Networks and Protocols
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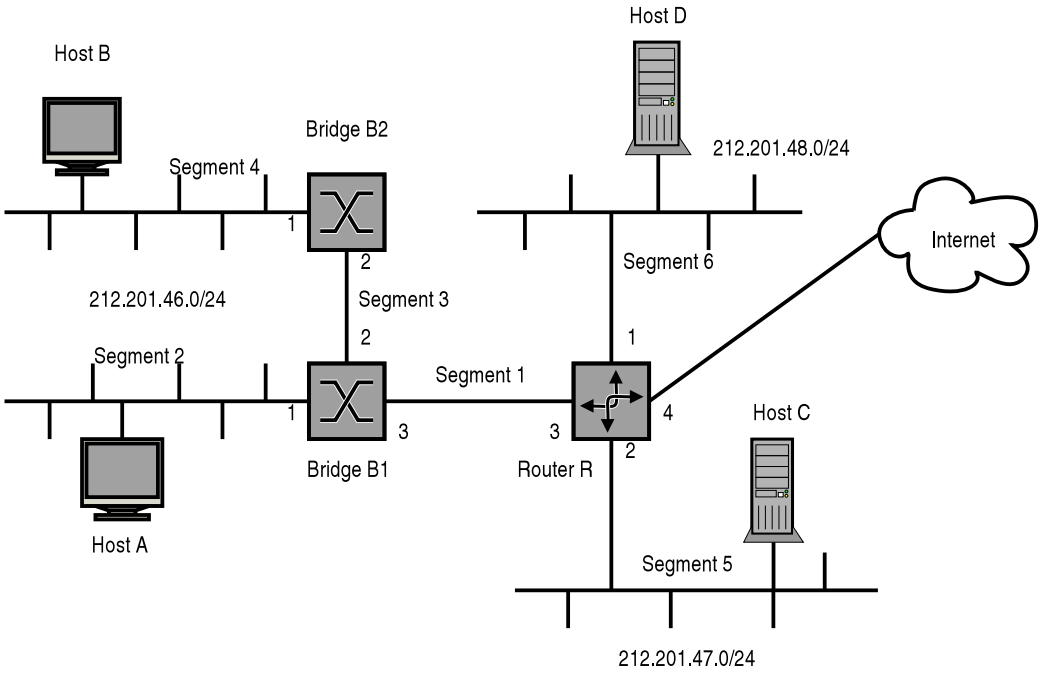
Final Examination

Problem F.1: *IP over Ethernet* (10+20+10=40 points)

Consider the following network topology:



The IP network consists of three sub-networks: The 212.201.46.0/24 network contains the bridges B1 and B2 and the hosts A and B, the 212.201.47.0/24 network contains the host C, and the 212.201.48.0/24 network contains the host D. All three networks are interconnected by the router R which is also connected to the global Internet. The ports / interfaces on the bridges and the router are identified by the numbers shown in the network topology map.

1. Define the forwarding table that must be installed in the router R so that every host and communicate with every other host and all hosts can access the global Internet. Assume that the next router in the global Internet has the address 212.201.49.42.

2. Suppose the correct static IP forwarding tables have been installed and the network is turned on (the hosts, bridges and routers have no dynamic state information). Host C now sends an IP packet to host B and B in turn sends a response IP packet back to host C. Create a table similar to the one shown below which explains how many Ethernet frames are transmitted over the six Ethernet segments and what the frames contain.

No	Segment	Eth Src	Eth Dst	IP Src	IP Dst	Description

   Note: You can use the symbolic names A, B, C, D, R, B1, B2 to indicate Ethernet or IP addresses. Use a star to indicate a broadcast address. Mark table cells that are not applicable with a hyphen.

3. What is the contents of the forwarding databases of the bridges B1 and B2 after the exchange of all the frames?

Problem F.2: *tail drop vs. random early drop* (10 points)

Routers can use different policies to deal with congestion. Let us look at two alternatives:

a) The router waits until the buffer is filled. Datagrams arriving while the buffer space is filled are simply discarded. This policy is called trail drop.

b) The router starts to discard packets with a probability p once the buffer usage has crossed a certain threshold T. This policy is called random early drop (RED). If all buffer space has been filled, the router discards packets, essentially falling back to the tail drop policy.

Consider a router which carries traffic from N active TCP connections where $N \gg 1$. Assume this router is getting congested. Which of the two policies mentioned above will perform better in this situation? Explain why.

Problem F.3: *ASN.1 / BER / SNMP* (20 points)

Decode the following BER encoded SNMPv1 packet. What does the packet mean?

```
30 22 02 01 00 04 00 A4 1B 06 07 2B 06 01 04 01
8C 27 40 04 7F 00 00 01 02 01 00 02 01 00 43 02
0C CB 30 00
```

Note: The ASN.1 definition of SNMPv1 can be found in the ASN.1 section of the lecture notes.

Problem F.4: *domain name system* (10+10+10=30 points)

The network shown on the first page has been configured to run an HTTP server on host D and a DNS server on host C. The DNS server contains the following resource records for the domain `example.org`:

```
www             IN      CNAME   D
A               IN      A       212.201.46.12
B               IN      A       212.201.46.44
C               IN      A       212.201.47.22
D               IN      A       212.201.48.22
```

1. A user on host A types `http://www.example.org/` into his Web browser. Explain how the URL is resolved into a transport layer address which can be used to establish a connection to the HTTP server. Which DNS request is sent to the DNS server and what does the server's DNS response contain? (Note that the client can not know whether a name is a `CNAME` or not.)

2. The Web server logs information about each incoming request in a file. Which resource records must be added to the DNS server so that the Web server can log the names of the clients coming from `example.org` instead of just their IP addresses?

3. Suppose the Web server is not able to handle the load and it is necessary to use multiple servers to handle all the requests. All these servers require different IP addresses. However, these addresses should not be visible to the clients — the clients should continue to use the URL `http://www.example.org/`. Someone claims that a simple extension of the DNS system can help. Explain how and discuss any drawbacks such a proposal might have.