX [1% Sref(λo), 5% S(λi)] (threshold), MAX [1% Sref(λo) , 2% S(λi)] (goal).

The relative spatial radiometric accuracy of the (Earth) radiance and reflectance measurements will be smaller than 0.25% (1σ).

4.4.5 Data navigation and registration performances

The knowledge of the navigation information is better than

•Over land: 0.1 (Goal)/ 0.2 (Threshold) SSD (1-sigma).

•Over ocean: 0.5 SSD (1-sigma).

Interband spatial co-registration knowledge between bands will be better than 0.2 SSD between NIR and the UV and VIS bands; and 0.1 SSD between the UV and VIS band.

The inter-channel (intra-band) spatial co-registration within each band will be better than 10% of SSD.

4.5 *Level 2* Product Generation Services

In order to provide continuity to the present Meteosat Second Generation (MSG) programme and its set of derived products, the extraction of *Level 2 product(s)* is also foreseen as a key service for MTG.

The list of products to be generated from the MTG missions, the respective generation philosophies, and the decision where each product is generated (at the EUMETSAT Headquarter or within the SAF network) are decisions taken by Council following the established process as described below.

For the *Level 2* products generated at the Headquarter, the process for preparing these decisions include the consultation of the STG-SWG and OPS-WG before being presented to STG and approved by Council. For the SAF network, the decisions are taken in the context of the CDOP approval by Council of the SAF proposals and also by subsequent decisions of SAF SGs, as SAF plans evolve in response to user requirements.

4.5.1 *Level 2* Product Generation at EUMETSAT HQ

[EURD] MET-08020 iss: 4

The *Level 2 Products* generation service at EUMETSAT Headquarters shall provide a continuity of service between MSG and MTG concerning the *Level 2 Products* generated, albeit with improved quality, resolution, *timeliness* and new *Level 2 Products*, as defined in [MTGDIS].

Note: [MTGDIS] is reviewed and approved by delegate bodies.

[EURD] MET-08040 iss: 4

Deleted

4.5.2 *Level 2 Product(s)* Product Generation by the SAFs

The Satellite Application Facilities (SAFs) use specialised expertise in Member States, to complement the production of *Level 2 product(s)* at EUMETSAT's HQ.

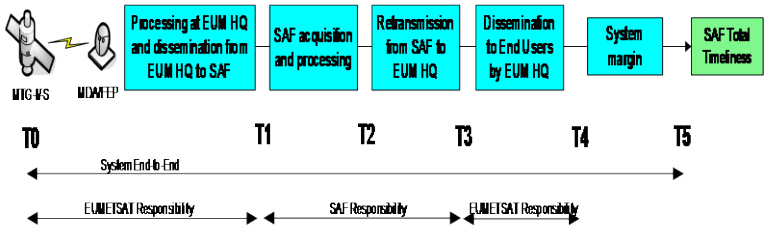
The SAFs also supply software packages for generating products at the end-users' own sites or generate additional products which may be fed or not into EUMETSAT's dissemination infrastructure.

As is the case for the centrally generated *Level 2 product(s)*, the SAFs ensure a continuity of service between MSG and MTG while new MTG specific products are developed.

The *operational availability* requirements that apply to product generation at the SAF are to be agreed between EUMETSAT and the SAFs.

The timeliness apportionment for SAF products is calculated such that for the end-users, the timeliness is comparable to centrally generated products.

The following diagram is showing the apportionment of the activities required for providing SAF products to the final users.



The timeliness depends on the characteristics of the product, in particular its periodicity.

The following tables are showing the allocation of the end-to-end timeliness to the various contributors according to SAF categories. Like for any other L1 and L2 products, details per product are recorded in [MTGDIS] §5.1.3

Table 14: FCI based SAF products

FCI based SAF products					
Product Generation Frequency	**T0 to T5 timeliness (end to end**	**T0 to T1 Processing level 1 at EUMETSAT**	**T1 to T3 Timeliness SAF acquisition, processing and SAF to EUM HQ transmission**	**T3 to T4 Timeliness for SAF retransmission to End Users (applicable at product level**	**T4 to T5 System Margin**
Less than hourly	45 mn	15 mn	15 mn	10 mn	5 mn
Hourly products	90 mn	15 mn	35 mn	20 mn	20 mn
3 hourly or more	180 mn	15 mn	65 mn	60 mn	40 mn

Table 15: LI based SAF products

LI based SAF products				
T0 to T5 timeliness (end to end)	**T0 to T1 Processing level 1 at EUMETSAT**	**T1 to T3 Timeliness SAF acquisition, processing and SAF to EUM HQ**	**T3 to T4 Timeliness for SAF retransmission to End Users**	**T4 to T5 System Margin**

		transmission	**(applicable at product level)**	
20 mn	2 mn	7 mn	10 mn	1 mn

Table 16: UVN based SAF products

UVN based SAF products				
T0 to T5 timeliness (end to end	**T0 to T1 Processing level 1 at EUMETSAT**	**T1 to T3 Timeliness SAF acquisition, processing and SAF to EUM HQ transmission**	**T3 to T4 Timeliness for SAF retransmission to End Users (applicable at product level)**	**T4 to T5 System Margin**
120 mn	60 mn	35 mn	20 mn	5 mn

Note 1: The T1 to T3 Timeliness include a tentative allocation of 5 min for SAF to EUM HQ transmission

Note 2: Timeliness for FCI based products is calculated on a repeat cycle basis

Note 3: Timeliness for LI is calculated per chunk of ca 10s.

Note 4: Timeliness for UVN based products is calculated on a chunk / granule.

Note 5: Timeliness for LI initial processing is 2mn specified with a 30s goal as per DIS-14220. See also note 2 of this requirement. For T0 to T5, the product timeliness is documented in [MTGDIS] and is the reference for the end to end operational validation of SAF MTG products

Note 6: The SAF system provides the catalogue update to MME-DAC (for archiving) within a day of the products generation.

[EURD] MET-08060 iss: 4

The *Level 2 Products* generation service by the SAF shall provide a continuity of service between MSG and MTG concerning the *Level 2 Products* generated, albeit with improved quality, resolution, *timeliness* and new *Level 2 Products* as defined in [MTGDIS].

Note: [MTGDIS] is reviewed and approved by delegate bodies.

[EURD] MET-08080 iss: 4

Deleted

[EURD] MET-08090 iss: 4

The *operational availability* for the SAF acquisition, processing and SAF to EUM HQ transmission shall be 98% within the *timeliness* defined in Table 14, Table 15 and Table 16 in the column T1 to T3.

Note 1: This is verified by each SAF individually. *Operational availability*, *timeliness* and the calculation method are defined in [EURD] annex F.

Note 2: The operational validation of the end to end performance (T0 – T5) is performed jointly by EUM and SAF against the thresholds values defined in the [MTGDIS], see also §5.

4.6 DCP Message Acquisition, Bulletin and Statistics Generation Services

The MTG Data Collection Platform (DCP) services involves, as a continuity of MSG service, the relay of *DCP messages* by the *satellite*, on-ground processing of the *digitised DCP spectrum* and dissemination of the resulting *DCP messages*, statistics and *DCP Bulletins* to end-users. The DCP platforms can be fixed on land or embarked on a buoy, ship, balloon or airborne.

Two types of DCP messages exist:

- self-timed messages: messages transmitted periodically within the allocated time-slots,

- alert messages: special messages transmitted when the values of one or more measured parameters exceed predefined thresholds**.**

The performance monitoring of the DCP mission includes monitoring of the reception of DCP reference platforms and the quality and *timeliness* of DCP messages.

[EURD] DCP-10020 iss: 3A

In continuity of MSG, the system shall provide the following functionality for handling Data Collection Platform (DCP) messages:

a) Acquire data, via MTG-I *satellite* relay from registered DCPs for further distribution.

b) Monitor and derive statistics for each individual DCP (e.g. deviations from the nominal time slot and frequency channel allocation) and provide notification to the relevant DCP operator within 2 working days of any anomaly detected.

c) Provide real time indication on the quality of the signal.

d) Process DCP alert messages without waiting, for further distribution via EUMETCast and internet.

e) Create DCP bulletins from acquired DCP messages for further distribution.

Note: Deleted

4.7 Archiving Services

The *EUMETSAT Data Centre* (previously UMARF) provides long-term archiving and catalogue functions for all EUMETSAT programmes and projects. This section provides the requirements for the archiving. The retrieval requirements are provided in §6.

It is expected that the EUMETSAT existing multi-mission *EUMETSAT Data Centre* evolves to cope with the MTG needs.

The SAFs are each expected to have their own local archive for the SAF-generated products. However, some SAF-generated products may be transferred for archiving in the *EUMETSAT Data Centre*. In any case, each SAF makes available the catalogue of its own archive on the EUMETSAT Earth Observation Portal. In this way, it is possible for end-users to browse the catalogue of SAF-generated products, as well as all of the centrally stored mission data.

[EURD] ARC-12020 iss: 3A

The following *datasets* shall be archived and catalogued in the *EUMETSAT Data Centre* to allow later retrieval:

a) The *Level 0 datasets* received from EUMETSAT *satellites* including all *auxiliary data* necessary for reprocessing.

b) The *Level 1b* and *Level 1c disseminated dataset* which have been centrally generated.

c) The *Level 2 disseminated dataset* which have been centrally generated.

d) Selected SAF *Level 2 product(s)*.

e) Reprocessed *datasets* from *Level 1*, *Level 2* and selected SAF *Level 2 product(s)*.

f) *Verification* / *validation* data and products, including external data used for *verification* and *validation* purposes;

Note 1: Appendix B lists the archived *Level 1 datasets* at the time of publication of this document. They are identified in the column "*EUMETSAT Data Centre*".

[EURD] ARC-12040 iss: 3A

The MTG System shall include, for each SAF either:

a) the catalogue of products generated and archived by that SAF;

b) an interoperability mechanism which allows the access to the SAF product catalogue.

Note: Assuming that the catalogue is maintained by the SAF archiving centre and provided to EUMETSAT.

[EURD] ARC-12060 iss: 4

The MTG System shall ensure that mission related *datasets* shall be available in the *EUMETSAT Data Centre*, for later retrieval, with a *completeness* of 99%

[EURD] ARC-12120 iss: 3A

The *EUMETSAT Data Centre* archive and catalogue of all *archived dataset* elaborated from Meteosat First Generation (MOP/MTP), Meteosat Second Generation (MSG) *satellites*, and MTG shall be maintained over the lifetime of the MTG programme.

Note: The continuity of EPS archive has to be addressed by Post-EPS programme and the continuity of Jason archive has to be addressed by Jason follow-on programme.

[EURD] ARC-12140 iss: 3A

The MTG System shall allow reprocessing of any *archived dataset* to derive and archive new *datasets* or new versions of any *dataset* without impact on the nominal operational missions.

5 NEAR REAL TIME DATA DISSEMINATION AND RELAY SERVICES

The following near-real time dissemination and relay services are covered in the following sections:

- EUMETCast Services,
- RMDCN Dissemination Service (GTS),
- EUMETSAT Earth Observation Portal,
- Search & Rescue (SAR) Relay Service.

5.1 *EUMETCast* Dissemination Services

The *EUMETCast* Dissemination Services might in future consist out of a combination of different telecommunication means such as satellite and terrestrial links.

The assignment of a service to a delivery mechanism is flexible and depends on the geographical distribution and size of the user communities.

The split between them depends mostly on the amount of *datasets* to be delivered to users, with associated *timeliness* requirements taking into account their affordability to the users/member states.

Note: The need of different dissemination systems: EUMETCast over Europe and Africa and other distribution mechanism (Terrestrial, OLDA, GTS, MME-DAC, MME-MON) and the split between them depends mostly on the amount of datasets to be delivered to users, with associated timeliness requirements taking into account their affordability to the users/member states (main reason why there were two different dissemination methods in MTP and MSG). With the information at hand today, delivery of the full set of MTG datasets to all potential users at all potential locations might not be possible within the financial envelope of MTG (at least at the beginning of the programme).

The following main MTG *disseminated datasets* are expected to be delivered by *EUMETCast* (satellite or terrestrial):

- The radiometrically calibrated and geometrically rectified FCI *images* at reduced, normal or high spatial resolution and reduced or normal temporal resolution
- A compressed representation (e.g. Principal Components) of calibrated and geolocated IR sounder spectra
- Calibrated and geolocated UVN sounder *datasets*.
- *Level 2 Products* generated at EUMETSAT Head Quarters
- Data Collection Platforms *DCP Messages* and *DCP Bulletins*
- Selected SAF Products
- Service messages

•Encryption Control Information

The dissemination coverage is split in several zones (e.g. Europe, Africa, terrestrial…) and the exact content depends on the zone.

EUMETCast is also transmitting data from other internal programmes and is relaying as well data from third parties e.g. Foreign Satellite Data (FSD) and Meteorological Data Dissemination (MDD). Those are no more addressed in this document.

Table 17:* Operational Availability *within* timeliness *for EUMETCast dissemination

disseminated dataset	**operational availability** *(1)*	*End to end* **timeliness** *per product are defined in [MTGDIS] within the following constraints* ***(3)***	*Timeliness applies to:*
FCI Rectified *images*	95% with a goal of 98%		Repeat Cycle
Full Disc Scanning Service (FCI-FDSS)		15 mn with a goal of 10 mn	
Rapid Scanning Service (FCI-RSS)		5mn with a goal of 2.5mn	
FCI Level 2 Products	95% with a goal of 98%		Chunk level when existing otherwise to *Level 2 Product*
>=Daily products (e.g. CRM)		Half a day	
>=3-hourly products		60mn	
>=Hourly products		30mn	
< hourly		20mn	
DCP messages and DCP bulletins	95% with a goal of 98%		
Alert messages		3mn with a goal of 2mn	Message
Bulletins		10mn with a goal of 5mn	Last contributing message
IR Sounder *Level 1 dataset (principal components)*	95% with a goal of 98%	15 mn (see open issue in Section 1.5)	Dwell
IRS Level 2 Products	95% with a goal of 98%	30mn (see open issue in Section 1.5)	Chunk level when existing otherwise to *Level 2 Product*
S4/UVN sounder *Level 1 dataset*	95% with a goal of 98%	60mn	5 mn *data chunk*
S4/UVN sounder *Level 2 Product*	95% with a goal of 98%	60mn (120mn for day 2 *Level 2 Products*	5 mn *data chunk*
Lightning Group and	95% with a goal of	2mn with a goal of 30s	Flash

Flash product (5)	98%	(see open issue in §1.5)	
SAF Products	95% with a goal of 98%	See Section 4.5.2	Product
Service Messages	95% with a goal of 98%	60mn	Message

Note 1: Operational availability, timeliness and the calculation method are defined in [CONV]. A dataset arriving after the mentioned timeliness is not considered as available for the end-user. These figures apply as is to EUMETCast by Satellite. In the case of EUMETCast terrestrial, the network used has no formal Service Level Agreement (SLA), offering a best effort service. Thus its outages are classified as external outages and are not taken into account in the figures. When including the availability of the network, the achieved value of the EUMETCast terrestrial service is expected to be above 95%.

Note 2: Deleted

Note 3: The objective is to achieve the goal during routine operations. This implies that the initial MTG System and its operation are designed to achieve the goal. The difference between the spec and the goal being a margin allowing some design optimisation and shared between system, ground segment and facilities. At system level the formal verification will consist in the assessment of the margin against the specified values. The operational system validation will be against the goal.

Note 4: Deleted

Note 5: The LI flash product is generated following level 2 processing and consists of LI triggered events clustered into LI groups associated with a particular lightning flash.

5.1.1 Data Delivered and Coverage

[EURD] DIS-14020 iss: 4

The *EUMETCast* Dissemination Services shall provide data to the following geographic regions with the following characteristics:

a) *EUMETCast* terrestrial services for pre-defined users.

b) *EUMETCast* Satellite service over Europe.

c) *EUMETCast* Satellite service over Africa.

d) Deleted

Note 1: Deleted

[EURD] DIS-14040 iss: 4

The list and periodicity of *disseminated dataset* transmitted by EUMETCast, for each of the geographic regions, shall be as defined in [MTGDIS].

Note: The dissemination of IRS *level 2 products* for the LAC 1, 2 or 3 is not a condition for the entry into operational services of the other IRS based services.

Note 2: Deleted

[EURD] DIS-14045 iss: 4

Deleted

[EURD] DIS-14047 iss: 4

Deleted

[EURD] DIS-14048 iss: 4

The list, timeliness and periodicity of the datasets disseminated via the various dissemination mechanisms shall be configurable.

[EURD] DIS-14050 iss: 4

The IRS *disseminated dataset* shall consist of a number of principal component (PC) scores derived from the full set of *spectral channels*.

Note: To be based on the experience derived from IASI data distribution.

5.1.2 Dataset Operational Availability

[EURD] DIS-14060 iss: 3A

The *operational availability* of rectified images of the Full disc scanning service (FCI-FDSS) shall be as per Table 17.

[EURD] DIS-14080 iss: 3A

The *operational availability* of FCI *Level 2 product(s)* shall be as per Table 17.

[EURD] DIS-14100 iss: 4

Deleted

[EURD] DIS-14120 iss: 3A

The *operational availability* of DCP messages & bulletins shall be as per Table 17.

[EURD] DIS-14140 iss: 4

Deleted

[EURD] DIS-14160 iss: 3A

The *operational availability* of rectified images of the Rapid scanning service (FCI-RSS) shall be as per Table 17.

[EURD] DIS-14180 iss: 3A

The *operational availability* of IR sounder *dataset* shall be as per Table 17.

[EURD] DIS-14190 iss: 4

The *operational availability* of IRS *level 2 products* shall be as per Table 17.

[EURD] DIS-14200 iss: 3A

The *operational availability* of UVN sounder *dataset* shall be as per Table 17.

[EURD] DIS-14220 iss: 4

The *operational availability* of Lightning group and flash product shall be as per Table 17.

Note: During development phase, the design will be scrutinized. Should there be a risk that one minute is not achievable, the situation will be reported and reconsidered in particular at the CDR. During AIV and Commissioning, reasonable attempts will be made to tune the configuration parameters to try to improve the timeliness to achieve the 30s target (in particular over Europe). If not sufficient, bottleneck will be identified and a further design improvement will be considered taking benefit of technology evolution.

[EURD] DIS-14240 iss: 4

The *operational availability* of SAF Products shall be as per Table 17.

Note 1: The timeliness allocation for SAF Products dissemination is defined in §4.5.2.

5.2 RMDCN Dissemination Service

The Regional Meteorological Data Communication Network (RMDCN) is used by WMO Region VI to carry the following GTS traffic (within Europe):

- A subset of *Level 1* datasets,
- A subset of *Level 2 product(s)*,
- Data Collection Platforms (DCP) Bulletins,
- Service messages.

The Global Telecommunication System (GTS) of the WMO (World Meteorological Organisation) may further distribute these data to users which are not connected to the RMDCN.

An evolution of the GTS into the WMO Information System (WIS) is foreseen.

Table 18: Characteristics and* operational availability *within* timeliness *for RMDCN Dissemination

disseminated dataset	Operational Availability	Timeliness
Level 1 dataset	95% with a goal of 98%	1 hour
Level 2 product(s)	95% with a goal of 98%	1 hour
DCPs bulletins	95% with a goal of 98%	1 hour
Service Messages	95% with a goal of 98%	1 hour

Note: *Operational availability*, *timeliness* and the calculation method are defined in Annex C. A *dataset* arriving after the mentioned *timeliness* is not considered as available for the end-user.

5.2.1 Data Delivered (RMDCN)

[EURD] DIS-14250 iss: 4

The list, characteristics and periodicity of *disseminated datasets* transmitted via RMDCN shall be as defined in [MTGDIS].

Note 1: Deleted

Note 2: Deleted

[EURD] DIS-14260 iss: 4

Deleted

5.2.2 Dataset Operational Availability (RMDCN)

[EURD] DIS-14270 iss: 3B

The *operational availability* of *Level 1 datasets* shall be as per Table 18.

[EURD] DIS-14280 iss: 3A

The *operational availability* of *Level 2 product(s)* shall be as per Table 18.

[EURD] DIS-14300 iss: 3A

The *operational availability* of DCP bulletins shall be as per Table 18.

5.3 Search and Rescue (SAR) Relay Service

Since MSG-1, every METEOSAT *satellite* carries a Search and Rescue (SAR) transponder for relay of 406 MHz beacons activated anywhere in its *field of view*. This secondary mission means that the *satellite* is part of the constellation of *satellite*s that constitutes the space segment of the Cospas-Sarsat international system, whose aim is to provide distress alert and location information to appropriate rescue authorities for maritime, aviation and land users in distress.

A detailed description of the SAR system can be found at [www.cospas-sarsat.org]

[EURD] DIS-14340 iss: 3A

The MTG System shall support the SAR mission by accommodating a *satellite* repeater, on each MTG-I, between the SAR distress beacons and the SAR receive ground stations, as long as this is not to the detriment of the other missions.

[EURD] DIS-14360 iss: 3A

The *operational availability* of the *satellite* SAR repeater shall be better than 99%.

Note: Achieved when considering two MTG-I satellites in orbit. Otherwise redundancy is ensured via Cospas-Sarsat satellites overlapping.

5.4 Section deleted

The retrieval of data via internet is now merged into §6 Data Retrieval Services.

[EURD] DIS-14380	iss: 4
Deleted	
[EURD] DIS-14390	iss: 4
Deleted	
[EURD] DIS-14400	iss: 4
Deleted	
[EURD] DIS-14420	iss: 4
Deleted	
[EURD] DIS-14440	iss: 4
Deleted	

6 DATA RETRIEVAL SERVICES

EUMETSAT provides Data Retrieval services as part of the multi-mission *EUMETSAT Data Centre* and internet downloading services which allow:

- for authorised users to retrieve recent centrally *disseminated datasets*;
- for the DCP operators to retrieve their own *DCP messages* and information about the operational status of their DCP platforms including statistics on the performance of the DCP system;
- for authorised users, to retrieve the *archived datasets*;
- for the general public, via the EUMETSAT website, to retrieve some *dataset* (e.g. *Satellite Images* or animation).

The service allow the users to register, navigate through the catalogue of MTG data, retrieve historical scientific mission data, browse low to moderate resolution data/products, and request data. The *dataset* retrieval for off-line users is addressed in §7.4 Helpdesk service.

Registration is done via the EO Portal service described in §7.2. The Corporate web interface is addressed in §7.3.

[EURD] RET-16020 iss: 3A

The *EUMETSAT Data Centre archived dataset* and catalogue of all Meteosat programmes shall be available for retrieval by users over the lifetime of the MTG programme.

Note: For MTG, the *archived dataset* are defined in §4.7.

[EURD] RET-16040 iss: 3B

The *EUMETSAT Data Centre* archive user guide (EUMETSAT Archive User Guide (see [UG04]) shall be maintained, to describe the ordering mechanism and options including the available media, the delivery formats and other characteristics of the MTG *archived datasets* which can be retrieved.

Note 1: For *EUMETSAT Data Centre* supported service and performances, refer to publication in http://www.eumetsat.int..

Note 2: One of the supported format for *archived datasets* retrieval is the one currently used for dissemination.

Note 3: Minor differences are acceptable between what is disseminated and what is retrieved, as long as it is documented for End Users. Differences may relate to time ranges of data, subsetting, compression, etc.

[EURD] RET-16080 iss: 3A

The *operational availability*, with a *timeliness* of 1 hour, of *disseminated dataset* for retrieval by End-Users shall be better than 99%.

7 USER SUPPORT SERVICES

The User Support Services are indispensable for enhancing the usage and reach of EUMETSAT *Datasets* and Services both within the EUMETSAT Member States as well as within the WMO Member States by:

- The distribution of information about the operational status of the systems and services.
- The provision of a centralised data access point (the Earth Observation Portal).
- The provision of Operational Programmes data content on EUMETSAT corporative web pages.
- The provision of a helpdesk function.
- The provision of training.

The User support services are capable of providing general, descriptive and expert information about the MTG and its mission data, products and services, both routinely and in response to requests.

7.1 Operational information dissemination service

Depending on the context and urgency, the following Service Messages concerning the operational services are provided to the users:

- Administrative - Summarising the service interruptions during the whole of the previous calendar day.
- News - Announcement of an interruption to services in real-time
- Weekly schedule - Announcement of scheduled service interruptions in the forthcoming week

[EURD] USR-18020 iss: 4

Service messages shall provide information on the status and planning of the MTG operational services, including regular administrative messages (historical information), news messages (on event occurrence) and scheduled service *outages* (one week in advance), via:

a) EUMETCast satellite Europe
b) EUMETCast satellite Africa
c) EUMETCast terrestrial
d) RMDCN/GTS dissemination.
e) User Notification e-mails.

Note: The service messages and their release conditions are described in Appendix A.

7.2 EUMETSAT EO Portal service

The EUMETSAT *Earth Observation Portal* is a component of the *multi-mission element Data Centre* which provides to the users a single online access point to all data and

dissemination services including the supporting user administration functions. It allows users, taking into account [DATAPO], to:

•Discover the collection of *datasets* (e.g. *image*, *Level 2 Products*, Level 3 Products, SAF) and related services for EUMETSAT data and partners;

•Search for and order of specific instances of EUMETSAT *archived datasets* (see §6) and of external partners (WMO, NOAA, ESA, CNES...);

•Subscribe to EUMETSAT or external partners dissemination services;

•Subscribe to User Notification Services (UNS).

•Access to service-related documentation, and appropriate links to information available on EUMETSAT internet.

It also allows partner agencies to discover, search, order and subscribe to EUMETSAT data and dissemination services through their own portal.

It federates with a common interface the following operational services:

•Subscription to the real-time dissemination services:

•Satellite Direct Dissemination services (for MSG only);

•Satellite broadcast services (e.g. EUMETCast);

•Network dissemination services: via RMDCN, GTS and WIS,

•Internet retrieval services (e.g. *images*, DCP downloading);

•*EUMETSAT Data Centre* Retrieval services including catalogue searching and ordering services;

•Archive Direct services (for MTP only);

•User Notification Services (UNS).

[EURD] USR-18040 iss: 3A

MTG Mission *archived dataset* and services shall be discoverable by users through the EUMETSAT Earth Observation Portal.

[EURD] USR-18060 iss: 3A

Users shall be able to search, order, and retrieve MTG *archived datasets* through the EUMETSAT *Earth Observation Portal*.

[EURD] USR-18080 iss: 3A

Users shall be able to register to MTG services through the EUMETSAT Earth Observation Portal.

Note: For description of EO portal functions and performances refer to http://www.eumetsat.int .

[EURD] USR-18090 iss: 3A

Users shall be able to retrieve all the information necessary to read and display *archived datasets* and *disseminated datasets*.

Note: This includes pseudo code where appropriate, documentation, user guides...

7.3 Web Information

[EURD] USR-18100 iss: 3A

Through EUMETSAT Corporative web interface, using a browser, any anonymous user shall be able to retrieve:

a) Information about the MTG programme, data, documentation, services and status;

b) A subset of MTG sub sampled images.

7.4 Helpdesk Services

A significant part of these services are available on-line (through the EO portal (see §7.2) and the internet web pages (§7.3)). However some users may not have a proper internet access and thus an alternative way is provided here.

A helpdesk service is provided to:

•respond to user requests for the provision of user documentation to assist in the full exploitation of the operational services (as an alternative to the on-line access);
•respond to general queries or complaints about the operational services;
•respond to off-line user requests for *archived dataset* retrieval or dissemination subscription (as an alternative to the on-line access);
•respond to user requests for licenses and decryption units for nonessential services (as an alternative to the on-line access);
•respond to requests for admission to the Data Collection Service (as an alternative to the on-line access);
•respond to requests for the certification of Data Collection Platforms;
•maintain a register of users of the operational services (as an alternative to the on-line access);
The response time of the Helpdesk Function depends on whether the user request involves a bespoke response or an off-the-shelf response (e.g. one which can be found on the EO portal).

[EURD] USR-18120 iss: 3A

Multiprogramme and Corporative wide Help desk capabilities shall be upgraded to extend its service and coverage to MTG.

7.5 User Training

The scope of user training provided covers the following:

- provision of classroom workshops to National Meteorological Services (NMS'), to assist them in the optimisation of satellite-data usage for current operational services and transition to future ones
- provision of information to NMS' and other user groups, to assist in the development of EPS, MSG and MTG applications
- facilitation in the generation of further Computer Aided Learning modules (CAL - e.g. ASMET, EUMeTRAIN etc.)
- co-operation in international training activities on satellite meteorology and remote sensing for the GEO societal benefit areas, in the framework of EUMETCAL and the WMO Virtual Laboratory for education and training
- support of training courses in Africa and other WMO regions, with the aim of establishing discussions/cooperation (between users of EUMETSAT data), using the WMO Virtual Laboratory focus group mechanism.
- organisation of Graduate Trainee Fellowships
- organisation of Training Placements (in accordance with Council decision)

EUMETSAT commitments concerning training will be extended to cover MTG data use and will be defined for agreement with Council.

8 DATA POLICY

When delivering the services, the EUMETSAT [DATAPO] and the Sentinel-4 [DATAPO-S4] data policies are taken into account.

Annex AService Message Baseline

Service message types and their schedule of dissemination are as follows:

Type	*Schedule*			*Description*
	EUMETCast	**RMDCN**	**MTG specific service message**	
ADMIN	- Updated every day in the morning, - Closed, every 15 minutes - Open, every 30 minutes	N/A	Updated every day	Service details for the previous calendar day (24 hours). This message contains: - Sections for open and closed related information. - *datasets* - Non available *repeat cycles*
NEWS	Once, at the time of problem detection			The news message is used to inform users in real time of problems that have occurred, issuing further messages when problems are resolved.
REG-RPT	Updated weekly every Thursday, disseminated once per day			This report contains scheduled announcements for the following week.

Annex B MTG Level 1 datasets generation and dissemination baseline

The MTG *Level 1 Datasets* generation and dissemination baseline is provided in [MTGDIS].

Annex CCONVENTIONS and TERMS

The following text lists definitions for all *reserved terms* used in this document. It is a subset of the "MTG Conventions and Terms" document. The section numbers below are the original section numbers from this document.

C.1 [EURD] specific conventions and terms

LI lightning spectral radiance

The LI lightning spectral radiance is the lightning optical pulse radiance as measured by the LI instrument in orbit.

The LI lightning spectral radiance is defined as the spectral radiance from the triplet of emission lines from the 3p 5P1,2,3 -> 3s 5S2 transitions of neutral atomic oxygen, with the following spectral characteristics:

1. Wavelengths of the emission peaks at 777.408 nm, 777.631 nm and 777.753 nm vacuum wavelengths (see Table 1).
2. Peak intensities of the three spectral lines according to the oscillator strengths specified in Table 1, where it shall be assumed that the relative emission strength of the lines depends linearly on the oscillator strength f (dimensionless number).
3. Line widths (full width at half maximum) of each of the three spectral lines is 0.1 nm.
4. Each of the three spectral lines is a Gaussian.

More details about these emission lines are provided in Table 1.

Wavelength in vacuum [nm]	**Oscillator strength f [dimensionless]**	***E_i*** **[cm^{-1}]**	***E_k*** **[cm^{-1}]**	**Lower Level Conf., Term, J**	**Upper Level Conf., Term, J**
777.408	0.45	73 768.200	86 631.454	$2s^2 2p^3(^4S°)3s,^5S°,J=2$	$2s^2 2p^3(^4S°)3p,^5P,J=3$
777.631	0.32	73 768.200	86 627.778	$2s^2 2p^3(^4S°)3s,^5S°,J=2$	$2s^2 2p^3(^4S°)3p,^5P,J=2$
777.753	0.19	73 768.200	86 625.757	$2s^2 2p^3(^4S°)3s,^5S°,J=2$	$2s^2 2p^3(^4S°)3p,^5P,J=1$

Notes:

1. E_i and E_k are the atomic oxygen energy levels from which the transition wavelengths are derived.

2. The two rightmost columns provide background information on the oxygen energy levels and spin states.

Table 1: Spectral characteristics of the 3p 5P1,2,3 -> 3s 5S2 transitions in neutral atomic oxygen.

C.2 Programme wide conventions and terms

Annex F.2 MTG Naming Conventions

The MTG space segment elements (MTG *satellites*) are named according to their type and launch sequence as:

[Conventions and Terms] MTG-I1 iss: 3B

- The first *MTG-I satellite* launched.

[Conventions and Terms] MTG-I2 iss: 3B

- The second *MTG-I satellite* launched.

[Conventions and Terms] MTG-I3 iss: 3B

- The third *MTG-I satellite* launched.

[Conventions and Terms] MTG-I4 iss: 3B

- The fourth *MTG-I satellite* launched.

[Conventions and Terms] MTG-S1 iss: 3B

- The first *MTG-S satellite* launched.

[Conventions and Terms] MTG-S2 iss: 3B

- The second *MTG-S satellite* launched.

[Conventions and Terms] MTG-I iss: 3B

Any imaging *satellite* of the series (*MTG-I1*, *MTG-I2*, *MTG-I3* or *MTG-I4*).

[Conventions and Terms] MTG-Siss: 3B

Any sounding *satellite* of the series (*MTG-S1*, *MTG-S2*).

[Conventions and Terms] reserved terms iss: 3B

It designates the terms defined in the Conventions and Terms document.

Annex F.3 System Wide Conventions

Annex F.3.1 Data Definition

[Conventions and Terms] Datasetiss: 3D

A dataset is a logical grouping of data e.g. it can be a packet, a subset of *image* or interferogram (group of related *spatial samples* or lines, *swath*, segment, *spectral sounding* information), *LI triggered events*, *LI group*, meteorological products, *DCP messages* or *DCP bulletins*... or a collection of the above over time (e.g. for climate related dataset).

[Conventions and Terms] Housekeeping Telemetryiss: 3D

Housekeeping telemetry (HKTM) is all the telemetry necessary to monitor the health and status of the *satellite* and transmitted through the S-band telemetry link.

Note: Data going exclusively via the *Payload* telemetry link does not qualify as *housekeeping telemetry*, but may be classed as *instrument auxiliary data* or *platform auxiliary data* or more generally as *satellite auxiliary data*

[Conventions and Terms] Payload Data iss: 4D

All the data transmitted via the payload telemetry link. After decryption and extraction of the packets from the frames the payload data is presented as:

- *instrument data*,
- *digitised DCP spectrum*,
- *Platform auxiliary data*,
- a copy of the *housekeeping telemetry*.

Note: Extraction of the packets from the transfer frames includes any necessary re-ordering and *consolidation*.

[Conventions and Terms] Instrument data iss: 3B

For each instrument, the instrument data is composed of:

- *science data* at *Level 0*,
- *Instrument auxiliary data*.

Note: Compression may apply according to the instrument design.

[Conventions and Terms] Digitised DCP Spectrum iss: 4G

See *Digitised DCP Signal*

[Conventions and Terms] Platform Auxiliary Data iss: 3D

Platform auxiliary data is any *auxiliary data* derived from *platform* equipments that is not transmitted as part of the *housekeeping telemetry*.

Note: Raw data coming from the AOCS is classed as platform auxiliary data, since it cannot be transmitted as part of the HKTM on the S-band telemetry link due to its volume or any other appropriate reason.

[Conventions and Terms] Science Data iss: 3B

The science data is the observation data originating from the instrument(s)/sensors, it applies at any *data level*.

Note: Earth location information is part of associated *auxiliary data*.

[Conventions and Terms] Instrument Auxiliary Data iss: 3B

Instrument auxiliary data is *auxiliary data* recording the internal parameters of an instrument as necessary for *instrument data processing*.

[Conventions and Terms] Auxiliary Data iss: 3B

Auxiliary data is any data that is neither *science data*, *Digitised DCP spectrum* nor *housekeeping telemetry*, used in or generated by *Instrument Data Processing* or *Application Ground Processing*. See also *instrument auxiliary data*, *platform auxiliary data*, *IDP auxiliary data*, *IQT auxiliary data*, *AGP auxiliary data*...

[Conventions and Terms] IDP Auxiliary Data iss: 3B

IDP auxiliary data is *auxiliary data* resulting from the *instrument data processing*.

Note: for example: radiometric and *spectral calibration* information, Earth location information, data derived from external sources and data quality metrics.

[Conventions and Terms] AGP Auxiliary Data iss: 3B

AGP Auxiliary Data is *auxiliary data* resulting from the *application ground processing*.

Note: for example: radiometric and *spectral calibration* information, earth location information, data derived from external sources and data quality metrics.

[Conventions and Terms] Disseminated Dataset iss: 3D

The Disseminated Dataset includes all the data disseminated in Near Real Time via the various dissemination mechanisms (e.g. *EUMETCast*, internet, GTS/RMDCN...).

Note: For *Level 1 dataset* and *Level 2 Product*, it contains all the information necessary for the user to:

- interpret the *science data* temporally, spatially, spectrally and radiometrically;

- be informed of the quality of the *science data*;

- be informed of the configuration of the *processing chain* (*satellite*, IDP, AGP).

[Conventions and Terms] Archived Dataset iss: 3D

The Archived Datasets includes all the data stored in the *Data Centre* and retrievable by internal or external users.

[Conventions and Terms] Level 1 Dataset iss: 4I

The Level 1 dataset consists of the *science data* at *level 1* and the *IDP auxiliary data* nominally collected during one *repeat cycle* or *accumulation interval*.

Note: It is composed of one or more *data chunks* (for processing) or *data segments* (for dissemination)

[Conventions and Terms] Level 2 Product iss: 4I

The Level 2 Products consists of the *science data* at *level 2* and the *AGP auxiliary data* nominally collected during the product time span (e.g. one or several *repeat cycles*).

[Conventions and Terms] DCP Messages iss: 3D

Messages sent by DCP platforms containing measured meteorological information. Two types of DCP messages exist, the self-timed messages: messages transmitted periodically within the allocated time-slots and the alert messages which are special messages transmitted when the values of one or more measured parameters exceed predefined thresholds**.**

[Conventions and Terms] DCP Bulletins iss: 3D

DCP Bulletins are generated from one or more *DCP Messages* conforming to the WMO Manual on Codes depending on their contents and dissemination formats.

[Conventions and Terms] External Data iss: 3D

The External Data are those necessary for the *Level 1* and *Level 2* (re-)processing (include forecast data, observation data, calibration data) or for relaying by *EUMETCast* (e.g. MDD).

[Conventions and Terms] IQT Auxiliary Data iss: 3B

The IQT auxiliary data is the additional data produced by the IQT at the same time as the *level 1 science data* allowing the interpretation of the *science data* and providing the *satellite* and IQT model status.

Note: This excludes the off-line *IQT performance assessment data*.

Annex F.3.3 Operational availability

[Conventions and Terms] Operational availability iss: 4D

The ratio of the *datasets* “received” and that meet the *Quality threshold*, with that scheduled to have been “sent” or ”made available", for a given period (removing the part of the period corresponding to the *scheduled outages* and the *external outages*).

Note 1: Implicitly it is a measurement of *unscheduled outages* due to either space or ground segment problems.

Note 2: By removing the "seasonal effect" (the *scheduled outage*), the obtained performance can be compared over time to detect any degradation of the service.

Note 3: For the End-users, it is calculated across a complete chain, for example for *images*, from data acquisition by the Meteosat *satellite* until reception by the User.

Note 4: A *dataset* is deemed "received" if at least one representative user stations / receiver terminals has received it.

Note 5: Unless otherwise specified, the *operational availability* is calculated over a calendar month.

Note 6: The *Scheduled outages* have to be announced to the end-user through the weekly schedule message.

Note 7: It is also used to derive the contributions of the off-line functions to service to end-users.

[Conventions and Terms] Outage iss: 3B

Outages are defined as "the state of an item of being unable to perform its required function or performances". Outages can be *scheduled outage*, *unscheduled outage* or *external outage*.

[Conventions and Terms] Satellite Availability iss: 3D

Satellite availability is defined as the percentage of the time during which the *Satellite* provides all the required *payload data*, with *Quality threshold* being met. All sources of *outages* have to be considered. It has to include the allowance for response from the ground as defined in [SRD]/[OBRD].

Note: The sources of *outage* to be considered are those at satellite level.

Annex F.3.3.1 Quality Threshold (Completeness, Accuracy, Timeliness)

[Conventions and Terms] Quality threshold iss: 3B

The Quality threshold is met when the requirements on *Completeness*, *Accuracy* and *Timeliness* are fulfilled.

Note: This implies that a short *outage* preventing a *repeat cycle* to be completed on time has to be considered as an *outage* of the whole *repeat cycle*.

[Conventions and Terms] Completeness iss: 3D

A *dataset* is complete if no data has been lost since its generation, unless a requirement in the product specification or service specification allows some losses (e.g. *missing samples*).

Note 1: service specification only applies at system and ground segment level, not at *satellite* level. Product is used in the sense of the ECSS.

Note 2: For example for *Level 1* dissemination this means that no data is missing during satellite sampling and any subsequent handling (downlink, *payload data* processing, dissemination) beyond what is specified in the [SRD].

[Conventions and Terms] Accuracy iss: 3D

The requirements on accuracy are *dataset* specific and provided in the product specification or service specification.

Note: service specification only applies at system and ground segment level, not at *satellite* level. Product is used in the sense of the ECSS.

[Conventions and Terms] Timeliness iss: 4F

The timeliness is the time difference between the foreseen end of acquisition of the last contributing data (e.g. from a sample, a *dwell*, a *swath*, granule, a segment, an *image*, a file) by EUMETSAT (at *satellite* level for Meteosat, Metop or at *Ground Segment* level for *external data* like FSD and SAF), and the end of reception of the corresponding data (possibly processed) by the users (i.e. before decryption and decompression).

Note 1: It excludes delay introduced by transmission lines and networks outside EUMETSAT control (e.g. internet, RMDCN, GTS, WIS). It excludes also the processing time outside EUMETSAT control (e.g. SAF processing time).

Note 2: It can also be applied at any level (*satellite*, ground segment, *facility*...) as long as the start point and end point are defined.

Annex F.3.3.2 Scheduled Outages

[Conventions and Terms] Scheduled Outage iss: 4D

The scheduled outages are due to planned operations or predictable events. At *satellite* level the specification limits these *outages* to 3% per year. Other scheduled *outages* are mainly due to planned ground segment maintenance and should be less than 0.5%.

Also, the quality of around 5% of the acquired *datasets* per year may be degraded for some channels during *eclipse* seasons.

The tentative list hereafter identifies the events leading to the *outage* or quality degradation and attempts to estimate their individual duration.

Planned operations or predictable events:

- *Satellite* orbit manoeuvres (e.g. *Station Keeping*) leading to a disturbance of the *satellite* attitude. The frequency of the *outages* depends on several parameters such as orbital position, *satellite* collocation strategy, *satellite* design and manoeuvre strategy. There can be up to a few tens of manoeuvres per year with the *outage* lasting up to three hours each time.
- *Satellite yaw-flip* leading to re-orientation of the *satellite* attitude and consequently to an interruption of the mission. This occurs twice a year and with the *outage* lasting up to half a day [TBC 1] each time.
- Instrument decontamination requires that the Infrared sensors are switched off, thus interrupting the imaging in these channels. The decontamination may also require interrupting/degrading the other channels (due to distortions introduced by the IR decontamination). *Outage* is typically one day once or twice per year, influence on other channels will be re-assessed once the *satellite* supplier / design is known.
- *Outage* due to wheel off-loading manoeuvres. Frequency and duration will be refined once the *platform* supplier / design is known.
- Sun, *satellite*, ground station co-linearity effect. When the Sun enters the main lobe of the ground station antenna, this may prevent the proper reception of the Ka-Band link. The co-linearity occurs twice a year around the Equinox seasons for around 10 days, impacting a few *repeat cycles* per day. The extend of the co-linearity effect will be re-assessed once the MDA sites and characteristics are known.
- The swap of a mission from one *satellite* to another (e.g. after the completion of *satellite commissioning* when the operational missions are transferred to a new *satellite*) will result in an *outage* of a few hours.
- The temporary swap of the full disc scanning service (FDSS) from the prime to the secondary imaging *satellite* and vice versa would result in an *outage* of a few hours on the FCI-FDSS at each swap and an *outage* of the Rapid Scanning Service (FCI-RSS) for the whole duration of the swap (e.g. during prime *satellite* decontamination, yaw flip manoeuvre).
- Some ground segment maintenance may not be achievable without service interruption (e.g. to swap between a prime and redundant service). These interruptions are sporadic over the year and their exact duration depends on the *disseminated dataset* and maintenance activity performed.
- Calibration / sun measurements
- Morning / evening sun illumination

Other images quality degradation:

- During the *eclipse* season the *dataset* quality will be degraded for some channels and/or a part of the *coverage*, however no interruption of the *dataset* acquisition and dissemination is foreseen. The quality degradation around the *eclipse* is primarily due to *stray light* and thermal effects. The degradation occurs typically for a few hours around midnight. There are 2 *eclipse* seasons per year, each lasting 42 days. The exact influence of the *stray light* on the *dataset* will be characterised in orbit, although the period of affected data will be predicted from on-ground analysis.

Annex F.3.3.3 Unscheduled Outages

[Conventions and Terms] Unscheduled Outage iss: 3B

This denotes all the unscheduled outages, thus a precise list cannot be made. The most common causes for the unscheduled outages are:

- Ground segment reconfiguration may cause *outages*, however such maintenance activities are normally scheduled in advance.
- Loss of communication links (e.g. between ground stations and headquarters).
- *Satellite* single event upset (SEU)
- *satellite* safe mode
- random *failures*
- any disasters or major events outside EUMETSAT's control.

Annex F.3.3.4 Outages outside EUMETSAT control

[Conventions and Terms] External outage iss: 5

This term groups all the *outages* outside EUMETSAT control, thus a precise list cannot be made. The most common causes for the *outages* outside the control of EUMETSAT are:

- Networks outside EUMETSAT responsibility, which in this context are networks that are not managed by EUMETSAT or for which no Service Level Agreement (SLA) exists (for instance RMDCN, GTS, Internet, GEANT.)
- *External data* unavailability (e.g. Meteorological Data Dissemination (MDD), Foreign Satellite Data (FSD), incoming forecast data...).
- Effect of lack of redundancy of the space segment (i.e. only one *satellite* in orbit).
- Unavailability of DCP beacons and SAR beacons, or those working outside specification.
- Interface with ESA S4 Mission Management.

Annex F.3.7 Lifetime

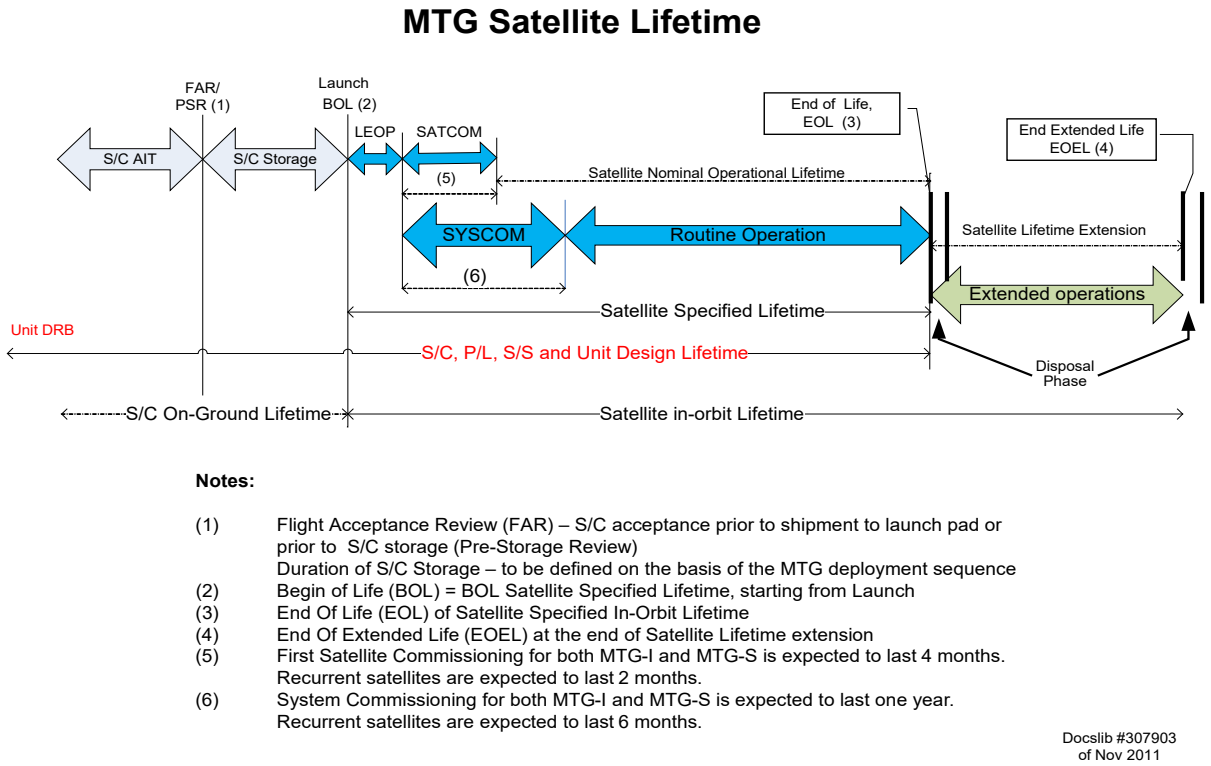


Figure 12: MTG satellite Lifetime

[Conventions and Terms] Satellite Specified Lifetime iss: 3G

The Satellite Specified Lifetime is defined as the time in orbit from separation from the launch vehicle to satellite re-orbiting as depicted in Figure 1.

[Conventions and Terms] Satellite Nominal Operational Lifetime iss: 3D

The satellite nominal operational lifetime is defined as the time in orbit over which the performances have to be met with a given *satellite availability* and excluding the time necessary for the execution of LEOP and *satellite commissioning* (see Figure 1).

Annex F.3.9 Space Segment related

[Conventions and Terms] Satellite iss: 3B

The word Satellite is used within MTG system to define a complete self standing subset of the MTG space segment, including *Platform* and *Payload* (observational instruments), all *Platform* and *Payload* supporting functionalities, and the interfaces to the external environment. Two types of *'satellite'* are foreseen in the MTG system, the *MTG-I* and the *MTG-S*.

[Conventions and Terms] Platform iss: 3B

The part of the *satellite* excluding the *payload*. The '*platform*' provides all the resources, functionalities and performances necessary to support the nominal and contingency operation of the *payload*.

[Conventions and Terms] Payload iss: 3B

The parts of the *satellite* used to acquire the data that will generate the mission products.

Note: For MTG the *payload* comprises FCI, IRS, LI, UVN, DCP and SAR when embarked on their respective *satellites*.

[Conventions and Terms] Consumable iss: 3B

A *satellite* item that can be physically depleted after a given period of time. Applies e.g. to propellant.

[Conventions and Terms] Ranging iss: 5A

Orbit determination of a spacecraft requires as input measurements that are related to the *satellite*'s position and velocity.

The classical two-way radar ranging employs a ranging signal that is radiated from the ground station to the *satellite*. A *satellite* transponder is required to receive the signal and to transmit it back to the ground station. The ground station receives the transponder ranging signal from the *satellite* and determines the signal travel time T. This is expressed as an equivalent range value R= cT, which is equal to the sum of the uplink and downlink distance.

There are basically two different techniques, see Figure 2, to generate ranging signals:

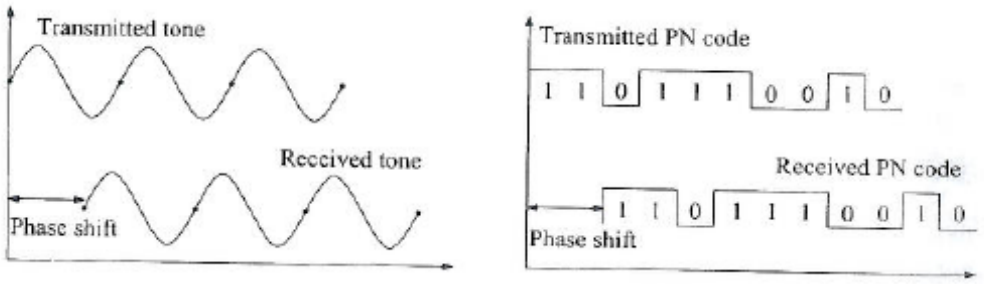


Figure 13: Principle of distance measurements using tone ranging (left) and code ranging (right)

[Conventions and Terms] Nominal longitude range iss: 3B

On the geostationary arc, with a longitude anywhere between 10°W and 10°E.

Note: This value is defined in the SRD requirement SYS-00630

Annex F.3.10 Ground Segment related

[Conventions and Terms] Ground Segment iss: 3D

The part of the MTG System that is on ground and encompasses all software and hardware resources (including communication) to enable operations of all in-orbit MTG *satellites*, interfacing with external entities (e.g. Launch provider, *satellite* manufacturer, ECMWF) and provision of the services to the end-users with high *operational availability*. It also encompasses additional resources enabling development, testing, *verification* and operational *validation* of software, hardware and configuration data, as well as operations preparation, training and performance analysis, in parallel to operations.

[Conventions and Terms] Instrument Data Processing iss: 3D

Instrument data processing (IDP) is the function that converts *instrument data* coming from the *satellites* into *level 1 datasets*.

[Conventions and Terms] Application Ground Processing iss: 3D

Application Ground Processing is the combination of the central *Level 2 Processing* located at the EUMETSAT Headquarter and the decentralised Satellite Application Facilities (SAF).

[Conventions and Terms] Level 2 Processing iss: 3D

Level 2 Processing (L2P) is the function that converts *Level 1 Datasets* into *Level 2 Products*.

[Conventions and Terms] Data Centre iss: 3D

The Data Centre is a *Multi-Mission Element* (MME) composed of *UMARF*, *Earth Observation Portal* and *GSICS server*.

[Conventions and Terms] EUMETSAT Data Centre iss: 3B

see *Data Centre*

[Conventions and Terms] UMARF iss: 3D

Data Centre component that receives and archives *datasets* at *level 0*, *level 1* and *level 2* together with *auxiliary data* and other associated data for all EUMETSAT *satellites* in view of deferred retrievals. The archiving process is automated, and is carried out 24 hours a day, every day of the year.

[Conventions and Terms] Earth Observation Portaliss: 3D

Data Centre component that provides a comprehensive data retrieval service including On-line access (via internet) to the *archived dataset* catalogues and other information on the archive. The EUMETSAT EO Portal provides means to discover the *archived dataset* collections, navigate and query the MTG catalogue. The retrieved *archived datasets* can be tailored (e.g. spectral and spatial sub-setting) prior to media / online *dataset* delivery.

The service includes administration functions with end-user interface (User Management and licensing, Help-desk, information Service, ordering, subscription, etc.).

[Conventions and Terms] GSICS server iss: 3D

Data Centre component. The GSICS data and products server is a platform for the inter-calibration of operational *satellite* sensors. The Global Space-based Inter-Calibration System (GSICS) is an international collaborative effort to examine and harmonize calibration data from operational weather *satellites* sensors to improve climate monitoring and weather forecasting.

[Conventions and Terms] EUMETCast iss: 3D

EUMETSAT's Broadcast System for Environmental Data is a *Multi-Mission Element* dissemination system based on standard Digital Video Broadcast (DVB) technology. It uses commercial telecommunication geostationary *satellites* to multicast files (e.g. *Level 1 dataset*, *Level 2 products*) to the user community.

Annex F.3.12 Process relevant

[Conventions and Terms] Commissioning iss: 4B

Verification and *validation* activities conducted after the launch and before the entry in operational service either on the space elements only or on the overall system (including the ground elements).

Note: As per ECSS-E-ST-10-02C

[Conventions and Terms] System commissioning iss: 3B

Commissioning of the overall system terminating with the closure of the System Commissioning Results Review (SCRR).

[Conventions and Terms] Satellite commissioning iss: 4B

A subset of the overall *system commissioning* focusing on the *satellite* aspects and terminating with the closure of the *satellite* Commissioning Result Review (CRR)

[Conventions and Terms] Verification iss: 4C

Confirmation through the provision of objective evidence that specified requirements have been fulfilled.

Note : As per ECSS-S-ST-00-01C.

[Conventions and Terms] Validation iss: 4B

Confirmation, through the provision of objective evidence that the requirements for a specific intended use or application have been fulfilled.

Note: As per ECSS-S-ST-00-01C.

Annex F.4 Observation Missions Conventions

Annex F.4.1 General

[Conventions and Terms] Centroid iss: 3B

The centroid is the generalized mathematical expression for quantities used in science and engineering such as centre of gravity, centre of mass and barycentre. The *centroid* of a function of N independent variables is the intersection of all hyperplanes that divide the function into two parts of equal moment. The co-ordinates of the centroid in terms of the independent variables is given by the equation:

$$\bar{x}_i = \frac{\int \ldots \int x_i . f(x_1, \ldots, x_N) dx_1 \ldots dx_N}{\int \ldots \int f(x_1, \ldots, x_N) dx_1 \ldots dx_N}$$

where

$\bar{x}_i$ is the centroid co-coordinate for independent variable x_i

x_i is the independent variable, with $1 \leq i \leq N$

$f(x_1, \ldots, x_N)$ is the dependent function

For example the *centroid* of a function with two independent variables is given by the equation:

$$\bar{x} = \frac{\iint x . f(x, y) dxdy}{\iint f(x, y) dxdy}$$

$$\bar{y} = \frac{\iint y . f(x, y) dxdy}{\iint f(x, y) dxdy}$$

where

$\bar{x}$, $\bar{y}$ are the centroid co-ordinates

x, y are the independent variables

$f(x,y)$ is the dependent function

[Conventions and Terms] Data Level iss: 3B

Data levels are used to describe the condition of the *science data* at various points in the ground processing cycle. The WMO lists the following data levels on their web site:

Level 0 - Raw data.

Level 1 - Data extracted by instrument, at full instrument pixel resolution, with Earth-location and calibration information.

Level 2 - Geophysical value (temperature, humidity, radiative flux…) at instrument pixel resolution.

Level 3 - Remapped (gridded) product based on geophysical value derived at instrument pixel resolution.

Level 4 - Composite product (multisource) or result of model analysis of lower level data.

For MTG the basic sense of WMO data levels is maintained, without the concept that the *science data* has to be at instrument *pixel* resolution. However, the WMO data sub-levels are not used. Enhancements of the data level definitions are given in the definitions of *level 0*, *level 1* data.

[Conventions and Terms] Level 0 iss: 3B

Level 0 data is the *science data* at packet level, after restoration of the packet-wise chronological data sequence for a given instrument.

[Conventions and Terms] Level 1 iss: 3D

Level 1 describes, for a given instrument, a variety of different data sub-levels that are related to *Instrument Data Processing* (IDP). Refer also to *level 1a*, *level 1b* and *level 1c*.

Note 1: Not all of the sub-levels will appear as an externally available *dataset* for each instrument and may remain internal to the *instrument data* processing process or not be generated.

Note 2: Earth-location and calibration information are treated as part of the *IDP auxiliary data* that will be disseminated and archived with the *level 1* data.

Note 3: A *radiance sample* appearing at *level 1b* can represent a measurement taken from an individual *detector element* or a combination of measurements derived from a group of *detector elements*. At *level 1b radiance samples* are associated with a particular *spatial sample*. The *spatial samples* may then be rectified to form *pixels* located at fixed positions in the *reference grid* giving the *level 1c* data.

[Conventions and Terms] Level 1a iss: 3B

Level 1a data is *level 0 science data* in counts after removal from the packets, whilst maintaining the spatio-temporal sequencing of the data.

[Conventions and Terms] Level 1b iss: 3B

Level 1b data is *level 1a science data* radiometrically and spectrally calibrated.

[Conventions and Terms] Level 1c iss: 3B

Level 1c data is *level 1b science data* rectified to a *reference grid*.

[Conventions and Terms] Level 2 iss: 3B

Level 2 relates to *level 1b* or *level 1c science data* converted to geophysical values (temperature, humidity, radiative flux…) during *application ground processing*.

[Conventions and Terms] Spatial Sampling Distance iss: 3B

The spatial sampling distance is the required *spatial sample* spacing and is used as a base unit against which geometric requirements are assessed. All requirements expressed in spatial sampling distance are taken to apply at the *sub-satellite point* and can be translated to a *spatial sampling angle* used to evaluate the requirement at all other positions in the area of *coverage*.

[Conventions and Terms] Spatial Sampling Angle iss: 3B

The angle subtended by the *spatial sampling distance* at the *Sub-Satellite Point* as seen from the *satellite*.

[Conventions and Terms] Sub-Satellite Point iss: 3B

The sub-satellite point (SSP) is the intersection by the line drawn from the *satellite* to the centre of the Earth with the surface of the <Earth's Reference Ellipsoid>.

[Conventions and Terms] Reference Grid iss: 3B

The reference grid defines the geo-referenced position of the *image pixel centroids* at *level 1c*.

The grid angles are defined, in terms of the *Normalized Geostationary Projection*, as follows:

- Rotation about the axis S_3 (λ_S);

- Rotation about the axis S_2' (φ_S), where S_2' lies in the S_1/S_2 plane at an angle λ_S from S_2 about the S_3 axis.

The grid steps are equiangular both in λ_S and φ_S and equal to the *spatial sampling angle* of the considered channel, Figure 3. The corresponding projected distance at the *sub-satellite point* is the *spatial sampling distance*.

For reference grids of differing resolutions the grids are aligned as given in Figure 4 i.e. the fine grid *pixel* centres are offset by half the smaller *spatial sampling angle* from the coarse grid *pixel* centres in both λ_S and φ_S.

See Figure 5.

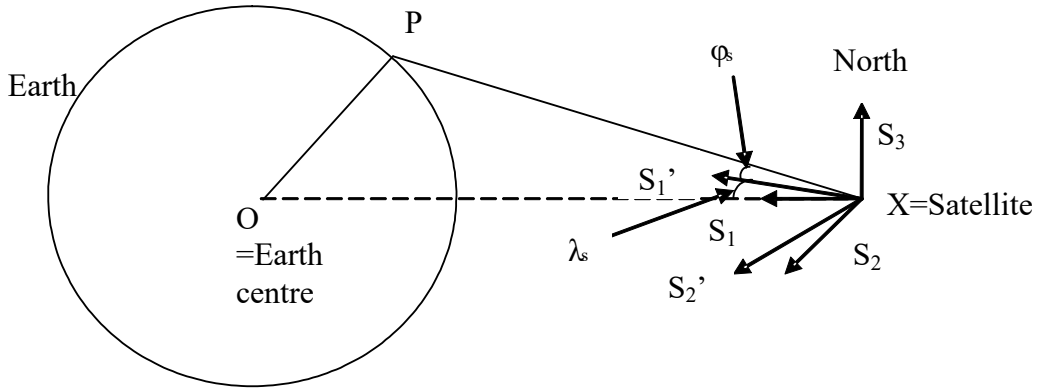


Figure 14: Angular Definition of the Reference Grid

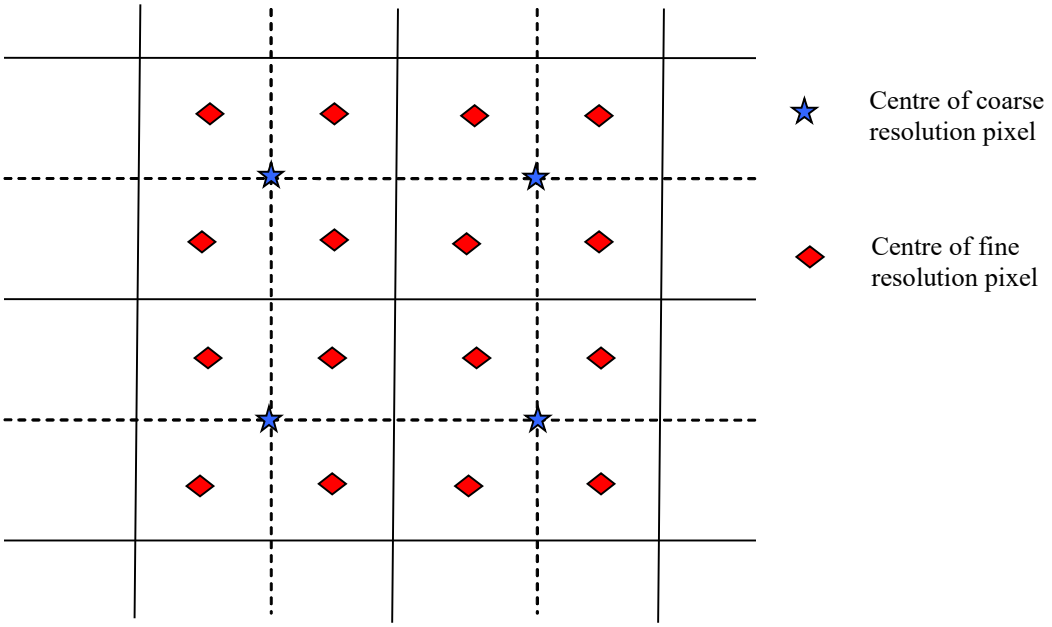


Figure 15: Alignment of Reference Grids of Differing Resolutions

[Conventions and Terms] Target Grid iss: 3B

The Target Grid is the set of *spatial samples* defined by the scan strategy for an unperturbed spacecraft at a fixed geostationary position. The points are defined using the same projection as the *reference grid*.

Note: See Figure 5.

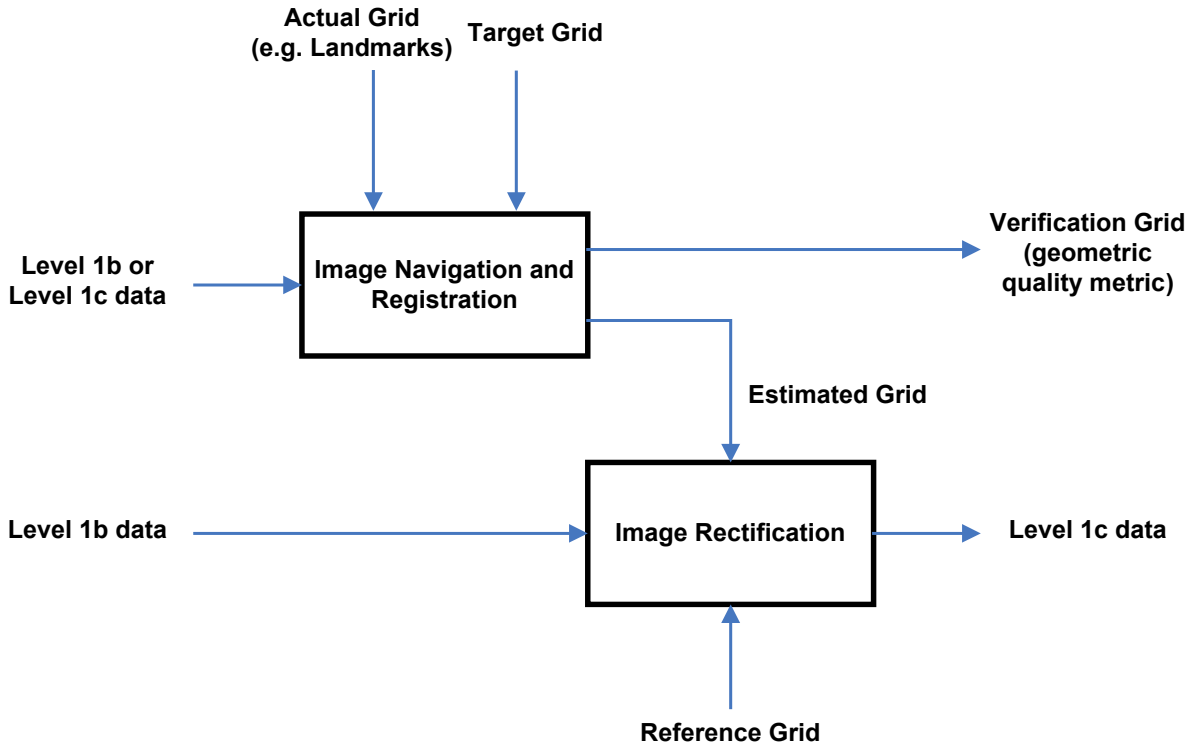


Figure 16: Relationship between data grids

[Conventions and Terms] Estimated Grid iss: 3B

The estimated grid is the set of *spatial samples* defined as an outcome of the *image navigation* process, i.e. each *spatial sample*'s location in space as a result of the *image navigation* process. The points are defined using the same projection as the *reference grid*.

See Figure 5.

[Conventions and Terms] Verification Grid iss: 3B

The verification grid is the set of *spatial samples* used for *image navigation verification* in conjunction with the *estimated grid*. The points are defined using the same projection as the *reference grid*.

See Figure 5.

Annex F.4.2 Dataset Acquisition and Generation

[Conventions and Terms] Image iss: 3B

An image is defined as the set of *radiance samples* acquired in a *repeat cycle*, associated with a single *spectral channel* and

- at *level 1c*: with all the points (*pixels*) of the *reference grid* that are included in the area of *coverage*;
- at *level 1a* and 1b: with all the points (*spatial samples*) of the *actual grid* that are included in the area of *coverage*.

[Conventions and Terms] Imagette iss: 3B

An imagette is defined as a fraction of an *image*.

[Conventions and Terms] Coverage iss: 3B

Coverage is defined as the region over which *science data* is collected.

[Conventions and Terms] Full Disc Coverage iss: 3B

Full Disc Coverage (FDC) is defined as the maximum area of *coverage* required from an instrument, particularly if this involves the complete *coverage* of the Earth disc.

[Conventions and Terms] Local Area Coverage iss: 3B

Local Area Coverage (LAC) is defined as a sub-area of *full disc coverage*.

[Conventions and Terms] LAC Zone iss: 3B

A LAC zone is defined as an area of *coverage* meeting the LAC requirements. In cases where more than one LAC zone are in use the LAC zones should be numbered from south to north starting from 1; see Figure 6 and Figure 7.

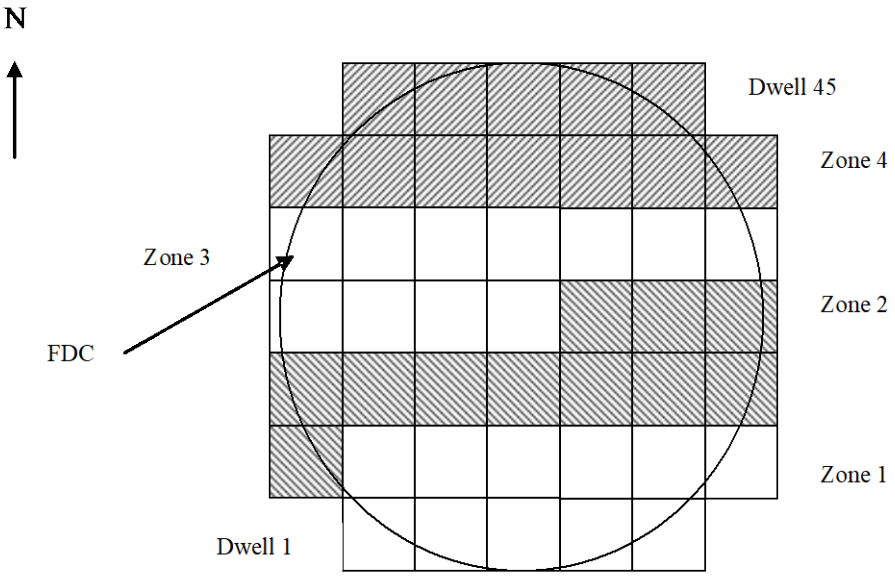


Figure 17: Illustration of LAC zone numbering for the IRS

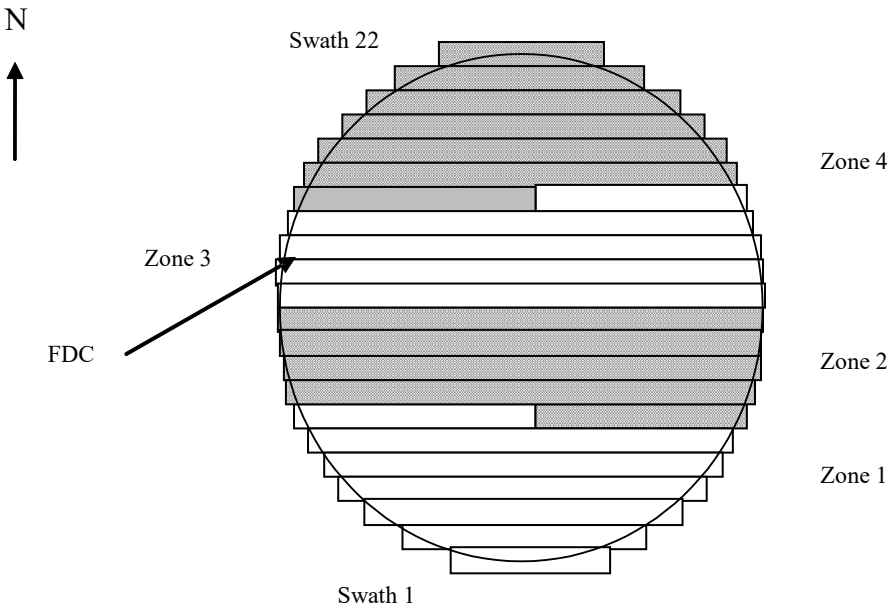


Figure 18: Illustration of LAC zone numbering for the FCI

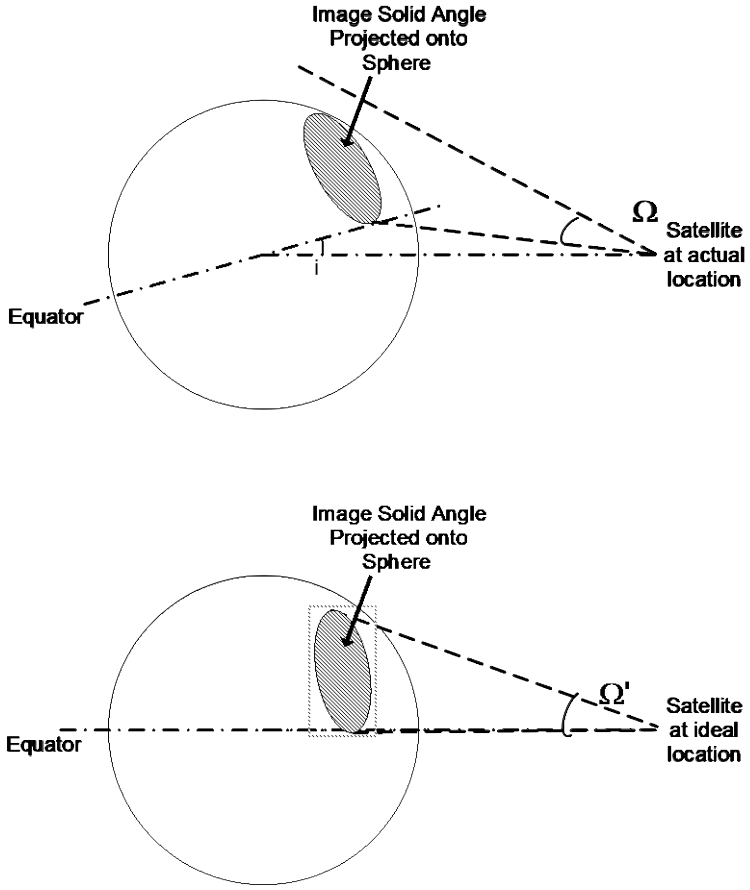


Figure 19: Illustration of the derivation of the image solid angle for LAC Clipping calculation

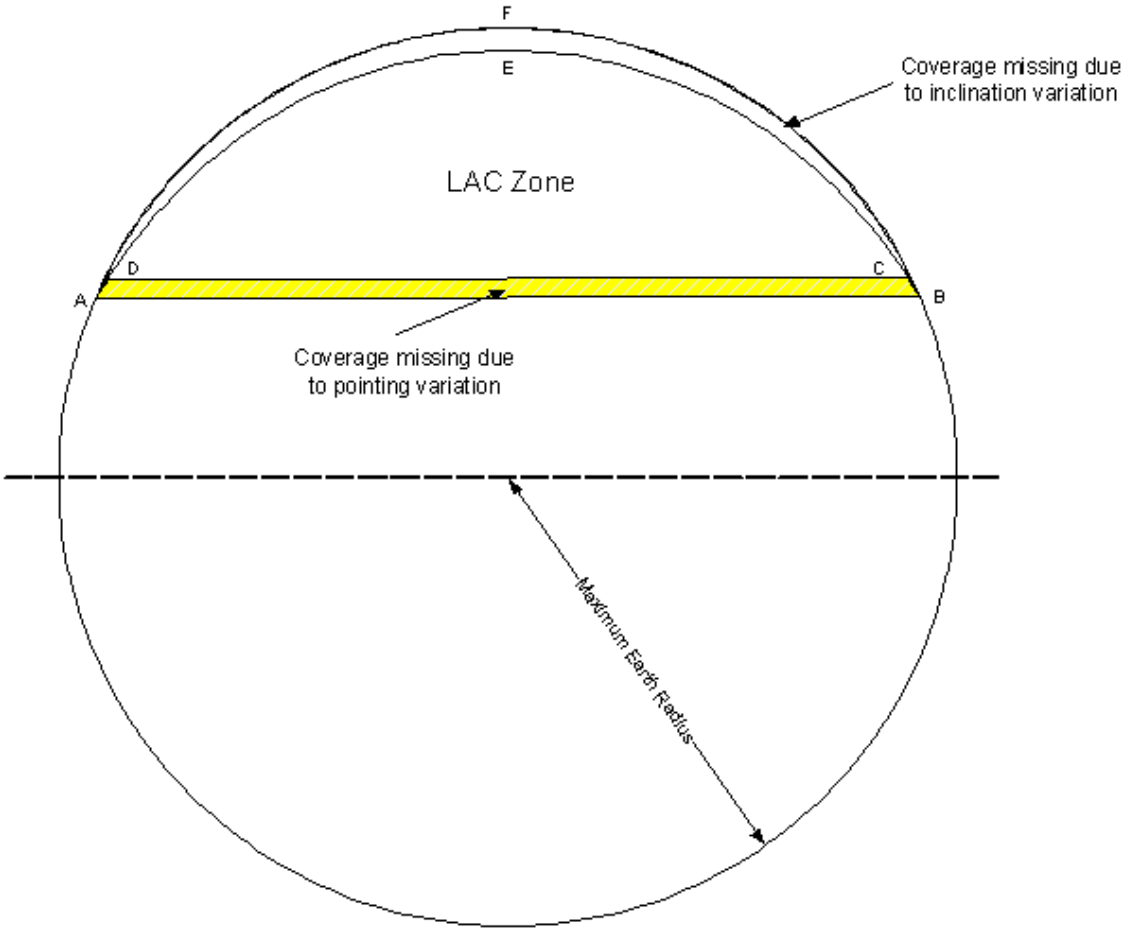


Figure 20: Illustration of areas of LAC missing due to pointing and inclination variation

[Conventions and Terms] Dwell iss: 3B

A dwell is the time period and area over which the sounder gathers simultaneously a group of *spectral soundings* and has properties of *dwell time* and *dwell coverage*. The dwells within a *LAC zone* are numbered in the order of acquisition starting from 1; see Figure 10.

Synonyms: Stare

***Figure 21: Illustration of dwell numbering within a* LAC zone**

[Conventions and Terms] Dwell Coverage iss: 3B

Dwell coverage is the area covered by all *spatial samples* of the *spectral soundings* collected during the same acquisition time.

[Conventions and Terms] Dwell Time iss: 3D

The dwell time is the time period required to collect an interferogram (from which are deduced all *spectral samples*).

[Conventions and Terms] Swath iss: 3B

A swath is defined as the area covered by the *spatial samples* collected during a single east to west or west to east scan of a scanning instrument. The swaths are numbered from south to north staring from 1; see Figure 11.

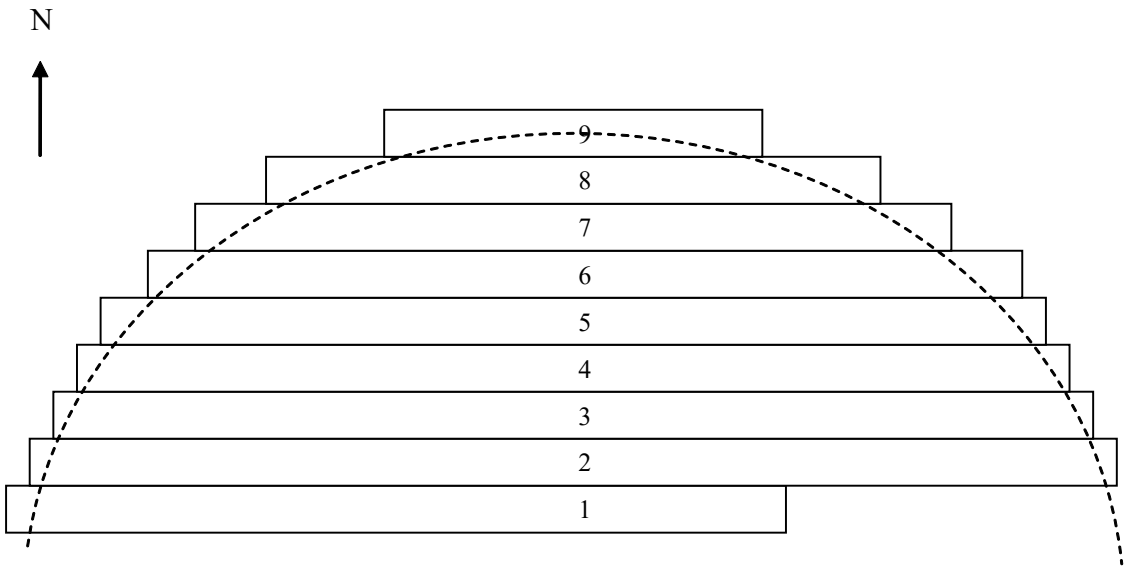


Figure 22: Illustration of swath numbering

[Conventions and Terms] Row iss: 3B

A row is defined as a line of *spatial samples* or *pixels* running in a (nominal) East to West and West to East direction. The rows are numbered from the south to north starting from 1. The term row can be applied to *dwells*, *swaths* or rectified *images*; see Figure 12, Figure 13 and Figure 14.

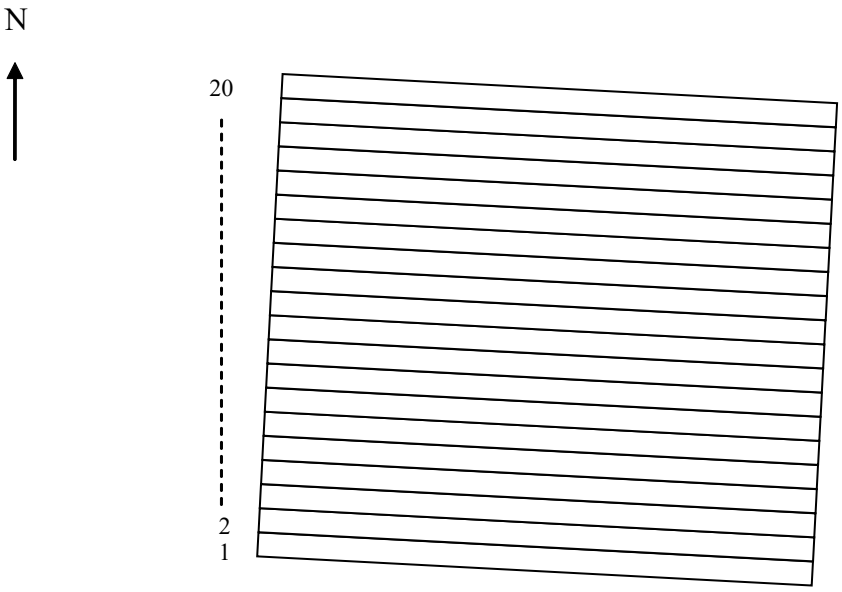


Figure 23: Illustration of row numbering within a **dwell**

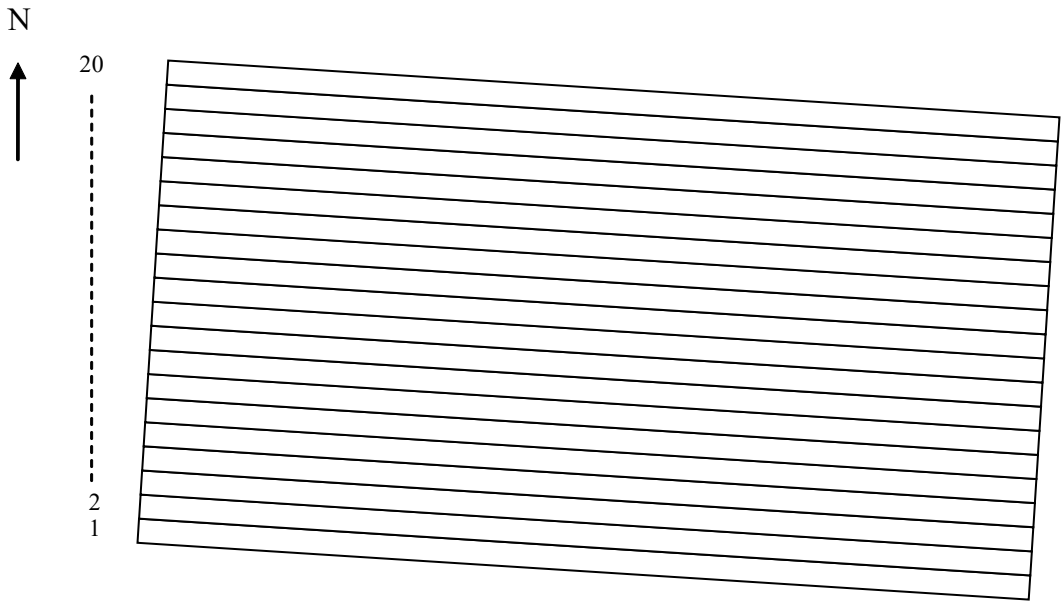


Figure 24: Illustration of row numbering within a **swath**

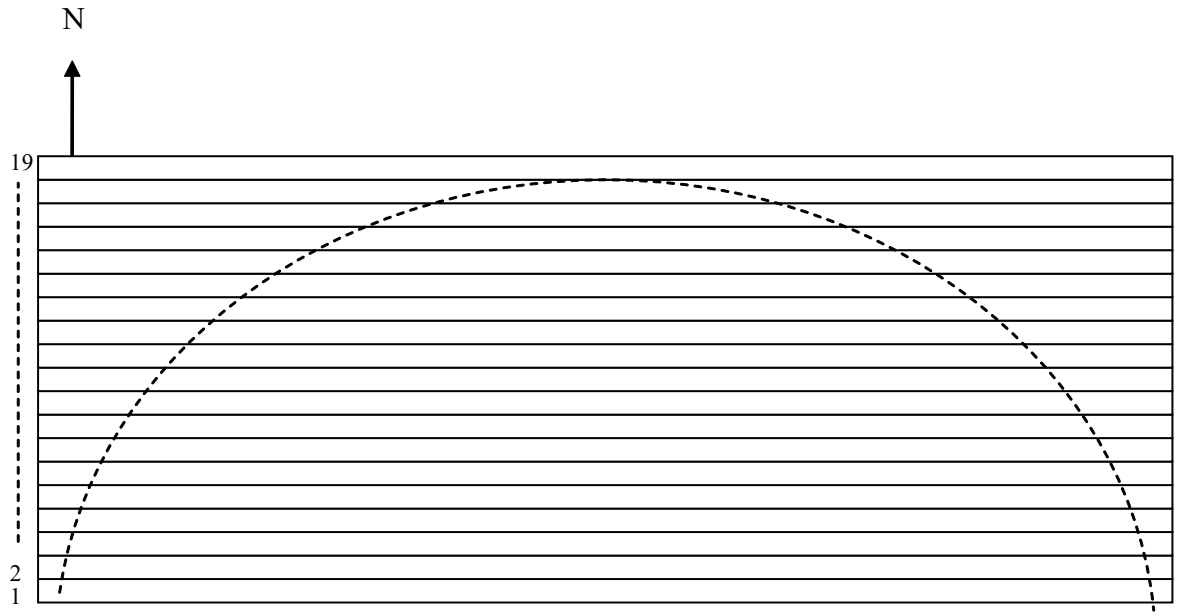


***Figure 25: Illustration of row numbering within a rectified* image**

[Conventions and Terms] Column iss: 3B

A column is defined a line of *spatial samples* or *pixels* running in a (nominal) South to North direction. The columns are numbered from the west to east starting from 1. The term column can be applied to *dwells*, *swaths* or rectified *images*; see Figure 15, Figure 16 and Figure 17.

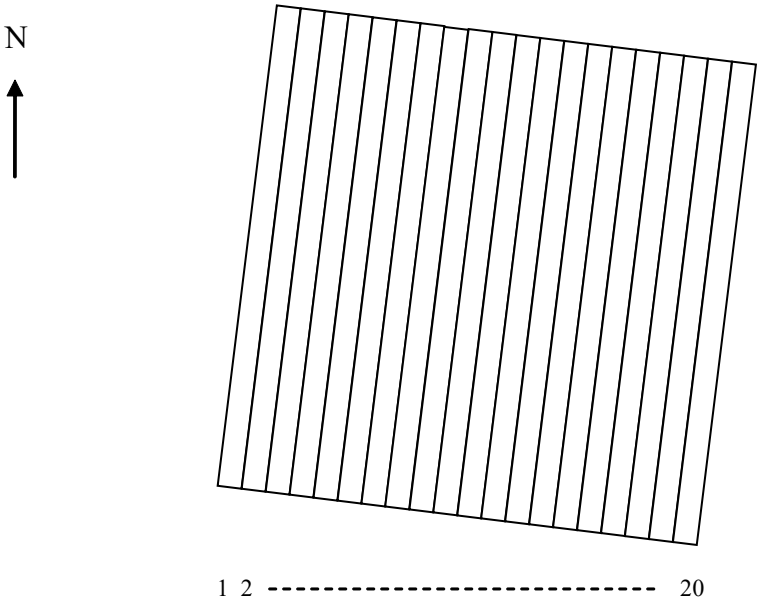


Figure 26: Illustration of column numbering within a **dwell**

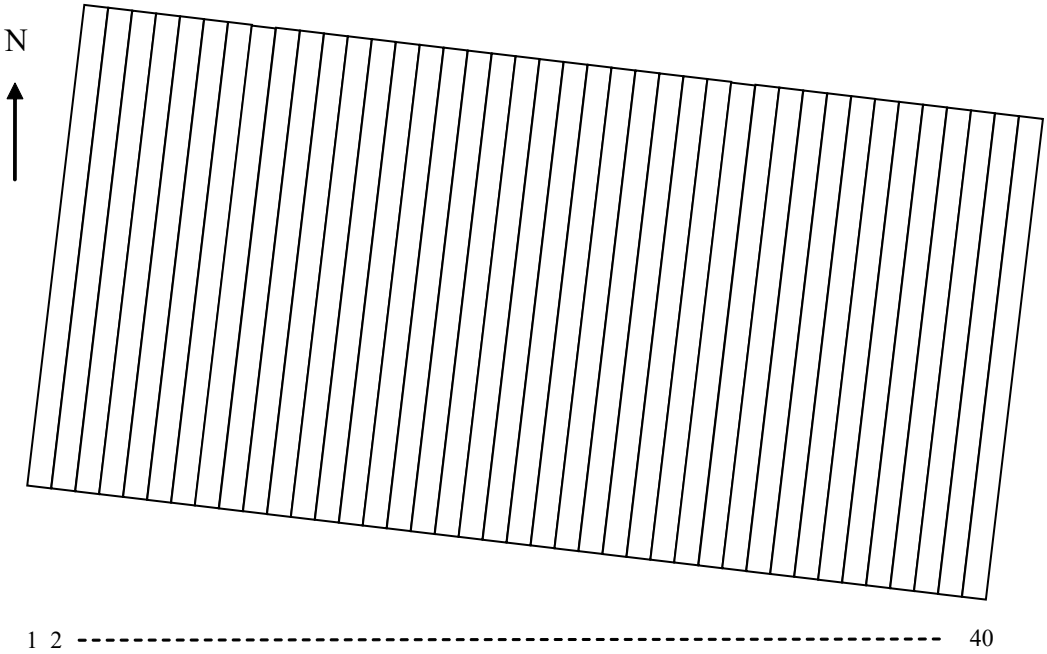


Figure 27: Illustration of column numbering within a **swath**

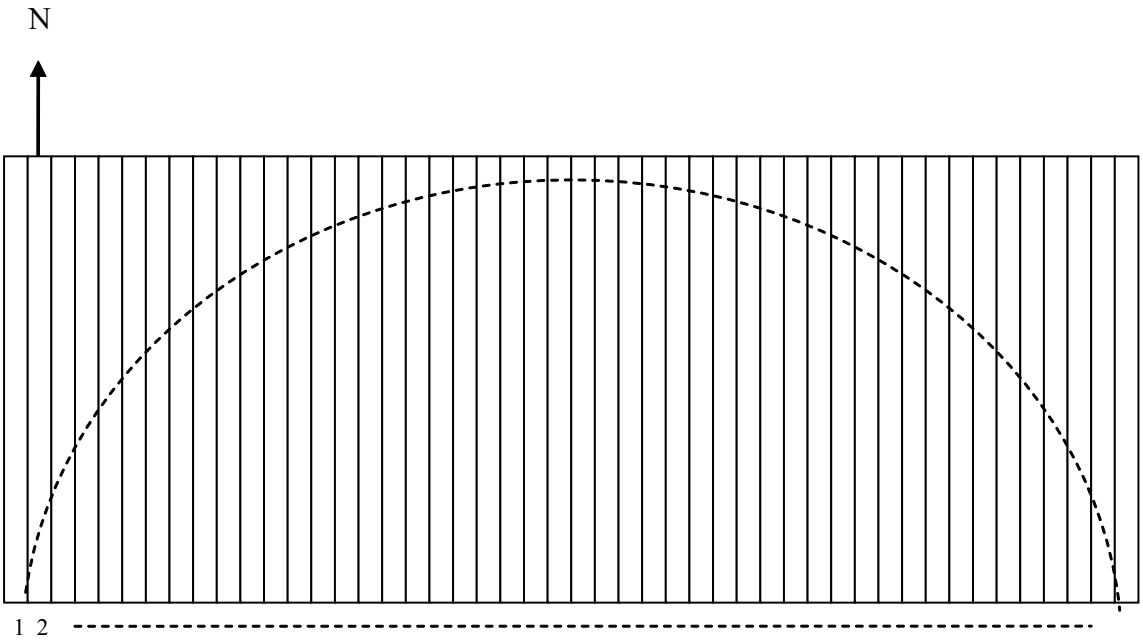


***Figure 28: Illustration of column numbering within a rectified* image**

[Conventions and Terms] Repeat Cycle iss: 5

For the FCI: The repeat cycle is defined as the time elapsed between the start of two consecutive sets of *images* taken in all *spectral channels* covering the same defined *coverage*.

For the IRS: The repeat cycle is defined as the time elapsed between the start of the data acquisition for two consecutive *LAC zones*.

For the LI: The repeat cycle is defined as the time elapsed between the start of the data acquisition for two consecutive *LI background radiance images*.

For the UVN: The repeat cycle is defined as the time elapsed between the start of two consecutive east-west scans.

Note: In above definition, consecutive should be interpreted as temporally consecutive.

Note: For data from other sources (e.g. *LI triggered event* or from satellite platform), an *accumulation interval* may be defined.

[Conventions and Terms] Detector Element iss: 3B

A detector element is a single measurement device that, together with others with similar characteristics, makes up a *detector array*. The detector element responds to incoming radiation to produce a signal that can be converted from an analogue to a digital format.

[Conventions and Terms] Detector Array iss: 3B

A detector array is a collection of *detector elements*. It may be linear or two dimensional.

[Conventions and Terms] Lightning Optical Pulse iss: 3B

A lightning optical pulse is produced by an electric discharge within or below a cloud, where the optical radiation is emitted from the hot lightning channel. The *lightning pulse* duration is on the order of 50 µs and the released photons are transported to the cloud surfaces by scattering. The resulting lightning optical signal to be observed at the cloud top has a pulse duration delayed and widened in time to about 600 µs, distributed over an enlarged area of a minimum of about 100 km^2 up to a maximum area of about 10.000 km^2 depending on the number of scattering processes involved. The spectral and temporal characteristics are illustrated in Figure 18.

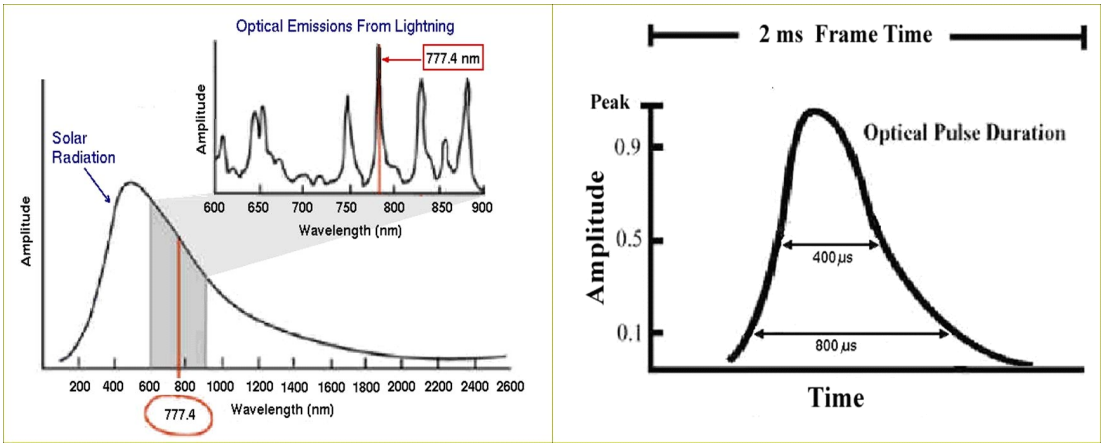


Figure 29: Optical emission from lightning and* lightning pulse *duration

[Conventions and Terms] Lightning Pulse iss: 3B

Synonym for *Lightning Optical Pulse*

Annex F.4.3 Dataset Quality Threshold

[Conventions and Terms] Missing Sample iss: 4

For the FCI: A *radiance sample* is deemed a missing sample if either no measurement has been returned or the difference between its *radiometric error* and the *radiometric accuracy* is more than N times the specified *radiometric noise* for a specific *repeat cycle*.

For a missing sample:

$$\left|\Delta L^{eff}{}_{[ijksr]} - \overline{\Delta L^{eff}{}_{[kr]}}\right| > N * NEdL^{eff}{}_{[k]}$$

Where

$\Delta L^{eff}{}_{[ijksr]}$ is the *radiometric error*

$\overline{\Delta L^{eff}{}_{[kr]}}$ is the *radiometric accuracy*

NEdLeff[k] is the *noise equivalent delta radiance* requirement

i and j identify the *spatial sample* within a *swath* in terms of *column* and *row*

k is the *spectral channel*

s is the *swath* of a *repeat cycle*

r is the *repeat cycle*

N is the *noise equivalent delta radiance* multiplication factor as given in the requirement for missing samples.

[Conventions and Terms] Missing Sounding iss: 4

For the IRS: A *spectral sounding* is deemed a missing sounding if either no measurement has been returned or a fraction of the *spectral channels* greater than M, within the considered *spectral band*, have associated *radiance samples* where the difference between the *radiometric error* and the *radiometric accuracy* is more than N times the specified *radiometric noise*, for a specific *repeat cycle*.

For a missing sounding:

$$\left|\Delta L^{eff}{}_{[ijksr]} - \overline{\Delta L^{eff}{}_{[kr]}}\right| > N * NEdL^{eff}{}_{[k]}$$

Where

$\Delta L^{eff}{}_{[ijksr]}$ is the *radiometric error*

$\overline{\Delta L^{eff}{}_{[kr]}}$ is the *radiometric accuracy*

$NEdL^{eff}{}_{[k]}$ is the *noise equivalent delta radiance* requirement

i and *j* identify the *spatial sample* within a *dwell* in terms of *column* and *row*

k is the *spectral channel*

s is the *dwell* of a *repeat cycle*

r is the *repeat cycle*

N is the *noise equivalent delta radiance* multiplication factor

Note: The parameters *M* and *N* are given in the requirement for *missing sounding*.

Annex F.4.4 Spectral

[Conventions and Terms] Wavenumberiss: 3B

Wavenumber, ν, is defined as the reciprocal of the spectral wavelength.

$$\nu = \frac{1}{\lambda}$$

Note: In this definition the symbol ν is used in place of the symbol σ used in ISO 31-6-4:1992(E)

[Conventions and Terms] Spectral Variable iss: 3B

The spectral variable, ξ, is any quantity used to represent the frequency behaviour of a monochromatic wave. The spectral variable can be a spectral frequency, wavelength or *wavenumber*. The term spectral variable will be used in all the statements that are applicable to any one of the above mentioned quantities.

[Conventions and Terms] Spectral Range iss: 3B

The spectral range is defined as the complete spectral domain over which the instrument is able to produce calibrated measurements. The spectral domain may or may not be contiguous (continuous, with its parts in uninterrupted contact).

[Conventions and Terms] Spectral Band iss: 3B

A spectral band is a subset of the *spectral range* of an instrument that has associated common properties and is contiguous. For example the IRS has two spectral bands MWIR and LWIR.

[Conventions and Terms] Spectral Channel iss: 3B

A spectral channel is the smallest spectral interval measured by an instrument. A *spectral band* is formed by a set of contiguous spectral channels.

For the FCI: A spectral channel is characterised by a set of *spectral response functions* per *spatial sample* that comply with the spectral response template for that spectral channel.

For the IRS: A spectral channel is defined after *spectral resampling* of the measured *spectral samples* to a discrete spectral positions separated according to the *spectral channel interval* within the *spectral band*.

The spectral channel, identified by the index k, has an associated *spectral variable*, ξ_k, where this location corresponds to the position of its *spectral response function centroid*.

See also *radiance sample*.

[Conventions and Terms] Radiance Sample iss: 3B

A radiance sample is an *effective radiance* measured by the instrument at a specific spatial and spectral location, see Figure 19. The radiance sample has spatial properties of spatial location (x_i,y_j) and shape (*point spread function*). Together the spatial properties are referred to as the *spatial sample* or *pixel* depending on whether the radiance sample has been located on the *estimated grid* or the *reference grid* respectively. Likewise the radiance sample has spectral properties of spectral location (ξ_k) and shape (*spectral response function*). Together the spectral properties are referred to as the *spectral sample* or *spectral channel* depending on whether the radiance sample is located according to a reference spectral location and *spectral response function*. The *point spread function* and *spectral response function* are related to the *instrument response function*.

For the FCI: The *spectral channel* is fixed by the optical and *detector element* spectral filtering characteristics. Thus for each *spatial sample* of a *spectral channel* a single radiance sample is measured. The *spatial samples* are rectified to the *reference grid* to form *pixels*, again each with their associated radiance sample.

For the IRS: A *spectral sounding* is taken at a location given by the *spatial sample*. Once the *spectral sounding* interferogram has been Fourier transformed to the spectral domain a series of *spectral samples* are obtained, each with its own radiance sample. The *spectral samples* are then subject to *spectral resampling* to fixed spectral locations and *spectral*

response functions to form *spectral channels*, again each with their associated radiance sample.

For the LI: A single *spectral channel* is defined, thus each *spatial sample* has an associated radiance sample.

Note: In the case of the IRS the PSF of the *spatial sample* will vary with the *spectral sample* or *spectral channel*, although the nominal location will be the same across the *spectral variable* range.

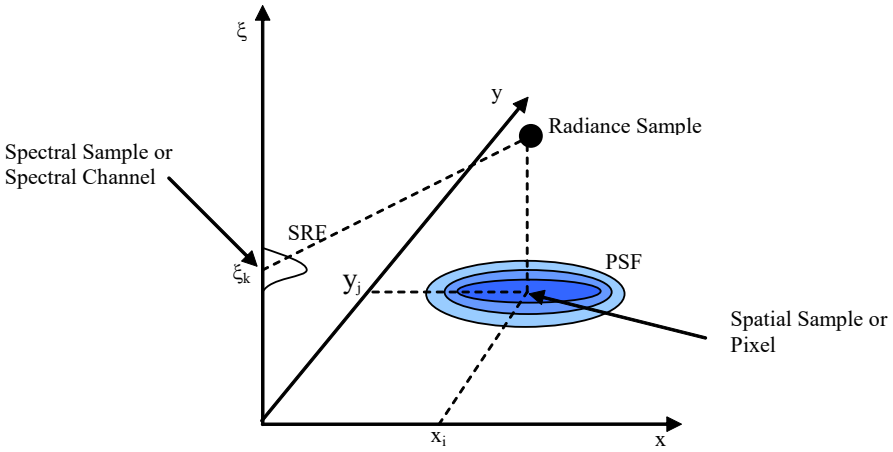


Figure 30: Radiance Sampling

[Conventions and Terms] Spectral Sample iss: 3B

For the IRS: Spectral samples are obtained by performing a discrete Fourier Transform of the sampled *spectral sounding* interferogram for a *spatial sample*.

The spectral sample, identified by the index k, has an associated *spectral variable*, ξ_k, where this location corresponds to the position of its *spectral response function centroid*.

See also *radiance sample*.

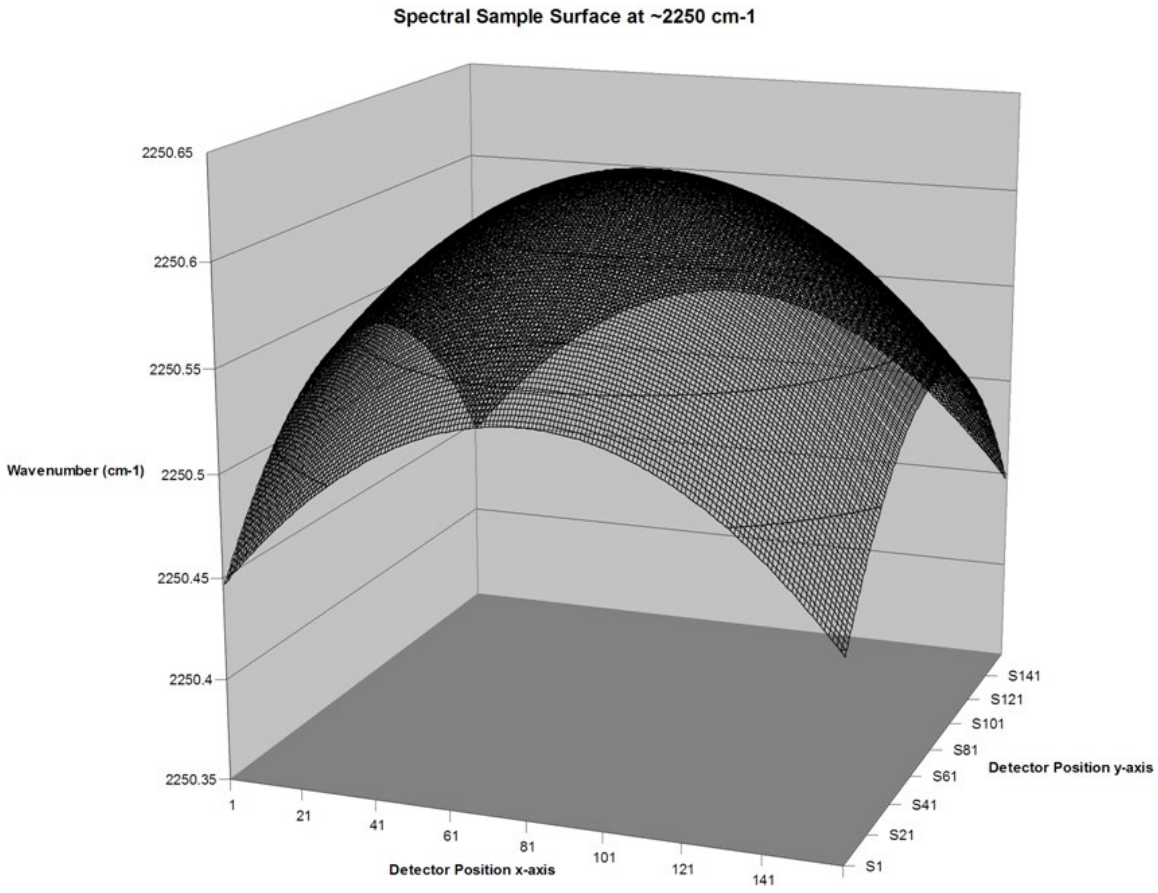
Note: As the IRS will perform a number of *spectral soundings* simultaneously there will be a scale change between the spectral spacing of the *spectral samples* for each *spatial sample*. This is due to the change in *maximum optical path difference* caused by the position of a *spatial sample* in relation to the optical axis. Thus each *spatial sample* will have *spectral samples* taken at a set of *wavenumbers* specific to that *spatial sample*.

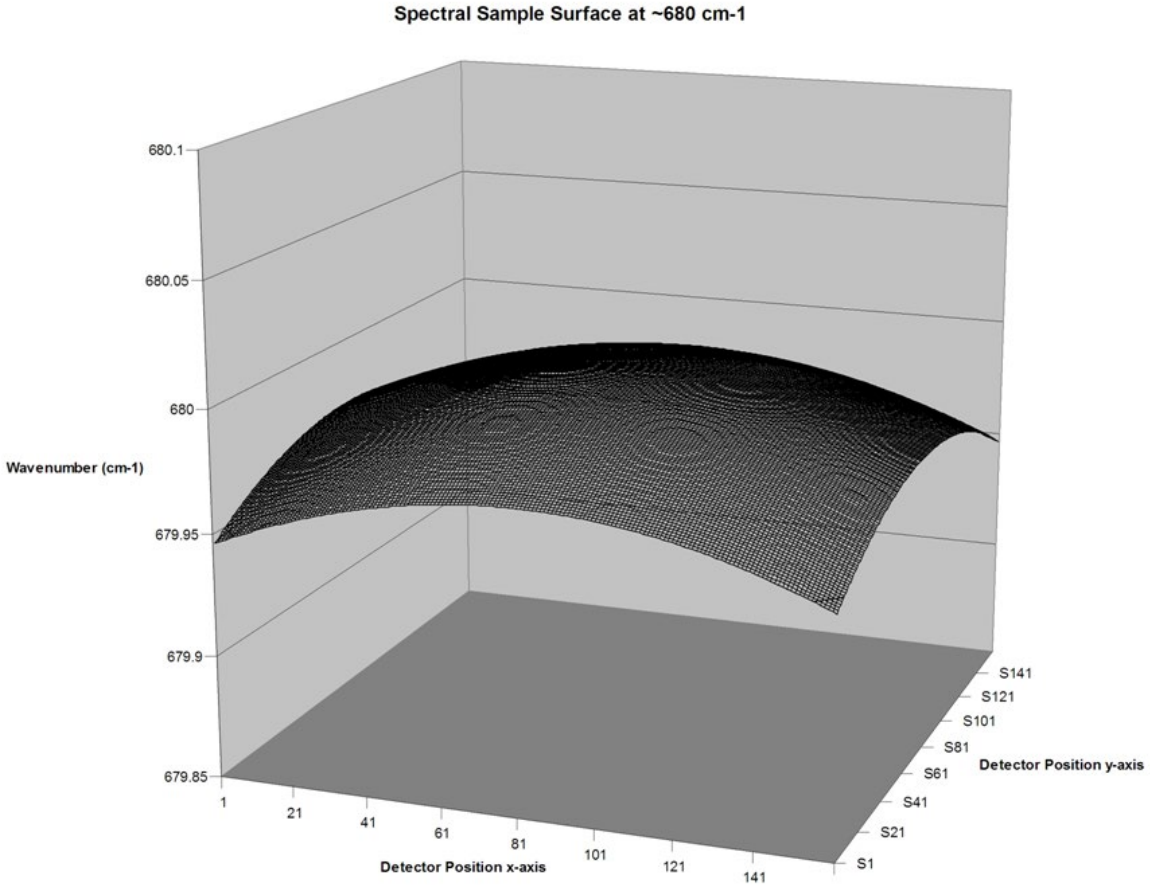
[Conventions and Terms] Spectral Sample Surface iss: 3D

For the IRS: The spectral sample surface is defined as the group of *spectral samples* with the same index number following the discrete Fourier transform of all the *spectral sounding* interferograms in an area of *coverage*. The spectral sample surface has an associated *wavenumber* that is taken as the *wavenumber* corresponding to a *spectral*

sample located on the optical axis. The *wavenumbers* of the individual *spectral samples* making up a spectral sample surface is illustrated in Figure 20,

Note: In this definition it is assumed that each *spectral sounding* consists of the same number of interferogram samples. On performing a Fourier transform of the interferogram each *spectral sounding* has the same number of *spectral samples*.





Notes:

1. The plots of the spectral sampling surfaces are generates assuming a 4km *spatial sampling distance*, a 0.625 cm^{-1} *spectral channel interval*, a magnification ratio of one and are plotted for a *dwell coverage* of 640km x 640km.

2. The plots assume that the optical axis lies in the centre of the *dwell coverage* and that the Zero Optical Path Difference (ZOPD) for each interferogram within the *dwell* is in the same interferogram sample position.

Figure 31: Illustration of Spectral Sample Surface

[Conventions and Terms] Spectral Channel Interval iss: 3B

For the IRS: The spectral channel interval is the spectral distance between adjacent *spectral channels* with in a *spectral band*.

Note: The spectral channel interval defines the standard grid to which the *spectral samples* collected for each *spatial sample* are spectrally resampled to form *spectral channels*

[Conventions and Terms] Spectral Width iss: 3B

For the FCI: The spectral width is used to specify the spectral extent of a *spectral channel* in terms of the *normalised spectral response* envelope.

Note: The specified spectral width, $\Delta\lambda_0$ will be different from the actual spectral width, $\Delta\lambda_s$, of a *spectral channel*, where the actual spectral width has traditionally been defined as the Full Width Half Maximum value of the *spectral response function*, ignoring local oscillations in the passband. However, with the usage of *effective radiance* there is strictly speaking no longer a need to provide the actual spectral width, although in practice the spectral width will still be quoted for historical comparison and conceptual understanding reasons.

[Conventions and Terms] Central Wavelength iss: 3B

For the FCI: The central wavelength is used to specify the spectral location of a *spectral channel* in terms of the *normalised spectral response* envelope.

Note: The specified central wavelength, λ_0, will be different from the actual central wavelength, λ_s, of a *spectral channel*, where the actual central wavelength has traditionally been defined as the *centroid* of the *spectral response function*. However, with the usage of *Effective Radiance* there is strictly speaking no longer a need to provide the actual central wavelength, although in practice the central wavelength will still be quoted for historical comparison and conceptual understanding reasons.

[Conventions and Terms] Spectral Calibration iss: 3B

For the **IRS**: Spectral calibration is the process of determining the position and shape of the *spectral response function* (SRF) of a *spectral sample* or group of *spectral sample*s by the observation of a known, stable spectral scene.

See ECSS-P-001B 3.28 Calibration.

[Conventions and Terms] Spectral Resampling iss: 3B

For the IRS: Spectral resampling is the process by which the *spectral samples* derived from a sampled interferogram are relocated to pre-determined *wavenumber* locations, thus forming *spectral channels*. The positions of the *spectral channels* are those given by the *spectral channel interval* starting at the first *wavenumber* in the *spectral band*.

[Conventions and Terms] Normalised Spectral Responseiss: 3B

The normalised spectral response is equal to the *spectral response function* normalised by the maximum *spectral response function* over the *spectral variable* range of interest at the time of measurement.

$$S_{[ijksr]}(\xi) = \frac{SRF_{[ijksr]}(\xi)}{\max\left(SRF_{[ijksr]}(\xi)\right)}$$

where

$S_{[ijksr]}(\xi)$ is the normalised spectral response

$SRF_{[ijksr]}(\xi)$ is the *spectral response function*

i and *j* identify the *spatial sample* within a *swath*/*dwell* or the *pixel* within a *repeat cycle* in terms of *column* and *row*

k is the *spectral sample* or *spectral channel*

s is the *swath* or *dwell* of a *repeat cycle* when considering *spatial samples*

r is the *repeat cycle*

ξ is the *spectral variable*

[Conventions and Terms] Instrument Response Function iss: 4

The Instrument Response Function (IRF) is defined as the output signal to input *radiant intensity* ratio, with the output signal being the *effective radiance* measured by the instrument when observing a monochromatic point source. The IRF is specific to the selected *spatial sample* or *pixel* and *spectral sample* or *spectral channel* and is a function of the spatial position and the *spectral variable* of the source. The IRF units are m^{-2}. μm^{-1}.

As a consequence of the above definition

$$L^{eff}{}_{[ijksr]} = \int_0^{\infty}\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} IRF_{[ijksr]}(x,y,\xi).L_{\xi}(x,y,\xi)dxdyd\xi$$

where

$L^{eff}{}_{[ijksr]}$ is the *effective radiance*, including all the spectral and spatial filtering actions produced by the combined effect of the optical system, the detector and processing up to point of interest .

$IRF_{[ijksr]}(x,y,\xi)$ is the instrument response function

$L_{\xi}(x,y,\xi)$ is the spectral *radiance* of the scene

i and *j* identify the *spatial sample* within a *swath*/*dwell* or the *pixel* within a *repeat cycle* in terms of *column* and *row*

k is the *spectral sample* or *spectral channel*

s is the *swath* or *dwell* of a *repeat cycle* when considering *spatial samples*

r is the *repeat cycle*

x and *y* are the spatial variables

ξ is the *spectral variable*

Another consequence of the definition is the fact that the integral of IRF along the spatial variables and *spectral variable* is unity.

$$\int_0^{\infty}\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} IRF_{[ijksr]}(x,y,\xi)dxdyd\xi = 1$$

Note: In the definition of IRF the instruments are assumed to be linear.

[Conventions and Terms] Spectral Response Function iss: 4

The Spectral Response Function (SRF) is defined as the output signal to input *radiance* ratio, with the output signal being the *effective radiance* measured by the instrument when observing a spatially uniform, monochromatic source. The SRF is specific to the selected *spatial sample* or *pixel* and *spectral sample* or *spectral channel* and is a function of the *spectral variable* of the source. The SRF units are μm^{-1}.

The SRF can be equivalently defined as integral of IRF

$$SRF_{[ijksr]}(\xi) = \int_{-\infty}^{+\infty}\int_{-\infty}^{+\infty} IRF_{[ijksr]}(x,y,\xi)dxdy$$

where

$IRF_{[ijksr]}(x,y,\xi)$ is the *instrument response function*

$SRF_{[ijksr]}(\xi)$ is the spectral response function

i and *j* identify the *spatial sample* within a *swath*/*dwell* or the *pixel* within a *repeat cycle* in terms of *column* and *row*

k is the *spectral sample* or *spectral channel*

s is the *swath* or *dwell* of a *repeat cycle* when considering *spatial samples*

r is the *repeat cycle*

x and *y* are the spatial variables

ξ is the *spectral variable*

As a consequence of the above definition, in the special case where the scene is spatially uniform, the SRF can be used (in place of the IRF) to evaluate the instrument output by the equation:

$$L^{eff}{}_{[ijksr]} = \int_0^{+\infty} SRF_{[ijksr]}(\xi)L_{\xi}(\xi)d\xi$$

where

$L^{eff}_{[ijksr]}$ is the *effective radiance* including all the spectral and spatial filtering actions produced by the combined effect of the optical system, the detector and processing, up to the point of interest.

$L_{\zeta}(\xi)$ is the spectral *radiance* of the scene

Another consequence of the definition is the fact that the integral of SRF along the *spectral variable* is unity.

$$\int_{0}^{+\infty} SRF_{[ijksr]}(\xi)d\xi = 1$$

Synonyms: *instrument spectral response function*, *instrument line shape*

Note: In the definition of SRF the instruments are assumed to be linear.

[Conventions and Terms] Instrument Spectral Response Function iss: 3B

Synonym for *Spectral Response Function* (SRF)

[Conventions and Terms] Instrument Line Shape iss: 3B

Synonym for *Spectral Response Function* (SRF).

[Conventions and Terms] Spectral Response Function Difference iss: 3B

The spectral response function difference is given for two different conditions.

For the difference between the actual SRF and a characterised SRF

$$\Delta SRF_{[ijksr]} = \int_{\xi 1}^{\xi 2} \left| SRF^{a}_{[ijksr]}(\xi) - SRF^{m}_{[ijksr]}(\xi) \right| d\xi$$

where

$\Delta SRF_{[ijksr]}$ is the spectral response function difference

$SRF^{m}_{[ijksr]}$ is the characterised *spectral response function*

$SRF^{a}_{[ijksr]}$ is the actual *spectral response function*

i and *j* identify the *spatial sample* within a *swath*/*dwell* or the *pixel* within a *repeat cycle* in terms of *column* and *row*

k is the *spectral sample* or *spectral channel*

s is the *swath* or *dwell* of a *repeat cycle* when considering *spatial samples*

r is the *repeat cycle*

ξ is the *spectral variable*

$\xi 1$ and $\xi 2$ are the integration limits

For the difference between two actual SRF separated either in space or in time

$$\Delta SRF_{[(i1-i2)(j1-2)ks(r1-r2)]} = \int_{\xi 1}^{\xi 2} \left| SRF_{[i1\,j1ksr1]}(\xi) - SRF_{[i2\,j2ksr2]}(\xi) \right| d\xi$$

where

$\Delta SRF_{[(i1-i2)(j1-j2)ks(r1-r2)]}$ is the spectral response function difference

$SRF_{[i1\,j1ksr1]}(\xi)$ and $SRF_{[i2\,j2ksr2]}(\xi)$ are the *spectral response functions* for either two different *spatial samples* within the same *repeat cycle* (r1=r2) or the same *spatial sample* belonging to two different *repeat cycles* (i1=i2, j1=j2) for *spectral channel k*

Synonym: *SRF shape error index*

[Conventions and Terms] SRF Shape Error Index iss: 3B

Synonym for *spectral response function difference*

[Conventions and Terms] Fourier Transform Spectrometer iss: 3B

A Fourier Transform Spectrometer (FTS) is an interferometer concept that converts input spectral *radiances* into interferograms that contain spectral information within the bandpass of the interferometer.

[Conventions and Terms] Spectral Sounding iss: 3B

A spectral sounding is defined as the complete set of *spectral samples* for any fixed *spatial sample* captured during a *dwell* of a sounder.

See also *radiance sample*.

Annex F.4.5 Radiometric

[Conventions and Terms] Radiant Energy iss: 3B

Radiant energy is the energy emitted, transferred or received in the form of electromagnetic radiation.

[Conventions and Terms] Radiant Power iss: 3B

Radiant power is the *radiant energy* per unit time.

[Conventions and Terms] Irradiance iss: 3B

Irradiance is defined as the *radiant power* incident on a surface element, divided by the area of the element:

$E = d\Phi / ds$

where

ds is an infinitesimal element of surface

$d\Phi$ is the *radiant power* incident over ds

E is the irradiance evaluated on ds

As all the radiometric quantities, irradiance can be integral or spectral. The above definition is applicable to the integral irradiance (with Φ the *radiant power* over a generic spectral interval). The spectral irradiance is irradiance per unit spectral interval and is represented by the equation:

$E_\xi = dE / d\xi$

where

ξ is the *spectral variable*

E_ξ is the spectral irradiance per unit *spectral variable*

[Conventions and Terms] Radiance iss: 3B

Radiance is defined as the *radiant power* per unit projected area and unit solid angle, leaving a surface in a given direction.

$L = \frac{d^2\Phi}{ds.d\Omega.\cos\theta}$ where

ds is an infinitesimal element of surface

θ is the angle between the direction of observation and the normal to ds

$d\Omega$ is an infinitesimal solid angle around the observation direction

$d^2\Phi$ is the *radiant power* emitted by ds within the solid angle dΩ

L is the radiance from the surface, in the direction given by θ

The spectral radiance is radiance per unit spectral interval and is represented by the equation:

$L_\xi = dL / d\xi$ where

ξ is the *spectral variable*

L_ξ is the spectral radiance per unit *spectral variable*

[Conventions and Terms] Radiant Intensity iss: 3B

Radiant intensity is defined as the *radiant power* per unit solid angle leaving a surface or point source

$$I = \frac{d\Phi}{d\Omega}$$

where

$d\Omega$ is an infinitesimal solid angle around the observation direction

$d\Phi$ is the *radiant power* emitted in the solid angle $d\Omega$

I is the radiant intensity from the surface or point source

[Conventions and Terms] Effective Radiance iss: 3B

The effective radiance is the calibrated output of an instrument with finite spatial and spectral resolution, in units of spectral *radiance*. It equates to spectral *radiance* of a spatially and spectrally flat scene that would produce the same output as that produced by the actual scene.

[Conventions and Terms] LI Effective Radiance iss: 3E

The LI effective radiance is the calibrated output of the LI instrument with finite spatial and temporal resolution, in units of *radiance*. It is equal to the *radiance* of a spatially homogeneous scene with a constant output in time that would produce the same output as that produced by the actual scene.

[Conventions and Terms] Radiometric Measurement Range iss: 3B

The radiometric measurement range is defined as the complete radiometric domain over which the instrument is able to produce calibrated measurements.

[Conventions and Terms] Planck Function Derivative in Temperature iss: 3B

The Planck function derivative in temperature is given by:

In terms of wavelength (λ) in m

$$\frac{\partial B}{\partial T}(\lambda,T).d\lambda = \frac{2\cdot h^2\cdot c^3}{k.T^2.\lambda^6}\frac{e^{\frac{h\cdot c}{k.\lambda.T}}}{\left(e^{\frac{h\cdot c}{k.\lambda.T}}-1\right)^2}.d\lambda$$

In terms of wavelength (λ') in μm

$$\frac{\partial B}{\partial T}(\lambda',T).d\lambda' = \frac{2\cdot h^2\cdot c^3}{k.T^2.\lambda'^6}\frac{e^{\frac{10^6.h\cdot c}{k\lambda' T}}}{\left(e^{\frac{10^6.h\cdot c}{k\lambda' T}}-1\right)^2}.10^{30}.d\lambda'$$

In terms of *wavenumber* (ν) in m^{-1}

$$\frac{\partial B}{\partial T}(\nu,T).d\nu = \frac{2\cdot h^2\cdot c^3\nu^4}{k.T^2}\frac{e^{\frac{h.c.\nu}{k.T}}}{\left(e^{\frac{h.c.\nu}{k.T}}-1\right)^2}.d\nu$$

In terms of *wavenumber* (ν') in cm^{-1}

$$\frac{\partial B}{\partial T}(\nu',T).d\nu' = \frac{2\cdot h^2\cdot c^3\nu'^4}{k.T^2}\frac{e^{\frac{100.h.c.\nu'}{k.T}}}{\left(e^{\frac{100.h.c.\nu'}{k.T}}-1\right)^2}.10^{10}.d\nu'$$

[Conventions and Terms] Reflectance iss: 3B

For a given spectral value, reflectance is the ratio between the power per unit surface area emitted by a surface and the power per unit surface area (*irradiance*) incident on the surface.

[Conventions and Terms] Albedo iss: 3B

For a given spectral interval, albedo is the ratio between the power per unit surface area emitted by a surface and the power per unit surface area incident on the surface.

[Conventions and Terms] Spectral Radiance at the Top Of Atmosphere iss: 4

For the VIS/NIR *spectral channels* the spectral radiance at the Top Of Atmosphere (TOA) is estimated according to the following formula:

$$L^{sun}{}_{\lambda}(\lambda) = \frac{\rho(\lambda).E^{sun}{}_{\lambda}(\lambda).\cos(\theta^{sun})}{\pi}$$

Where

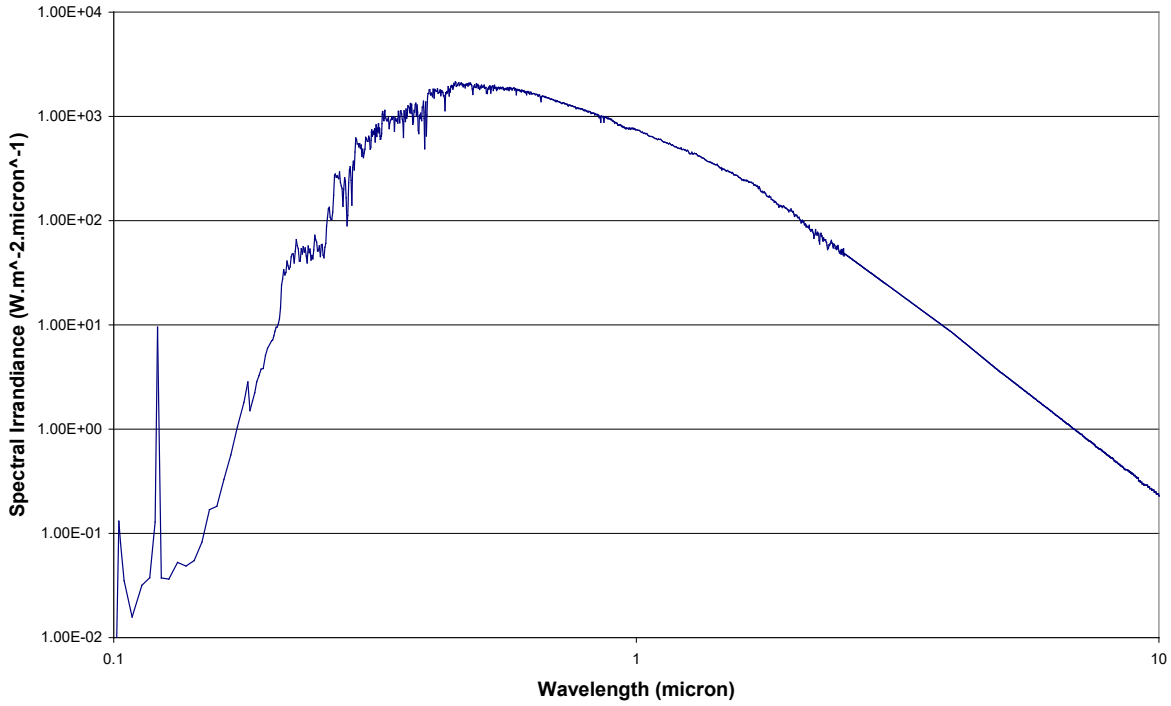
$L^{sun}{}_{\lambda}(\lambda)$ is the spectral radiance at TOA

$\rho(\lambda)$ is the *reflectance* at TOA

$E^{sun}{}_{\lambda}(\lambda)$ is the sun extraterrestrial spectral *irradiance* perpendicular to the direction of propagation. Unless otherwise indicated this is given in Figure 21

λ is wavelength

θ^{sun} is the solar zenith angle



Note: The data needed to generate these plots can be found on the EUMETSAT website (<http://www.eumetsat.int/Home/Main/Satellites/MeteosatThirdGeneration/Resources/index.htm EUM/MTG/DEF/10/0611)

***Figure 32: FCI Reference Solar Spectral* Irradiance**

[Conventions and Terms] Radiometric Error iss: 3B

The radiometric error is defined as the difference between the measured *effective radiance* for a particular *radiance sample* and the reference *effective radiance*

$$\Delta L^{eff}{}_{[ijksr]} = L^{eff,m}{}_{[ijksr]} - L^{eff,r}{}_{[ijksr]}$$

where

$\Delta L^{eff}{}_{[ijksr]}$ is the radiometric error

$L^{eff,m}{}_{[ijksr]}$ is the measured *effective radiance*

$L^{eff,r}{}_{[ijksr]}$ is the reference *effective radiance*

i and *j* identify the *spatial sample* within a *swath*/*dwell* or the *pixel* within a *repeat cycle* in terms of *column* and *row*

k is the *spectral sample* or *spectral channel*

s is the *swath* or *dwell* of a *repeat cycle* when considering *spatial samples*

r is the *repeat cycle*

Note: In this definition the measured *effective radiance* is assumed to contain calibration related errors and *radiometric noise* contributions, whereas the reference *effective radiance* is derived using a perfectly characterised reference *spectral response function* viewing a scene, traceable to a radiometric standards (e.g. National Physical Laboratory (UK)), with zero *radiometric noise* contribution.

[Conventions and Terms] Radiometric Noise iss: 3G

The *radiometric noise* is the standard deviation of the *radiometric error* associated with a *spectral sample surface* or a *spectral channel* respectively, collected during one *repeat cycle*. When expressed in this form the *radiometric noise* is given as *noise equivalent delta radiance* (NEdL).

$$NEdL^{eff}{}_{[kr]} = \sqrt{\frac{\sum_s \sum_i \sum_j \left(\Delta L^{eff}{}_{[ijksr]}\right)^2}{n} - \overline{\Delta L^{eff}{}_{[kr]}}^2}$$

$$n = \sum_s \sum_i \sum_j 1$$

where

$\Delta L^{eff}{}_{[ijksr]}$ is the *radiometric error*

$\overline{\Delta L^{eff}{}_{[kr]}}$ is the *radiometric accuracy*

$NEdL^{eff}{}_{[kr]}$ is the *noise equivalent delta radiance*

i and *j* identify the *spatial sample* within a *swath*/*dwell* or the *pixel* within a *repeat cycle* in terms of *column* and *row*

k is the *spectral sample* or *spectral channel*

s is the *swath* or *dwell* of a *repeat cycle* when considering *spatial samples*

r is the *repeat cycle*

n is the number of *spatial samples* or *pixels* in the *repeat cycle*

For the infrared (IR) *spectral channels*, the *radiometric noise* can be given in terms of *noise equivalent delta temperature* (NEdT) associated with a blackbody temperature at which the NEdT is computed.

$$NEdT_{[kr]} = \frac{NEdL^{eff}{}_{[kr]}.n}{\sum_s \sum_i \sum_j \int_0^{+\infty} SRF^r_{[ijskr]}(\xi).\frac{\partial B(\xi,T)}{\partial T}.d\xi} \approx \frac{NEdL^{eff}{}_{[kr]}}{\partial B(\xi_0,T)/\partial T}$$

where

$NEdT_{[kr]}$ is the *noise equivalent delta temperature*

$\frac{\partial B(\xi,T)}{\partial T}$ is the *Planck function derivative in temperature*

$SRF^{r}_{[ijskr]}(\xi)$ is the reference *spectral response function*

ξ_0 is the *spectral channel* reference position; *central wavelength* for the FCI and *wavenumber* of the *spectral channel* for the IRS.

For the VIS/NIR *spectral channels*, the *radiometric noise* can be given in terms of *signal to noise ratio* (SNR) associated with a signal at which the SNR is computed.

$$SNR_{[kr]} = \frac{\overline{L^{eff}{}_{[kr]}}}{NEdL^{eff}{}_{[kr]}}$$

$$\overline{L^{eff}{}_{[kr]}} = \frac{\sum_{s}\sum_{i}\sum_{j} L^{eff}{}_{[ijksr]}}{n}$$

where

$SNR_{[kr]}$ is the *signal to noise ratio*

$L^{eff}{}_{[ijksr]}$ is the measured *effective radiance*

Note: *Radiometric noise* applies to radiometrically calibrated spectra, meaning that the noise induced by *radiometric calibration* is included.

[Conventions and Terms] 1/f Noise iss: 3B

1/f noise is a non-stationary noise associated with each *pixel*; when present, this noise causes each *pixel* to drift with respect to the other *pixel*s on the array in a spatially uncorrelated manner.

1/f noise is the component of the *noise power spectral density* that falls of according to the formula.

$$NPSD^{1/f}{}_{[pqksr]} = a.\kappa_p^{m_p}.\kappa_q^{m_q}$$

$$m_p \approx -1$$

$$m_q \approx -1$$

where

$NPSD^{1/f}{}_{[pqksr]}$ is the *noise power spectral density* 1/f noise component

a is a constant of proportionality for the 1/f noise component

m_p and m_q are constants defining the slope of the 1/f noise in a logarithmic plot in the *column* and *row* directions

κ_p and κ_q are the *normalised spatial frequencies* in the *column* and *row* directions

p and q identify the sample in the spatial frequency domain in the ‘directions’ of *column* and *row* respectively

k is the *spectral sample* or *spectral channel*

s is the *swath* or *dwell* of a *repeat cycle* {when considering *spatial samples*}

r is the *repeat cycle*

See *white noise* for the derivation of the constants from the *noise power spectral density*.

Synonyms: Pink noise

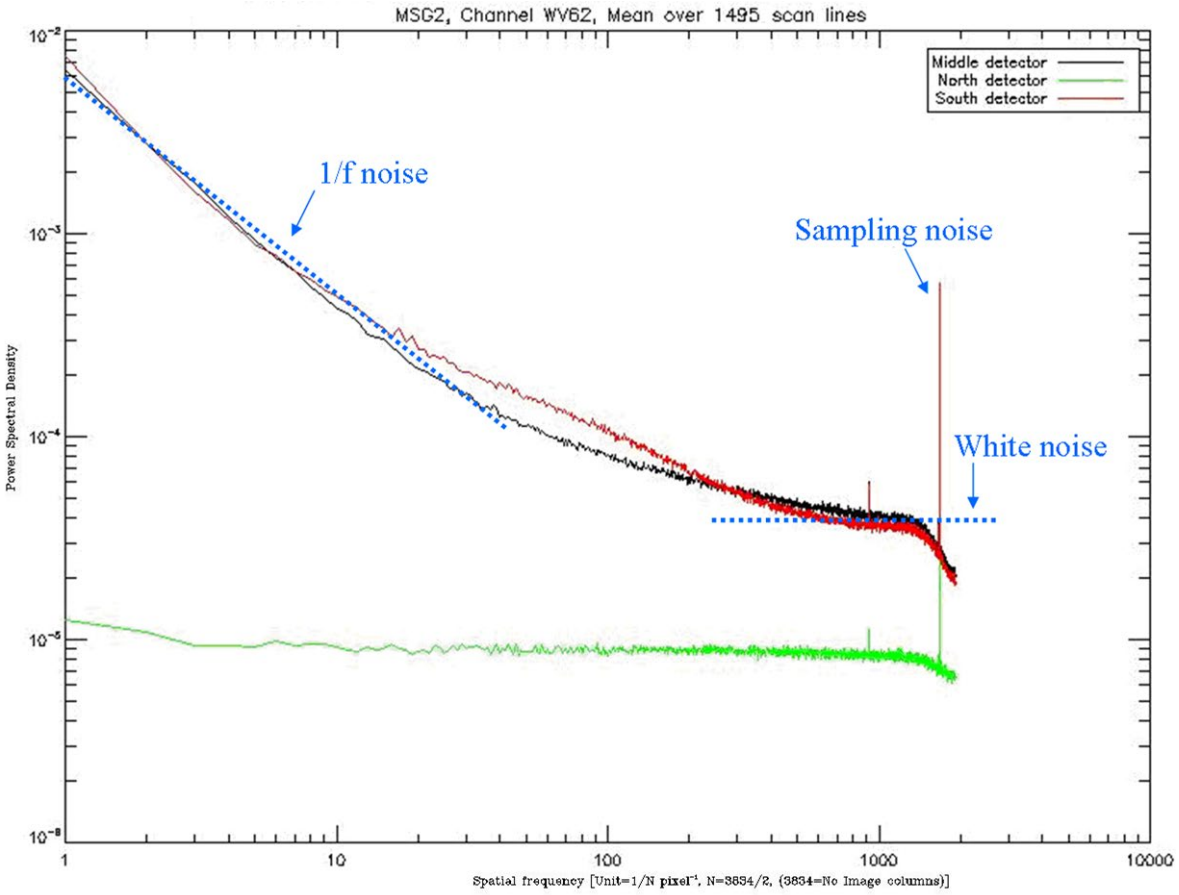


Figure 33: Example of* 1/f noise *and* white noise *characterisation

[Conventions and Terms] Radiometric Scaling Function iss: 4C

The radiometric scaling function is used to derive radiometric requirements for measurement conditions different from the reference case.

For the IR *spectral channels*, the radiometric scaling function, applied to radiometric requirements given in equivalent temperature, is given by the equation

$$R(T^m) = R(T^r)\cdot\frac{\partial B(\xi_0, T^r)/\partial T}{\partial B(\xi_0, T^m)/\partial T}$$

Where

$R(T^m)$ and $R(T^r)$ are the radiometric requirements for the measured and reference temperatures respectively

$\partial B(\xi_0, T^m)/\partial T$ and $\partial B(\xi_0, T^r)/\partial T$ are the *Planck function derivative in temperature* for the measured and reference temperatures respectively

ξ_0 is the *spectral channel* reference position, being *central wavelength* for the FCI and position given by the *wavenumber* for the IRS.

T^m and T^r are the measured and reference temperatures respectively

For the FCI IR3.8 *spectral channel*, the radiometric scaling function, applied to radiometric requirements given in equivalent temperature, is given by the equation

$$R(T^m) = R(T^r).\frac{\partial B(\xi_0, T^r)/\partial T}{\partial B(\xi_0, T^m)/\partial T}$$; for Tm≤Tr

$$R(T^m) = R(T^r).\sqrt{\frac{\partial B(\xi_0, T^r)/\partial T}{\partial B(\xi_0, T^m)/\partial T}}$$; for Tm>Tr

For the VIS/NIR *spectral channels*, the radiometric scaling function, applied to radiometric requirements given as *signal to noise ratio*, is given by the equation:

$$SNR^m = SNR^r.\sqrt{\frac{\rho^m(\lambda_0).\cos(\theta^{sun,m})}{\rho^r(\lambda_0).\cos(\theta^{sun,r})}}$$

Where

SNR^m and SNR^r are the *signal to noise ratios* for the measured and reference conditions respectively

$\rho^m(\lambda_0)$ and $\rho^r(\lambda_0)$ are the *reflectance* at the TOA for the measured and reference conditions respectively.

$\theta^{sun,m}$ and $\theta^{sun,r}$ are the solar zenith angles for the measured and reference conditions respectively

λ_0 is the *central wavelength* of the *spectral channel*

The radiometric scaling function, applied to radiometric requirements given as a percentage, is given by the equation:

$$R(L^m) = R(L^r).\frac{\rho^r(\lambda_0).\cos(\theta^{sun,r})}{\rho^m(\lambda_0).\cos(\theta^{sun,m})}$$

Where

$R(L^m)$ and $R(L^r)$ are the radiometric requirement in percent for the measured and reference *radiances* respectively

[Conventions and Terms] Radiometric Resolution iss: 3B

The radiometric resolution is the minimum radiometric quantization step of an instrument.

[Conventions and Terms] Noise Equivalent delta Temperatureiss: 3B

See *radiometric noise*.

Synonyms: *noise equivalent differential temperature*, *noise equivalent temperature*

[Conventions and Terms] Noise Equivalent differential Temperature iss: 3B

Synonym for *noise equivalent delta temperature*.

[Conventions and Terms] Noise Equivalent Temperature iss: 3B

Synonym for *noise equivalent delta temperature*.

[Conventions and Terms] Noise Equivalent delta Radiance iss: 3B

See *radiometric noise*.

Synonyms: *noise equivalent differential radiance*.

[Conventions and Terms] Noise Equivalent differential Radiance iss: 3B

Synonym for *noise equivalent delta radiance*.

[Conventions and Terms] Signal to Noise Ratio iss: 3B

See *radiometric noise*.

[Conventions and Terms] Radiometric Accuracy iss: 3B

The radiometric accuracy is the mean *radiometric error* associated with a *spectral sample surface* or a *spectral channel*, collected during a *repeat cycle*. In terms of *effective radiance* this is expressed by the equation

$$\overline{\Delta L^{eff}{}_{[kr]}} = \frac{\sum_s \sum_i \sum_j \Delta L^{eff}{}_{[ijksr]}}{n}$$

$$n = \sum_s \sum_i \sum_j 1$$

Where

$\overline{\Delta L^{eff}{}_{[kr]}}$ is the radiometric accuracy expressed as an *effective radiance*

$\Delta L^{eff}{}_{[ijksr]}$ is the *radiometric error*

i and *j* identify the *spatial sample* within a *swath*/*dwell* or the *pixel* within a *repeat cycle* in terms of *column* and *row*

k is the *spectral sample* or *spectral channel*

s is the *swath* or *dwell* of a *repeat cycle* {when considering *spatial samples*}

r is the *repeat cycle*

n is the number of *spatial samples* or *pixels* in the *image*

For the IR *spectral channels* the radiometric accuracy is measured in terms of a brightness temperature; this can be related to the *effective radiance* expression by the equation

$$\overline{\Delta T_{[kr]}} = \frac{\overline{\Delta L^{eff}{}_{[kr]}}.n}{\sum_s \sum_i \sum_j \int_0^{+\infty} SRF^r_{[ijksr]}(\xi).\frac{\partial B(\xi,T)}{\partial T}.d\xi} \approx \frac{\overline{\Delta L^{eff}{}_{[kr]}}}{\partial B(\xi_0,T)/\partial T}$$

where

$\overline{\Delta T_{[kr]}}$ is the radiometric accuracy expressed as a brightness temperature

$\frac{\partial B(\xi,T)}{\partial T}$ is the *Planck function derivative in temperature*

$SRF^r_{[ijksr]}(\xi)$ is the reference *spectral response function*

ξ_0 is the *spectral channel* reference position; *central wavelength* for the FCI and *wavenumber* of the *spectral channel* for the IRS.

For the VIS/NIR *spectral channels* the radiometric accuracy is expressed as a percentage of the *effective radiance* when viewing the solar *irradiance* reflected with a *reflectance* of $\rho(\lambda)$ and a solar zenith angle of θ_s; this can be related to the *effective radiance* expression by the equation

$$\overline{\Delta L^{sun}{}_{[kr]}} = \frac{\overline{\Delta L^{eff}{}_{[kr]}}.\pi.n}{\sum_s \sum_i \sum_j \int_0^{+\infty} SRF^r_{[ijksr]}(\lambda).\rho(\lambda).E^{sun}{}_{\lambda}(\lambda).\cos(\theta^{sun})d\lambda}.100$$

$\overline{\Delta L^{sun}{}_{[kr]}}$ is the radiometric accuracy expressed as a percentage of the *effective radiance* when viewing the solar *irradiance* reflected with a *reflectance* of $\rho(\lambda)$ and a solar zenith angle of θ^{sun}.

$\rho(\lambda)$ is the *reflectance* at TOA

$E^{sun}{}_{\lambda}(\lambda)$ is the sun extraterrestrial spectral *irradiance* perpendicular to the direction of propagation given in Figure 21

λ is wavelength

θ^{sun} is the solar zenith angle

Note: The above definition deviates from the ISO 5725:1998 usage of the term accuracy.

[Conventions and Terms] Radiometric Stability iss: 3G

The radiometric stability is the absolute value of the difference between the *radiometric accuracy* of two different *images*.

$$\overline{\Delta L^{eff}{}_{[k(r1-r2)]}} = \overline{\Delta L^{eff}{}_{[kr1]}} - \overline{\Delta L^{eff}{}_{[kr2]}}$$

where

$\overline{\Delta L^{eff}{}_{[k(r1-r2)]}}$ is the radiometric stability

$\overline{\Delta L^{eff}{}_{[kr]}}$ is the *radiometric accuracy*

k is the *spectral sample* or *spectral channel*

r is the *repeat cycle*

r1 and *r2* are two different *repeat cycles*

For the IR *spectral channels* the radiometric stability is measured in terms of a brightness temperature; this can be related to the *effective radiance* expression by the equation

$$\overline{\Delta T_{[k(r1-r2)]}} = \frac{\overline{\Delta L^{eff}{}_{[k(r1-r2)]}}.2.n}{\sum_{s}\sum_{i}\sum_{j}\int_{0}^{+\infty}\left(SRF^{r}_{[ijksr1]}(\xi)+SRF^{r}_{[ijksr2]}(\xi)\right)\frac{\partial B(\xi,T)}{\partial T}.d\xi} \approx \frac{\overline{\Delta L^{eff}{}_{[k(r1-r2)]}}}{\partial B(\xi_0,T)/\partial T}$$

$$n = \sum_{s}\sum_{i}\sum_{j}1$$

where

$\overline{\Delta T_{[k(r1-r2)]}}$ is the radiometric stability

$\frac{\partial B(\xi,T)}{\partial T}$ is the *Planck function derivative in temperature*

$SRF^{r}_{[ijksr1]}(\xi)$ is the reference *spectral response function*

i and *j* identify the *spatial sample* within a *swath*/*dwell* or the *pixel* within a *repeat cycle* in terms of *column* and *row*

s is the *swath* or *dwell* of a *repeat cycle* when considering *spatial samples*

ξ is the *spectral variable*

ξ_0 is the *spectral channel* reference position; *central wavelength* for the FCI and *wavenumber* of the *spectral channel* for the IRS.

n is the number of *spatial samples* or *pixels* in the *image*

For the VIS/NIR *spectral channels* the radiometric stability is expressed as a percentage of the *effective radiance* when viewing the solar *irradiance* reflected with a *reflectance* of $\rho(\lambda)$ and a solar zenith angle of θ^{sun}; this can be related to the *effective radiance* expression by the equation

$$\overline{\Delta L^{sun}_{[k(r1-r2)]}} = \frac{\overline{\Delta L^{eff}_{[k(r1-r2)]}}.\pi.2.n}{\sum_s \sum_i \sum_j \int_0^{+\infty} \left(SRF^r_{[ijksr1]}(\lambda) + SRF^r_{[ijksr2]}(\lambda)\right).\rho(\lambda).E^{sun}{}_{\lambda}(\lambda).\cos\left(\theta^{sun}\right)d\lambda}.100$$

where

$\overline{\Delta L^{sun}_{[k(r1-r2)]}}$ is the radiometric stability expressed as a percentage of the *effective radiance* when viewing the solar *irradiance* reflected with a *reflectance* of $\rho(\lambda)$ and a solar zenith angle of θ^{sun}.

$\rho(\lambda)$ is the *reflectance* at TOA

$E^{sun}{}_{\lambda}(\lambda)$ is the sun extraterrestrial spectral *irradiance* perpendicular to the direction of propagation given in Figure 21

λ is wavelength

θ^{sun} is the solar zenith angle

[Conventions and Terms] Medium Term Radiometric Stability iss: 4I

For the FCI **IR** *spectral channels* the medium term *radiometric stability* is the radiometric stability between any two *images* lying in the interval between two calibration cycles. For the FCI **VIS/NIR** *spectral channels* the medium term radiometric stability is the *radiometric stability* evaluated between any two *images* separated by less than or equal to 24 hours. For the IRS *spectral channels* the medium term radiometric stability is the *radiometric stability* evaluated between any two sounding LAC's or FDC's separated by less than or equal to 24 hours.

[Conventions and Terms] Long Term Radiometric Stability iss: 3G

The long term radiometric stability is the *radiometric stability* evaluated between any two *images* separated by less than or equal to the *satellite nominal operational lifetime*.

[Conventions and Terms] LI Triggered Event iss: 3B

A triggered event occurs when the energy registered by a *detector element* exceeds the *LI trigger threshold*.

[Conventions and Terms] LI Trigger Threshold iss: 3B

The trigger threshold is used, at *detector element* level to discriminate a *lightning optical pulse* from the background *radiance*.

[Conventions and Terms] LI background radiance images iss: 3B

The Background Radiance for each LI *detector element* in the LI *detector array* averaged over a given time interval.

[Conventions and Terms] Lightning Event iss: 3B

A lightning event is defined as a *LI triggered event* caused by a *lightning optical pulse*.

Annex F.4.6 Spatial and Temporal

[Conventions and Terms] Field of View iss: 3B

The field of view (FOV) is the solid angle subtended by some portion of an instrument. The term can be applied to a *detector element*, a *detector array*, a focal plane containing multiple *detector arrays* or the complete instrument

Note: Usage of the term field of view without a specific reference to the item under consideration is often confusing. Care should be exercised when using this term.

[Conventions and Terms] Spatial Sample iss: 3B

A spatial sample is a spatial location in the area of *coverage* at which an instrument returns a measurement.

For the FCI: The spatial sample is associated with a single *radiance sample* per *spectral channel*

For the IRS: The spatial sample is associated with a single *radiance sample* per *spectral sample* in the case of a non-resampled spectra, a single *radiance sample* per *spectral channel* in the case of a resampled spectra and the mean *radiance sample* for all *spectral samples* in the case of an *spectral sounding* interferogram.

For the LI: The spatial sample is associated with a single *radiance sample* for the single defined *spectral channel*

The spatial sample, identified by the indices (i,j), is spatially located at (x_i,y_j), where this location corresponds to the position of its *point spread function centroid*.

See also *radiance sample*.

[Conventions and Terms] Point Spread Function iss: 4

The Point Spread Function (PSF) is defined as the output signal to input spectral *radiant intensity* ratio, with the output signal being the *effective radiance* measured by the instrument when observing a spectrally uniform point source. The PSF is specific to the selected *spatial sample* or *pixel* and *spectral sample* or *spectral channel* and is a function of the spatial position. The PSF units are m^{-2}.

The PSF can be equivalently defined as integral of IRF

$$PSF_{[ijksr]}(x,y) = \int_{0}^{+\infty} IRF_{[ijksr]}(x,y,\xi)d\xi$$

where

$PSF_{[ijksr]}(x,y)$ is the point spread function

$IRF_{[ijksr]}(x,y,\xi)$ is the *instrument response function*

i and *j* identify the *spatial sample* within a *swath*/*dwell* or the *pixel* within a *repeat cycle* in terms of *column* and *row*

k is the *spectral sample* or *spectral channel*

s is the *swath* or *dwell* of a *repeat cycle* when considering *spatial samples*

r is the *repeat cycle*

x and *y* are the spatial variables

ξ is the *spectral variable*

As a consequence of the above definition, in the special case where the scene is spectrally uniform, the PSF can be used (in place of the IRF) to evaluate the instrument output by the equation:

$$L^{eff}{}_{[ijksr]} = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} PSF_{[ijksr]}(x,y).L_{\xi}(x,y)dxdy$$

where

$L^{eff}{}_{[ijksr]}$ is the *effective radiance* including all the spectral and spatial filtering actions produced by the combined effect of the optical system, the detector and processing up to point of interest.

$L_{\xi}(x,y)$ is the spectral *radiance* of the scene

Another consequence of the definition is the fact that the integral of PSF along the spatial variables is unity.

$$\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} PSF_{[ijksr]}(x,y)dxdy = 1$$

Note: In the definition of PSF the instruments are assumed to be linear.

Annex F.4.7 Geometric

[Conventions and Terms] Image Rectification iss: 3B

Image rectification is the process creating a *level 1c image* from a *level 1b image*. The *level 1c image* has the property that there is a well-defined and invariant relationship between *image* coordinates (*rows* and *columns*) and the Earth location (*geodetic latitude* and longitude). In order to achieve this transformation the *radiance samples* associated with the *level 1b spatial samples* are interpolated from the *estimated grid* to the *reference grid* to give *radiance samples* for each *level 1c pixel*.

[Conventions and Terms] Image Navigation iss: 3B

Image navigation specifically refers to the knowledge of the relationship between a *spatial sample* in instrument coordinates and the corresponding point on the earth, given by latitude and longitude coordinates. In general, image navigation refers to the methods employed to obtain that knowledge, whereas image navigation accuracy is a measure of how well that relationship is known. Image navigation is used to derive the *verification grid* of past *spatial sample* positions, where means to derive this knowledge are available. When used to derive the position of future *spatial samples* based on past information the *estimated grid* is generated.

[Conventions and Terms] Image Registration iss: 3B

Image registration is an indication as to how well *image navigation* knowledge is maintained and controlled between *images* separated over time or between different *spectral channels* or instruments.

[Conventions and Terms] Pixel iss: 3B

A pixel is a precise location on the *reference grid* at which an instrument returns a measurement. The pixel is constructed from a number of *spatial samples* that have been interpolated to the given *reference grid* location during the *image rectification* process.

The pixel, identified by the indices (i,j), is spatially located at (x_i,y_j).

See also *radiance sample*.

Note: Like the *spatial sample* the pixel also possess a *point spread function* that may extend over a number of SSDs in all directions, i.e. it will not be same as a square of sides SSD in length.

[Conventions and Terms] Actual Site iss: 3B

The actual site (AS) of a *spatial sample* corresponds to the *centroid* of the true projection of the *spatial sample point spread function* on the Earth's surface at the time of measurement.

Note: The combined actual sites of an *image* give the *actual grid*.

[Conventions and Terms] Measured Site iss: 3B

The measured site (MS) of a *spatial sample* corresponds to the estimate of the *spatial sample actual site* as derived from the *image navigation* process and used in the *image rectification* process or delivered as *IDP auxiliary data* with the *level 1b* data.

Note: The combined measured sites of an *image* give the *estimated grid*.

[Conventions and Terms] Reference Site iss: 3B

The reference site (RS) is the geographical location of a *pixel* and corresponds to one of the grid points of the *reference grid*.

[Conventions and Terms] Corrected Site iss: 3B

The corrected site (CS) is the true geographical location of the *centroid* of the PSF associated with a *pixel*. Ideally a corrected site corresponding to each *pixel* is measureable, but in practice only geographic features such as coast lines, mountains and lakes will be available.

Note: In practice the location of the geographic features will be to sub-SSD accuracy.

[Conventions and Terms] Absolute Sample Position Knowledge Error iss: 3B

The absolute sample position knowledge error (ASPKE) is defined by the equation

$$ASPKE_{[ijksrd]} = AS_{[ijksrd]} - MS_{[ijksrd]}$$

where

ASPKE is the absolute sample position knowledge error

AS is the *actual site*

MS is the *measured site*

i and *j* identify the *spatial sample* in terms of *column* and *row* within a *swath* or *dwell*

k is the *spectral channel*

s is the *swath* or *dwell* of a *repeat cycle*

r is the *repeat cycle*

d is the direction of evaluation (north/south or east/west)

[Conventions and Terms] Absolute Pixel Position Knowledge Error iss: 3B

The absolute *pixel* position knowledge error (APPKE) is defined by the equation

$$APPKE_{[ijkrd]} = CS_{[ijkrd]} - RS_{[ijkrd]}$$

where

APPKE is the absolute *pixel* position knowledge error

CS is the *corrected site*

RS is the *reference site*

i and *j* identify the *pixel* in terms of *column* and *row* within an *repeat cycle*

k is the *spectral channel*

r is the *repeat cycle*

d is the direction of evaluation (north/south or east/west)

[Conventions and Terms] Coregistration iss: 3B

Coregistration is used to describe the relative position of the *spatial sample*s or *pixel*s between different *spectral channels* of an instrument or between instruments. The term can be applied to the spatial or the temporal position of *spatial sample*s or *pixel*s.

[Conventions and Terms] Relative Sample Position Error iss: 3B

The relative sample position error (RSPE) is defined by the equation

$$RSPE_{[ij(k1-k2)s(r1-r2)d]} = AS_{[ijk1sr1d]} - AS_{[ijk2sr2d]}$$

where

RSPE is the relative sample position error

AS is the *actual site*

i ,j identify the *spatial sample* in terms of *column* and *row* within a *swath* or *dwell*

s is the *swath* or *dwell*

k1 and *k2* are two *spectral channels*

r1 and *r2* are two *repeat cycles*

d is the direction of evaluation (north/south or east/west)

The RSPE is assessed between *spectral channels* for r1=r2 or *repeat cycles* for k1=k2

[Conventions and Terms] Relative Sample Position Knowledge Error iss: 3B

The relative sample position knowledge error (RSPKE) is defined by the equation

$$RSPKE_{[ij(k1-k2)s(r1-r2)d]} = \left(AS_{[ijk1sr1d]} - MS_{[ijk1sr1d]}\right) - \left(AS_{[i'j'k2s'r2d]} - MS_{[i'j'k2s'r2d]}\right)$$

where

RSPKE is the relative sample position knowledge error

AS is the *actual site*

MS is the *measured site*

i ,j,s identify the *spatial sample* in terms of *column*, *row* and *swath* or *dwell* for *spectral channel k1* and *repeat cycle r1*

s is the *swath* or *dwell* of *spectral channel k1* and *repeat cycle r1*

i′*, j′, s′* identify the *spatial sample* in terms of *column*, *row* and *swath* or *dwell* for *spectral channel k2* and *repeat cycle r2* that lies closest in terms of the *measured site* position to *spatial sample (i,j,s)* of *spectral channel k1* and *repeat cycle r1*

k1 and *k2* are two *spectral channels*

r1 and *r2* are two *repeat cycles*

d is the direction of evaluation (north/south or east/west)

The RSPKE is assessed by the process of *image registration* between *spectral channels* for r1=r2 or *repeat cycles* for k1=k2

Synonyms: misregistration, *coregistration*

Note: RSPKE is only given for *spectral channels* of identical *spatial sampling distance*.

[Conventions and Terms] Relative Pixel Position Knowledge Error iss: 3G

The relative *pixel* position knowledge error (RPPKE) is defined by the equation

$$RPPKE_{[ij(k1-k2)(r1-r2)d]} = \left(CS_{[ijk1r1d]} - RS_{[ijk1r1d]}\right) - \left(CS_{[ijk2r2d]} - RS_{[ijk2r2d]}\right)$$

where

RPPKE is the relative *pixel* position knowledge error

CS is the *corrected site*

i and *j* identify the *pixel* or *pixel* group in terms of *column* and *row* within a *repeat cycle*

k1 and *k1* are two *spectral channels*

r1 and *r2* are two *repeat cycles*

d is the direction of evaluation (north/south or east/west)

The RPPKE is assessed by the process of *image registration* between *spectral channels* for r1=r2 or *repeat cycles* for k1=k2

When the RPPKE between *spectral channels* with differing *spatial sampling distance* is required:

A group of p^2 of the finer resolution *spectral channel pixels* centred on a coarse resolution *pixel* is taken as a *pixel* group. Each fine resolution *pixel* group is identified by the indices (i,j) of the coarse resolution *pixel*.

$$p = \frac{SSD_{coarse}}{SSD_{fine}}$$

where

SSD_{coarse} is the coarse resolution *spatial sampling distance*

SSD_{fine} is the fine resolution *spatial sampling distance*

The *reference site* for the fine resolution *pixel* group is the mean *reference site* of the fine resolution *pixels*. Due to the properties of the *reference grid* this means that the fine resolution *pixel* group and coarse resolution *pixel* are located at the same position. Likewise the *corrected site* for the fine resolution *pixel* group is the mean *corrected site* of the fine resolution *pixels*.

Synonyms: misregistration, *coregistration*

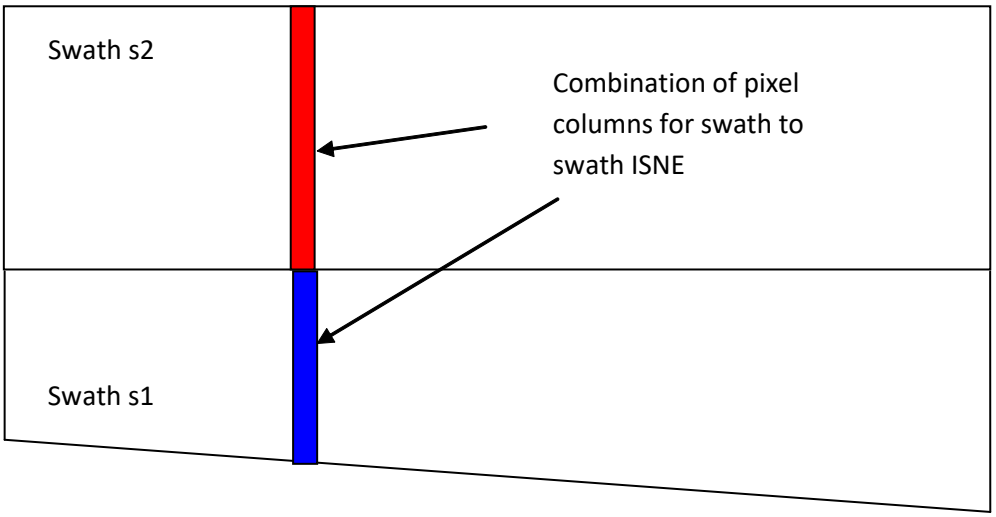


Figure 34: **Columns** *for ISNE Calculation*

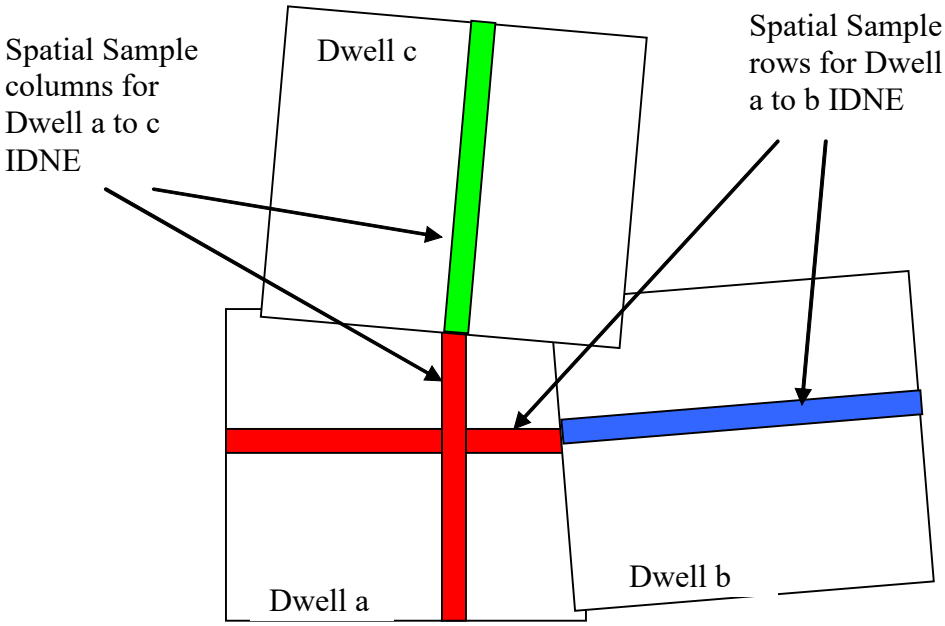


Figure 35: **Columns** *and* **Rows** *for IDNE Calculation*

Annex F.4.8 Restricted Operations

[Conventions and Terms] Eclipse iss: 3B

Eclipse is defined as when the solar disk is occulted by the Earth or Moon, as viewed from the MTG *satellite*. An eclipse can be total or partial.

The eclipse start is the time at which the sun starts to be occulted by the Earth or moon.

The maximum depth of an eclipse occurs at the time when the sun centre crosses the plane containing the *satellite* and Earth (or moon) centre lying perpendicular to the sun's direction of relative motion in *satellite* centred reference frame with the x axis pointing to the Earth (or moon) centre.

The solar restricted zones are applicable for the uneclipsed and partially eclipsed sun. It is defined to allow graded relaxation of requirements for *spatial samples* and *pixels* located close to the sun.

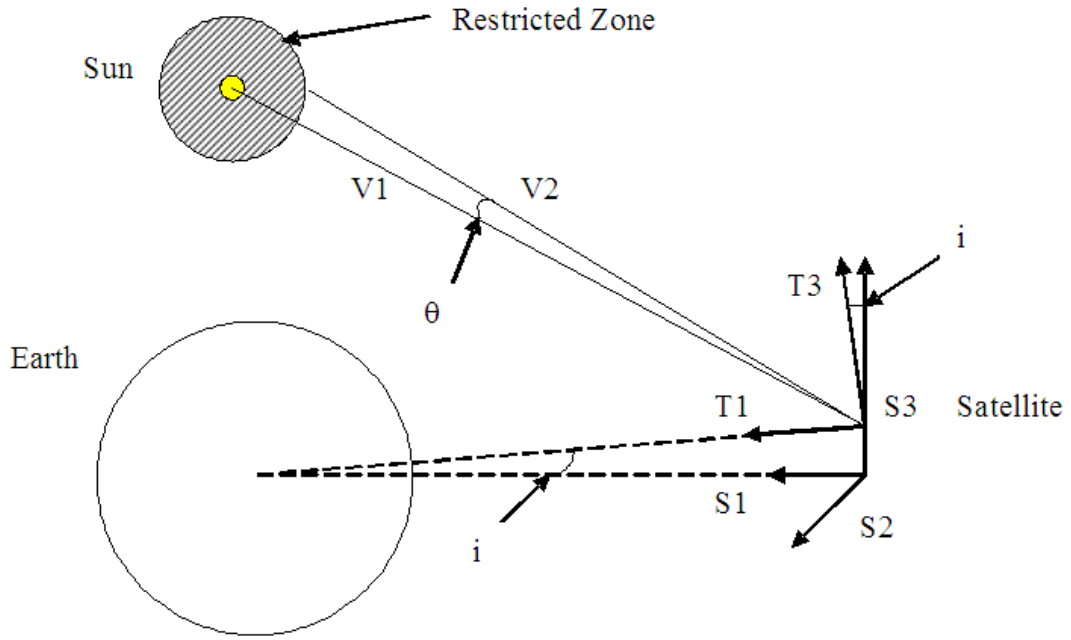


Figure 36: Illustration of Solar Restricted Zones including orbit inclination

Annex F.5 Coordinates Frame Conventions

Annex F.5.4 Body Frame Specifications

Annex F.5.4.1 MTG Satellite Coordinate Frames

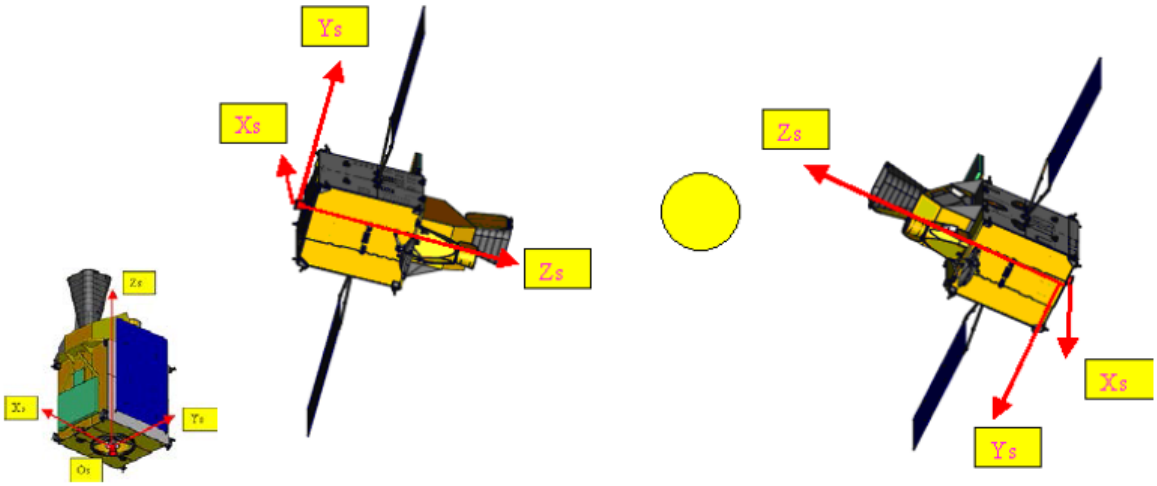


Figure 37: Schematic S/C Coordinate System

Annex F.5.4.2 Local Orbital Frame

[Conventions and Terms] Local Orbital Frame (LVLH) iss: 3B

'LVLH' stands for 'Local Vertical Local Horizontal'.

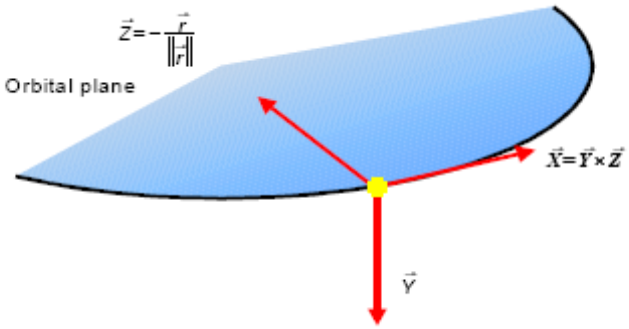


Figure 38: Local Orbital LVLH frame

[Conventions and Terms] Local Orbital Frame (T,N,W) iss: 3B

In 'TNW', T stands for tangential, N for normal, and W for the Greek omega (ω) denoting the axis of angular momentum.

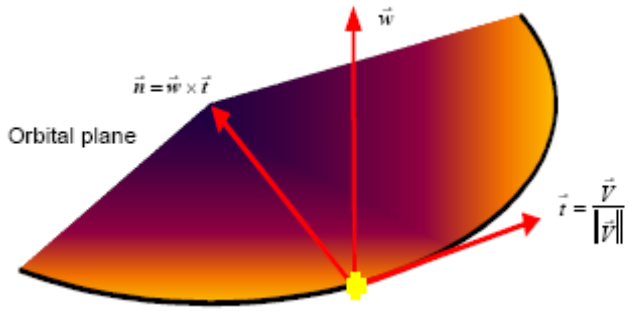


Figure 39: Local Orbital TNW frame

[Conventions and Terms] Local Orbital Frame (Q,S,W) iss: 3B

Also named RTN (Radial, Transverse, Normal).

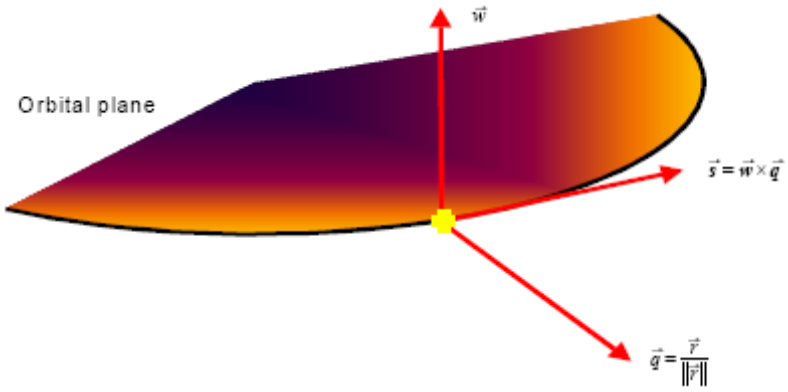


Figure 40: Local Orbital QSW frame

Annex F.5.6 Coordinate System Transformations

[Conventions and Terms] Normalized Geostationary Projection iss: 5A

The normalized geostationary projection describes the view from a virtual *satellite* to an idealized Earth. Herein, the virtual *satellite* is in a geostationary orbit, perfectly located in the Equator plane at the given longitude, λ_D. The distance between spacecraft and centre of Earth is given by the *geostationary radius* and the idealized Earth by the *Earth's reference ellipsoid*.

In the following a short description of the theoretical background is provided:

Two cartesian coordinate frames are introduced. (e_1,e_2,e_3) has its origin in the centre of the earth. (e_3) points in the northern direction, (e_1) points towards the Greenwich meridian. (s_1,s_2,s_3) has its origin at the *satellite* position. Again (s_3) points northwards, and (s_1) directs to the centre of the earth. Figure 30 visualizes this situation and identifies several angles and lengths used in the following.

The vector r_e points from the centre of the earth to a point P on the earth's surface. Thus, λ_e is the longitude and φ_e is the *geocentric latitude* describing the point P.

The transformation from *geographical coordinates* (lon, lat) to *geocentric latitude* and *geocentric longitude* is as follows:

$$\lambda_e = lon$$

$$\phi_e = \arctan\left(\frac{r_{pol}^2}{r_{eq}^2} \bullet \tan(lat)\right)$$

Where

r_{pol} is the earth's polar radius

r_{eq} is the earth's equatorial radius

Forwards Projection:

The cartesian components of the vector r_s (in the *satellite* coordinate frame) result as follows:

$$\vec{r}_S = \begin{pmatrix} r_1 \\ r_2 \\ r_3 \end{pmatrix} = \begin{pmatrix} h - r_e \cdot \cos(\phi_e) \cdot \cos(\lambda_e - \lambda_D) \\ - r_e \cdot \cos(\phi_e) \cdot \sin(\lambda_e - \lambda_D) \\ r_e \cdot \sin(\phi_e) \end{pmatrix}$$

Where

h is the *geostationary radius*

r_e is distance from the centre of the Earth to the point P on the earth's surface

$$r_e = \frac{r_{pol}}{\sqrt{1 - \frac{r_{eq}^2 - r_{pol}^2}{r_{eq}^2} \cdot \cos^2(\phi_e)}}$$

From the above equations the *satellite* scanning angles can be derived:

$$\lambda_s = \arctan\left(\frac{r_2}{r_1}\right)$$

$$\phi_s = \arcsin\left(\frac{r_3}{\sqrt{r_1^2 + r_2^2 + r_3^2}}\right)$$

Where

λ_s is the E-W scanning angle, but does not correspond to the standard definition of azimuth, for an observation from the instrument perspective, that runs from negative to positive in a clockwise sense. Instead λ_s but runs from negative to positive in an anti-clockwise sense. Thus *pixels* at the western side of the Earth have a lower index and a higher value of λ_s than those on the eastern side of the Earth.

ϕ_s is the N-S scanning angle and corresponds to the standard definition of elevation, for an observation from the instrument perspective.

Inverse Projection:

The inverse transformation can be used to convert from scanning angles (λ_s, ϕ_s) to *geographical coordinates*. This can be performed as follows:

$$\begin{pmatrix} lon \\ lat \end{pmatrix} = \begin{pmatrix} \arctan\left(\frac{s_2}{s_1}\right) + \lambda_D \\ \arctan\left(s_4 \cdot \frac{s_3}{s_{xy}}\right) \end{pmatrix}$$

Where:

$$s_1 = h - s_n \cdot \cos(\lambda_s) \cdot \cos(\phi_s)$$

$$s_2 = -s_n \cdot \sin(\lambda_s) \cdot \cos(\phi_s)$$

$$s_3 = s_n \cdot \sin(\phi_s)$$

$$s_4 = \frac{r_{eq}^2}{r_{pol}^2}$$

$$s_5 = \left(h^2 - r_{eq}^2\right)$$

$$s_{xy} = \sqrt{s_1^2 + s_2^2}$$

$$s_n = \frac{h \cdot \cos(\lambda_s) \cdot \cos(\phi_s) - s_d}{\cos^2(\phi_s) + s_4 \cdot \sin^2(\phi_s)}$$

$$s_d = \sqrt{(h \cdot \cos(\lambda_s) \cdot \cos(\phi_s))^2 - (\cos^2(\phi_s) + s_4 \cdot \sin^2(\phi_s)) \cdot s_5}$$

Scaling Function

The scaling function provides a linear relation between the intermediate coordinates or scanning angles (λ_s, ϕ_s), now written (x,y), and the image coordinates (c,r).

The definition is as follows:

$$c = (x_0 - x)/x\_scale + 1$$

$$r = (y - y_0)/y\_scale + 1$$

Where:

- r and c are the *row* and *column* respectively in the *reference grid*. Note that the first *row*, *column* of the *reference grid* is indexed 1,1.
- x_0 and y_0 gives the angle from the origin of the projection (the direction s_1) to the centre of the *pixel* in the first *row* and *column* of the *reference grid*.

x_scale and y_scale are the *reference grid spatial sampling angles*, representing scan angle increments between *pixels* in the W-E and S-N directions respectively.

Note: All trigonometric functions assume angles in degree.

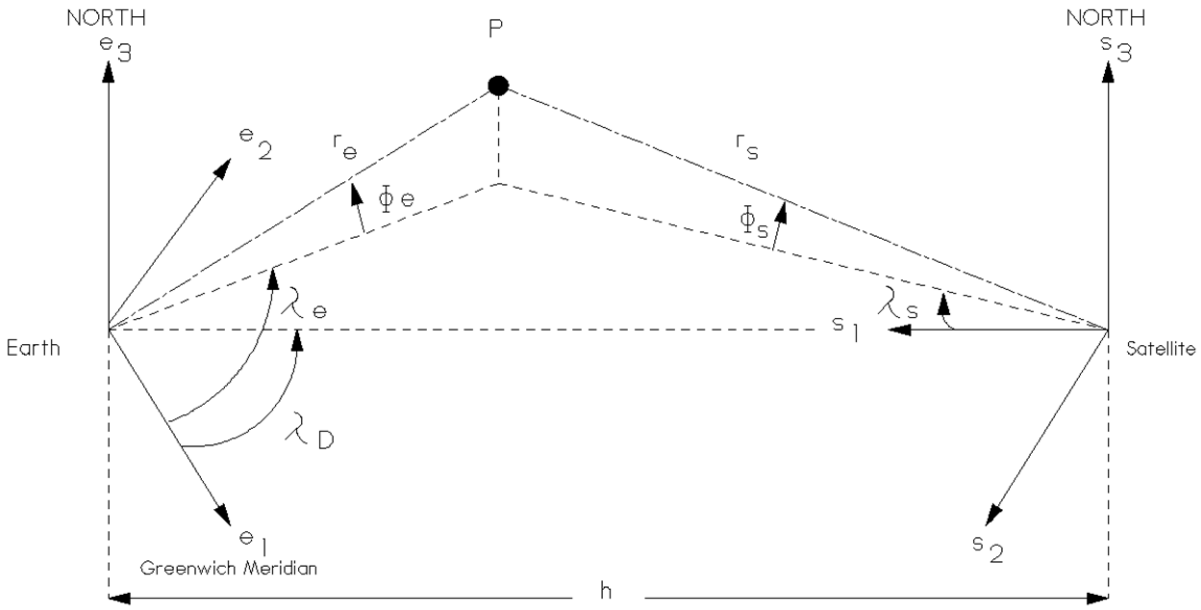


Figure 41: Coordinate Frames for Normalized Geostationary Projection

Annex F.6 System Parameter and Model Conventions

Annex F.6.1 Orbit and Attitude Parameters and Models

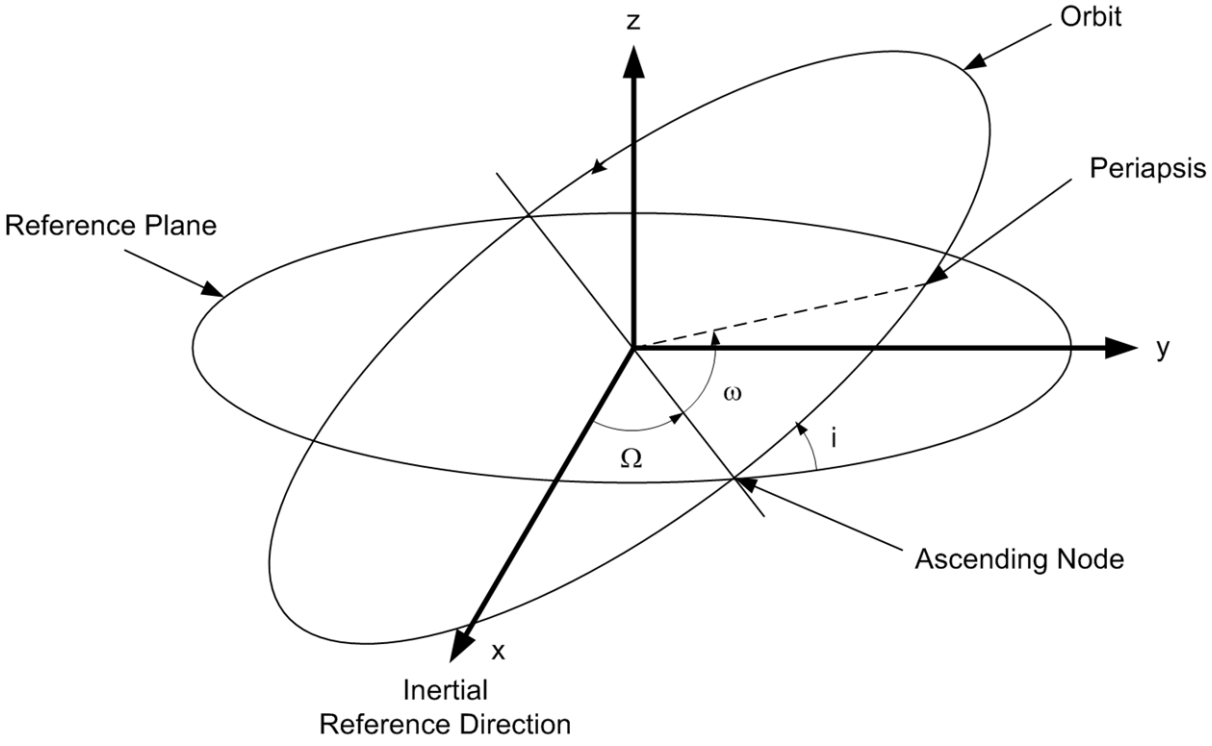


Figure 42: Classical Keplerian Orbit orientation angles

[Conventions and Terms] Geostationary Radius iss: 3B

The geostationary radius is the distance from the Earth's centre to the *satellite* in geostationary orbit and can be calculated from the sum of the *geostationary altitude* and the equatorial Earth radius, in turn derived from the *Earth's reference ellipsoid*.

[Conventions and Terms] Geostationary Altitude iss: 3B

The geostationary altitude (35786.4 km) is the distance from the *satellite* in geostationary orbit to the *sub-satellite point*.

Annex F.6.2 Earth related Parameters and Models

[Conventions and Terms] Geographical Coordinates iss: 3B

Geographical co-ordinates give a location on earth as determined by geographical longitude (lon) and geographical latitude (lat). Both co-ordinates are specified in degree.

The geographical longitude is counted eastwards positive, beginning at the Greenwich meridian. The permitted range is -180.0 ... +180.0. The geographical latitude is counted from -90.0 (south pole) through 0.0 (equator) until +90.0 (north pole).

Figure 32 shows the situation for a spherical model of the earth.

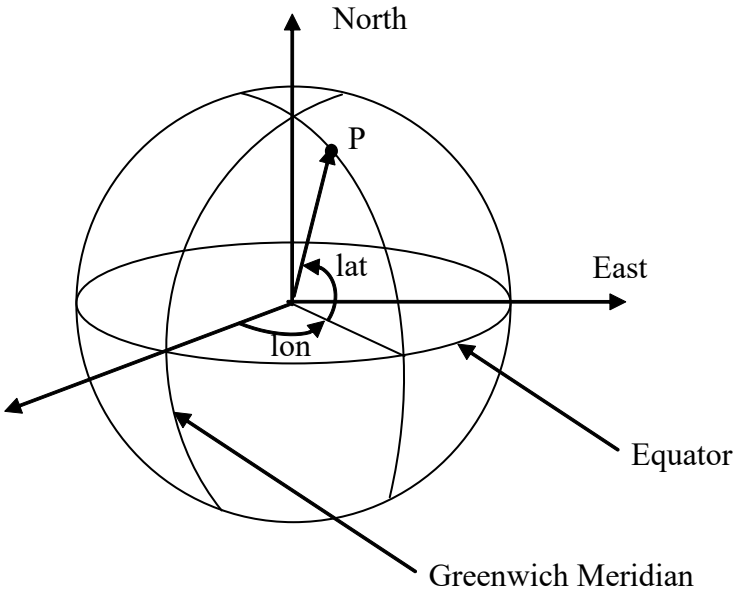


Figure 43: Geographical Coordinates

[Conventions and Terms] Geodetic position iss: 4G

The geodetic coordinates of a point are defined with respect to a given reference surface of the Earth (Earth´s Reference Ellipsoid). The normal projection of a point onto the local horizontal plane defines the *geodetic longitude* λ, latitude φ and the height h (see figure below).

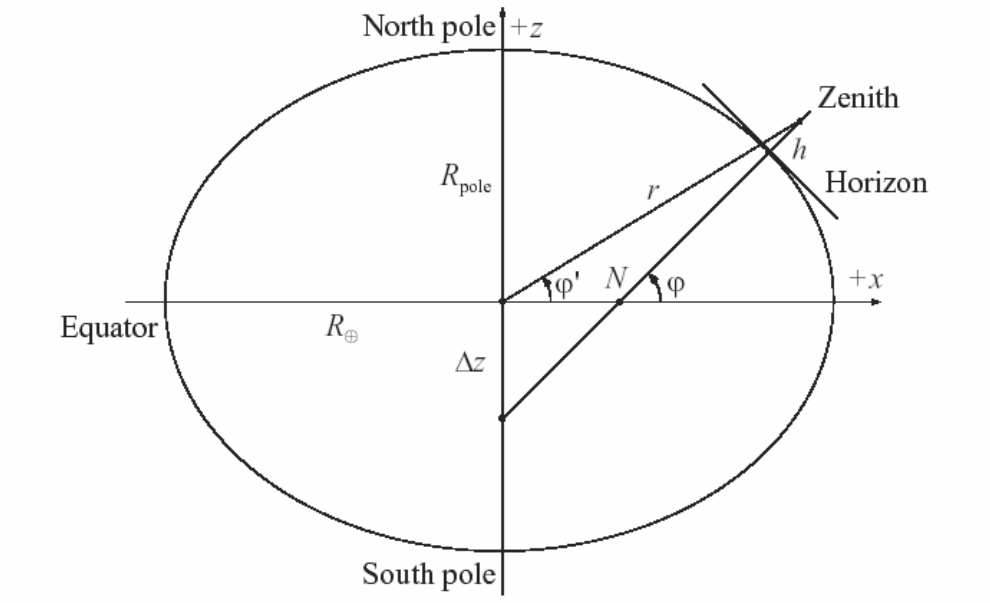


***Figure 44: Geocentric and* geodetic latitude**

[Conventions and Terms] Geodetic latitude iss: 5A

The geodetic latitude φ differs from the *geocentric latitude* φ' (see figure above) and are related by the expression:

$$\tan \varphi = \frac{1}{(1-f)^2} \tan \varphi'$$

[Conventions and Terms] Geocentric latitudeiss: 5A

The geocentric latitude is defined, with reference to Figure 33, as the angle, φ', between the equatorial plane and the radius from the centre or the earth to a point on the surface. See also *geographical coordinates*, *geodetic latitiude*.

Annex F.8 Date and Time Conventions

Annex F.8.1 Time Reference Systems

The following figure provides an overview of the differences between the most relevant time scales described in references [RD2] and [RD5]:

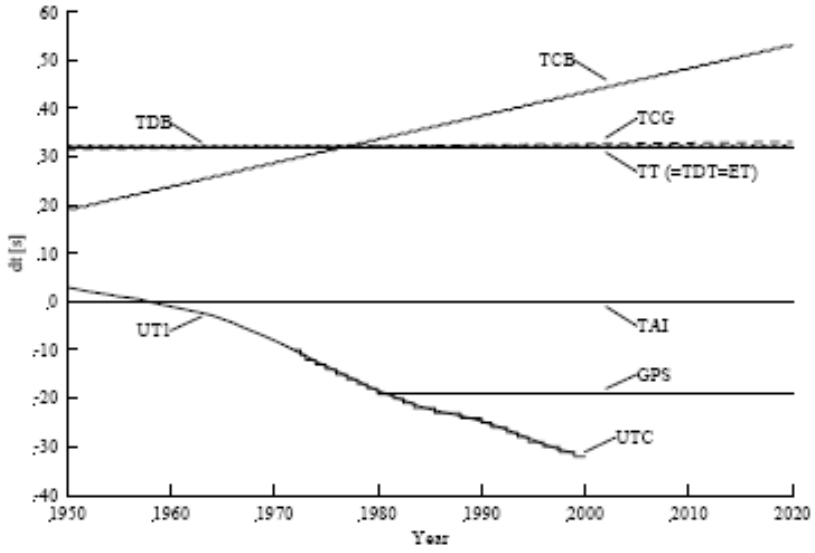


Figure 45: Differences between Relevant Time Scales between 1950 and 2020

Annex DGlossary

The following table lists definitions for all acronyms used in this document. It is a subset of the "MTG Glossary" document.

Acronym	Full name
AD	Applicable Document
AEG	Application Expert Group
AND	Alphanumeric Display
APPKE	Absolute Pixel Position Knowledge Error
ARGOS	Advanced Research and Global Observation Satellite
ASMET	African Satellite Meteorology Education and Training
ASPKE	Absolute Sample Position Knowledge Error
CAL	Calibration
CDOP	Continuous Development and Operational Phase
CGMS	Coordination Group for Meteorological Satellites
CNES	Centre National d'Etudes Spatiales (French Space Agency)
COSPAS	Cosmicheskaya Sistyema Poiska Avariynich Sudov (Space System for the Search of Vessels in Distress)
DCP	Data Collection Platforms
DCS	Data Collection System
DE	Detection Efficiency
DWD	Deutscher WetterDienst
E/W	East/West
EC	European Commission
ECMWF	European Centre for Medium Range Weather Forecasting
EO	Earth Observation
EOP	Earth Observation Portal
EPS	EUMETSAT Polar System
ESA	European Space Agency
EUMETCAL	The European Virtual Organisation for Meteorological Training
EUMETCast	EUMETSAT's Broadcast System for Environmental Data
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAR	False Alarm Rate
FAR	Final Acceptance Review
FAR	Flight Acceptance Review
FCI	Flexible Combined Imagery Mission
FDC	Full Disc Coverage
FDHSI	Full Disc High Spectral resolution Imagery mission
FDSS	Full Disc Scanning Service
FG	Fixed Gain
FOC	Full Operational Capability
FSD	Foreign Satellite Data
FTS	Fourier Transform Spectrometer
GEO	Geostationary Orbit
GEO	Group on Earth Observations
GEONETCast	global network of satellite based data dissemination systems
GEOSAR	Geostationary Search and Rescue mission
GIFTS	Geosynchronous Imaging Fourier Transform Spectrometer
GMES	Global Monitoring for Environment and Security
GTS	Global Telecommunication System
HQ	Headquarter
HRFI	High Resolution Fast Imagery mission
HRV	High Resolution Visible
IASI	Infrared Atmospheric Sounding Interferometer
IDCS	International Data Collection System

Acronym	Full name
IODC	Indian Ocean Data Coverage
IR	Infrared
IRS	Infrared Sounding Mission
LAC	Local Area Coverage
LI	Lightning Imagery Mission
LWIR	Long Wave Infra Red
MDD	Meteorological Data Distribution
MHz	MegaHertz
MIST	MTG IRS Science Team
MOSS	Meteosat Operation Service Specification
MSG	Meteosat Second Generation
MTG	Meteosat Third Generation
MTP	Meteosat Transistion Program
MWIR	Medium Wave Infra Red
N/A	Not Applicable
N/S	North/South
NEdT	Noise Equivalent Differential Temperature
NGA	National Geospatial Agency
NIR	Near-Infrared
NMS	National Meteorological Services
NMS	Network Monitoring System
NOAA	National Oceanic and Atmospheric Administration
NWP	Numerical Weather Prediction
OZA	Observation Zenith angle
PC	Principal components
PPP	Preparatory Programme Proposal
PRR	Preliminary Requirements Review
RMDCN	Regional Meteorological Data Communication Network
RPPKE	Relative Pixel Position Knowledge Error
RSE	Remote Sensing Expert
RSPE	Relative Sample Position Error
RSPKE	Relative Sample Position Knowledge Error
RSS	Rapid Scanning Service
SAF	Satellite Application Facilities
SAR (or S&R)	Search and Rescue
SARSAT	Search and Rescue Satellite - Aided Tracking
SEVIRI	Spinning Enhanced Visible and Infrared Imager
SNR	Signal to Noise Ratio
SRF	Spectral Response Function
SRR	System Requirement Review
SSD	Spatial Sampling Distance
SSI	Spectral Sampling Interval
SSP	Sub-Satellite Point (Nadir)
STG	Scientific and Technical Group
TBC	To Be Confirmed
TBD	To Be Defined/Determined
TBW	To Be Written
TIR	Thermal Infrared
TOA	Top of the Atmosphere
UMARF	Unified Meteorological Archive and Retrieval Facility
UNS	User Notification Service
UTC	Universal Time Coordinated
UV	Ultra-violet
UVN	Ultraviolet, Visible and Near-infrared
UVN	UV-VIS and NIR spectrometer/instrument

Acronym	Full name
VIS	Visible
WIS	WMO Information System
WMO	World Meteorological Organisation

Annex E List of TBCs / TBDs

List of TBC:

- *Satellite yaw-flip* leading to re-orientation of the *satellite* attitude and consequently to an interruption of the mission. This occurs twice a year and with the *outage* lasting up to half a day [TBC 1] each time. 71

List of TBD:

No table of figures entries found.

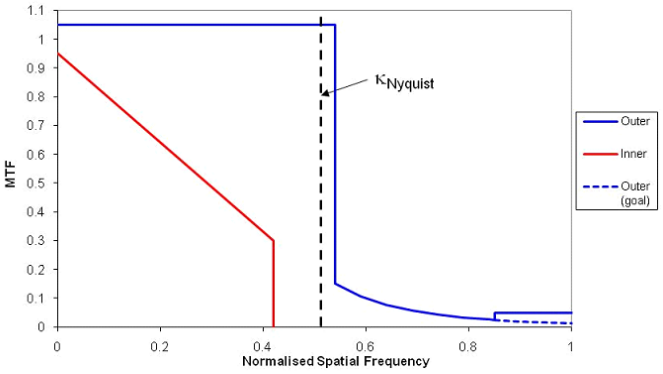
[This document was created from DOORS Module: /ProgPrep/MTG/Users/EURD; Module version: 3.0 (D Draft)]

Annex F Requirement modifications

F.1 Evolution between version 3C (programme proposal) and 4 (for STG-SWG/OPSWG sept 2018)

Comparison between successive versions and change justification

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
FCI-02040	Note 3: The operational practice for FDSS and RSS supported by a single *satellite* (based on FDC interleaved with LAC) is that the acquisition start times for FDC are around HH:00, HH:15, HH:30, HH:45 and the acquisition start times for LAC are around HH:10, HH:12.5, HH:25, HH:27.5, HH:40, HH:42.5, HH:55, HH:57.5, etc where HH represents the hours in UTC, as shown in Figure 3.	Note 3: The capability to support simultaneously the FDSS and RSS service using a single satellite is verified during MTG-I1 commissioning and data samples collected during this test. The potential use during routine operations depends on experience in orbit and recommendation of the OPS-WG. The reference scenario (based on FDC interleaved with LAC) is that the acquisition start times for FDC are around HH:00, HH:15, HH:30, HH:45 and the acquisition start times for LAC are around HH:10, HH:12.5, HH:25, HH:27.5, HH:40, HH:42.5, HH:55, HH:57.5, etc. where HH represents the hours in UTC, as shown in Figure 3.	Note Update Clarification of note to remove ambiguity between baseline and potential evolution tested during commissioning.
FCI-02055	Note: The implementation of the goal LAC zone 4 coverage might have technical implications making it impossible to scan the LAC zone 4 area in 2.5 minutes. With a reduction to 3.3 minutes, the LAC area could be enlarged to cover 1/3 of the FDC, i.e. north of 20°N	Note deleted	Note Update. Removal of note, as FDC/4 scan pattern covered the required area
FCI-02230	None	The *FCI modulation transfer function (MTF)* for each *spatial sample* shall: • For the *spectral channels* VIS 0.6, NIR 2.2, IR 3.8 and IR 10.5 when delivered in the HRFI sampling configuration comply with the values defined in Figure 6.	Mission performance clarification related to the Modulation Transfer Function (MTF)

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
		• For the *spectral channels* when delivered in the FDHSI sampling configuration comply with the values defined in Figure 5. Note 1: The aim of the MTF inner template at the point at which the analogue signal is converted to a digital signal is to maximise the sub-Nyquist MTF. Note 2: On-board and/or on-ground digital processing can be applied to achieve the MTF outer template, in order to minimise the super Nyquist MTF, i.e. minimise alias noise, at the specified SSD. Note 3: Digital OTF manipulation applied to meet the inter channel co-registration accuracy and N/S to E/W MTF similarity requirements is allowed provided that the resulting MTF complies with the MTF templates and radiometric requirements are met.  	

<table>
<tr><th>ID</th><th>[EURD v3C requirement</th><th>[EURD] v4 requirement</th><th>Category/Justification</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Normalised Spatial Frequency, κ</th><th>Inner MTF Template</th><th>Outer MTF Template</th></tr>
<tr><td>0</td><td>0.95</td><td>1.05</td></tr>
<tr><td>0.42</td><td>0.3</td><td></td></tr>
<tr><td>>0.42</td><td>0</td><td></td></tr>
<tr><td>0.54</td><td></td><td>1.05</td></tr>
<tr><td>0.54<κ=<0.85</td><td></td><td>$0.15/(\kappa/0.54)^4$</td></tr>
<tr><td>0.85<κ<=4 (for SSD= 1km)
0.85<κ<=8 (for SSD=2km)</td><td></td><td>0.05</td></tr>
<tr><td>(goal)
0.85<κ<=4 (for SSD=1km)
0.85<κ<=8 (for SSD=2km)</td><td></td><td>$0.15/(\kappa/0.54)^4$</td></tr>
</table>
Figure 5: MTF Template for FDHSI sampling configuration
</td><td></td></tr>
</table>

<table>
<tr><th>ID</th><th>[EURD v3C requirement</th><th>[EURD] v4 requirement</th><th>Category/Justification</th></tr>
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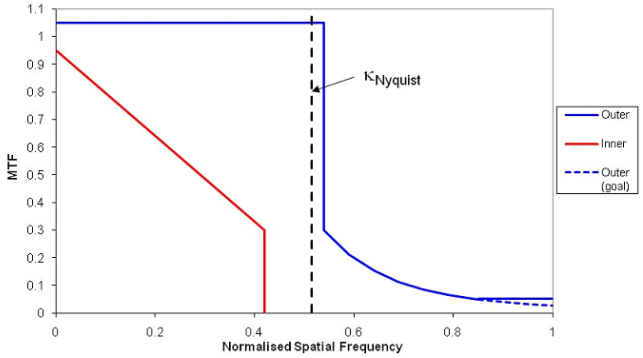

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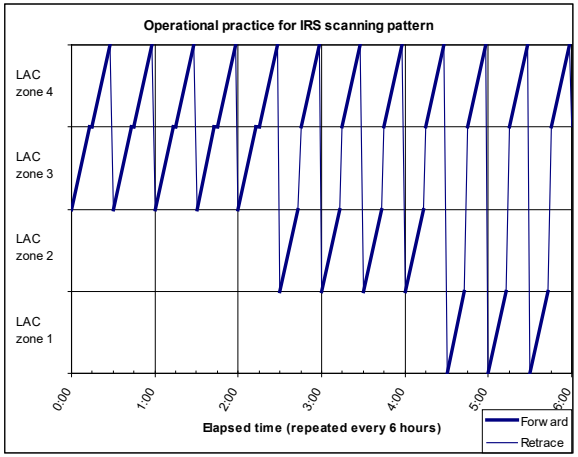
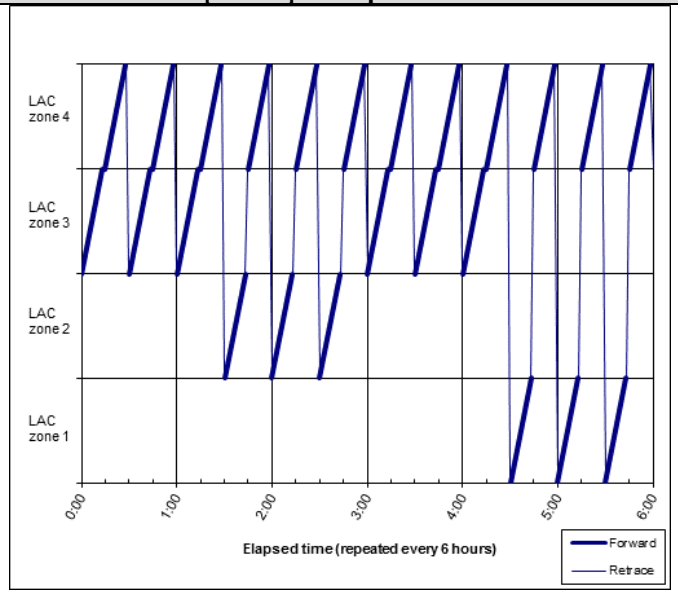
<tr><td>>0.42</td><td>0</td><td></td></tr>
<tr><td>0.54</td><td></td><td>1.05</td></tr>
<tr><td>0.54<κ=<0.85</td><td></td><td>$0.3/(\kappa/0.54)^4$</td></tr>
<tr><td>0.85<κ<=2 (SSD=0.5km) 0.85<κ<=4</td><td></td><td>0.05</td></tr>
</table>
</td><td></td></tr>
</table>

<table>
<tr><th>ID</th><th>[EURD v3C requirement</th><th>[EURD] v4 requirement</th><th>Category/Justification</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>(SSD=1km)</td><td></td><td></td></tr>
<tr><td>(goal)
0.85<κ<=2
(SSD=0.5km)
0.85<κ<=4
(SSD=1km)</td><td></td><td>0.3/(κ/0.54)^4</td></tr>
</table>
Figure 6: MTF Template for VIS 0.6, NIR 2.2, IR 3.8 and IR 10.5 in HRFI sampling configuration</td><td></td></tr>
<tr><td>FCI-02320</td><td>The absolute value of the FCI relative pixel position knowledge error (RPPKE) between two spectral channels when evaluated over all pixels between two FDC or LAC images taken in the same repeat cycle shall be:
a) For the spectral channels as specified in Table 5 at a 68.26% confidence level, when delivered in the HRFI sampling configuration.
b) For the spectral channels as specified in Table 6 at a 68.26% confidence level, when delivered in the FDHSI sampling configuration.
Table 5: FCI HRFI Relative Pixel Position Knowledge Error between Spectral channels (at SSP)
<table>
<tr><th></th><th>VIS</th><th>NIR</th><th>TIR</th></tr>
<tr><td>VIS</td><td></td><td><0.25 km (TBC)</td><td><1.00 km</td></tr>
<tr><td>NIR</td><td></td><td></td><td><1.00 km</td></tr>
<tr><td>TIR</td><td></td><td></td><td><0.5 km (TBC)</td></tr>
</table>
Table 6: FCI FDHSI Relative Pixel Position Knowledge</td><td>The absolute value of the FCI relative pixel position knowledge error (RPPKE) between two spectral channels when evaluated over all pixels between two FDC or LAC images taken in the same repeat cycle shall be:
a) For the spectral channels as specified in Table 5 at a 68.26% confidence level, when delivered in the HRFI sampling configuration.
b) For the spectral channels as specified in Table 6 at a 68.26% confidence level, when delivered in the FDHSI sampling configuration.
Table 5: FCI HRFI Relative Pixel Position Knowledge Error between Spectral channels (at SSP)
<table>
<tr><th></th><th>VIS</th><th>NIR</th><th>TIR</th></tr>
<tr><td>VIS</td><td></td><td><0.30 km</td><td><1.00 km</td></tr>
<tr><td>NIR</td><td></td><td></td><td><1.00 km</td></tr>
<tr><td>TIR</td><td></td><td></td><td><0.68 km</td></tr>
</table>
Table 6: FCI FDHSI Relative Pixel Position Knowledge</td><td>Mission performance clarification :
Removal of TBCs following alignment of the [EURD] requirement with the space segment specification.</td></tr>
</table>

<table>
<tr><th>ID</th><th>[EURD v3C requirement</th><th>[EURD] v4 requirement</th><th>Category/Justification</th></tr>
<tr><td></td><td>Error between Spectral channels (at SSP)
<table>
<tr><th></th><th>VIS</th><th>NIR</th><th>TIR</th><th>WV</th><th>O₃</th><th>CO₂</th></tr>
<tr><td>VIS</td><td><0.20 km (TBC)</td><td><0.20 km (TBC)</td><td><1.00 km</td><td></td><td></td><td></td></tr>
<tr><td>NIR</td><td></td><td><0.20 km (TBC)</td><td><1.00 km</td><td></td><td></td><td></td></tr>
<tr><td>TIR</td><td></td><td></td><td><0.15 km (TBC)</td><td><0.60 km (TBC)</td><td><0.30 km (TBC)</td><td><0.30 km (TBC)</td></tr>
<tr><td>WV</td><td></td><td></td><td></td><td><0.75 km (TBC)</td><td></td><td></td></tr>
<tr><td>O₃</td><td></td><td></td><td></td><td></td><td></td><td><0.40 km (TBC)</td></tr>
<tr><td>CO₂</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td><td>Error between Spectral channels (at SSP)
<table>
<tr><th></th><th>VIS</th><th>NIR</th><th>TIR</th><th>WV</th><th>O₃</th><th>CO₂</th></tr>
<tr><td>VIS</td><td><0.32 km</td><td><0.40 km</td><td><1.00 km</td><td></td><td></td><td></td></tr>
<tr><td>NIR</td><td></td><td><0.32 km</td><td><1.00 km</td><td></td><td></td><td></td></tr>
<tr><td>TIR</td><td></td><td></td><td><0.48 km</td><td><1.60 km</td><td><0.64 km</td><td><0.64 km</td></tr>
<tr><td>WV</td><td></td><td></td><td></td><td><1.92 km</td><td></td><td></td></tr>
<tr><td>O₃</td><td></td><td></td><td></td><td></td><td></td><td><0.84 km</td></tr>
<tr><td>CO₂</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td><td></td></tr>
<tr><td>FCI-02340</td><td>It shall be possible to rectify FCI images from a satellite to any longitude within +/- 10° (TBC) from the sub-satellite point of that satellite according to a reference grid and projection defined according to [CGMS_GS]
Note: The operational practice is to rectify at 0° if the satellite is located close to 0°.</td><td>It shall be possible to rectify FCI images from a satellite to any longitude within +/- 10° from the sub-satellite point of that satellite according to a reference grid and projection defined according to [CONV]
Note: The operational practice is to rectify at 0° if the satellite is located close to 0°.</td><td><u>Scope unchanged.</u>
Removal of TBC and replacement of [CGMS_GS] with [CONV]</td></tr>
<tr><td>IRS-04020</td><td>The IRS shall cover the spectral domain from 680 - 2250 cm^{-1} in two spectral bands; a long wave infrared (LWIR) and a medium wave infrared (MWIR) spectral band with the characteristics provided in Table 7.
<table>
<tr><th>Spectral</th><th>Status</th><th>Wavenum</th><th>Spectral Channel</th><th>Spatial Sampling</th></tr>
</table></td><td>The IRS shall cover the spectral domain from 680 - 2250 cm^{-1} in two spectral bands; a long wave infrared (LWIR) and a medium wave infrared (MWIR) spectral band with the characteristics provided in Table 7.
Table 7: Infra-Red Sounder (IRS) Spectral Bands</td><td><u>Mission performance clarification</u>
related to spectral channel interval</td></tr>
</table>

<table>
<tr><th>ID</th><th>[EURD v3C requirement</th><th>[EURD] v4 requirement</th><th>Category/Justification</th></tr>
<tr><td></td><td>
<table>
<tr><th>Band</th><th></th><th>ber range</th><th>Interval</th><th>Distance (SSD)</th></tr>
<tr><td>LWIR</td><td>Extended</td><td>680-700 cm^{-1}</td><td>0.625 cm^{-1}</td><td>4.0 km</td></tr>
<tr><td></td><td>Specified</td><td>700-1210 cm^{-1}</td><td></td><td></td></tr>
<tr><td>MWIR</td><td>Specified</td><td>1600-2175 cm^{-1}</td><td>0.625 cm^{-1}</td><td>4.0 km</td></tr>
<tr><td></td><td>Extended</td><td>2175-2250 cm^{-1}</td><td></td><td></td></tr>
</table>
</td><td>
<table>
<tr><th>Spectral Band</th><th>Status</th><th>Wavenumber range</th><th>Spectral Channel Interval</th><th>Spatial Sampling Distance (SSD)</th></tr>
<tr><td>LWIR</td><td>Extended</td><td>680-700 cm^{-1}</td><td>Better than 0.625 cm^{-1}</td><td>4.0 km</td></tr>
<tr><td></td><td>Specified</td><td>700-1210 cm^{-1}</td><td>Better than 0.625 cm^{-1}</td><td></td></tr>
<tr><td>MWIR</td><td>Specified</td><td>1600-2175 cm^{-1}</td><td>Better than 0.625 cm^{-1}</td><td>4.0 km</td></tr>
<tr><td></td><td>Extended</td><td>2175-2250 cm^{-1}</td><td>Better than 0.625 cm^{-1}</td><td></td></tr>
</table>
</td><td></td></tr>
<tr><td>IRS-04040</td><td>The IRS shall generate a dataset covering a subset of the full earth disc (called local area coverage (LAC)) with the repeat cycle duration and coverage as specified in Table 8.
Table 8: IRS coverage versus repeat cycle duration
<table>
<tr><th>Coverage</th><th>Repeat cycle duration</th><th>Comment</th></tr>
<tr><td>FDC = 17.70° diameter circle centred at SSP</td><td>N/A</td><td>Indicates the maximum coverage achievable by combining 4 LACs</td></tr>
<tr><td>LAC = FDC/4</td><td>15 minutes</td><td></td></tr>
</table>
</td><td>The IRS shall generate a dataset covering a subset of the full earth disc (called local area coverage (LAC)) with the repeat cycle duration and coverage as specified in Table 8.
<table>
<tr><th>Coverage</th><th>Repeat cycle duration</th><th>Comment</th></tr>
<tr><td>FDC = 17.70° diameter circle centred at SSP</td><td>N/A</td><td>The FDC coverage is the result of the combination of LAC 1, 2, 3, and 4.
Restriction of coverage to 16.80° diameter circle centred at SSP for LAC 1, 2, and 3 is acceptable.</td></tr>
<tr><td>LAC = FDC/4</td><td>15 minutes</td><td></td></tr>
</table>
Table 8: IRS coverage versus repeat cycle duration</td><td>Mission performance clarification related to the full disk coverage and scanning pattern</td></tr>
</table>

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
	Note 1: The operational practice is to have only sequences of quarter of disc scanning, with the complete sequence repeated every 6 hours according to the following patterns: 5 times (zone3 + zone4) followed by 4 times (zone2 + zone4) followed by 3 times (zone1 + zone4) as shown in Figure 5.  ***Figure 5: Operational practice for IRS scanning pattern***	Note 1: The reference pattern for satellite commissioning consists in sequences of quarter of disc scanning, with the complete sequence repeated every 6 hours according to the following patterns: 5 times (zone3 + zone4) followed by 4 times (zone2 + zone4) followed by 3 times (zone1 + zone4) Note 2: The operational practice is to have only sequences of quarter of disc scanning, with the complete sequence repeated every 6 hours according to the following patterns: 3 times (LAC3 + LAC4) followed by 3 times (LAC2 + LAC4) followed by 3 times again (LAC3 + LAC4) and ultimately 3 times (LAC1 + LAC4) as shown in Figure 5.	

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
		 *Figure 7: Operational practice for IRS scanning pattern*	
IRS-04075	The IRS *image* shall be such that: For the *LAC zone* 4 in the IRS **operational scenario** the complete Earth surface visible from *geostationary altitude* at 0° inclination and North of the LAC boundary described in Figure 7 is available.	The IRS *image* shall be such that: For the LAC zone 4 in the IRS **operational practice** the complete Earth surface visible from geostationary altitude at 0° inclination and North of the LAC boundary described in Figure 9 is available.	Scope unchanged. General replacement of Operational scenario by operational practice
IRS-04080	An IRS LAC *dataset* shall be considered complete if all of the conditions below are met: a) The IRS *dataset* acquisition requirements are met, b) **Less than** 5% of the MWIR *spectral soundings* in the LAC are declared *missing soundings*, c) **Less than** 15% of the LWIR *spectral soundings* in the LAC are declared *missing soundings*.	The IRS shall provide complete *datasets*. An IRS LAC *dataset* is considered incomplete if any of the conditions below occur: a) The IRS *dataset* acquisition requirements are not met, b) **More than** 5% of the MWIR *spectral soundings* in the LAC are declared *missing soundings*,	Mission performance clarification With a clearer wording and adding the case of contiguous missing soundings.

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
		c) **More than** 15% of the LWIR *spectral soundings* in the LAC are declared *missing soundings*. **d) Three or more contiguous *spectral soundings* (in either direction) are declared *missing soundings* and have been declared *missing soundings* for the previous 20 LAC *images*.** **where** **N=3 and M=0.01 in the definition of *missing sounding*** **Note 1: For contiguous *missing sounding* assessment the *spectral soundings* are referenced by *dwell*, *column* and *row*> (s,i,j) between LAC *images*.** **Note 2: The bullet d) intends to cover satellite detector ("permanent") *failure*. Thus for assessing the satellite performance, the whole requirement applies. For the assessment of the *completeness* of the data delivered to the End-Users, the last bullet d) has to be ignored, if it is due to a transient loss of *dataset* during the transmission**.	
IRS-04122	none	The *spectral channel interval* (Δν) for both IRS *spectral bands* LWIR and MWIR shall not exceed the value given in Table 7. Note: The *spectral channel interval* is given for the resampled *spectral channel* spacing. The actual spectral sampling of the interferogram will be variable across a *dwell coverage* dependent on the *maximum optical path difference* for a *spatial sample*.	Mission performance clarification related to spectral channel interval
IRS-04124	none	The full width half maximum (FWHM) of the IRS *spectral sample spectral response function* (SRF) shall be less than or equal to 0.754 cm-1.	Mission performance clarification Related to spectral FWHM.
IRS-04135	The IRS *spectral sample spectral response function difference* between the actual *spectral response function* and	The IRS *spectral sample spectral response function difference* between the actual *spectral response function*	Mission performance clarification To provide further information on

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
	that characterised during *spectral calibration* averaged over the *spectral calibration* period shall not exceed a value corresponding to a *radiometric error* of 50 mK (NEdT@280K) when considering a spatially homogeneous scene and the spectra given by Figure 8. Note: The requirement applies at a 68.26% confidence level calculated over all *spectral samples* within a *spectral band*, considering the LWIR and MWIR *spectral bands* separately.	averaged over one day, and that given by the *SRF Estimation model* shall not exceed a value corresponding to a *radiometric error* of 50 mK (NEdT@280K) when considering a spatially homogeneous scene and the spectra given by Figure 10. Note: The requirement applies at a 68.26% confidence level calculated over all *spectral samples* within a spectral band, considering the LWIR and MWIR *spectral bands* separately. This means that, for every *spectral band*, at least 68.26% of the spectral channels of every spatial sample) meet the requirement.	the parameter calculation method.
IRS-04140	The IRS *radiometric noise* shall be as given in Table 9 **with the NEdT scaled at signal levels between black body temperatures 200K and 280K according to the *radiometric scaling function* and between black body temperatures 280K to 313K with a scaling factor of 1.**	The IRS *radiometric noise* shall be as given in Table 9. New table 9 refinement in next row.	Scope unchanged. Removal of a redundancy with the text at beginning of §4.2.4
	Those radiometric requirements were defined during Phase A by the User Consultation process and led to the old table 9 here below. Since this time the following modifications have taken place: a. The requirement was split to before and after spectral calibration the former being applicable at spacecraft level and the latter at system level. The system level requirement includes an additional 100 mK error allowance for the spectral calibration process. b. At satellite level the NEdT template has been further rounded to take into account possible apodisation to meet IRS-04135 The old table 9, summarising the radiometric performances, is cross referenced by IRS-04140, IRS-04160, IRS-04180, IRS-04200.	Those requirements are unchanged but the table 9 cross referenced by them is updated. See table 9 refinement below.	Mission performance clarification Related to the refinement of the radiometric requirements

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
	Such requirements will not be considered in the statistics reported in this section.		
IRS-04230	none	For all IRS *spatial samples* of the *spectral channels* in the *wavenumber* range from 900 cm-1 to 2175 cm-1 the *integrated energy* (IE) shall be: over a square 4x4 km2 shall be equal to or larger than 67%. • over a square 4x4 km2 equal to or larger than 67%, • over a square 12x12 km2 equal to or larger than 92%.	Mission performance clarification related to integrated energy
IRS-04250	none	The absolute value of the IRS *absolute sample position knowledge error* (ASPKE) shall be as given in Table 11 when evaluated over any *LAC zone*.	Mission performance clarification related to ASPKE (LAC)
IRS-04255	none	The absolute value of the IRS *absolute sample position knowledge error* (ASPKE) when evaluated over a single *dwell* shall be as given in Table 11.	Mission performance clarification related to ASPKE (dwell)
LI-06020	The Lightning Imager (LI) *full disc coverage* shall include the Earth within a circle of 16º in diameter, shifted northward to cover high latitude regions. Note: If for design optimisation the *coverage* is not circular then it must cover at least 84% of the visible earth disc (a circle of 17.54° in diameter centred at SSP) and the European territories of all the EUMETSAT member states when the *satellite* is within the *nominal longitude range*.	The Lightning Imager (LI) *coverage* shall contain **at least the European territories of all the EUMETSAT member states and at least 84% of the visible earth disc (taken as a circle of 17.54° in diameter centred at SSP) when the *satellite* is within the *nominal longitude range*.** Note: The whole of Turkey is to be taken to lie within Europe for this definition. The *coverage* is to be achieved when the satellite is positioned at 0° longitude, with the requirement SYS-00130 not being applicable for the calculation of the *coverage*.	Mission performance clarification related to LI coverage
LI-06040	The *LI triggered events* shall consist in the measurements of the strongest lightning emission features within the cloud top optical spectra produced by the neutral oxygen lines in the near infrared. Note: The OI(1) line at 777.4 nm made of three lines	The *LI triggered events* shall **be obtained by measuring the *LI lightning spectral radiance* from** the strongest lightning emission features within the cloud top optical spectra produced by the neutral oxygen atom lines in the near infrared.	Mission performance clarification Definition of LI lightning spectral radiance added including the wavelength shift when leaving the Earth's atmosphere

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
	of nearly equal intensity with a total separation of 0.34 nm.		
LI-06100	The LI shall provide the *lightning event* radiance measured in the spectral interval centred at 777.4 nm and having a width of 0.34 nm, over the full range from 6.7 to 670 $mWm^{-2}sr^{-1}$, with an error (at 1σ) less than: a) 10% relative accuracy for *radiances* higher than 70 $mWm^{-2}sr^{-1}$ b) 7 mWm-2sr-1 absolute accuracy for *radiances* lower than 70 mWm-2sr-1	The LI shall provide the *lighting event radiance* measured **from the** *LI lightning spectral radiance* **specified in LI-06040,** over the full range from 6.7 to 670 mWm-2sr-1, with an error (at 1s) less than: a) 10% relative accuracy for *radiances* higher than 70 $mWm^{-2}sr^{-1}$ b) 7 mWm-2sr-1 absolute accuracy for *radiances* lower than 70 mWm-2sr-1	Mission performance clarification Definition of LI lightning spectral radiance added including the wavelength shift when leaving the Earth's atmosphere
LI-06120	The LI shall provide a *spatial sampling* ***distance*** less than or equal to 10km at 45oN for the sub-satellite longitude.	The LI shall provide a spatial sampling less than or equal to 10km at 45oN for the sub-satellite longitude.	Scope unchanged. The previous wording was contradicting the definition of spatial sampling distance.
MET-08020	The *Level 2* products generation service at EUMETSAT Headquarters shall provide a continuity of service between MSG and MTG concerning the *Level 2* Products generated, albeit with improved quality, resolution, *timeliness*.	The *Level 2 Products* generation service at EUMETSAT Headquarters shall provide a continuity of service between MSG and MTG concerning the *Level 2 Products* generated, albeit with improved quality, resolution, *timeliness* **and new** *Level 2 Products***, as defined in [MTGDIS].**	Introduction of [MTGDIS] Combine 2 requirements (MET-08020, MET-08040).
MET-08040	The *Level 2* products generation service at EUMETSAT Headquarters shall provide new *Level 2* Products specific to MTG as agreed by Delegate Bodies. Note: For the list of products generated at EUMETSAT Headquarters, refer to [L2HQ].	Deleted	Introduction of [MTGDIS] Combined with MET-08020 above. [L2HQ] is now part of [MTGDIS]
MET-08060	The Level 2 products generation service by the SAF shall provide a continuity of service between MSG and MTG concerning the Level 2 Products generated, albeit with improved quality, resolution, timeliness.	The *Level 2 Products* generation service by the SAF shall provide a continuity of service between MSG and MTG concerning the *Level 2 Products* generated, albeit with improved quality, resolution, *timeliness* and new *Level 2 Products* **as defined in [MTGDIS].**	Introduction of [MTGDIS] Combine 2 requirements (MET-08060, MET-08080).
MET-	The Level 2 products generation service by the SAF shall	Deleted	Introduction of [MTGDIS]

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
08080	provide new SAF Level 2 Products specific to MTG as agreed by Delegate Bodies. Note: For the list of products generated by the SAFs, refer to [L2SAF].		Combined with MET-08060. [L2SAF] is now included in [MTGDIS]
MET-08090	none	The operational availability for the SAF acquisition, processing and SAF to EUM HQ transmission shall be 98% within the timeliness defined in Table 14, Table 15 and Table 16 in the column T1 to T3. Note 1: This is verified by each SAF individually. *Operational availability*, *timeliness* and the calculation method are defined in [EURD] annex C. Note 2: The operational validation of the end to end performance (T0 – T5) is performed jointly by EUM and SAF against the thresholds values defined in the [MTGDIS], see also §5	Scope unchanged Performances copied from [L2SAF] such that End Users have a clear reference without digging into [L2SAF].
DCP-10020	Note: ARGOS/GEO signals are relayed as any DCP uplink/downlink. ARGOS data are also extracted from DCP downlink, but further on-ground processing for the ARGOS data is currently (TBD).	Note deleted	Note update Removal of Note, containing obsolete text: the contemplated relay of ARGOS signal by GEO satellites in cooperation with CNES didn't materialise in an agreement (abandoned by CNES).
ARC-12060	The MTG System shall ensure that mission related *datasets* shall be available in the *EUMETSAT Data Centre*, for later retrieval, with a *completeness* of 99% **(TBC)**	The MTG System shall ensure that mission related *datasets* shall be available in the *EUMETSAT Data Centre*, for later retrieval, with a *completeness* of 99%	Scope unchanged Removal of the TBC
DIS-14020	The EUMETCast & High Rate Dissemination services shall provide data to the following geographic regions with the following characteristics: a) High rate service over Europe; b) EUMETCast service over Europe. c) EUMETCast service over Africa. d) EUMETCast service over South America (TBC).	The *EUMETCast* Dissemination Services shall provide data to the following geographic regions with the following characteristics: a) *EUMETCast* terrestrial services for pre-defined users b) *EUMETCast* service via Satellite over Europe. c) *EUMETCast* service via Satellite over Africa.	Handled by Multi-Mission Element (MME) Reflect the abandon of south America dissemination already decided at corporate level. The rest is a change of terminology.

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
	Note 1: Coverage details regarding current implementation for MSG are provided in [TD15].	d) *DELETED* .	Note is no more relevant.
DIS-14040	The list and periodicity of disseminated *Level 1 datasets* transmitted by EUMETCast & High Rate dissemination, for each of the geographic regions, shall be as defined in Appendix B.. Note 1: Appendix B lists the contents of the dissemination service for each of the geographic regions at the time of publication of this document. Note 2: This implies that the services are configurable, during operations.	The list and periodicity of *disseminated dataset* transmitted by EUMETCast, for each of the geographic regions, shall be as defined in **[MTGDIS].** Note 1: The dissemination of IRS *level 2 products* for the LAC 1, 2 or 3 is not a condition for the entry into operational services of the other IRS based services.	Introduction of [MTGDIS] Combine 3 requirements (DIS-14040, DIS-14045, DIS-14047). Dissemination of LAC 1-3 has been added in [MTGDIS]. Note 2 is now DIS-14048.
DIS-14045	EUMETCast shall support the dissemination of centrally generated *Level 2 datasets*. Note: The list and characteristics of centrally generated *Level 2 datasets* and the dissemination periodicity are continuously reviewed through STG-SWG and STG OPS-WG before approval by Council.	Deleted	Introduction of [MTGDIS] Now part of DIS-14040
DIS-14047	EUMETCast shall support the dissemination of a subset of SAF *datasets*. Note 1: The list and characteristics of SAF *datasets* is subject to the approval of Council and is documented and specified in the Product Requirement Documents (PRD)s of each individual SAF. Note 2: The list of SAF *datasets* disseminated by EUMETCast and the associated periodicity are continuously reviewed through STG OPS-WG before approval by Council.	Deleted	Introduction of [MTGDIS] Now part of DIS-14040
DIS-14048	none	The list, timeliness and periodicity of the datasets disseminated via the various dissemination mechanisms shall be configurable.	Introduction of [MTGDIS] Former note 2 of DIS-14040 is now an explicit requirement.
DIS-	The IRS *disseminated dataset* shall consist of either **300**	The IRS *disseminated dataset* shall consist of a number of	Scope unchanged

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
14050	**(TBC) selected *spectral channels*** or 300 (TBC) principal component (PC) scores derived from the full set of *spectral channels*. Note: To be based on the experience derived from IASI data distribution.	principal component (PC) scores derived from the full set of *spectral channels*. Note: To be based on the experience derived from IASI data distribution.	Removal of the TBC as per recommendation 7 of the 3rd MIST meeting 31 August 2010 with positive response from the 29th SWG meeting 06/07 September 2010.
	The old table 14, defining the timeliness, is provided below. It is cross referenced by the requirements: DIS-14060, DIS-14080, DIS-14120, DIS-14160, DIS-14180, DIS-14200. Such requirements will not be considered in the statistics reported in this section.		
DIS-14100	The contribution of the EUM ground segment to the *operational availability* of Foreign Satellite Data shall be as per Table 14.	DELETED	Handled by Multi-Mission Element (MME) This is an operational corporate functionality for which MTG GS is not involved.
DIS-14140	The contribution of the EUM ground segment to the operational availability of MDD shall be as per Table 14.	DELETED	Handled by Multi-Mission Element (MME) This is an operational corporate functionality for which MTG GS is not involved.
DIS-14190	None	The *operational availability* of IRS *level 2 products* shall be as per Table 17.	Mission performance clarification Related to missing requirement on IRS L2 timeliness.
DIS-14220	The operational availability of Lightning dataset shall be as per Table 14.	The *operational availability* of Lightning group and flash product shall be as per Table 17. Note: During development phase, the design will be scrutinized. Should there be a risk that one minute is not ach ievable, the situation will be reported and reconsidered in particular at the CDR. During AIV and Commissioning, reasonable attempts will be made to	Scope unchanged Clarification note added to stress the importance of the timeliness goal recalled by LI-MAG. Update of terminology.

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
		tune the configuration parameters to try to improve the timeliness to achieve the 30s target (in particular over Europe). If not sufficient, bottleneck will be identified and a further design improvement will be considered taking benefit of technology evolution.	
DIS-14240	The contribution of the EUM ground segment to the *operational availability* of SAF Products shall be as per Table 14. Note: The *operational availability* of the SAF product generation for SAF Products that are not disseminated by EUMETSAT is not specified in this document but is specified in each SAF specification	The *operational availability* of SAF Products shall be as per Table 17. Note 1: The timeliness allocation for SAF Products dissemination is defined in §4 .5.2.	Scope unchanged Requirement is now end to end. Allocation to EUM GS is now MET-08090.
DIS-14250	The list, characteristics and periodicity of disseminated *Level 1 datasets* transmitted by RMDCN shall be as defined in Appendix B. **Note 1: Appendix B lists the contents of the dissemination service at the time of publication of this document.** Note 2: This implies that the services are configurable, during operations.	The list, characteristics and periodicity of *disseminated datasets* transmitted via RMDCN shall be as defined in **[MTGDIS].**	Introduction of [MTGDIS] Configurability is addressed in DIS-14048
DIS-14260	The RMDCN Dissemination service shall support the dissemination of *Level 2 datasets*.	DELETED	Introduction of [MTGDIS] Included in DIS-14250
DIS-14360	**None**	DIS-14360. **Note: Achieved when considering two MTG-I satellites in orbit. Otherwise redundancy is ensured via Cospas-Sarsat satellites overlapping.**	Note update Redundancy for Search And Rescue is ensured via satellite overlapping and is done on a best effort basis.
DIS-14380	The list, characteristics and periodicity of disseminated *Level 1 datasets* transmitted by Internet shall be as defined in Appendix B. Note 1: Appendix B lists the contents of the dissemination service at the time of publication of this	DELETED	Internet The retrieval of data via internet is now merged in §6 Data Retrieval Services

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
	document. Note 2: This implies that the services are configurable, during operations.		
DIS-14390	The Internet Dissemination Service shall support the dissemination of Level 2 datasets.	DELETED	Internet The retrieval of data via internet is now merged in §6 Data Retrieval Services
DIS-14400	The internet dissemination service user guide shall be made available, and kept up to date, to describe the formats and other characteristics of the disseminated dataset.	DELETED	Internet The retrieval of data via internet is now merged in §6 Data Retrieval Services
DIS-14420	The Internet Dissemination Service shall only deliver to the registered DCP Operator its own dataset.	DELETED	Internet Already included in DCP-10020. The retrieval of data via internet is now merged in §6 Data Retrieval Services
DIS-14440	The *operational availability* of the *datasets* via the Internet Dissemination Service shall be as defined in Table 14 for EUMETCast.	DELETED	Internet The retrieval of data via internet is now merged in §6 Data Retrieval Services
RET-16040		**Note 3: Minor differences are acceptable between what is disseminated and what is retrieved, as long as it is documented for end users. Differences may relate to time ranges of data, subsetting, compression, etc.**	Note update Requirement text unchanged but clarification added with note 3.
USR-18020	Service messages shall provide information on the status and planning of the MTG operational services, including regular administrative messages (historical information), news messages (on event occurrence) and scheduled service outages (one week in advance), via: a) EUMETCast dissemination. b) High-Rate dissemination.	Service messages shall provide information on the status and planning of the MTG operational services, including regular administrative messages (historical information), news messages (on event occurrence) and scheduled service outages (one week in advance), via: **a) EUMETCast satellite Europe** **b) EUMETCast satellite Africa**	Scope unchanged Harmonisation of terminology

ID	[EURD v3C requirement	[EURD] v4 requirement	Category/Justification
	c) RMDCN/GTS dissemination. d) User Notification e-mails. Note: The service messages and their release conditions are described in Appendix A	**c) EUMETCast terrestrial** d) RMDCN/GTS dissemination. e) User Notification e-mails. Note: The service messages and their release conditions are described in Appendix A.	

TABLE Radiometric requirements of the IRS Spectra

Old Table 9 used by requirements IRS-04140 IRS-04160, IRS-04180 and IRS-04200. The parts modified are in bold.

LWIR Wavenumber *(cm^{-1})*	*Ref. Signal, Tref*	Radiometric Noise *(NEdT)*	Medium Term Radiometric Stability	Long Term Radiometric Stability	Radiometric Accuracy
700	280K	<0.5K	<0.1K	<0.3K	<0.5K
714	280K	<0.5K	<0.1K	<0.3K	<0.5K
715	280K	<0.4K	<0.1K	<0.3K	<0.5K
729	280K	<0.4K	<0.1K	<0.3K	<0.5K
730	280K	<0.3K	<0.1K	<0.3K	<0.5K
769	280K	<0.3K	<0.1K	<0.3K	<0.5K
770	280K	<0.2K	<0.1K	<0.3K	<0.5K
1100	280K	<0.2K	<0.1K	<0.3K	<0.5K
1210	280K	<0.35K	<0.1K	<0.3K	<0.5K
MWIR *Wavenumber* (cm^{-1})	Ref. Signal, Tref	*Radiometric Noise*(NEdT)	*Medium Term Radiometric Stability*	*Long Term Radiometric Stability*	*Radiometric Accuracy*
1600	280K	**<0.2K**	<0.1K	<0.3K	<0.5K
1810	280K	**<0.2K**	<0.1K	<0.3K	<0.5K
1980	280K	<0.4K	<0.1K	<0.3K	<0.5K

2175	280K	**<0.85K**	<0.1K	<0.3K	<0.5K

New Table 9 used by requirements IRS-04140 IRS-04160, IRS-04180 and IRS-04200. The parts modified are in bold.

LWIR **Wavenumber** *(cm^{-1})*	*Ref. Signal, Tref*	**Radiometric Noise** *(NEdT)*	**Medium Term Radiometric Stability**	**Long Term Radiometric Stability**	**Radiometric Accuracy**
700	280K	<0.5K	<0.1K	<0.3K	<0.5K
714	280K	<0.5K	<0.1K	<0.3K	<0.5K
715	280K	<0.4K	<0.1K	<0.3K	<0.5K
729	280K	<0.4K	<0.1K	<0.3K	<0.5K
730	280K	<0.3K	<0.1K	<0.3K	<0.5K
769	280K	<0.3K	<0.1K	<0.3K	<0.5K
770	280K	<0.2K	<0.1K	<0.3K	<0.5K
1040	280K	<0.2K	<0.1K	<0.3K	<0.5K
1118	**280K**	**<0.224K**	**<0.1K**	**<0.3K**	**<0.5K**
1210	280K	<0.35K	<0.1K	<0.3K	<0.5K
MWIR *Wavenumber* **(cm^{-1})**	**Ref. Signal**, **Tref**	*Radiometric Noise***(NEdT)**	*Medium Term Radiometric Stability*	*Long Term Radiometric Stability*	*Radiometric Accuracy*
1600	280K	**<0.224K**	<0.1K	<0.3K	<0.5K
1630	**280K**	**<0.2K**	**<0.1K**	**<0.3K**	**<0.5K**
1750	**280K**	**<0.2K**	**<0.1K**	**<0.3K**	**<0.5K**
1871	280K	**<0.269K**	<0.1K	<0.3K	<0.5K
1980	280K	<0.4K	<0.1K	<0.3K	<0.5K
2134	**280K**	**<0.757K**	**<0.1K**	**<0.3K**	**<0.5K**
2175	280K	**<0.906K**	<0.1K	<0.3K	<0.5K

TABLE: Operational Availability within timeliness for EUMETCast dissemination

Old Table 14 (now Table 17) used by requirements DIS-14060, DIS-14080, DIS-14100, DIS-14120, DIS-14140, DIS-14160, DIS-14180, DIS-14200, DIS-14220, DIS-14240, DIS-14400. The parts modified are in bold.

disseminated dataset	operational availability	***End to end* timeliness *via EUMETCast (see Note 1)***	***End to end* Timeliness *via high rate dissemination (see note 1)***
FCI Rectified *images*	95% with a goal of 98%		
Full Disc Scanning Service (FCI-FDSS)		**15mn**	**10mn with a goal of 5mn**
Rapid Scanning Service (FCI-RSS)		**N/A**	**5mn with a goal of 2.5mn**
Level 2 Products	95% with a goal of 98%		**N/A**
>=Daily products		**60mn**	
>=3-hourly products		60mn	
>=Hourly products		30mn	
<= hourly		20mn	
Retransmission of Foreign Satellite Data (FSD)	**95% with a goal of 98%**	**60mn**	**N/A**
DCPs messages and bulletins	95% with a goal of 98%		**N/A**
Alert messages		3mn with a goal of 2mn	
Bulletins		10mn with a goal of 5mn	
Retransmission of MDD data received from RMDCN	**95% with a goal of 98%**	**60mn**	**N/A**

disseminated dataset	operational availability	***End to end* timeliness *via EUMETCast (see Note 1)***	***End to end* Timeliness *via high rate dissemination (see note 1)***
IR Sounder *dataset*	95% with a goal of 98%	**N/A**	**30 mn**
UVN sounding *dataset*	95% with a goal of 98%	**N/A**	**60mn (TBC)** **See Note 2**
Lightning *dataset* **Events** **Background Images** Products	95% with a goal of 98%	 **2mn with a goal of 30s** **N/A** **2mn**	**N/A**
Retransmission of SAF Products (see note 4) **3 hourly or more** **Hourly products** **Less than hourly** **Not disseminated via EUMETCast**	**95% with a goal of 98%** **N/A**	 **60mn** **20mn** **10mn** **N/A**	**N/A**
Service Messages	95% with a goal of 98%	60mn	

Note 1: Operational availability, *timeliness* and the calculation method are defined in [CONV]. A *dataset* arriving after the mentioned *timeliness* is not considered as available for the end-user. **Delays outside EUMETSAT control have to be added (e.g. for FSD, MDD, SAF).**

Note 2: **TBD if required & financed in context of GMES.**

Note 3: The objective is to achieve the goal during routine operations. This implies that the initial MTG System and its operation are designed to achieve the goal. The difference between the spec and the goal being a margin allowing some design optimisation and shared

between system, ground segment and facilities. At system level the formal verification will consist in the assessment of the margin against the specified values. The operational system validation will be against the goal.

Note 4: The specified timeliness only refers to the EUMETCast contribution, i.e. the dissemination of SAF products and does not include the time required to generate the products at the SAFs. The latter is specified in the respective SAF Product Requirements Documents.

New Table 17 (was Table 14) used by requirements DIS-14060, DIS-14080, DIS-14120, DIS-14160, DIS-14180, DIS-14190, DIS-14200, DIS-14220, DIS-14240. The parts modified are in bold.

disseminated dataset	operational availability *(1)*	*End to end* timeliness ***per product are defined in [MTGDIS] within the following constraints (3)***	***Timeliness applies to:***
FCI Rectified *images*	95% with a goal of 98%		**Repeat Cycle**
Full Disc Scanning Service (FCI-FDSS)		15 mn **with a goal of 10 mn**	
Rapid Scanning Service (FCI-RSS)		**5mn with a goal of 2.5mn**	
FCI Level 2 Products	95% with a goal of 98%		**Chunk level when existing otherwise to *Level 2 Product***
>=Daily products (e.g. CRM)		**Half a day**	
>=3-hourly products		60mn	
>=Hourly products		30mn	
< hourly		20mn	
DCP messages and DCP bulletins	95% with a goal of 98%		

disseminated dataset	operational availability *(1)*	*End to end* timeliness ***per product are defined in [MTGDIS] within the following constraints (3)***	***Timeliness applies to:***
Alert messages		3mn with a goal of 2mn	**Message**
Bulletins		10mn with a goal of 5mn	**Last contributing message**
IR Sounder ***Level 1 dataset (principal components)***	95% with a goal of 98%	**15 mn (see open issue in Section 1.5)**	**Dwell**
IRS Level 2 Products	**95% with a goal of 98%**	**30mn (see open issue in Section 1.5)**	**Chunk level when existing otherwise to *Level 2 Product***
S4/UVN sounder ***Level 1 dataset***	95% with a goal of 98%	**60mn**	**5 mn *data chunk***
S4/UVN sounder *Level 2 Product*	**95% with a goal of 98%**	**60mn (120mn for day 2 *Level 2 Products***	**5 mn *data chunk***
Lightning **Group and Flash product (5)**	95% with a goal of 98%	2mn **with a goal of 30s**	**Flash**
SAF Products	**95% with a goal of 98%**	**See Section 4.5.2**	**Product**
Service Messages	95% with a goal of 98%	60mn	**Message**

Note 1: Operational availability, timeliness and the calculation method are defined in [CONV]. A *dataset* arriving after the mentioned *timeliness* is not considered as available for the end-user. **These figures apply as is to EUMETCast by Satellite. In the case of EUMETCast terrestrial, the network used has no formal Service Level Agreement (SLA), offering a best effort service. Thus its outages are classified as external outages and are not taken into account in the figures. When including the availability of the network, the achieved value of the EUMETCast terrestrial service is expected to be above 95%.**

Note 2: **Deleted**

Note 3: The objective is to achieve the goal during routine operations. This implies that the initial MTG System and its operation are designed to achieve the goal. The difference between the spec and the goal being a margin allowing some design optimisation and shared

between system, ground segment and facilities. At system level the formal verification will consist in the assessment of the margin against the specified values. The operational system validation will be against the goal.

Note 4: **Deleted**

Note 5: The LI flash product is generated following level 2 processing and consists of LI triggered events clustered into LI groups associated with a particular lightning flash.

Statistics

Category of the change	Requirements modified	Requirements added	Requirements deleted	Total
Related to [MTGDIS] introduction (minor)	4	1	5	10
Related to internet dissemination merged into Data retrieval (minor)	0	0	5	5
Scope Unchanged but wording had to be modified (minor)	9	1	0	10
Handled by Multi-Mission Element - MME (minor)	1	0	2	3
Mission performance clarification (major)	8	7	0	15
Total	22	9	12	43

Modification affecting only notes are not tracked in the statistics but still listed above for completeness.

F.2 Evolution between version 4 (for STG-SWG/OPSWG sept 2018) and 4A (for STG before CDR)

Comparison between successive versions and change justification

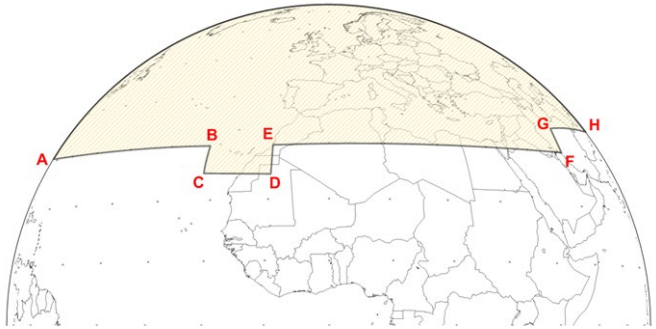
<table>
<tr><th>ID</th><th>[EURD v4 requirement</th><th>[EURD] v4A requirement</th><th>Category/Justification</th></tr>
<tr>
<td>FCI-02055</td>
<td>The FCI image shall be such that:

When delivering FDSS:

The complete FDC area of coverage is available in the acquired image;

When delivering RSS:

the complete Earth surface visible from geostationary altitude at 0° inclination and North of latitude 30°N (OR with a goal of the LAC zone 4 boundary described in Figure 4) is available.

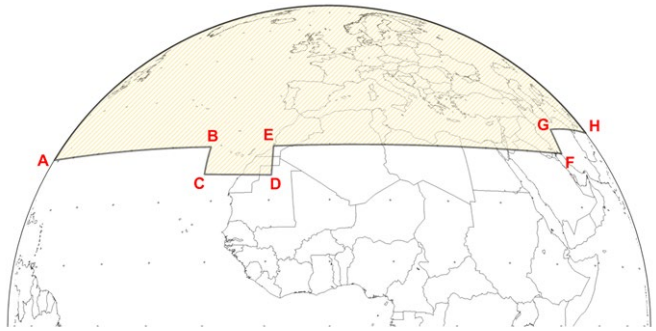
<table>
<tr><td>AB</td><td>30°N</td></tr>
<tr><td>BC</td><td>22°W</td></tr>
<tr><td>CD</td><td>25°N</td></tr>
<tr><td>DE</td><td>10°W</td></tr>
<tr><td>EF</td><td>30°N</td></tr>
<tr><td>FG</td><td>50°E</td></tr>
<tr><td>GH</td><td>35°N</td></tr>
</table>
</td>
<td>The FCI image shall be such that:

When delivering FDSS:

The complete FDC area of coverage is available in the acquired image;

When delivering RSS:

At least the complete Earth surface visible from geostationary altitude at 0° inclination and at the north of the boundary described in Figure 4 is available.

<table>
<tr><td>AB</td><td>30°N</td></tr>
<tr><td>BC</td><td>22°W</td></tr>
<tr><td>CD</td><td>25°N</td></tr>
<tr><td>DE</td><td>10°W</td></tr>
<tr><td>EF</td><td>30°N</td></tr>
<tr><td>FG</td><td>50°E</td></tr>
<tr><td>GH</td><td>35°N</td></tr>
</table>
</td>
<td>Mission performance clarification.
Former goal is now baseline (OPSWG sept 2018)</td>
</tr>
</table>

ID	[EURD v4 requirement	[EURD] v4A requirement	Category/Justification
	Note: The diagram indicates the **goal** LAC zone 4 *coverage* in terms of latitude and longitude on the earth. ***Figure 46: Goal LAC zone 4* coverage *for FCI***	Note: The diagram indicates the **minimum** LAC zone 4 *coverage* in terms of latitude and longitude on the earth. ***Figure 47: Minimum LAC zone 4* coverage *for FCI***	

Statistics

Category of the change	Requirements modified	Requirements added	Requirements deleted	Total
Mission performance clarification (major)	1	0	0	1
Total	1	0	0	1

Modification affecting only notes are not tracked in the statistics but still listed above for completeness.

F.3 Evolution between version 4A (for STG before CDR) and 4B (for Council approval before CDR)

None

F.4 Evolution between version 4B (for Council approval before CDR) and 4C (approved by Council before CDR)

None