Title	Grade of Service (GoS) based adaptive flow management for Software Defined Heterogeneous Networks (SDHetN)
Authors	Müge Erel, Zemre Arslan, Yusuf Özçevik, Berk Canberk

Current radio access deployments uses statical assignment for resource management which causes underutilization. The access medium considered during the paper is the wireless access medium. There exist many work which tries to resolve the given issue. Cognitive Radio and Dynamic Spectrum Access are examples of such work. Though the proposed approaches are encouraging to increase resource utilization, they still lack providing scalability as the resource allocation and configuration is static at some point.

Software Defined Networking paradigm which seperates the data plane and control plane is an encouraging architectural solution that provides global view of the network for increasing resource utilization. However, having single entity to manage and compute all the control logic seems to create a bottleneck for scalability as well in the existing solutions. The SDHetN introduces virtualization mechanism to overcome scalability issue. Multiple access points are clustered together and managed as one by the control entity which reduces the computational requirements. The clustered access points are named as Flow Authority Virtual Switch (FAVS). In addition, the data plane traffic is fairly distributed using the global view of the controller. As opposed to conventional static flow distribution schemes flows are fairly distributed among switches within FAVS. Moreover, entire topology is processed within the threads to increase the response time of the controller. The controller entity responsible for fair distribution of flows is called as Flow Admisssion Control Algorithm(FACA). The entity responsible for clustering the access points is called Topology Control Algorithm and it runs whenever the Grade of Servis (GoS) in the network exceeds the given threshold as seen in Figure 1.

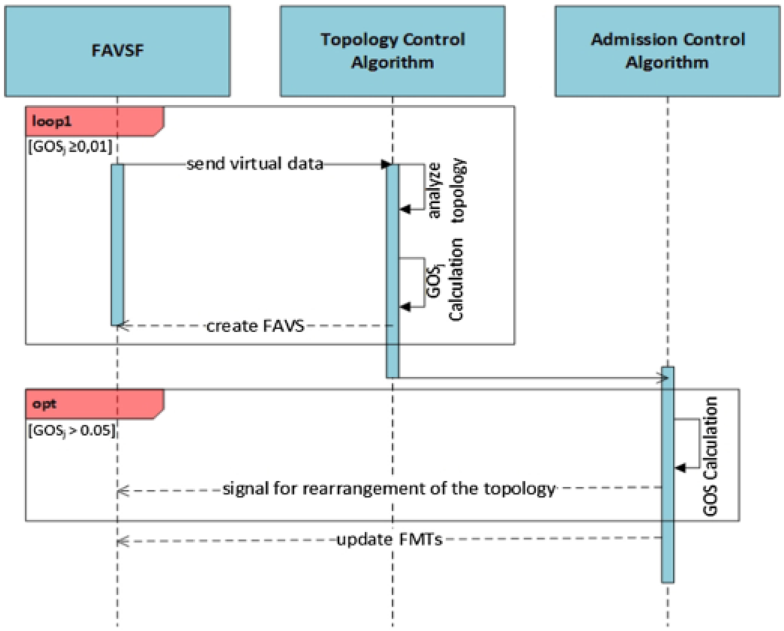

Figure 1 - Sequence Diagram

Each cluster created within the TCA is modeled as M/M/1/1 Markod Process which causes the entire system to be modeled as m dimensional M/M/1/1 system. Moreover, the state transition diagram of such system for m=3 is given in Figure 2.

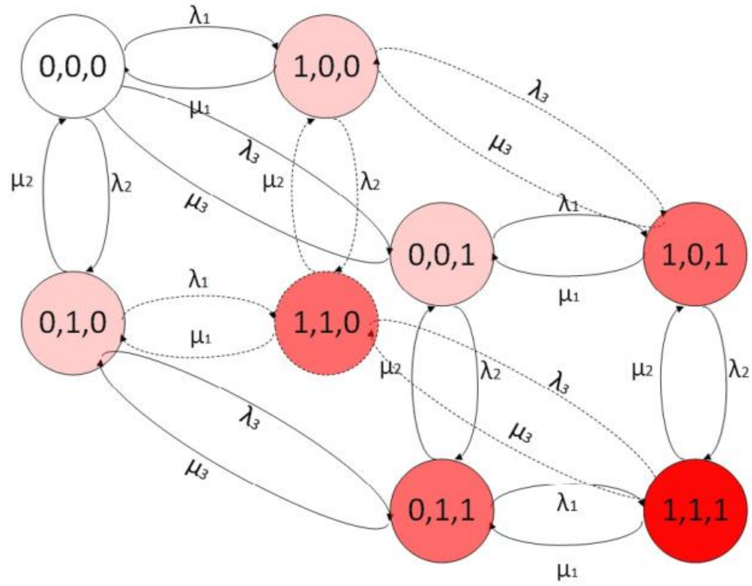

Figure 2 -State Transition Diagram for 3 dimensional M/M/1/1 System

The performance of the proposed framework is compared with conventional approach using 24 different scenarios in which the number of access points is increased from 10 to 60 while two different traffic conditions are considered.

In conclusion, the proposed SDHetN framework outperformed conventional approach in low traffic condition by increasing number of flows that can be handled by 14% for low traffic scenarios whereas the gain reaches upto 40% in dense traffic scenarios. The affect of dense traffic is observed as the decrease in number of clusters as the number of clusters reduces the number of flow that can be handled increases. The reason for this is proved in the appendix of the paper. As the number of clusters reduces, more flows will be processed and distributed using the statistical approach which increases the resource utilization as it can be seen in Figure 3.

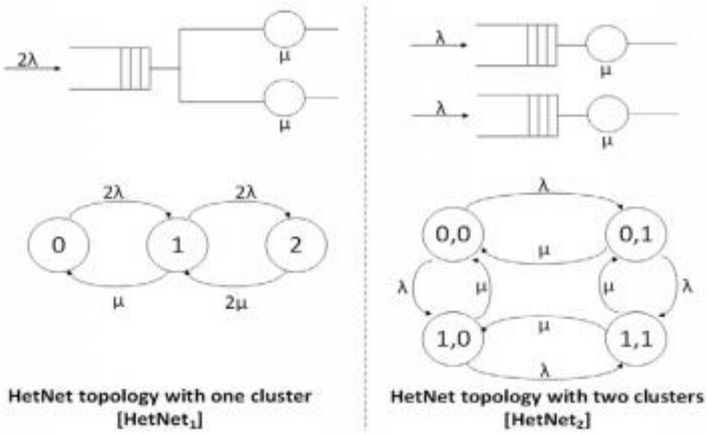

Figure 3 - Cluster Size Effect