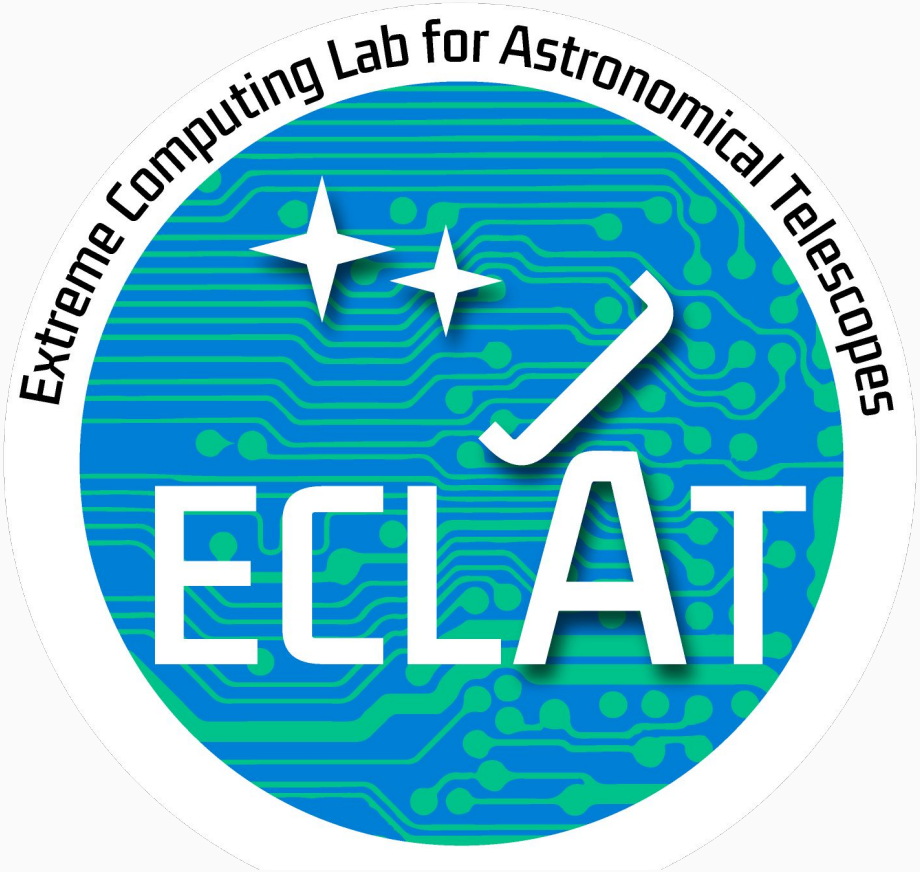
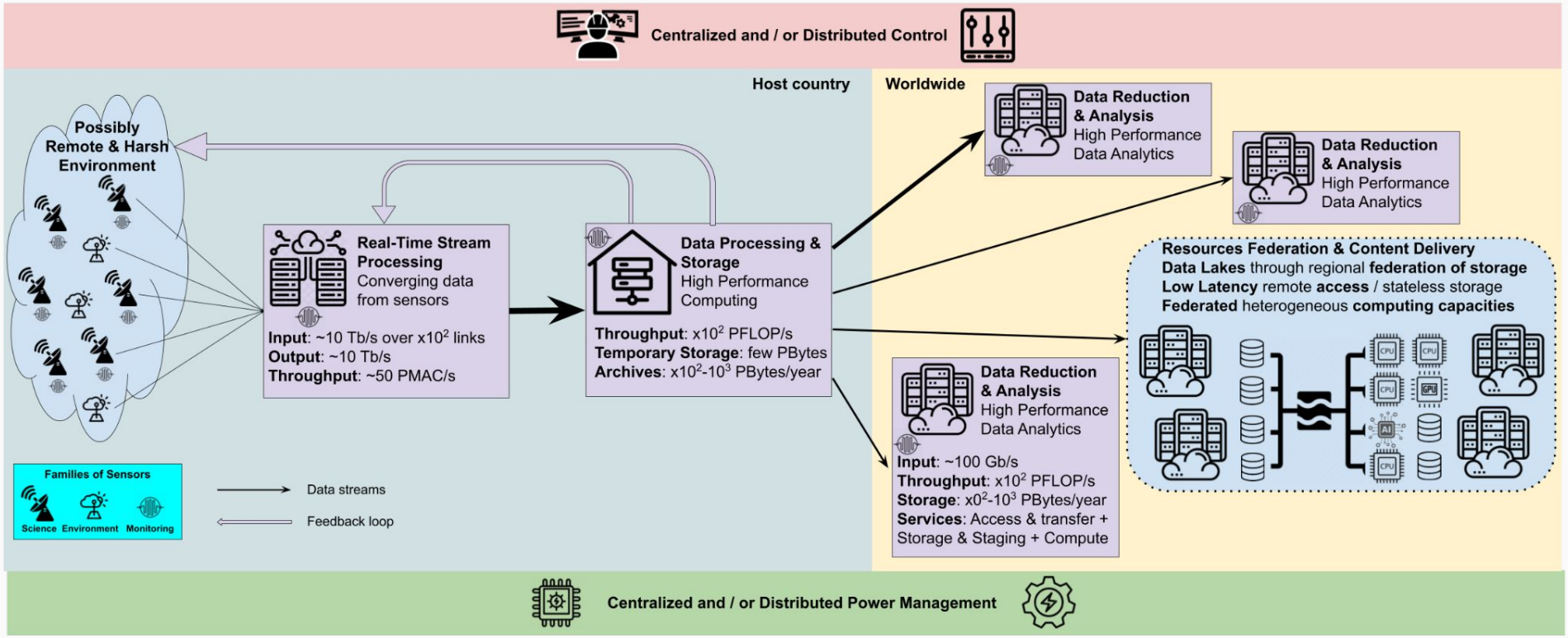


Joint Laboratory CNRS - Atos - INRIA

SKA COMPUTING CHALLENGES

Hierarchical architecture: system of systems

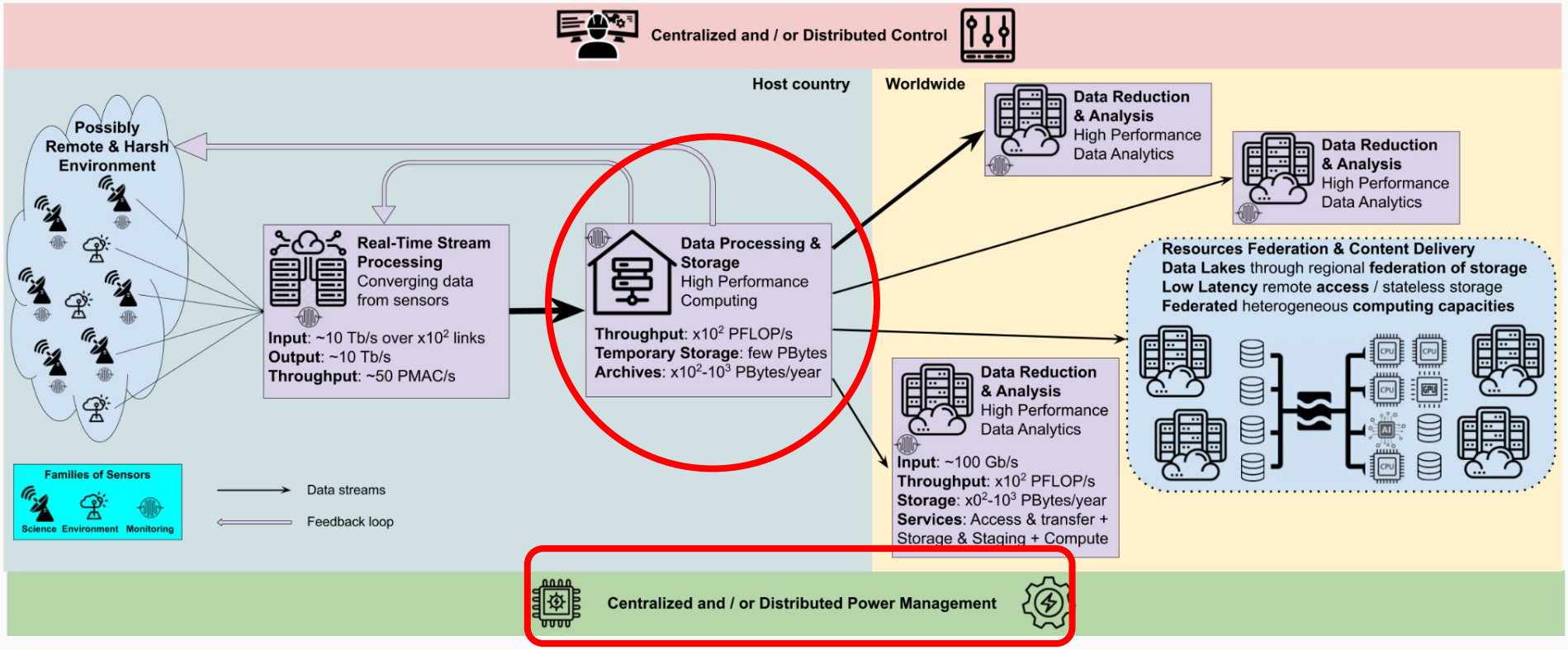
From large amount of distributed & heterogeneous sensors to distributed network of national processing facilities for content delivery to the users



SKA COMPUTING CHALLENGES

Contribution from France expected on Science Data Processor implementation

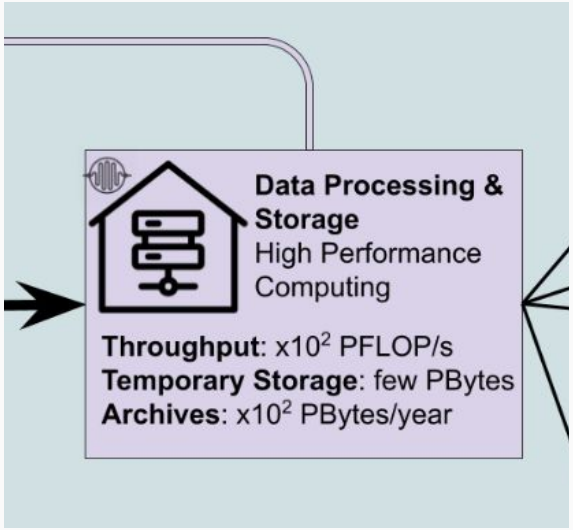
- State-of-the-art datacenter for processing, storage and distribution
- Focus on Energy Efficiency & Power Management



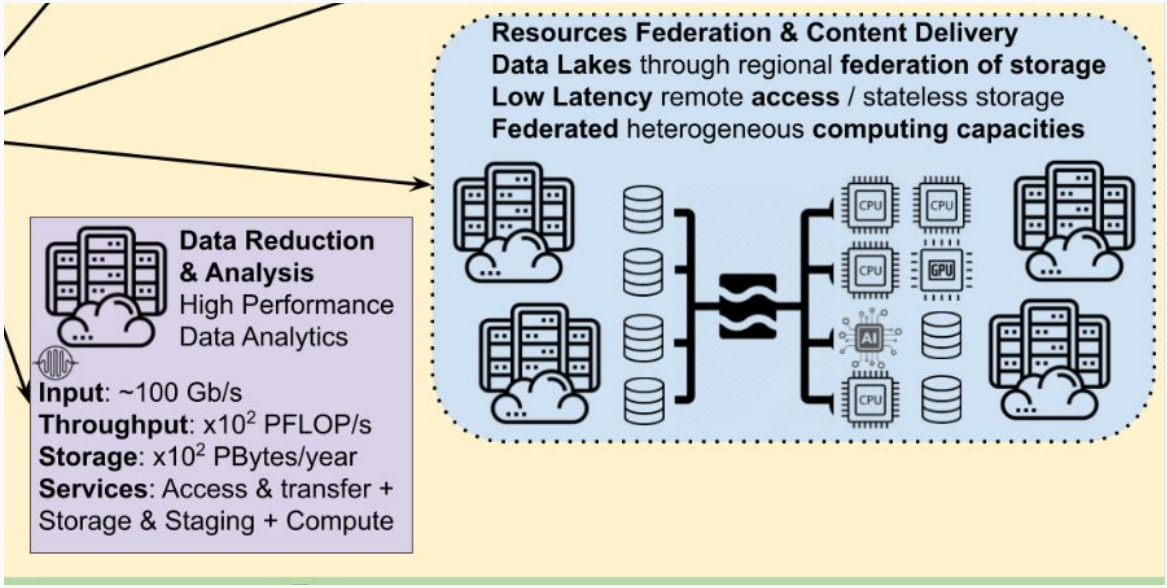
SKA COMPUTING CHALLENGES

Existing synergies with Regional Centers

- Heterogeneous high performance computing & data distribution



- Resources federation (compute / storage)
- Portability
- Distributed Learning for AI

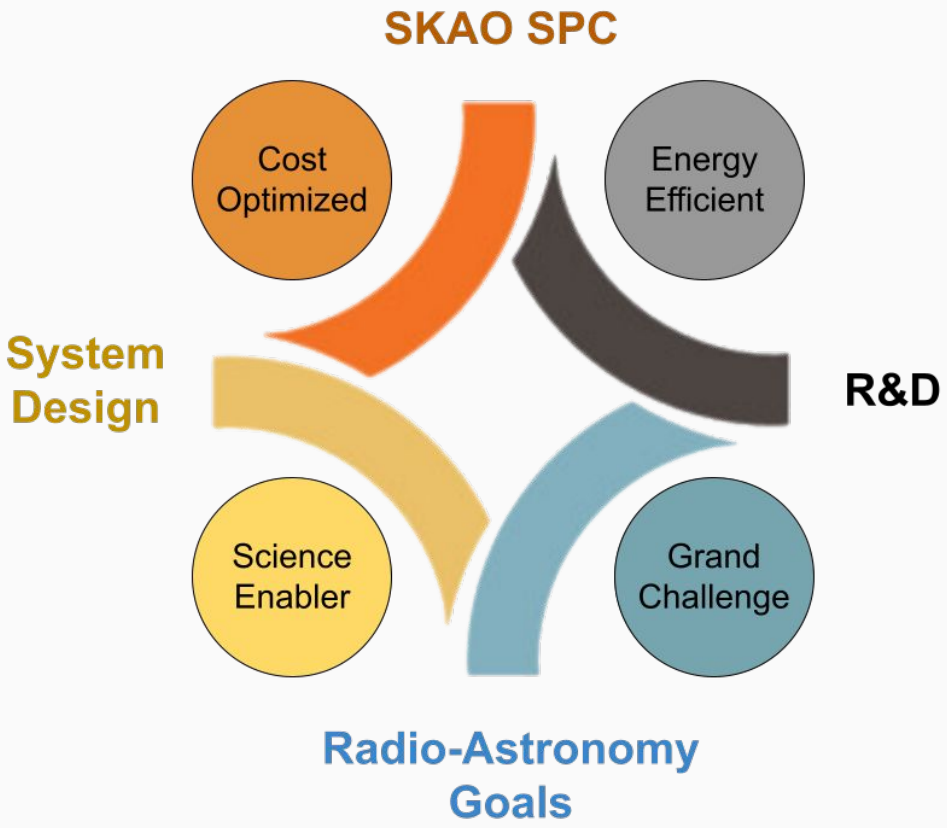


- Energy Efficiency
- Cost Containment
- Heterogeneity / Portability

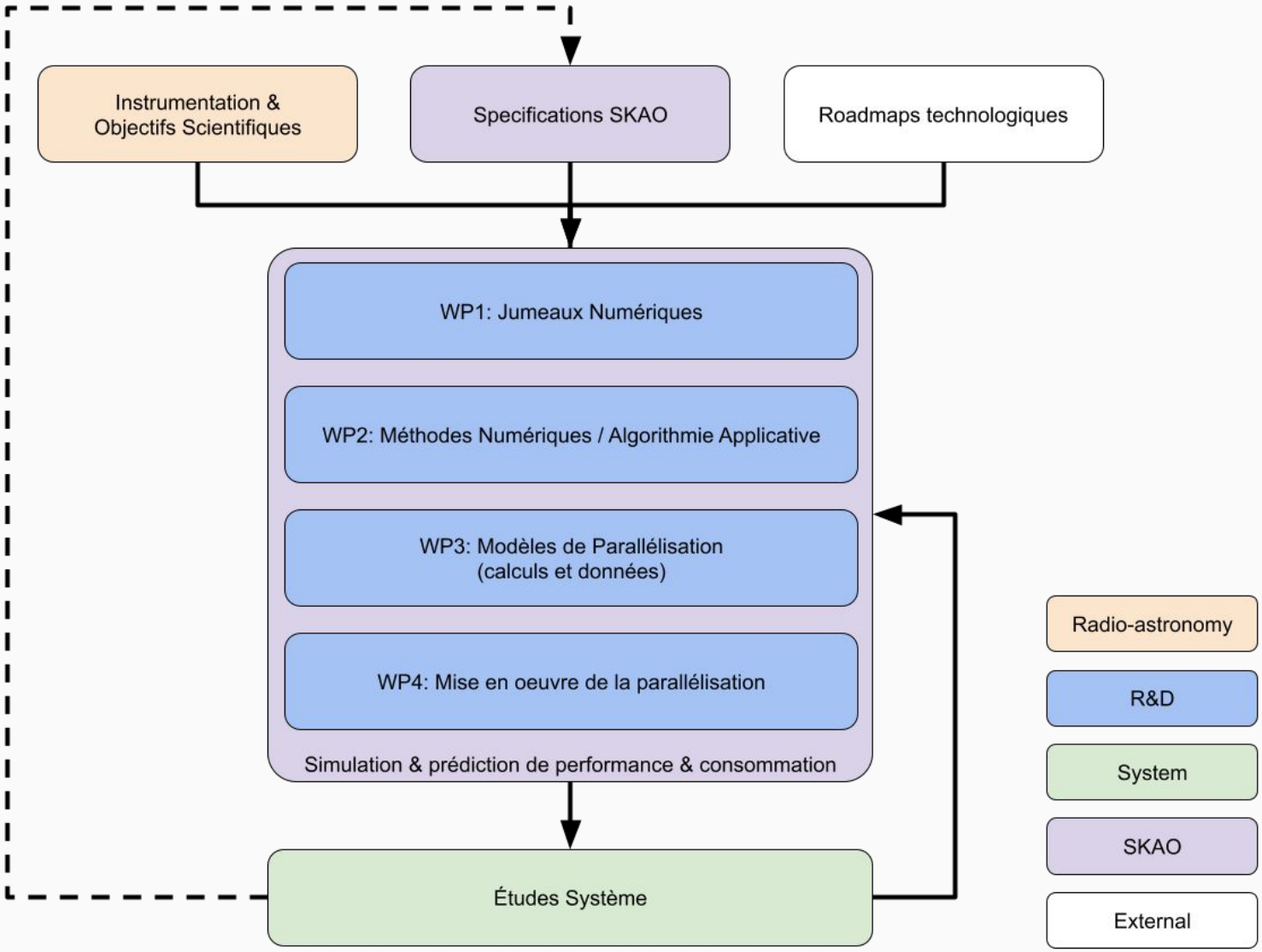
Co-Design of Science Processing Centers for SKA

Provide solutions for an extremely challenging sub-system under cost and energy efficiency constraints

- **4 main topics**
  - Radio-Astronomy goals
  - System Design
  - R&D
  - SKAO SPC
- **4 main drivers**
  - HPC Grand Challenges
  - Science Enabler
  - Cost Optimization
  - Energy Efficiency



Proposed Implementation



R&D Activities

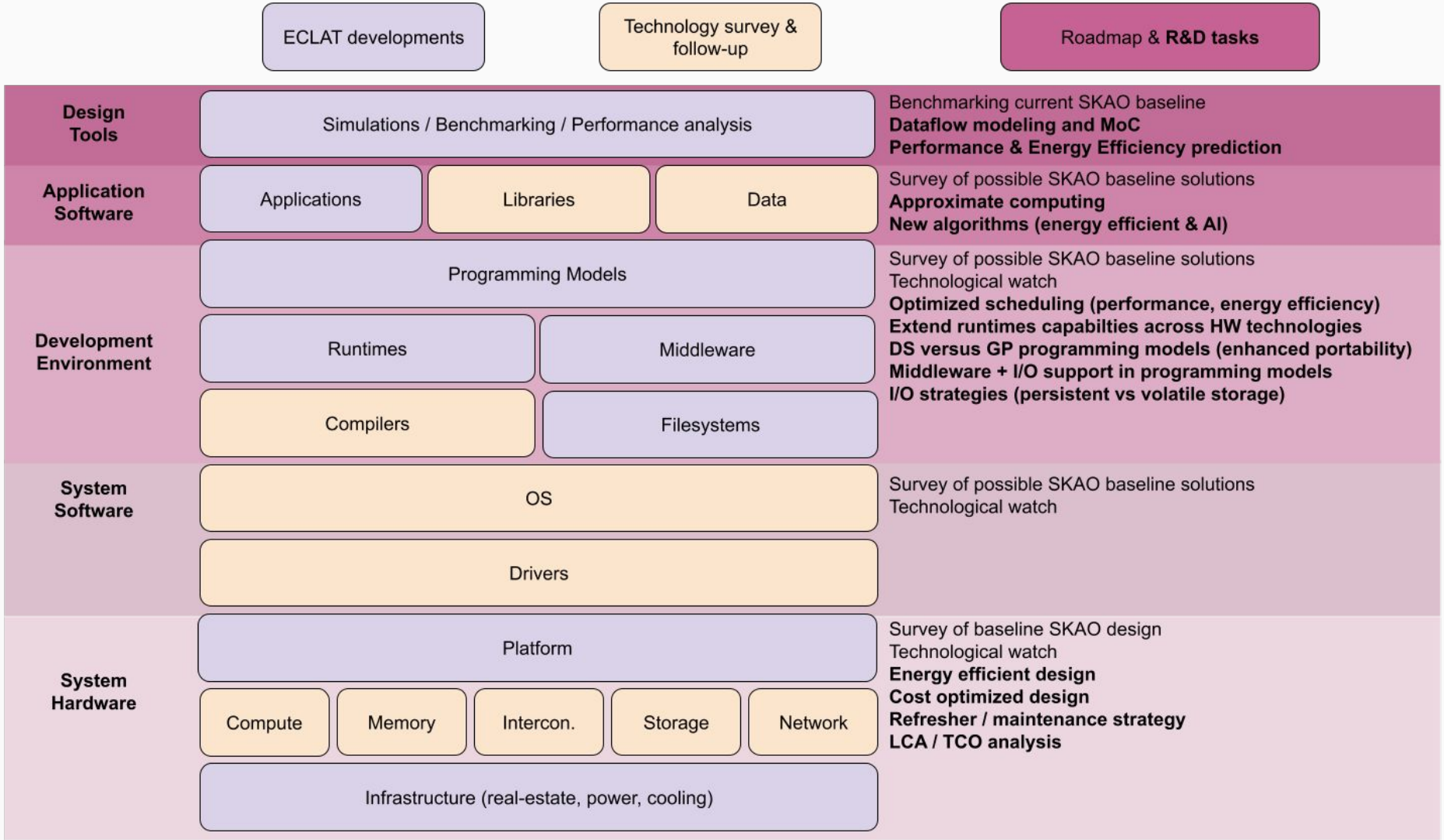
2 transversal topics

- **Artificial Intelligence**
  - New hardware solutions (wide spectrum from “specialized cores” to FPGA)
  - New algorithms (trustworthy AI, energy efficient AI)
  - Energy management of the whole infrastructure to minimize carbon footprint
  - Real-time performance
- **Green Computing**
  - Holistic view: from optimization at the node level to efficient distribution (data, workload) to a global view at the level of the whole infrastructure
  - Adapt power consumption dynamically depending on operating scenario
  - Use models of computing at the core of this strategy

5 main axes of development:

- System architecture
- I/O & interconnect
- Storage management
- Emerging compute technologies
- New algorithms & AI

R&D Activities



CONTRIBUTE TO SKAO SPC ROADMAP

Incorporate effort in current roadmap

- Benchmarking activities related to current baseline
- Rely on existing hardware / middleware / software solution
- Work on portability using various programming models options

Propose new approaches

- Hardware: emerging solutions with high enough TRL
- Software: new algorithms (better science), new programming models (portability)
- Middleware: enhanced scalability / energy efficiency
- Additional work on infrastructure + deployment strategy
- Couple with science drivers

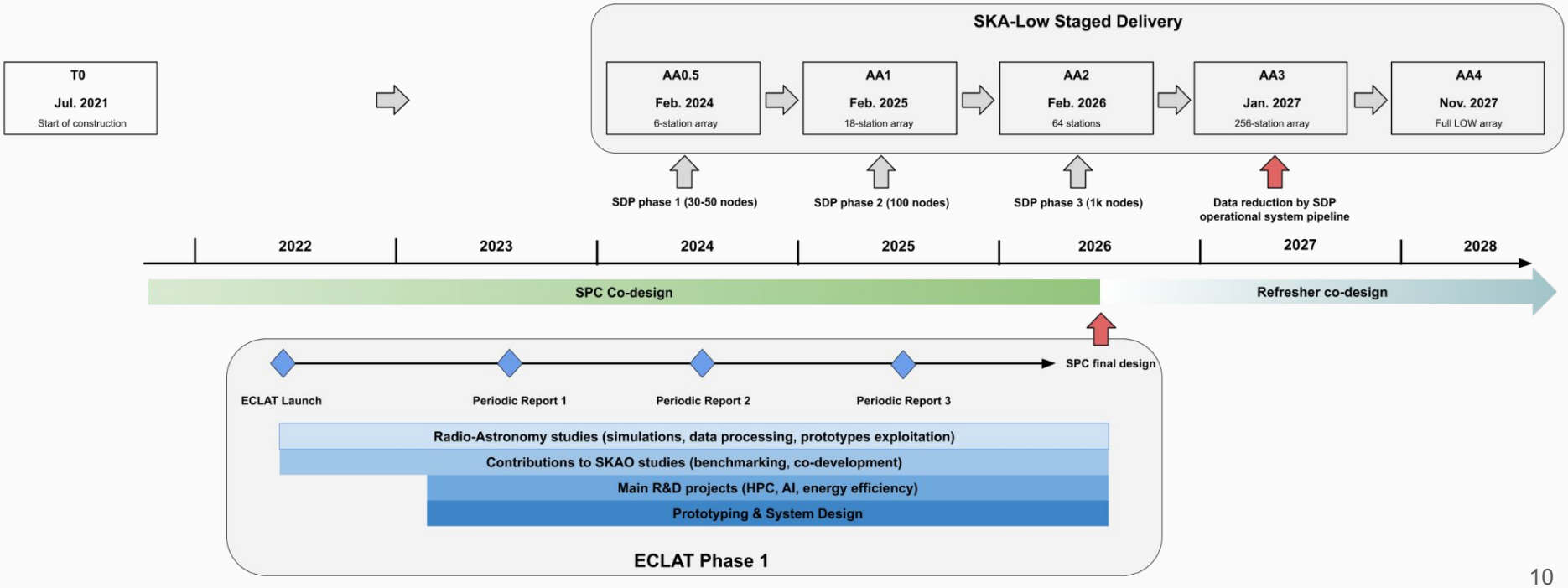
Progress towards final proposal for SPC delivery

- In sync with SKAO
- Aligned with science objectives

ECLAT PRELIMINARY ROADMAP

Based on SKA 1 construction proposal

- Contingencies on actual delivery of Array Assembly (AA)
- Agile project management at SKAO level
- Staged delivery process TBD (merging strategy ? budget ?)
- Need to refine Milestones for each axis within ECLAT



Supporting Initiatives

Collaboration with Atos and Main vendors

- Support from Atos engineers (in-kind support to joint lab)
- Requesting support from vendors (Intel, AMD, NVIDIA, etc..): external funding to the lab (cash + hardware donations) on dedicated sub-projects / sub-tasks

National / European funding

- ANR (french national funding agency): disruptive R&D
- Horizon Europe: Rising STARS mobility grant (link with Australia)
- PhD / Postdoc grant opportunities locally

Collaborations with external partners

- EPFL & ASTRON: data processing, co-design, R&D
- BSC: programming models / AI
- KAUST: high performance linear algebra / task scheduling / mixed precision / cache optimisation
- Open to more collaborations ...

Concluding remarks

Ambitious goals to lead the co-design study of one of the main SKA sub-systems

- Enable science while promoting French expertise (science + technology)
- Address Grand Challenges (Astronomy and HPC / HPDA)
- Spin-offs are expected in other domains (optical astronomy, simulations, …)

Still at a preliminary stage

- Official launch expected in the coming weeks
- Working with the community to refine goals and establish longer term milestones
- Happy to collaborate widely (providing support / getting associated with other initiatives)

France is getting back onboard while construction is starting

- Need to ramp up quickly
- Need every good will in the community !