# Pratyaastha: An Efficient Elastic Distributed SDN Control Plane

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## 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

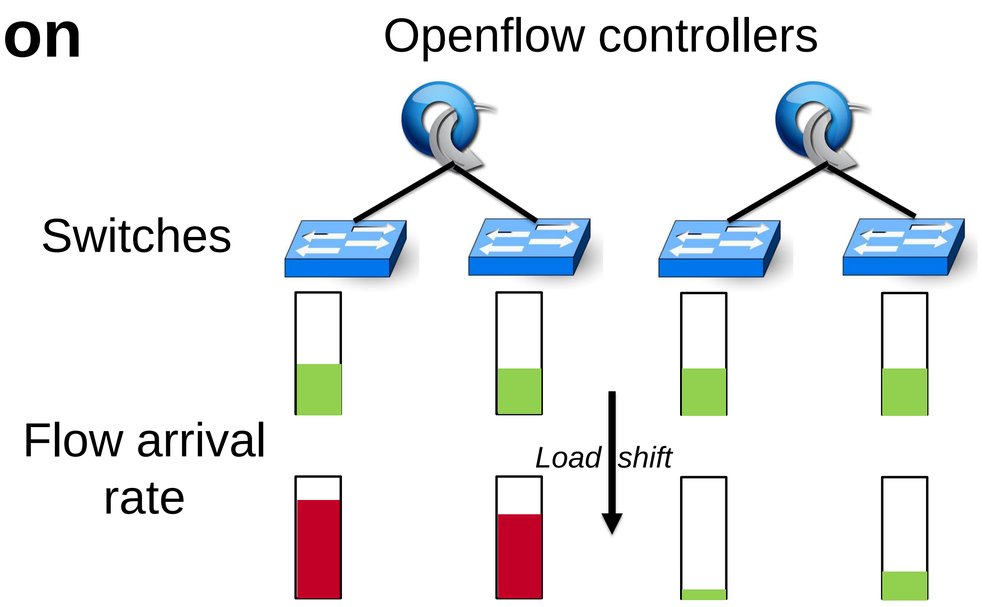
A static switch-to-controller assignment strategy suffers from:

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

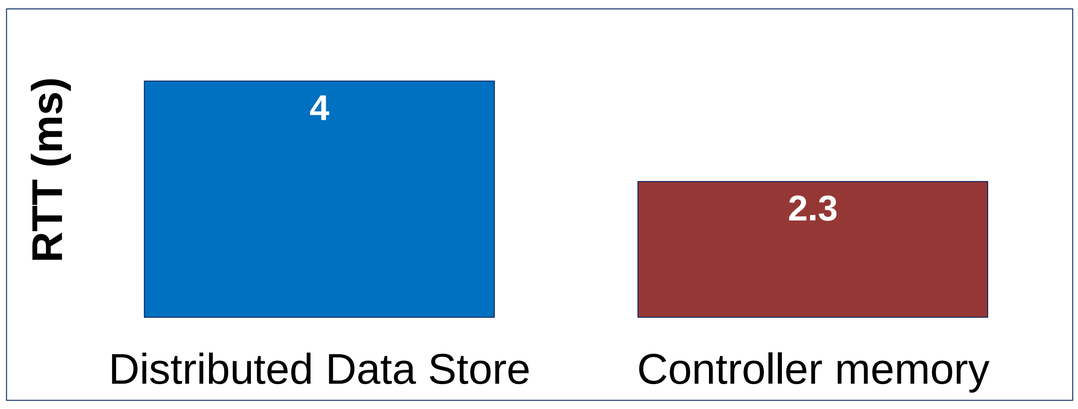
### State Storage & Access

Flow setup latency is impacted by:

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

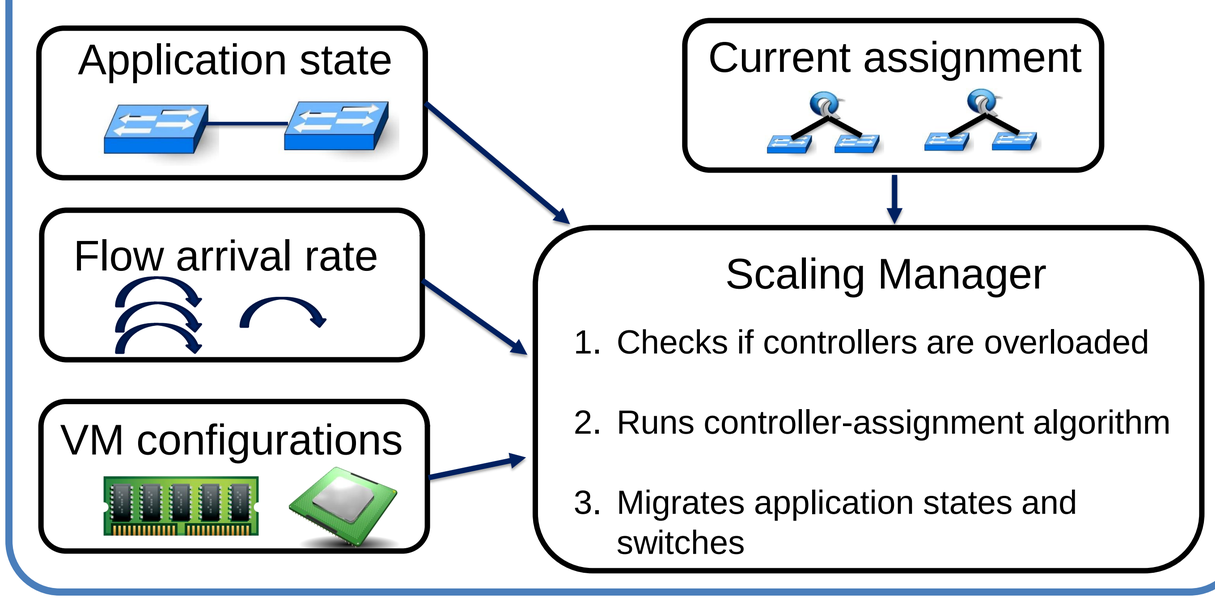



*Static Assignment impacts performance and cost*




*Remote State Access impacts performance*

## Architecture




## Controller assignment

**ILP formulation**

Variables:

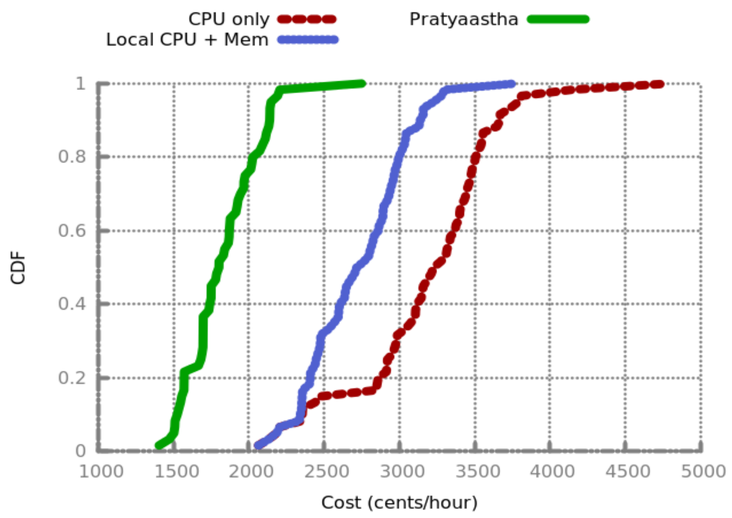
- Compute requirements from flow arrival rate of switches
- Memory requirements from application state
- Application state and switch dependency
- Virtual Machine cpu and memory capacities
- Virtual Machine costs (used to launch controllers)

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