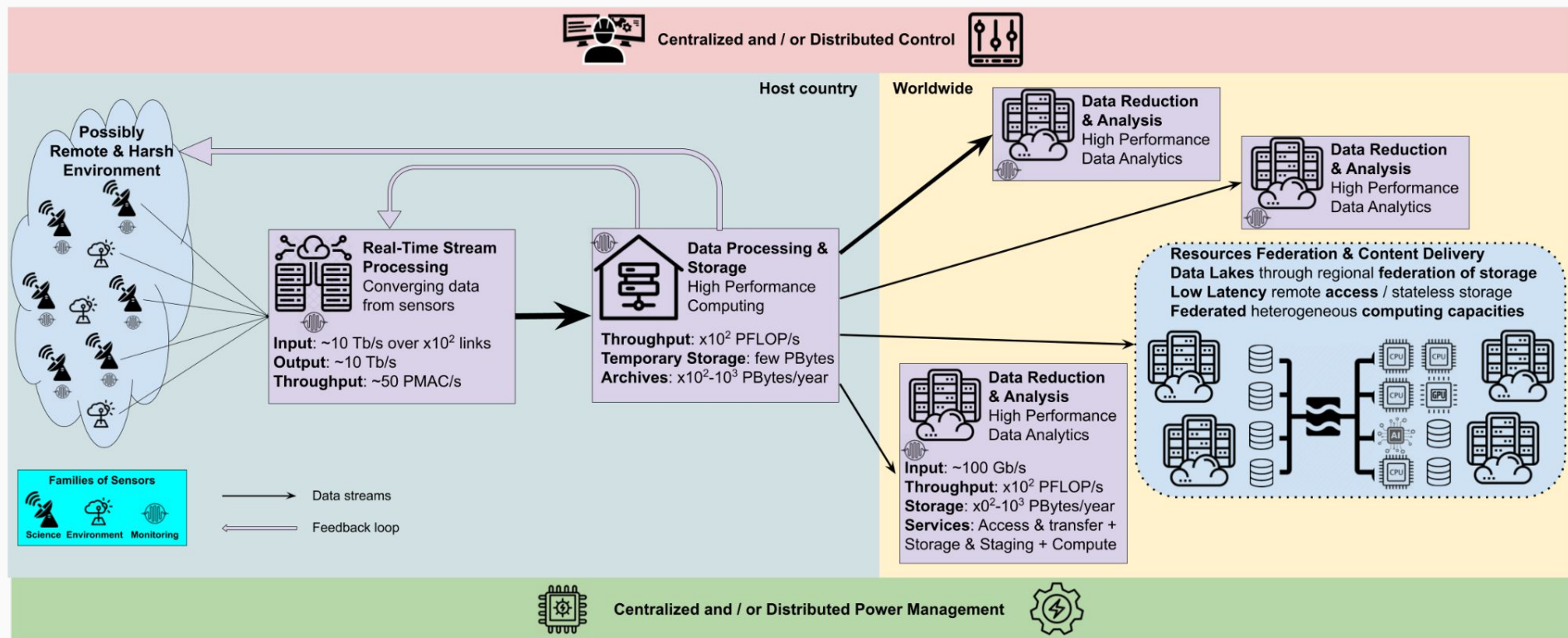


JOINT LABORATORY CNRS - Atos - INRIA

SKA COMPUTING CHALLENGES

Hierarchical architecture: system of systems

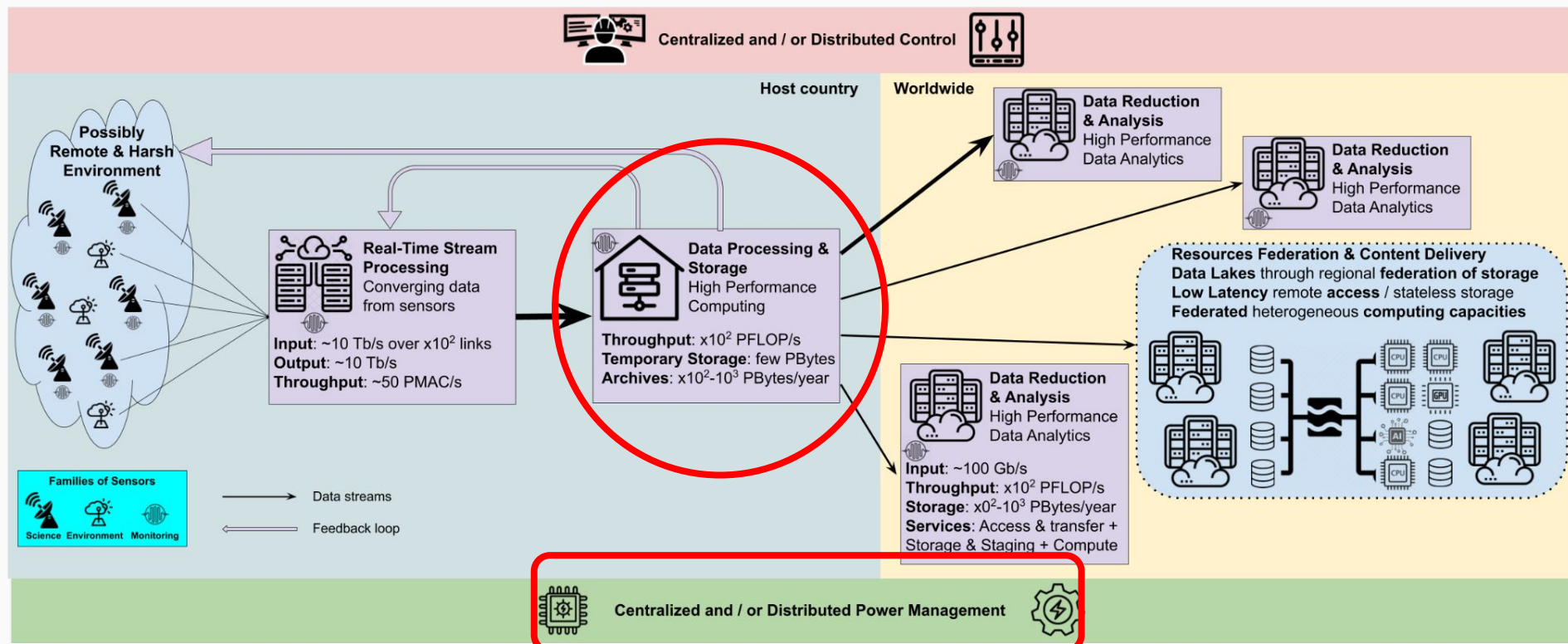
From large amount of distributed & heterogeneous sensors to distributed network of national processing facilities for content delivery to the users



SKA COMPUTING CHALLENGES

Contribution from France expected on Science Data Processor implementation

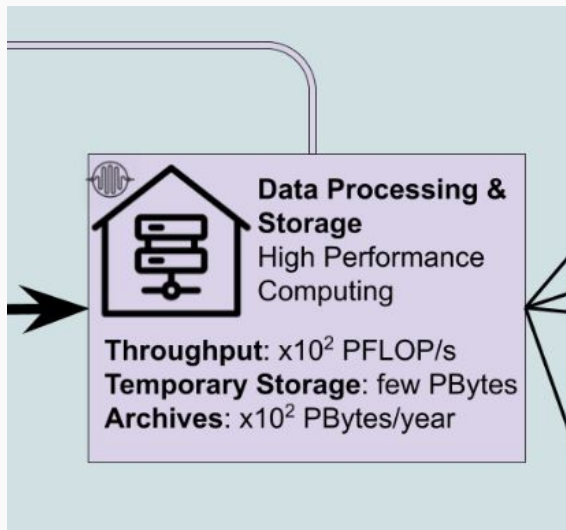
- State-of-the-art datacenter for processing, storage and distribution
- Focus on Energy Efficiency & Power Management



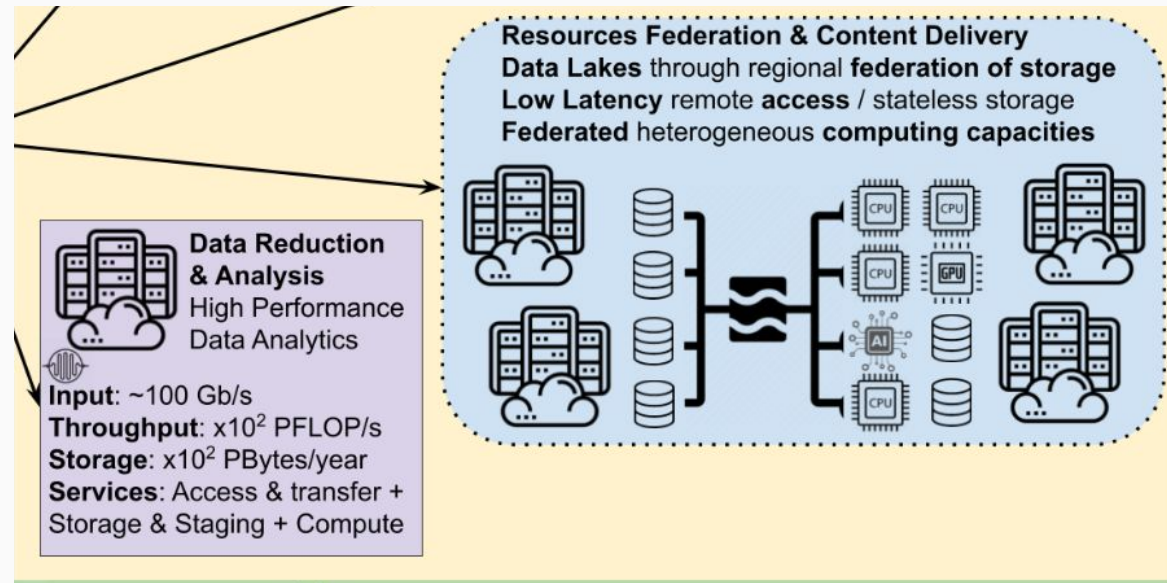
SKA COMPUTING CHALLENGES

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

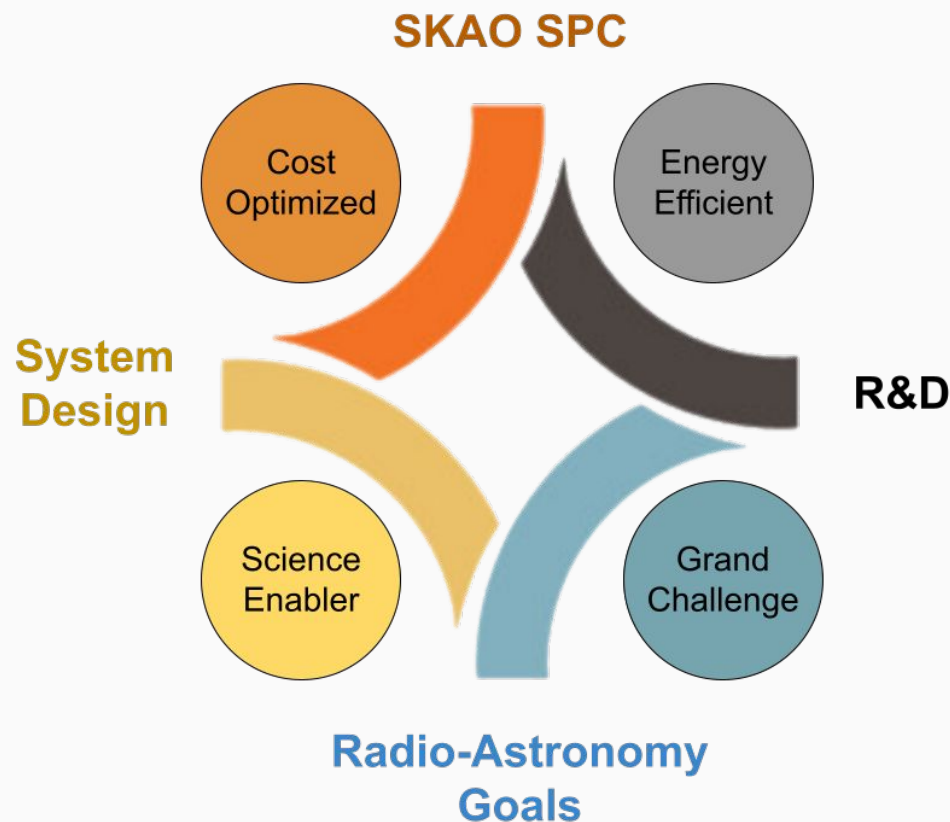
Provide solutions for an extremely challenging sub-system under cost and energy efficiency constraints

- **4 main topics**

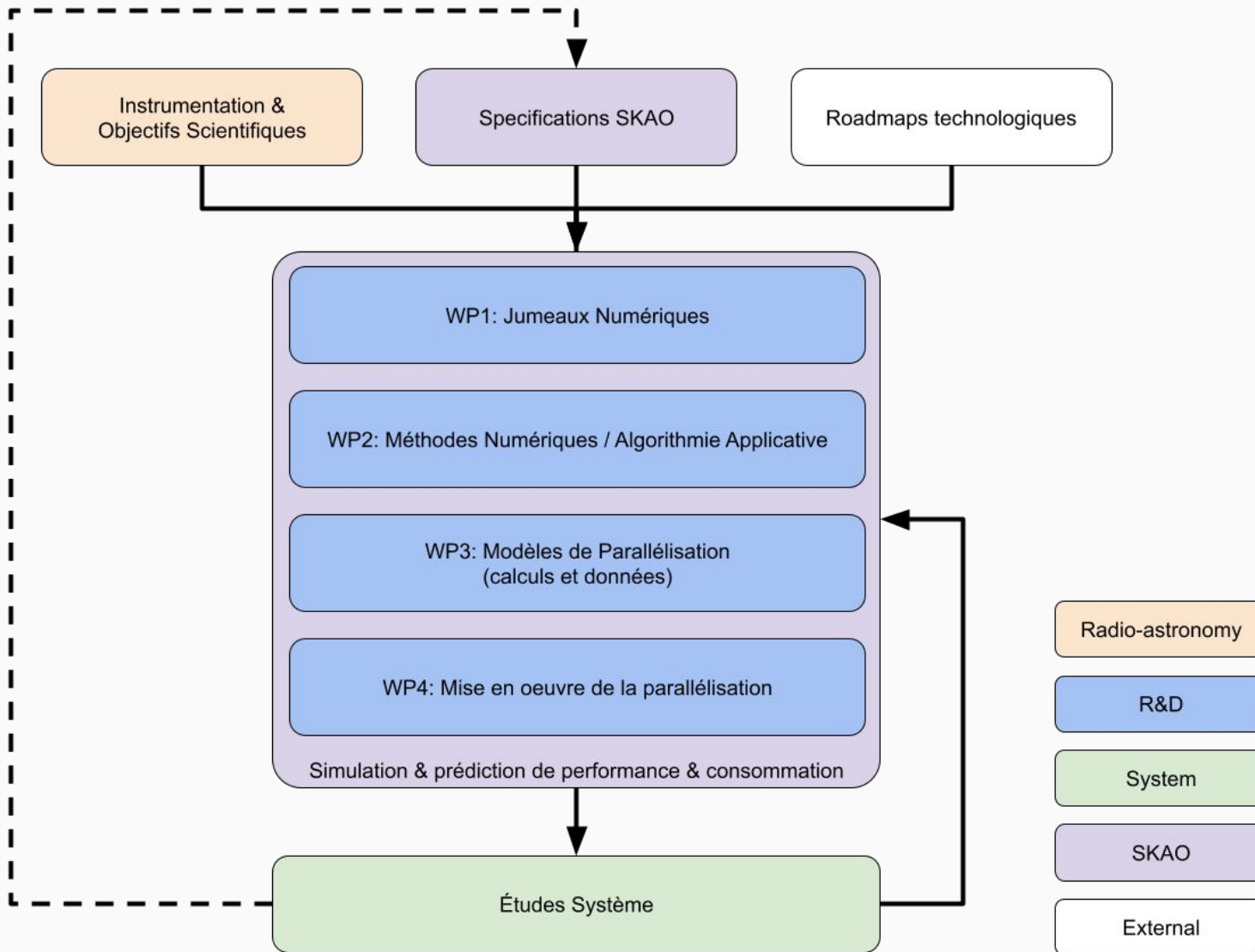
- Radio-Astronomy goals
- System Design
- R&D
- SKAO SPC

- **4 main drivers**

- HPC Grand Challenges
- Science Enabler
- Cost Optimization
- Energy Efficiency



PROPOSED IMPLEMENTATION



ReD 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

ReD ACTIVITIES

ECLAT developments

Technology survey & follow-up

Roadmap & R&D tasks

Design Tools	Simulations / Benchmarking / Performance analysis					Benchmarking current SKAO baseline Dataflow modeling and MoC Performance & Energy Efficiency prediction
Application Software	Applications	Libraries	Data			Survey of possible SKAO baseline solutions Approximate computing New algorithms (energy efficient & AI)
Development Environment	Programming Models					Survey of possible SKAO baseline solutions Technological watch Optimized scheduling (performance, energy efficiency) Extend runtimes capabilities across HW technologies DS versus GP programming models (enhanced portability) Middleware + I/O support in programming models I/O strategies (persistent vs volatile storage)
	Runtimes		Middleware			
	Compilers		Filesystems			
System Software	OS					Survey of possible SKAO baseline solutions Technological watch
	Drivers					
System Hardware	Platform					Survey of baseline SKAO design Technological watch Energy efficient design Cost optimized design Refresher / maintenance strategy LCA / TCO analysis
	Compute	Memory	Intercon.	Storage	Network	
	Infrastructure (real-estate, power, cooling)					

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

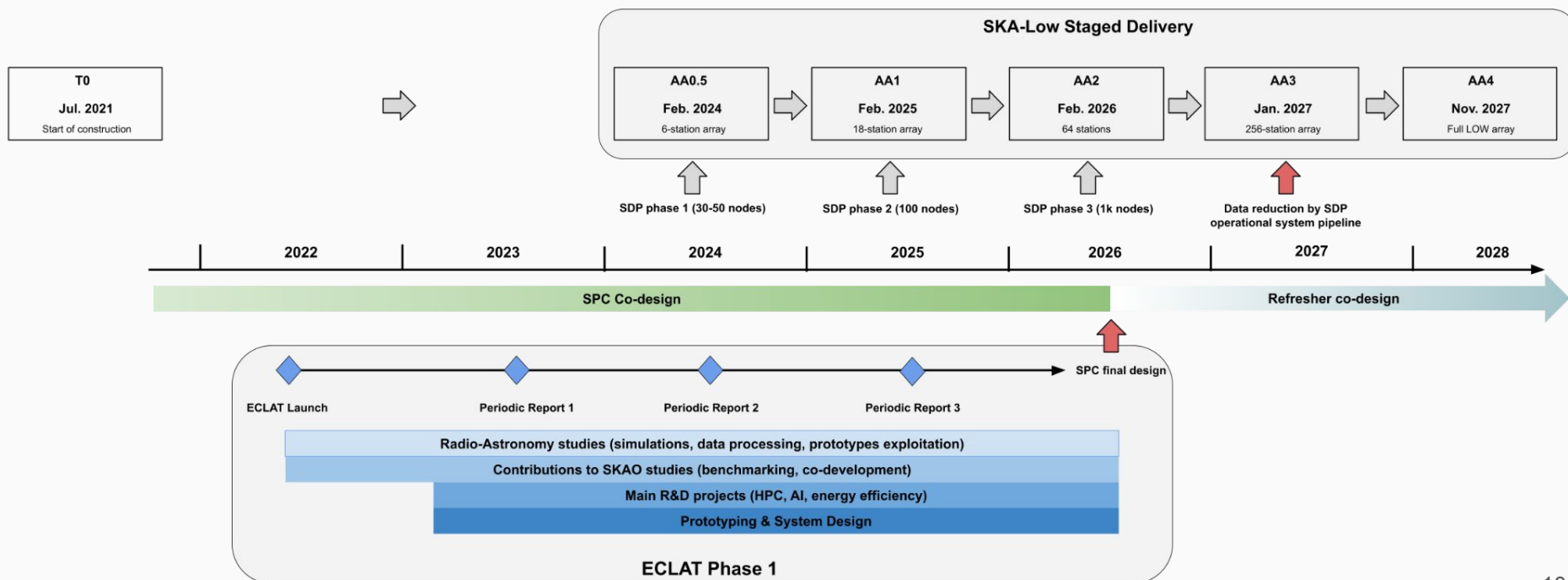
Progress towards final proposal for SPC delivery

- 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 !