Sample Solution for Exercise Communication Networks I

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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 - Multiple Choice

a) What does the Binary Exponential Backoff Algorithm do?

A) Sets and resets the Backoff bit
B) Determines whether the token runs clockwise or counter-clockwise.
C) Determines the waiting time of a station after a collision.
D) Searches a specific station in an Ethernet
E) Counts the stations in an Ethernet

Solution: Answer C

b) Which of the following access control procedures has central coordination?

A) pure ALOHA
B) TDMA (Time Division Multiple Access)
C) Reservation
D) Token procedure
E) Polling

Solution: Answer E

c) Which Channel Allocation algorithm does not work with time slots?

A) 1-persistent CSMA
B) Slotted ALOHA
C) TDMA with reservation
D) TDMA with Master
E) p-persistent CSMA

Solution: Answer A

d) Which of the following fields is not part of the frame format of the IEEE 802.3 protocol?

A) Frame control
B) Start frame delimiter
C) Source address
D) Length
E) Destination address

Solution: Answer A

e) Which of the following statements are/is true?

I) There is a maximum length for Ethernet frames.
II) In an Ethernet, channel utilization is higher when frames are shorter.
III) There is a minimum length for Ethernet frames.

A) Only II
B) Only I
C) I, II and III
D) I and II
E) I and III

Solution: Answer E

f) Which transmission encoding does 802.5 Token Ring use?

A) Manchester Encoding
B) Differential Manchester Encoding
C) Advanced Binary Encoding
D) IBM Baseband Encoding
E) Binary Encoding

Solution: Answer B

g) Which of the following protocols does not support random access control?

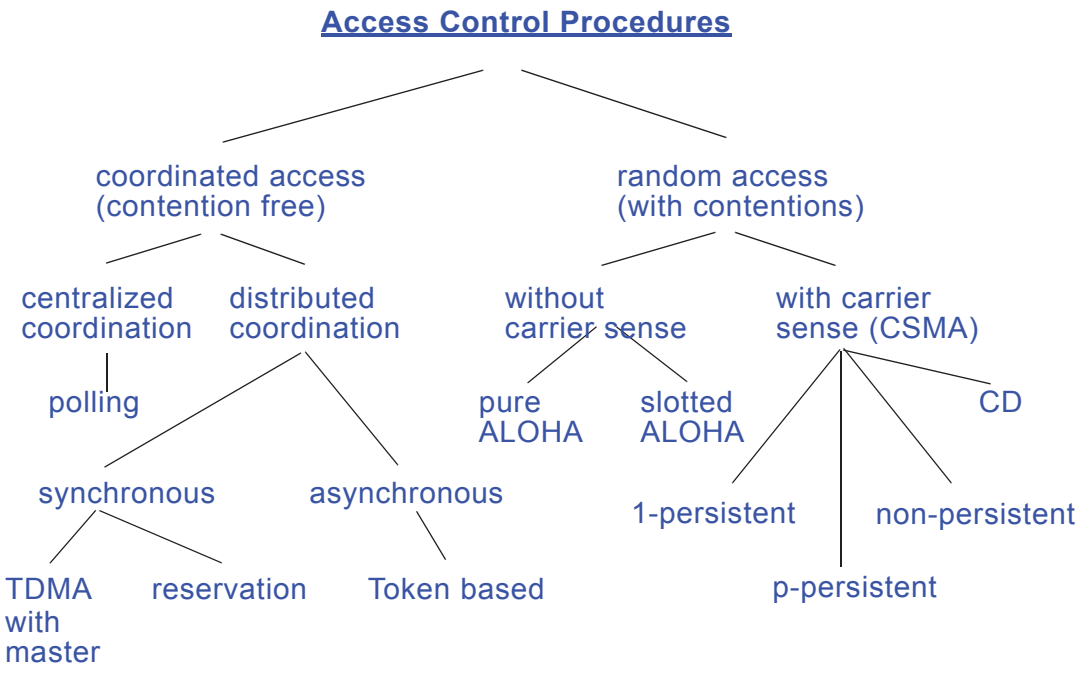
A) Pure ALOHA
B) Carrier Sense Multiple Access with Collision Detection
C) Slotted ALOHA
D) TDMA (Time Division Multiple Access)

Solution: Answer D

Problem 2 - Access Control Procedures

a) Name different access control procedures and classify them (type of access, type of coordination, synchronous/asynchronous ···).

Solution:



b) Explain the advantages and disadvantages of TDMA (Time Division Multiple Access) in comparison to CSMA (Carrier Sense Multiple Access). Give two examples where it is better to use TDMA.

Solution: TDMA is coordination based medium access control procedure which guarantees a certain transmission rate to each node in the network. When network is congested, TDMA is a good solution to avoid collisions in the network. However, when there is not too much traffic in the network, TDMA can lead to inefficient network usage where the utilization will be small due to the fact that some senders have no data to send and therefore do not use their time slots. CSMA is a random access control procedure which outperforms TDMA when the network is not congested. However, when the traffic in the network is quite too much, CSMA will lead to many collisions in the network. One example where TDMA is good to use is mobile voice communications where each sender should have a guaranteed minimum amount of bandwidth. For example, GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile) uses Time Division Multiple Access (TDMA) as its access scheme. TDMA is also used in the Digital Enhanced Cordless Telecommunications (DECT) standard for portable phones.

c) Now compare the following access control procedures: ALOHA, CSMA 0, 1 and p-persistent and CSMA/CD and answer the following questions:

- Do they use any mechanisms to divide the medium?
- Do they check the channel at any time?

- What is the behaviour when a collision occurs?

Solution:

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="3">channel is checked (regarding decision to send, not with regard to collision)</td><td colspan="3">behavior in case of desire to send and if one of the following states has been determined</td><td rowspan="2">time slot</td></tr>
<tr><td>before</td><td>during</td><td>after</td><td>busy</td><td>available</td><td>collision</td></tr>
<tr><td rowspan="2">ALOHA</td><td>pure</td><td></td><td></td><td>X</td><td colspan="2" rowspan="2">sender does not know these conditions</td><td rowspan="2">re-transmit after random time interval</td><td></td></tr>
<tr><td>slotted</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td rowspan="3">CSMA</td><td>nonpersist.</td><td>X</td><td></td><td>(X)</td><td>re-check channel only after random time interval</td><td rowspan="2">sends immediately</td><td rowspan="3">wait random time interval

then re-check channel and send (if possible)

(depending on algorithm “available/ busy”)</td><td></td></tr>
<tr><td>1 persist.</td><td>X</td><td></td><td>(X)</td><td>continuous wait until channel is available</td><td></td></tr>
<tr><td>p persist.</td><td>X</td><td></td><td>(X)</td><td>initially: continuous wait until chnl/slot available</td><td>sends with probability p, waits with probability 1-p (for next slot, then rechecks status)</td><td>X</td></tr>
<tr><td colspan="2">CSMA/ CD</td><td>X</td><td>X</td><td></td><td colspan="2">depending on procedure, s.a. 1-persistent = Ethernet</td><td>terminates sending immediately, waits random time</td><td></td></tr>
</table>

Problem 3 - LAN – ALOHA

a) Give an example of a communication scenario in which pure ALOHA overcomes slotted ALOHA. Describe why?

Solution: When the network is not congested, slotted ALOHA has higher delay (half slot time) than pure ALOHA. Therefore, it is better to use pure ALOHA when there is not too much exchanged traffic in the network. However, when the network is congested, slotted ALOHA outperforms pure ALOHA by limiting the number of collisions in the network.

b) Several stations share a channel with a bandwidth of 30000 bps. The following is a list of send requests on a time axis. For simplification, unsucessful send requests are not buffered. Which of the Frames are transmitted correctly if pure ALOHA is used?

I) Send request after 10 msec (Length: 180 bit)
II) Send request after 20 msec (Length: 300 bit)
III) Send request after 40 msec (Length: 100 bit)
IV) Send request after 44 msec (Length: 70 bit)
V) Send request after 95 msec (Length: 360 bit)
VI) Send request after 111 msec (Length: 80 bit)
VII) Send request after 120 msec (Length: 200 bit)

Solution: All frames will be sent correctly.

c) Which of the Frames are transmitted correctly if slotted ALOHA with a time slot of 20msec is used?

Solution: Transmitted are: III, IV and V

Problem 4 - FDDI

a) Name the differences between Token Ring and FDDI.

Solution: e.g.:
Bandwidth, double ring, dual- and single attachment stations, larger extension, more stations, fiber glass are standard medium,
Timed Token Protokol (⇒ synchronous und asynch. communication)
possibly.: Early-Token-Release (compared to first Token Rings)
isochronous transmission (in FDDI II)

b) An FDDI ring has the following configuration: 3 stations, TTRT = 12 time units (TU), synchronous traffic per station: 1 TU. Sending time for asynchronous traffic is always used before the time for synchronous traffic is used. The buffer on the network interface card is unlimited. Complete the following table. *Send* denotes data, that is sent from the network layer (the amount of data, the station **wants** to send, converted in TU), *Buf* denotes data that is buffered on the network interface card (because it could not yet be sent). In the column *TRT* the current Token Rotation Time has to be entered, in the fields *syn* and *asyn* the amount of data actually sent in synchronous resp. asynchronous mode (everything converted in TU)

Solution:

Station A					Station B					Station C				
Send	Buf	TRT	syn	asyn	Send	Buf	TRT	syn	asyn	Send	Buf	TRT	syn	asyn
10	0	0	0	10	18	0	10	1	2	12	0	13	1	0
12	0	14	1	0	0	15	5	1	7	12	11	10	1	2
4	11	12	1	0	0	7	12	1	0	13	20	5	1	7
0	14	10	1	2	0	6	12	1	0	0	25	12	1	0
0	11	5	1	7	0	5	10	1	2	0	24	12	1	0
0	3	12	1	0	0	2	5	0	2	0	23	4	1	8
0	2	12	1	0	0	0	12	0	0	0	14	10	1	2
0	1	4	0	1	0	0	4	0	0	0	11	4	1	8
0	0	10	0	0	0	0	9	0	0	0	2	9	0	2
12	0	2	1	10	20	0	13	1	0	7	0	14	1	0
0	1	13	1	0	0	19	3	1	9	0	6	12	1	0
0	0	12	0	0	0	9	11	1	1	0	5	3	0	5
0	0	7	0	0	0	7	7	1	5	0	0	11	0	0
13	0	6	1	6	0	1	13	1	0	0	0	8	0	0
0	6	8	1	4	0	0	6	0	0	0	0	5	0	0
0	1	5	0	1	0	0	1	0	0	0	0	1	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

c) Why do exist two rings at Layer 1 of the FDDI topology?

Solution: The second ring is for backup, so that even if both rings are cut between two stations, there remains a logical ring.

d) Describe what the "Early Token Release" in FDDI does!

Solution: When a station gets the token, it sends its data and immediately after that it puts the token on the ring.