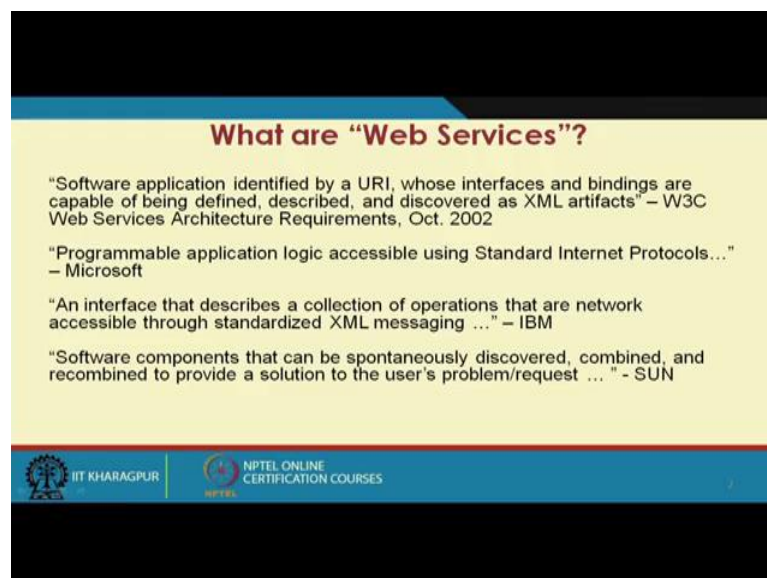


Cloud Computing
Prof. Soumya Kanti Ghosh
Department of Computer Science and Engineering
Indian Institute of Technology, Kharagpur

Lecture – 10
Web Services, Service Oriented Architecture

Hi, welcome to this series of lectures on cloud computing, today we will be discussing on one aspect which is sometime considered as one of the major prime mover or building block of cloud computing, that is web services and service oriented architecture. So, we look at that what exactly it means and try to have a overall a overview of the whole thing. So, that it will help us in understanding that; how it build up and how things are going on.

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What are “Web Services”?

“Software application identified by a URI, whose interfaces and bindings are capable of being defined, described, and discovered as XML artifacts” – W3C Web Services Architecture Requirements, Oct. 2002

“Programmable application logic accessible using Standard Internet Protocols...” – Microsoft

“An interface that describes a collection of operations that are network accessible through standardized XML messaging ...” – IBM

“Software components that can be spontaneously discovered, combined, and recombined to provide a solution to the user’s problem/request ...” - SUN

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Now, what are web services there are several definitions, you will find in the literature and the internet. So, like if you see the W3C web service architecture requirement specification, it says that software application identified by a URI, whose interfaces and bindings are capable of being defined described discovered as XML artifacts. So, this is a very versatile definition.

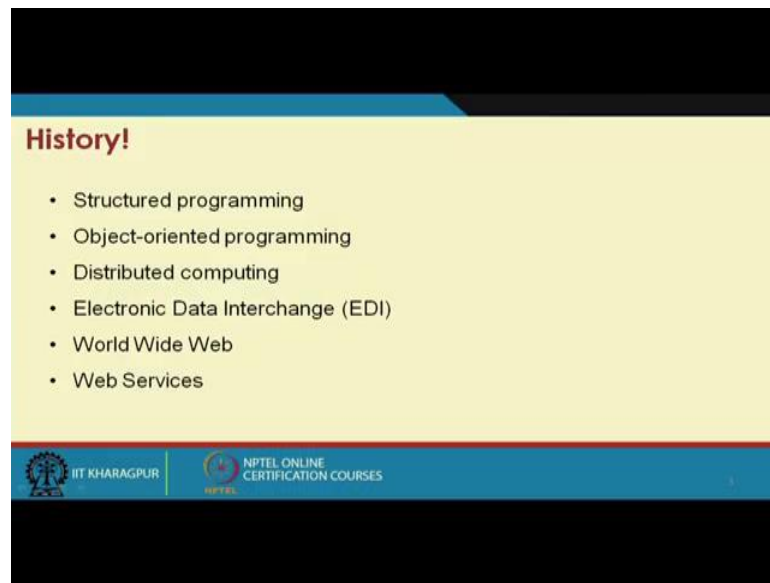
So, it is, what it says that the software applications, which are identified by URI and whose interfaces are bindings are capable so that you can define, you can describe, you

can discover and all is underlining XML base languages, right. Whereas if you look at the Microsoft define as a programmable application logic accessible using standard internet protocol right. Other definition an interface that describes a collection of operation that the network accessible through standardized accessible messaging and software components that can be spontaneously discovered combined recombined to provide solution to the users problems and request right. So, from this different sort of definitions what we can see one thing is there that is a, it is a XML based phenomena, right.

So, XML as you know it is a more of a data transformation language, it helps in interoperability and helps in application talking to each other right. So, web services are those type of services, which are available on with can be defined in the, can be accessible through a standardize URI and it works on a message exchange type of protocol which is based on XML, right. So, what it gives us it gives us a you can any application can now to application can talk to each other, I am not bothered about what is at the background of the how things are there, I only bothered about where the service is available and how I can talk to that services, right I do not bother about the background processing of the things. This also helps in bringing this legacy application to talk to other applications, right.

So, this is a different way of looking at the things, those who are costumed with client server type of protocol, which are more tightly bound this is more loosely bound and can talk to each other very easily and if you look at the; if I say the genesis of the history of the things.

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History!

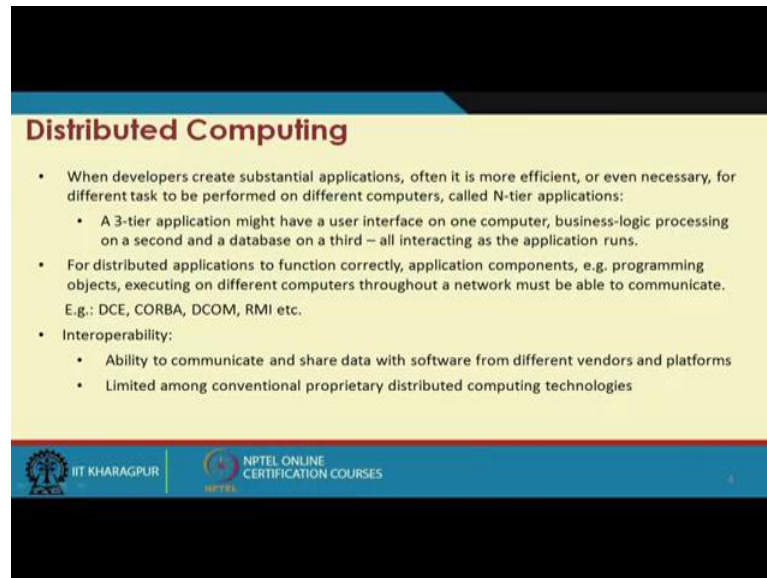
- Structured programming
- Object-oriented programming
- Distributed computing
- Electronic Data Interchange (EDI)
- World Wide Web
- Web Services

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So, there are different aspects which help or which promoted this web services one is definitely structured programming, which evolved to a next suggestion of object oriented programming, distributed system as we have discussed in our previous lectures.

So, it is played a important role, there is another concept of electronic data exchange between two entities primarily to business entities, when they want to interface that data for some particular purpose. Of course, this World Wide Web which allows the whole computing phenomena to connect to each other right with backbone internetworking primarily driven by internet protocol. So, these are this is also a one of the phenomena, these you know. So, this all this component has all these components have; now has what we say facilitated that this development of web services or the evolution of web services.

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Distributed Computing

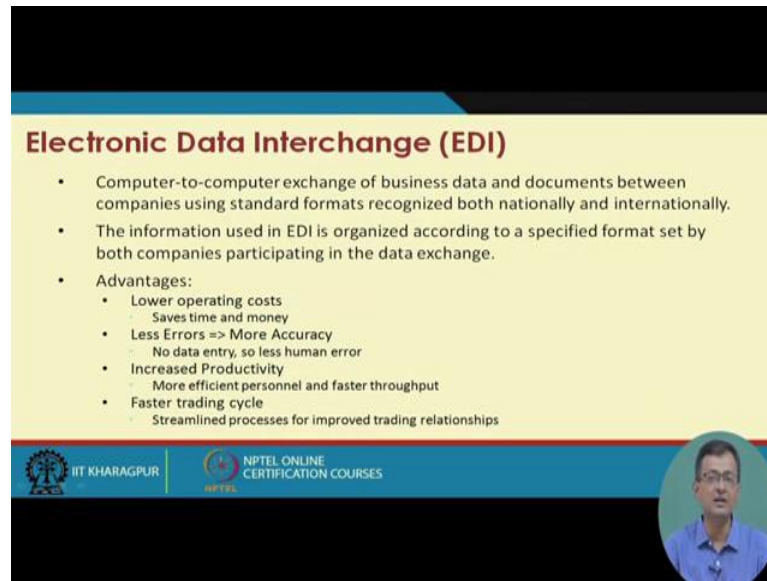
- When developers create substantial applications, often it is more efficient, or even necessary, for different tasks to be performed on different computers, called N-tier applications:
 - A 3-tier application might have a user interface on one computer, business-logic processing on a second and a database on a third – all interacting as the application runs.
- For distributed applications to function correctly, application components, e.g. programming objects, executing on different computers throughout a network must be able to communicate. E.g.: DCE, CORBA, DCOM, RMI etc.
- Interoperability:
 - Ability to communicate and share data with software from different vendors and platforms
 - Limited among conventional proprietary distributed computing technologies

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Now, distributed computing we are I am not going any detail, because there is we have talked in detail talked in length that in our previous lectures. So, one of the issues; whenever we are doing distributed computing interoperability right one of the major issues; other than it working another type of things.

So, ability to communicate and share data with software from different vendors and platform very interesting phenomena and which allows this whole world of or whole gamut of application to talk to each other that is it allows you to communicate share data software from different vendors to platforms. Limited among conventional proprietary distributed computing technologies like in case of interoperability and more, limited scopes, we need to expand it.

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Electronic Data Interchange (EDI)

- Computer-to-computer exchange of business data and documents between companies using standard formats recognized both nationally and internationally.
- The information used in EDI is organized according to a specified format set by both companies participating in the data exchange.
- Advantages:
 - Lower operating costs
 - Saves time and money
 - Less Errors => More Accuracy
 - No data entry, so less human error
 - Increased Productivity
 - More efficient personnel and faster throughput
 - Faster trading cycle
 - Streamlined processes for improved trading relationships

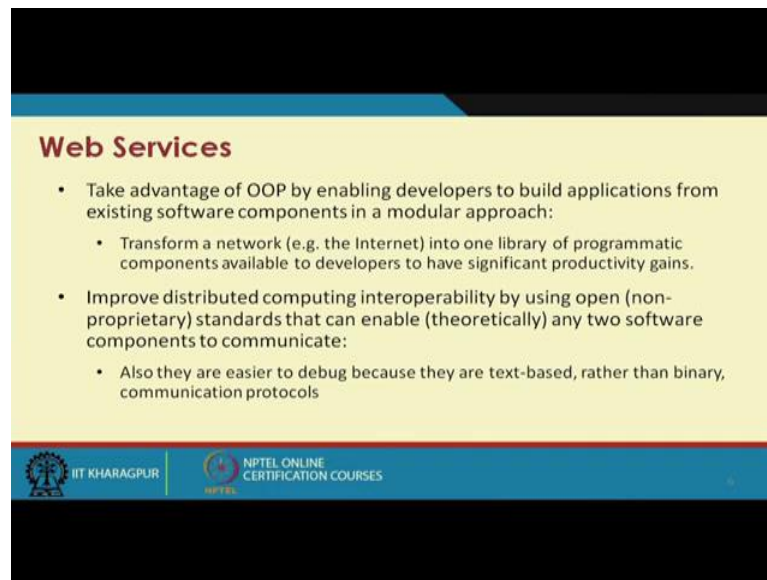
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There is another major development means in this area is the EDI or which is popularly known as electronic data interchange, that computer to computer exchange of business data and documents between companies using standard formats recognized both nationally and internationally; that means, it is a primarily a business data or formats, but the formats are recognized by the both the party.

So, I understand that the other the organization A system understand the; what the what type of message is coming from the organization B and then go was exchanging. The information used in EDI is organized according to a specific format said by both companies participating the exchange. So, it is important that the format is somewhat pre known or pre defined that how or exchange that format or the schema exchange previous to the exchange of the data.

So, other party knows that what sort of data is expecting. There are lot of advantages like one is that low operating cost because you do not bothered about when exchanging data less data more accuracy because this data exchange phenomena loop is not there. So, no data entry less human error. So, directly getting the data from the other things; increase productivity obvious and faster trading cycle if there are multiple companies are working together that is one aspect.

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Web Services

- Take advantage of OOP by enabling developers to build applications from existing software components in a modular approach:
 - Transform a network (e.g. the Internet) into one library of programmatic components available to developers to have significant productivity gains.
- Improve distributed computing interoperability by using open (non-proprietary) standards that can enable (theoretically) any two software components to communicate:
 - Also they are easier to debug because they are text-based, rather than binary, communication protocols

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Now all those things have somewhat facilitate this as we are discussing is that the web services. So, it take the advantages, advantages of object oriented programming by enabling developers to build application from existing software component in a modular's approach, right. So, it helps developer to develop applications and from the legacy things or the existing thing, and help them to different component to develop different components in a modular approach.

So, transform a network that is internet into a library of programmatic components available to the developers, to have significant productivity gains. So, if we look at its a as if the library of different programming components are there, now you can go on building things to make your application now, right. So, one if we will take a type of example that this how this services are exchange, is maybe what we can think of is our this online reservation or booking systems right, I book a train or say flight.

So, I have the I gave means when I do when we use a particular address or URI to access that, and then I then those in-turn say any that particular travel portal is not having neither having flights, non having hotels or non having anything right. So, it in-turn talk to the other different airlines services pull the data showed to the user its selects and then the if the booking process goes on, then it goes on a it through a credit card debit card, net banking so other services are called.

So, if you see there is a multiple services are being amalgamated in a proper choreographic way to execute a job. So, my job was to select say a best possible flight based on my budget and my convenience of time, and I want to do it online. So, I go for a some sort of a travel portal or what we say some sort of a broker right which allows me to see different airlines stuffs and then I select my suitable things go on paying through my credit card, debit card etcetera and then the I get the ticket generative right. So, see neither this airline organizations, they are directly; I am not directly hooking to them, they are being connected neither this your credit card or debit card service provider, have any clue that whether you are buying a ticket, etcetera. So, it what it says that if it gets a request in a particular form, it will acknowledge it and then replied it one particular form, right.

So; that means, it is some sort of a XML type of message, exchange going on to the things. So, this allows us to generate different type of mega applications of using some different type of different software components or different type of other application.

So, I can mix and match and doing the things and it goes on a choreographic way list minimal involvement of the different service provider and it goes on like that. So, if you see that improve distributed computing interoperability by open non-proprietary standard; that can enable theoretically any two or more software components to communicate; so, it uses a open standard and facilitated interoperability as you are discussing about XML and type of things.

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Web Services (contd...)

- Provide capabilities similar to those of EDI (Electronic Data Interchange), but are simpler and less expensive to implement.
- Configured to work with EDI systems, allowing organisations to use the two technologies together or to phase out EDI while adopting Web services.
- Unlike WWW
 - Separates visual from non-visual components
 - Interactions may be either through the browser or through a desktop client (Java Swing, Python, Windows, etc.)

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So, it provides capability similar to those of EDI like exchanging data, but a simpler and less expensive to implement, like I do not have a any sort of a predefined agreement on the data format etcetera right. Rather somewhere other I should able to know that where the things have goes on. Configured to work with EDI systems can be configured to work allowing organizations to use two technologies together or to phase out EDI while adopting web services right.

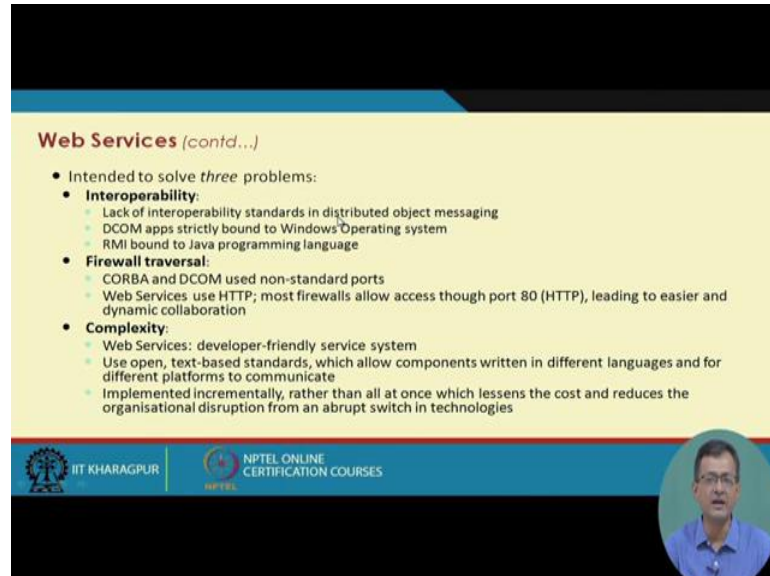
So, unlike www or World Wide Web, separate visual from non visual components, right. So, this is important one is that what I visually see right another is that what goes on the background. So, these two things are separated like if you look at the XML type of things XML is more of a data transformation language. So, it is not a data visualization language; in other since html as we know is more of a data visualization or it displays the things, right. So, XML more work on interoperability type of issues and how did I will be exchange and so and so forth.

So, XML with styling of the XML plus styling of the data will help in visualize or displaying the data. So, unlike our normal http base things which displays the thing it is more of a data representation or data transformation type of stuff.

So, interaction maybe either through browser or through desktop client, like can be java swing, python, windows etcetera that can be there are different type of desktop clients

we can interact with the things or the common interface is the; to the interfacing with the browser.


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Web Services (contd...)

- Intended to solve *three* problems:
 - **Interoperability:**
 - Lack of interoperability standards in distributed object messaging
 - DCOM apps strictly bound to Windows' Operating system
 - RMI bound to Java programming language
 - **Firewall traversal:**
 - CORBA and DCOM used non-standard ports
 - Web Services use HTTP; most firewalls allow access through port 80 (HTTP), leading to easier and dynamic collaboration
 - **Complexity:**
 - Web Services: developer-friendly service system
 - Use open, text-based standards, which allow components written in different languages and for different platforms to communicate
 - Implemented incrementally, rather than all at once which lessens the cost and reduces the organisational disruption from an abrupt switch in technologies

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Now, if we look at web service, it tries to address three major components: interoperability, like lack of interoperability standard in distributed object messaging. So, interoperability between two software; between two parties.

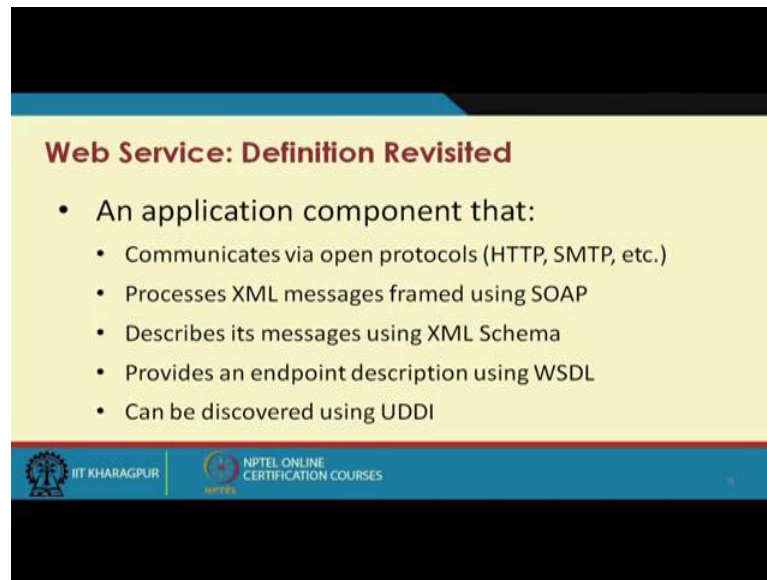
Firewall traversal. Now, as which as the web service is piggyback on different Internet or TCP/IP based protocol, primarily http protocol. So, it has a it can basically go over the firewall most of our firewalls are http at port 80 are allowed.

So, web service can still work on the things. So, CORBA and DCOM used nonstandard ports web service is use mostly the http. So, it is not only the not only http, it can use others, but primarily http most firewalls allows port 80 http leading to easier dynamic collaboration that is one major aspects and complexity web service is it is a more of a developer friendly service system correct. So, it is the much easier to develop. So, use open text based standards like one of them is XML which allows components written in different language or different platform to communicate, right.

So, this is important. So, and it can be implemented incrementally right not on the day one everything has to be done are other deployment also can be done in incrementally, rather than all at a once which lessens the cost and reduces organizational disruption

from the abrupt switch to the technologies, right. So, these are the different aspects another major aspect is still organization can run that legacy software and tools if you have proper web service interface for the external world.

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Web Service: Definition Revisited

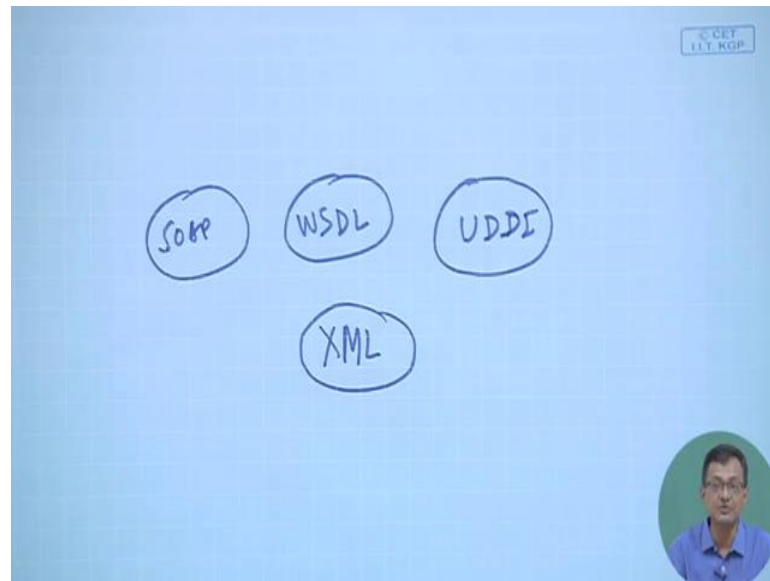
- An application component that:
 - Communicates via open protocols (HTTP, SMTP, etc.)
 - Processes XML messages framed using SOAP
 - Describes its messages using XML Schema
 - Provides an endpoint description using WSDL
 - Can be discovered using UDDI

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So, if we just try to again sum up that communication via open standard like it can be HTTP it can be SMTP or any type of any other TCP/IP application layer protocol meant be there. Process of XML messages framed using SOAP, we will come to that what is SOAP and. So, it is a it is primarily XML based messaging system and one of the popular thing is the SOAP. Described its messages using XML schema, how the how my data is organized; I can basically describe is using a XML schema. Provides an endpoint description using WSDL will again see what is web service description language.

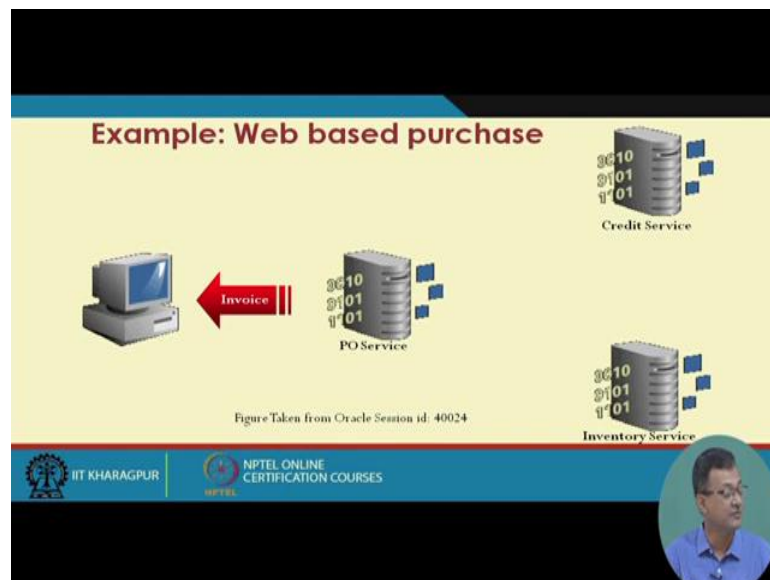
So, where my service is launched how it is configured, I we can do at a WSDL and basically I can publish and discover using a UDDI. So, my web service description discovery and integration it is facilitated by the UDDI. So, one way of implementing is that we have XML as the base.

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And we have three major component SOAP, WSDL, UDDI, right. So, this is the things all are W3C compliant and use the de facto XML based things, will just look into that how things works.

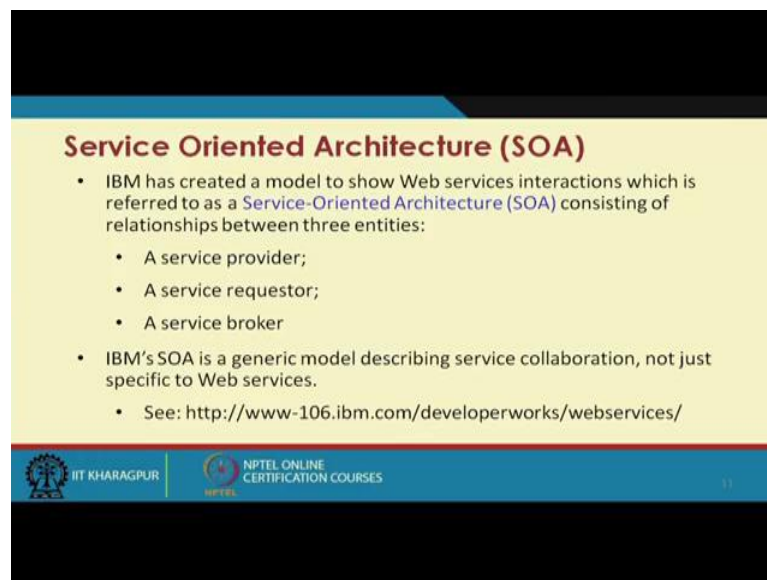
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So, purchase one example. So, as if purchase order goes then credit check, reserve inventory, credit response, inventory response, consolidate result and return to the invoice right. So, there are different parties like credit service, inventory service, PO services and so and so forth and those are being can be choreographed to service the

things. It is taken from a resource, but what it tries to do so that, I can provide different type of services, I can compose it and create a larger application bringing different type of application into the things. This application when choreographs to other type of things or integrated in other fashion; can give some other type of services.

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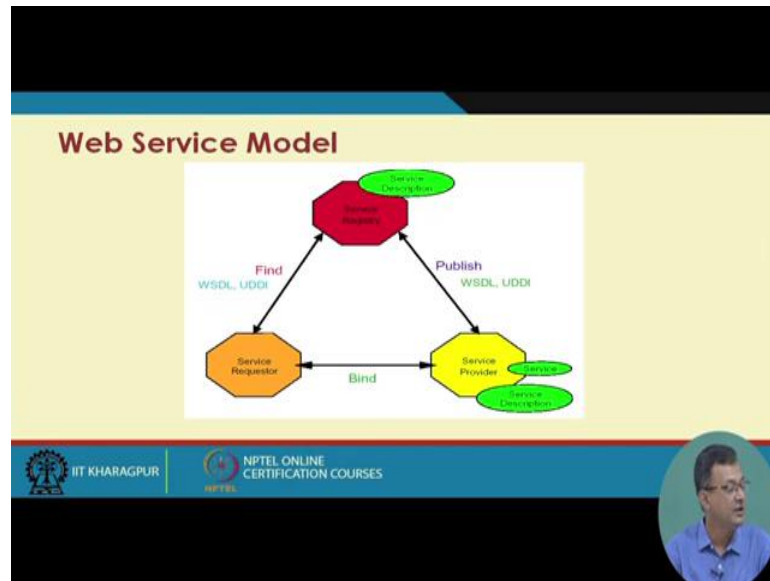
Service Oriented Architecture (SOA)

- IBM has created a model to show Web services interactions which is referred to as a **Service-Oriented Architecture (SOA)** consisting of relationships between three entities:
 - A service provider;
 - A service requestor;
 - A service broker
- IBM's SOA is a generic model describing service collaboration, not just specific to Web services.
 - See: <http://www-106.ibm.com/developerworks/webservices/>

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Now looking at this whole thing, it has evolved to another overall architecture what is the web service oriented architecture SOA. So, IBM created a model to show web service interaction, which is referred to as service oriented architecture consisting of a relationship between three entities. So, with this basic philosophy we have three entities; one is a service provider, one is a service requestor or service consumer and there is a service broker right or there is something which allows this consumer and provider, requestor or consumer and the broker and to talk to each other to find where the services are there, etcetera.

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So, if we look at this figure a very popular figure, available in you will find in different literature.

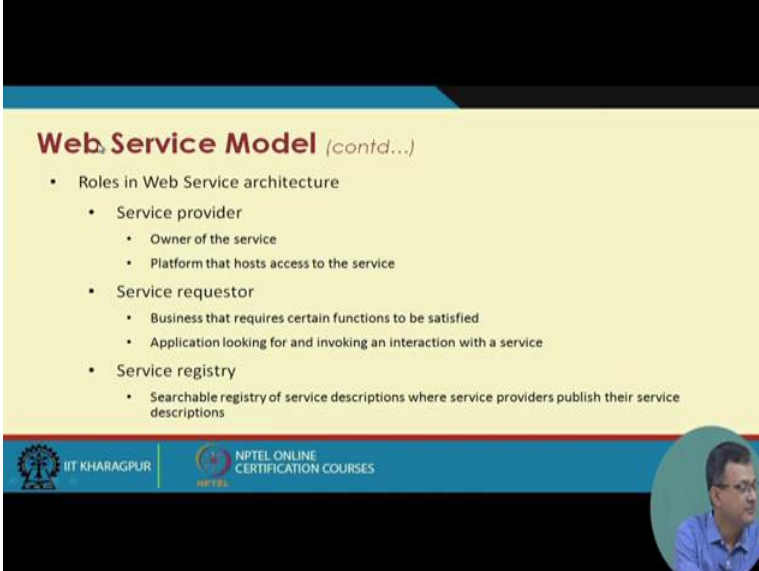
So, I have the service requestor of the consumer which wants to get the services to the; from the service provider, but the how the service requestor find that where it services will be there? So, there is a registry where it can find out right that which type of services are there. If I try to look at a analogy those who have seen our, because now a days this is more or less obsolete, our telephone directory right which comes from telephone exchange. So, there is to be things like at the beginning that yellow pages, white pages and so and so forth. So, where you find that where to find what? Rather the directory itself is tell you that by how to search for a particular thing; like suppose you are looking for plumbing or base or something.

So, you go and lift through the thing etcetera. So, it acts as a directory service right or registry service. So, that type of things is here also require which basically have a registry service. So, it is there are service description out here, the service request are finds the this it a required service from this registry service using that QSDL and UDDI and then basically bind with the service provider it goes for it can find more than one service provider and so and so forth.

A service a provider once a new service is launched on when say service is updated it is basically it publish the service in the registry, so that prospective buyer or prospective consumer.

Consumer requestor can find that where that these types of services are there. So, you can find that this is a triangle where different component works and if anything is developed based on this type of things what we say that it is a service driven or service oriented architecture.

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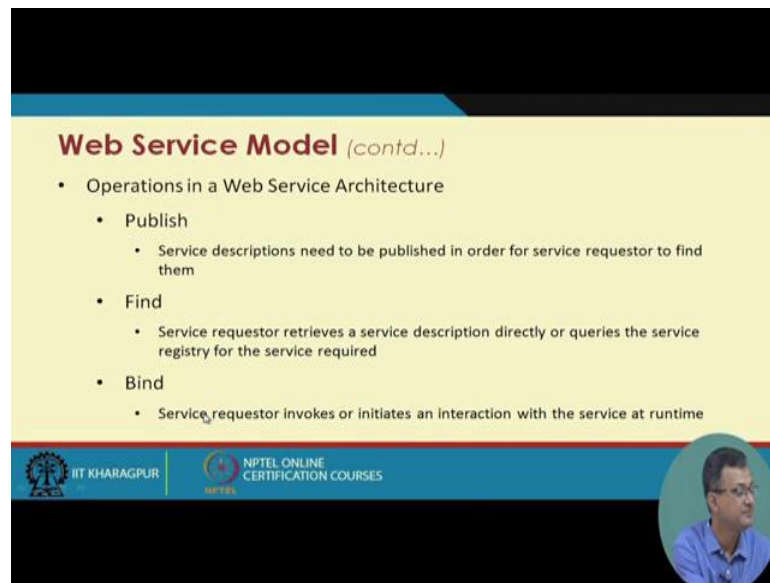
Web Service Model (contd...)

- Roles in Web Service architecture
 - Service provider
 - Owner of the service
 - Platform that hosts access to the service
 - Service requestor
 - Business that requires certain functions to be satisfied
 - Application looking for and invoking an interaction with a service
 - Service registry
 - Searchable registry of service descriptions where service providers publish their service descriptions

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So, if we look at that web service models that the roles of service architecture this service provider owner of the service, platform that hosts access to the things, service requestor business that requires or the consumer which wants consume, and service registry searchable registry of service description where service provider publish their service description.

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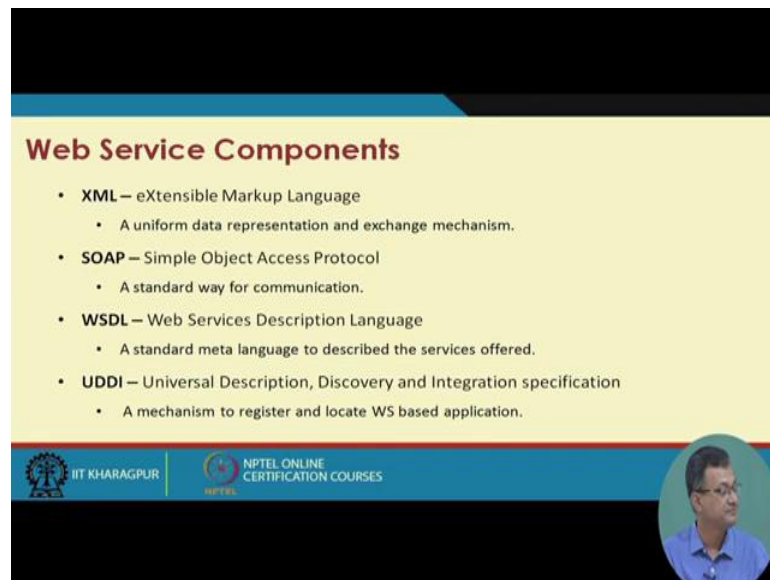
Web Service Model (contd...)

- Operations in a Web Service Architecture
 - Publish
 - Service descriptions need to be published in order for service requestor to find them
 - Find
 - Service requestor retrieves a service description directly or queries the service registry for the service required
 - Bind
 - Service requestor invokes or initiates an interaction with the service at runtime

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So, three major operations in the service web service architecture, one is publish to publish the service provider things, find the consumer, finds the things consumer find the things and bind once is find and it finally, binds with the service consumer with the provider.

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Web Service Components

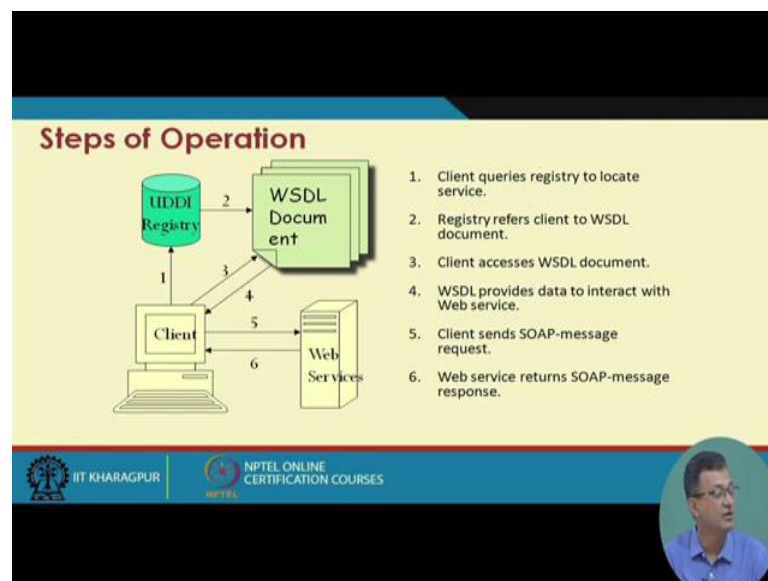
- **XML** – eXtensible Markup Language
 - A uniform data representation and exchange mechanism.
- **SOAP** – Simple Object Access Protocol
 - A standard way for communication.
- **WSDL** – Web Services Description Language
 - A standard meta language to described the services offered.
- **UDDI** – Universal Description, Discovery and Integration specification
 - A mechanism to register and locate WS based application.

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And one of the popular component is there, there are others also that is one is the which are the component one is the XML, extensible markup language. I believe all of you know if some of if you if not you should go through any standard book or even W3C

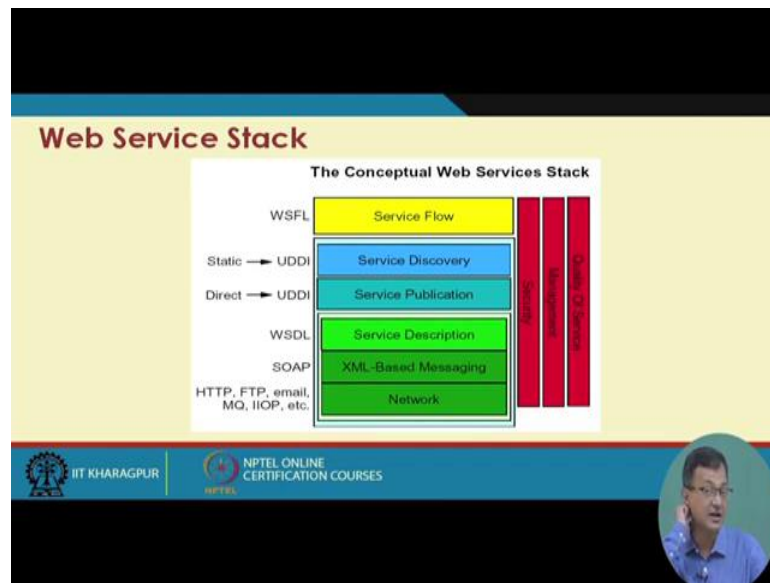
tutorial swearing find a good tutorial on XML. So, its uniform data representation and exchange mechanisms it provides. SOAP, Simple object access protocol, right a standard way for communications over using again XML. WSDL, web services description language, uses XML and it is a standard meta language to describe the services offered. And UDDI, universal description discovery and integration specification, its provide its helps in building of the registry service and a mechanism to register and locate web service applications.

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So, we can look at other way as we have seen that the client goes for the client queries the registry to locate services, registry refers to WSDL document where the description is there, the client access WSDL document provides data to interact with the web services and client send SOAP message to the SOAP message request to the provider, and service returns from the SOAP message from the response.

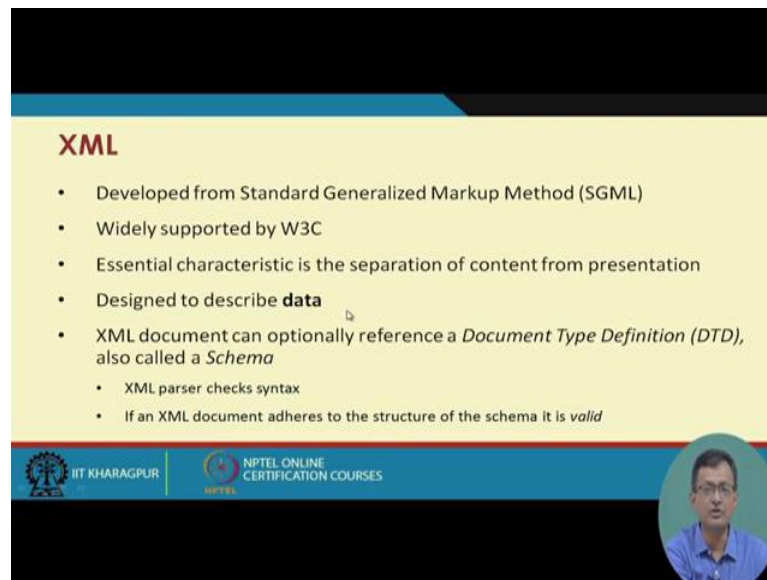
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So, that is someone binding the things and these are the different components this underlining thing is the it works on the internetworking or the our standard network protocol TCP, IP or OSI. So, this is the backbone over that SOAP messaging the description the UDDI; UDDI can be a static publication or it can be a dynamic publication and then there are other things like WSFL that is flow management and type of things.

So, for other type of aspects and there are three other component, it goes and in an one is the quality of service that what sort of service, they are giving a QS management issues that how whole thing can we manage, and then the security aspects like in doing. So, whether there is a security breach how to things, what will be the security policies, whom to trust and all those components will be there.


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XML

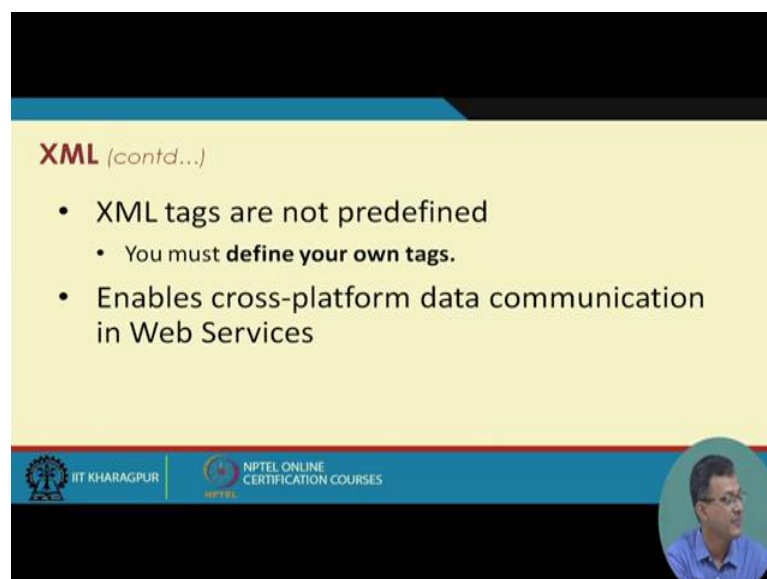
- Developed from Standard Generalized Markup Method (SGML)
- Widely supported by W3C
- Essential characteristic is the separation of content from presentation
- Designed to describe **data**
- XML document can optionally reference a *Document Type Definition (DTD)*, also called a *Schema*
 - XML parser checks syntax
 - If an XML document adheres to the structure of the schema it is *valid*

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XML, I am not dealing in details; it is a standard generalized method of a generalized markup language is evolved from. It is a extensible markup language, primarily used to describe data, and it helps in separation of content from the presentation and XML document can be optimally refer to a by a DTD the more popular is XSD, that XML schema definition language schema definitions so that, whether we can the scheme is defined.


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XML (contd...)

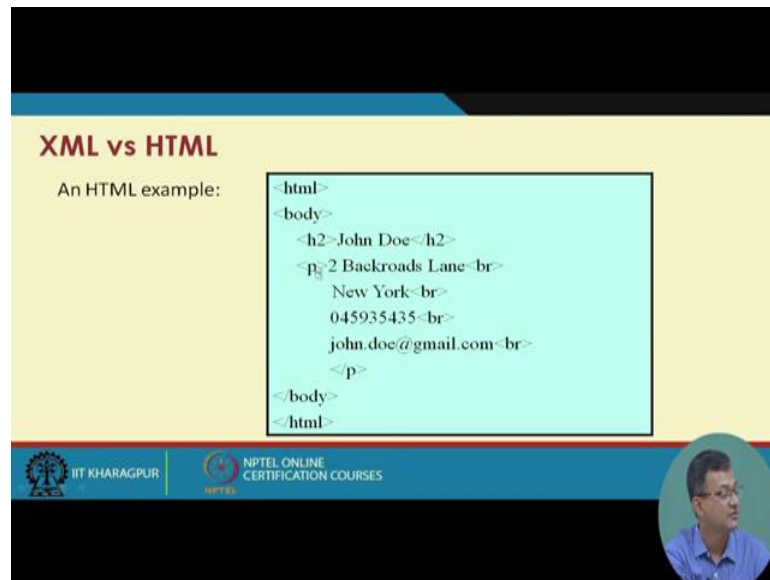
- XML tags are not predefined
 - You must **define your own tags**.
- Enables cross-platform data communication in Web Services

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So, in case of XML tags are not predefined. So, you can define your own tags unlike html enables cross platform communication in web services. So, this is a typically a XML thing like it describes.

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XML vs HTML

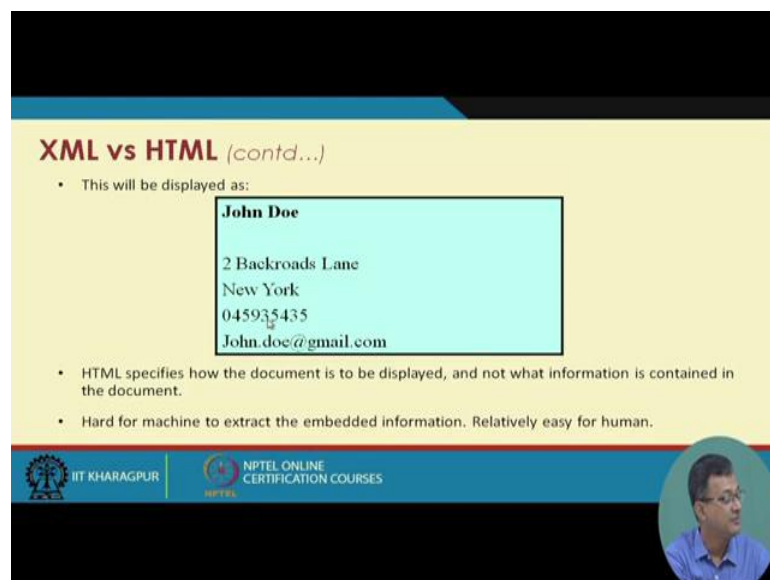
An HTML example:

```
<html>
<body>
  <h2>John Doe</h2>
  <p>2 Backroads Lane<br>
  New York<br>
  045935435<br>
  john.doe@gmail.com<br>
</p>
</body>
</html>
```

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So, sorry, it is a html thing like it basically shows that how a particular person is address or personal email address etcetera the contact of a person called John does defined.

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XML vs HTML (contd...)

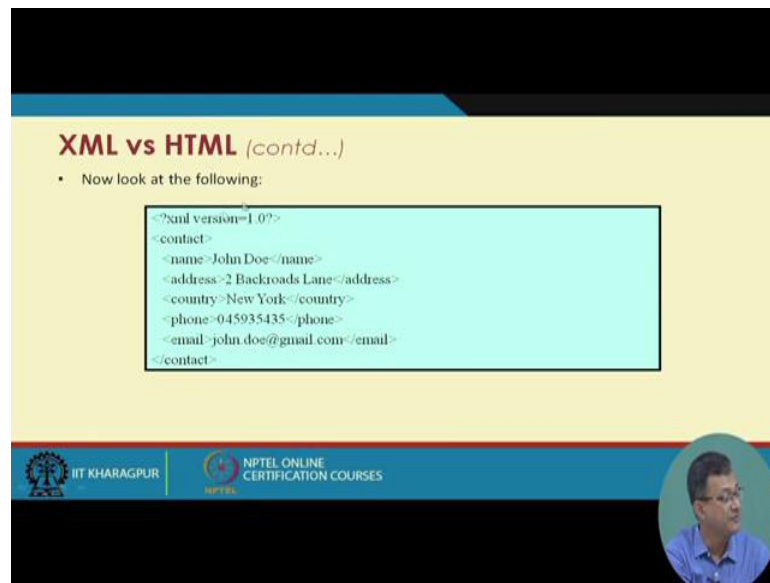
- This will be displayed as:

```
John Doe
2 Backroads Lane
New York
045935435
John.doe@gmail.com
```

- HTML specifies how the document is to be displayed, and not what information is contained in the document.
- Hard for machine to extract the embedded information. Relatively easy for human.

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XML vs HTML (contd...)

- Now look at the following:

```
<?xml version=1.0?>
<contact>
  <name>John Doe</name>
  <address>2 Backroads Lane</address>
  <country>New York</country>
  <phone>045935435</phone>
  <email>john.doe@gmail.com</email>
</contact>
```

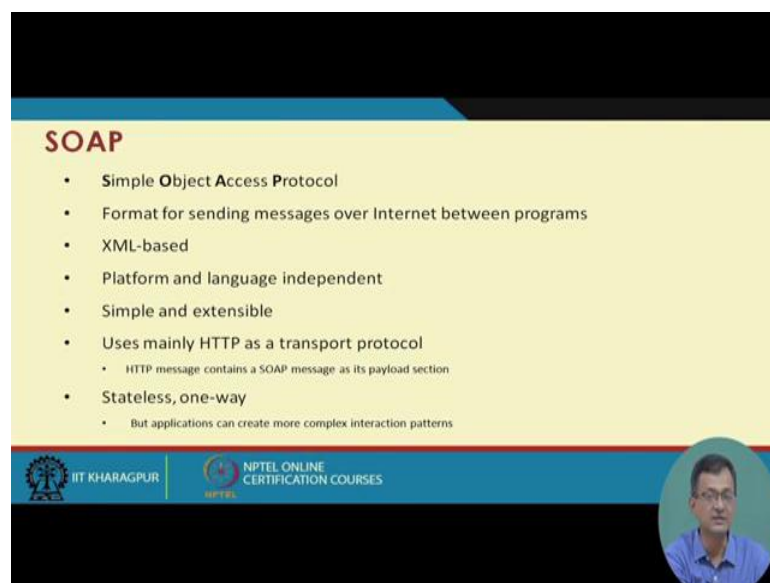
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And if we use these html in standard any browser so, it will show like this, however if I want to look at the same thing as a XML. So, you see this is more of a data description, right. So, it is a name, it is a address, this is the country phone, email and type of things, right.

So, this is a XML type of things this not any presentation. So, for representing we need to do a something.


(Refer Slide Time: 25:17)



SOAP

- Simple Object Access Protocol
- Format for sending messages over Internet between programs
- XML-based
- Platform and language independent
- Simple and extensible
- Uses mainly HTTP as a transport protocol
 - HTTP message contains a SOAP message as its payload section
- Stateless, one-way
 - But applications can create more complex interaction patterns

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So, as we were discussing three major component one of the thing is SOAP, is a more of a messaging protocol, like simple object access protocol format for sending messages over the internet it is XML based, W3C compliant and stateless and one way uses mainly http as the what we say transport protocol. This this transport protocol should not be mix up with our TCP/IP transport protocol, this is transporting this web services.

So, a here the http access the carrier protocol. So, there are different building block I am not going to the nitty-gritty of the things, how a SOAP building blocks are there.

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SOAP Building Blocks

- Envelope (required) – identifies XML document as SOAP message
- Header (optional) – contains header information
- Body (required) – call and response information
- Fault (optional) – errors that occurred while processing message

The diagram illustrates the structure of a SOAP message. It is contained within a 'Transport protocol' container. Inside this container is a 'MIME header'. Below the MIME header is the 'SOAP ENVELOPE', which is further divided into 'SOAP HEADER' and 'SOAP BODY'. The 'SOAP BODY' contains the 'FAULT' information.

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So, transport protocol is over all envelope, then the MIME header is there then SOAP envelop SOAP header and SOAP body and there are fault and defication scenarios, but all are XML base.

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SOAP Message Structure

- Request and Response messages
 - Request invokes a method on a remote object
 - Response returns result of running the method
- SOAP specification defines an “envelop”
 - “envelop” wraps the message itself
 - Message is a different vocabulary
 - Namespace prefix is used to distinguish the two parts

Application-specific message vocabulary

message

SOAP envelope

SOAP Envelop vocabulary

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So, message structure it goes on a SOAP envelope and goes through this its piggyback on this transport, basically become a envelope and become a pay load for this transport protocol in this case http, again I am repeating this transport protocols do not be mix up with our TCP/IP or OSI protocols.

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SOAP Request

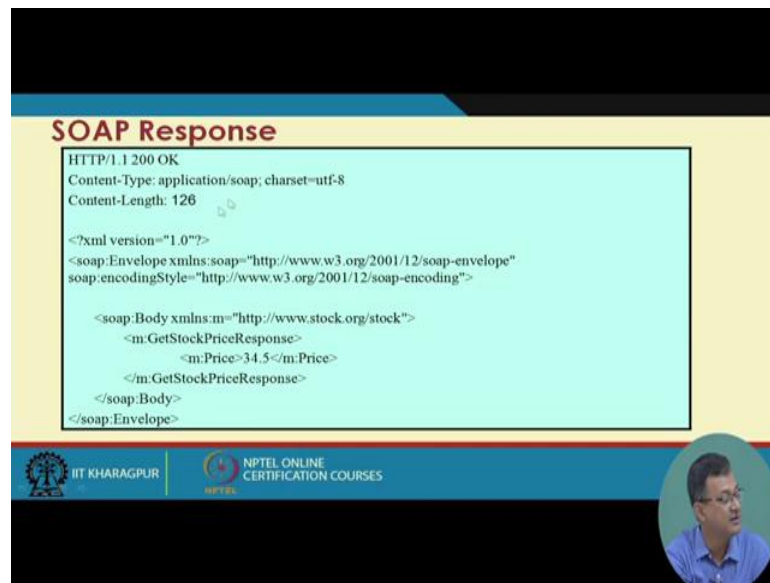
```
POST /InStock HTTP/1.1
Host: www.stock.org
Content-Type: application/soap+xml; charset=utf-8 Content-Length: 150

<?xml version="1.0"?>
<soap:Envelope
xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
  <soap:Body xmlns:m="http://www.stock.org/stock">
    <m:GetStockPrice>
      <m:StockName>IBM</m:StockName>
    </m:GetStockPrice>
  </soap:Body>
</soap:Envelope>
```

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The SOAP request goes like that if you see this is a post message in our http stuff and the SOAP message in this case its goes for a get a particular stock price and stock name particular may be the IBM and so and so forth and the response is again.

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SOAP Response

```
HTTP/1.1 200 OK
Content-Type: application/soap; charset=utf-8
Content-Length: 126

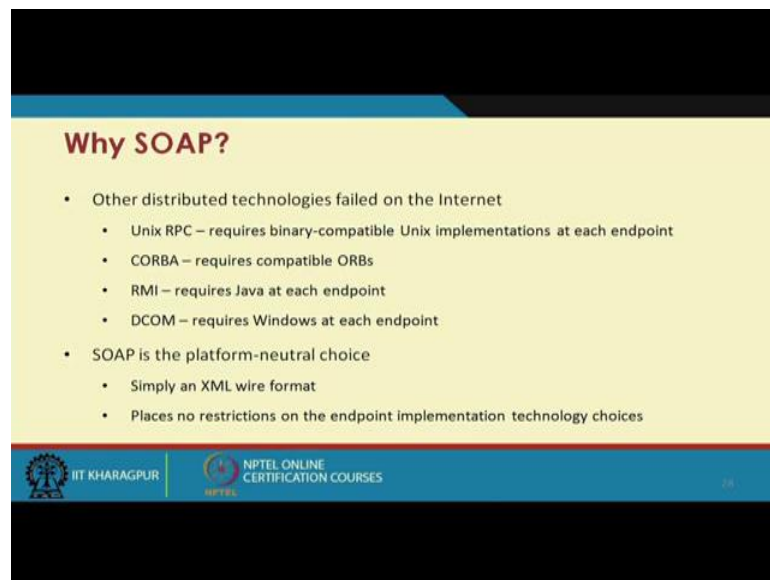
<?xml version="1.0"?>
<soap:Envelope xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">

  <soap:Body xmlns:m="http://www.stock.org/stock">
    <m:GetStockPriceResponse>
      <m:Price>34.5</m:Price>
    </m:GetStockPriceResponse>
  </soap:Body>
</soap:Envelope>
```

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Again if you see that http response, and it response with a again a value. Since this is more of a structured way of exchanging data, it does not say out can be displayed for the display unit to have a html type of a stuff.

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Why SOAP?

- Other distributed technologies failed on the Internet
 - Unix RPC – requires binary-compatible Unix implementations at each endpoint
 - CORBA – requires compatible ORBs
 - RMI – requires Java at each endpoint
 - DCOM – requires Windows at each endpoint
- SOAP is the platform-neutral choice
 - Simply an XML wire format
 - Places no restrictions on the endpoint implementation technology choices

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So, why soap? It is are there are other technologies which are not could not do this type of application to applications, SOAP is a platform neutral choice simple XML wire format, places no restriction on endpoint implementation of the technology, that you can run your legacy things, etcetera.

(Refer Slide Time: 27:20)

SOAP Characteristics

- SOAP has three major characteristics:
 - Extensibility— security and WS-routing are among the extensions under development.
 - Neutrality - SOAP can be used over any transport protocol such as HTTP, SMTP or even TCP.
 - Independent - SOAP allows for any programming model.

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There are major three characteristics this is extensible, neutral and independent. So, this is exactly suited for our distributed applications talking to each other and type of things.

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SOAP Usage Models

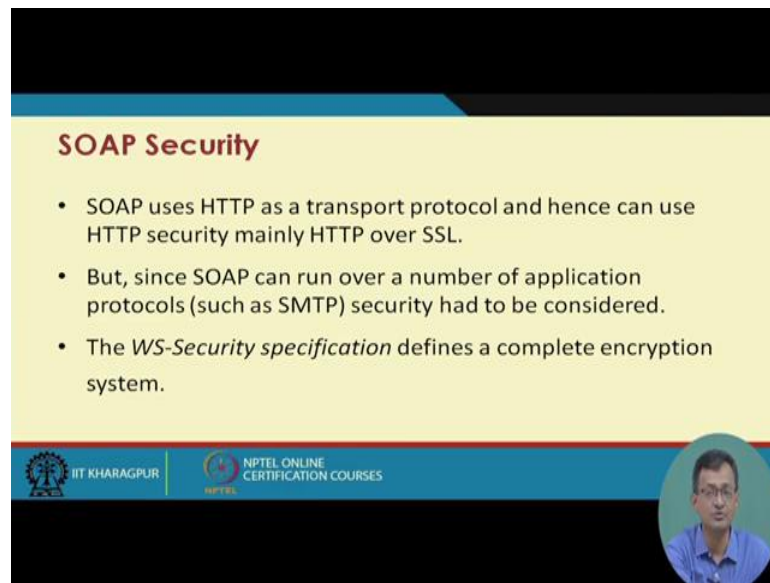
- RPC-like message exchange
 - Request message bundles up method name and parameters
 - Response message contains method return values
 - However, it isn't required by SOAP
- SOAP specification allows any kind of body content
 - Can be XML documents of any type
 - Example:
 - Send a purchase order document to the inbox of B2B partner
 - Expect to receive shipping and exceptions report as response

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And there are different usage models, one can be RPC like message exchange or SOAP specification allows any kind of body content so and so forth.


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SOAP Security

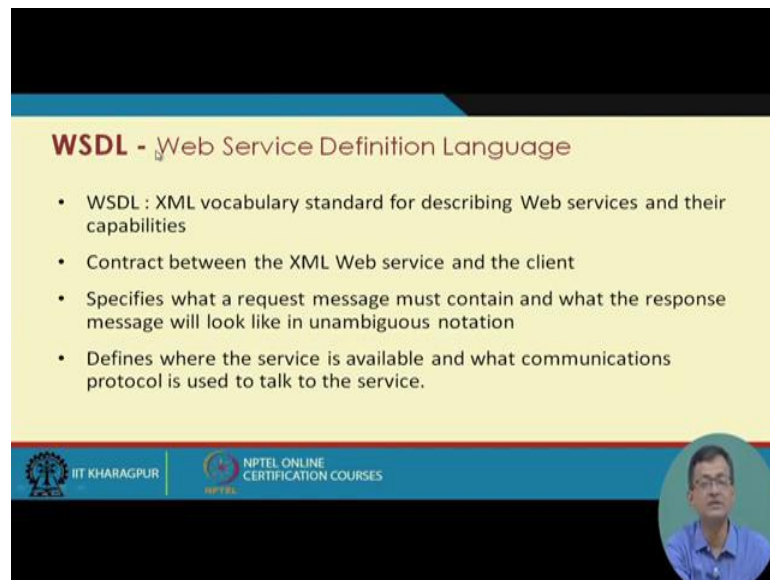
- SOAP uses HTTP as a transport protocol and hence can use HTTP security mainly HTTP over SSL.
- But, since SOAP can run over a number of application protocols (such as SMTP) security had to be considered.
- The *WS-Security specification* defines a complete encryption system.

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And there as other security aspects we are not going to that we will talk about these when you talk about out security.


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WSDL - Web Service Definition Language

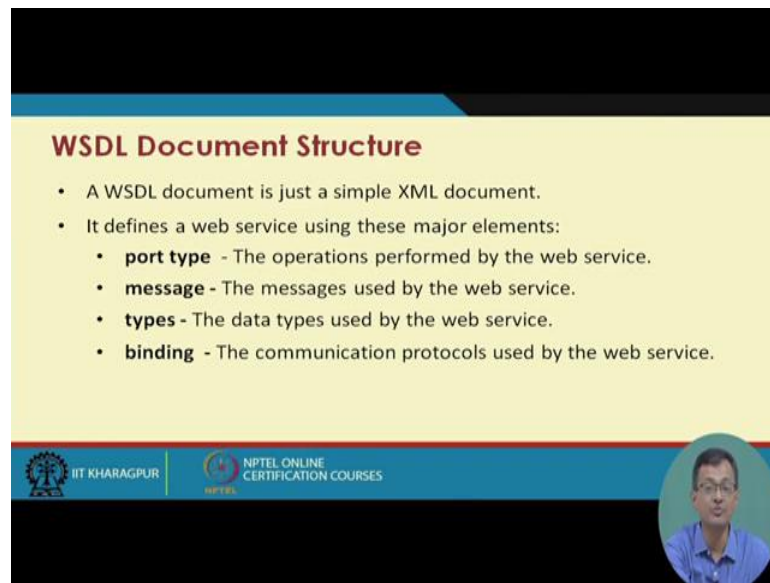
- WSDL : XML vocabulary standard for describing Web services and their capabilities
- Contract between the XML Web service and the client
- Specifies what a request message must contain and what the response message will look like in unambiguous notation
- Defines where the service is available and what communications protocol is used to talk to the service.

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The other one is the WSDL, web service description language. So, it allows to it is again XML base W3C complaint allows to describe the language.

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WSDL Document Structure

- A WSDL document is just a simple XML document.
- It defines a web service using these major elements:
 - **port type** - The operations performed by the web service.
 - **message** - The messages used by the web service.
 - **types** - The data types used by the web service.
 - **binding** - The communication protocols used by the web service.

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So, it has different structure that what will be port type where the how can be defined that where the particular services will be enabled and a web things will be there; the message types of message and so and so forth. How this binding process will go on between the service provider and the consumer.

(Refer Slide Time: 28:22)



A Sample WSDL

```
<message name="getTermRequest">
  <part name="term" type="xs:string"/>
</message>

<message name="getTermResponse">
  <part name="value" type="xs:string"/>
</message>

<portType name="glossaryTerms">
  <operation name="getTerm">
    <input message="getTermRequest"/>
    <output message="getTermResponse"/>
  </operation>
</portType>
```

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(Refer Slide Time: 28:26)

Binding to SOAP

```
<message name="getTermRequest">
  <part name="term" type="xs:string"/>
</message>
<message name="getTermResponse">
  <part name="value" type="xs:string"/>
</message>
<portType name="glossaryTerms">
  <operation name="getTerm">
    <input message="getTermRequest"/>
    <output message="getTermResponse"/>
  </operation>
</portType>
<binding type="glossaryTerms" name="b1">
  <soap:binding style="document"
    transport="http://schemas.xmlsoap.org/soap/http"/>
  <operation
    soapAction="http://example.com/getTerm">
    <input/>
    <soap:body use="literal"/>
    </input>
    <output/>
    <soap:body use="literal"/>
    </output>
  </operation>
</binding>
```

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So, it is a sample WSDL message, it is a binding see that it is a SOAP message with the WSDL the SOAP message is bind with these things; that means, the description over that the messaging of the SOAP message how the data is transferred over that things is bind between the source destination or any like from requestor to the registry to the consumer and so and so forth.

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UDDI - Universal Description, Discovery, and Integration

- A framework to define XML-based registries
- Registries are repositories that contain documents that describe business data and also provide search capabilities and programmatic access to remote applications
- Businesses can publish information about themselves and the services they offer

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Finally we have the UDDI, universal description discovery and integration, it is a registry service right. So, a frame work to define XML based registries. So, that all these

metadata informations are there, where from the this consumer or the requestor look for that particular bases and how to binding with that particular provider and so and so forth.

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UDDI Roles and Operations

- Service Registry
 - Provides support for publishing and locating services
 - Like telephone yellow pages
- Service Provider
 - Provides e-business services
 - Publishes these services through a registry
- Service requestor
 - Finds required services via the Service Broker
 - Binds to services via Service Provider

```
graph TD; SR((Service Registry)) -- Publish --> SP((Service Provider)); SP -- Bind --> SRQ((Service Requestor)); SRQ -- Find --> SR;
```

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So, it is service provider registry and requestor, just if you remember the previous couple of slides before. So, you little bit what we say that orientation is different. So, the registries the service provider publish it, requestor finds it and binds with things. So, it plays extremely important role for keeping the whole things working together.

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How can UDDI be Used?

1. Harbour Metals creates online website with local ASP
2. ASP registers Harbour Metals with UBR
3. Marketplaces and search engines query UBR, cache Harbour Metals data, and bind to its services
4. Consumers and businesses discover Harbour Metals and do business with it

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So, if you the same thing, it basically publish another thing the consumer search and go on binding with the provider.

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UDDI Benefits

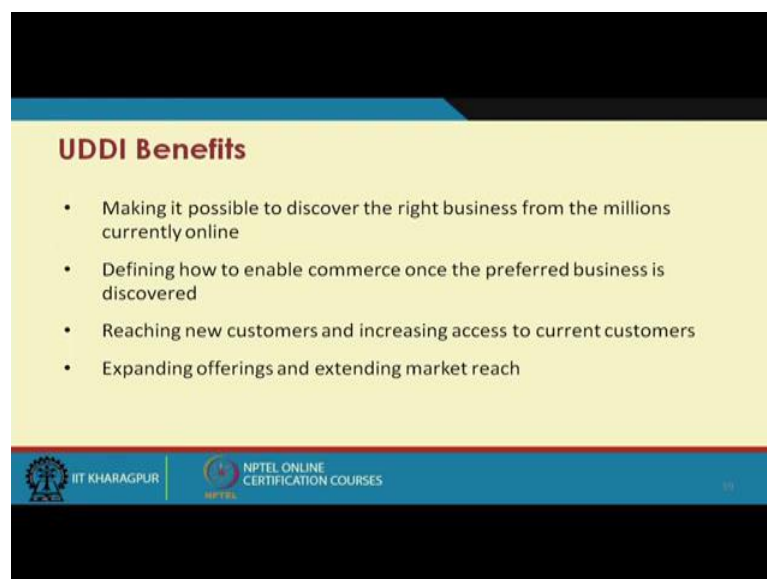
- Making it possible to discover the right business from the millions currently online
- Defining how to enable commerce once the preferred business is discovered
- Reaching new customers and increasing access to current customers
- Expanding offerings and extending market reach

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There are several benefits any registry service gives a very benefits of keeping the data in a particular format. So, there it can be search, making it possible discover right business from the millions of currently online.

So, you can finding how to enable say connectivity with the preferred business and so and so forth.

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UDDI Benefits

- Making it possible to discover the right business from the millions currently online
- Defining how to enable commerce once the preferred business is discovered
- Reaching new customers and increasing access to current customers
- Expanding offerings and extending market reach

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We will not go to the detail of the things this security will work. So, in security becomes a another important aspect of soap, a aspect of web services it works on a vertical line as we have seen in our previous some of the one of the previous figure, and it has different components right like web service policy, trust, privacy, secure conversation, federation and authorization and different type of components. So, this becomes a integral one there are other things like management and QoS which also works.

So, what we are try to see in this particular lecture is that this web services and service oriented architecture, is a plays a important role in setting up this cloud. The whole cloud process if you see that IaaS, PaaS or SaaS say XaaS or anything as a service. So, it its basic building block is the web services the all this phenomena of web services of publish, bind and find bind and publish find and bind, this also is true for the things whenever we have cloud services. So, I need to basically look at the, who is the service provider and consumer, I need to know that where the service is launched and type of things, right.

So, this is a extended in a appropriate way to realize this cloud services. So, it plays; this development of web services and service oriented architecture, has played a important role in bringing this cloud computing as a viable things. So, we will stop here today and we will continue in our future lecture with other aspects of cloud computing.

Thank you.