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► **To cite this version:**

Damien Saucez, Nikos Makris. Thought experiments, data and reproducibility for networking and FutureG research: Hackathon. 2024. hal-04755954

**HAL Id: hal-04755954**

**<https://inria.hal.science/hal-04755954v1>**

Submitted on 28 Oct 2024

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# Thought experiments, data and reproducibility for networking and FutureG research: Hackathon

Damien Saucez  
*Inria*  
Sophia Antipolis, France  
damien.saucez@inria.fr

Nikos Makris  
*University of Thessaly*  
Volos, Grece  
nimakris@uth.gr

**Index Terms**—5G, blueprint, reproducibility, RAN, SLICES

## I. TITLE AND ACRONYM

**Title:** Thought Experiments, dAta and reproducibility for networking and FutureG research: Hackathon

**Acronym:** TEA'24

## II. ORGANIZERS

### A. Co-Chairs

#### 1) Nikos Makris:

- **affiliation** University of Thessaly
- **email** nimakris@uth.gr
- **bio** Dr. Nikos Makris is a Postdoctoral Researcher with the Department of Electrical and Computer Engineering, University of Thessaly, Greece, and the Centre for Research and Technology Hellas (CERTH). He received his bachelor's degree in 2011, a Master's degree in Computer Science and Communications in 2013, and his Ph.D. in ECE in 2020 from the same department. In the period 2020-2021, he worked as a Postdoctoral Associate in the Dept. of Electrical Engineering, Yale University, USA. Since 2011, he has been participating in several EU- and NSF-funded collaborative research projects. His research interests include experimentally driven research with several radio access technologies (WiFi, LTE, 5G-NR), conducted under real environment settings, the control- and user-plane disaggregation of base station units, Multi-access Edge Computing and NFV orchestration using open-source platforms.

#### 2) Damien Saucez:

- **affiliation** Inria
- **email** damien.saucez@inria.fr
- **bio** Before being researcher at Inria Sophia Antipolis since 2011, Damien Saucez was PhD student at UCLouvain, working in interdomain traffic engineering with LISP with Prof. Olivier Bonaventure. At Inria, Damien is specialised in the applications of the Software Defined

Networking (SDN) paradigm to realise robust, resilient, and provable large-scale complex networks. From 2019 to 2020, he moved to the industry, where he applied this methodology to aircraft cabin-networks at Safran Electrical and Power in Toulouse, France. Back to Inria in late 2020, he specialised in the application of the concept – in conjunction with cloud-native – to large 5G and beyond research infrastructures, where he is technical leader of the SLICES-RI blueprints. All his research is driven by reproducibility and he is actively involved to make the community research work reproducible. Among others he lead the ACM SIGCOMM 2017 Reproducibility Workshop and by co-chaired several Artifact Evaluation Committees, the later in date being the ACM SIGCOMM 2023 AEC. His work is always driven by its applicability to operational environment, promoting so standardisation (he co-authored 7 IETF RFCs) and free-to-use open source software.

### B. Steering committee

The proposed hackathon is fundamentally linked to the SLICES-RI project and to guarantee its adequacy with the long term goals and operations of the project, the following key leaders of the project are also involved in the elaboration, publicity, and follow-up of the hackathon.

#### 1) Serge Fdida:

- **affiliation** Sorbonne Université
- **email** serge.fdida@sorbonne-universite.fr
- **bio** Serge Fdida is a Professor with Sorbonne Université since 1995. His research interests are related to the future internet technology and architecture. He has been leading many research projects in Europe, notably pioneering the activity on federated Internet testbeds. He established PlanetLab Europe in 2007 and the OneLab and FIT facilities. He was one of the initiators of the ACM Conext conference, general chair of ACM Mobicom 2015, IEEE Infocom 2019 and in 2021 and started the NetworkingChannel program. Serge Fdida has also developed a strong experience related to innovation and industry transfer, - he was the co-founder of the Qosmos and Hopcast companies, - one of the active contributors to the creation of the Cap Digital cluster

This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement SLICES-SC – GA-101008468 and from the European Union's Horizon Europe Research and Innovation Programme under the Grant Agreement SLICES-PP – GA-101079774.

in Paris and President of EIT Health France. He is currently coordinating SLICES, the first large-scale scientific instrument in Digital Sciences, supported by the EU ESFRI framework. Serge Fdida received his PhD from Université Pierre & Marie Curie (UPMC), Paris in 1984. He received his Habilitation in 1989. Assistant Professor UPMC (1983-1987). Associate Professor UPMC (1988-1991). Professor Université Paris Descartes (1991-1995). Sabbatical at IBM Raleigh in 1995. Professor Sorbonne Université. Adviser ITC Department CNRS (2000-2005). Vice-President European affairs of UPMC (2014-2018). VP International Development of Sorbonne Université (2018-2021).

2) *Raymond Knopp*:

- **affiliation** Eurecom
- **email** raymond.knopp@eurecom.fr
- **bio** Professor Raymond KNOPP received his PhD degree in Communication Systems from the Swiss Federal Institute of Technology (EPFL), Lausanne in 1997. His current research and teaching interests are in the area of digital communications, software radio architectures, and implementation aspects of signal processing systems and real-time wireless networking protocols. He is currently head of the Communication Systems Department at EURECOM, Sophia Antipolis, France. He is a leading figure in the OpenAirInterface (OAI) Community and has been instrumental in making open software for Radio Access Networks a reality through contributions over two decades. He is one of the very first and one of the most significant contributors to the OAI codebase. He was elected as the President of the OpenAirInterface Software Alliance (OSA), a non-profit organization federating the OAI and Mosaic5G codebases in December 2018. He is a fellow of the IEEE. He is co-inventor of numerous patents targeting ongoing 3GPP 5G standardization and participates in technical contributions to 3GPP RAN study and work items on behalf of EURECOM.

3) *Andrea Passarella*:

- **affiliation**
- **email** andrea.passarella@iit.cnr.it
- **bio** Andrea Passarella (Ph.D 2005) is a Research Director at the Institute of Informatics and Telematics (IIT) of the National Research Council of Italy (CNR). Prior to join IIT he was with the Computer Laboratory of the University of Cambridge, UK. He has published 200+ papers on Online and Mobile social networks, decentralised AI, Next Generation Internet, opportunistic, ad hoc and sensor networks, receiving the best paper award at IFIP Networking 2011 and IEEE WoWMoM 2013. He served as General Chair for IEEE PerCom 2022. He is the founding Associate Editor-in-Chief of Elsevier Online Social Networks. He is co-author of the book "Online Social Networks: Human Cognitive Constraints in Facebook and Twitter Personal Graphs" (Elsevier, 2015), and was Guest Co-Editor of several

special sections in ACM and Elsevier Journals. He is the PI of the EU CHIST-ERA SAI (Social Explainable AI) project.

### III. WORKSHOP DESCRIPTION

Digital Infrastructures and the future Internet including 5G and beyond technologies are the main enabling factors contributing to the digital transformation of our society. Research and innovation in this domain represent an industrial need, a sovereignty concern, a security threat and an economic and societal development opportunity.

Unfortunately, deploying a fully-fledged 5G network remains a matter of specialists that have to choose the right combination of software, hardware, and locations of the infrastructure. Even worth, when looking for high performance and complex, but real-life, scenarios, having a real 5G network is out of reach for the average researcher as it would require high expenses (specific radios and switches that cost tens of thousands of dollars) and know-how, limiting thus innovation to a small fraction of the community. This is where the SLICES Research Infrastructure (SLICES-RI) [1] comes into play. The EU-funded SLICES-RI research infrastructure aims to provide a post-5G support to the research and innovation community. One important role of SLICES-RI is to provide long-term access to large scale distributed cutting-edge hardware and state-of-the-art deployments.

SLICES-RI relies on blueprints and their associated support to allow researchers to replicate and extend the work done by the community [2]. To reach this objective, the blueprints provide a set of replicable tools, software, hardware, and methodologies to make sound experimental research with cutting-edge 5G environments. As such, researchers worldwide can focus on their core research (e.g., testing a new frequency allocation scheme) and leverage the rest of the infrastructure offered by the community.

As shown in Fig. 1, experiments in SLICES are orchestrated by the plain orchestrating service (pos) [3], which manages the experiment itself but also its setup and evaluation. This allows to archive all data and meta-data of experiments to allow sound analysis and reproducibility. The blueprint applies this methodology to deploy a fully-featured 5G network with a cloud-native core [4] and split 7.2 radio access network [5]. The blueprint is flexible enough to allow its deployment in fully virtual environments (e.g., in a public cloud) or with dedicated physical hardware on SLICES premises.

In this hackathon, we plan to bootstrap new software and features for the research community.

On one side, we expect to create packaging to simplify experiments for students and researchers willing to run 5G experiments. Potential contributions could be the writing of an Ansible module to control pos, removing thus the need to learn pos experiment description idiomatic and reduce its learning curve. Another contribution could be to well-package the provisioning of cloud infrastructure with Terraform. In the current form, Terraform recipes are written for several types of resources but they are not unified. Having a unified approach

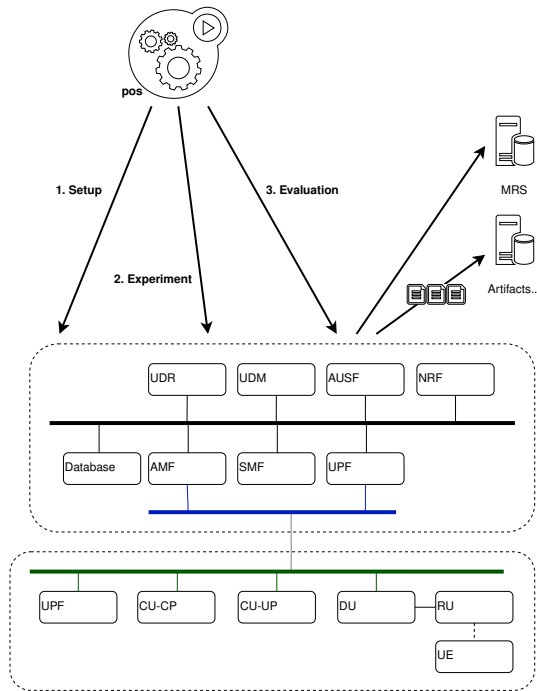


Fig. 1. De-aggregated 5G network managed by the pos framework in the SLICES Research Infrastructure.

would allow to easily pass from one type of infrastructure (e.g., starting little on a laptop) to another (e.g., growing to a complex distributed environment with on and off-prem resources).

On the other hand, we would like to contribute to the open-source software community by adding features that would be beneficial for SLICES-RI and the blueprint. For example, we could add smooth support for OpenID in OpenVPN and link it to RBAC in kubernetes clusters, for example with the help of Keycloak. Another example would be to improve the OpenAirInterface platform documentation of the CU/DU separation. Yet another example would be to create a front-end to OpenAirInterface 5G core to easily insert or remove SIM cards for authentication.

As one can see, the objective of the hackathon is to improve blueprint implementations for SLICES, but always in a way that is beneficial beyond SLICES. As such results of the hackathon are not only usable in SLICES but can be beneficial for the entire research community or even broader, independently of SLICES.

**Important notice:** This hackathon is a companion activity of the *Thought experiments, data and reproducibility for networking and FutureG research* workshop that has already been accepted at IFIP Networking 2024.

The workshop and the hackathon will provide synergy as the workshop is related to test platforms at large while the hackathon looks at how to bootstrap new collaborative tools for test platforms. The audience of the two events are not in competition. The workshop will attract a more conventional audience composed of researchers, deciders, post-docs...) and the hackathon, by its very nature, will mostly attract research

engineers and developers, that are typically working jointly with the expected attendees of the workshop.

#### IV. TECHNICAL PROGRAM COMMITTEE

Find here below a first proposal of TPC for the workshop, members with a \* are confirmed.

- Armir Bujari (University of Bologna)
- Attila Farkas (SZTAKI)
- Serge Fdida (Sorbonne Université)\*
- Sebastian Gallenmüller (TUM)\*
- Carmen Guerrero (UC3M)
- Nikos Makris (UTH)\*
- Raymond Knopp (Eurecom)\*
- Andrea Passarella (IIT)\*
- Michele Polese (Northeastern University)
- Esa Posio (Oulu University)\*
- Damien Saucez (Inria)\*
- Ivan Seskar (Rutgers University)
- Thanasis Korakis (UTH)\*
- Brecht Vermeulen (IMEC)\*

#### V. PLANNED FORMAT OF THE WORKSHOP

The proposed event is a workshop in its purest form, i.e., a meeting where people engage to passionate activity. The full day will be decomposed in 4 main parts:

- A first session of 45 minutes will introduce SLICES and the blueprints from a technical standpoint;
- A 2h session will then be used to define the projects to work on during the rest of the day and set the teams. During this session each proposal will be present in a lightning talk of 180 seconds;
- The rest of the day will be dedicated to code sprinting on the projects;
- In the evening, each team will make a 5 minutes demo of its contribution and we will collectively elect the winner of the hackathon.

As illustrated above, lively and interactive discussions are key for the success of the workshop.

Teams will be supervised by experienced engineers specialized in the agile methodology and doing code sprints in their day-to-day practice.

Projects proposals are to be submitted by email prior to the workshop with the submission of an *Expression of Interest* (EoI) to the workshop co-chairs in the form of an abstract that must explain:

- a proposed team of a maximum of 4 persons (minimum 1 person) with the identification of its leader;
- a 200 words summary of the project;
- a workplan with the different milestones to be achieved the day of the hackathon and potential extensions;
- an explanation of why the project would be beneficial to SLICES-RI and to the whole research community.

We plan to make teams of four people, the teams will be decided on the morning of the event, based on the hack projects decided collectively.

Prize amounts of money are not permitted with the type of funding that we have. However, as organizers of the workshop, we can sponsor coffee breaks, lunch, and dinner.

We will cover travel expenses for the leader of the best two project proposals. This decision will be taken collectively by the TPC and openly based on the novelty of the proposition, its potential usage by a large community, and its originality.

The winning team of the day will get privileged access to the next SLICES Open Call [6], offering support to further projects of the team members that would leverage SLICES-RI.

## VI. PAST EVENTS

SLICES-RI is a long-term project (over 2 decades). This will be the first hackathon dedicated to the project. However, we already had two major successful events that helped us gain confidence in the interest of such event for the research community.

In 2022 we organized the first SLICES Summer School (<https://www.slices-ri.eu/events/slices-sc-summer-school/>) that gathered about 60 attendees moving between tutorials and hands-on.

Based on the success of the first summer school, we organized in 2023 the second SLICES Summer School (<https://www.slices-ri.eu/events/slices-sc-2nd-summer-school/>) that gathered about 80 attendees over 3 days with more time dedicated to hands-on. Given the big success of this event, a third summer school is organized in summer 2024 where about 100 attendees are expected to be present. It will be mostly split between talks and tutorials.

In parallel to physical events, the SLICES-Academy [7] offers a detailed tutorial on deploying the blueprint. About 40 students follow this class and a dozen regularly practice the class.

## VII. PUBLICITY AND ADVERTISING PLAN TO ATTRACT PAPER SUBMISSIONS AND ATTENDEES

We will leverage the SLICES network to advertise the hackathon via mailing lists, social networks, and events such as The Networking Channel (<https://networkingchannel.eu/>). All these means of communication offer a direct reach to more than then thousands of interested researchers from the community.

This hackathon is a companion activity of the *Thought experiments, data and reproducibility for networking and FutureG research* workshop that has already been accepted at IFIP Networking 2024.

The workshop and the hackathon will provide synergy as the workshop is related to test platforms at large while the hackathon looks at how to bootstrap new collaborative tools for test platforms. The audience of the two events are not in competition. The workshop will attract a more conventional audience composed of researchers, deciders, post-docs...) and the hackathon, by its very nature, will mostly attract research engineers and developers, that are typically working jointly with the expected attendees of the workshop.

## VIII. CALL FOR PAPERS

SAME as Sec. III

### A. Submission Guidelines

Projects proposals are to be submitted by email with the submission of an *Expression of Interest* (EoI) to the workshop co-chairs (nimakris@uth.gr and damien.saucez@inria.fr) in the form of an abstract that must explain:

- a proposed team of a maximum of 4 persons (minimum 1 person) with the identification of its leader;
- a 200 words summary of the project;
- a workplan with the different milestones to be achieved the day of the hackathon and potential extensions;
- an explanation of why the project would be beneficial to SLICES-RI and to the whole research community.

The format can be a PDF or a link to a git repository clearly documented.

The name and email address of each member of a proposed team must be provided in the EoI.

To promote openness and reproducibility authors and reviewers are not anonymous and it is expected to have interactions between the authors and reviewers during the review process.

All code produced during the hackathon will be done under a public, free, and open source license.

Team members engage to physically attend the hackathon if their EoI is selected.

### B. Important dates

- Expression of Interest (EoI) submission: 21 March 2024.
- Feedback on EoI (notification): 25 April 2024.
- Notification of travel expenses coverage: 25 April 2024.
- Final Lightning talk slides: 2 May 2024.
- Hackathon date: 3 June 2024.

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