Demonstration of SDN-based Control of IoT Network by Brain-inspired Bayesian Attractor Model and Network Slicing

Onur Alparslan, Shin'ichi Arakawa, Masayuki Murata

Introduction

- It is difficult to estimate Traffic Matrix in large networks even by getting flow statistics with software defined networking (SDN) control.
- We propose a different approach than trying to estimate the traffic matrix from flow-level statistics.
- Some IoT networks like the surveillance system in this demo exhibit a limited set of traffic matrix patterns.
- In our framework, brain-inspired Bayesian Attractor Model (BAM) is used for identifying the current traffic pattern by using the utilization statistics of a limited set of edge links instead of flow-level statistics.
- Our framework allows traffic engineering without traffic matrix estimation from flow-level statistics. Moreover, it supports network slicing, which improves the QoS, security, and power efficiency of IoT networks

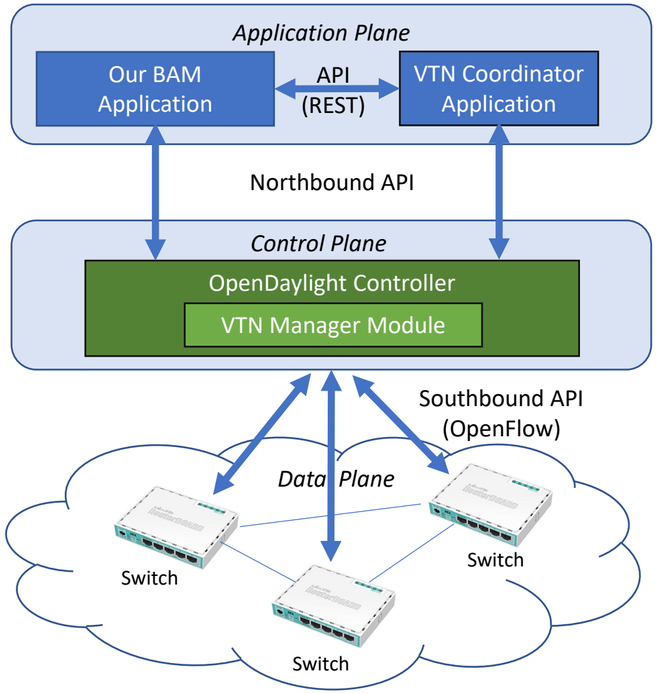
Bayesian Attractor Model

- One of the models in the literature for modeling the behavior of the brain is Bayesian attractor model (BAM), which is a kind of supervised machine-learning algorithm.
- According to this model, the brain assigns stochastic variables to possible decisions (attractors) .
- Brain chooses one of them when enough evidence is collected from sensory systems to achieve a confidence level high enough to make a decision.
- We used BAM for identifying the traffic matrix from edge link utilization statistics.

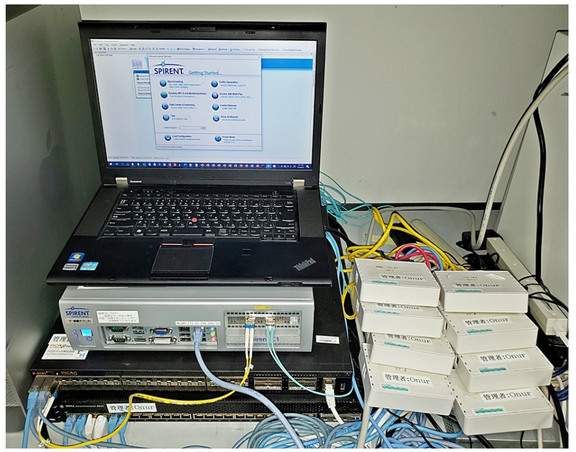
This research and development work was supported by Ministry of Internal Affairs and Communications of Japan.

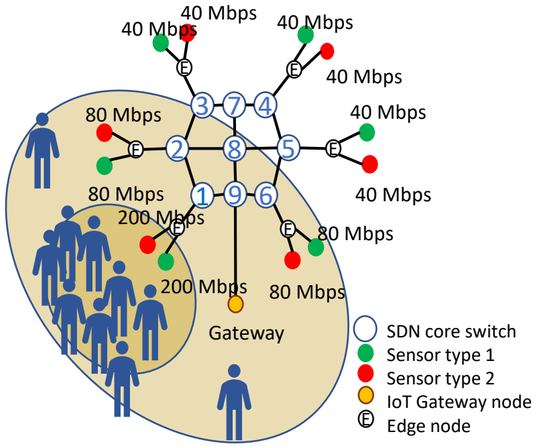
Architecture

- Our BAM-based traffic engineering framework is implemented as an SDN application.
- Initially, a list of possible traffic patterns is given as Bayesian attractors to our application.
- BAM assigns stochastic variables to these attractors indicating the confidence level of each attractor.
- BAM periodically receives the utilization of edge links from the controller and updates the confidence level of attractors.
- When a new traffic pattern is identified, the BAM application sends a new optimized network slice configuration to the VTN Coordinator.



Testbed





Demonstration

- Tested an SDN-based IoT network of crowd surveillance system with 12 IoT sensors. Producing six traffic matrix patterns. Two network slices each carrying 6 sensors.
- BAM Application tried to identify traffic patterns by sampling only the edge link utilization.
- Link congestion occurred after a change in traffic pattern at around 55 seconds.
- It took around 21 seconds to identify the new traffic pattern by BAM.
- Then the network slices are reconfigured for the new traffic pattern to solve congestion.