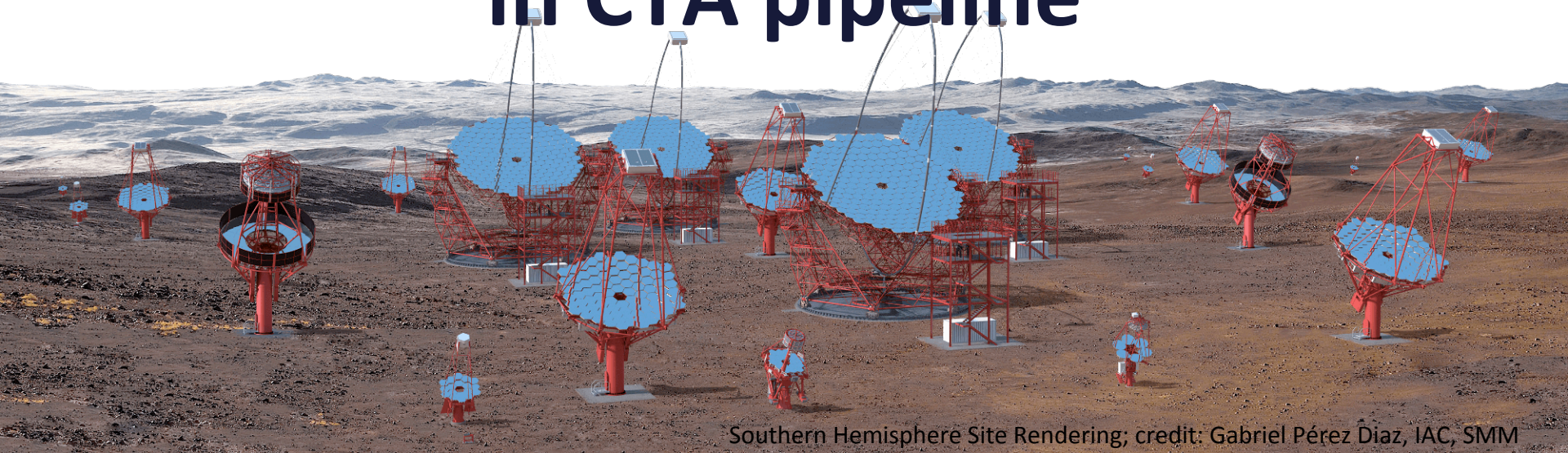# Provenance implementation in CTA pipeline

Southern Hemisphere Site Rendering; credit: Gabriel Pérez Diaz, IAC, SMM

Michèle Sanguillon[1], Catherine Boisson[2], Johan Bregeon[1], Karl Kosack[3], Nicolas Renault-Tonacci[2], Mathieu Servillat[2]

[1] LUPM, Montpellier, France   [2] LUTH, Meudon, France [3] CEA, Paris, France

Context

- Next Generation Gamma-Ray Astronomy (succeeding H.E.S.S., MAGIC and VERITAS)
- Two arrays of 99 (South) and 19 (North) Cherenkov telescopes (4, 12 et 24 m in diametre)
- Observatory open to the Astronomy community
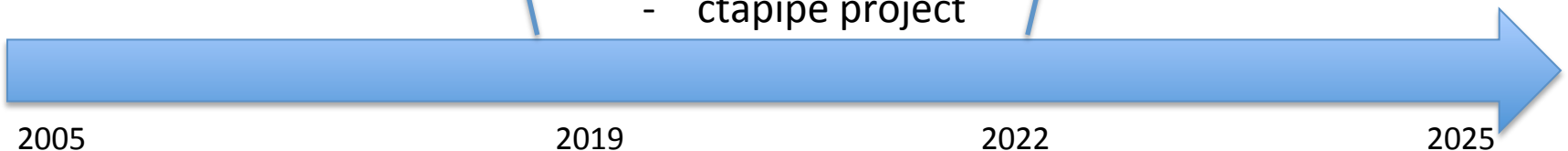- Timeline:

Pre-Construction phase:
- Simulations

Pre & Production phase:
- Data model definition
- Software development
  - Prototype OPUS
  - ctapipe project

Operation phase:
- Acquisitions
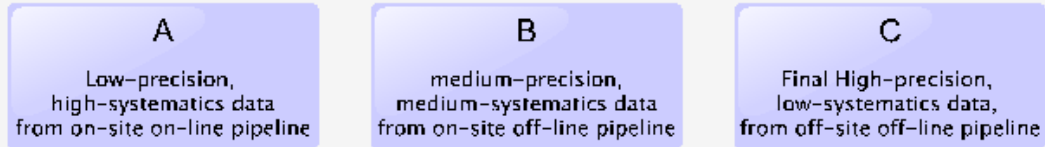- High level data available
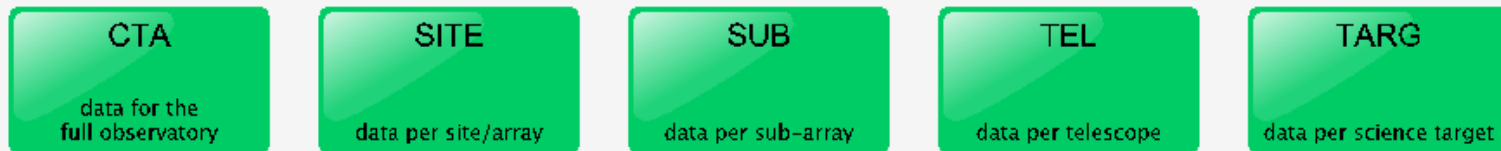
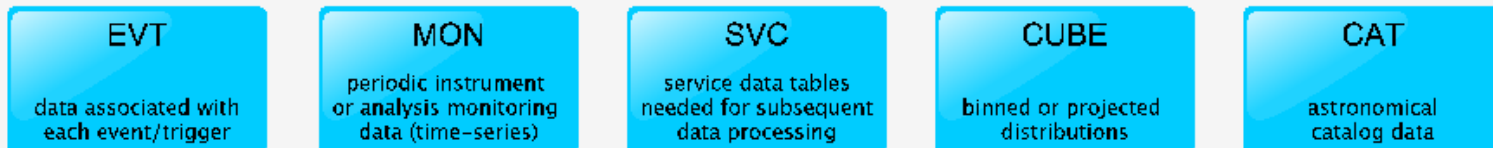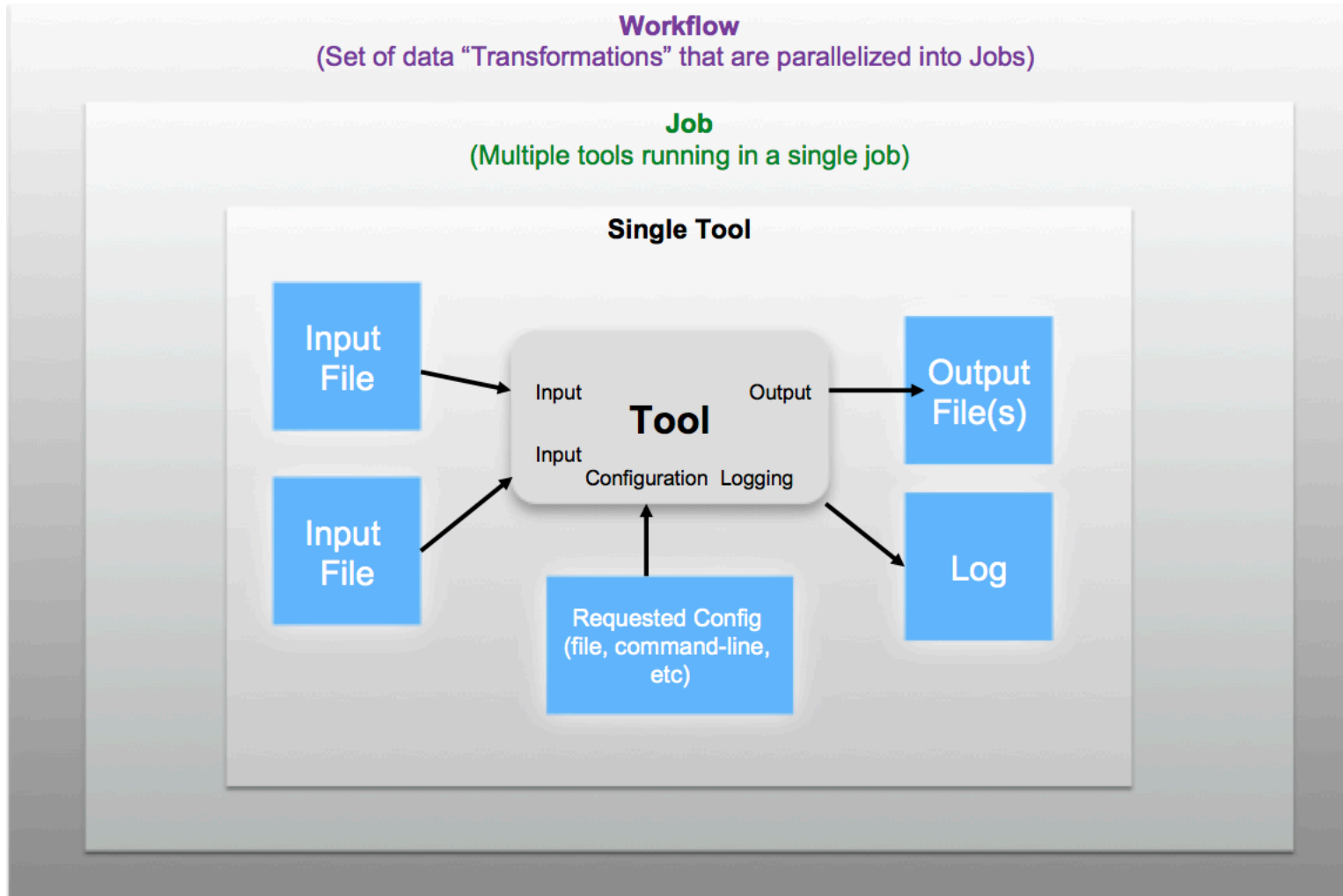2005   2019   2022   2025

Data Model

Software

Software

- Software tools are used or under development but not yet validated by the CTA Observatory

- Ctapipe :
  - **https://github.com/cta-observatory/ctapipe**
  - Framework containing the different tools (Python)

What is provenance?

- Implementation of Provenance includes to work on:
  - How to catch the information?
  - How to store the information?
    - In a database: ProvenanceDM!
    - In data products (header, etc.)
    - In files
  - How to retrieve the information?
    - ProvSAP: to request Provenance path
    - ProvTAP: to search data products based on Provenance

Capture

- The provenance of all data (low and high levels) must be carefully registered and easily available for further use.

- Provenance is captured *a priori* during a workflow execution at the level of each tool

- Provenance Tracking is integrated in the ctapipe framework => Provenance module (ctapipe.core.provenance)

ctapipe

- Provenance module
  - ctapipe.core.provenance
  - Developed so that each tool automatically register provenance information
  - This module has been designed to return a dictionary with all provenance information

```
[{'activity_name': 'ctapipe-display-muons',
  'activity_uuid': '93fc2206-59de-4852-868d-ec045ec2
5d1d',
  'config': {'MuonDisplayerTool': {'events': 'proton
_20deg_180deg_run22___cta-prod3-demo-2147m-LaPalma-b
aseline.simtel.gz'}},
  'duration_min': 0.01649999999998819,
  'input': [{'role': 'dl0.sub.evt',
    'url': '/Users/bourgeat/Documents/CTA/Provenance
/ctasoft/ctapipe/tests/proton_20deg_180deg_run22___c
ta-prod3-demo-2147m-LaPalma-baseline.simtel.gz'}],
  'output': [{'role': 'dl1.tel.evt.muon',
    'url': '/Users/bourgeat/Documents/CTA/Provenance
/ctasoft/ctapipe/tests/muons.hdf5'}],
  'start': {'time_utc': '2019-05-07T06:28:44.605'},
  'status': 'completed',
  'stop': {'time_utc': '2019-05-07T06:28:45.595'},
  'system': {'arguments': ['/Users/bourgeat/anaconda
3/lib/python3.6/site-packages/ipykernel_launcher.py'
,
    '-f',
    '/Users/bourgeat/Library/Jupyter/runtime/kernel-
d793d0e4-abd3-4989-a71c-19b68194ea9e.json'],
  'ctapipe_resources_version': '0.2.15',
  'ctapipe_svc_path': None,
  'ctapipe_version': '0.6.1',
```
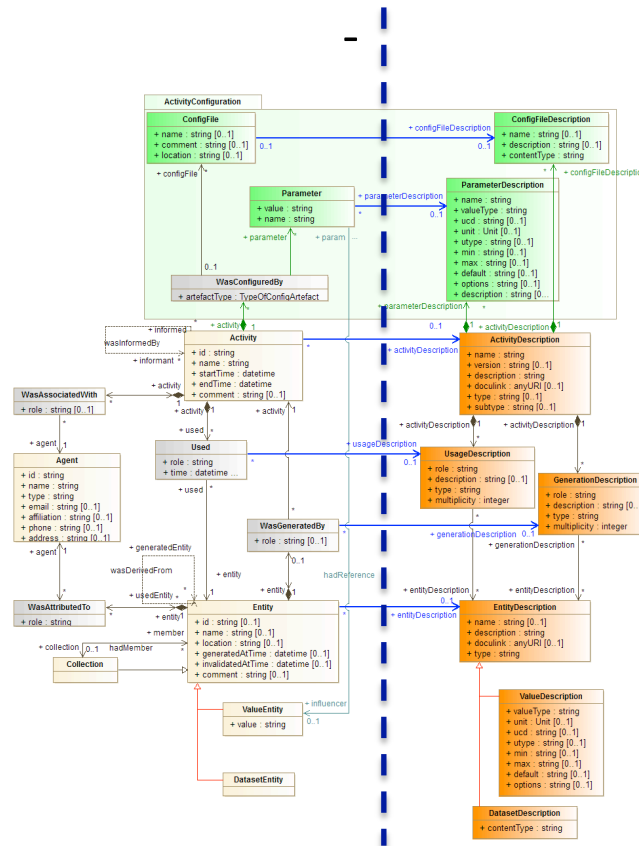
Fill the Prov DB

The Provenance Database will be fed
- initially with the tool description information
- then at the end of each run of tool with the information from the dictionary.
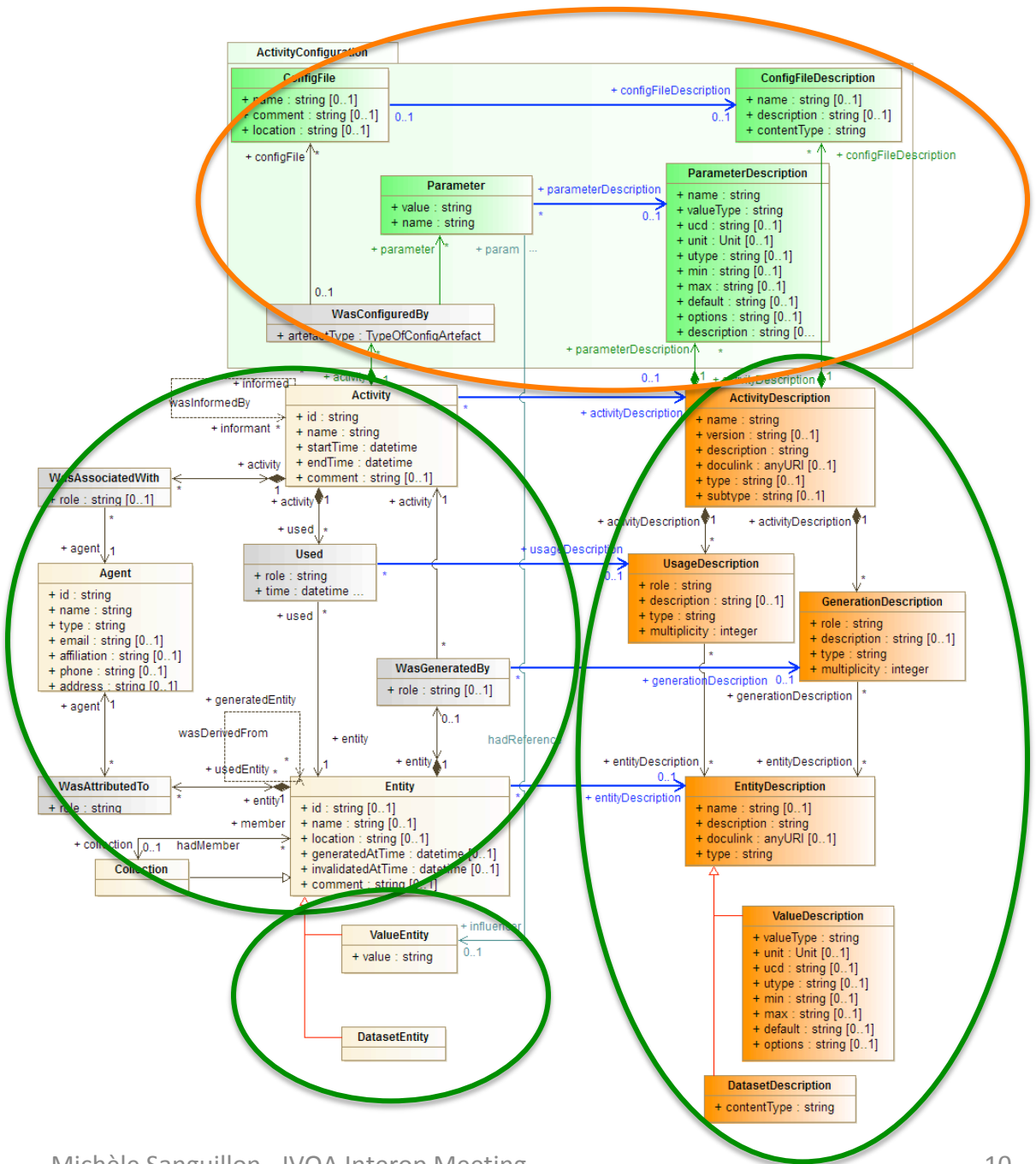
Information relative to each run of tool

Descriptions relative to each type of tool
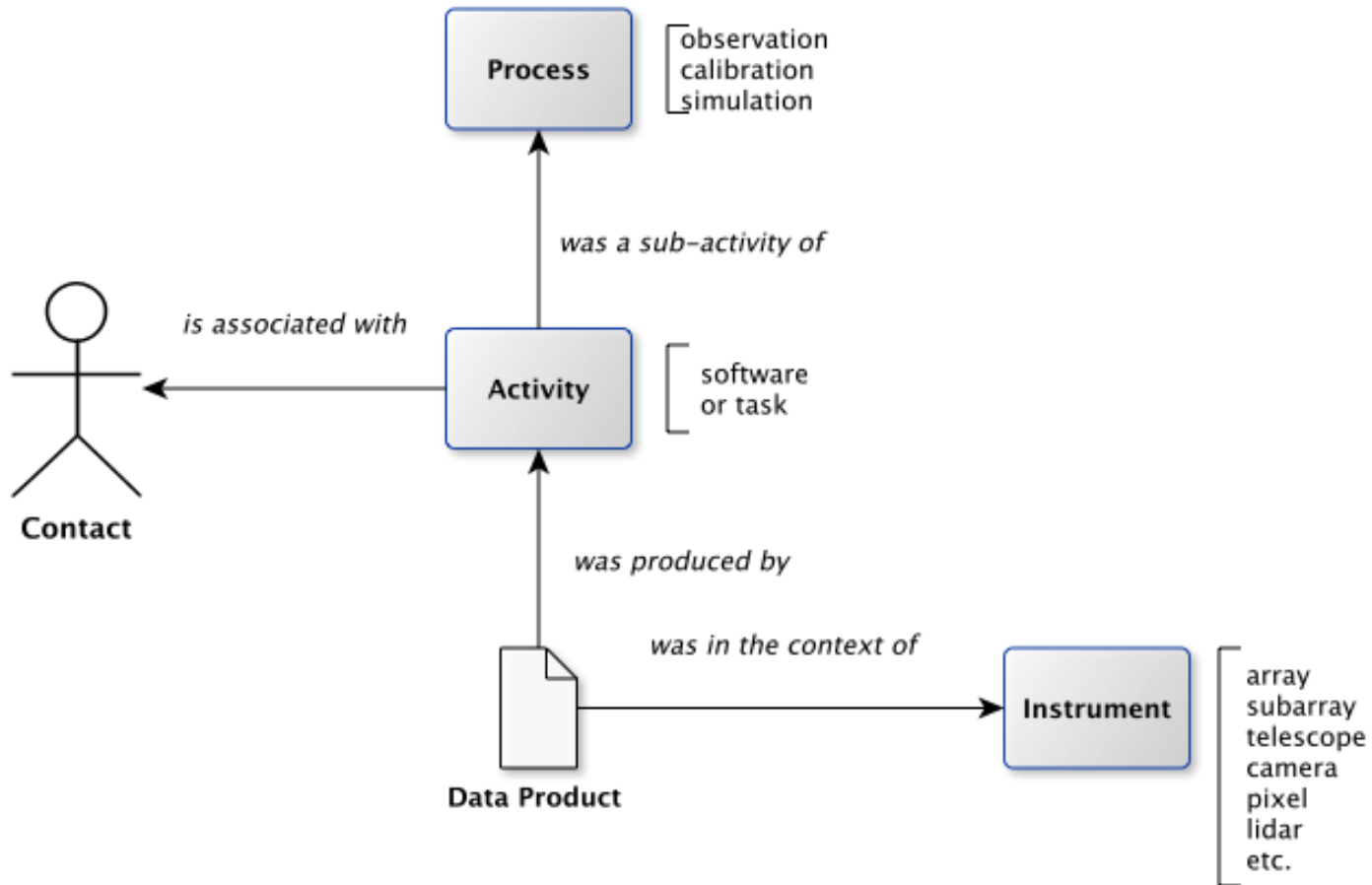
Storage in the Provenance DB

Dev steps:
1: ◯
2: ◯

Product minimal metadata

Choices made

- Rules to associate an item with its description
  - Activity: activity_name + cta_pipe_version
  - Entity: activity description + role

- Unique Identifiers
  - Activity.id: uuid generated in the job
  - Entity.id: uuid depending on file(location+name), DIRAC lfn?
  - Relations Used.id, WasGeneratedBy.id, WasAttributedTo.id, WasAssociatedWith.id are intergers and autoincremented

I thank you for your attention

Any questions?