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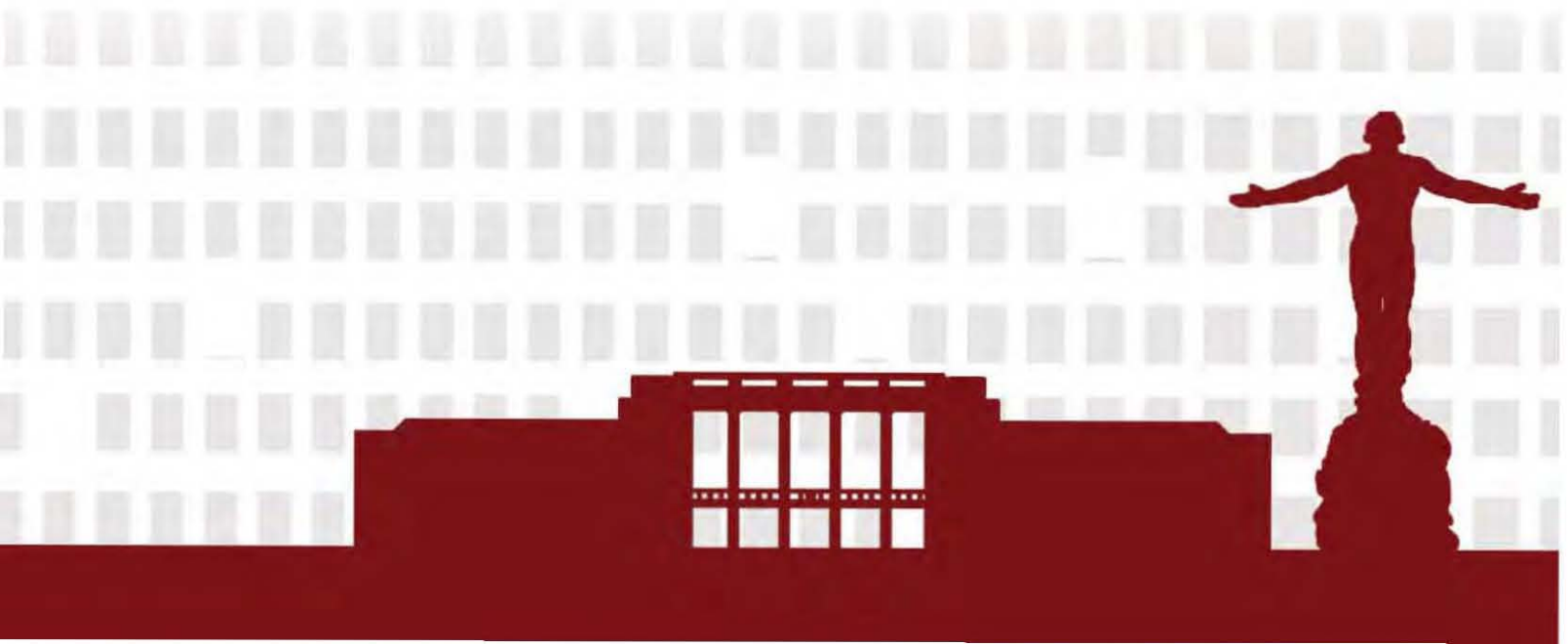

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PERFORMANCE EVALUATION OF CENTRALIZED IN-NETWORK CACHING POLICIES AND CONTENT VISIBILITY LEVELS IN INFORMATION CENTRIC NETWORK OVER EMULATED AND PC-BASED OPENFLOW TESTBED

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ABSTRACT

Performance is a key factor for designing Information Centric Network (ICN) under the support of Software Defined Networking (SDN) [1]. In this network, the network controller plays a very important role to coordinate in-network caching and content searching mechanism. Moreover, the implementation of centralized in-network caching policies and content visibility levels surely affects the performance. This paper plans to evaluate the performance of ICN under SDN support when three different mechanisms of centralized in-network caching policy with content visibility level are applied by using both emulated and PC-based OpenFlow testbed. It also aims to compare the network performance between the two testbed environments. Those three mechanisms consist of non-cooperative in-network caching policy with individual content visibility mechanism, path cooperative in-network caching policy with path content visibility level mechanism and global cooperative in-network caching policy with global content visibility level mechanism. In non-cooperative in-network caching policy with individual content visibility mechanism, the network controller does not coordinate ICN nodes to cache the content. Also, it does not help the ICN nodes search for any data contents. Each ICN node is responsible by itself for content caching or searching. The controller just only stores the routes to forward packets in the network. For path cooperative in-network caching policy with path content visibility level mechanism, the controller chooses only the ICN nodes along the shortest path from the requester to the server to cooperate with one another to cache contents/data. Also, the controller can only search for location of required content storage along the same path. In global cooperative in-network caching policy with global content visibility level mechanism, the controller has the ability to search for locations of all contents in the network and to decide to cache data packet in any nodes inside the network.

To evaluate the performance; three performance metrics including server hit ratio, average hop count, message rate between control and data plane were utilized. The experiments were conducted in two experimental environments including PC-based OpenFlow testbed and emulation by Mininet. In PC based OpenFlow testbed environment, computers were utilized as components of the network. One open-vswitch-installed PC referred to one ICN node. Each requester was a PC installed with Scapy to generate request packets. Every computer has Celeron 2.7GHz CPU core. POX controller was run in core-i5-1.9GHz computer. Ethernet cables were used for connecting the network components. On the contrary, in emulated testbed, Mininet[2] was utilized as emulator to create virtual network topology. It was run in a virtual box. The requesters generated request packets by using Scapy. All ICN nodes including content server run open vswitch version 1.9. POX was selected as the network controller. In each environment, the network topology as shown in figure 1 was tested.

In the experiment, there are 1000 contents divided into 10 classes and stored in the server. The request pattern follows Zifp distribution[3] with the exponent equal to 2. The request rate for each requester is 5 requests/sec and the total requests of each requester are 5000.

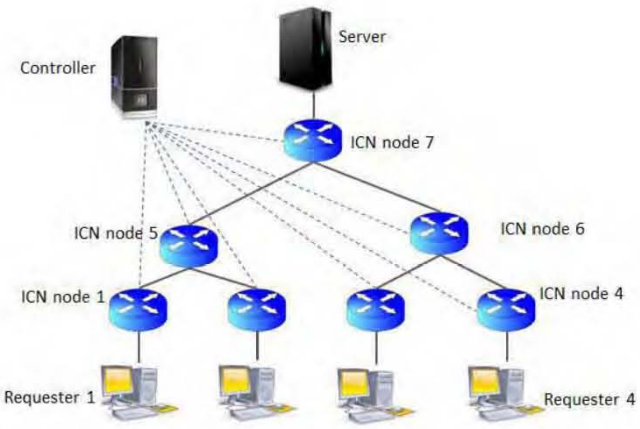

Figure 1. Tree topology network

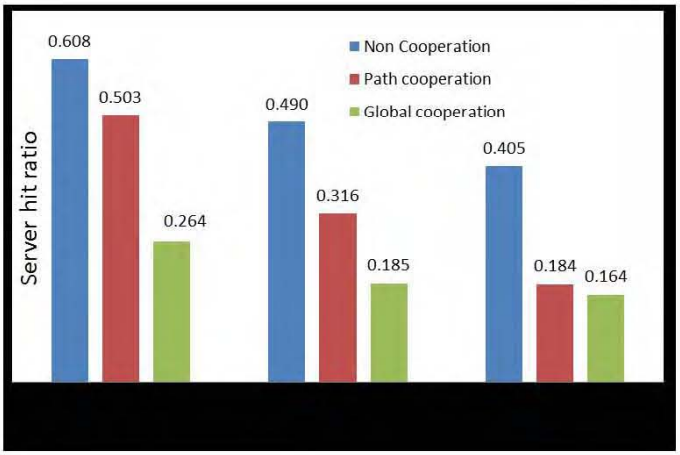

Figure 2. Sever hit ratio

The results show that each mechanism has its own advantages and drawbacks. The global cooperative in-network caching policy with global content visibility level mechanism outperforms others in terms of server hit ratio and average hop count, except message rate between control and data plane. However, according to the limited space, only sever hit ratio result obtained from PC-based OpenFlow testbed is shown in figure 2. Moreover, the performance results obtained from emulated testbed experiment are almost the same as those obtained from the PC based testbed experiment. Emulation by Mininet is recommended to use because it utilizes less resource and gives the same results as those in PC-based OpenFlow testbed environment.

Keywords: Centralized in-network caching, Content visibility, OpenFlow testbed, Information centric network.

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