Sample Solution for Exercise Communication Networks I

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Published at:	29.06.2015
Tutorial date:	02.07.2015

General Remarks

Welcome to the exercise for Communication Networks I. Please adhere to the following general remarks regarding the organization of the exercise during this summer term.

- One week before the tutorial, a new exercise will be published at the Exercise area of the KN1 Moodle (`https://moodle.tu-darmstadt.de/course/view.php?id=5268`)
- The exercise serves as your hands-on experience in addition to the lecture and as a preparation for the exam
- The questions in the exercise can be discussed at the tutorial date
- The sample solution for the exercise is available at the Exercise area of KN1 Moodle in addition to the corresponding tutorial. Nevertheless, we encourage students to try to solve the exercise themselves before the tutorial date without looking into the solution as a good practice to understand the subject of the lecture

Problem 1 - Mobile Routing

a) What are the challenges in a wireless network? Why is CSMA CD not able to ensure a reliable medium access in these scenarios?

Solution: *Hidden terminals:* Two nodes that are within each others transmission range try to communicate with a third node. This third node is able to receive messages from both nodes and, therefore, collisions may occur at this node.
Exposed terminals: Two nodes communicate with each other, a third node, that is within the transmission of the sender but is not in range of the receiver is not allowed to transmit data when CSMA-CD is used. However, as this third node is not within the transmission range of the receiver packets, that were sent by this third node would not result in collisions at the receiver. Therefore, bandwidth is wasted due to CSMA-CD.

Solution: CSMA CA notifies nodes in transmission range via RTS (sender) and CTS (receiver) messages when the channel is used. Therefore, collisions can be avoided.

b) What are the differences between proactive and reactive protocols. What might be the merits and flaws?

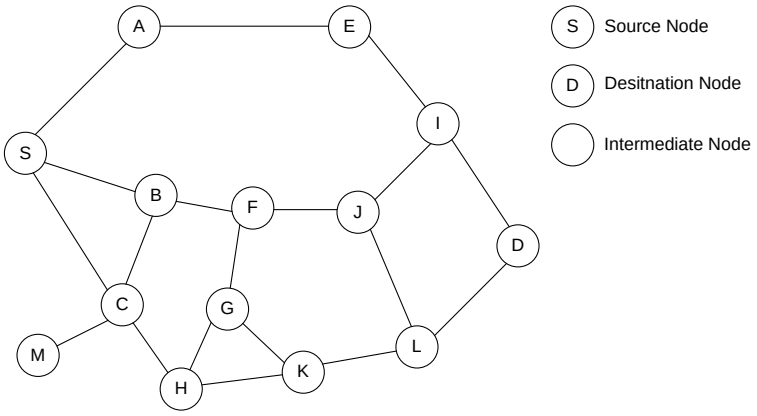
Solution: proactive:
Provide routes to each node in the network all the time.
Merits: Routes that are readily available when required.
Flaws: Overhead generated due to update mechanism.

reactive: Determine route on demand only.
Merits: No overhead due to updates.
Flaws: Routing has to be completed before the first pack can be sent.

c) What are the differences between AODV and DSR?

Solution: AODV:
Routes are stored at the routing table locally. Due to this, each node is only aware of the next hop in order to be able to forward incoming messages with a specific destination.
DSR:
The complete route is attached to each message. Therefore, even intermediate nodes are aware of the complete route.

d) We are considering a scenario as shown in the figure below and the AODV as routing protocol. Which route is established by AODV (e.g. A-B-C-D...)?



Solution: S-A-E-I-D

Problem 2 - Transport Layer Basics

a) What is the function of the Transport Layer? Which Transport Services are provided? Describe two types of Transport Services and name corresponding protocols and applications making use of the different service types.

Solution:

- Transport Layer provides reliably, efficiently and low-cost data transport for process-to-process communication
- Transport services
  - connection-oriented: 3 phases - connection set-up, data transfer, disconnect (TCP)
  - connectionless: transfer of isolated units (UDP)
- Applications:
  - connection-oriented: FTP, Telnet, SMTP
  - connectionless: DNS, SNMP, TFTP

b) What are the main differences between the Network and the Transport Layer? Why are these two layers necessary?

Solution: The Transport Layer provides an end-to-end communication for processes, whereas the network layer is responsible for the communication between systems. The Transport Layer isolates upper layers form the technology and improves the Network Service Quality (reliable service, necessary time guarantees)

c) How does addressing work in the Transport Layer? How does the specific address of a service become known? Describe three different approaches.

Solution: The Transport Layer uses the Transport Service Access Point (TSAP) for addressing. There are different ways how the specific address of a service becomes known:

1. TSAP known implicitly
2. “initial connection protocol”
3. Name Server

d) Describe how a Three-way Handshake Protocol works in principle. Describe two different alternatives how to disconnect an existing connection.

Solution:

1. Connect Request: initiator sends a request with a sequence number selected by the sender
2. Connect Confirmation: Receiver responds with the transmitted number and with an own randomly selected number
3. Acknowledgment: Sender acknowledges these two sequence numbers. After receiving a valid ACK, receiver accepts data

How to disconnect:

- Asymmetric Disconnect: Connection will be terminated, when only one host sends a disconnect
- Symmetric Disconnect: the disconnect has be done by both connected hosts

Problem 3 - UDP and TCP

a) Name some general functions of Transport Protocols.

Solution:

- Multiplexing/ demultiplexing data
- Connection Establishment
- Error Control
- End-to-end flow control
- Congestion Control

b) Characterize UDP. What are the main advantages and disadvantages?

Solution: UDP is a simple transport protocol which is

- Unreliable
- Connectionless
- Message-oriented

Advantages\Disadvantages

+ needs few resources in end systems
+ causes less overhead in each data unit
+ faster transmission since there is no connection establishment is required
+ simple implementation
- no flow control
- no error control or retransmission

c) Characterize TCP. What are the main advantages and disadvantages?

Solution: TCP provides reliable end-to-end byte streams over an unreliable internetwork.

- Two-way communication
- Point-to-Point (data may be transmitted simultaneously in both directions over a TCP connection)

Advantages\Disadvantages

+ reliable data transmission
+ efficient data transmission despite complexity
+ flow control
+ congestion control
- higher resource requirements for buffering, status information, timer usage
- connection set-up and disconnect necessary

d) What are the main differences between UDP and TCP?

Solution:

UDP	TCP
connectionless	connection-oriented
needs few resources	higher resource requirements
not reliable	reliable
no flow and no error control	flow and error control
faster transmission	connection set-up and disconnect necessary