# Lab1 – Physical Layer and Ethernet Overview

## Phase 1

### Description

Lab 1 Phase 1 is the introductory part of a four-week networking laboratory in which students will be introduced to foundational networking concepts. The laboratory exercise will concentrate on the Physical Layer of the Open System Interconnect (OSI) model in order to provide you supporting material from the concepts delivered in lecture. It is imperative that each member of the group have a chance to see and touch the computers during this laboratory as the concepts and skills learned in this laboratory will be expanded upon in each of the subsequent projects. The initial steps necessary to create a stable computing environment necessary for the remainder of the laboratory assignments is established in Lab 1. Complete each of these objectives **prior** to the beginning of the next scheduled Check-off laboratory meeting. Students are expected to use the best practices discussed in lecture in this and all subsequent laboratory activities. Door access is required for the course therefore be sure Purdue ID has been enabled for swipe access.

### Objectives

**General Network Configuration**

- Run CAT 5e/6 cables to connect domain-based computer to Cisco 3750 series switch to start network configuration. Wide Area Network (WAN) uplink connections already established.
- Reset the Cisco 3750 series switch to provide network connectivity to your lab station
- Configure the computers (two Windows 10 computers and one Ubuntu computer) TCP/IP addressing using static IPs
  - Each lab group should be using 10.25.xx.yy IP addresses, where xx is your group number and yy is a unique number between 2 to 254. (This will need done every time the machine is rebooted.)

Standard IP Configuration Settings

| Group # | WAN Gateway Address | LAN Addresses 255.255.255.0 subnet mask | DNS settings | Subnet Mask |
|---|---|---|---|---|
| XX | 10.25.XX.1 | 10.25.XX.2-10.25.XX.254 | 10.2.1.11<br>10.2.1.12 | 255.255.255.0 |

- Make certain that each of your machines can complete the following tasks
  - Prove connectivity between workstations via file sharing
  - Connect to the world wide web
  - Connect to the lab printer at **10.3.1.206**
- Switch Console Access
  - Use the console cable to connect the console port of the switch and serial port of the PC and use terminal software, such as putty to make a connection to the switch.
  - Reference: CCENT/CCNA Exam guide from Purdue Library (may require Purdue credentials)
  - Find the right commands to
    - Record MAC table in lab and describe the purpose of the Mac table in the report.
    - Record start-up configuration and running configuration. Explain in lab report the purpose of the two configurations.
    - Record how many VLANS were configured and assigned.
    - Record the configuration in a text file to record your general configuration and research the method of making your running configuration your start-up configuration.

# Phase 2

## Description

The goals of Lab1 Phase 2 are as follows:

- Learn how to interact with an enterprise switch/router using console cable
- Use network packet capture tools to analysis network traffic data
- Use SPAN (Switched Port Analyzer) to monitor network
- Create a standard patch cable and a crossover patch cable using tools provided in lab, will be tested during check-off.

## Objectives

### Packet Analyses

- Use 'Notepad' to create a text file that has 600~1000 words (such that the size of the file is more than 2K and less than 10K). Share this file from one PC and access/download it from another PC. Please use Wireshark to capture all the packets that were transmitted between the two PCs and use the captured the packets to explain:
    - What layers of the OSI model are involved in file sharing across the network?
    - What protocols were involved during file sharing process in the LAN environment?
    - Use one packet as an example to explain the how TCP/IP layered architecture and the encapsulation processed
    - If someone were only given the captured packets, are they able to reassemble the file transmitted? Use the captured packets to support your answer.

### SPAN

- Many switches supported the notation of port mirroring or Switched Port Analyzer (SPAN). Basically, a port can be configured to receive copies of data that is to/from the ports on the same switch (or ports on a remote switch in the case of RSPAN). Usually, the monitoring port will stay in the 'listening' mode and will not be able to send packets.
    - Configure the system such that one of PC can monitor all the traffic in and out of the uplink of the switch.
    - Use the non-monitoring PC visit http://espn.com
    - Capture the packets from the monitoring PC and explain the results
    - Reset the SPAN monitor session.

### Construction of twisted-pair media (individual)

- Each group member is to construct and verify a straight-through cable following the TIA-568B specification. Students keep the cables.
    - (One of the two cables with traditional RJ-45 terminators and one with the new pass thru RJ45 terminators.
- Each group member is to construct and verify a crossover cable following the TIA-568A specification. Students keep the cables.
    - (One of the two cables with traditional RJ-45 terminators and one with the new pass thru RJ45 terminators.
- What are the physical layer characteristics of the cables you have constructed?
- Evaluate the physical layer characteristics and resulting data rates of each type of ISO/IEC 11801:2002 standards for "Category" cable.
- What is the correct term for each of the cables you constructed? That is, why should the cables not be called "Ethernet cables"?

**Applications of different types of cables**

- What kinds of connections typically use straight-through cables, crossover cables, and rollover cables?
- Use a crossover cable that you construct to directly connect two PCs (no switches and do not unplug the wiring from the back of the computers – use the cross-connects in Knoy 203 to make the connection) and configure the lab computers such that files can be shared between computers. What IP addresses and network mask were used? Does a default gateway need to be configured?

**Analysis and evaluation of unknown cable construction**

- Use a modular tester to troubleshoot a series of potentially "broken" cables
- Assuming these are cables constructed using the TIA-568B standard, what must be done to repair each of these cables?
- Assuming these are cables constructed using the ISOC standard, what must be done to repair each of these cables?
- Why will a rollover cable not be sufficient for transmission of data over an Ethernet-based network?

# Phase 3

## Description

In this laboratory, students will begin using enterprise-class network equipment to identify the operations of the network itself and how data flows through this network. At the conclusion of this laboratory exercise, students should be able to clearly explain many of the day-to-day operations of an Ethernet-based network, describe some optional features and the feature's purpose, as well as identify when the features should and should not be used in an enterprise network.

## Objectives

**Establishing the Laboratory Architecture**

- Investigate the network interface card settings on the lab computer in Device Manager Look for settings that apply to discussion in the lecture materials such as the speed and duplex settings on each of the host computers to enable auto-negotiation
- Add the HP ProCurve/Aruba managed switch and another Cisco 3750 switch to the network architecture according to Figure 1 below.
    - Please reset the settings for the switches to factory defaults
    - Identify MAC broadcast domain and the contention domain(s) in this architecture

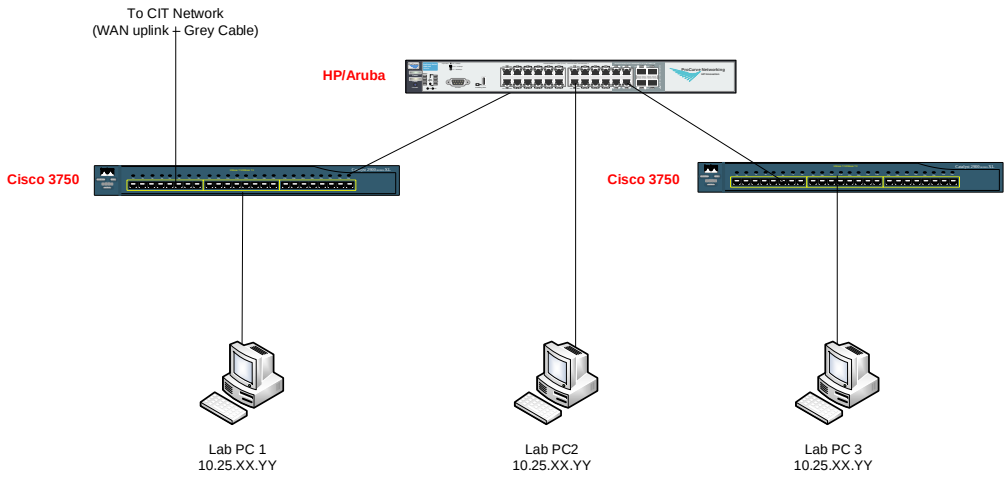


**Figure 1 – Architecture for use in Lab 1 Phase 3**

**Analysis of bidirectional communication & line speeds in Ethernets**

Before proceeding, please investigate:

1) How to change the speed and duplex settings of the computer NICs
2) What Windows Command can create a file with size of exactly 100MB and 1MB?

- Set the following line speeds/duplex settings on the 3 lab computers attached to network topology following the network diagram below and then transfer a small file (~1 MB) and a large file (~100 MB) between the hosts in order to compare timing and performance.
    - 100 Mbps full-duplex
    - 100 Mbps half-duplex
    - 10 Mbps full-duplex
    - 10 Mbps half-duplex
    - How does the calculated time compare to the actual time? Why?

- Set the following line speeds and duplex settings on one of the clients attached to your network. Then transfer a small file (~1 MB) and a large file (~100 MB) between the host and a site on the Internet (such as OneDrive, box, and google drive) in order to compare timing and performance.
    - 100 Mbps full-duplex
    - 100 Mbps half-duplex
    - 10 Mbps full-duplex
    - 10 Mbps half-duplex
    - How does the calculated time compare to the actual time? Why?
- Summarize the findings in a table. Compare and contrast the impact of link speed and duplex mode.

*NOTE: If the file transfer process is not likely to be completed within 3 minutes, please document down what percentage it has completed and project how long it will take to compete the whole transfer process.*

**Establishing Ethernet Baseline Performance**

- Examine the MAC address table on the switch and explain the purpose and function of the MAC address table

- Reconfigure the MAC address on one of the host computers to be 00:11:22:33:44:55
    - Show and explain the effect this has on the host and the switch
    - Why would it be necessary to reconfigure a host in this manner?

- Copy a large file (>250 MB) between Host A and Host B while recording the time elapsed
    - Calculate the number of Ethernet frames required to transfer of this file based on the standard payload size of Ethernet frames (assuming no errors occur in transmission)
    - Is this the actual number of frames that were transmitted? Explain.
    - Track the number of errored/retransmitted frames that occurred during this transfer. Explain the potential cause(s).

Resources:

1) Wireshark Introduction Video - https://www.youtube.com/watch?v=JnKc6fptviI

## Extra Credit: (10 points)

**Configuring Ethernet Options**

- Copy the same large file between Host A and B using **Jumbo Frames** and record the time elapsed.
    - What's the Jumbo Frame size that is agreeable to the hosts and the switch?
    - Calculate the number of Ethernet frames required using Jumbo Frames
    - Is this the actual number of frames that were transmitted? Explain.
    - Compare and contrast the performance of this transfer against the original transfer
    - Track the number of errored/retransmitted frames that occurred during this transfer. Explain the potential cause(s).
- Copy the same large file between Host A and B while recording the time elapsed after configuring the hosts and switch to use **Flow Control.**
    - Copy the same large file between Host A and Host B while simultaneously having Host C send another large file to Host B while recording the time elapsed
    - Compare and contrast the performance of these transfers against the original transfer
    - Compare and contrast the performance of these transfers without Jumbo Frames enabled against the original transfer
    - Explain the purpose of flow control and its effect on the transfer of these files
- Monitor and report the amount of traffic between each of the interfaces associated with the hosts on your network.
    - Compare and contrast the number of ingress and egress frames. Explain.
    - What is the correlation between octets, frames, and packets?