Embedded Systems

CS 397

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Hands-On 4-3
Ethernet – LwIP UDP Echo Client

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Hands-On LwIP UDP Echo Client

Objectives

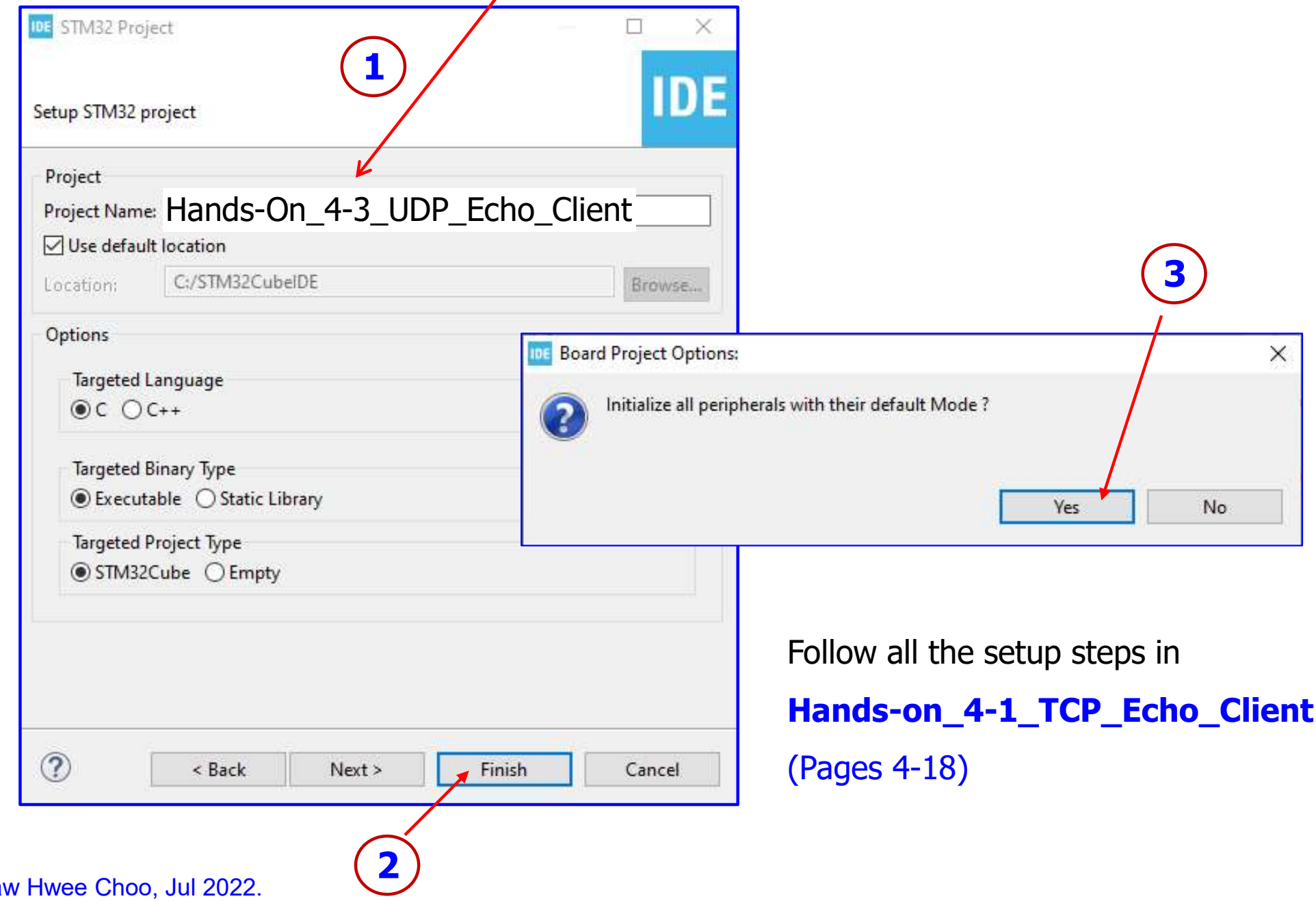
The aims of this hands-on session are to

- implement a STM32 (STM32CubeIDE) project
- set up the Ethernet – LwIP UDP Echo Client application using STM32F767 microcontroller
- configure and program the Ethernet peripheral to make the microcontroller as a UDP client that connects to a UDP server
- test the developed program using the echotool.exe software
- build up the knowledge of Ethernet application development

    - Run STM32CubeIDE
    - Select workspace: C:\STM32_CS397
    - File -> Close All Editors
    - Start a New STM32 Project
    - Select the Nucleo-F767ZI Board

Hands-On LwIP UDP Echo Client

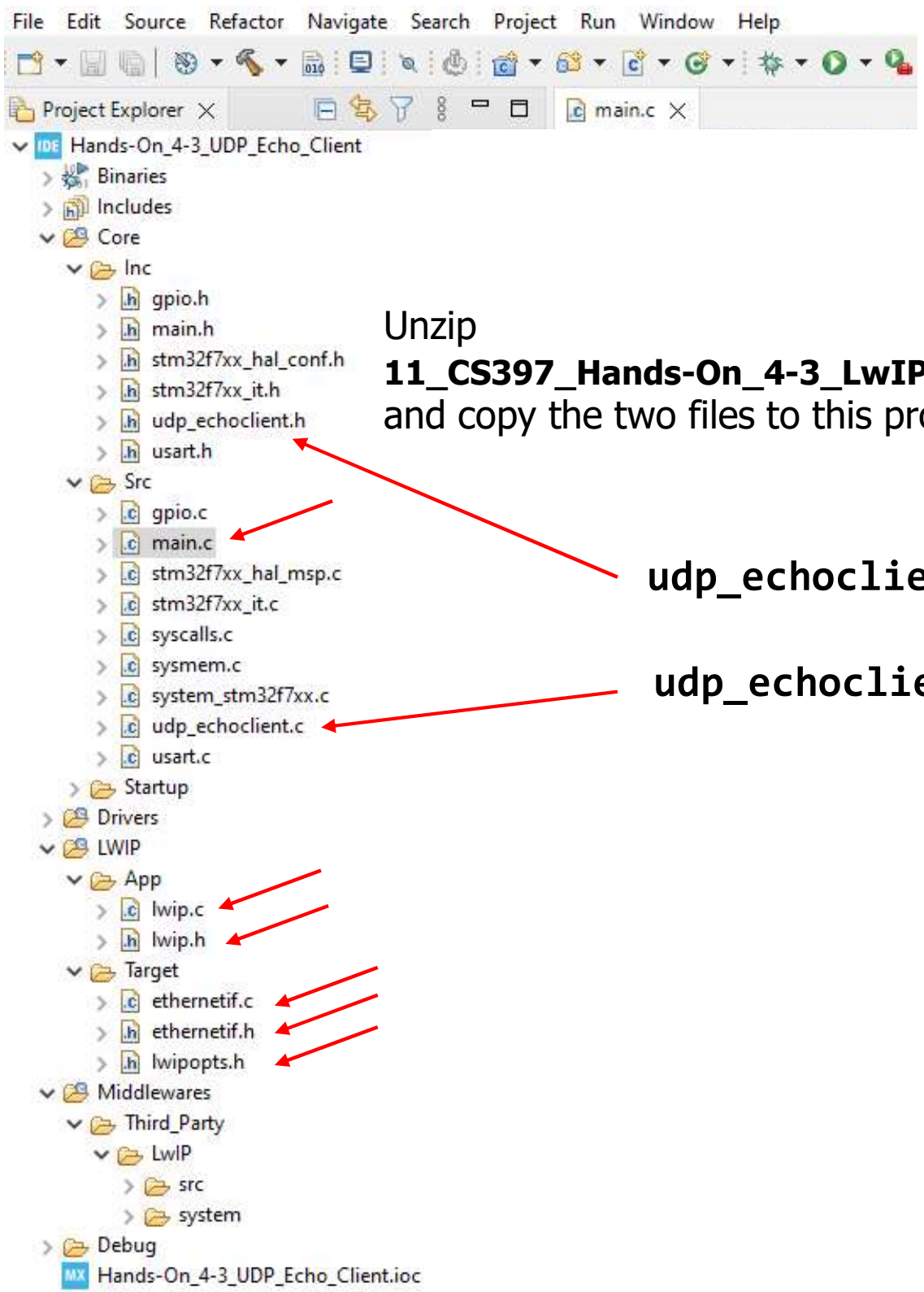
Enter Project Name: Hands-On_4-3_UDP_Echo_Client



Follow all the setup steps in

Hands-on_4-1_TCP_Echo_Client

(Pages 4-18)



Unzip **11_CS397_Hands-On_4-3_LwIP_udp_echoclient.zip**, and copy the two files to this project:

udp_echoclient.h

udp_echoclient.c

Hands-On LwIP UDP Echo Client

Add Code to **main.c**

```
/* Private includes */
/* USER CODE BEGIN Includes */

#include "udp_echoclient.h"

/* USER CODE END Includes */


/* USER CODE BEGIN 2 */

udp_echoclient_connect();

/* USER CODE END 2 */

/* Infinite loop */
/* USER CODE BEGIN WHILE */
while (1)
{
    MX_LWIP_Process();
    /* USER CODE END WHILE */

    /* USER CODE BEGIN 3 */
  }
  /* USER CODE END 3 */
}
```

```
/* USER CODE BEGIN 4 */

void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin)
{
    if(GPIO_Pin == GPIO_PIN_13)
    {
        HAL_GPIO_TogglePin(GPIOB, LD2_Pin);
        udp_echoclient_send();
    }
}

/* USER CODE END 4 */
```

Purpose and Test procedure:

UM1713 User manual

Developing applications on STM32Cube

with LwIP TCP/IP stack

Section 6 Using the LwIP applications

6.1.3 UDP Echo Client

Hands-On LwIP UDP Echo Client

Modify Code in **udp_echoclient.c**

```
/* Includes */
#include "main.h"
#include "lwip/pbuf.h"
#include "lwip/udp.h"
#include "lwip/tcp.h"
#include <string.h>
#include <stdio.h>
#include "udp_echoclient.h"

#define DEST_IP_ADDR0   (uint8_t)192
#define DEST_IP_ADDR1   (uint8_t)168
#define DEST_IP_ADDR2   (uint8_t)1
#define DEST_IP_ADDR3   (uint8_t)175

#define UDP_SERVER_PORT    7   /* define the UDP local connection port */
#define UDP_CLIENT_PORT    7   /* define the UDP remote connection port */
```

For a different router (gateway):

```
#define DEST_IP_ADDR0   (uint8_t)192
#define DEST_IP_ADDR1   (uint8_t)168
#define DEST_IP_ADDR2   (uint8_t)50
#define DEST_IP_ADDR3   (uint8_t)175
```

Ensure these lines are defined
(your PC IP address)

Hands-On LwIP UDP Echo Client

Generated Code in **`Lwip.c`**

```
/* LwIP initialization function  */
void MX_LWIP_Init(void)
{
  /* IP addresses initialization */
  IP_ADDRESS[0] = 192;
  IP_ADDRESS[1] = 168;
  IP_ADDRESS[2] = 1;
  IP_ADDRESS[3] = 205;
  NETMASK_ADDRESS[0] = 255;
  NETMASK_ADDRESS[1] = 255;
  NETMASK_ADDRESS[2] = 255;
  NETMASK_ADDRESS[3] = 0;
  GATEWAY_ADDRESS[0] = 192;
  GATEWAY_ADDRESS[1] = 168;
  GATEWAY_ADDRESS[2] = 1;
  GATEWAY_ADDRESS[3] = 1;

/* USER CODE BEGIN IP_ADDRESSES */
/* USER CODE END IP_ADDRESSES */

  /* Initilialize the LwIP stack without RTOS */
  lwip_init();

  /* IP addresses initialization without DHCP (IPv4) */
  IP4_ADDR(&ipaddr, IP_ADDRESS[0], IP_ADDRESS[1], IP_ADDRESS[2], IP_ADDRESS[3]);
  IP4_ADDR(&netmask, NETMASK_ADDRESS[0], NETMASK_ADDRESS[1] , NETMASK_ADDRESS[2], NETMASK_ADDRESS[3]);
  IP4_ADDR(&gw, GATEWAY_ADDRESS[0], GATEWAY_ADDRESS[1], GATEWAY_ADDRESS[2], GATEWAY_ADDRESS[3]);

  /* add the network interface (IPv4/IPv6) without RTOS */
  netif_add(&gnetif, &ipaddr, &netmask, &gw, NULL, &ethernetif_init, &ethernet_input);
```

For a different router (gateway):

```
IP_ADDRESS[0] = 192;
IP_ADDRESS[1] = 168;
IP_ADDRESS[2] = 50;
IP_ADDRESS[3] = 205;
NETMASK_ADDRESS[0] = 255;
NETMASK_ADDRESS[1] = 255;
NETMASK_ADDRESS[2] = 255;
NETMASK_ADDRESS[3] = 0;
GATEWAY_ADDRESS[0] = 192;
GATEWAY_ADDRESS[1] = 168;
GATEWAY_ADDRESS[2] = 50;
GATEWAY_ADDRESS[3] = 1;
```

Testing of the Application – LwIP UDP Echo Client

This application is used to test basic UDP echo connections. The STM32 MCU acts as a UDP client that connects to a UDP server.

To test the UDP echo client application, follow these steps:

1. Build and program the project code into the STM32F767ZI Flash memory.
2. On the remote PC, open a command prompt window and go to **c:\CS397**
3. At the command prompt, enter:

   C:\CS397>echotool /p udp /s

   where:

   – /p udp is the protocol (UDP protocol)

   – /s is the actual mode of connection (Server mode)

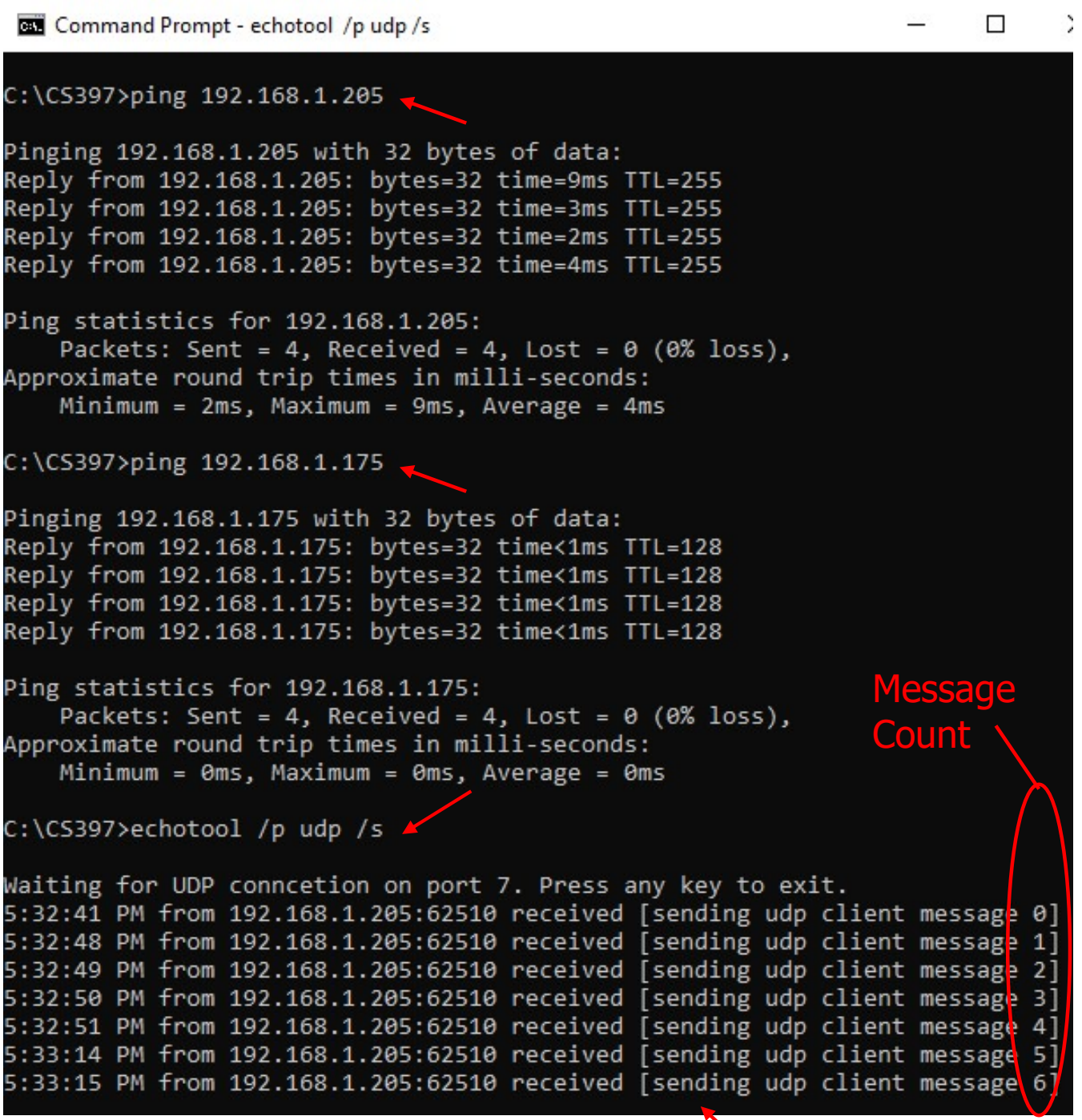
4. When the user-button on the board (Nucleo-F767ZI) is pressed, LD2 is toggled, and the client (board) sends a string and the server (PC) echoes back the same string to the client.

Hands-On LwIP UDP Echo Client

Note:

1. Create another application with the dynamic address allocation "DHCP" for testing.
2. For "DHCP" application, check the router or "Advanced IP Scanner" for the board IP and PC addresses if needed.
3. Figure shows an example of the command string and the module response.

Need to press the user-button to get the response/echo.



The Results of LwIP UDP Echo Client