Optimized SDN Controller Placement Strategy in Edge Networks

Contributors:

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Scope: Edge controller placement problem (ECP) aims at an optimal strategy toward minimizing traffic overheads and delays, which is a crucial concern when adopting Software Defined Networking (SDN) in-band control with multiple controller instances in edge networks.

Description: We demonstrate our solution to ECP, edge controller placement problem, which provides methods to place multiple SDN controller instances in an edge network, with minimum communication overhead or delay required.

We address on following challenges. Firstly, a model describing and quantifying the communication overhead from and to SDN controllers is necessary. We establish such model by taking measurements of state-of-the-art SDN controllers. We particularly emphasize the overhead's dependence on the network scale, i.e. number of nodes and flows. Secondly, we notice that network delay has significant impact in the control plane of edge networks. We analyze it by conducting experiments using real mobile devices. Last but not the least, we model the controller placement problem in the context of minimizing overhead and delay costs as an integer programming problem and propose an algorithm to solve it efficiently.

The demonstration contains following aspects:

1. A virtual network containing multiple SDN-enabled switches will be established, where we deploy a cluster of ONOS controllers. We design and implement a manager communicating with all ONOS instances through API, calculating and executing our optimal controller placement strategy in real time.
2. We analyze different types of SDN-related costs in the network. Statistics will be shown after a placement, including the average delay from a switch to its controller, the traffic monitoring of controller-node overheads and inter-controller overheads. The manager permits interactions, by changing the weight between delay cost and overhead cost, leading to different cluster configurations dynamically. The statistics will intuitively indicate the impact of different placement schemes, how our algorithm optimizes the costs, as well as the trade-off between delay and overhead.
3. Besides the emulated network, we deploy SDN components in off-the-shelf mobile devices, such as Android smartphones and IoT devices. In this way we examine realistic application scenarios of edge networking.