NATIONAL UNIVERSITY OF SINGAPORE

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ONLINE EXAMINATION

Matriculation No.:	**A0232935A**
Module Code:	**EE4204**
Number of pages in this PDF file (including this cover page and Declaration Form): i.e. 2+no. of answer pages	**9**

INSTRUCTIONS TO CANDIDATES

1. Follow the instructions for online examination and invigilation.

2. Write your answers on A4 size paper with black or dark blue ink.

3. Write the question number at the top left corner of each page. Start the answer to each question on a new page. Indicate the part, e.g. "(a)", on the left margin.

4. At the end of the exam:
   a) scan or take photographs of your answers (make sure your writing and/or drawings can be seen clearly);
   b) enter your matriculation number, module code and the total number of pages (including the cover and declaration pages, i.e. 2+number of answer pages) on the cover page;
   c) merge the completed cover page, signed declaration form and your answers into a single PDF file named **<matric_no>-<module code>.pdf** (e.g. **A1234567R-EExxxx.pdf**)
   d) open the PDF file to ensure that it has been generated without error and the contents are correct;
   e) upload your PDF file into the stated LumiNUS exam submission folder within the stipulated deadline. Late submissions will not be accepted.

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Question	Mark	Remarks
1		
2		
3		
4		
TOTAL		

Q4. (a) ~~RTT~~ T_t = Transmission time ≈ 0.

T_p = Propagation = 100 km / 1km/5us = 500 us

Total packets = $\frac{x \text{ bytes}}{8 \times 1000 \text{ Bytes}}$

$$\text{Throughput} = \frac{x \text{ bytes}}{\frac{x \text{ bytes}}{8 \times 1000 \text{ bytes}} \times (T_t + 2T_p)} \approx 64 \text{ Mbps}.$$

Q.1 (b). Yes, Because the divisor polynomial has both x^0 term and x^k term. Hence, it can detect the error.

Q.1 (c). $T_f = \frac{100 \text{ bytes}}{100 \text{ Mbps}} = 8 \times 10^{-6}$ s.

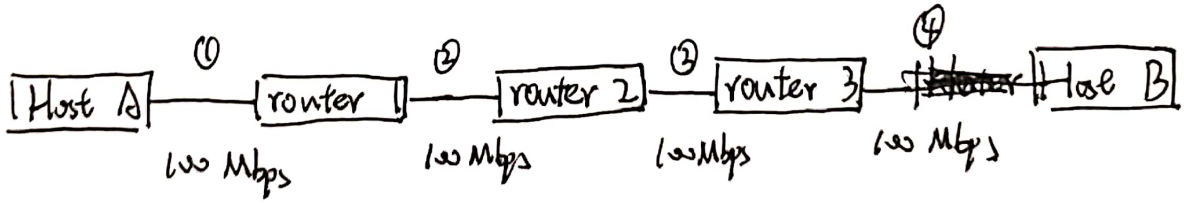
$RTT = 2T_p \leq T_f$.

$\Rightarrow T_p \leq \frac{T_f}{2} = 4 \times 10^{-6} s = 4ms$. , So the maximum one-way propagation time is 4 us.

Q.1 (d) ~~Success~~ Successful: one host use the slots but others not.

~~0.1 x 0~~ $10 \times 0.1 \times (1-0.1)^9 = 0.387$.

Q.1 (e)



$T_t = \frac{1000 \text{ byte}}{100 \text{ Mbps}} = 8 \times 10^{-5}$ s.

① retransmitte. 5 Mbps

② 10 Mbps

③ 15 Mbps

④ 20 Mbps.

Q.2(a)

(i) {4, 5}.

Although receiver sends RR1, senders don't receive it, the window won't change.

(ii). {5}.

After that, the window will shrink 1 bit.

(iii) {5},

Senders ~~don't~~ haven't received the RR3

(iv) {5, 6, 7, 0, 1}.

RR3 means data before 3 (7, 0, 1, 2) have been received, the window will expand 4 bit.

Q.2 (b) $T_t = \frac{500 \text{ byte}}{10 \text{ Mbps}} = 0.4 \text{ ms}$

$T_p = 500 \text{ km} \times 5\text{us/km} = 2.5 \text{ ms}.$

$a = \frac{T_p}{T_f} = 6.25$

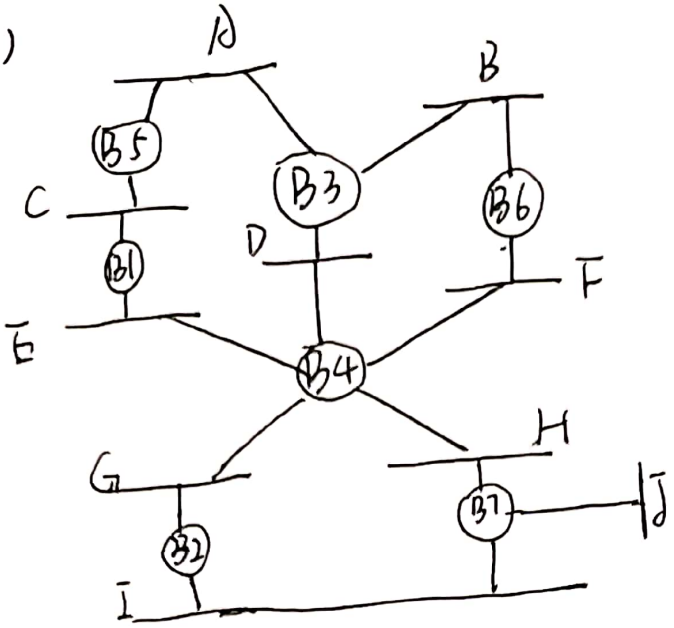
$1+2a = 13.5 < W.$

So the data can be sent continuously.

Total frame per second $= \frac{1 \text{ s}}{\frac{500 \text{ byte}}{10 \text{M bps}}} = 2500$ frames per second.

~~Q.2 (c)~~

Q.2(c)



B5 receives (B1, 0, B1) on LAN C

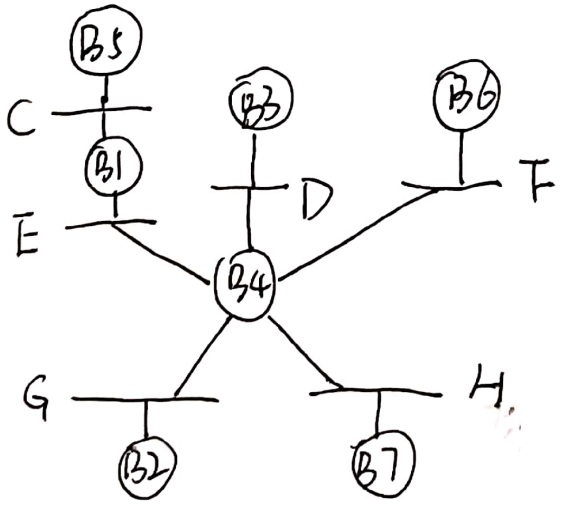
B4 receives (B1, 0, B4) on LAN E.

B3 receives (B1, ϕ, B3) on Lan D (from B4)

B6 receives (B1, 1, B6) on Lan F. (from B4)

B2: (B1, 1, B2) on Lan G (from B4)

B7: (B1, 1, B4) on Lan H (from B4)



Q.2 (d)

T.	RTS	CTS	Successful
0	A to B A to D A to E B to A B to C B to E C to B C to D	B to A	NO.
15.	~~A~~ C to D C to B.	B to C. D to C.	No
50	B to A B to C B to E	E to B	A to B C to B C to D
60	\	\	A to B C to B C to D.

Q.3

(a) (i). ~~192.168.128.144~~

192.168.128.128/27.

(ii) starting IP: 192.168.128.129

Ending IP: 192.168.128.158

(iii) 192.168.128.128

(iv) 192.168.128.159

(v) ~~Same~~ It could lead to stifling of innovation and difficult maintenance.

(b) Yes.

A: 192.168.128.0/25

B: 192.168.128.128/26

C: 192.168.128.192/26.

(c) Removing Edge C-D. Yes. Because after that no node can reach node D, But S_A_B, don't know, they will count to infinity.

Removing Edge S-A. No. Because S can reach A via S-B-C-A.

Removing Edge S-A, S-B. Yes. The reason is same as first. No node can reach node S, and node C, d don't know. The will count to infinit.

Removing Edge A-C and B-C. Yes. ~~The rea~~ S, A, B and C, D can't reach each other.

Q.3

(d). Edge | (i) Tree ? | (ii) Order of edges.

Edge	(i) Tree ?	(ii) Order of edges.
S-A	✓	1
S-B	✓	1
A-C	✓	2
B-C	X	
C-D	✓	3.

(iii).

Destination	Next Hop	Cost to Destination
A	A	2
B	B	3
C	A	3
D	A	5.

(iv) When $x+y \geq 2+1$, the results is true.

$\Leftarrow \Rightarrow y \geqslant -7$ (y is a integer).

Q.4

(a) Because TCP is fair, but UDP not. The router will satisfy UDP first, and after TCP flow share the remain throughput together

UDP: 20 Mbps

$$TCP\text{-}1 = TCP\text{-}2 = TCP\text{-}3 = TCP\text{-}4 = \frac{60\text{Mbps} - 20\text{Mbps}}{4} = 10\ \text{Mbps}.$$

(b) If use max-min fair allocation, those flows will get same bandwidth until they are satisfied.

$$UDP = TCP\text{-}1 = TCP\text{-}2 = TCP\text{-}3 = TCP\text{-}4 = \frac{60\ \text{Mbps}}{5} = 12\ \text{Mbps}.$$

(c) Same as (i) UDP = 20 Mbps.

TCP use AIMD, it increament CW by one packet per RTT And sender can send at most one packet per RTT.

So: TCP-1 = TCP-2 = 13.33Mbps

TCP-3 = TCP-4 = 6.67 Mbps.

(d) ~~(i) Time out: round 6-7; round 22-23.~~

(i) Packet loss: 15-16.

(ii) Time-out: round 6-7; round 22-23

(iii) round 15-16.

(iv) Slow start

(v) AIMD (Additive Increase / Multiplicative Decrease)

Exam Declaration Form

Please read sections A, B and C below. Sign and submit this declaration form together with your answers.

A. Academic, Professional and Personal Integrity

1. *The University is committed to nurturing an environment conducive for the exchange of ideas, advancement of knowledge and intellectual development. Academic honesty and integrity are essential conditions for the pursuit and acquisition of knowledge, and the University expects each student to maintain and uphold the highest standards of integrity and academic honesty at all times.*

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B. I have read and understood the rules of the assessments stated below:

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C. I understand that by breaching any of the rules above, I would have committed offences under clause 3(l) of the NUS Statute 6, Discipline with Respect to Students, which is punishable with disciplinary action under clause 10 or clause 11 of the said statute.

3) Any student who is alleged to have committed or attempted to commit, or caused or attempted to cause any other person to commit any of the following offences, may be subject to disciplinary proceedings:
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I have read and will abide by the NUS Code of Student Conduct (in particular, (A) Academic, Professional and Personal Integrity), B and C when attempting this assessment.

Signature: 刘伟豪. Date: 25 Nov 2021.

Matric. No.: A0232935J