Whitelisting catalogue service for hard target processing

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Space Debris - The problem:

- Pollution in space: it does not decompose, it does not fall down

- Even tiny particles can cause huge damage at 7 km/s.

- Every collision event creates more debris => Kessler syndrome

- Several Mega-constellations under active development and deployment

- If unchecked, can render human activities in space impossible!

Space Debris - What EISCAT can do

N✦RCE

- Observations made with UHF and ESR since 1998
  - Markkanen, Lehtinen, Vierinen

- Very sensitive instruments!
  - Debris population modeling
  - Re-entry predictions

- Good location for low, high-inclination orbits popular for Earth Observation-type applications

- ESA-funded Performance study indicates E3D observations highly valuable.

Space Debris - What EISCAT can do

NORCE

- - EISCAT Blue book quote:

"The Association may contribute to the international task of tracking objects in space (natural or man-made) [...]"

Space Debris - What EISCAT can *not* do

- There are satellites whose owners want to keep them hidden
  - and whose owners EISCAT must listen to

- "The aim of [EISCAT] is [...] to provide access to radar for non-military, scientific purposes""

# Space Debris - What EISCAT can *not* do   N✺RCE

- - EISCAT Blue book quote:

"The Association may contribute to the international task of tracking objects in space (natural or man-made). For this activity, an agreed list of objects shall be maintained and the Association shall only conduct tracking of objects from this list."

- Policies and procedures are in place to make sure this is what happens.
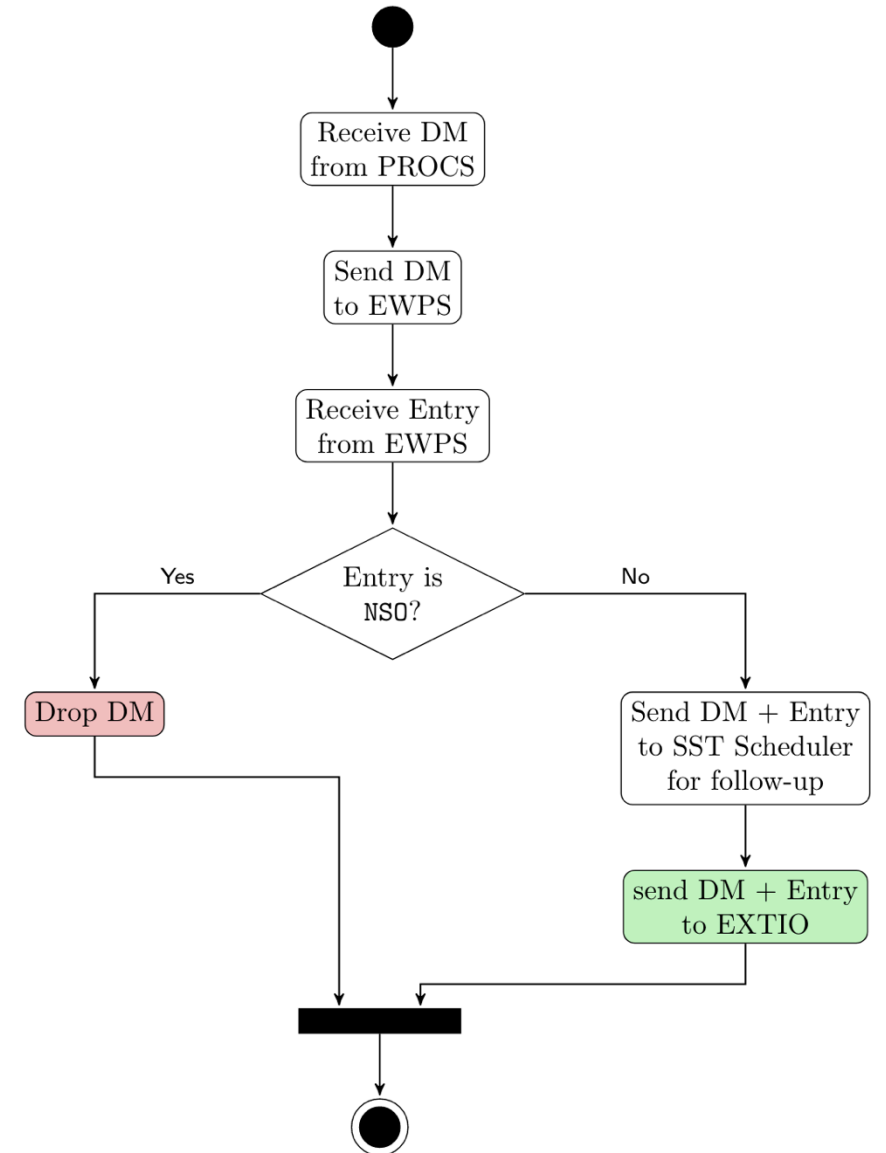
EISCAT_3D Processing Chain: Architecture

- Policy-defined Filtering Component as gatekeeper
  - of observation requests
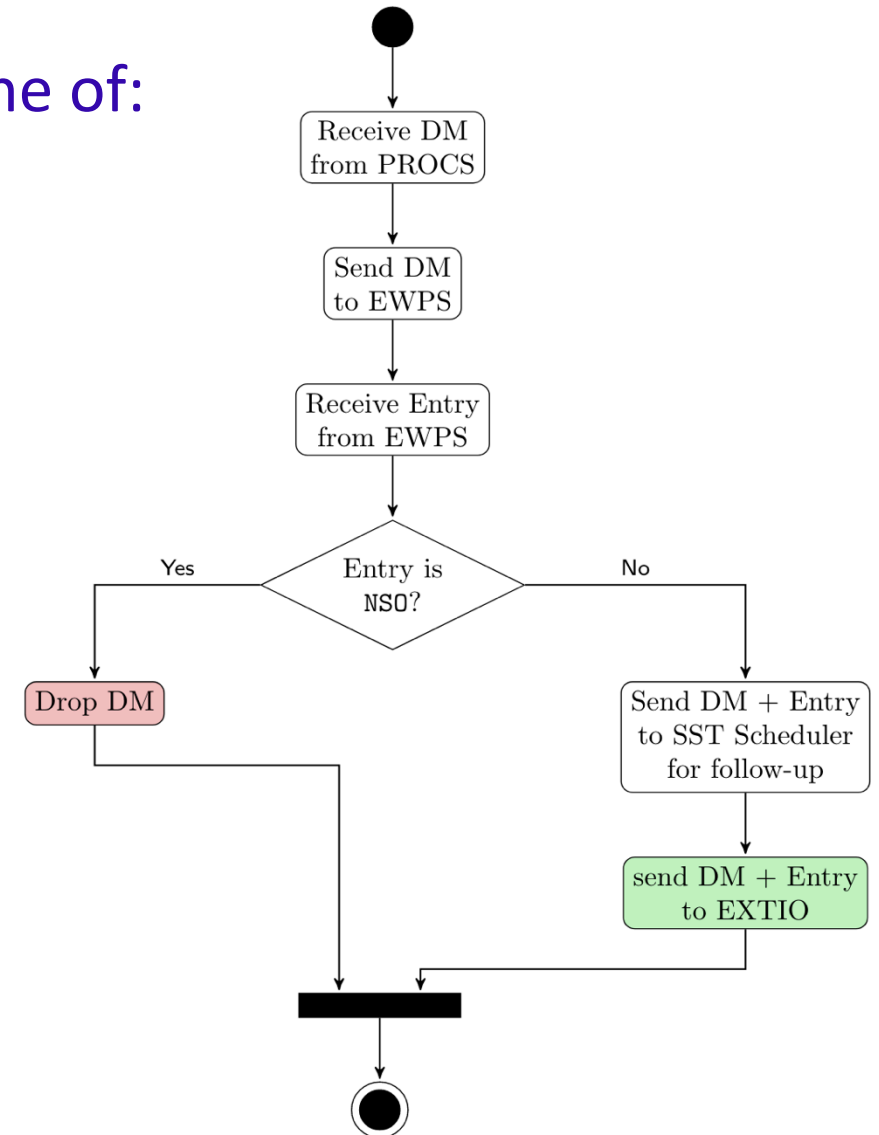 - and of analysed data (tracklets)
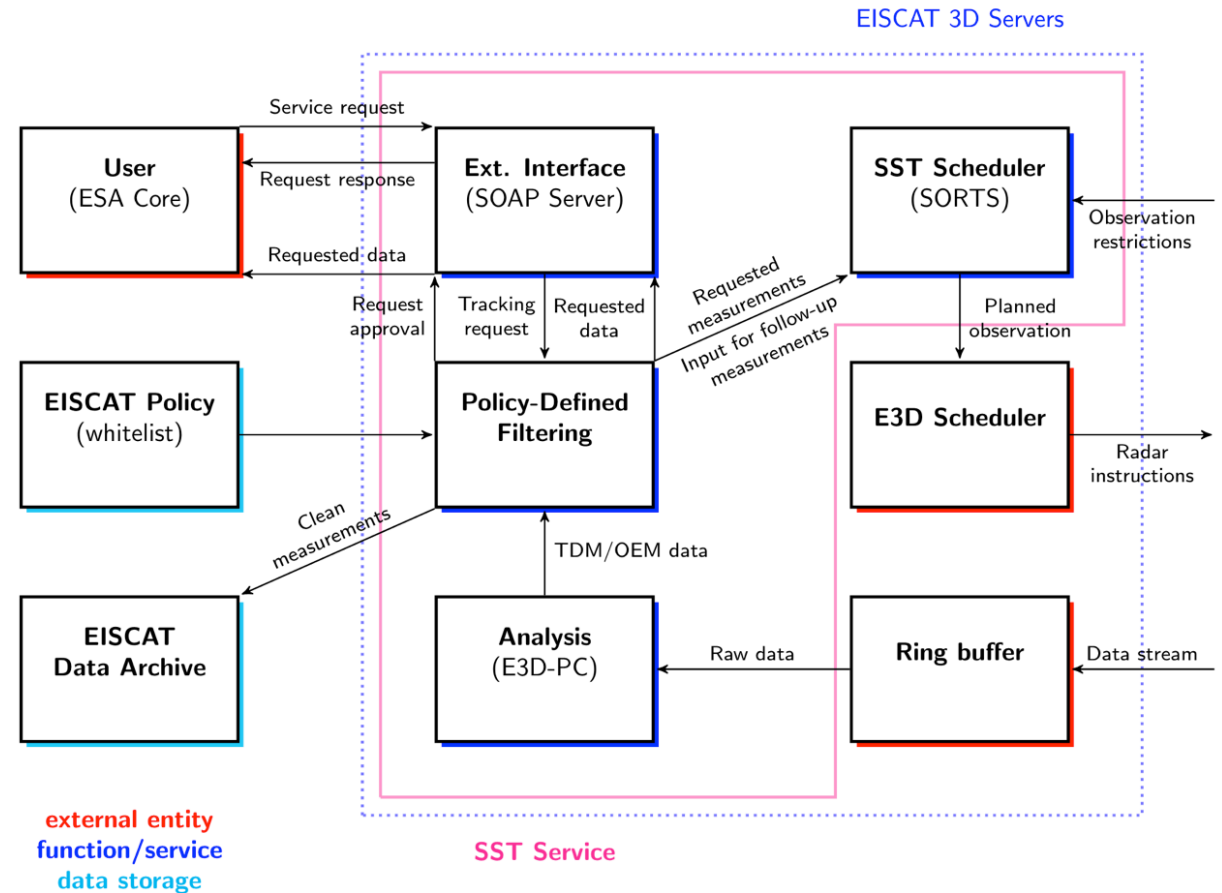
Filtering of Analysed Data

- A Data Message (DM) contains:
  - Internal unique ID
  - Time-stamped vector range
  - Time-stamped vector range rate

Filtering of Analysed Data

A DM sent to Whitelisting Service, response is one of:

- NSO [No Such Object], or

- A message in two parts:

  - Global Unique ID (catalogue name), and

  - Most up-to-date orbit information for object.

- If Response was not NSO, then a message composed of DM and Response is

  - archived (for transparency)

  - returned to requestor (if appropriate)

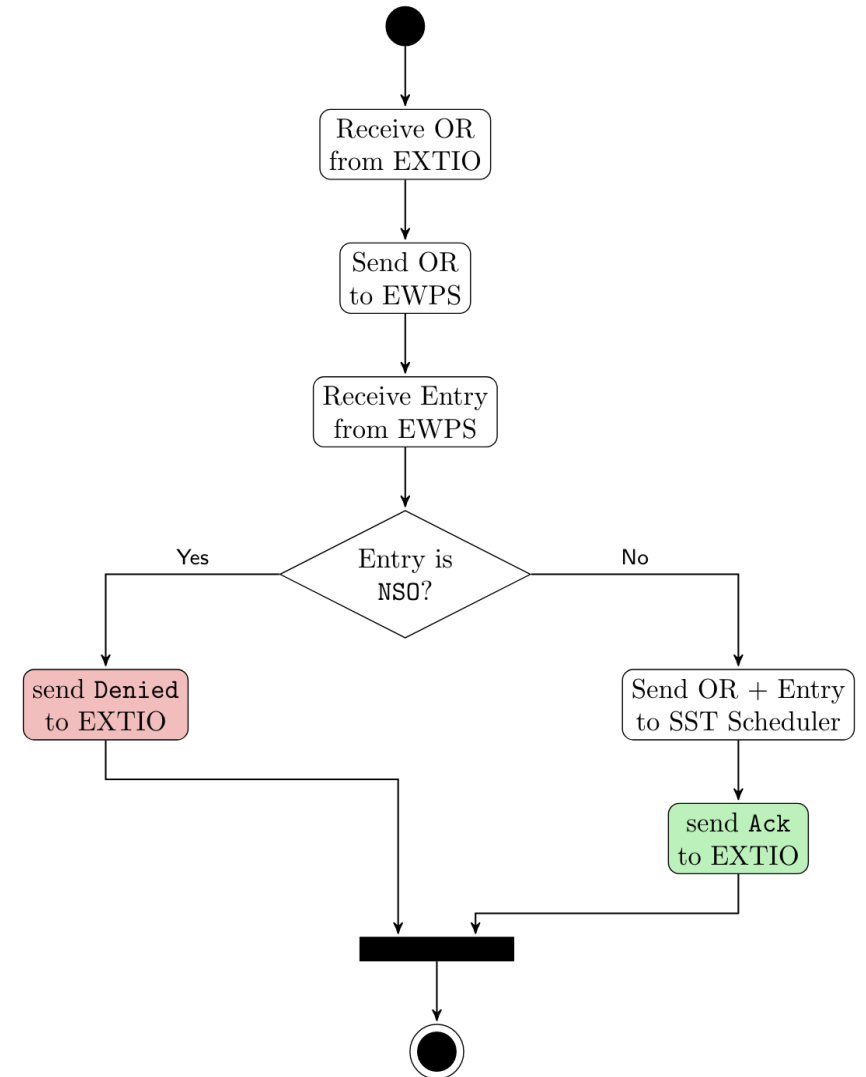 - Sent to SST scheduler for follow-up observations

In principle that's it, we're done!

Filtering of Observation Requests

- An Observation Request (OR) contains:
  - Global unique ID (catalogue name) [optional]
  - Requestor's most fresh orbit information [optional]
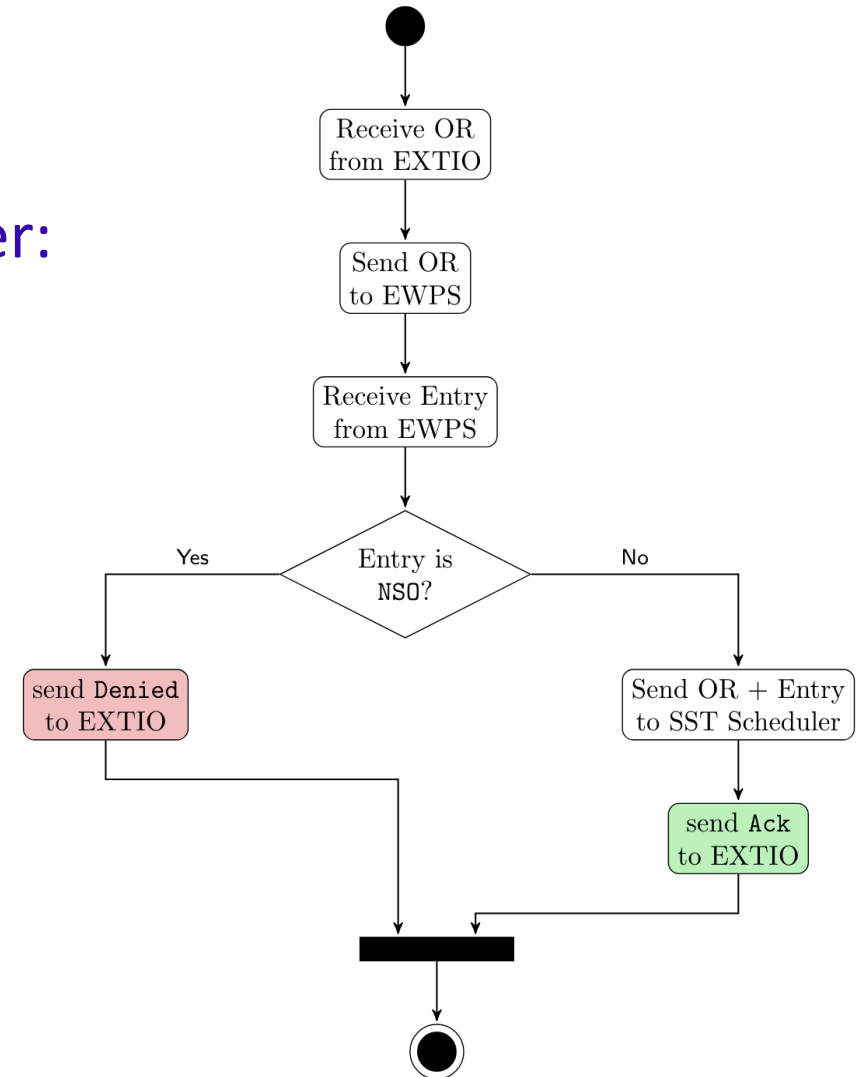 - both cannot be empty

Filtering of Observation Requests

OR sent to Whitelisting Service, Response is either:

- NSO [No Such Object], or

- a message in two parts

  - Global Unique ID (catalogue name), and

  - Most up-to-date orbit information for object.

Filtering of Observation Requests

- If Response was NSO:
  - "Denied" sent towards requestor
- If Response was not NSO:
  - a message composed of Response and OR is sent to the SORTS Scheduler for internal scheduling and eventual presentation to the EISCAT Scheduler
  - "Ack" sent towards requestor
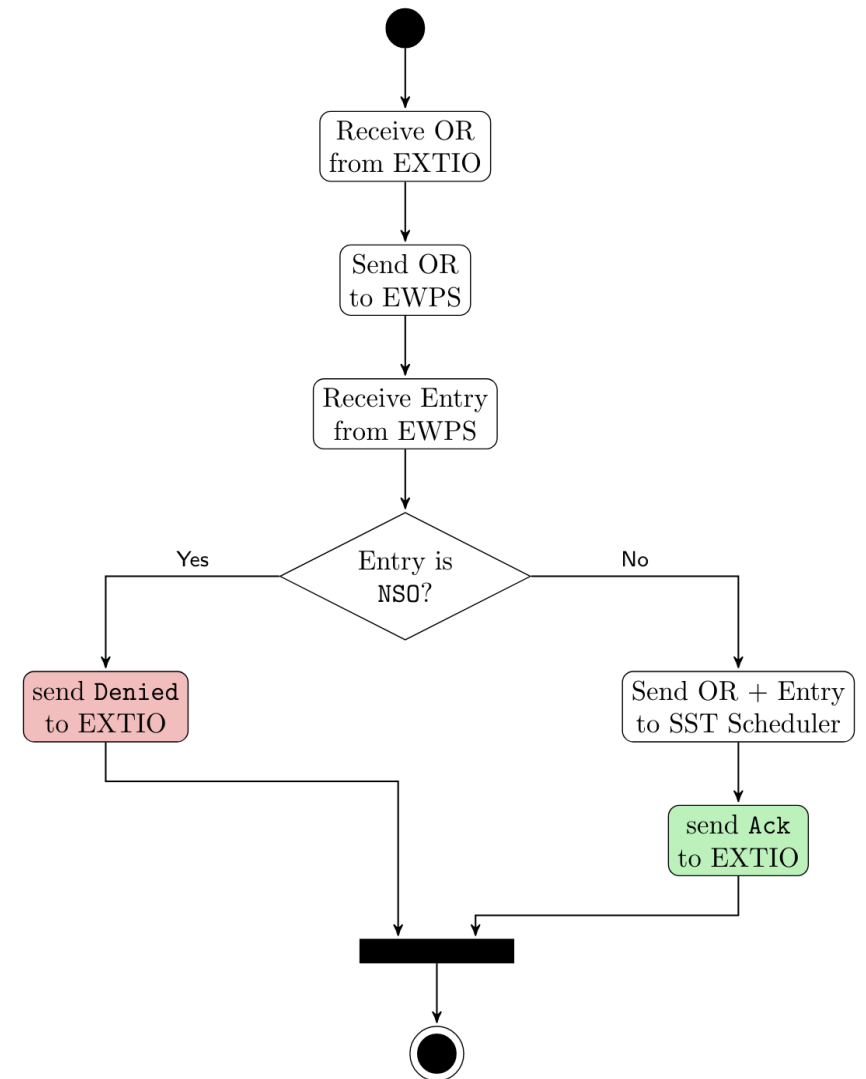
Whitelisting Catalogue Service:
Currently planned behaviour:

- Service internal data:
  - (Fresh) catalogue with orbit information on publicly known objects
  - Whitelist of unique object IDs for allowed objects (subset of catalogue)
- If incoming request contains object ID:
  - If ID is not on whitelist:
    - Response is NSO
  - If request contains no orbit information:
    - Reponse is catalogue entry

Whitelisting Catalogue Service:
Currently planned behaviour:

- If incoming requests contain orbit information:
  - Correlate against catalogued objects
  - If no objects correlated:
    - Response is NSO
  - If no object ID was provided by requestor and found ID is on whitelist:
    - Response is catalogue entry*
  - If found ID agrees with provided ID:
    - Response is catalogue entry
    - Otherwise, response is NSO**

Benefits of the approach:

- Security preserved at all times

- Minimal exposure of potentially sensitive data

- Convenience for EISCAT:
  - no need to inspect every pointing direction of every experiment
  - policy or whitelist can be updated at any time
  - Separate catalogue and whitelist makes adding or removing objects easy

- Convenience for Users:
  - ask for anything and not worry about violating policy
  - ask for all objects of interest and let SORTS schedule