# Keystone Image File Formats | User Manual

Spacemetric

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# Contents

# Chapter 1

# Image file format overview

**Topics:**

- *Important notices*

The Keystone System supports a wide range of image formats. These include standard image formats such as TIFF and formats specific to imagery from individual satellites or distributors. The Keystone System also reads the metadata supplied with the image file. Depending upon the specific format, the metadata can be embedded in the image file or be contained in a separate metadata file.

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### 1.1.1. Copyrights



### 1.1.2. Disclamer

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Chapter

2

# Import

**Topics:**



Description of the import step in the context of image file formats.

Import is a pre-processing step performed on all imagery ingested into the Keystone System. The import step reads and processes the image metadata and generates all the data structures and geometrical models used by the Keystone System. The result is stored in a SIP metadata file (`*_meta.sip`) or uploaded to the catalogue.

In some cases, the image files are processed during import to correct for band misregistration or to merge tiled images into a single image. No-data values are used consistently in all image processing steps such as rectification. However, the value must be set correctly when the image is imported. Some formats have a defined no-data value and others depend on a default zero value. The handling of no-data is especially important when importing DEMs.

## 2.1. Supported import formats

| Format ID | Sensor | Metadata Format | Image Format | Processing Level |
|---|---|---|---|---|
| StandardImageFormat | Any | Image header<br>RPC file (optional)<br>world file (optional) | BIL, BIP, BSQ<br>TIFF, JFIF (JPEG), PNG, BMP, ...<br>GeoTIFF, NITF, DTED<br>ErdasImagine | |
| SIP (Keystone propriatory) | Any (generic) | SIP (*_meta.sip) | any | |
| DimapFormat | Any (generic) | Dimap generic | Raw and Standard image formats | |
| IkonosCarterraFormat | Ikonos-2 | Carterra | GeoTIFF/NITF | Geo or Geo Ortho Kit (UTM) |
| DigitalGlobeFormat | Quickbird-2<br>Worldview-1<br>Worldview-2 | XML (Image support data) | GeoTIFF/NITF | Basic, Standard (UTM) |
| ErosFormat | Eros A1 | "PASS" file | TIFF | 1A |
| SpotCapFormat | Spot 1-4 | CAP | CAP | 1A, 1B, 2A |
| SpotDimapFormat | Spot 1-4<br>Spot 5 | Dimap | TIFF | 1A, 1B, 2A |
| SpotDimap2Format | Pleiades-1A<br>Spot-6 | Dimap v2 | TIFF, JPEG2000 | SENSOR, ORTHO |
| LandsatFastFormat | Landsat 7 ETM+ | FAST-L7A | BSQ (band separate) | 1G (UTM) |
| EosatFastFormat | Landsat 4-5 TM | Eosat Fast Format (Fast B Format) | BSQ (band separate) | System Corrected (UTM) |
| LandsatEsaCeosFormat | Landsat 4-5 TM<br>Landsat 7 ETM+ | CEOS | CEOS | System Corrected (UTM) |
| LandsatNlapsFormat | Landsat MSS<br>Landsat 4-5 TM<br>Landsat 7 ETM+ | NDF (NLAPS) | BSQ (band separate) | System Corrected (UTM) |
| Landsat8Format | Landsat 8 OLI, TIRS | USGS LDCM Level 1 format | GeoTIFF (band separate) | L1T, L1Gt |
| ErsPriFormat | ERS SAR | CEOS | CEOS | PRI |
| RadarsatFormat | Radarsat 1-2 | CEOS<br>XML | CEOS<br>GeoTIFF | SGF, SGX |
| IrsSuperStructureFormat | IRS P6 | LGSOWG (super structure) | LGSOWG | System Corrected |
| IrsOrthoKitFormat | IRS R2 | Ortho Kit (INF + RPC files) | GeoTIFF | System Corrected |
| CartosatFormat | Cartosat-1 and -2 | MET.TXT | TIFF | Rad corr path oriented |
| FormosatFormat | Formosat-2 | Dimap | TIFF | 1A |
| OrbViewFormat | OrbView-3 | "PVL" file (with rpc coefs) | GeoTIFF | BASIC |
| GeoEyeFormat | GeoEye-1 | "PVL" file | GeoTIFF, NITF (not compressed) | BASIC |

| Format ID | Sensor | Metadata Format | Image Format | Processing Level |
|---|---|---|---|---|
| KompsatFormat | Kompsat-2 | .txt, .rpc, .eph | TIFF | L1G |
| DmcFormat | UK-DMC<br>AlgeriaSat-1<br>NigeriaSat-1<br>Beijing-1<br>UK-DMC2<br>Deimos-1 | SIP group file (*-group.sip) | TIFF | L1, L2 |
| Dmc2Format | UK-DMC2<br>Nigeriasat-X | DMC format TIFF tags | TIFF | L0R |
| N2Format | Nigeriasat-2 | *_L0R.xml | TIFF | L0R |
| FrameCameraFormat | Aerial frame camera | Generic aerial frame camera format (XML) | TIFF | |
| LeicaAdsFormat | Leica ADS40 | Support file (*.sup) | TIFF | Level 1 |
| RapidEyeFormat | RapidEye 1-5 | *_metadata.xml | TIFF | L1B, L3A |
| TheosFormat | Theos-1 | DIMAP *.dim | TIFF | 1A, 2A |
| TerrasarXFormat | Terrasar-X | XML TSX1_SAR_*.xml | GeoTIFF | MGD, GEC, EEC |
| EnvisatFormat | ENVISAT-ASAR<br>ENVISAT-MERIS<br>ENVISAT-AATSR | ESA Envisat format (*.N1) | ESA Envisat format (*.N1) | Level 1 |
| CbersFormat | CBERS-2B | XML (CBERS_2B_HRC_*.xml) | TIFF | Level 2 |
| Ska36Format | Ska36 | XML | NITF, TIFF | |
| Ska36NitfFormat | Ska36 | NITF | NITF | |

## 2.2. Supported import sensors

| Sensor | Format ID | Metadata Format | Key file default pattern | Image Format | Processing Level |
|---|---|---|---|---|---|
| Any | StandardImage Format | Image header<br>RPC file (optional)<br>world file (optional) | *.tif, *.jpg, *.jp2, *.png, *.bmp, *.ntf, *.img, *.dt0, etc... | BIL, BIP, BSQ, TIFF, JFIF (JPEG), PNG, BMP, ..., GeoTIFF, NITF, DTED, ErdasImagine | |
| Any (generic) | SIP (Keystone propriatory) | SIP metadata file | *_meta.sip | | |
| Any (generic) | DimapFormat | Dimap generic | *.dim | Standard image formats | |
| Ikonos-2 | IkonosCarterra Format | Carterra | *_metadata.txt | GeoTIFF/NITF | Geo or Geo Ortho Kit (UTM) |
| GeoEye-1 | GeoEyeFormat | "PVL" file | GeoTIFF, NITF (not compressed) | GEO | |
| GeoEye-1 | IkonosCarterra Format | Carterra | *_metadata.txt | GeoTIFF/NITF | Geo or Geo Ortho Kit (UTM) |
| Quickbird-2 | DigitalGlobe Format | XML | *.xml | GeoTIFF/NITF | Basic, Standard (UTM) |
| Worldview-1 | DigitalGlobe Format | XML | *.xml | GeoTIFF/NITF | Basic, Standard (UTM) |
| Worldview-2 | DigitalGlobe Format | XML | *.xml | GeoTIFF/NITF | Basic, Standard (UTM) |

| Sensor | Format ID | Metadata Format | Key file default pattern | Image Format | Processing Level |
|---|---|---|---|---|---|
| Eros A1 | ErosFormat | "PASS" file | *.pass | TIFF | 1A |
| Eros B1 | ErosFormat | "PASS" file | *.pass | TIFF | 1A |
| Spot 1-4 | SpotCapFormat | CAP | lead_*.dat | TIFF | 1A, 1B, 2A |
| Spot 1-5 | SpotDimap Format | Dimap | *.dim | TIFF | 1A, 1B, 2A |
| Spot 6 | SpotDimap2 Format | Dimap v2 | DIM_*.xml | TIFF, JPEG2000 | SENSOR, ORTHO |
| Pleiades 1A | SpotDimap2 Format | Dimap v2 | DIM_*.xml | TIFF, JPEG2000 | SENSOR, ORTHO |
| Landsat 8 OLI, TIRS | Landsat8 Format | USGS LDCM L1 format | *_MTL.txt | GeoTIFF (band separate) | L1T, L1Gt |
| Landsat 7 ETM+ | LandsatFast Format | FAST-L7A | *_hrf.fst, *_htm.fst, *_hpn.fst | BSQ (band separate) | 1G (UTM) |
| Landsat 7 ETM+ | LandsatEsaCeos Format | CEOS | vdf_dat.* | CEOS | System Corrected (UTM) |
| Landsat 7 ETM+ | LandsatNlaps Format | NDF (NLAPS) | *.h1, *.h2, *.h3, *.hd | BSQ (band separate) | System Corrected (UTM) |
| Landsat 4-5 TM | EosatFas tFormat | Eosat Fast B Format | header.dat | BSQ (band separate) | System Corrected (UTM) |
| Landsat 4-5 TM | LandsatEsaCeos Format | CEOS | vdf_dat.* | CEOS | System Corrected (UTM) |
| Landsat 4-5 TM | LandsatNlaps Format | NDF (NLAPS) | *.h1, *.hd | BSQ (band separate) | System Corrected (UTM) |
| Landsat MSS | LandsatNlaps Format | NDF (NLAPS) | *.h1, *.hd | BSQ (band separate) | System Corrected (UTM) |
| ERS SAR | ErsPriFormat | CEOS | lea_* | CEOS | PRI |
| Radarsat 1-2 | RadarsatFormat | CEOS<br>XML | lea_*<br>*.xml | CEOS<br>GeoTIFF | SGF, SGX |
| IRS P6 | IrsSuperStructure Format | LGSOWG (super structure) | leader* | LGSOWG | System Corrected |
| IRS R2 | IrsOrthoKitFormat | Ortho Kit (Euromap) | *_inf.txt | GeoTIFF | System Corrected |
| Cartosat 1-2 | CartosatFormat | Cartosat | band*.tif, band*.paa | TIFF | Rad corr path oriented |
| Formosat-2 | FormosatFormat | Dimap | *.dim | TIFF | 1A |
| OrbView-3 | OrbViewFormat | "PVL" file | *.pvl | GeoTIFF | BASIC |
| Kompsat-2 | KompsatFormat | .txt, .rpc, .eph | *_1G.tif | TIFF | L1G |
| DMC satelites (UK-DMC, AlgeriaSat-1, NigeriaSat-1, Beijing-1, UK-DMC2, Deimos-1) | SIP (Keystone propriatory) | SIP metadata file | *_meta.sip | TIFF | L1 |
| UK-DMC2 | Dmc2Format | DMC format TIFF tags | *p0_L0R.Tif, *s0_L0R.Tif | TIFF | L0R |
| Nigeriasat-X | Dmc2Format | DMC format TIFF tags | *p0_L0R.Tif, *s0_L0R.Tif | TIFF | L0R |
| Nigeriasat-2 | N2Format | XML | *_L0R.xml | TIFF | L0R |
| Aerial frame camera | FrameCamera Format | Generic aerial frame camera format (XML) | *.xml | TIFF | |
| Leica ADS40 | LeicaAdsFormat | Support file | *.sup | TIFF | Level 1 |
| RapidEye 1-5 | RapidEyeFormat | XML | *_metadata.xml | TIFF | L1B, L3A |
| Theos-1 | TheosFormat | DIMAP *.dim | *.dim | TIFF | 1A, 2A |
| Terrasar-X | TerrasarXFormat | TerraSar-X XML | *_SAR_*.xml | GeoTIFF | MGD, GEC, EEC |
| Envisat ASAR<br>Envisat MERIS | EnvisatFormat | ESA Envisat (*.N1) | *.N1 | ESA Envisat (*.N1) | Level 1 |

| Sensor | Format ID | Metadata Format | Key file default pattern | Image Format | Processing Level |
|---|---|---|---|---|---|
| Envisat AATSR | | | | | |
| CBERS-2B | CbersFormat | XML | CBERS_2B_HRC_*xml | TIFF | Level 2 |
| Ska36 | Ska36Format<br>Ska36NitfFormat | XML<br>NITF | *.xml<br>*.ntf | NITF, TIFF<br>NITF | |

## 2.3. StandardImageFormat

The StandardImageFormat opens images that have no specific information on the sensor. It only opens the image as an unknown image raster. If available, georeferencing information is read from the image header or from auxiliary files.

### 2.3.1. Raw image format

The raw image formats supported are:

| | |
|---|---|
| **BIL** | bands interleaved by line |
| **BIP** | bands interleaved by pixel |
| **BSQ** | bands sequential |

These files do not contain any information on how the pixels are organised. The import routines therefore require as a minimum the following attributes to be provided:

- Number of pixels in a line
- Number of lines
- Number of bands
- Number of bytes to skip in the file before the image data starts
- Data type (byte, short integer, etc.)

### 2.3.2. Simple standard image formats

The simple standard image formats are self-documented image formats such as JFIF(JPEG), TIFF, GIF, PNG and BMP. The import routine will try to read any file presented to it. These formats contain information only on how the image data is organised in the file. No georeferencing information is available.

### 2.3.3. Simple georeferencing auxiliary files

The raw and simple standard format images can have their georeferencing information set from different kinds of auxiliary files. These files have the same file name as the image file, but a separate file extension that is indicating its type. When the import routine is presented with an image file that has no georeferencing information, it will search for a number of these auxiliary files to try to recover the georeferencing data.

The import will look for auxiliary georeferencing files in the following order:

1. RPC file
2. ESRI world file

**RPC file**
An RPC file can provide georeferencing information in the form of coefficients for a rational function model. The file format used for this file is the same as is used for Ikonos imagery. The file must have the same name as the image file but with the extension `.rpc`. The RPC file always uses WGS84 as the coordinate reference system.

**ESRI world file**
The ESRI world file is an ASCII text file associated with an image and contains six lines:

- Line 1: A1
- Line 2: A2
- Line 3: B1
- Line 4: B2
- Line 5: A0
- Line 6: B0

The coefficients read from these lines define an affine transformation from image raster coordinates to a ground coordinate system. The transformation is defined as:

```
X = A0 + A1 * column + A2 * row
Y = B0 + B1 * column + B2 * row
```

The raster coordinate system has its origin at the centre of the pixel in the upper left corner.

The world file must follow a naming convention. If the image file name has a 3-character extension (`image.tif`), the world file has the same name followed by an extension containing the first and last letters of the image's extension and ending with a "w" (`image.tfw`). If the extension has more or fewer than three characters, including no extension at all, the world file name is formed by simply appending a "w" to the image file name.

The world file does not carry any information on which coordinate reference system the coordinates refer to. The coordinate reference (in the form of the EPSG code) must be supplied to the import routine.

### 2.3.4. Georeferenced standard image formats

Some standard image files contain full georeferencing information integrated with the image file. In these cases, the import routine will generate the geometrical model without the need for any auxiliary file or additional setting of attributes.

**GeoTIFF**
A GeoTIFF file is an ordinary TIFF file with some extra tags containing georeferencing information. When the standard import routine is presented a TIFF file, it always tries to find the GeoTIFF tags. If available, it is used to georeference the image.

**NITF**
If the standard image import routine encounters an NITF file, it will try to extract georeferencing information from it. If available, it is used to georeference the image. No other metadata is extracted by the standard import routine.

**DTED**
DTED is a format specific for digital elevation models (*.dt0). The standard image import routine will georeference it.

**Erdas Imagine**
This is the Erdas Imagine propriatory format (*.img). The standard image import routine will read the georeferencing information if available.

## 2.4. DimapFormat

The DIMAP generic format is a general purpose metadata format for remote sensing imagery. In addition to storing the pure image layout and georeferencing information, it can carry detailed information on the satellite sensors used, processing information and many other types of metadata. The DIMAP generic format is used by Keystone as the main format for import/export of full metadata when no specialised format is available.

DIMAP generic is metadata stored in an XML-based format. It is stored in a separate file, usually with the extension `.dim`. The specification is available at *http://www.spotimage.fr/dimap/spec/dictionary/dictionary.htm*.

## 2.5. IkonosCarterraFormat

Import of Ikonos or GeoEye scenes is supported in Space Imaging Carterra format (*http://www.geoeye.com*). Each product is delivered in a separate folder with a `*_metadata.txt` metadata file describing the product. The import will open this metadata file. The rest of the files corresponding to this product must exist in the same folder as the metadata file. The file is decoded and a general 3D-polynomial model is generated with rigorously calculated parallax components. The model is derived from the RPC coefficients if an RPC file is available for the scene (Geo Ortho Kit). If no RPC file is available, (Geo) a rigorous satellite orbital model is created (by reverse engineering) from which the 3D polynomial model is then derived.

The metadata file sometimes describes multiple scenes. Each scene is then imported to a separate image with a separate geometrical model.

The scene is sometimes divided into several tiles, with separate image files for each tile. Then there are two options for the import:

1. The tiles can be merged into a single scene file. The file format will be TIFF. Tile size and compression are selectable.
2. The import also supports the concept of virtual mosaic images. This means that the import constructs the metadata for a mosaic of all the tiles in the catalogue. This virtual mosaic scene can then be accessed as if it was a real image. Keystone uses its on-the-fly processing to produce the scene mosaic as one single image when requested.

If both the panchromatic and multispectral image information are present in the same metadata file, the geometrical models for the images will be connected.

The products supported are:

- Carterra Geo or Geo Ortho Kit
- GeoTIFF/NITF
- (UTM)

## 2.6. DigitalGlobeFormat

Quickbird-2 and Worldview-1 images are available from DigitalGlobe (*http://www.digitalglobe.com*). Each scene is delivered in a separate folder with an XML metadata file describing the scene. The import will open the XML file and decode its metadata. If the scene is a Basic product, it will generate a rigorous satellite orbital model. If it is a Standard ortho-ready product, it will generate a general 3D-polynomial model from the RPC coefficients.

The scene is sometimes divided into several tiles, with separate image files for each tile. Then there are two options for the import:

1. The tiles can be merged into a single scene file. The file format will be TIFF. Tile size and compression are selectable.
2. The import also supports the concept of virtual mosaic images. This means that the import constructs the metadata for a mosaic of all the tiles in the catalogue. This virtual mosaic scene can then be accessed as if it was a real image. Keystone uses its on-the-fly processing to produce the scene mosaic as one single image when requested.

The products supported are:

- Quickbird-2 Basic, Standard (ortho-ready)
- Worldview-1 Basic, Standard (ortho-ready)
- Worldview-2 Basic, Standard (ortho-ready)

## 2.7. ErosFormat

The system supports import of Eros-A1 scenes from ImageSat International (*http://www.imagesatintl.com*). The import will open a metadata file with the name `*.PASS`. The image file, with extension `*.1A` or `*.tif`, must be present in the same folder as the metadata file. The file is decoded and a rigorous satellite orbit geometrical model is generated.

The product supported is Eros-A1 Basic Scene level 1A.

## 2.8. SpotDimapFormat

The import routine supports Spot scenes in DIMAP format using the profile “Spot Scene” (*http://www.spotimage.fr/dimap/spec/dimap.htm*).

The import will open a DIMAP metadata file with the name `metadata.dim`. The file is decoded and a rigorous satellite orbital geometric model is generated.

The products supported are:

- Spot-1/2/3 HRV level 1A, 1B and 2A
- Spot-4 HRVIR level 1A, 1B and 2A
- Spot-5 HRG level 1A, 1B and 2A

## 2.9. SpotDimap2Format

Pleiades images are available from Astrium (*http://www.astrium-geo.com/en/3030-pleiades-format-delivery*). Each scene is delivered in a separate folder with an XML metadata file describing the scene. The XML file is encoded in Dimap version 2 format. The import will open the XML file and decode its metadata. If the scene is a Sensor product, it will generate a rigorous satellite orbital model.

The scene is sometimes divided into several tiles, with separate image files for each tile. Then there are two options for the import:

1. The tiles can be merged into a single scene file. The file format will be TIFF. Tile size and compression are selectable.
2. The import also supports the concept of virtual mosaic images. This means that the import constructs the metadata for a mosaic of all the tiles in the catalogue. This virtual mosaic scene can then be accessed as if it was a real image. Keystone uses its on-the-fly processing to produce the scene mosaic as one single image when requested.

The products supported are:

- Pleiades-1A: Sensor, Ortho

- Spot-6: Sensor, Ortho

## 2.10. SpotCapFormat

An alternative Spot format is CAP format (*http://www.crisp.nus.edu.sg/spot/cap.html*).

The import will open a metadata file with the name `LEAD_xx.DAT`, where `xx` is the number of the scene. The image file `IMAG_xx.DAT` must exist in the same folder as the metadata file. The file is decoded and a rigorous satellite orbital model is generated.

If the product is a Spot-4 multispectral scene, the image will be preprocessed to eliminate initial misregistration in the SWIR band. This is one case where the image data is processed along with the metadata when the import is performed.

If a Spot-4 multispectral image and monospectral image from the same scene are imported at the same time, their geometrical image models will be connected.

The products supported are:

- Spot-1/2/3 HRV level 1A, 1B and 2A
- Spot-4 HRVIR level 1A, 1B and 2A

## 2.11. Landsat8Format

The USGS format for LDCM level 1 scenes is used to provide orthorectified Landsat-8 products. The import will open a metadata file with the name `*_MTL.txt`. Each spectral band is stored in a separate GeoTIFF file. All image files must exist in the same folder as the metadata file.

The products supported are:

- Landsat-8 L1T
- Landsat-8 L1Gt

If the product contains OLI or OLI+TIRS, import will result in two images: one for the panchromatic band at 15 m resolution and one for the remaining bands at 30 m resolution. If the product only contains TIRS there will only be one image generated with bands in 30 m resolution. If two images are generated, they will still share the same scene and geometrical model. The panchromatic image will have a tag=PAN set, while the multispectral image will have a tag=MUL set.

The property STRIP_ID can be used to explicitely set the strip id in the catalogue. If this property is not set, the strip id will be constructed as "LANDSAT8_" + path number + "_" + orbit date.

In addition to the standard Keystone metadata, the following properties can be set and added as keywords:

- L0_PROCESSOR_VERSION
- L0_QUALITY_ALGORITHM_VERSION

In addition to the standard Keystone metadata, the following attributes from the _MTL.txt file are added as keywords:

- ELEVATION_SOURCE
- BPF_NAME_OLI
- BPF_NAME_TIRS
- CPF_NAME
- RLUT_FILE_NAME

The last four of these values contain a time range that can be parsed. If the parsed time range does not correspond to the acqusition time of the Landsat scene, they are out of date. This is signalled by setting the following collections:

- BPF_NAME_OLI_INVALID
- BPF_NAME_TIRS_INVALID
- CPF_NAME_INVALID
- RLUT_FILE_NAME_INVALID

## 2.12. LandsatFastFormat

Landsat-7 ETM+ scenes can be imported in FAST-L7A format (*http://landsathandbook.gsfc.nasa.gov/handbook/pdfs/level1_dfcb_rev5_401.pdf*).

The import will open a metadata file with the name:

- `*_HPN.FST` Panchromatic band (band 8)
- `*_HRF.FST` Reflective bands (bands 1-5, 7)
- `*_HTM.FST` Thermal bands (bands 6A, 6B)

The image files `*_Bxx.FST` must exist in the same folder as the metadata file. The file is decoded and a general 3D-polynomial model with rigorously calculated parallax components is generated.

If more than one metadata file from the same scene is imported, the geometrical models for their corresponding images will be connected.

The product supported is Landsat-7 ETM+ level 1G (UTM projection).

## 2.13. EosatFastFormat

The Eosat Fast Format (or FAST B FORMAT) is an older version of the Fast Format which sometimes is used for Landsat 4/5 TM scenes. The import will open a metadata file with the name `header.dat`. All image files must exist in the same folder as the header file. The dataset is decoded and a general 3D-polynomial model with rigorously calculated parallax components is generated.

The products supported are Landsat-4/5 TM level 1G (UTM projection).

## 2.14. LandsatEsaCeosFormat

Landsat TM and ETM+ scenes can be imported in ESA's CEOS format (*http://earth.esa.int/pub/ESA_DOC/LandsatEtmCeos.3.1.pdf*).

All image files and metadata files must exist in the same folder as the volume directory file. The dataset is decoded and a general 3D-polynomial model with rigorously calculated parallax components is generated.

In the case of Landsat-7 ETM+, the panchromatic and the multispectral image are imported with a connected geometrical model. If a SIP file is generated, the PAN image will be the first component.

The products supported are:

- Landsat-4/5 TM level 1G (UTM projection)
- Landsat-7 ETM+ level 1G (UTM projection)

## 2.15. LandsatNlapsFormat

The NLAPS (or NDF) format of the USGS is used to provide various Landsat image products (*http://landsat.usgs.gov/documents/NLAPS_II.pdf*). The import will open a header file with the name `*.H1`, `*.H2` or `*.H3`. All image files must exist in the same folder as the header file. The dataset is decoded and a general 3D-polynomial model with rigorously calculated parallax components is generated.

The products supported are:

- Landsat MSS level 1G (UTM projection)
- Landsat-4/5 TM level 1G (UTM projection)
- Landsat-7 ETM+ level 1G (UTM projection)

## 2.16. ErsPriFormat

SAR imagery from ERS-1 and ERS-2 are available in CEOS format. The PRI (slant-range image) product is supported.

The import will open the leader file with a name starting with `LEA_*`. All image files must exist in the same folder as the leader file. The dataset is decoded and a rigorous satellite orbital model is generated.

The products supported are ERS-1 and -2 PRI.

## 2.17. RadarsatFormat

**Radarsat-1**
Radarsat-1 products are available in CEOS format (*http://www.asf.alaska.edu/content/reference/pdf/R1L0ref.pdf*). The Path image (SGF) and Path image plus (SGX) products are supported.

The import will open the leader file with a name starting with `LEA_*`. All image files must exist in the same folder as the leader file. The dataset is decoded and a rigorous satellite orbital model is generated.

The products supported are Radarsat-1 SGF, SGX.

**Radarsat-2**
Radarsat-2 (and Radarsat-1) products are available in GeoTIFF format with XML metadata (*http://www.radarsat2.info/product/51-2713_-_RSAT-2_Product_Format_Definition_-_Iss1_7.pdf*).

The import will open the XML file with a name `product.xml`. All image files must exist in the same folder as the leader file. The dataset is decoded and a model is generated from the rational function coefficients in the metadata.

The products supported are Radarsat 1-2 SGF, SGX.

## 2.18. IrsSuperStructureFormat

Images from IRS-P6 are supported in the LWSOWG (SuperStructure) format (*http://www.euromap.de/download/p6super_20050222.pdf*).

The import will open the leader file with a name starting with `LEADER`. All image files must exist in the same folder as the leader file. The dataset is decoded and a general 3D-polynomial model with rigorously calculated parallax components is generated.

The product supported is IRS P-6 System corrected.

## 2.19. IrsOrthoKitFormat

Images from IRS-R2 are supported in the Ortho Kit format from Euromap (*http://www.euromap.de*).

The import will open the metadata file with a name ending with `_inf.txt`. There will be one image file and one RPC file present for each band. An example of a product folder is given below:

`120703R200370035L0000S4_2_green.tif`

`120703R200370035L0000S4_2_green_rpc.txt`

`120703R200370035L0000S4_3_red.tif`

`120703R200370035L0000S4_3_red_rpc.txt`

`120703R200370035L0000S4_4_nir.tif`

`120703R200370035L0000S4_4_nir_rpc.txt`

`120703R200370035L0000S4_5_swir.tif`

`120703R200370035L0000S4_5_swir_rpc.txt`

`120703R200370035L0000S4_inf.txt`

All image files must exist in the same folder as the inf file. The dataset is decoded and a general 3D-polynomial model with parallax components is generated.

The product supported is IRS-R2 System corrected.

## 2.20. CartosatFormat

Images from Cartosat-1 and Cartosat-2 are supported in the TIFF format (*http://www.euromap.de/products/prod_041.html*), (*http://www.euromap.de/products/prod_051.html*).

The import will open the image file and two metadata files (ending with `_MET.TXT` and `_RPC_ORG.TXT` or `_RPC.TXT`). All image files must exist in the same folder as the leader file. The dataset is decoded and a general 3D-polynomial model with rigorously calculated parallax components is generated.

The product supported is Radiometric corrected path oriented.

## 2.21. FormosatFormat

Images from Formosat-2 are available from SpotImage in DIMAP format, using the FORMOSAT-2_1A_SCENE profile (*http://www.spotimage.fr/web/en/979-formosat-2-imageryfeatures.php*).

The import will open the DIMAP file with the extension `.dim`. The dataset is decoded and a rigorous satellite orbital model is generated.

The product supported is Formosat-2 Level 1A.

## 2.22. OrbviewFormat

Images from Orbview-3 are supported in the TIFF + PVL format ( *http://staff.glcf.umiacs.umd.edu/sns/trunk/htdocs/library/guide/Orbview3_Product_Guide_25jan06.pdf*).

The import will open the metadata file with the `.pvl` extension. The image TIFF file is assumed to have the same name with a `.tif` extension. The dataset is decoded and a general 3D-polynomial model with rigorously calculated parallax components is generated from the RPC coefficients.

The product supported is Orbview-3 Basic product.

## 2.23. GeoEyeFormat

Images from GeoEye-1 are supported in the PVL format.

The import will open the metadata file with the `.pvl` extension. The image (TIFF or NITF) file is assumed to have the same name with `.tif` or `.ntf` extension. Ephemeris and attitude files are also assumed to be present with the same name but with `.eph` and `.att` extension. The dataset is decoded and a rigorous satellite orbital model is constructed.

The products supported are GeoEye-1 Basic product (TIFF and uncompressed NITF).

There is also a compressed NITF product option available which is not presently supported by this import routine.

## 2.24. KompsatFormat

Images from Kompsat-2 are supported in the TIFF format (*http://www.spotimage.fr/web/en/1155-kompsat-2-images.php*).

The import will open the image TIFF file and decode the three metadata files with the `.txt`, `.rpc` and `.eph` extensions. The dataset is decoded and a general 3D-polynomial model with rigorously calculated parallax components is generated from the RPC coefficients.

The product supported is Kompsat-2 level 1G (2A).

## 2.25. FrameCameraFormat

Generic aerial frame camera format.

The generic metadata is an XML file describing the interior orientation of a frame camera and the exterior orientation of a set of image acquisitions. The format is described in detail in Generic Frame Camera Format.

The import will open the XML metadata file and decode data for the images described in the file. Only the images for which the metadata file path points to an existing disk file are returned in the array of opened images.

The product supported is generic aerial frame camera.

## 2.26. LeicaAdsFormat

Images from the Leica ADS40 aerial pushbroom scanner.

The import will open the associated Socet Set Support file (`*.sup`). The support file supplies the names for the following files:

- ADS file (`*.ads`). This file contains the names of the image files and tiling schemes.
- CAM file (`*.cam`). The camera calibration file with detector position map.
- ODF file (`*.odf`, `*.odf.adj`). These files contain the orientation data. The adjusted variant (`*.odf.adj`) is selected if available, otherwise the original (`*.odf`) is used.

All files must be available in the same directory as the support file.

The import will open the support file and decode metadata from all the referenced files. A rigorous geometrical observation model is generated for the full image.

The product supported is Level 1.

## 2.27. EnvisatFormat

The system supports import of Envisat images from the ASAR, MERIS and AATSR instruments. The products must be in ESA Envisat format (*http://envisat.esa.int/support-docs/productspecs/*) and processed to level 1. The import will open a combined image and metadata file with the name `*.N1`. The file is decoded and a 3D polynomial geometrical model is generated.

## 2.28. CbersFormat

**CBERS-2B**

CBERS-2B products are available from INPE. They are available for free download at (*http://www.cbers.inpe.br/*).

The import will open the metadata file with the default name pattern `CBERS_2B_HRC_*.xml`. The image file is assumed to have the same name as the metadata file, but with the extension ".tif".

The product level supported is level 2. This is an image rectified to a map projection but without using GCP's or DEM. Keystone reconstructs the 3D viewing geometry during import so that orthorectification of the products becomes possible.

## 2.29. Dmc2Format

Images from UK-DMC2 and Nigeriasat-X processed to level L0R are supported.

The import will open a TIFF file with the default name pattern `*_p0_L0R.Tif` or `*_s0_L0R.Tif`. It then reads the metadata from the TIFF tags. The complete set of files for a n L0R import are normally as in the example below (port bank Nigeriasat-X):

- `DXFFFF83p0_L0R.Tif`
- `DXFFFF83p1_L0R.Tif`
- `DXFFFF83p2_L0R.Tif`

The import will create a separate geometric model for each spectral band. Each band will be a separate output image from the import. The image ID's in the catalogue are constructed from the image ID's given in the metadata. In the example above the image ID's will become:

- `DXFFFF83_p_NIR`
- `DXFFFF83_p_RED`
- `DXFFFF83_p_GREEN`

where `DXFFFF83` is the event id, `p` is the bank id and `NIR` is the spectral band id.

#### Virtual band-merged image

The import also supports the concept of virtual band-merged images. This means that the import constructs the metadata for a band registered nir-red-green image in the catalogue. This multispectral image can then be accessed as if it was a real image. Keystone uses its on-the-fly processing to produce the multispectral image when requested. The ID for the virtual multispectral image in the example above will be:

- `DXFFFF83_p_MUL`

The ID's for the separate multispectral bands (GREEN, RED, NIR) will normally be treated by Keystone as "hidden images" and not visible. There is an attribute in Keystone preferences that controls if the "hidden images" shall be visible or not.

#### Shared strip model

Each spectral band will have its own geometrical model but they all share the same orbit- and attitude models. This is also true for the two banks in a single event. The strip model is stored in the catalogue with the event as ID. The ID for the strip model in the example above will be:

- `DXFFFF83`

The consequence of the shared strip model is that an adjustment of the model parameters for a single band or bank will affect the models for all bands and banks for the event..

## 2.30. N2Format

Images from Nigeriasat-2 processed to level L0R are supported. Both the VHRI and MRI sensors are supported.

The import will open the XML metadata file with the default name pattern `DM*_L0R.xml`. It then reads the AOCS and image files referenced in the metadata file. The complete set of files for a single scene VHRI L0R import are normally as in the example below:

- `DM000147VI_001_0L0R.BSQ`
- `DM000147VI_001_1L0R.BSQ`
- `DM000147VI_001_2L0R.BSQ`
- `DM000147VI_001_3L0R.BSQ`
- `DM000147VI_001_4L0R.BSQ`
- `DM000147VI_001_L0R.xml`
- `DM000147VI_AOCS.xml`

The import will create a separate geometric model for each spectral band. Each band will be a separate output image from the import. The image ID's in the catalogue are constructed from the image ID's given in the metadata file. In the example above the image ID's will become:

- `DM000147VI_001_BLUE`
- `DM000147VI_001_GREEN`
- `DM000147VI_001_RED`
- `DM000147VI_001_NIR`
- `DM000147VI_001_PAN`

where `DM000147VI` is the strip id, `001` is the scene number in the strip and `BLUE` is the spectral band id.

### Virtual band-merged image

The import also supports the concept of virtual band-merged images. This means that the import constructs the metadata for a band registered blue-green-red-nir image in the catalogue. This multispectral image can then be accessed as if it was a real image. Keystone uses its on-the-fly processing to produce the multispectral image when requested. The ID for the virtual multispectral image in the example above will be:

- `DM000147VI_001_MUL`

The ID's for the separate multispectral bands (BLUE, GREEN, RED, NIR) will normally be treated by Keystone as "hidden images" and not visible. There is an attribute in Keystone preferences that controls if the "hidden images" shall be visible or not.

### Virtual strip image

The import also supports the concept of virtual strip-mosaic images. This means that the import constructs the metadata for a mosaic of all images in a single strip of acquisition in the catalogue. This strip mosaic can then be accessed as if it was a real image. Keystone uses its on-the-fly processing to produce the strip as one single image when requested. The strip-mosic image can't be accessed until all the images in a strip have been imported. The ID's for the strip images generated for the example above would be:

- `DM000147VI_000_BLUE`
- `DM000147VI_000_GREEN`
- `DM000147VI_000_RED`
- `DM000147VI_000_NIR`
- `DM000147VI_000_PAN`
- `DM000147VI_000_MUL`

where 000 identifies that this is the full strip and not a single scene. As in the virtual band-merged case, the BLUE, GREEN, RED, NIR images will be treated as "hidden images" and normally not be visible.

### Shared strip model

Each spectral band will have its own geometrical model but they all share the same orbit- and attitude models. This is also true for all the scenes in a strip. The strip model is stored in the catalogue with the event as ID. The ID for the strip model in the example above will be:

- `DXFFFF83`

The consequence of the shared strip model is that an adjustment of the model parameters for a single band or scene will affect the models for all bands and scenes for that strip..

# Chapter 3

# Generic frame camera format

**Topics:**



Concept definition.

## 3.1. Generic frame camera format overview

The FrameCameraFormat is intended for a generic definition of the geometry in aerial frame camera images. The metadata is provided in an XML file describing the interior orientation of a frame camera and the exterior orientation of a set of image acquisitions. The structure of the metadata XML file is described below. The elements with a dashed outline are optional elements.

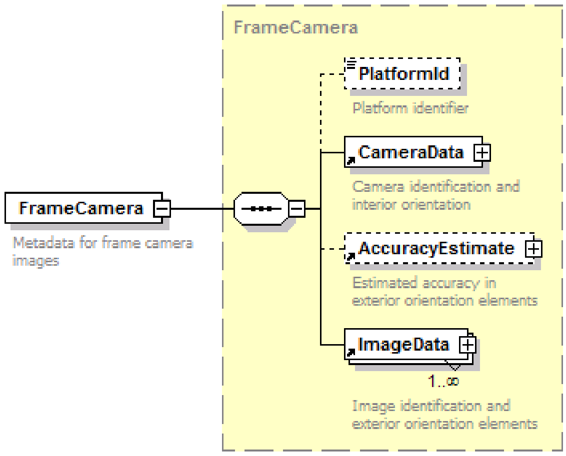


***Figure 1: Frame camera base element***

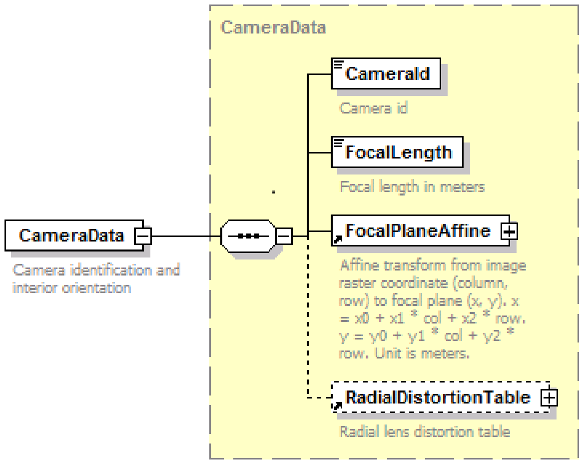


***Figure 2: Camera data element***

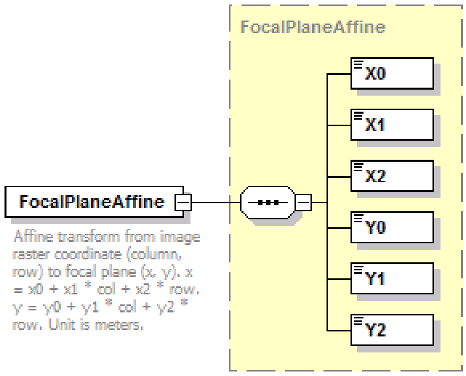


***Figure 3: Focal plane affine transform element***

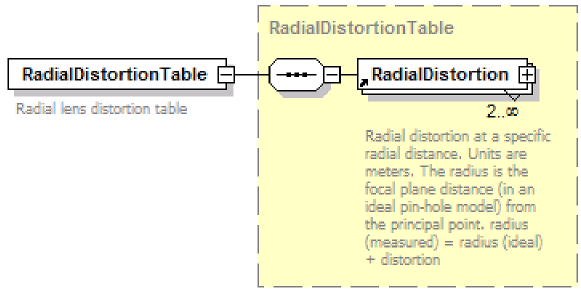


***Figure 4: Radial distortion table element***

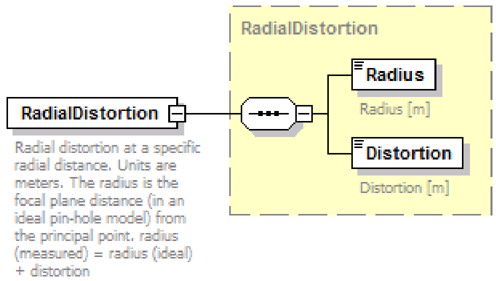


***Figure 5: Radial distortion element***

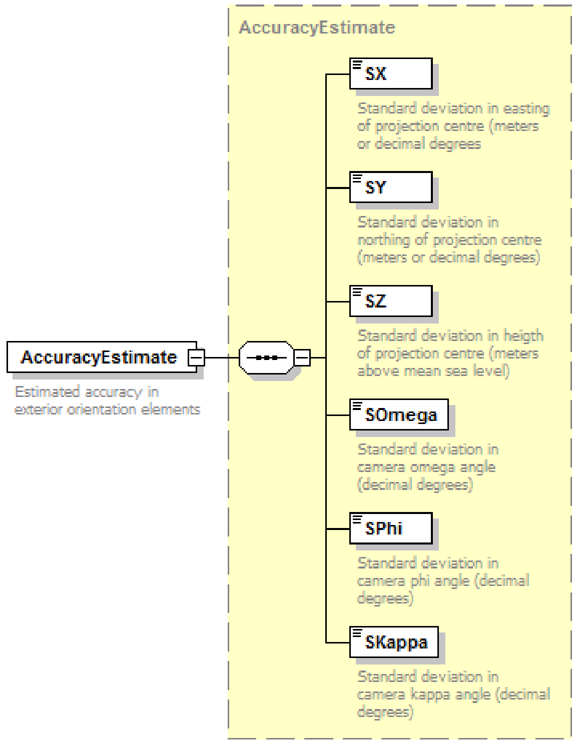


***Figure 6: Accuracy estimate element***

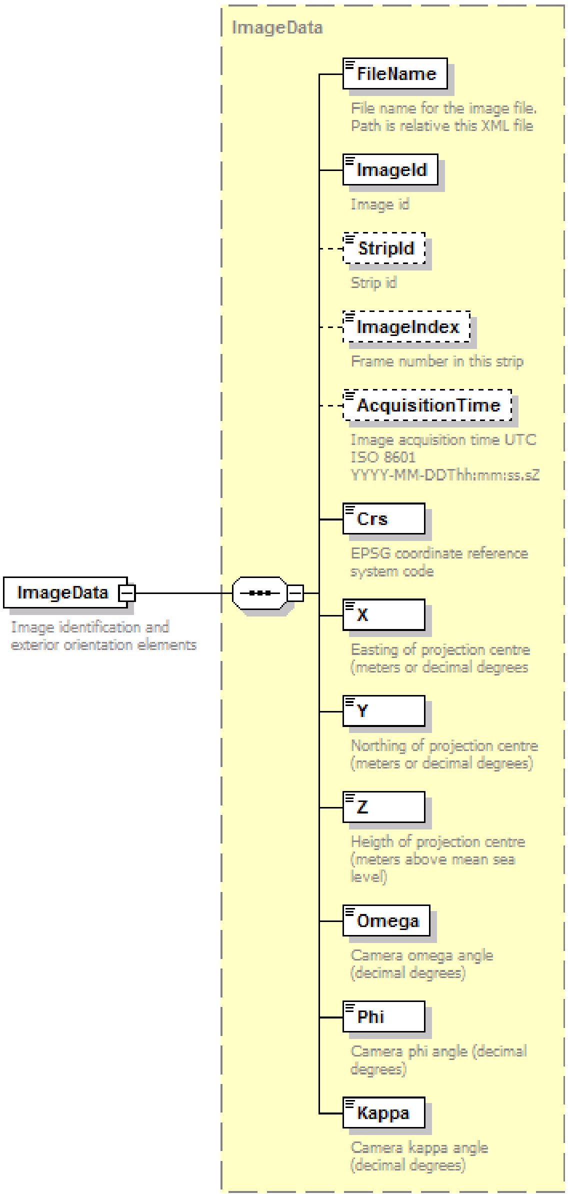


***Figure 7: Image data element***

## 3.2. Coordinate system conventions

The coordinate systems used in this definition are based on three right-handed systems:

1. The ground coordinate system (X, Y, Z). This is the easting, northing and orthometric height in the ground coordinate reference system.
2. The camera coordinate system (x, y, z) is fixed in the platform with the optical centre as its origo. This system has the x-axis in the aircraft length direction (flying direction), the z-axis upward and the y-axis completing the right-handed system. The attitude angles describes the rotation of this system relative to the ground system.
3. The raster coordinate system (col, row) represents the full frame image raster coordinates. It has its origo (0, 0) in the centre of the upper left pixel in the image.

The image model places the image between the ground and the optical centre. It is positioned parallel to the camera x/y plane but at z = -focal length. This means that an image object will have a viewing direction vector in the camera system = (x, y, -focalLength).

The relation between the raster (column, row) system and the camera (x, y) system is described by the focal plane affine transform:

```
x = x0 + x1 * column + x2 * row
y = y0 + y1 * column + y2 * row
```

This takes into account the orientation of the raster in the camera frame system, the detector size and the location of the principal point.

The attitudes are described by the omega, phi, kappa rotations angles. They describe the rotation of the camera coordinate system relative to the ground coordinate system. The rotation definitions and order of application are:

1. Omega – rotation around the camera x axis (positive y -> z)
2. Phi – rotation around the camera y axis (positive z -> x)
3. Kappa – rotation around the camera y axis (positive x -> y)

## 3.3. FrameCameraFormat XML schema

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns="http://www.spacemetric.com/framecamera/"
targetNamespace="http://www.spacemetric.com/framecamera/"
elementFormDefault="qualified" attributeFormDefault="unqualified">
    <xsd:simpleType name="intList">
        <xsd:list itemType="xsd:int"/>
    </xsd:simpleType>
    <xsd:simpleType name="intMatrix">
        <xsd:restriction base="xsd:string"/>
    </xsd:simpleType>
    <xsd:simpleType name="longList">
        <xsd:list itemType="xsd:long"/>
    </xsd:simpleType>
    <xsd:simpleType name="longMatrix">
        <xsd:restriction base="xsd:string"/>
    </xsd:simpleType>
    <xsd:simpleType name="floatList">
        <xsd:list itemType="xsd:float"/>
    </xsd:simpleType>
    <xsd:simpleType name="floatMatrix">
        <xsd:restriction base="xsd:string"/>
    </xsd:simpleType>
    <xsd:simpleType name="doubleList">
        <xsd:list itemType="xsd:double"/>
    </xsd:simpleType>
    <xsd:simpleType name="doubleMatrix">
        <xsd:restriction base="xsd:string"/>
    </xsd:simpleType>
    <xsd:complexType name="stringList">
        <xsd:sequence>
            <xsd:element name="ITEM" type="xsd:string" minOccurs="0"
maxOccurs="unbounded"/>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:element name="FrameCamera" type="FrameCamera">
        <xsd:annotation>
            <xsd:documentation>Metadata for frame camera
images</xsd:documentation>
        </xsd:annotation>
    </xsd:element>
    <xsd:complexType name="FrameCamera">
        <xsd:sequence>
            <xsd:element name="PlatformId" type="xsd:string" minOccurs="0">
                <xsd:annotation>
```

```
                    <xsd:documentation>Platform identifier</xsd:documentation>

                </xsd:annotation>
            </xsd:element>
            <xsd:element ref="CameraData"/>
            <xsd:element ref="AccuracyEstimate" minOccurs="0"/>
            <xsd:element ref="ImageData" maxOccurs="unbounded"/>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:element name="ImageData" type="ImageData">
        <xsd:annotation>
            <xsd:documentation>Image identification and exterior orientation
 elements</xsd:documentation>
    </xsd:annotation>
    </xsd:element>
    <xsd:complexType name="ImageData">
        <xsd:sequence>
            <xsd:element name="FileName" type="xsd:string">
                <xsd:annotation>
                    <xsd:documentation>File name for the image file. Path is
 relative this XML file</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="ImageId" type="xsd:string">
                <xsd:annotation>
                    <xsd:documentation>Image id</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="StripId" type="xsd:string" minOccurs="0">
                <xsd:annotation>
                    <xsd:documentation>Strip id</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="ImageIndex" type="xsd:nonNegativeInteger"
minOccurs="0">
                <xsd:annotation>
                    <xsd:documentation>Frame number in this
strip</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="AcquisitionTime" type="xsd:dateTime"
minOccurs="0">
                <xsd:annotation>
                    <xsd:documentation>Image acquisition time UTC ISO 8601
YYYY-MM-DDThh:mm:ss.sZ</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="Crs" type="xsd:int">
                <xsd:annotation>
                    <xsd:documentation>EPSG coordinate reference system
code</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="X" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Easting of projection centre (meters
or decimal degrees</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="Y" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Northing of projection centre (meters
 or decimal degrees)</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="Z" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Height of projection centre (meters
```

```
above mean sea level)</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="Omega" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Camera omega angle (decimal
degrees)</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="Phi" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Camera phi angle (decimal
degrees)</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="Kappa" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Camera kappa angle (decimal
degrees)</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:element name="AccuracyEstimate" type="AccuracyEstimate">
        <xsd:annotation>
            <xsd:documentation>Estimated accuracy in exterior orientation
elements</xsd:documentation>
        </xsd:annotation>
    </xsd:element>
    <xsd:complexType name="AccuracyEstimate">
        <xsd:sequence>
            <xsd:element name="SX" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Standard deviation in easting of
projection centre (meters or decimal degrees</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="SY" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Standard deviation in northing of
projection centre (meters or decimal degrees)</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="SZ" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Standard deviation in height of
projection centre (meters above mean sea level)</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="SOmega" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Standard deviation in camera omega
angle (decimal degrees)</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="SPhi" type="xsd:double">
                <xsd:annotation>
                   <xsd:documentation>Standard deviation in camera phi angle
 (decimal degrees)</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="SKappa" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Standard deviation in camera kappa
angle (decimal degrees)</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
        </xsd:sequence>
```

```
    </xsd:complexType>
    <xsd:element name="CameraData" type="CameraData">
        <xsd:annotation>
            <xsd:documentation>Camera identification and interior
orientation</xsd:documentation>
        </xsd:annotation>
    </xsd:element>
    <xsd:complexType name="CameraData">
        <xsd:sequence>
            <xsd:element name="CameraId" type="xsd:string">
                <xsd:annotation>
                    <xsd:documentation>Camera id</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="FocalLength" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Focal length in
meters</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element ref="FocalPlaneAffine"/>
            <xsd:element ref="RadialDistortionTable" minOccurs="0"/>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:element name="RadialDistortionTable" type="RadialDistortionTable">
        <xsd:annotation>
          <xsd:documentation>Radial lens distortion table</xsd:documentation>

        </xsd:annotation>
    </xsd:element>
    <xsd:complexType name="RadialDistortionTable">
        <xsd:sequence>
            <xsd:element ref="RadialDistortion" minOccurs="2"
maxOccurs="unbounded"/>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:element name="RadialDistortion" type="RadialDistortion">
        <xsd:annotation>
          <xsd:documentation>Radial distortion at a specific radial distance.
 Units are meters. The radius is the focal plane distance (in an ideal pin-hole
 model) from the principal point. radius (measured) = radius (ideal) +
distortion</xsd:documentation>
        </xsd:annotation>
    </xsd:element>
    <xsd:complexType name="RadialDistortion">
        <xsd:sequence>
            <xsd:element name="Radius" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Radius [m]</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
            <xsd:element name="Distortion" type="xsd:double">
                <xsd:annotation>
                    <xsd:documentation>Distortion [m]</xsd:documentation>
                </xsd:annotation>
            </xsd:element>
        </xsd:sequence>
    </xsd:complexType>
    <xsd:element name="FocalPlaneAffine" type="FocalPlaneAffine">
        <xsd:annotation>
            <xsd:documentation>Affine transform from image raster coordinate
 (column, row) to focal plane (x, y). x = x0 + x1 * col + x2 * row. y = y0 +
 y1 * col + y2 * row. Unit is meters.</xsd:documentation>
        </xsd:annotation>
    </xsd:element>
    <xsd:complexType name="FocalPlaneAffine">
        <xsd:sequence>
            <xsd:element name="X0" type="xsd:double"/>
```

```
            <xsd:element name="X1" type="xsd:double"/>
            <xsd:element name="X2" type="xsd:double"/>
            <xsd:element name="Y0" type="xsd:double"/>
            <xsd:element name="Y1" type="xsd:double"/>
            <xsd:element name="Y2" type="xsd:double"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:schema>
```

## 3.4. FrameCameraFormat example

This following example describes three image acquisitions taken with Applanix DSS camera. It includes a radial distortion table.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<FrameCamera xmlns="http://www.spacemetric.com/framecamera/">
    <CameraData>
        <FocalLength>0.054939</FocalLength>
        <FocalPlaneAffine>
            <X0>-0.01822014</X0>
            <X1>9.0E-6</X1>
            <X2>0.0</X2>
            <Y0>0.01820754</Y0>
            <Y1>0.0</Y1>
            <Y2>-9.0E-6</Y2>
        </FocalPlaneAffine>
        <RadialDistortionTable>
            <RadialDistortion>
                <Radius>0.0010</Radius>
                <Distortion>-2.2E-8</Distortion>
            </RadialDistortion>
            <RadialDistortion>
                <Radius>0.0020</Radius>
                <Distortion>-1.8E-7</Distortion>
            </RadialDistortion>
            <RadialDistortion>
                <Radius>0.0030</Radius>
                <Distortion>-6.07E-7</Distortion>
            </RadialDistortion>
            <RadialDistortion>
                <Radius>0.0040</Radius>
                <Distortion>-1.439E-6</Distortion>
            </RadialDistortion>
            <RadialDistortion>
                <Radius>0.0050</Radius>
                <Distortion>-2.8119999999999995E-6</Distortion>
            </RadialDistortion>
            <RadialDistortion>
                <Radius>0.0060</Radius>
                <Distortion>-4.86E-6</Distortion>
            </RadialDistortion>
            <RadialDistortion>
                <Radius>0.0070</Radius>
                <Distortion>-7.718E-6</Distortion>
            </RadialDistortion>
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