Introduction to Internet of Things
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Lecture – 53
Industrial Internet of Things – Part – I

This lecture is on industrial internet of things which is popularly known as IIoT.

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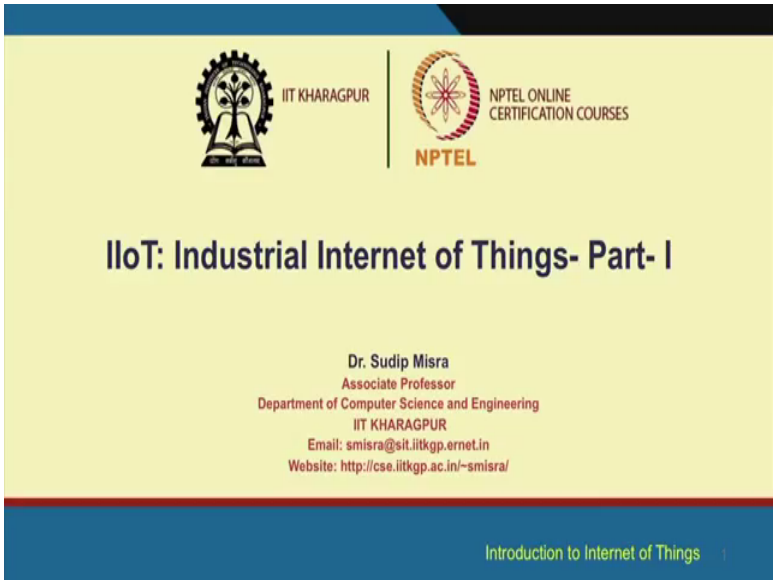

So, IIoT has differences with the existing IoT the popular IoT internet of things. So, industrial internet of things has a different scope and there are some specificities that are there in IIoT. So, we are going to understand in this particular lecture, what IIoT is how it differs from the regular IoT and how IIoT solutions are useful to real life industrial problems.

So, it is in two parts this particular lecture is in two parts the first part we are going to talk about some of the basics of IIoT.

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So, we start with the quote by Paul Howarth and what he has said is that IoT as a concept has crossed the chasm from slide ware to reality with many industries implementing IoT solutions. So, basically you know what it means is that IoT is no longer confined to theory and you know a type based a notion it is no longer like that you know. So, it is being used in reality in industries different IoT solutions are being implemented in the industry for solving different industrial problems to make industrial processes, manufacturing processes much more efficient then the way it is at present.

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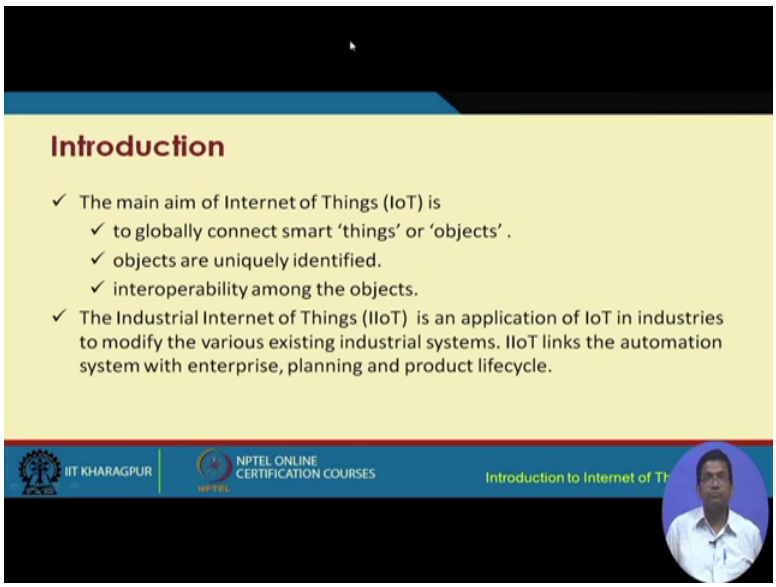

So, let us try to understand IIoT vis a vis IoT, as we have already understood through the previous lectures that the main aim of IoT is to interconnect different things and these things are different objects on the smart objects. So, what is required is to globally connect these smart object or the things so that the objects are uniquely identified and they are able to interoperate between themselves.

So, it is you know in an IoT solution we what we have are different objects which are smart objects, where there is intelligence that are embedded in the different things. So, there are embedded systems that are attached to the different things the worldly things and these things they which have their abstraction as smart objects they are able to interconnect with each other they are able to internetwork with each other and so on.

So, in the contrast in industrial internet of things, we are focusing on industries particularly focusing on industrial systems, industrial automation enterprise, systems enterprise, planning product life cycle and so on. And while we do it we basically digress from the core requirements of IoT and there are some specific requirements which concern industrial processes that come into picture. So, we are going to understand what these are in this particular lecture.

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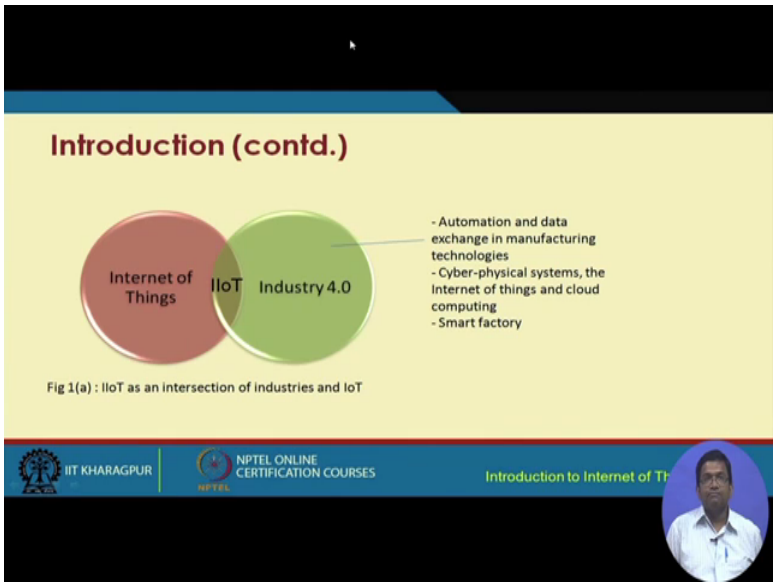

So, before that in terms of the scope of IIoT basically it borrows some of the features of the existing internet of things IoT, plus it borrows some features from the vision of industry 4.0. So, industry 4.0 basically gives a frame work for automation and data

exchange in manufacturing technologies. So, it is a vision it is a way forward that has been proposed. So, industry 4.0 basically tries to improve the automation and data exchange in manufacturing technologies, it tries to incorporate concepts from cyber physical systems IoT cloud computing and so on. So, what we have essentially is what is well known as the smart factory.

So, IIoT basically takes some features from the regular IoT the conventional IoT, some from industry 4.0 and try tries to have a separate vision separate technology for itself. So, what we have we have already understood that whereas, IIoT combines features from IoT and industry 4.0, it is not IoT as such we have to understand this thing. There are certain features that have been borrowed from IoT, but it is not the IoT. IIoT and IoT are not the one and the same they are not where as IoT focuses on consumer level services consumer level products and so on. IIoT basically has the focus on the enterprise. So, the scope for IoT is consumer level where as the scope for IoT is enterprise level.

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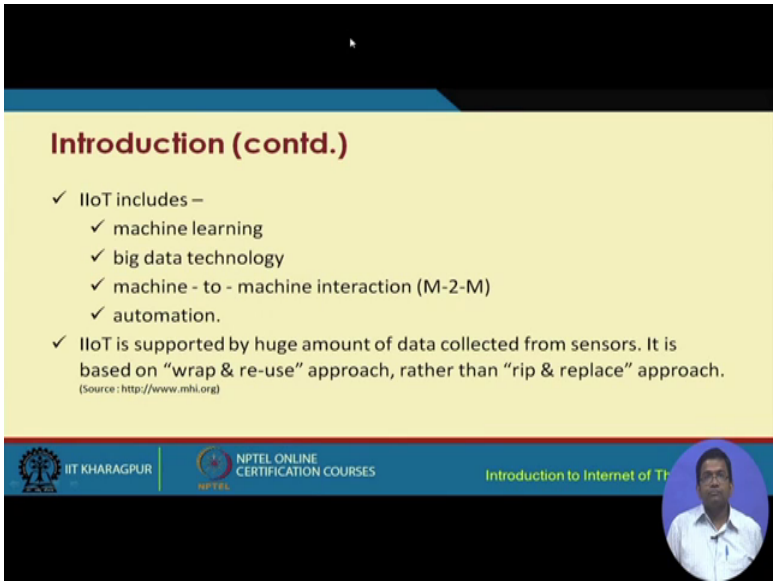

So, things such as concepts technologies methodologies, such as machine learning big data technology M-2-M machine to machine communication, automation these are some of the integral components for building IIoT. So, machine learning I think we all understand machine learning is very very popular it is a part of artificial intelligence it is a kind of artificial intelligence. So, which basically now learns you know. So, learning

form the past and there are different things you know. So, there are different aspects of machine learning.

So, learning from the data; the existing data and trying to make things predictive and trying to have things which are better in the future; so, machine learning techniques and technologies are used big data, we are going to talk about big data later on. So, in another lecture we are going to talk about big data how to handle big data what are the tools that are available. So, we will talk about that when we talk about data handling and data analytics.

Then machine to machine interaction machine to machine communication is about two machines directly talking to each other, directly communicating with each other getting a particular work or a task accomplished without any human intervention. So, for example, a robotic arm opening the door of a refrigerator and then performing certain other tasks in the refrigerator that is an example of machine to machine. So, may be the robotic arm goes and opens the door of the refrigerator checks whether there is sufficient milk in the milk pot of the refrigerator or not if there is no if there is no sufficient milk, then the system as a whole will send or the milk pot or the refrigerator will send an SMS to the milk person.

So, what is happening in the entire processes there is no human intervention. So, we have communicating with machine, another machine communicating with another machine and so on we have machine to machine communication M-2-M without any human intervention. So, going back we have machine to machine communication and automation. So, these are the different features different aspects of IIoT. So, IIoT is supported by huge amount of data collected from sensors, it is based on wrap and reuse approach rather than rip and replace approach.

So, what is meant by these terms is when we talk about IIoT, we are not talking about building a new system from scratch, we are talking about using the existing manufacturing systems, existing industrial systems you know rap them with sensors actuators and so on and make things efficient. We are trying to reengineer the existing systems and the processes and we are not building anything brand new from scratch. So, this is what we have to remember when we discuss IIoT.

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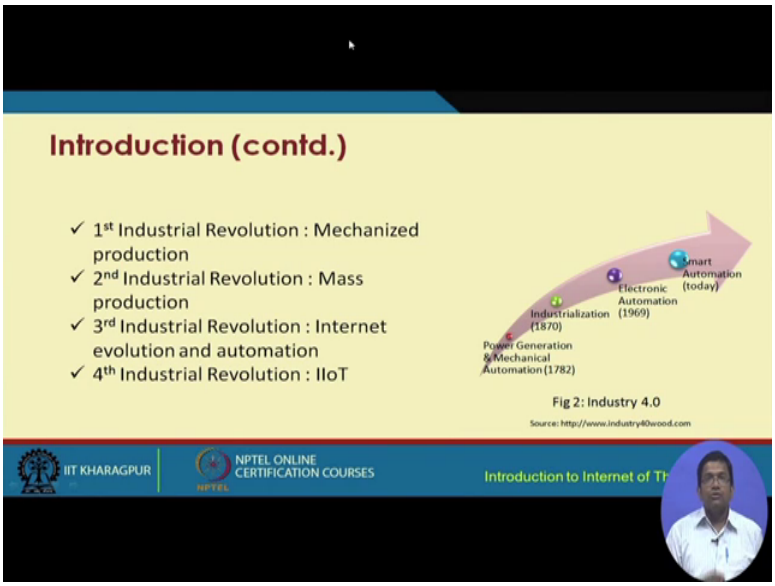

So, let us try to understand the evolution of IIoT. So, the first industrial evaluation happened with mechanized production, then came mass production which is the second industrial revolution in the third industrial revolution internet and automation was featured in manufacturing and at present what we have is the fourth industrial revolution which incorporates IIoT. So, IIoT is featured as part of the fourth industrial revolution. So, if we look at this particular figure what we have starting from 1700 when there was power generation and mechanical automation, then came the 1800s industrialization, in 1900s we had this electronic automation and at present we have smart automation and this is what this is how the industry 4.0 evolved today. So, in industry 4.0 we have smart factories and so on in the industrial sector.

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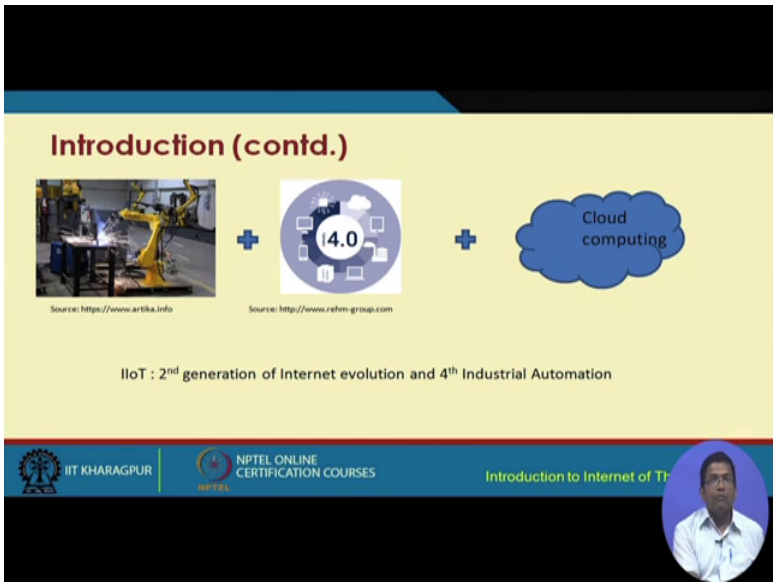

So, when we talk about IIoT it is about fourth generation of industrial automation; that means, industry for 4.0 clubbed with the second generation of internet evolution. So, internet at present; so, the first generation of internet is the internet that we all use the regular internet with connects different computers throughout the world this is the first generation of the internet. Second generation of the internet is about connecting different things, connecting different machines and so on.

So, IIoT basically combines the second generation of internet, fourth generation of industrial automation and cloud computing. So, cloud has become very popular technology since about more than half a decade or so, cloud has become very popular it is being used in the industrial sector as well. So, what happens is cloud basically offers computational environments computational infrastructure, computational platforms, computational software in addition to regular storage. So, cloud is like a huge data storage, which can store lot of data. And all these things huge data storage coupled with you know infrastructure software platform hardware and so on and so forth. Everything one can get access to in an industry without basically having to purchase these of their own right.

So, cloud computing is very popularly used not only in others spheres of everyday life, but also in the industry.

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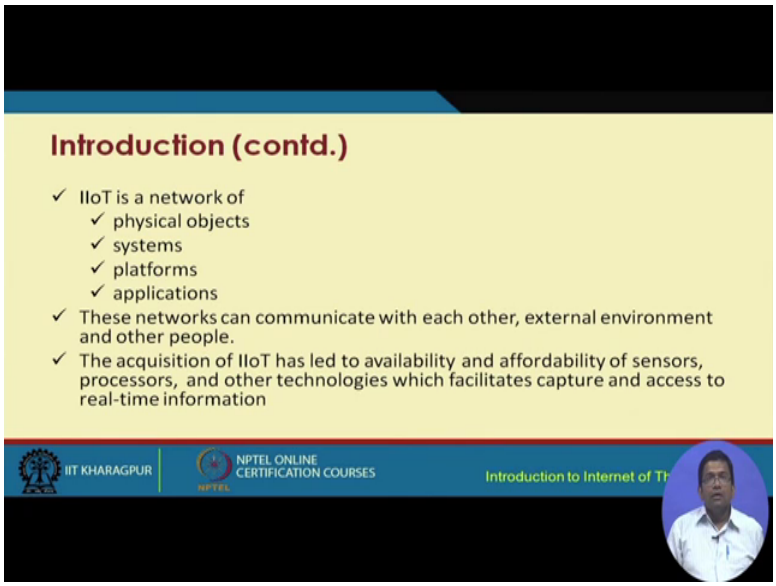

So, in the IIoT network we have physical objects that are interconnected, we have different systems subsystems that are interconnected, there are different platforms types of platforms that work together, different applications and so on. So, these networks are IIoT networks can communicate with one another, the external environment they communicate with the external environment and different people. So, people are also part of these IIoT networks. So, there are different peoples the different end users stake holders everybody at the enterprise level you know everything that is there they all form part of IIoT; they have to be internetworked of course, they have to be connected these things the things people processes everything together connected.

The acquisition of IIoT has led to availability and affordability of sensors processors and other technologies, which facilitate capture and access to real time information. So, all these IIoT devices and where ever they are deployed through sensors, sensors have become affordable they are readily available nowadays, the different processes, other computers other computing devices technologies and so on. They capture lot of data and they offer the data in real time for further analysis; making things much more efficient from the data that is collected.

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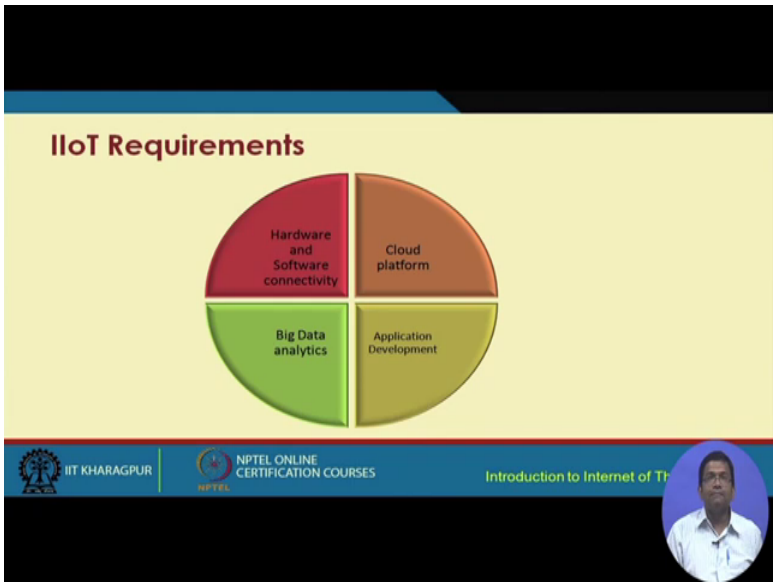

Moving ahead, IIoT for building; IIoT there are 4 broad requirements. We need the hardware and software connectivity, we need a cloud platform and I already told you briefly about the necessity of cloud in the industrial sector and how cloud can help with respect to processing infrastructure data storage and so on and so forth. Application development and big data analytics; big data analytics is very important all these different sensors in the industrial sensors the actuators that are fitted to these different machines, manufacturing equipment and so on they throw in lot of data they throw in lot of data and that data is very important is very crucial, it can reveal a lot of information and that by mining that data one can predict different things in a to make these industrial processes much more efficient.

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Different other views of IIoT requirements; one is access, access with respect to any time anywhere, anything connectivity and anything connectivity is very important it is a third dimension that has been added to anytime, anywhere which was the you know pervasive which was the vision of pervasive communication, pervasive systems. So, excess can you know one can have access anything can be accessed at anytime from anywhere in IIoT. End to end security is important and that is not only important for IIoT, but for any IoT based system. In fact, for any computer based system.

User experience is very crucial; you know ultimately it is all about offering services to the user's different stake holders. So, user experience has to be taken into account as one of the fundamental requirements for building IIoT. So, what the users exactly want, how they are problems can be addressed how it can be solved the problems can be solved, and how through the use of the system that is being developed the IIoT system that is being developed the users can do things better, and how their experience as a whole can be improved.

Transition to smart machines; so, machines by adding sensors actuators etcetera we are making the machine smart. Asset management is very important though assets management you know though these different sensors actuators etcetera the assets can be managed the industrial assets can be managed in a much more efficient way. So, how the

assets can be managed this is one of the requirements that have to be considered for building IIoT systems.

Big data and cloud are very important cloud offers storage computational efficiency and so and so forth. Without basically having one to procure and by procure and deploy this computational infrastructure at their own workplaces or industrial in the industry and big data you already told you that all these sensor actuators and each and every thing that we have talked about so far, the enterprise level at the enterprise level the people process things systems and so on and so forth. They are going to throw in a lot of data these data are going to be sent quite the data are going to be sent in real time and they have characteristics they are not only big in volume, they have they come in huge velocities and you know they there are different types of data test data, speech data, multimedia other types of data like images video etcetera all of which coming at the same time it has to be handled and so on.

So, this is what we are going to cover in one of the next lectures, when we talk about how to handle data handling and how to analyze the data that is received.

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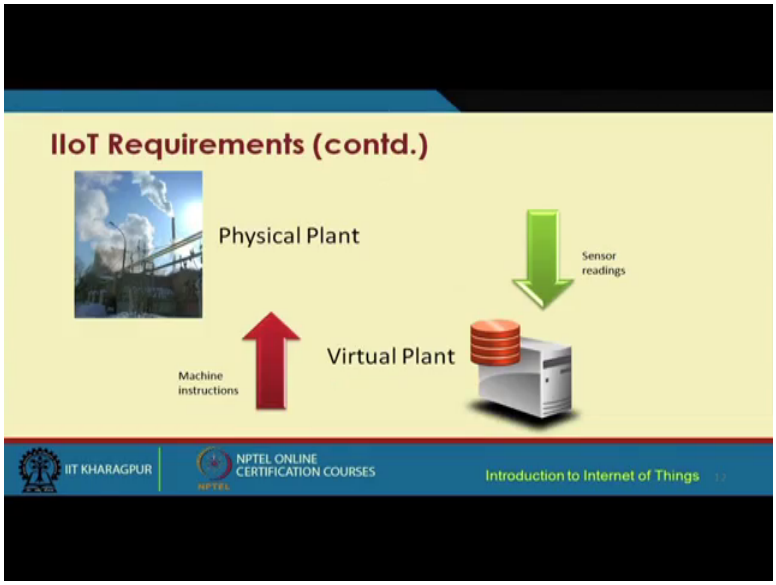

So, what we what is required is to have a virtualized version of a physical plant. So, through IIoT systems what we are trying to build is a virtualized plant corresponding to a physical industrial plant. So, these physical plant and the different machines in the plant are fitted with different sensors which throw in lot of data the sensors readings, and from

these virtualized plant lot of different types of instructions can be sent to the physical plant and the embedded systems that are attached to these machines to these instructions can help to maneuver to perform different operations on these machines.

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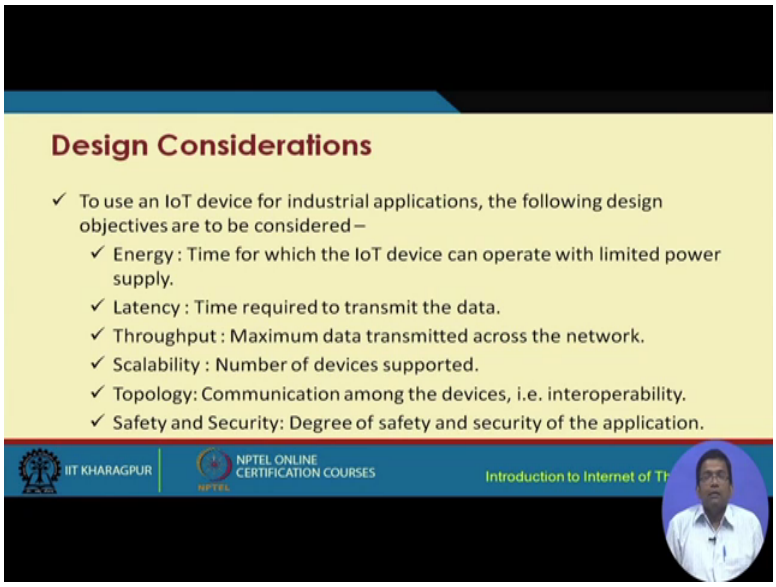

There are different design considerations for building IIoT, to use an IoT device for industrial applications these design objectives have to be considered. Energy is paramount energy with respect to the time for which the IoT device can operate with limited power supply. So, we have limited power supply and we want to extend the lifetime of the IoT device that is installed that is fitted with an industrial machine.

Latency is very crucial it corresponds to the time that is required to transmit the data latency has to be minimized. Because let us say that we are talking about sensors that are fitted to a welding machine. So, you see that if latency is not very minimum then what is going to happen by the time the instruction reaches the machine or you know the data is sent to the operator or from the operator to the machine, what happens is the welding machine might have performed more welding. Even in a been a fraction of a second. So, you know. So, more part will get welded which is not required.

So, precision with respect to the time is very crucial and when you talk about that latency of operations latency in the transmission of the data is very crucial latency has to be minimized to the extent possible. Through put is quite understandable we need maximum data to be transmitted across the IIoT network, scalability likewise is very under stable

we are talking about not just one or two machines, but large number of machines in the IIoT sphere.

Topology how these different because you know ultimately what is going to happen is this sensors and this communication devices, they have they are going to be internetworked. So, what we are going to have is a network topology and in this particular network topology we have different devices with different specifications, and they have been manufactured individually by different vendors. So, interpretability is very important not only that interoperability is important, but how these devices form the network is very crucial as well. So, the overall network topology formed out of the devices and how these devices interoperate with one another is something that has to be taken as one of the important primary design considerations in building IIoT.

Safety and security likewise I do not need to elaborate further, but are very important issues that also have to be taken into considering industrial safety you know. So, we need to understand this thing properly. When we are talking about automation as a whole in the industry it should not happen you know. So, things have to very reliable, the systems have to be very reliable it should not happen that the sensor is giving a wrong reading because of which a crankshaft or in a some of fuel you know goes through causing accident to the people who are working in the plant right. So, industrial safety is very important. So, IIoT system automation you know systems which offer automation etcetera they have to be very much reliable, and they have to take in to account the degree of safety and the security of the application.

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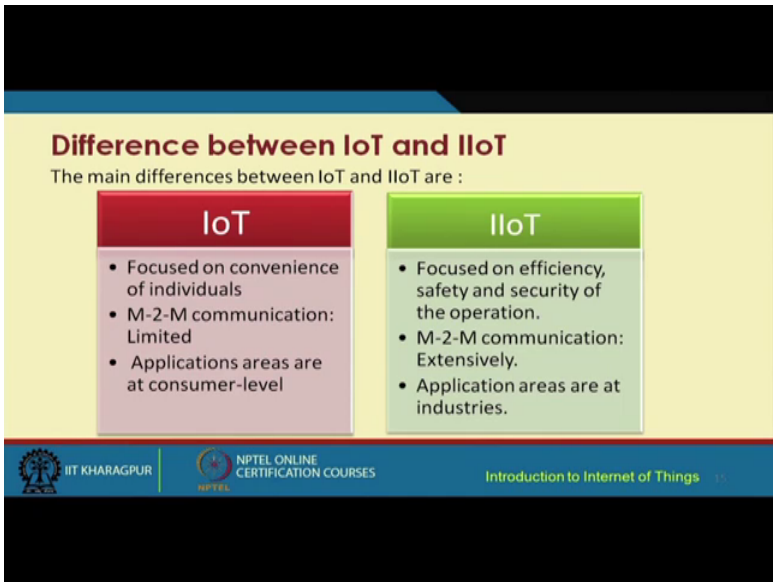

So, going back trying to understand IIoT vis a vis IoT. So, whereas, IoT traditionally focuses on the convenience of the individuals, IIoT focuses on the efficiency safety and security of operation. In terms of the machine to machine communication and machine to machine communication I already spoke about earlier, in terms of machine to machine communication IoT definitely uses machine to machine communication, but it is not very exclusive you know the use of IoT machine to machine communication in IoT is limited whereas, IIoT extensively uses machine to machine communication M-2-M communication is extensively used in IIoT the whole industrial operation in a plant is automated. So, one machine talking to another machine second machine talking to third to fourth and so on this is quite extensive it is quite present in the industrial sector IIot. So, IIoT heavily depends on machine to machine communication.

So, whereas, IoT traditionally focuses on applications at the consumer level, IIoT basically focuses on applications at the industrial level at the enterprise level.

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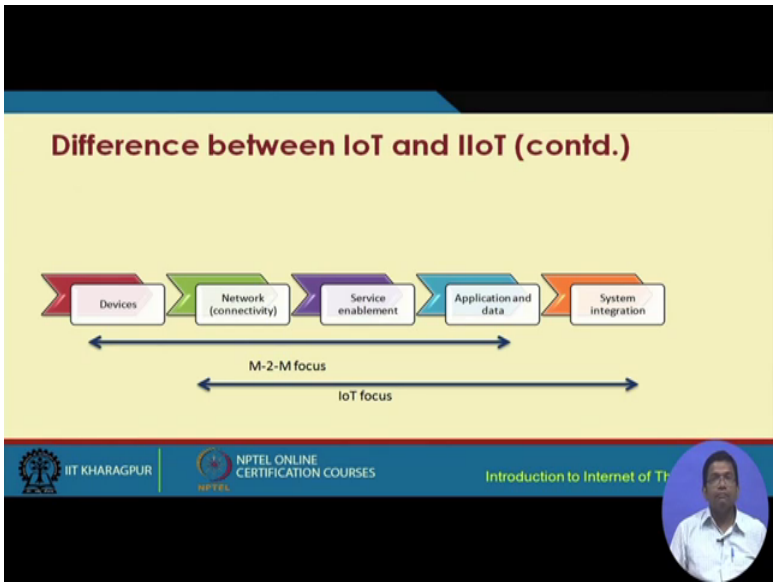

Let us look at one more aspect. So, here M-2-M when we talk about M-2-M. So, M-2-M and IoT M-2-M focuses on device to device communication, there is a emphasis on communication between devices between machines, and IoT on the other hand focuses on the overall system integration of the system components sub components sub systems integration is a one of the important features of IIoT. So, this is what we need to understand. So, M-2-M versus IoT M-2-M focus on devices of course, both of both M-2-M and IoT they have focus on other aspects like network connectivity service enablement application and data these are there for both M-2-M and IoT whereas, M-2-M focuses on particularly on devices IoT basically focuses more on the system level integration.

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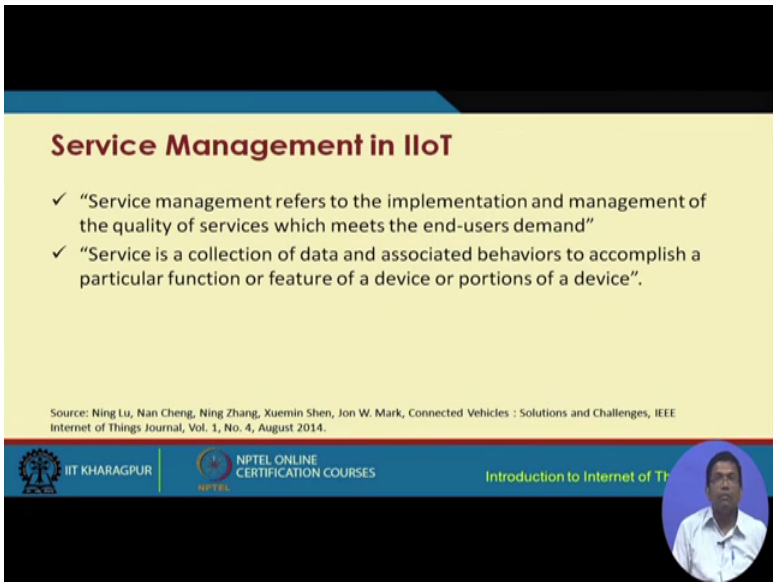

Now, service management in IIoT is very important it is all about why do you want IIoT we want to offer improved services. So, service management is very crucial. So, service management basically what it is referring to is the implementation and management of the quality of service, which meets the end user demand end users demands are met and increasing the overall quality of service?

So, service is basically a collection of data and the associated behaviors to accomplish a particular function or feature of a device or portions of a device. So, through IIoT solutions the overall services the management of the different services have to be improved.

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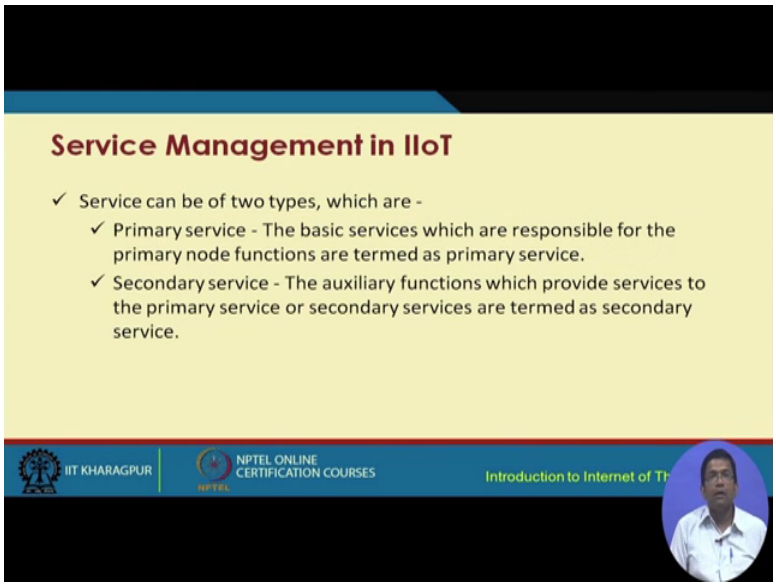

So, I will talk about very briefly over here services can be of two types one is the primary service the other one is the secondary service. Primary services are basics services which are responsible for the primary node functions whereas, the secondary services are auxiliary services auxiliary functions which provides services to the primary service or secondary services are termed as secondary service right. So, what we have primary service are basic they are very important, you know you need those services whereas, secondary services are auxiliary services which may or may not be there.

So, with this we come to an end of the first part of IIoT, we have understood the basics of IIoT, how IIoT differs from IoT, what is the difference between IoT and M-2-M. So, this; what we have looked at in this part of the lecture on industrial internet of things.

Thank you.