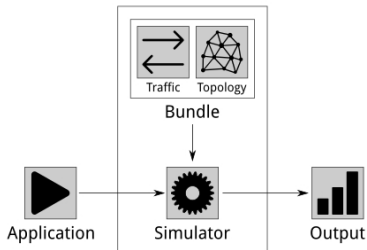


Towards a Shared Evaluation Environment for Software-Defined-Networking Applications

Fachgespräch Network Softwarization

Addis Dittebrandt, Michael König, **Felix Neumeister** | October, 13th 2017

INSTITUTE OF TELEMATICS — DEPARTMENT OF INFORMATICS — KIT



Shared Evaluation Environment for SDN

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

- Challenges of simulative SDN-Application Evaluation
 - Poor Reproducibility of Results
 - Comparing of Results often not possible
 - Usage of Simulators unnecessarily complicated
- Approach and Implementation
- Usage
- Conclusion

Problems hindering reproducibility:

- Conflicting experiment descriptions
- Unclear parameters
- Broken artifacts

⇒ What were the exact experiments done?

Approach: Allow and require explicit experiment description

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What makes results incomparable:

- Unclear description of simulated scenarios
- Broadly similar scenarios with different parameters
- Specific description often not given
- No common ground on realistic scenarios

⇒ How can a simulation scenario be fully described?

Approach: Specify a format to describe a simulated scenario in a single file

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Configuration of Simulators complicated



Configuration time-consuming and error-prone:

- Can induce side effects into results
- Configuration efforts duplicated

Current workflow when using simulators:

- Familiarize with simulator API
- Model topology and traffic
- Implement topology and traffic in simulator
- Configure simulation environment with external components

⇒ How can problems be mitigated?

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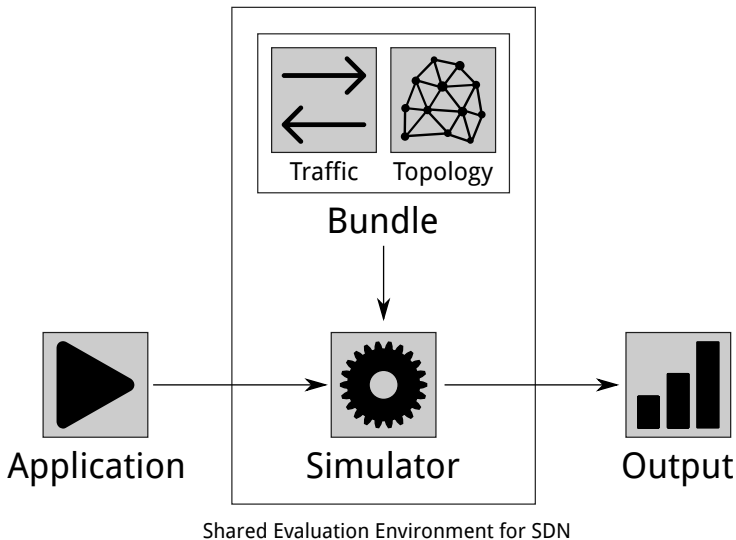
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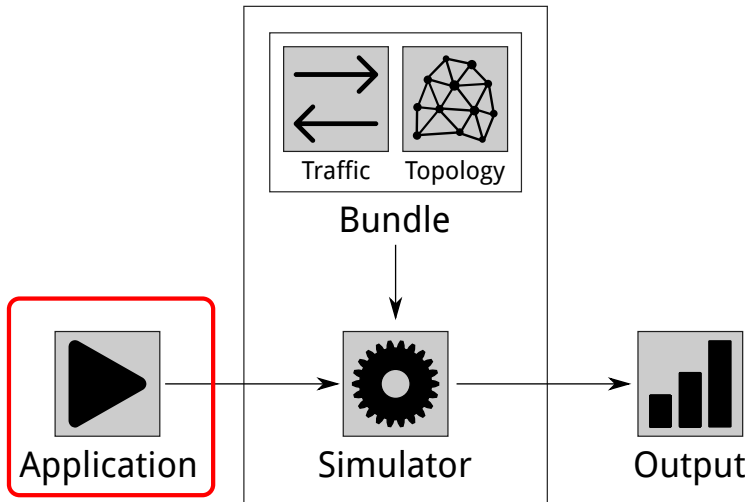
Outline

- Challenges of simulative SDN-Application Evaluation
- **Approach and Implementation**
- Usage
- Conclusion

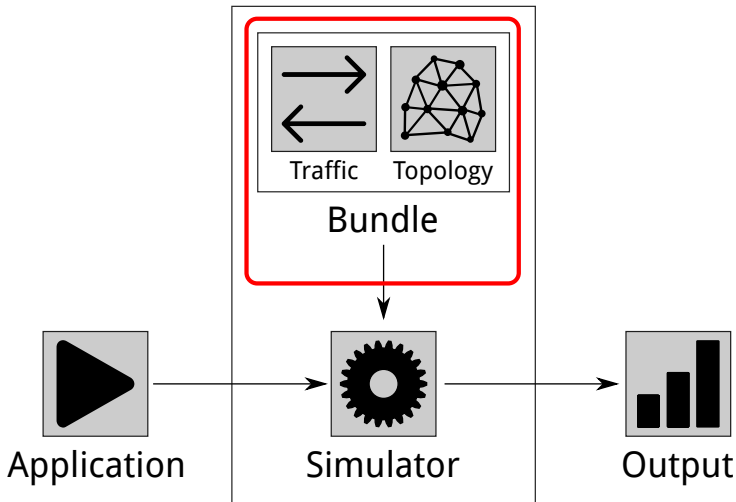
Approaches:

- Explicit experiment specification
- Scenario description
- Easy setup using configuration files

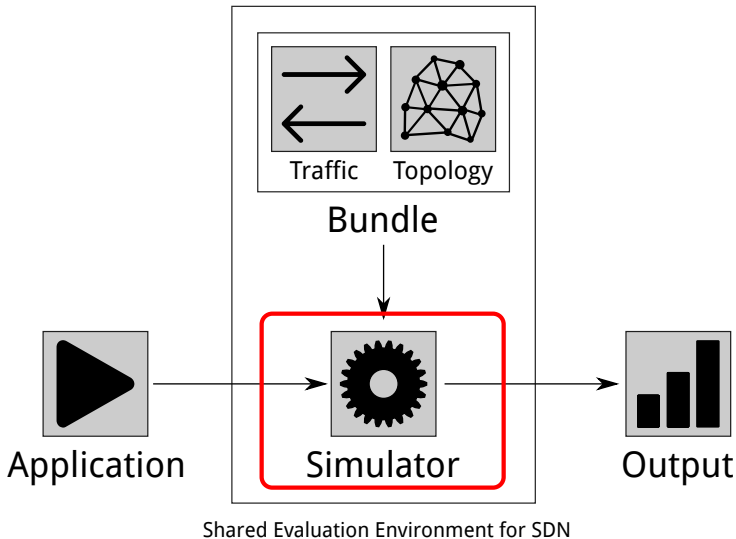




Shared Evaluation Environment for SDN



Shared Evaluation Environment for SDN



- Easier reproducibility

Components

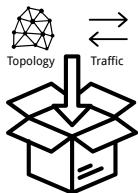
- Application(s)
- Scenario
- Simulator
- Parameters

Experiment Description

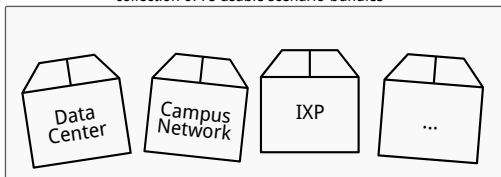
Scenario-Bundles

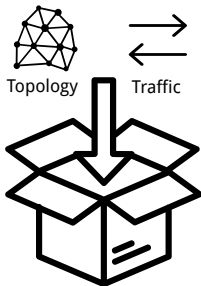
(= Traffic + Topology)

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



collection of re-usable scenario-bundles





Describes complete scenario

- Topology
- Traffic

Properties

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

Tasks

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



OMNeT++

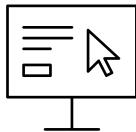
Implementations

- mininet
- OMNeTT++
- ns-3

The logo for ns-3 Network Simulator, featuring four vertical bars of increasing height in green to the left of the text 'ns-3' in a bold, dark grey font. Below 'ns-3' is the text 'NETWORK SIMULATOR' in a smaller, dark grey font.

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



Outline:

- Challenges of simulative SDN-Application Evaluation
- Approach and Implementation
- **Usage**
- Conclusion

- 1 Choose simulator
- 2 Choose Scenario-Bundle
- 3 Enter path to own SDN-application
- 4 Execute SEED
- 5 Evaluate results

Example usage:

```
./seed -app pbce -scenario datacenter -simulator ns3
```

```
./seed -app ecmp -scenario campus -simulator mininet
```

- 1 Choose simulator
- 2 Choose Scenario-Bundle
- 3 Enter path to own SDN-application
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```
./seed -app ecmp -scenario campus -simulator mininet
```

Applications:



- **iTAP:** in-network Traffic Analysis Prevention
 - Altering traffic meta-data to randomize communication patterns
- **PBCE:** Port Based Capacity Extensions
 - Migration of flow-rules to neighboring switches
- **ECMP:** Equal Cost Multi Path
 - Multi-path load balancing

Scenarios	Simulators	Applications
Campus		ECMP
Datacenter		ITAP
IXP/ISP		PBCE





Usage Example

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Usage Example

Scenarios	Simulators	Applications
Campus		ECMP
	OMNeT++	ITAP
IXP/ISP		

		ns-3	OMNeT++	Mininet
Controller Support	Internal	✓	✓	-
	External	✓	X	✓
Scenario	Datacenter	✓	✓	✓
	Campus	✓	✓	✓
	ISP & IXP	WIP	WIP	WIP
SDN-App	PBCE	✓	X	✓
	iTap	WIP	X	✓
	ECMP	✓	WIP ¹	✓

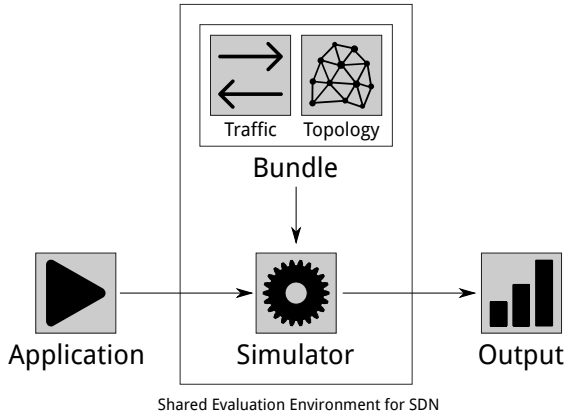
SEED compatibility-matrix

¹vereinfachte Version

- Limited by features of simulators
- Limited selection of traffic generators
- Rudimentary node configuration
- OpenFlow only
- Only external controllers

Conclusion:

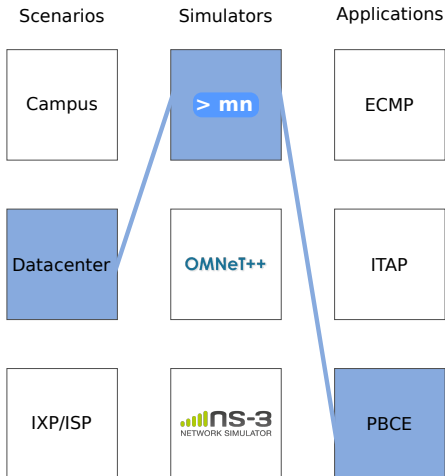
- Evaluation process, reproducibility & comparability simplified
 - SEED-prototype implemented
 - Current SEED-version tested
 - Example Scenario-Bundles implemented
-
- Code will be made available as opensource
 - Call for Participation: <https://git.scc.kit.edu/seed>



SEED:
Shared Evaluation Environment for
Software-Defined-Network Applications

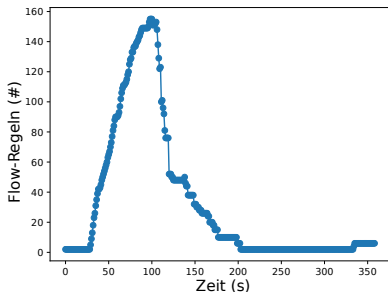
- NS-OF13 extension only supports exactly OpenFlow 1.3 (no backwards-compatibility)
- Implementation of POX 1.3 fork not stable yet
- OMNeT++-extension for OpenFlow 1.3 only implements rudimentary functions

Example Evaluation

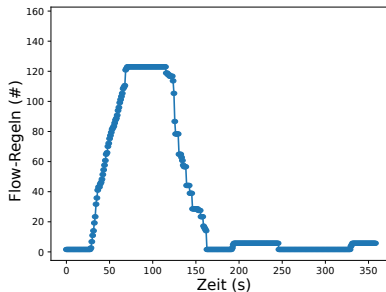


Results

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



Flowtable-Usage **without** PBCE



Flowtable-Usage **with** PBCE

Sources I



Icons: thenounproject.com

