Spatial Informatics
Prof. Soumya K. Ghosh
Department of Computer Science and Engineering
Indian Institute of Technology, Kharagpur

Lecture – 09
Spatial Web Services (4)

Hello. So, we will continue our discussion on Spatial Web Services. So, if you recollect in our last lecture, we discussed about OGC or Open Geospatial Consortium OGC compliant services and we discussed about the concept of GML. So, that is the basic philosophy is a XML with geometry considering the geometry features. So, there is a geographic marker language and also we talked about different services. So, if we look at GML is the content of the things right. So, if we if I can have the data in a GML form that helps in interoperability. So, that any GML like XML, GML can be read by any other systems or any other applications which understands this XML things right.

So, as we have seen in case of XML also in case of GML we require the structure of the language right; the structure overall structure of the things or existing the schema. So, once I know the schema and the GML, then I can decipher that it. Another important thing is the namespace like which namespace we are working on. So, one is that by default I can have a GML namespace or there are other namespaces which in encompasses. In other sense, it follows all the philosophy the way the XML works. This helps as we have seen this helps in segregating the data repository with the external world right.

So, data repository still work in the way, it was working and then we have this interface of this GML and other web services right. So, one some popular web services are WFS web feature service, WMS web map service and web catalog service, coverage service, registry service and so and so forth. So, who defines this services or who standardizes that is the OGC. OGC has again a close correspondence with the ISO standard; so, it is a standard. So, if I say IIT Kharagpur wants to launch a spatial data sets, it is it says that I have this services to offer right.

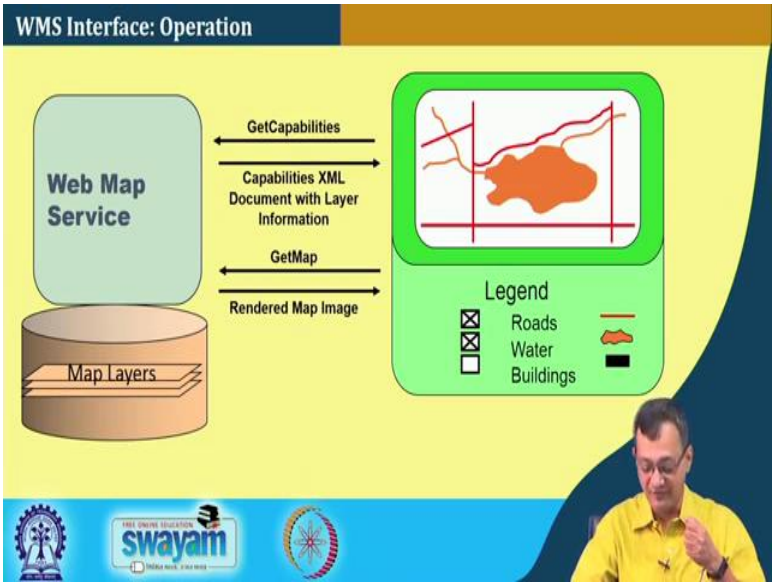
So that means, I am having this WFS server, WMS servers and other servers and the other end what you require a client for that. So, you can consume the data to work on that services right. This helps in a big way. One of one this that the still the organizations

still work on the on their standard tools sets and type of things and there is a interface which only allows it to connect to the external world.

So, once we request what the type of data set comes out is the XML of spatial data or we say that GML type of data sets right. So, in the last lecture, we have discussed about WFS services, web feature services and in this particular talk will be most we will be looking at the WMS services where web map services. And also we plan to show you a small demo not in this particular lecture a separately that how this services works and how things are there that where we talked about XML, GML, WMS, WFS etcetera and how they work together. Really a very small scale demo, but it shows that how things works together rights.

Now so, today we look at the WMS or W map service again you see it is a W OGC compliant services.

(Refer Slide Time: 04:20)



So, what it does? It allows you to display maps right. So, here your layers are data; data is there. So, it web map service. So, we request for that map, it is sends back the XML or so to say the GML of the thing right. And then we based on that this is the get capability like means what sort of data you are having that is the get capabilities, they what is the capability of the service. It says that documents with layered information, we request that particular information and display, like in this case we are recording road, water and building right. So, those are getting displayed right.

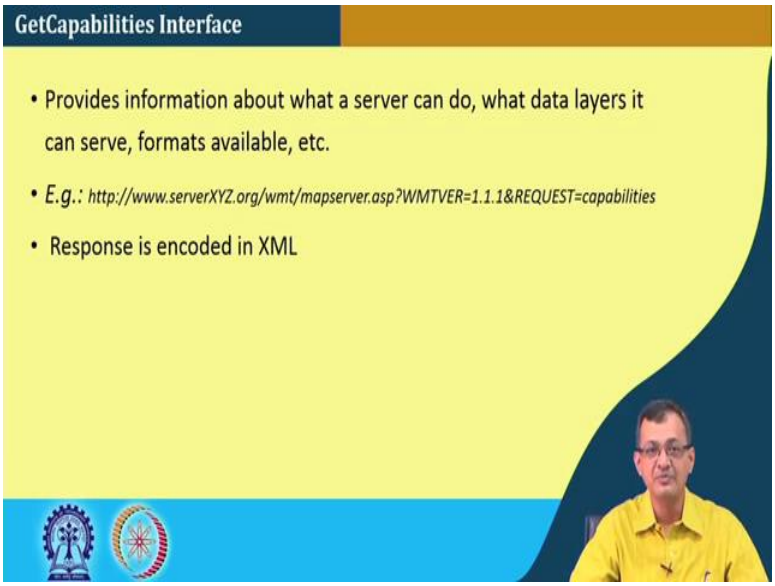
Now, there is a things to understand right. One once the GML data is there; if you remember that GML or XML data, it is a text type of data right. While you display, you display with different say like different colors, different font, different type of say road, width etcetera. So, how to how do I handle those things right? So, I should have a some sort of a style file right. So, XLD or XXLD this style file, so that means, along with the data, I put this style together and then I have this display on the things right. And for displaying things, the browser it should be browser understandable stuff right like html type of things right. So, somewhere this your but search should create those type of stuff, otherwise browser will not able to understand; if you want to display on a browser.

If it is a customize package then, you can handle the way you can handle right. So, first of all we require this GML file along with that a styling file to display the things like which style it will be displayed like whether it will be black, green, magenta, yellow, blue etcetera or the line will be thick, thin, dash line etcetera that has need to be decide by a style frame.

(Refer Slide Time: 06:26)

So, like as we have seen in the web feature service or WFS in web map service also, there are three components right; one is GetCapabilities, GetMap, GetFeatureInfo. So, these are the typical WMS type of services are giving, like again, if the IIT Kharagpur launches a spatial data repository, then it gives this type of services to things.

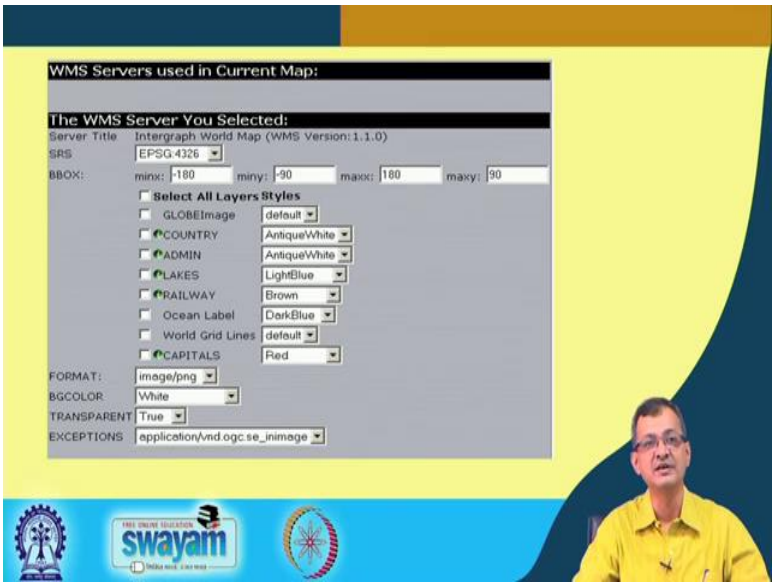
(Refer Slide Time: 06:54)



Now, so, GetCapabilities like one of the things, what it gives? Provides information about what a server can do; WMS server can do, what data layers it can serve, format availability etcetera right. So, that means, a particular WMS server when it is requested for a get capability, it reply back that what sort of data, what data it is having, what sort of formats available etcetera because that is needed because of the client end I need to know that what I can handle right; what are the things available right.

Like typical example it is piggybacking on a http services is that may be a thing like it is request like a map server and sort of a things right and it is responded by is encoded in XML or again I repeat in a GML file right. So, it is primarily XML file. So, it is encoded in the XML and it reward back as a GML file which can be parts at our end.

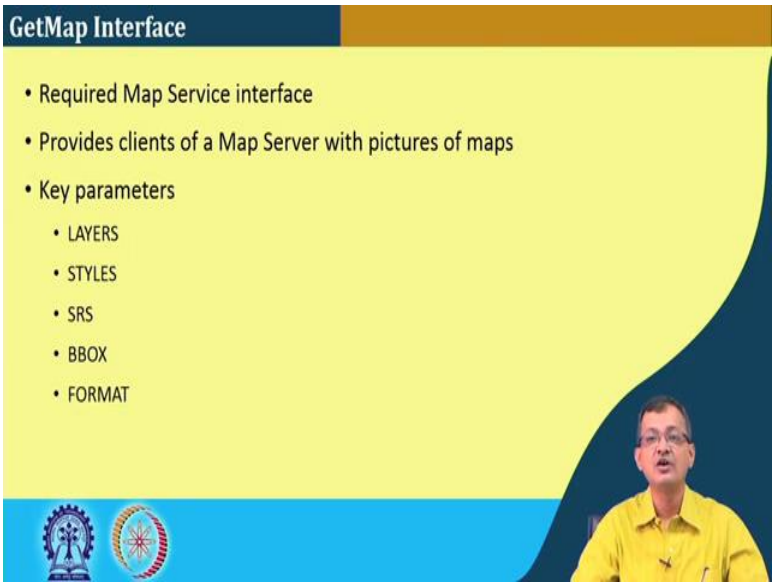
(Refer Slide Time: 08:10)



So, this is a standard somewhere you will find there are several tool something we take for demo at the for, from the internet. So, you can have different type of specifications right like what is the minimum, what is the SRS standard, what is the bounding box of the thing. This is considering the whole universe whole earth then, what is the different type of things that how it will be displayed, which color etcetera that this part is mostly the styling of the thing.

So, what should be the format? Image and png format, background color white etcetera. Now, what you are seeing that along with the data, we are trying to put the style into the things right. First of all what is the bounding box, what is the format of the data that is a what is the SRS or spatial reference system of the data and then rest of the things is that what are the color schemes etcetera along with that what sort of like image formats and so on and so forth. Because finally, you need to compile it as a image data.

(Refer Slide Time: 09:19)



So, GetMap interface. So, that is as we have seen that WMS as a interface called GetMap required map service interface right. Provides client of a map server with pictures of the maps like what we are looking for is the map. So, GetMap interfaces like that key parameters may be our layers which are the layers of data, what are the different styles that spatial reference systems or SRS, BBOX is the bounding box of the whole things like I may require only IIT Kharagpur, I may require the whole West Bengal or whole India whole universe and type of things a whole of art and type of things.

So, what is your bounding box and of course, the format of the data what you are looking for. So, this is the GetMap service. So, one is that what we have seen that is GetCapability, what are your capabilities of the map server. And then once the understanding the capability, then you needs to specify that what how I want to extract that map or the through the get map service right. So, these are the things which is need to be specified. And in the previous things also, you think that we are SRS is specified bounding box is specified different formats are specified and etcetera styles are specified these are the stylings right.

All select all layers and these are different type of stylings etcetera there. So, if I want to switch off one of the layers like I do not want to display say any road network, then I can give a it is as a no color or transparent or all roads in the same color. I am more interested only in the land use right, how is land is used and road for me all roads are the

same. It is a road right; it is nothing to distinguish between national highway, state highway or etcetera even street road or approach road and type of things. So, for that I give the same color of the all the roads right. So, that can be a road map service that can be a styling. So, in the style I can do. Somebody in the road who are working with the road may be interested in the more specification of the road; rest of the things is not much interested.

So, for road we give the appropriate style of the things. So, it gives you an handles bounding box is that which area you want to display even the whole dataset is there and which format the things will come.

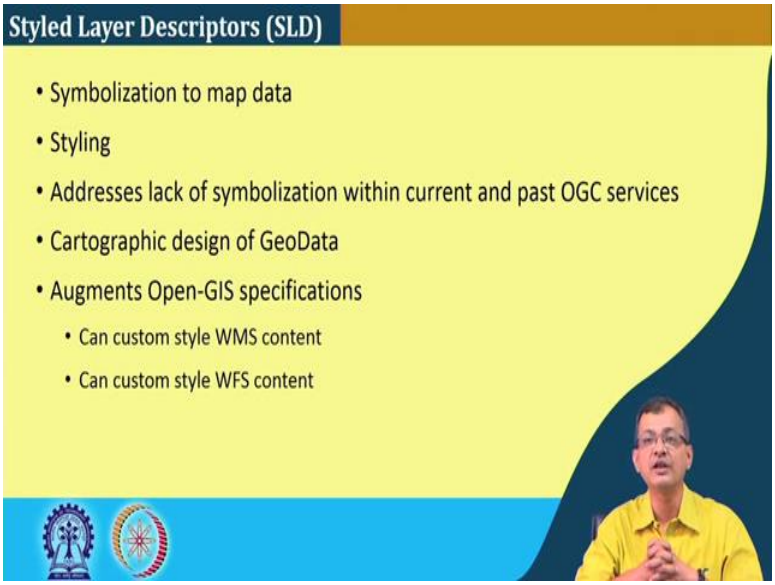
(Refer Slide Time: 11:41)

So, GetMap Request is typically is going as a map request, Request GetMap, SRS is defined, bounding box is defined in the this is in the may be in the lat long terms or in some this is EPSG 4326 format. Width, height of the things, layered, what are the different layers, what are the different styling for this layers like which are the different colors or type of things. Formats is a png type, a background color is something set and if it is other things that transparency is true and type of things.

If you see some sort of a analogy we will find that when you style in some of the things like in some cases html and other things right. So, these are the things you about to do. Now we saw as we understand, this is primarily for displaying things right. So, you need

to have this different type of displaying stuff into the format right; so, different way of formatting different styling and etcetera. So, that it goes as a GetMap Request right.

(Refer Slide Time: 12:52)



So, there is a another feature as we are referring always is the style layered descriptor right; which are the style and how the description will be there like as we are telling that road as a black line, thick line or you want to put some symbols or do the thing. So, there is a phi there is a format called SLD or Style Layered Descriptor. Now you see I get the data from the by through WFS, I have my style layer descriptor; I can do that right or I can see latest style at the descriptor and filter the things right. So, it is the descriptor which changes. The same data, I can display in different scale right. Somewhere the road is more important, so, I described in that way and type of things.

So, SLD play an important role for visualization or display of the map right. So, symbolization of the map data; so, what symbol which data to be, which sort of data etcetera that is symbolization of the data. Styling of the data which how it can be styled. Addresses lack of symbolization within current and past OGC services. So, that there are if there is a different services which has a not that same set of symbolization, we can have still SLD to handle that. Cartographic designs of GeoData, augments Open-GIS or open geospatial specification can custom style WMS contest sorry there is a things.

So, it is can customize style WMS. Not only that SLD can be used to custom these WFSs; WFS content also right. So that means, see through styling I can basically some

sort of a transform the data right. So, we using appropriate styling I can basically transforming some have a no sign of transforming the data having a appropriate stylings it. So, SLD plays a important road or style descriptor to for any display purpose.

(Refer Slide Time: 15:04)

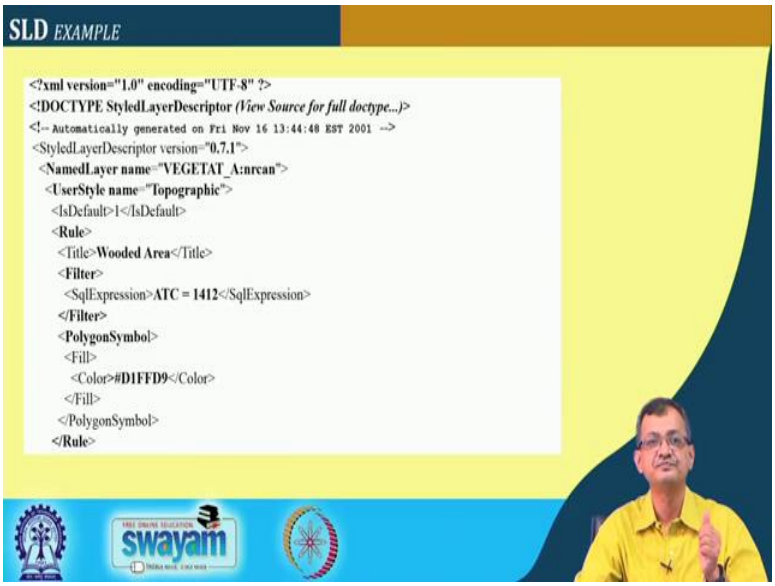
So, how it goes on? So, use a layer user defined layer or user defined styles are I can say. Again, I can represent in this standard XML type of things that user defined constraint that there can be a condition that we can have condition like filters like map scale constraint like there as we understand that the map there is another important of scaling of the map right. Like as sometime back we discussed that like 1 is to 50000 map; 1 is to 25000 maps; 1 is to 1 lakh map. As we had discussed; that means, 1 meter or 1 inch on the map is primarily is 50000 inch on the actual ground.

So, it is the scale factor. Now when we are having different type of data sets from heterogeneous sources, there can be different scale factors right. It cannot it I do not have a control that how things are there. So, I can have this type of map scales constant into this SLD layer that which layer which constraint and how to scale them and map them. So, we have different else condition, legend labeling. So, it is a very strong constraint which have not only the user defined layer and user defined style, but also have different filtering operation, map scale constraint and etcetera. So, these are the things which we can have into the stuff.

(Refer Slide Time: 16:49)

So, as we discuss SLD also provides symbols LineString, Polygon, LineString polygon, Point, Text, Raster. So, these are the different symbol, also different other things like stroke so, or color, opacity, width, join and cap, dash line etcetera for different graphics. There is a fill that how the color filling will be there different graphics things takes things raster thing. In other sense, these are the things which you require for styling displaying etcetera. So, it will be more practical or more things if you those who are interested can look into some of the sample SLD, change yourself; there are different open source tools are available on the net and see that how things are going on. Primarily it is for styling mechanisms right or different sort of styling mechanism. And for the filter, I require the expression what sort of filter you want to put into the things.

(Refer Slide Time: 17:53)

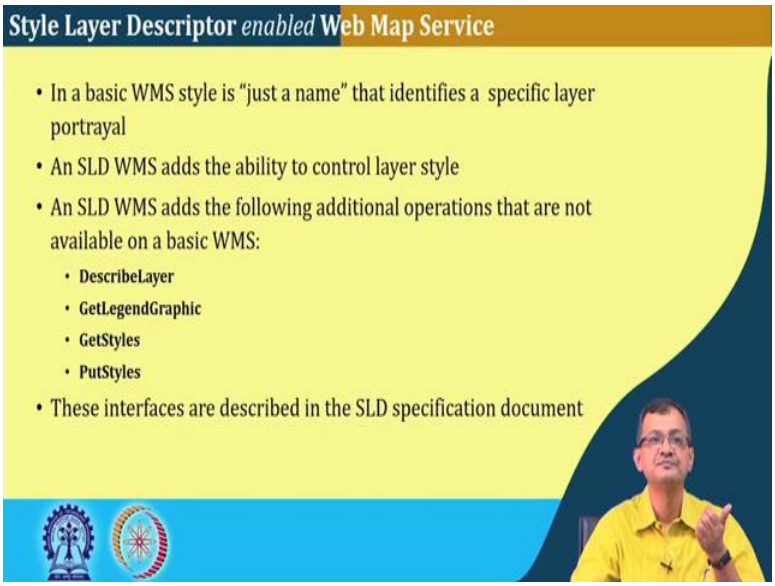


Now, this is a sample SLD. So, XML version this one DOCTTYPE StyledLayerDescriptor View full Source document and you have different type of a things like NamedLayer is something VEEGTAT A considering that vegetation cover, then we can have different type of thing user style layer topographic. Rule is that tile is Wooded Area, Filter some SQL query it is equal to 1472 SQL query; that means, I have a SQL query which specify a particular record or particular identity like in case it is equal to 1432. And then we have different polygons symbol into the things like color filling and type of things.

Now we see what we are having here is something which attributes to the data for display right. I can filter some of the data sets right. I can filter out some of the data sets, I can put colors to the or different type of symbols and colors and style to the data set and have the display. That means, as such the DA GML or the XML data is not continuing the style per say right. So, I need to put the style in other to display the things.

Well display the things; I may want to filter out some of the things right. I may not be interested in all the things to be displayed. So, based on that things I can take out the other things. So, this is a snapshot taken again from the internet sources for description, you will see different other type of things sources if you look at the stuff if you look in the internet and type of things.

(Refer Slide Time: 19:47)

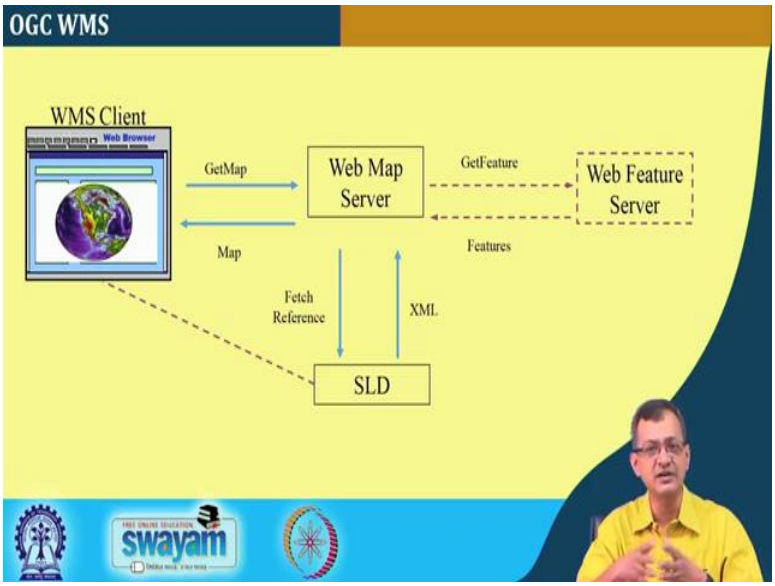


So, SLD enabled web map services in a basic WMS style layer is just a name that identify the specific layer portrayal right. So, an SLD WMS adds the ability to control the layer style right. One is that whatever is there what you are displaying in the things whereas it is SLD WMS or SND enabled WMS you have the ability to control the layer style. So, an SLD WMS has the following additional operator that are not available in the W basic WMS.

So, what we have seen in the basic WMS, there I get GetCapability GetMap services and type of things. Now this SLD WMS the style layered enabled WMS, we have some of these additional operations like DescriptionLayer, GetLegendGraphics, GetStyle, PutStyles and type of things. So, these are some of the things which are more enriched version not in the basic WMS. So if your WMS server is a SLD enabled, they will be able to handle these functionalities otherwise it will be doing that all that basic operations. So, these interfaces are described in SLD specification document right.

So, this particular this interfaces like describe layer, get legend etcetera those things are defined in that SLD specification document. So that means, I have a reference document of the SLD specification and we can refer to those things to find out those what are the interfaces. So, these are the SLD enable WMS structures.

(Refer Slide Time: 21:28)



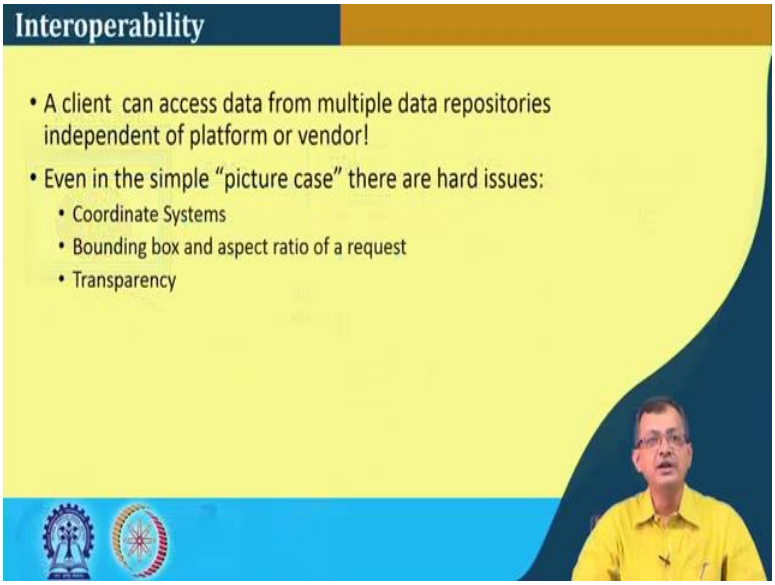
So, if we look at the big picture so, we have a wave feature service right. So, GetFeature and get the feature. So, that is the data per say the content of the things right coming as a GML or XML file fine, but that is the data itself. So, get feature service reply back with the features which can be consumed by the web map service right.

So, when we have this web map service it gives the map, but who will styled you want to follow. So, based on that it takes up that style and render the things. So, this rendering or that adding this style to the things is based on this SLD right. So, based on the SLD so, it is fetch e the reference and get a XML or that SLD XML and this web map service is styled accordingly right. So, web map server put that style along with that whatever the, get feature services are there right. Say I have the whole road network of this West Bengal I only want the road network of Kolkata right. So, I get take that only feature of that particular bounding box right and I may be only interested in particular road of the things male arterial road of the things. So, I can basically get those features if not I only the Kolkata road network. So, I extract that road network then I add the style.

Based on that how I want to display, I can again filter the data based on that whatever they available and then render the data for displaying based on this style right. The style SLD or the style layer can be can be initiated by the from the client and that what sort of style can be used for the WMS client and accordingly things are displayed on the things right. If you want to display in a as a web browser, then it has to be enabled as a how the

web browser can understand. If you want to display as a in your own application, then it is based on that show which sort of a format etcetera you handled it so.

(Refer Slide Time: 23:41)



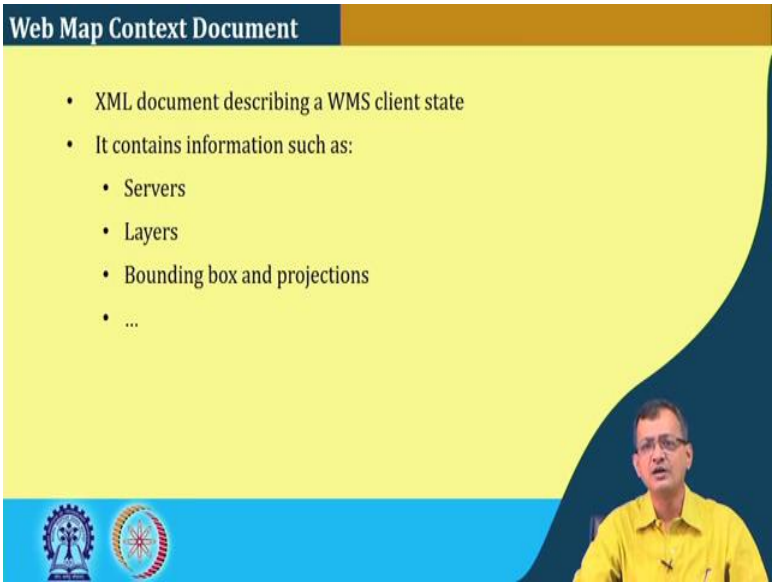
Interoperateability; so, what we are looking at that using this WMS WFS services what we are looking at is that interpret. So, we again just to repeat that one wave feature service which extract the particular feature in XML format and deliver in the web map service which allows me to display maps. And also it needs the style layer or a cellulous are been to display the thing right. Now a client can access data from multiple source data repositories independent of the platform and the vendor right.

So, that is our objective of the things, a client can access from multiple data repositories right. I want to have some date some working on some say spatiotemporal data analysis. I data that particular region, I extract that different feature set land use and other data. From I want to do some climatology model from the IMD dataset, I can extract that if there is a something related to the soil etcetera. I can extract the data set from the some soil survey of India or soil serve whoever maintains that soil things. So, from the different depositories, I get the data. How I get the data? I take as the GML, I get it as a web map a feature service.

Then I can either I store that in the in our database in our in my own data repositories spatial data spatial database some standard spatial database and then I do analysis and query and then create again GML and then display along with the style, I can display as a

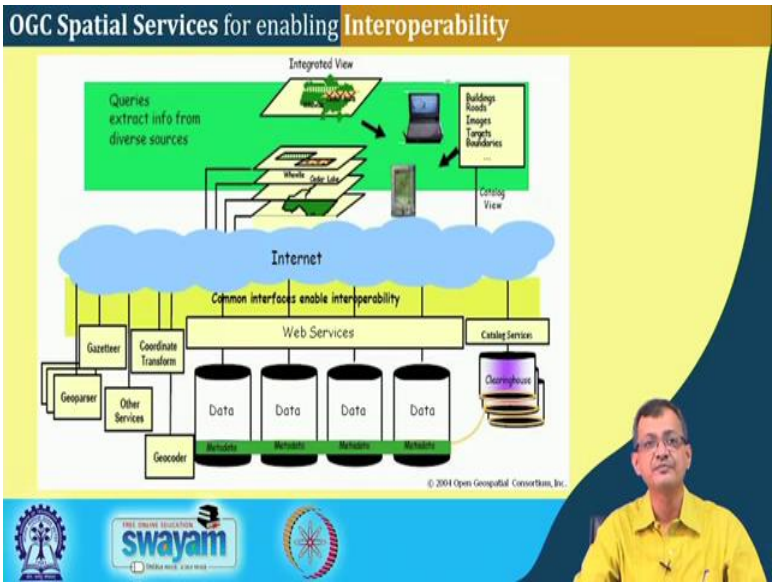
wave feature service right. So, this I can do. So, even in the simple picture case, there are some of the challenging issues like what should be the coordinate systems right. It should be a standard coordinate system, how the bounding box and aspect ratio of a request, how when I requests, what should be the bounding box, what should be the aspect ratio it based on my display feature etcetera, what should be the transparency of the whole thing. So, there are different challenges when you are connecting multiple data and one to make them talk to each other and display things.

(Refer Slide Time: 26:03)



So, there is a web map context document like XML document describing a WMS client state. It contains information like servers, layer, bounding box and projections. So, it gives overview of the whole thing.

(Refer Slide Time: 26:19)



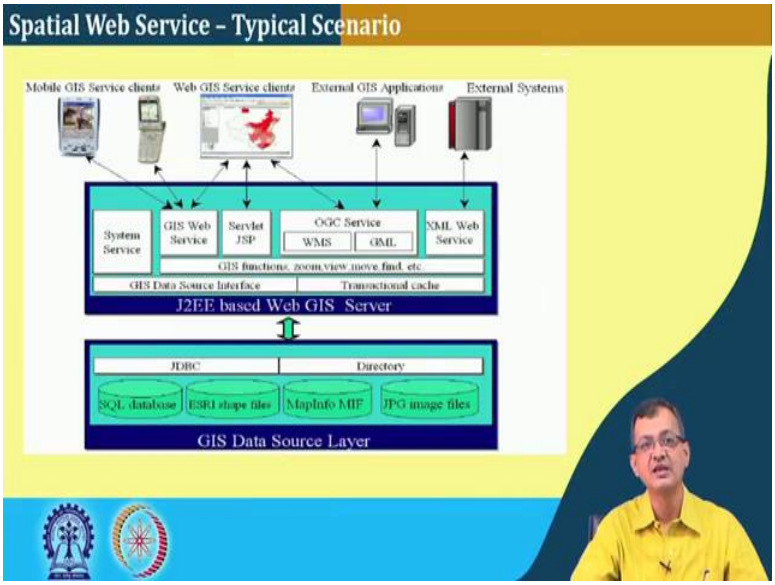
Now, looking at the keeping all this WMS WFS and spatial web services into place, what we are trying to have? We are trying to enable interoperability between data sources right. So, this is a picture. So, this is taken from again some old picture from OGC, you can get some recent and there are several data. We will show you some demo also. So, there are different data repositories along with that metadata repositories right.

So, these are enable through web services; that means, they prime that bottom line is there they exchange GML or XML files right and there is a on the other side we have these client systems right. So, systems along with different so, what I am looking for is there are different layers of data which can be from different sources and there can be integrated view overlapping or merging one or more layers into the things. So, it can have building, roads, images and get a different type of stuff into the things and I can have this for processing at my end or it can be for simply displaying.

So, it in between what we have a network of connection or internetworking and there are is a common interface enabling interpretability like all OGC compliant web services may is the one of them. And there are different other what we say, associated services like gazette service or coordinate transformation service one coordinate to another coordinate, geo parseeing. There are several other services geo coder and there are clearinghouse; that means, which have different catalog services before queering the

client want to know that what are the different data services, what is the data load and there are a lot of other meta data informations right.

(Refer Slide Time: 28:14)



So, looking at the some other point of view this is a typical way how from the implementation point of view. So, these are different layers of data from different sources right. We have intermediate GIS web services etcetera and then we have different type of feature services which enabled different type of external stuff. So, that can be way of looking at the things right.

(Refer Slide Time: 28:42)

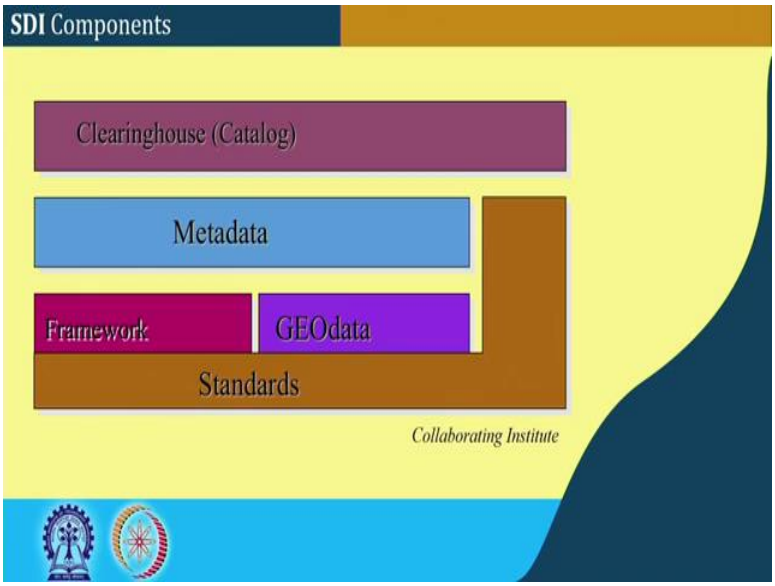
This enabled we will have taking all though all together later on a one or two lectures on spatial data infrastructure, but it is what due to mention it. This things enabled us to a another next level of looking at this spatial data what we look at spatial data infrastructure.

So, what it says that it ensure spatial data from multiple sources; multiple heterogeneous sources at different level it may be government, academia, private sector are widely available and easily integrated to enhance knowledge and understanding of our physical and cultural aspects; very broad definition right very broad definitions right. But it there is a underlining things; that means, I can have different type of data sources, I should have a infrastructure where I can request for the data. I am not bothered about who is storing etcetera data right; again I am falling back it is like a infrastructure. We call about telecom infrastructure; what you require a device, a sim card and a connectivity. Once you connected, you are connected right; you are not bothered about how calls are routed from one place to another, how you the call data video streaming etcetera doing on.

So, long you are taking as a services. Here also we want to look at that as a services how the services are enabled underlining the spatial web services are enabled. That is not that very straightforward as I am telling in a one liner, but these are the enabling forces right. These are not easy not that difficult to look at as a for experimentation because these spatial OGC compliant services or spatial services. There are several open source tools are availables. We will show you some of the things and that you can easily look at the things and you can have your own services to look at all right.

So, underlining we can have this spatial data infrastructure, we will talk about this later on sometimes if time permits.

(Refer Slide Time: 30:40)



So, also typically component if you say the data set is this is the core of the things definitely. We have the clearinghouse which have that catalog type of services which looks at the metadata and which encompassing is the standard like OGC standard unless there is a standard interoperating or talking to each other is impossible right and there is a overall framework which holds the thing right. So, that exactly we want to achieve with the things.

So, one way of looking at this I it we model the data, have standardization database, query, engines, etcetera, but in order to have this data to be used interoperate in a larger scale I require a infrastructure which is enabled by this spatial; different spatial standard special web services right. So, with this let us conclude our today's lecture and of course, we will continue with our next lecture. We will we will have a small demo in our next lecture on a demo session on this; how this web services like way WMS, WFS and other things are can bidding; it is a small demo and we will try to show you that through open source. You can also try and type of things.

Thank you.