Best Effort Delivery - User Datagram Protocol Part 1

Exercise 1: Understanding the Use of Ports

1. Start one copy of the UDP Workbench (found under the UDP tab on the Networking Workbench) on computer A and one copy on computer B.
2. Prepare the following settings:
    i) Set the correct **destination IP addresses** for each workbench so that the address shown in the "Address 1" field is the address of the other computer. To check the address of a computer, click on the Start button, look for cmd.exe to launch the command line then type in "ipconfig"
    ii) Select the "unicast" mode for this exercise.
    iii) The **send port** corresponds to the port that the packet will be sent to; that is, it is the value that is written into the destination port number in the UDP packet header.
    iv) The **receive port** number is the port number that the receiving UDP software module listens on.
3. Click the "Enable Receiver" button to enable receiving.
4. To change a receive port number, you must click the "Stop Receiving" button, then change the port number, and then re-enable receiving.
5. Try each of the port number configurations shown below. In each case, try holding a two-way conversation between the two workbench instances

Trial	Computer	Send Port	Receive Port
1	A	8000	8002
	B	8001	8003
2	A	8001	8002
	B	8001	8002
3	A	8001	8001
	B	8002	8002
4	A	8001	8001
	B	8001	8001
5	A	8001	8002
	B	8002	8001

Which of these send and receive port configurations work (i.e., allow 2-way communication)?

> Trials 3, 4, and 5 send receive port configurations. However, only trial 5 was able to establish a 2-way communication.

What then is the underlying requirement for port-based communication?

> The underlying requirement for port-based communication is a unique combination of IP address and port number that allows devices and applications to establish and manage connections on a network. This ensures that data is sent to the correct application or service on a specific device.

Which of the above configurations work if both copies of the UDP Workbench are running on the same computer?

> Trial 5

What is the reason for the difference in outcome?

> Programs on the same machine share an IP address but use unique port numbers to establish separate communication channels. On different machines, each device has a distinct IP address and can use available port numbers to communicate. Ensuring unique IP and port combinations avoids conflicts and maintains clear communication channels.

Exercise 2: Broadcasting with UDP

1. Choose 1 computer to serve as the sender and set its UDP Workbench to broadcast communication.
2. Choose another 1 computer to serve as target. (You may work with PCs of other groups).
3. Set up the UDP Workbench on target computer and enable the receiver. Make sure to set the receive port on the target computers to match the send port of the sender then enable the receiver.
4. Try sending a broadcast message using the sender PC. Does the target computer receive the broadcast message? If no, why?

> Yes, the target computer will receive the broadcast message if both devices are on the same network and the sender uses the broadcast IP address as the destination.

When a message is broadcast to a network of 5 computers, how many messages are sent? How many messages are received (hint: look at the statistics windows)? Explain how this can be

> When the sender broadcasts a message to a network of five computers, it sends the message five times. Each computer on the network receives the broadcast as an individual packet, resulting in a total of five packets, each intended for a different computer.

Exercise 3: Achieving a Multicasting Effect with UDP

UDP directly supports only unicast and broadcast modes of addressing, and therefore must use workarounds to achieve multicasting.

1. Set the UDP Workbench to multicast communication on a source computer.
2. Set two addresses (“Address 1,” “Address 2,”) to point at two different existing computers that will serve as targets. (You may use IP addresses of PCs of other groups)
3. Set up the UDP Workbench on each target computer and enable the receivers. Make sure the port configurations are correct (refer to exercise 1 and 2 above if you have any doubt).

What happens when you send a message, in terms of the number of messages actually sent by the sending process and the numbers of messages received by each of the receiving process?

> The source computer initiates a sending process to multicast a message to multiple target systems. The identical message is sent once to each destination, with the sender generating as many copies as there are target addresses, ensuring each recipient receives a copy.

4. Now, set the two addresses to all point at the same computer.

What happens when you send a message (hint: look at the statistics windows)?

> Even when two addresses pointing to the same computer are specified, the target computer receives the message twice.

Can you determine what method was used (in the UDP Workbench) to achieve the multicast effect?

> The UDP Workbench employed a replication-based multicast method, where the sender creates duplicates of the message and sends individual unicast copies to each target address.

Suggest another method by which a multicast effect can also be achieved using UDP without sending multiple copies of the same unicast?

> Multicast communication in UDP can be achieved using a predefined group address, allowing the sender to send a single message to the group. Receivers listen to this address and receive messages sent to it. This approach avoids sending individual messages to each machine, as one transmission is received by all group members.