Spatial Informatics
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Lecture – 06
Spatial Web Services (1)

Hello. So, we will continue our discussion on Spatial Informatics. Today, we will be discussing on Spatial Web Services. So, to say another will be having a couple of lectures rather on spatial web services, which is becoming very popular or these days. And, also we will see that also it opens up lot of avenues of research and applicability for several fields which uses spatial data alright.

So, we will look at that space what is the fundamental or the basic philosophy behind the spatial web services, how these standard services are build up and how to make use of it those type of things we will look at it. Also will at the after couple of lectures we will try to show you one some use case that how this web service can be useful, not only for researcher, not only for academician also for different development programming activity or there are several active, they were applicability of this type of things right.

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So, we will broadly is very broadly the type of concepts or to we want to address is one is these interoperability issues a basic interaction to GML or what we say geographic matrices markup language. Also a spatial web service per se what are the different

services technologies and services. And, also there is as we mention several times that visualization is the important aspect. How this things helps us in visualization right. So, these are the aspects we will be covering in coming few lectures.

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Now, you see these days if we look at these days, we have huge volume of data sets right or what we say huge volume of data sets being collected or stored maintained by several organizations alright. So, say if we look at the Indian context. So, there are data set collected by large organization like survey of India department of science and technology Indian space research organization GSI. And, so, to say several organizations which collected data, which are mostly with our surface right or thing. There are other type of data like traffic data, there are data like census data which are being also collected.

So, what we see there are different type of data or detailed data are being collected or as this data are collected it also incur a lot of cost into the things. Now, there is the problem is that when we want to do some query on the data. So, how this data will talk to each other? I as the some of the example we are using frequently say I want to increase the width of the road between Kolkata and Kharagpur from say full lane to 8 lane right.

So, I want to find out that that the basically that road authority or so, to say national highway authority of India. They want to may they may look for that what is in my cut and field? How much total cost will be there? How much agricultural field will be

covered, how much buildings it needs to be broken down, how many bridges has to be there etcetera.

So, in order to doing this spatial computation or spatial operations, so, to say so, what we require the data from different sources like I require the data the transportation debt department or the road network. I need that agricultural data, we need that how this build up area where buildings etcetera there and maybe there are as remains and that may be that we want that, educational like say schools etcetera that for maybe that government rule may say that you cannot break a school.

But, you need to deviate the road accordingly. So, I require based on that I do a calculation. Now, these datasets are with different organization. Now, when I want the data sets one way is that I collect the data set into my system convert them appropriate form maybe in particular database, and then query on the database that is one way of doing it. And, it is pretty cumbersome why; first of all every time you want to do you get the data. Once you take the data to your own repository it becomes you are the maintainability and all operation related to the data is the responsibility of the now the user.

Now, instead it could have been a much better that I want to fire this query in somewhere, because I required my basic objective is to full lane to 8 lane and this is my output. So, I want to whether I can make a mechanism where I can fire this query, which takes care of different data sets and then reply me that see this is nothing right. This is nothing maybe the map and some calculation etcetera etcetera. It may happen for different for disasters management or anything any type of things.

So, in other sense we see we are not looking for data, but we are looking for services right. Like, as we mentioned earlier that, if I want to book a train ticket or flight ticket you are looking for services, that how I can do a online booking by paying something etcetera. You we are not looking at how many bogies in the train are there or who is the driver of the train or etcetera etcetera or any other aspects. My objective is that I require this things where are things; that means, we are looking from data to services. For the spatial thing also we need to do for the data to services.

So, what is happening this huge volume of data is there, but there is a non-union, when we mixed I to mix the data we need to collect convert it into appropriate format and do it.

And, first of all it is too large and expensive to move and convert this data. The data volume is pretty large right. So, it is a enormously large volume of data like, as we mentioned earlier, like even with a our own satellite system or any remote sensing satellite system, if we have a if we look at the raster data of this one snap of Kharagpur with 8 band data may be a something 5000 cross, 7000 metrics of 8 band, if it is a multispectral it can go for different band everything as a again even with 8 bit data. The amount of volume of data is enormous.

Doing anything with that requires a huge computational and storage mechanisms right. And, it become it is always inconvenient to store and manage centrally this sort of data. Operational constraining and administrative challenging to mandate a single technology supplier right, like if we have multiple organization even if you see those who are working, that if you have you different section you know organization, maintaining a single tool cells software across the thing becomes different. Especially when it is a multi-organization, it all everybody goes on their requirement and they are cost to return or the maximum return on their investment type of things right.

So, you cannot we cannot guarantee or enforce number of cases when we have this sort of collaborative organizations type of things, which from where the data is being collected maintained and things. So, first of all it becomes an operational issue top or administrative issue of a challenging or to a single technology handling all this data. In other sense starting from format or syntax to semantics and several other aspects will become a challenge to have this data together. So, that we can do a multi-layer modeling, where who this special service may be a way of looking at it or a special web service may be we are looking at it.

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So, what is the solution how to go about it, the first thing that we need to interoperate it right, the different data set need to talk to each other right. So, seamlessly a query can be fired with multiple data sets right. So, the basic philosophy is the data should remain in place. So, if it is collected by organization a should be collected and maintained it should be remaining place. So, that is the best place where the data can be there, they do have the domain expertise they are doing the things etcetera for years together and things are like that right.

No constraint or maintenance policy or operational policy. If, it is the data is with this then there is no things see say survey of India maintaining the data related to their things. So, they are doing whatever their way they are doing. So, with there is no as such no constant. Existing in-house tool applications remain in place whatever they are using, they are using. Only what we need to ensure some something that there should be a defined interface, need to be well defined interoperating clients and servers right.

So, if I want to require something they will reply provided that is not against their policy right. So, you request for some data, it replied the data back to you right. So, that is it that is a well-defined, exactly or some analogies again our, if we fall back to our reservation system or of train, flight, hotel etcetera. You send some form that date of travel, type of travel, name of the passenger, etcetera. It returns that whether the seat is available or not if available a gives a interface to booking it you booked it with your

credit card, net banking etcetera etcetera. And, then get the ticket which you can make a which is sent to SMS, or mail, etcetera or you can take a download the PDF and so on and so forth.

In other things there are multiple parties, where the certain say for the railway or the flight system, that is defined, that if you request send me a request like this, I reply back like this right. So, this mechanism is if it is well defined then how the data is maintained by railway, or how the data is maintained by the banker for net banking, or how the credit card fellow? I am not bothered right. I require a well-defined interface. Similarly, for spatial data if I want to query such things, I require a well-defined interface which allows me to talk to the data sets of the different. So, that exactly we try to looking at.

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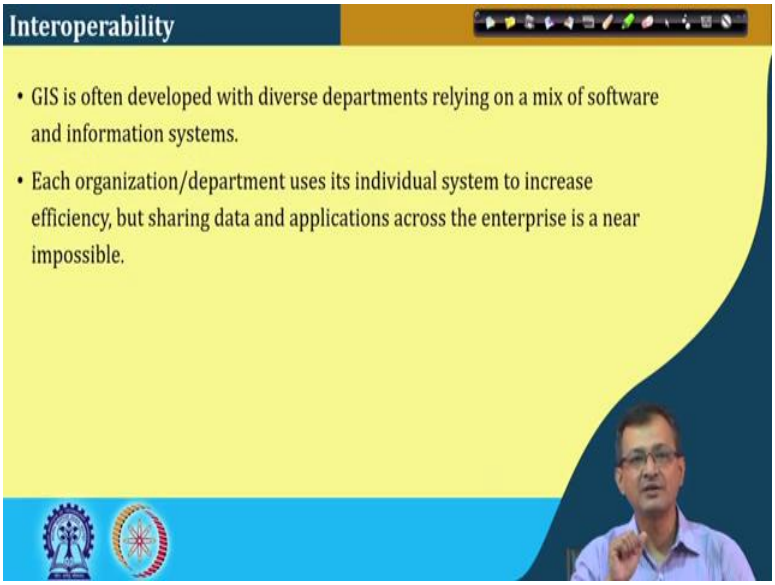

So, interoperability is a core of the things right. So, GIS or more broadly if I say geospatial data sets is often developed with diverse department relying on a mix of software and information systems right. So, based on my requirement I have developed that things whatever IIT wants to do for their own management of their resources etcetera they will do it or any other organization. So, each organization and department uses it is individual systems to increase efficiency.

But, sharing data and application across enterprise is a some sort of quote unquote near impossible, it is they may be over killing, it is a very very difficult challenge unless we follow some standard right.

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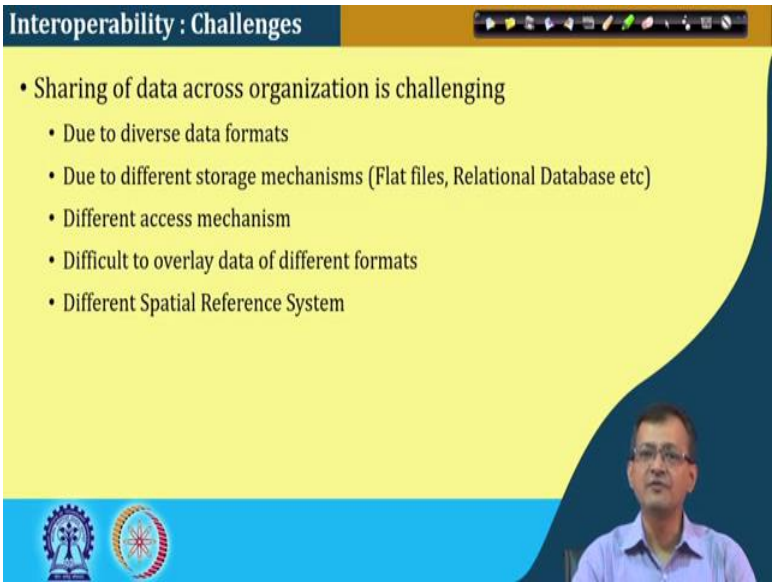

So, these are the challenges due to diverse data formats or syntax due to different storage mechanisms somebody is data base, somebody may be flat file, somebody maybe some spreadsheet etcetera, different access mechanisms how they how you want to access that data, whether that is to a wave access or through physical access to pen drive and other things. Difficult to overlay data of different formats like, if you have different data formats since they are very difficult. Some data is coming from a database say and some data is coming from say some spreadsheet and then if you want to overlay and work on finding say, I have a data set of the student basic information in some relational database. Whereas, the marks data set is with some data set is with some in say some spreadsheet.

Now, on to query that to together with this then I did not need to write it a parser or query engine for that it. So, either I convert this to this or this to conversion is required right. And, there is another challenges when we talk about spatial data is the spatial reference systems. So, what is the reference system as we discussed earlier also. Reference system is how you refer the things, think of a graph paper our lower left hand corner may be the 0 0, and you do all the points etcetera. I come with another drawing I say no mine is upper left hand corner is a 0 0, then that is the reference system goes for a or somebody say center.

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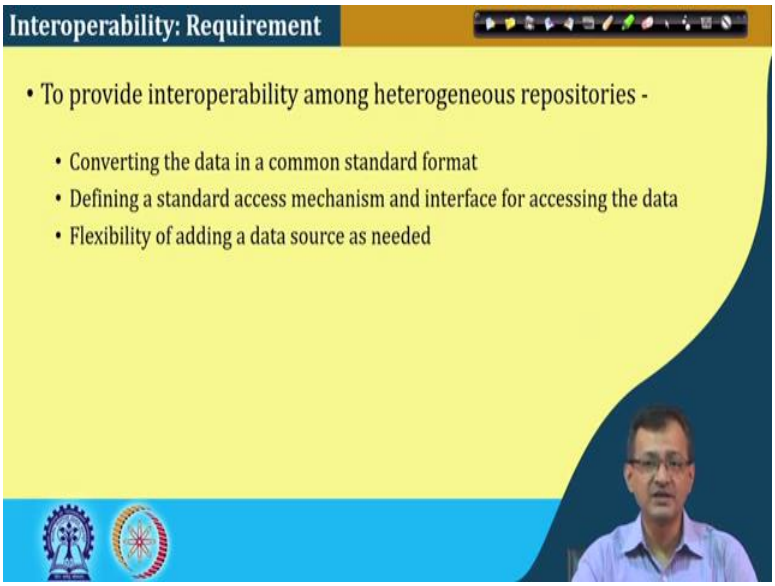

So, that that should have a different different system, not only that there is a problem of scaling right, scale right, I say there are we hear about that one is to 20, 000, one is to 25, 000, one is to 50, 000 this scale. So; that means, the map or in the data set 1 inch or 1 meter is 20, 000 meter in the ground right. So, you can get data of different scaling you get the road network in some scale some other data in the some scale then when you talk to each other, then that should be properly matched.

So, these there are these are spatial challenges. Other challenges are true for other interoperable systems these are the spatial challenges of in spatial data. And, also we will see that when we talk we deal with spatio temporal data set. So, what is the repeatability of the data sets also problem? Some of the census may be collecting every day, some of the census every month, some may be every minutes.

So, that what frequency, how to sample and other things will become a big challenge. So, in order to interoperate from heterogeneous repository so, to say converting data in a common standard format is the thing which is very hot core and very time consuming costly affair, but that is one of the process. Defining a standard access mechanism and interface for accessing the data.

So, otherwise I defined a access mechanism. I do not want to allow you to see the next to that what is the data, but I will define a access mechanisms, by which you can look at the data access the data right. I say that if you query like this it will get back like this.

Flexibility of adding data source as needed there is another challenge right. So, there should be an flexibility of data source as needed, that is why even again falling back to the booking system, we have different brokering right brokers or mediators, where you connect to the things right.

Like from say IRCTC or different type of things right, we are booking dot com make my trip etcetera etcetera there are n number of things, but what they are they are primarily a broking system, they connect two different parties at the other end right, or in other things that you can easily connect sources into the things. So, I should have a mechanism by which I can able to do this right.

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Now, another thing is important, what is the standardization things right? Geospatial Standards right so, what we say open geospatial consortium is one of the agencies, it is a consortium which is where all government organization or governments or every government is a member to that or every country is a membered to that, along with that major vendors, or major software suppliers, data maintainer, our members to that right.

In other sense they try to make a standard right. Like, we have ISO standards are there are several I triple E standard for different mechanism. So, they say a standard. So, everybody follow that standard mechanism, while developing different services. So, that that is the open geospatial consortium those who can those who are interested can visit

this their site and see that how things are there, India is also a member along with other major vendor.

So, it is a international nonprofit organization committed to making quality open standard for digital say global geospatial community right. These standards are made through consensus process right, like it is floated everybody keep their comments and then finally, for everyone to use improve the sharing of the means spatial datasets. So, OGC standards are used in wide variety of domain including geosciences and environment, defense, intelligence, smart city applications, IOT sensors, mobile technologies, building planning or 3 D and build environment, emergency response disasters aviation etcetera etcetera right.

On in other sense what we can have that you everybody following the standards will be able to do that. So, another we have seen that a standard mechanisms when you will when we look at our overall internet working or per se networking right everybody is following a standard. Either it is a W 3 standard, W 3 C standard, I EEE standard, that is why I can have any devices from any may who are following the standard it can able to connect it.

I write a applications which you be able to do to the rest of the world, because we are following standards right. So, like ways I standard etcetera what you have what we know from the networking things. Here also whether we can have a this type of spatial data and services standards right. So, publicly available implementation specifications are available, if you can visit the site there are publicly what we say specs are available, where you can we can follow the things and implement the things, there are several open source tools availables which implement the basic propositions of OGC, and it easily work we will show in some use cases here.

Also that how OGC can help us at their early standards can help us in interoperate and type of things it has close relations. So, with ISO standards and uses other standard wherever possible if there is a standard thing they use the things. So, it is more of a standardization platform which helps us again to interoperate.

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So, the other thing which come a comes up is a geographic markup language right. What is a markup language? The, I believe that you are familiar with a markup language like XML extensible markup language thing, we are used to html right. So, this is that hypertext markup language. So, it is a language which can be defined by different tags and markups right by which the parser can read and decipher the things.

Now, XML has a typical property in supporting interoperability right. So, what we will quickly little go through this XML and service oriented architecture web services I believe many of you are conversion with that those who are not. So, much conversation we could have a what we say quick walk through with the things before we fall back to the GML. So, GML is a OGC endorsed standard or spec for encoding spatial information.

So, if I have a GML encoded data sets then I can interoperate other can understand. So, when I give the data I say that it is a GML encoded data. So, your GML parser at your end can read it. And, once read you can put it to your own proprietary system to process etcetera either use it and if you want to decipher again you convert to a GML and send it all right.

So, it is a XML based on XML technologies for handling spatial data on the internet. So, the basic core is philosophies from the XML and technologies for handling. International standard for spatial data endorsed by government companies agency across the world.

So, who ever want to willing to interoperate or work in a tandem using this sort of a GML framework. So, again will as I have been saying we will have a quick walk through to this as those everything is based on the service oriented architecture web services XML.

So, for the benefit of all or mostly though are not conversant with will have a quick walk through on the things right. This is not only applicable for spatial data; it is applicable to any spatial service oriented architecture whatever we are having.

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So, we will have a some basics on service oriented architecture, web service, XML. Little bit looking at the wing not core spatial, but it is used to the spatial data.

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So, service oriented architecture or sometimes what we say SOA type of things, consist of a set of business align services and collectively fulfill in an organization business process, business process goals and objectives right. So, it is a service driven or service oriented other than the data driven. So, these services can be choreographed to into composite application and can be invoked through internet based open standard and protocols right. So, we will see how things works?

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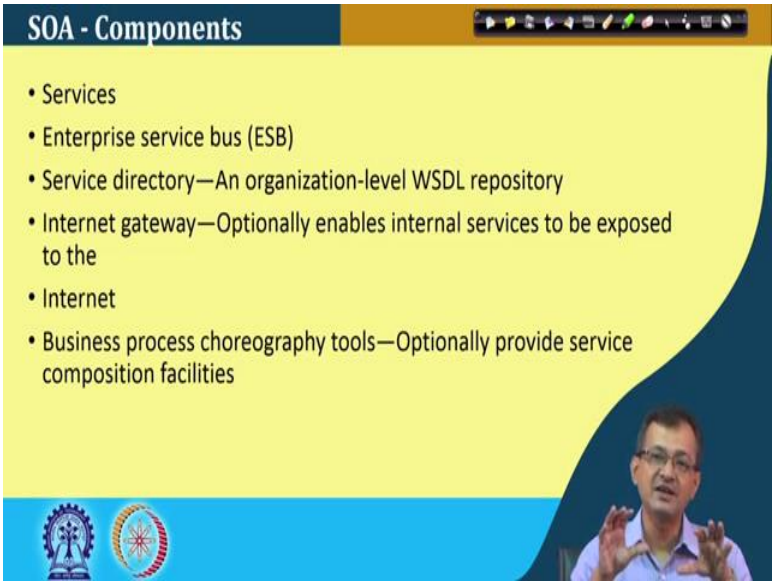

So, if we see so, it is a architecture which allows you to have different services, which can be accessed not only that this number of services can be choreographed to have a composite services. So, services is the core of the things, there are enterprise service bus by which you connect the things will come to that, there is a internet gateway optionally. So, there is a service discovery right.

How do I know that where the services are there? So, either there should be some way of discovering that things right and organization level W WSDL repository will see to that that what you what this mean by web service description language or WSDL repository. Internet gateway optionally enables internal services to be exposed to the internet sorry there is a short typo so, exposed to the internet. Business process choreography tool optionally provide service of composite facilities right.

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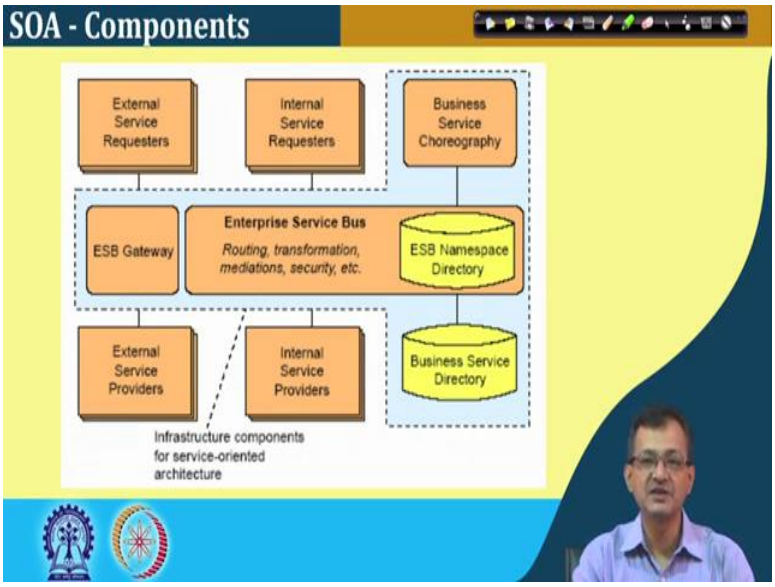

We will come to this picture and see so, taken from again from internet resources for purely this academic purpose. So, what we see there is a service bus. So, that are rather we let us look at other aspects right. We have some of these different services like, say a service is extracting will fall back to the road network things, I want a service which gives me if I request, it gives me a road network, the road network for a region of interest, my region of interest is may be skipping Kharagpur at the center a 10 kilometer cross 10 kilometer right.

A square so, I require the thing. So, my objective that if I send you a request you give me back the road network all possible, major road, minor road, state, etcetera. So, if there is something then there should be anything for that I need to find out whether at all this type of services that get network service is there or not. That, I can see some whether there is a repository is there right, from there I take the services right. Now, if new service is coming up where you will see that the service bus it can plug in that I am I am here.

So, that service bus is a more generic type of things. So, there can be external service provider or internal. If, it is a external I require a gateway to connect to the things like in case our network, if you want to access something out of the network, you require a gateway and routing mechanism to go out of the network care also things a similar type of things.

Also, if I want a composite service right. I want a service which say which not only the road network, if I want expand the road network I want to find how much agricultural field will be effective; that means, I require a competition network, it finds the networks, new network, make a buffer on the road network, like suppose I want to may increase the road by X meter on the both sides so, create a buffer. And, on the buffer it does a overlay with the agricultural layer and find out that how much agricultural land will be likely to be cut and feel of a type of things right.

So, that requires a choreograph first calculating the buffer etcetera, it is not that it is to be in a particular fashion right. So, that is the things. There is another what called names namespace right. So, that which namespace I am working on; that means, whatever that I am looking for whether it is in a particular say road network may have a road namespace have or agriculture may have a name namespace. So, that what are the definition of the things right.

So; that means, I require this sort of a composite things which allows me have a service oriented architecture.

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So, enterprise service bus as we have seen the major function communication middleware, supporting a variety of communication paradigm quality of services, and platform protocols etcetera, ability to transfer messages format between the consumer provider. So, if there is a data set I get and then need to be transferred for the provider or other way around in some form that this enterprise service bus will allow me to do that those type of things, and also allows to different connect. Ability to a ability to convert transport protocol between consumer and provider right.

So, ability to convert that transport protocol. In this these transport protocol we should not mix up with our network transport protocol, anything which is carrying this sort of a data. If we consider the payload is XML data whoever is carry. The most popular in this case transport protocol is the our http, because if http is only openly present. So, that becomes a carrier for this type of things, but we can have a other type of things we can even have ftp, smtp, and other type of things which allows me to carry the this sort of mechanisms right.

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So, there is another term which comes up along with the things the web services. So, web service technology is an idol technology of choice for implementing service oriented architecture. So, service oriented architecture is more give that what should be the architecture and type of things whereas, this web services is basically how it can be deployed right? How, I create a service and type of things finally, it to work right.

So, web services are standard based interoperatively is the key business advantage within the enterprise and is crucial for any business to business applications right. Web services are widely supported across industry all major vendors are recognizing and providing support to the web services. So, these are another aspect. Web services are platform for our language independent right. There is no bias or against any particular hardware or software platform; that means, your things remains in place. So, that it does not say that you need to change this etcetera.

So, it is so, web services can be implemented in any programmer programming language or toolset. So, and this is important because there is a continued industry support for the development of standard interoperating from the vendor implementation. So, every organization can have their own things, only they need to have appropriate services. This technology provides a migration path to gradually enabling existing business function to web enabled business functions right.

So, what was more code to the things I make it more universally available? So, this also this technology supports synchronous, asynchronous, RFP, RPC based and complex message oriented exchange patterns. So, this is the how it, how it can be implemented? Right.

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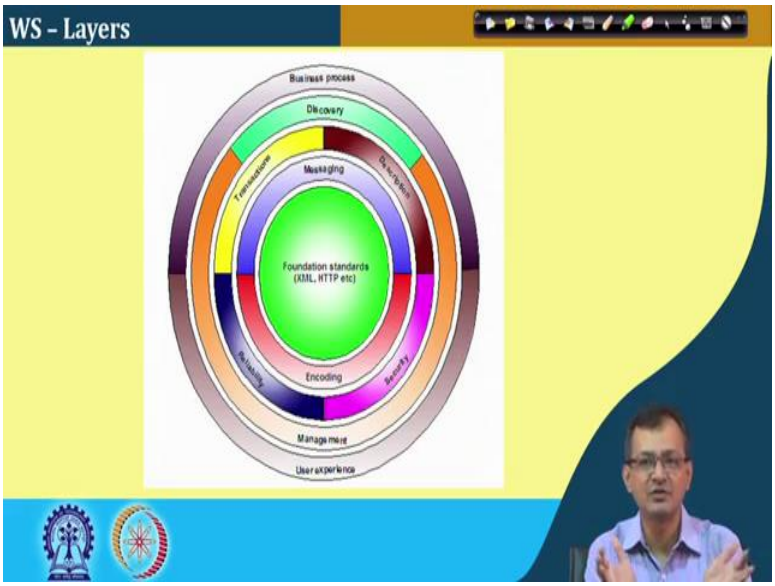

So, rather if we try to look at the different layers or the typically that onion. So, foundation is the XML will see quickly many of you already knowing, and this carrier is http typically, over that I did need some messaging and encoding, over that how do I describe the description, whether the aspect of how these transactions things are there, issues of reliability and quality of service. And, of course, in many of several cases there is the issue of security into the things right. And, over that we have discovery how to discover that web services are there, I want to find out a road network a road network service.

How I found that where the road network service is there? So, that should be a discovery mechanism and that overall management of the web services. And, finally, at the top there is the business process finally, I have a business process. I want to do something because things are there, I want to book a ticket that is my business process, I want to book a ticket so, and so, date I have something to be there, I want to book a ticket, along with cab, along with hotel, etcetera. So, they have a business process right.

So, how do whether that type of things can be implemented based on the things and also there is a how user experiences are there. So, this has to have a implementation mechanisms to have this access to the things.

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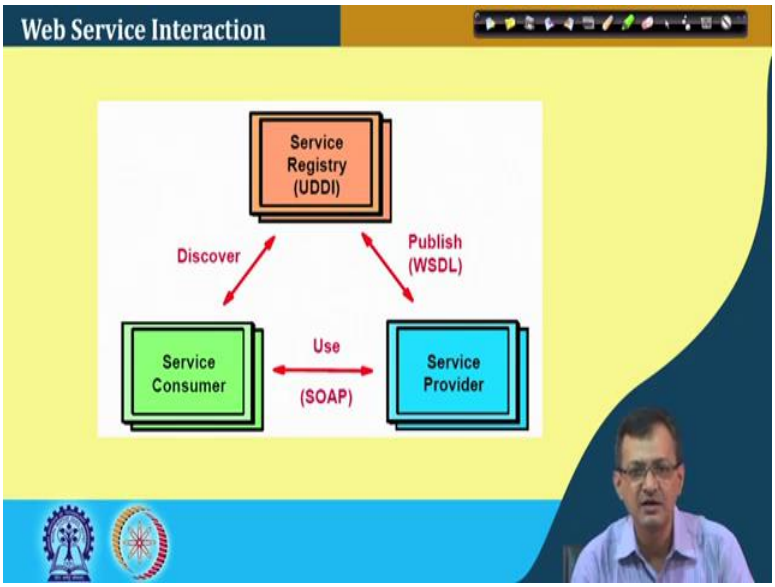

And, this is a popular picture those who have worked with web services or read and then you know that we have service registry, where any service available into the things the service registry. The service consumer consult this registry and discover and then connect with this service provider using thing.

So, there is different mechanism that how so, and a provider when say new services there is published in the service registry. So, this registry publish and this goes on publishing these are all disconnected right. Service whenever is there it is published, whenever it requires you look at the registry, if you do not want to give the service you take out from the registry right and this goes on right. It is something very not so, good analogy, something is our days old telephone directly; I do not know how many of you have seen that these days are not there. So, there are different things are there.

So, there is a it is a registry type of things you can have type of thing. There are yellow pages green pages like where popular things then you call back to the other description anyway. So, that is the registry. So, discovery or what we say binding use or popularly we say binding. So, publish discover bind. So, some consumer and provider binds each other and get the services there may be a payment mechanism etcetera etcetera right.

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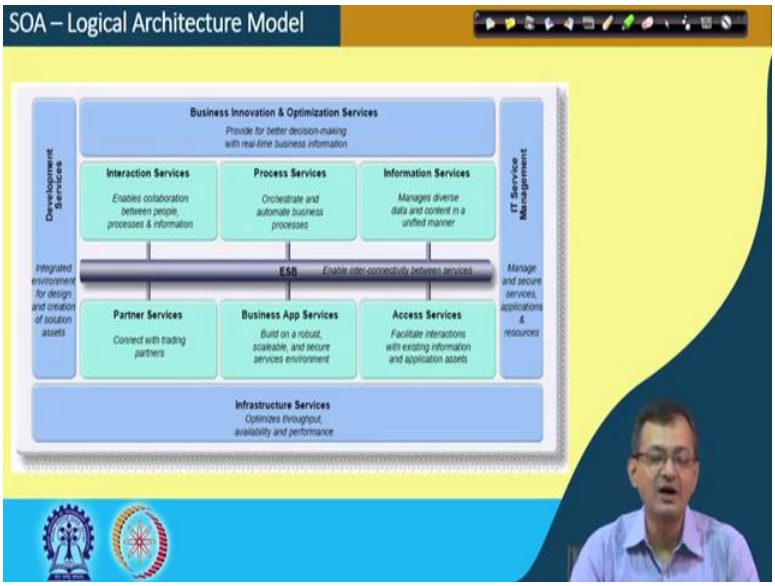

So, that is the thing. So, again coming falling back to the logical architectural model what we have seen. So, there is one part is business innovation, optimization, service provide etcetera. The there are development services, and this is the service, inter service connect bus and there are different services, interaction services process services information services, and this vertical lines one is service management and developing the services.

So, I require different web services to do that and at the down we have a inter infrastructural services which supports that. So, these are very what we say very philosophical view. So, we want to look at that more core of the things. So, what we will do will continue this discussion in our subsequent lecture. So, little bit of XML and then we will fall back to that how our web service spatial web services exploit this. So, this is more generic doing for anything any mechanism. So, we will continue our lecture in the thing in the in our next class.

Thank you.