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
"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

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

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
Motivation

Increasing number of SDN-applications & research
Motivation

Increasing number of SDN-applications & -research
Lack of Comparability

compare

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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 Results

Reproducibility of SDN-applications often not feasible:
- Contradicting experiment descriptions
- Unclear evaluation setup (missing information)
- Broken, incomplete or missing artifacts
Evaluation Setup is Complex

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

  can be *time consuming and error-prone*
Evaluation Setup is Complex

- Selection and configuration of tools to generate
  - representative traffic
  - representative topologies
  can be time consuming and error-prone

- Evaluation design has to be re-done
  by each research-team
Current way to evaluate simulatively

- Simulator
- Traffic
- Topology
- Metrics
- SDN-Application
- Logs/Artifacts
Current way to evaluate simulatively

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- Traffic
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Current way to evaluate simulatively

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

→ one coupled "blob"
Challenges of (SDN-)evaluations

- Lack of Comparability
- Reproducibility often not feasible
- Evaluation-Setup is time consuming & error-prone
  (+ Sharing of existing setups difficult)
Replace this:
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Systematic Evaluation Environment for SDN-Applications

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Systematic Evaluation Environment for SDN-Applications

 choosable

 Metrics

 Scenario-Package

 Traffic Topology

 Application

 Simulator

 Output

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SEED: Systematic Evaluation Environment for SDN-Applications

- **Intro**
- **Motivation**
- **SEED**
- **Conclusion**

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1. Scenario-Package
2. Traffic
3. Topology
4. Metrics
5. Simulator
6. Unified Format
7. Systematic Evaluation Environment for SDN-Applications

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Components Exchangeable

Systematic Evaluation Environment for SDN-Applications

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Components Exchangeable

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Components Exchangeable

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Components Exchangeable

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Clear Experiment Description

- Enable reproducibility & sharing
  → one file describes complete evaluation setup

Components
- Application(s)
- Scenario
- Simulator
- Parameters

Experiment Description
Unified starting point for experiments:

- Preprocessing 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

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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

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

Implementations
- mininet
- OMNeT++
- ns-3
Traditional Evaluation Process

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

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

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:

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

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

Flowtable-Usage **without** PBCE

Flowtable-Usage **with** PBCE

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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
Scenario-Package
Systematic Evaluation Environment for SDN-Applications

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Sources I

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