

Final examination on Introduction to the Internet

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1 Problems

1. Consider the queuing delay in a router buffer. Suppose all the packets are L bits long, the transmission rate is R bit/sec and that N packets arrive simultaneously at the buffer every LN/R seconds.

Find the **average** queuing delay of a packet.

(*Hint*: The queuing delay for the first packet is 0; for the second packet it is L/R ; for the third packet it is $2L/R$ etc. The last packet (number N) has already been transmitted when the second batch (i.e. group) of packets arrives.)

2. Consider the queuing delay in a router buffer. Let I denote the traffic intensity, that is: $I = La/R$. Suppose that the queuing delay takes the form $IL/R(1 - I)$ for $I < 1$.

- (a) Provide a formula for the total delay, that is, the queuing delay plus the transmission delay.

- (b) Express the total delay as a function of L/R .

3. We consider sending voice from host A to host B over a packet-switched network (for example, Internet phone). Host A converts analog voice to a digital **64 Kbps** bit stream on the fly. Host A then groups the bits into a **48-byte** packets. There is one link between host A and B; its transmission rate is **1 Mbps** and its propagation delay is **2 msec**.

As soon as host A gathers a packet, it sends it to host B. As soon as host B receives an *entire* packet, it converts the packet's bits into an analog signal.

How much time elapses from the time a bit is created (from the original analog signal at host A) until the bit is decoded (as part of the analog signal at host B)?

2 Review questions

1. For a communication session between two hosts, which host is the client and which is the server?
2. List at least two user agents you personally use.
3. Why do HTTP, FTP, SMTP, POP3 and IMAP run on top of TCP rather than UDP?
4. Consider an e-commerce site that wants to keep a purchase record for each of its customers.
 - (a) Describe (briefly) how this can be done with HTTP authentication.
 - (b) Describe (briefly) how this can be done with cookies.
5. Is it possible that an organisation's web server and mail server have exactly the same alias for a hostname? What would be the type for the RR that contains the hostname of the mail server?