15-744 Computer Networks (Fall 2011)
Homework 4

Due: Nov. 21, 2011, 3:00PM (in class)

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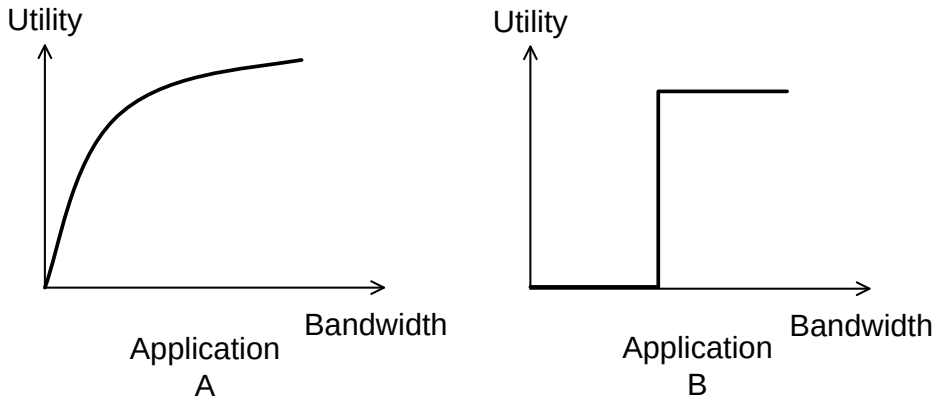
A Short Answers

1. The graph below shows the utility function of two types of applications (A&B).



(a) Answer the following for a network with applications of type A

{Does} or {Does Not} require admission control for the network

Solution: This type of application DOES NOT require admission control.

WHY?

Solution:
Because the shape of the utility curve is concave: admitting more flows would increase the total utility.

(b) Answer the following for a network with applications of type B

{Does} or {Does Not} require admission control for the network

Solution: This type of application DOES require admission control.

WHY?

Solution:
Because admitting too many flows may cause the bandwidth of each flow to drop below the threshold and then utility becomes 0.

2. Why is Rabin fingerprint used in DOT ?

Solution: Rabin fingerprint divided data according to data-dependent boundaries.

3. The Incast paper suggests to lower the value of *RTOmin* to microseconds in datacenters. Briefly state how this change could impact TCP for transfers in the wide area.

Solution: It could potentially cause loss of performance due to a sudden increase in latency in the wide area.

4. In the PortLand paper, what is the Pseudo-MAC used for?

Solution: It encodes the location for each end host in the topology.

B Flat Address Internet

5. (10 points) Bin is thinking about a future Internet architecture. He has an idea to remove the IP layer and run TCP/UDP on top of Ethernet directly. Therefore, packets are addressed and forwared by their MAC address. Routers use routing tables of MAC addresses to decide which packets should be forwarded to which interface.

   (a) What is the impact of using a flat address on router design?

   > **Solution:** Generally routers need to store much larger routing tables as the MAC addresses are less likely to be aggregated by their prefixes as IP addresses.

   (b) Do we still need routing protocols like BGP and why?

   > **Solution:** Yes, autonomous systems still need to exchange the routing information. But the routing information such as path vector will become MAC-based.

   (c) With this flat address, for a malicious host is it easier or harder to spoof an other host in other subnets? Please briefly explain your answer.

   > **Solution:** It becomes easier. In an IP network, a malicious host claiming an IP address outside its subnet will receive no packet.

C DDos

6. (10 points) Suppose Alice is transfering 90,000,000 bits of data to Bob, including protocol overhead. Bob's 10 Mbit per second access link is the bottleneck and Bob's upstream router does per-source fair queuing.

   (a) How long does it take for Bob to finish the transfer, with no competing traffic?

   > **Solution: 4 points**
   > 9×10^7 bits / 10^7 bits/sec = 9 seconds

   (b) Mallory doesn't want Bob to get this file quickly so his army of 99 bots launches a DDoS attack against Bob at the same time that Alice starts the transfer. Each bot sends bogus data at the same rate that Alice is sending the file at. Assume that they can't spoof IP addresses. How long does it take for Bob to finish the transfer when under attack?

   > **Solution: 5 points**
   > Fair-share means each source gets 10^7 bits/sec / 10^2 hosts = 10^5 bits/sec/host. Thus, the transfer takes 9×10^7 bits / 10^5 bits/sec = 900 seconds.

   (c) Now suppose the network supports capabilities. Assume that capability requests are 625 bytes (= 5000 bits) and each capability lasts for 100 seconds. The network performs ingress filtering to ensure that no source can send more than 2 capability requests per second.

   If Bob only grants capabilities to Alice, how long will it take for Bob to finish the transfer when under attack by Mallory? To simplify your calculation, you may assume that there are 100 bots (instead of 99). Assume that each bot tries to get capabilities as fast as possible and, if they get one, send data at the same rate as Alice.

Solution: 5 points

Alice sends an additional 5000 bits once to get a capability which will last long enough to finish the transfer. This takes a negligable amount of time. Each bot can send 2 capabilities (10000 bits) each second to Bob, so in aggregate they take up $100 \times 10^4 = 10^6$ bits/sec of Bob's bandwidth. Hence, the transfer takes 9×10^7 bits / $(10^7 - 10^6)$ bits/sec = 10 seconds.