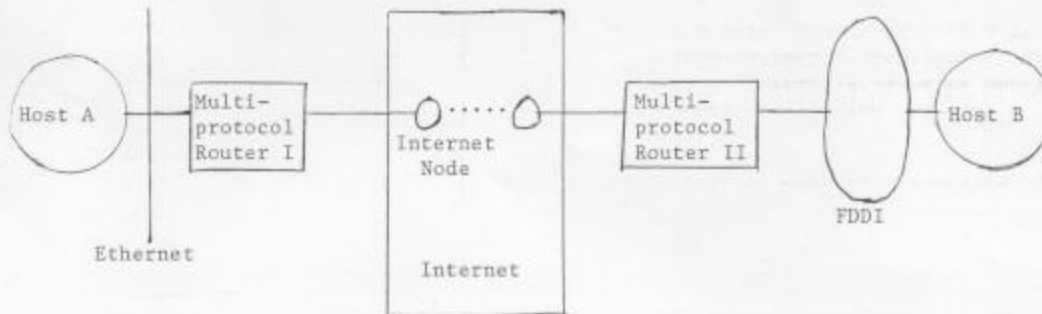


B1. Networks (25 points)

Given the following network, where host A and host B are running SMTP, ftp, TELNET, SNMP, VT, http, JAVA, as well as end-system client and server applications.



- a) (15 points) Following the layered OSI model and using the protocols mentioned and the figure, draw the required actual protocol layers (stack) at each host, router and Internet node.
- b) A client process at host A is trying to communicate with an e-trade server process at host B to view a html page and mail-order some items over www.
 1. (5 points) What are the transport and network layer quality of service (QoS) parameters?
 2. (5 points) How does a client process access a server process to view the items?

B2. Networks (25 points)

Consider Stop-and-Wait, Selective Repeat and Go-back-N Connection-oriented reliable service data link layer protocols.

- a) (10 points) How do these three protocols differ?
- b) (10 points) Frames of 1000 bits are sent over a 1-Mbps satellite channel. Acknowledgements are always piggybacked onto data frames. Headers are very short. Three-bit sequence numbers are used. What is the maximum achievable channel utilization for each of these protocols? Discuss other relevant performance issues for these protocols.
- c) (5 points) What are advantages/disadvantages of a receiver purposely delaying returning positive acknowledgements for piggybacking onto data frames?

B3. Networks (25 points)

The success of the Internet is attributed to its Network Layer functions and the Internet Protocol (IPv4) which deal with two closely related problems: heterogeneity and scale. The problem of heterogeneity is that users on one type of network want to communicate with users on other types of networks. The problem of scale is signified by the growth of the Internet, which has roughly doubled in size each year for 20 years.

- a) (10 points) Describe succinctly what algorithms, models, mechanisms, and protocols are used by the Internet to deal with the heterogeneity problem.
- b) (15 points) Describe succinctly what algorithms, models, mechanisms, and protocols are used by the Internet to deal with the scaling problem.

B4. Networks (25 points)

- a) (5 points) Describe succinctly the differences between flow control and congestion control.
- b) (8 points) How does TCP facilitate flow control and congestion control, respectively? How are TCP's flow control and congestion control "integrated" (or used together) within the protocol implementation?
- c) (5 points) List three functions that can be provided by sliding window protocols.
- d) (7 points) How does the TCP's sliding window protocol differ from the Data Link Layer's sliding window protocol? And why?