

1. What is the value of prefix in link local address format?

- The prefix for a link-local address in IPv6 is FE80::/10. This indicates that the first 10 bits of the address are set to 1111 1110 10 in binary, which corresponds to FE80 in hexadecimal notation. The remaining 54 bits of the 64-bit prefix are set to 0.

So, the link-local addresses range from FE80:: to FEBF:FFFF:FFFF:FFFF:: within the /10 subnet, but typically, the addresses are formatted with a /64 prefix, like FE80::/64. This means that the first 64 bits define the network part (with the specific link-local prefix), and the remaining 64 bits are used for the interface identifier.

Here's a breakdown of the link-local address structure:

- Prefix: FE80::/10
- Remaining bits of the first 64 bits: Set to 0 (to make it a /64 prefix, often used in link-local addresses)
- Interface Identifier: The last 64 bits, which are unique to each network interface on the local link.

An example link-local address might look like

FE80::1A2B:3C4D:5E6F:7G8H, where 1A2B:3C4D:5E6F:7G8H represents the interface identifier.

2. What is the size of UDP header? What are the different fields? Describe its fields.

- The UDP (User Datagram Protocol) header is 8 bytes (64 bits) long and consists of four fields, each 2 bytes (16 bits) in size. The fields are as follows:

1. Source Port (16 bits):

- Specifies the port number of the sending application. This is used by the receiver to know which application sent the data. If the sender does not need a reply, this field can be set to 0.

2. Destination Port (16 bits):

- Specifies the port number of the receiving application. This is used to direct the data to the correct application on the receiving device.

3. Length (16 bits):

- Indicates the total length of the UDP packet, including both the header and the data. The minimum value for this field is 8 bytes (the length of the UDP header), and the maximum value is 65,535 bytes.

4. Checksum (16 bits):

- Provides a method for error-checking the header and data. The checksum is calculated by the sender and verified by the receiver. If the checksum is not correct, the packet is discarded. This field can be set to 0 if checksum calculation is not required, although it is recommended to use it for reliability.

Summary of UDP Header Fields:

- **Source Port (16 bits):** Port number of the sending application.
- **Destination Port (16 bits):** Port number of the receiving application.
- **Length (16 bits):** Total length of the UDP packet (header + data).
- **Checksum (16 bits):** Error-checking field for the header and data.

3. What is the size of TCP header, What are the different fields? Describe its fields.

- The TCP (Transmission Control Protocol) header has a minimum size of 20 bytes (160 bits) and can be larger depending on the presence of optional fields. The TCP header consists of the following fields:

1. Source Port (16 bits):

- Specifies the port number of the sending application.

2. Destination Port (16 bits):

- Specifies the port number of the receiving application.

3. Sequence Number (32 bits):

- Used for data reassembly at the receiver's end. It indicates the position of the first byte of data in the segment within the overall data stream.

4. Acknowledgment Number (32 bits):

- Contains the value of the next sequence number that the sender of the segment is expecting to receive. This is used for acknowledging received data.

5. Data Offset (4 bits):

- Indicates the size of the TCP header in 32-bit words. This value tells where the data begins. The minimum value is 5 (indicating a header size of 20 bytes), and the maximum value is 15 (indicating a header size of 60 bytes).

6. Reserved (3 bits):

- Reserved for future use and should be set to zero.

7. Flags (9 bits) (also known as control bits):

- URG (1 bit): Urgent pointer field significant.
- ACK (1 bit): Acknowledgment field significant.
- PSH (1 bit): Push function.
- RST (1 bit): Reset the connection.
- SYN (1 bit): Synchronize sequence numbers to initiate a connection.
- FIN (1 bit): No more data from sender (indicates the end of data transmission).
- ECE (1 bit): ECN-Echo (explicit congestion notification echo).
- CWR (1 bit): Congestion Window Reduced.
- NS (1 bit): Nonce Sum (for protection against accidental misrouting).

8. Window Size (16 bits):

- Specifies the size of the sender's receive window (buffer space) available. This is used for flow control.

9. Checksum (16 bits):

- Used for error-checking the header and data.

10. Urgent Pointer (16 bits):

- If the URG flag is set, this field is an offset from the sequence number indicating the last urgent data byte.

11. Options (variable length):

- Optional field(s) that may vary in length. The options field is used for various purposes such as Maximum Segment Size (MSS), Window Scaling, and timestamps. If options are present, they must end on a 32-bit boundary.

12. Padding (variable length):

- Used to ensure that the header ends on a 32-bit boundary. Padding consists of zeroes.

❖ Summary of TCP Header Fields:

- **Source Port (16 bits):** Port number of the sending application.
- **Destination Port (16 bits):** Port number of the receiving application.
- **Sequence Number (32 bits):** Position of the first byte of data in the segment.
- **Acknowledgment Number (32 bits):** Next sequence number expected by the sender.
- **Data Offset (4 bits):** Size of the TCP header in 32-bit words.
- **Reserved (3 bits):** Reserved for future use.
- **Flags (9 bits):** Various control flags.
- **Window Size (16 bits):** Size of the sender's receive window.
- **Checksum (16 bits):** Error-checking field.
- **Urgent Pointer (16 bits):** Offset for urgent data if the URG flag is set.
- **Options (variable length):** Optional field for various purposes.
- **Padding (variable length):** Ensures the header ends on a 32-bit boundary.

