**Spatial Informatics**
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**Lecture - 08**
**Spatial Web Services (3)**

Hi, let us continue our discussion on Spatial Informatics. So, last few lectures we are discussing on Spatial Web Services all right. So, rather if you recollect last lecture, we discussed about the basic building block of this web services or XML and other spatial service oriented architecture. Now today we will look at the more in specifically with respect to the spatial web services like what are the standards which are definitely XML based standards and how they allow us to this to help us in interoperating; interoperation another type of things right.

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So, before going to that there is a consortium, call Open Geospatial Consortium and so, to say peoples talk about open geo spatial standards which basically set the guidelines for what will be the data formats, what will be the services etcetera right. Those who are interested or it is I encourage you to look into that OGC or Open Geospatial Consortium website which says that how this services will be defined and things like that. This is important as we were discussing; this is important because unless we follow some standard, it is difficult to interoperate.

So, if we look back to our problem so, we have now most of the organization most of the data set collected across the world in some form of digital some digital form right. It is hardly any paper type of things if even if there is a paper type of recording it is finally, put into digital. But incidentally those data sets are put into our in their different formats based on the applications of software individual organization or individuals whoever using. So, when we want to interoperate like I want to overlay say road network, over land use or over other political boundaries which are coming from different sources. The problem comes that how they will interoperate right. Some maybe some other formats and some other scale etcetera; there are several challenges. The basic challenge that how I can manage this format.

Now, if everybody follows a standard like as we discussed in our normal web services or normal service oriented architecture, then it is easy to look into the things and that exactly we talk about spatial data infrastructure. In infrastructure which help us in interoperating right. So, that where this OGC standard comes from. So, it is a international non-profit organizations where all the countries across the world; most of the countries across the world are member and most of the large vendors or the spatial who operates with spatial data are member of the things; that means, all agree to follow those standards. And are a wide variety of domain, it goes from geo science environment, to defense, intelligence, smart city, IoT web sensors, a mobile technology, 3D or built environment and so and so forth. Disasters management aviation energy and so and so forth; that means, it helps us in more or less working with any type of data sets right.

So, it is a collaboration of vendors, integrators, government, private agencies, university, end users and it give some abstract specification right. So, it gives a abstract specification when by which we can build our own tools and software right. Rather following OGC standard, there are various you will find in the internet; there are various applications which are or freeware which are available in the net for freely using and the things right.

It has a close relationship ISO standard and like for example, TC211 and also uses other standards wherever possible. That means, it this OGC attempts to put up a standard; if it is followed, then you can interoperate that is why if you a if you develop a data set in following OGC standard and then you can easily interoperate with any other data sets

like for example, say Google map or say open street map or any other map right. So, why because they are all are following some basic standard.

So, it is interoperation becomes easier and it is easier you can provide your connection with the APIs and all those benefits of this service oriented architecture coming into play right. Your steal; your internal operations comes remains the same only the external manifestation is the with the standard.

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So, OGC endorsed adopted specification for encoding spatial information, a set of XML technology for handling spatial data on the internet. So, it is XML based as we told and it is set of XML technologies which are internet. So, it is a international standard for spatial data endorsed by like as you are told endorsed by government vendors private agencies and so and so forth. So, it is a standard.

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So, one of the as we if you recollect, when we started with GML; when you started with spatial, one term came into play which is the Geographic Markup Language. So, it is a markup language. It is a markup language it is so, to say same philosophy as XML or it is a XML language with geographic extension; that means, it is a XML which understands the geography right. So, if you look at we make it simple that we need to initially cater for three type of things like point, polyline and polygon right. So, represent the along with that we need to look at the SRS or the what we say spatial reference system or the coordinate system where the things are there like if I want to say from a b to location and then, try to find out shortest path this a b should be with some reference system, their coordinate system.

The best known coordinate system or best popular coordinate system, what we see in from our childhood is the lat long right over the in with respect to the earth surface though at times will see that there are challenges in using it, but not going to those complicacies. So, GML what is tries to say that you can encode those things. So, it is a de facto language for geographic information to help in interoperation. It is can be read and understood easily as it is XML based. GML can be easily distributed spatial data sets that are linked together local, maintenance and development and global access. That means, what I do that if I am organization maintaining a some spatial data sets say for that matter say I am maintaining the road network of IIT Kharagpur right.

So, I maintain the whatever way I want to do; I may use any tools and type of things we can use. But when you request me for any data set of a of the day of roads of data IIT Kharagpur, I reply you back in a giving you back in a GML or a GML file which is easily understandable and you can decipher. Nevertheless still my in house processing remaining space; this the my interface goes on changing. And GML like XML is a web friendly easily easy to manipulate, display, using current and emerging web technologies. GML is a non proprietary and open. So, it is a not a proprietary language. GML enables non proprietary web service, feature services, image map, annotation map, styling, spatial analysis and all those things those are handle by the GML.

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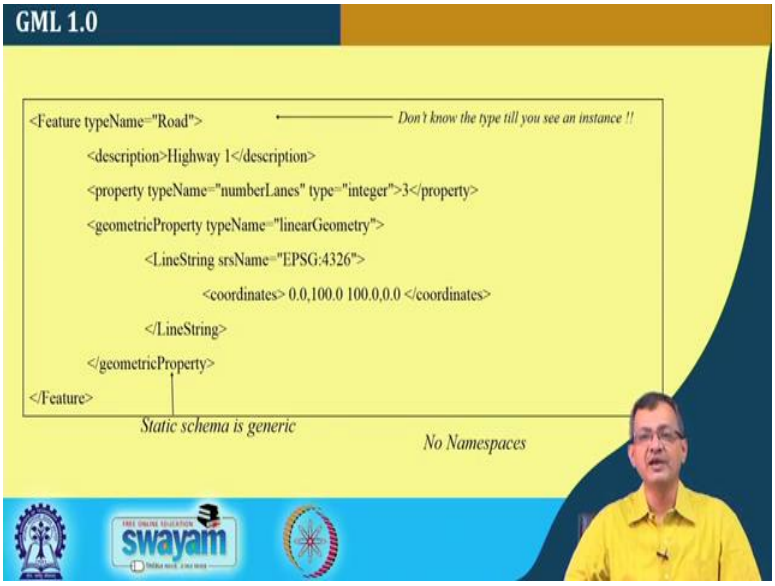


Like typical GML looks likes a like this; if you again if you recollect our XML things are those who are already accustom with XML, then you will see that it is a basically a XML type of things right. So, it is a feature type of is a feature class with the type of road and the description of the load and etcetera so and so forth.

In other sense, we have we can defined our no own structure right. These are the it is a highway one description and so and so forth and the thing is that we along with that we have this coordinate system right. And also this is a spatial reference systems like what is your coordinate system url; whether like if you if you remember the school day mathematics like we say Cartesian coordinate or polar coordinate system etcetera; that means, which coordinate systems you are referring to. So, EPSG: 4326 is a standard. So,

if you say I am following this standard, there people know that where is your what is the coordinate system you are using and with respect to that this is your points right now.

If I have another coordinate system so, I can convert this. I know that EPSG 4326 to some EPSG something or something SWS WGS something conversion, then I basically do a put a map are things to map this coordinate system to the other coordinate systems. So, that that is the bottom line of the thing right.

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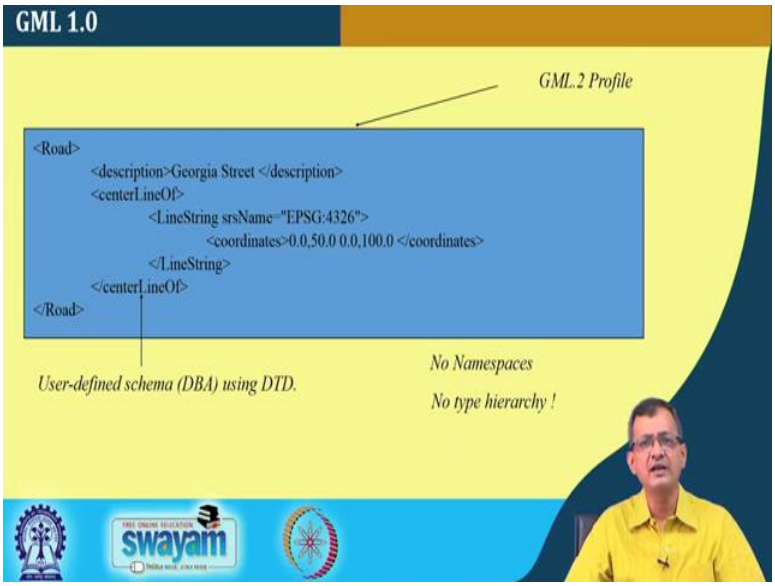


So, this is the basic stuff and this is GML 2; 0.2 profile with no long space on no type hierarchy. So, we have some user defined schema with DDT that is DTD that is that what we have seen for the XML. So, we can have a user define schema out here.

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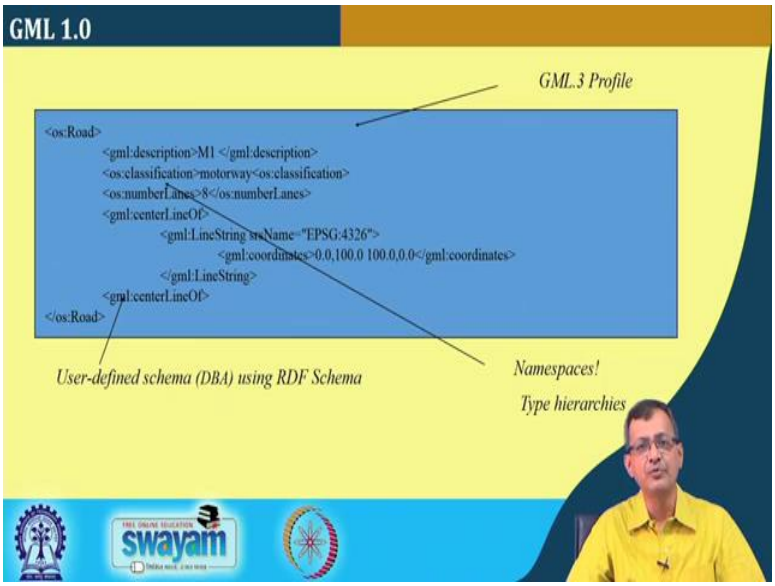


And we can have GML profile 0.3 profile where we have some namespaces right. See that we are declaring a namespace called os namespace gml colon. So, there are two type of namespace are there. Some of the gml namespace; in this case, we have not defined anything right all are in the same namespace, no different namespace right.

So, here we are defining different namespace again if you recollect. So, this is following the philosophy of the XML correct I can define my own namespace. So, the way I define the road network of IIT, Kharagpur; if there is a any specific definitions, I can define the things. This happens mostly when we have some standard say country wise or state wise right. So, you define that this is way my road is defined, this is way my something else is defined, then you define the namespace. So, what you need to say a is that namespace data. So, if I know your name space that I know that how the data is defined.

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So, a standard of so, what we see a GML is a standard for encoding spatial information content for encoding geographic information right. GML allow us to leverage on the world of XML. It is a basically XML based and also can able to handle this 2D, 3D representation. It helps it also facilitate query and element selection.

So, we will see that it is a meta data and relationships can be handled; that means, more on also to say that semantics of the data can be handled and also it facilitates transformative transformation data transformation right; from one form to another. So, I can have some sort of a lookup table or some sort of XSLT file and so that. So, I can transform the data to one form of one form to another right like for example, I want to segregate out only a particular set of road network right which are say category of national highway etcetera. So, I can write a filter which takes care of the things. So, it is it transform to the some other type of things. I can have a coordinate transformation and all those things to the things. So, GML will enable ubiquitous use of the spatial data that is important right

So, now the spatial data which is more confined with organization with government or etcetera. If want to use it for a larger scale, we can do it right. So, to say if government of India allow so, the data collected for the say road data or land use data can be used by some other person or some other organization to do some other things right. I can find out that say navigation purpose, I can use the say land use data for doing some other

things like maybe planning something say agricultural planning, urbanization plan etcetera. The data being collected and stored maintain and stored by something which is exposed in such a way the other can consume the data. Other the consumption of the data is a big problem, otherwise you have to buy the data or take the data take the data to your own thing, then convert and so and so forth. There are lot of challenges in it, you need to understand their format clearly and your format clearly.

Right of course, you may be knowing your format and there are the problem of maintenance right. Say any change in the data will not be reflected unless you carry the data to your own place. Say in other sense if I say that data remained in place whenever I request you give me a data in a interoperable format or so to say is a GML format. I transform the data to my own thing and work on it and if I want to again share, I want to share that data with other thing; I again I can put it on the GML format. So, the interfaces are well defined where my underlining working remains same right.

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So, there are a various applications. So, to say so, there are internet mapping. So, like for example, MapQuest internet based situation management like disasters management, accident and police investigation emergency services. So, this data can be accessed right like I say that I have a road network which are psuedo static road is not changing day in, day out right. So, those data are in GML format. If there is a accident or some problem on the road so, I those data if we share then, I can I can add as a another service provider;

we can say that which roads are free, which are the traffic. If I have some of the traffic data collected by different sensing mechanisms like maybe camera or other type of sensors say, those things can be on the fly can be simulated and see that how the things are there. Now see the data collected by multi party not that all data are collected by me, but I can do this heterogeneous data to give different type of things

It may help in disaster management, accident and police investigation or police patrolling, emergency services. Public private system for land, titles, lease, permits etcetera right. So, I can have different say municipalities etcetera that land demarcation etcetera in a proper format and which can be used for different purposes. Location based services for wireless user like different location based services for which are which can be connected through wireless means or can be connected to wired means by through wired means internet GIS, different GIS portals are can be enabled pretty easily or you can have different services which can be enabled disabled as far will private municipal and other government services can be made activated.

And these days we see in our country also, this most of the municipalities most of the several land registration authorities are going in a in a spatial way right. They can demarket and type of things there are mis or other information non spatial information along this the spatial data is there which is highly possible or made it more easily possible through GML. It is not like that all are using this technology, but eventually using this technology will be a much easier to handle those things right.

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So, if we free it is build on W3C standards. So, GML is there that of course, the underlining XML, XSLT, SVG, VML XLink, XPointer, XSD and all are XPath and other things which are there in the W3C standards are being adopted here also or GML is based on that. That means, it supports a global standard that helps in interoperability easily to make tools to make that type of things.

Like we say in our if you look at telecom or networking sector, they are all following some standard as it is followed by some standard, then making a device is basically following a standard you want to make a protocol you follow the standard. So, it interoperates. So, those are things which are possible out here right.

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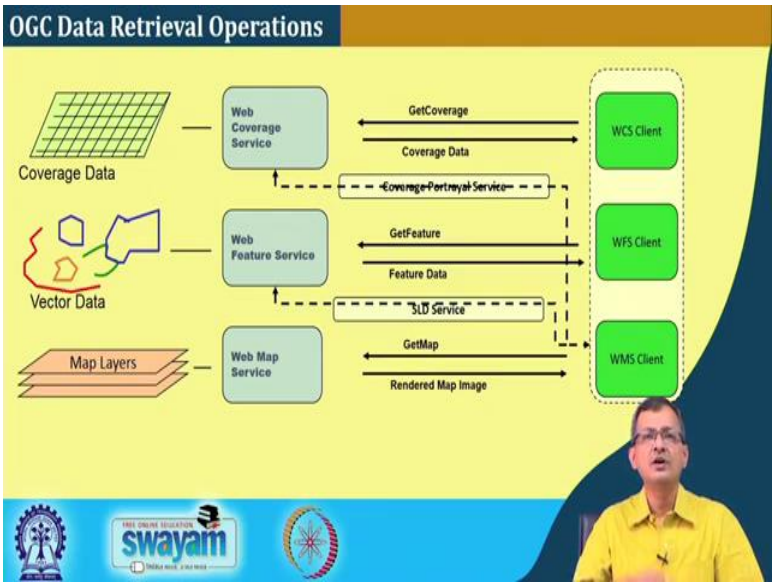


So, will come in details to the things just to give you an overview. So, what we required when we have this data sets? Now see we require first of all display of the data. I get a road data and then I want to display the data on the on the screen or on the things right. So, what we say it is mode of a map services or web map services. OGC define this WMS or Web Map Services. So, what we require? The data along with some sort of a styling of the data.

So, that the map can be rendered right like I give you a road of different structures in national highways, street highway sorry national highway, state highway, street roads etcetera road and road and type of things. Now when you want to display on the map, they will have different styling like some may be thicker with green colors, some maybe some dash road and type of things. There are different way of representing. There may be also standard in the road representation, there may be a way of you want to visualize it. So, you get the data which is raw; now this timing file allow you to make the display.

Now, if you look at the browser, browser understand some of the things. So, you WMS along with the style has to be put into some form which are this browser friendly which are which we can do on the fly right. The z data generator need not be bothered that how you are using the data right so, but what is provided by the server is a WMS service or web map services right to display the data.

So, I can have different say suppose today ISRO or that our data survey of India, GSI who are custodian of the data. They say that I you can see my data using WMS or web map services right. You can display the data on your screen right. So, these are the web map services. Now secondly, I may be interested not on the displaying of the data not only on it, but I want to on the processing of the data. I want to do a overlay of the things; I want to take a road network make a buffer of say 100 meters and try to see that what is the land use.

So, I need the data in a in which is feature for that we have a service call web feature service. So, the services will be at the server end, I have a web future client with the things right, then there are other type of service like I want to find out that what is the coverage of the data, how much data is covered which are the layered etcetera for that coverage services are there. There are catalogue services or registry services on to data which data where it is available and other type of metadata information.

So, there are different type of registry or catalogue services. So, these are different services which are which are what we say exposed to the data repository to the external world. That means, if I have a custodian of the data say of IIT Kharagpur, then I say that if you want my data, then I have these are the services. You can display my data using my web map services, you should have a WMS client as it is OGC compliant, you do not have to do not have to take the format from me because I am following that I made my server following OGC and you also make it by OGC client.

So, you can display it if you want to have a you want that I want a data that agreement with data access agreement and then I want to data as a feature. I want to data not in that text to display, but the data as a whole as a GML file and type of things. Then we have a web feature services right and then I may have different coverages, catalogues, registry and type of things right. The beauty of the thing is that my internal processing or storing of the data remains same not only that I can only expose that the portion of the data which I feel like it is I am ready to ready to sell or ready to share with right.

So, these are the different way of looking at. So, map services map layers. These are the different feature services and we have those different feature services and there are different coverage services; there can be other different services.

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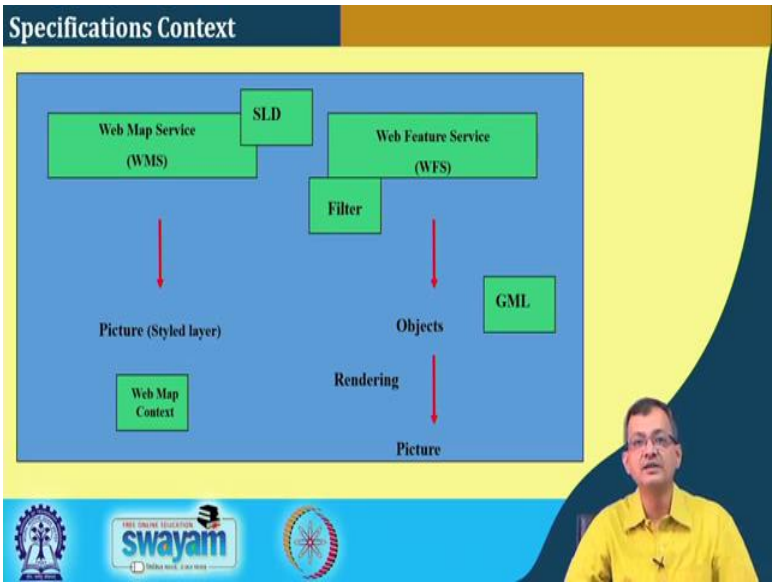


So, there are different context, we have web map services. So, there should be a style file so that it can be displayed where as the web feature services, it takes all these objects in the GML form. And you can also you can do rendering and do the display the picture or you can do the GML for further processing. There is a filtering operations I may want to filter the data based on the my need as a client that I may not be interested in the all data set, but I want to filter the data based on my requirement.

Or there can be something which can filter at the server end also, I may not able want to expose all the data which I have collected. So, I have a process of restricting or filtering and sharing the data what you want to share.

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So, web services as we I am not going to again because we have detail. So, is a software based design to support interoperable machine to machine interaction over the network and other things you already know and we have discussed in detail right.

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So, we will come to this different type of services or different type of OGC compliant services right. One is the web feature service or popularly known as WFS or OGC WFS type of services right.

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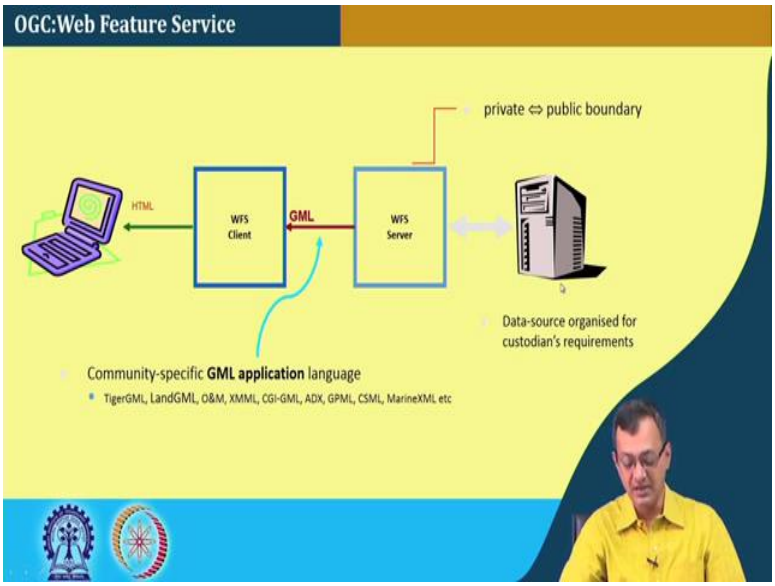


So, we have a data source. So, there is a WFS server which is facing to the external world and then there is a request of the any WFS. It creates a GML which is consumed by the WFS client which in turn can be displayed using with a style sheet making as a html compatible file to be displayed or I can consume the data and do other processing of the things right. So, at the boundary there is a some web WFS server which allows me to extract the data from the repository. The way the repository is maintained can be something like I can have some proprietary databases to handle a type of things.

So, community-specific GML application language so, that can be TigerGML and GML, XSML and there are several type of languages which we can handle right. So, you see so, what we have the data. I have a WFS server which able to read this data and convert it into the GML based on your request. So, if when I say that WML a WFS client sends a request, it prepare WFS the, it prepares a GML file based on the things and send to the things this in send back to the client. So, it is the where we can do say I request for the road network which are only national highways right or all road network. So, it extract from the things and give it to prepare a GML file and send this. WFS client in turn consume this GML file and then put it to other user; it maybe a display using a style sitting etcetera and it may be some other processing and so and so forth. So, this makes as a private public boundary right; you do not you do not go beyond this or the client does not see; the user does not see that what is happening out here.

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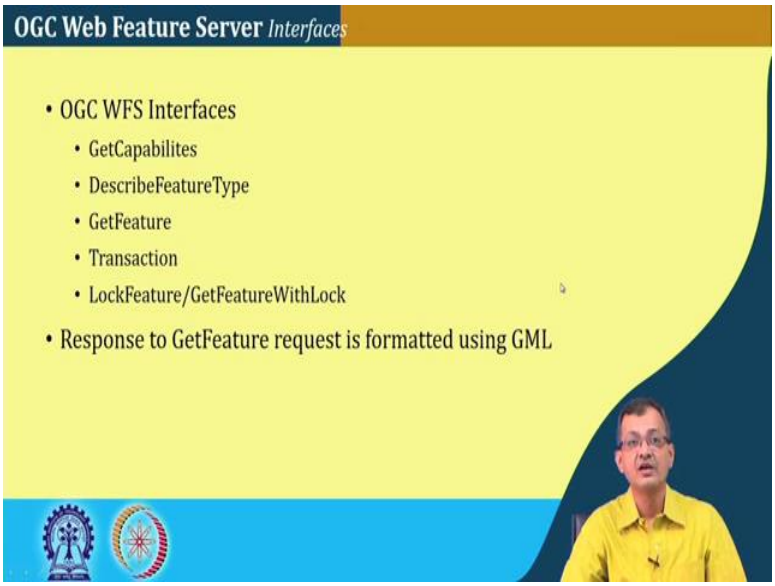


So, WFS features server or WFS server, Web Feature Server; there are interfaces OGC WFS interfaces. So, there are GetCapability. So, there are different functionalities; GetCapabilities, DescribeFeatureType, GetFeature, Transaction, LockFeature; GetFeatureWithLock and type of things. Response to the GetFeature request is formatted using GML. So, whenever you goes for a get feature, it is response is an a GML file which can be consumed by the client.

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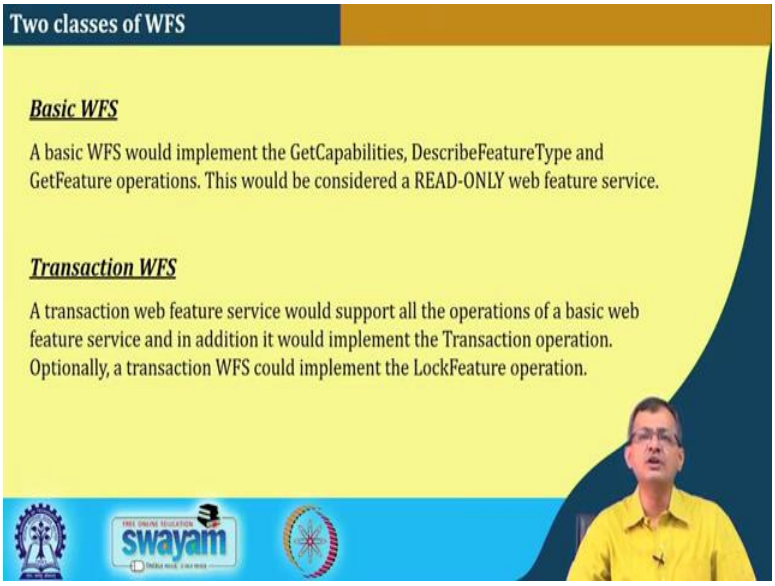

So, there are broadly two basic type of WFS; two type of WFS; one is basic WFS a basic WFS would implement the GetCapabilities, DescribedFeatureType and GetFeature operations. This should consider a READ-ONLY web feature services or there is a another WFS what we say transactional WFS. A transaction web service would support all the operation of a basic web feature service and in addition, it would implement transaction operation right. Optionally a transaction WFS would implement lock feature operation also. So, there are different. So, it is it does a transactional thing right; I can those are would implement get capability describe feature and get feature operations, but here you can do a transaction into the thing; based on your query the things are written.

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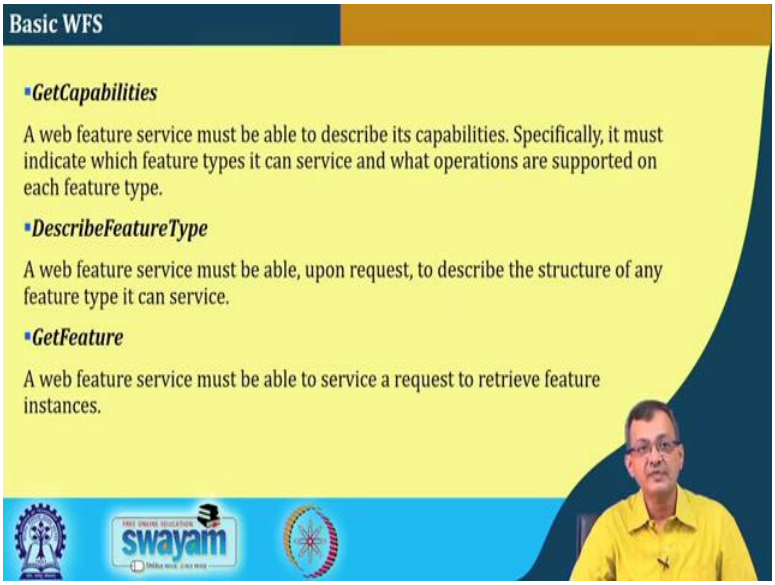


So, the basic WFS, GetCapability is a web feature service must be able to describe its capabilities like specifically, it must indicate which are types it can service and what operations are supported on each feature type etcetera. So, these are the GetCapabilities. DescribedFeatureType, a feature web feature service must be able to able upon request to describe the structure of any feature type it can service right. So, there is a one is what are my capabilities or the capabilities of this repository, what are the feature type description of the feature type and there is a GetFeature, if it is a request that a web feature service must able to service a request to retrieve feature instances. So, there is a GetFeatured service, it should retrieve the data set.

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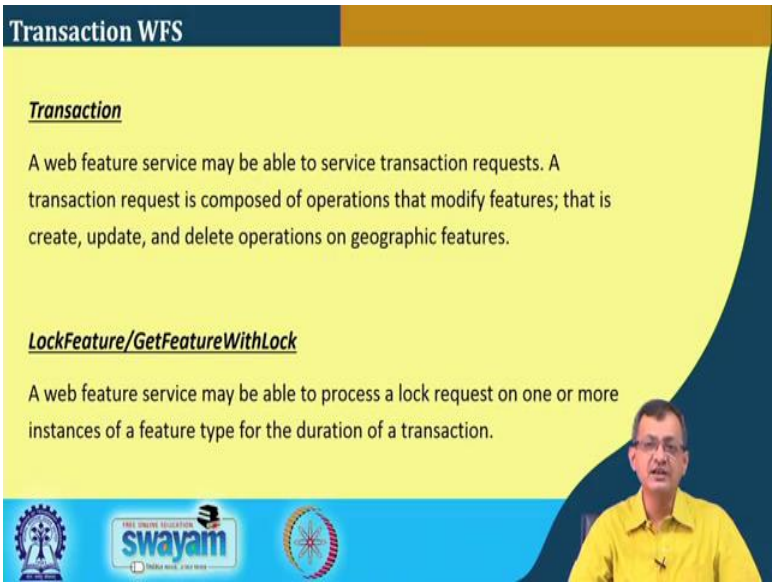


Along with that in case of transactional WFS so, there is a transaction a web feature service may be able to service transactional request right. A transaction request is composed of operation that modify feature that is create, update, delete operation on the geographic features right. So that means, I want to do some updation of the things that also I do by a web service OGC compliant web service. So, that is a transaction. So, transaction can be create, update, delete other than reading also, but that is also I can have that to the GetFeature service. But it is a updating the repository right, I can I may want to update some road network, I may want to update some land use pattern, I may want to update something else and etcetera so that transactional.

And there is a another feature that LockFeature or LockFeature with GetFeatureWithLock. A web feature service may be able to create a lock request by on one or more instances of a featured type of other duration of the transaction.

So, that during the transaction duration, I can have a lock feature because during the transaction there should not be any change of the things. So, these are the things with the lock feature. These are some of the advanced features in case of WFS.

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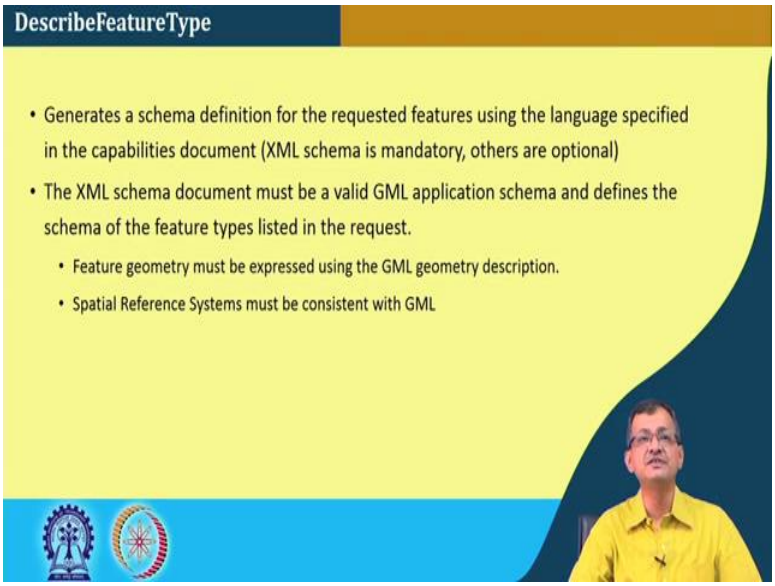


And then we have a describe feature generate a schema definition like XSD, what you have learnt earlier. Schema definition of the requested feature using language specific in the in the capabilities document; XML schema is mandatory others are optional. The XML schema document must be a valid GML right.

So, as XSD as you remember those are the GML, it should be also valid it was XML this XML schema document or XSD should be a valid GML application schema and defined the schema of the feature type listed in the request right. So, it should be a valid GML schema with proper XSD and type of things right conforming to OGC standard. So, feature geometry must be described using geometry GML geometry description or GML geometry class and SRS of the spatial reference system must be consistent with the GML. So, two things are important; one is the geometry description should be there right what sort of geometry etcetera is there, another is the SRS should be properly defined or the spatial difference system should be properly defined.

See these are the things where which were not specifically needed when we talk about the um; when we look at the standard XML or standard data transfer or XML data sets.

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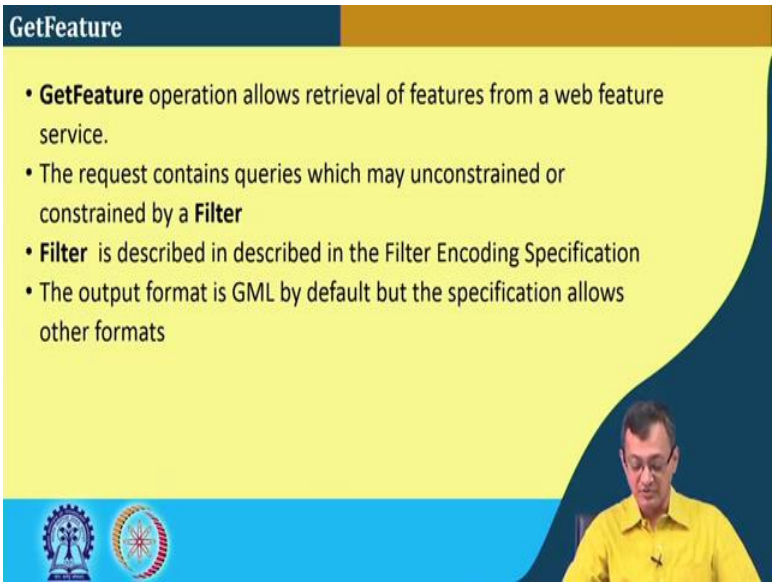


So, GetFeature operations allow retrieval of feature from web feature services. So, it the feature contains queries that constrained or unconstrained or constrained by a filter. Filter is described in filter in coding specification the output format is GML by default, but the specification allows other format also by default it is GML. But you can output it for the different other format and this filter operations allowed you to filter out or some of the data sets that not that whole data sets.

So, what we see this is this web feature service allows us to extract a different data in GML format from the repository. It is a tremendous powerful things like if I take the data from different repository and then, I make a functional or make a business process on the things right. Kike as I was telling that I want to find out that say, shortest path the standard thing.

So, I want to find out the different road network. It may decide in one database on multiple database and then I need to have the road network in aggregated form and then I need to find then the shortest path algorithm on the things right. That is not the headache of the repository; they are storing the data as per their need. So, then what I do I do WFS queries get those data in my thing and then I make a say graph of this road network and find the shortest path right. That that way we can do and we have seen that is the basic GML feature with GetCapabilities GetFeature and type of things and there are transactional things right. I can have a transactional thing and transactional. We again

there are features with lock etcetera; those are advance feature, but nevertheless these are all feature services. So, in the next class, we will discuss about other services. So, let us conclude our discussion of this class here.

Thank you.