데이터통신 중간고사

20160427(수) 오후 1시

학번_____ 이름_____

1. 다음 질문에 답하시오. (10점)

What are the propagation time and the transmission time for a 5-MB (megabyte) message (an image) if the bandwidth of the network is 1 Mbps? Assume that the distance between the sender and the receiver is 12,000 km and that light travels at 2.4×10^8 m/s.

Propagation time: _____ (ms)

Transmission time = _____ (s)

2. 다음 질문에 답하시오. (24점)

We have four sources, each creating 250 characters per second. If the interleaved unit is a character and 1 synchronizing bit is added to each frame, find (1) the data rate of each source, (2) the duration of each character in each source, (3) the frame rate, (4) the duration of each frame, (5) the number of bits in each frame, and (6) the data rate of the link.

(1) _____ (kbps)

(2) _____ (ms)

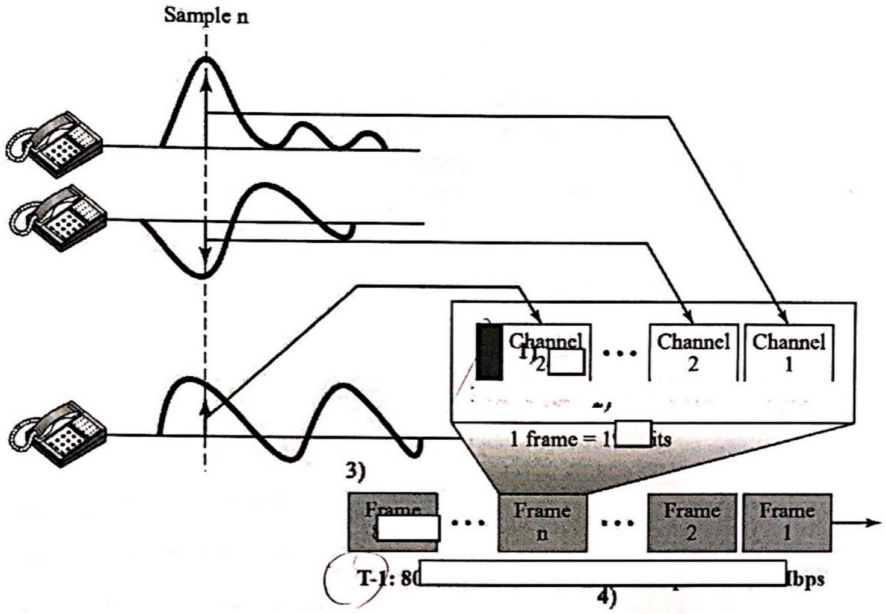
(3) _____ (frames per second)

(4) _____ (ms)

(5) _____ (bits)

(6) _____ (bps)

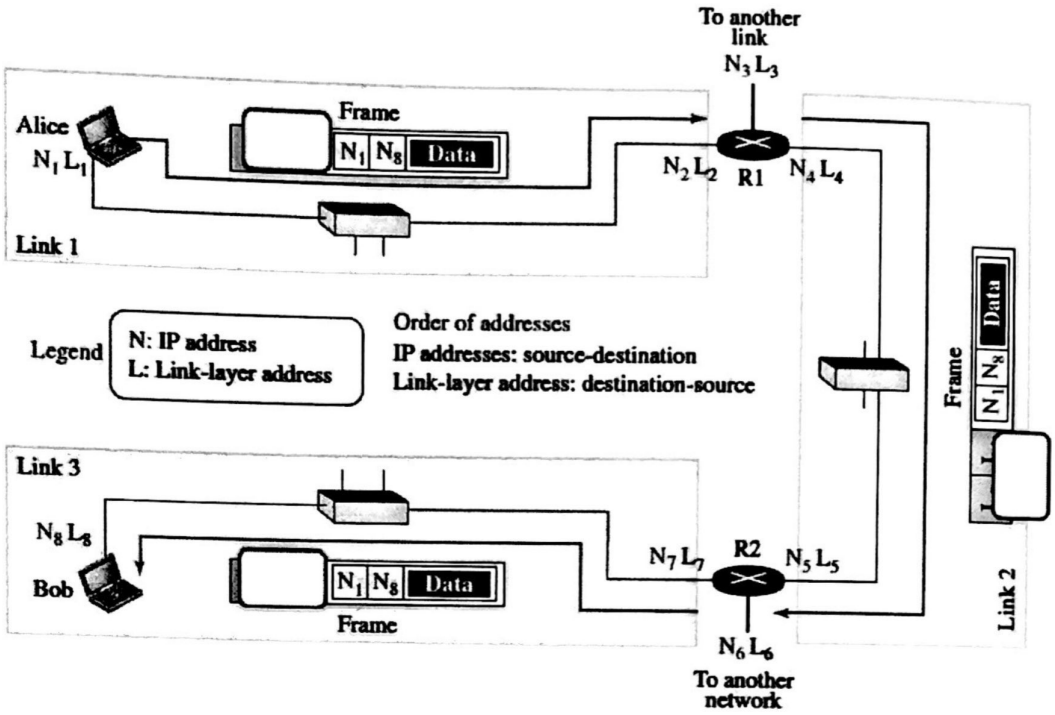
3. 다음 빈간을 채우시오. (16점)



4. 다음 질문에 답하시오. (10점)

Four data channels (digital), each transmitting at 1 Mbps, use a satellite channel of 800 kHz. Draw an appropriate configuration using FDM. (10점)

5. 다음 빈간을 채우시오. (첫번째는 송신자, 두번째는 수신자) (15점)



6. 다음은 tshark로 패킷을 캡처한 화면의 일부이다. (10점)

```
Frame 4: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
    Interface id: 0
    Encapsulation type: Ethernet (1)
    Arrival Time: Apr 26, 2016 07:35:20.462955000 UTC
    [Time shift for this packet: 0.000000000 seconds]
    Epoch Time: 1461656120.462955000 seconds
    [Time delta from previous captured frame: 0.000249000 seconds]
    [Time delta from previous displayed frame: 0.000249000 seconds]
    [Time since reference or first frame: 0.036485000 seconds]
    Frame Number: 4
    Frame Length: 66 bytes (528 bits)
    Capture Length: 66 bytes (528 bits)
    [Frame is marked: False]
    [Frame is ignored: False]
    [Protocols in frame: eth:ip:tcp]
Ethernet II, Src: 12:34:56:78:9a:bc (12:34:56:78:9a:bc), Dst: Microsof_40:24:c6 (00:0d:3a:40:24:c6)
    Destination: Microsof_40:24:c6 (00:0d:3a:40:24:c6)
        Address: Microsof_40:24:c6 (00:0d:3a:40:24:c6)
        .... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
        .... ...0 .... .... .... .... = IG bit: Individual address (unicast)
    Source: 12:34:56:78:9a:bc (12:34:56:78:9a:bc)
        Address: 12:34:56:78:9a:bc (12:34:56:78:9a:bc)
        .... ..1. .... .... .... .... = LG bit: Locally administered address (this is NOT the factory default)
        .... ...0 .... .... .... .... = IG bit: Individual address (unicast)
    Type: IP (0x0800)
Internet Protocol Version 4, Src: 168.188.125.46 (168.188.125.46), Dst: 10.0.0.4 (10.0.0.4)
    Version: 4
    Header length: 20 bytes
    Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
        0000 00.. = Differentiated Services Codepoint: Default (0x00)
        .... ..00 = Explicit Congestion Notification: Not-ECT (Not ECN-Capable Transport) (0x00)
    Total Length: [redacted]
    Identification: 0x9123 (37155)
    Flags: 0x02 (Don't Fragment)
        0... .... = Reserved bit: Not set
        .1.. .... = Don't fragment: Set
        ..0. .... = More fragments: Not set
    Fragment offset: 0
    Time to live: 45
    Protocol: TCP (6)
    Header checksum: 0x8cb2 [validation disabled]
        [Good: False]
        [Bad: False]
    Source: 168.188.125.46 (168.188.125.46)
    Destination: 10.0.0.4 (10.0.0.4)
    [Source GeoIP: Unknown]
    [Destination GeoIP: Unknown]
```

```
Transmission Control Protocol, Src Port: 49914 (49914), Dst Port: ssh (22), Seq: 1, Ack: 1, Len: 0
    Source port: 49914 (49914)
    Destination port: ssh (22)
    [Stream index: 0]
    Sequence number: 1    (relative sequence number)
    Acknowledgment number: 1    (relative ack number)
    Header length: [redacted]
    Flags: 0x010 (ACK)
        000. .... .... = Reserved: Not set
        ...0 .... .... = Nonce: Not set
        .... 0... .... = Congestion Window Reduced (CWR): Not set
        .... .0.. .... = ECN-Echo: Not set
        .... ..0. .... = Urgent: Not set
        .... ...1 .... = Acknowledgment: Set
        .... .... 0... = Push: Not set
        .... .... .0.. = Reset: Not set
        .... .... ..0. = Syn: Not set
        .... .... ...0 = Fin: Not set
    Window size value: 783
    [Calculated window size: 783]
    [Window size scaling factor: -1 (unknown)]
    Checksum: 0x2452 [validation disabled]
        [Good Checksum: False]
        [Bad Checksum: False]
```

각 질문에 대한 답과 근거를 적으시오.

(1) IP Total Length : _____ (bytes) (3점)

(2) TCP Header Length : _____ (bytes) (3점)

(3) Application Layer Total Length : _____ (bytes) (4점)

7. Python에서 ARP 패킷을 캡쳐하여 헤더 정보를 출력하는 parse_arp() function을 작성하시오. (15점)

< 유의사항 >

1. struct는 import 되어 있다고 가정한다.
2. 인자로 받은 패킷의 0번째부터 ARP 패킷의 정보가 들어있다고 가정한다.
3. 다음 페이지의 참고자료를 활용할 것

```
def parse_arp(recv_packet):
```

참고 1. ARP 헤더 구조

Internet Protocol (IPv4) over Ethernet ARP packet		
octet offset	0	1
0	Hardware type (HTYPE)	
2	Protocol type (PTYPE)	
4	Hardware address length (HLEN)	Protocol address length (PLEN)
6	Operation (OPER)	
8	Sender hardware address (SHA) (first 2 bytes)	
10	(next 2 bytes)	
12	(last 2 bytes)	
14	Sender protocol address (SPA) (first 2 bytes)	
16	(last 2 bytes)	
18	Target hardware address (THA) (first 2 bytes)	
20	(next 2 bytes)	
22	(last 2 bytes)	
24	Target protocol address (TPA) (first 2 bytes)	
26	(last 2 bytes)	

참고 2. Python struct

7.3.2.1. Byte Order, Size, and Alignment

By default, C types are represented in the machine's native format a
compiler).

Alternatively, the first character of the format string can be used to inc

Character	Byte order	Size	Alignment
@	native	native	native
=	native	standard	none
<	little-endian	standard	none
>	big-endian	standard	none
!	network (= big-endian)	standard	none

7.3.2.2. Format Characters

Format characters have the following meaning; the conversion between C and Python values
the packed value in bytes when using standard size; that is, when the format string starts wit
platform-dependent.

Format	C Type	Python type	Standard size	Notes
x	pad byte	no value		
c	char	string of length 1	1	
b	signed char	integer	1	(3)
B	unsigned char	integer	1	(3)
?	_Bool	bool	1	(1)
h	short	integer	2	(3)
H	unsigned short	integer	2	(3)
i	int	integer	4	(3)
I	unsigned int	integer	4	(3)
l	long	integer	4	(3)
L	unsigned long	integer	4	(3)
q	long long	integer	8	(2), (3)
Q	unsigned long long	integer	8	(2), (3)
f	float	float	4	(4)
d	double	float	8	(4)
s	char[]	string		
p	char[]	string		
P	void *	integer		(5), (3)