SLICES-RI: Scientific Large-Scale Infrastructure for Computing / Communication Experimental Studies

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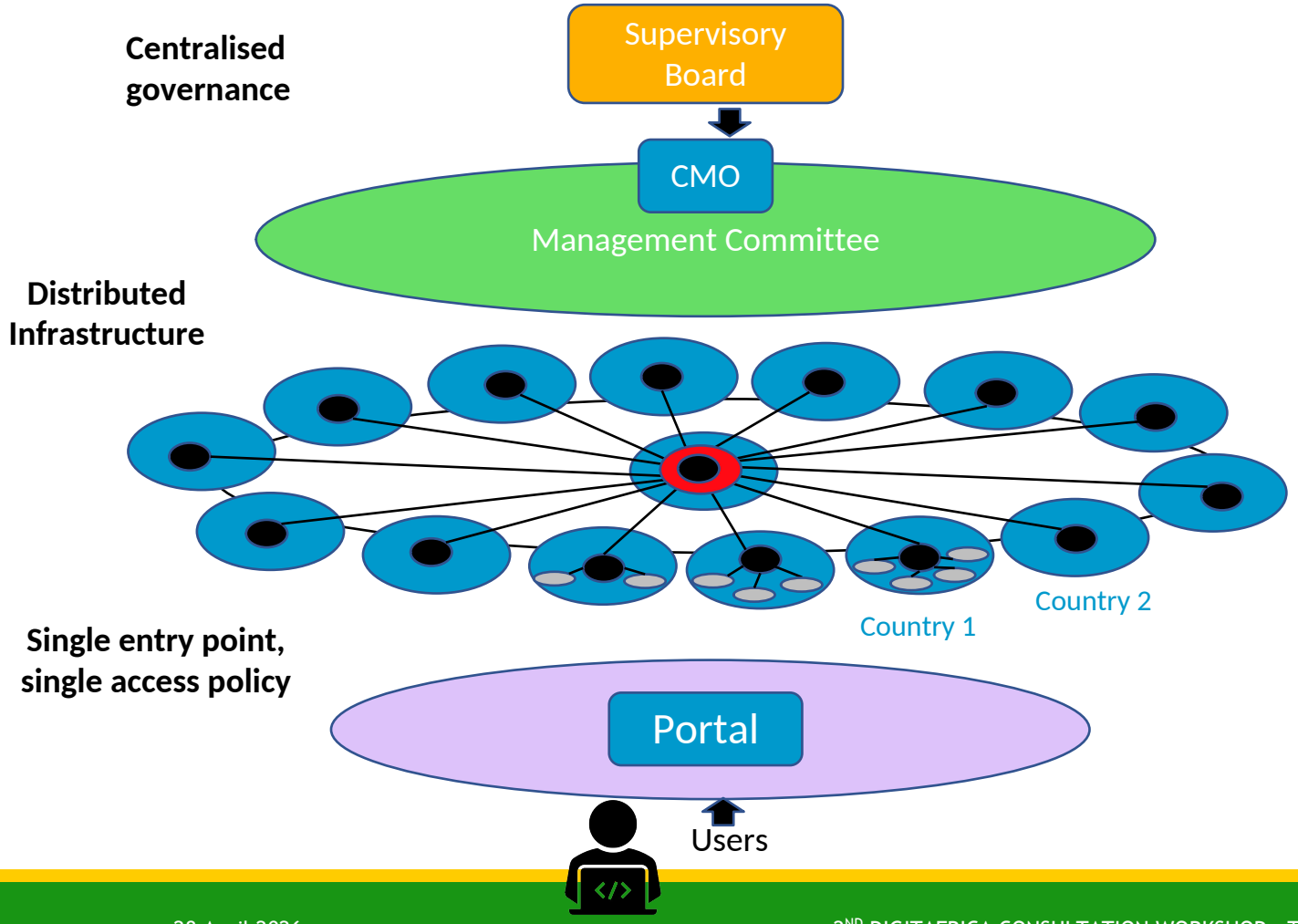
https://www.slices-ri.eu

Funded by the European Union

DIGITAfrica project has received funding from the EU Horizon Europe research and innovation Programme and Switzerland under Grant Agreement No. 101187966. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

SLICES-RI Overview



SLICES-RI is a **European Research Infrastructure** designed to enable large-scale, **reproducible** experimentation on **next-generation Internet** and **digital systems**. It provides an integrated, **distributed platform** combining advanced **computing**, **networking**, **wireless** technologies, and **data** resources, allowing researchers to design, deploy, and validate complex experiments under realistic conditions. Key distinguish features of SLICES-RI are strong emphasis on **FAIR data management** and rigorous **experiment lifecycle management**.

Why SLICES-RI is needed?

Square Kilometre Array (SKA)

Research Infrastructures as a Scientific Instrument

MAKING SCIENCE HAPPEN

A new ambition for Research Infrastructures in the European Research Area

Large Hadron Collider (LHC)

Scientific instruments are key for credibility and innovation

- Over 90% of scientific papers published in the past decade involved the use of advanced scientific instruments and thought experiments.
- Without advanced instruments, the rate of scientific progress and depth of understanding would be significantly diminished
- Without trustable and shared research infrastructure, credibility of networking research is at risk
  - When Something *Looks too Good to be True, it Usually is*! AI is Causing a Credibility Crisis in Networking
    - *Walter Willinger et al.*
    - *ACM SIGCOMM Computer Communication Review, Volume 55, Issue 1, January 2025*
  - 10,000 maniacs and *AI is destroying Computer Science*, one topic at a time….
    - *Jon Crowcroft*
    - *https://paravirtualization.blogspot.com/2024/06/10000-maniacs-and-ai-is-destroying.html*

Impactful research needs large-scale research infrastructures

ACM Sigcomm 2025 edition

Number of papers: 68

Almost **60%** of the papers from large industry

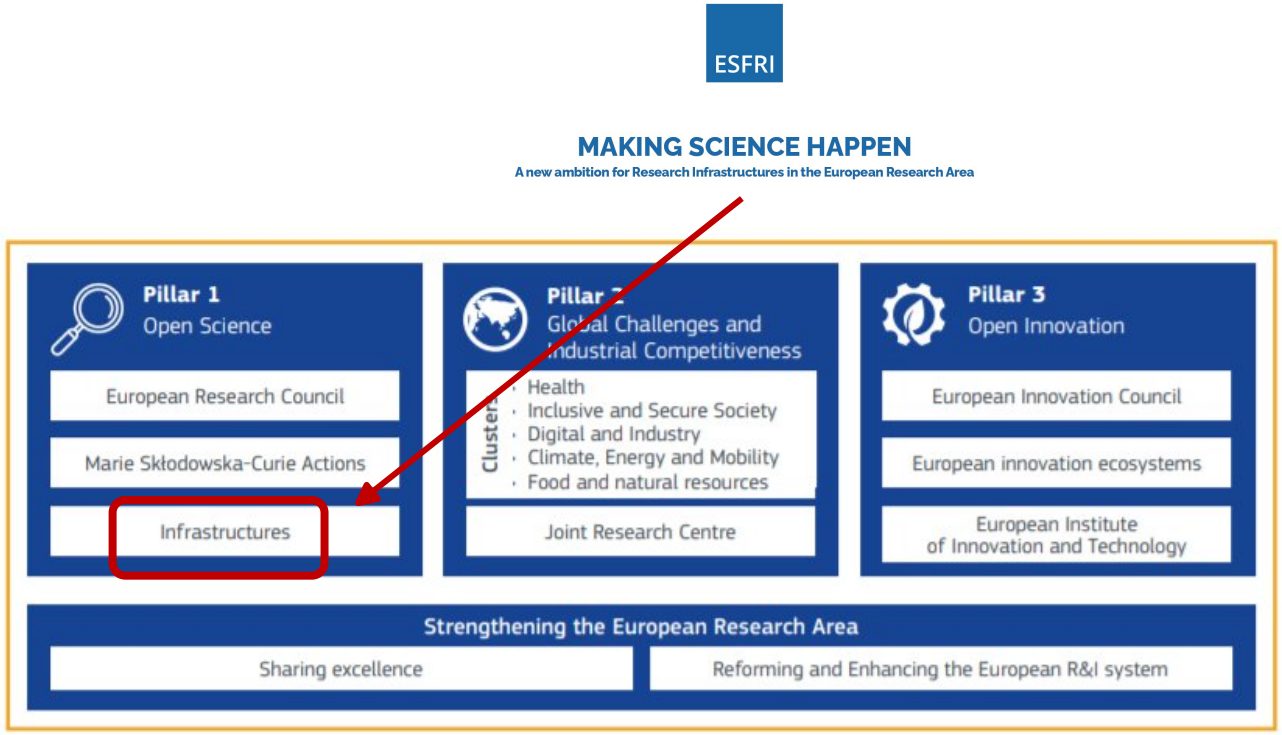
Often a large number of authors

- US tech: 14
- China Tech: 25
  - Alibaba: 11
  - Bytedance: 11

Risk For Academia

How to build a sustainable, large-scale RI?

From mid-Scale (~100M€) to Large-Scale (~B€)



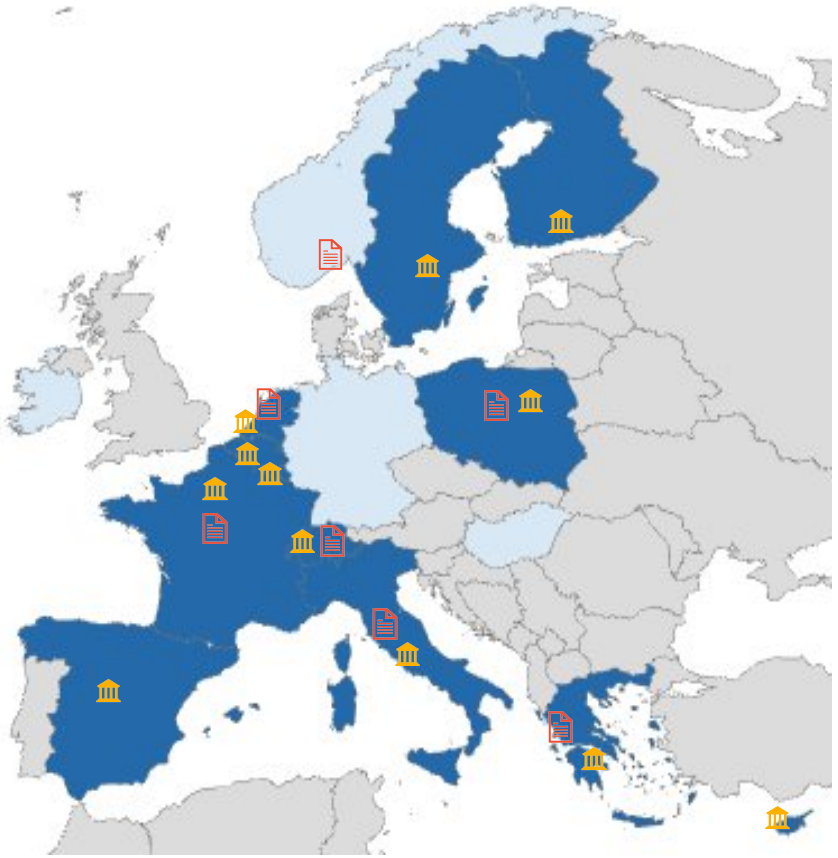
The European ESFRI framework

European Strategy Forum on Research Infrastructures

Supporting a scientific methodology

http://www.esfri.eu/

SLICES-RI is first one in digital sciences to enter the ESFRI Roadmap in 2021

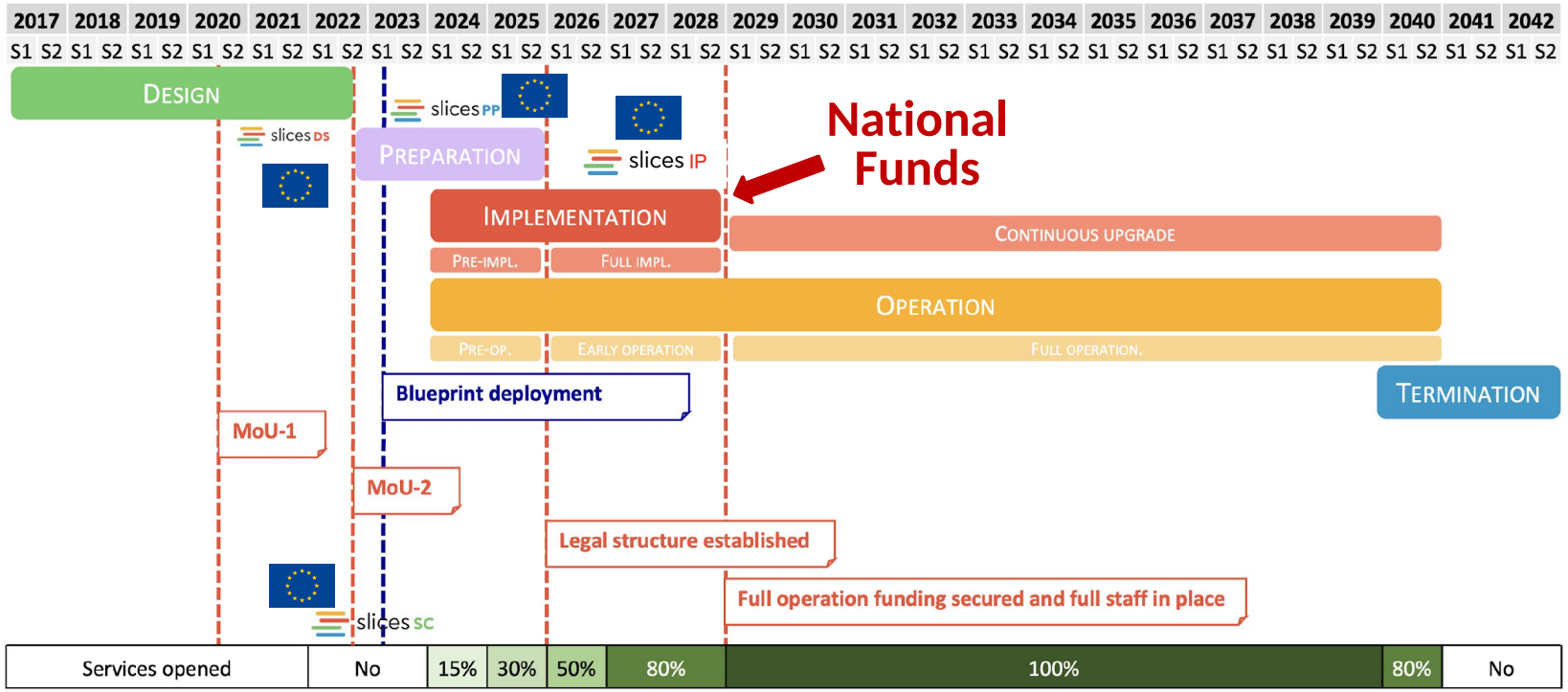


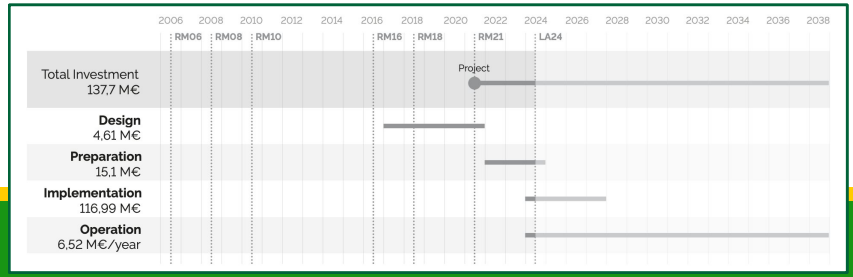
Initiated in 2017, entered the roadmap in 2021:

16 EU countries engaged:

- **12 political support** from National Ministries
- included in **8 national roadmaps**

SLICES-RI: a long journey

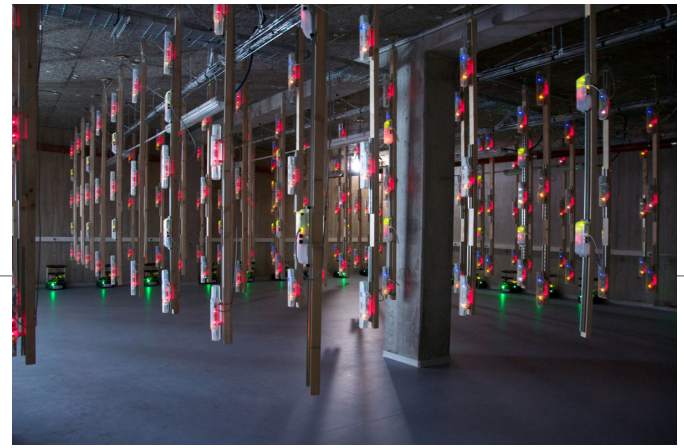




What does SLICES-RI offer?

SLICES-RI resources

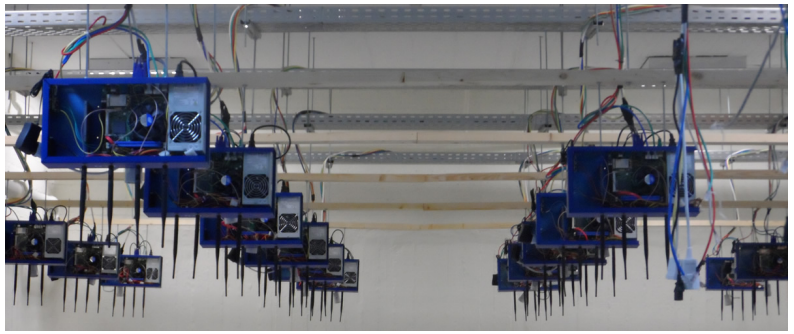
IoT



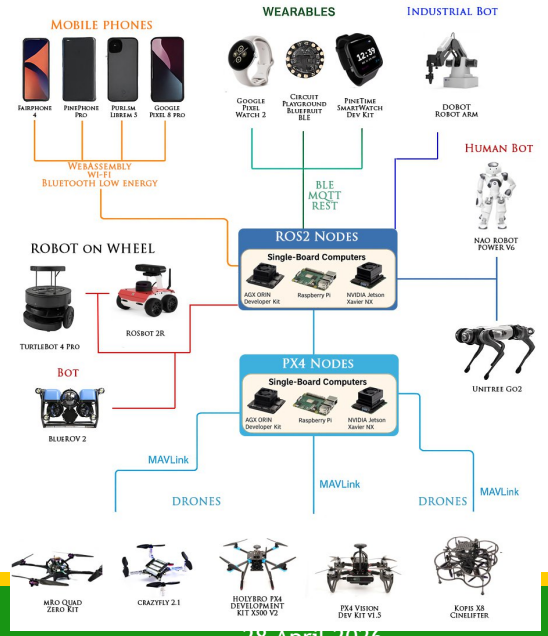
QKD

CPU/GPU

wireless experimentation

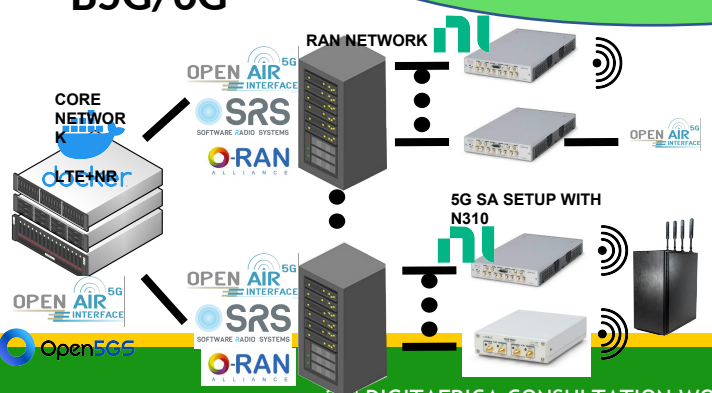


Drones

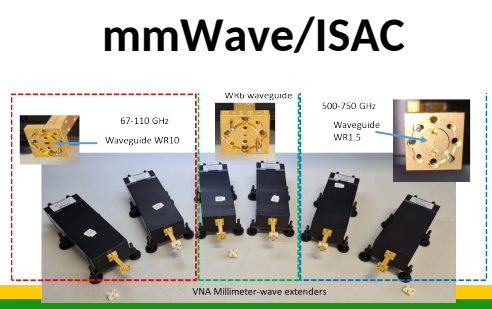


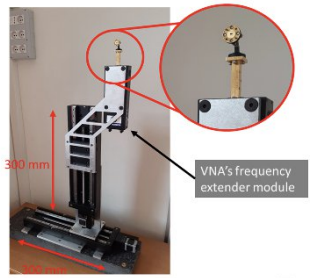
Physical/virtual resources that are programmatically offered to RI users

B5G/6G



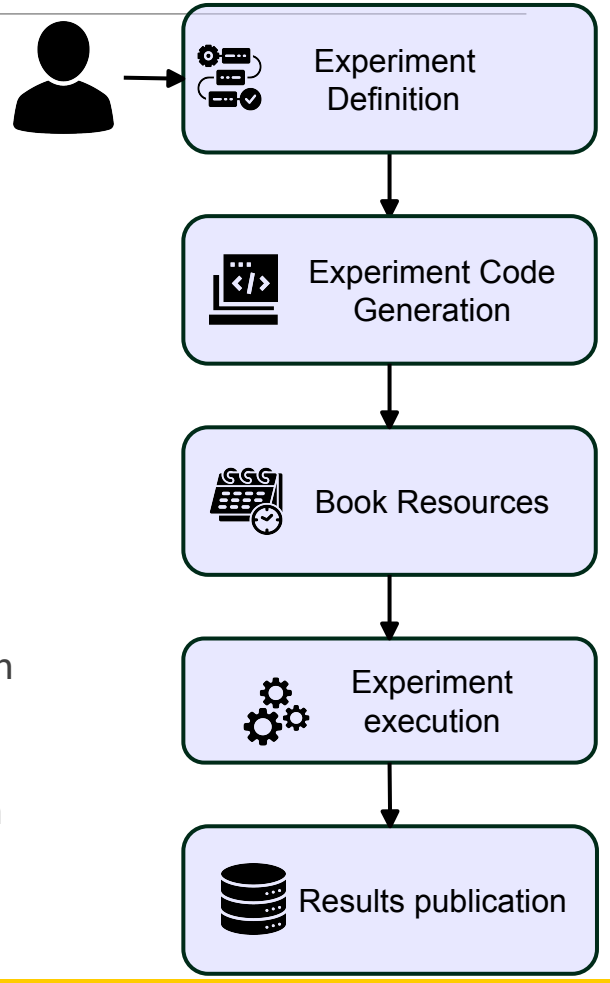
mmWave/ISAC



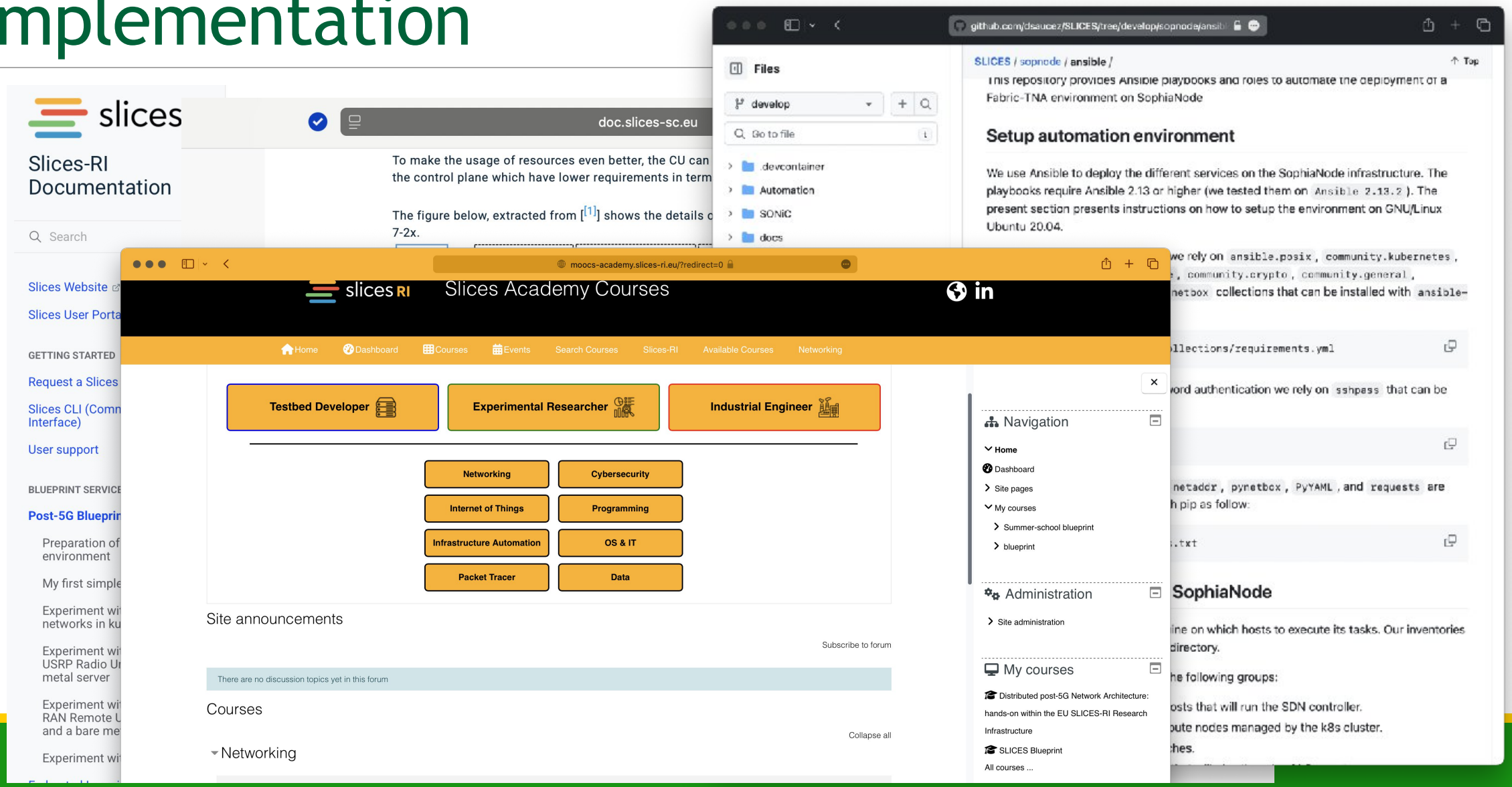


SLICES-RI methodology: an intent-based approach to produce *Blueprints*

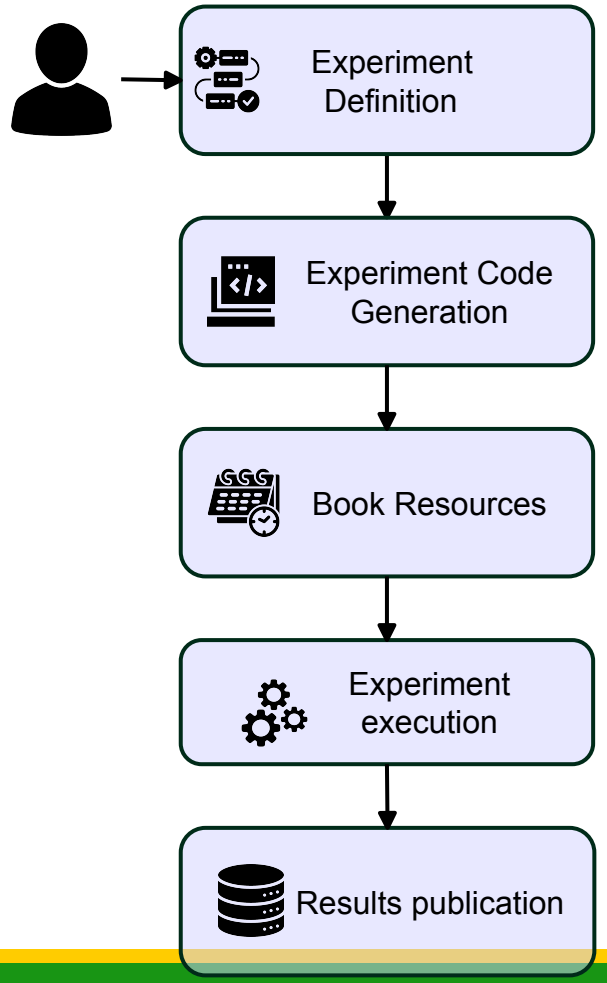
- High-level specification of the **scientific objectives**, constraints and expected system behaviour
- This intent is expressed declaratively, abstracting the underlying resources, software and configurations
- From this intent, a **Blueprint** is generated: a structured, machine-readable description of the **"*reference*" test platform** that captures both the **logical topology** and the **experimental workflow**
  - same experiment can be **deployed identically across sites** or reproduced **at a later time**
  - A blueprint integrate experiment description, orchestration, and data collection within **a single lifecycle**.
  - technically, the reference implementation provides a **replicable set of software, hardware and methodologies** for conducting experimental research in a given domain

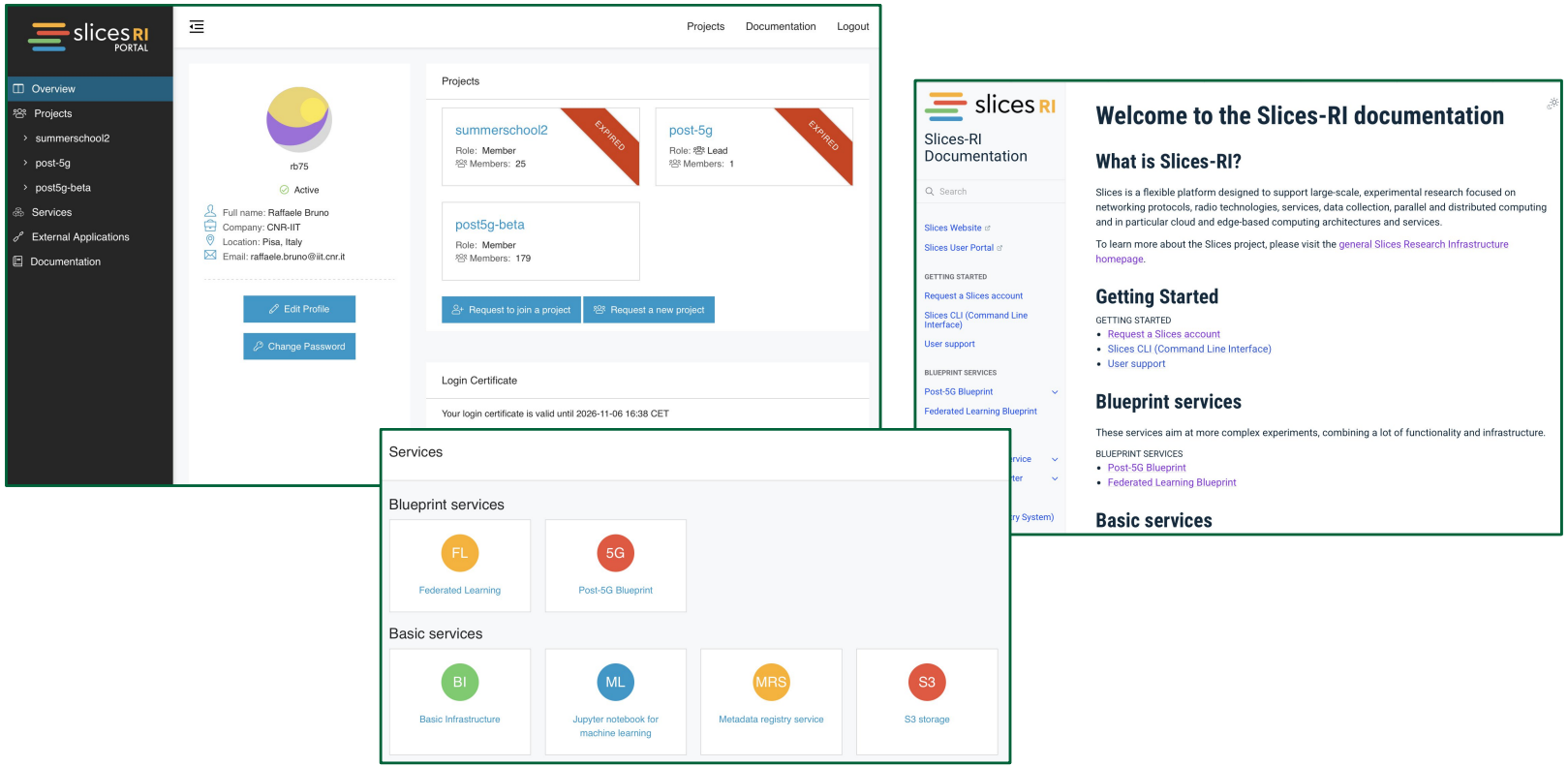


Documented and with reference implementation



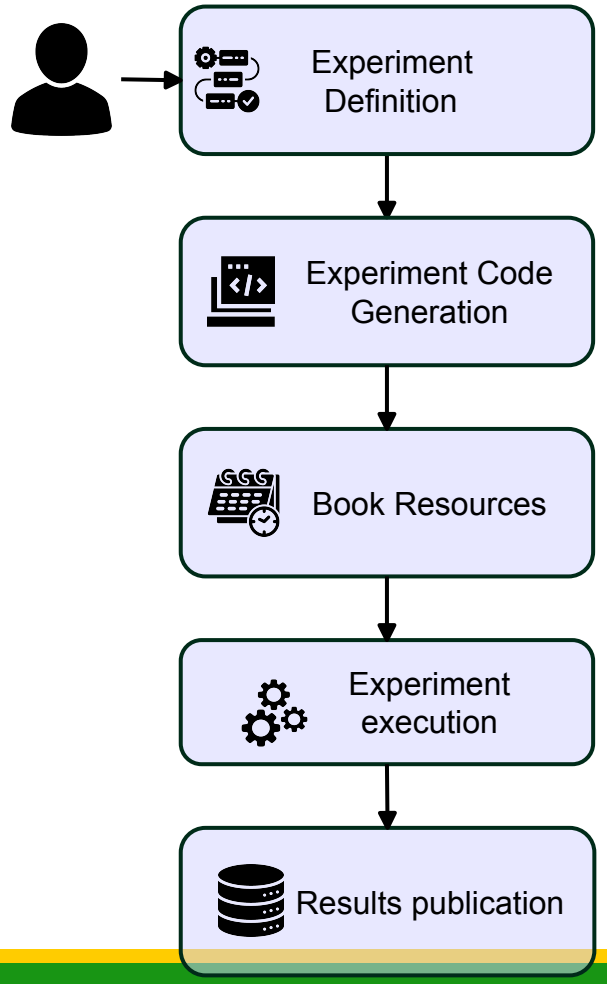
The SLICES-RI experiment journey

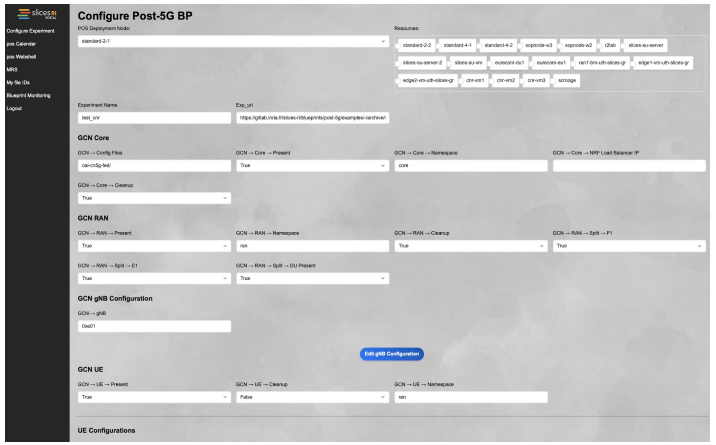


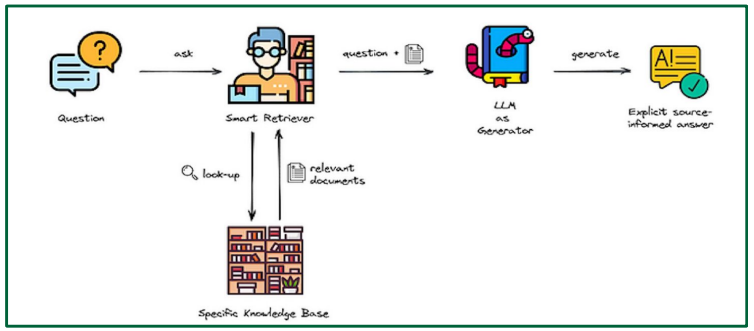


- A single **user portal** to access documentation, basic services, blueprint services, and user projects

The SLICES-RI experiment journey

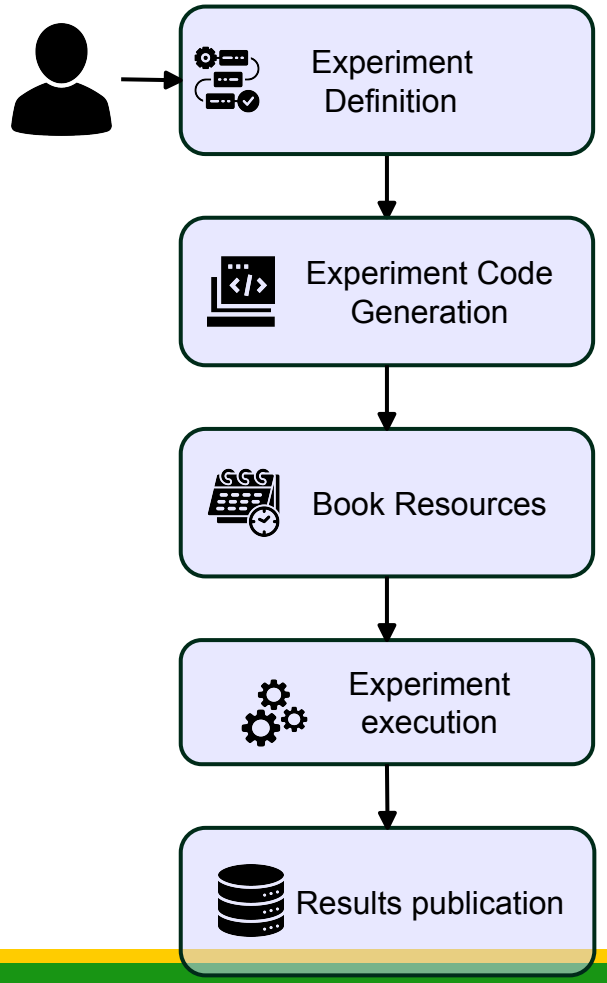




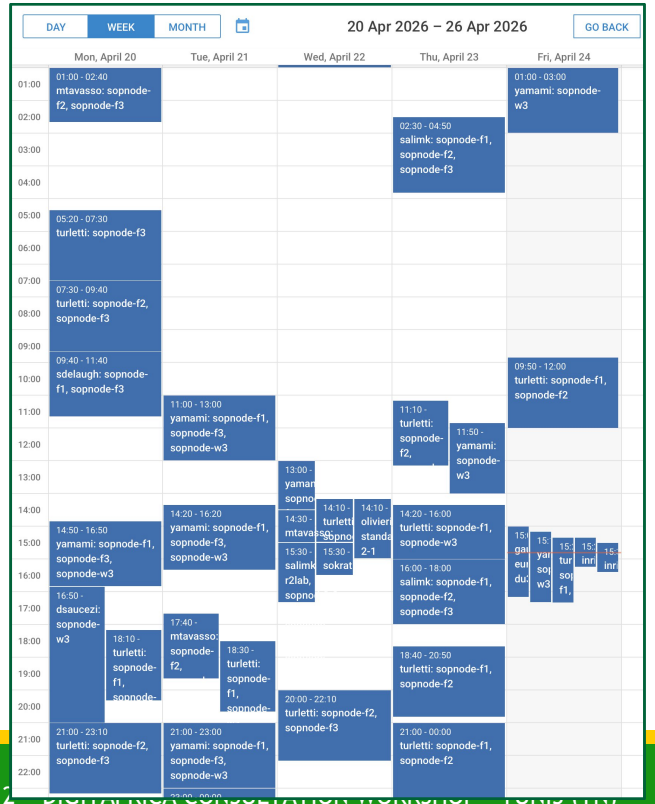


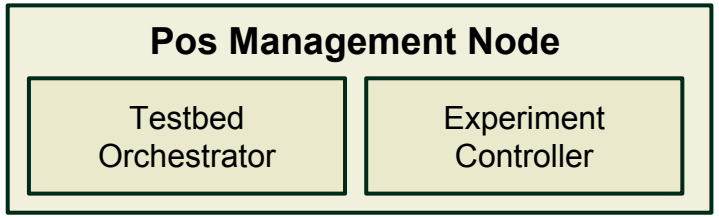
- A **static experiment dashboard** to generate experiment code for the blueprint reference test platform. It is being enhanced by a LLM Chatbot to simplify this task

The SLICES-RI experiment journey

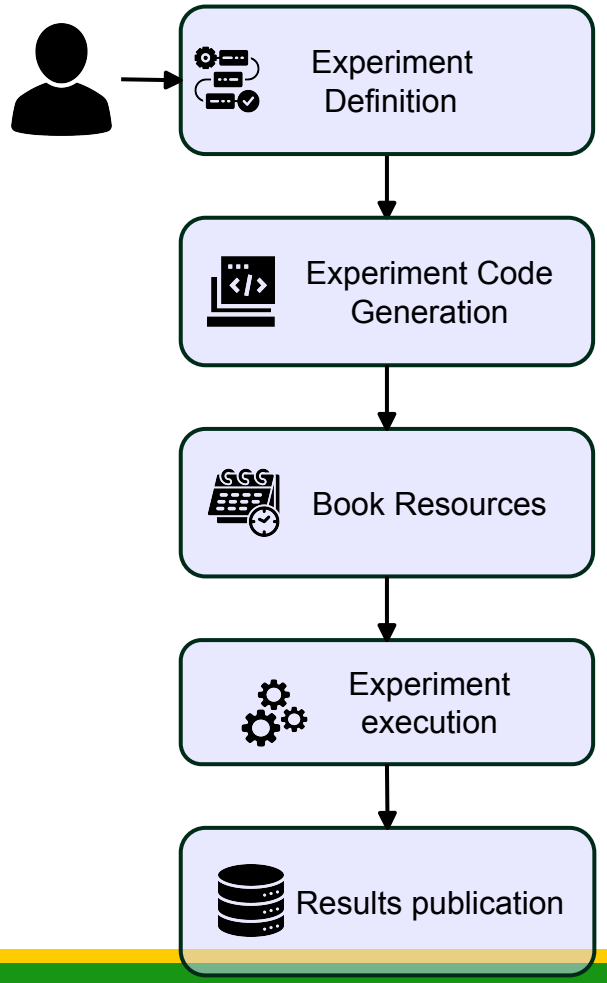


- A **testbed orchestrator**, **experiment controller**, and **management node** (the POS framework of SLICES-RI) enable the automated deployment and control of experiments across heterogeneous infrastructures

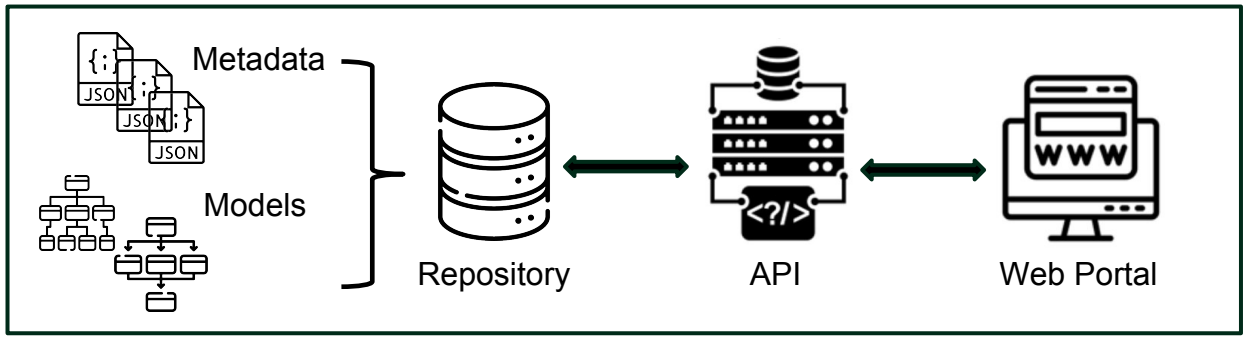




The SLICES-RI experiment journey



- When an experiment runs, all results, configuration files, monitoring data, and provenance information are automatically **stored** and **indexed**
- **SLICES Metadata Registry System (MRS)**: acts as a centralized platform for managing and retrieving metadata on digital objects, with a focus on interoperability within and outside the SLICES network



Data Management Infrastructure (DMI)

https://doc.slices-ri.eu/BasicServices/MRS/MRS.html

MRS: Flexible Hierarchical Metadata Model

Level 1: Domain-agnostic

- SLICES core **F**AIR **D**igital **O**bject, coined **S-FDO**
- **Primary** (e.g., persistent identification, description, resource type, creator), **Management** (e.g., version, metadata profile), **Access**(access type, access mode), **Links**, Languages, **User Information**, Rights (e.g., licence)

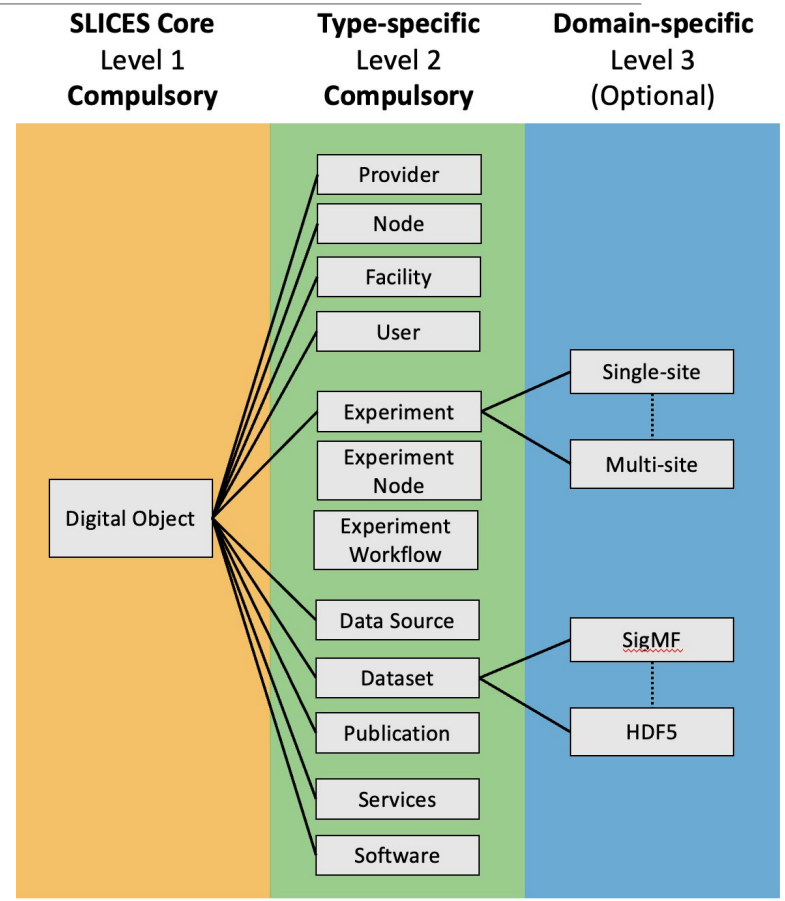
Level 2: Type-specific

- Extends basic metadata with type specific metadata
- E.g., Datasets may have start/end date

Level 3: Domain-specific

- Serves the needs of a specific community

Easily expandable with new types



MRS

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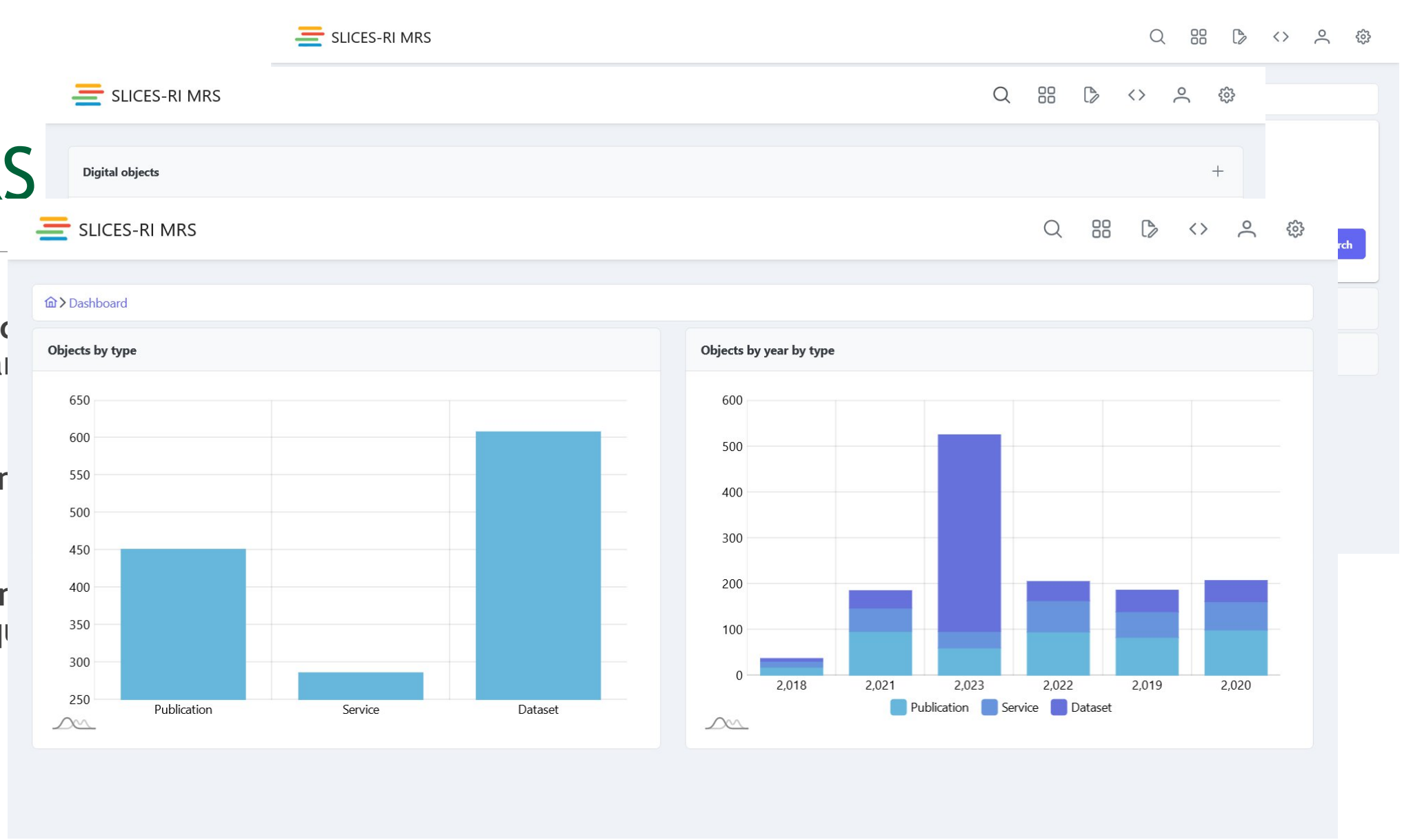
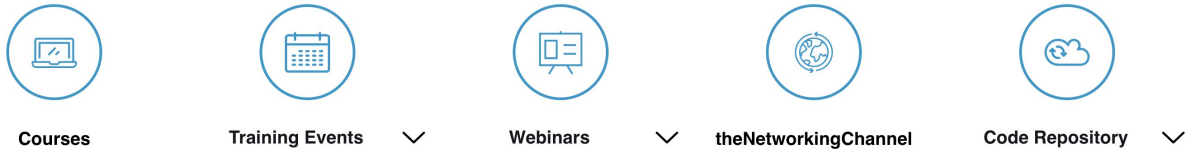


Building a community of SLICES-RI users

Training and capacity building

SLICES Academy

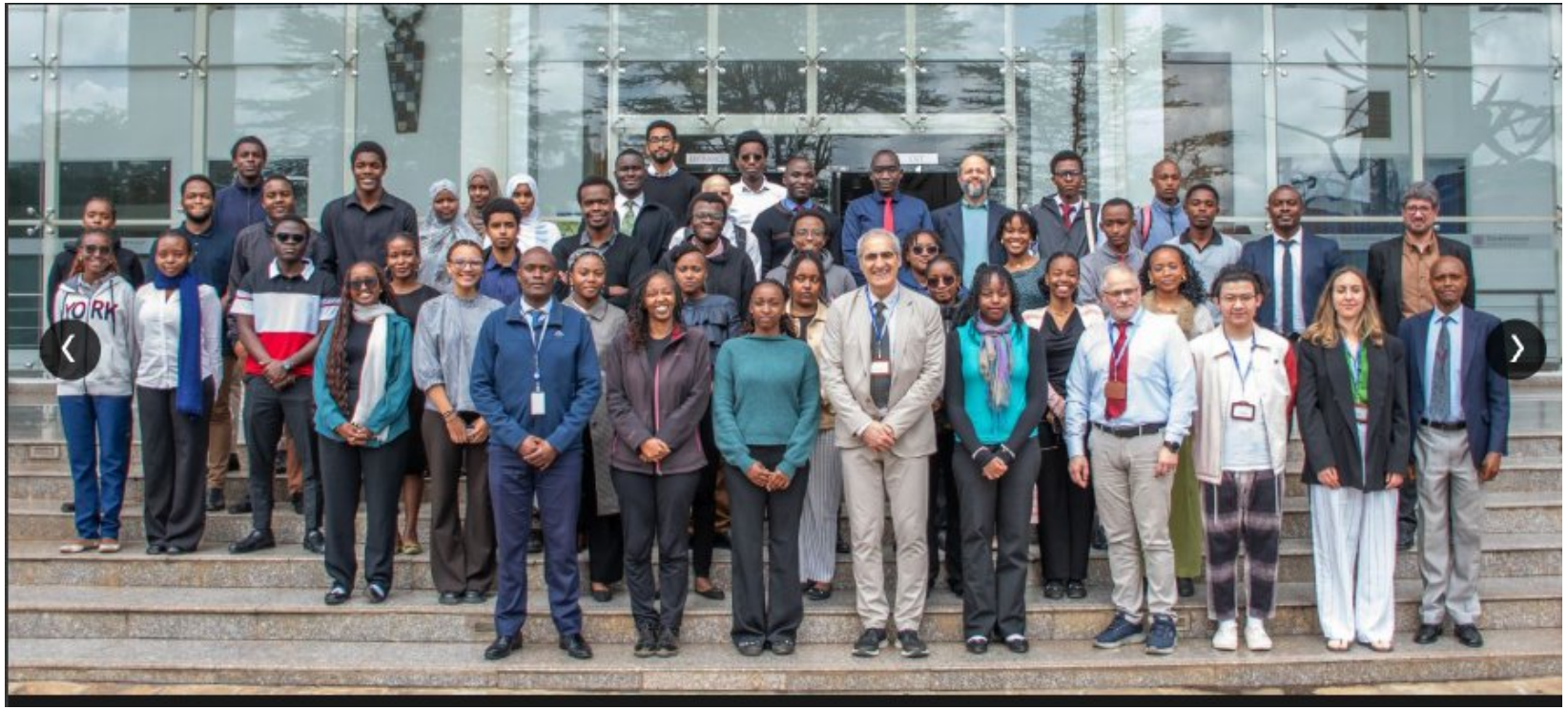


SLICES Summer school: Greece (2022), Finland (2023), Italy (2024), Portugal (2025), Spain (2026)

theNetworking Channel

Follow the *NetworkingChannel*,
brought to you by
ESFRI SLICES, NSF PAWR and ACM Sigcomm

Training on the SLICES 5G BluePrint



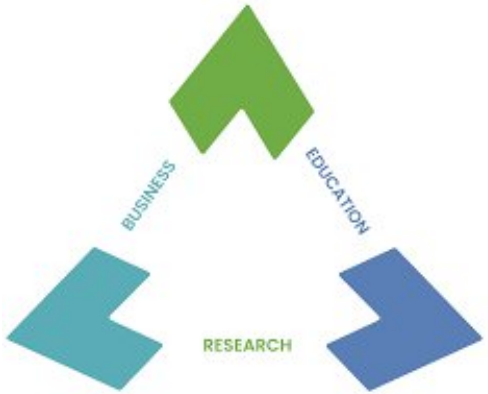
Europe +
Chile
Guatemala
Kenya
South Africa
Tunisia
Vietnam

201 attendees in total, 14 countries, 4 years

SLICES-RI as a Catalyst

SUSTAINABLE

OPEN



Knowledge Triangle

INCLUSIVE

Thanks for your attention

Questions?

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