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THE COPPERBELT UNIVERSITY

COMPUTER SCIENCE DEPARTMENT

Internet Technologies I Test 2
Time allowed 2hrs
Answer all questions
All questions have equal marks
Date: 29th May, 2019
Prepared by Dr DB Ntalasha

Question one

a) You are given the following address space: 128.37.22.0/23, you are required to divide it to 4 subnets. One of the subnets has to accommodate 200 hosts and the 3 other subnets have to accommodate 59 hosts each. What are the 4 subnet network addresses and their corresponding prefixes? [4 marks]

b) What is the broadcast address for each subnet? [2 marks]

c) Suppose you are an ISP that owns a /22 address block. Can you accommodate requests from six customers who need addresses for 9, 15, 20, 41, 128, and 260 computers, respectively? If so, how? If not, explain why. [2 marks]

d) Reassembling of IP fragments at the ultimate destination is advantageous. Give reasons. [2 marks]

ANSWER

a) 128.37.22.0/24
128.37.23.0/26
128.37.23.64/26
128.37.23.128/26

b) 128.37.22.255
127.37.23.63
128.37.23.127
128.37.23.191

c) In order to accommodate six customers, the prefix must be extended by at least 3 bits for a total of at least 25 bits. So, the suffix should be at most 7 bits. But 260 > 2^7 - 2; So it is not possible.

d) Processes are created &destroyed dynamically. A sender therefore cannot identify the processes on the receiver machine.
The receiver may replace processes (say by rebooting the machine) without informing all the senders.
The need is to identify destinations from the functions they implement.
A process may handle two or more functions simultaneously.

Question two

a) The Routing Information Protocol version 2 introduces certain improvements to the Routing Information Protocol version 1. One of these improvements is the next hop address field. How would you interpret the value 0.0.0.0 in the next hop field? [2 marks]

b) How does a computer know whether an arriving frame contains an ARP message? Explain [3 marks]

c) An organization is granted the block 130.34.12.64/26. The organization needs to have four subnets. What are the subnet addresses and the range of addresses for each subnet? [5 marks]

ANSWER

a) The next hop address is the IP address of the gateway that handles the route. If the address is 0.0.0.0, the source of the update packet is the gateway for the route. The next hop route permits a RIP-2 supplier to provide routing information about gateways that do not speak the RIP-2.

b) The type field in the frame header specifies that the frame contain an ARP message. A sender must assign an appropriate value for the type field before transmitting the frame and a receiver must examine the type field in each incoming frame. For example, the Ethernet standard specifies that the type field in an Ethernet frame carrying an ARP message must contain the hexadecimal value Ox806.

c) The suffix length is 6. This means the total number of addresses in the block is 64 (2^6). If we create four subnets, each subnet will have 16 addresses.
Let us first find the subnet prefix (subnet mask). We need four subnets, which means we need to add two more 1s to the site prefix. The subnet prefix is then /28.
Subnet 1: 130.34.12.64/28 to 130.34.12.79/28.
Subnet 2 : 130.34.12.80/28 to 130.34.12.95/28.
Subnet 3: 130.34.12.96/28 to 130.34.12.111/28.
Subnet 4: 130.34.12.112/28 to 130.34.12.127/28.

Question three

a) A supernet has a first address of 205.16.32.0 and a supernet mask of 255.255.248.0. How many blocks are in this supernet and what is the range of addresses? [4 marks]

b) The challenge for IPv6 is for its transition to be complete before IPv4 routing and addressing break. Explain two transition requirements and IPv6 transition mechanisms features for end-users, system administrators, and network operators to understand and carry out. [6 marks]

ANSWER

a) **The supernet has 21 1s. The default mask has 24 1s. Since the difference is 3, there are 2^3 or 8 blocks in this supernet. The blocks are 205.16.32.0 to 205.16.39.0. The first address is 205.16.32.0. The last address is 205.16.39.255.**

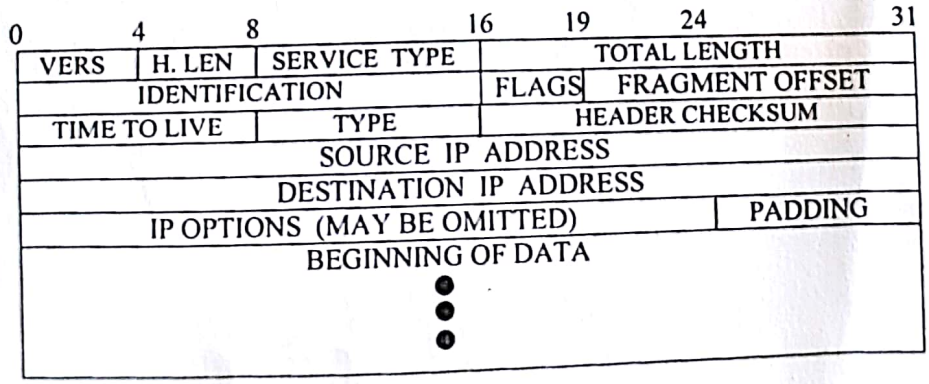
b) **The two transition requirements, which are the most important are flexibility of deployment and the ability for IPv4 hosts to communicate with IPv6 hosts. There will be IPv6-only hosts, just as there will be IPv4-only hosts.**

- **Incremental upgrade and deployment. Individual IPv4 hosts and routers may be upgraded to IPv6 one at a time without requiring any other hosts or routers to be upgraded at the same time. New IPv6 hosts and routers can be installed one by one.**
- **Minimal upgrade dependencies. The only prerequisite to upgrading hosts to IPv6 is that the DNS server must first be upgraded to handle IPv6 address records. There are no pre-requisites to upgrading routers.**
- **Easy Addressing. When existing installed IPv4 hosts or routers are upgraded to IPv6, they may continue to use their existing address. They do not need to be assigned new addresses. Administrators do not need to draft new addressing plans.**
- **Low start-up costs. Little or no preparation work is needed in order to upgrade existing IPv4 systems to IPv6, or to deploy new IPv6 systems.**

Question four

Draw and explain the IP datagram header format [10 marks]

ANSWER



Each field in the IP datagram header has a fixed size. The datagram, begins with a 4-bit protocol version number (the current version is 4) and a 4-bit header length that specifies the number of 32-bit quantities in the header. The SERVICE TYPE field contains a value that specifies whether the sender prefers the datagram to travel over a route with minimum delay or a route with maximum throughput; a router that knows multiple routes to the destination can use the value to choose a route. The TOTAL LENGTH field contains a 16-bit integer that specifies the total number of octets in the datagram, including both the header and the data.

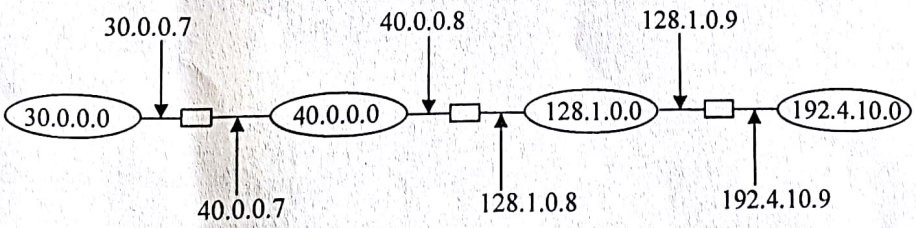
The TIME TO LIVE field is used to prevent a datagram from travelling forever around a path that contains a loop; such paths can arise when software malfunctions or when a manager misconfigures routes. The sender initialises the TIME TO LIVE field to a positive integer between 1 and 255. If the counter reaches zero, the datagram is discarded and an error message is sent back to the source.

The HEADER CHECKSUM field ensures that bits of the header are not changed in transit. To keep the header of most datagrams small, IP defines a set of *options* that can be present, if needed. When an IP datagram does not carry options, the header length field (labelled H.LEN) contains 5, and the header ends after DESTINATION IP ADDRESS field. Because the header length is specified in 32-bit multiples, if options do not end on a 32-bit boundary, PADDING that contains zero bits is added to make the header a multiple of 32 bits.

Question five

a) Consider sending a 3,000 byte datagram into a link which has an MTU of 500 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are their characteristics? [5 marks]

b) Consider an internet of four networks and three routers with an IP address assigned to each router interface. What is a routing table and derive this table for a centre router. [5 marks]



ANSWER

a) The maximum size of data field in each fragment = 480 (20 bytes IP header). Thus the number of required fragments (3000- 20)/480 = 7 Each fragment will have Identification number 422. Each fragment except the last one will be of size 500 bytes (including IP header). The last datagram will be of size 120 bytes (including IP header). The offsets of the 7 fragments will be 0, 60, 120, 180, 240, 300, 360. Each of the first 6 fragments will have flag=1; the last fragment will have flag=0.

b) Routing Table

Destination	Mask	Next Hop
30.0.0.0	255.0.0.0	40.0.0.7
40.0.0.0	255.0.0.0	deliver directly
128.1.0.0	255.255.0.0	deliver directly
192.4.10.0	255.255.255.0	128.1.0.9

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SCHOOL OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

COMPUTER SCIENCE DEPARTMENT

Internet Technologies I Test one
Time allowed 2 hrs min
Answer all questions
All questions have equal marks
Date: 23rd September 2019
Prepared by Dr DB Ntalasha

Question one

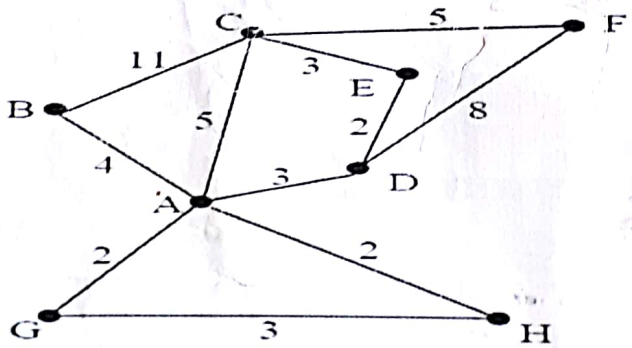
a) Consider sending a 3,000 byte datagram into a link which has an MTU of 500 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are their characteristics? [5 marks]

b) What is an IP address? Discuss the class field in IP address. [3 marks]

c) Why is packet switching important? Give at least two reasons [3 mars]

Question two

Use the weighted network graph shown in the following diagram to answer the following questions related to network routing protocols for heterogeneous networks. Assume that each point in the graph represents a local sub network and that an hierarchical routing approach is being used.



a) Assume that a distance routing protocol is being used to maintain the routing table information and that the network graph shown above has been in a stable configuration and running for some time. Describe the process that B will following to compute its routing vector when the next routing table update takes place. What data will it receive? Show the data that will be received and how that data is used to compute a new routing vector at node B. [6 marks]

b) If node A fails in the network shown, what is the effect on the routing information stored at B over a few routing update cycles? Show the changes for 3 update cycles after the failure of A. Comment on what is happening, is there a problem? [4 marks]

Question three

a) Discuss the reason for using stack based approach to designing and implementing communication protocols. What is gained by using the "stack" approach? Name and discuss three (3) key objectives addressed in the design and specification of the OSI 7 layer protocol. Contrast the OSI and TCP/IP designs. [6 marks]

b) A network has a packet size of 1000 octets, a throughput capacity of 2 Mbps, and a delay of 50 milliseconds. The network hardware can transport 2 Mbps from one computer to another on this network. Calculate the maximum rate (expressed as a bit rate) at which data can be sent using stop-and-go in this network. [4 marks]

Question four

a) What is network capacity? Define this quantity using a simple formula. Write a paragraph that explains why the capacity of a network is relevant to the design of the sliding window protocols. [5 marks]

b) Comment on the use of classes for network routing in the Internet protocol. What classes of networks are defined and how are they allocated? What problems are emerging in the internet as a result of this approach to routing? [5 marks]

Question five

a) As IPV6 contain multiple headers, how does it know where particular header ends and next item begins? [4 marks]

a) How many responses does a computer expect to receive when it broadcast an ARP request? Why? [3 marks]

b) Why is fragmentation needed on Internet not on a typical WAN? [3 marks]

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