technische universität
dortmund

Fakultät für Informatik
Lehrstuhl 4

Dr. Jan Kriege
Dipl.-Inf. Horst Schirmeier

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Computer Networks and Distributed Systems
Exercise Sheet 12

Exercise 12.1 Classification of Relays

You have already learned the principles of IP routing, i.e. forwarding of IP datagrams from one net into another according to the analysis of the network layer address. Forwarding datagrams can be done in any layer. Depending on that layer relays can be classified. The definitions are not consistent in the literature. We chose the notation that is common in a TCP/IP ethernet environment. Please note, that in other environments, e.g. ATM, a different terminology might be used.

Bridge Connects two segments that use the same protocol for communication Filters frames or forwards them according to their MAC address.

Gateway Traditional term for a router, that is e.g. used by the `netstat -r` command. Nowadays the task of a gateway is the conversion of information of an application from one protocol stack to another.

Hub In ethernets a hub is a multiport repeater, i.e. a repeater, that is connected to several network segments. In general a hub is the central device in a star topology.

Proxy Server An intermediary program that acts as both, client and server, to issue a request for the client. Requests of clients are either processed internally or forwarded to other servers. A proxy server interprets requests and modifies them, if necessary, before forwarding them.

Relay General term for devices that forward datagrams (bridge, router, etc.).

Repeater A device that receives and retransmits a signal at a higher level and works between two net segments.

Router Sometimes also called gateway. Forwards datagrams according to their network address (here: IP address). Determines the optimal path using parameters (metrics).

Switch-Router Combination of router and switch. Ports are assigned to logical networks. Switching is performed between ports of the same logical network. Routing is performed between ports of different logical networks.

Switch Connects several network segments, that use the same communication protocol. Filters frames and forwards them either to a specific or to all connected network segments according to their MAC address.

For the description of the behavior of the different relays we introduce the terms collision and broadcast domain:

Collision domain For ethernet it describes that section of a network, where frames can collide while being sent.

Broadcast domain All devices, that can receive an (ethernet) broadcast frame sent from any of those devices.

(a) Assign the relays to the different layers of the TCP/IP ethernet protocol stack.

(b) Which of the relays separate broadcast and/or collision domains?

(c) Which of the relays require their own IP- and/or MAC(ethernet) address?

Exercise 12.2

Explain the functionality and the purpose of the ARP protocol? Why are broadcasts frames used for ARP requests? Why is an ARP response sent in a frame with a specific target address?

Exercise 12.3

Consider an ethernet with the transmission rate of 10 MBit/s (1 MBit = 10^6 Bit) and the velocity of propagation of $10^8 \frac{m}{s}$. Assume that hosts connected to the net have a distance of at most 2,5 km from each other.

(a) Why is a minimum packet size necessary?

(b) What is the minimum packet size?

(c) Express the maximal length l of a cable between two hosts in an ethernet with a velocity of propagation v as a function of the minimum packet size p. The medium propagates signals with $\frac{2}{3}$ of the speed of light. (Speed of light $c = 3 \cdot 10^8 \frac{m}{s}$).