Embedded System Design with ARM
Prof. Kamalika Datta
Department of Computer Science and Engineering
National Institute of Technology, Meghalaya

Lecture – 35
GSM and Bluetooth

(Refer Slide Time: 00:31)

Welcome to lecture-35. In this lecture, I will be discussing about two communication protocols, one is GSM and another is Bluetooth. So, this GSM this technology I will be discussing, and how we can interface with standard boards. And I will also discuss about Bluetooth technology, and how we can interface with standard boards.

(Refer Slide Time: 00:45)

So, GSM stands for Global System for Mobile Communication.

(Refer Slide Time: 00:53)

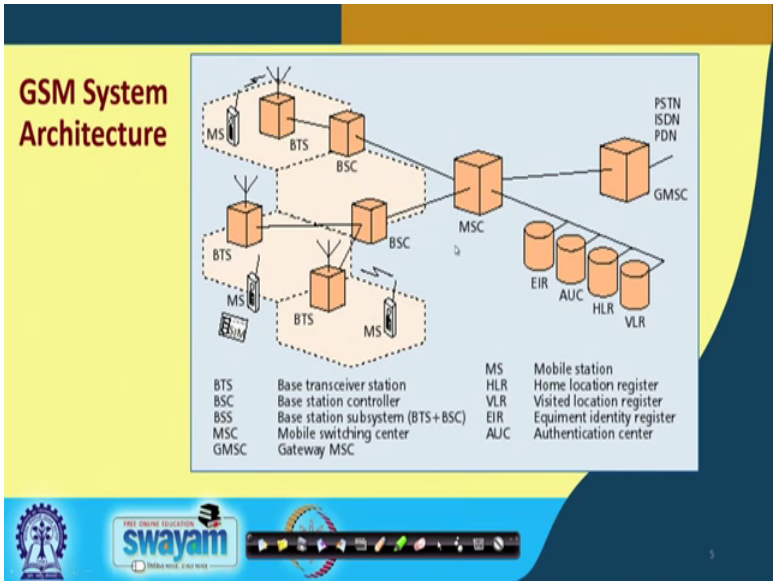
So, what is it? GSM is a digital mobile network that is widely used by mobile phone users ok. What it uses? It uses a variation of Time Division Multiple Access that is TDMA. So, GSM digitizes and compresses data, then it sends it over a channel with two other streams of user data, each in its own time slot. So, what does it mean? It means that it digitizes the data, compresses it, and sends through a channel where two other data are

also moving. So, they are sharing that channel ok, sharing a particular channel using time division multiple access.

GSM, along with other technologies, is part of the evolution of this mobile telecommunication, which include many other protocols as well. Like General Packet Radio Service that is GPRS for sending the packet data. Enhanced Data GSM Environment, that is EDGE. And Universal Mobile Telecommunication Service that is UMTS ok.

In our case, we have used GSM for transmitting SMS from the microcontroller to any other mobile device, and to receive the SMS from any other mobile device to the GSM that is connected with the microcontroller. So, these are the two things that we have shown in the experiment, but other things can also be done. You can send a packet through GPRS, so accordingly you have to make your GSM work upon. So, you have to use that particular command to make or send the data through GPRS.

(Refer Slide Time: 03:11)



This is basically the GSM system architecture. This MS is the Mobile Station ok, it is the mobile station, and it consists of two components basically. One is the mobile equipment, and another is Subscriber Identity Module that is the SIM ok. So, this is the mobile station. BTS stands for Base Transceiver Station ok, you see this is one person. So, this is one cell you have one BTS in this cell, you have another cell where you have one more BTS ok. And this is used and consist of high speed transmitter and receiver. So,

this BTS has got high speed transceiver and receiver. And it provides two channels, one for signaling for transfer of signaling data, and other for data channel.

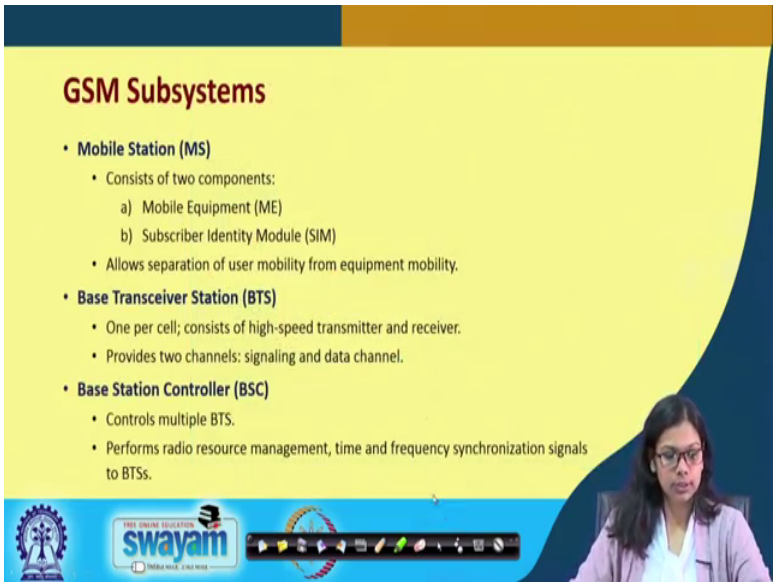
Then we have Base Station Controller BSC. And you see that this base is coming connected with two BTS ok. So, this base station controller, it controls multiple BTS, you have one BTS here, one BTS here, so which is controlled by this BSC you can see. And it also performs radio resource management, time and frequency synchronization signals to BTS ok. So, we have mobile station. Each of this has got one BTS in this cell. And these BTS number of BTS, which are in different different cells are connected with BSC that is Base Station Controller.

Next we see this MSC ok. So, this MSC is Mobile Switching Center MSC is mobile switching center. So, the switching node of a Public Land Mobile Network that is PLMN ok. So, this is basically the switching node of a public land mobile network. And what it manages its manages allocation of radio resources like handoff, and mobility of subscribers like location, registration etcetera etcetera. And there can be several MS's in this PLMN ok. So, you can have multiple such MSC's here. in the Public land mobile network.

Then you have one GMSC, which is Gateway MSC. So, you this MSC is connected now with the gateway ok. So, you have a this gateway MSC, which connects mobile network to a fixed network ok. And we often say that we are at home or we are at roaming ok, so that is HLR which is Home Location Register, and another is visited location or visitor location this register ok. So, these are the two important aspect of this GSM. So, for home location register this for all registered user, it keeps what it keeps the user profile basically.

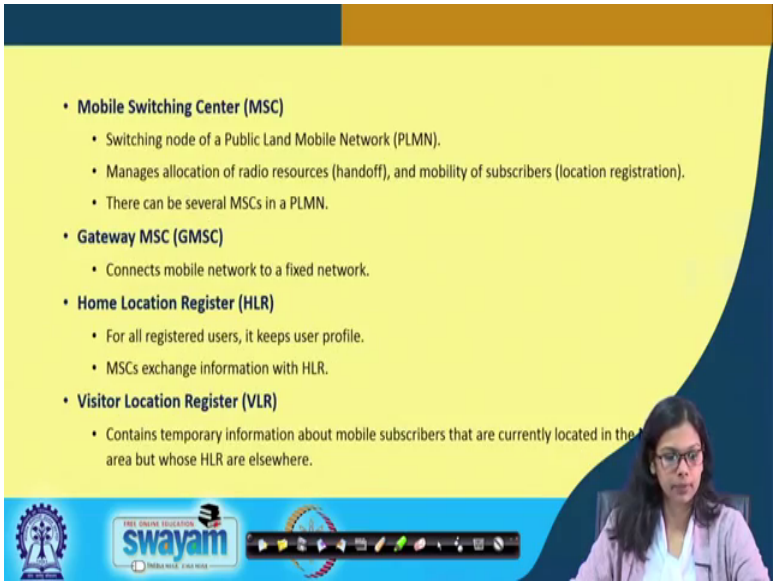
And this MSC exchange information with this HLR, so this MSC it exchanges information you see there is a connection with this HLR. And then this visitor location register, it contains temporary information, when you move let us say from location a, which is your home location to location b, which is the visitor location. There we have this visitor register ok. So, it keeps track of it contains temporary information about the mobile subscriber that are currently located in that MSC service area, but whose HLR are elsewhere that means, the home is elsewhere, but it is now a visitor for the other location ok. So, it keeps that information in this visitor location register.

(Refer Slide Time: 08:03)



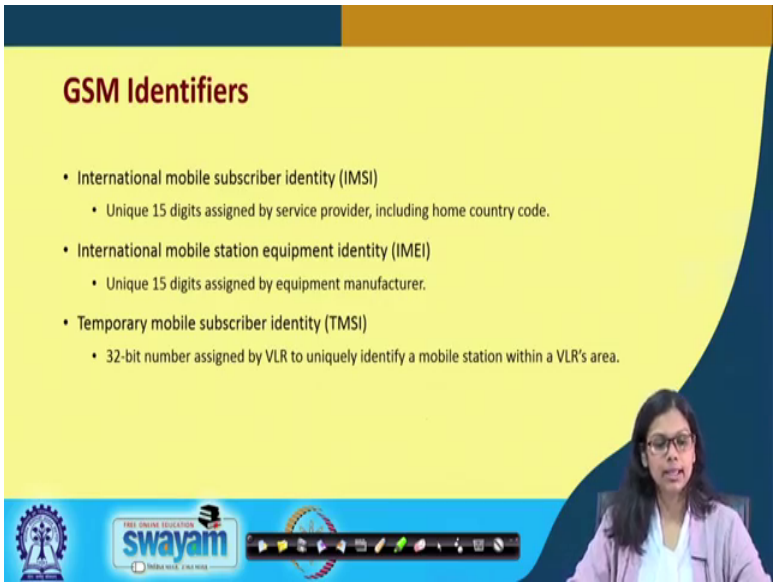
So, this is exactly what I have already discussed about Mobile Station, Base Transceiver Station that is the BTS, Base Station Controller.

(Refer Slide Time: 08:13)



Mobile Switching Center, a gateway MSC that is Gateway Mobile Switching Center, Home Location Register, and Visitor Location Register, which I have already discussed.

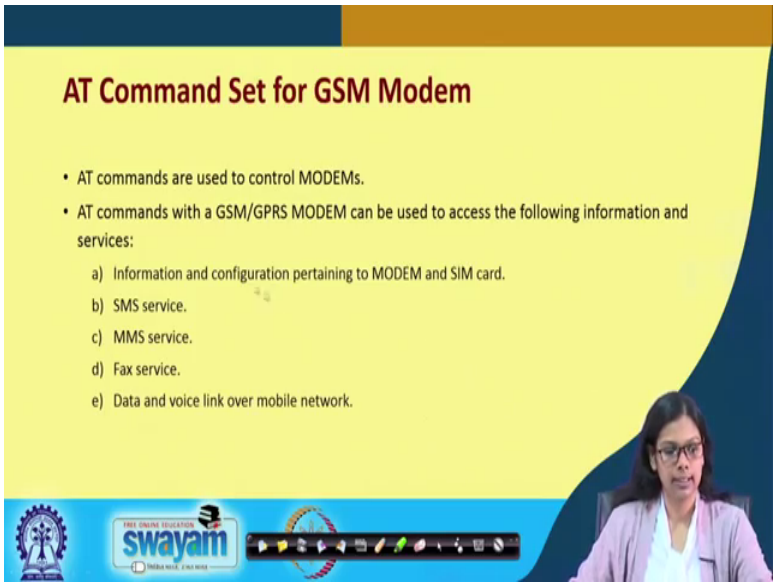
(Refer Slide Time: 08:27)



Now, this is an important thing what are the GSM identifiers. So, how a GSM is identified? So, it has got some unique identity. The first one is International Mobile Subscriber Identity, which is called IMSI. This is a unique 15 digit assigned by the service provider. So, you are actually taking the service from some service provided, so it is assigned by them including home country code. So, the home country code will be there. So, when you move to some other country and you use same thing, then that unique country code will be attached to it.

Next was next one is International Mobile station Equipment Identity, we have all heard of it that is IMEI number ok. So, this is a unique 15 digit assigned by the equipment manufacturer. So, when the manufacturer manufactures that particular device, it gives a unique number to it that is called IMEI number. Then there could be a Temporary Mobile Subscriber Identity, which is a 32-bit number which is assigned when you move to some other location by VLR to uniquely identify a mobile station within a VLR's region. So, this will also keep track of how many people from other region is moving here. So, they give this 32-bit number to get to those mobile you know mobile mobiles that are moving there.

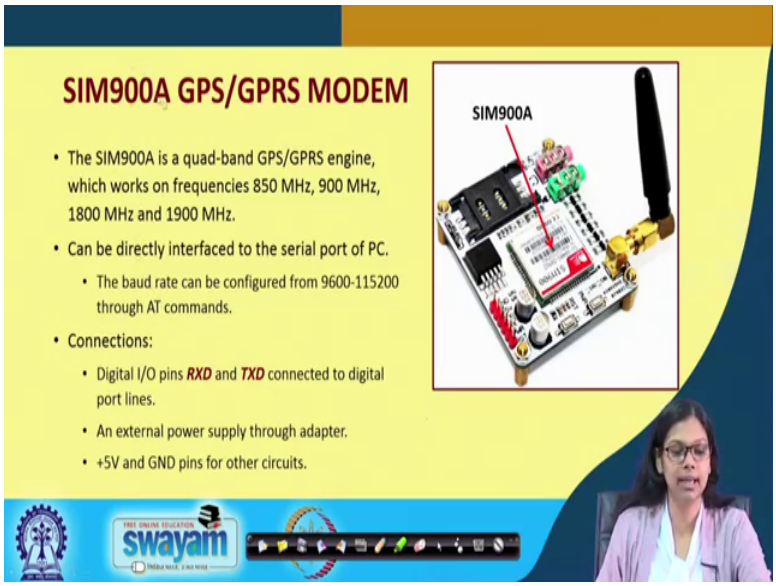
(Refer Slide Time: 10:17)



Now, these AT commands are used for to set up this GSM module. So, the GSM modem that we will be using we used AT commands, which we have also used in our code when we show you next. So, AT commands are used to control the MODEM's generally. And these commands with GSM or GPRS modem can be used to access the following information and services. What are the following information, information and configuration pertaining to MODEM and SIM card what is the information, I mean what kind of SIM card we are using about other configuration regarding the MODEM etcetera.

SMS service, MMS service, fax service, and of course data and voice link over mobile network. So, it provides all these services. In our case, we have used SMS service you can also use GPRS service for sending packet as well, but in our case will show you how we can use SMS service.

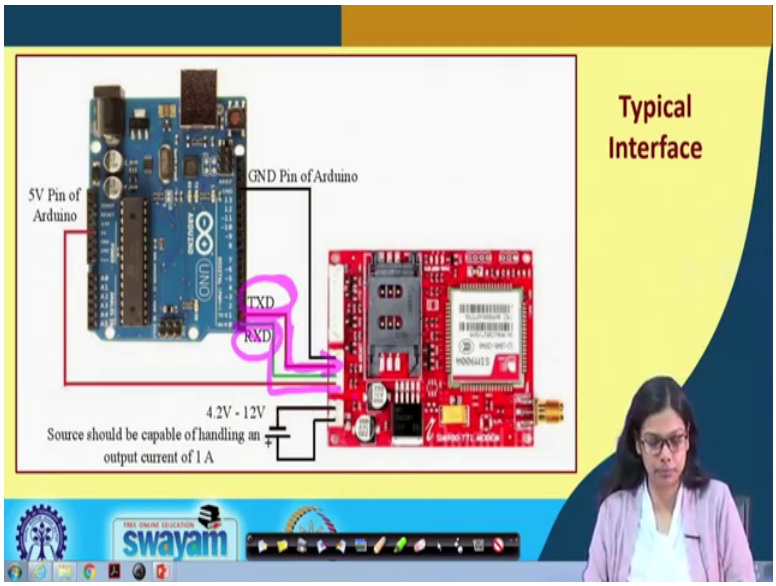
(Refer Slide Time: 11:29)



This is SIM900A GPS, GPRS MODEM. So, you see that whatever is the chip this is for the chip area, and this is the nine hundred SIM900. So, this SIM 900 is the same, and the board might be different. So, as I have already told you in the previous lecture that SIM900A is a quad-band GPS, GPRS engine which works on these frequency 850 megahertz, 900 megahertz, 1800 megahertz, and 1900 megahertz.

And it can be directly interfaced to the serial port of the PC; you can directly connect it to the serial port of the PC. The baud rate can be configured from 9600 to 115200 that also we can do through AT commands. Now, the connection is fairly still straightforward. The digital pins RXD and TXD that is the receiver and transmitter connected to the digital port lines, we will see that how we have connected. So, you have to make certain pincers transmitter and receiver in your board that will be connected to the GSM board transmitter and receiver. An external power supply through an adapter, generally we have given. And of course, plus 5 volt and ground pins for other circuits, it is required.

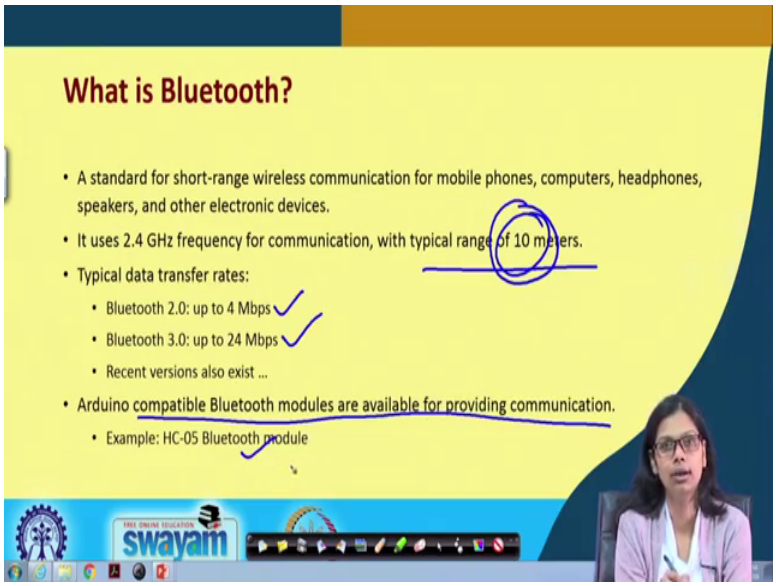
(Refer Slide Time: 13:03)



This is how the connection goes, this is the Arduino Uno board this is the 5 pin volt, which is connected to the GSM 5 pin GSM 5 volt. And this is for the ground, which is connected to the ground of the GSM. And the receiver of this GSM must be connected the transmitter of this pin, and the transmitter of this pin must be connected with the receiver of this Arduino pin.

So, we must understand this particular thing that whenever I say that here this will send some data, it will receive some data; this will send some data, and it will receive that data ok. So, one way communication will be this to this, one way communication will be this to this. So, accordingly the TX pin of this particular Arduino board must be connected to the RX pin of this SIM module. And the RX pin of Arduino must be connected with the TX pin of this particular model. So, we need to make sure that we are done with this proper connection is the typical interface that I am talking about.

(Refer Slide Time: 15:07)



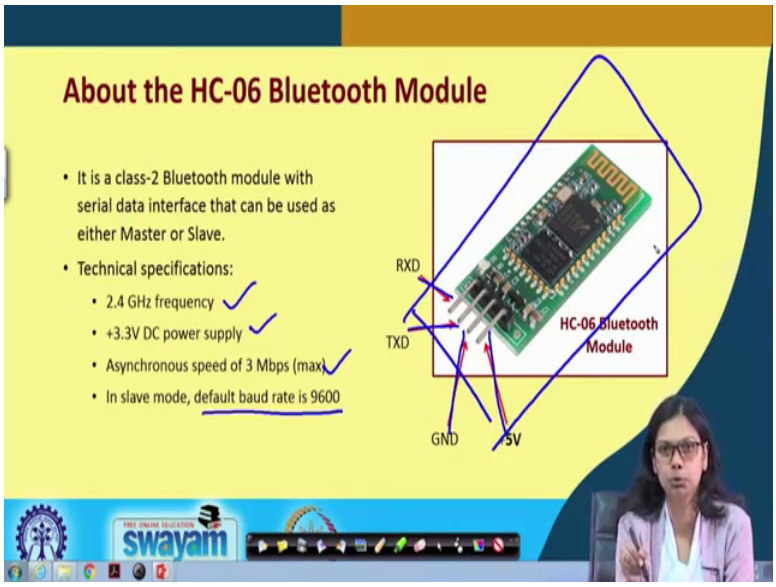
Next I will talk about Bluetooth; we all might have used Bluetooth in our mobile phones for transferring some let us say photos or any data ok. So, let me very briefly talk about Bluetooth. This is a standard for short-range wireless communication for mobile phones, computers, headphones, speakers, and other electronic devices. These days you must have seen that you have wireless mouse and wireless keyboard ok. The communication between the PC and the device is done through Bluetooth communication that is how they communicate with each other.

So, it uses 2.4 gigahertz frequency for communication, this is the frequency that used for the communication. And the typical range is basically this typical range is basically this 100 meter range it has sorry 10 meter range, it has got this is what is given that is 10 meter. So, the range for communication is not huge. So, in previous GSM module, we were saying that we were using a SIM module that was sending the data through SMS ok. So, if internet connection is there, then you can send the message to any place, any mobile number that range is not limited. But, here you see that it is limited by 10 meter only 10 meter devices could communicate with each other.

So, the typical data transfer rates are for Bluetooth 2.0 is up to 4 Mbps. And for Bluetooth 3.0, it is 24 Mbps, there are some recent version also exists. So, Arduino compatible Bluetooth are also there and of course STM compatible. Bluetooth module could be compatible with any board, you must connect it in that fashion, and you must

use the correct command for using it. So, you need to set certain things, certain baud rate you have to set, and accordingly you can use it. So, the example could be HC-0 fly 05 Bluetooth module or HC-06 Bluetooth module.

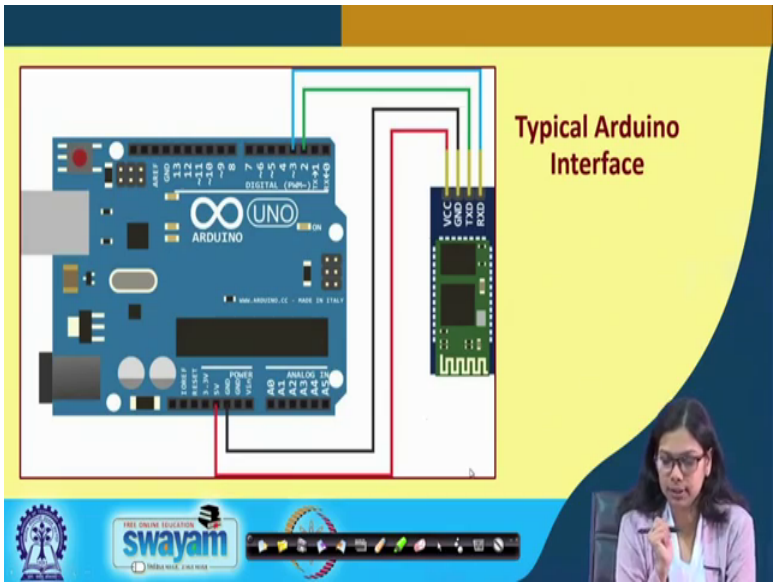
(Refer Slide Time: 17:35)



Let us see this HC-06 Bluetooth module. This is the Bluetooth module that we have also used it in our experiment ok. So, it has got this is 5 volt must be connected this is must be connected with ground, and this is the TX and this is the RX ok. It is a class-2 Bluetooth module with serial data interface that can be used as either master or slave.

Basically, so this is the, these are some technical specification, which I have already discussed 2.4 gigahertz frequency plus 3.3 volt DC power supply. And the speed of around 3 Mbps max. And in sleep mode, the default baud rate is 9600. So, when we do the programming, we will show you how to make connection with this particular Bluetooth module along with STM or without Arduino.

(Refer Slide Time: 18:49)



So, this is the typical Arduino interface if you see, where VCC is connected with the VCC 5 volt ground is connected, TX is connected with pin-2, which will be the RX. And RX is connected with pin-3, which was be the TX ok. So, this is the typical connection. So, this is all about some of the communication protocols that are there, and these are the protocols that we will be using it in the coming experiments.

Thank you.