Standard Archive Format for Europe

Mission Specialisation Control Book

LANDSAT

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1. Introduction

1.1. Purpose and scope

The present document is part of the Standard Archive Format for Europe specialisation for LANDSAT (SAFE Specialisation for LANDSAT). This specialisation consists of the following set of documents:

- the current book, which is the LANDSAT mission specialisation control book, and is the top-level document of the specialisation, containing all the information that is common to all SAFE LANDSAT products.
- one LANDSAT product specialisation control book for LANDSAT Level-0 products.

1.2. Book Organisation

The LANDSAT mission specialisation control book is organized as follows:

Chapter 1: Introduction	Introductory part of the document.
Chapter 2: General Description	Overall description of the mission, instruments and products generated for each processing level in scope of this specialisation.
Chapter 3: Error: no se encontró el origen de la referencia	SAFE LANDSAT metadata specialisation.
Chapter 4: Naming Conventions	SAFE LANDSAT package names and URN specifications.
Appendix A: Representation Information Packages	List of SAFE LANDSAT Representation Information Packages characteristic of the specialisation.
Appendix B: SAFE Package Examples	List of SAFE LANDSAT EO Product Packages examples.

1.3. Specialisation Volume Set

The following list references the documents that constitute the SAFE LANDSAT specialisation volume set.

[LANDSAT-BOOK-MISSION]	LANDSAT Mission Specialisation (PDGS-SAFE-GMV-LANDSAT-MISSION)
[LANDSAT-BOOK-L0]	LANDSAT Specialisation for Level 0 products (PDGS-SAFE-GMV-LANDSAT-L0)

The specialised SAFE LANDSAT Representation Information Packages and examples of SAFE LANDSAT EO Product/Auxiliary Packages are also considered part of the present specialisation and are provided alongside the documents as separate files. The complete file list is described in Appendix A and Appendix B.

1.4. Bibliography

[OAIS-RM] *Reference Model for an Open Archival Information System (OAIS)* - 650.0-B-1- January 2002- Blue Book- Copyright © 2002 Consultative Committee for Space Data Systems (CCSDS) -

[OGC EOP O&M] *Earth Observation Metadata profile of Observations & Measurements* – OGC 10-157r3 version 1.0 (Publication Date: 2012-06-12) Copyright © 2012 Open Geospatial Consortium -with the following set of approved Change Requests:

- *Change proposal: EO PMOS SWG Improved expression of EO product quality and status information, OGC 13-085*
- *Change Proposal: EO PMOS SWG Addition of optional group identificator, OGC 13-086*
- *Change Proposal: EO PMOS SWG Improve the description of EO Product Masks, OGC 13-087*
- *Change Proposal: EO PMOS SWG Correct inconsistencies between UML model and tables, OGC 13-088*
- *Change Proposal: EO PMOS SWG Improved way of expressing the timeliness of EO Product acquisition and processing, OGC 13-093*
- *Change Proposal: EO PMOS SWG Add optional elements referring to products instead of images, OGC 13-094*
- *Change Proposal: EO PMOS SWG Replace example of EO Product Metadata extension, OGC 13-098*
- *Change Proposal: EO-PMOS Corrections related to the implementation of the eoptype attribute, OGC 14-031*
- *Change Proposal: EO-PMOS Addition of optional elements creationDate and modificationDate, OGC 14-032*

[SAFE_CORE] *Standard Archive Format for Europe - Control Book - Volume 1 - Core Specifications* - PGSI-GSEG-EOPG-FS-05-0001- v2.3-

[SAFE_REC_SPEC] *Standard Archive Format for Europe - Control Book - Volume 2 - Recommendations for Specialisations* - PGSI-GSEG-EOPG-FS-05-0002- v2.3-

[SI] *The International System of Units (SI)* - 1998- 7th edition- Bureau International des Poids et Mesures - Copyright © 1998 Organisation

Intergouvernementale de la Convention du Mètre -

[SI-SUP2000] *The International System of Units (SI)*- Supplement 2000: addenda and corrigenda of the 7th edition (1998) - 1998- 7th edition- Bureau International des Poids et Mesures – Copyright © 1998 Organisation Intergouvernementale de la Convention du Mètre -

[XFDU] *XML Formatted Data Unit (XFDU) - Structure and Construction Rules* - 661.0-B-1- September 2008- Blue Book - Copyright © 2008 Consultative Committee for Space Data Systems (CCSDS) -

1.5. Glossary of Terms

1.5.1. Definitions

1.5.1.1. General

Auxiliary data	All data used to generate a product, other than the direct measurements of the instrument. EO Auxiliary data include calibration data measured on-board that are not part of the main measurements of the instrument, external calibration files from sources other than the satellite, processor configuration files, and any other files needed by instrument processors.
Auxiliary file-type	A file type that characterizes all EO Auxiliary files sharing common representation information.
EO Product	The result of the processing of remote sensing data. Earth Observation products are specific to each mission and sensor combination. A data product can be an entire acquisition strip (the data segment continuously acquired by a ground station) or a single frame (a subset of the acquisition strip of standard length as defined by the WRS).
Manifest	A document containing metadata about Components, and the relationships among them. This information is stored as a Component, using an XML language designed for just this purpose. [XFDU].
Metadata	Data about other Data [OAIS-RM].
Metadata file	A file containing the Metadata associated to an EO Product or EO Auxiliary file.
Product-type	A file type that characterizes all the EO Product files sharing common representation information.
SAFE Package	An XFDU Package specialised for Earth Observation data purposes. In previous versions of SAFE, the term SAFE product was used instead because the content information was limited to Earth Observation products. It has been replaced by SAFE Package because the types of Content Information described by SAFE are not only Earth Observation products, but also Representation Information files and EO Auxiliary files.
SAFE Specialisation	A SAFE Specialisation is a restriction of the SAFE Core specifications for a more specific type of data. Examples of SAFE Specialisation include specialisations for ENVISAT or LANDSAT Products, for CCSDS Telemetry Data, or for SPOT Measurements.
XFDU Package	A Package Interchange File that contains an XFDU Manifest and is conforming to the semantics specified in the XFDU Specifications. An XFDU Package is a specialization of Package Interchange File [XFDU].

1.5.2. Acronyms and Abbreviations

1.5.2.1. General

CCSDS	Consultative Committee for Space Data Systems
EO	Earth Observation
ESA	European Space Agency
GML	Geography Mark-up Language
ISO	International Organization for Standardization
MMCC	Mission Monitoring and Control Center
O&M	Observations and Measurements
OAIS(-RM)	Reference Model for an Open Archival Information System
OGC	Open Geospatial Consortium
SAFE	Standard Archive Format for Europe
SI	The International System of Units
URN	Uniform Resource Name
WRS	World Reference System
XFDU	XML Formatting Data Unit
XML	eXtensible Mark-up Language

1.5.2.2. Specialisation

EMS	Electromagnetic Spectrum
EOSAT	Earth Observing Satellite Corporation
ERTS	Earth Resources Technology Satellite
ETM(+)	Enhanced Thematic Mapper (plus)
ICD	Interface Control Document
MSS	Multi-Spectral Scanner
NASA	National Aeronautics and Space Administration
PDS	Payload Data Segment
S/C	Spacecraft
TM	Thematic Mapper
USGS	U.S. Geological Survey
VAFB	Vandenberg Air Force Base
SLC	Scan Line Corrector
SMA	Scan Mirror Assembly
SAM	Scan angle monitor
SME	Scan mirror electronics
PAN	Panchromatic
TIR	Thermal Infrared
VNIR	Visible Near Infrared

1.5.3. Conventions Used

The present book assumes that all physical quantities are expressed according to a standard system of units. The selected standard is the SI defined by the Bureau International des Poids et Mesures (BIPM) in documents [SI] and [SI-SUP2000].

2.General Description

2.1. Mission Overview

The Landsat Project is a joint initiative of the U.S. Geological Survey (USGS) and the National Aeronautics and Space Administration (NASA). Landsat's Global Survey Mission is to establish and execute a data acquisition strategy that ensures repetitive acquisition of observations over the Earth's land mass, coastal boundaries, and coral reefs.

The first Landsat (originally named ERTS-A), was developed and launched by NASA on July 23, 1972. The satellite carried a television camera and an experimental sensor called the Multi-Spectral Scanner (MSS). The utility of the synoptic, digital, MSS images was recognized rapidly and proved so valuable that a version of the sensor was flown on each of the following four Landsat satellites.

The quality and impact of the resulting information exceeded all expectations so Landsat-1 was followed by Landsat-2 (launched on Jan. 22, 1975) and Landsat-3 (launched March 5, 1978). Their MSS instrument built up the historical record of continental surface condition and changes.

The Landsat spacecraft series evolved from an experimental program (Landsat-1 to Landsat-3) to an operational program (Landsat-4 and Landsat-5) as NASA developed and launched considerably improved spacecraft that were placed into lower orbits than the previous Landsat spacecraft and carried improved instrument suites.

Landsat-4 carried a new sensor, the Thematic Mapper (TM), inaugurating a second generation of remote sensing satellites when launched July 16, 1982. The TM (a multispectral scanning radiometer) was a significant improvement over the initial sensor, providing greater resolution in the visible and near-infrared regions (30 meters versus 80 meters) and three additional spectral bands. A second Thematic Mapper was launched aboard Landsat-5 on March 1, 1984.

Landsat-6, managed by the Earth Observing Satellite Corporation (EOSAT), was launched from Vandenberg aboard a Titan II rocket, but the spacecraft failed to reach orbit after launch in October 1993.

Landsat-7, with an Enhanced Thematic Mapper-Plus (ETM+) sensor, was successfully launched in April 15, 1999. It's primary goal is to refresh the global archive of satellite photos, providing up-to-date and cloud-free images. On May 31, 2003, a failure of the Scan Line Corrector (SLC) occurs. Efforts to recover the SLC were unsuccessful. Without an operating SLC, the line of sight traces a zigzag pattern along the satellite ground track with resulting data gaps that form alternating wedges that increase in width from the center of the image to the edge. Landsat 7 is still capable of acquiring highly geometrically and radiometrically accurate data worldwide. The USGS has provided the user community with methods to fill gaps in a Landsat 7 scene. Whether or not they choose to fill the gaps, many users continue to find Landsat 7 data useful.

Mission objectives:	Provide insights into geologic, agricultural, and land-use surveys, and led eventually to new paths of resource exploration in all, for a better understanding of the Earth system.
Mission orbit:	**Landsat-1/-2/-3**: Sun-synchronous near-circular orbit, average altitude of 907 to 915 km, inclination of 99º, period of 103 min, repeat cycle of 18 days (251 orbits in cycle), local equator crossing time at 9:45 hours on a descending node (i.e., in north-south direction). **Landsat-4/-5**: Sun-synchronous near-circular orbits with an altitude of 705 km, inclination of 98.2º, repeat cycle of 16 days.

	Landsat-7: Sun-synchronous polar orbit (AM orbit), altitude = 705 km, inclination = 98.2º, period = 99 minutes, repeat coverage = 16 days, the nominal descending equator crossing time is at 10:00 to 10:15 hours.
Payload	**MSS**: Opto-mechanical scanning instrument (whiskbroom technique, unidirectional operation) consisting of a double reflector-type telescope, scanning mirror, filters, detectors, and associated electronics (Landsat-1 to Landsat-5). **TM**: Multispectral mechanically scanning optical imager operating in the visible and infrared regions of the EMS (Electromagnetic Spectrum) (Landsat-4 to Landsat 5). **ETM+**: Scanning radiometer consisting of: A primary mirror that sweeps side-to-side (cross-track) to produce forward and revers image scans, and a scan line corrector (SLC) mirror assembly that sweeps forward-to-aft to compensate for the forward motion of the spacecraft during integration time (Landsat-7).
Launch	**Landsat-1**: 23 July 1972 (End of operations: 02 January 1978) **Landsat-2**: 22 January 1975 (End of operations: 25 February 1992) **Landsat-3**: 05 March 1978 (End of operations: 31 March 1983) **Landsat-4**: 16 July 1982 (End of operations: 1983) **Landsat-5**: 1 March 1984 (End of operations: 18 November 2011) **Landsat-7**: 15 April 1999

Table 1: LANDSAT Missions summary

2.2. Instrument Overview

2.2.1. *MSS (Multispectral Scanner)*

The first five Landsat missions carried the MSS as a payload instrument. The objective of MSS was to provide repetitive daytime acquisition of high-resolution, multispectral data of the Earth's surface on a global basis and to demonstrate that remote sensing from space is a feasible and practical approach to efficient management of the earth's resources. MSS is an opto-mechanical scanning instrument (whiskbroom technique, unidirectional operation) consisting of a double reflector-type telescope, scanning mirror, filters, detectors, and associated electronics.

The MSS consisted of an oscillating mirror scanning the ground in the cross-track direction by using six simultaneous line scans (one line scan per detector per spectral band). The sensor operated by repeatedly scanning a 24-element fiber-optic array (arranged in 6 x 4 elements) from west to east across the Earth's surface, the orbital motion provides the natural north-south scanning motion. A separate binary-number array was generated for each spectral band. Mirror scan rate: 13.6 Hz (74 ms period); telescope: 22.9 cm diameter, f/3.6, Ritchey-Chretien type telescope; size 53 x 58 x 127 cm; six detectors were employed in each of the four spectral bands.

Note: the line array of six detectors was positioned in the along-track direction, thus providing an instantaneous parallel along-track coverage of about 480 m in one cross-track scan with the configuration. This wide along-track coverage permitted sufficient integration time for all cells in each scan sweep. Spectral bands 4 to 6 used photomultiplier tubes (PMT) as detectors, and band 7 used silicon photodiodes.

Type	High resolution optical imager.
Technical Characteristics	
Swath width	185 km (continuous strip image)
Spatial resolution	80 m
Spectral range	Band 4) Visible green 0.5 – 0.6 µm Band 5) Visible red 0.6 – 0.7 µm Band 6) Near-Infrared 0.7 – 0.8 µm Band 7) Near-Infrared 0.8 – 1.1 µm
Configuration	Six detectors for each spectral band provided six scan lines on each active scan
Ground Sampling Interval (pixel size)	57 x 79 m
Earth Topics	High-resolution land and vegetation observation.

Table 2: MSS Instrument summary

2.2.2. TM (Thematic Mapper)

Landsat-4 and Landsat-5 carried the TM as a payload instrument. TM is a multispectral mechanically scanning optical imager operating in the visible and infrared regions of the EMS (Electromagnetic Spectrum). The instrument consists of the following elements or subsystems:

- SMA (Scan Mirror Assembly)
- Telescope
- SLC (Scan Line Corrector)
- Primary focal plane detector array
- Relay optics
- Cooled focal plane detector array
- Internal calibrator.

Whiskbroom bi-directional scanning method: The TM detector array features a total of 96 parallel line arrays (16 each for the seven spectral bands), oriented in the along-track direction. This new arrangement technology provides a parallel coverage of 480 m along-track in one scan sweep (cross-track direction). The wide along-track coverage permits sufficient integration time for all cells in each scan sweep.

Type	High resolution optical imager.
Technical Characteristics	
Swath width	185 km (continuous strip image)
Spatial resolution	Band 1,2,3,4,5,7) 30 m Band 6) 120 m
Spectral range	Band 1) Visible (0.45 - 0.52 µm) Band 2) Visible (0.52 - 0.60 µm) Band 3) Visible (0.63 - 0.69 µm) Band 4) Near-Infrared (0.76 – 0.90 µm) Band 5) Near-Infrared (1.55 – 1.75 µm) Band 6) Thermal (10.40 – 12.50 µm) Band 7) Mid-Infrared (2.08 – 2.35 µm)
Ground Sampling Interval (pixel size)	30 m reflective, 120 m thermal
Earth Topics	High-resolution land and vegetation observation.

Table 3: TM Instrument summary

2.2.3. ETM+ (Enhanced Thematic Mapper)

ETM+ was the payload of Landsat-7. It was 8-band whiskbroom scanning radiometer consisting of:

- A primary mirror that sweeps side-to-side (cross-track) to produce forward and reverse image scans, and
- A scan line corrector (SLC) mirror assembly that sweeps forward-to-aft to compensate for the forward motion of the spacecraft during integration time. The motion of these mirrors deviates from an ideal line profile, introducing along- and cross-track geometric distortions that require compensation.

The principal functional differences between the ETM and the former TM series are the addition of a 15 m resolution panchromatic band and two 8-bit "gain" ranges. The ETM+ adds a 60 m resolution thermal band, replacing the 120 m band on ETM/TM (band No. 6).

The Scan Mirror Assembly (SMA) provides the cross-track scanning motion to develop the 185 km long scene swath. The SMA consists of a flat mirror supported by flex pivots on each side (which have compensators to equalize pivot reaction torque), a torquer, a scan angle monitor (SAM), 2 leaf spring bumpers and scan mirror electronics (SME). The bi-directional SMA sweeps the detector's line of sight in west-to-east and east-to-west directions in cross-track direction, while the spacecraft's orbital path provides the north-south motion.

The ETM+ scanner contains 2 focal planes that collect, filter, and detect the scene radiation in a swath, 185 km wide. The primary focal plane consists of optical filters, detectors, and preamplifiers for 5 of the 8 ETM+ spectral bands (bands 1-4, 8). The second focal plane is the cold focal plane which includes the optical filters, infrared detectors, and input stages for ETM+ spectral bands 5,6, and 7. The temperature of the cold focal plane is maintained at 91 K using a radiative cooler. The detector line arrays (16 for VNIR bands, 32 for PAN, and 8 detectors for TIR) of the whiskbroom scanner are oriented in the along-track direction. This arrangement provides a parallel coverage of 480 m along-track in one scan sweep (cross-track direction). The wide along-track coverage permits sufficient integration time for all cells in each scan sweep.

Type	High resolution optical imager.
Technical Characteristics	
Swath width	185 km (continuous strip image)
Spatial resolution	Band 1,2,3,4,5, 7) 30 m Band 6) 60 m Band 8) 15 m
Spectral range	Band 1 Visible (0.45 - 0.52 µm) Band 2 Visible (0.52 - 0.60 µm) Band 3 Visible (0.63 - 0.69 µm) Band 4 Near-Infrared (0.77 - 0.90 µm) Band 5 Near-Infrared (1.55 - 1.75 µm) Band 6 Thermal (10.40 - 12.50 µm) Low Gain / High Gain Band 7 Mid-Infrared (2.08 - 2.35 µm) Band 8 PAN (0.52 - 0.90 µm)
Ground Sampling Interval (pixel size)	30 m reflective, 60 m thermal
Earth Topics	High-resolution land and vegetation observation.

Table 4: ETM+ Instrument summary

2.3. Product file-type List

The following sections list all the product-types and auxiliary-types which are in scope of the SAFE Specialisation for LANDSAT.

2.3.1. Level 0

2.3.1.1. Product Types

Acronym	Description
MSS_MSS_0P	LANDSAT MSS Level 0 data.
TM__TM__0P	LANDSAT TM Level 0 data.
ETM_ETM_0P	LANDSAT ETM+ Level 0 data.

Table 5: L0 product-type list

2.4. Processing chain description

This section provides a conceptual workflow description for the Landsat processing chain for TM (Thematic Mapper), Enhanced Thematic Mapper + (ETM+) and Multi Spectral Sensor (MSS) instruments, giving general information about the process and the inputs/outputs that are needed/generated in each step.

The general, high level processing chain showing the mandatory inputs and all possible outputs is shown in Figure 1

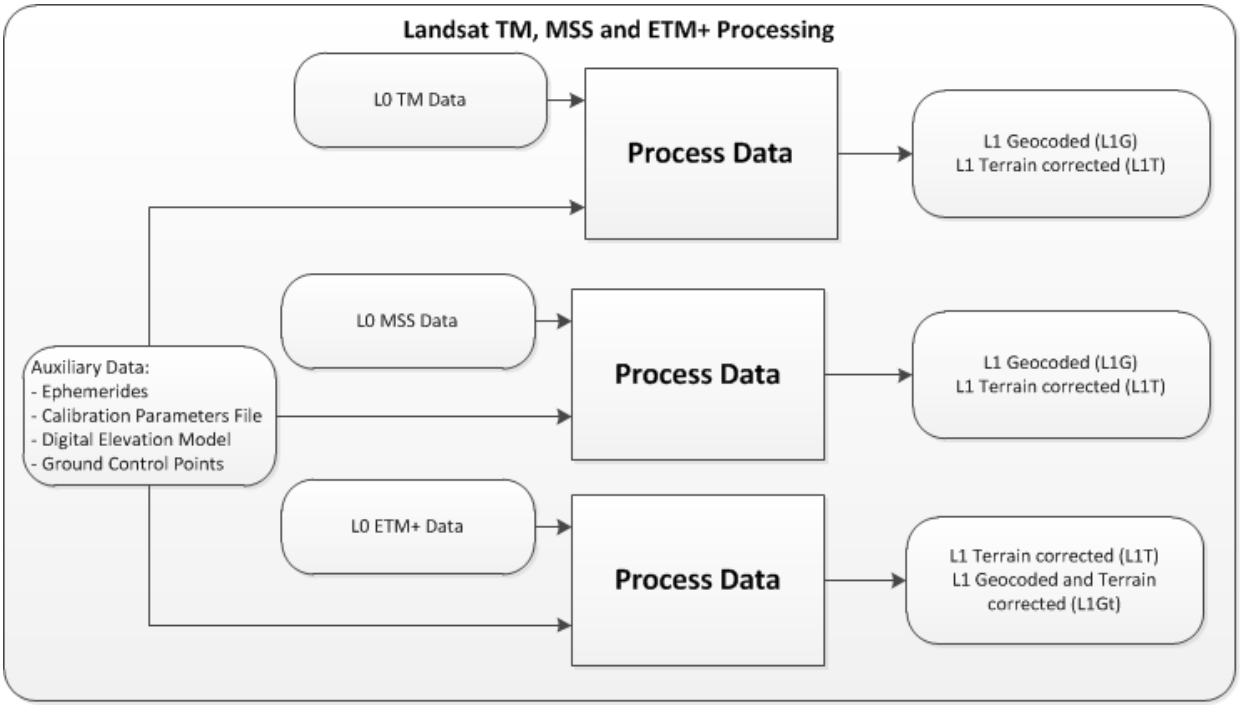

Figure 1: Generic high level processing chain showing inputs and possible outputs of the processing chain

Summary information about the Landsat processors is shown in Table 6 and Table 7.

Instrument:	TM and MSS
Output Processing Level:	L1G, L1T
Developer:	ACS
Documentation reference:	IDEAS Landsat Product Descriptions Document, IDEAS-VEG-SRV-REP-1320, Issue 6.0 SLAP Interface Control Document, SLAP-ID-ACS-GS-0100, v 1.11
Possibility to reuse the processor:	Yes (ESA)
Possibility to modify the processor:	No (binary)

Table 6: Summary information about Landsat TM and MSS

Instrument:	ETM+
Output Processing Level:	L1T, L1Gt
Developer:	ACS
Documentation reference:	IDEAS Landsat Product Descriptions Document, IDEAS-VEG-SRV-REP-1320, Issue 6.0 SLAP Interface Control Document, SLAP-ID-ACS-GS-0100, v 1.11
Possibility to reuse the processor:	Yes (ESA)
Possibility to modify the processor:	No (binary)

Table 7: Summary information about Landsat ETM+ processor

2.4.1. TM and MSS Processing Chain

The processing of TM and MSS data and the types of auxiliary files that are used during the process are summarised in Figure 2

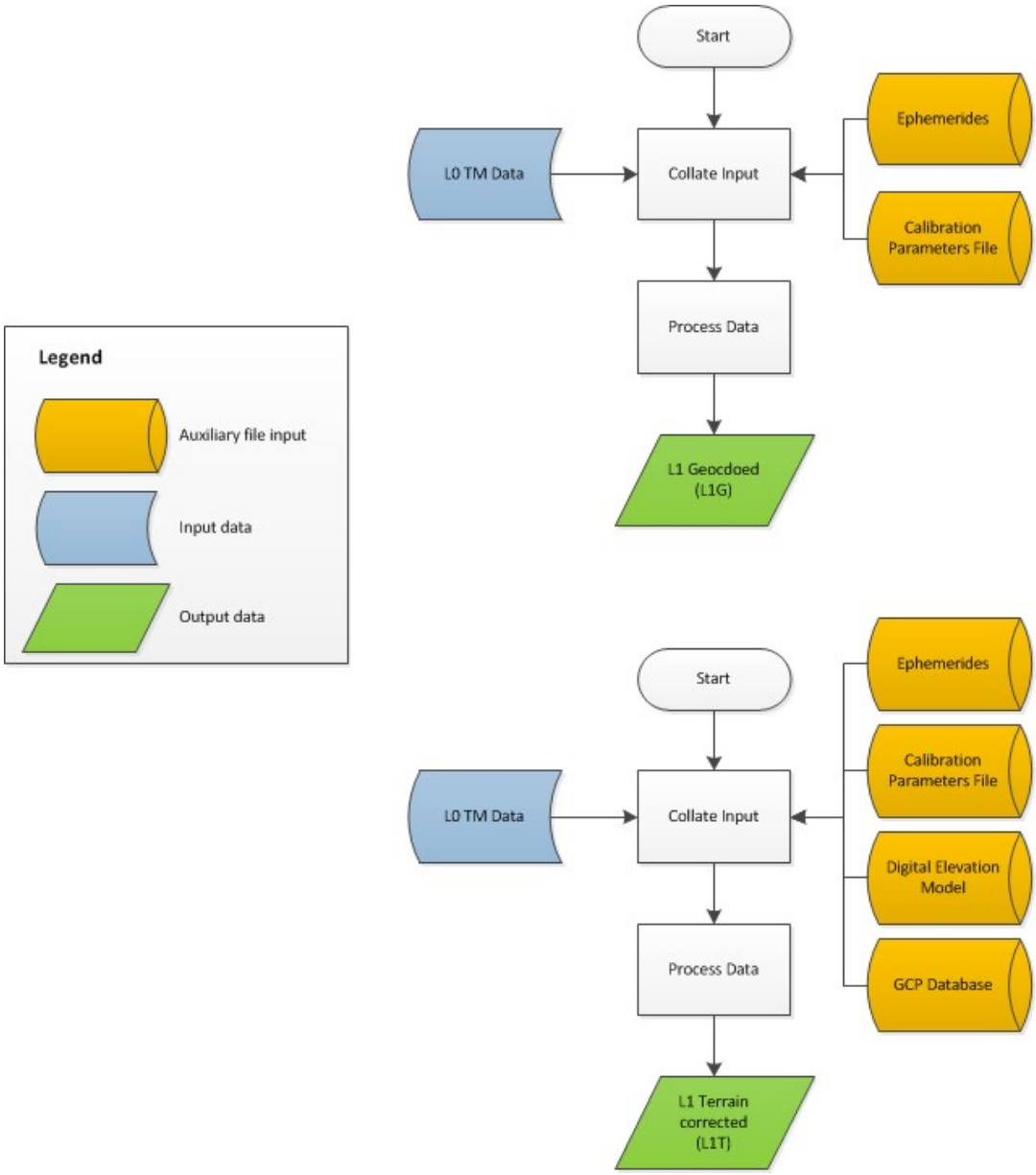

Figure 2: Processing of TM and MSS data

The inputs required TM and MSS data and the outputs generated are listed below. The processor will use L0 input and produces a L1 Geocoded (L1G) and Terrain corrected outputs (L1T).

Input	Processor	Output	Destination (next Processor)
Product-types:	Landsat IPF	**Product-types:**	N/A
L0 TM Data L0 MSS Data		L1 Geocoded (L1G)	
Auxiliary-types:		**Auxiliary-types:**	
Ephemerides Calibration Parameters File		N/A	

Table 8: Landsat L0 TM and MSS Data to L1 Geocoded

Input	Processor	Output	Destination (next Processor)
Product-types:	Landsat IPF	**Product-types:**	N/A
L0 TM Data L0 MSS Data		L1 Terrain corrected (L1T)	
Auxiliary-types:		**Auxiliary-types:**	
Ephemerides Calibration Parameters File Digital Elevation Model Ground Control Point Database		N/A	

Table 9: Landsat L0 TM and MSS Data to L1 Terrain corrected

2.4.2. ETM+ Processing Chain

The processing of ETM+ data and the types of auxiliary files that are used during the process are summarised in Figure 3.

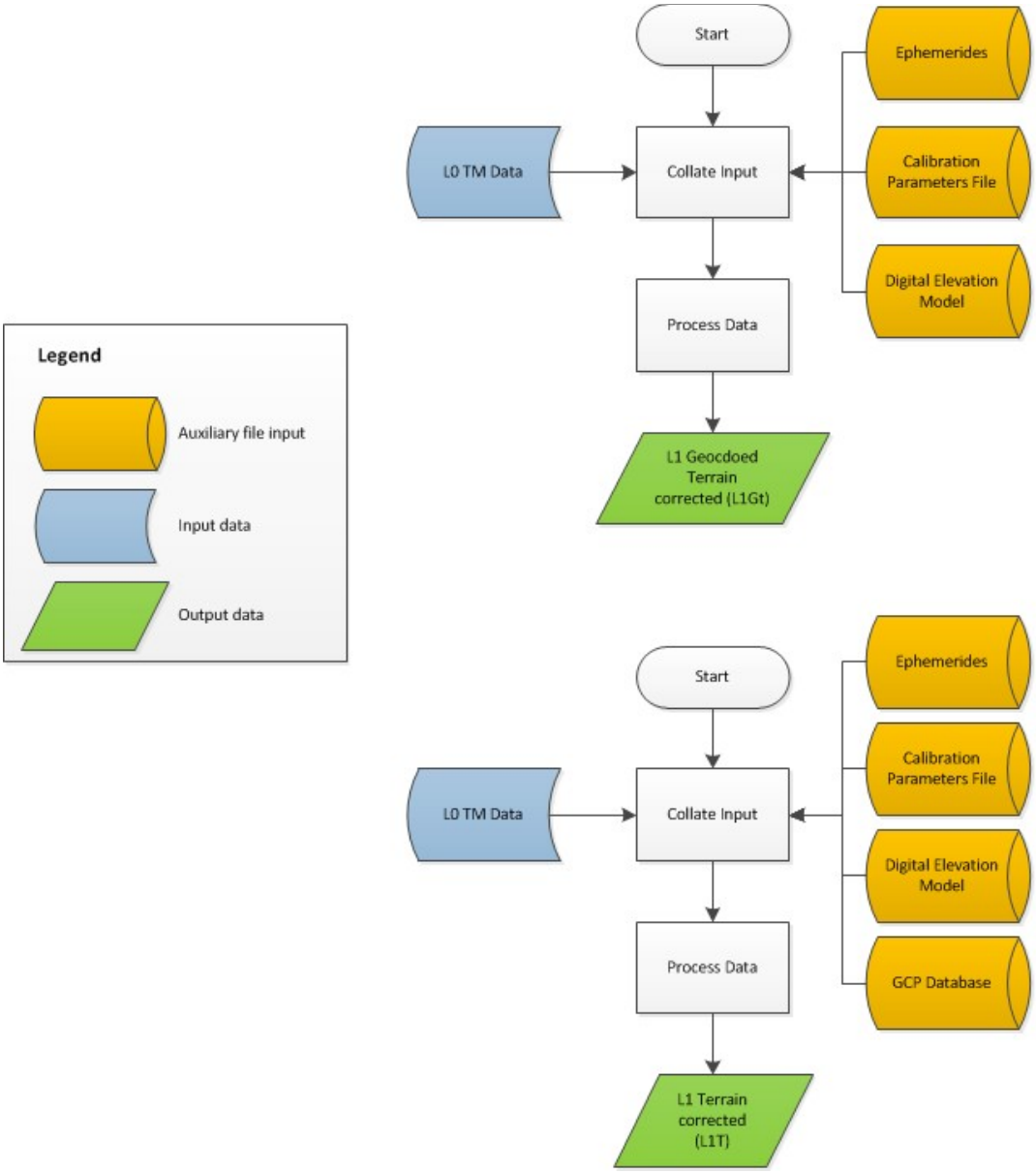

Figure 3: Processing of ETM+ data

The inputs required ETM+ data and the outputs generated are listed below. The processor will use L0 input and produces a L1 Geocoded Terrain corrected (L1Gt) and Terrain corrected outputs (L1T).

Input	Processor	Output	Destination (next Processor)
Product-types:	Landsat IPF	**Product-types:**	N/A
L0 ETM+ Data		L1 Geocoded Terrain corrected (L1Gt)	
Auxiliary-types:		**Auxiliary-types:**	
Ephemerides Calibration Parameters File Digital Elevation Model		N/A	

Table 10: Landsat L0 ETM+ Data to L1 Geocoded Terrain corrected

Input	Processor	Output	Destination (next Processor)
Product-types:	Landsat IPF	**Product-types:**	N/A
L0 ETM+ Data		L1 Terrain Corrected (L1T)	
Auxiliary-types:		**Auxiliary-types:**	
Ephemerides Calibration Parameters File Digital Elevation Model Ground Control Point Database		N/A	

Table 11: Landsat L0 ETM+ Data to L1 Terrain Corrected

3. Metadata Specialisation

All metadata types that are defined from scratch or modified by the present specialisation have been included in this section. Several of the non-modified metadata types, such as those from XFDU or from OGC EOP O&M, are not repeated in the present book as they are considered implicitly inherited and therefore, unchanged (the reader is simply referred to the corresponding schemas). However, for some of the OGC EOP O&M metadata types, additional clarifications or restrictions applicable to this SAFE specialisation are provided.

This section details:

1) the specific metadata elements that are considered applicable from the [OGC EOP O&M] metadata model for the SAFE EO products.
2) the specific metadata elements that are considered applicable from the SAFE scene set metadata model (safe-ssm.xsd) for the EO Scene Product (that can be obtained from the data striplines measured by the SAR instrument).

As part of this specialisation, the following sections describe the extensions that are needed to be included in the metadata models to allocate a particular metadata not foreseen by the model, and/or to restrict the metadata model to accommodate some of the values that are required by the products/auxiliary files.

3) the specific metadata elements that are considered applicable from the SAFE auxiliary metadata model (safe-aux.xsd) for the Auxiliary files.

The metadata specialisation has been classified by different abstraction levels (column “Abstraction”):

- Mission level (M): These metadata are common to all products generated for the mission.
- Instrument level (I): These metadata are common to all products generated for a specific instrument.
- Processing level (P): These metadata are common to all products generated for a specific product level. In this case, the specialisation is specified in a separate control book (i.e. [LANDSAT-BOOK-L0] for L0 products).

3.1. EO Products

The following table represents the metadata specialisation with respect to the OGC EOP O&M metadata model applicable to all products of the current mission (applicable version of the OGC EOP O&M metadata model is referenced in [OGC EOP O&M]).

Where:

- ***XML element or attribute***: Element or attribute from the EOP O&M metadata model (leaf node is in black).
- ***Cardinality:*** Cardinality of the element/attribute tailored for the mission.

- ***Description:*** Brief description of the element/attribute.
- ***Format/Allowed Values:*** Expected format and possible values identified for the mission.

3.1.1. Metadata specialisation at Mission level

The following table describes all the metadata elements that must be present in the metadata file of a SAFE EO Product package generated in this mission:

XML element or attribute	Cardinality	Description	Format/Allowed values
eop:EarthObservation/ **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file
eop:EarthObservation/ *om:phenomenonTime/* *gml:TimePeriod/* **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file
eop:EarthObservation/ *om:phenomenonTime/* *gml:TimePeriod/* **gml:beginPosition**	1	Acquisition start date time in ISO 8601 format.	Format: CCYY-MMDDThh:mm[:ss[.cc]]Z
eop:EarthObservation/ *om:phenomenonTime/* *gml:TimePeriod/* **gml:endPosition**	1	Acquisition end date time in ISO 8601 format	Format: CCYY-MMDDThh:mm[:ss[.cc]]Z
eop:EarthObservation/ *om:resultTime/* *gml:TimeInstant/* **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file
eop:EarthObservation/ *om:resultTime/* *gml:TimeInstant/* **gml:timePosition**	1	The time when result becomes available in ISO 8601 format.	Format: CCYY-MMDDThh:mm[:ss[.cc]]Z Same value as the metadata element: *eop:EarthObservation/* *om:phenomenonTime/* *gml:TimePeriod/*

XML element or attribute	Cardinality	Description	Format/Allowed values
			gml:endPosition
sar:EarthObservation/ om:procedure/ eop:EarthObservationEquipment/ **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file
eop:EarthObservation/ om:procedure/ eop:EarthObservationEquipment/ eop:platform/ eop:Platform/ **eop:shortName**	1	Platform short name.	Format: String Value: **Landsat**
eop:EarthObservation/ om:procedure/ eop:EarthObservationEquipment/ eop:platform/ eop:Platform/ **eop:serialIdentifier**	1	Platform serial identifier	Format: String Possible values: • **1** • **2** • **3** • **4** • **5** • **7**
eop:EarthObservation/ om:procedure/ eop:EarthObservationEquipment/ eop:instrument/ eop:Instrument/ **eop:shortName**	1	Instrument (Sensor) name	Format: String Possible values: • **MSS** • **TM** • **ETM**
eop:EarthObservation/ om:procedure/ eop:EarthObservationEquipment/ eop:sensor/ eop:Sensor/ **eop:sensorType**	1	Sensor type.	Format: String Value: **OPTICAL**
eop:EarthObservation/	1	Sensor mode. Possible values are mission specific and should be	Format: String

XML element or attribute	Cardinality	Description	Format/Allowed values
om:procedure/ *eop:EarthObservationEquipment/* *eop:sensor/* *eop:Sensor/* **eop:operationalMode**		retrieved using codeSpace.	Value: **IM**
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:acquisitionParameters/* *sar:Acquisition/* **eop:orbitNumber**	1	Absolute orbit at sensing start time.	Format: Integer
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:acquisitionParameters/* *sar:Acquisition/* **eop:orbitDirection**	1	Acquisition orbit direction	Format: String Possible values: • **ASCENDING** • **DESCENDING**
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:acquisitionParameters/* *sar:Acquisition/* **eop:wrsLongitudeGrid**	1	Track number	Format: String
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:acquisitionParameters/* *sar:Acquisition/* *eop:wrsLongitudeGrid/* **@codeSpace**	1	Code space of the WRS. Used to point the reference grid	Format: String Value: **urn:esa:eop:Landsat:<WRS_name>** Where - WRS-1 for Landsat 1 to 3 - WRS-2 for Landsat 4, 5 and 7. Sequential “path” number: - 1 to 251 for WRS-1 - 1 to 233 for WRS-2.

XML element or attribute	Cardinality	Description	Format/Allowed values
opt:EarthObservation/ om:procedure/ opt:EarthObservationEquipment / eop:acquisitionParameters/ eop:Acquisition/ **eop:ascendingNodeLongitude**	1	Longitude at ascending node of orbit.	gml:MeasureType.
eop:EarthObservation/ om:procedure/ eop:EarthObservationEquip-ment/ eop:acquisitionParameters/ eop:Acquisition/ eop:ascendingNodeLongitude **@uom**	1	Unit of measure	Format: String Value: **deg**
eop:EarthObservation/ **om:observedProperty**	1	xlink to the observed property definition	This field is mandatory but not used and has to be set to null as reported below. `<om:observedProperty xsi:nil="true" nilReason="inapplic-able"/>`
eop:EarthObservation/ om:featureOfInterest/ eop:Footprint/ **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file.
eop:EarthObservation/ om:featureOfInterest/ eop:Footprint/ eop:multiExtentOf/ gml:MultiSurface/ **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file.
eop:EarthObservation/ om:featureOfInterest/ eop:Footprint/ eop:multiExtentOf/ gml:MultiSurface/ gml:surfaceMember/ gml:Polygon/ **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file.

XML element or attribute	Cardinality	Description	Format/Allowed values
eop:EarthObservation/ *om:featureOfInterest/* *eop:Footprint/* *eop:multiExtentOf/* *gml:MultiSurface/* *gml:surfaceMember/* *gml:Polygon/* *gml:exterior/* *gml:LinearRing/* **gml:posList**	1	Acquisition footprint coordinates, described by a closed polygon (last point=first point), using CRS:WGS84, Latitude,Longitude pairs (per-WGS84 definition of point ordering, not necessarily per all WFS implementations).	Format: String The footprint is made by the following points (seen from flight direction): • first right • right side standard scene corners • last right • last left • left side standard scene corners • first left • first right (repeated to close the polygon) The Polygon geometry shall be encoded in the EPSG:4326 geographic coordinate reference system and the coordinate pairs shall be ordered as lat /lon. Polygons enclose areas with points listed in CCW direction.
eop:EarthObservation/ *om:result/* *eop:EarthObservationResult/* **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	String.The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file
eop:EarthObservation/ *om:result/* *eop:EarthObservationResult/* *eop:product/* *eop:ProductInformation/* *eop:fileName/* *ows:ServiceReference/* **@xlink:href**	1	URN Reference to the EO product package.	Format: String
eop:EarthObservation/ *om:result/* *eop:EarthObservationResult/* *eop:product/* *eop:ProductInformation/* *eop:fileName/* *ows:ServiceReference/* **ows:RequestMessage**	1	OWS request message.	This mandatory element shall be left blank
eop:EarthObservation/ *om:result/* *eop:EarthObservationResult/* *eop:product/*	1	Product size (bytes) allowing the user to realise how long a download is likely to take If product size is not known, an estimation shall be provided rounding the average estimated size to the 2 most	Format: Long Integer

XML element or attribute	Cardinality	Description	Format/Allowed values
eop:ProductInformation/ **eop:size**		significant digits Product Facility must at least provide an estimation of the size if not the real one.	
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* ***eop:identifier***	1	Identifier for metadata item, includes ground segment namespace to guarantee uniqueness within EOP (Product name without extension)	Format: String
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* **eop:parentIdentifier**	0,1	Product Facility Dataset / collection Identifier (e.g. for CDS: the DataSet identifier or Sub DataSet Identifier). If the product is associated to various identifiers, the other identifiers have to be provided through Metadata Update Reports.	Format: String
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* **eop:acquisitionType**	1	Used to distinguish at a high-level the appropriateness of the acquisition for "general" use.	Format: String Value: **NOMINAL**
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* ***eop:acquisitionSubType***	1	Acquisition sub-type.	Format: String Possible values: • **SAM** • **BUMPER**
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* **eop:productType**	1	Describes product type in case that mixed types are available within a single collection.	Format: String Possible values: • **MSS_MSS_0P** • **TM__TM__0P** • **ETM_ETM_0P**
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* **eop:status**	1	Product status.	Format: String Value: **ARCHIVED**
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetadata/* *eop:downlinkedTo/*	1	Acquisition/receiving station code.	Format: String Possible values:

XML element or attribute	Cardinality	Description	Format/Allowed values
eop:DownlinkInformation/ **eop:acquisitionStation**			• **MPS** *(for Maspalomas)* • **KSE** *(for Kiruna)* • **TRS** *(for Tromsoe)* • **MTI** *(for Matera)* • **MLD** *(for Malindi)* • **NSG** *(for Neustrelitz)* • **FUI** *(for Fucino)* • **LBG** *(for Libreville)* • **BSK** *(for Bishkek)* • **OHG** *(for O'Higgins)*
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetadata/* *eop:downlinkedTo/* *eop:DownlinkInformation/* ***eop:acquisitionStation*** **@codeSpace**	1	Code space of the Acquisition Station.	Format: String Value: **urn:esa:eop:facility**
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetadata/* *eop:processing/* *eop:ProcessingInformation/* **eop:processingCenter**	1	Processing center code.	Format: String Value to be operationally defined.
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetadata/* *eop:processing/* *eop:ProcessingInformation/* **eop:processingDate**	1	Processing date time in in ISO 8601 format.	Format: CCYY-MMDDThh:mm[:ss[.cc]]Z
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetadata/* *eop:processing/* *eop:ProcessingInformation/* **eop:processingLevel**	1	Processing level.	Format: String Value: **other: L0**

XML element or attribute	Cardinality	Description	Format/Allowed values
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetadata/* *eop:processing/* *eop:ProcessingInformation/* **eop:auxiliaryDataSetFileName**	1	Name(s) of auxiliary dataset(s) that are available in addition to L0 data for higher level processing (1..N)	Format: String

Table 12: EOP O&M Product Metadata tailoring

3.2. *EO Scene Products*

SAFE EO Product Packages will always contain a single XML file applying to the whole product (based on the [OGC EOP O&M] model as described in previous section) and optionally, another XML file containing scene information that can be extracted from the data striplines measured by each instrument.

The following table provides the tailoring of the XML elements to be used in this optional metadata file inside the EO Product Packages considering the scene set metadata model specified for SAFE (safe-ssm.xsd).

Where:

- ***XML element or attribute***: Element or attribute from the EOP O&M metadata model (leaf node is in black).
- ***Cardinality:*** Cardinality of the element/attribute tailored for the mission.
- ***Description:*** Brief description of the element/attribute.
- ***Format/Allowed Values:*** Expected format and possible values identified for the mission.

XML element or attribute	Cardinality	Description	Format/Allowed values
eop:EarthObservation/ **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file
eop:EarthObservation/ *om:phenomenonTime/* *gml:TimePeriod/* **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter

XML element or attribute	Cardinality	Description	Format/Allowed values
			starting from 1 and incremented with each gml:id attribute present in a given file
eop:EarthObservation/ *om:phenomenonTime/* *gml:TimePeriod/* **gml:beginPosition**	1	Acquisition start date time in ISO 8601 format.	Format: CCYY-MMDDThh:mm[:ss[.cc]]Z
eop:EarthObservation/ *om:phenomenonTime/* *gml:TimePeriod/* **gml:endPosition**	1	Acquisition end date time in ISO 8601 format	Format: CCYY-MMDDThh:mm[:ss[.cc]]Z
eop:EarthObservation/ *om:resultTime/* *gml:TimeInstant/* **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file
eop:EarthObservation/ *om:resultTime/* *gml:TimeInstant/* **gml:timePosition**	1	The time when result becomes available in ISO 8601 format.	Format: CCYY-MMDDThh:mm[:ss[.cc]]Z Same value as the metadata element: *eop:EarthObservation/* *om:phenomenonTime/* *gml:TimePeriod/* **gml:endPosition**
sar:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:platform/* *eop:Platform/* **eop:shortName**	1	Platform short name.	Format: String Value: **Landsat**
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:platform/* *eop:Platform/* **eop:serialIdentifier**	1	Platform serial identifier	Format: String Possible values: • **1**

XML element or attribute	Cardinality	Description	Format/Allowed values
			• **2** • **3** • **4** • **5** • **7**
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:instrument/* *eop:Instrument/* **eop:shortName**	1	Instrument (Sensor) name	Format: String Possible values: • **MSS** • **TM** • **ETM**
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:sensor/* *eop:Sensor/* **eop:sensorType**	1	Sensor type.	Format: String Value: **OPTICAL**
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:sensor/* *eop:Sensor/* **eop:operationalMode**	1	Sensor mode. Possible values are mission specific and should be retrieved using codeSpace.	Format: String Value: **IM**
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:acquisitionParameters/* *sar:Acquisition/* **eop:orbitNumber**	1	Absolute orbit at sensing start time.	Format: Integer
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:acquisitionParameters/* *sar:Acquisition/* **eop:orbitDirection**	1	Acquisition orbit direction	Format: String Possible values: • **ASCENDING** • **DESCENDING**
eop:EarthObservation/ *om:procedure/*	1	Track number	Format: String

XML element or attribute	Cardinality	Description	Format/Allowed values
eop:EarthObservationEquipment/ *eop:acquisitionParameters/* *sar:Acquisition/* **eop:wrsLongitudeGrid**			
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:acquisitionParameters/* *sar:Acquisition/* *eop:wrsLongitudeGrid/* **@codeSpace**	1	Code space of the WRS. Used to point the reference grid	Format: String Value: **urn:esa:eop:Landsat:<WRS_name>** Where - WRS-1 for Landsat 1 to 3 - WRS-2 for Landsat 4, 5 and 7. Sequential "path" number: - 1 to 251 for WRS-1 - 1 to 233 for WRS-2.
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:acquisitionParameters/* *sar:Acquisition/* **eop:wrsLatitudeGrid**	1	Frame number	Format: String
eop:EarthObservation/ *om:procedure/* *eop:EarthObservationEquipment/* *eop:acquisitionParameters/* *sar:Acquisition/* *eop:wrsLatitudeGrid/* **@codeSpace**	1	Code space of the WRS. Used to point the reference grid	Format: String Value: **urn:esa:eop:Landsat:<WRS_name>** Where - WRS-1 for Landsat 1 to 3 - WRS-2 for Landsat 4, 5 and 7. Sequential "path" number: - 1 to 251 for WRS-1 - 1 to 233 for WRS-2. Sequential "row" number:

XML element or attribute	Cardinality	Description	Format/Allowed values
			- 1 to 248
eop:EarthObservation/ **om:observedProperty**	1	xlink to the observed property definition	This field is mandatory but not used and has to be set to null as reported below. `<om:observedProperty xsi:nil="true" nilReason="inapplicable"/>`
eop:EarthObservation/ *om:featureOfInterest/* *eop:Footprint/* **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file.
eop:EarthObservation/ *om:featureOfInterest/* *eop:Footprint/* *eop:multiExtentOf/* *gml:MultiSurface/* **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file.
eop:EarthObservation/ *om:featureOfInterest/* *eop:Footprint/* *eop:multiExtentOf/* *gml:MultiSurface/* *gml:surfaceMember/* *gml:Polygon/* **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	Format: String The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file.
eop:EarthObservation/ *om:featureOfInterest/* *eop:Footprint/* *eop:multiExtentOf/* *gml:MultiSurface/* *gml:surfaceMember/* *gml:Polygon/* *gml:exterior/* *gml:LinearRing/* **gml:posList**	1	Acquisition footprint coordinates, described by a closed polygon (last point=first point), using CRS:WGS84, Latitude,Longitude pairs (per-WGS84 definition of point ordering, not necessarily per all WFS implementations).	Format: String The footprint is made by the following points (seen from flight direction): • first right • right side standard scene corners • last right • last left • left side standard scene corners • first left • first right (repeated to close the polygon) The Polygon geometry shall be encoded in the EPSG:4326 geographic coordin-

XML element or attribute	Cardinality	Description	Format/Allowed values
			ate reference system and the coordinate pairs shall be ordered as lat /lon. Polygons enclose areas with points listed in CCW direction.
eop:EarthObservation/ *om:result/* *eop:EarthObservationResult/* **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	String.The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file
opt:EarthObservation/ *om:featureOfInterest/* *eop:Footprint/* *eop:centerOf/* *gml:Point/* **gml:pos**	1	Coordinates of the center of the scene.	Central coordinates (Lat/Lon) of the acquisition line at the center time of the scene.
opt:EarthObservation/ *om:result/* *opt:EarthObservationResult/* **@gml:id**	1	Mandatory identifier required by GML. Its value must be unique among all the gml:id attributes of the XML file.	String. The convention is to use eop:identifier + _N (as a suffix), where N is a counter starting from 1 and incremented with each gml:id attribute present in a given file
eop:EarthObservation/ *om:result/* *eop:EarthObservationResult/* *eop:product/* *eop:ProductInformation/* *eop:fileName/* *ows:ServiceReference/* **@xlink:href**	1	URN Reference to the EO product package.	Format: String
eop:EarthObservation/ *om:result/* *eop:EarthObservationResult/* *eop:product/* *eop:ProductInformation/* *eop:fileName/* *ows:ServiceReference/* **ows:RequestMessage**	1	OWS request message.	This mandatory element shall be left blank
opt:EarthObservation/ *om:result/* *opt:EarthObservationResult/* ***opt:cloudCoverPercentage***	1	Cloud cover percentage for the WRS scene.	Format: String
opt:EarthObservation/	1	Unit of measure.	Format: String

XML element or attribute	Cardinality	Description	Format/Allowed values
om:result/ *opt:EarthObservationResult/* ***opt:cloudCoverPercentage/*** ***@uom***			Value: **%**
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* ***eop:identifier***	1	Scene identifier.	Format: String
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* **eop:parentIdentifier**	0,1	Identifier of the product containing the scene.	Format: String
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* **eop:acquisitionType**	1	Used to distinguish at a high-level the appropriateness of the acquisition for "general" use.	Format: String Value: **NOMINAL**
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* ***eop:acquisitionSubType***	1	Acquisition sub-type.	Format: String Possible values: • **SAM** • **BUMPER**
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* **eop:productType**	1	Describes product type in case that mixed types are available within a single collection.	Format: String Possible values: • **MSS_MSS_0P** • **TM__TM__0P** • **ETM_ETM_0P**
eop:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* **eop:status**	1	Product status.	Format: String Value: **ARCHIVED**
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetadata/* *eop:downlinkedTo/* *eop:DownlinkInformation/*	1	Acquisition/receiving station code.	Format: String Possible values: • **MPS** *(for Maspalomas)*

XML element or attribute	Cardinality	Description	Format/Allowed values
eop:acquisitionStation			• **KSE** *(for Kiruna)* • **TRS** *(for Tromsoe)* • **MTI** *(for Matera)* • **MLD** *(for Malindi)* • **NSG** *(for Neustrelitz)* • **FUI** *(for Fucino)* • **LBG** *(for Libreville)* • **BSK** *(for Bishkek)* • **OHG** *(for O'Higgins)*
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetadata/* *eop:downlinkedTo/* *eop:DownlinkInformation/* ***eop:acquisitionStation*** **@codeSpace**	1	Code space of the Acquisition Station.	Format: String Value: **urn:esa:eop:facility**
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* **eop:productQualityDegradation**	1	Quality degradation percentage (percentage of missing lines in the WRS scene).	Format: String
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* *eop:productQualityDegradation* **@uom**	1	Unit of measure.	Format: String Value: **%**
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* *eop:vendorSpecific/* *eop:SpecificInformation/* **eop:localAttribute [gainChange]**	0,1	The pair localAttribute/localValue is used to provide additional attributes in the product metadata without changing the model	Format: String Value: **gainChange** *(ETM+ only)*
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* *eop:vendorSpecific/* *eop:SpecificInformation/* **eop:localValue [gainChange]**	0,1	Presence of gain change in the WRS scene.	Format: String Possible values: • **TRUE** • **FALSE**

XML element or attribute	Cardinality	Description	Format/Allowed values
			(ETM+ only)
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* *eop:vendorSpecific/* *eop:SpecificInformation/* **eop:localAttribute [gainSettings]**	0,1	The pair localAttribute/localValue is used to provide additional attributes in the product metadata without changing the model.	Format: String Value: **gainSetting** *(ETM+ only)*
opt:EarthObservation/ *eop:metaDataProperty/* *eop:EarthObservationMetaData/* *eop:vendorSpecific/* *eop:SpecificInformation/* **eop:localValue [gainSettings]**	0,1	Gain settings for the WRS scene. The gain is switched by group of bands: - Bands 1-2-3 - Band 4 - Bands 5-7 - Band 8.	Format: String Example: HHLL to indicate the setting HHH.H.L.LH.L.L for Bands 123.4.5.66.7.8 *(ETM+ only)*

Table 13: EOP O&M Scene Products Metadata tailoring

4. Naming Conventions

4.1. LANDSAT MSS

4.1.1. Level 0 Products

4.1.1.1. Package Names

Representation Information Metadata package
MSS_MSS_0P_RPI-MTD_<*cccc*>.SAFE
Representation Information Data package
MSS_MSS_0P_RPI-DAT_<*cccc*>.SAFE
Naming convention for Collection package
MSS_MSS_0P_COL-MTD_<*cccc*>.SAFE
Naming convention for product packages
MSS_MSS_0P_<*start*>_<*stop*>_<*procCenter*>_<*orbit*>_<*nnnn*>_<*cccc*>.SAFE

Table 14: SAFE Package Names for LANDSAT MSS L0 products

Where:

<*start*>	Start date/time of the product from the UTC time of the first DSR (15 characters: YYYYMMDD_hhmmss)
<*stop*>	Stop date/time of the product (15 characters: YYYYMMDDThhmmss)
<*procCenter*>	Processing center (3 characters)
<*orbit*>	Orbit number (4 characterks)
<*nnnn*>	Numerical wrap-around counter for quick file identification (4 characters).
<*cccc*>	Is the CRC-16 value calculated over the manifest file inside the SAFE Package (4 characters).

4.1.1.2. URN Specifications

Representation Information Metadata package
urn:x-safe:LANDSAT:MSS_MSS_0P_RPI-MTD
Representation Information Data package
urn:x-safe:LANDSAT:MSS_MSS_0P_RPI-DAT
Naming convention for collection package
urn:x-safe:LANDSAT:MSS_MSS_0P_COL-MTD
Naming convention for product packages
urn:x-safe:LANDSAT:MSS_MSS_0P_<*start*>_<*stop*>_<*procCenter*>_<*orbit*>_<*nnnn*>

Table 15: URN Specification for LANDSAT MSS L0 packages

4.2. LANDSAT TM

4.2.1. Level 0 Products

4.2.1.1. Package Names

Representation Information Metadata package
TM__TM__0P_RPI-MTD_<*cccc*>.SAFE
Representation Information Data package
TM__TM__0P_RPI-DAT_<*cccc*>.SAFE
Naming convention for Collection package
TM__TM__0P_COL-MTD_<*cccc*>.SAFE
Naming convention for product packages
TM__TM__0P_<*start*>_<*stop*>_<*procCenter*>_<*orbit*>_<*nnnn*>_<*cccc*>.SAFE

Table 16: SAFE Package Names for Landsat TM L0 products

Where:

<*start*>	Start date/time of the product from the UTC time of the first DSR (15 characters: YYYYMMDD_hhmmss)
<*stop*>	Stop date/time of the product (15 characters: YYYYMMDDThhmmss)
<*procCenter*>	Processing center (3 characters)
<*orbit*>	Orbit number (4 characters)
<*nnnn*>	Numerical wrap-around counter for quick file identification (4 characters).
<*cccc*>	Is the CRC-16 value calculated over the manifest file inside the SAFE Package (4 characters).

4.2.1.2. URN Specifications

Representation Information Metadata package
urn:x-safe:LANDSAT:TM__TM__0P_RPI-MTD
Representation Information Data package
urn:x-safe:LANDSAT:TM__TM__0P_RPI-DAT
Naming convention for collection package
urn:x-safe:LANDSAT:TM__TM__0P_COL-MTD
Naming convention for product packages
urn:x-safe:LANDSAT:TM__TM__0P_<*start*>_<*stop*>_<*procCenter*>_<*orbit*>_<*nnnn*>

Table 17: URN Specification for Landsat TM L0 packages

4.3. LANDSAT ETM+

4.3.1. Level 0 Products

4.3.1.1. Package Names

Representation Information Metadata package
ETM_ETM_0P_RPI-MTD_<*cccc*>.SAFE
Representation Information Data package
ETM_ETM_0P_RPI-DAT_<*cccc*>.SAFE
Naming convention for Collection package
ETM_ETM_0P_COL-MTD_<*cccc*>.SAFE
Naming convention for product packages
ETM_ETM_0P_<*start*>_<*stop*>_<*procCenter*>_<*orbit*>_<*nnnn*>_<*cccc*>.SAFE

Table 18: SAFE Package Names for Landsat ETM+ L0 products

Where:

<*start*>	Start date/time of the product from the UTC time of the first DSR (15 characters: YYYYMMDD_hhmmss)
<*stop*>	Stop date/time of the product (15 characters: YYYYMMDDThhmmss)
<*procCenter*>	Processing center (3 characters)
<*orbit*>	Orbit number (4 characters)
<*nnnn*>	Numerical wrap-around counter for quick file identification (4 characters).
<*cccc*>	Is the CRC-16 value calculated over the manifest file inside the SAFE Package (4 characters).

4.3.1.2. URN Specifications

Representation Information Metadata package
urn:x-safe:LANDSAT:ETM_ETM_0P_RPI-MTD
Representation Information Data package
urn:x-safe:LANDSAT:ETM_ETM_0P_RPI-DAT
Naming convention for collection package
urn:x-safe:LANDSAT:ETM_ETM_0P_COL-MTD
Naming convention for product packages
urn:x-safe:LANDSAT:ETM_ETM_0P_<*start*>_<*stop*>_<*procCenter*>_<*orbit*>_<*nnnn*>

Table 19: URN Specification for Landsat ETM+ L0 packages

Appendix A. Representation Information Packages

SAFE Representation Information Packages are characteristic of the specialisation and during the nominal operations of a SAFE archive such Packages will not normally be created. Therefore, the packages listed in the following sections can be used as-is to introduce LANDSAT support to a SAFE archive.

A.I. Rep. Info Packages for Level 0 products

The files listed below are distributed together with the set of documents that constitute the SAFE specialisation for LANDSAT L0. Each SAFE Package is compressed into a zip file which should be decompressed before usage.

These SAFE Packages may contain either the representation information of the target of preservation EO product (RPI-DAT) or the representation information of the metadata (RPI-MTD) for the product types.

[LANDSAT-BOOK-L0] provides a detailed description of those schemas (stored in the RPI-DAT packages) describing the data structure of the target of preservation.

#	Filename
1	ETM_ETM_0P_RPI-DAT_1436.SAFE.zip
2	ETM_ETM_0P_RPI-MTD_4130.SAFE.zip
3	MSS_MSS_0P_RPI-DAT_5875.SAFE.zip
4	MSS_MSS_0P_RPI-MTD_4738.SAFE.zip
5	TM__TM__0P_RPI-DAT_4105.SAFE.zip
6	TM__TM__0P_RPI-MTD_2617.SAFE.zip

Appendix B. SAFE Package Examples

The packages listed in the following subsections are examples of SAFE LANDSAT EO Products distributed only for illustrative purposes together with the set of documents that constitute the SAFE specialisation.

Each SAFE Package is compressed into a zip file which should be decompressed before usage.

B.I. SAFE Package examples for L0

#	Filename
1	LS07_ETM_ETM_0P_20010220T101230_20010220T101834_MPS_9856_8544_5B42.SAFE.zip
2	LS03_MSS_MSS_0P_19820828T071459_19820828T072025_KSE_22825_3221_2D8E.SAFE.zip
3	LS05_TM__TM__0P_19960324T070718_19960324T071326_FUI_64160_5210_AF85.SAFE.zip

Appendix C. Acquisition stations

In the following table the list of acquisition stations are reported.

Station name	2-char station code	3-char station code
Fairbanks	AF	ASF
AliceS pring	AS	ASA
Atlanta Test Site	AT	ATL
Beijing	BJ	BJG
Bishkek	BK	BSK
Cordoba	CA	COA
Cachoeira Paulista	CP	CPA
Chetumal	CM	MEX
Cotopaxi	CO	CPE
Cuiaba	CU	CUB
Fucino	FS	FUI
Gatineau	GH	GAT
Grimstadt	GR	GRS
Hatoyama	HA	HAJ
Hyderabad – former Shadnadar	SE	HYD
Hobart	HO	HOA
Hawaii	HW	HW
Hyderabad	HY	HYD
PariPari	IN	DKI
TelAviv (IR)	IR	ISR
Johannesburg	JO	JOS
Kitab	KB	KTB
Khanty Mansisk	KM	KMY
Kiruna	KS	KIR
Kumamoto	KU	KUJ
Libreville	LI	LBG
Matera	MA	MTI
Miami	MI	MIM
Malindi	ML	MLD
McMurdo	MM	MMR

Station name	2-char station code	3-char station code
Maspalomas	MS	MPS
Moscow	MW	MSW
Norman	NO	NOM
Neustrelitz	NZ	NSG
O'Higgins	OH	OHG
PrinceAlbert	PH	PAS
Rhyad	SA	RSA
Singapore	SG	SGP
Syowa	SY	SYW
O'Higgins	TF	OHG
Bangkok	TH	BKT
Taipei (Taiwan)	TP	TPE
Tromsoe	TS	TRS
Istanbul	TU	IST
Chung-Li (Taiwan)	TW	TWN
Ulan Bator	UB	ULB
UNKNOWN	XX	XXX
West Freugh	WF	WFR