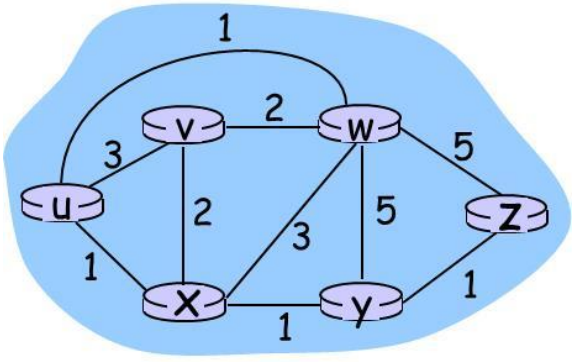
Internet Protocols Final Exam Solutions

2016. 6. 15

1. Suppose OSPF computes the routing table for the following network topology. What will go into the 'Next Hop' column in the routing table at router "w"? Fill in the empty boxes in the table. **[10pts]**



Destination	*Next Hop*
u	u
v	v
x	u
y	u
z	u

2. The following is a part of an email header. Answer the following questions about the header.

```
Delivered-To: hyogon@gmail.com
Received: by 10.36.116.84 with SMTP id o81csp820722itc;
        Thu, 26 May 2016 19:39:28 -0700 (PDT)
X-Received: by 10.36.89.4 with SMTP id p4mr5768972itb.44.1464316767990;
        Thu, 26 May 2016 19:39:27 -0700 (PDT)
Return-Path: <drbp@korea.ac.kr>
Received: from spam3.korea.ac.kr (spam3.korea.ac.kr. [163.152.6.95])
        by mx.google.com with ESMTPS id h66si19956832ioe.183.2016.05.26.19.39.26
        for <hyogon@gmail.com>
        (version=TLS1 cipher=AES128-SHA bits=128/128);
        Thu, 26 May 2016 19:39:27 -0700 (PDT)
Received-SPF: pass (google.com: domain of drbp@korea.ac.kr designates 163.152.6.95 as
permitted sender) client-ip=163.152.6.95;
Authentication-Results: mx.google.com;
       spf=pass (google.com: domain of drbp@korea.ac.kr designates 163.152.6.95 as permitted
sender) smtp.mailfrom=drbp@korea.ac.kr
Received: from unknown (HELO smtp1.korea.ac.kr) (163.152.6.96)
          by 163.152.6.95 with ESMTP; 27 May 2016 11:39:05 +0900
```

A. How many mail servers are involved in this mail delivery? _____5_____**[3pts]**

B. We can see that the Google mail server (`mx.google.com`) checks if `163.152.6.95` is indeed a mail server address for `korea.ac.kr` domain. What resource record (RR) type is used in this checking? _____txt_____**[3pts]**

C. Among the three variants of STMP used in the conversations between mail servers, which do you think involves secure conversation? __ESMTPS_____ (Hint: TLS = Transport Layer Security, AES = Advanced Encryption Standard, SHA = Secure Hash Algorithm). **[2pts]**

D. What is the time difference between the Korea University mail servers and the Google's mail servers? _____16 (hours)_____ **[3pts]**

3. Another part of the same email is shown below. Answer the following questions.

```
MIME-Version: 1.0
Content-Type: multipart/mixed;
          boundary="----=_Part_1935876_1963977598.1464316408514"
X-Priority: 3
X-Sensmail-Info: korea.ac.kr;5747b3093fef59897b765d84;drbp;d0001;49;1
X-ClientIP: 163.152.72.97

------=_Part_1935876_1963977598.1464316408514
Content-Type: multipart/alternative;
          boundary="----=_Part_1935879_1547514179.1464316408519"

------=_Part_1935879_1547514179.1464316408519
Content-Type: text/plain; charset="utf-8"
Content-Transfer-Encoding: base64
```

A. Based on the `Content-Type` and the boundary string, at least how many "atomic" parts can you expect to see in the mail body? _____3_____ **[4pts]**

B. This mail contains Korean characters. What keyword in the header most strongly signals it? _____base64_____ **[4pts]**

4. What is the difference between a stub AS and a multi-homed AS? **[5pts]**

A multi-homed AS has more than 1 connection to other AS's, whereas a stub AS has only 1.

5. ASCII code of 'A' is 65 in decimal, 'B' is 66, 'C' is 67, …, and 'Z' is 90. A Base64 encoded string is **U1VNTUVS**. What was the original ASCII string before it was encoded in Base64? ___SUMMER__(note: all capital)_____ **[10pts]**

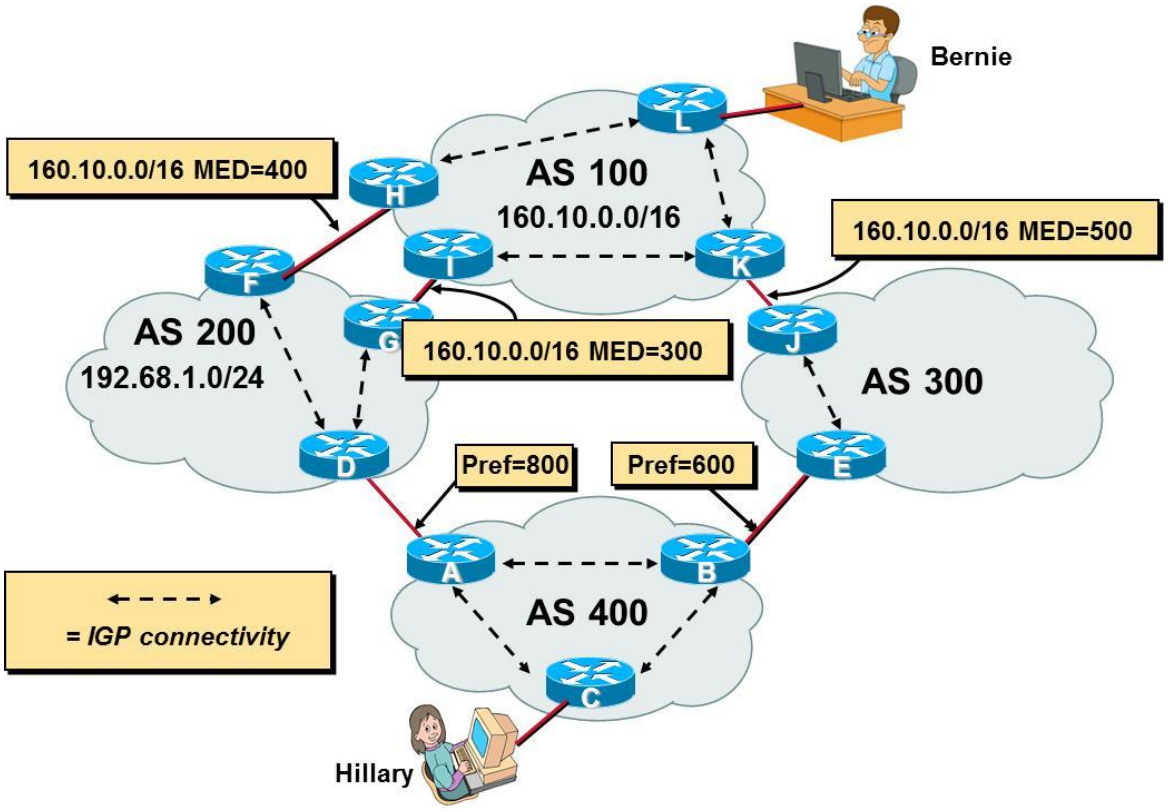
Table 1: The Base 64 Alphabet

Value	Encoding	Value	Encoding	Value	Encoding	Value	Encoding
0	A	17	R	34	i	51	z
1	B	18	S	35	j	52	0
2	C	19	T	36	k	53	1
3	D	20	U	37	l	54	2
4	E	21	V	38	m	55	3
5	F	22	W	39	n	56	4
6	G	23	X	40	o	57	5
7	H	24	Y	41	p	58	6
8	I	25	Z	42	q	59	7
9	J	26	a	43	r	60	8
10	K	27	b	44	s	61	9
11	L	28	c	45	t	62	+
12	M	29	d	46	u	63	/
13	N	30	e	47	v		
14	O	31	f	48	w	(pad)	=
15	P	32	g	49	x		
16	Q	33	h	50	y		

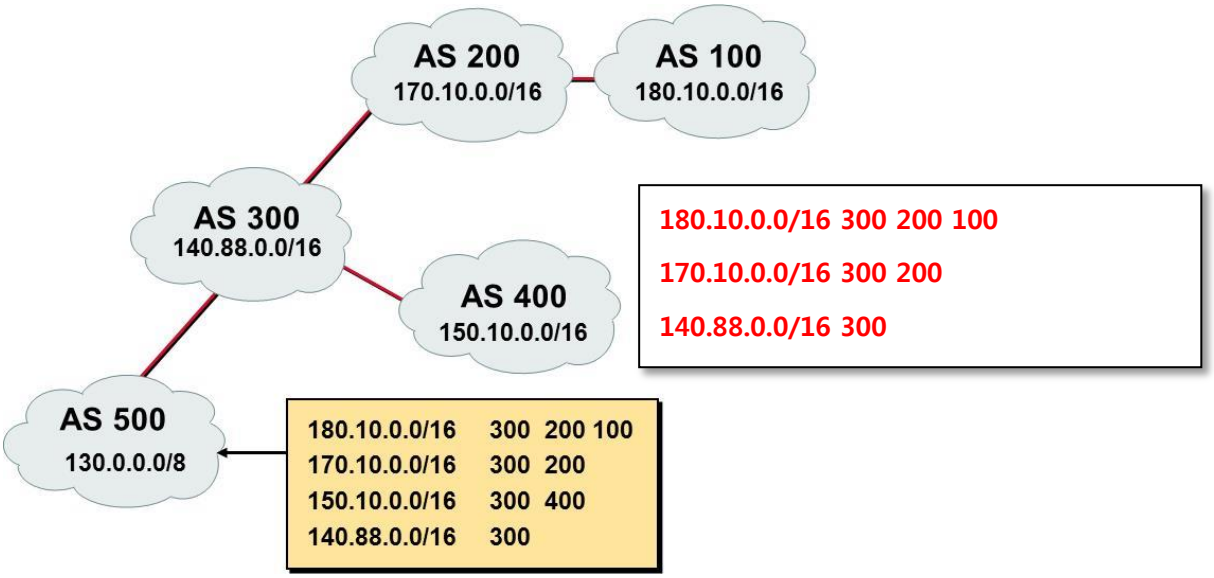
6. The following shows how you use `telnet` command to connect to the POP3 server at `mail.korea.ac.kr` to retrieve emails if any. (It turns out that there is no mail waiting for you there.) Suppose your username is `obama` and the password is `putin`. Fill the four empty lines. **[8pts]**

```
C:\Users\obama> _________telnet mail.korea.ac.kr 110_______
+OK       SensMail       8.0       POP3       service       ready.
<1402932554133.1234@mail.korea.ac.kr>
_______user obama_____________________________________________
+OK Password required for messi@korea.ac.kr
_______ pass putin _____________________________________________
+OK Maildrop has 0 messages (0 bytes)
_______ quit_____________________________________________
+OK Sensmail POP3 service closing session
C:\Users\obama>
Connection closed.
```

7. In the following AS graph, if only the local preference and the multi-exit descriptors are used to find the best path, what will be the result of a traceroute (tracert) from Hillary to Bernie? Write down the sequence of routers as they appear in the output.
   _____(Hillary) → A → D → G → I → K → L → (Bernie)___ **[10pts]**



8. The following figure shows that AS 500 has four entries in its BGP table that correspond to the prefixes of AS 100, 200, 300, and 400. Fill in the BGP table of AS 400. **[8pts]**



---------- ***Review questions from Midterm #1/2/3*** ----------

1. Suppose an IP datagram arrives at a computer that has two interfaces whose IP addresses are 163.152.161.2 and 10.16.10.3, respectively. Now, the datagram has destination address 121.129.49.80, and the computer is configured to function as a router. If the routing table at the computer is as shown below,

Destination	Netmask	Gateway	Interface	Metric
0.0.0.0	0.0.0.0	163.152.161.1	163.152.161.2	20
0.0.0.0	0.0.0.0	10.16.10.1	10.16.10.3	25
10.16.10.0	255.255.255.0	Connected	10.16.10.3	281
10.16.10.167	255.255.255.255	Connected	10.16.10.3	281
10.16.10.255	255.255.255.255	Connected	10.16.10.3	281
127.0.0.0	255.0.0.0	Connected	127.0.0.1	306
127.0.0.1	255.255.255.255	Connected	127.0.0.1	306
127.255.255.255	255.255.255.255	Connected	127.0.0.1	306
163.152.161.0	255.255.255.0	Connected	163.152.161.2	266
163.152.161.54	255.255.255.255	Connected	163.152.161.2	266
163.152.161.255	255.255.255.255	Connected	163.152.161.2	266
255.255.255.255	255.255.255.255	Connected	127.0.0.1	306
255.255.255.255	255.255.255.255	Connected	163.152.161.2	266
255.255.255.255	255.255.255.255	Connected	169.254.195.4	286
255.255.255.255	255.255.255.255	Connected	10.16.10.167	281

A. How many matching entries are there for the arriving packet? [ ] **[3pts]**

B. What will be the destination address in the datalink layer header if the ARP cache is as given below? [ ] **[3pts]**

121.129.49.81	64-ae-0c-41-32-c0	dynamic
163.152.161.1	64-ae-0c-41-32-c0	dynamic
10.16.10.1	f8-66-f2-7d-99-ff	dynamic
255.255.255.255	ff-ff-ff-ff-ff-ff	static

C. If you perform a limited broadcast, what interface will the packet go out on? (Identify the IP address of the interface) **163.152.161.2** **[3pts]**

2. Suppose a table in a SNMP agent has the following structure.

130	1	130
130	2	130
89	1	1600
92	2	444
93	1	1600
92	1	1600

A. Which should be the index column(s)? **1 & 2** **[3pts]**

B. If the OID of the table is .1.3.6.1.2.1.2.2 and the OID of the table entry is .1.3.6.1.2.1.2.2.1, what would be the OID of the value 444 in the table? **.1.3.6.1.2.1.2.2.1.3.92.2** **[3pts]**

3. In the following IGMPv2 trace that is captured at a set-top box for Korea Telecom's IPTV,

No.	Time	Source	Destination	Info
32173	47.317590	118.48.34.143	233.18.158.62	Membership Report group 233.18.158.62
32177	47.335167	61.72.223.167	233.18.158.52	Membership Query, specific for group 233.18.158.52
32979	48.337557	61.72.223.167	233.18.158.52	Membership Query, specific for group 233.18.158.52
34092	49.696186	118.48.34.143	224.0.0.2	Leave Group 233.18.158.62

A. What is the IP address of the IGMP speaker that is a member of 224.0.0.1 but not 224.0.0.2? ___**118.48.34.143**_____ **[3pts]**

B. What group did the set-top box newly join? ___**233.18.158.62**_____ **[3pts]**

4. The following TCP trace shows the last part of a connection.

No.	Time	Source	Destination	Info
8418	86.346041	10.16.30.142	64.233.189.239	12668 > 443 [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=256 SACK_PERM=1
8443	86.409622	64.233.189.239	10.16.30.142	443 > 12668 [SYN, ACK] Seq=0 Ack=1 Win=43152 Len=0 MSS=1380 SACK_PERM=1
8444	86.409688	10.16.30.142	64.233.189.239	12668 > 443 [ACK] Seq=1 Ack=1 Win=16384 Len=0

17004	149.083421	10.16.30.142	64.233.189.239	12668 > 443 [FIN, ACK] Seq=789 Ack=5757 Win=16384 Len=0
17028	149.145223	64.233.189.239	10.16.30.142	443 > 12668 [FIN, ACK] Seq=5757 Ack=790 Win=45312 Len=0
17029	149.145277	10.16.30.142	64.233.189.239	12668 > 443 [ACK] Seq=790 Ack=5758 Win=16384 Len=0

A. What MSS would this connection use for the data exchange? ____**1380**____ **[3pts]**

B. How many data bytes did this connection transport from 10.16.30.142 to 64.233.189.239? _____**788**_____**[3pts]**

C. How many data bytes did this connection transport from 64.233.189.239 to 10.16.30.142? _____**5756**_____**[3pts]**