

Development and Evolution of the LOFAR 2.0 Science Programme

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LOFAR ERIC

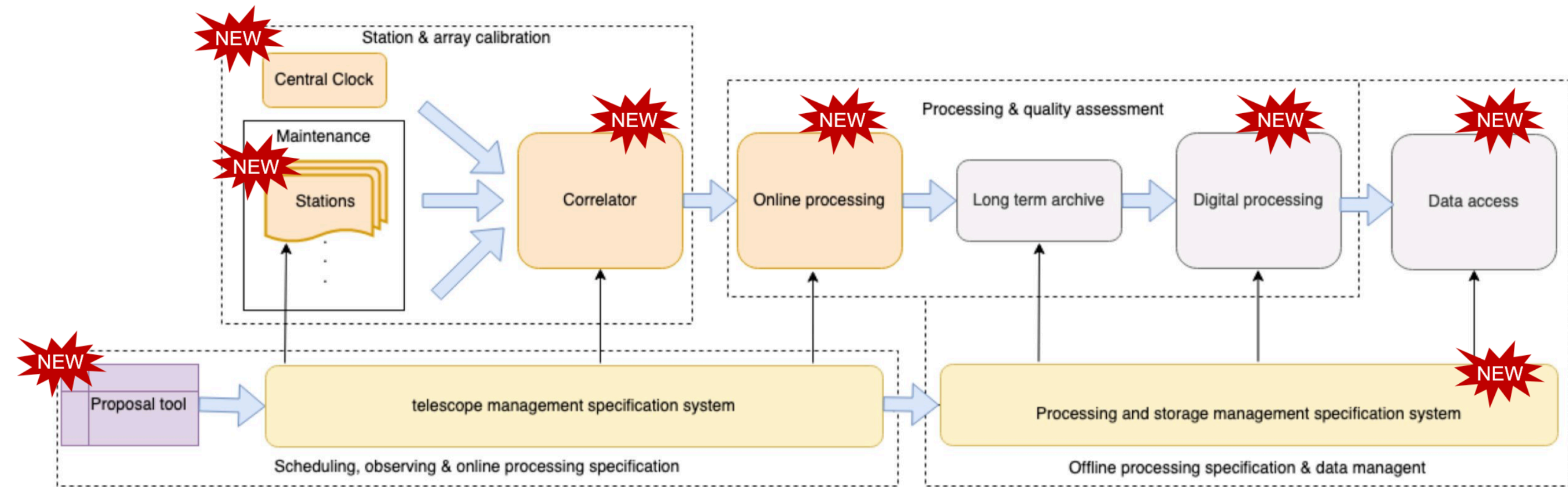
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LOFAR Family Meeting - Observatory Session - 23 September 2025

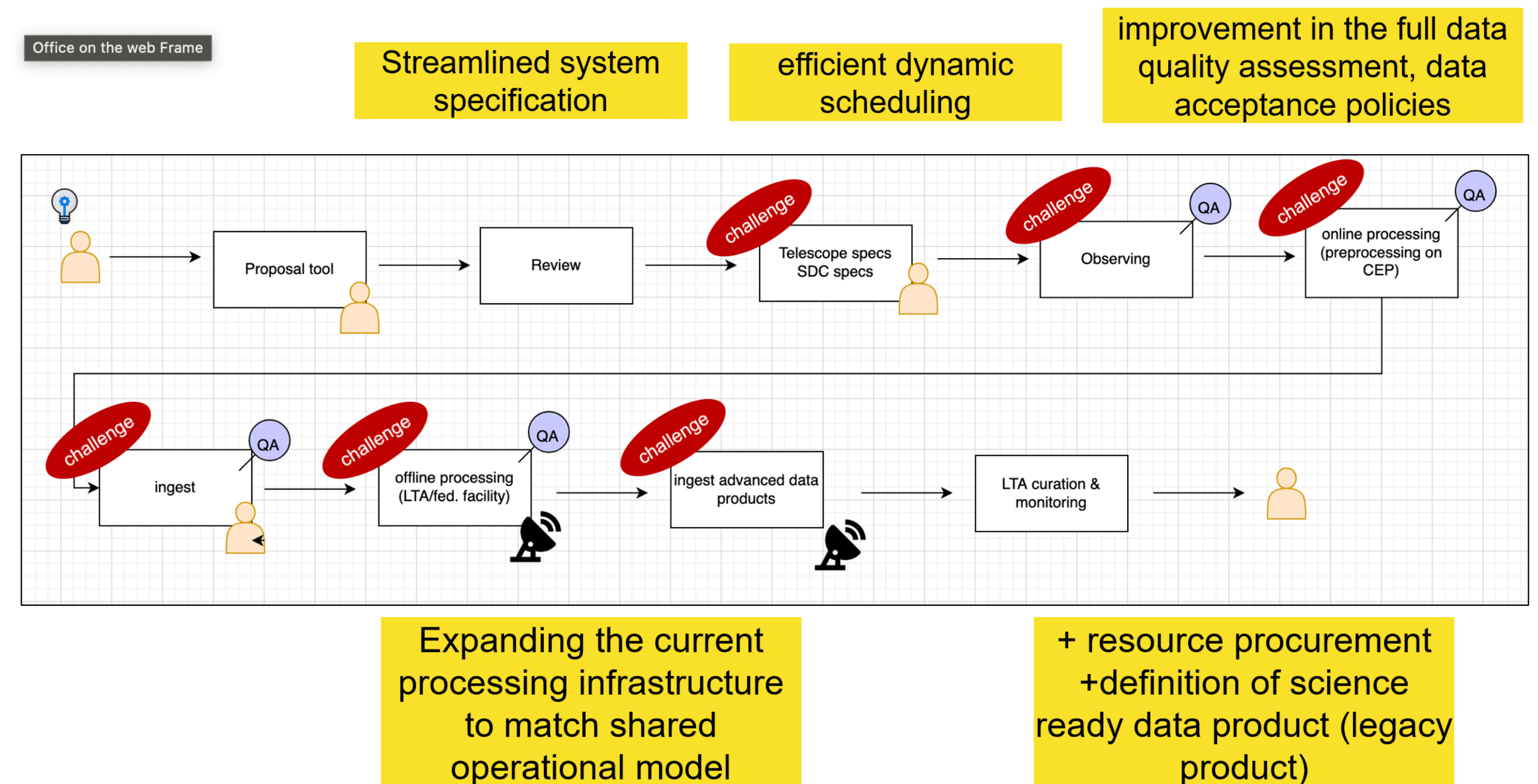


LOFAR 2.0 Challenges

- System & subsystem overview
- many new or revised subsystems



- Significant changes to the LOFAR 2.0 data handling workflow bring challenges
- Conclusion: LOFAR 2.0 is essentially a new observatory



LOFAR 2.0 Large Programmes



- 5-year programme (nominally 2026-2030)
 - 1 commissioning year + 4 years of operations
 - Major part of net observing time (about 17,500-20,000 hours) devoted to Large Programme Portfolio
 - Smaller, PI-led projects of more limited scope will run in parallel in later years.
- Resources will be limited - e.g. processing of “raw” data within 1-2 year time window
- Not all functionality will be available at once - development of certain capabilities will take longer
 - Therefore not all Large Programmes can start once LOFAR 2.0 roll-out is complete
- Staged approach with initial allocations with later adjustments
- Deadline: 12 October 2023
 - 15 proposals received - **oversubscription 2.4-2.7x**
 - Priority Ranking of Proposals completed by PC in April 2025

Challenge: how to connect L2LP evaluation and allocation with LOFAR2.0 development and roll-out timeline

LOFAR 2.0 Large Programme Call - Procedural Steps



1. Technical review by SDC Operations - completed
2. Priority ranking by Program Committee - completed
3. Priority ranking shared with the PIs and with development and commissioning teams - completed
4. Both development and commissioning teams take the ranking of the proposals into account in the development and commissioning plans - ongoing (2025 & 2026)
5. Verification review for every Large Programme to assess viability and availability of required resources (storage/compute/telescope time)
6. Final recommendation of telescope time (and other resources) by PC
7. Recommendation of L2LP Portfolio by LOFAR ERIC Director to Council (based on PC recommendation and Member Consultation)
8. Approval by Council
9. Observing - starting




Review Process as outlined in LOFAR 2.0 Large Programme Call



Review by experts who will consider:

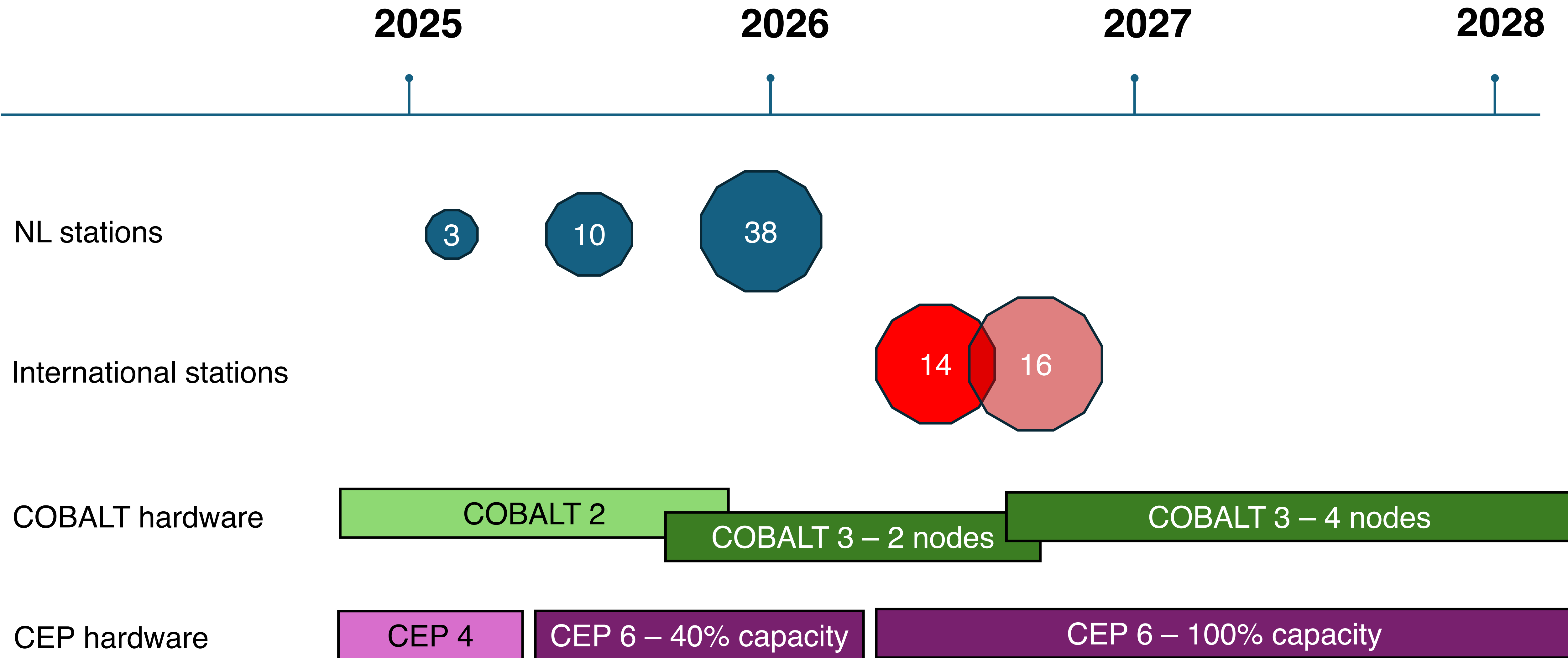
- Scientific merit and impact
- Feasibility of observing and processing
- Strength and inclusiveness of the proposing team
- Plans for publication & dissemination of results
 - including distilled data products with value to a broader community
- **Review will lead to Advice to ILT Board (now LOFAR ERIC Council)**
- **Council will establish Large Programme Portfolio based on**
 - Scientific Excellence
 - Feasibility and timeliness
 - other considerations
 - the overall breadth, legacy value, and productivity of LOFAR,
 - specific relevance for partner country research communities, and
 - general impact and engagement of the wider community,
 - within the available and affordable resource constraints.

Establishing the L2LP Portfolio

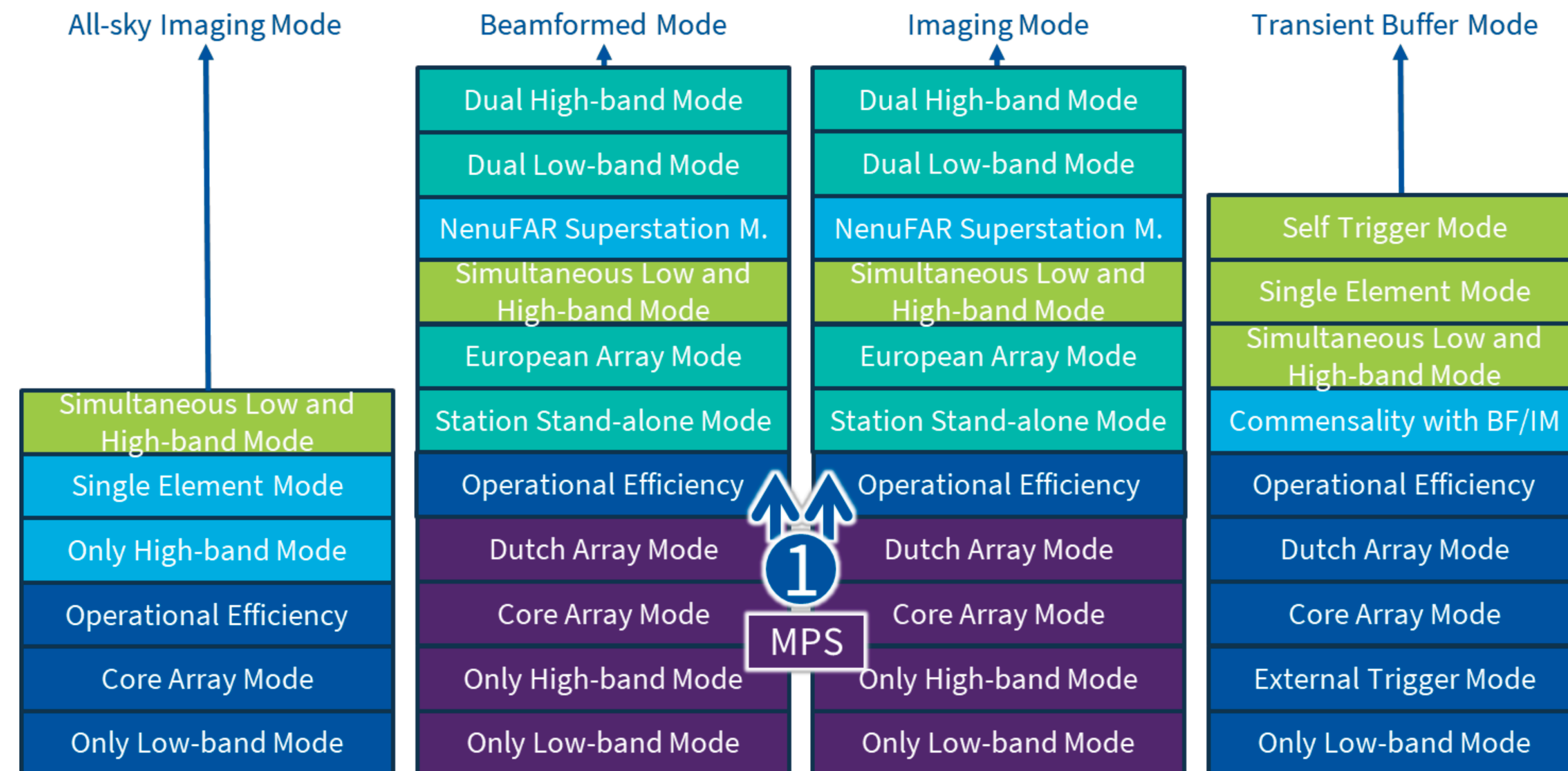
- None of the proposals has been rejected
- but... ranking will play a role in the final allocations
- Specific advice to lower ranked proposals:
 - investigate targets that avoid highly oversubscribed LST range
 - investigate re-use of existing data, or data taken for other L2LP
 - consider open time calls - first one in ~2027 (t.b.c.)
- LOFAR ERIC Director will work with Observatory staff, Programme Committee and in consultation with Members to deliver to Council a well balanced L2LP Portfolio that meets these criteria outlined in the Call for Proposals.
- will take into consideration specific LOFAR 2.0 improvements
- Two models for processing LP data: 1) centralised and 2) federated - **see John Swinbank's talk presented by Roberto Pizzo for details.**

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LOFAR 2.0 Roll-Out Milestones



Development of LOFAR 2.0 Capability



Observatory Capabilities expected at the end of 2025/early 2026

- End-to-end operations
- Dutch stations only
- LBA or HBA observing
- BF mode for Pulsar Timing
- HBA-NL imaging
- Calibration
- HBA-NL pre-processing, LINC, Pulsar Timing and Rapthor (t.b.c.)
- Delivery of data products

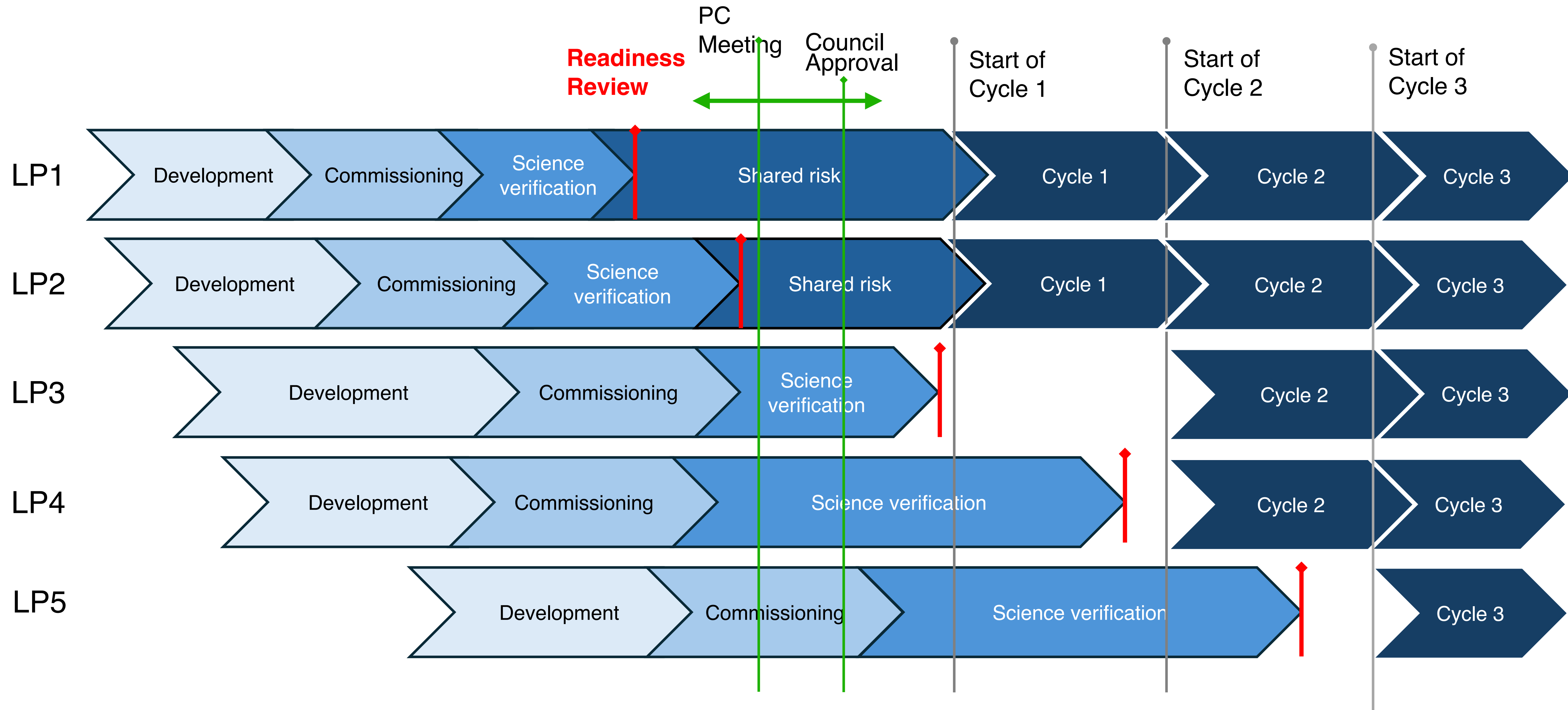
Operational Efficiency will be low - data delivery limited to Science Verification

Capability to be developed in stages:

- Minimum Production System (MPS) available in Q1 2026
- Additional capability development is (ASTRON) resource limited
- STC has advised on prioritisation of post-MPS development
- Development of full suite of modes will run into 2027-2028
 - This will impact the start of individual Large Programmes and the overall LOFAR 2 Large Programme

Implications of Delayed Delivery of Certain Observing Modes

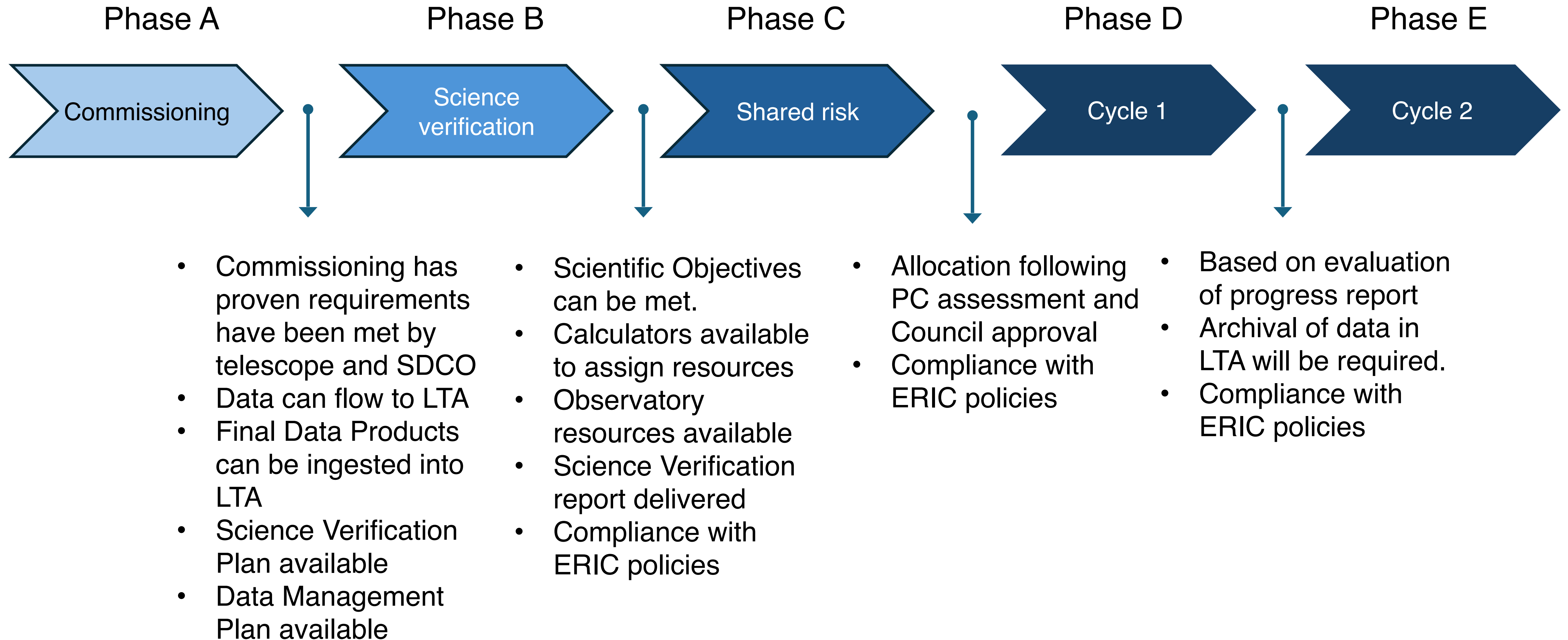
Schematic Overview of Phases, Reviews and Decisions



Definitions of Phases

- **Commissioning:** verifying instrument capabilities to enable science (by the Observatory) up to the point of delivering data to the programme and ingest of data produced by programme into Long Term Archive (i.e. it will include processing of at least a single observation by programmes that execute processing themselves).
Proprietary Period: NO Publications allowed: LOFAR 2 Paper; Further publications t.b.d.
- **Science Verification:** verify that the L2LP (PI) can execute their science at sufficient scale/time - it includes establishing the information for calculation for resources - for this they will be provided with a (small) set of representative data.
Proprietary Period: NO (t.b.c.) Publications allowed: YES (t.b.c.)
- **Shared Risk - First science**
 - Programmes to provide further intensive feedback on what works and not. What resources they need/use. Etc.
 - Programme risk: quality and amount of data delivered
 - Observatory risk: no (timely) delivery of final/science products/outputs by programmes.
 - Observatory can decide on shared risk 'allocation'; resources (Observing Time and Compute/Storage used will be subtracted from the programme allocation as advised by the PC and confirmed by Council.Proprietary Period: YES Publications allowed: YES
- **Science Production** - Observatory able to reliably deliver data and programmes ready to process and deliver generated final data reliably to the archive.
Proprietary Period: YES Publications allowed: YES

Requirements for Transitions between Phases



Verification Reviews



- Planned to start in 2026
- Will assess readiness of:
 - LOFAR 2.0
 - Processing Pipelines
 - Resources required to carry out L2LP (people, storage, compute,...) - e.g. data management plan
 - Based on additional information for detailed scheduling
- L2LP Teams will be able to provide additional/updated information (including response to PC feedback provided in March 2025) ahead of the review.
- Review will not be carried out by PC, but experts familiar with LOFAR design and operations
- Verification reviews will precede next PC meeting (step 6)



Thank You