

# SLICES-RI Plain Orchestrating System (pos)

## Reproducible Experiment Workflows by Design

### Reproducibility by Design

#### Our goals:

##### How to limit the effort spent on reproducibility?

- ▶ Reduce effort for researchers
- ▶ Integrate reproducibility into experiment design
- **Automate entire experiment** (setup, execution, evaluation)

##### How to create robust, reproducible experiments?

- ▶ Documentation of all relevant parameters
- ▶ Automate the documentation of experiments
- **Well-structured experiment workflow** serving as experiment documentation

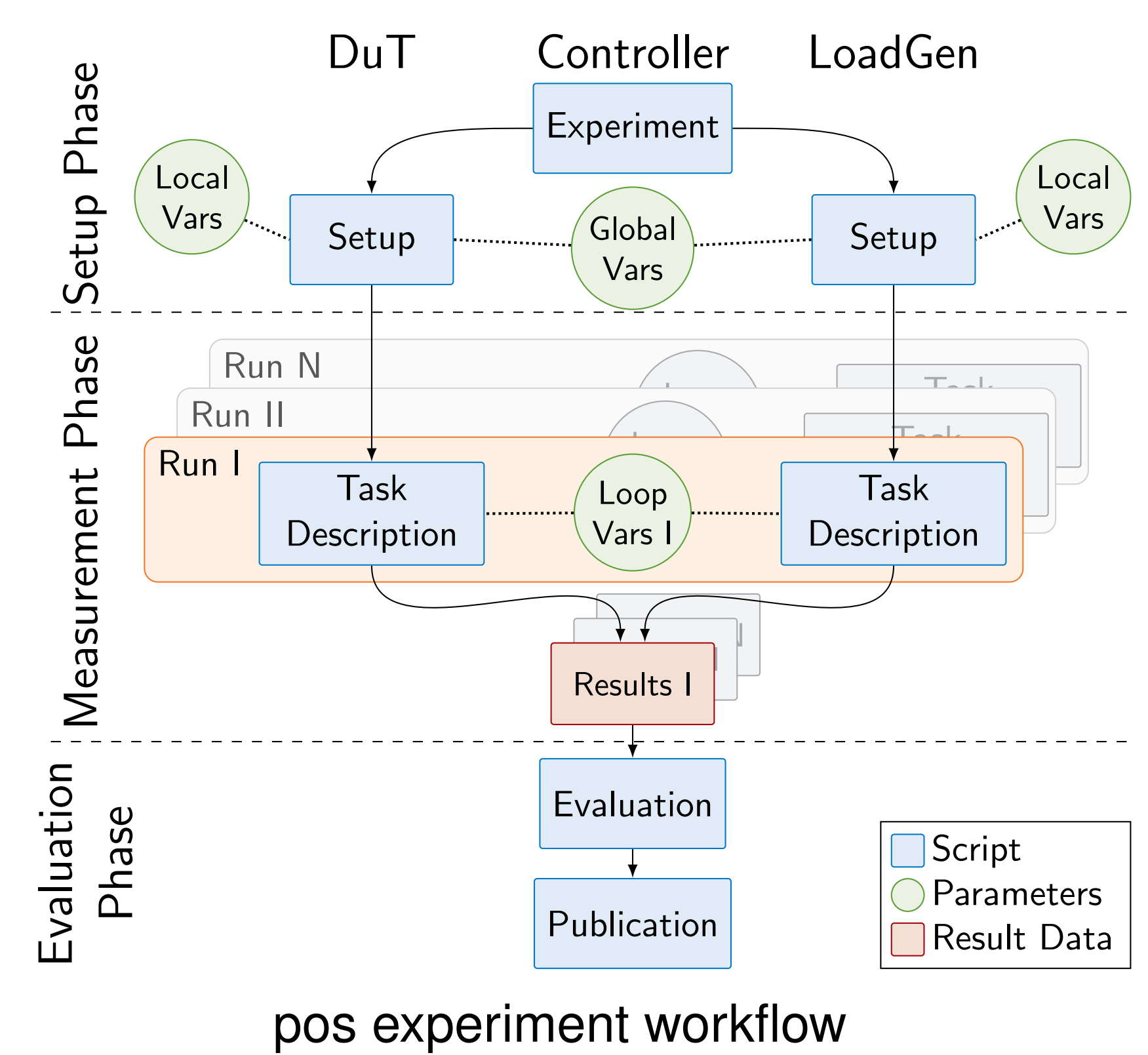
#### Our solution: plain orchestrating service [3]

##### Achieving Repeatability

- ▶ Full experiment automation
- ▶ Live images (clean slate on reboot)
- Experiments become **repeatable**

##### Achieving Reproducibility

- ▶ Sharing access to testbed
- ▶ Other researchers (re-)run experiment
- Experiments become **reproducible**



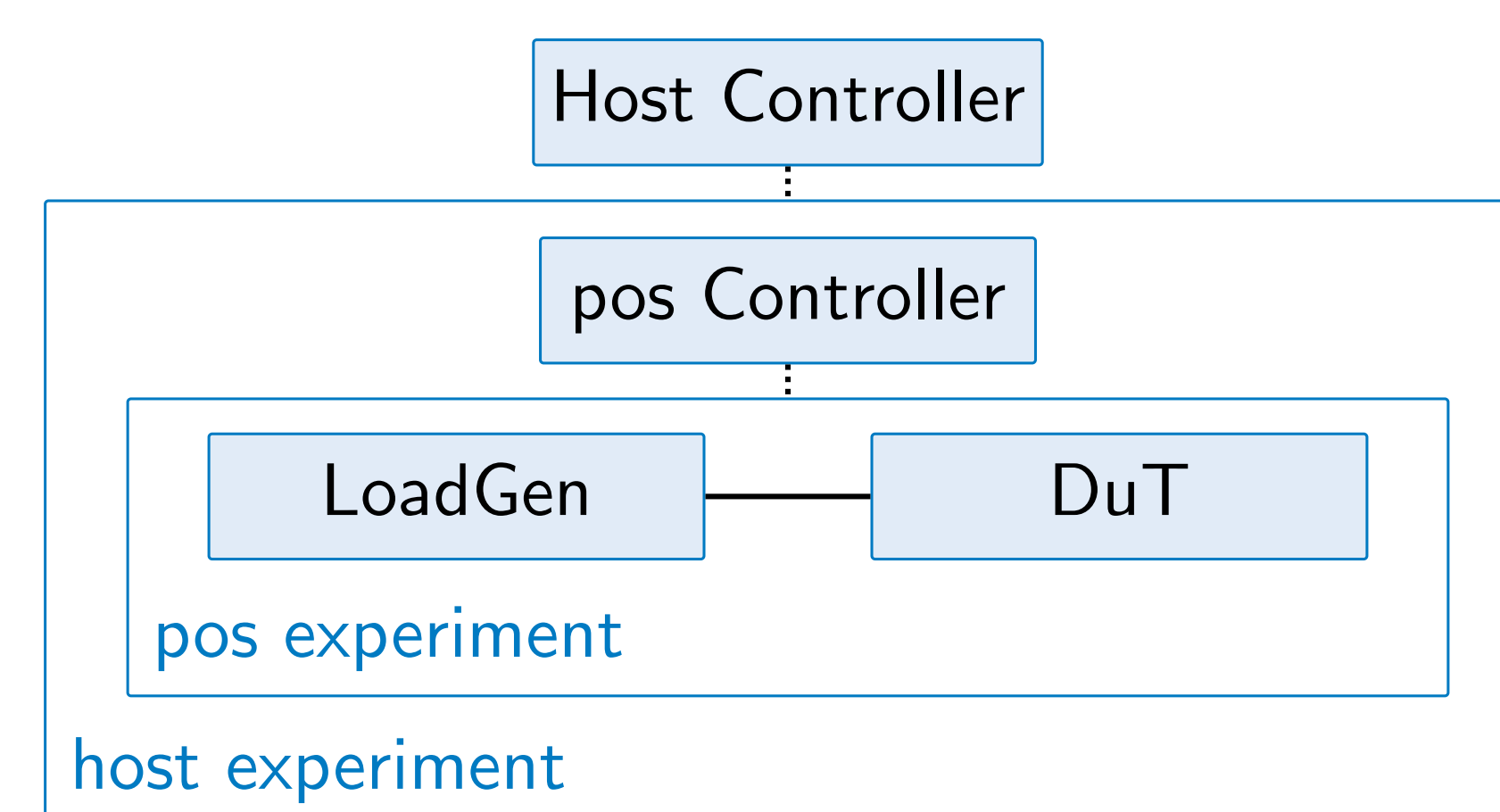
### Measurement Tools

#### MoonGen [2] packet generator for 100 Gbit/s Ethernet and beyond

- ▶ High performance based on DPDK
  - Supports bandwidths of  $\geq 100$  Gbit/s
  - Over 100 million packets per second
- ▶ Hardware timestamping functionality
  - Utilizing off-the-shelf NICs
  - Timestamps with ns-resolution
  - High accuracy and precision
- ▶ Flexible configuration by Lua user scripts
  - Support for new protocols can be added easily
  - Modification of packets before sending via user-defined scripts
- ▶ MoonGen has been used for 350+ scientific publications since 2015



### Reproducibility Across Heterogeneous Testbeds



- ▶ Limitation: Experiment workflow depends on pos controller
- Solution: Export pos testbed controller to other testbeds
  1. Create experiment in host testbed
  2. Deploy pos inside the experiment of host testbed
  3. Deploy pos workflow inside the pos environment
- ▶ Ongoing work:
  - Porting pos to other testbeds such as CloudLab or Chameleon

### SLICES & EOSC [1]



#### Offering SLICES services to EOSC

- ▶ Providing state-of-the-art digital research infrastructure (5G/6G networks, IoT, cloud infrastructures)
- ▶ Powerful experiment APIs to utilize different infrastructures
- ▶ Services such as reproducible experiment workflows

#### Embedding SLICES into EOSC ecosystem

- ▶ Application of EOSC-supported principles and methodologies (e.g., RO-Crate)
- ▶ FAIR Research Lifecycle Management (cf. RELIANCE project)

### SLICES-RI



slicesRI



- ▶ EU initiative with 15 member countries
- ▶ Goal: Creation of a large-scale digital research infrastructure
- ▶ Shared pos-inspired API:
  - Cross-reproduction of experiments on participating testbeds
  - Establishing a widely-accepted template for reproducible research
- ▶ **Contact us:**
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[1] Y. Demchenko, S. Gallenmüller, S. Fdida, P. Andreou, C. Crettaz, and M. Kirkeng. Experimental Research Reproducibility and Experiment Workflow Management. In *15th International Conference on COMMunication Systems & NETWORKS, COMSNETS 2023*, Bangalore, India, 2023.  
 [2] P. Emmerich, S. Gallenmüller, D. Raumer, F. Wohlfart, and G. Carle. MoonGen: A Scriptable High-Speed Packet Generator. In *Internet Measurement Conference 2015 (IMC'15)*, Tokyo, Japan, Oct. 2015.  
 [3] S. Gallenmüller, D. Scholz, H. Stubbe, and G. Carle. The pos Framework: A Methodology and Toolchain for Reproducible Network Experiments. In *Conference on emerging Networking EXperiments and Technologies (CoNEXT)*, Munich, Germany, 2021.