

Overview

Distributed SDN controller architectures have been proposed to mitigate the risks of overload and failure.

Operator Goals: i) Satisfying SLAs  ii) Minimizing controller operating costs 

Current state of the art approaches are not sufficient to meet the above goals. To address this, we propose a novel approach for assigning SDN switches and partitions of SDN application state to distributed controller instances.

Motivation

Flow setup latency is critical for SDN applications like MiceTrap (traffic engineering), Multi-tenant virtualized data centers, etc.

Static Switch Assignment

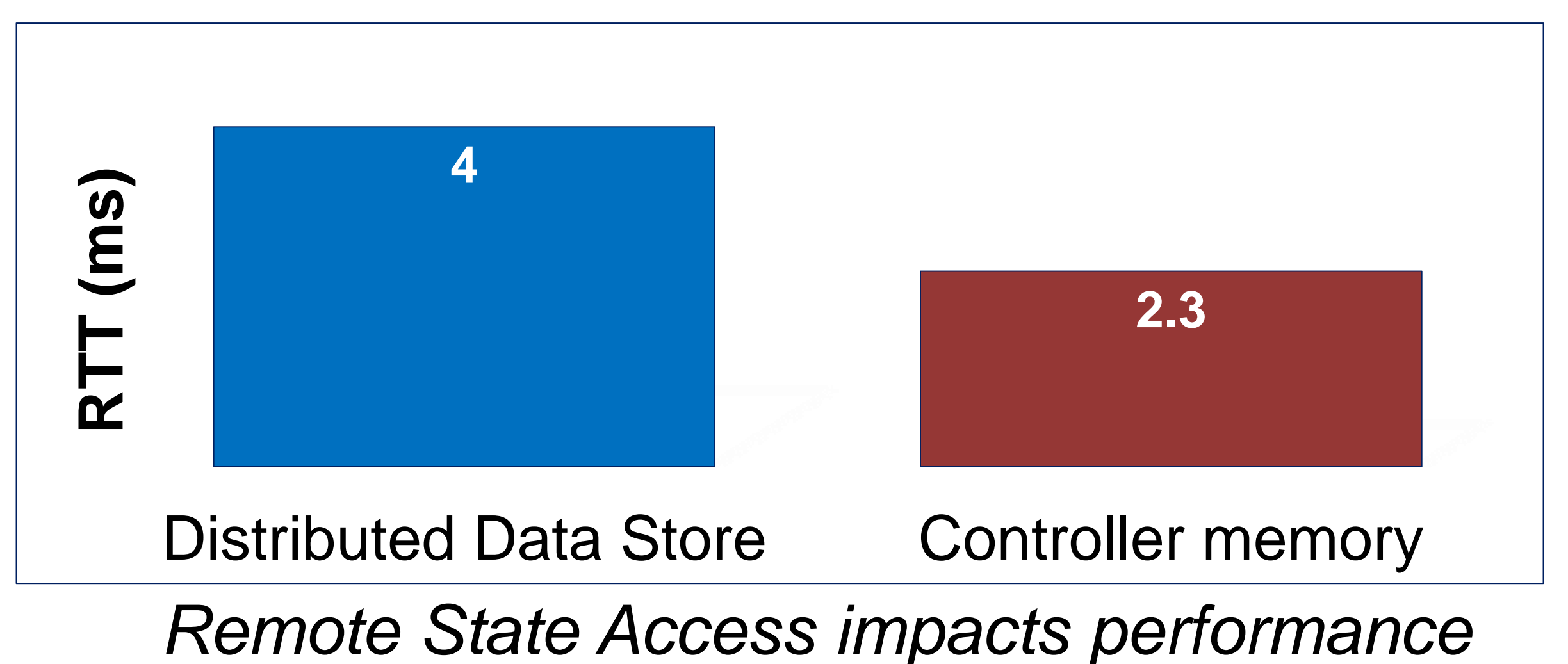
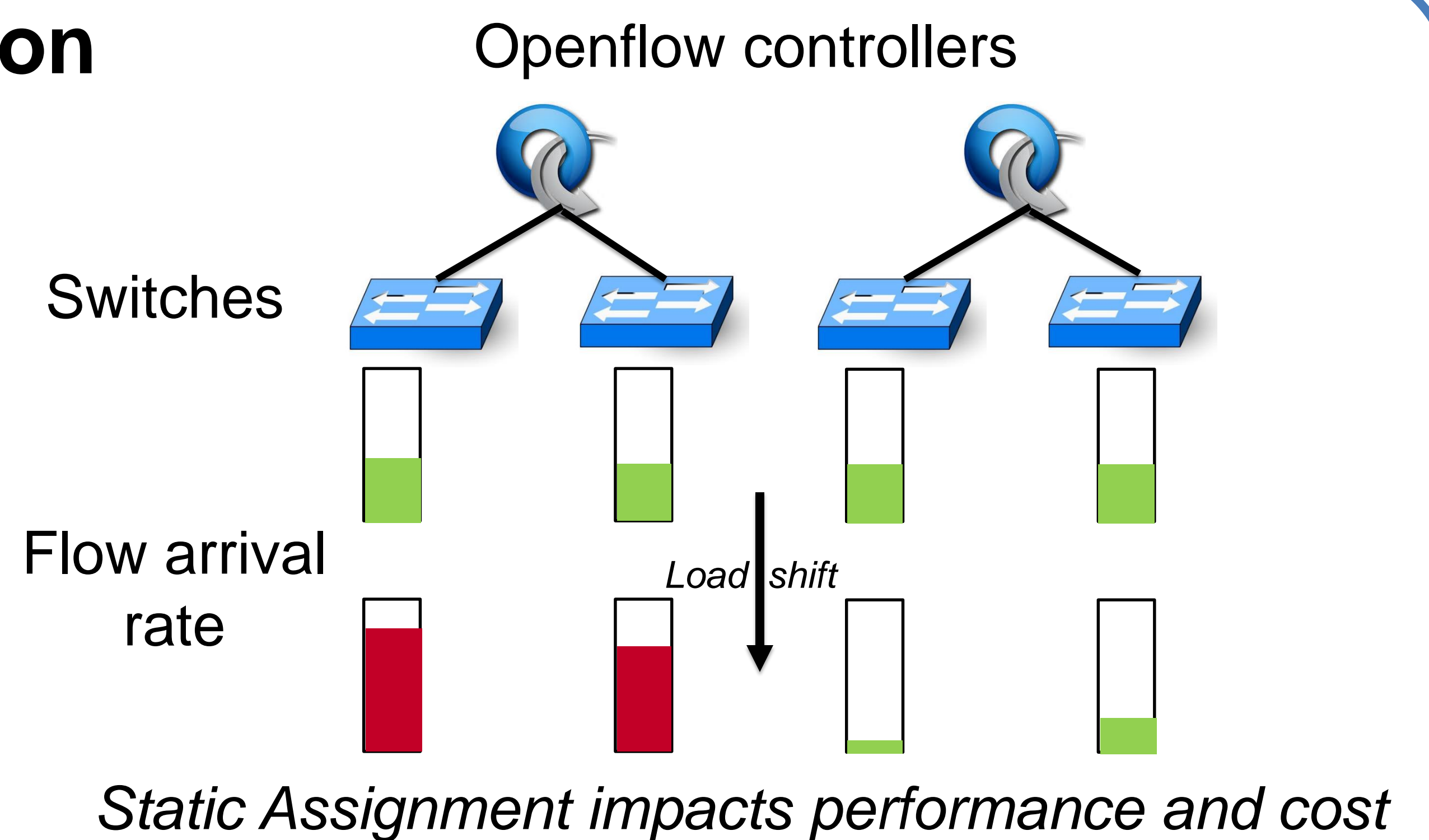
A static switch-to-controller assignment strategy suffers from:

- degraded performance (insufficient CPU resources)
- inefficient hardware resource utilization (traffic load variations)

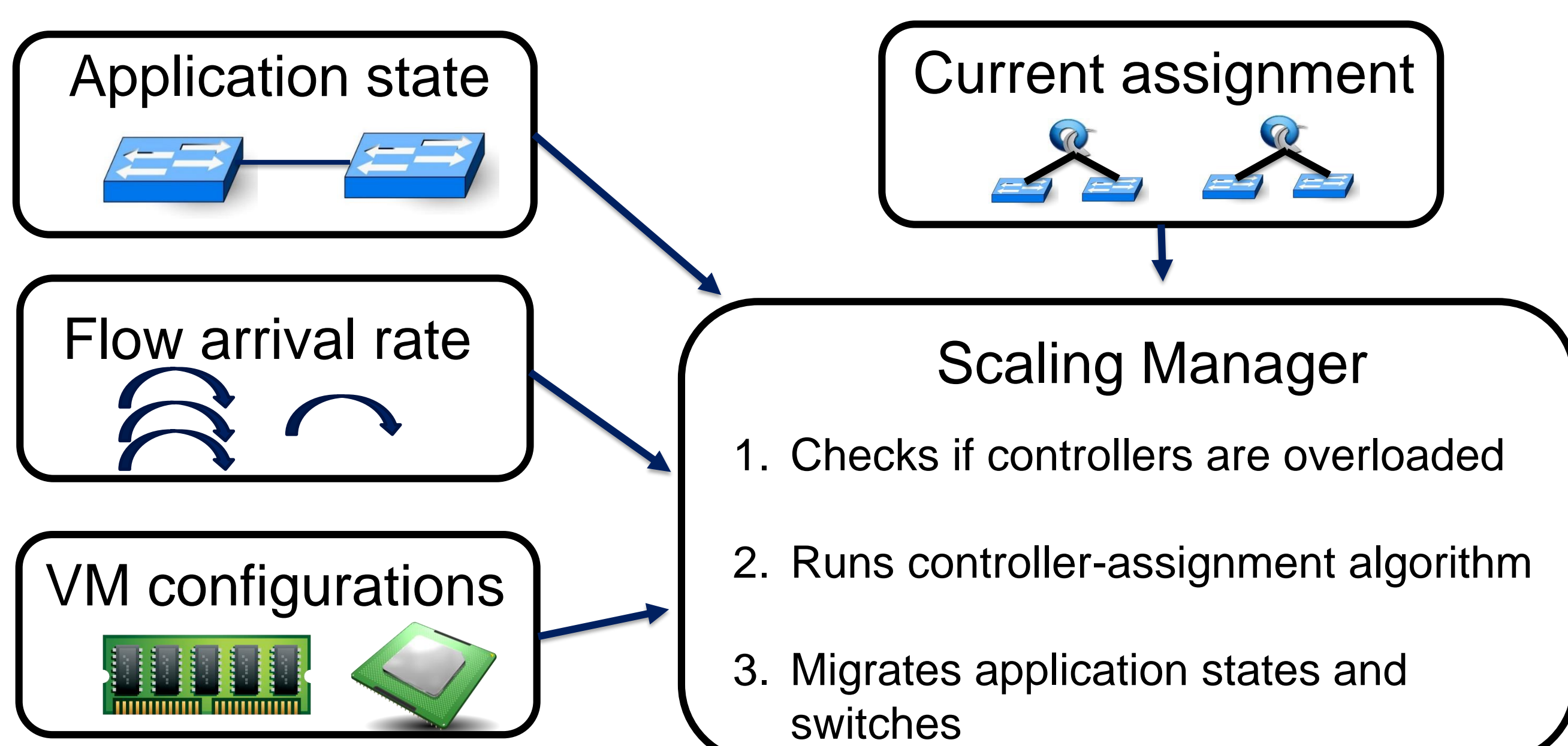
State Storage & Access

Flow setup latency is impacted by:

- State access from a distributed data store or another controller instance
- Inter-controller communication to install flow rules



Architecture



Controller assignment

ILP formulation

Variables:

- Compute requirements from flow arrival rate of switches
- Memory requirements from application state
- Application state and switch dependency
- Virtual Machine cpu and memory capacities
- Virtual Machine costs (used to launch controllers)

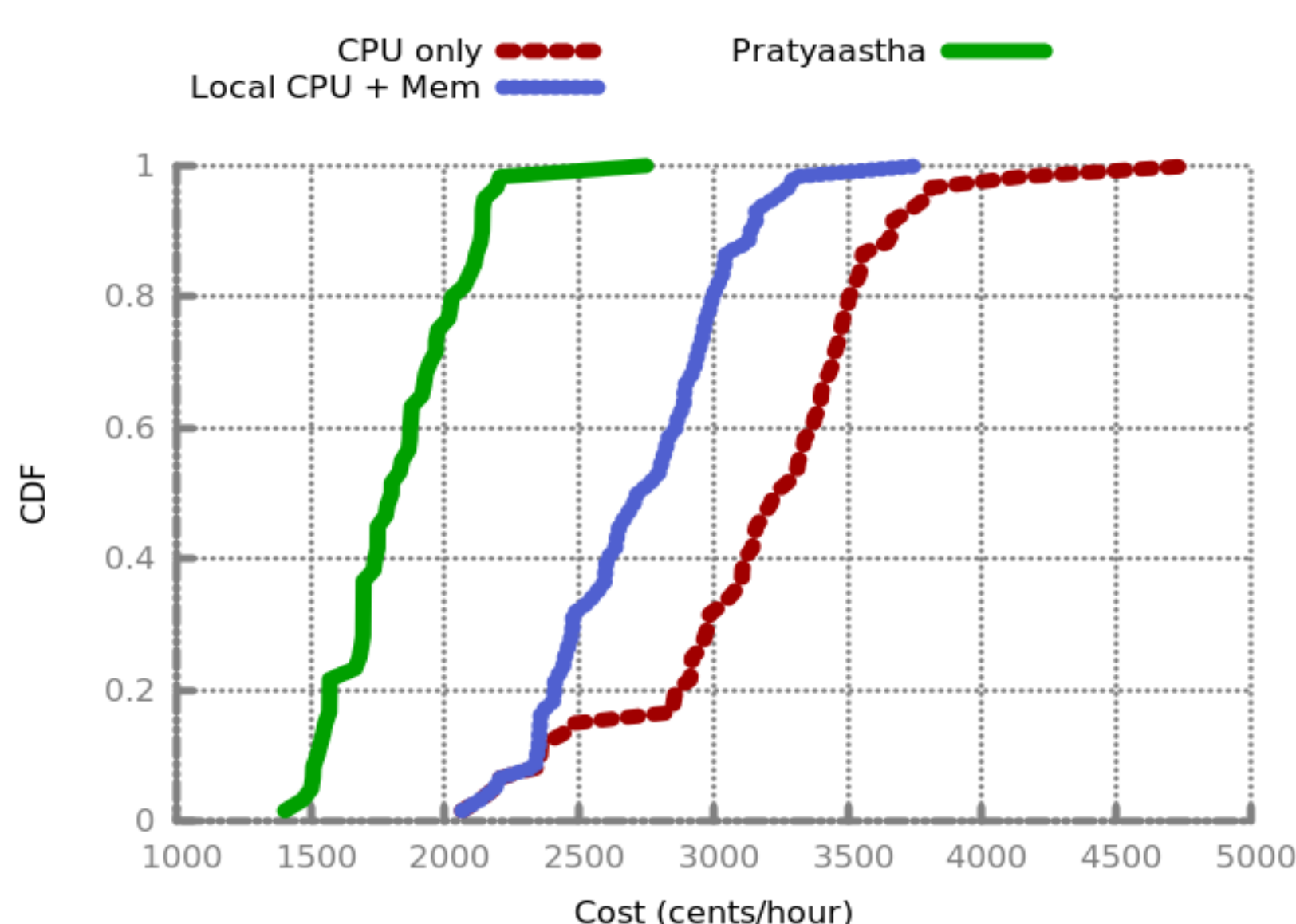
Objective:

- Minimize controller resource cost and inter-controller communication
- Constants α and β to tune the weight of both objectives

Heuristic:

Local Search algorithm (hill climbing with simulated annealing)
First-fit decreasing assignment is set as initial state

Evaluation



42% reduction in controller operating costs

44% decrease in flow-setup latency

References

- [1] Openflow. <http://www.openflow.org/>
- [2] Teemu Koponen et al. Onix: A distributed control platform for large-scale production networks
- [3] Advait Abhay Dixit et al. Towards an elastic distributed SDN controller
- [4] Theophilus Benson et al. Network traffic characteristics of data centers in the wild