Astronomy ESFRI & Research Infrastructure Cluster
ASTERICS - 653477

# Prototyping Provenance metadata for the Virtual Observatory

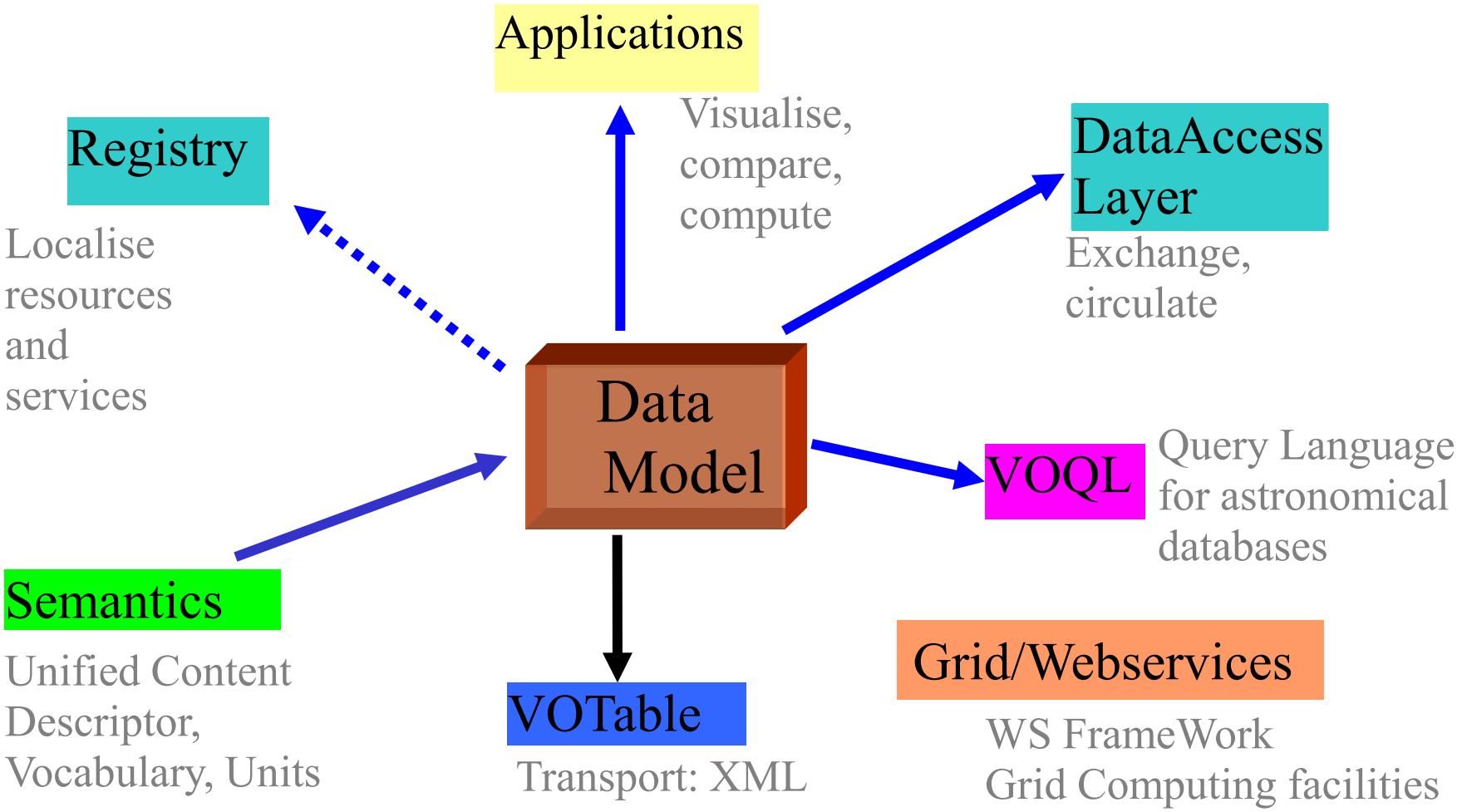
Mireille Louys, CDS & ICube Laboratory
University of Strasbourg

# International Virtual Observatory Alliance

# ivoa.net

- Science driven
- Information technology developments for astronomical science
- Fosters interoperability
- Standardisation process a la W3C
  - Working groups
  - Technical coordination
  - Science priority comittee
  - Executive Board representing all national projects

# Working Groups / Interactions



# Assisting astronomers for data search

- What astronomers may look for ?
  - Select data sets according to their science topic
    - Project, instrument, facility ( telescope name and type)
    - Location ( position in the sky or class of object)
    - Physical properties in space , time, spectral domain, flux
    - Types , Formats, Size
- Existing VO data models for metadata
  - Characterisation, ObsCoreDM, SpectralDM, PhotDM, CubeDM, … available on http://ivoa.net/documents
  - Coarse description only on data Provenance

# Provenance metadata in the IVOA

- Explains how data sets were produced
  - Observing process and conditions
  - Data reduction, selection and extraction methods applied to raw measures to build up science-ready data products

    (source lists, spectra, light curves, images, …)
- Helps VO users to :
  - Derive selection criteria to filter out suitable data for his/her scientific needs
  - Estimate better which data release fits the best for their needs
  - Run his/her own reduction method on intermediate data products in order to refine data analysis.

  →Expose progenitors of science data products

# Provenance in the W3C

## W3C Provenance definition

*"Provenance is information about entities, activities, and people involved in producing a piece of data or thing, which can be used to form assessments about its quality, reliability or trustworthiness. PROV-DM is the conceptual data model that forms a basis for the W3C provenance (PROV) family of specifications."*

PROV-OVERVIEW (Note), an overview of the PROV family of documents

PROV-PRIMER (Note), a primer for the PROV data model

PROV-O (Recommendation), the PROV ontology, an OWL2 ontology allowing the mapping of the PROV data model to RDF

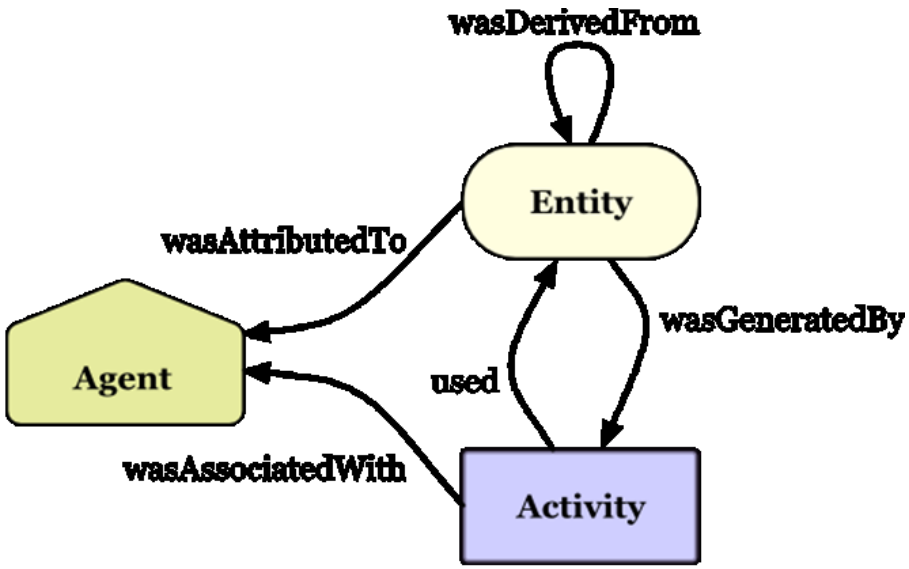
PROV-DM (Recommendation), the PROV data model for provenance (this document)

PROV-N (Recommendation), a notation for provenance aimed at human consumption

PROV-XML (Note), an XML schema for the PROV data model

PROV-AQ (Note), mechanisms for accessing and querying provenance

# W3C Provenance pattern




- Makes explicit:
  - Processing steps
  - Chain of dependencies
  - Responsibilities
- Useful for all execution sequence of tasks, workflow, reduction pipeline, analysis workflow, etc.
- Applies for both acquisition and reduction steps

# In our context

Entity

- data products (files), ancillary data (calibration, instrumental response, etc.), processing parameter files

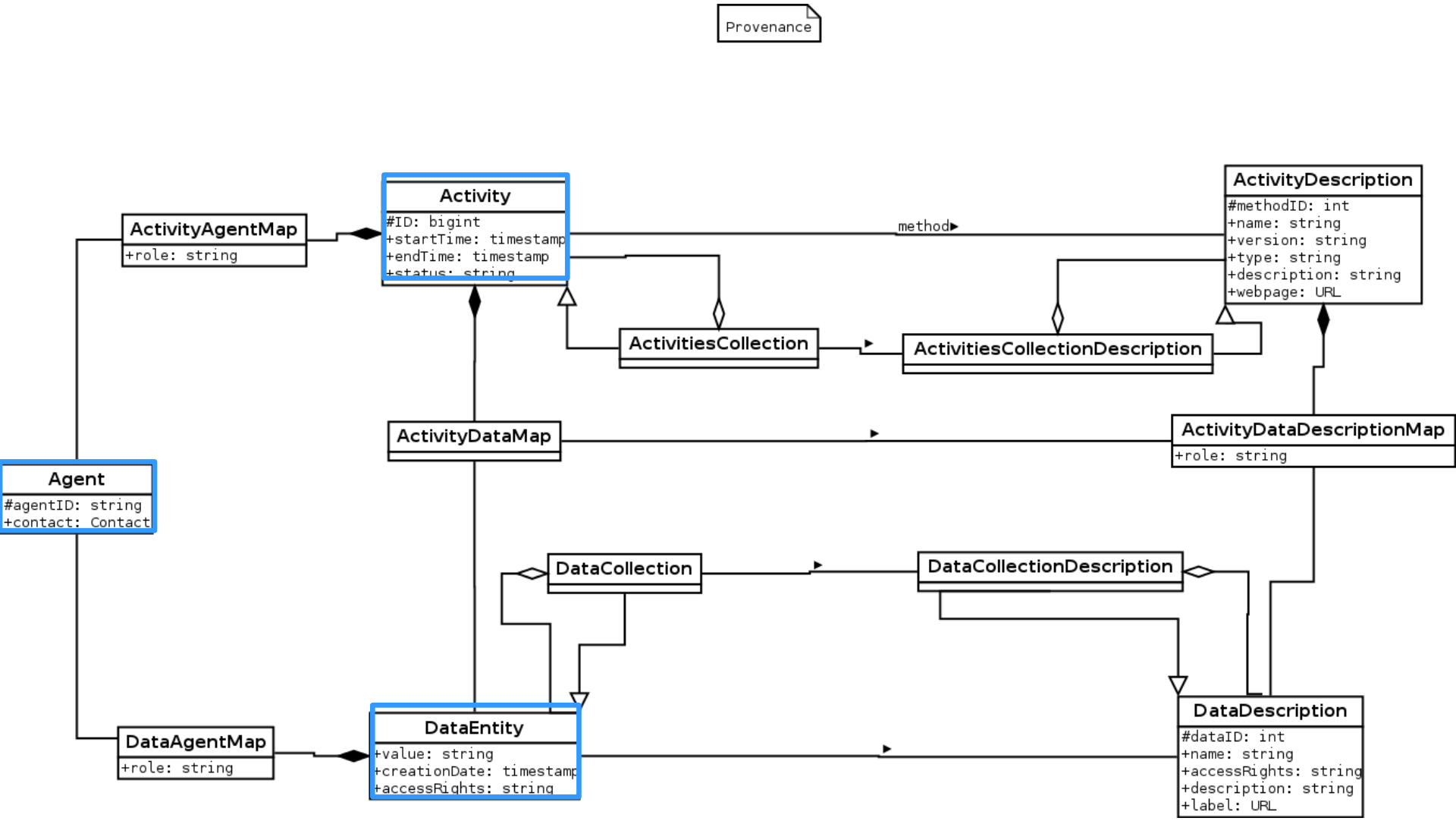
Activity

- data acquisition, mosaicing, regridding, fusion, calibration, …, transformation

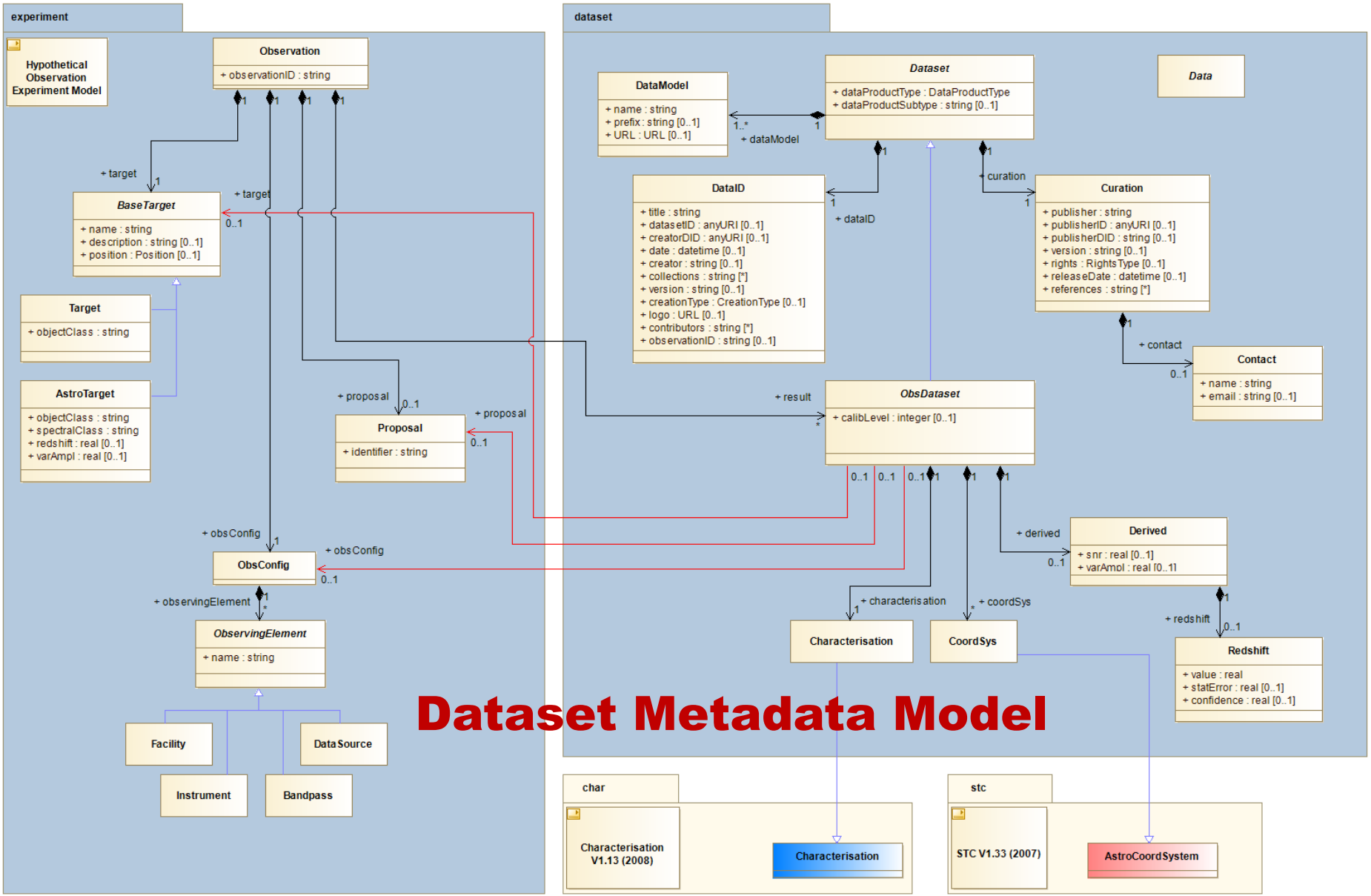
Agent

- Telescope astronomer, pipeline operator, principal investigator, etc.

# Customized re-use



# Binding to existing data models



# Work Package 4

- More use-cases to work out with this pattern
- Explore the ActivityDescription class for various use-cases
  - M.Servillat, C. Boisson, M.Sanguillon, J. Bregeon

    → CTA data products (4 levels of progenitors)
  - High energy physics

    → Fitting parametric models profiles for XMM spectra
  - Theoretical spectra

    →Provenance  for the Pollux data base at LUPM

# Need for a serialisation format

- Currently most of the provenance information in astronomy collections is available as :
  - log files
  - list of launched command lines in FITS headers in COMMENT keywords
- W3C offers various forms of syntax, translators
- see Kristin Riebe astronomical use-case for the RAVE pipeline http://wiki.ivoa.net/internal/IVOA/InterOpJune2015DM/Provenance.pdf
- PROV-N (W3C)
  - Traces the execution scenario in simple text
  - Defines a grammar

# Conclusion

- Emergence of massive projects (LSST, …)
  - The « code to data » strategy requires a precise and interoperable description of processing
- Appropriate time to consider Provenance metadata for astronomical data products
- Which levels of details according to use-cases
  - Science user → highlights for data quality
  - Pipeline /workflow management → reproducibility