IDL DM Study and Archiving Ingestion Tests
Giacomo Coran – INAF OATs

Spoke 3 II Technical Workshop, Bologna Dec 17 -19, 2024

BIRALES Test Case & Efficient Physical Data Models

- **TDM files to archive satellite & space debris tracking data used for orbit determination**

- **Developement of a logical data models for this use case**

- **BIRALES data used as test case to develop an effective physical data model**

Birales

| ID	mediumint(9)	PK	NOT NULL AUTO INCREMENT
CCSDS_TDM_VERS	varchar(255)		DEFAULT NULL
CREATION_DATE	varchar(255)		DEFAULT NULL
ORIGINATOR	varchar(255)		DEFAULT NULL
TIME_SYSTEM	varchar(255)		DEFAULT NULL
START_TIME	varchar(255)		DEFAULT NULL
STOP_TIME	varchar(255)		DEFAULT NULL
PARTICIPANT_1	varchar(255)		DEFAULT NULL
PARTICIPANT_2	varchar(255)		DEFAULT NULL
PARTICIPANT_3	varchar(255)		DEFAULT NULL
PATH	varchar(255)		DEFAULT NULL
ANGLE_TYPE	varchar(255)		DEFAULT NULL
TRANSMIT_BAND	varchar(255)		DEFAULT NULL
RECEIVE_BAND	varchar(255)		DEFAULT NULL
TIMETAG_REF	varchar(255)		DEFAULT NULL
RANGE_UNITS	varchar(255)		DEFAULT NULL
DATA_QUALITY	varchar(255)		DEFAULT NULL

```
CCSDS_TDM_VERS = 1.0
COMMENT 39086
CREATION_DATE = 2023-10-31T10:59:00.334348
ORIGINATOR = INAF

META_START
COMMENT 39086
TIME_SYSTEM = UTC
START_TIME = 2023-10-31T04:39:42.839413
STOP_TIME = 2023-10-31T04:40:06.998604
PARTICIPANT_1 = IT_BIRALES-A
PARTICIPANT_2 = 2013-009A
PARTICIPANT_3 = IT_TRF-TX
PATH = 3,2,1
ANGLE_TYPE = AZEL
TRANSMIT_BAND = UHF
RECEIVE_BAND = UHF
TIMETAG_REF = RECEIVE
RANGE_UNITS = km
DATA_QUALITY = VALIDATED
META_STOP
```
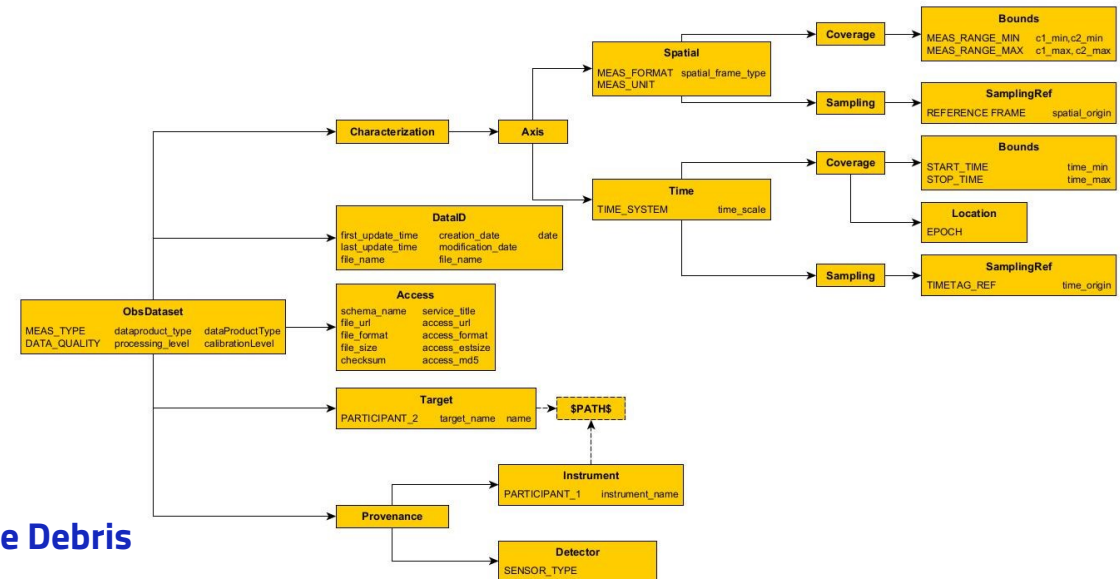
Logical Data Model

- **Mapping in the ObsCoreDM amplified in the description by CharacterizationDM, DatasetDM and ProvenanceDM documentation**

- **Use of the EPNcore metadata dictionary to map TDM metadata in the IVOA standard**

- **Necessary improvements in metadata description to respect interoperability**

- **Necessary extension due to lack of an already dedicated data model**

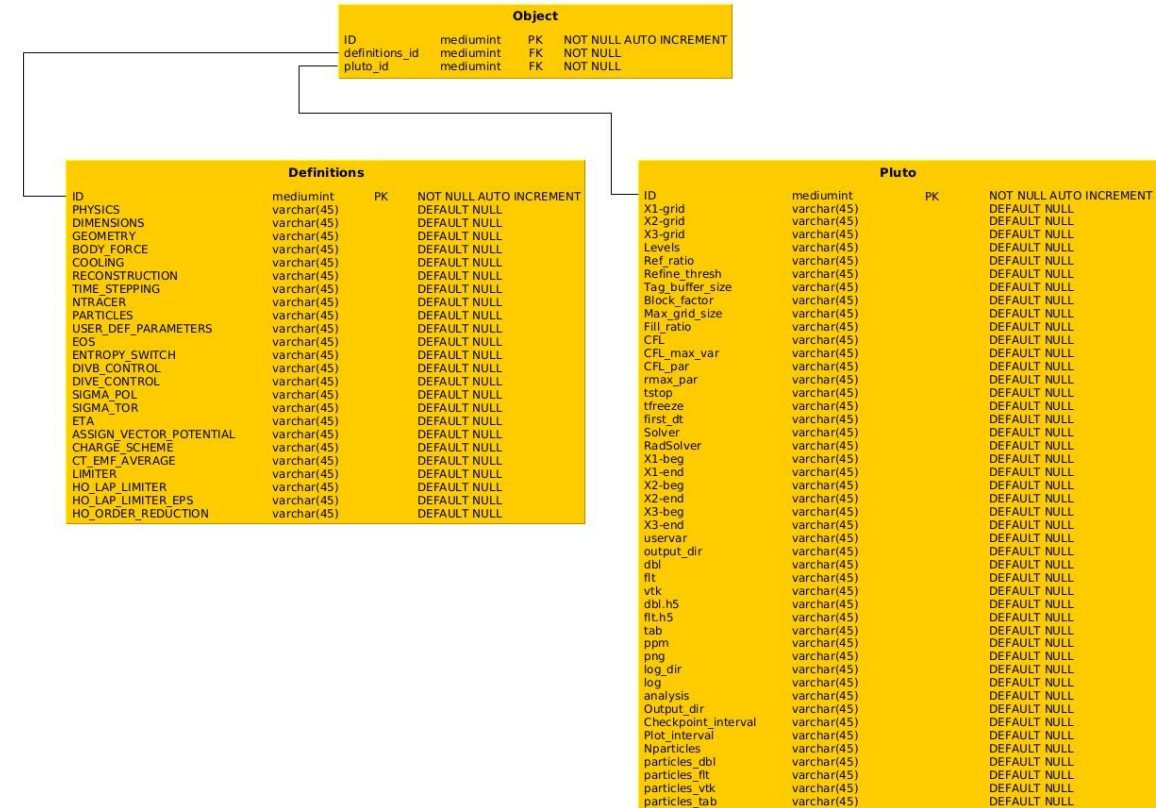- **Standardization process required within international organizations**

Birales
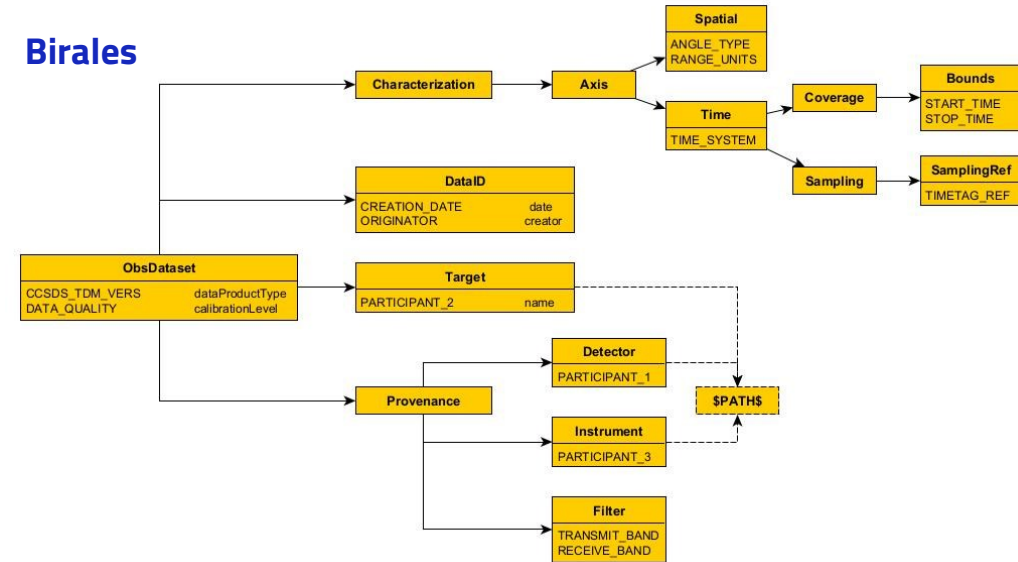
Space Debris

Simulative Data Model

- **Possible physical archiving structure rappresentation ready since April 2024**

- **Missing the IVOA standardize logical model, the SimDM, since it is under refinement, locks the correction of the physical rappresentation**

- **We could proceed with this version but the standard required for the interoperability would not be met**

Object

ID	mediumint	PK	NOT NULL AUTO INCREMENT
definitions_id	mediumint	FK	NOT NULL
pluto_id	mediumint	FK	NOT NULL

Definitions

ID	mediumint	PK	NOT NULL AUTO INCREMENT
PHYSICS	varchar(45)		DEFAULT NULL
DIMENSIONS	varchar(45)		DEFAULT NULL
GEOMETRY	varchar(45)		DEFAULT NULL
BODY_FORCE	varchar(45)		DEFAULT NULL
COOLING	varchar(45)		DEFAULT NULL
RECONSTRUCTION	varchar(45)		DEFAULT NULL
TIME_STEPPING	varchar(45)		DEFAULT NULL
NTRACER	varchar(45)		DEFAULT NULL
PARTICLES	varchar(45)		DEFAULT NULL
USER_DEF_PARAMETERS	varchar(45)		DEFAULT NULL
EOS	varchar(45)		DEFAULT NULL
ENTROPY_SWITCH	varchar(45)		DEFAULT NULL
DIVB_CONTROL	varchar(45)		DEFAULT NULL
DIVE_CONTROL	varchar(45)		DEFAULT NULL
SIGMA_POL	varchar(45)		DEFAULT NULL
SIGMA_TOR	varchar(45)		DEFAULT NULL
ETA	varchar(45)		DEFAULT NULL
ASSIGN_VECTOR_POTENTIAL	varchar(45)		DEFAULT NULL
CHARGE_SCHEME	varchar(45)		DEFAULT NULL
CT_EMF_AVERAGE	varchar(45)		DEFAULT NULL
LIMITER	varchar(45)		DEFAULT NULL
HO_LAP_LIMITER	varchar(45)		DEFAULT NULL
HO_LAP_LIMITER_EPS	varchar(45)		DEFAULT NULL
HO_ORDER_REDUCTION	varchar(45)		DEFAULT NULL

Pluto

ID	mediumint	PK	NOT NULL AUTO INCREMENT
X1-grid	varchar(45)		DEFAULT NULL
X2-grid	varchar(45)		DEFAULT NULL
X3-grid	varchar(45)		DEFAULT NULL
Levels	varchar(45)		DEFAULT NULL
Ref_ratio	varchar(45)		DEFAULT NULL
Refine_thresh	varchar(45)		DEFAULT NULL
Tag_buffer_size	varchar(45)		DEFAULT NULL
Block_factor	varchar(45)		DEFAULT NULL
Max_grid_size	varchar(45)		DEFAULT NULL
Fill_ratio	varchar(45)		DEFAULT NULL
CFL	varchar(45)		DEFAULT NULL
CFL_max_var	varchar(45)		DEFAULT NULL
CFL_par	varchar(45)		DEFAULT NULL
rmax_par	varchar(45)		DEFAULT NULL
tstop	varchar(45)		DEFAULT NULL
tfreeze	varchar(45)		DEFAULT NULL
first_dt	varchar(45)		DEFAULT NULL
Solver	varchar(45)		DEFAULT NULL
RadSolver	varchar(45)		DEFAULT NULL
X1-beg	varchar(45)		DEFAULT NULL
X1-end	varchar(45)		DEFAULT NULL
X2-beg	varchar(45)		DEFAULT NULL
X2-end	varchar(45)		DEFAULT NULL
X3-beg	varchar(45)		DEFAULT NULL
X3-end	varchar(45)		DEFAULT NULL
uservar	varchar(45)		DEFAULT NULL
output_dir	varchar(45)		DEFAULT NULL
dbl	varchar(45)		DEFAULT NULL
flt	varchar(45)		DEFAULT NULL
vtk	varchar(45)		DEFAULT NULL
dbl.h5	varchar(45)		DEFAULT NULL
flt.h5	varchar(45)		DEFAULT NULL
tab	varchar(45)		DEFAULT NULL
ppm	varchar(45)		DEFAULT NULL
png	varchar(45)		DEFAULT NULL
log_dir	varchar(45)		DEFAULT NULL
log	varchar(45)		DEFAULT NULL
analysis	varchar(45)		DEFAULT NULL
Output_dir	varchar(45)		DEFAULT NULL
Checkpoint_interval	varchar(45)		DEFAULT NULL
Plot_interval	varchar(45)		DEFAULT NULL
Nparticles	varchar(45)		DEFAULT NULL
particles_dbl	varchar(45)		DEFAULT NULL
particles_flt	varchar(45)		DEFAULT NULL
particles_vtk	varchar(45)		DEFAULT NULL
particles_tab	varchar(45)		DEFAULT NULL

Ingestion Tests

- **Modified WP4 Importer software for data and metadata ingestion**

- **Simple integration with the INFN blockchain, optimizing time and resources**

- **Successful ingestion test with data correctly stored in Minlo**

Conclusions

- **2 out of 3 data sources identified, Birales for the space debris observations and Pluto and Ramses for the simulative cases (66%)**

- **Identified possible solutions for the data models, both physical and logical (~50%)**

- **Necessary development of a standardized data model, extended to satisfy satellites and space debris tracking (~20%)**

- **Necessity to implement correct metadata description to respect international astronomical standards**

- **Necessity to develop the standard to define the interoperability for simulative use cases (~15%)**

- **Developed the ingestion software that takes care for data preprocess and metadata extraction (100%)**

- **Successful ingestion processes for the Birales use case and Fermi tests (99%)**

Next Steps

- **Definition of a standardized logical data model for the community for the space debris and satellite tracking**

- **Developement of the standardized IVOA conceptual data model for the simulative use cases**

- **Definition of the final set of radio data to use as radio test case**

- **Further ingestions and tests with more INAF data for the next months**

Thank you!

Spoke 3 II Technical Workshop, Bologna Dec 17 -19, 2024

ICSC Italian Research Center on High-Performance Computing, Big Data and Quantum Computing

Missione 4 • **Istruzione e Ricerca**