CS 168 Introduction to the Internet: Architecture and Protocols
Fall 2024 Sylvia Ratnasamy, Rob Shakir, and Peyrin Kao Discussion 3: Ethernet and Layers

1 True or False

1. Having a link between every pair of machines compared to a single shared wire between all machines can cause less signal collisions to occur.

   Solution: True. A link between every pair of machines lessens the chance of signal collision, but this requires an infeasible amount of physical ports and computing power.

2. Token passing can waste time waiting for nodes to act.

   Solution: False. Token passing allows for no time to be wasted on idling.

3. For ALOHA, if a node gets no acknowledgement from its recipient after sending a packet, it waits a fixed amount of time and re-sends the packet.

   Solution: False. Instead of waiting a fixed amount of time, it instead waits a random amount of time for re-sending the packet. This randomness can help avoid more collisions later on.

4. When sending out a unicast using the Ethernet, we set the destination address in our data packet to the recipient's IP address.

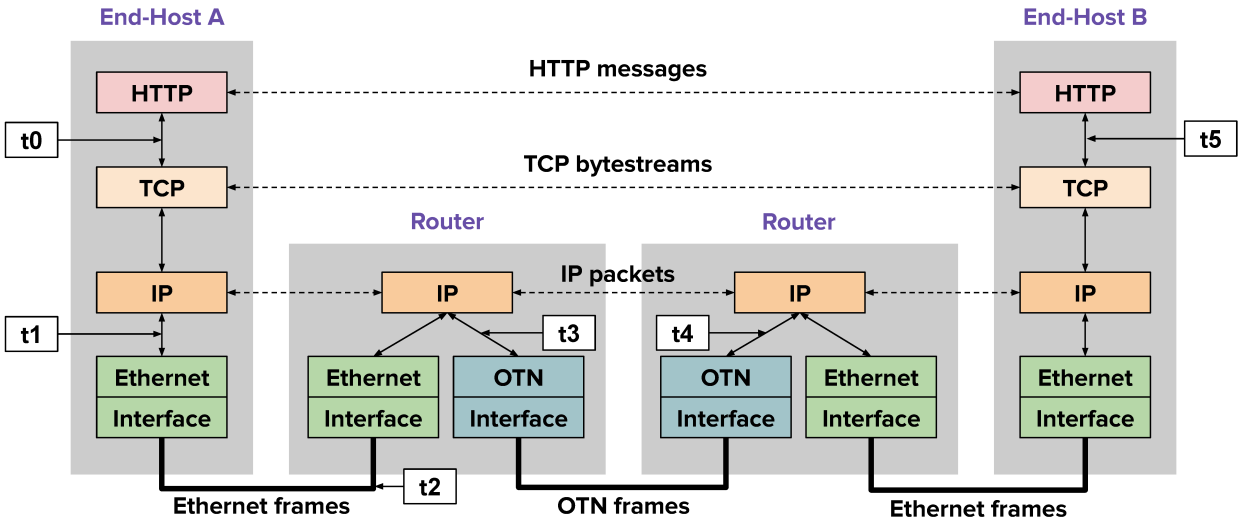
   Solution: False. We use the MAC address instead for the recipient's destination address.

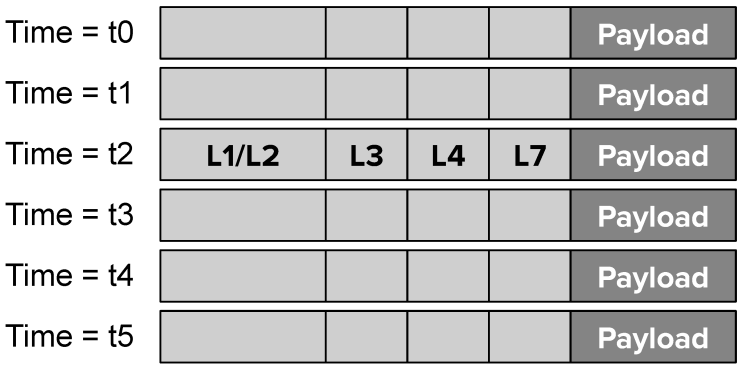
5. The payload in the Ethernet's data packet is the only variable-length field.

   Solution: True. Every other field has a fixed length.

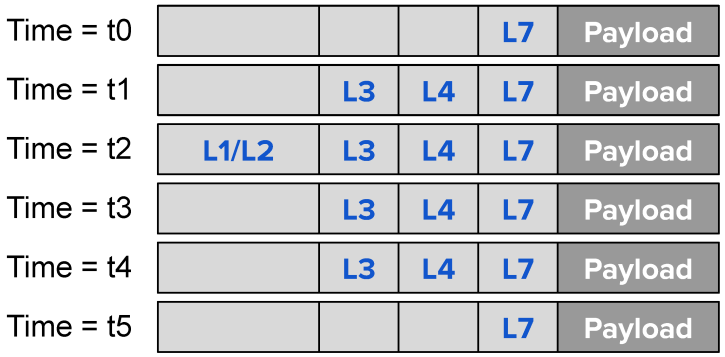
2 Protocol Diagram

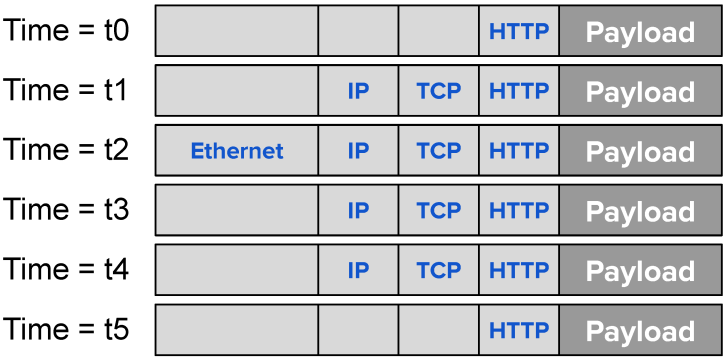
Refer to the figure below, which is similar to the one from Lecture 3. In this example, Host A sends one packet to host B at time t = 0. In this question, we explore how the packet header changes as the packet traverses different layers and protocols of the network. At each time step, fill in the empty blocks to describe which headers are attached to the payload. The packet headers are provided at time t = 2 for reference.


End-Host A
End-Host B
HTTP messages
HTTP
HTTP
t0
t5
TCP bytestreams
TCP
TCP
Router
Router
IP packets
IP
IP
IP
IP
t1
t3
t4
Ethernet
Interface
Ethernet
Interface
OTN
Interface
OTN
Interface
Ethernet
Interface
Ethernet
Interface
t2
Ethernet frames
OTN frames
Ethernet frames


Time = t0
Payload
Time = t1
Payload
Time = t2
L1/L2
L3
L4
L7
Payload
Time = t3
Payload
Time = t4
Payload
Time = t5
Payload

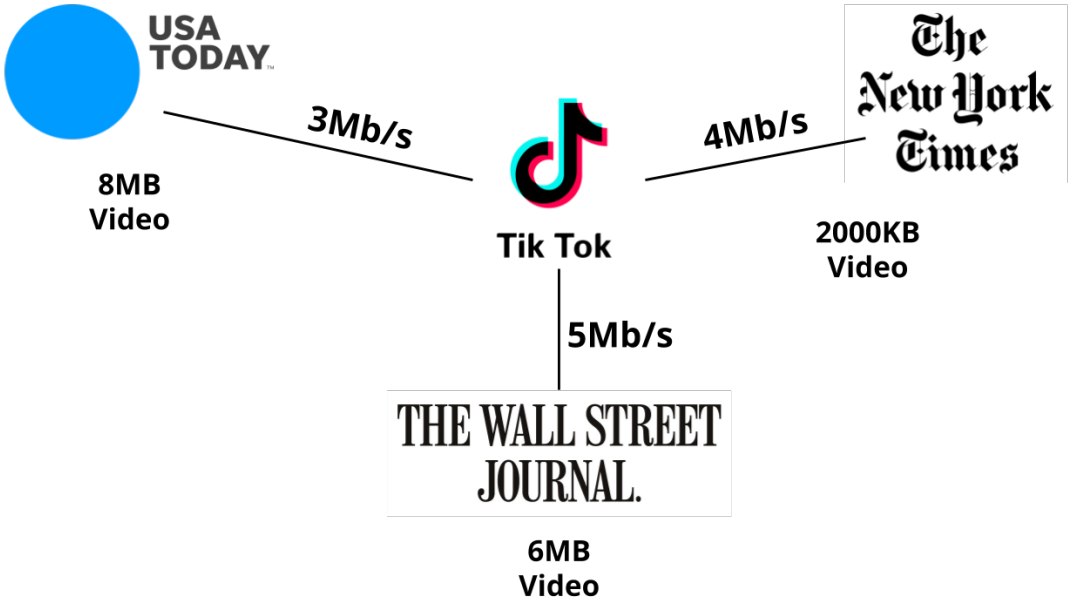
Solution:


Time = t0
L7
Payload
Time = t1
L3
L4
L7
Payload
Time = t2
L1/L2
L3
L4
L7
Payload
Time = t3
L3
L4
L7
Payload
Time = t4
L3
L4
L7
Payload
Time = t5
L7
Payload


Time = t0
HTTP
Payload
Time = t1
IP
TCP
HTTP
Payload
Time = t2
Ethernet
IP
TCP
HTTP
Payload
Time = t3
IP
TCP
HTTP
Payload
Time = t4
IP
TCP
HTTP
Payload
Time = t5
HTTP
Payload

3 First one to TikTok wins!

As you may know, the Washington Post has a pretty spicy TikTok account. Execs at the New York Times, the Wall Street Journal, and USA Today have also noticed the Post's success and want to promote their brand on the platform. Each organization has filmed a take on the 9 to 5 challenge video to use as their first upload to TikTok. They are all waiting for the perfect moment to post.



Upon seeing the perfect opportunity, all three organizations begin uploading their video at almost the same time (within 3-seconds of each other). If we assume that propagation time is negligible, which news organization will be the first to publish their video (and ultimately become #1 trending on TikTok)?

Solution: Let's first compute the transmission time for the videos uploaded:

The NYTime's video is 2000KB and takes

$$\frac{2000\text{KB}}{1000\frac{\text{KB}}{MB}} \cdot 8\frac{\text{bits}}{\text{byte}} \div 4\frac{Mb}{s} = \boxed{4.0 \text{ seconds}}$$

to upload the entire video.

The USA Today's video would need around

$$8\text{MB} \cdot 8\frac{\text{bits}}{\text{byte}} \div 3\frac{Mb}{s} = \boxed{21.3 \text{ seconds}}$$

to be put onto the link.

The WSJ's video would need around

$$6\text{MB} \cdot 8\frac{\text{bits}}{\text{byte}} \div 5\frac{Mb}{s} = \boxed{9.6 \text{ seconds}}$$

to be put onto the link.

The NYTimes video is the first uploaded because it's time to upload is 5.6 seconds faster than the next fastest upload from the WSJ (which is greater than the 3-second range of uploading).