Guidelines for CCDB mapping to GS files(v1.2)
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Michele Zundo, Dulce Lajas (ESA EOP-PEP)
Jose Barbosa (RDA Research)

This TN describes general guidelines based on lessons learned in the context of ESA Earth Observation Missions regarding the approach to :

- handle the so-called CCDB (Satellite/Space Segment) Calibration and Characterisation Data Base, logical split and format definitions.

- facilitate the management and exchange of this information between the Space Segment and the Ground Segment while maintaining a strict and separate configuration management.

CONCLUSION: It is recommended to define 2 physically separated and decoupled CCDB representations (with the same parameters):

a) one used within the **Space Segment activities** (the deliverables from Space Segment to Ground Segment)

b) the second being the set of AUX (Auxiliary) files ingested by the Data Processors and managed by the **Ground Segment** orchestration.

Note1: the GS data processor orchestration function uses as input-output and data repository only the **files** (generally XML, NetCDF) with standard naming and formatting and **not a databases management system** of parameters (like for example SQL, Oracle or MS Access).

Note2: the standard GS nomenclature distinguishes between calibration (CAL) and auxiliary (AUX) data: CAL refers to files obtained dynamically through a calibration process and automatically used, while AUX refers to files input to processors and used for anything else static or quasi static (instrument characteristics, alignment matrices, trends, drifts, etc) or externally generated (IERS bulletin, data from other missions). (See Fig. 1 below)

Note3: it is considered that online calibration files (CAL) produced during the mission data processing are not part of the CCDB although they can be post-processed into AUX data, which then becomes part of the CCDB. (See Fig. 1 below)

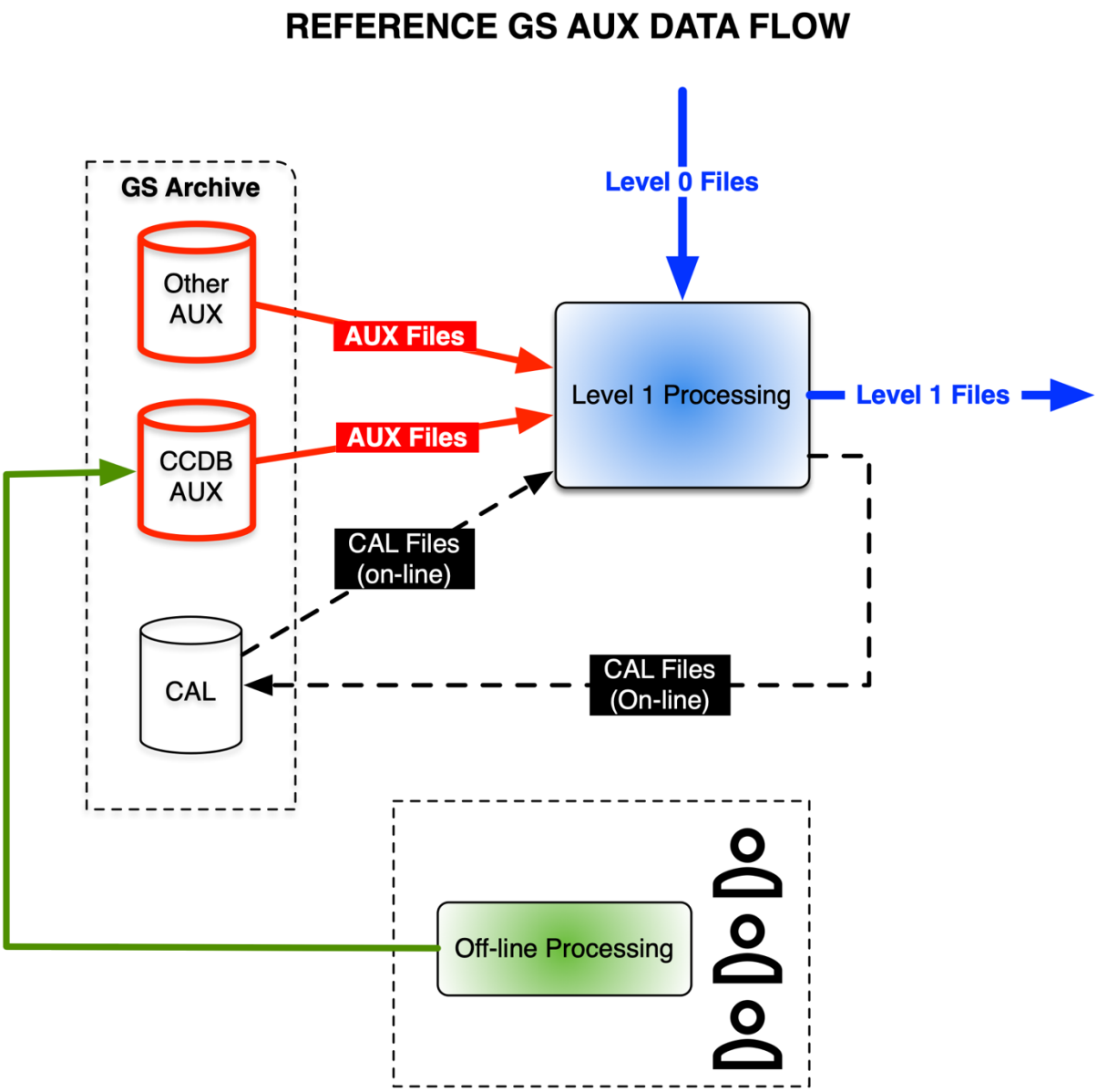

Fig. 1 Reference Data flow of AUX and CCDB related files

Content and Structure

The CCDB (also called Calibration Key Data (CKD) in some missions) used within the Space Segment activities can contain, mixed together and in a not distinguishable way (in standard GS sense), multiple versions of identical parameters e.g. design values, measured values, in-flight calibration values.

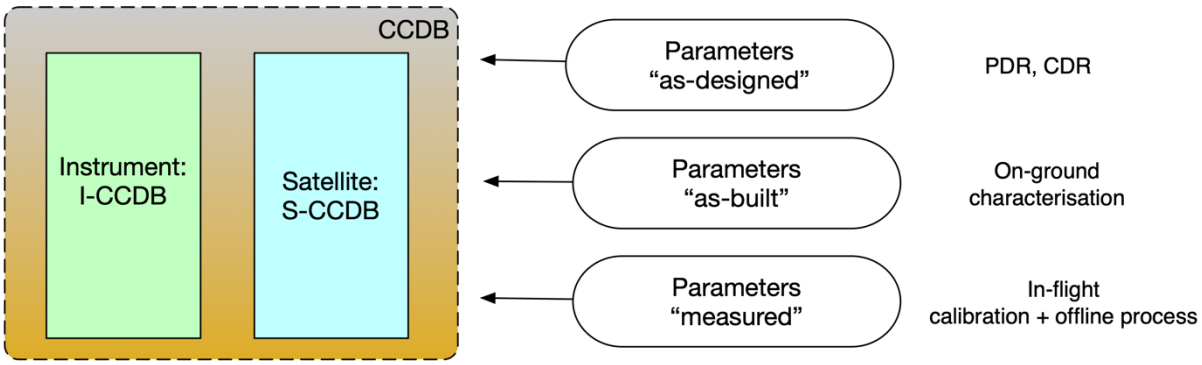

Fig. 2 Relation between CCDB and I-CCDB and S-CCDB and parameters

Although this might not be a problem for the Space Segment internal activities and specific tools, it is **not recommended** for E2E mission performance and Ground Segment development/activities since it does not match the structured, file-based, configuration-controlled system in which the ground data is organized and that is used by the orchestration and processors, as it introduces a strong dependency between Space Segment and Ground Segment.

The management of the CCDB as a single configuration management item is also problematic as even individual parameter changes result in the definition of a completely new versioned baseline for the whole parameter set.

A first step to address the problem above is to perform a logical and physical split with a defined structure, having in mind the various classes of parameters that are used differently:

- parameters related/used for each specific algorithm/correction/processing step
- design parameters (instrument-as-designed)
- on-ground measured data/parameters (instrument as-built)
- parameter timeliness (i.e., frequency of update, some data are static and other data can instead be frequently updated).

The two main criteria to perform the splitting and grouping are:

1) physically separate and in differently named AUX files
    a. instrument design/model parameter values,
    b. instrument measured parameter values (from on-ground calibration)
    c. fast changing parameters that are computed continuously during systematic processing

d. slow changing parameters derived infrequently from the mission data to update quasi-static data

2) split data per subsystem/algo

Chronological aspects

The CCDB used within the Space Segment activities is generally used as a generic historical repository of all the design and calibration data generated on-ground at different times in many cases even with the same name. This is not recommended since it creates ambiguity, duplication of data, cannot be used with standard GS orchestration selection rules and is not needed by the GS.

It is recommended that the CCDB is delivered to the GS containing only one copy of each calibration coefficient/parameter (either as designed or as ground calibrated) and not the historical archive of all the values coming from pre-launch activities performed by the Space Segment.
If there is the need at GS Processor level to use both (e.g. to allow for degraded processing to reverting to the *as-design* values) this is then managed in the Ground segment with definition of separate files of different type and therefore unique naming per time and data type must be ensured for any file containing these parameters.

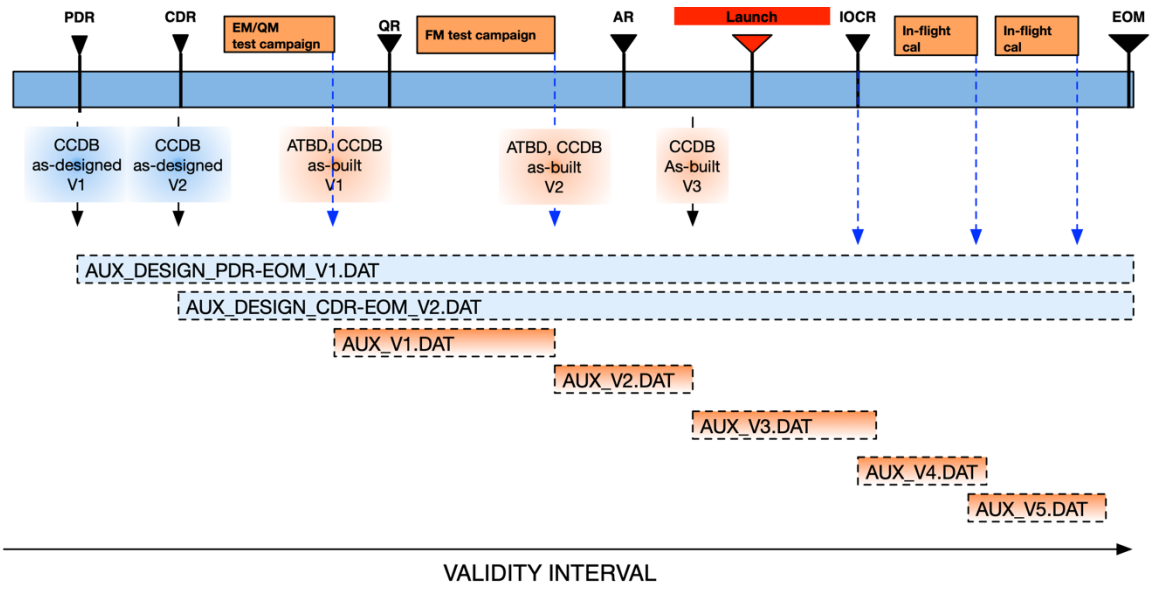

Fig. 3 Timeline of updates of AUX files containing CCDB parameters

The AUX files are used in the GS for data processing based on their validity interval in relation to the observation data to be processed. A definition of a validity based concept for AUX file contained in metadata and in the filename is mandatory for example:

FLX_OPER_AUX_DNGAIN_<yyyymmddThhmmss>_<yyyymmddThhmmss>_<yyyymmddThhmmss>__<ooooo>

Where the 2 red fields are validity start and stop (see also the EOP File Format Standard PE-TN-ESA-GS-0001).

Example

A parameter X is a 3x3 matrix of coefficients. Its value can be measured on ground or computed by use of calibration after launch. It is expected its' value will regularly change.

Within the Space segment and CCDB the following parameters instances

XD1	Design value of X at PDR
XD2	Design value of X at CDR
XC1	The measured value on ground after the first characterisation
XC2	The measured value on-ground after the second characterisation
XC3	The value of X after third characterization measurements and specific statistical processing (which is defined pre-launch as "the best knowledge of this parameter)
XF1	The value that is derived in Flight using some specific mission data (observation or CAL) during **commissioning** at **time T0**
XF2	The value that is derived in Flight Phase E2 using mission data (observation or CAL) at **time T1**
XF3	The value that is derived in Flight Phase E2 using mission data (observation or CAL) at **time T2**

Within the GS the values and associated files would be

XD1	AUX file containing design values at PDR	AUX_X_DES_X_001
XD2	AUX file containing design values at CDR	AUX_X_DES_X_002
XC1	AUX file containing first set of result on-ground campaign.	AUX_X_GC_001
XC2	AUX file containing second set of result on-ground campaign.	AUX_X_GC_002
XC3	AUX file containing third set of result on-ground campaign.	AUX_X_GC_003
XF1	AUX file containing the value that is derived in Flight using some specific mission data (observation or CAL) during **commissioning** at **time T0**	AUX_X_OPER _T0
XF2	AUX file containing the value that is derived in Flight Phase E2 using mission data (observation or CAL) at **time T1**	AUX_X_OPER _T1
XF2	AUX file containing the value that is derived in Flight Phase E2 using mission data (observation or CAL) at **time T2**	AUX_X_OPER _T2

Table 1. Example of parameter matching between Space Segment and Ground Segment.

Formats

The CCDB used within the Space Segment activities can be (and generally is) physically formatted in a way that is not directly/easily usable in the GS software (Simulator, Processors, etc) without extensive rework and with ambiguities.

In the past ESA has received from the Space Segment CCDBs made as: excel sheet, CSV files, directory tree structure with semantic value containing parameters files, on-line database accessed via web, etc..

The best approach at system level is to define and maintain a separate decoupled instantiation of the parameters from the CCDB as a set of AUX Ground Segment files defined by Level 1 developer and GS engineers. These files will follow the GS format standards/naming and match the standard processor orchestration approach at Level 1. The development of a tool that automatically converts the CCDB format into the GS format is the best way to maintain physical decoupling and parameter alignment.

In addition, in the context of the E2E Mission Performance Simulators, it is desirable to keep the files/parameters required for Instrument Simulator Module (ISM) physically defined as different files (IDS-CCDB) from the one required by Level 1 Processor (GS-CCDB) to avoid cross use mistakes.

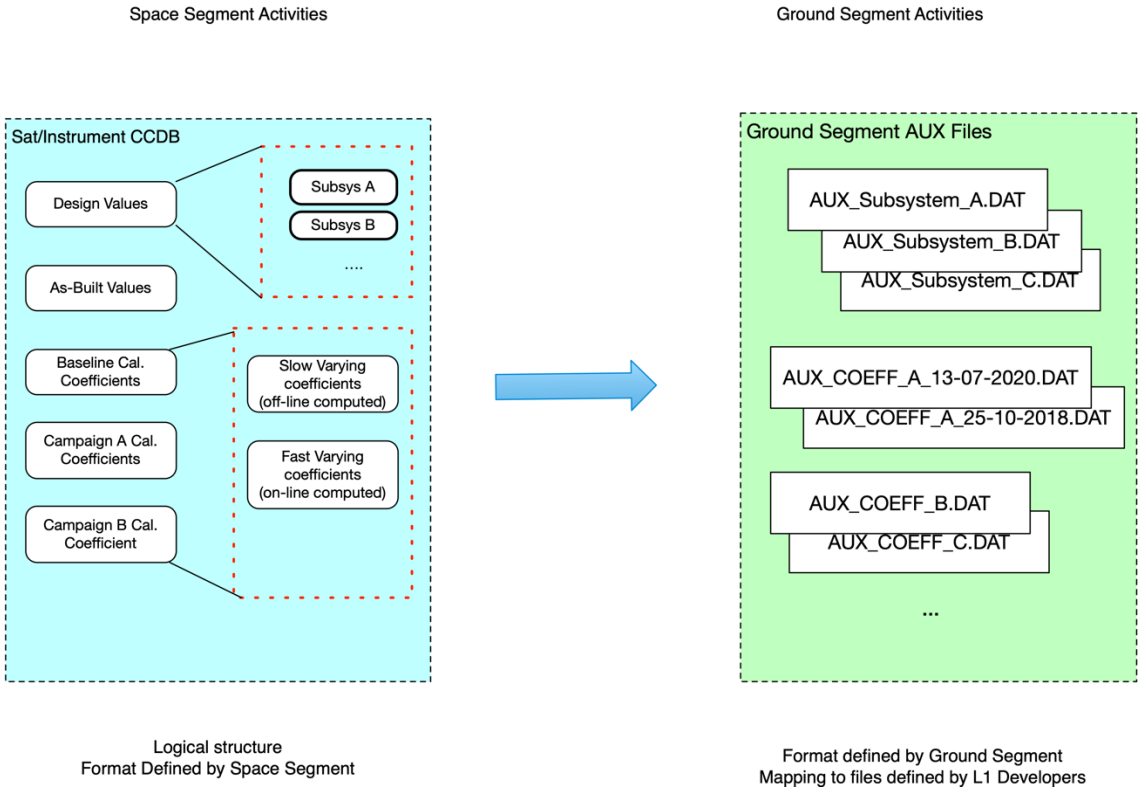

Fig. 4. Mapping from CCDB parameters to GS files

Other miscellanea recommendations:

Recommended to avoid in the E2ES (e.g. as input to ISM) a single config file containing thousands of parameters.