Task 1: Research and Review

1. UDP Protocol

1.1UDP Definition

- One Transport Layer protocol is called User Datagram Protocol (UDP). The Internet Protocol suite is sometimes called the UDP/IP suite.

- Unlike TCP, it is an unreliable and connectionless protocol. Therefore, establishing a connection is not necessary before data transfer. Over the network, the UDP aids in the establishment of low-latency, loss-tolerant connections.

- As a straightforward, best-effort protocol with low overhead and minimal error checking, UDP is appropriate in situations where efficiency and speed are more important than reliability.

1.2The operation of UDP

- The "datagrams," or packets of data, are transferred to a specified target computer. There is no method to verify that the datagrams arrived at their intended location.

- The absence of a mandatory connection in UDP creates an issue, even though it has checksums to ensure data integrity and port numbers to distinguish the role data plays at source and destination.

- UDP does not guarantee the order of packet delivery or reliability, so the receiver handles any necessary error detection or reordering at the application layer.

- However, this might not be a big deal if there's no need to review the data that has been delivered or fix any problems. UDP is utilized in video applications for this reason among others. These problems are worth it to get the video signal to its destination on time.

1.3Common use cases for UDP

- When communications are time-sensitive and it is preferable to occasionally drop packets rather than wait, UDP is frequently utilized.

- UDP is used by VoIP (Voice over Internet Protocol) services to provide real-time voice communication, such as Skype and WhatsApp. UDP is utilized to ensure quick and effective data transmission since packet delays caused by congestion control might be visible in voice communication.

- It is also used by DNS (Domain Name System) for request and response communications. Because DNS requests are usually brief and demand a fast response

- UDP is used by DHCP (Dynamic Host Configuration Protocol) to dynamically assign IP addresses to networked devices. Due to the small size of DHCP messages, packet loss or retransmission delays are usually not an issue for this application.

- The following image describes the top 4 used cases of UDP

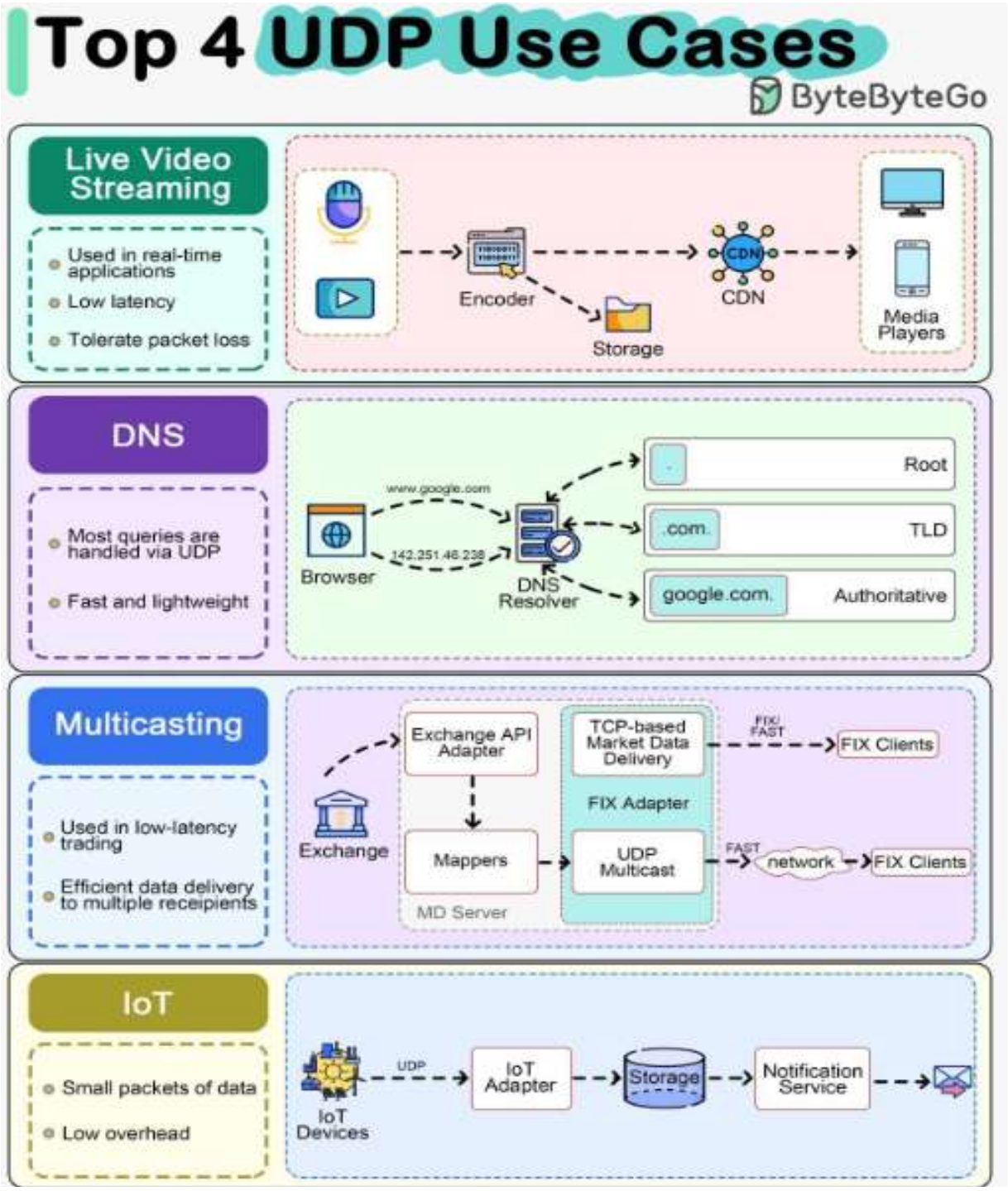

Figure 1.1

1.4Advantages of using UDP

- Speed: Because UDP avoids the overhead of connection establishment and dependable data transmission, it is faster than TCP.

- Reduced latency: There is less delay and quicker reaction time.

- Tinier packet size: Compared to TCP, UDP employs smaller packet sizes, which helps lessen network congestion and enhance network performance in general.

- User Datagram Protocol (UDP) offers higher bandwidth and latency efficiency.

1.5Disadvantages of using UDP

- Data packets may lose their way from the source to the destination while using UDP. It can also make a distributed denial-of-service (DDoS) attack relatively simple for hackers.
- As UDP is not suitable for applications that demand dependable data transmission, such as email or file transfers, so it is limited use cases
- Lack of reliability: UDP does not ensure packet delivery or delivery sequence, which may result in data that is missing or duplicated.

2. CAN Protocol

2.1 CAN Protocol Definition

- An abbreviation for CAN stands for "controller area network." The ISO 11898 standards define a controller area network as an electronic communication bus. These standards specify, among other things, how wiring is set up, how communication takes place, and how messages are put together.

- With collision detection and message priority arbitration, the CAN communication protocol is a carrier-sense multiple-access protocol (CSMA/CD+AMP). With CSMA, a bus's nodes are required to wait a certain amount of time for no activity before attempting to send a message.

2.2 The operation of the CAN protocol

- CAN is a multi-master serial bus standard for connecting Electronic Control Units or ECUs, known as nodes.

- A two-wire twisted pair cable with a characteristic impedance of 120 Ω (nominal) connects each node.

- Every node has a microcontroller of its own that handles receiving and sending messages. A node on the shared bus transmits data so that it can be received by all other nodes. The following are the main phases of communication:

1) Arbitration: CAN uses an arbitration procedure based on message priority to stop collisions when numerous nodes try to transmit at the same time. Messages with lower identifier values have higher priority.

2) Error detection: Within CAN networks, integrated error detection systems guarantee data integrity. These consist of acknowledgment bits from receiving nodes, frame check sequences (FCS), and cyclic redundancy checks (CRC).

3) Fault confinement: A node will go into an "error passive" state until normal functioning is restored if it detects an error or malfunctions during transmission. This keeps bad transmissions from interfering with the overall operation of the system.

2.3 Typical applications of CAN

- The original purpose of the CAN protocol was to address the problem of communication that arises inside automobiles. Later on, however, because of its qualities, it is employed in several different sectors. The CAN protocol has the following applications:

1) Automobiles (buses, trucks, and vehicles)
2) Electronic devices used in aviation and navigation
3) Mechanical control and industrial automation
4) escalators and elevators
5) developing automation
6) Medical devices and equipment

2.4 Advantages of using CAN

1) Over 10,000 messages per second, short and high in frequency.

2) high usage of available bandwidth.

3) sufficient transmission rates.

4) Support for higher-layer protocols such as J1939 (heavy-duty vehicle standard) and CAN open (standardized protocol for devices and applications from different manufacturers).

2.5 Disadvantages of using CAN

1) There can be no more than 64 connected devices at any one time due to electrical overload.
2) The 40-meter (just over 131 feet) maximum cable length is not an issue for the majority of use cases, but it may restrict some applications.

3) The highest speed allowed by the standard is 1 Mbit/s; however, CAN FD has solved this issue and offers 5 Mbit/s.

4) Excessive electric noise may be produced by CAN.

- **References**

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