**TCP/IP Packet Routing POGIL Activity**

In this POGIL activity, you will work in groups of 4 to act out the layers in the TCP/IP model to encapsulate and transmit an email message in a local area network (LAN). Each group of 4 should be given an IP address such as 10.1, 10.2, etc. to simulate a computer in the LAN. Each group member should take on the role of one of the layers in the TCP/IP model:

* Application Layer (protocol: SMTP for email)
* Transport Layer (protocol: TCP)
* Internet Layer (protocol: IP)
* Link Layer (protocol: Ethernet)

**The Teacher in the class should fill in the following Routing Table (adding rows and IP addresses as necessary) and make it available for students to see on the board or projector:**

|  |  |
| --- | --- |
| **Name of Application Layer student in each group** | **IP Address** |
|  | 10.1 |
|  | 10.2 |
|  | 10.3 |
|  | 10.4 |

Here are roles of each student in a group simulating a computer on a LAN:

|  |  |
| --- | --- |
| **Application Layer**  **(protocol: SMTP for email)** | **Send:** Composes a message to another student and passes it to the Transport layer.  **Receive:** Receives and reads out messages from other students passed on from the Transport layer. |
| **Transport Layer**  **(protocol: TCP)** | **Send:** Splits the message into packets, adds TCP headers to number the packets, and sends them to the Internet layer.  **Receive:** Receives packets from the Internet layer, puts them in order, and passes them to the application layer when all is received. |
| **Internet Layer**  **(protocol: IP)** | **Send:** Uses the routing table above to add the destination IP address to each packet and passes them to the Link layer.  **Receive:** Receives packets from the Link layer and checks that it’s their own group’s IP address. If it is, it passes it to the transport layer. If it is not, it gives it back to the link layer to give to another group. |
| **Link Layer**  **(protocol: Ethernet)** | **Send:** Passes the individual packets randomly to the link layer of other groups.  **Receive:** Receives packets from other groups and passes them to the Internet Layer. |

Use the worksheets below as you simulate packet routing. Try to make sure every group sends and receives one message.

**APPLICATION LAYER (**SMTP protocol) **Student Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Our IP Address:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**SEND:** Write a **6-9 word** message from you to **a student who is the application layer in another group**, using just **first and last names i**n the To and From fields. Then, pass this paper to the Transport layer in your group.

To: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

From: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Message: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Here’s an example:

To: Jesse B.

From: Casey Z.

Message: Hi, how are you doing today?

**RECEIVE:** When you receive message packets in order from the Transport layer, read them out.

**TRANSPORT LAYER (TCP)**  **Student Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Our IP Address:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**SEND:** When you receive the message from the Application Layer in your group, break the message up into packets where each packet contains **at most 3 words** of the message. Add the number of the packet in the **TCP header**. Leave the IP header blank for the Internet Layer. Pass each packet to the Internet layer. These packets should be cut out of this handout so that they can be delivered in any order to the next layer. Here’s an example packet:

|  |  |  |
| --- | --- | --- |
| IP header | TCP header  3 of 6 | Data  \_Hi,\_ How\_\_ \_are\_ |

**Receive:** When you receive packets from the Internet layer, put them in order, and if they are all received, pass them to the application layer.

**Fill in the following packets and cut them out to pass to the Internet layer:**

|  |  |  |
| --- | --- | --- |
| IP header  \_\_\_\_\_\_\_\_ | TCP header  1 of \_\_ | Data  To: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |  |  |
| --- | --- | --- |
| IP header  \_\_\_\_\_\_\_\_ | TCP header  2 of \_\_ | Data  From: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |  |  |
| --- | --- | --- |
| IP header  \_\_\_\_\_\_\_\_ | TCP header  3 of \_\_ | Data  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |  |  |
| --- | --- | --- |
| IP header  \_\_\_\_\_\_\_\_ | TCP header  4 of \_\_ | Data  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |  |  |
| --- | --- | --- |
| IP header  \_\_\_\_\_\_\_\_ | TCP header  5 of \_\_ | Data  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

**INTERNET LAYER (**IP) **Student Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Our IP Address:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**SEND:** When you receive packets from the Transport Layer, look up the IP address in the **routing table** for the student named in the To field of the message and write the IP address in the IP header of each packet. Pass each packet to the Link layer in your group as you complete them. Feel free to mix them up. Here’s an example packet:

|  |  |  |
| --- | --- | --- |
| IP header  10.2 | TCP header  3 of 6 | Data  \_Hi,\_ How\_\_ \_are\_ |

**RECEIVE:** When you receive a packet from the Link layer, check that it’s your group’s IP address. If it is, pass it to the transport layer in your group. If it is not, give it back to the link layer in your group to give to another group.

**LINK LAYER (**Ethernet Protocol) **Student Name:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Our IP Address:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**SEND:** When you receive a packet from your group’s Internet layer, deliver the packet to a student playing the role of the link layer in another group. Don’t worry if they are the correct group. They will check and pass on the packet if they are not the correct group. Feel free to process the packets in any order.

**RECEIVE:** If you receive a packet from another group, pass it on to the Internet Layer in your group.

**Discussion Questions**

Once you have sent and received a message, discuss the following questions with your POGIL group.

1. **Packet Order.** Does it matter whether the packets of a message arrive in order? Explain how this set of protocols handles that.
2. **(Portfolio) Missing Packets.** What should happen if a packet goes missing? Who (which layer) would handle this? What action would they have to take? And what additional information would be needed in the packet in order to handle it?
3. **Corrupted Packets.** Suppose there’s some kind hardware glitch that corrupts one or more bits in a packet? Can this be detected? What action should be taken in this case? What additional information would be needed to handle this issue?
4. **(Portfolio) Security/Privacy:** As the packets are being transmitted through the network, can people other than the sender and receiver read the messages? What methods can we use to protect the message?