Secure Your RESTful API

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About me

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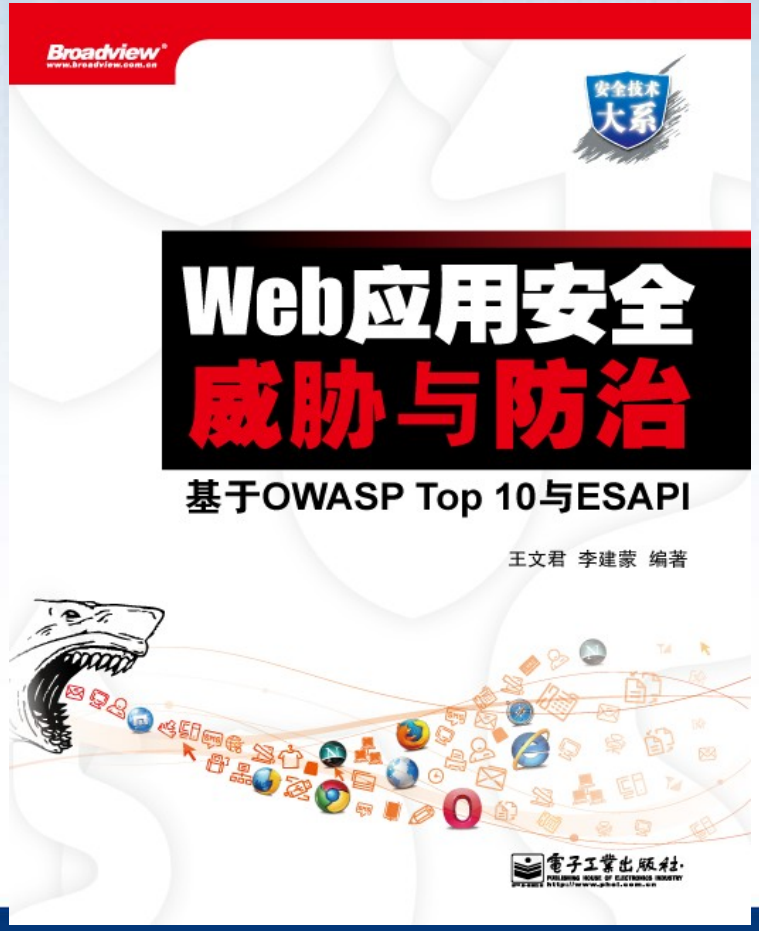

Agenda

- REST brief introduction
- Secure your RESTful API
- Some attack examples

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Chapter 1
REST brief introduction

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Representational State Transfer

- The URL identifies the resource
- Click on the url (resource) in page (hypermedia)
  - html page is transferred to the browser
  - Representational State transfer occurs

REST Tenets

- Resources (nouns)
  - Identified by a URI, For example:
    - http://www.parts-depot.com/parts
- Methods (verbs) to manipulate the nouns
  - Small fixed set:
    - GET, PUT, POST, DELETE
      - Read, Update, Create, Delete
- **Representation** of the Resource
  - data and state transferred between client and server
  - XML, JSON…
- Use verbs to exchange application state and representation

method

resource

Request: GET
http://localhost:8080/RestfulCustomer/webresources/model.customer/1

Status: 200 (OK)

Time-Stamp: Fri, 14 Dec 2012 02:19:34 GMT

Received:
{"name":"Jumbo Eagle Corp","state":"FL","customerId":1,
"addressline1":"111 E. Las Olivas Blvd","addressline2":"Suite 51",
"city":"Fort Lauderdale","phone":"305-555-0188","fax":"305-555-0189",
"email":"jumboeagle@example.com","creditLimit":100000
}

representation

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Use standard HTTP method

- Example
  - `GET /store/customers/123456`

HTTP Method	Operation Performed
GET	Get a resource (Read a resource)
POST	Create a resource
PUT	Update a resource
DELETE	Delete a resource

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Example

- /orders
  - GET - list all orders
  - POST - submit a new order

  /orders/{order-id}
  - GET - get an order representation
  - PUT - update an order
  - DELETE - cancel an order

  /orders/average-sale
  - GET - calculate average sale
- /customers
  - GET - list all customers
  - POST - create a new customer

  /customers/{cust-id}
  - GET - get a customer representation
  - DELETE- remove a customer

  /customers/{cust-id}/orders
  - GET - get the orders of a customer

Multiple Representations

- Offer data in a variety of formats, for different needs
  - XML /JSON/(X)HTML

- Support **content negotiation**
  - Accept header

```
GET /foo
Accept: application/json
```

  - Response header
  - Content-Type application/xml

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Key benefit for REST

- Server side
  - Uniform Interface
  - Cacheable
  - Scalable
- Client side
  - Easy to experiment in browser
  - Broad programming language support
  - Choice of data formats

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Chapter 2
Secure your RESTful API

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Authentication: Configure web.xml

```
<login-config>
    <auth-method>BASIC</auth-method>
    <realm-name>admin</realm-name>
</login-config>
```

- **Login-config:**
  - **defines how HTTP requests should be authenticated**
- **Auth-method:**
  - **BASIC, DIGEST, FORM, CLIENT_CERT. corresponds to Basic, Digest, Form and Client Certificate authentication, respectively.**

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Authentication: Configure web.xml

```
<security-constraint>
   <web-resource-collection>
     <url-pattern>/secure/*</url-pattern>
     <http-method>POST</http-method>
  </web-resource-collection>
...
```

- **security constraint**
  - **defines access privileges to a collection of resources**
- **url-pattern:**
  - **URL pattern you want to secure**
- **Http-method:**
  - **Methods to be protected**

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Authentication: Configure web.xml

```
<security-constraint>
...
  <auth-constraint>
     <description>only let admin login </description>
     <role-name>admin</role-name>
  </auth-constraint>
```

- **auth-constraint:**
  - **names the roles authorized to access the URL patterns and HTTP methods declared by this security constraint**

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Encryption: Configure web.xml

```
<security-constraint>
...
  <user-data-constraint>
    <description>SSL</description>
    <transport-guarantee>CONFIDENTIAL</transport-guarantee>
 </user-data-constraint>
</security-constraint>
```

- **user-data-constraint: NONE, INTEGRAL, or CONFIDENTIAL**
  - **how the data will be transported between client and server**

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Use case 1

HTTP GET operation on a set of web resources should be accessible only by an user with the role "Employee".

```
01. <security-constraint>
02.   <display-name>Restricted GET To Employees</display-name>
03.   <web-resource-collection>
04.     <web-resource-name>Restricted Access - Get Only</web-resource-name>
05.     <url-pattern>/restricted/employee/*</url-pattern>
06.     <http-method>GET</http-method>
07.   </web-resource-collection>
08.   <auth-constraint>
09.     <role-name>Employee</role-name>
10.   </auth-constraint>
11.   <user-data-constraint>
12.     <transport-guarantee>NONE</transport-guarantee>
13.   </user-data-constraint>
14. </security-constraint>
```

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Use case 2

We would like to utilize *FORM* based authentication mechanism.

```
1. <login-config>
2.   <auth-method>FORM</auth-method>
3.   <form-login-config>
4.     <form-login-page>/login.html</form-login-page>
5.     <form-error-page>/error.html</form-error-page>
6.   </form-login-config>
7. </login-config>
```

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Authorization Annotations

roles permitted to execute operation

```
@Path("/customers")
@RolesAllowed({"ADMIN", "CUSTOMER"})
public class CustomerResource {
    @GET
    @Path("{id}")
    @Produces("application/xml")
    public Customer getCustomer(@PathParam("id")
          int id) {...}
    @RolesAllowed("ADMIN")
    @POST
    @Consumes("application/xml")
    public void createCustomer(Customer cust) {...}
    @PermitAll
    @GET
    @Produces("application/xml")
    public Customer[] getCustomers() {}
}
```

any authenticated user

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JAX-RS Security Context

```
public interface SecurityContext {
```

Determine the identity of the user

```
   public Principal getUserPrincipal();
```

check whether user belongs to a certain role

```
   public boolean isUserInRole(String role);
```

whether this request was made using a secure channel

```
   public boolean isSecure();

   public String getAuthenticationScheme();
}
```

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JAX-RS Security Context

```
@Path("/customers")
public class CustomerService {
   @GET
   @Produces("application/xml")
   public Customer[] getCustomers(@Context
      SecurityContext sec) {
      if (sec.isSecure() && !sec.isUserInRole("ADMIN")){
        logger.log(sec.getUserPrincipal() +
                        " accessed customer database.");
      }
      ...
   }
}
```

check whether user belongs to a certain role

Determine the identity of the user

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Anti CSRF

For resources exposed by RESTful web services, it's important to make sure any PUT, POST and DELETE request is protected from Cross Site Request Forgery.

- **Custom request header with token INTERNAL_TOKEN:{token value}**

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Insecure Direct Object Reference

Suppose there is a bank web service as below – what will happen?

- https://example.com/account/325365436/transfer?amount=$100.00&toAccount=473846376

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Output encoding

- X-Content-Type-Options: nosniff
- JSON encoding

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Chapter 3
Some attack examples

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Case 1 - XXE – XML External Entity

Input

```
<?xml version="1.0"?>
<!DOCTYPE customer[<!ENTITY name SYSTEM "file:///c:/temp/password">]>
<customer>
  <name>&name;</name>
</customer>
```

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Output

<?xml version="1.0" encoding="UTF-8" standalone="yes"?>

<customer>

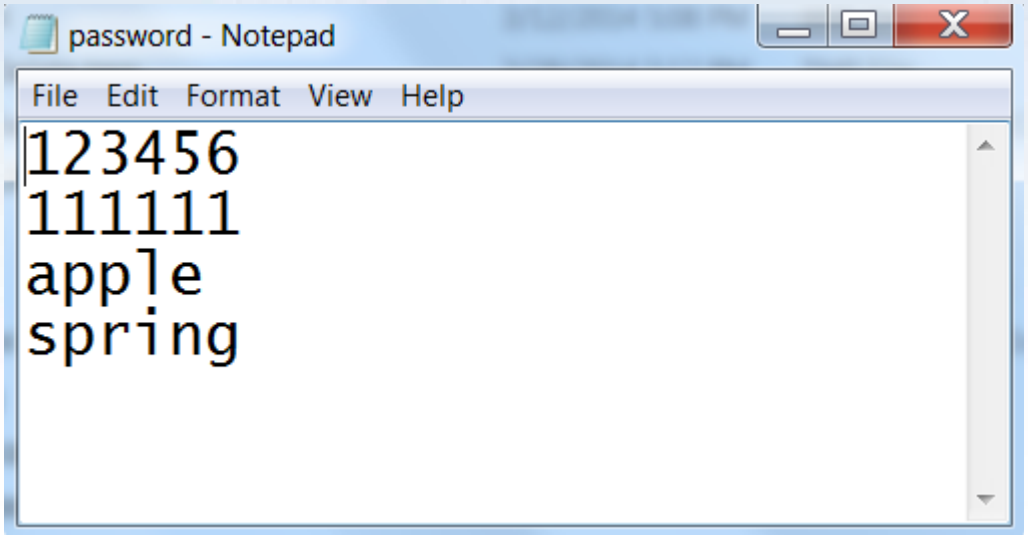
<name>123456

111111

apple

spring</name>

</customer>



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XXE - Solution

```
XMLInputFactory xif = XMLInputFactory.newFactory();

xif.setProperty(XMLInputFactory.IS_SUPPORTING_EXTERNAL_
ENTITIES, false);

xif.setProperty(XMLInputFactory.SUPPORT_DTD, false);
```

Case 2 - HPPP - HTTP Path & Parameter Pollution

User

- Hacker

Security Filter/ Servlet

- Allows GET requests for public but POST, PUT and DELETE for only admin users
- /creditInfo

REST Service

- Provides credit info

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Bypass

User

- Hacker
- "_method" parameter

Security Filter/ Servlet

- Looks like a GET **but turns into PUT, POST, or DELETE**
- creditInfo?_method=PUT

REST Service

- Updates credit info

Think by yourself

```
String entity = request.getParameter("entity");
String id = request.getParameter("id");
URL urlGET = new URL("http://svr.com:5984/client/" + entity + "?id=" + id );
```

Change it to a POST to the following URL

http://svr.com:5984/admin

Answer

```
String entity = request.getParameter("entity");

String id = request.getParameter("id");

URL urlGET = new URL("http://svr.com:5984/client/" + "../admin" + "?id=" +
"1&_method=POST" );
```

Change it to a POST to the following URL

http://svr.com:5984/admin

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Case 3 - XML serialization issues

- REST API allows the raw input of XML to be converted to native objects. This deserialization process can be used to execute arbitrary code on the REST server.

XMLDecoder in RESTlet

org.restlet.representation

Class ObjectRepresentation<T extends Serializable>

```
java.lang.Object
  └org.restlet.representation.Variant
      └org.restlet.representation.RepresentationInfo
          └org.restlet.representation.Representation
              └org.restlet.representation.StreamRepresentation
                  └org.restlet.representation.OutputRepresentation
                      └org.restlet.representation.ObjectRepresentation<T>
```

Type Parameters:

`T` - The class to serialize, see `Serializable`

```
public class ObjectRepresentation<T extends Serializable>
extends OutputRepresentation
```

Representation based on a serializable Java object.
It supports binary representations of JavaBeans using the `ObjectInputStream` and `ObjectOutputStream` classes. In this case, it handles representations having the following media type: `MediaType.APPLICATION_JAVA_OBJECT` ("application/x-java-serialized-object"). It also supports textual representations of JavaBeans using the `XMLEncoder` and `XMLDecoder` classes. In this case, it handles representations having the following media type: `MediaType.APPLICATION_JAVA_OBJECT_XML` ("application/x-java-serialized-object+xml").

XMLDecoder Demo 1 - normal

XMLDecoder Demo 2 - Calculator

XMLDecoder Demo 3 – Get Shell via MetaSploit

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If you want to share something with us in the next OWASP session, just give me an email: shanda.wang@owasp.org.cn

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Thank you

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