Graduate School of Science and Technology Master's Thesis Abstract

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Abstract

Software Defined Networking (SDN) is a paradigm that decouples the control plane from the data plane in network devices, enabling centralized and programmable network management. Distributed SDN is designed to solve the problems of centralized SDN while preserving the necessary logically centralized view of the network state to simplify the development of network applications. To maintain consistency across multiple controllers, some sort of consensus algorithms are required, which may degrade the system's performance since a consensus algorithm requires communication and synchronization between multiple nodes in a distributed environment. Moreover, these overheads will increase further if the network latency between controllers is large. Therefore, optimizing the placement of multiple distributed SDN controllers considering network latency is a challenging problem.

In my research, I decide to use Open Network Operating System (ONOS) which is a popular open-source controller platform for building OpenFlow-based SDN, a consistent shared view of the network state across multiple controllers is achieved by the Raft consensus algorithm provide by Atomix node. To improve controller performance I evaluated controller performance by measuring the three types of latency generated in a distributed controller, including delay between switch and controller, delay between controller and Atomix, and delay between Atomix and Atomix. I developed a practical model called Flow Setup Time (FST) to estimate switch perceived response time that was accurately validated in a running software-defined wide area network (SD-WAN). To find the optimal controller placement, I formalized the multi-objective optimization problem to minimize reaction time and find the optimal number of controller/Atomix nodes.