Net Centric Systems

Summer Term 2011

http://www.p2p.tu-darmstadt.de/teaching/summer-term-2011/ncs-net-centric-systems/

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Exercise 6

Submit until 10/6/2011, 18:00 in moodle (as pdf file).

This exercise is relevant for the exam bonus.

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Task 6.1: Routing (7 P.)

a) Which nodes in a network have to be informed about a link cost change when link-state routing is used? Which algorithm is used to inform them? (1 P.)

b) Consider a network in which several paths exist between each pair of nodes. How can a single rogue router try to convince the other routers in the network to route over him (e.g. with the goal to steal or "blackhole" the traffic) (2 P.)

- When link-state routing is used?
- When distance-vector routing is used?

c) How can an attack like in b) be detected in link-state routing? (2 P.)

d) Consider a connected graph with positive edge weights. The shortest paths with one node as source form a spanning tree of the graph. Show that the shortest path tree (at one node) is not always a minimum spanning tree by constructing a small example graph. (2 P).

Task 6.2: IP Address Aggregation & NAT (7 P.)

a) A CIDR router receives the IP addresses 78.54.96.0/21, 78.54.104/21, 78.54.112/21, 78.54.120.0/21. Assume that the addresses are all forwarded over the same outgoing interface. To what address/addresses can the four addresses be aggregated? Why is aggregation of the four addresses possible? (2 P.)

b) Assume a CIDR router with several outgoing interfaces. The address ranges 31.19.0.0 to 31.19. 59.255 and 31.19.64.0 to 31.19.127.255 are assigned to outgoing interface nr. 1 and the address range 31.19.60.0 to 31.19.63.255 is assigned to outgoing interface nr. 2. Which entries are put in the routing table to

represent the address ranges? Why are two entries in the routing table enough and no further entries necessary? (3 P.)

c) What is the main motivation for using network address translation (NAT) in IP? (1 P.)

d) Assume a host wants to join a peer-to-peer system. Why might NAT be a problem in this case? (1 P.)

Task 6.3: Broadcasting/Multicasting (10 P.)

Consider the topology of figure 6.1 with attached link costs.

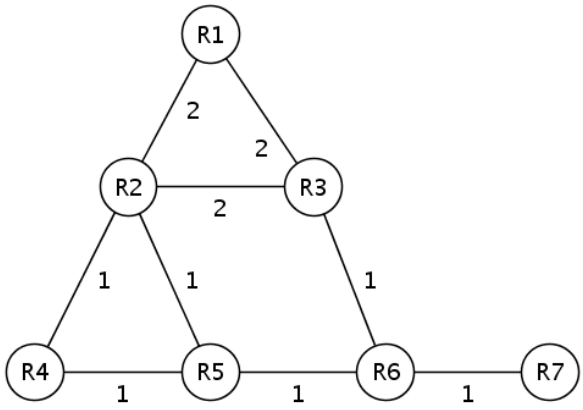

Figure 6.1 Network topology

a) Node R1 does a broadcast using reverse path forwarding. (3 P)

- For each message sent during the broadcast name the sender, the receiver and whether it is forwarded or dropped by the receiver. You can use the notation (sender, receiver, drop) resp. (sender, receiver, forward) for each message.
- How many messages are sent in total for the broadcast?

b) How many messages are needed for a broadcast from node R1 when a spanning tree is used for broadcasting ? (1 P)

c) Compute a core-based tree containing all nodes with node R7 as core node. (To specify the tree you can just state the set of tree edges.) (2 P.)

d) Node R1 does a broadcast using the core-based tree from question c) as group-shared tree. For each destination state the number of hops needed from the source to the destination. Compute the average number of hops needed. (2 P.)

e) Node R1 does a broadcast using the cost-optimal source-specific tree for R1. For each destination state the number of hops needed from the source to the destination. Compute the average number of hops needed. (2 P.)

Task 6.4: Delays and Packet Transmission (12 P.)

a) A sea cable from Japan to America has a length of 8000 km. An electric signal in a copper wire travels at a speed of about $2*10^8$ m/s. (3 P.)

Calculate:

- How much time does it take to transfer one Bit from Japan to America?
- With a data rate of 10 GBit/s, up to how many Bits can be simultaneously on the sea cable?

b) A geostationary satellite is located at an altitude of approximately 36000km above the earth's surface. Here, signals travel with the speed of light ($3*10^8$ m/s): (3 P.)

- How much time does it take to transfer one Bit over such a satellite connection?
- With a data rate of 6 GBit/s, up to how many Bits can be simultaneously on the transmission medium?

c) A client sends a 600 byte request message for a service, which produces a response containing 80000 bytes. Estimate the total time to complete the request in each of the following cases, with performance assumptions listed below: (3 P.)

- Using connectionless (datagram) communication (for example, UDP);
- Using connection-oriented communication (for example, TCP);

Latency per packet (local and remote, incurred on both send and receive): 5 milliseconds

Connection setup time (TCP only): 6 milliseconds

Data transfer rate: 100 megabits per second

Server request processing time: 4 milliseconds

Assume that the network is lightly loaded.

d) Consider now a MTU of 10000 bytes. How do the times from question c) change? (3 P.)

Hint: MTU stands for Maximum Transmission Unit and describes the maximum size of one packet. Packets greater than the given MTU are split.