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# Experiment. Innovate. Transform.

## The future of digital infrastructure starts with SLICES

**Bridging research and innovation in digital infrastructure, SLICES supports the scientific community with cutting-edge experimentation tools and environments**

**THE DESIGN** and deployment of the Next Generation Internet (NGI) challenges the digital infrastructure (DI) research community: how can we build and operate an increasingly complex ecosystem bridging communication, networking, distributed systems, computing, data management and more and more artificial intelligence (AI)?

NGI research needs combinations of legacy and emerging technologies, including, but not limited to, 5G/6G wireless, Internet of Things (IoT) devices, and programmable elements in the IoT-edge-continuum over systems and networks of all kinds. The enormous amount of data generated and exchanged over the network, with the rise of AI and sensing everywhere, requires going beyond incremental changes and investigating radically new infrastructure designs and data management approaches. More experimentation and data-driven research are required to address these challenges. Consequently, there is an urgency for the creation of large-scale research infrastructures to support DI investigative work and to make results trusted, repeatable, and accessible to the worldwide community.

### **Understanding the role of research infrastructures**

A research infrastructure (RI) refers to a facility, system, or service that enables the research community to explore, experiment and produce knowledge in a sustained, collaborative and high-impact way. These infrastructures may be physical, digital, or hybrid in nature and are designed to provide the advanced tools, platforms, and data necessary for addressing complex scientific and technological questions. At the European level, RIs are long-term strategic assets that underpin excellence in research and innovation across disciplines.

SLICES is positioned as a strategic RI, since it directly addresses the increasing complexity and interdependence of future digital infrastructures. As a response to the evolving needs of the scientific community working on networking, distributed systems, cloud-to-edge computing, IoT and AI, SLICES provides the scale, flexibility and reproducibility needed to support cutting-edge experimentation. Its inclusion in the ESFRI Roadmap since 2021 confirms its critical role in reinforcing Europe's capacity for scientific leadership, technological autonomy, and innovation in the Next Generation Internet landscape.



### **The need for scalable, verifiable and reproducible experimentation in DI research**

Worldwide digital communication and computer infrastructures are among the largest systems ever created, as demonstrated by the sheer size of the internet or the scale of cellular networks. The convergence of the internet, computing, and networking is accelerating due to new applications

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and services, resulting in a sophisticated, interconnected digital landscape that is increasingly visualised and programmable. This landscape uses technologies ranging from data centres (DCs) for cloud services and advanced wireless equipment to small IoT devices for sensing and control.

A complementary set of scientific fields – including physics, mathematics, and engineering – has contributed to the design, deployment, operation and management of these systems. It is well known that verifiable experiments are essential to the discovery process in all these fields and represent a shared best practice. In the field of digital infrastructures (DI), the scientific reproducibility of experiments is especially critical due to the complex, dynamic, and distributed nature of systems under study. Without rigorous control and repeatability, experimental findings lack credibility and cannot be reliably validated or built upon.

However, experimentation in DI research has been curtailed by the limitations of commercial infrastructures or small-scale custom testbeds. Repeatable, reproducible, and verifiable research and experiments are cornerstones of all research. This requires full control of the environment, together with the ability to scale and reproduce results before deployment. To meet this need, SLICES is designed to support end-to-end experimentation, enabling researchers to reproduce complex scenarios with precision. It ensures consistent system states, data flows, and execution conditions – essential elements for high-quality, reproducible science.

SLICES integrates the FAIR data management principles – Findability, Accessibility, Interoperability, and Reusability – not only to ensure that research data can be properly archived and shared, but also to support collaborative work, reproducibility, and long-term impact. In the context of DI, where experiments often involve massive, heterogeneous, and real-time data, FAIR compliance is fundamental to achieving scientific rigour and openness.

By embedding reproducibility, FAIR principles, and interoperability at its core, SLICES sets a new benchmark for trustworthy and collaborative digital infrastructure research.

### Europe's gap in network research

Improvements needed for the current internet, as well as for 5G+ networks to support next-generation services and applications, require new research and development (R&D) infrastructures and platforms. International initiatives, such as the US National Science Foundation (NSF) [Platforms for Advanced Wireless Research \(PAWR\)](#), [Fabric](#), [Colosseum](#), [ChameleonCloud](#), and China's National Future Intelligent Network Test Facility (CENI) have been developed. In this global context,



SLICES-RI emerges as Europe's concerted response to these challenges, positioning itself within a broader continental strategy aimed at reinforcing scientific collaboration and technological leadership. By fostering synergies among European Member States, SLICES strengthens the continent's capacity to act collectively in shaping the digital future.

This collective effort is not only about innovation, but also about ensuring Europe's digital sovereignty – the ability to independently design, test, and deploy foundational technologies in networking, computing, and data infrastructure without relying on external actors. In this sense, SLICES plays a strategic role in supporting the autonomy and resilience of European digital ecosystems.

To support sensitive experimentation, SLICES-RI incorporates robust security and privacy mechanisms at all levels of its infrastructure. This includes sandboxed environments, strict access controls, and resource isolation to guarantee safe, confined testing. For experiments involving AI models, IoT sensors or personal and contextual data, confidentiality is preserved through data anonymisation, encrypted communications, and dedicated privacy-preserving protocols.

Moreover, the platform is fully compliant with the General Data Protection Regulation (GDPR) and other relevant European frameworks, including cybersecurity directives and data governance standards. These guarantees ensure that all research conducted on SLICES meets the highest legal and ethical standards, while also reinforcing trust in the experimental results.

**Supporting end-to-end experimentation in Europe**  
SLICES-RI (SLICES-Research Infrastructure), included in the 2021 ESFRI Roadmap, aims to tackle NGI challenges by building the large infrastructure needed for experimentation on various aspects of networking and telecommunications in the post-5G/6G era. It also aims to enable advanced research in related DI fields, such as distributed systems, IoT, and federated learning (FL), integrating these within the emerging edge-cloud continuum. Through multidisciplinary experimentation, SLICES-RI provides the means to create innovative horizontal and vertical services.



SLICES-RI addresses the full lifecycle management of the experimental process – from initial design to data, services, and applications – and offers necessary resources to support implementation, operation, and automation.

SLICES-RI brings several assets to the European ecosystem :

- **Cost-effectiveness:** SLICES eliminates the need for academics and companies to invest in new equipment or develop specific internal expertise from the ground up.
- **Neutrality:** As a politically agnostic, goal-independent platform, SLICES allows even competing industrial stakeholders to conduct evaluations and proof-of-concept validations in a shared, impartial environment.
- **Long-term sustainability:** While most projects have a lifespan of three to four years, SLICES – as an ESFRI – offers continuity over two decades or more, enabling sustained experimentation and impact.

SLICES can positively impact other fields that need DI capabilities, including remote robotics and automation, intelligent agriculture, remote medicine, and learning. This can be achieved by constantly assessing the needs of the research communities; identifying the key research challenges to be addressed at the European and international levels; and developing its experimental offerings accordingly.

### Building Europe's reference platform for digital experimentation

SLICES-RI aspires to become the reference European platform for experimentation and high-quality research on digital infrastructures and services. It aims to meet the needs of an increasingly multidisciplinary research community and respond to the significant demand from both the research community and industry, including small and medium enterprises (SMEs), in a fast-evolving market landscape.

Its value proposition rests on providing users with the ability to experiment with cutting-edge technologies, emulating a large pallet of scenarios that include data sensing through IoT and sensors to data processing and storage in the cloud, going through different networks to carry it. Such scenarios are increasingly present in numerous verticals, such as Industry 4.0, smart agronomy, or remote medicine. SLICES-RI creates a dynamic ecosystem between research and industry to deliver solid results that lead to scientific breakthroughs as well as innovative solutions and products for commercial markets. Researchers can test their ideas in real, flexible, and open technology environments – a DI 'Living Lab' – guaranteeing reproducibility

of experiments and the trustworthiness of results. Simultaneously, industrial users can reduce costs by testing emerging, unproven technologies, enabling them to innovate, create new products, increase revenues, and become more resilient to change.

This is particularly valuable for SMEs and startups, which often face high barriers to entry in technological innovation due to limited resources. By accessing advanced infrastructures and support services without the need for heavy initial investment, these actors can accelerate their R&D cycles, de-risk experimentation, and gain faster access to market opportunities.

In this sense, SLICES-RI becomes not only a scientific asset but also a strategic lever for innovation, competitiveness, and technological sovereignty at the European level.

### From early testbeds to a European research infrastructure

SLICES benefits from experience gained since 2005 by designing, deploying, and operating several test platforms such as PlanetLab Europe and EU FIRE testbeds. The initiative has been implemented through consecutive projects to validate its concept and lead to implementation.

The H2020 SLICES-DS allowed researchers to define the foundation of the RI architecture, including technical requirements, legal structures, costs, and financial aspects. This effort was made possible thanks to strong support from the European Commission through the Horizon 2020 programme, and is now continuing under Horizon Europe, demonstrating sustained institutional trust in the long-term strategic value of SLICES.

The H2020 SLICES-SC (starting community) project launched actions and open calls to build a research community around the SLICES-RI ecosystem and strengthen relationships with industrial stakeholders to support future commercial exploitation.

The current Horizon Europe SLICES-PP (preparation phase) addresses key technical questions necessary for deployment, defines research blueprints for targeted areas, and supports the legal framework to become a European Research Infrastructure Consortium (ERIC) in 2027.

Once established, the ERIC will be governed by a council composed of representatives appointed by the participating countries, ensuring strong national engagement in strategic, financial, and operational decisions. Today, 16 European states are participating in discussions to build this structure (France, Germany, Spain, Italy, Greece, Belgium, Ireland, Cyprus, Hungary, Switzerland, Sweden, Poland, Norway, Netherlands, Finland and Luxembourg).



### Serving a diverse and evolving research community

The SLICES-RI infrastructure serves a large, diverse community primarily composed of scientists and engineers contributing to internet development and underlying technologies. Due to convergence in DI, the community now also includes distributed computing, data science, and applied AI researchers. These experts participate in scientific and standardisation organisations, such as the Internet Engineering Task Force (IETF), the Institute of Electrical and Electronics Engineers (IEEE), and the Association for Computing Machinery (ACM), relying on these bodies to disseminate their work.

### Driving scientific excellence in digital infrastructure research

Since its inception, SLICES-RI's vision has been to design, implement, and operate a large, interconnected infrastructure that supports experimental research in future networking, telecommunications, distributed computing, federated learning, and IoT for horizontal and vertical applications. It emphasises integration across the edge-cloud continuum, from IoT sensing and imaging at the edge to large cloud data centres.

SLICES' ongoing mission is to enable end-to-end experimentation and reproducible research across hardware, software, and applications – covering data capture, processing, inference, storage, radio management in 5G/6G, and dynamic deployment of edge services – while offering full research flexibility.

### Sustainability and environmental impact in SLICES-RI

From the beginning, SLICES-RI has also committed to minimising its environmental footprint by embedding Green IT principles into the design, deployment, and operation of the infrastructure. This includes the development of a clear policy for the procurement and deployment of equipment, aiming to optimise energy usage through intelligent orchestration of workloads, resource sharing across storage, networking, and compute, and efficient infrastructure utilisation. Moreover, SLICES adopts a responsible lifecycle management approach, considering the environmental impact of equipment manufacturing, maintenance, and end-of-life processes to ensure sustainability throughout the entire asset lifecycle.

In parallel, SLICES will serve as a platform to assess and monitor the carbon footprint of the services and experiments it hosts, providing researchers with tools to measure energy consumption and gain awareness of its environmental impact. This emphasis on sustainability aligns with the objectives of the European Green Deal and broader EU digital responsibility goals, positioning SLICES as a strategic instrument for reducing the environmental footprint of digital technologies.

### From collaboration to governance: Building SLICES-RI together

Today, the SLICES-RI consortium is collaboratively

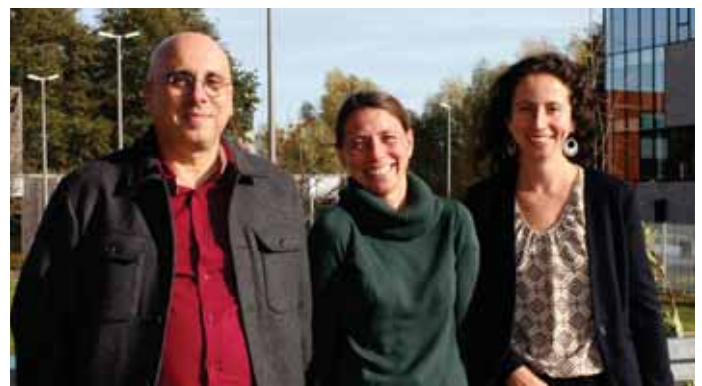
developed by 26 partners across 16 European Member States. Over 700 researchers and engineers actively contribute, working together to structure the platform at national and European levels. The infrastructure under development is expected to become an ERIC by 2027, governed by a board composed of representatives appointed by governments of participating countries. France, as host country and main sponsor, is expected to host the headquarters.

While demanding for all involved, the preparation phase is a decisive step to build a resilient foundation for SLICES. The ambition is to shape an infrastructure capable of evolving over the next 20 years, anticipating and adapting to major technological and societal transformations that will define Europe's and the world's digital future, while maintaining scientific excellence and ensuring adaptability to ongoing technological transitions.

### Building tomorrow's digital infrastructure: Your involvement matters

SLICES-RI represents Europe's strategic initiative to establish a leading, open, and sustainable digital research infrastructure that empowers researchers and industry alike. By fostering collaboration, reproducibility, and innovation, SLICES is poised to shape the future of digital infrastructures and services for decades to come.

Currently, our partners are actively developing the core services and expanding the platform's capabilities. To best address the needs of current and future users, we seek your input and requirements. If you are interested in SLICES, we encourage you to get in touch, share your needs, visit [SLICES-RI website](#), explore our tutorials, and participate in our dedicated schools and workshops. Follow us on LinkedIn to stay informed and engaged.



Left to right: Christian Perez, Nathalie Mitton and Solenne Fortun



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