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

- **Application state**
- **Flow arrival rate**
- **VM configurations**

**Current assignment**

1. Checks if controllers are overloaded
2. Runs controller-assignment algorithm
3. Migrates application states and switches

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

[4] Theophilus Benson et al. Network traffic characteristics of data centers in the wild