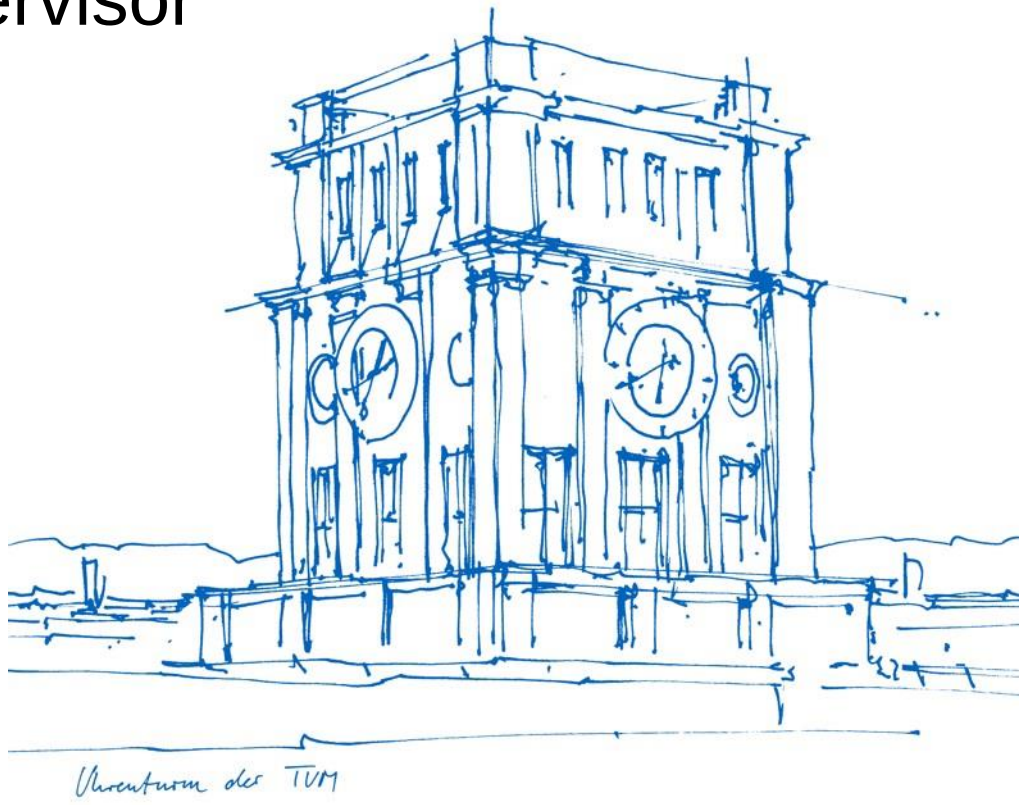
Chair of Communication Networks
Department of Electrical and Computer Engineering
Technical University of Munich

Challenges and Solutions for a Flexible High-Performant SDN Hypervisor

Nemanja Đerić
nemanja.deric@tum.de

Prof. Wolfgang Kellerer
wolfgang.kellerer@tum.de



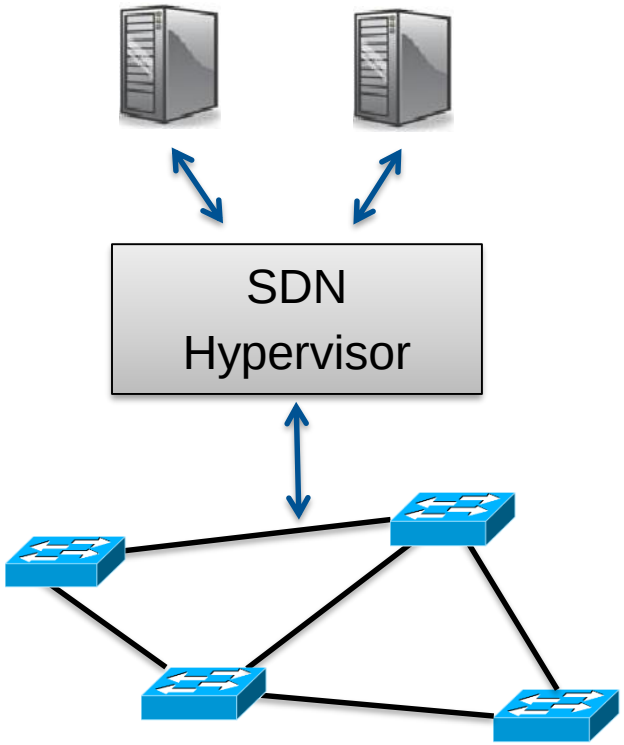
©2017 Technical University of Munich

Overview

- Introducing SDN hypervisor
- Main Hypervisor Function
- Control Plane Resource Management
  - Resource Management in HyperFLEX
  - Motivation
  - Plans & Goals
- Resolving Switch Diversity
  - Motivation
  - Problems

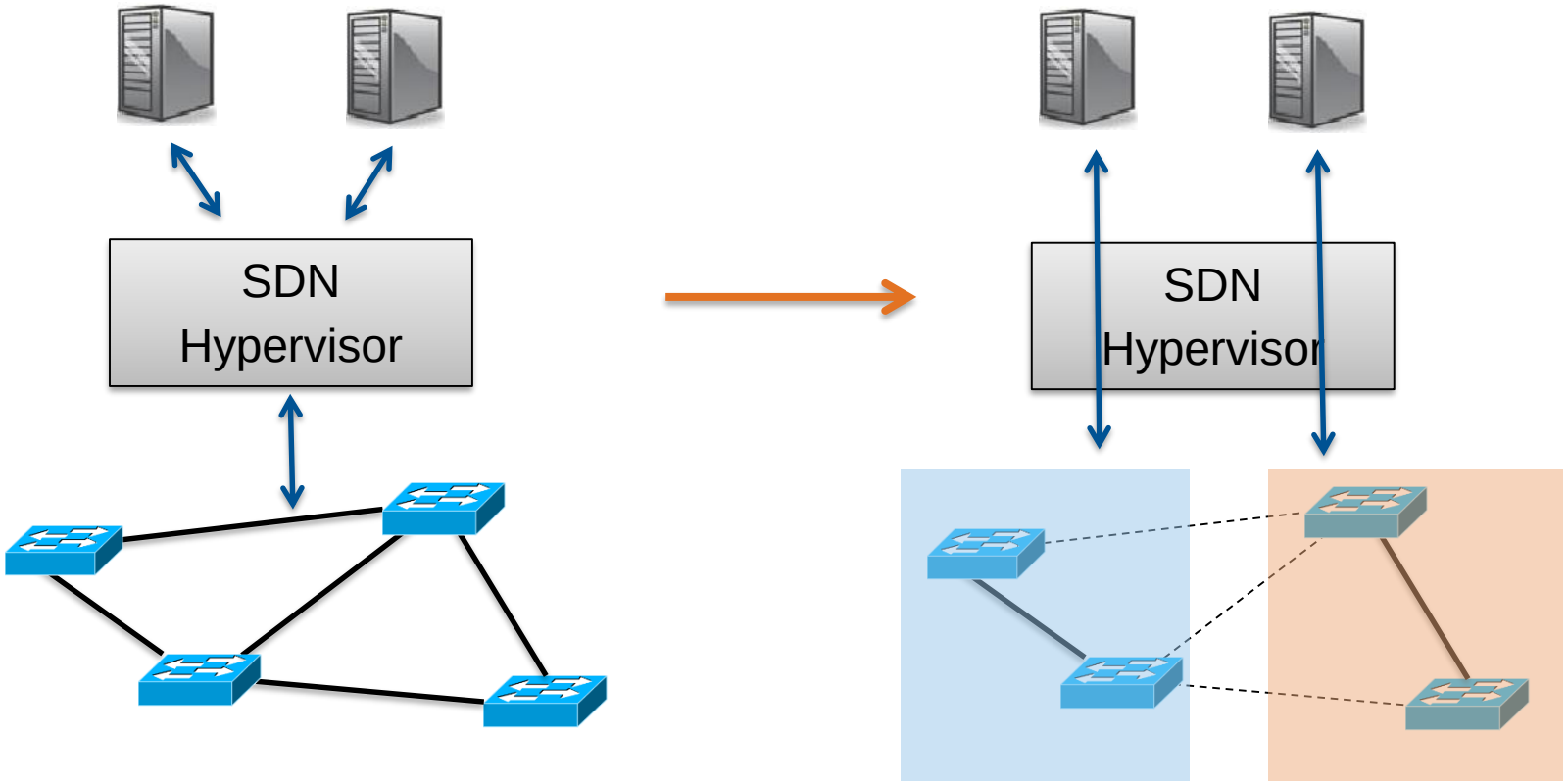
Introducing SDN hypervisor

- Provide SDN network as a on-demand service (NaaS)
  - Improves utilization and reduces the overall cost
- Every Tenant could use own controller and applications



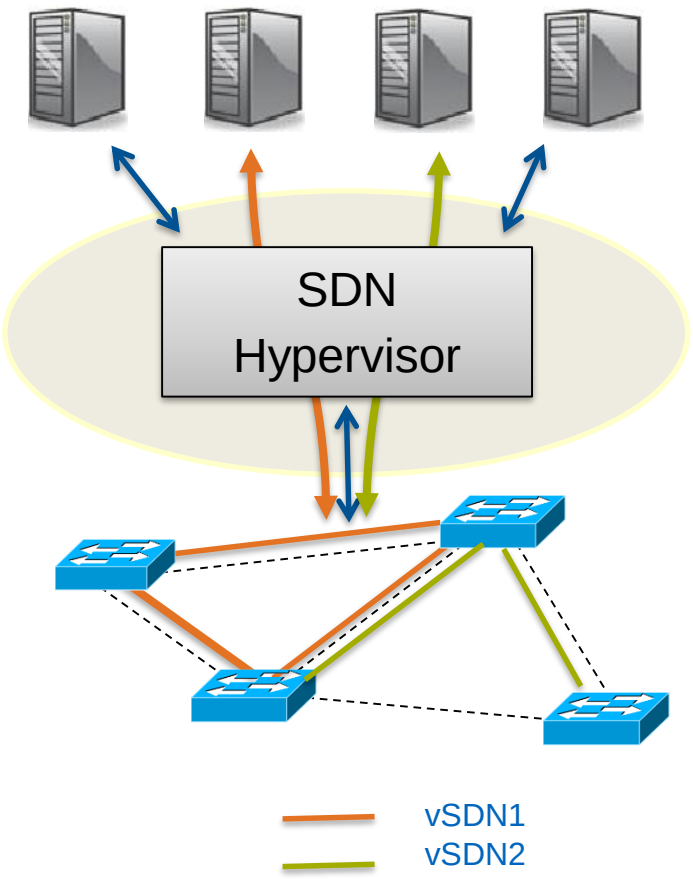
Introducing SDN hypervisor

- Provide SDN network as a on-demand service (NaaS)
  - Improves utilization and reduces the overall cost
- Every Tenant could use own controller and applications



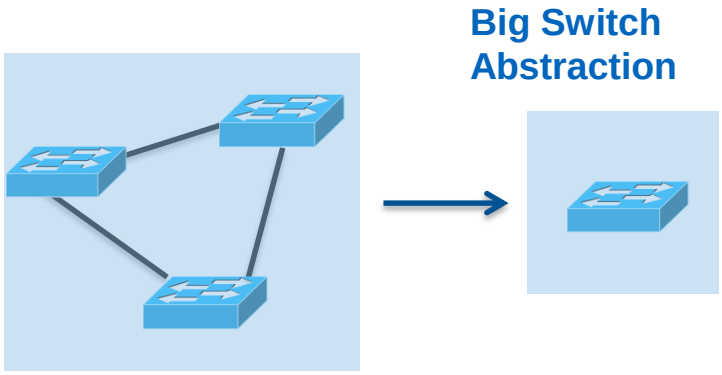
Hypervisor Functions & Shortcomings

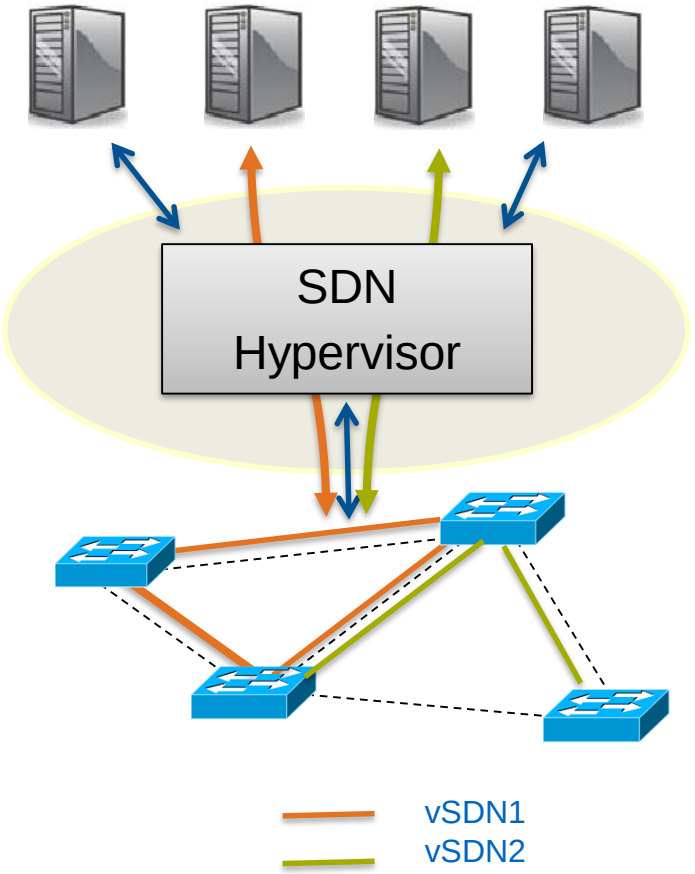
- Three Main Functions:
  - Control & Data Plane Isolation
  - Translation
  - Abstraction



Hypervisor Functions & Shortcomings

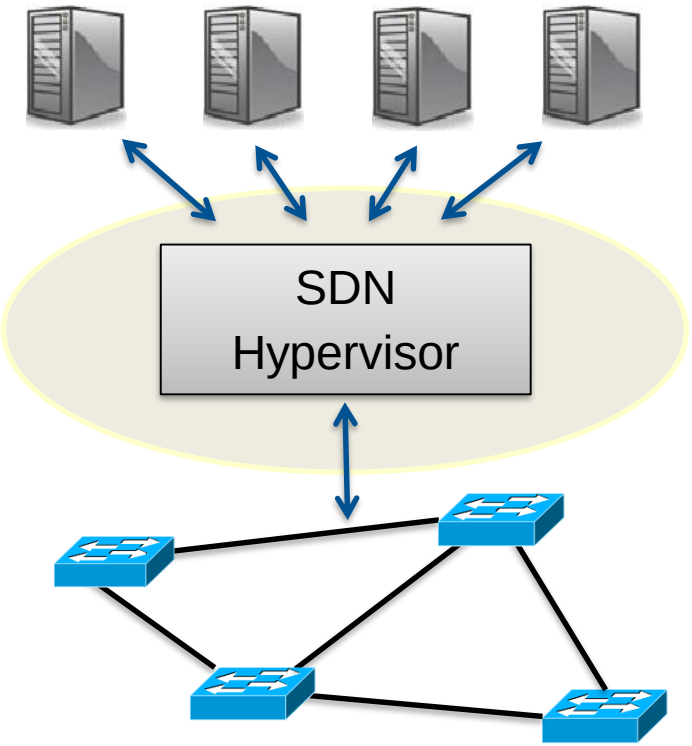
- Three Main Functions:
  - Control & Data Plane Isolation
  - Translation
  - Abstraction





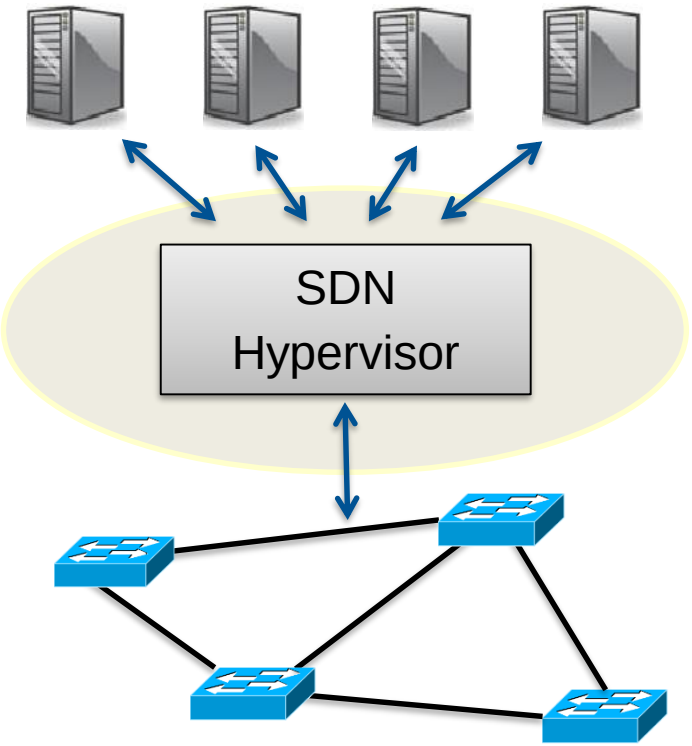
Control Plane Resource Management - Motivation

- **SDN hypervisor** resources are shared between each tenant
  - e.g. CPU, RAM



Control Plane Resource Management - Motivation

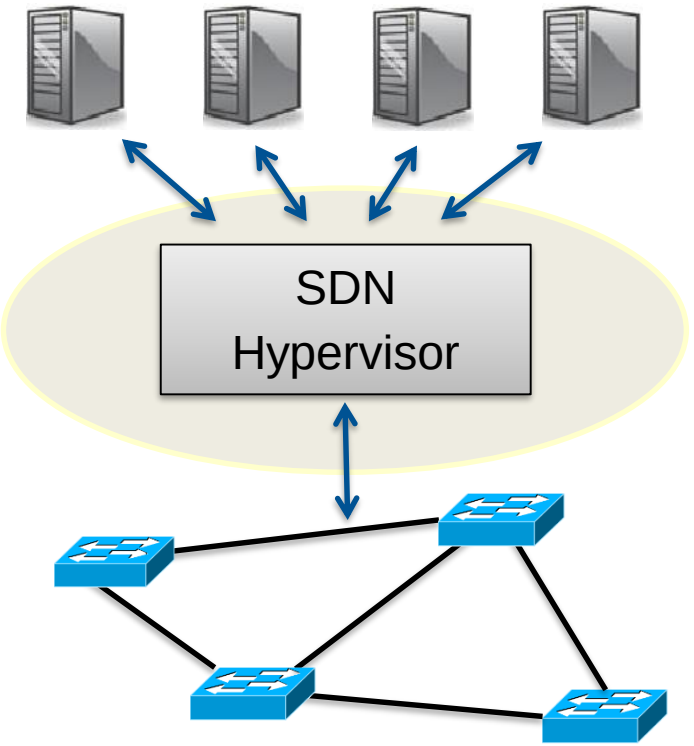
- **SDN hypervisor** resources are shared between each tenant
  - e.g. CPU, RAM
- One vSDN might **over-utilize** the hypervisor resources leading to **cross-effects** between vSDNs



Control Plane Resource Management - Motivation

- **SDN hypervisor** resources are shared between each tenant
  - e.g. CPU, RAM
- One vSDN might **over-utilize** the hypervisor resources leading to **cross-effects** between vSDNs

- Admission control and resource isolation guarantees are necessary!



Control Plane Resource Management

- HyperFLEX – SDN Virtualization Tool developed at LKN [1]
- Introduces **admission control** based on the available hypervisor resources (e.g. CPU)
  - Hypervisor resources are estimated based on the offline mapping between CPU consumption and number of OF messages

Control Plane Resource Management

- HyperFLEX – SDN Virtualization Tool developed at LKN [1]
- Introduces **admission control** based on the available hypervisor resources (e.g. CPU)
  - Hypervisor resources are estimated based on the offline mapping between CPU consumption and number of OF messages
- Online resource estimation is extended in [2]
  - Machine Learning is used to learn and fit the exponential mapping between number of OF messages and CPU consumption

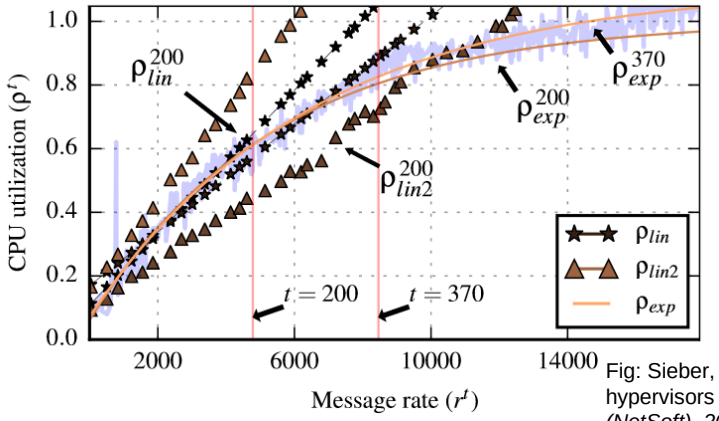


Fig: Sieber, Christian, et al. "Online resource mapping for SDN network hypervisors using machine learning." *NetSoft Conference and Workshops (NetSoft), 2016 IEEE*. IEEE, 2016.

What is missing?

- Only Simple SDN network scenarios are considered!
  - Number of OF messages per each vSDN ✓
  - Type of OF messages ✓
  - Isolation and abstraction not considered! ✘

What is missing?

- Only Simple SDN network scenarios are considered!
  - Number of OF messages per each vSDN ✓
  - Type of OF messages ✓
  - Isolation and abstraction not considered! ✘

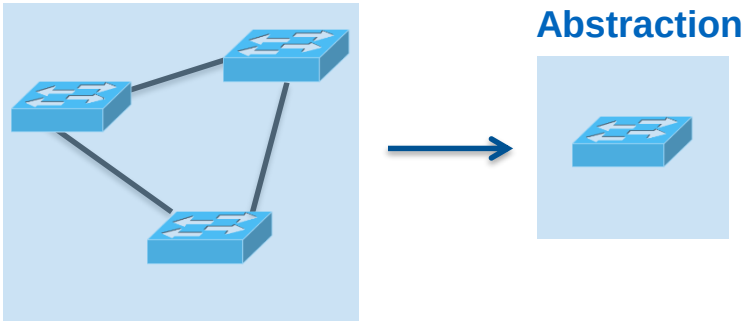
- Does control plane isolation affect resource utilization?
  - Isolation function has to process and count every transitioning packet!

What is missing?

- Only Simple SDN network scenarios are considered!
  - Number of OF messages per each vSDN ✓
  - Type of OF messages ✓
  - Isolation and abstraction not considered! ✘

- Does control plane isolation affect resource utilization?
  - Isolation function has to process and count every transitioning packet!

- Does complexity of abstraction of network topologies matter?
  - Tasks for *big-switch* abstraction:
    - Provide corresponding *mapping*
    - Rewrite all messages on the control plane
    - Establish routing in the *big-switch*



Resource estimation – Problems & Goals

1. Explore and study effects of complex network scenarios on hypervisor performance and resource consumption

2. Develop appropriate models for mapping between different hypervisor functions and resource consumption

Resource estimation – Problems & Goals

1. Explore and study effects of complex network scenarios on hypervisor performance and resource consumption

2. Develop appropriate models for mapping between different hypervisor functions and resource consumption

3. Extend it with **online** solutions as they:
   - Don’t need extensive *benchmarks*
   - Support live hypervisor *migrations* (e.g. due to failure or lack of resources)

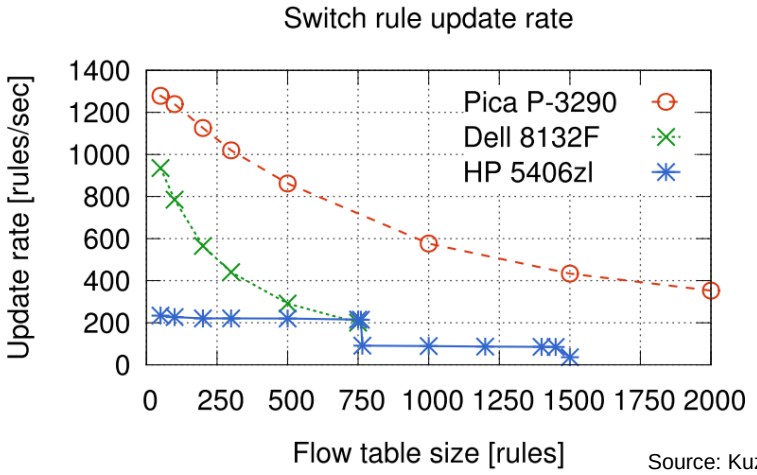
4. Integration in HyperFLEX framework

Resolving Switch Diversity - Motivation

- Table Size Difference [3]

Switch	Table Size [Approx]
PICA 3290	2000
DELL S3048-ON	500
PICA 3297	3500

- Flow Mod Update Rate [4]



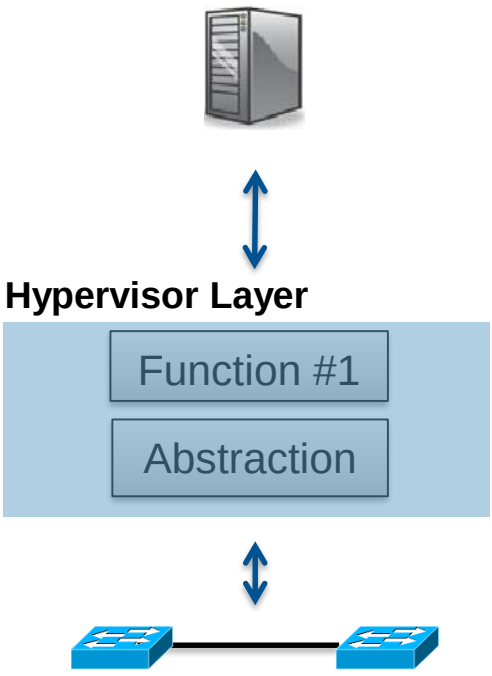
Source: Kuzniar, Maciej, Peter Peresini, and Dejan Kostic. *What you need to know about SDN control and data planes*. No. EPFL-REPORT-199497. 2014.

Resolving Switch Diversity - Problems

1. How to gather data from switches?
   - What resources are the most influential (e.g. Flow Table Size, Update Rates)?
   - How to automate benchmarking and automation?

2. How to do embed vSDN based on the switch diversity?

3. How to add rules on run-time based on switch diversity?



References

- [1] Blenk, Andreas, Arsany Basta, and Wolfgang Kellerer. "HyperFlex: An SDN virtualization architecture with flexible hypervisor function allocation." *Integrated Network Management (IM), 2015 IFIP/IEEE International Symposium on*. IEEE, 2015.
- [2] Sieber, Christian, et al. "Online resource mapping for SDN network hypervisors using machine learning." *NetSoft Conference and Workshops (NetSoft), 2016 IEEE*. IEEE, 2016.
- [3] Michael Remmler, “Entwicklungeines OpenFlow-Switch Leistungstestes.“ Masterarbeit in Informatik, Technische Universität München, Fakultät für Informatik, 2017.
- [4] Kuzniar, Maciej, Peter Peresini, and Dejan Kostic. *What you need to know about SDN control and data planes*. No. EPFL-REPORT-199497. 2014.

Questions?