**ECE/CS 5565: Project1**

**Fall 2024**

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1. **Network Simulation**

**1.1 Network image**

A screenshot of a computer network

Description automatically generated

EthernetHub

A screenshot of a computer network

Description automatically generated

Ethernet Switch

**1.2 Numerical Results Table**

EthernetHub

SwitchedEthernet

|  |  |
| --- | --- |
| **Field** | **Value** |
| Module name | SwitchedEthernet.client1.app[0] |
| Mean | 5.216841 |
| StdDev | 3.007523 |

|  |  |
| --- | --- |
| **Field** | **Value** |
| Module name | Hub.client1.app[0] |
| Mean | 29.334582 |
| StdDev | 17.007569 |

**1.3 Histograms**

A graph with blue lines

Description automatically generated

A graph with blue squares

Description automatically generated

**1.4 Comparison**

We found that Hub has a higher latency as compared to the switch. We also found that the standard deviation was highly visible in the fluctuations and end-to-end delays.

An Ethernet switch operates at the data link layer, ensuring data is sent only to the intended recipient's port. Each port operates independently, reducing the chance of data collisions and retransmissions.

The results clearly indicate a significant performance difference between the Ethernet Hub and the Switched Ethernet configurations. For the Switched Ethernet, the mean latency is 5.216841 with a standard deviation of 3.007523, highlighting lower overall delays and a more stable transmission performance.

In contrast, the Ethernet Hub shows a much higher mean latency of 29.334582, accompanied by a considerably larger standard deviation of 17.007569. This higher latency and greater variability in the hub's performance are likely due to increased data collisions and retransmissions, which occur when the hub broadcasts data to all connected devices, resulting in inefficient handling of network traffic.

These differences show the efficiency of switches, which, by directing traffic to the appropriate port and reducing the risk of collisions, ensures smoother communication with significantly lower and more consistent latency values.

**1.5 Discussion**

The only problem encountered was during the OMNET++ installation in Mac the Rosetta setup was tricky.

1. **Wireshark**

**2.1 Wireshark Images**

A screenshot of a computer

Description automatically generated

Ethernet Switch

A screenshot of a computer

Description automatically generated

Ethernet Hub

**2.2 Ethernet Switch Networking Questions**

a

Server1 0a:aa:00:00:00:03

Client1 0a:aa:00:00:00:01

Client2 1 0a:aa:00:00:00:02

Server2 0a:aa:00:00:00:04

b.

Client1: 192.168.01

Client2: 192.168.02

Server1: 192.168.03

Server2: 192.168.04

c.

ARP protocol is used in frames1,2 and 3.

Frames 1 and 2 are ARP requests, where devices with IP addresses 192.168.0.1 and 192.168.0.2 are asking for the MAC addresses corresponding to IPs 192.168.0.3 and 192.168.0.4, respectively. Frame 3 is an ARP reply from the device with IP 192.168.0.3, providing its MAC address (0a:aa:00:00:00:03) to the device that requested it.

d.

Frames 4, 5, and 6 represent the **TCP three-way handshake**, which establishes a reliable connection between two devices:

* **Frame 4:** A **TCP SYN** packet from 192.168.0.1 to 192.168.0.3, initiating the connection (Seq=0).
* **Frame 5:** A **TCP SYN-ACK** packet from 192.168.0.3 to 192.168.0.1, acknowledging the SYN and synchronizing the connection (Seq=0, Ack=1).
* **Frame 6:** A **TCP ACK** packet from 192.168.0.1 to 192.168.0.3, completing the handshake (Seq=1, Ack=1).

e.

Frame7:

Time recorded at 0.000953000s

f.

Frame:74633

10.425444

A screenshot of a computer

Description automatically generated

g.

Ethernet II, Src: 0a:aa:00:00:00:03 (0a:aa:00:00:00:03)

Dst: 0a:aa:00:00:00:01 (0a:aa:00:00:00:01)

Internet Protocol Version 4, Src: 192.168.0.3, Dst: 192.168.0.1

Transmission Control Protocol, Src Port: 1000, Dst Port: 1025

h.

Breakdown of Sizes:

* Ethernet II Header: 14 bytes
* IP Header: 20 bytes
* TCP Header: 20 bytes
* TCP Payload: 384 bytes
* Ethernet Trailer: 4 bytes

In total, the frame size is 14 + 20 + 20 + 384 + 4 = 442 bytes

A close-up of a paper

Description automatically generated

i.

Bytes transferred from Client1 to Server1: 12 MB. This includes all header bytes (Ethernet, IP, and TCP headers).

Duration of the conversation: 10.4253 seconds.

Effective bit rate from Client1 to Server1: 9420 kbps.

**2.3 EthernetHub**

Client1: 0a:aa:00:00:00:01

Client2: 0a:aa:00:00:00:02 Server1: 0a:aa:00:00:00:03 Server2: 0a:aa:00:00:00:04

a.

Frame 7

T= 0.001033s

b.

Frame 147424

T=58.348568s

c.

Bytes transferred from Client1 to Server1: 12 MB. This includes all header bytes (Ethernet, IP, and TCP headers).

Duration of the conversation: 58.3527 seconds.

Effective bit rate from Client1 to Server1: 1683 kbps.

**2.4 Comparison**

In both cases, the same amount of data was transferred, but the performance differed significantly. The Ethernet hub exhibited a longer duration and a lower effective bit rate of 1683 kbps, compared to the Ethernet switch’s significantly higher bit rate of 9420 kbps. The Ethernet switch achieves a higher throughput and better efficiency by sending data only to the intended recipient port, which optimizes bandwidth usage and minimizes collisions and retransmissions. In contrast, the Ethernet hub broadcasts data to all connected ports indiscriminately, leading to increased collisions and retransmissions, which degrade performance and reduce efficiency.

**2.5 Discussion**

I didn’t encounter any problems in the Wireshark part.

**Key References**

*• OMNeT++ Discrete Event Simulator: https://omnetpp.org/*

*• INET Framework: https://inet.omnetpp.org/*

*• “Getting Started with INET | OMNeT++ Tutorial” on YouTube: https://youtu.be/ujQ\_jaItx\_Y*

*• Wireshark Network Protocol Analyzer: https://www.wireshark.org/*