



NTNU
Norges teknisk-naturvitenskapelige universitet
Institutt for telematikk

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Contact during exam

Name: Poul Heegaard
Tlf: 99 28 68 58

TTM4150 INTERNET NETWORK ARCHITECTURE

August 9, 2007
0900 - 1300

No remedies.

Results will be ready in 4 weeks.

**Glance over all pages before you start answering the exercises.
Take care to share your time between the exercises.
It is better to answer a little on all the exercises than to answer a lot on a few.
If you feel there is a lack of information to solve an exercise, state the assumptions you make.**

Exercise 1 Internet network architecture

- (a)** Justify why the IP layer is considered not trustworthy. Focus on the properties of unicast IPv4.
- (b)** Describe how the lack of trust at the IP layer may affect the deployment of multicast. Include a description of the factors that have the largest impact.
- (c)** Describe the end-to-end (e2e) argument and how it has been used for placement of functionality in the Internet routers, servers and end systems. Justify whether the multicast routing protocol PIM-SM is in accordance with the e2e principle for functionality placement.
- (d)** What does implementation of QoS (quality of service) in the network add to the original best-effort internet service model?

Exercise 2 Quality of service

- (a)** What are the four different QoS parameters?
- (b)** Comment on the statement “End systems cannot always correct for late arriving packets as they correct for lost packets” with respect to functions performed at the receiving side.
- (c)** Explain how one of the basic building blocks/mechanisms to provide network quality of service makes use of the Internet Protocol field “Type of service”.
- (d)** One-way delay of 150 ms end-to-end (from mouth to ear) ensures user satisfaction for telephony applications. What are the various components of delay (network and service) that a VoIP (Voice over IP) system design needs to take into account considering the end-to-end delay?

Exercise 3 Multicast

An Internet service provider uses IP multicast for TV distribution of the three TV channels: NRK1 (market share 20%), NRK 2 (market share 5%) and TV2 (market share 20%). Market share is defined as the percentage of users viewing the channel at any time. We use the simplified assumption that the number of viewers are constant through out the day. A single TV server is connected to an ethernet over a fiber ring with 4 ADSL multiplexing points (ADSL mux). The fiber ring is unidirectional, and the packets inserted by the TV server circulate only to the last ADSL mux requiring the packet. Each ADSL mux serves 2000 customers. The connection between a user and the ADSL multiplexer point is ethernet over twisted pair. Each ADSL mux is a fully functional IP router.

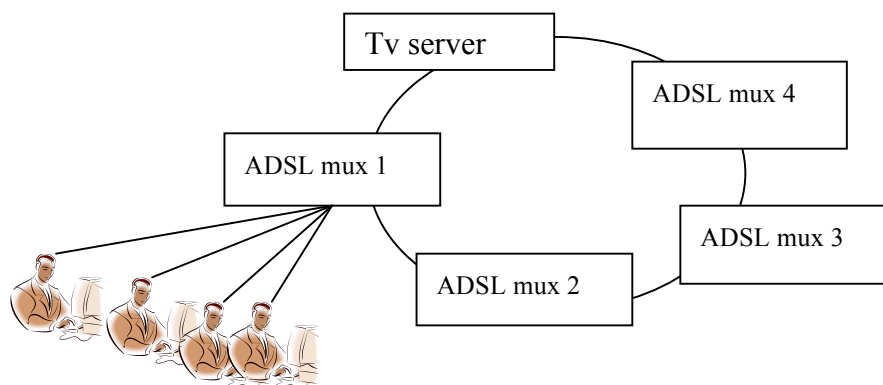


Figure 1 TV distribution architecture

- (a) Which differences are there between shared and source specific multicast distribution trees? Which tree is the most suited for the system described above? Discuss both bandwidth efficiency and overhead.
- (b) The internet group management protocol (IGMP) is used between the user and the TV server. If we consider only the subsystem consisting of the fiber ring, and the TV distribution server and the 4 ADSL mux, is there a difference in efficiency between using IGMP v1 and IGMP v2? Justify your answer.
- (c) If we consider the whole system, i.e. also include the communication between the users and the ADSL mux, is there a difference in efficiency between IGMPv1 and IGMPv2. Justify your answer.
- (d) In PIM-SM why must a source initially tunnel packets to the RP (Rendezvous point)?
- (e) Are unicast and multicast packets treated the same in the forwarding plane of a router? Describe common functionality and differences based on multicast forwarding under the PIM-SM.

Exercise 4 Mobility and Ad-hoc networks

- (a)** Mobile IP uses two tiered addressing. Describe what is meant by two tiered addressing, and describe the two alternative mechanisms that could be used to implement it in mobile IP.
- (b)** Describe the purpose of the Host Identifier protocol (HIP). Will two tiered addressing be required at the IP layer to handle mobility if HIP is used?
- (c)** In mobile IP, describe the mechanism in route optimization to handle the lack of trust at the IP layer.
- (d)** In the proactive ad-hoc routing protocol, OLSR, the concept of Multipoint relay node (MPR) is used. What is the function of an MPR node, and what are the benefits?
- (e)** Compare the mechanisms used to avoid stale routes (old routes that no longer are valid) in the proactive routing protocol OLSR and the reactive protocol AODV.

Exercise 5 Transport protocols

- (a) Explain why TCP sliding window is more complex than a link layer sliding window.
- (b) Describe two options/extensions to TCP that have an affect on measured end-to-end performance.

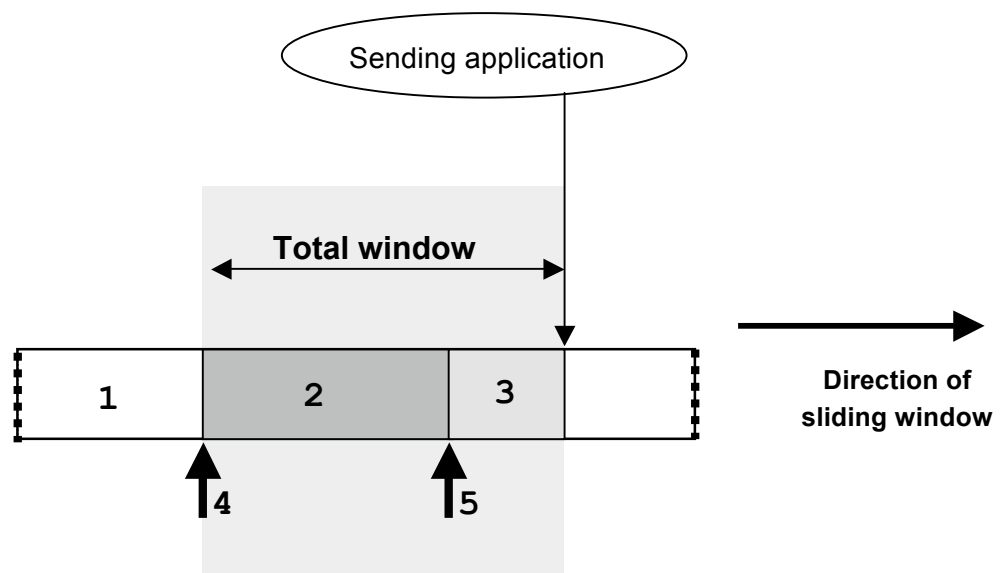


Figure 2 TCP sliding window

Figure 2 illustrates part of a sending TCP byte stream.

- (c) Describe the byte areas at the sender marked with 1, 2, and 3 and describe what makes the state variables indicated by 4 and 5 change value.

The transport protocol DCCP (datagram congestion control protocol) has an underlying motivation of avoiding congestion collapse.

- (d) Explain what is meant by “congestion collapse”.
- (e) Briefly describe the service model of the transport-layer protocol DCCP.