

# SLICES, A catalyst for international cooperation in Open testbeds



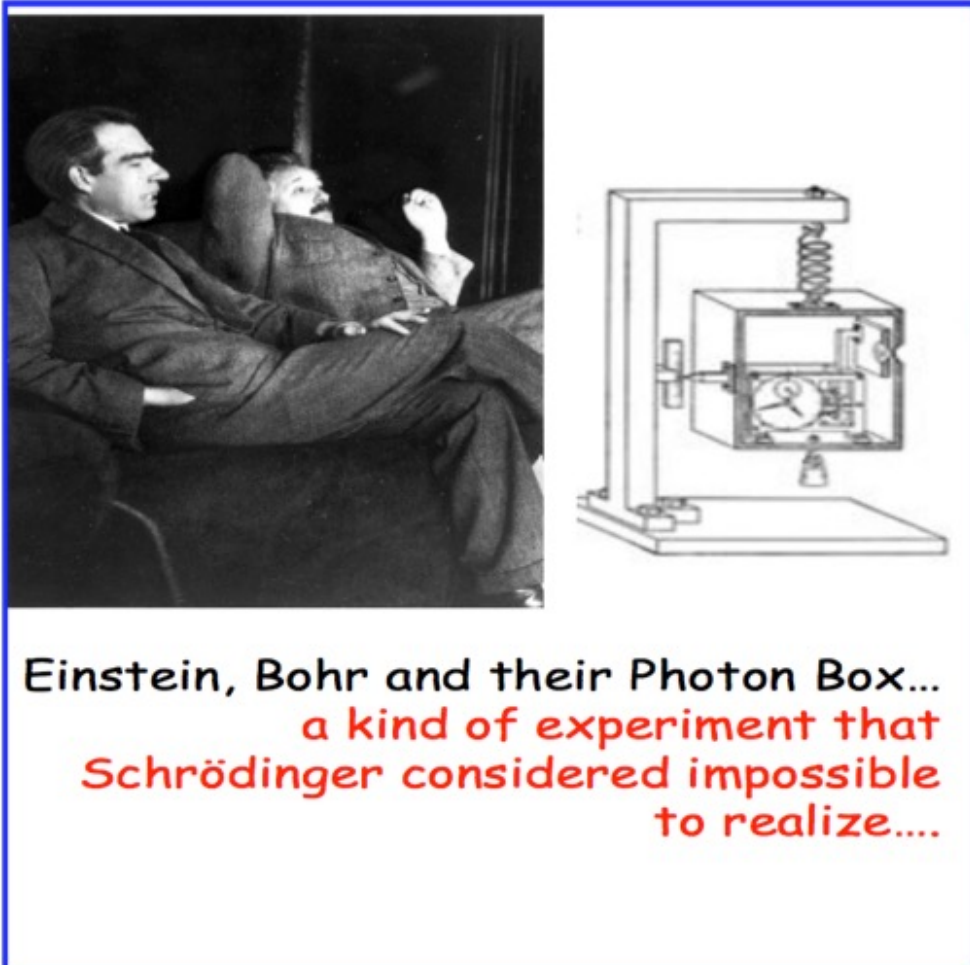
Serge Fdida  
Sorbonne Université, France

OPENRIT 6G

Cape Town, March 20, 2024

# What is in SLICES?

# Thought experiments



## THE NOBEL PRIZE

### Nobel Price in Physics 2022

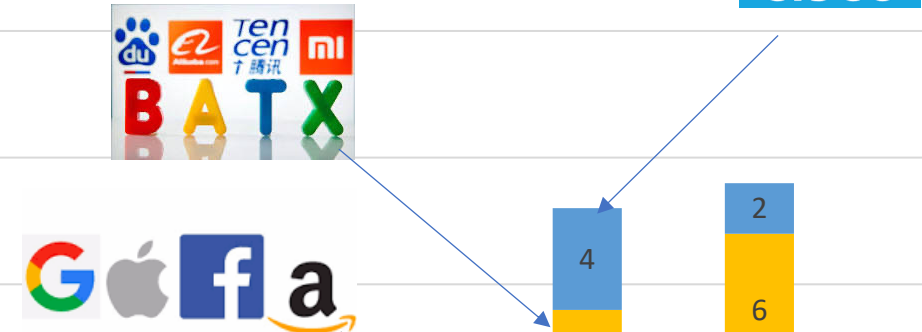
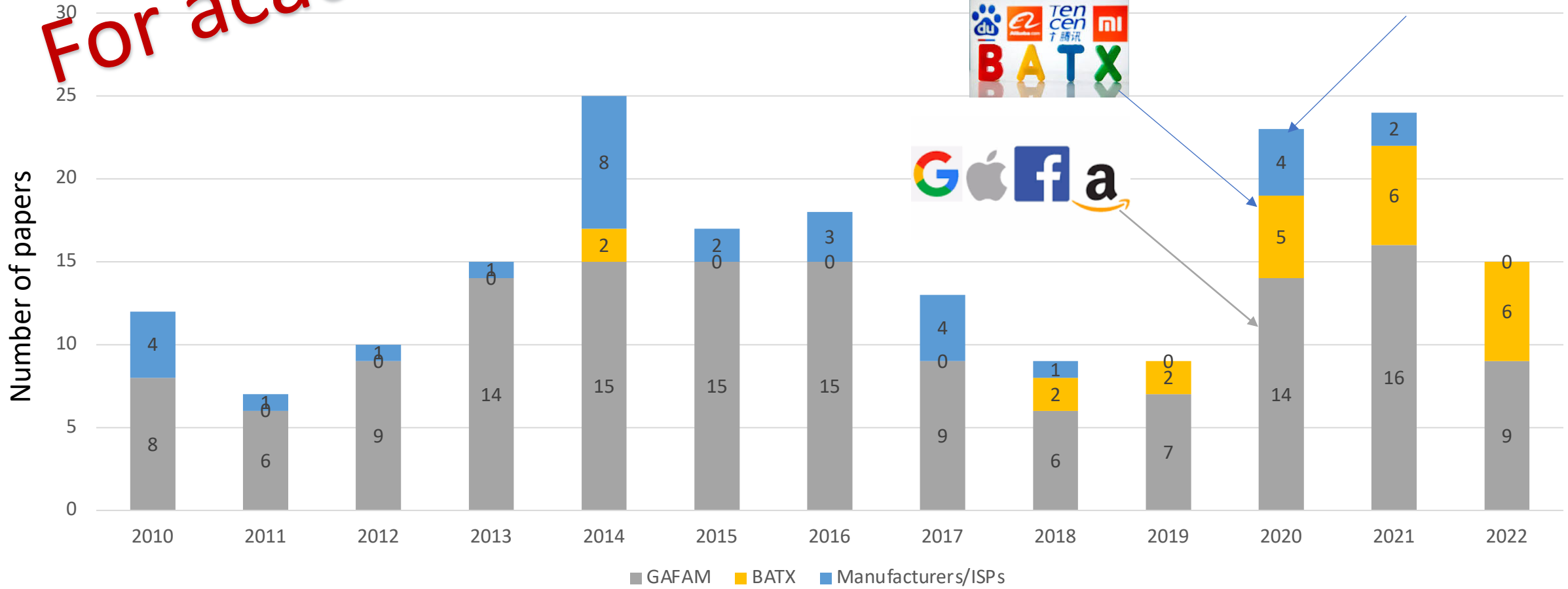
For groundbreaking **experiments** using entangled quantum states, where two particles behave like a single unit even when they are separated

### Nobel Price in Physics 2023

for **experimental** methods that generate attosecond pulses of light for the study of electron dynamics in matter

Risk  
For academia

# ACM SIGCOMM Papers



## ACM Sigcomm Edition (year)



# Why Most Published Research Findings Are False

John P.A. Ioannidis



PLoS Medicine | [www.plosmedicine.org](http://www.plosmedicine.org)

0696

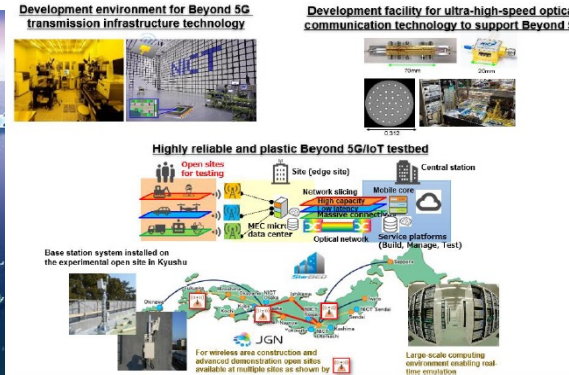
August 2005 | Volume 2 | Issue 8 | e124

## Summary

There is increasing concern that most current published research findings are false. The probability that a research claim is true may depend on study power and bias, the number of other studies on the same question, and, importantly, the ratio of true to no relationships among the relationships probed in each scientific field. In this framework, a research finding

Risk  
For trust in  
Science

# Third generation Mid-Scale Test Platforms



**USA NSF PAWR** (Platforms for Advanced Wireless Research): NSF + Industry, 100M€, 2017-2022

**NSF Fabric:** NSF, 20 M€, 2019-2023 +

**Colosseum:** NSF-DARPA, 20+7,5M\$, 2017-2025.

**BRIDGES:** NSF, 2.5M€, 2020-2024

**EU Horizon Europe**

ICT 17-19-52, 2018-2022, 205 M€

SNS Stream C, 2 calls, 2022-2027, 25+xM€

**Japan NICT R&D**

**Shared Open Platform**  
200 M\$

2022-2026

**China CENI**

Chinese Experimental National Infrastructure

2018-2022

190 M€

**Future Network testbeds**

CSTNET test platform

# 6G (Digital Infrastructures) Research Infrastructures?







# *Research Infrastructures as a Scientific Instrument*



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**MAKING SCIENCE HAPPEN**  
A new ambition for Research Infrastructures in the European Research Area

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<http://www.esfri.eu/>



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



ESFRI

## MAKING SCIENCE HAPPEN

A new ambition for Research Infrastructures in the European Research Area



## The European ESFRI framework

European Strategy Forum on Research Infrastructures

Supporting a scientific methodology

Joint investment strategy between EU and Member States

<http://www.esfri.eu/>



# SLICES, first in digital sciences to entered the ESFRI Roadmap 2021



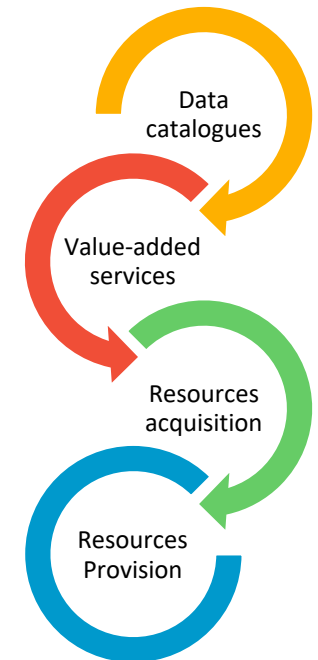
Strategy Report on Research Infrastructures  
**ROADMAP 2021**



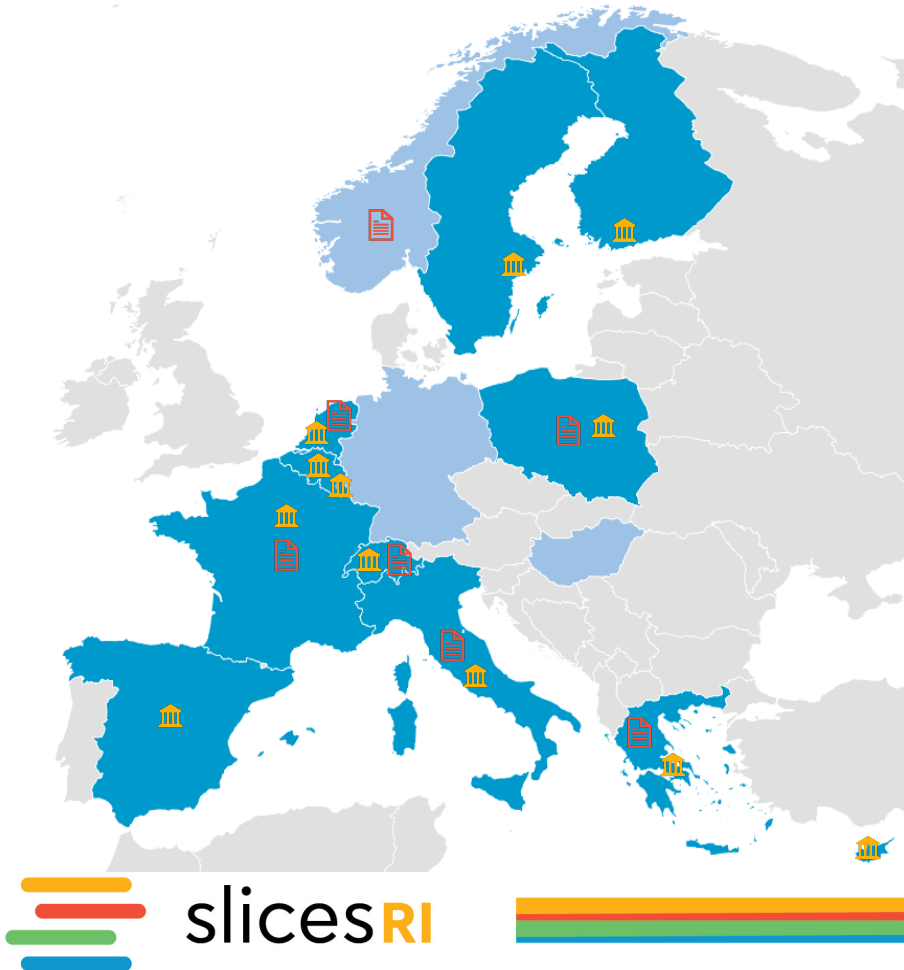
## what we offer

- Launched in 2017, **SLICES** is an **RI** to support the **academic and industrial research community** that will design, develop and deploy the **Next Generation of Digital Infrastructures**:
  - **SLICES-RI** is a **distributed RI** providing several **specialized instruments** on challenging research areas of Digital Infrastructures, by **aggregating** networking, computing and storage **resources** across countries, nodes and sites.
  - **Scientific domains**: networking protocols, radio technologies, services, data collection, parallel and distributed computing and in particular cloud and edge-based computing architectures and services.

[www.slices-ri.eu](http://www.slices-ri.eu)



# SLICES for research on Digital Infrastructures

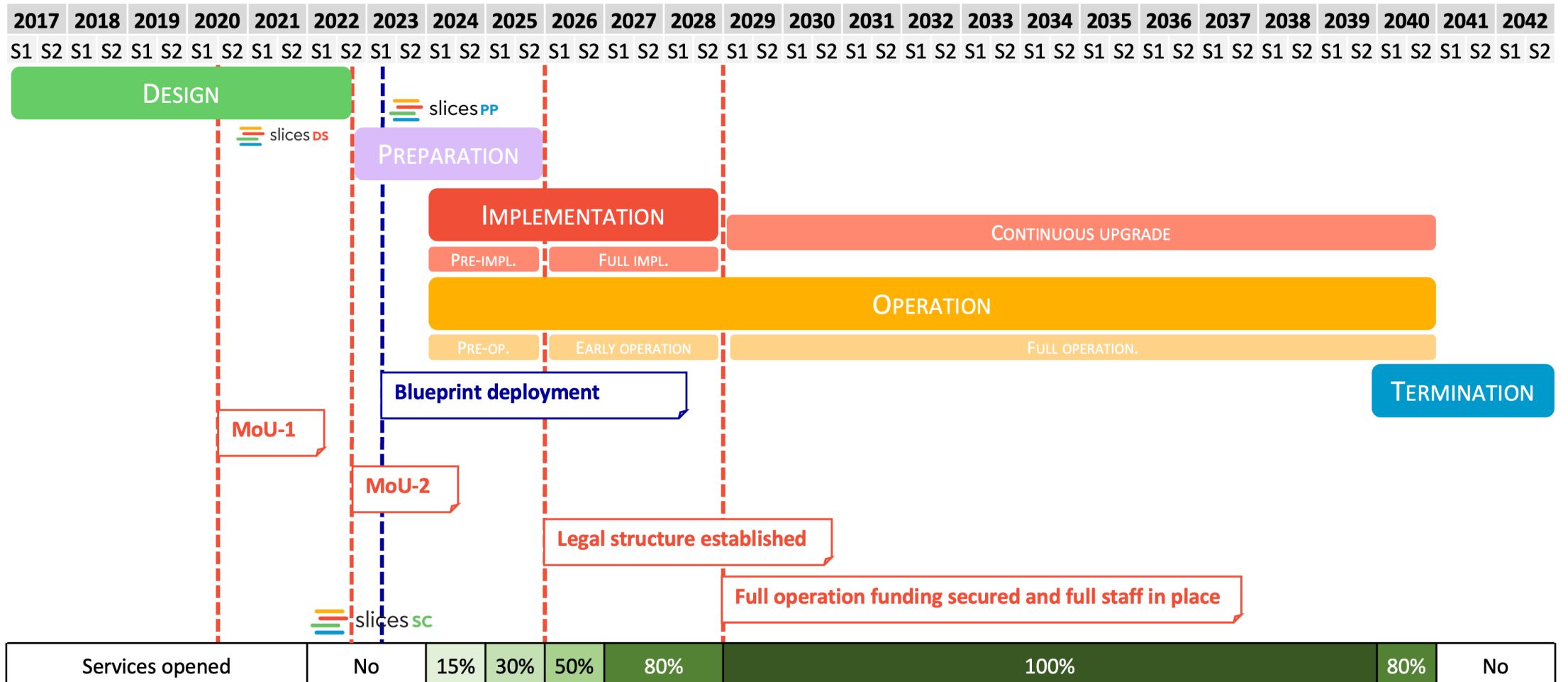


Initiated in 2017, **25 partners** from 15 countries:

- **12 political support** from National Ministries 🏛️
- included in **7 national roadmaps** 📄

SLICES will enable **scientific excellence and breakthrough** and will **foster innovation in the ICT domain**, strengthening the **impact of European research**, while contributing to European agenda to address **societal challenges**, and in particular, the twin transition to a sustainable and digital economy.

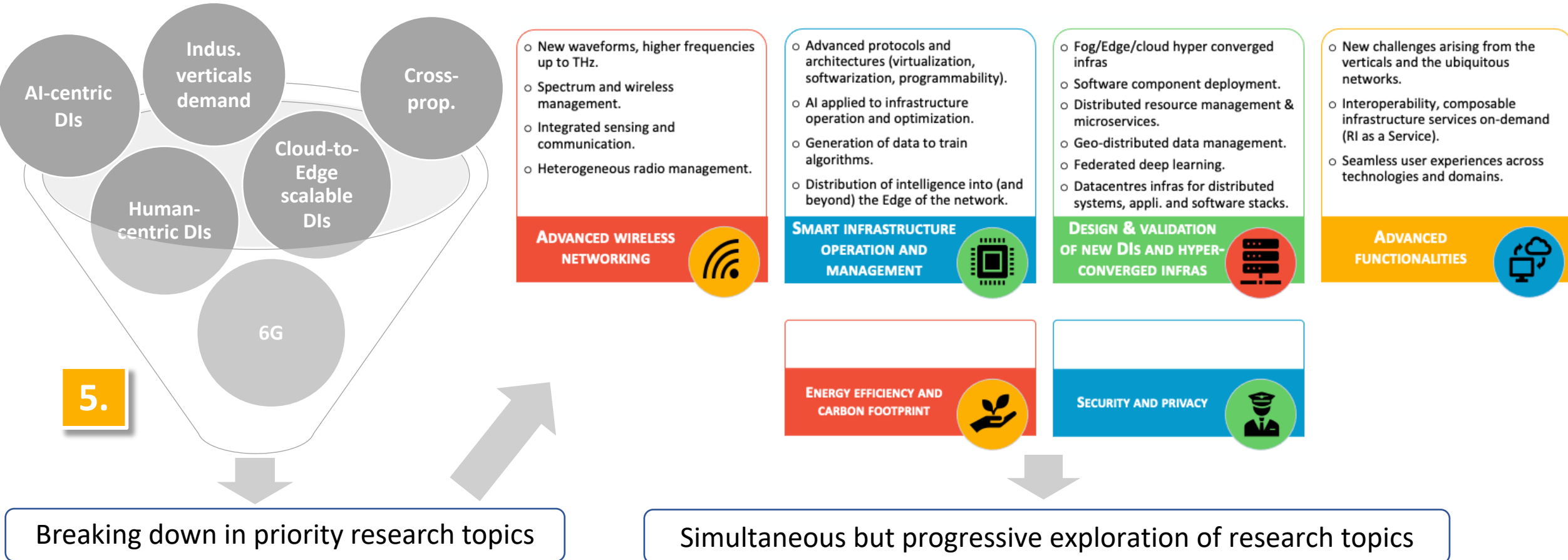
# SLICES timeline



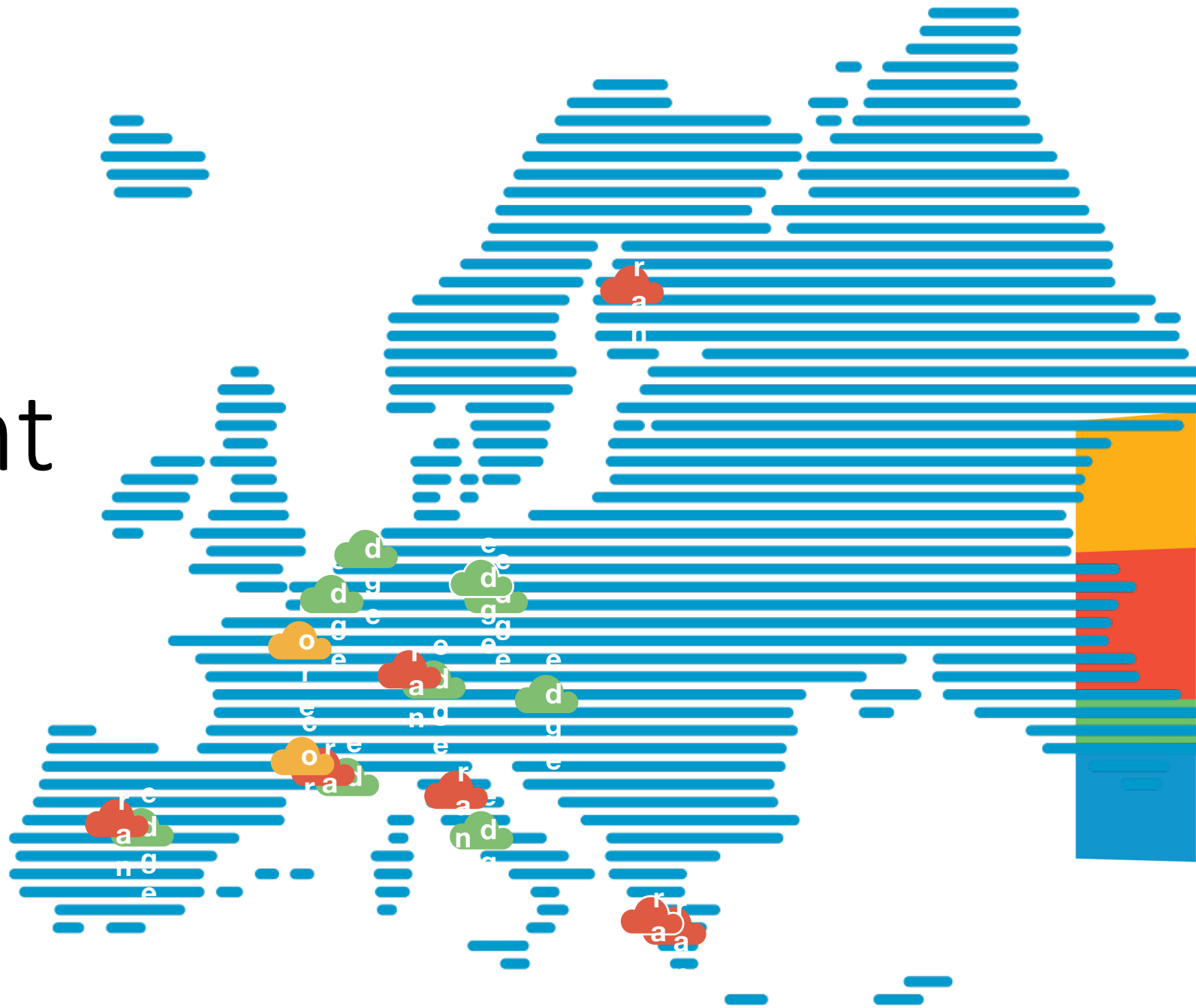


# Prioritisation of research topics

What's the methodology behind it?



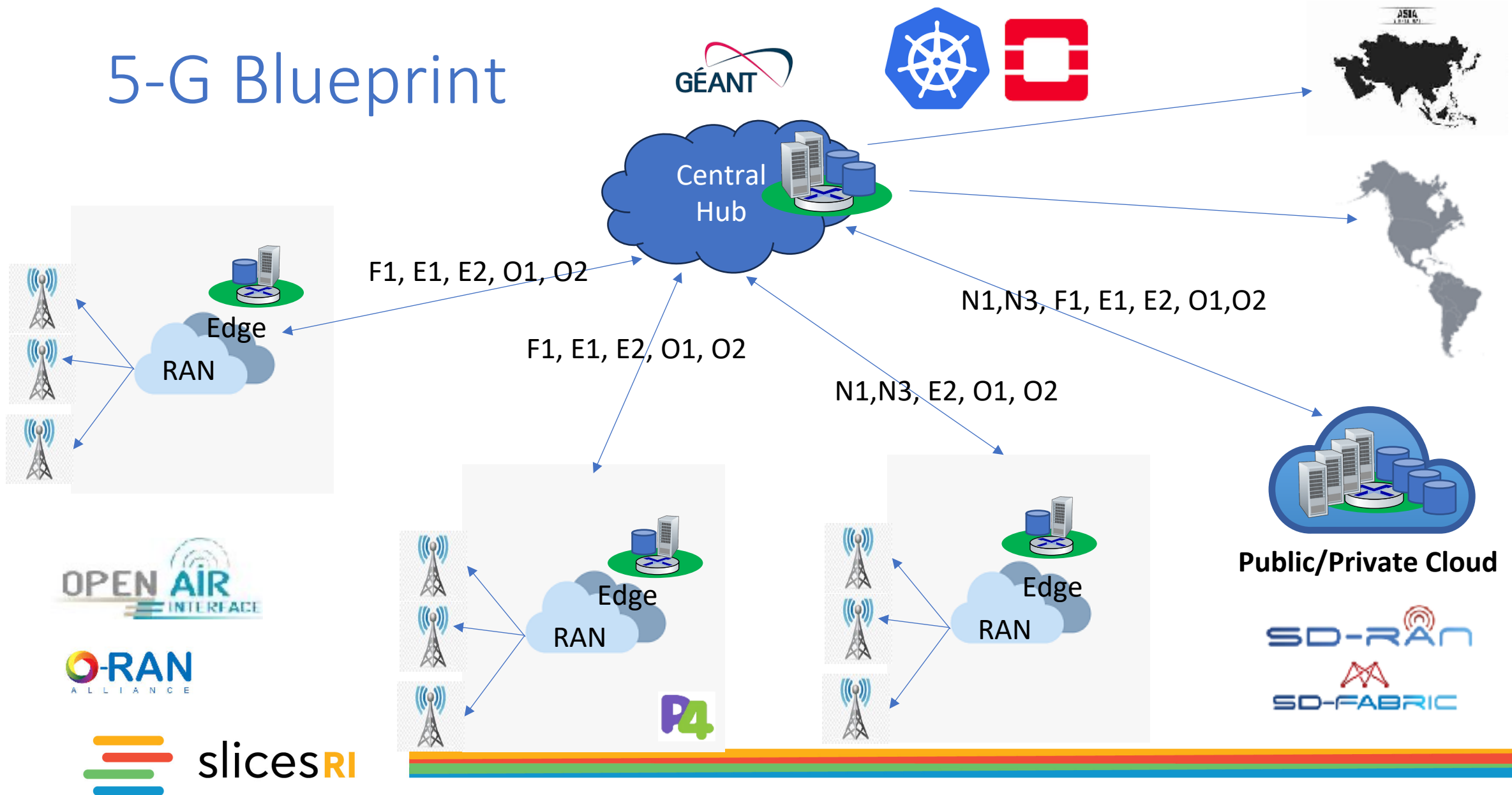
# Blueprint



# A Blueprint?

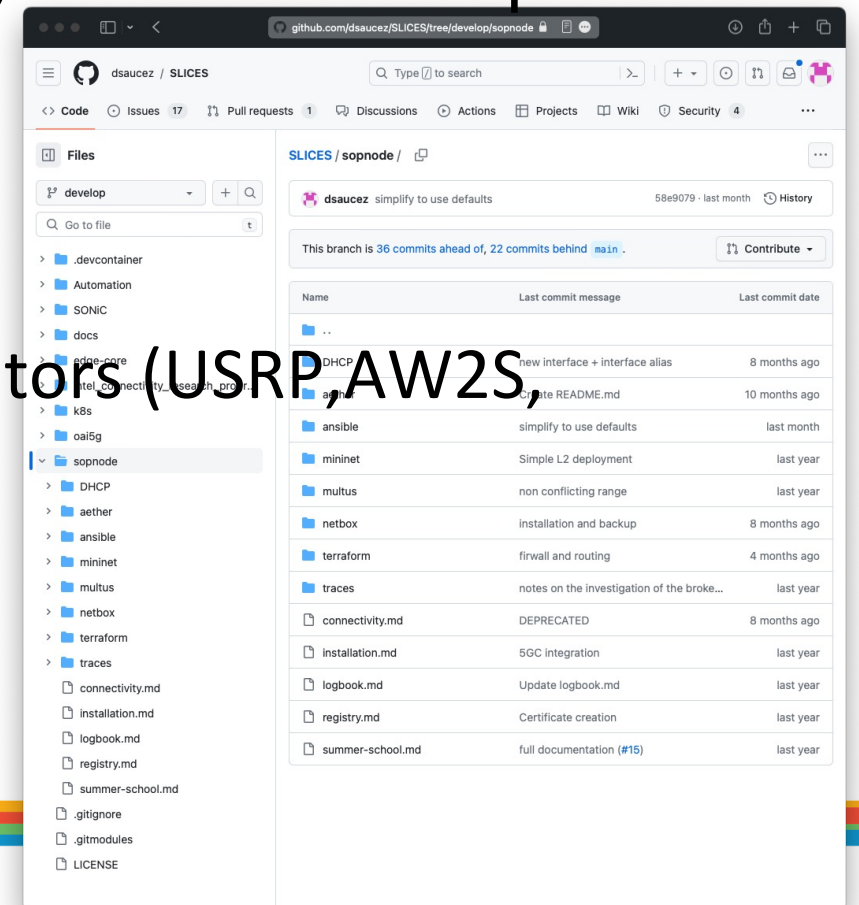
- A **blueprint** is an initial 'product backlog' and accompanying documents, representing the main requirements for the project
- Define a common terminology that doesn't require in-depth, technical knowledge
- Pick up the right resources, be iterative, review and validate, and keep it as a baseline.
- A **baseline system** can be built to validate requirements

# 5-G Blueprint



# Reference implementation (1/2)

- pos + Terraform (AWS, GCP, OpenStack) + Ansible for xp cycles
- Baremetal + kubernetes + docker + VM
- OpenAirInterface for core and RAN
- Software and/or hardware radio and accelerators (USRP, AW2S, Tofino)
- Automatic publication of data and metadata



# Reference implementation (2/2)

- Complete documentation and SLICES Academy integration

The screenshot shows a web browser displaying the 'SLICES Blueprint' documentation. The page title is 'SLICES Blueprint' and it includes a search bar and a navigation menu on the left. The main content area contains text explaining the blueprint's purpose and a section titled 'Architecture' which includes a network diagram. The diagram shows a 'pod network' with components like UDR, UDM, AUSF, NRF, Database, AMF, SMF, and UPF, connected to a 'Dedicated network' and a 'cloud'.

The screenshot shows the 'SLICES Academy' website. The header features the 'slices RI' logo and navigation links. The main content area is titled 'Slices Academy' and includes a grid of course cards. The cards are categorized into 'Training Events', 'Webinars', 'theNetworkingChannel', 'MOOCs', and 'Code Repository'. The 'MOOCs' section is expanded, showing several course cards with titles like 'Distributed post-5G Network', 'OpenDaylight @ NITOS', 'Quick overview of the portal and first', and 'Running OpenWiFi on a testbed'. Each card is marked as 'FREE'.





# Example of set-up

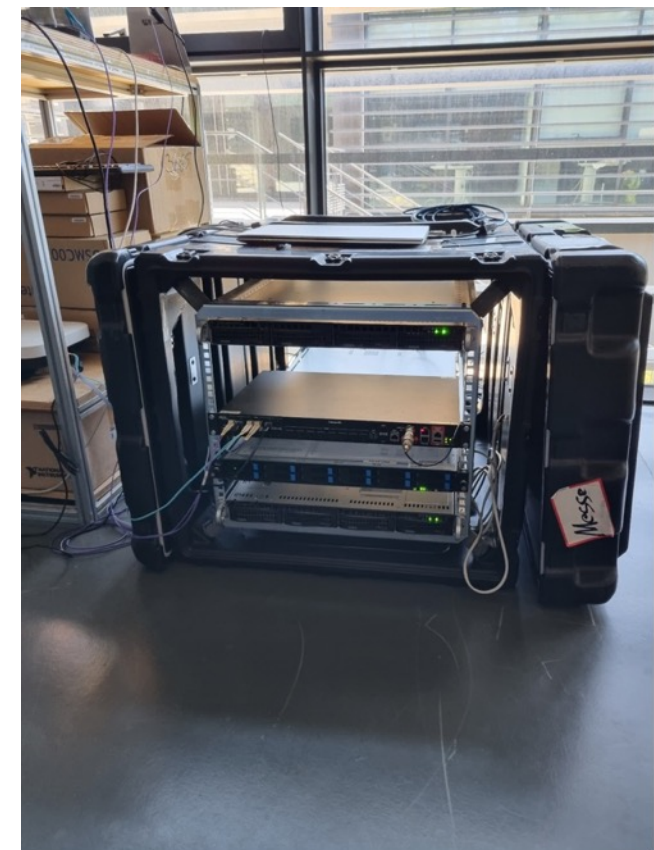


**core**

**slicesRI**



**Fronthaul**



# SLICES and EOSC Interoperability and Integration

EOSC: European Open Science Cloud

<https://eosc-portal.eu/>





# 6G Federated Data Infrastructure?



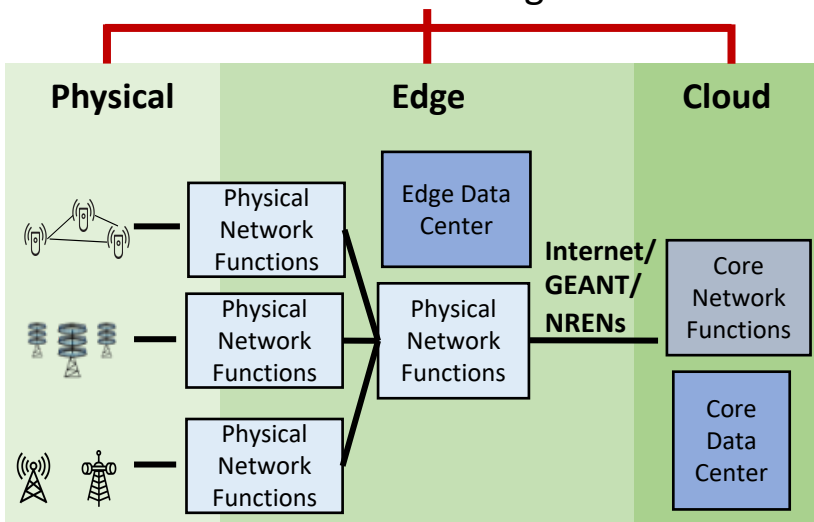
# SLICES contribution to the development of the EOSC



EUROPEAN OPEN SCIENCE CLOUD

Objectives: **federate existing research data infrastructures in Europe** and **realise a web of FAIR data and related services for science.**

## #1 Enable experimentation at multiple network levels through SLICES RI



Allow experimentation with future/emerging digital, IT and network technologies (e.g., 6G, IoT, Edge, AI, hyper-converged infrastructure).

## #2 EU-wide availability of unique Software and App Repositories

- ICT research-related services (e.g., testing new infrastructure and network solutions);
- Applications deployed within SLICES;
- Simulation tools;
- Data analysis tools.

Published in the EOSC Catalog and Marketplace and accessible with different access options.



open access



Orderable via provider channel



Orderable via EOSC hub

## #3 Interoperability with Open and FAIR data

- Producers of unique data;
- Maximize data reuse by adopting of FAIR data principles in Data Management and Governance;
- Processing of sensitive and personal information.

## #4 Integration of the SLICES communities to EOSC

- SLICES community building
  - More than 120 participants to the 1<sup>st</sup> SLICES workshop;
  - Thousands of users of existing infrastructures.
- Training services

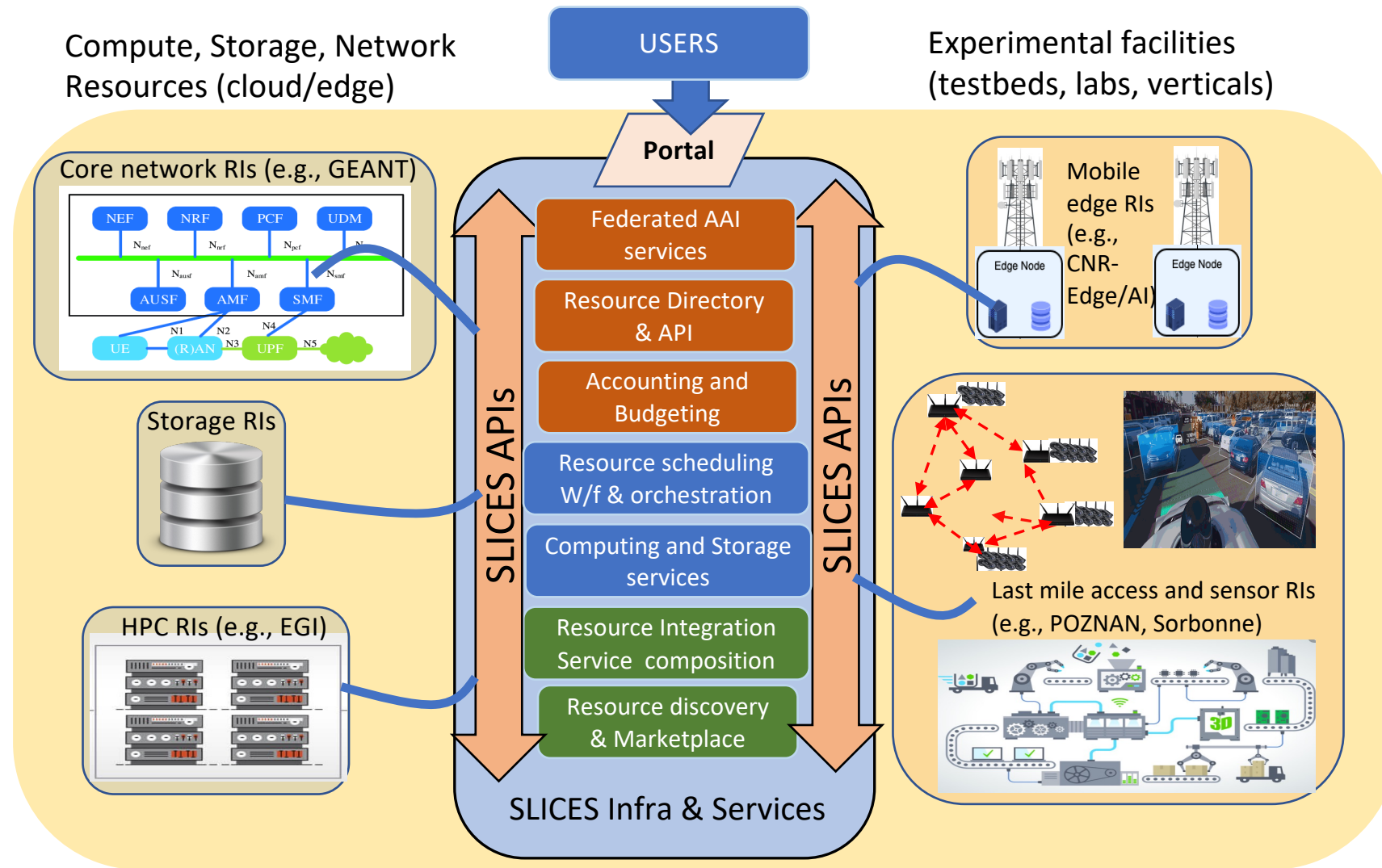


# SLICES-RI

## support for Open Data



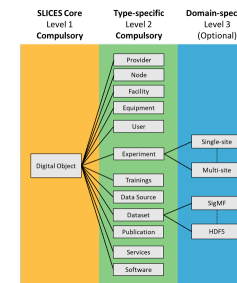
# SLICES infrastructure and Services



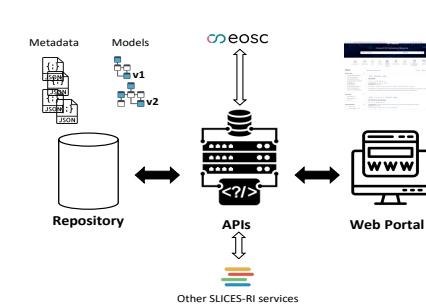
# SLICES FAIR DIGITAL OBJECT (SFDO)

## • Data Standards to support Open Data

- Flexible and Open Metadata Model
- FAIR compliance
- Data Licensing and Access



Hierarchical Metadata



Implemented Metadata Registry

```

// Access rights related with the digital object.
// Summary:
[JsonSchemaExtensionData(*x-slices-code", "SLICES_RT.63")]
public required string AccessRights { get; set; }

// License related with the digital object.
// Summary:
[JsonSchemaExtensionData(*x-slices-code", "SLICES_RT.64")]
public required string License { get; set; }

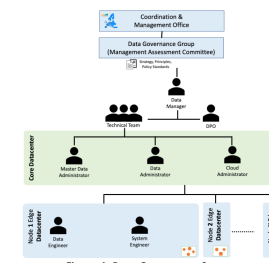
// A URI for the license related with the digital object.
// Summary:
[JsonSchemaExtensionData(*x-slices-code", "SLICES_RT.65")]
public required string? LicenseURI { get; set; }

// Copyrights holder related with the digital object.
// Summary:
[JsonSchemaExtensionData(*x-slices-code", "SLICES_RT.66")]
public required string? CopyrightHolder { get; set; }
    
```

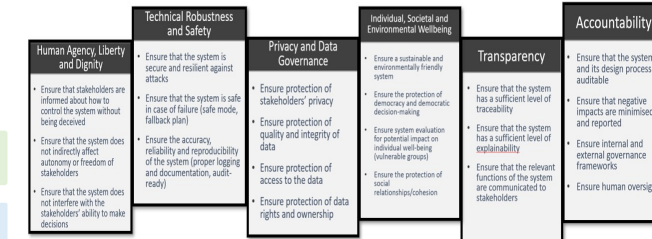
Machine-readable/actionable Metadata

## • Data Policies to support Open Data Management

- Data Management, Governance and Stewardship
- Data Privacy and Security Measures

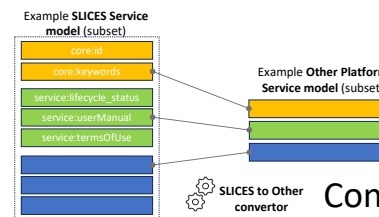


Multi-level/Stakeholder Data Governance



Ethics/Privacy Assessment Framework

## • Interoperability and Machine-actionability



Convertors (import/export) to known standards

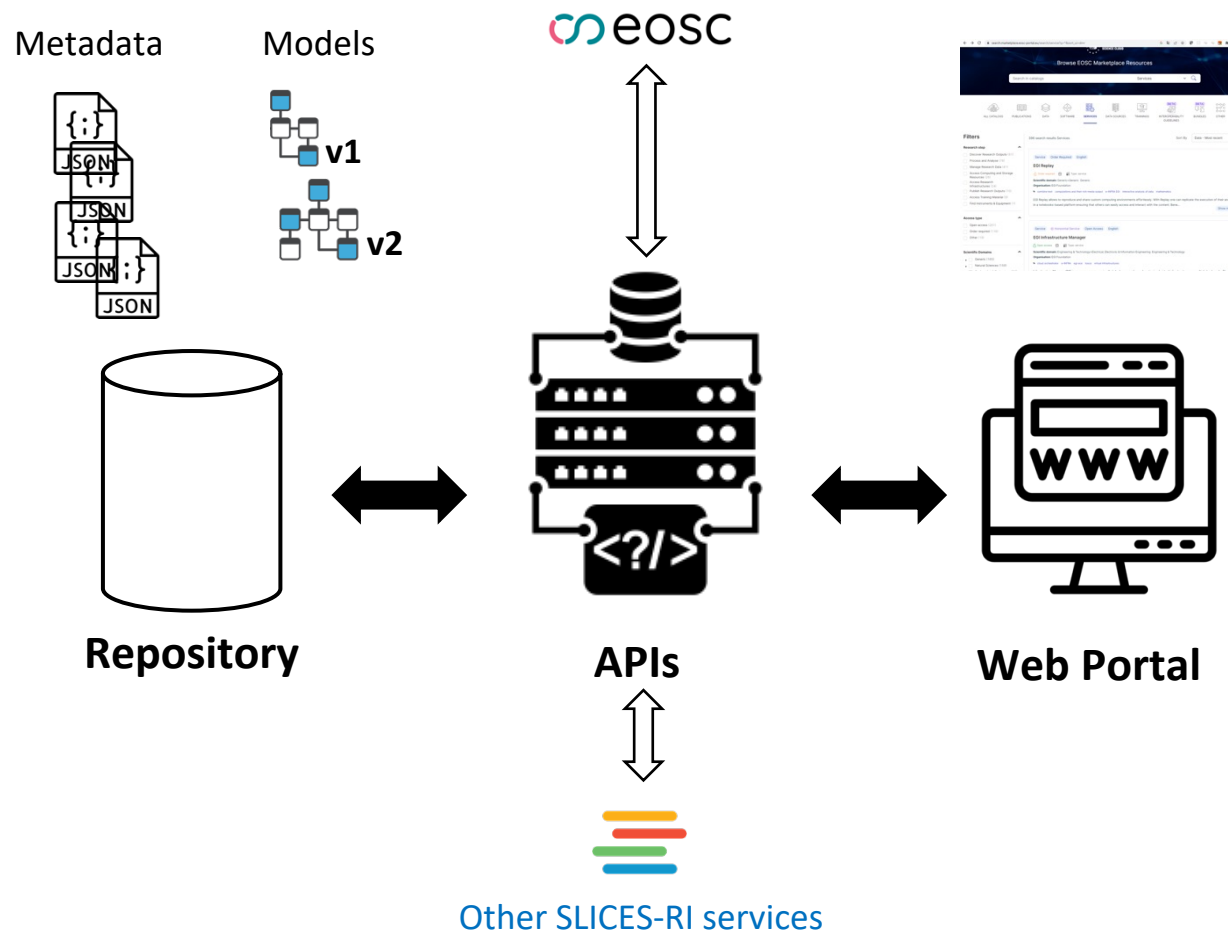
```

openapi:
  info:
    title: "SLICES Metadata Registry System"
    version: "v1.2"
  servers:
    - url: "http://local.host:5022"
  paths:
    /:
      components:
        schemas:
          DigitalObjectMetadata:
    
```

Well-documented APIs, versioning



# Metadata Registry System (MRS/SFDO)



- Realizes the SLICES metadata model
- Repository
  - Metadata data (datasets, services, experiments, etc.)
  - Metadata models used for versioning
- APIs
  - Discovery, Reporting services
  - Interoperability services (e.g., EOSC)
- Web portal
  - Access to the services
  - Dashboards



# SLICES Reproducible Experiment Workflow



# The pos Experiment Workflow

## Setup phase

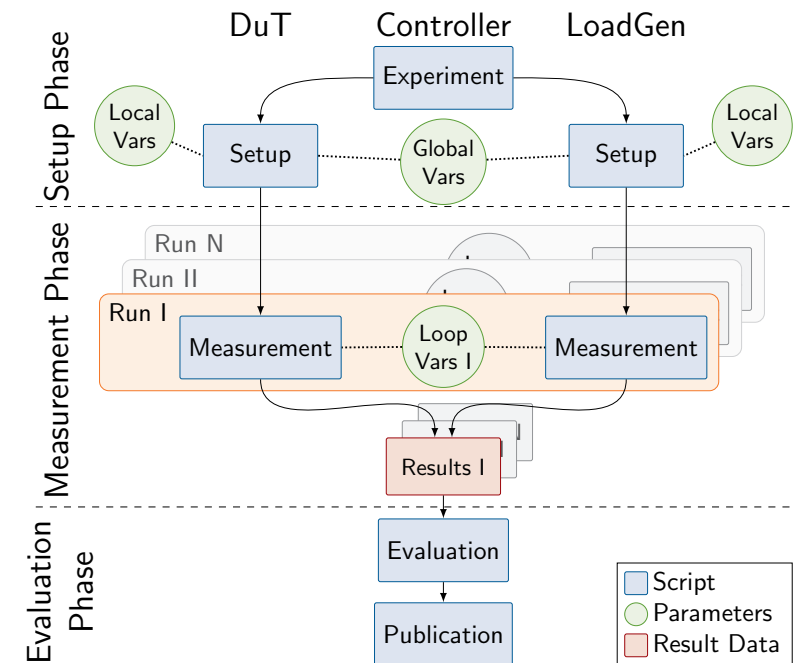
- Controller manages experiment
- Controller configures experiment nodes (DuT, LoadGen)
- Global/local variables (vars) parametrize setup

## Measurement phase

- Repeated execution of measurement script
- Loop variables parameterize each measurement run
  - e.g., different packet rates
  - data of each run is connected to a specific set of loop vars

## Evaluation phase

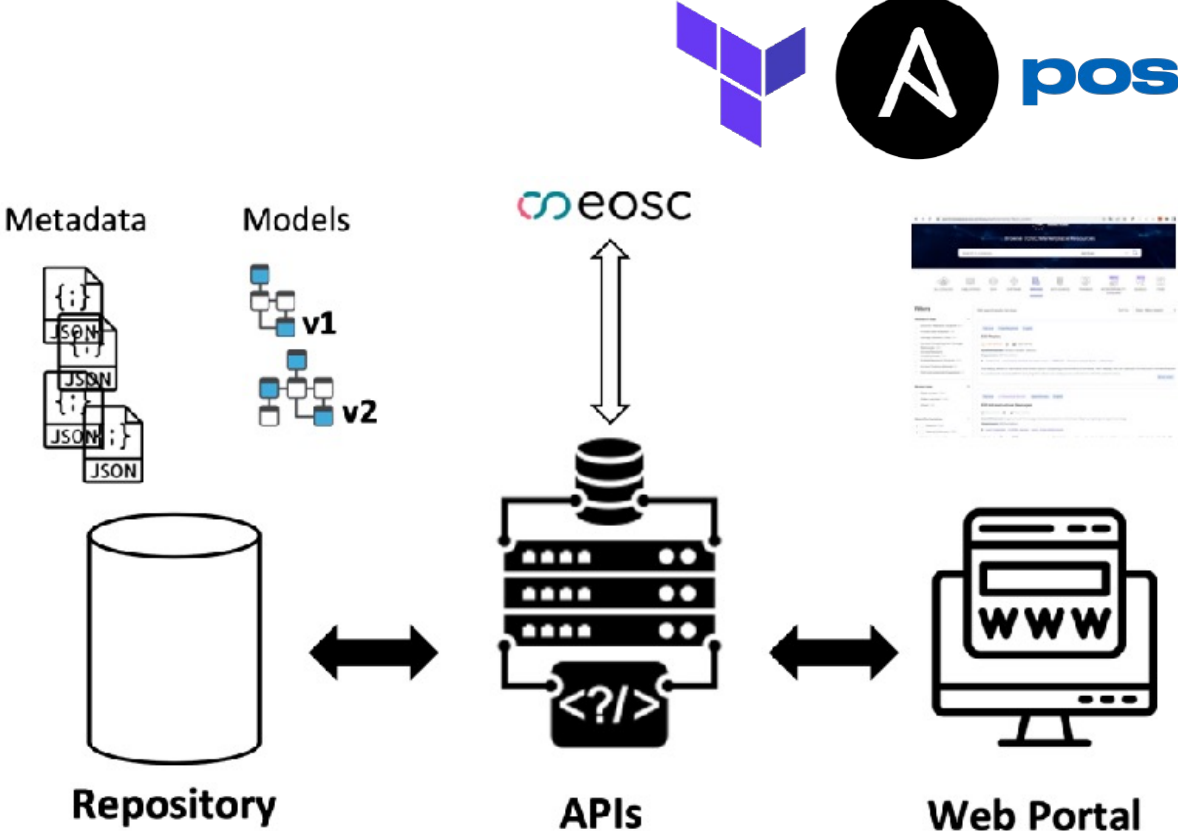
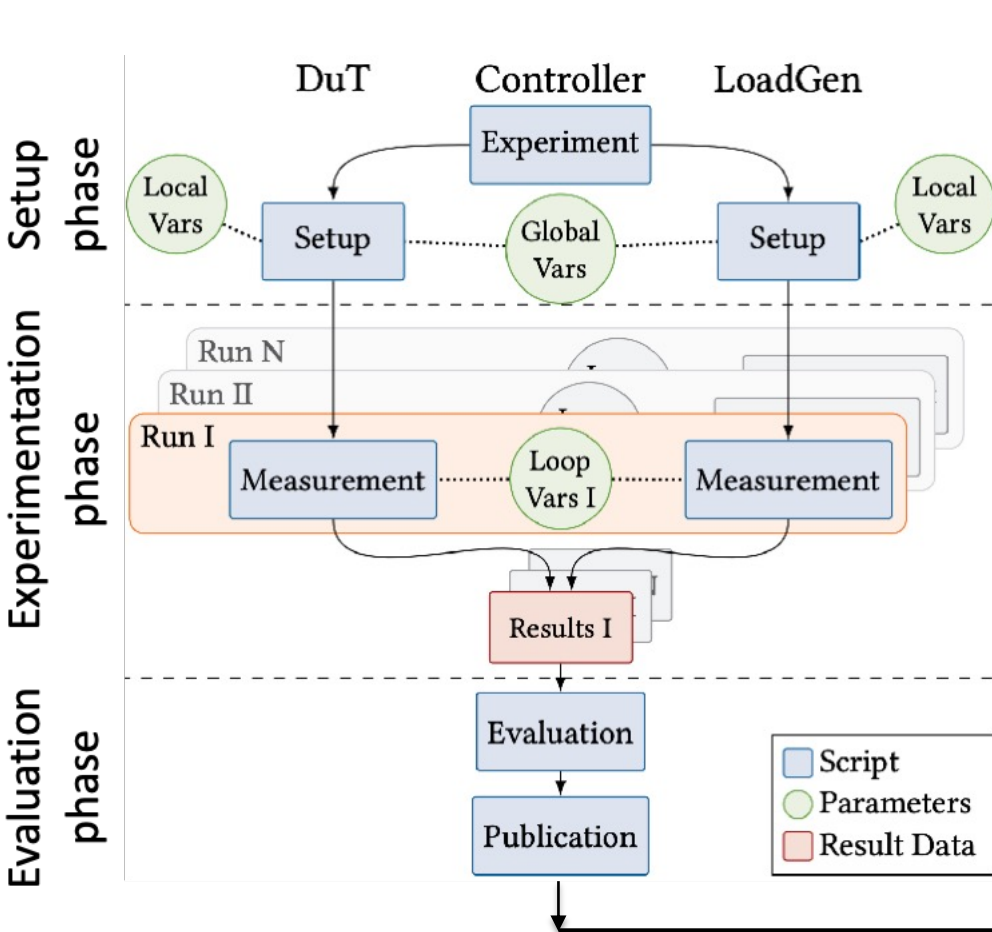
- Collected results/loop vars used for experiment evaluation
- Automated experiment release (git repository, website)



Structured Experiment Workflow with  
pos



# Experiment life-cycle comes true

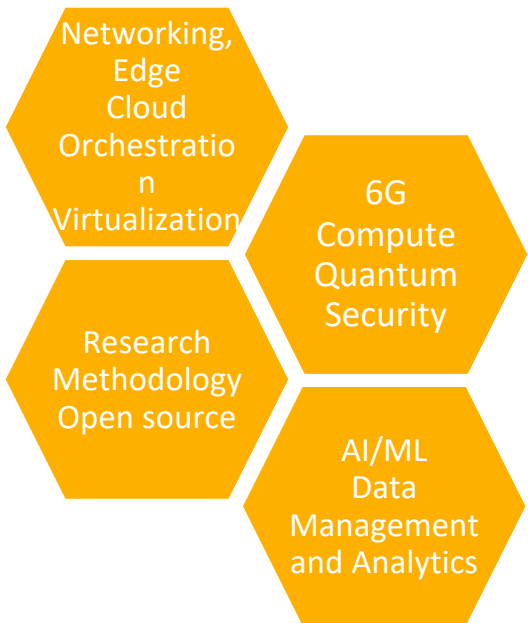




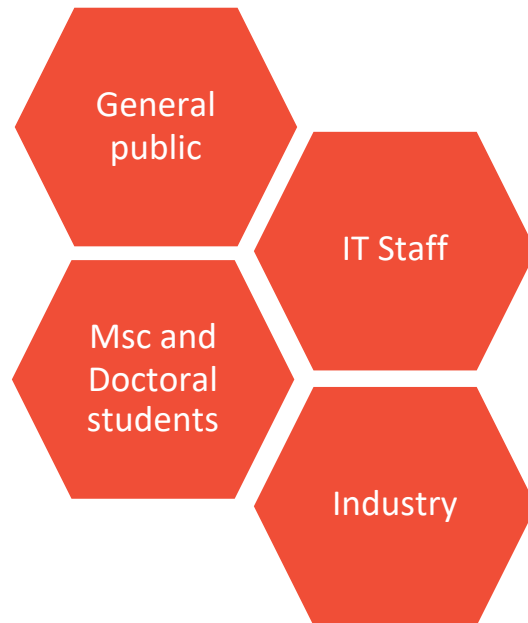
# SLICES Academy

# SLICES Academy

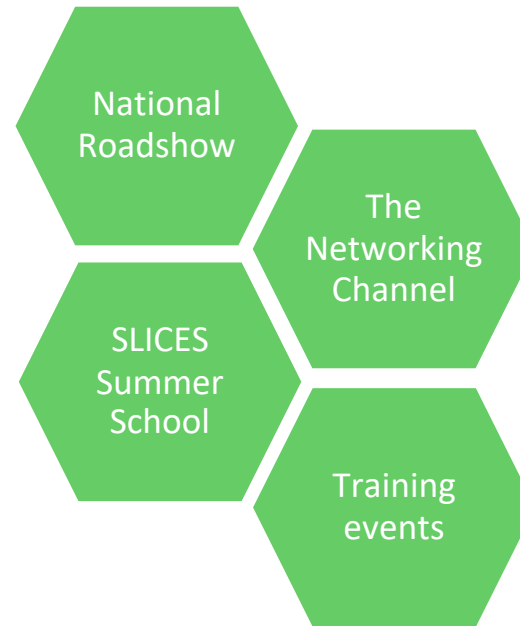
## Skills



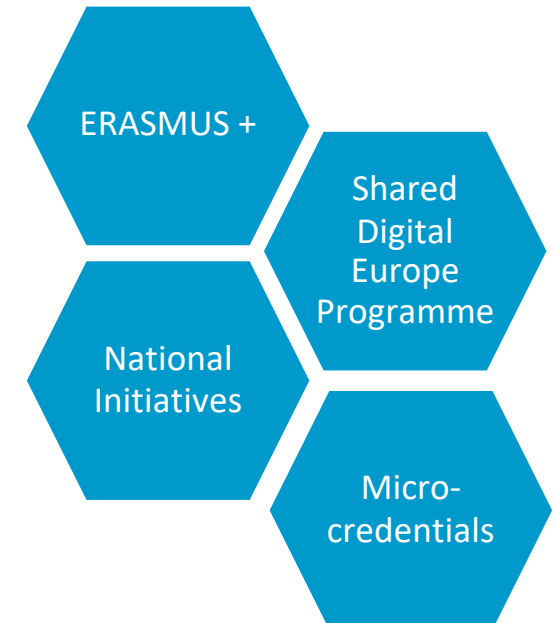
## Audience



## Tools

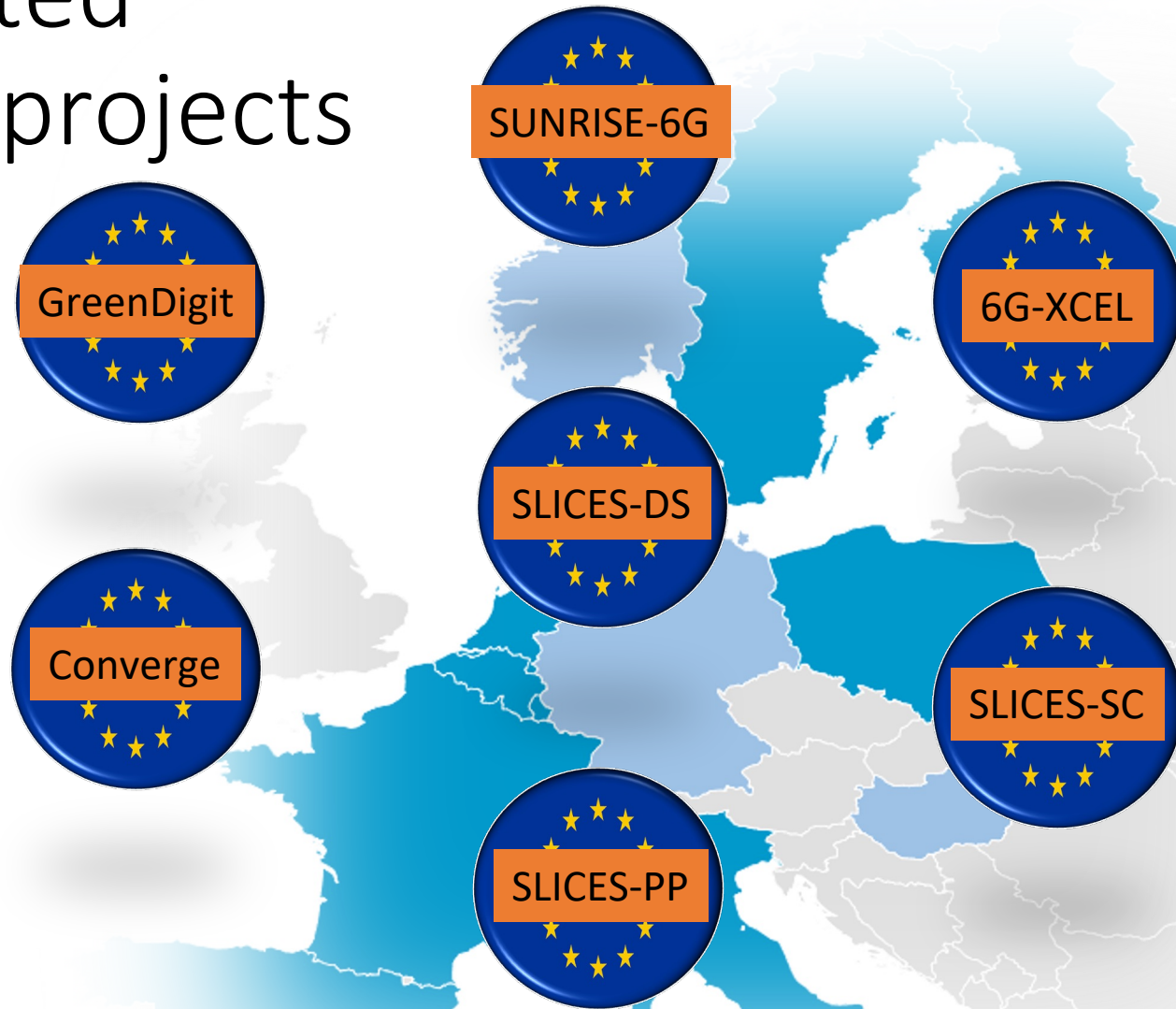


## Funding



# SLICES cooperation framework

# SLICES related EU funded projects



# SLICES as a Catalyst



# DIGITAfrica



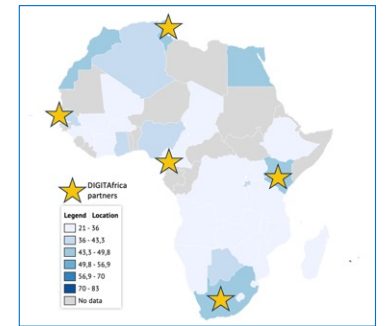
## Towards a comprehensive pan-African research infrastructure in Digital Sciences

- Strathmore University (STR)
- Université Cheikh Anta Diop de Dakar (UCAD)
- Université de la Manouba (UMA)
- Université de Ngaoundéré (UN)
- University of Cape Town (UCT)

Kenya  
Senegal  
Tunisia  
Cameroon  
South Africa



# DIGITAfrica



Network Readiness Index for Africa

## *Design an effective and long-term pan-African Digital research infrastructure*

- Co-construct a comprehensive strategy to structure a **pan African RI** in Digital Sciences
- Enhance **community building** in Digital Sciences
- Develop **capacity building** in Digital Sciences
- Set up a **playground** and demonstrate the Proof of Concept (PoC)
- Define a **sustainable** path for DIGITAfrica RI





Thanks for your attention

Questions?

For more information, please contact:

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