Design for Internet of Things
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Lecture - 08
Introduction to RFID

Welcome back. What we will do now is we will take up this module on RFID. This is a very important chapter indeed. And this is actually the origins for the IoT itself. I will show you a graphic on that. But that is as we go along. But it is important to understand the protocol in great detail and also to dispel all the confusion that exists in RFID systems.

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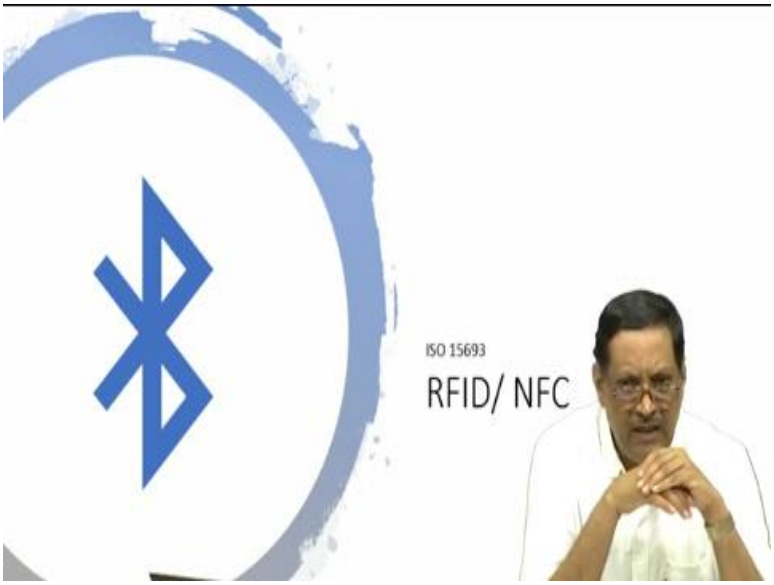

I have with me in the slide here, the RFID slash NFC, which I call the reason is NFC stands for Near Field Communication. And on top I wrote one number which is ISO 15693. You have to note this number carefully and within the 13.56 HF range itself, you have near field communication. I am sure you are some of you who have slightly higher end smartphones actually have Android Beam.

If there is an Android phone, you will have Android Beam and that Android Beam typically stands for the NFC capability on a phone. So, NFC has actually gone down to coming into a phone and there is a standard for NFC and of course, why ISO 15693 is a very popular NFC standard.

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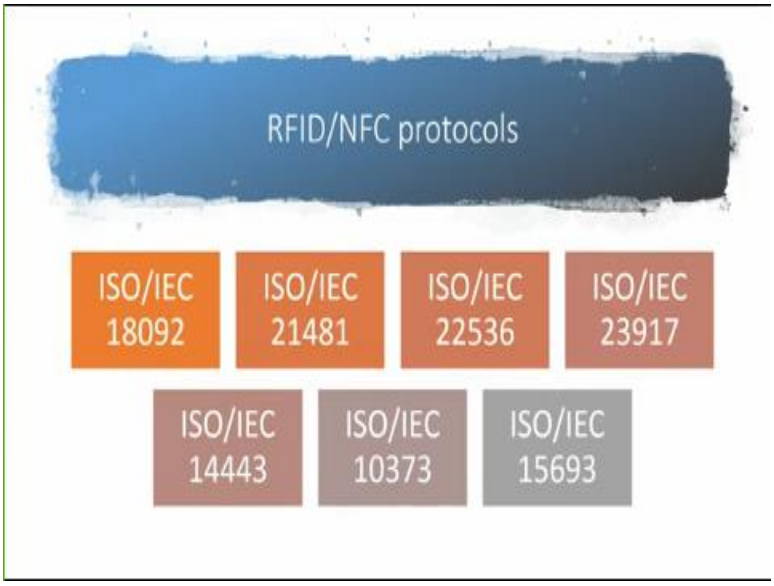

Quite like NFC and quite like ISO 15693 you also have other frequencies other protocols, there is a ISO 18092 and so on and so forth. What is important is apart from 15693, which you see on the extreme right, the extreme left is 14443 also very popular. So, 14443 and 15693 are 2 of the systems which essentially are very competing.

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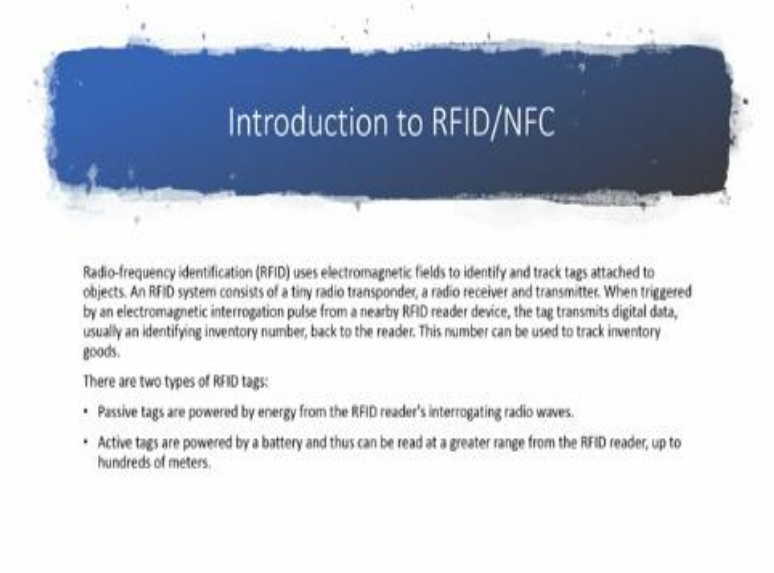

Now RFID uses electromagnetic fields, this is important and it is used to track identify and track the tags attached to objects. And as I mentioned, the RFID system comprises of a transponder which is also called the tag which is also called the card in our context and a transmitter. So, transmitter and receiver can be in one part of the system which is the reader and the transponder

is the one that is battery less and it may want to power up using the power given by the reader which is also called the interrogator and then respond back.

So how does it do that? Whenever it is triggered by an electromagnetic interrogation pulse from a nearby RFID reader device, the tag transmits digital data usually an identifying inventory number back to the reader. This number is used for to track the inventory of several goods. I mentioned to you that RFID tags are of two types, One is passive power is coming directly from the reader.

And it is giving information back to the reader using the same radio waves, which was submitted are supplied by the reader. We will see a little bit about that in the coming time. Then there are active tags, which I mentioned is also battery powered. And they can be read at a slightly greater distance from the leader up to a few hundreds of meters.

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This is an example of the ISO 15693 standard. You can see this application, particularly in COVID times. There is a device attached to the arm of the human. Maybe he is a patient and then, there is a device which the caregiver of the medical attendant can come close to the human and moment the device comes close to that device the other small tablet which is attached to the circular disk that is attached to the human.

It can read the blood glucose values which are stored on that tag and if it is being regularly monitored and stored on the tag, it means that the system must be holding on to a battery. So, this is in a way battery based tags which have the ability to acquire blood glucose from samples monitoring from the human store it and once a bigger device like the interrogator comes close to them, they have the ability to transmit that data back to those interrogating devices.

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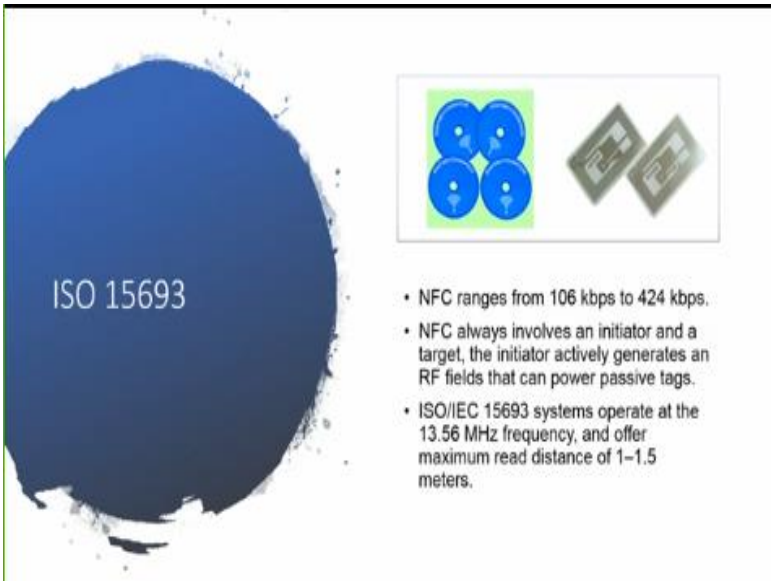

A little about 15693, the range is- so people often ask what is the data rate and what is the kind of transfer speeds that you get NFC typically gives you anywhere between 106 kilobytes per second to about 424 kilobytes per second. What you see on top are two pictures of a packaged tag and on the right side, what you see is a the inlay kind of tag where the chip along with the antenna is displayed to you to show that you get ISO15693 in different shapes and in different applications.

The claim is it should work between one and 1.5 meters, but we have not seen that kind of range at all.

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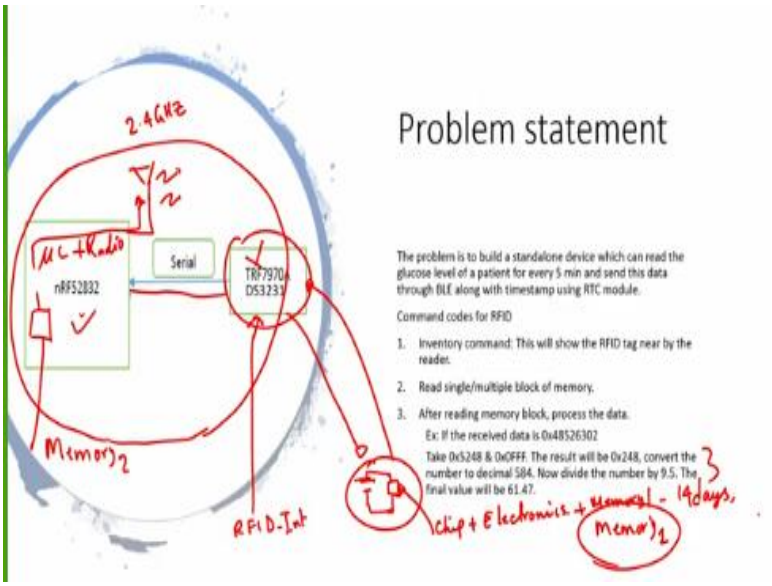

So, before we go into do anything, let us look at this problem that we want to solve and this way we can motivate ourselves into RFID. The problem is very simple. On the right side, what you see is this TRF7970A, ISO 15693 slash ISO 14443 chip, it can do both. Let us say you are able to configure this chip for ISO 15693 standard and using this little device we would like to fetch data from the disc which is available attached to the human.

And perhaps this disc inside if you open there is also a battery. So, let us redraw this disk for better understanding, there is this chip plus some other electronics, which is acquiring a blood glucose from the human and making an analysis of that and storing plus memory. And storing those values into the ram of this disk, you can store up to let us say 14 days. And the number of samples per day can be 2 samples per day or 3 samples per day or 4, depending on what you have configured, how often you want to know, the glucose level blood glucose level.

You could configure that this little disk and attach it to the human. And once this is put as a patch on the human, it is business is to go and collect the blood glucose values. Now once the data is there, you want to build a device like this. This is a microcontroller, it also has a radio and so on. So if you look it will have a radio of its own and this will be working in the 2.4 gigahertz range.

You want to get data from this RFID interrogator, where is this interrogator getting its data from? Well when you take this interrogator close to this disk data gets acquired back here, once the data is acquired here, it is now simple. So, when this device comes here, it puts data back here. Once the data is here, the data moves in this direction, and stores into this memory. I will call this memory 2, I will call this memory 1.

So, what is happening the human has one dispatch and data is collected stored in memory 1, every time this device which has the NRF and TRF7970A is brought close to this patch. Memory 1 data is given back to TRF, which in turn goes on serial port and stores in memory 2. And periodic intervals, you may want to take this and then put it out on the 2.4 gigahertz link. In other words, some of the parameters which are collected are now made available to you for further analysis.

So that is the experiment that we want to do. The notes are out here, we should try these things. The problem is to build a standalone device, which can read the glucose level of a patient for every 5 minutes and send his data through BLE along the timestamp using RTC module. So, it is a beautiful simple exercise, and we should be able to construct this from scratch and then we should understand RFID from that perspective, because we are trying to build some applications in RFID.

Now, what are the commands that one should use? Well, you should look up the datasheet along with the RFID manual standard to see how you can read the data. So we will spend some time there. One of the first things is the inventory command, this will show the RFID tag near by the reader then you have single read multiple block of memory, how much do you want to do? Do you want to read the whole of memory 1 which is now organized in terms of memory blocks or you want to do a single read is also to be decided?

And after reading the memory block, you have to process the block you may also want to do that and then make it available for communication over 2.4 gigahertz link. So, you can this last step is typically done not on this chip, but it is done here, it is done by the controller.

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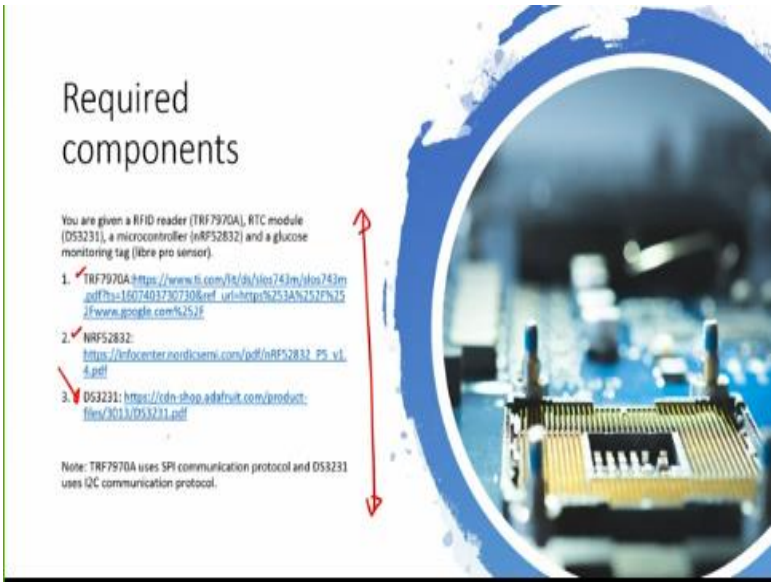

You can look up all these help parts, I leave it on the screen for you. You will know a little more about TRF7970A, ISO 15693 standard that you can configure for this chip. Then you can also know a little bit about the controller. And you will also know a little bit about the disk which we are using along with something related to the RTC chip.

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So these are some of the references. And for NRF 52832 you can look up how to test SPI, how to test I2C and so on. So let us try this practically and then move on with further topics on RFID. Thank you.