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PERFORMANCE EVALUATION OF SWITCHED AND ROUTED ACCESS LOCAL AREA NETWORKS

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ABSTRACT
Design for performance is one of the most important considerations that a computer networks designer is interested in when building it. The 3-tiers hierarchical network architecture (tiers are access, distribution, and core) provides a high degree of availability, scalability, flexibility, security and manageability. while the connection between distribution and core as a layer 3 connection (routing using routing protocols such as EIGRP or OSPF) has obvious advantages and importance, the access layer can be connected to the distribution via a layer 2 connection (switched access design) or layer 3 connection (routed access design). In this work, the performance of the switched access and routed access designs were compared based on two elements: delay and packet loss. The two designs were emulated using GNS3 software then generate a synthetic data traffic between the network hosts. The results of the experiments showed that routed access-OSPF design is the highest in the delay criterion - a difference that does not significantly affect network performance in real environments - while at the same time it is the best in terms of data loss assessment. Due to the widespread use of the OSPF protocol, which is an open standard protocol, and due to the advantages of the routed access design the study recommended adopting the routed access-OSPF design whenever possible.

Keywords:
LANs, Switching, Routing, Switched Access, Routed Access, Performance

INTRODUCTION

To build efficient computer networks, the network designer should consider the network performance so that the network must have the optimal performance suitable for the services it provides now and in the future.
The network performance is closely related to its design. The term design is called on the network layout (network map) and the techniques used in the network. To get things clear, in this paper we distinguish between the two cases. We used the term “network architecture” to describe the network map, and the term “design” to describe the techniques used in the network.
There are several models of network architecture, but the hierarchical network is the best for modern campus networks -which are classified as local area networks-. In the hierarchical architecture, networking devices are divided into several interconnected tiers each of them performs specific functions.
The 3-tires hierarchical architecture consists of the core tire, distribution tire, and the access tier in which the hosts are directly connected.

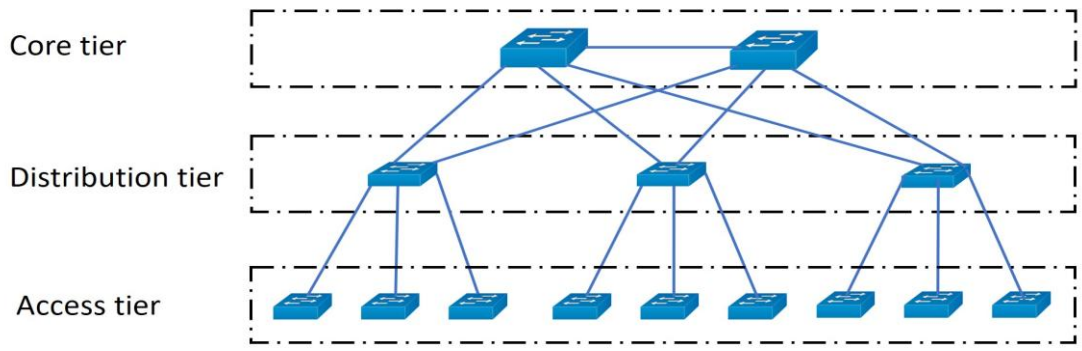

Figure 1. 3-tires hierarchical network architecture

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While the traditional design depends on connecting the core to the distribution by routing (depending on a routing protocol, the most commonly used OSPF or EIGRP) and connecting the access to the distribution by switching (so it is called a switched access), the other design is based on connecting between the distribution and access by routing (so it is called a routed access). This connection and protocols used is what we call "design" here.
Based on the above, the presence of four proposed designs are shown as the Switched Access-EIGRP, Switched Access-OSPF, Routed Access-EIGRP, and Routed Access-OSPF.

TESTBED INVIRONMENT

In order to evaluate the performance of the network, it was emulated using GNS3 software. Graphical Network Simulator 3 (GNS3) appeared in 2008 as an open source network emulation tool.
The network is designed on the premise that basically includes two buildings each with 2 distributed switches and three access switches for the hosts. The backbone of the network consists of 2 core switches connecting the two buildings. This is enough to test the network performance. Finally, three hosts were connected to each access switch. Figure 2 shows the architecture of the experiment network

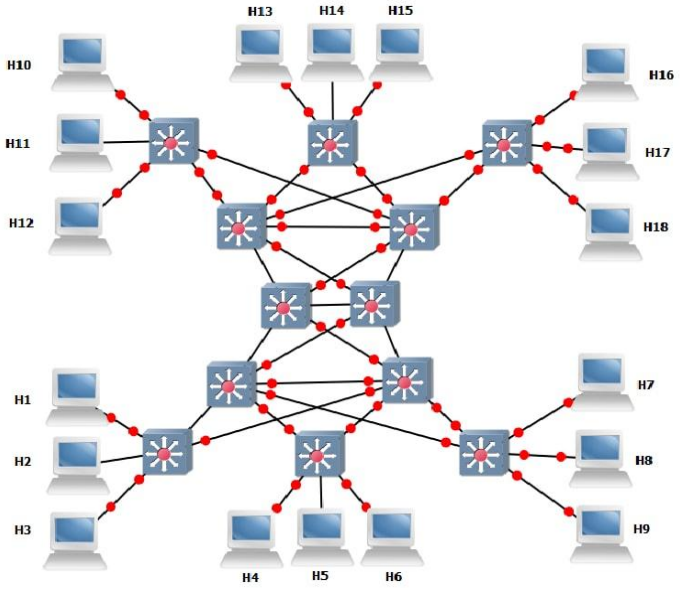

Figure 2. Experiment network architecture

All networking device used are Cisco 3725 (R7000) processor at 240MHz, with Cisco IOS Software, 3700 Software (C3725-ADVENTERPRISEK9-M), Version 12.4(15)T5, RELEASE SOFTWARE (fc4). Figure 3 illustrate the four network designs (Switched Access-EIGRP, Switched Access-OSPF, Routed Access-EIGRP, and Routed Access-OSPF).

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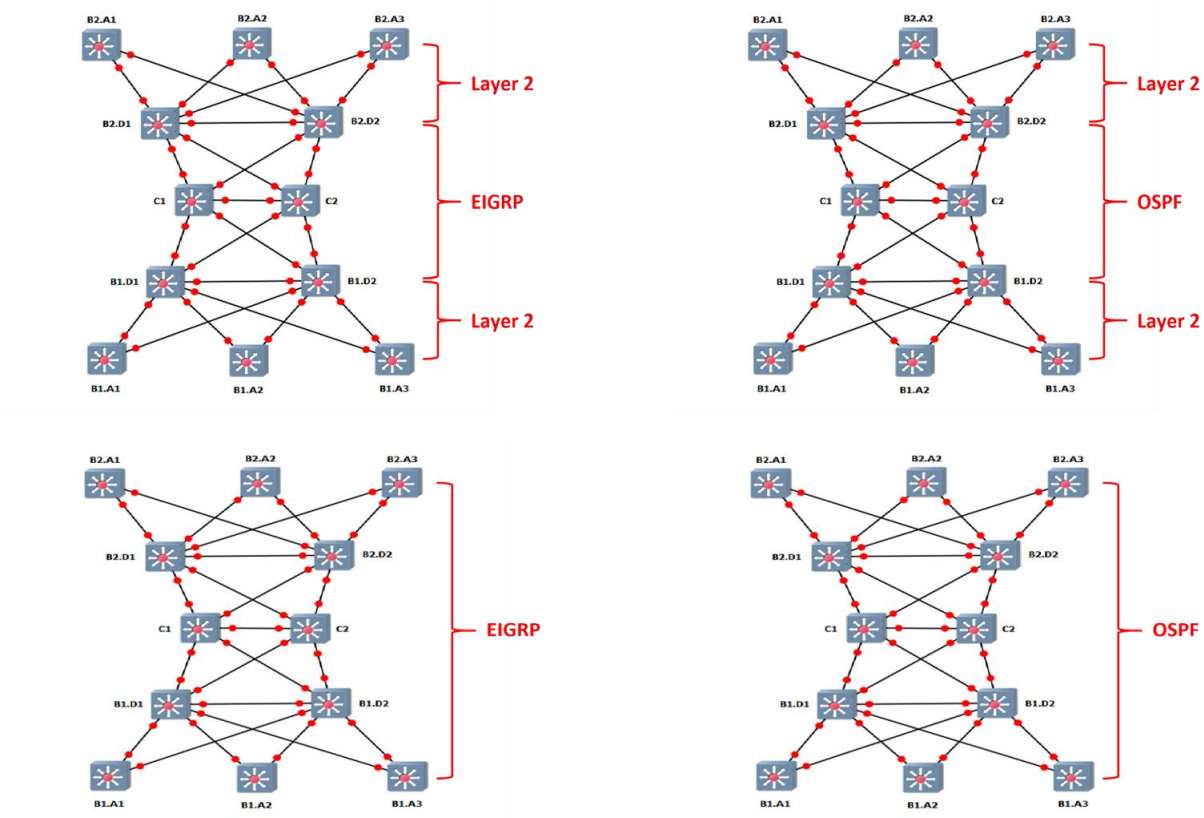

Figure 3. The four network designs

we measured the performance of the network using an active measurement methodology that depends on the synthetic packet stream using the Packet InterNet Groper (PING) software utility. Ping generate a series of Internet Control Message Protocol (ICMP) request/replay messages to test the connection with a host and determine the round-trip delay and other statistics like the packet loss.

In these experiments, each host ping another host in the network with a specified number of messages ranging from 500 messages up to 5000 messages, adding 500 messages per experiment (Thus, we have 10 experiments for each of the four network designs). This means that the hosts are formed in pairs and the data is transmitted between all at the same time to simulate the data traffic in the real environments.

For example, in the first experiment, we used 500 ping messages per host, so the data traffic was 500 (ping) * 18 (host)= 9000 ping messages, which took up to 3 minutes.

In the last experiment we used 5000 ping messages per host, so the data traffic was 5000 (ping) * 18(host) = 90000 ping messages, which took about 23 minutes.

RESULTS AND DISCUSSION

The results of the experiments can be summarized in Figures 4 and 5. Figure 4 summarizes the results of the delay criterion while figure 5 summarizes the packet loss criterion.

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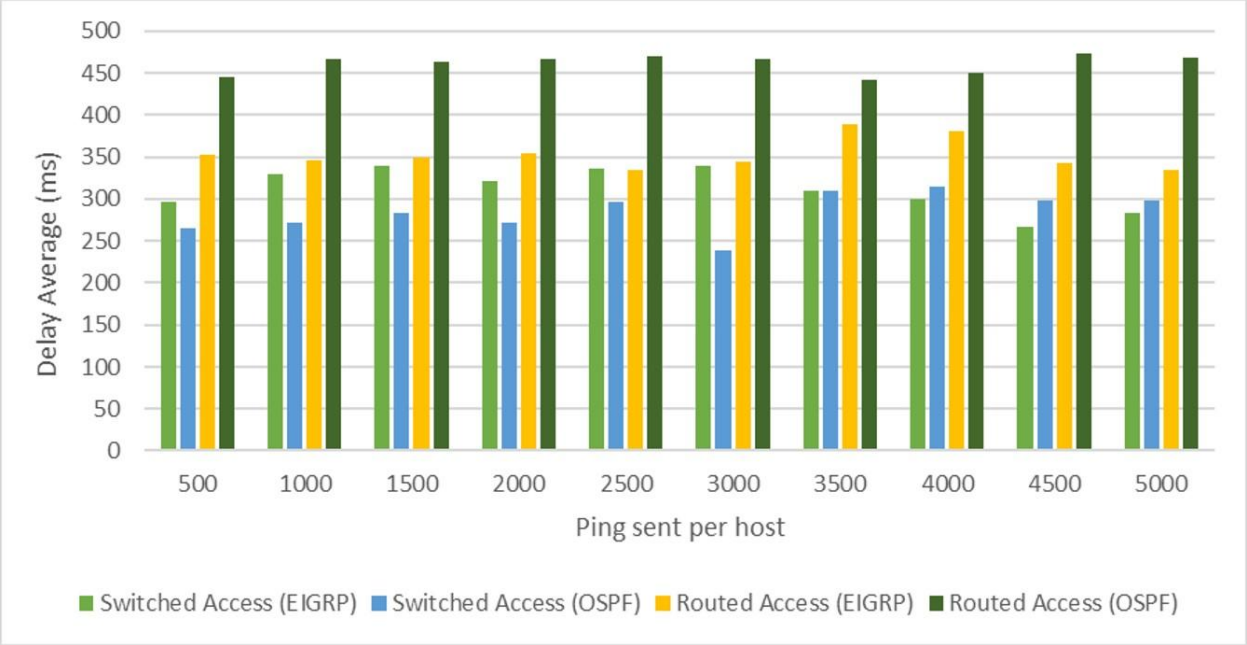

Figure 4. Delay Average Results

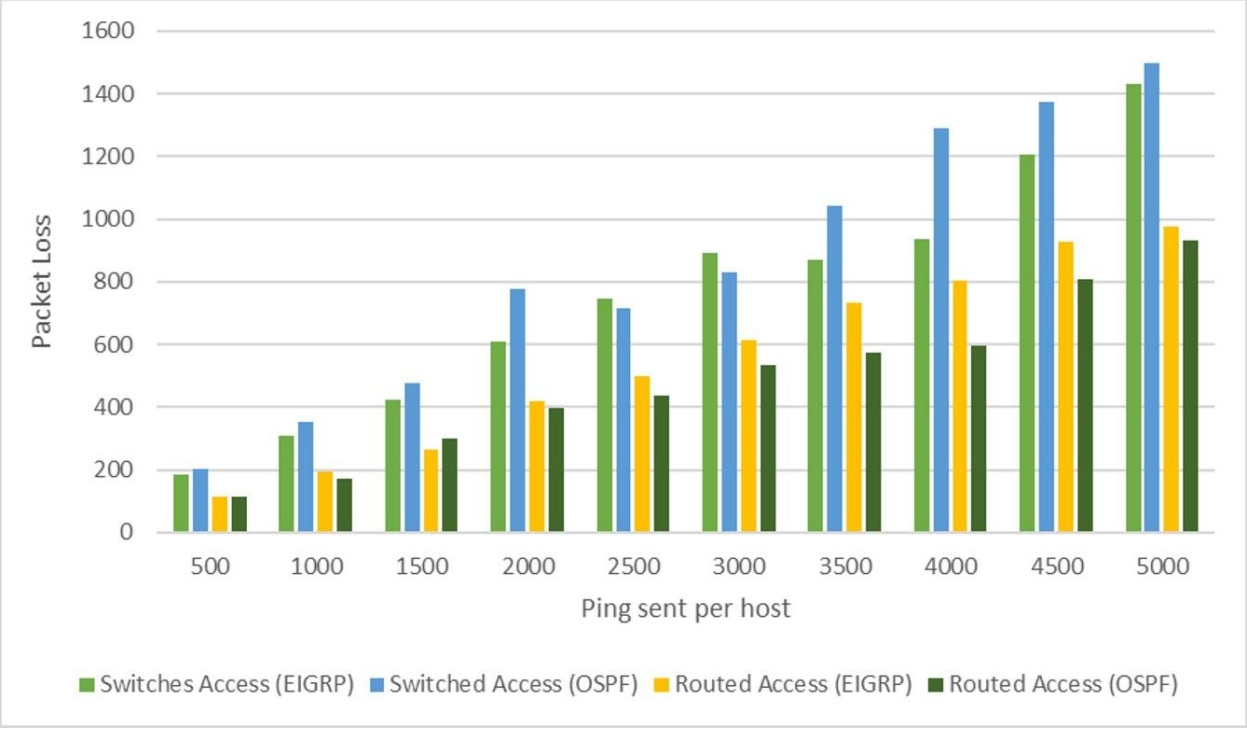

Figure 5. Packet Loss Results

In both designs, we observed convergence of network performance so that both achieved high service quality rate.

Although the switching is a hardware-based process while the routing is a software-based process, the technical development is as close to performance as is evident from the results. We can also conclude the relative stability of the network performance in its various designs.

Routed Access-OSPF exceeds the remainder in the delay average, the rest of the designs are close to the results. However, this increase in the delay rate does not make a significant difference in the performance of the network, especially given that the current speeds are faster than Fast Ethernet as the switches currently support Gigabit Ethernet, 10 Gigabit Ethernet and even optical fiber.

On the other hand, the routed access-OSPF design is the best performance in terms of packet loss, converged with the router access-EIGRP design. Followed by two switched access approaches that offer close results.

During the preparation of the experiment, the researcher pointed out that the routed access design greatly reduces the complexity of the network in terms of configuration and troubleshooting.

Although EIGRP has become an open standard after it was a Cisco Proprietary, many vendors still do not support this protocol while OSPF is widely supported and this should be taken into consideration by the designer and network administrator since the enterprise campus network, mostly, consists of equipment supplied by different vendors and must be integrated with each other.

Based on the above, the researcher recommends that designers and network administrators switch to routed access-OSPF design whenever possible.

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