Homework Assignment #2

Due 10/11 at 3:50pm

EE122 Fall 2010

Please submit your solutions using BSpace (https://bspace.berkeley.edu/). Log in to BSpace with your CalNet ID, click on the EL ENG 122 Fa10 tab, and click on Assignments under Course Tools. Assignments should be submitted in one of the following formats: .txt, .pdf, or .ps.

1) General Information [2 points] (you are allowed to look these answers up)

Marking scheme: 0.4 points each

(a) Which protocol uses port 56
   XNS Authentication

(b) Who assigns addresses to ISPs in Africa?
   AfriNIC

(c) Who owns the address 123.45.234.34?
   Samsung Networks

(d) Who is the Chairman of ICANN?
   Peter Dangate Thrush

(e) How many network addresses did the original IP addressing structure support?
   256

2) Addresses [2 points]

For each of the following addresses, state whether it is a legal, globally routable address and, if not, why not.

Marking scheme: 0.4 points each. 0.2 for Yes/No and 0.2 for reason each.

(a) 10.7.123.14
   No, reserved for private use
(b) 169.13.14.28
   Yes
(c) 245.74.37.126
   No, Class E address
(d) 113.56.263.47
   No, invalid IP address (263 > 255 is not a valid entry)
(e) 225.232.63.33
   Multicast address (both yes and no accepted as answer since multicast routing isn’t globally supported, but it is theoretically globally routable)

3) Design Principles [3 points]

Below are three design decisions, followed by three design principles. Please match each decision with the principle most applicable to that decision.

Decisions:

1. Transport protocols should not be aware of the link-layer technology used to carry packets.
2. Routers do not hold per-flow state.
3. Hosts do not depend on the network for reliable packet delivery.

Principles:

(a) End-to-End principle
(b) Layering
(c) Fate Sharing

Your answer should be of the form:

1. Letter
2. Another letter
3. The remaining letter

Marking scheme: 1 point each
1-(b), 2-(c), 3-(a)
4) **IPv6 Header [2 points]**

*Marking scheme: 0.4 points each.*

(a) Why did IPv6 eliminate the packet header length field?  
*Header is of fixed length (40 bytes)*

(b) Does IPv6 support fragmentation?  
*No*

(c) How does IPv6 support options?  
*Using Next Header*

(d) What is the most notable header feature that IPv6 has that IPv4 does not?  
*Flow Label*

(e) Assuming an MTU of 1500 bytes, and no options, what percentage of bandwidth is wasted on the header?  

\[
\frac{40}{1500} \times 100 = 2.67\%
\]

5) **Headers [1 point]**

Consider a packet being sent from an application using TCP, which is running over IP, which in turn is running over Ethernet. Which header is outermost (that is, occupies the leading bits of the packet)?

*Ethernet Header*

6) **"Our Design" [1 point]**

*(Covered during the lecture “Designing the Internet in 90 minutes”)*

i) In “our” design we proposed an addressing structure. Is this addressing structure most like:

(a) The Internet’s original addressing structure

(b) Classful addressing

(c) CIDR

\*(a) Our addressing scheme had a Domain:LocalAddress structure, so “host” and “network” components were well separated (as in the original Internet scheme). But both (a) and (b) were accepted as correct answers. Only CIDR, which does not have a well-defined boundary between host and network (unless you know the mask), was considered incorrect.*

ii) What are the four aspects to “network security”? Define each of the terms in a few words.
Marking scheme: 0.25 points for mentioning the aspects and 0.25 points for explaining them

**Confidentiality:** Keeping information private

**Integrity:** Ensuring that data is not tampered with, and if it is, it can be detected.

**Provenance:** Ensuring that the source of the data is what you think it is

**Availability:** Ensuring that one can get network service

7) Routing Tables [6 points]

Marking scheme: 2 points each

Suppose a router has four interfaces, numbered 0 through 3. The network administrator wants the following address ranges to be forwarded to these interfaces as follows:

- -> interface 0
  Address 11100000 00000000 00000000 00000000 through 11100000 11111111 11111111 11111111

- -> interface 1
  Address 11100001 00000000 00000000 00000000 through 11100001 00000000 11111111 11111111

- -> interface 2
  Address 11100001 00000001 00000000 00000000 through 11100001 11111111 11111111 11111111

- -> interface 3
  All other addresses  -----------------------> Interface 3

a) Provide a forwarding table that has four entries, using longest-prefix matching, and forwards packets to the correct link interfaces.

<table>
<thead>
<tr>
<th>Address</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>11100000</td>
<td>Interface 0</td>
</tr>
<tr>
<td>11100001 00000000</td>
<td>Interface 1</td>
</tr>
<tr>
<td>11100001</td>
<td>Interface 2</td>
</tr>
<tr>
<td>All other addresses</td>
<td>Interface 3</td>
</tr>
</tbody>
</table>

b) Consider three datagrams with the following addresses. For each one, which interface would they be sent to?

i) 11001000 10010001 01010001 01010101
ii) 11100001 00000000 1100011 00111100

iii) 11100001 10000000 00010001 01110111

i. Interface 3
ii. Interface 1
iii. Interface 2

c) Rewrite this forwarding table using a.b.c.d/x notation instead of the binary string notation.

<table>
<thead>
<tr>
<th>a.b.c.d/x notation</th>
<th>→</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>224.0.0.0/8</td>
<td>→</td>
<td>Interface 0</td>
</tr>
<tr>
<td>225.0.0.0/16</td>
<td>→</td>
<td>Interface 1</td>
</tr>
<tr>
<td>225.0.0.0/8</td>
<td>→</td>
<td>Interface 2</td>
</tr>
<tr>
<td>All other addresses</td>
<td>→</td>
<td>Interface 3</td>
</tr>
</tbody>
</table>

Last entry can also be written as:

<table>
<thead>
<tr>
<th>a.b.c.d/x notation</th>
<th>→</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0.0.0/0</td>
<td>→</td>
<td>Interface 3</td>
</tr>
</tbody>
</table>

(Both are correct)

8) Fragmentation [4 points]

An IP datagram consisting of 1400-bytes of data and a 20-byte header is fragmented into 3 fragments with payload lengths of 512, 512, and 376 bytes respectively each with a 20-byte header. If these fragments pass through another router with an MTU of 380 bytes, what would be the resulting fragment sizes and byte offsets? Give the number of fragments, and the size and byte offset for each fragment.
Number of Fragments = 6
Size of fragments = 360, 152, 360, 152, 360, 16
Offsets = 0 bytes, 360 bytes, 512 bytes, 872 bytes, 1024 bytes, 1384 bytes
Or
Offsets = 0, 45, 64, 109, 128, 173 (Offsets are generally group of 8 bytes.)

Both answers for offsets (bytes, and groups of 8 bytes) are given full credit.

9) NAT [4 points]
a) Why is it said that NAT violates the end-to-end principle?
   Marking scheme: 1 point for explaining the end-to-end principle and 1 point for explaining the violation.
   The end-to-end principle states that one should think twice before implementing functionality in the network. If hosts can implement functionality correctly, implement it in a lower layer only as a performance enhancement, but do so only if it does not impose burden on applications that do not require that functionality.
   People say that NATs violate the end-to-end principle in that NATs intercept traffic and change the packet headers in transit. However, it is not clear that end hosts can easily implement the desired functionality (of sharing a single IP address) without network involvement. One could, of course, use various forms of proxies to perform the same functions as NAT boxes, but this would require changes to host software.

b) How has the uptake of NAT deferred the implementation of IPv6?
Marking scheme: 2 points if mentioned the lack of IPv4 addresses being solved using NAT.
   NAT mitigates the problems of the dearth of IPv4 addresses. If it hadn’t been for NAT we would’ve run out the IPv4 addresses long ago and ISPs would’ve been forced to take up IPv6 with more urgency. Hence, NAT has deferred the implementation of IPv6. It isn’t clear whether this is a good or bad thing.