**LAB 1**

**Ⅰ.Introduction**

In this lab, the general knowledgeable of ZigBee network and the hardware will be introduced, which is aim to familiar with ZigBee network and the software named Zena. And this lab divided into five parts: Introduce ZigBee, Introduce the hardware, Get familiar with the working environment, Learn how to use ZENA packet sniffer and Run the ZigBee demo.

**Ⅱ. Lab steps and results**

**Section 1. Introduction on ZigBee**

In this section, we looked into “ZigBee 2006 Application note (AN1232). By reading this note, we have got general information about ZigBee, such as ZigBee is a wireless protocol implemented in the wireless network with low data rate sensors. And it uses the IEEE 802.15.4 and has network formation, device address assignments, routing, messaging and device discovery functions.

**Section 2. Hardware**

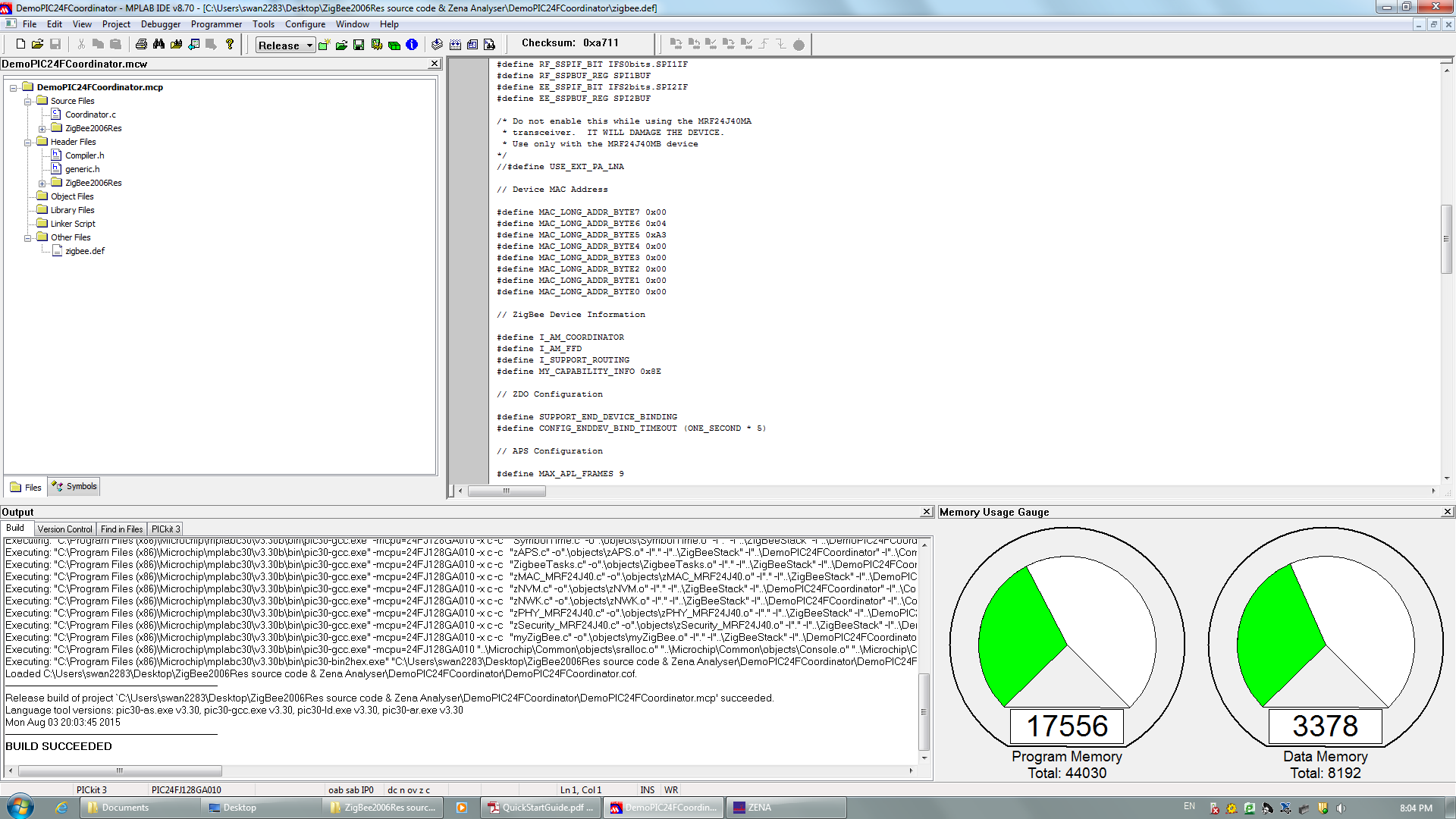
For this step, we have learnt about the hardware of ZigBee. In this lab we used demo board (PIC24fj256 MCU) with RF module (MRF24j40) as ZigBee node, Pickit 3 to connect the Demo board with the PC, RS232 cable and Zena network analyzer.

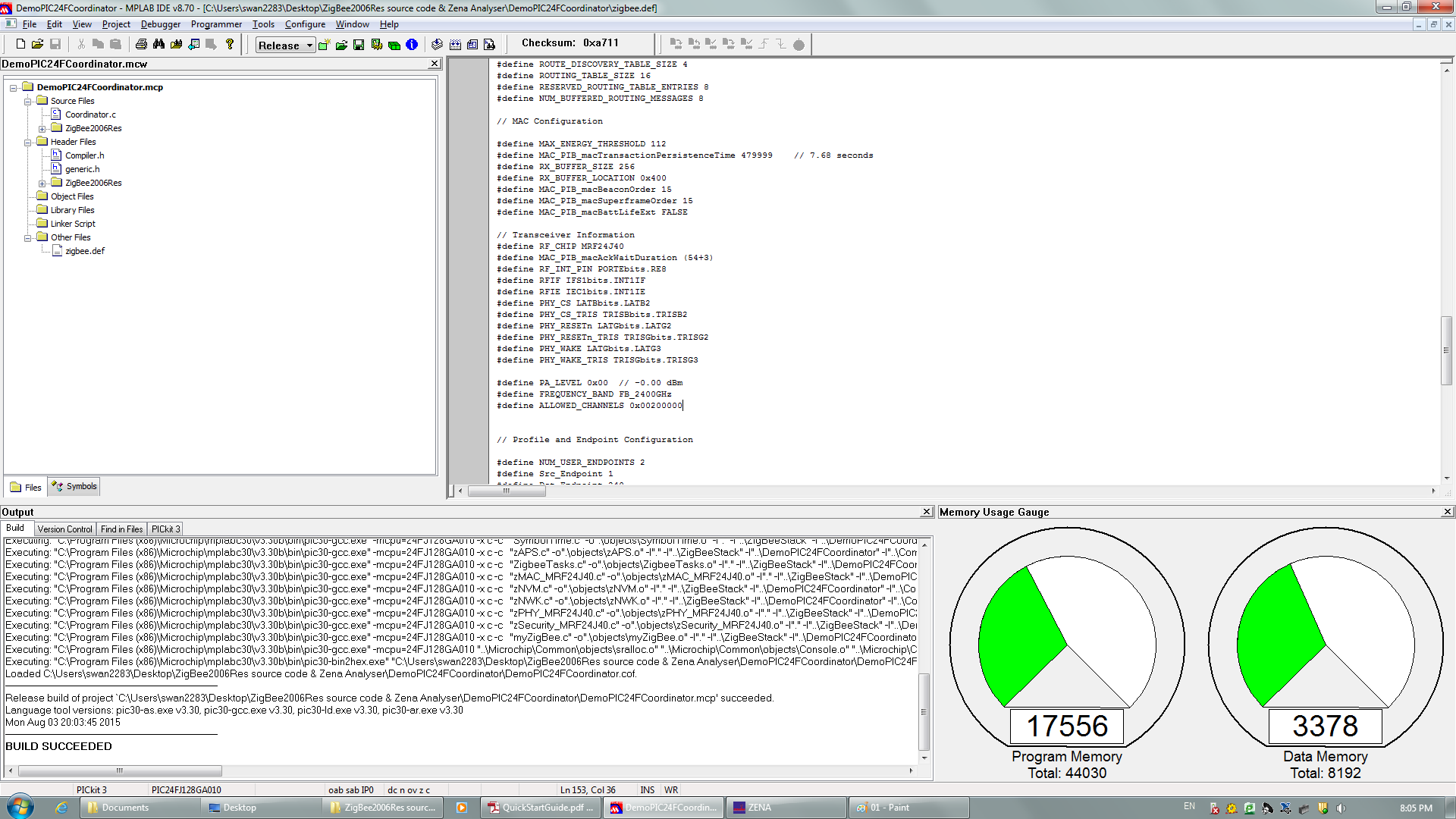
**Section 3. Working environment**

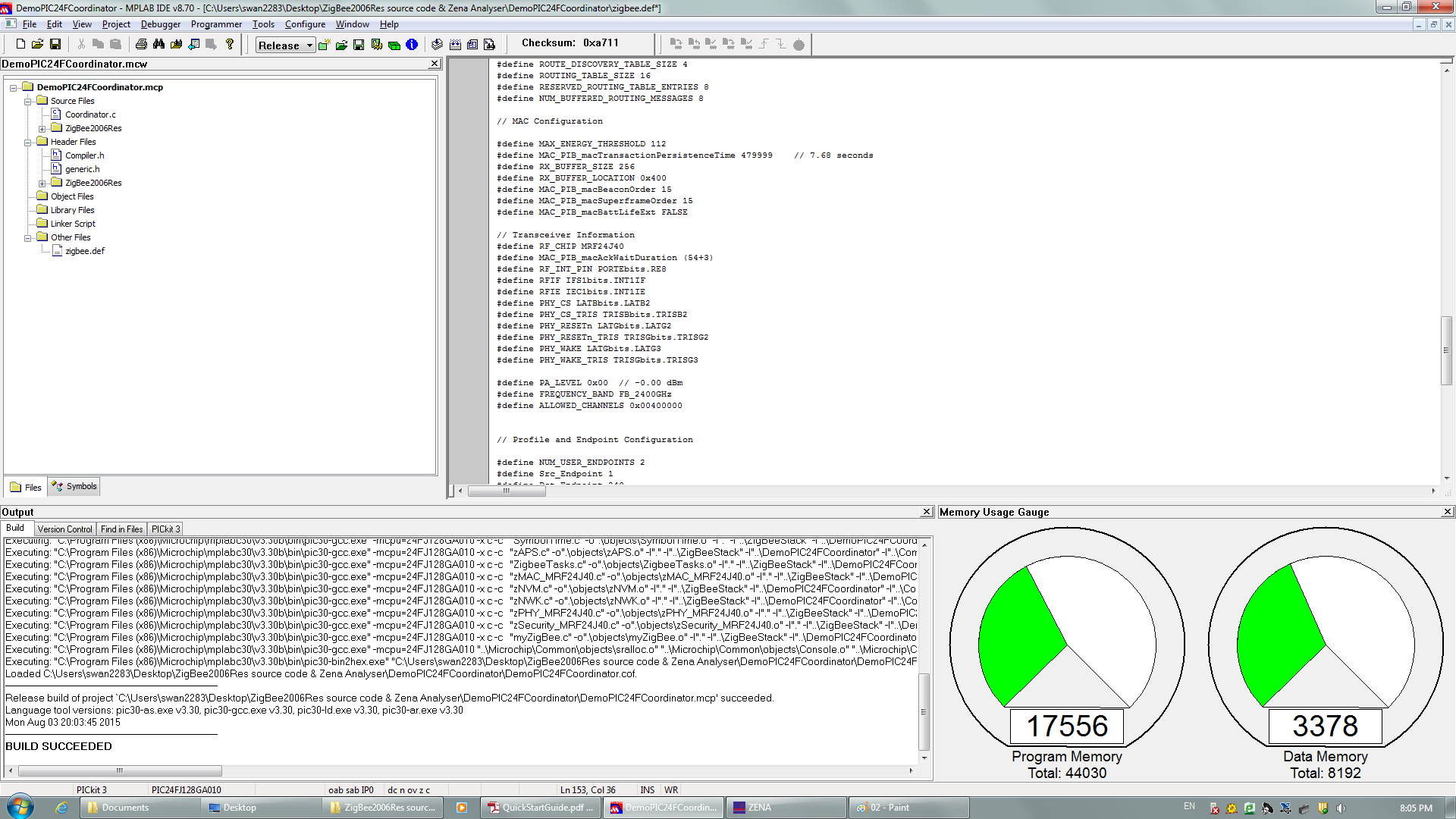
In this section, we built the demo applications by following the steps of lab notes and connected devices with PC.

**Section 4. Zena network sniffer**

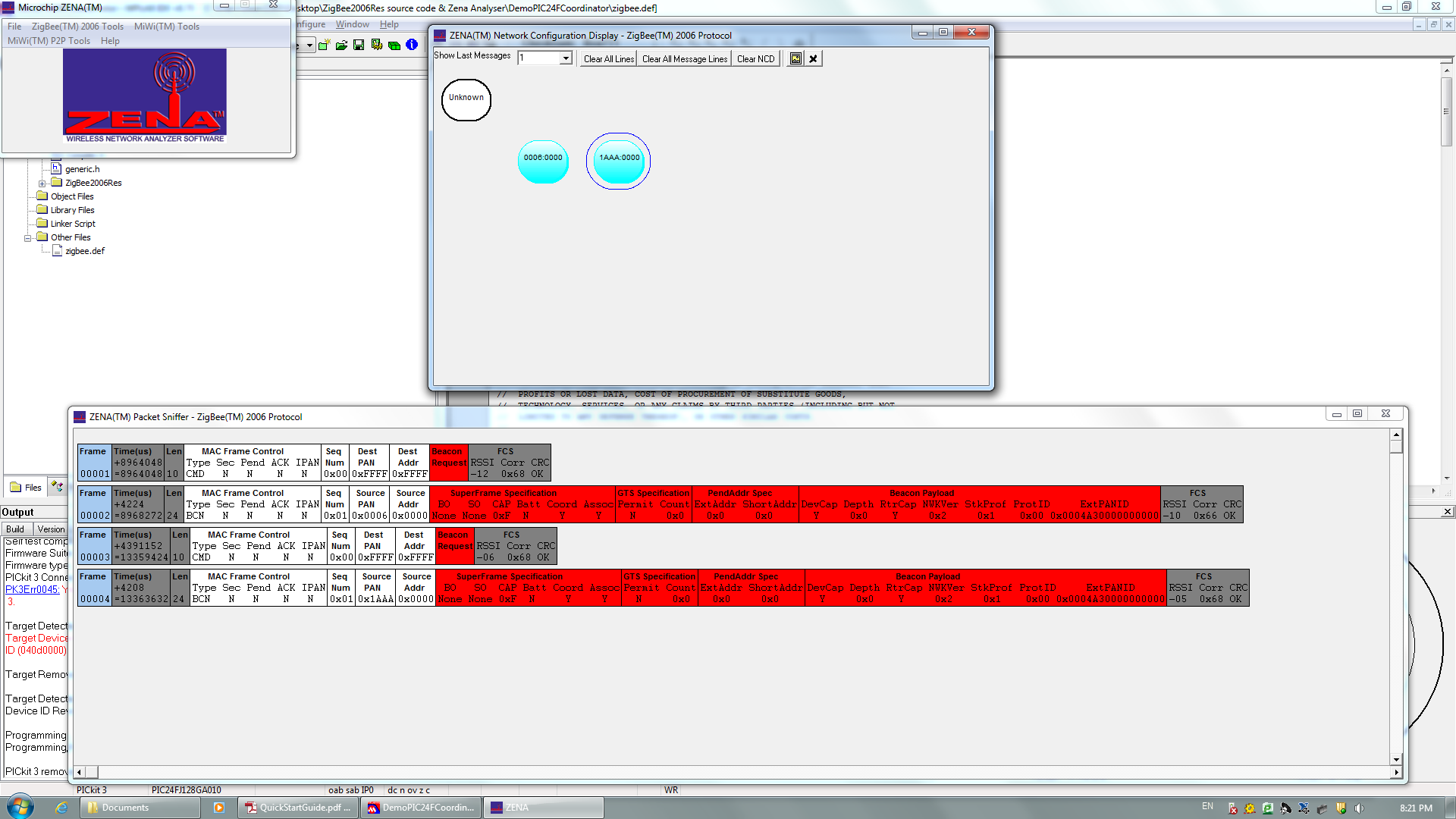
We did every single steps of section 4 that is shown in QuickStartGuide and changed the channel to our group number 22. The result is shown below:





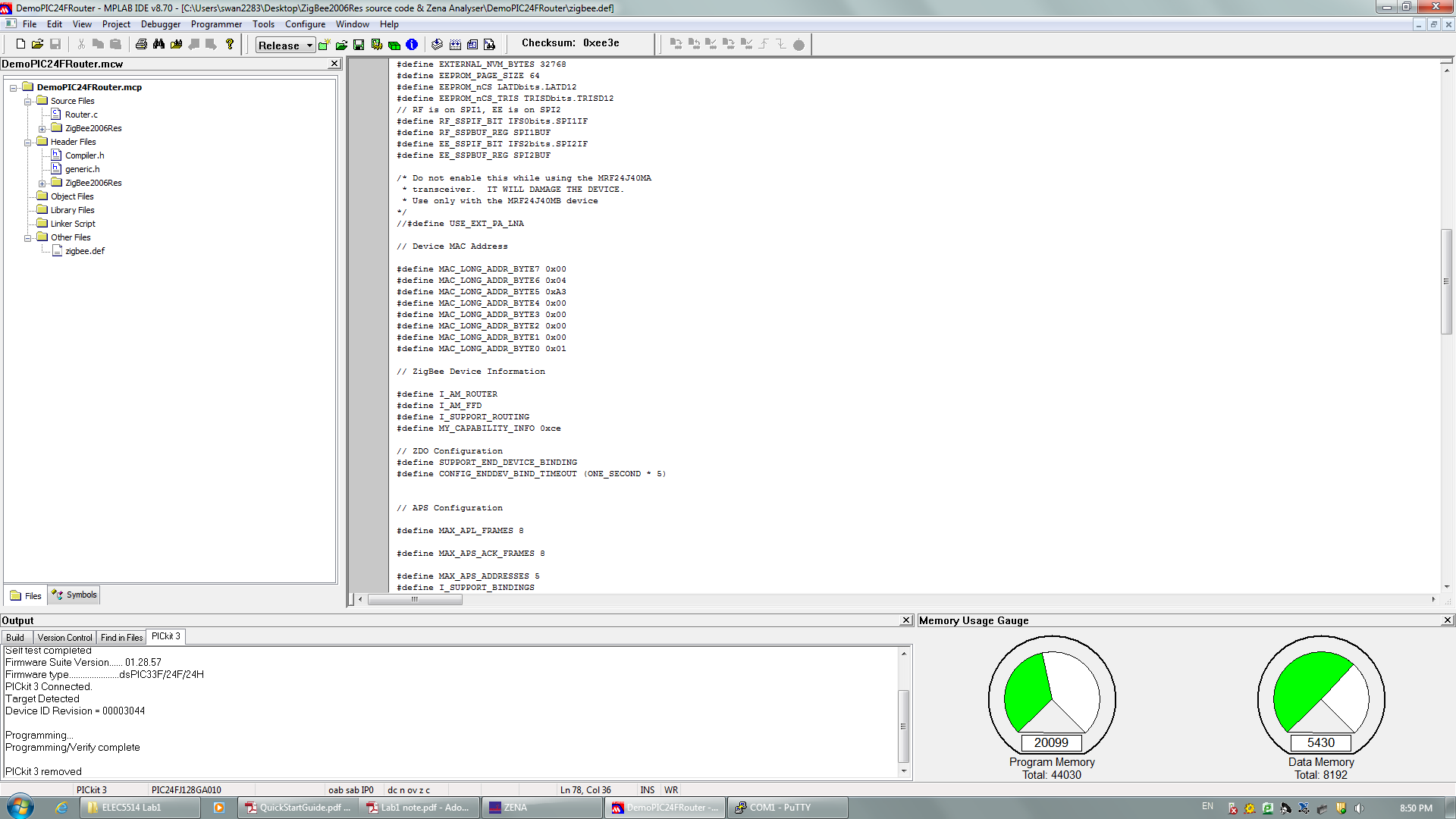


And the network topology is:

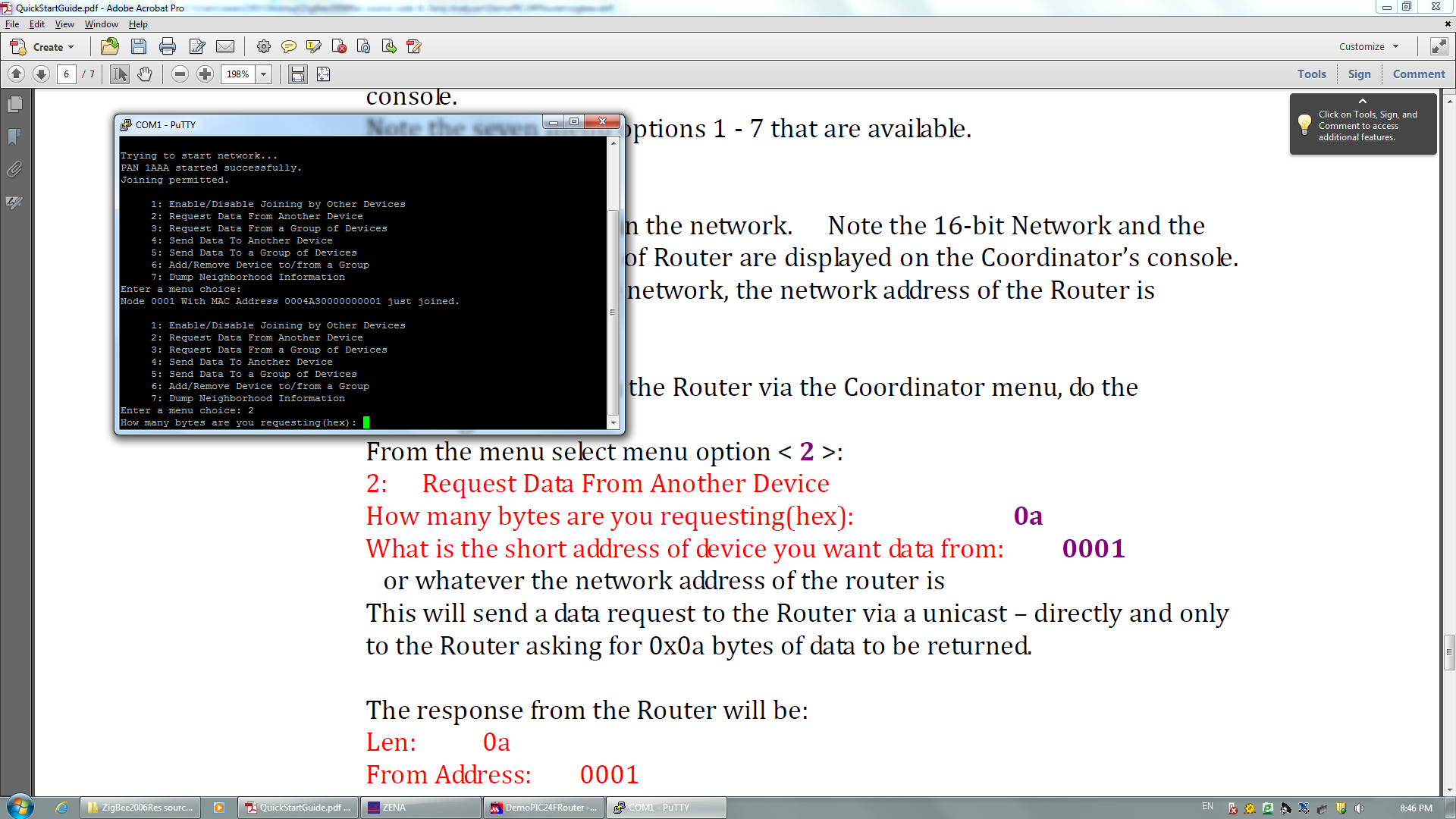


**Section 5. Run the ZigBee demo**

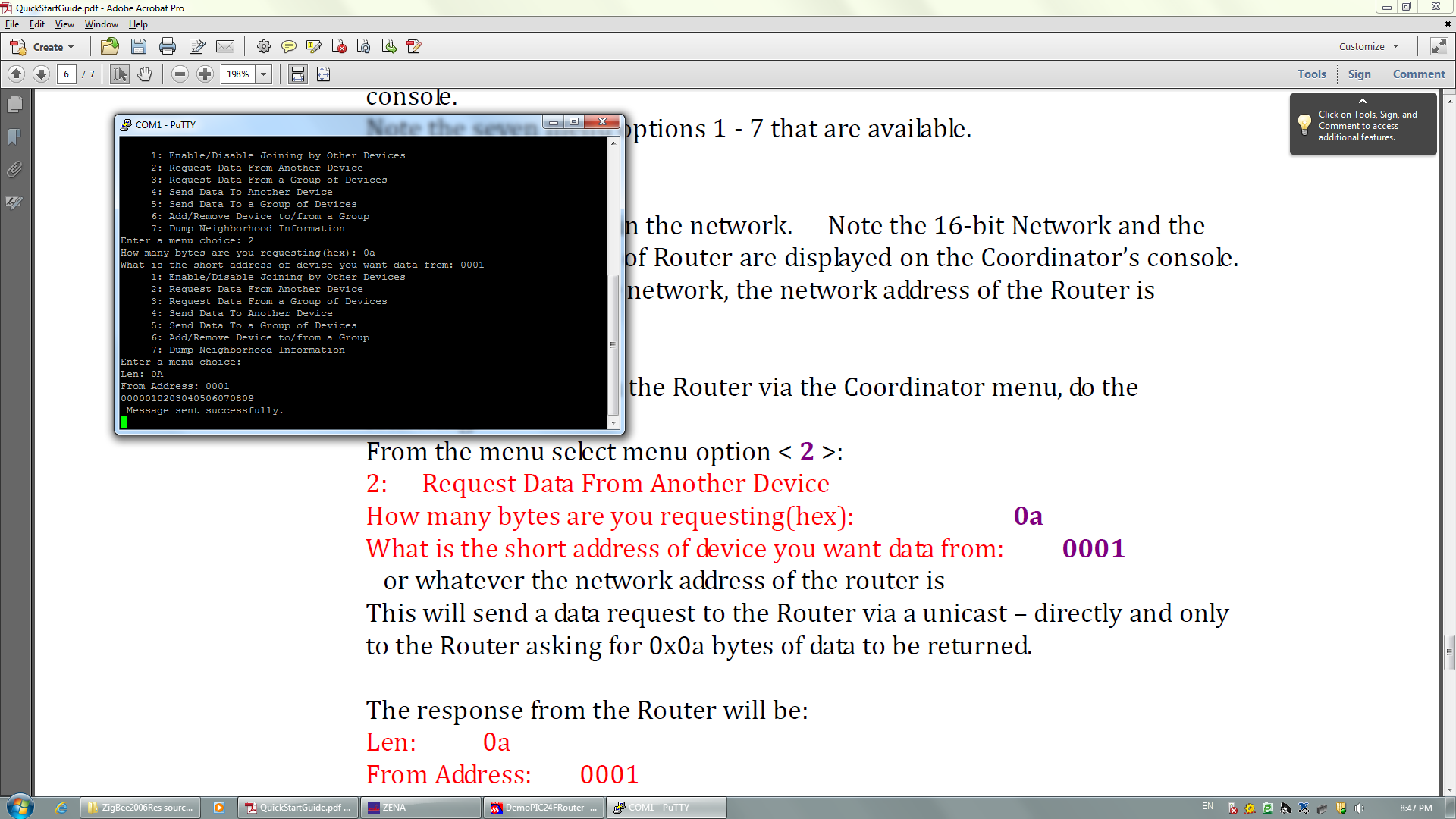
Firstly, we programed two devices, coordinator and one router. Then switch the device power off. And connected a RS-232 cable from the coordinator device to the PC. Finally, opened up a Putty window on the PC to the COM port.



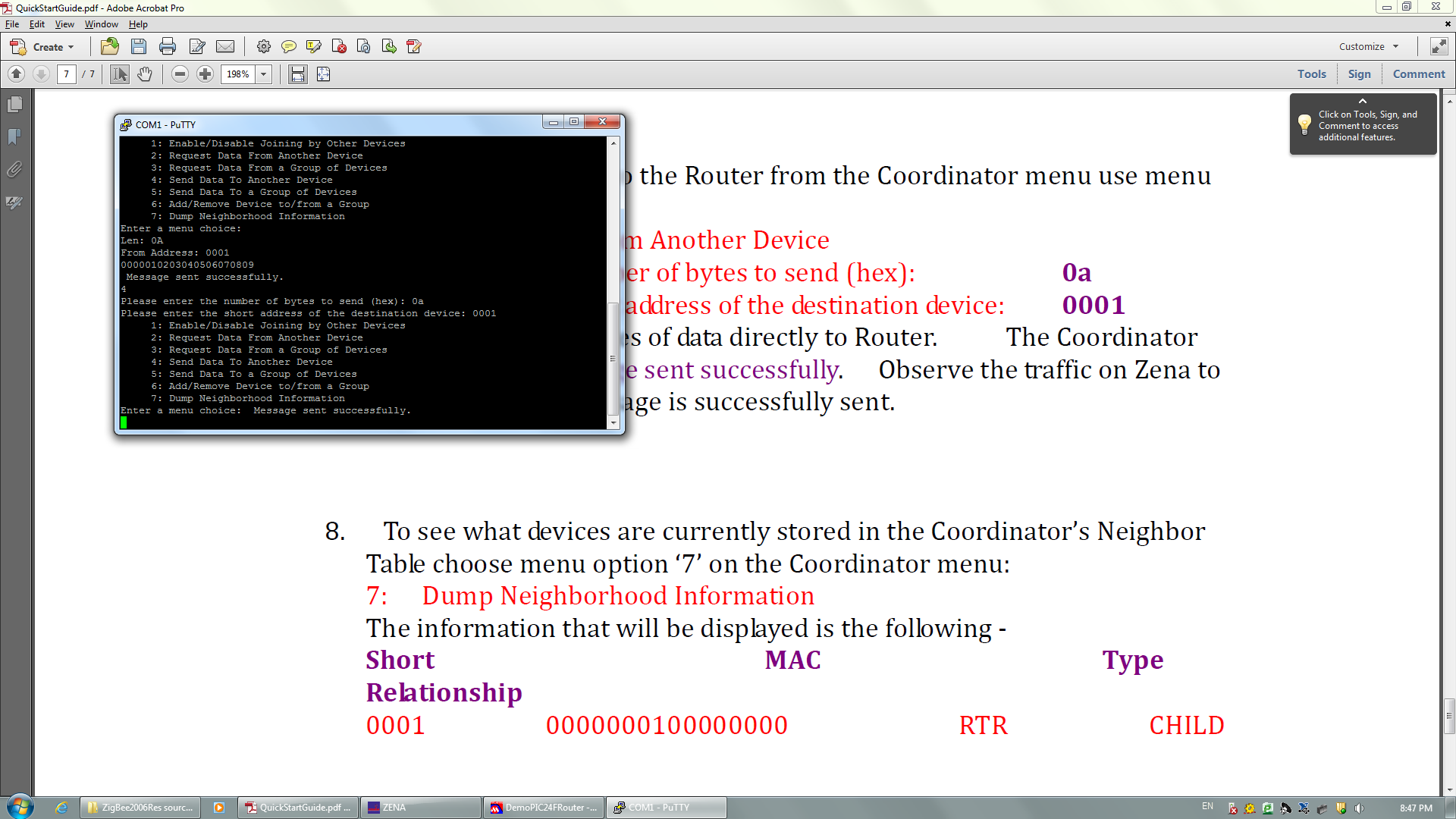
Hit the ‘Enter’, the menu system showed as below:



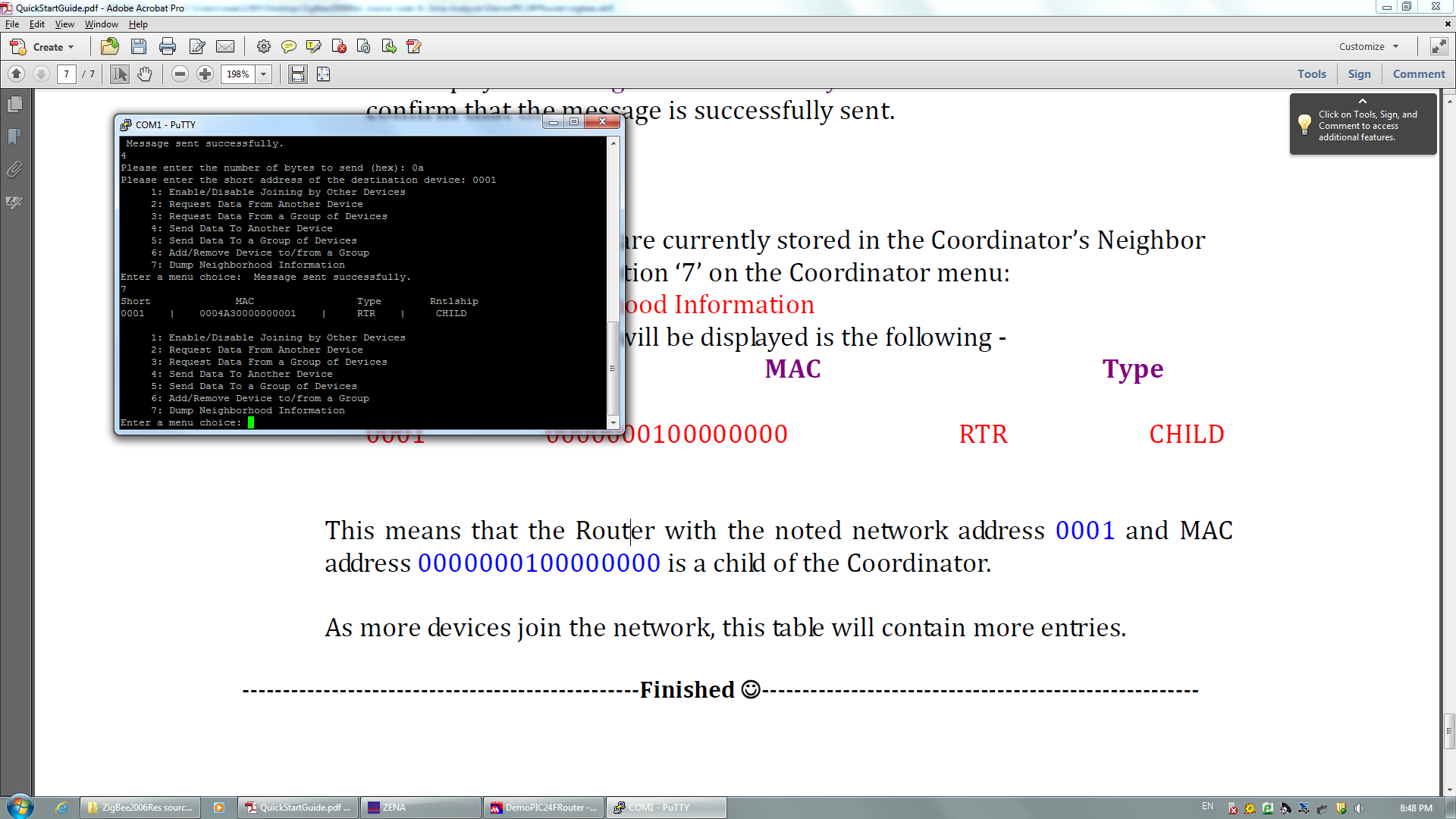
Then we typed 2 in the menu, the figure below shows the result:



Then select option 4, the result is:



The result of option 7 is shows as below:



**Ⅲ. Conclusion**

In this lab, we have learnt the general knowledgeable of ZigBee network and the hardware of this system, and got familiar with the working environment, learnt how to use ZENA packet sniffer. Also, the demo code was understood.

**LAB 2**

**Ⅰ.Introduction**

This report include two sections:

1. ZigBee network layer basics.
2. Try ZigBee networking through PuTTy.

**Ⅱ. Lab steps and results**

**Section 1**

The ZigBee coordinator use NWK (Network layer) to start new network, it can also provide new addressing to the device that joined the network.

There are three topologies for the ZigBee NWK: star, tree and mesh. For the star topology, the coordinator control other end devices directly. In Figure.1 the blue one represents the coordinator, in the PuTTy window we select option 1 and then choose enable join to let other devices join the coordinator, the pink one is an end device who join the network.

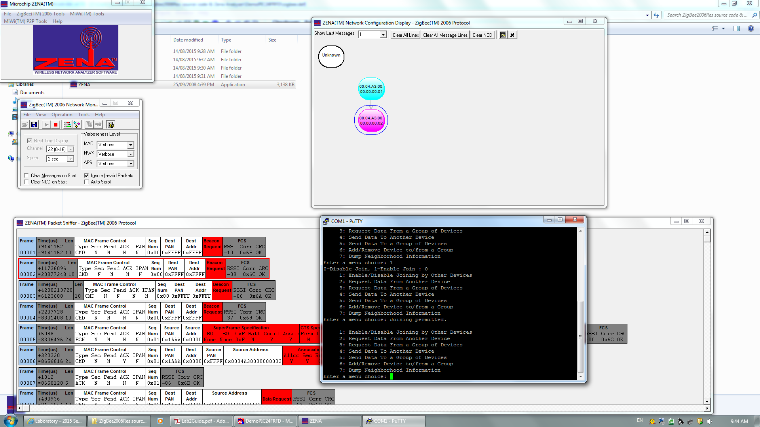


Figure.1

After that, we disable the join option of the coordinator, then setup a new device. As shown in Figure.2, the yellow one is the new device, it connects with the device we use in the last step. Otherwise, it will connect the coordinator if we do not disable the join for the coordinator, which shown in Figure.3

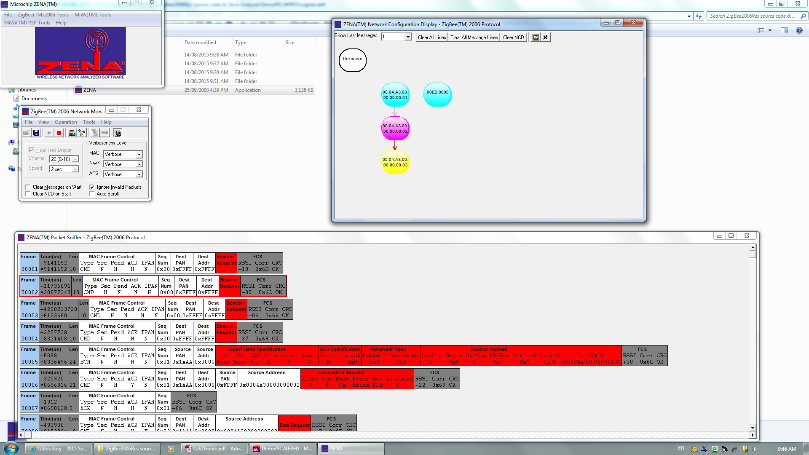


Figure.2

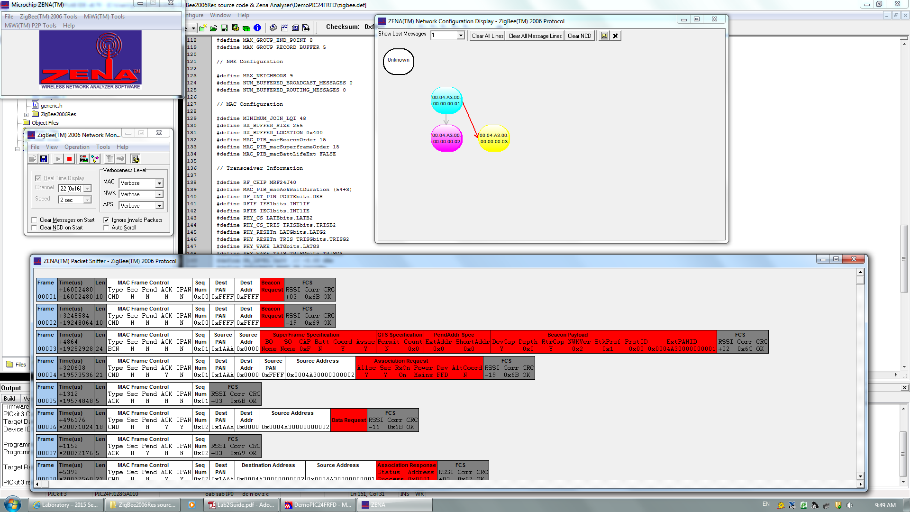


Figure.3

Here the figure.2 refers to tree topology and the Figure.3 refers to star topology.

**Section 2**

In this section, we establish a real ZigBee connection which include sending and receiving messages

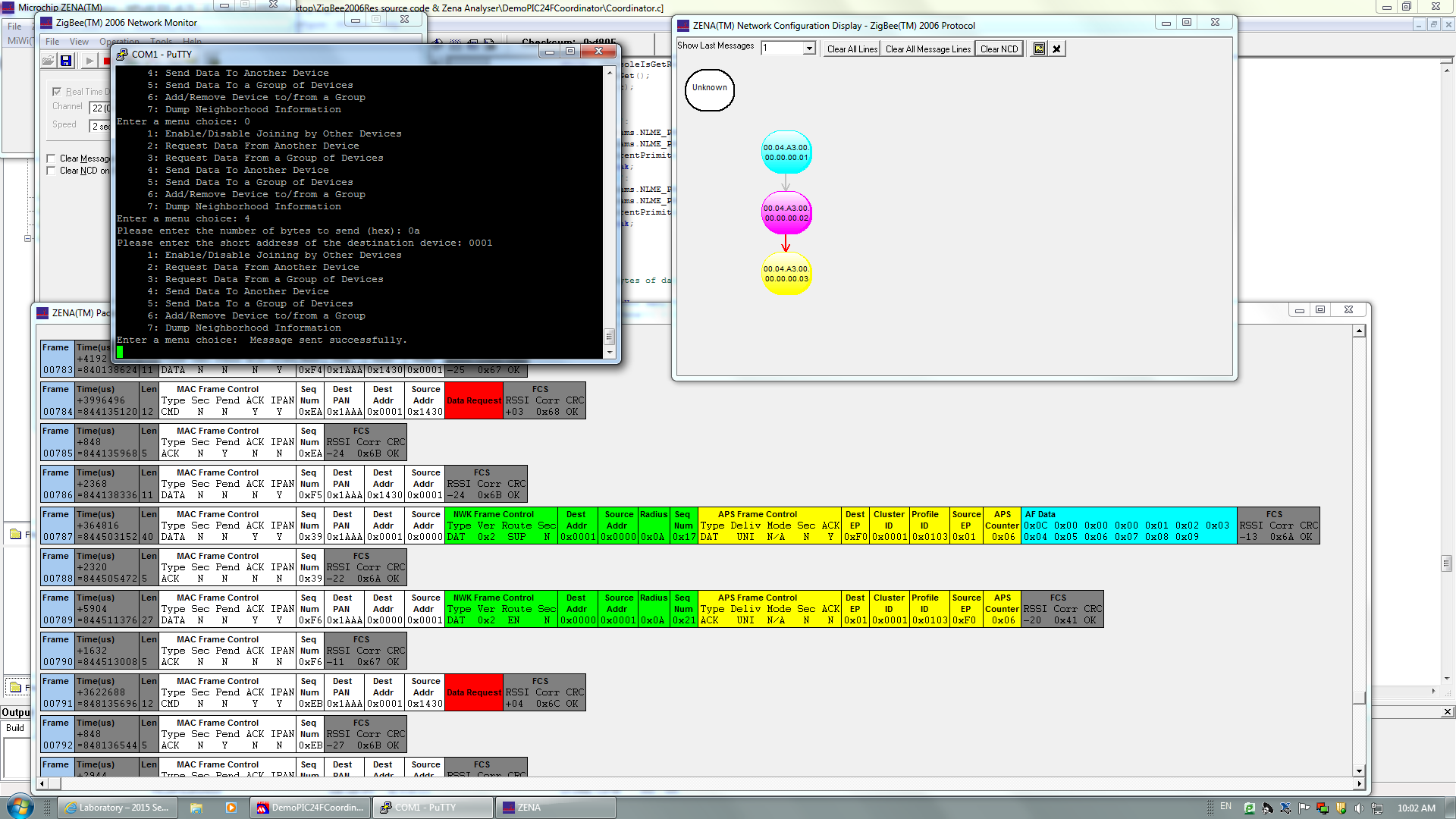


Figure.4

As shown in Figure.4, we can see MAC header (white part) and Network header (green part), in these two parts, we can easily find the Dest address and Source address.

There are three routing modes: suppress, enable and force. In this section, we only focus on the enable and suppress modes. Firstly we program the enable modes, as shown in figure.5 we write the codes from lab guide to change it.

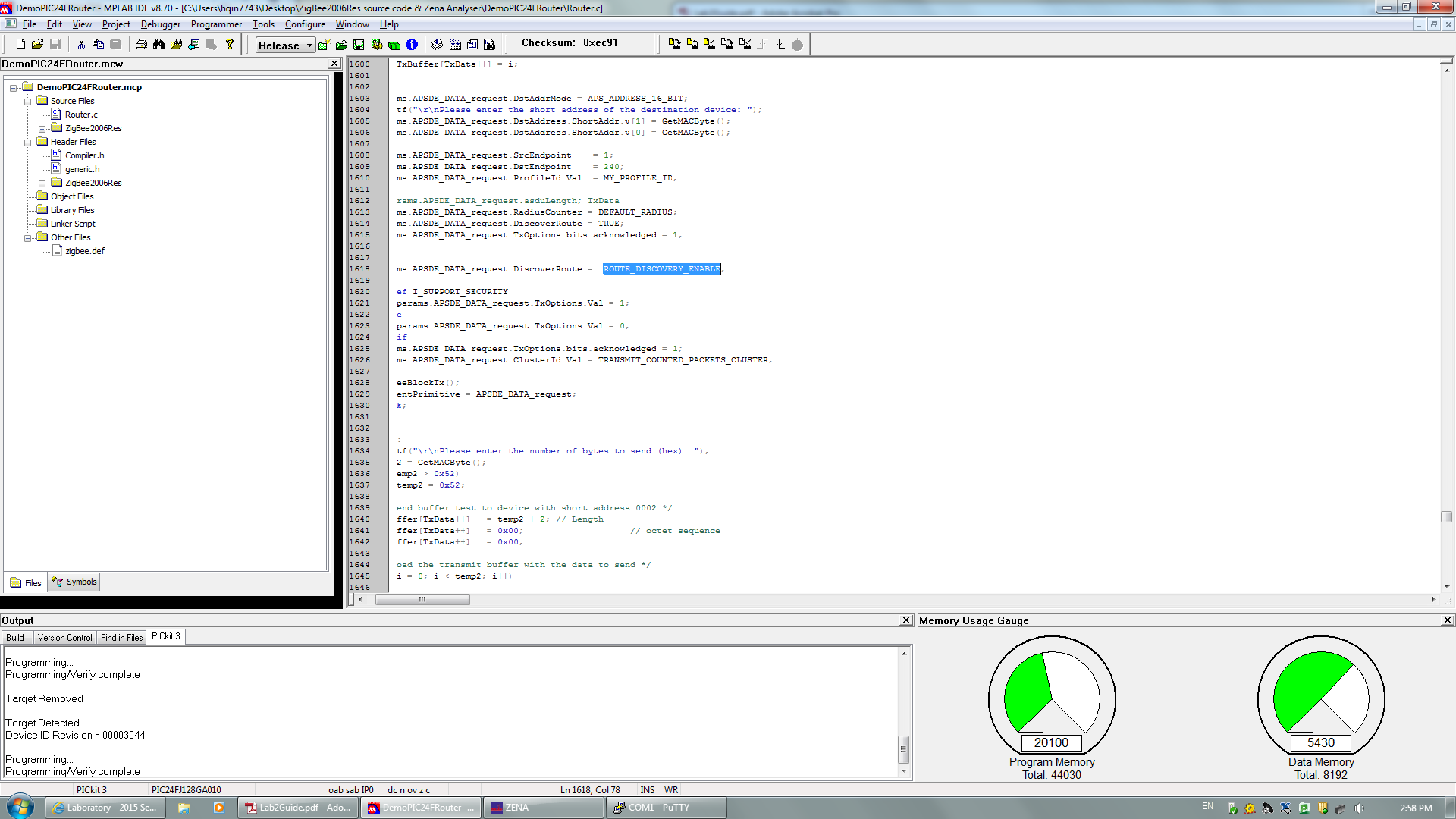


Figure.5

And now we can get the enable modes, we can check the result in Zena windows, in the Network header, we can see the EN which means the enable modes.

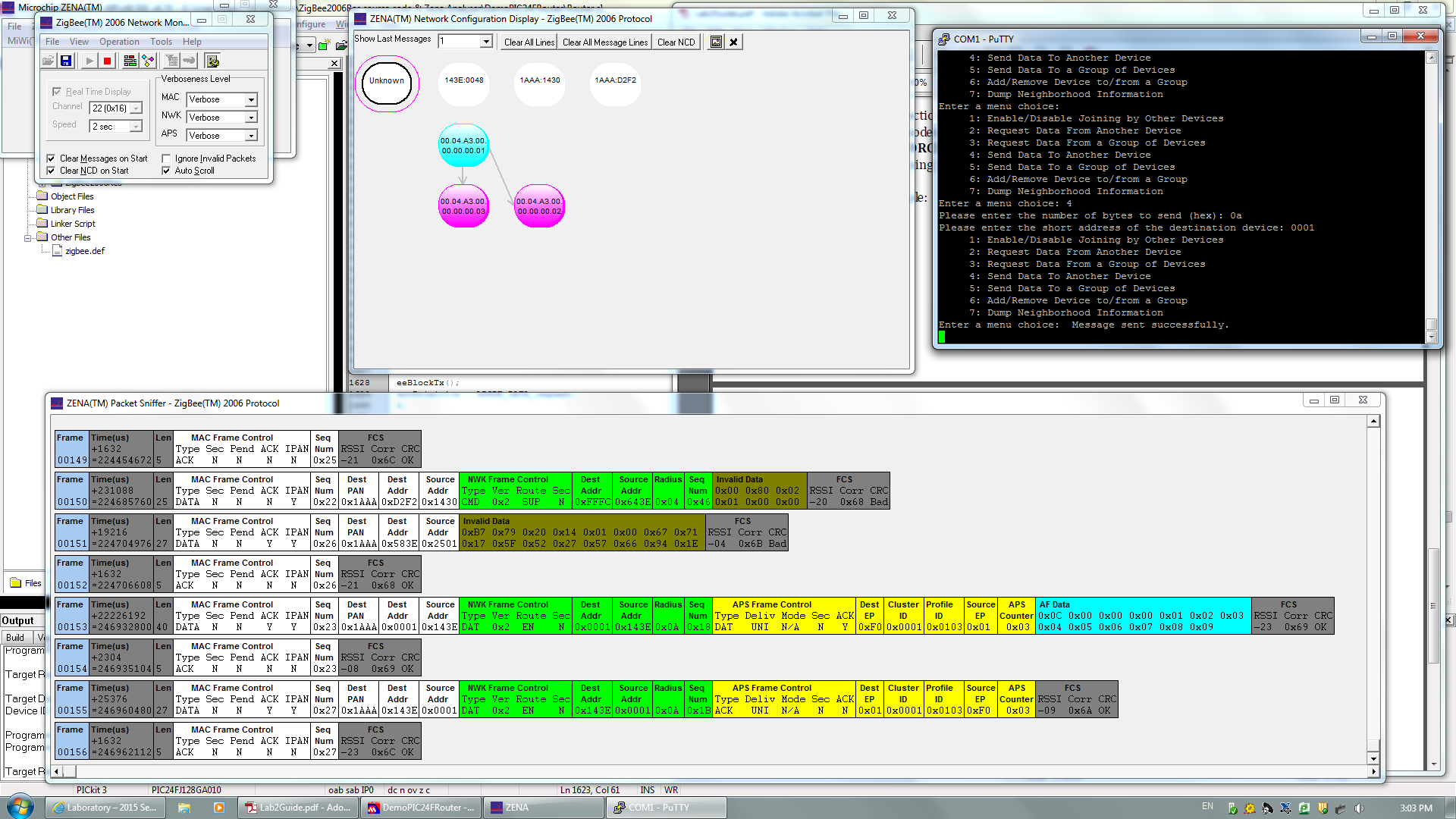


Figure.6

Next, we program the suppress modes by using the same way, as shown in figure.7.

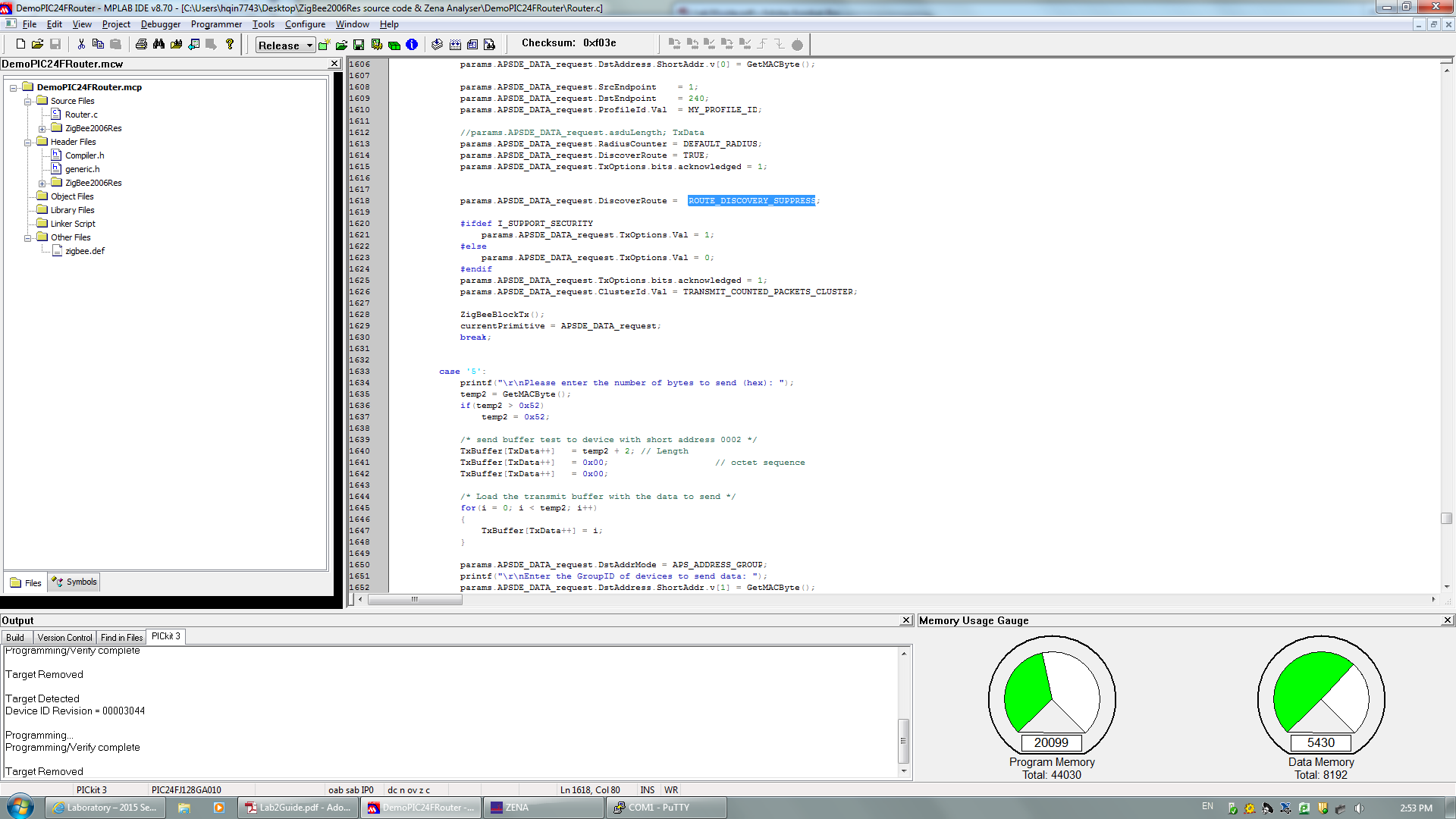


Figure.7

And now we can get a suppress modes, just check the Zena result shown in figure.8.

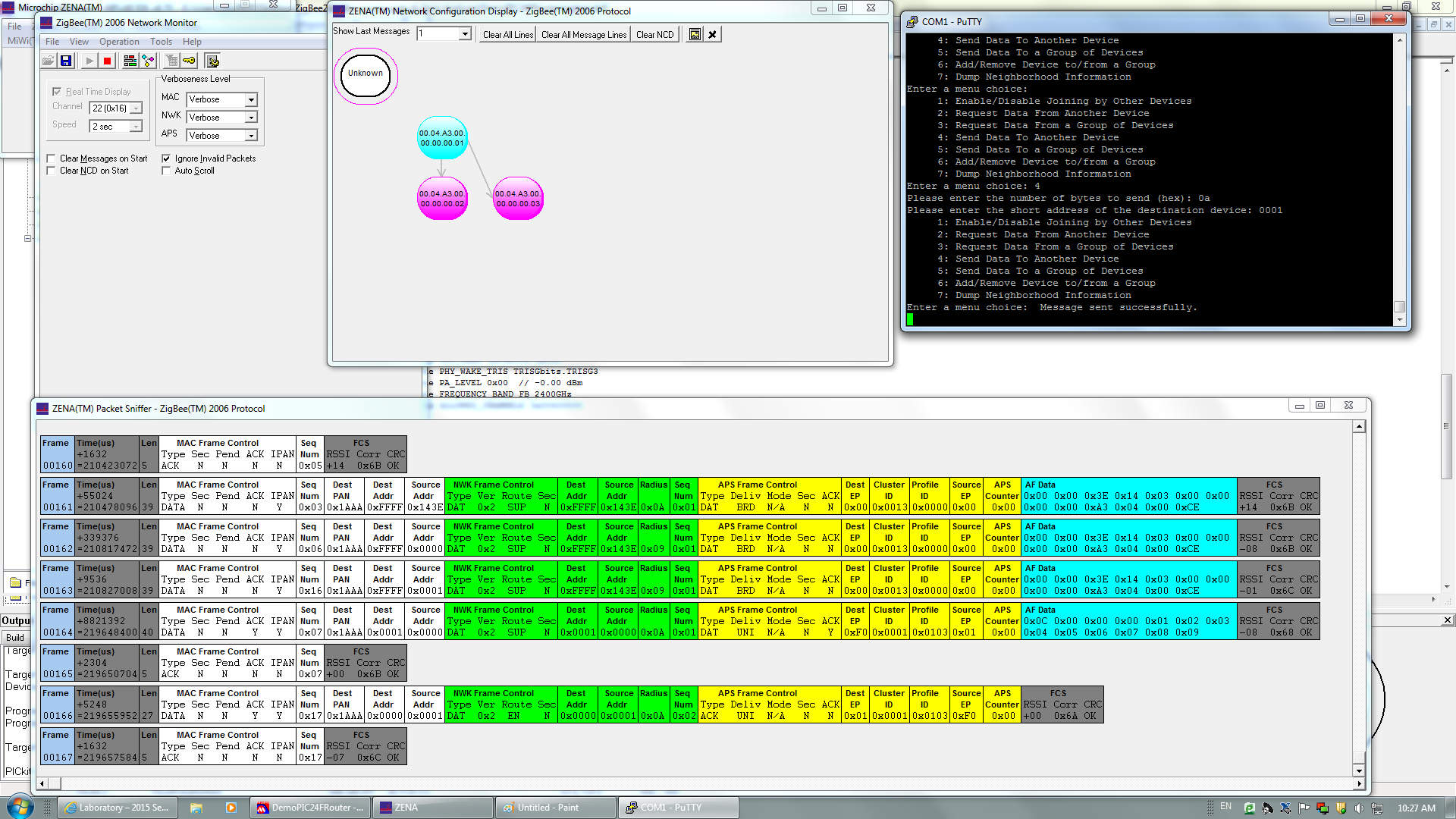


Figure.9

And now we get the suppress mode and we can see the packet capturing clearly.

**Lab 3**

**Ⅰ.introduction**

In this lab, we will start to learn the ZigBee source code structure, and how to program the ZigBee node by C language.

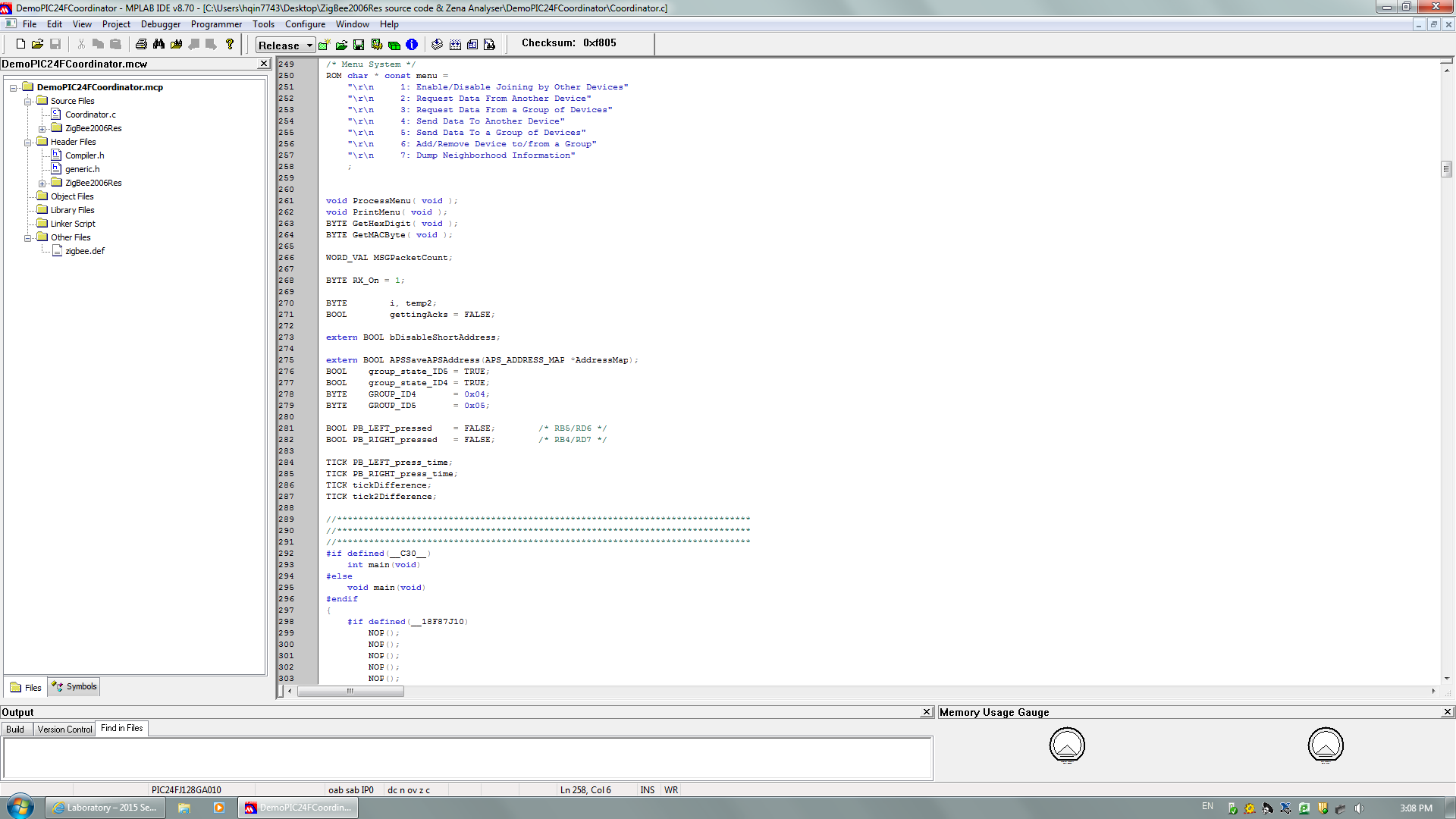
**Ⅱ .Lab steps and results**

**Section 1**

In this section, we investigate the source code of the ZigBee stack, we need to read the “Coordinator.c” file and try to understand the structure in the code.

**Section 2**

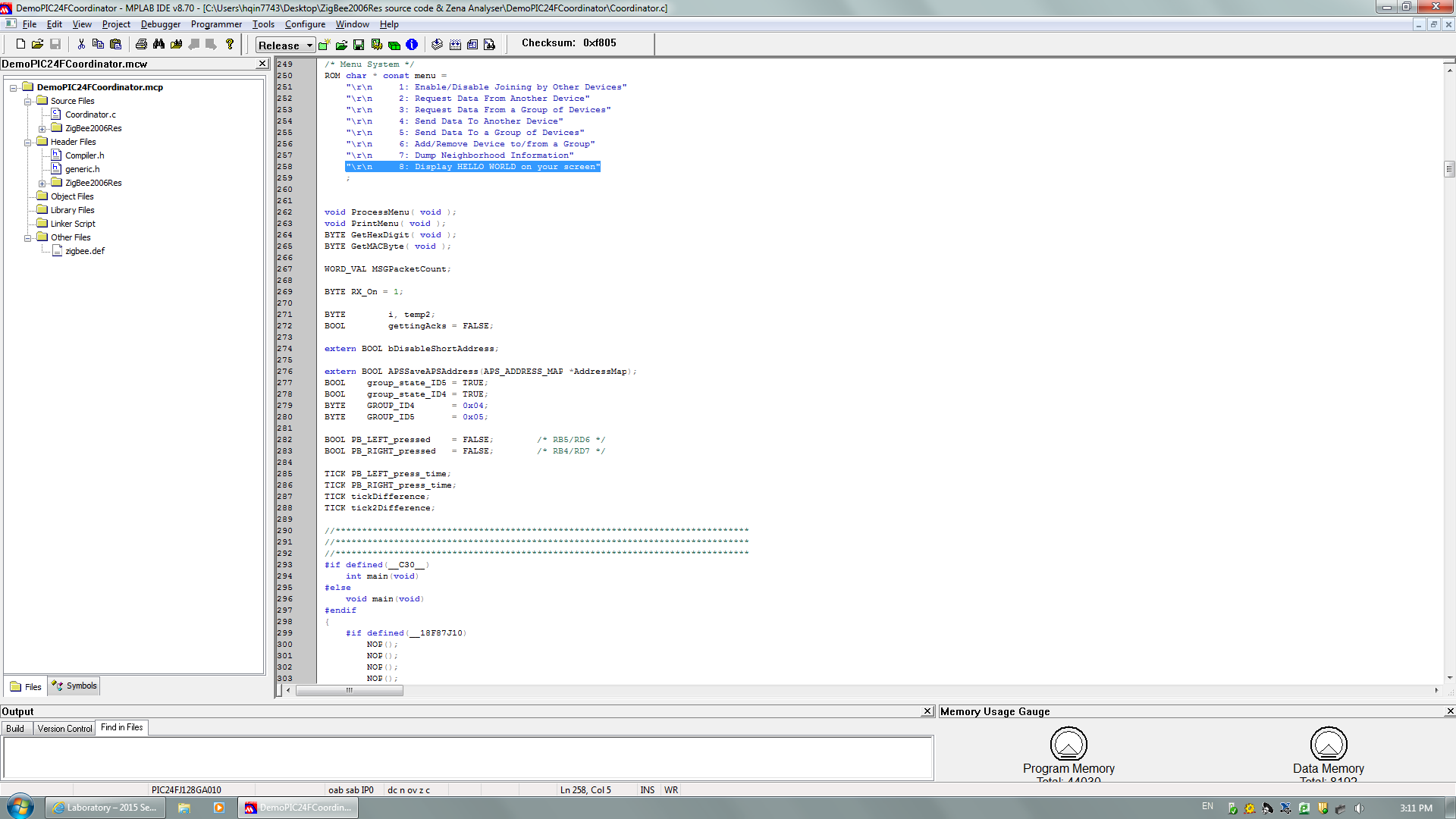
For this section ,we first read the menu of the “Coordinator.c” file to understand the how its written and how the functions works.



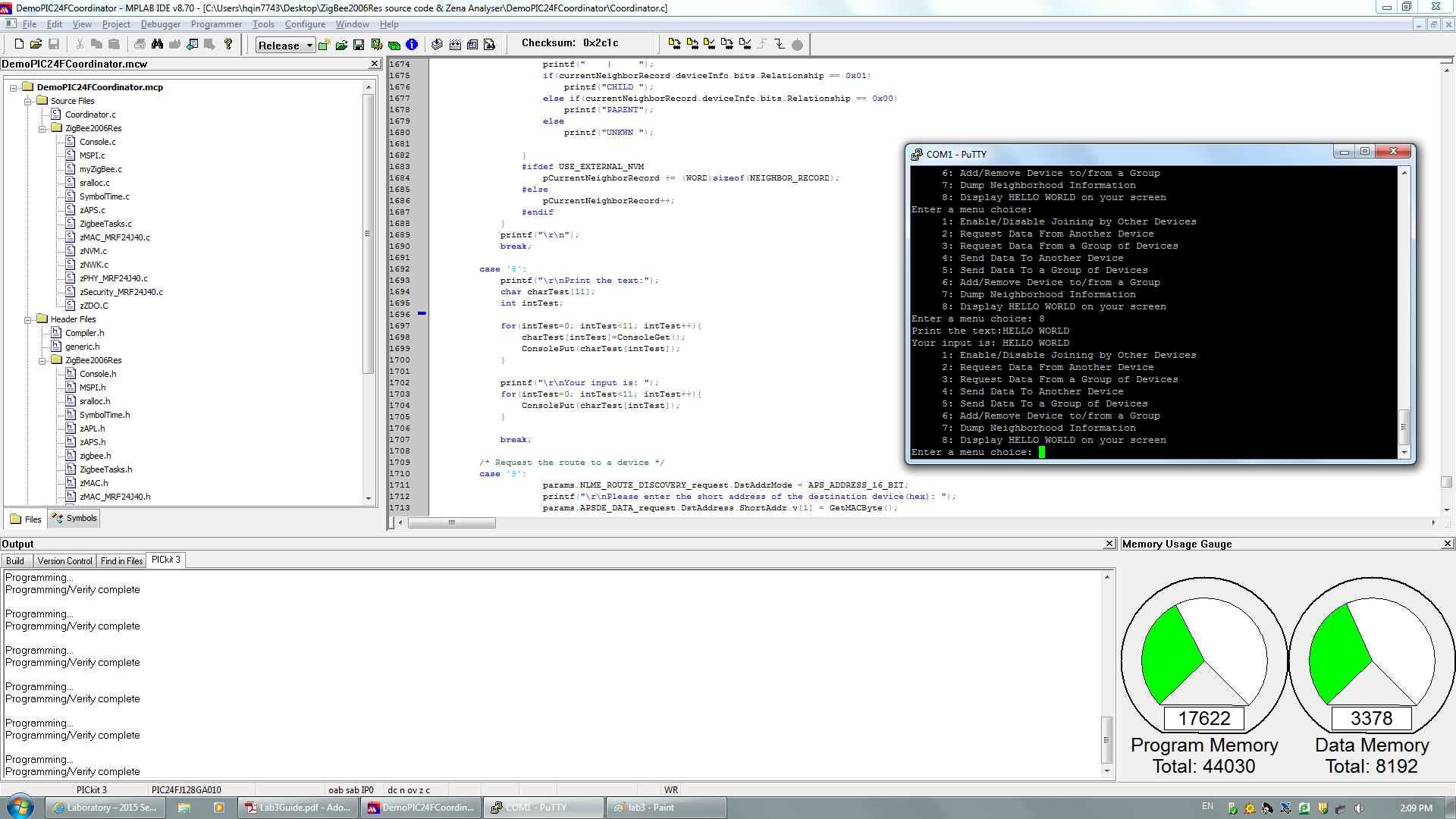
This is the picture of menu.



This is the code for one of the cases.

Then ,we try to modify the menu, we add an extra choice on the menu to display a string of characters.

From the picture above, we add case 8 option.



This is our detailed C code for case 8 in order to display a string of characters.

**Ⅲ .conclusion**

In this lab, we learned some information and knowledge about the structure of the source code and did some modification on the functions.

**LAB 4**

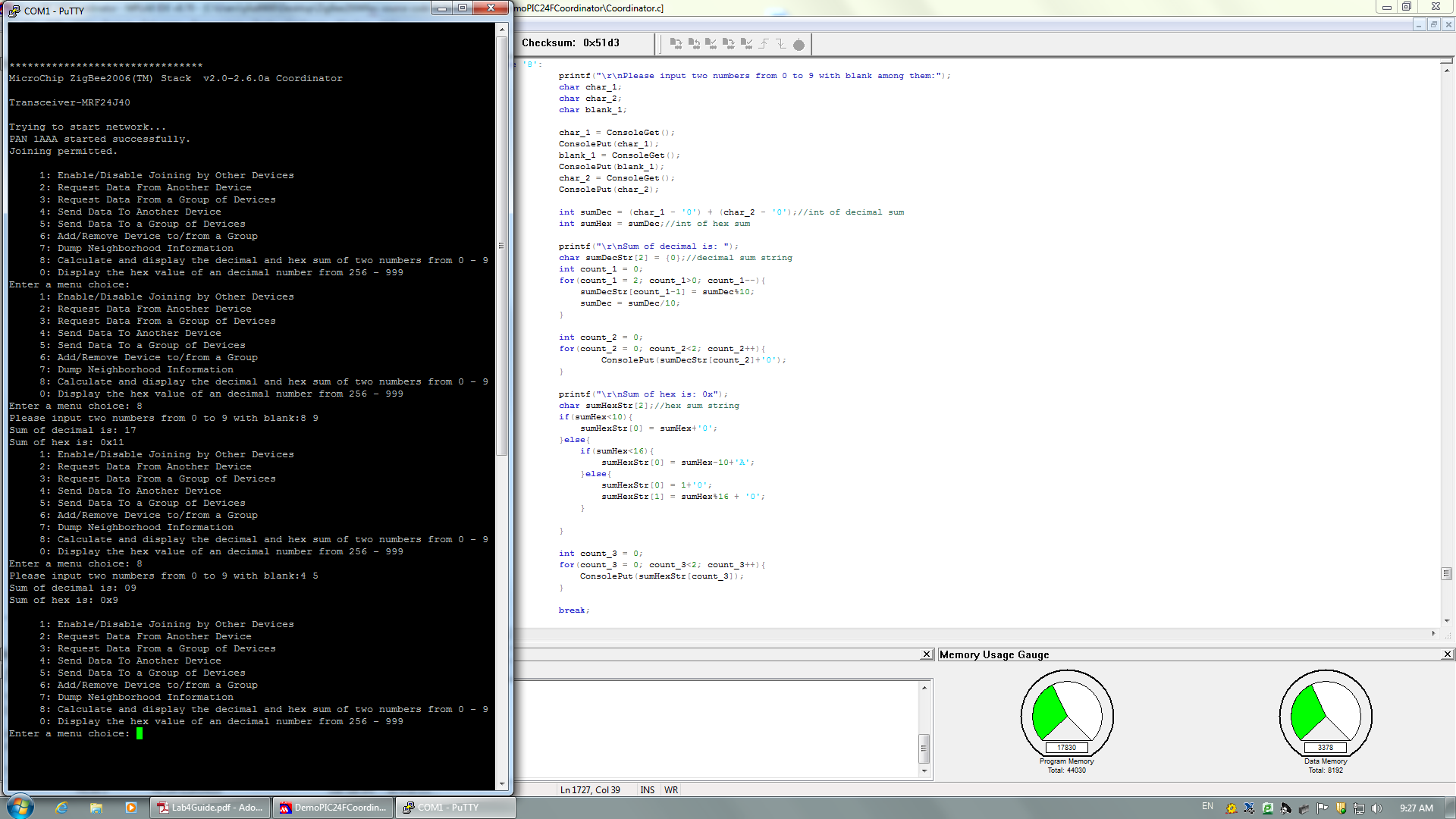
**Ⅰ.introduction**

In this lab, we have two program tasks, first is to calculate and display the sum of 2 numbers and second is convert decimal number to a hex number.

**Ⅱ. Lab steps and results**

**Section 1:**

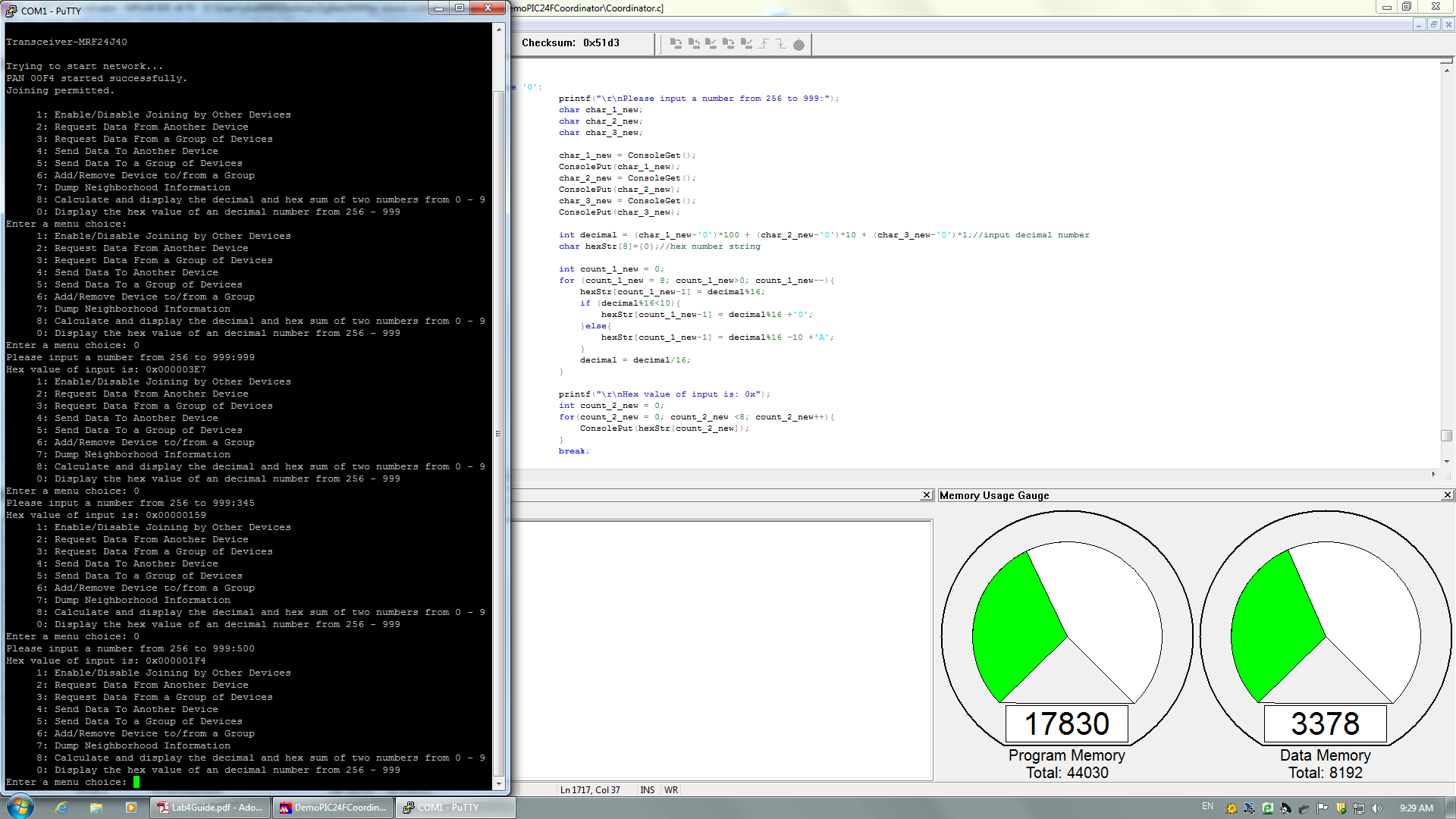
In this part we need to calculate and display the sum of two decimal input numbers which from 0 to 9, and turn it into hex value.

The code is displayed as follow.

And the outcome is shown in the putty interface, when we input 4 and 5 the sum is displayed as 9 along with its hex value 0x9.

**Section 2:**

In this section we will try to input a decimal value with wider range(from 256 to 999) and then convert it into hex form and output it.

The code we programmed is shown as follow.

As shown in the putty interface ,when we input decimal value 999, 345 and 500, we get 0x000003E7, 0x00000159 and 0x000001F4 respectively.

**Ⅲ .conclusion**

In this lab, we reviewed the C language and used that to add some new function for the source code.