EN.601.414/614 Computer Networks

Exercise and Lab

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Fall 2020 (TuTh 1:30-2:45pm on Zoom)

https://github.com/xinjin/course-net

True or False

- **The Internet is a network of networks. The Internet ties together different networks with the TCP protocol.**

True or False

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  - ➢ False. With the IP protocol.

True or False

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True or False

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  - ➢ True. This is for scalability. Directly connecting N nodes to each other would require N^2 links.

True or False

- **End-systems, switches and routers implement all five layers.**

True or False

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  - False. Switches only implement physical and datalink layers, and routers only implement physical, datalink and network layers.

True or False

- **HTTP is a stateless protocol. As a result, there is no way to keep state.**

True or False

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  - ➢ False. We can use cookies.

True or False

- **CDNs are only useful for web pages that contain static content.**

True or False

- **CDNs are only useful for web pages that contain static content.**
  - ➢ False. They can still serve the static parts of a web page that also includes dynamic content. Moreover, some CDNs can perform some dynamic processing on behalf of the content provider.

Network Measurement

- **Two end-points (A and B) communicate by a path of 5 routers. The packet size is 1500 bytes. The distance between A and B is 6000 km. The bit propagation speed is $2x10^8$ m/s. Assume 1 Mb/s = 10^6 bit/s and 1 Gb/s = 10^9 bit/s.**
- (1) What are the four components to evaluate network delay?
- (2) Assume there is no queueing delay and processing delay. Assume all links run at 10Mb/s. What is the end-to-end delay (one way, not round trip) for sending a packet?
- (3) Assume there is no queueing delay and processing delay. Assume all links run at 10Gb/s. What is the end-to-end delay (one way, not round trip) for sending a packet?
- (4) Assume there is no processing delay. Assume all links run at 10Mb/s. Assume the buffer size in each router is 10 packets. What is the maximum end-to-end delay (one way, not round trip) for sending a packet?

Network Measurement

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- (1) What are the four components to evaluate network delay?
- Transmission delay, propagation delay, queuing delay, and processing delay.

Network Measurement

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- (2) Assume there is no queueing delay and processing delay. Assume all links run at 10Mb/s. What is the end-to-end delay (one way, not round trip) for sending a packet?
- Transmission delay = $1500 \times 8 / (10 \times 10^6) = 1.2$ ms
- Propagation delay = $6000000/(2 \times 10^8) = 30$ ms
- Delay = propagation delay + transmission delay x 6 hops = 37.2 ms

Network Measurement

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- (3) Assume there is no queueing delay and processing delay. Assume all links run at 10Gb/s. What is the end-to-end delay (one way, not round trip) for sending a packet?
- Transmission delay = $1500x8 / (10x10^9)$ = 0.0012 ms
- Propagation delay = $6000000/(2x10^8)$ = 30 ms
- Delay = propagation delay + transmission delay x 6 hops = 30.0072 ms

Network Measurement

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- (4) Assume there is no processing delay. Assume all links run at 10Mb/s. Assume the buffer size in each router is 10 packets. What is the maximum end-to-end delay (one way, not round trip) for sending a packet?
- Transmission delay = $1500 \times 8 / (10 \times 10^6) = 1.2$ ms
- Propagation delay = $6000000/(2 \times 10^8) = 30$ ms
- Queueing delay = 9 * 1.2 = 10.8ms
- Delay = propagation delay + transmission delay x 6 hops + queueing delay x 5 routers = 91.2ms

HTTP Performance

- **A user would like to download 100 objects from the server using HTTP. There are a few different methods: one-at-a-time, concurrent (assume using 10 concurrent connections), persistent, and pipelined. Assume the RTT is 100 ms, and assume the objects are small objects. What are the latencies to download the objects with each method?**

HTTP Performance

- **A user would like to download 100 objects from the server using HTTP. There are a few different methods: one-at-a-time, concurrent (assume using 10 concurrent connections), persistent, and pipelined. Assume the RTT is 100 ms, and assume the objects are small objects. What are the latencies to download the objects with each method?**
- One-at-a-time: 2 * RTT * 100 objects = 20 s
- Concurrent: 2 * RTT * 100 objects / 10 concurrent connections = 2 s
- Persistent: 2 * RTT (first object) + 1 * RTT * 99 (other objects) = 10.1 s
- Pipelined: 2* RTT = 200ms

HTTP Performance

- **Now assume the objects are large. All objects have the same size of 100 MB (i.e., 10^8 bytes). Assume the bandwidth for each TCP connection is 10 Mb/s (i.e., 10^7 bit/s). What are the latencies to download the objects with each method?**

HTTP Performance

- **Now assume the objects are large. All objects have the same size of 100 MB (i.e., 10^8 bytes). Assume the bandwidth for each TCP connection is 10 Mb/s (i.e., 10^7 bit/s). What are the latencies to download the objects with each method?**
- Transmission time: $\frac{100MB}{10Mb/s} = 80s$
- One-at-a-time: 80 s * 100 objects = 8000 s
- Concurrent: 80 s * 100 objects / 10 concurrent connections = 800 s
- Persistent: 80 s * 100 objects = 8000 s
- Pipelined: 80 s * 100 objects = 8000 s

Assignment Tips

- **Do I get a full score?**
  - Pass all test cases in test_client_server.sh
- **What to submit?**
  - 4 files.
  - server-c.c, client-c.c
  - server-python.py, client-python.py

Assignment Tips

- **Search error messages on Google**
- **Restart the VM**
- **Don’t forget to compile C program**

Assignment Tips

- **How to read stdin?**
  - n = fread(buffer, sizeof(char), SEND_BUFFER_SIZE, stdin)
  - buffer = sys.stdin.read(SEND_BUFFER_SIZE)
- **Why does my program fail on BINARY message?**
  - There might be characters like EOL(\n) or NULL(\0)

Thanks!
Q&A