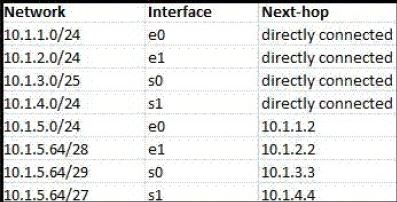
**Question 1 :**



According to the routing table, where will the router send a packet destined for 10.1.5.65? Why?

The packet will be sent to 10.1.5.64/29. 31 bits, all but the last bit match and the prefix 29 is larger than the rest while matching every bit in that prefix.

|  |  |  |
| --- | --- | --- |
| Packet | 10.1.5.65 | 00001010.00000001.00000101.01000001 |
| Send To | 10.1.5.64/29 | 00001010.00000001.00000101.01000000 |

**Question 2:**

Classless Inter-domain Routing (CIDR) receives a packet with address 131.23.151.76. The router’s routing table has the following entries:

Prefix Output Interface Identifier

131.16.0.0/12 3

131.28.0.0/14 5

131.19.0.0/16 2

131.22.0.0/15 1

The identifier of the output interface on which this packet will be forwarded is \_\_\_\_\_\_. Why?

The packet 131.23.151.76 will be sent to the interface 1 of 131.22.0.0/15. This is because the packet address matches the most bits from the interface 1’s address.

|  |  |  |
| --- | --- | --- |
| Packet | 131.23.151.76 | 10000011.00010111.10010111.01001100 |
|  | 131.16.0.0/12 | 10000011.00010000.00000000.00000000 |
|  | 131.28.0.0/14 | 10000011.00011100.00000000.00000000 |
|  | 131.19.0.0/16 | 10000011.00010011.00000000.00000000 |
| Send To | 131.22.0.0/15 | 10000011.00010110.00000000.00000000 |
|  | 131.16.0.0/12 | 10000011.00010000.00000000.00000000 |

**Question 3:**

Consider the following routing table of a router.

|  |  |
| --- | --- |
| **PREFIX** | **NEXT HOP** |
| 192.24.0.0/18 | D |
| 192.24.12.0/22 | B |

Consider the following three IP addresses, what their next hop will be?

1. 192.24.6.0
2. 192.24.14.32
3. 192.24.54.0

Address Range for 192.24.0.0/18 :

14 bits left to turn on.

Turn on 8 bits 192.24.0.255. 6 bits left to turn on.

Remaining 6 bits turned on 192.24.63.255

Address Range is 192.24.0.0 -> 192.24.63.255

Address Range for 192.24.12.0/22:

10 bits left to turn on.

Turn on 8 bits 192.24.12.255. 2 bits left to turn on.

Remaining 2 bits turned on 192.24.15.255

Address Range is 192.24.12.0 -> 192.24.15.255 (Within address range of 192.24.0.0/18)

* 1. 192.24.6.0 Hops to D 192.24.0.0/18 (Longest matching prefix)

|  |  |  |  |
| --- | --- | --- | --- |
| IP Address | 192.24.6.0 | 11000000.00011000.00000110.00000000 | D |
| Hop To : | 192.24.0.0/18 | 11000000.00011000.00000000.00000000 | D |
|  | 192.24.12.0/22 | 11000000.00011000.00001100.00000000 | B |

* 1. 192.24.14.32 Hops to B 192.24.12.0/22 (Longest matching prefix)

|  |  |  |  |
| --- | --- | --- | --- |
| IP Address | 192.24.14.32 | 11000000.00011000.00001110.00100000 | B |
|  | 192.24.0.0/18 | 11000000.00011000.00000000.00000000 | D |
| Hop To : | 192.24.12.0/22 | 11000000.00011000.00001100.00000000 | B |

* 1. 192.24.54.0 Hops to D (Longest matching Prefix and falls within the address range of 192.24.0.0/18, not 192.24.12.0/22)

|  |  |  |  |
| --- | --- | --- | --- |
| IP Address | 192.24.54.0 | 11000000.00011000.00110110.00000000 | D |
|  | 192.24.0.0/18 | 11000000.00011000.00000000.00000000 | D |
| Hop To : | 192.24.12.0/22 | 11000000.00011000.00001100.00000000 | B |

**Question 4:**

Draw an TCP header. Capture packets using wireshark and explain the fields for a particular TCP packet captured. Try to explain the purpose of each field.

|  |  |  |  |
| --- | --- | --- | --- |
| Source Port : 443 | | Destination Port : 53604 | |
| Sequence Number : 26731 | | | |
| Acknowledgement Number : 2641 | | | |
| DO : 32 bytes | RSV : 0 | Flags : 0x010(ACK) | Window : 303 |
| Checksum : 0x6bf6 (unverified) | | Urgent Pointer : 0 | |
| Options : 12 bytes, NOP, NOP, SACK | | | |
| Data (optional) | | | |

Source Port : 16 bit field that represents the port number of the sender. Assigned by the sending host. Allows you to have multiple application sessions running simultaneously.

Destination Port : 16 bit field representing the port number of the receiver, the called port. Who you are connecting to, what application etc.

Sequence Number : 32 bit field representing how much data was sent during the TCP session. Establishes reliability, ensuring data is sequenced correctly and identifies if any data is missing. Essentially it identifies the first byte of data in the segment.

Acknowledgement Number : 32 bit field used by the receiver to request the next TCP segment. Usually the sequence number incremented by 1.

DO (Data Offset): Also known as the header length. 4 bit data offset field that represents the length of the TCP header so we can determine where the data begins.

RSV : 3 bit reserved field that is unused and set to 0 always.

Flags : 9 control bits for flags. Used to establish connections, send data and terminate connections. There are 6 standard control flags and 3 extended control flags. They can be set to 1 or 0 indicating whether they are turned on or off. They indicate the purpose and function of the TCP segment.

Window : 16 bit window field determining how many bytes of data the receiver is willing to receive. Used so the receiver can tell the sender they wish to receive more data than they are currently receiving.

Checksum : 16 bits used to check if the TCP header is ok or not, check if it is corrupt or tampered with. Verifies the integrity of the segment header and data.

Urgent Pointer : 16 bits used when the URG (a flag) bit has been set, indicates data that is to be delivered as quickly as possible, this pointer shows where the urgent data ends. Otherwise it is set to 0.

Options : Optional field that ranges in size from 0 bits to 320 bits. Used for optimizations depending on the data being sent. There are multiple options that can be applied but they are not mandatory. Examples Window scaling, Maximum Segment Size, Selective Ack etc.

**Question 5:**

Draw an UDP header. Capture packets using wireshark and explain the fields for a particular UDP packet captured. Try to explain the purpose of each field.

|  |  |
| --- | --- |
| Source Port : 443 | Destination Port : 64094 |
| Length : 36 | Checksum : 0x3dae (unverified) |
| Data : (optional) 45ea0eceedb053a39c45113c5fb7e4c14a249ce176a6ddca0a761518 | |

Source Port : The port of the device sending the data, can be set to 0 if the destination device does not need to reply to the sender.

Destination Port : The port of the device receiving the data. UDP port numbers are set between 0 and 65,535.

Length : Specifies the number of bytes making up the UDP header and UDP payload data.

Checksum : Verifies the integrity of the packet header and payload. Checks for corruption or tampering of data.