**Score: \_\_\_\_\_**

**NA1 – Network Abstractions**

**Activities**

COMP256 – Computing Abstractions

Dickinson College

Spring 2023

Prof. Grant Braught

**Name:**

**Introduction:**

In today’s class we introduced the idea of computer networks and thought about what they do at both a very high and a very low level. The Internet was described as a network of networks and will be used as the guiding example throughout this unit. We used an airline travel metaphor to think about the functioning of networks, like the Internet. This metaphor emphasized a view of the Internet using layers of abstraction with each layer providing a distinct service by using the layers below it. Finally, the five specific layers used in the Internet were described and the lowest layer, the physical layer, was introduced.

**The Internet:**

🔑 1. Fill in each row of the left column with the term listed below that best matches the description in the right column. Some terms will be used more than once.

Node Host Access Point Router/Switch Communication Link

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | **Term** | **Description** |  |
|  |  | The connection between two nodes in the network. |  |
|  |  | Device through which hosts connect to the network. |  |
|  |  | Your laptop, desktop computer or mobile phone. |  |
|  |  | Any device connected to a communication link. |  |
|  |  | Device that directs packets between hosts. |  |
|  |  | The air between your laptop and the WiFi hot spot. |  |
|  |  | A web server. |  |
|  |  | The network cable that plugs into your computer. |  |
|  |  | The cellular tower that your phone is connected to. |  |
|  |  |  |  |

2. Consider the Postal System as a metaphor for the Internet.

a. At the lowest level of the Internet are mechanisms for the exchange of 0’s and 1’s between nodes over a *direct communication link* between them. What would be analogous to these direct communication links in the Postal System metaphor?

b. At its highest level of the Internet it provides services for the exchange of information*between application programs* on distant hosts. What would be analogous to these application programs in the Postal System metaphor?

🔑 3. Describe the operation of a packet switched network using the Postal System as a metaphor.

4. Most of the information moving around the Internet is done using packet switched networks, they have both advantages and disadvantages. Comparing them to circuit switched networks provides one way to highlight these advantages and disadvantages.

It is optional but if you find you would like some different presentations on packet and circuit switched networks you can find a few here:

* Jen English From TechTarget discusses “Circuit Switching vs. Packet Switching”
  + <https://www.youtube.com/watch?v=j85O69Utlz8> (2:34)
* MrBrownCS explains “Packet vs Circuit Switching”
  + <https://www.youtube.com/watch?v=ulKhM0edtDI> (9:53)

Fill in the “Switching Type” column with either *packet* or *circuit* to indicate which type of switching would be best suited for the application that is described.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | **Switching Type** | **Application** |  |
|  |  | Applications that must be highly adaptable to the failure and addition of communication links. |  |
|  |  | Applications that require consistent high data rates over extended periods of time. |  |
|  |  | Applications that transfer bursts of information separated by periods of silence. |  |
|  |  | Applications in which data must be guaranteed to be delivered without delay. |  |
|  |  |  |  |

**Network Layers:**

As was introduced in class, it is often helpful to think about networks working in layers. Each layer is an abstraction. Each layer provides a well-defined service. In addition, each layer uses the abstraction provided by the layers below it to implement its service. Airline travel was used as a metaphor for understanding this layered model and the five-layer model of the Internet was introduced as a concrete example.

It is optional, but if you get stuck in this section, would like another explanation of the airline metaphor, or you would like a take on how to describe the five layers differently than was done in class you might watch the following videos:

* Jim Kurose explains “Layering and Encapsulation” using the airline metaphor.
  + <https://www.youtube.com/watch?v=IZ_PnVXtMeY> (10:49)
* A Coursera lecture presents the “TCP/IP Five-Layer Network Model.”
  + <https://www.youtube.com/watch?v=2qRcOfj5tbA> (5:14)

5. Invent a layered metaphor of your own, like that of the airline, that captures the idea of each layer creating a service built using the ones below. Your metaphor should have at least three layers.

a. Briefly describe your metaphor using a process-oriented view. That is, explain how a message moves from the top layer at the source, through lower layers across a physical medium and back up to the top layer at the destination. Indicate what information is added/

b. Draw a layered diagram like the one from class that illustrates a service-oriented view of your metaphor. Each layer of your diagram should be labeled with the name of the service and the additional information that it adds/uses.

🔑 6. Each of the five internet layers (Application, Transport, Network, Link and Physical) provide a service. Fill in the left-hand column below with the layer that would be responsible for providing the service that best matches the activity described on the right.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | **Layer** | **Activity Description** |  |
|  |  | Passes information between two nodes that share a communication link. |  |
|  |  | Makes it possible for players in a multi-player game to see the other players and what they are doing. |  |
|  |  | Carries electrical signals, pulses of light or radio waves that encode 0’s and 1’s. |  |
|  |  | Divides large downloads into smaller pieces at the source and reassembles them into the whole at the destination. |  |
|  |  | Determines the specific path that a packet will take across the internet as it moves from source to destination. |  |
|  |  |  |  |

**Network Speeds**

8. Rank the following physical layer media from fastest to slowest based on their bandwidth: Optical fiber, coaxial cable (1 channel), WiFi, twisted pair, 5G cellular.

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  | **Fastest** |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  | **Slowest** |  |
|  |  |  |

9. Visit the SPEEDTEST web site (<https://www.speedtest.net/>) from a computer that is on WiFi, from a computer that is wired into the campus network (via Twisted Pair) and from your mobile phone over the cellular network (i.e. turn off WiFi and use your data plan. If you do not have a mobile phone or a data plan, skip this step.) Collect SPEEDTEST results for download speed and upload speed for each medium. Then rank the mediums in order from fastest to slowest by the average data rate that you observe. Be sure to include units for your data rates.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  | **Download Medium** | **Ave. Data Rate** |  | **Upload**  **Medium** | **Ave. Data Rate** |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

🏆10. Briefly explain why the SPEEDTEST web site is measuring data rate and not bandwidth.

Optional: To help me improve and scope these activities for future semesters please consider providing the following feedback.

a. Approximately how much time did you spend on this activity outside of class time?

b. Please comment on any particular challenges you faced in completing this activity.