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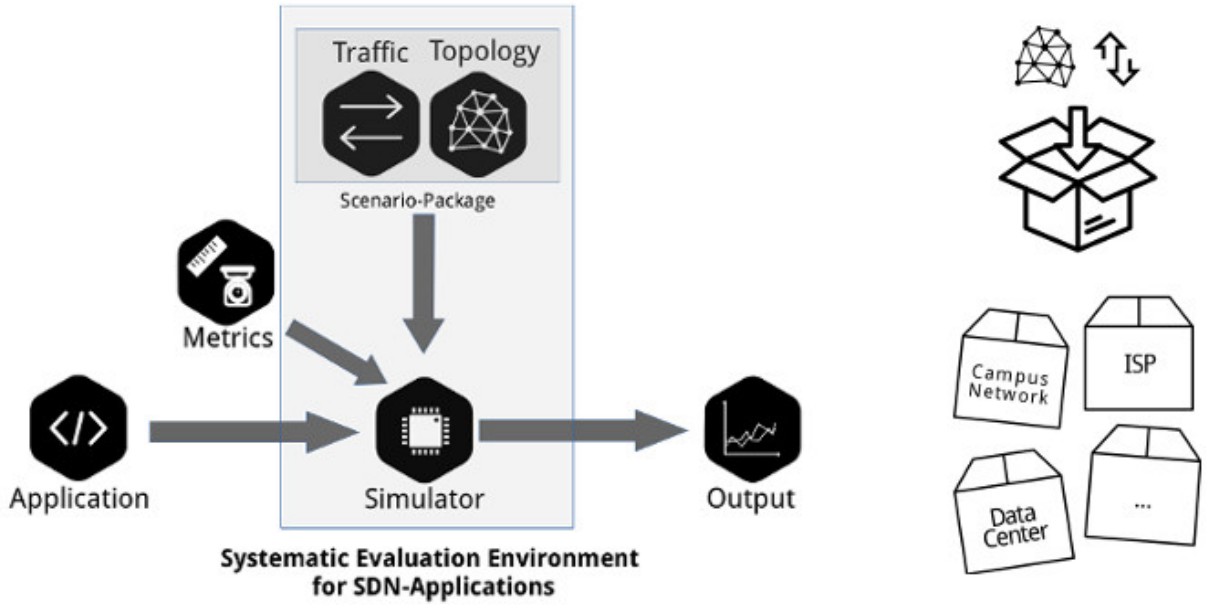
# SEED: Towards a Systematic Evaluation Environment for Software-Defined-Network Applications

9th SDN Switzerland Workshop, Zürich

Addis Dittebrandt, **Michael König**, Felix Neumeister | December 4th, 2017

INSTITUTE OF TELEMATICS — DEPARTMENT OF INFORMATICS — KARLSRUHE INSTITUTE OF TECHNOLOGY



# Praxis der Forschung

"Research in Practice":
Student research project

- Duration: 2 semesters
- Identify state of the art
- Write project application
- Conduct research project
- Write research paper


Source: xkcd.com

# Central Question

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**How are SDN-applications evaluated and how can this evaluation process be simplified?**

# Goal

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**Focus of the overall project:**

Systematic Evaluation Environment for SDN Applications

**Focus of this presentation:**

Short Project Presentation

+

Call-for-participation

# Outline

- Motivation: Challenges with SDN-evaluations
  - Reproducibility
  - Comparability
  - Setup-overhead
- Current way to evaluate simulatively
- Our approach: SEED
  - Idea / Architecture
  - Components
  - Workflow
- Conclusion

# Motivation

## Increasing number of SDN-applications & -research

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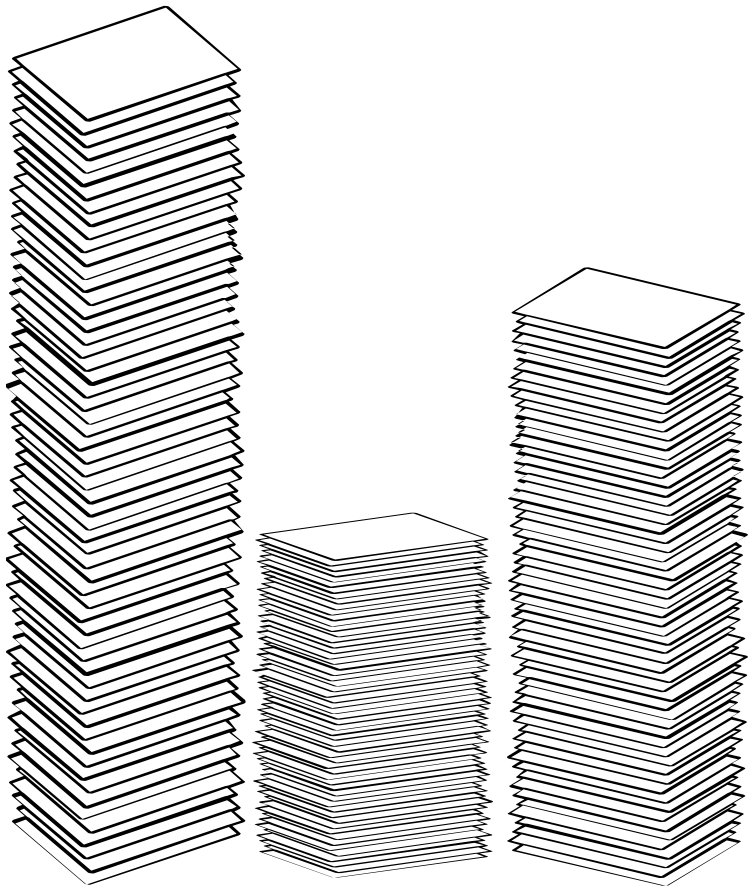
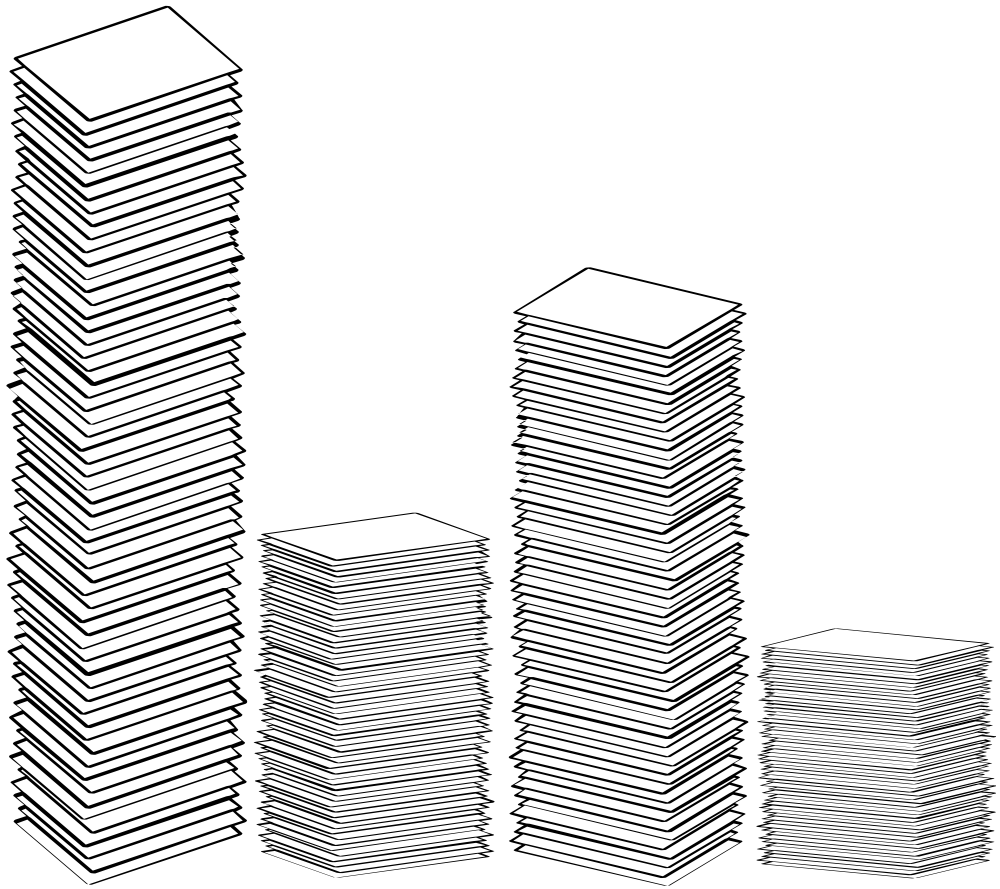
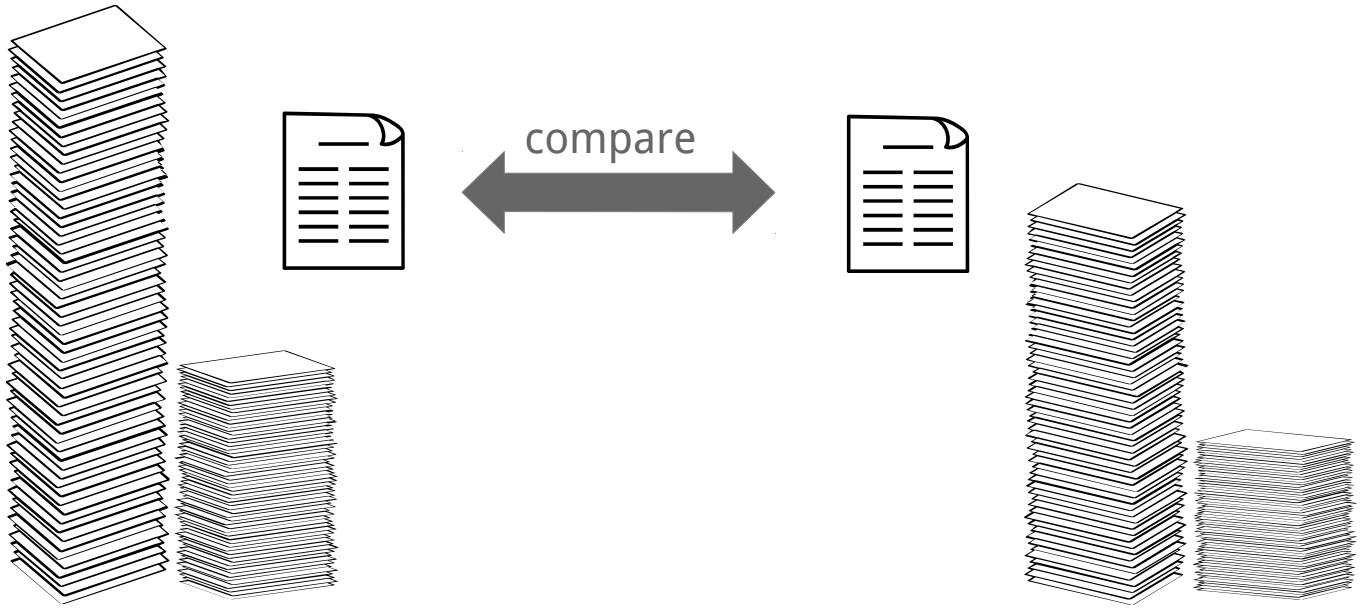


# Motivation

## Increasing number of SDN-applications & -research



# Lack of Comparability



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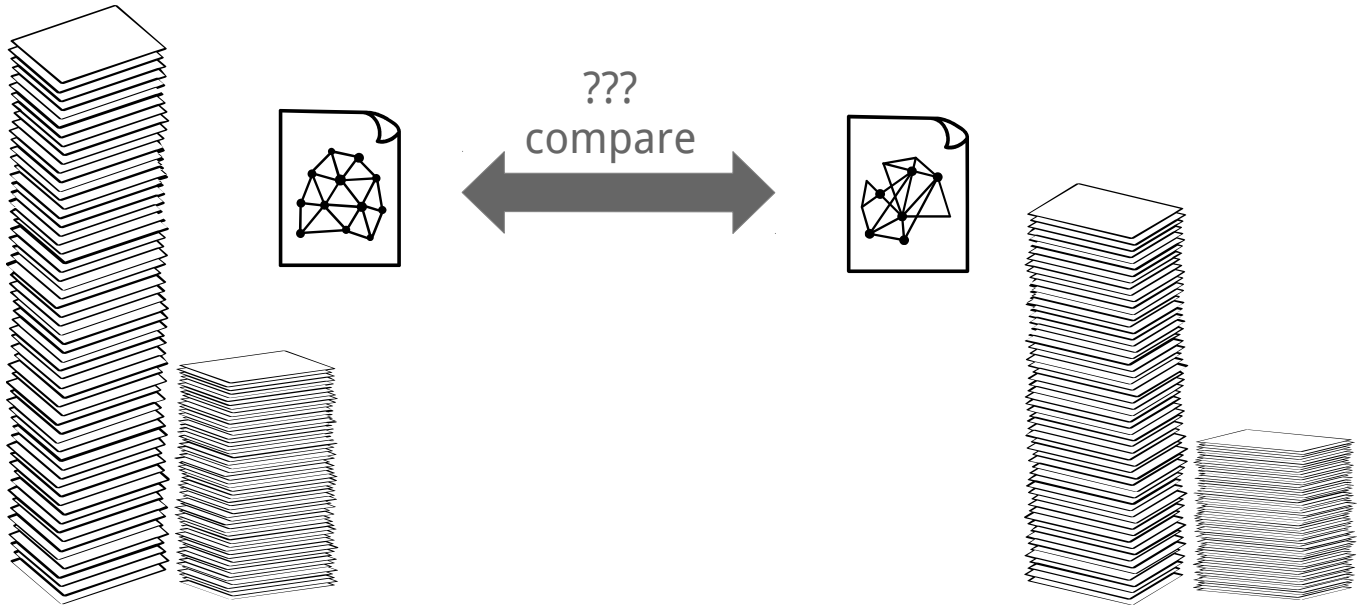
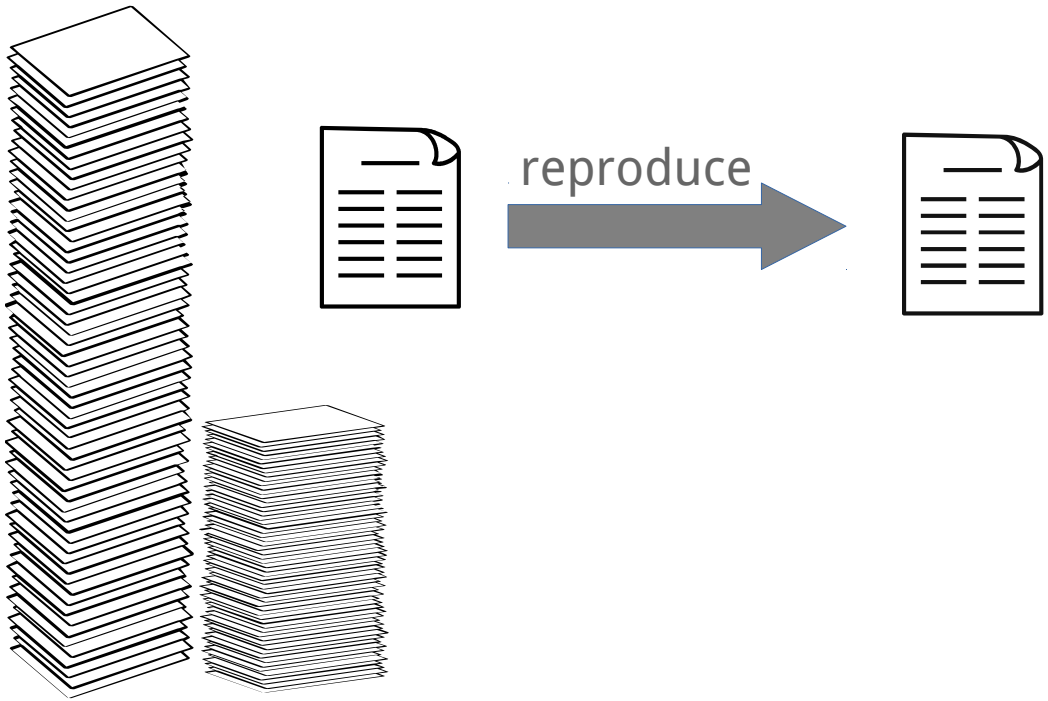



Comparison between SDN-applications often not trivial or infeasible:

- Scenario description unclear or not existing . . .
- Usage of different topologies, traffic, metrics, parameters . . .
- Commonly used scenarios (e.g. "'Stanford Campus Network"') only equivalent in name

# Reproducibility of Results



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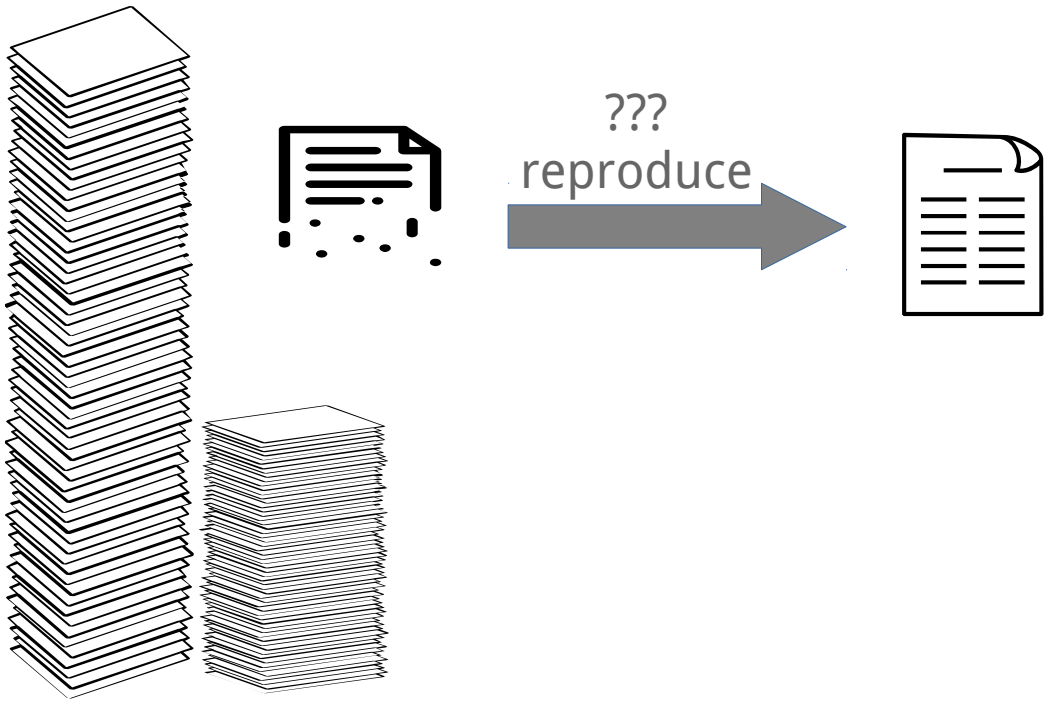


Reproducibility of SDN-applications often not feasible:

- Contradicting experiment descriptions
- Unclear evaluation setup (missing information)
- Broken, incomplete or missing artifacts

# Evaluation Setup is Complex

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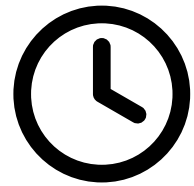
- Selection and configuration of tools to generate
  - representative traffic
  - representative topologies

  can be time consuming and error-prone



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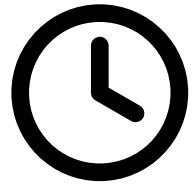
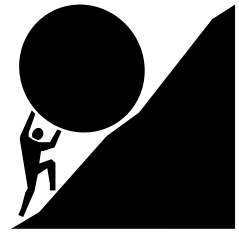
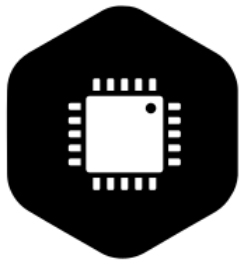


- Evaluation design has to be re-done
  by each research-team



# Current way to evaluate simulatively



- Simulator
- Traffic
- Topology
- Metrics
- SDN-Application
- Logs/Artifacts

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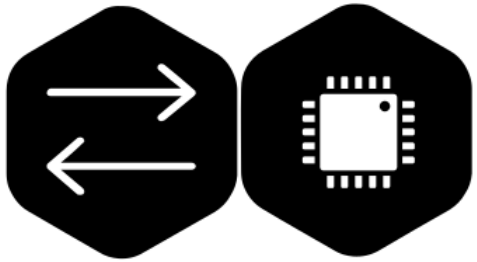

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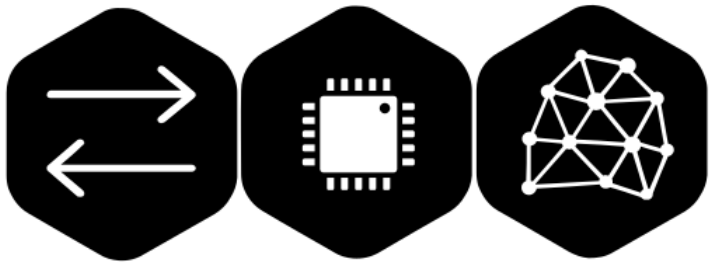

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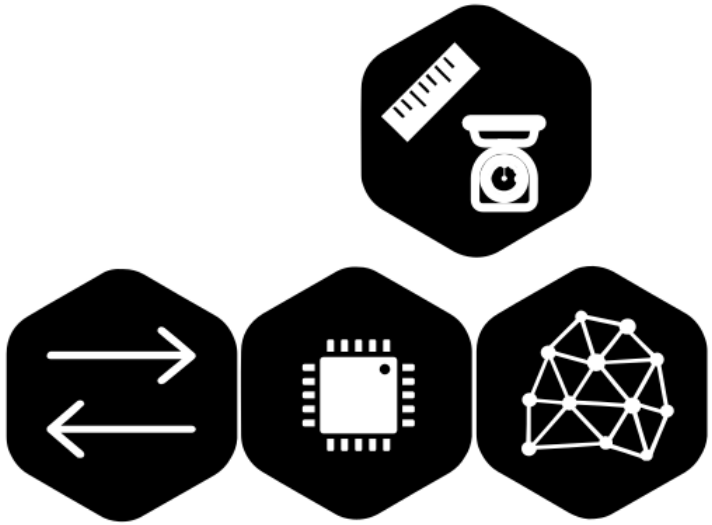

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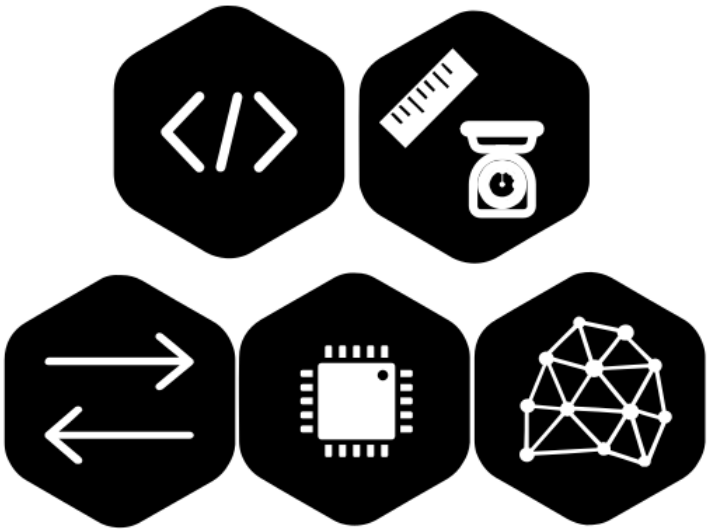

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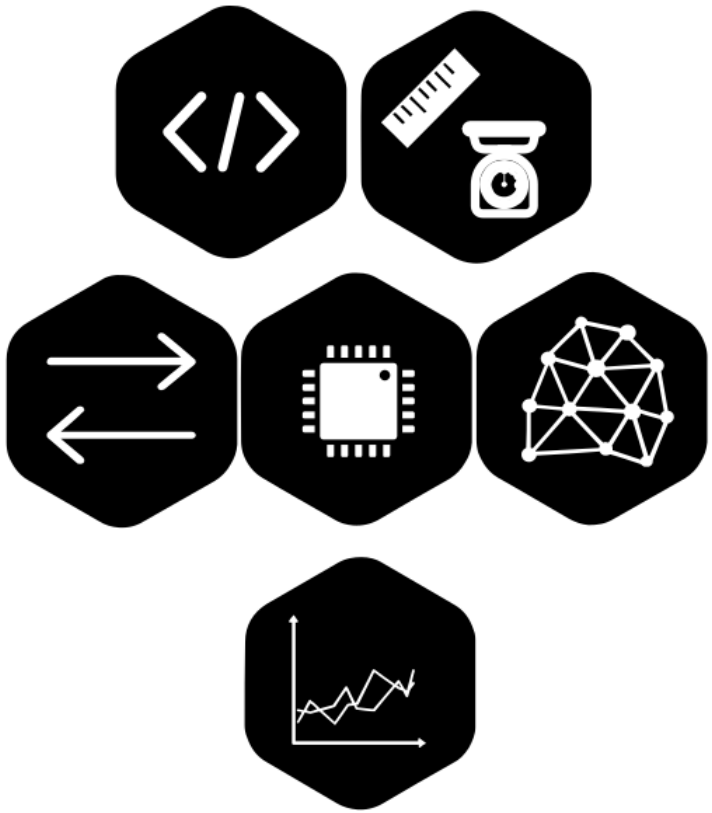

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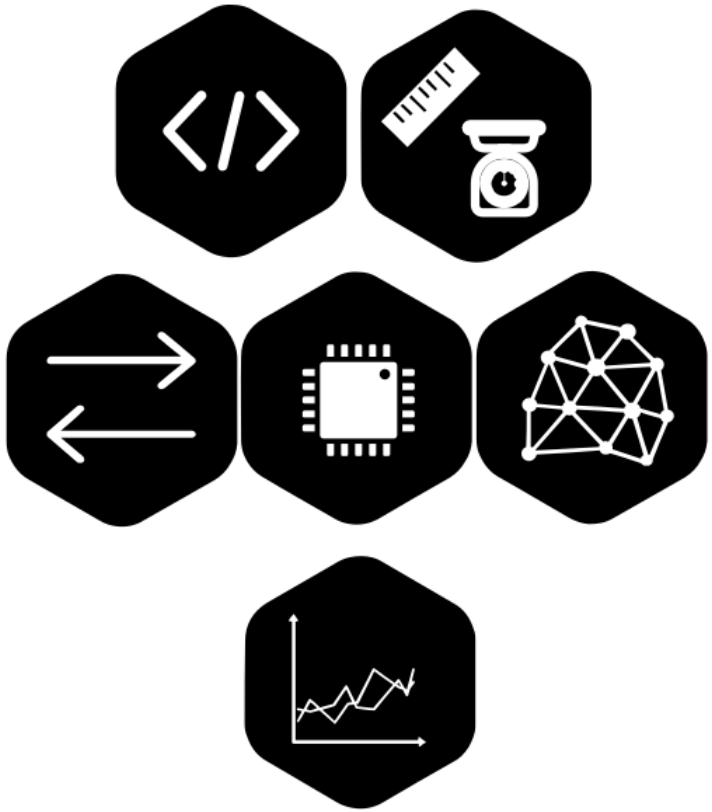

- Simulator
- Traffic
- Topology
- Metrics
- SDN-Application
- Logs/Artifacts

$\Longrightarrow$ one coupled "blob"

# Challenges of (SDN-)evaluations

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- Lack of Comparability
- Reproducibility often not feasible
- Evaluation-Setup is time consuming & error-prone
  (+ Sharing of existing setups difficult)

# SEED

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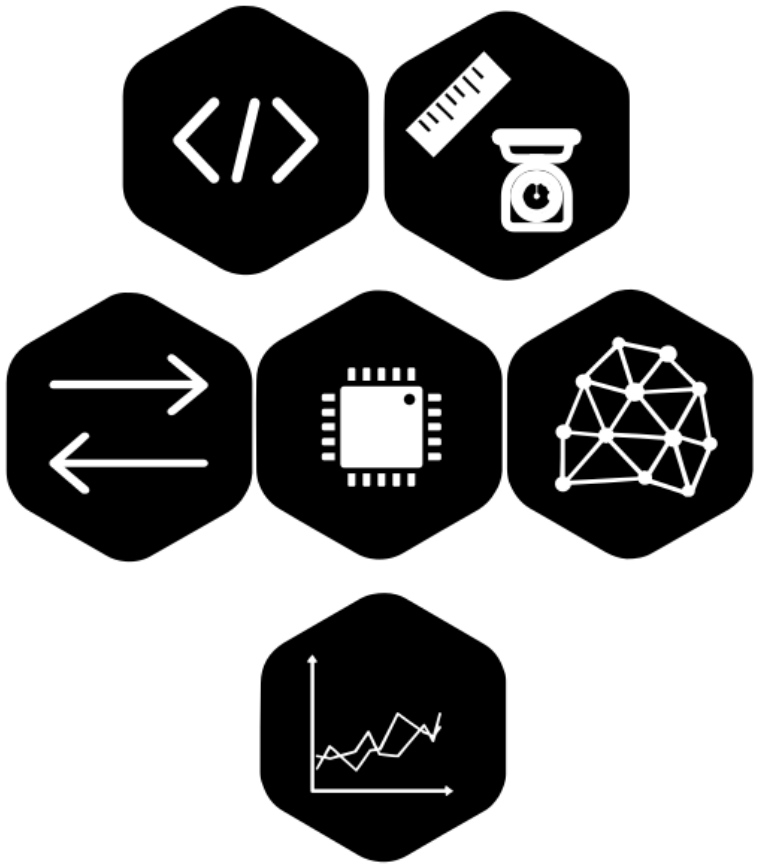
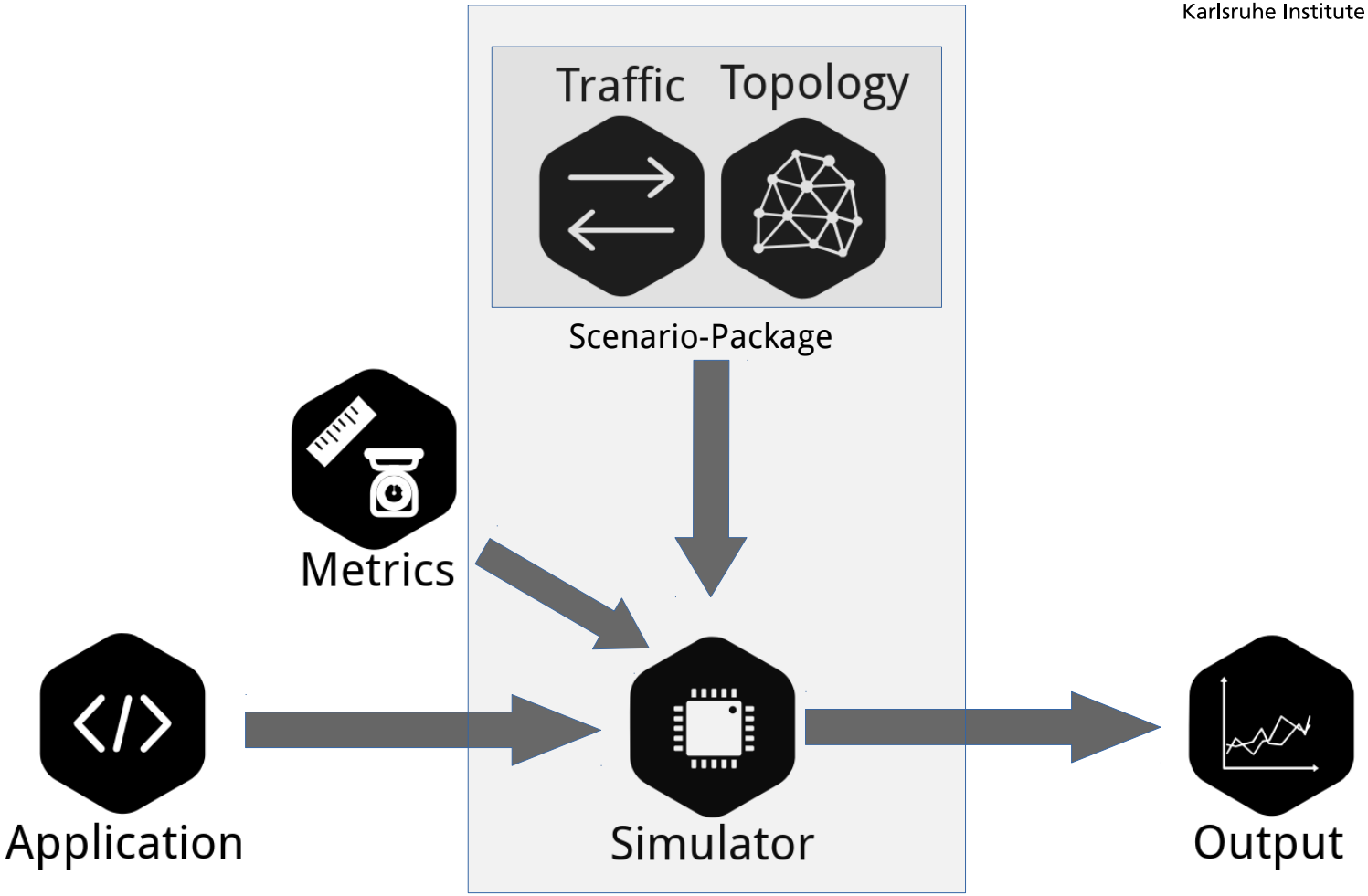
## Replace this:

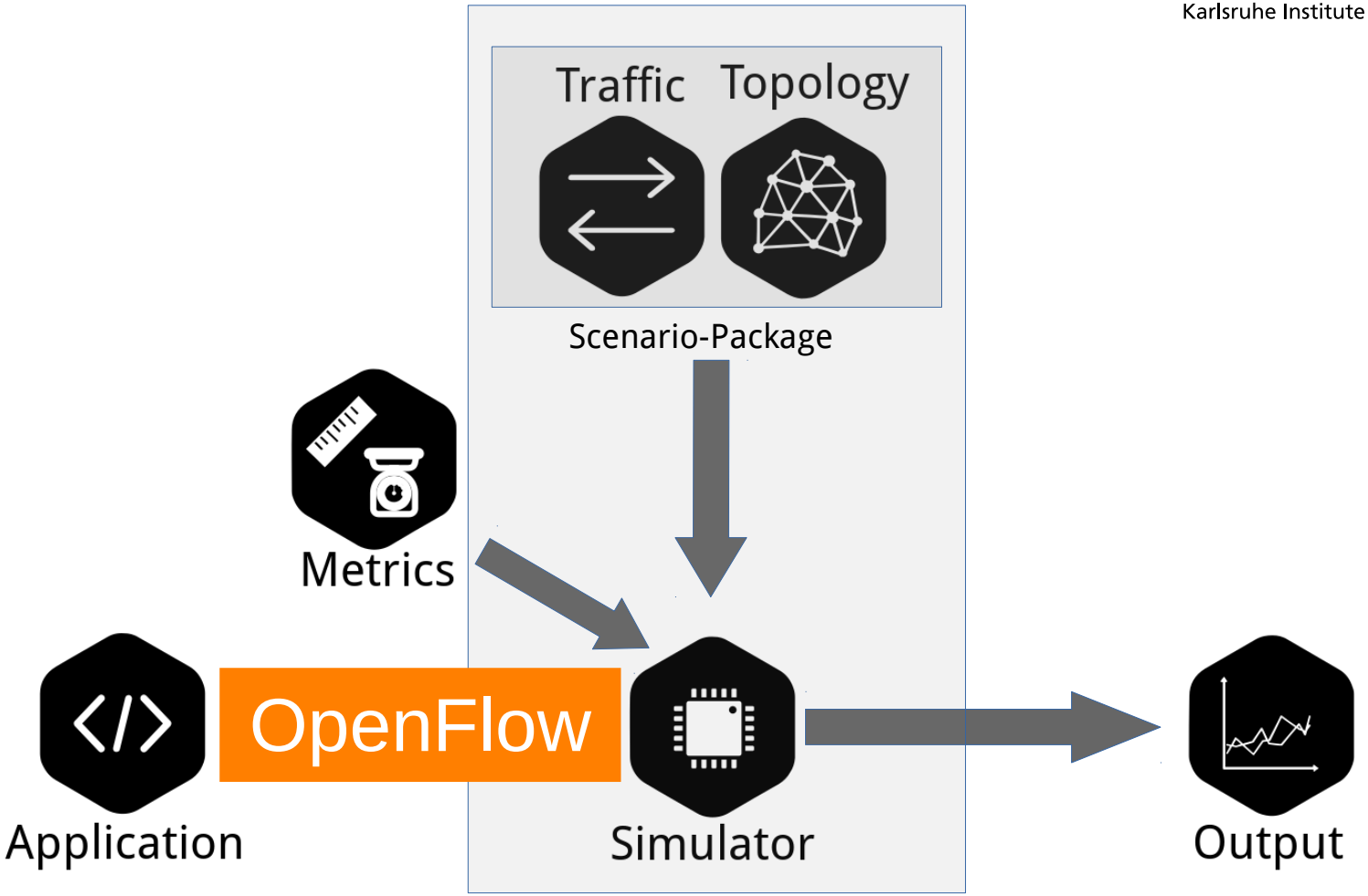


# SEED




**Systematic Evaluation Environment for SDN-Applications**

# SEED

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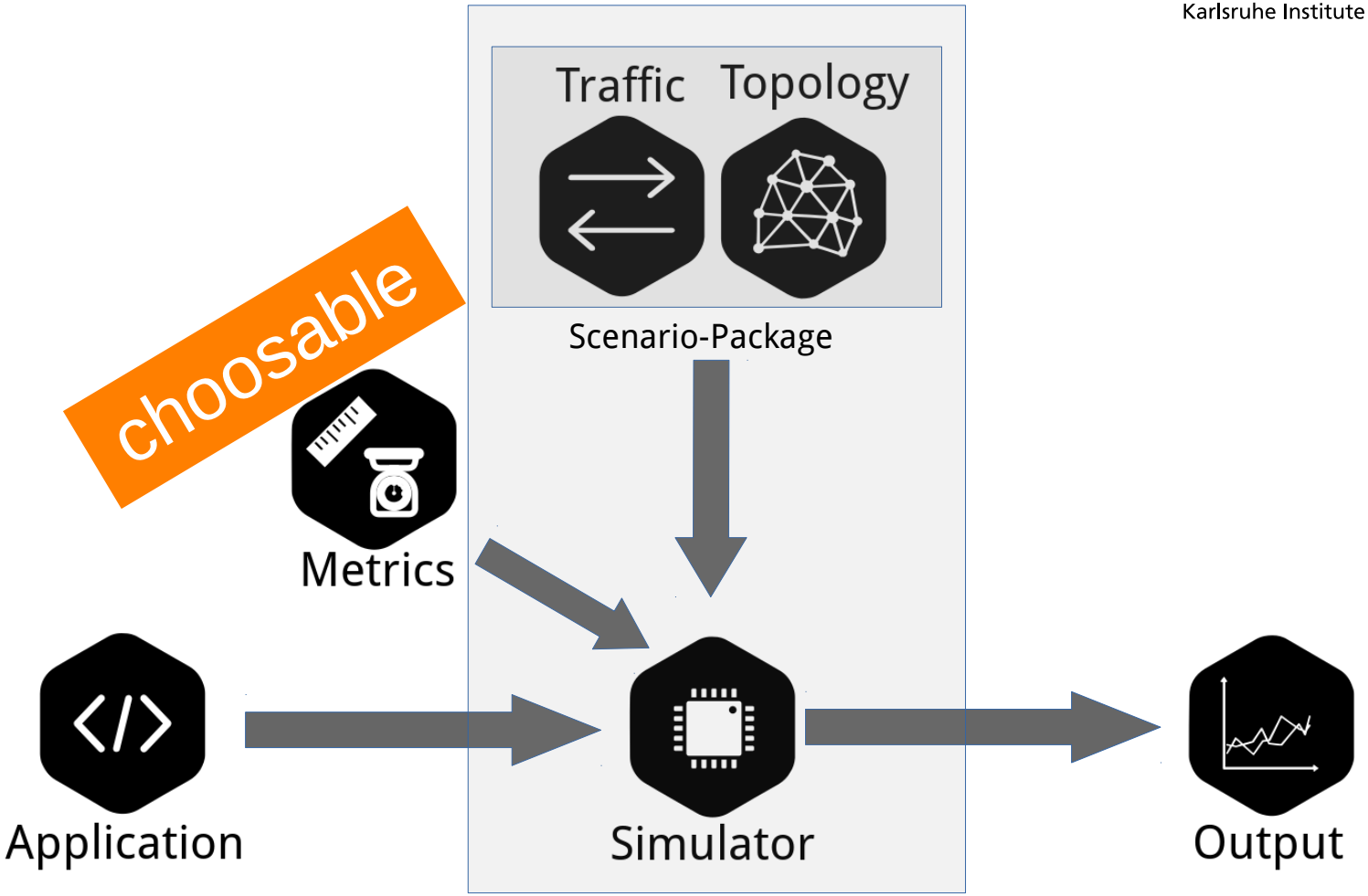


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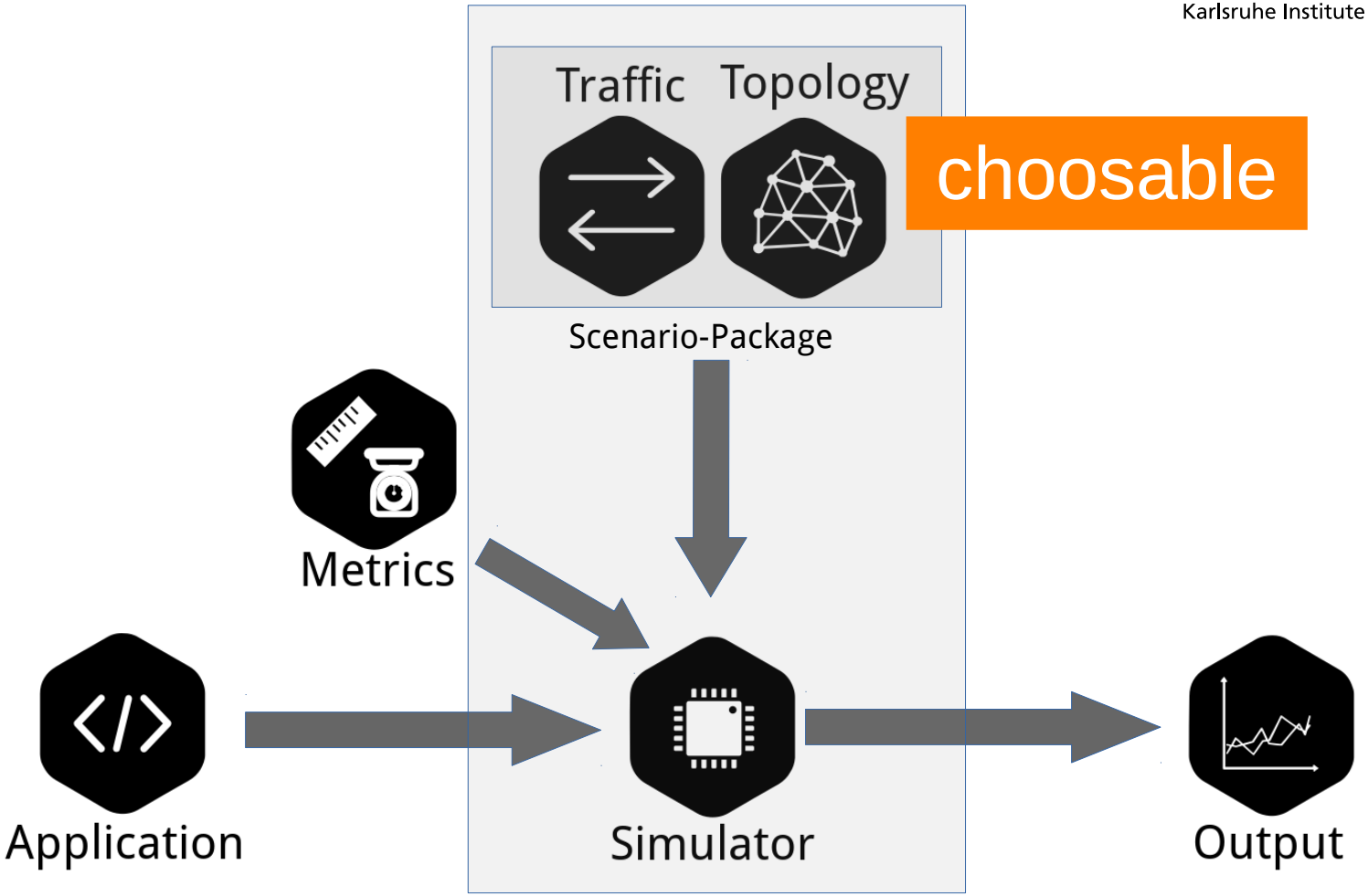


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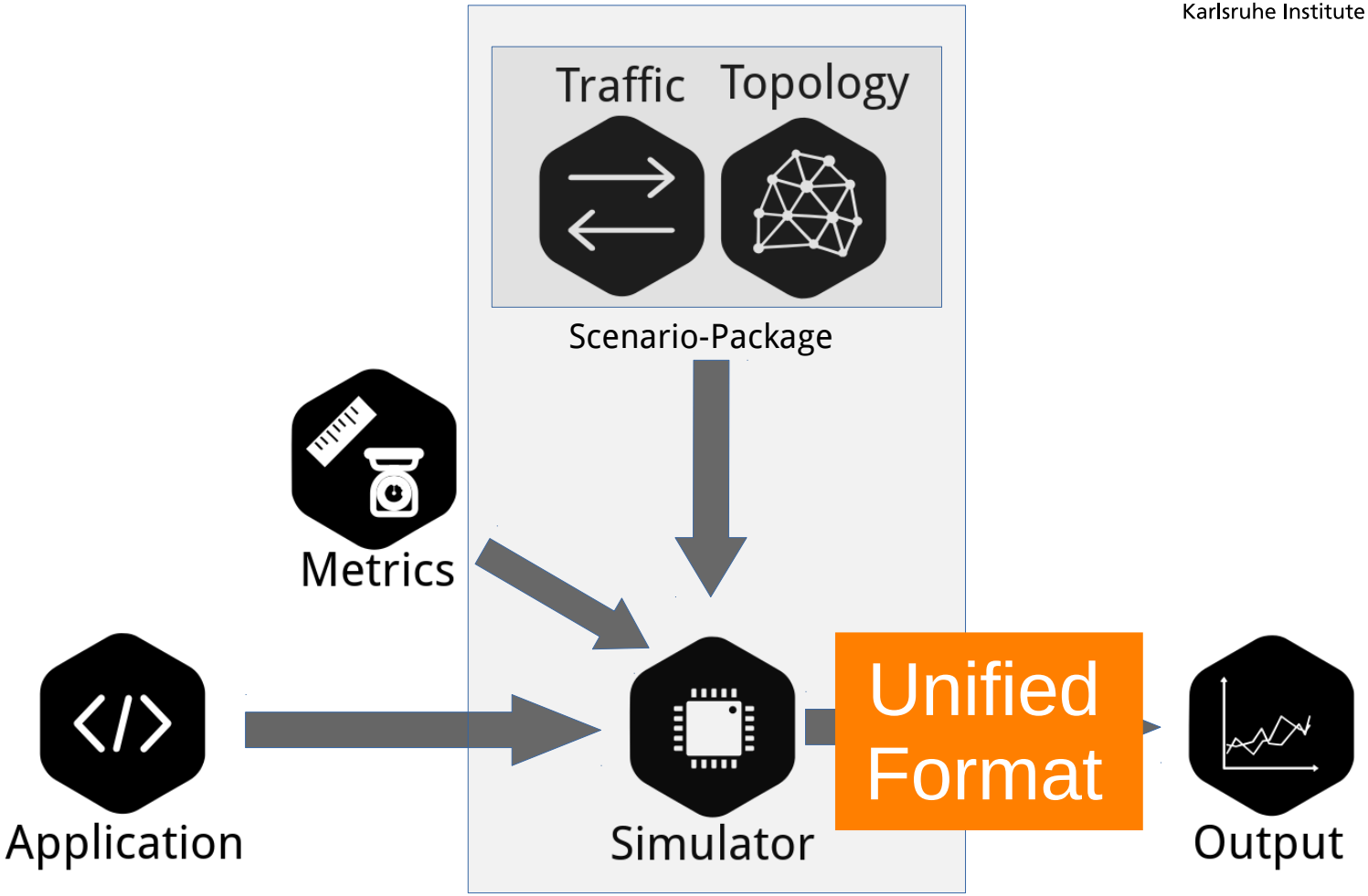
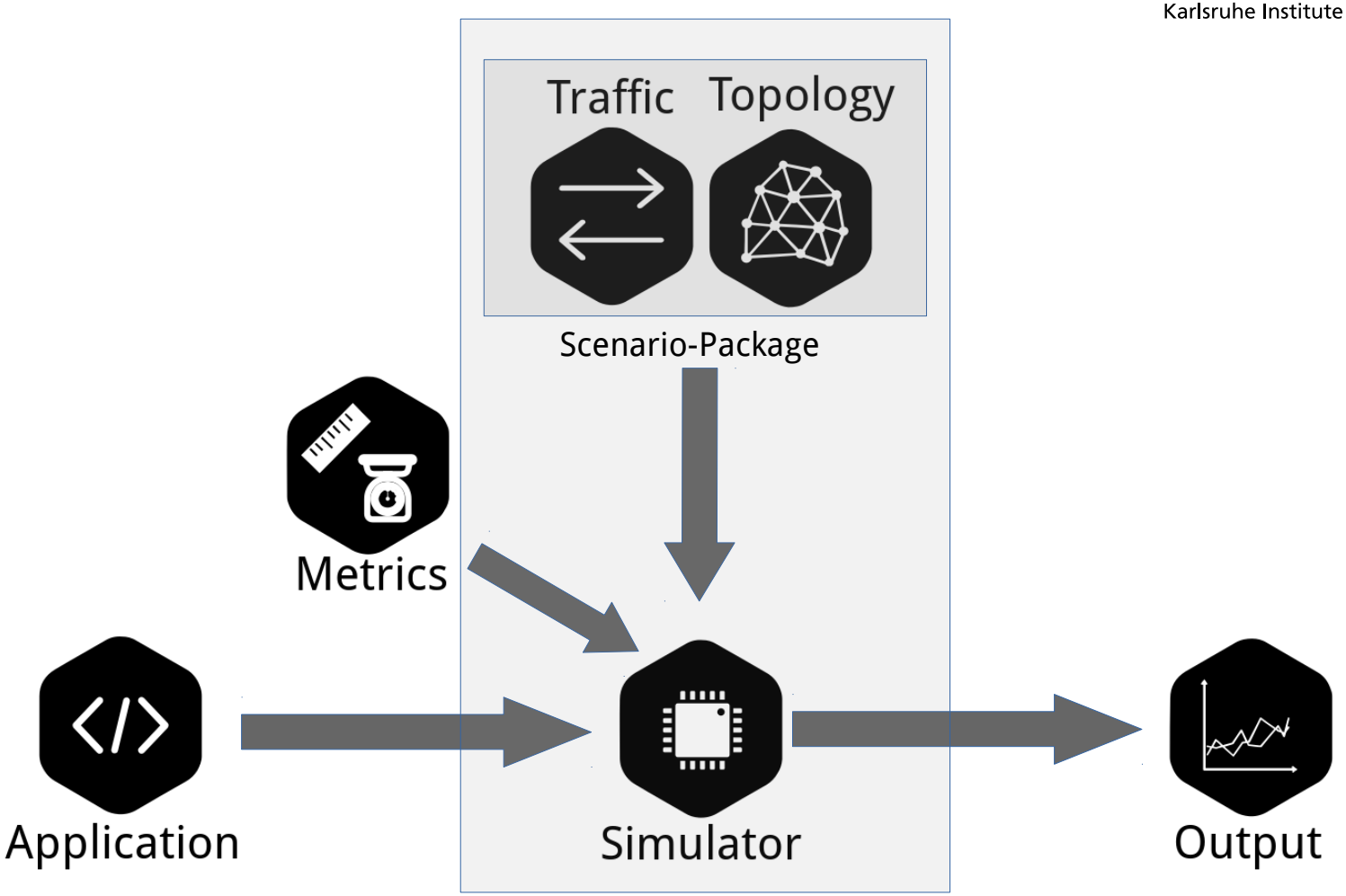



**Systematic Evaluation Environment for SDN-Applications**

# Components Exchangeable

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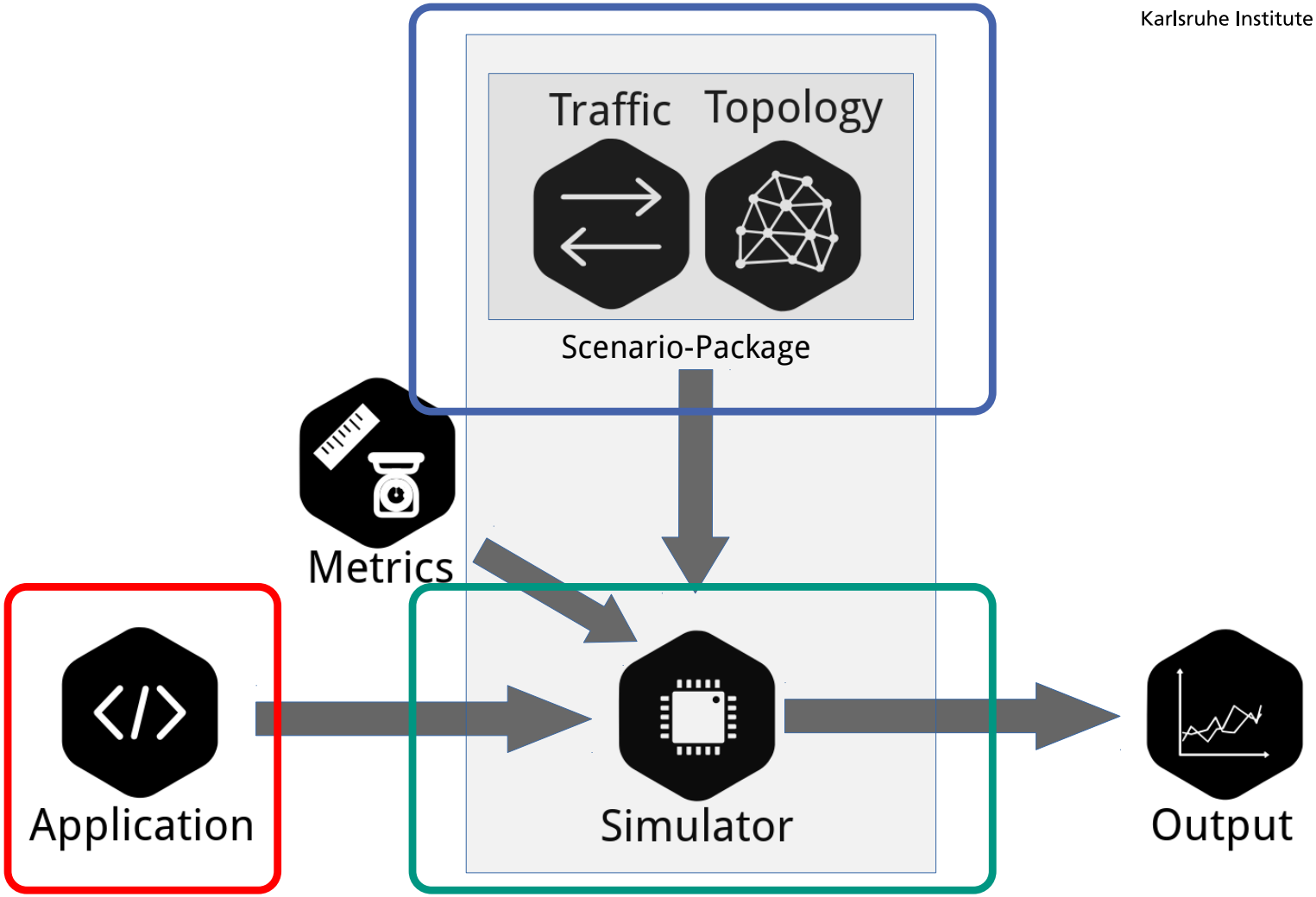


**Systematic Evaluation Environment for SDN-Applications**

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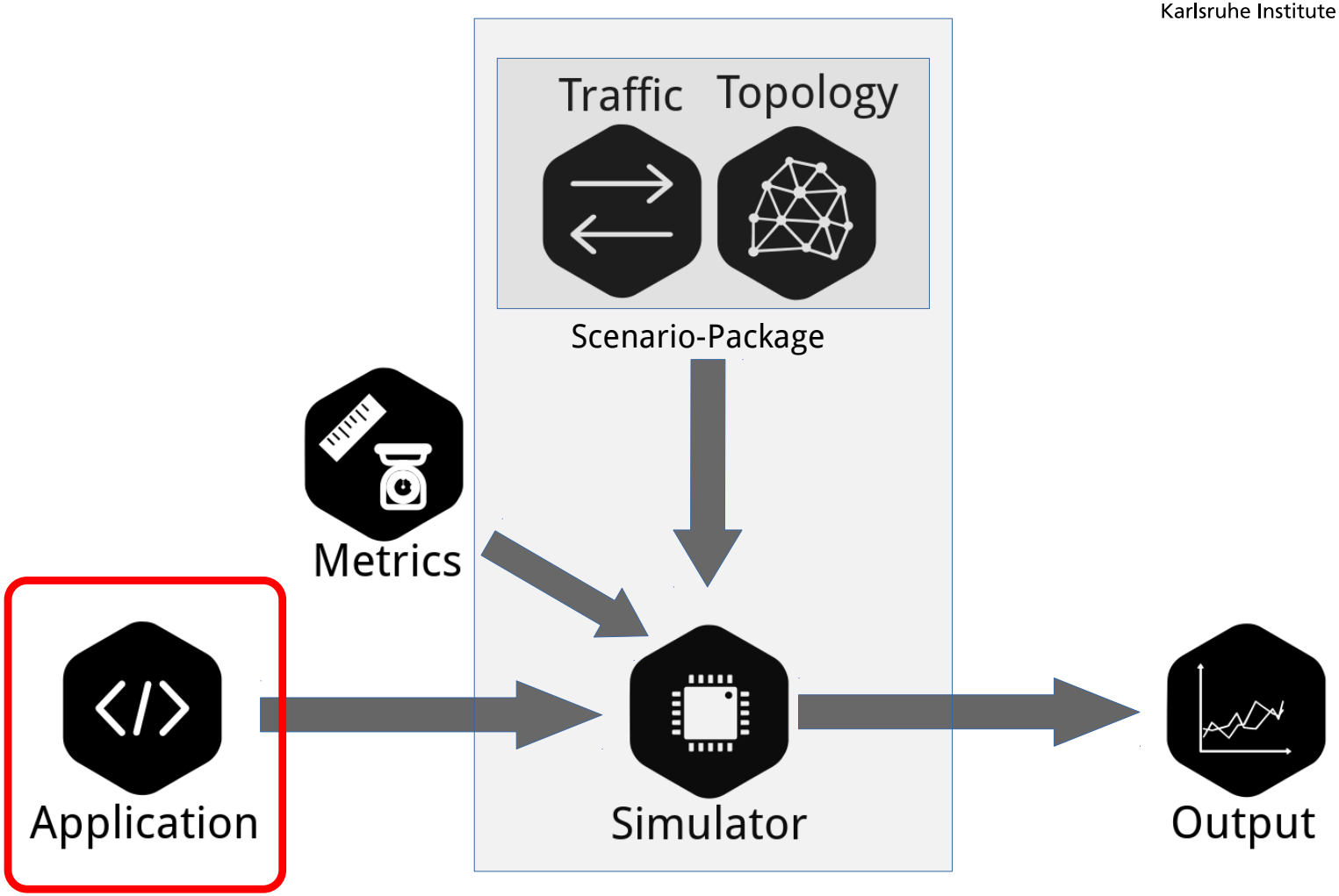


**Systematic Evaluation Environment for SDN-Applications**

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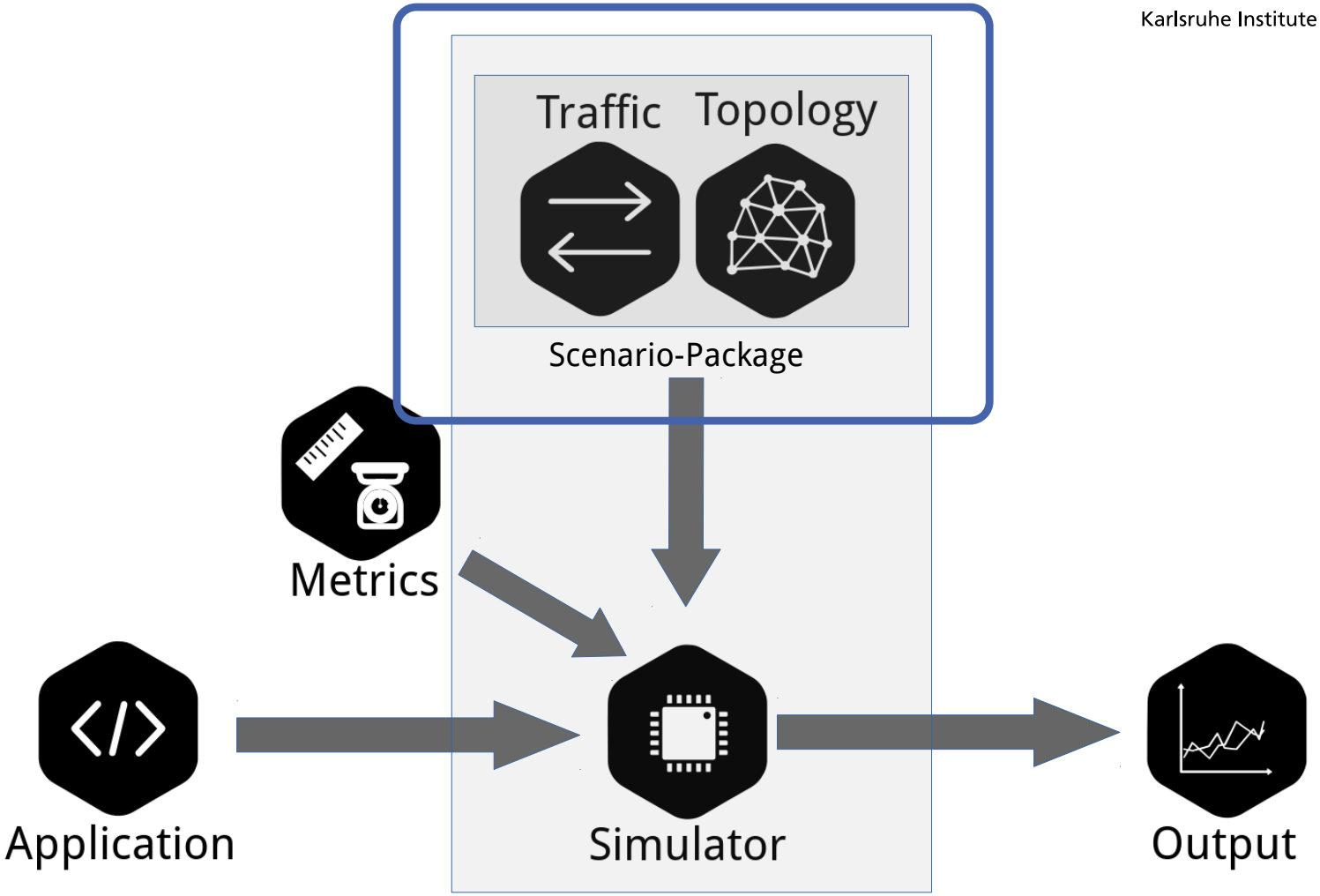


**Systematic Evaluation Environment for SDN-Applications**

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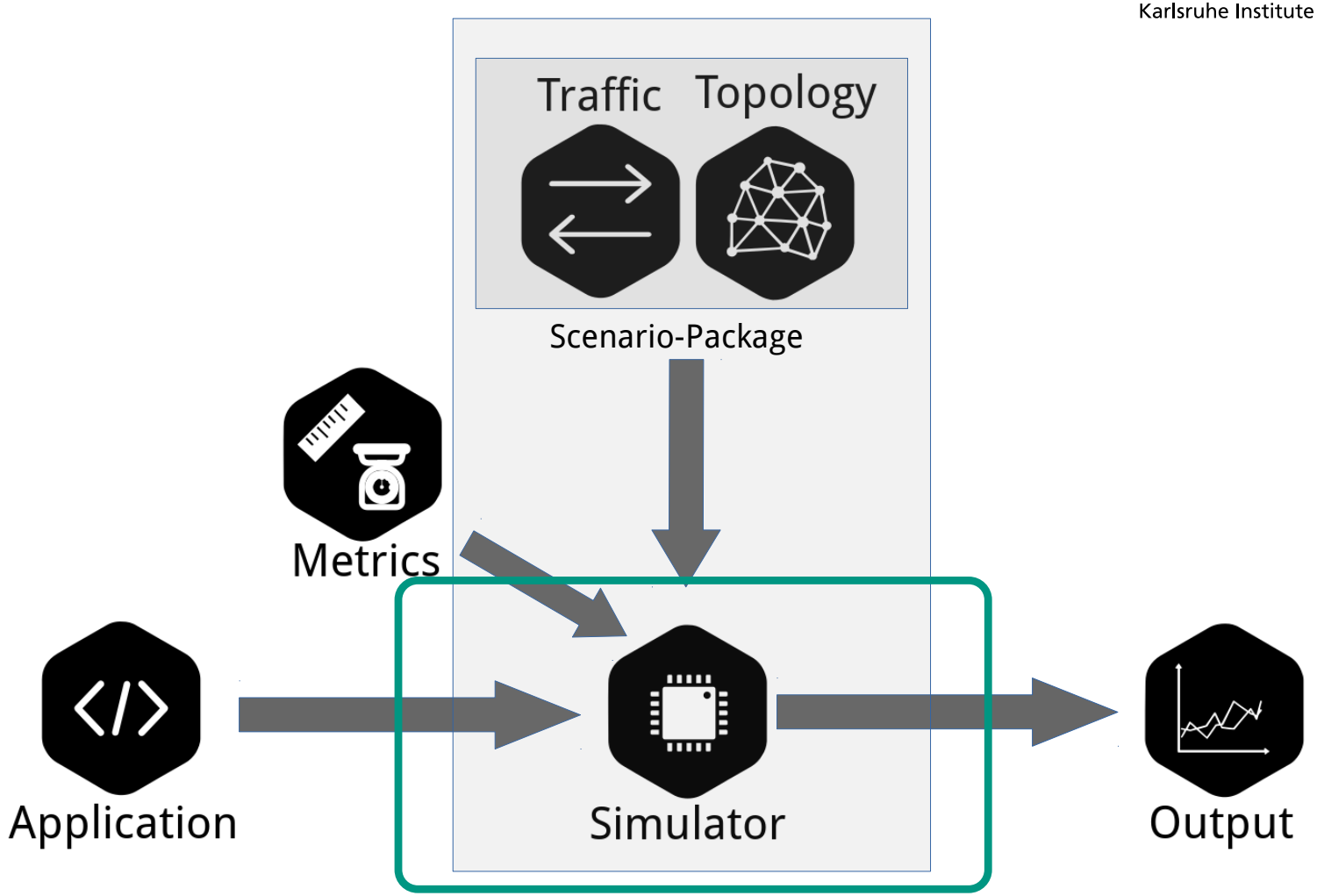


# Clear Experiment Description

- Enable reproducibility & sharing
  $\rightarrow$ one file describes complete evaluation setup

**Components**

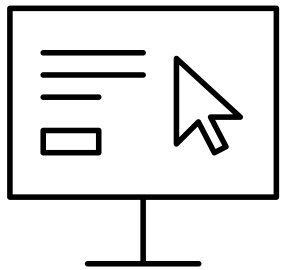
- Application(s)
- Scenario
- Simulator
- Parameters

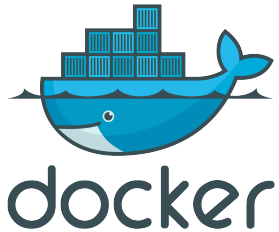
Experiment Description

# SEED-Frontend

**Unified starting point for experiments:**

- Preproccessing of configurations
- Initialization and start of
  - SDN-controller
  - Corresponding SDN-applications
  - Simulation environment
- Connection between components
- Docker Support: Faster setup

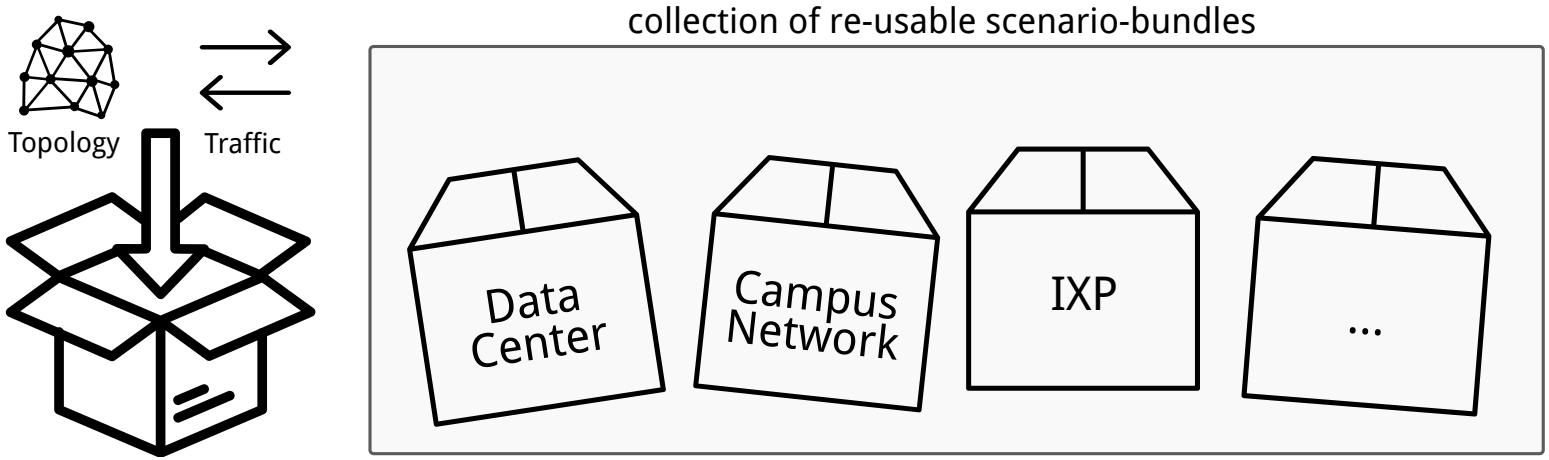




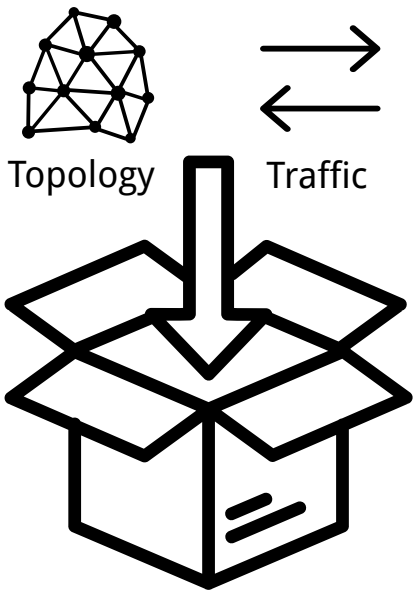
# Scenario-Bundles

Scenario (= Traffic + Topology)

- Enable uniform evaluation scenarios
- Fast experiment setup
- Easy sharing & reuse



# Format of Scenario-Bundles




## Describes complete scenario

- Topology
- Traffic

## Properties

- XML-based
- Addressing & grouping of network components
- Process-based traffic generation
- Integration of SDN-components

# Simulator-Adapters

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## Tasks

- Parsing of scenario-bundles
- Connection of SDN-components (via OpenFlow)
- Construction of the topology
- Execution of traffic & events

## Implementations

- mininet
- OMNeTT++
- ns-3

# Traditional Evaluation Process

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1. Choose simulator
2. Familiarize with simulator
3. Choose topology
   (investigation necessary)
4. Build topology in simulator
5. Design traffic model
   (investigation necessary)
6. Integrate traffic into simulator
7. Attach SDN-application
8. Execute simulator
9. Evaluate results

# Evaluation Process with SEED

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1. Choose simulator
2. Familiarize with simulator
3. Choose topology (investigation necessary)
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5. Design traffic model (investigation necessary)
6. Integrate traffic into simulator
7. Attach SDN-application
8. Execute simulator
9. Evaluate results

Choose/Provide

- Scenario-bundle
- Location of SDN-app

# Workflow

1. Choose simulator
2. Choose scenario-bundle
3. Provide path to own SDN-application
4. Execute SEED
5. Evaluate results

**Example usage:**

```
./seed -app app1 -scenario scenario1 -simulator sim1
./seed -app app2 -scenario scenario2 -simulator sim2
```

# Workflow

1. Choose simulator
2. Choose scenario-bundle
3. Provide path to own SDN-application
4. Execute SEED
5. Evaluate results

**Example usage:**

```
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```
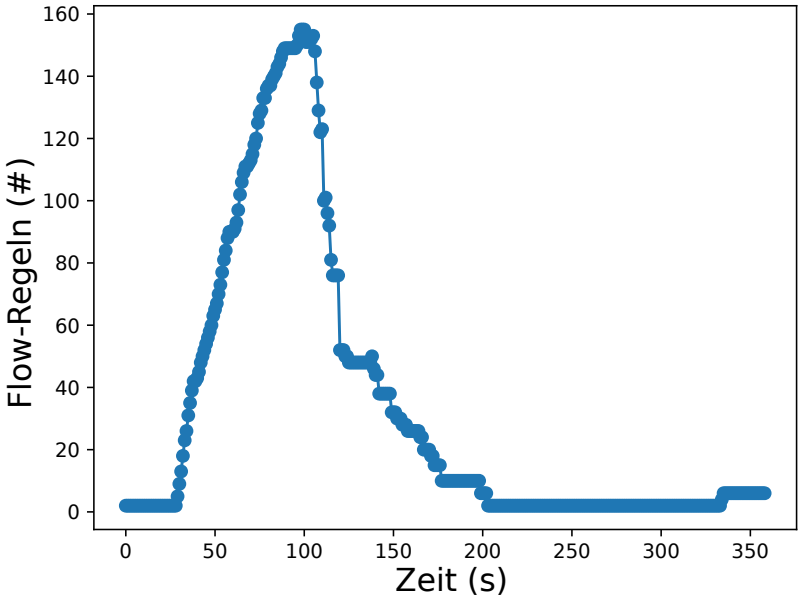
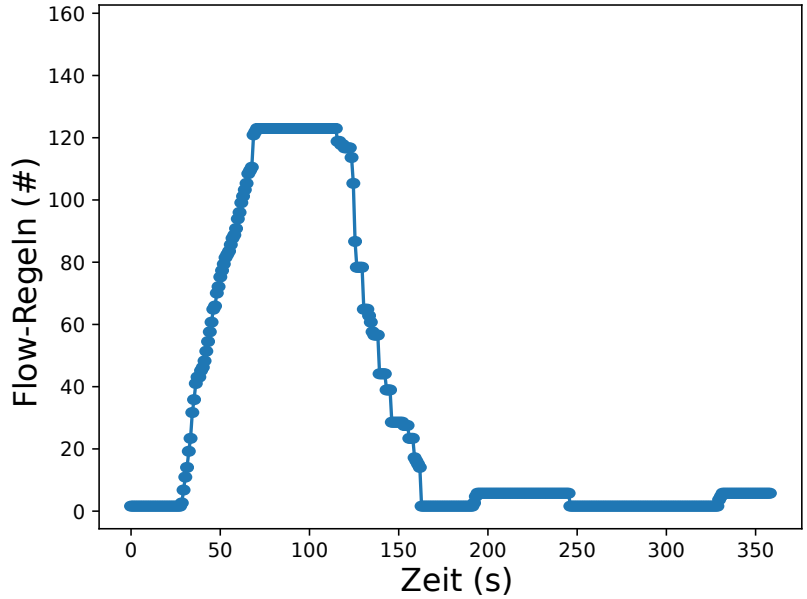

# Example Results

```
./seed -app switch -scenario datacenter -simulator mininet
./seed -app pbce -scenario datacenter -simulator mininet
```




Flowtable-Usage **without** PBCE




Flowtable-Usage **with** PBCE

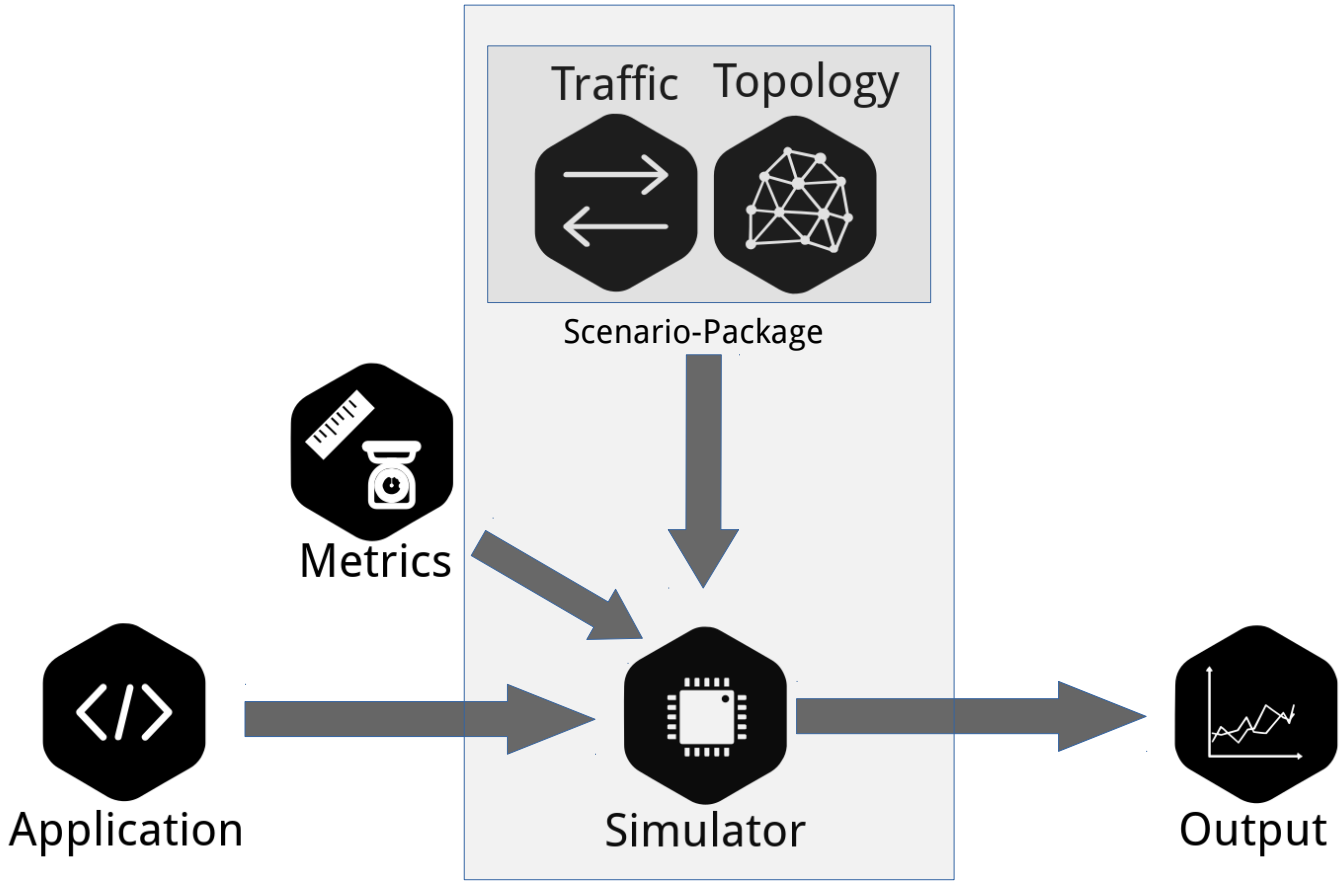
# Conclusion

SEED provides a systematic evaluation environment for SDN-applications.

It promotes and simplifies

- The evaluation process
- Reproducibility of evaluation results
- Comparability of evaluations

- Code will be made available as opensource
- Call for Participation: `https://git.scc.kit.edu/seed`




**Systematic Evaluation Environment for SDN-Applications**

# Sources I

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Icons: thenounproject.com