1. **As a communication systems engineer, what are the metrics you would use in system design?**

Throughput, delay, packet loss at the network layer, Bit error rate at the physical layer, Security at the application layer, scalablity -can I handle large number of users., Power consumption, Cost of building the system, Cost of using the system.

2. **Describe the layers and corresponding functions of the OSI reference model. What layers comprise the TCP/IP stack?**

Application Layer: It is concerned with how data at both ends is handled, user interface.
Presentation Layer: It converts the data into a format compatible with the receiver's system format and suitable for transmission.
Session Layer: It is responsible for setting up and maintaining the communication connection between two computers in the computer network during data transmission.
Transport Layer: It manages end-to-end flow of data, reliability, congestion control.
Network Layer: It consists of several protocols, primary protocol is IP-which performs routing and provides hierarchical addressing.
Data Link Layer: It manages transmission of data on a link-by-link basis, link-level reliability.
Physical Layer: It is used for transmitting data on the physical medium.
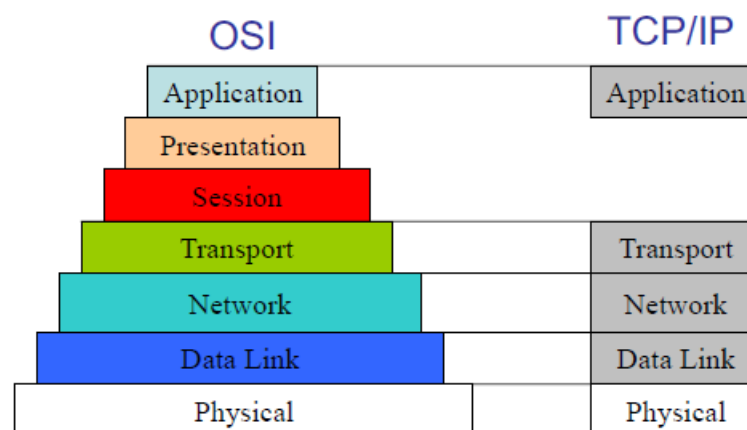
Here five layers comprise the TCP/Ip stack.
Application Layer
Transport Layer:
Network Layer
Data Link Layer
Physical Layer

3. **What are the pros and cons of cross layer design?**
Pros:
1) This contributes to improve the QoS in mobile networks.4

2) It is used in cutting off the congestion in various Internet applications.
3) It is used in various Routing Schemes and for reservation mechanism.
4) It is used in efficient transfer of multimedia resources in wireless networks.
5) This strategy supports information exchange and optimization across layers.

Cons:
1) It suffers with the lack of proper architecture.
2) Unchecked Cross-Layer patterns may create chaos.
3) Unintended Cross-Layer Interaction may lead to unforeseen dependencies among the layers.
4) Cross-Layer designs cannot be easily integrated.
5) Chances of various improper stability issues if not handled correctly.

4. I characterized Packet Switching and the End-to-End principle as the two key design choices for the Internet. Describe them.

Packet-switched describes the type of network in which relatively small units of data called packets are routed through a network based on the destination address contained within each packet. Breaking communication down into packets allows the same data path to be shared among many users in the network.

Point-to-point network is a type of Layer-2 connection which can have only 2 endpoints, in contrast to multipoint networks like Ethernet, which may have more than 2. The end-to-end principle is a classic design principle in computer networking. In networks designed according to the principle, application-specific features reside in the communicating end nodes of the network, rather than in intermediary nodes, such as gateways and routers, that exist to establish the network.

5. At what layer does ARQ exist? At what layer does TCP exist? Compare them in terms of how they provide reliability.

ARQ exits on Data Link Layer and in the Transport Layer.

TCP exits on Transport Layer.

ARQ is a group of error – control protocols for transmission of data over noisy or unreliable communication network.

TCP numbers its packets. It also makes sure they have a deadline to reach the destination (a duration of several hundred milliseconds called time-out) and some other technical provisions. For each packet received, the sending device is notified through a packet called acknowledgment. The name says it all. If after the time-out, no acknowledgment is received, the source sends another copy of the probably missing or delayed packet. Out-of-order packets are also not acknowledged. This way,

all packets are always assembled in order, without holes and within a specific and acceptable delay window.

6. Describe the hierarchical structure and addressing of the Internet.

The internet a hierarchical network of networks with the Internet Protocol (IP) used for routing. IP addresses are assigned in a hierarchical fashion so that routers do not have to maintain entries for all possible addresses (for example, IPv4 has a 32 bit IP address allowing for over 4 billion addresses). If we assign addresses in a hierarchical fashion (so that addresses physically close together share a common address prefix), one entry in a routing table can match multiple addresses. IP addresses use a binary hierarchy (see CIDR in the notes) and routers use longest prefix matching to make forwarding decisions. In other words, hierarchical addressing facilitates routing by allowing blocks of addresses to be grouped together into single routing table entries.

7. Explain the tradeoff between Packet Switching and Circuit Switching?

Packet switching exploits statistical multiplexing to increase overall system efficiency since resources are used opportunistically. The main problem is that individual users will not have performance guarantees such as bounded delay or minimum bandwidth. Circuit switching provides guarantees by allocating resources in a static fashion.

8. Why do we have both MAC & IP Addresses?

MAC addresses are used by the link layer within a LAN and IP addresses are used by the network layer within an Internet. We have both because LANs are designed to work with arbitrary network layer protocols. Additionally, we do not want the adapter ID of a node to change every time the node is moved. Finally, if the network layer were to read link layer packets and do filtering, it would slow down processing. In summary, MAC & IP addressing allows for layers to be independent.

9. In setting up a network, should you use a switch or a router? Describe the pros and cons.

A switch is appropriate for a LAN while a router is needed for connecting two networks. A switch is simpler than a router in that it can learn the forwarding table while the router must be configured. For example, in a home network, a router is needed to share the internet connection between multiple PCs. If you only use a switch, then one of the computers must have two network cards and be configured to do Internet Connection Sharing (which is essentially the router functions).

10. Think about security in a layer 2 and layer 3. What kind of attacks are there at layer 2 and layer 3? Hint: Lookup the broadcast storm, ARP/switch poisoning, and Denial of Service.

The security in a layer 2: ARP/switch poisoning
The security in a layer 3: the broadcast storm ang the Denial of Service.