

HORIZON 2020 H2020 - INFRADEV-2019-3

D5.2 M12 Dissemination and Communication Report

Acronym	SLICES-DS
Project Title	Scientific Large-scale Infrastructure for Computing/Communication Experimental Studies – Design Study
Grand Agreement	951850
Project Duration	24 Months (1/9/2020 – 31/8/2022)
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Executive Summary

The objective of this document is to update the communication and dissemination strategy plan as appropriate and to report on M12 activities. It also includes input about what have been the most effective communication tools and channels in terms of community reach. In addition, it reports on activities pursued to grow social media innovation community and engagement of stakeholders.

The document describes the activities SLICES-DS partners pursued to guarantee broad visibility, promotion and up-take of SLICES-RI.

This deliverable also paves the way to the future D5.4 "Strategy for the future communication and exploitation of the SLICES-RI" that will be prepared at M24.





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1 Introduction

1.1 Intended audience

This document is aimed at SLICES-DS consortium members, to update the effective and integrated approach to dissemination and communication activities and to contribute to the overall objectives of SLICES-DS. In addition, it aims to inform about the status of the dissemination and communication activities within the first 12 months of SLICES-DS implementation.

1.2 Document structure

The document is structured into the following sections:

- Chapter 1 – INTRODUCTION: it introduces the intended audience of the document and its structure.
- Chapter 2 – SLICES-DS AT A GLANCE.
- Chapter 3 – DISSEMINATION CHANNELS AND TOOLS REPORT: report on dissemination activities during the first 12 months.
- Chapter 4 – DISSEMINATION EVENTS: EVENTS, ORGANISED BY SLICES-DS CONSORTIUM MEMBERS AND THIRD PARTIES – report on events during the first 12 months.
- Chapter 5 – MONITORING AND EVALUATION: for the dissemination activities.
- CONCLUSIONS





2 SLICES-DS at a glance

Digital Infrastructures as the future Internet, constitutes the cornerstone of the digital transformation of our society. As such, innovation in this domain represents an industrial need, a sovereignty concern and a security threat. Without Digital Infrastructure, none of the advanced services envisaged for our society is feasible. They are both highly sophisticated and diverse physical systems but at the same time, they form even more complex, evolving and massive virtual systems. Their design, deployment and operation are critical. In order to research and master Digital Infrastructures, the research community needs to address significant challenges regarding their efficiency, trust, availability, reliability, range, end-to-end latency, security and privacy. Although some important work has been done on these topics, the stringent need for a scientific instrument, a test platform to support the research in this domain is an urgent concern.

SLICES-RI (Research Infrastructure) ambitions to **provide a European-wide test-platform**, providing advanced compute, storage and network components, interconnected by dedicated high-speed links. This will be the main experimental collaborative instrument for researchers at the European level, to explore and push further, the envelope of the future Internet. A strong, although fragmented expertise, exists in Europe and could be leveraged to build it. SLICES-RI is our answer to this need. It is ambitious, practical but overall timely and necessary. The main objective of SLICES-DS is to adequately design SLICES-RI in order to strengthen research excellence and innovation capacity of European researchers and scientists in the design and operation of Digital Infrastructures. The SLICES Design Study (DS) will build upon the experience of the existing core group of partners, to **prepare in details the conceptual and technical design of the new leading-edge SLICES-RI for the next phases of the RI's lifecycle**.

Regarding the objectives, all SLICES-DS objectives have been defined in relation to the list of Minimal Key Requirements of the ESFRI 2021 Roadmap for the Preparatory phase, in order to be reached at the end of the Design Study.

SLICES-DS consortium identified 5 main objectives to be reached during the 24-months duration of the project, keeping in mind the overall SLICES-RI initiative:

1. To adequately design SLICES-RI in order to strengthen research excellence and innovation capacity of European researchers and scientists in Digital Infrastructures;
2. To accomplish preparatory work and planning of the new Research Infrastructure;
3. To define governance and management of the new Research Infrastructure;
4. To define models for the financing of the new Research Infrastructure;
5. To define stakeholder and engagement strategy on community-based research.

SLICES-DS consortium gathers partners from **nine countries** (France, Greece, Poland, Switzerland, Spain, the Netherlands, Cyprus, Italy, Belgium) with a special focus in networking and wireless research; Future Internet; Internet of Things and Internet of Services; mobile communications, security of telecommunications and applications; Network protocols and architectures, NFV, cloud/edge/fog computing, artificial intelligence; deployment of 5G testbeds for experimentation; Data Management, Data Analytics.

However, SLICES-DS is an instrument to support the development of the SLICES community, its identity, role and mission statement. Therefore, a global and inclusive approach for dissemination and outreach is pursued. As a consequence, SLICES-DS is integrated as a project in the SLICES-RI dissemination strategy (slices-ri.eu) as a consequence of our long-term development and sustainability.



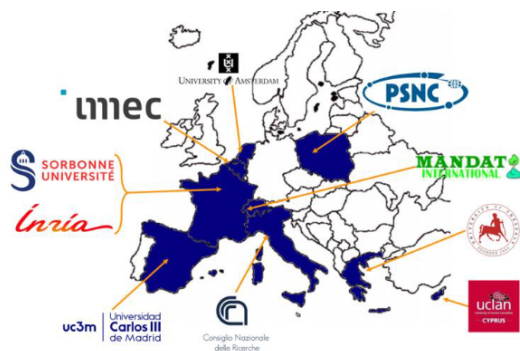


Figure 1 – Overview of SLICES-DS partnership and its deployments in Europe

3 Dissemination Channels and Tools report

The dissemination of SLICES-DS integrates several forms of media. In the following chapter, the dissemination results for the different tools and usage statistics are presented.

3.1 SLICES-DS website

<http://slices-ds.eu/>

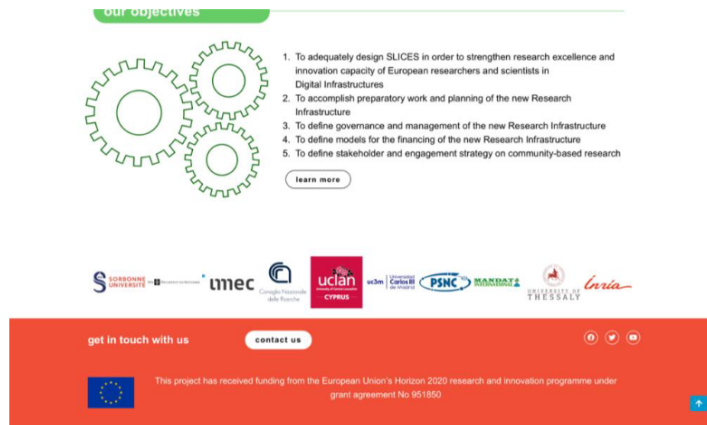


what is Slices-DS?

The design, deployment and operation of complex and continuously evolving digital infrastructures is crucial to keeping our technologically advancing society humming. This is why the research community needs a large-scale test platform to address issues of innovative and possibly even disruptive scientific concepts and technologies at the basis of digital infrastructures, along the multi-dimension of efficiency, reliability, availability, range, end-to-end latency, security and privacy. The EU-funded SLICES-DS will provide a complete design study for a Europe-wide test platform designed to support large-scale, experimental research on digital infrastructures. The SLICES design will account for advanced compute, storage and network components, interconnected by dedicated high-speed links. Pushing forward, the project's main goal is to strengthen the research excellence and innovation capacity of European researchers and scientists in the design and operation of future digital infrastructures.

who we are





The purpose of the website is to serve as the central source of information about SLICES-DS, its activities, its news and developments. It is targeted at all stakeholders to foster awareness raising and engagement and promoted on social media as well as digital and hard copy promotional materials and publications.

The structure of SLICES-DS website is depicted in the figure below:

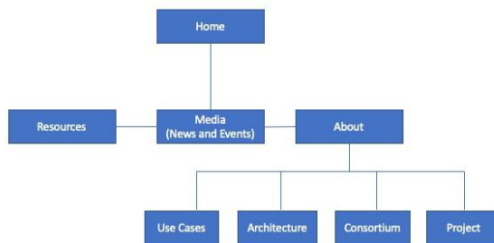


Figure 2 – SLICES-DS website structure

The website (integrated in slices-ri.eu) will be maintained throughout SLICES-DS cycle until M24. SLICES-DS website is hosted and managed by UTH, in Greece. It will be running for at least a period of 5 years after the project. The SLICES-RI website supports the sustainability of our community and infrastructure. SLICES-DS website provides static content and some news articles and events. Based on the progress of SLICES-DS will be updated and enhanced accordingly.

3.1.1 Statistics

The usage statistics of the website are depicted in the figures below.

As shown in the figures below, the website received more than 5,541 pageviews and the picks of the website visit are linked with organisation of events and project milestones. For example:



the pick middle of February is linked with the 1st SLICES-DS workshop, its announcement and the organisation of the workshop.

the pick in July 2021 is linked with the availability of SLICES Vision video and its announcement through the social media.

Overview of your user behaviors

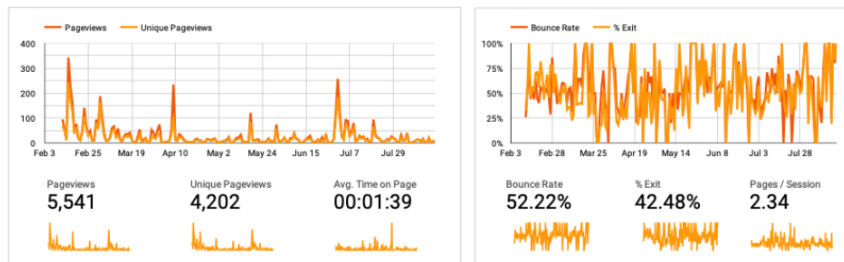


Figure 3 – Overview of user behaviour

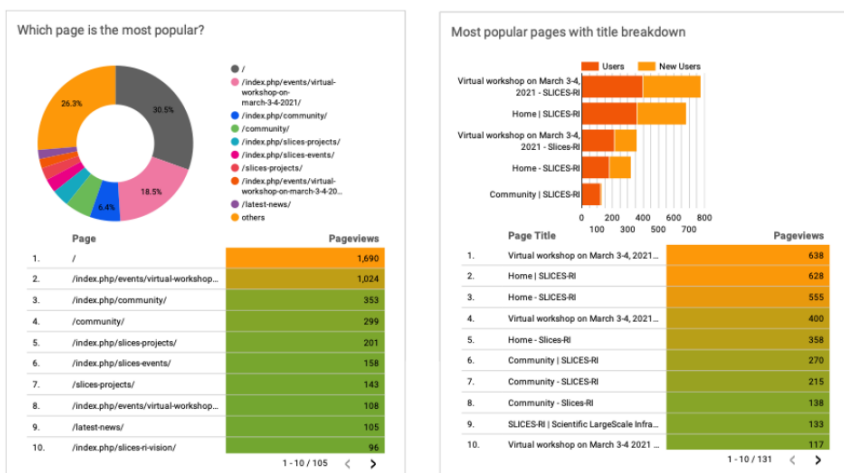


Figure 4 – Visits of specific pages

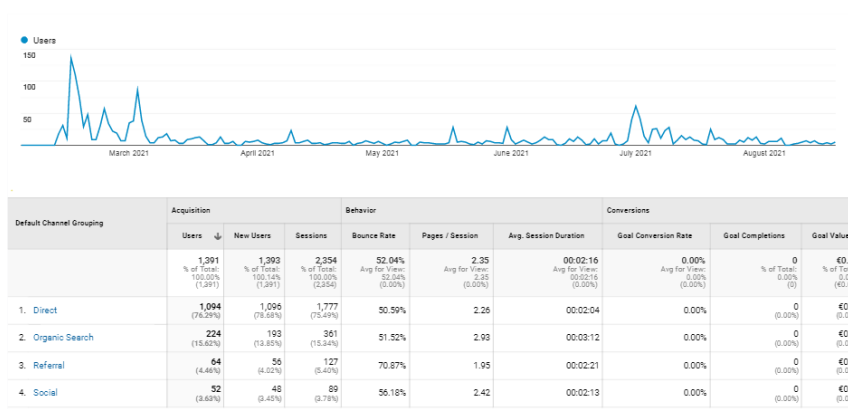


In the following diagram, we depicted the visitors of the website per country:

Total users per country

	Country	Users
1.	France	212
2.	United States	160
3.	Italy	102
4.	Spain	98
5.	China	91
6.	Greece	86
7.	Netherlands	67
8.	South Korea	58
9.	Germany	56
10.	Finland	54
11.	Belgium	42
12.	Poland	40
13.	Switzerland	27
14.	Norway	27
15.	United Kingdom	26
16.	Sweden	25

Figure 5 – Visitors of the website per country



Default Channel Grouping	Acquisition		Behavior				Conversions		
	Users	New Users	Sessions	Bounce Rate	Pages / Session	Avg. Session Duration	Goal Conversion Rate	Goal Completions	Goal Value
	1,391 % of Total: 100.00% (1,391)	1,393 % of Total: 100.14% (1,391)	2,354 % of Total: 100.00% (2,354)	52.04% Avg for View: 52.04% (0.00%)	2.35 Avg for View: 2.35 (0.00%)	00:02:16 Avg for View: 00:02:16 (0.00%)	0.00% Avg for View: 0.00% (0.00%)	0 % of Total: 0.00% (0)	€0.00 % of Total: 0.00% (€0.00)
1. Direct	1,094 (78.29%)	1,095 (78.68%)	1,777 (75.49%)	50.59%	2.26	00:02:04	0.00%	0 (0.00%)	€0.00 (0.00%)
2. Organic Search	224 (15.87%)	193 (13.89%)	361 (15.34%)	51.52%	2.93	00:03:12	0.00%	0 (0.00%)	€0.00 (0.00%)
3. Referral	64 (4.46%)	55 (3.92%)	127 (5.40%)	70.87%	1.95	00:02:21	0.00%	0 (0.00%)	€0.00 (0.00%)
4. Social	52 (3.63%)	48 (3.43%)	89 (3.78%)	56.16%	2.42	00:02:13	0.00%	0 (0.00%)	€0.00 (0.00%)

Figure 6 – Sessions per users



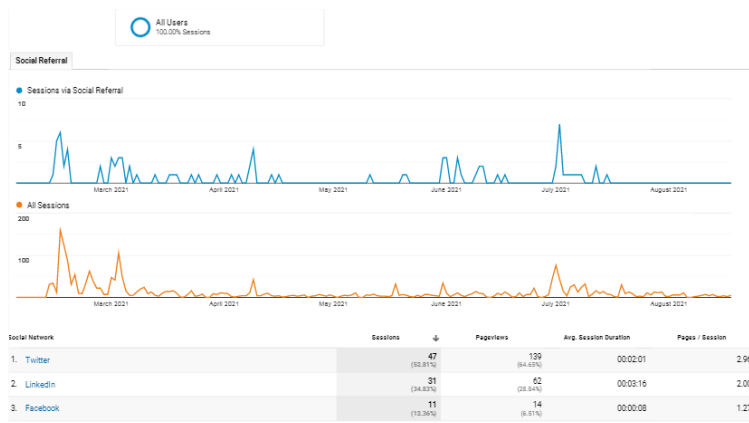


Figure 7 – Visitors of the website from social media referral

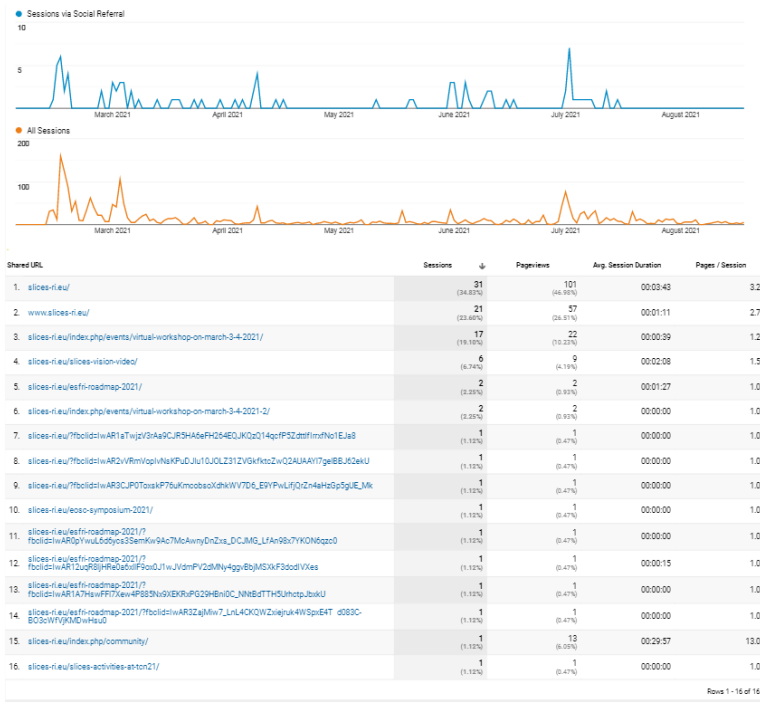


Figure 8 – Landing pages



3.2 Promotional material

Brochures/flyers are small booklets that have been prepared in line with the SLICES-DS visual identity. They are providing general information about SLICES-DS, including issues it aims to address and solutions it offers. Their aim is to provide information of target groups participating in offline events (meetings, workshops, conferences).

A briefing document on SLICES family projects disseminated to all participants of the 1st SLICES workshop (https://slices-ri.eu/wp-content/uploads/SLICES_summary_workshop_2021_v1.0.pdf).

Production of a roll-up/poster

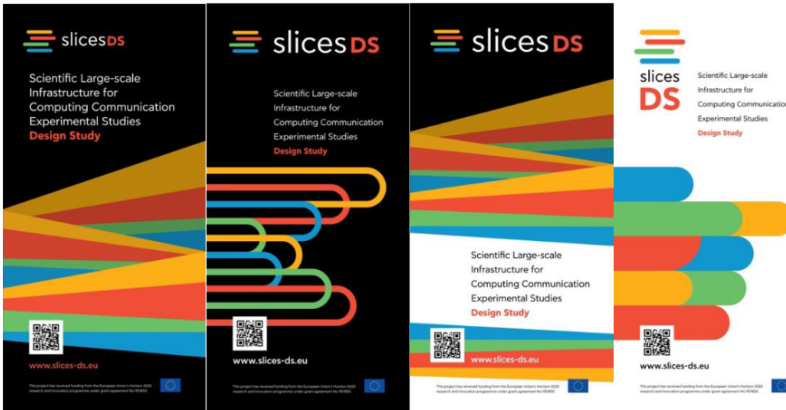


Figure 9 – SLICES-DS Poster and roll-ups

3.3 Social Media

In the planning stages of SLICES-DS, it was decided to build social media presence to represent the consortium members and the results of the project in an integrated way. Its main goals are to bring attention to the project website, amplify its content, support communication and impact creation of SLICES-DS and encourage participation in SLICES-DS communities. The following channels will be used: Twitter, YouTube and LinkedIn.

- **Twitter:** project related news and relevant articles from other sources in support Digital Research Infrastructures will be tweeted. The target groups are researchers, general public, scientific and academic personnel, businesses, NGOs technological developers, policy makers, funding authorities, etc. <https://twitter.com/SLICESRI>





Figure 10 – Twitter account

Your Tweets earned 833 impressions over this 28 day period



Figure 11 – Twitter account statistics

- **YouTube:** promotional videos and “Success Stories” to be linked to website, Twitter. Frequency: as videos become available. The target groups are researchers, general public, scientific and academic personnel, businesses, NGOs technological developers, policy makers, funding authorities, etc. The YouTube channel includes the recordings of the workshop, the videos related to SLICES.
https://www.youtube.com/channel/UCKM15y2D8rRYAnUDjpLsHug/featured?view_as=subscriber



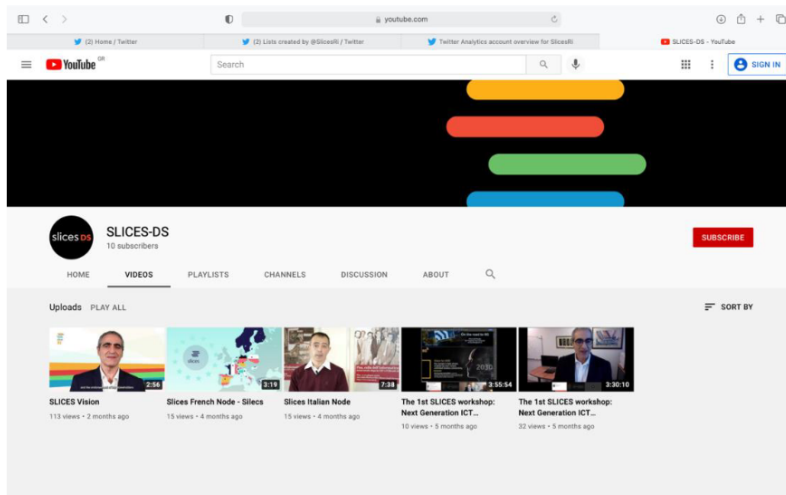


Figure 12 – YouTube account

- **LinkedIn:** project related news and relevant articles from other sources in support Digital Research Infrastructures tweeted and disseminated. The target groups are researchers, general public, scientific and academic personnel, businesses, NGOs technological developers, policy makers, funding authorities, etc. <https://www.linkedin.com/company/slices-ri>

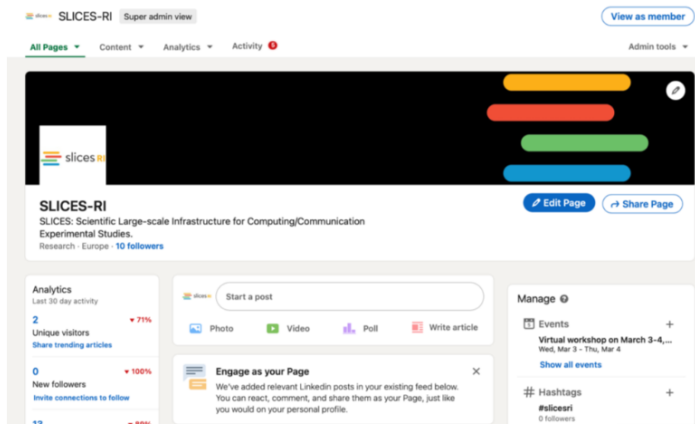


Figure 13 – LinkedIn account



4 Dissemination Events

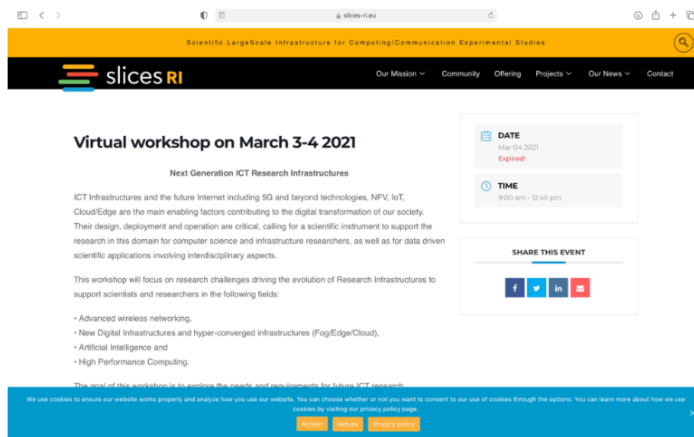
SLICES-DS organised dedicated event and participated to different third-party events. In the following section, we are reporting the events implemented during the first 12 months of SLICES.

4.1 SLICES-DS events

SLICES-DS organised a virtual workshop on March 3-4, 2021, titled: Next Generation ICT Research Infrastructures. The workshop focused on research challenges driving the evolution of Research Infrastructures to support scientists and researchers in the following fields:

- Advanced wireless networking,
- New Digital Infrastructures and hyper-converged infrastructures (Fog/Edge/Cloud),
- Artificial Intelligence and
- High Performance Computing.

The goal of this workshop was to explore the needs and requirements for future ICT research infrastructures that will support the research community with beyond state-of-the-art experimental facilities and guarantee high quality contributions to development of future ICT technologies. The workshop brought together decision and policy makers, Research Infrastructure stakeholders, industry representatives and research communities from Europe and outside with broad expertise in areas related to the discussion to establish better alignment and understanding of potential benefits to users from new ICT Research Infrastructures.



The screenshot shows a web browser displaying the SLICES-DS website. The page title is "Virtual workshop on March 3-4 2021" under the sub-heading "Next Generation ICT Research Infrastructures". The main content describes the workshop's focus on research challenges driving the evolution of Research Infrastructures to support scientists and researchers in the following fields:

- Advanced wireless networking,
- New Digital Infrastructures and hyper-converged infrastructures (Fog/Edge/Cloud),
- Artificial Intelligence and
- High Performance Computing.

The goal of the workshop is to explore the needs and requirements for future ICT research infrastructures. A sidebar on the right provides event details: DATE: Mar 04 2021 (Expired) and TIME: 9:00 am - 12:45 pm. Below the details is a "SHARE THIS EVENT" section with social media icons for Facebook, Twitter, LinkedIn, and YouTube. At the bottom, there is a blue cookie consent banner with buttons for "Accept", "Decline", and "Change settings".

The agenda of the workshop is attached in annex A.

SLICES-DS workshop statistics:

- 215 registrants,
- 152 attendees,
- 154 messages received
- 43 questions.

The summary of the activities is included in Annex B.





4.2 Third party events

SLICES-DS and its members participates and will keep participating in different relevant events according to the development and the results of the project. The dissemination is at all scales, namely, national, Europe and global, both in the US and Asia. The participation is either presentation, exhibition of results, etc.

- [EOSC Symposium 2021, 15-18 June 2021.](#)
 - Mandat International attended the EOSC Symposium 2021 in relation with the WP4 and the Task T1.3. Indeed, EOSC is a key topic of the WP4 and is also related to the Task T1.3 “Analysis of legal compliance and regulation issues in Europe” lead by MI. The EOSC Symposium permits to better understand the context of EOSC at the European level, the principles and the possibilities currently offered by EOSC.
- **The 5th Future Network Development Conference, 17-18 June, 2021.**
 - Serge Fdida, SLICES coordinator, gave a keynote speech focuses on SLICES activities at the 5th Future Network Development Conference that was held in Nanjing of China.
- [TCN-21, 21- 25 June 2021.](#)
 - Serge Fdida, SLICES coordinator, presented SLICES activities at TCN21.
- [IEEE 7th World Forum on Internet of Things, 14 June-31 July 2021.](#)
 - Sébastien Ziegler (MI) moderated a panel on European IoT Research and Large-Scale Pilots. Serge Fdida (SU) took part to this panel.
- [ICCCN 2021. The 30th International Conference on Computer Communications and Networks, Monday 19 July.](#)
 - SLICES has been presented at the panel of ICCCN 2021 conference Cities of the future: what possible evolution towards the creation of smart communities.
- **French National : GT-Plateformes : Cycle de conférences du GT Plateformes du GDR RSD, 27 August 2021.** The GDR is a group of research at the national level and the aim is to structure the French community.
 - Serge Fdida, SLICES coordinator, presented SLICES activities.

4.3 SLICES-DS future events

SLICES-DS will organise two different workshops between M13 and M24 to present the Design Study to policy makers and the communities. These **two workshops** will be organised according to the needs of the community and the progress of the design process of SLICES-DS.

4.4 Third party events

SLICES-DS and its members will participate in different relevant events according to the development and the results of the project. The participation will be either presentation, exhibition of results, etc.

Table 1 – External Events relevant for SLICES-DS

Type of Event	Event name
Scientific Conferences	<ul style="list-style-type: none"> ▪ EuCNC conference ▪ IEEE International Conference on Communications (ICC) ▪ IEEE CCNC (Consumer Communications and Networking Conference) ▪ Personal, Indoor and Mobile Radio Communications (PIMRC) ▪ SIGCOMM ▪ IEEE INFOCOM





	<ul style="list-style-type: none">▪ WiNTECH▪ TridentCom▪ Wireless World Research Forum Meeting▪ Mobile World Congress▪ International ACM Symposium on High-Performance Parallel and Distributed Computing▪ The International Conference for High Performance Computing, Networking, Storage, and Analysis (Supercomputing)▪ IEEE International Parallel and Distributed Processing Symposium
Research Infrastructures Roadmap meetings	<ul style="list-style-type: none">▪ ESFRI Roadmap meetings▪ National RI Roadmap meetings (in each country)▪ Annual meetings or presentation of other RIs from the European landscape▪ EOSC meetings and workshops

The following events are already planned for the next period.

- [IoT Week, 30 August 2021 - 3 September 2021.](#)
 - Serge Fdida (SU) will moderate a session related to international cooperation for large scale research infrastructures. Sebastien Ziegler (MI) will participate as a speaker.
- [IEEE 5G World Forum, 13-15 October 2021.](#)
 - Serge Fdida (SU) and Sebastien Ziegler (MI, representing the IoT Forum) will chair a session.





5 Monitoring and Evaluation

5.1 Key performance indicators for dissemination and communication

Defining key performance indicators to assess the progress of dissemination and communication in line with the overall project's approach is important to closely monitor the progress of our activities and measure their impact (as far as this is feasible from a quantitative point of view). We defined a set of key performance indicators, KPIs, which, with respect to dissemination and communication, will be monitored and managed throughout the lifespan of SLICES-DS. This will allow corrective measures to be taken and enforced, whenever the performance and progress marked by the consortium are not aligned with the set objectives. Table 1 gives figures for the Key Performance Indicators (KPIs) related to communication activities. The table will be updated yearly in order to depict the current status and results of the KPIs.

Table 2 – Key Performance Indicators for dissemination and communication (KPIs) per year

Measure	M12	M24	Total target	Achieved by M12
SLICES-DS brochure	200 copies	200 copies	400 copies	215 copies (downloads of SLICES leaflet from the website) (https://slices-ri.eu/wp-content/uploads/SLICES_summary_workshop_2021_v1.0.pdf)
Posters	1	1	2	2 (see figure 9)
Set of high-level materials for policy makers	1	1	1	1 (https://slices-ri.eu/wp-content/uploads/SLICES_summary_workshop_2021_v1.0.pdf)
SLICES-DS website	1000 visitors	1000 visitors	2000 visitors	1393 visitors 4202 unique page views
Social networks (Twitter)	200 followers	300 followers	500 followers	219 followers
Social networks (You Tube)	50 followers	50 followers	100 followers	10 subscribers (YouTube) More than 300 views of the SLICES related videos 10 Followers (Linkedin)
Workshops	1 workshop	2 workshops	3 workshops	1 workshop 215 registrations, 153 participants (details in chapter 4.1)
Videos	1 video	1 video	2 videos	8 videos (including SLICES vision and SLICES-DS workshop recordings)
Scientific publications	2 publications	3 publications	5 publications	Scientific publications will follow during the second year when the results of the projects will be available to be published
Presentations	3 presentations	3 presentations	6 presentations	6 (details in chapter 4.2)
Attended external events	3 external events attended	3 external events attended	6 external events attended	10





6 Conclusion

This document provides an overview of very active dissemination and communication activities implemented by SLICES-DS during the first 12 months in relation with the dissemination and communication strategy.

These activities, that SLICES-DS partners pursued, contribute to guarantee broad visibility, promotion and up-take of SLICES-RI. It ambitions that SLICES is identified as a prominent international actor in this domain.





The 1st SLICES workshop

Next Generation ICT Research Infrastructures

Wednesday 3 March afternoon & Thursday 4 March morning

<http://slices-ri.eu/index.php/events/virtual-workshop-on-march-3-4-2021/>

ICT Infrastructures and the future Internet including 5G and beyond technologies, NFV, IoT, Cloud/Edge are the main enabling factors contributing to the digital transformation of our society. Their design, deployment and operation are critical, calling for a scientific instrument to support the research in this domain for computer science and infrastructure researchers, as well as for data driven scientific applications involving interdisciplinary aspects.

This workshop will focus on research challenges driving the evolution of Research Infrastructures to support scientists and researchers in the following fields:

- Advanced wireless networking
- New Digital Infrastructures and hyper-converged infrastructures (Fog/Edge/Cloud)
- Artificial Intelligence
- High Performance Computing

The goal of this workshop is to explore the needs and requirements for future ICT research infrastructures that will support the research community with beyond state-of-the-art experimental facilities and guarantee high quality contributions to development of future ICT technologies.

The workshop will bring together decision and policy makers, Research Infrastructure stakeholders, industry representatives and research communities from Europe and outside with broad expertise in areas related to the discussion to establish better alignment and understanding of potential benefits to users from new ICT Research Infrastructures.

The specific objectives of the workshop:

- To provide a venue for researchers to share experiences and expectations for experimental research in the ICT field
- To identify key research directions for future Internet design and development and determine required functionality and features of new ICT Research Infrastructures
- To discuss and to address technological aspects in building future European digital Research Infrastructures
- To promote collaboration and research at the European level

The expected outcomes of the workshop:

- Better understanding of current limitations of existing research infrastructures
- Aligning research roadmaps and identifying critical challenges and needs for new ICT Research Infrastructures
- Effective sharing of knowledge and practices in support of the implementation of the new pan-European ICT Research Infrastructure



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Workshop agenda

<http://slices-ri.eu/index.php/events/virtual-workshop-on-march-3-4-2021/>

Wednesday 3 March 2021 (CET)

2:00 PM	Introduction	Serge Fdida, Sorbonne Université
2:15 PM	Keynote	Chair: Andrea Passarella, IIT-CNR, Italy
	<i>Federation, Generalisation, Heterogeneity or Edge v. In-Network compute?</i>	Jon Crowcroft, University of Cambridge
3:00 PM	BREAK	
3:10 PM	International RIs	Chair: Serge Fdida, Sorbonne Université
3:15 PM	<i>6G Ultimate Customizability Driven by Democratization</i>	Aki Nakao, University of Tokyo
3:30 PM	Q&A	
3:45 PM	<i>The Road Ahead: An approach to Building an ecosystem for Beyond 5G to 6G Research</i>	Manu Gosain, PAWR Office
4:00 PM	Q&A	
4:15 PM	<i>Towards 6G, the European agenda</i>	Bernard Barani, DG CONNECT
4:30 PM	Q&A	
4:45 AM	<i>Presentation</i>	David Fraboulet, French Ministry of Education, Research & Innovation
5:00 PM	Q&A	
5:15 AM	Conclusion of day 1 / Wrap up	Peter Van Daele, imec
5:20 PM	<i>End of day 1</i>	

Thursday 4 March 2021 (CET)

9:00 AM	Scientific challenges	Chair: Andrea Passarella, IIT-CNR, Italy
9:05 AM	<i>On the road to 6G</i>	Ari Pouttu, University of Oulu
9:20 AM	<i>Trusted data sharing and the responsible Internet</i>	Paola Grosso, Institute for Informatics at the University of Amsterdam
9:35 AM	<i>On Scaling Testbeds and Sharing Insights</i>	Joerg Ott, Technische Universität München
9:50 AM	<i>Autonomous Driving Slices: what SLICES can bring to Network AI research</i>	Dario Rossi, Huawei
10:05 AM	Q&A	
10:20 AM	BREAK	
10:30 AM	Socio Industrial perspectives	Chair: Sebastien Ziegler, Mandat International
	<i>Future business opportunities with Data and AI – what are the needs from perspective of the manufacturing industries?</i>	Thomas Hahn, Siemens AG
10:35 AM		
10:50 AM	<i>Presentation</i>	Vania Conan, Thales Group
11:05 AM	<i>Twinning Networks: On the Use and Challenges of Network Digital Twins</i>	Diego Lopez, Telefónica
11:20 AM	Q&A	
11:35 AM	BREAK	
11:50 AM	INFRA, EOSC and ESFRI as potential catalysts for SLICES	Chair: Arturo Azcorra, IMDEA Networks



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11:50 AM	<i>The evolving landscape of ESFRI, eInfras and EOOSC</i>	Liina Munari, Deputy Head of Unit - European Commission - DG CONNECT - CNECT.C1 Open Science and Digital Modelling
12:10 PM	Q&A	
12:45 PM	Conclusion	Bartosz Belter, PSNC
12:45 PM	<i>End of day 2</i>	



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8 ANNEX B – Summary of the activities of the Workshop



SLICES Workshop

Round-Up – Day 1

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slices

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Round-Up Day 1



Our society gets “Digital”

- Everything connected --- Always connected --- Everybody connected (democratized)

“Digital Society” is on the agenda at all levels of public authority & worldwide

“Digital Society” supported by a wide range of technologies

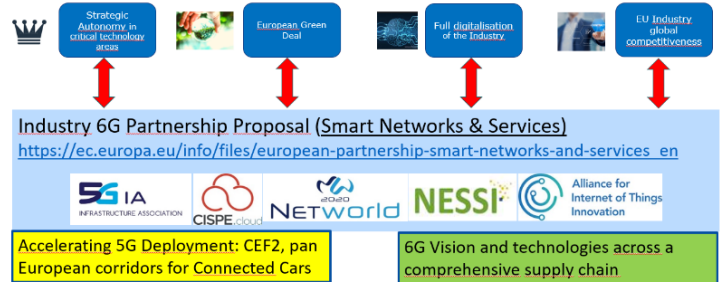


And it goes fast!!

5G is just being installed
→ we are moving to 6G
(through local/private 6G)

Towards a 6G European Initiative

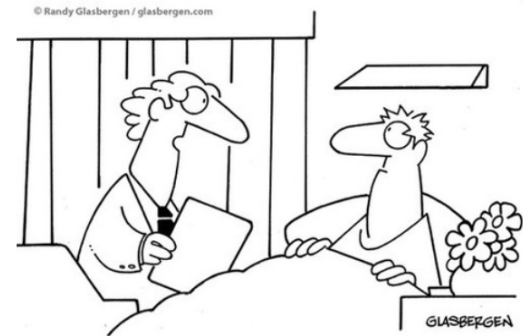
5G PPP: ICT-52 implementation of 8 6G exploratory projects, 1 flagship= 60 M€ (bridging phase)



Although the future is difficult to predict ... but we already know it will be about ...

- Smarter (devices & networks) / autonomous devices
- More intelligence (devices & networks)
- More flexibility / programmability / update (networks)
- Customized services
- Faster / capacity / lower latency
- Reliability & Privacy & Security
- Lower energy & Sustainable
-

**Can we expect a new
“trend breaker” effect from ... ??
(AI? Quantum?)**



"I ran all of your symptoms through the computer
and now the computer is sick too."

“Digital Society” is built on heterogeneity

New ideas, concepts,.. need to be implemented in a

- Highly competitive environment with
- Rapidly evolving requirements

Consequently Research, Innovation, Development, ...
Calls for

- Up-to-date testing facilities
- Skilled support
- “Experimental Twins”



But this is far too expensive for many players ...

SLICES Research Infrastructure

has the objective to

- serve the **community** and to
- support **digital transformation**

by

- offering **low threshold** access to
- a **top-quality / vendor neutral** Research Infrastructure
- for a **broad spectrum** of activities in the IT domain
- covering a **wide range of technologies**
- and supporting application across **multi-technology**



SLICES Research Infrastructure



allowing:

- academia, research groups, SME's, start-ups, industry to
- research, develop, test, valorize, benchmarking,...
- new concepts, new technologies, new products, upscaling,...
- in a trustable and reproducible manner

SLICES Research Infrastructure



- Many scientific challenges lie ahead
- With a huge socio-economical / industrial impact
- And within an international & worldwide context (geopolitics)

**Join us for Workshop 1 – Part 2
On Thursday 04 March
at 9 AM CET**

SLICES Workshop

Round-Up – Day 2

Bartosz Belter

Poznan Supercomputing and Networking Center



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Round-Up Day 2



Theme 1: Scientific Challenges

Theme 2: Industrial Perspectives

**Theme 3: Potential catalysts for SLICES
– the EC perspective**

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Scientific Challenges (1)

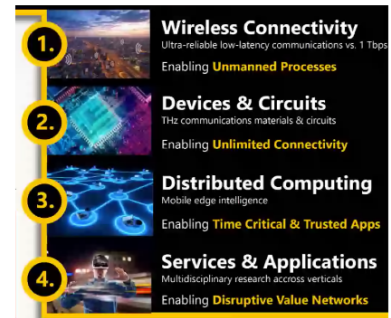
Vision for 2030

Our society will be data-driven; unlimited wireless connectivity
Wireless connectivity is driving major societal changes

Finland runs the World's first 6G Research Program

Critical Drivers towards 6G

Society, Business, Security, Radio technologies, AI, Standards



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Scientific Challenges (2)

- User-centric Internet; Responsible Internet to increase Trust
 - It's all about **Data Transparency Accountability Controllability**



Data about people



Photo source: Genetic Library Project

Personalized medicine (EPI)

Research data



Photo source: SKA organisation

Radio astronomy (SKA)

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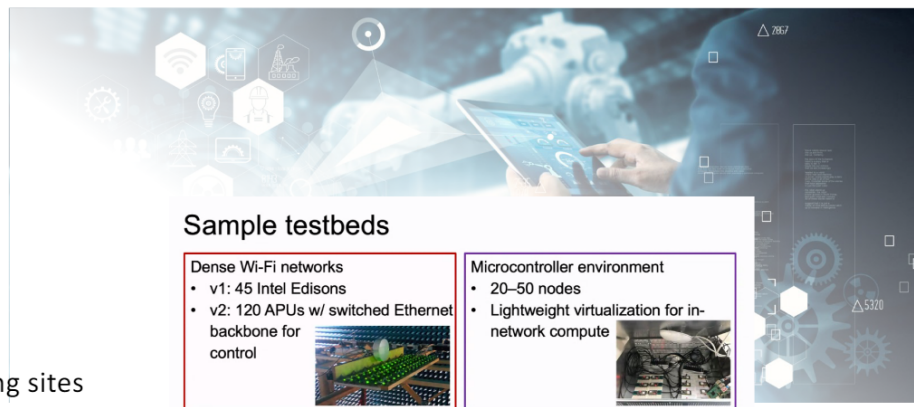
Scientific Challenges (3)

Scaling the testbeds

- Automation
- Numbers and topology: interconnecting sites
- Diversity I: device and platform heterogeneity
- Diversity II: Users/machines and mobility
- Network architectures and protocols

Sharing the testbeds

- Automation and documentation
- Target audience
- Access to infrastructure
- Interconnecting
- Slicing in time & space
- Users' Data



Sample testbeds

Dense Wi-Fi networks

- v1: 45 Intel Edisons
- v2: 120 APUs w/ switched Ethernet backbone for control



Microcontroller environment

- 20–50 nodes
- Lightweight virtualization for in-network compute



Mobile node emulation

- Up to 1-10K nodes
- Running as VMs
- Connectivity controlled via simulator / traces

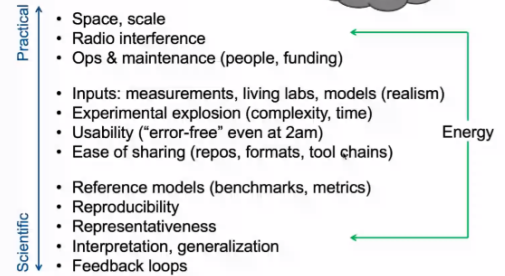


In-vehicle network testbed

- Software-defined topology
- Ansible-based config & test exec



Some challenges



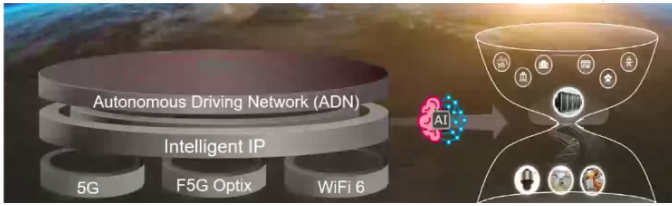
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Industrial Perspectives (1)



Perspective of network vendors

- **Autonomous networking** as key topic
- **Network AI** in the spotlight!



Network 4 AI viewpoint

- ❑ **Model training**
 - E.g., realism in federated learning from heterogeneous deployments (practical system-level AI challenge)
- ❑ **Model-driven telemetry (MDT)**
 - Heterogeneity in the input data: multi-vendor (good to have “dirty data” AI problem)
- ❑ **Real-time**
 - Where (Cloud vs Fog vs Edge) to allocate AI resources: architectural tradeoffs of privacy vs cost vs ...
- ❑ **Control**
 - Delay+noise of MDT data streams: controllable/reproducible AI experiment in more challenging environment
 - Train on simulation (e.g., DRL takes lifetimes, cannot learn from real network) refine & validate on SLICES

AI 4 Network viewpoint

- ❑ **Model-driven O&M**
 - Unsupervised algorithms still need ground truth for benchmark
 - Large SLICES crowd: can the community crowdsource anomaly detection database beyond KDD99 (s/ImageNet/AnomalyNet)?
- ❑ **Heterogeneity (again)**
 - Model ages and data drifts: study ageing of models imperative for deployment in a full AI lifecycle
- ❑ **Incremental training**
 - Incremental training: system-level problems bring algorithmic challenges
- ❑ **Real-time inference**
 - Inference: real-time low cost accurate inference

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Industrial Perspectives (2)

Future business opportunities with Data and AI
What are the needs from perspective of manufacturing industries?

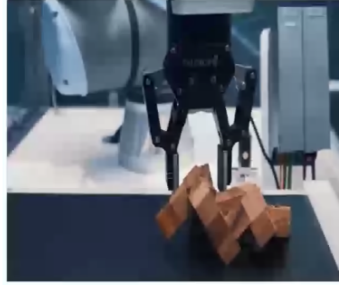
Perspective of manufacturing industries

- **AI and Robotics** are key enablers for innovation and a core driver of productivity

Self-operation

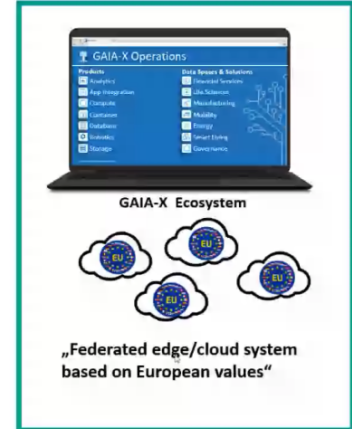


Self-adaptation (based on data)



Vision: Self-x without detailed programming or engineering
... and without human supervision

GAIA-X: a federated data infrastructure for Europe



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Industrial Perspectives (3)

Perspective of technology supplier, service provider and system integrator

- **5G is a game changer** (while not the case for 4G)
- While delivering to different vertical markets (trains, drones, cars, airplanes, etc.) **vertical end-to-end slicing** is a key!



New research & testing methods:

(i) From build to run

(ii) Ilities



**CRITICALITY
CYBERSECURITY
RESILIENCE**

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Industrial Perspectives (4)

Perspective of the network operator



• Replication in Digital Era: **Twinning Networks**

- The native complexity of networks has made more difficult DT application

- Metcalfe's law
- Laser effect(s)
- The invariants: topology/geometry, conservation, openness

- Beware the network differential facts

- Topology (and geometry!) awareness
- The conservation principle
- Openness
- Integrity and auditability
- Isolation

- Deal with heterogeneity

- At all levels: sources, consumers, models, deployment styles, supporting infrastructures

An Essential Tool for Harnessing AI in Networks

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Industrial Perspectives (5)

Recommendation for SLICES



Recommendations and conclusions from the session speakers wrt RIs:

- Allow **repeatability** of experiments
- Ensure **data is collected** for further analysis
- Keep in mind **industry can provide use cases and new business models** for further validation in RIs
 - Blue-Sky Research vs Applied Science
- Research Infrastructures should not only offer technology components, but should be also capable of providing data from on-going and past experiments
 - Consider “**Experimental Data as a Service**”

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Potential catalysts for SLICES – the EC perspective

THE EUROPEAN RESEARCH INFRASTRUCTURE LANDSCAPE

- **Intergovernmental RIs:** Well established RIs supported by the member states.
- **New Pan-European RIs:** RIs listed in the ESFRI Roadmap
- **Networks of National RIs:** Networks of national and regional RIs open to all European researcher from both academia and industry. **These networks of RIs are promoted by the European Commission through projects supported by Horizon 2020 and Horizon Europe.**

What is the SRIA?

A strategic roadmap identifying key challenges and priorities for investment over the next funding period



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Potential catalysts for SLICES – the EC perspective



The 2018 ESFRI Roadmap

18 ESFRI Projects (6 new)

37 ESFRI Landmarks

18 ESFRI Projects (6 new)						37 ESFRI Landmarks					
ENE	ENV	HF	PSE	SCI	DIGIT	ENE	ENV	HF	PSE	SCI	DIGIT
EU SOLARIS		AnaEE				JHR	EMSO ERIC	BBMRI ERIC	E-ELT	CESSDA ERIC	PRACE
WIND SCANNER		ISBE					EUROARGO ERIC	EATRIS ERIC	ELI	CLARIN ERIC	
MYRRHA		MIRRI			2010		IAGOS	ECRIN ERIC	Eur. Spallation Source ERIC	DARIAH ERIC	
							ICOS ERIC	ELIXIR	EU-XFEL	ESS ERIC	
	ACTRIS	EMPHASIS	EST	E-RIH			LIFEWATCH ERIC	INFRA FRONTIER	FAIR	SHARE ERIC	
	DANUBIUS-RI		KM3NeT 2.0		2016			INSTRUCT ERIC	ILL		2006
									SKA		
									SPIRAL2		
IFMIF-DONES	DISSCo	EU-IBISBA		EHRI		ECCSEL ERIC	EISCAT-3D	EMBRIC ERIC	EMFL		
	eLTER	METROFOOD-RI			2018		EPOS ERIC	EU-OPEN Screen ERIC	CTA		
								ERINHA			
								EuroBio Imaging			2008
									ESRF-EBS*		
									HL-LHC		2016

Limited presence of DIGIT RIs.

But there are RI with main ICT components in other domains (ENV, SCI, etc.)

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Potential catalysts for SLICES – the EC perspective

Opportunities for SLICES within EOSC

Last H2020 projects to start - H2020-INFRAEOSC-2020-2

- **INFRAEOSC-07**: Increasing the service offer of the EOSC Portal (24 mio):
 - **EGI-ACE** (a1: Distributed and cloud computing resources)
 - **DICE** (a2: Data services)
 - **OpenAIRE Nexus** (a3: Services supporting scholarly communication at open access)
 - **C-SCALE & RELIANCE** (a6: Additional research enabling services)
- **INFRAEOSC-03**: Integration and consolidation of the existing pan-Europe: access mechanism to public research infrastructures and commercial services through the EOSC Portal (40 mio)
 - **EOSC FUTURE**

Horizon Europe – Pillar 1 WP 2021-2022

- > **Destination #1**: Developing, consolidating and optimising European Research Infrastructures to maintain global leadership
- > **Destination #2**: Enabling an operational, open and FAIR EOSC ecosystem
- > **Destination #3**: RI services to support health research, accelerate the green and digital transformation, and advance frontier knowledge
- > **Destination #4**: Next generation of scientific instruments, tools and methods and advanced digital solutions
- > **Destination #5**: Network connectivity – Enabling collaboration without boundaries

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Potential catalysts for SLICES – the EC perspective



Challenge?

"However, while an instrumented, interconnected and intelligent world has unprecedented potential to solve the key challenges of the time, this potential will only be realised if research infrastructures are evolving to allow scientists to make the best use of the available information"

SLICES Research Infrastructure



A scientific instrument designed to support large-scale, experimental ICT research

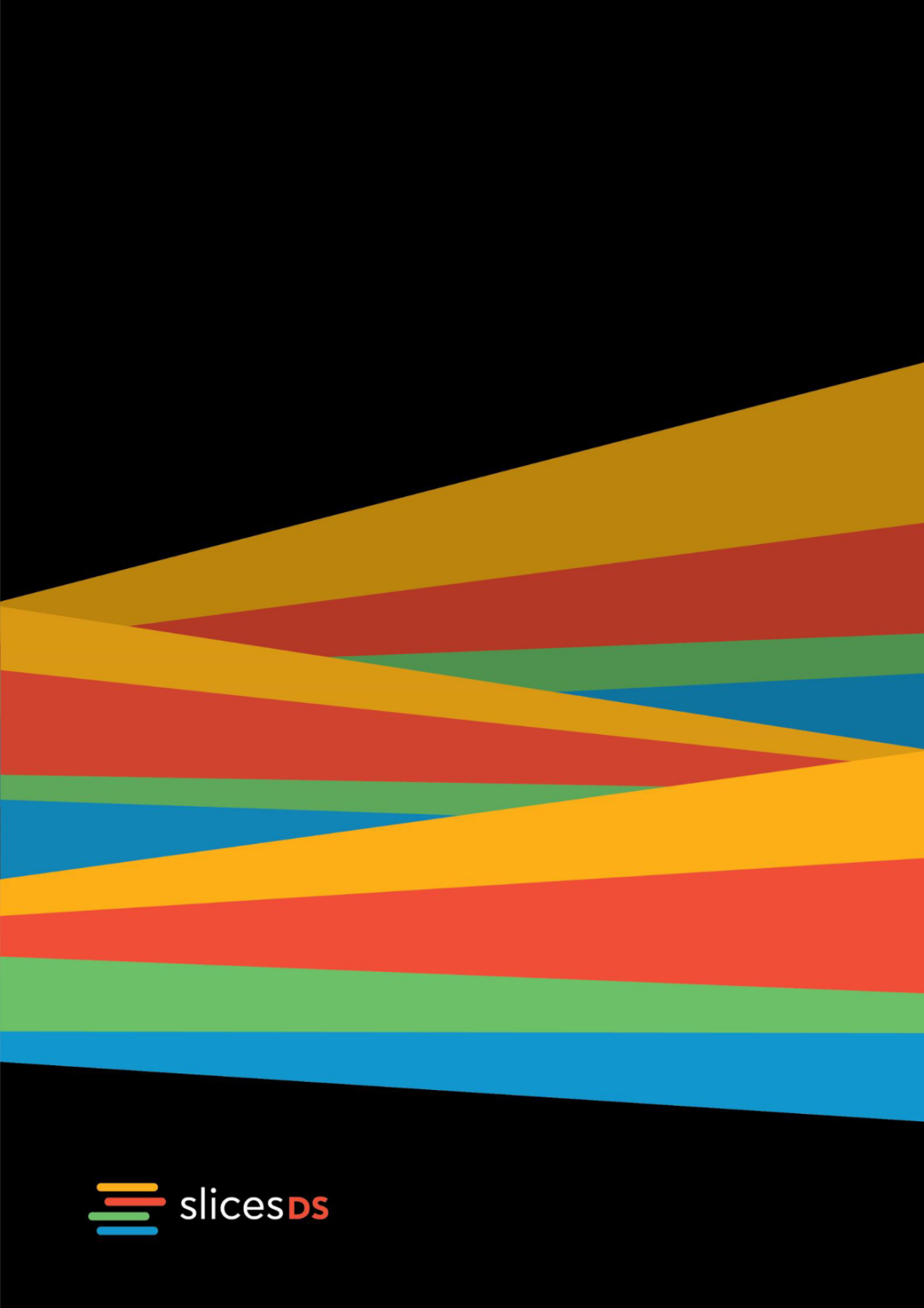
A programmable platform

The network infrastructure and services seen as networked software (not just a set of network protocols)

Thank you for joining!

**You may watch recordings from the
workshop on our website soon:**

www.slices-ri.eu



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