LOFAR Use Cases - DAC21

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LOFAR Central Core
(Super Terp)
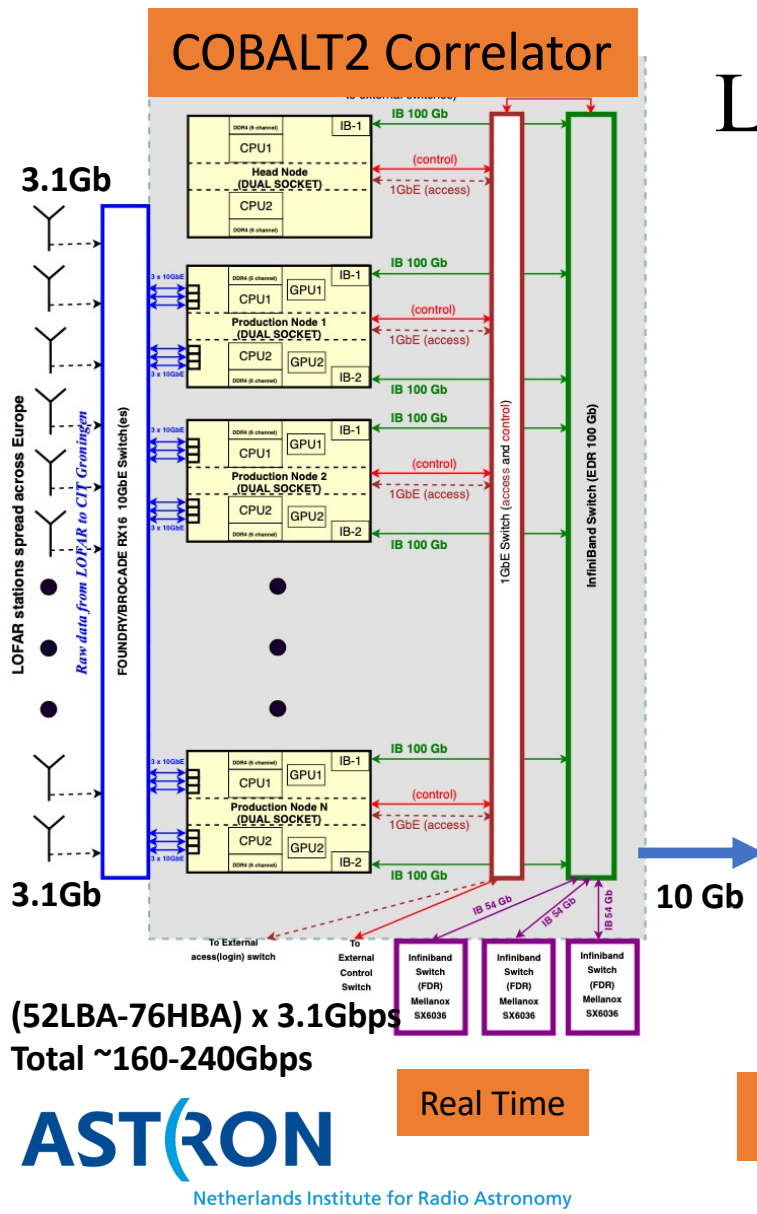
Low Band Antennae
(10-90 MHz)

High Band Antennae
(110-240MHz)

LOFAR in one slide

From the first stars to lightning on earth, and anything in between (10-240MHz)

LOFAR - Workflow

COBALT2 Correlator

3.1Gb

3.1Gb

(52LBA-76HBA) x 3.1Gbps
Total ~160-240Gbps

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Real Time

10 Gb

Central Processing Cluster

Offline – Near Real Time

Total ~ 50PB
expected ~ 4-7PB/year

20 Gb

SURF

JÜLICH
Forschungszentrum

PSNC

LOFAR – Long Term Archive (LTA)

Apertif Archive (iRODS)

Looking into near future

Low-Band Antennas
10-90 MHz

LOFAR Upgrade (Planned):-

- LOFAR Mega Mode (multiple overlapping science cases in parallel) (<30% data increase)
- DUPPLO (Both LBA & HBA Observations in parallel) (<50% data increase)
- LOFAR2.0 (more stations & upgrade) (increase depends on plan but <<50% increase)
- Except occasional cases 20Gb is acceptable.

![ASTRON logo] **AST**(**R**)**ON**
Netherlands Institute for Radio Astronomy

High-Band Antennas
110-240 MHz
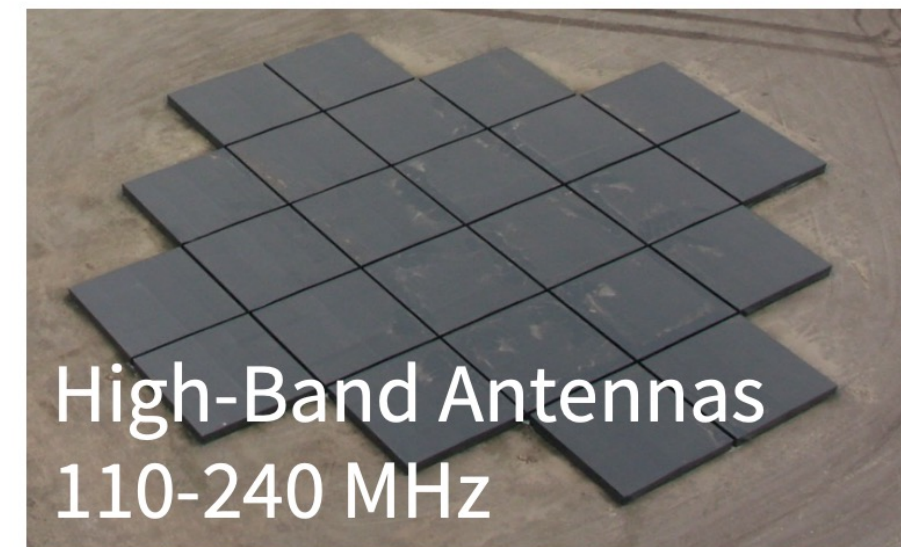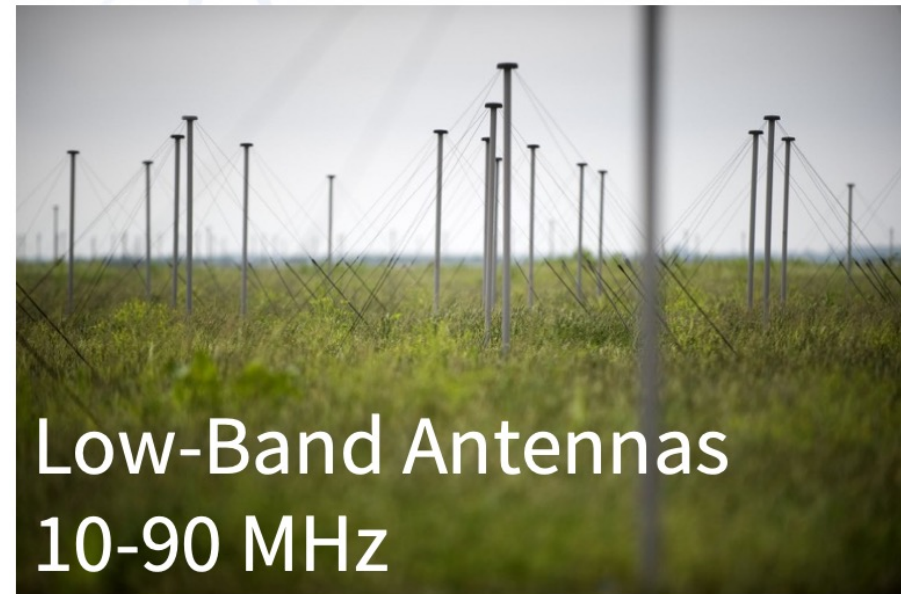
Use case 1: Datalake as LTA

- Ingest data from a two nodes representing our processing cluster into the datalake ("LTA")
  - Typically we have 20Gbit/s data streams right now so 2 nodes with 10Gbit interfaces attempt to model that
  - 1 Targets, 2 calibrators
  - Typically 6-8 hr observations, so the tests also takes similar time.
- Manual transfer to a non-deterministic RSE.
  - Ideally this would be the storage of the Central Processing.
  - But maybe we want to upload it manually (for operational reasons) but then we may want to use tooling optimised for our data

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Use case 1: Datalake as LTA (QOS)

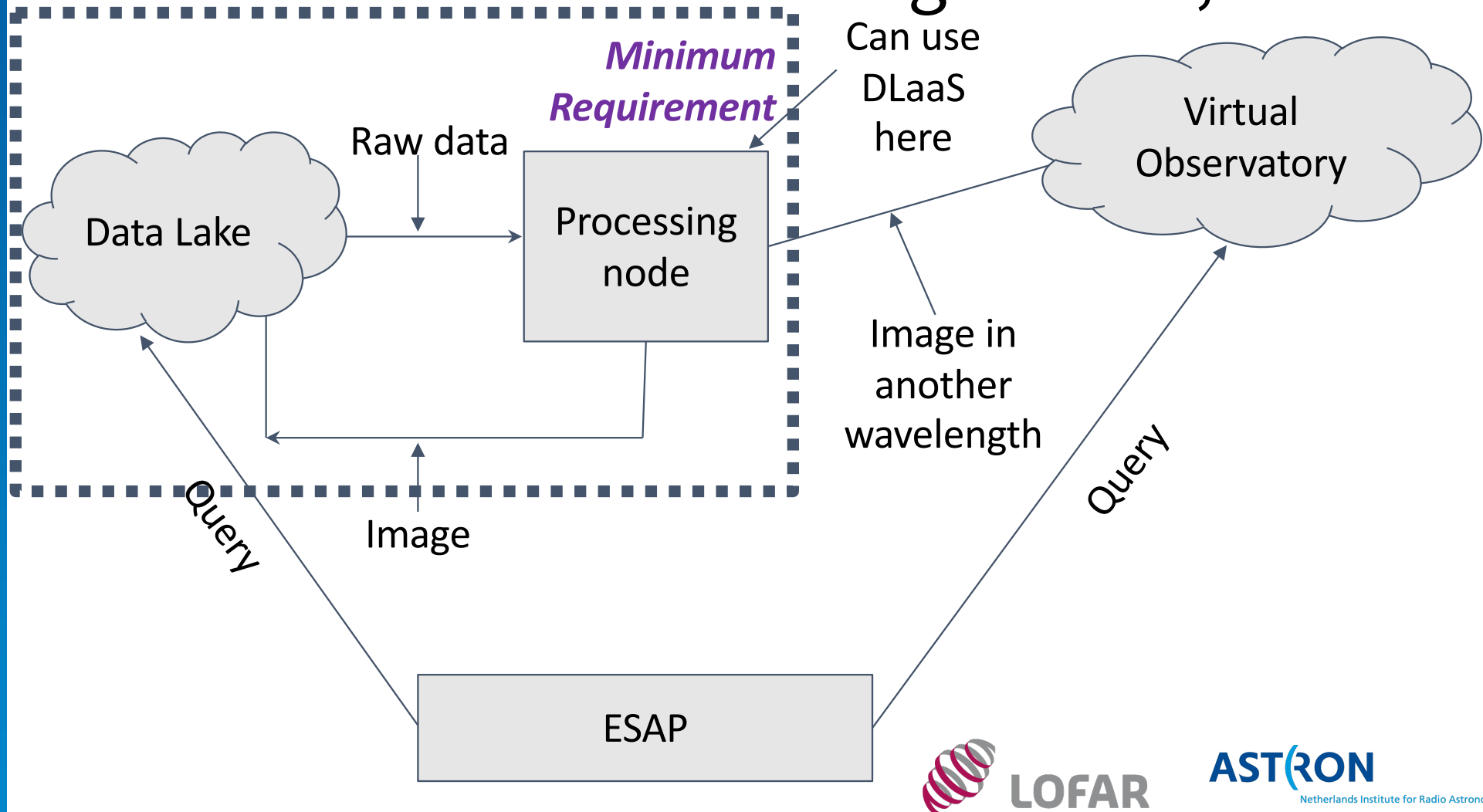| Stage	QoS level	Comment
Upload	Fast (non-det RSE)	Upload is to a non-deterministic RSE. Storage that needs to be able to support 10Gbps ingest (or more)
First day after upload	Fast + Cheap	In normal circumstances this would be a week, but for DAC21 we keep it to a day. Keep data on fast storage to give the user the chance to get to the data. NB: This Fast can be a different one from the upload one, as long as the user can get the data from there.
Second day after upload ("forever")	Cheap	Data can be on a cheap QoS for the rest of its lifetime. For processing (Use Case 2) there will be a step putting it back to a Fast QoS for downloading/direct data access.

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Use case 1: To do

- Non-deterministic RSE for upload (need to follow up on this*)

- Prepare data (One observation already there and another to be selected)

- Prepare two nodes of upload (one is ready, other one is being requested)

- Data Volume: (~15-20 TB); we will monitor progress and success measures will be defined.

- Typically 15TB of data in 480 files (~60G per file for target, 2GB per file cal).

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Use case 2: Data Processing & ESAP,DLaaS

Minimum Requirement

Can use DLaaS here

Raw data

Data Lake

Processing node

Virtual Observatory

Image in another wavelength

Query

Image

Query

ESAP

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Use case 2:

- Use data that is on the data lake to make an image, and combine it with the image of another wavelength to create a multiwavelength image (optional).
  - For an image we need a **target** and a **calibrator** observation that each consist of many (244) **sub bands** (i.e. frequency band data).
    - Want to create one **dataset** for the **target** and one for the **calibrator**
    - Create a **container** (the 'processing package') with both the **target** and **calibrator** dataset.
    - Maybe for demonstration purpose, create another **dataset** with the currently present **target** and the same **calibrator** as before to show that a **dataset** can be in multiple containers.
    - We will use one of our custom build pipelines (Prefactor or Raphtor) and perhaps pre-calibrated data set to save processing time.
    - Some of the data to be used may not be public but the resulting image will be public.

Use case 2: (QoS)

Stage	QoS level	Comment
Staging	Fast + Cheap	Fast QoS is the place where users will access the data.
First day after staging	Fast + Cheap	In normal circumstances this would be a week, but for DAC21 we keep it to a day. Keep data on fast storage to give the user the chance to get to the data.
Second day after staging ("forever")	Cheap	Basically back to the normal long-term stage

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Use case 2: To do

- Data on the data lake to be processed/imaged.
- Get a DLaasS notebook with LOFAR software (in a singularity container).
- We will monitor progress and success measures will be defined.

- DLaaS notebook with LOFAR software stack

- DLaaS that can read the ESAP shopping basket
  - "poor man's solution is copy-pasting, and this is already there.

- Find a good-looking (extended) source (nice image)

- Data Volume (~2-3 TB)

Use case 3: Legacy Archive Import

Data Lake

(Read-only) (Read-only) (Read-only)
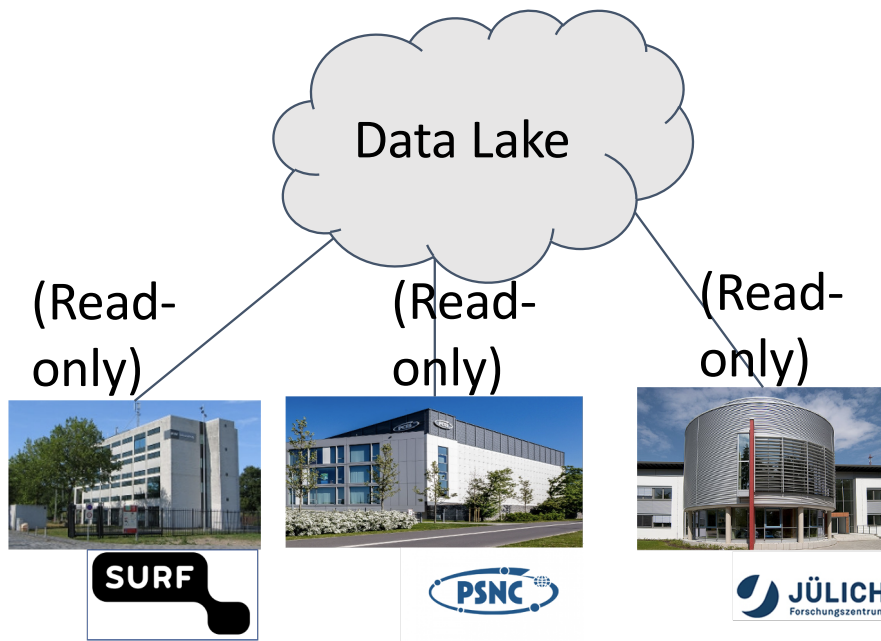
The current LTA

For DAC21 one location is of course enough. Proposal to use SURF

Use case 3: To do

- Need to discuss with AAI experts whether cross-VO transfers are realistic.

- Else we need to set up a special RSE

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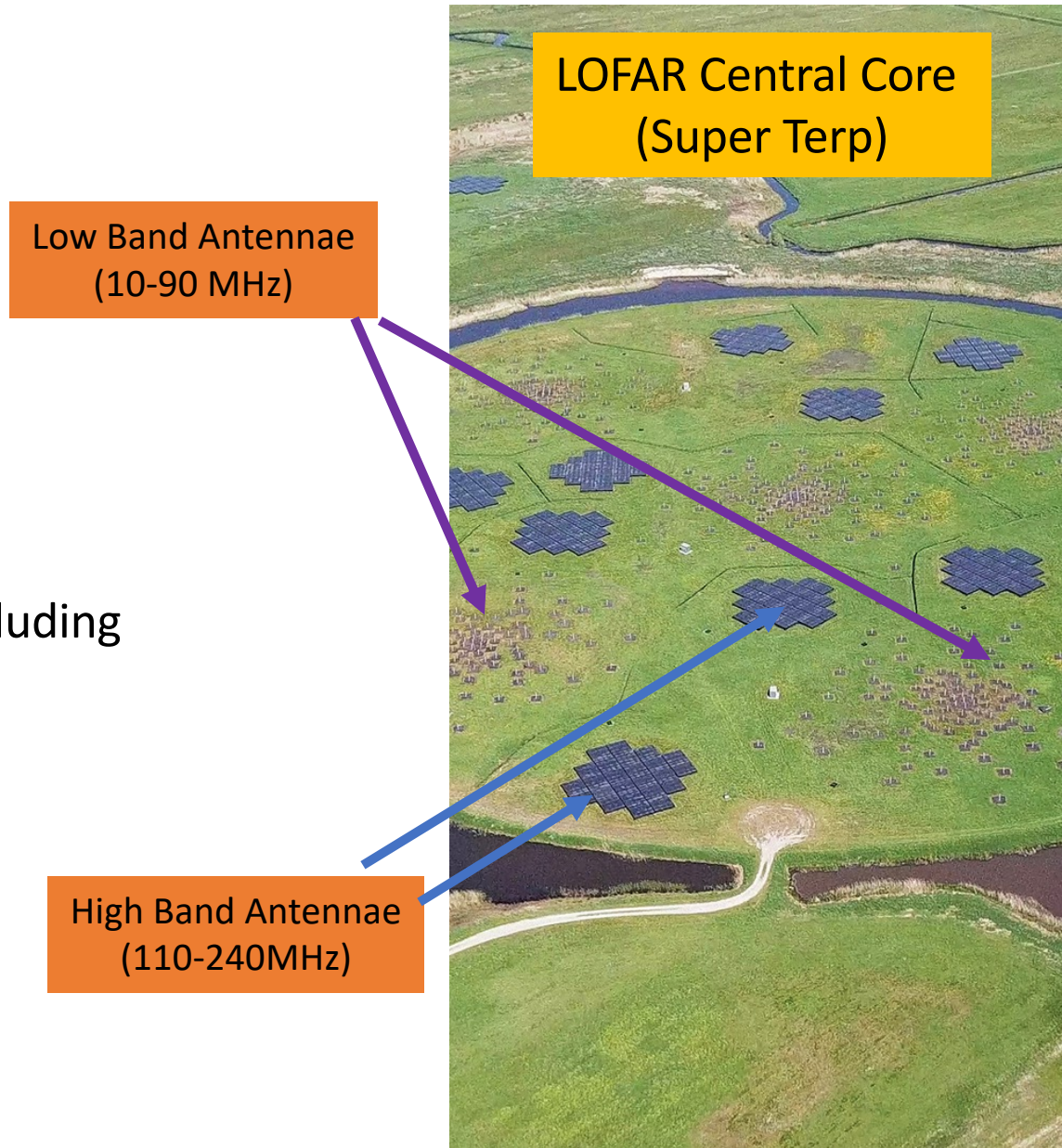
Use case 3: To do

- In a transition phase, one would like to include current archives in the Data Lake
  - Complication of integration of an existing LTA end point in the ESCAPE Rucio:
    - Multi-VO support (with VO-crossing data streams… Simple translation `lofar:/lofar/user` => `escape:/lofar` is probably enough).
  - Keep it read only (though lofar:/lofar/user is read-only anyway)
  - 'legacy' LTA initially only contains unregistered data. Not sure what the best approach here is (register all that's there, only register that what users request, …)

- If the multi-VO is too complex, we can assume in the future the LOFAR Rucio will probably run in the same VO as the LTA so we could create a special RSE which simulates the LTA.

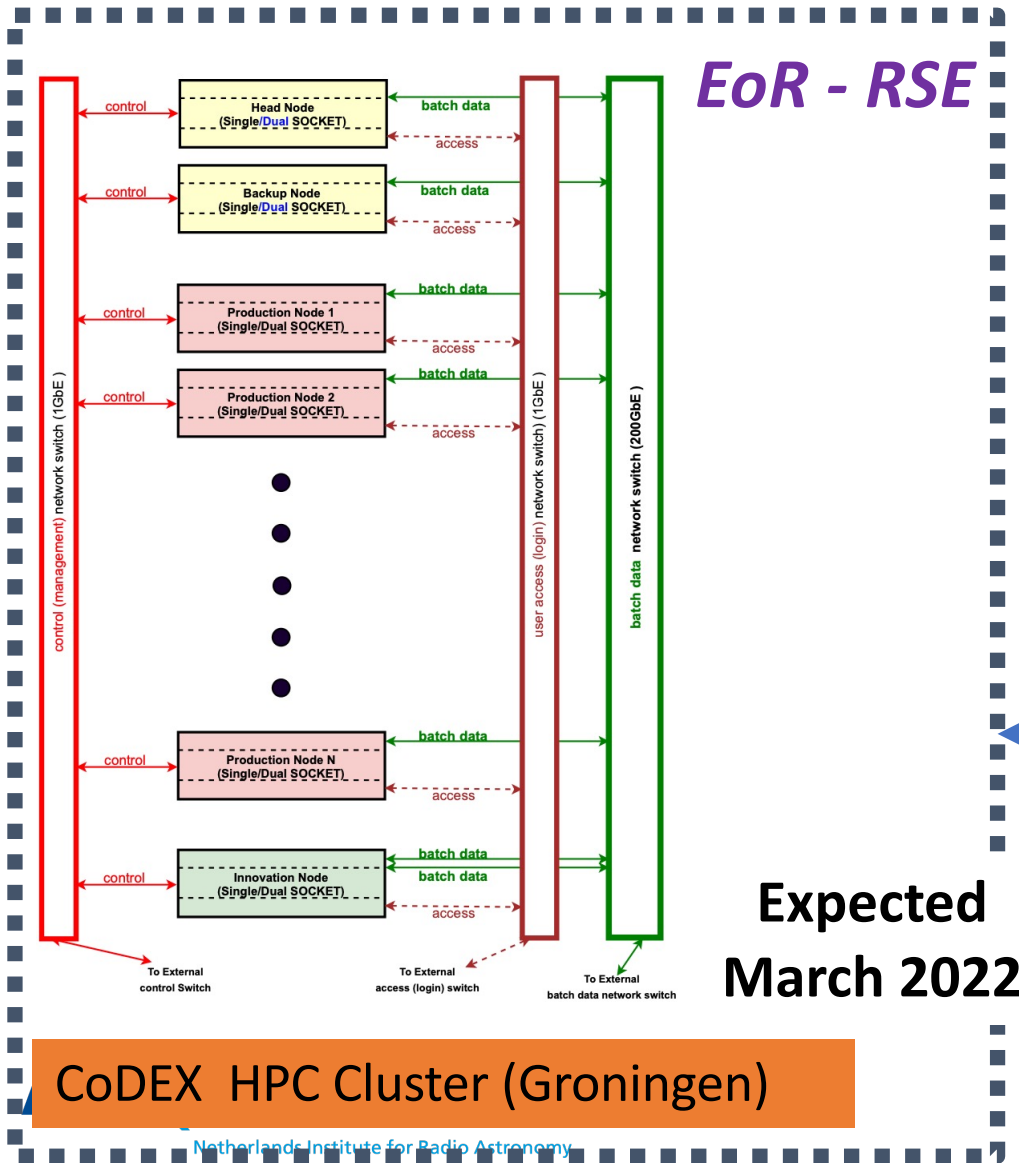- This may be considered a 'special QoS' level, but haven't thought this through…

Plans (Dates):-

- Nov 2-5 (Preparation)

- Nov 9-12 – Mock tests

- Nov 22-26 – DAC21

- 2022 – CoDEX node as RSE (local) including

  EoR Data

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LOFAR Central Core (Super Terp)

Low Band Antennae (10-90 MHz)

High Band Antennae (110-240MHz)

EoR - RSE

EOR Data Lake

Head Node (Single/Dual SOCKET)

Backup Node (Single/Dual SOCKET)

Production Node 1 (Single/Dual SOCKET)

Production Node 2 (Single/Dual SOCKET)

Production Node N (Single/Dual SOCKET)

Innovation Node (Single/Dual SOCKET)

control

batch data

access

control (management) network switch (1GbE)

user access (login) network switch (1GbE)

batch data network switch (200GbE)

To External control Switch

To External access (login) switch

To External batch data network switch

Expected March 2022

EOR – Project Archive (3PB) Dwingeloo

10 Gb

60Kms

CoDEX HPC Cluster (Groningen)

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Thank You