UDP Transmission and Broadcast and Multicast

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Abstract

This document presents the basics of the UDP protocol and the mechanisms of Broadcast and Multicast transmission in an accessible way. It includes diagrams and C code examples to help understand and implement them independently.

Contents

1 Introduction

UDP (User Datagram Protocol) operates at the transport layer of the OSI (or TCP/IP) model as a connectionless protocol. This means that unlike TCP's three-way handshake, no connection setup is required before sending the first packet. As a result:

- Minimal latency - There are no delays in establishing or tearing down a session.
- Low protocol overhead – the UDP header is only 8 bytes, compared to at least 20 bytes for TCP.
- No state management – the network does not keep track of session state (no windows, connection states, or retransmission queues).

2 The UDP Protocol

2.1 UDP Header

The UDP header has a fixed length of 8 bytes and consists of four fields:

- Source Port (2 bytes)
- Destination Port (2 bytes)
- Length (2 bytes) – length of the entire UDP packet
- Checksum (2 bytes) – optional but recommended

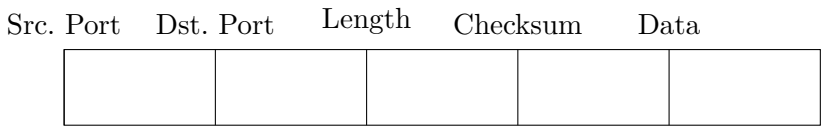

Figure 1: UDP header layout

3 Broadcast Transmission

Broadcast allows sending a packet to all devices on the same local network.

3.1 Broadcast Addresses

For IPv4 networks, the broadcast address ends with.255 (e.g., 192.168.1.255). Sending a packet to this address will be received by all hosts in the subnet.

3.2 Example Pseudocode (Broadcast)

```
BEGIN
    CREATE udp_socket
    ENABLE broadcast_option ON udp_socket

    SET destination_address.family TO IPv4
    SET destination_address.port TO 5000
    SET destination_address.ip TO "192.168.1.255"

    SEND "Hello, broadcast!" TO destination_address VIA udp_socket

    CLOSE udp_socket
END
```

Listing 1: Sending UDP broadcast in pseudocode

4 Multicast Transmission

Multicast allows sending a packet to a group of interested hosts that have joined a specific multicast group.

4.1 Multicast Addresses

IPv4 addresses in the range 224.0.0.0 to 239.255.255.255 are reserved for multicast.

4.2 Joining a Multicast Group

A host who wants to receive packets from a multicast group must send an IGMP request to the switch/router.

4.3 Example Pseudocode (Multicast)

```
BEGIN
    CREATE udp_socket

    SET local_address.family TO IPv4
    SET local_address.port TO 6000
    SET local_address.ip TO ANY

    BIND udp_socket TO local_address

    JOIN multicast_group "239.0.0.1" ON interface ANY

    WHILE true DO
        RECEIVE message INTO buffer VIA udp_socket
        IF message received THEN
            PRINT "Received: " + buffer
        ELSE
            BREAK
    END WHILE

    CLOSE udp_socket
END
```

Listing 2: Receiving UDP multicast in pseudocode

5 Broadcast vs Multicast Comparison

- **Broadcast**: sends a packet to all hosts in the subnet – simple but generates a lot of unnecessary traffic.
- **Multicast**: targets only the interested hosts – more efficient in larger networks.

6 Conclusion

UDP is a fast, connectionless solution, and broadcast and multicast are two approaches to sending data to multiple recipients. When deploying, pay attention to network limitations and router/switch configurations.