IBM Software Group

Discovering the Value of Verifying Web Application Security Using IBM Rational AppScan

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Agenda

- **Introductions & facilities**
- Security Landscape
- Vulnerability Analysis
  - Top Attacks Overview
  - Hands on Lab 1
- Vulnerability Analysis (continued)
  - Hands on Lab 2
- Automated Vulnerability Analysis
  - IBM® Rational® AppScan Overview
  - Hands on Lab 3

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Welcome to the Technical Exploration Center

- Introductions
- Access restrictions
- Restrooms
- Emergency Exits
- Smoking Policy
- Breakfast/Lunch/Snacks – location and times
- Special meal requirements?

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POT Objectives

By the end of this session you will:

- Understand the Web application environment
- Understand and differentiate between network and application level vulnerabilities
- Understand where the vulnerabilities exist
- Understand how to leverage AppScan to perform an automated scan for vulnerabilities

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Introductions

- Please introduce yourself
- Name and organization
- Current integration technologies/tools in use

What do you want out of this Exploration session?

Agenda

- Introductions & facilities
- **Security Landscape**
- Vulnerability Analysis
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  - Cross Site Scripting
  - Hands on Lab 1
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The Alarming Truth

"Approximately 100 million Americans have been informed that they have suffered a security breach so this problem has reached epidemic proportions."

Jon Oltsik – Enterprise Strategy Group

"Up to 21,000 loan clients may have had data exposed"

Marcella Bombardieri, Globe Staff/August 24, 2006

"Personal information stolen from 2.2 million active-duty members of the military, the government said…"

New York Times/June 7, 2006

"Hacker may have stolen personal identifiable information for 26,000 employees.."

ComputerWorld, June 22, 2006

Why Application Security is a High Priority

- **Web applications are the #1 focus of hackers:**
  - 75% of attacks at Application layer (Gartner®)
  - XSS and SQL Injection are #1 and #2 reported vulnerabilities (Mitre®)
- **Most sites are vulnerable:**
  - 90% of sites are vulnerable to application attacks (Watchfire®)
  - 78% percent of easily exploitable vulnerabilities affected Web applications (Symantec™)
  - 80% of organizations will experience an application security incident by 2010 (Gartner)
- **Web applications are high value targets for hackers:**
  - Customer data, credit cards, ID theft, fraud, site defacement, etc
- **Compliance requirements:**
  - Payment Card Industry (PCI) Standards, GLBA, HIPPA, FISMA,

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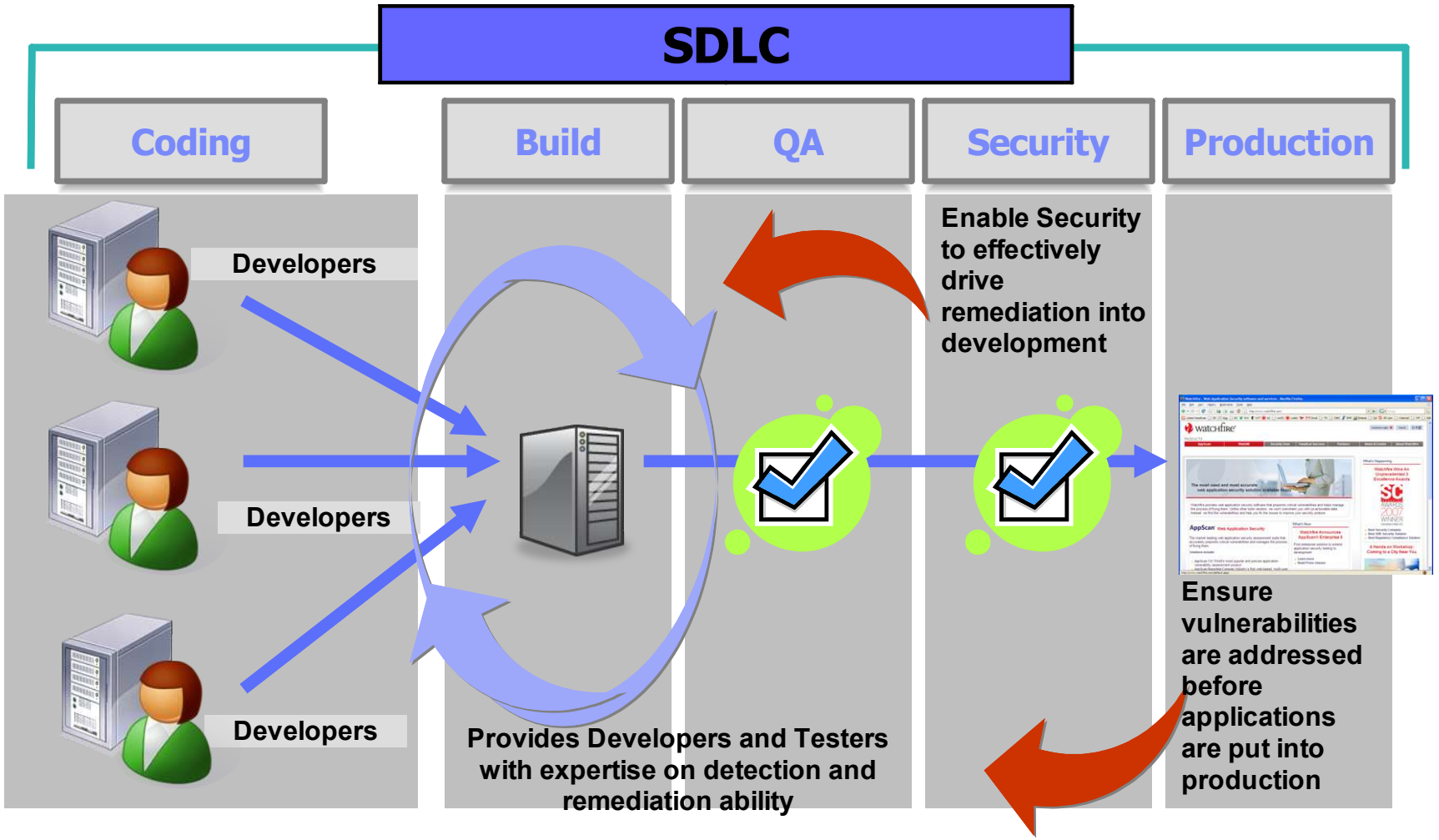
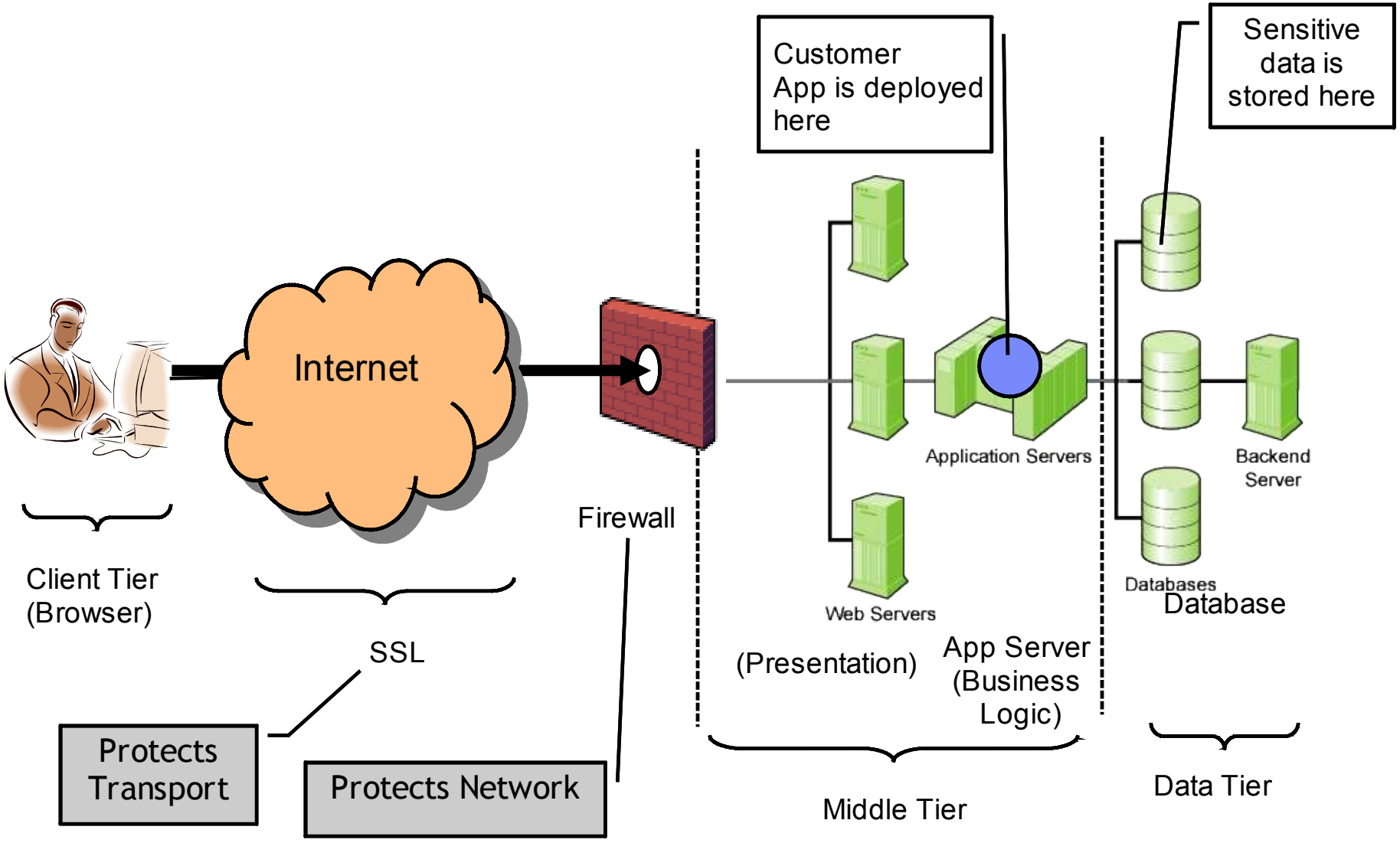
Building Security & Compliance into the Software Development Lifecycle (SDLC)

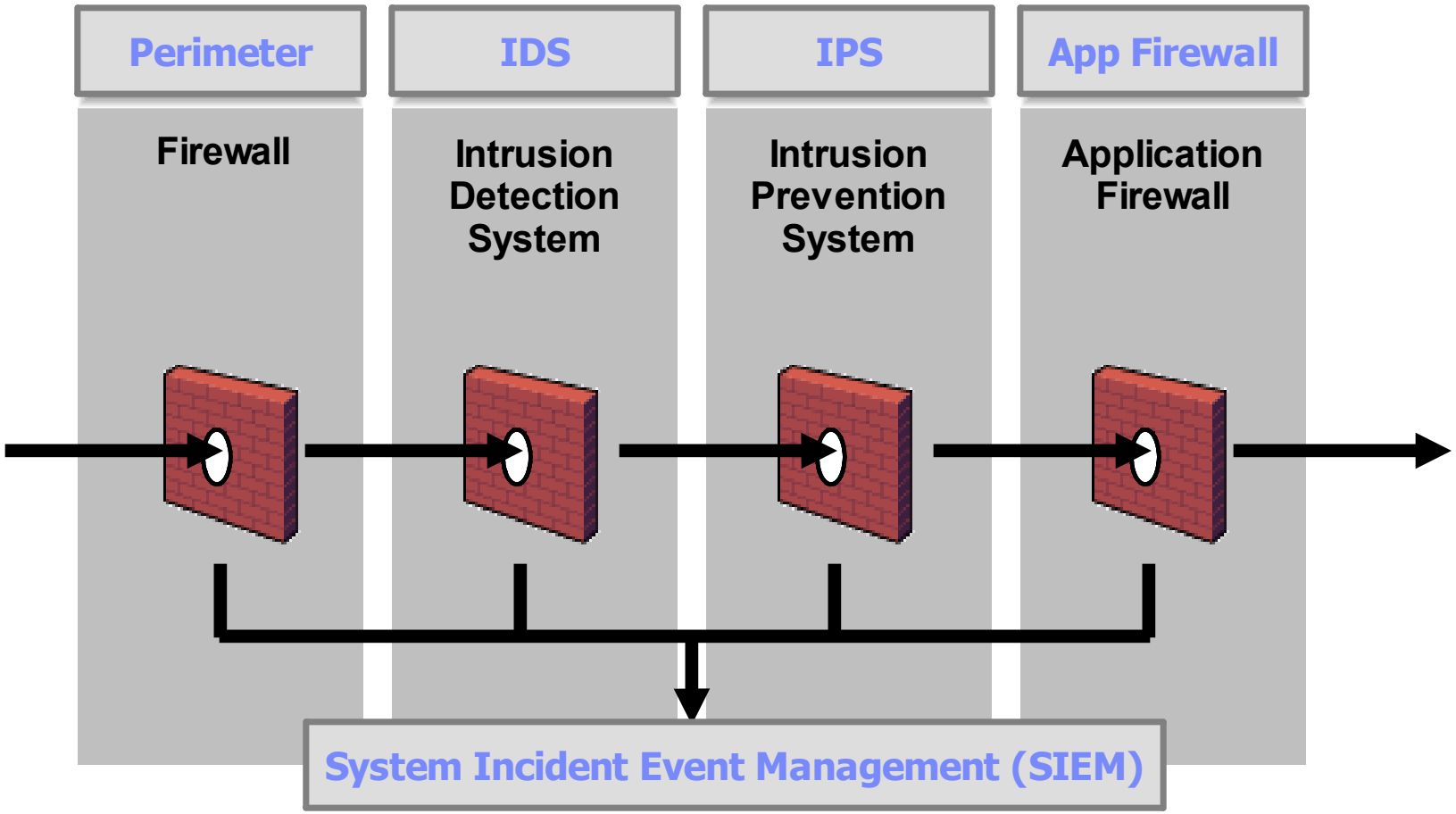


High Level Web Application Architecture Review



Security

Network Defenses for Web Applications



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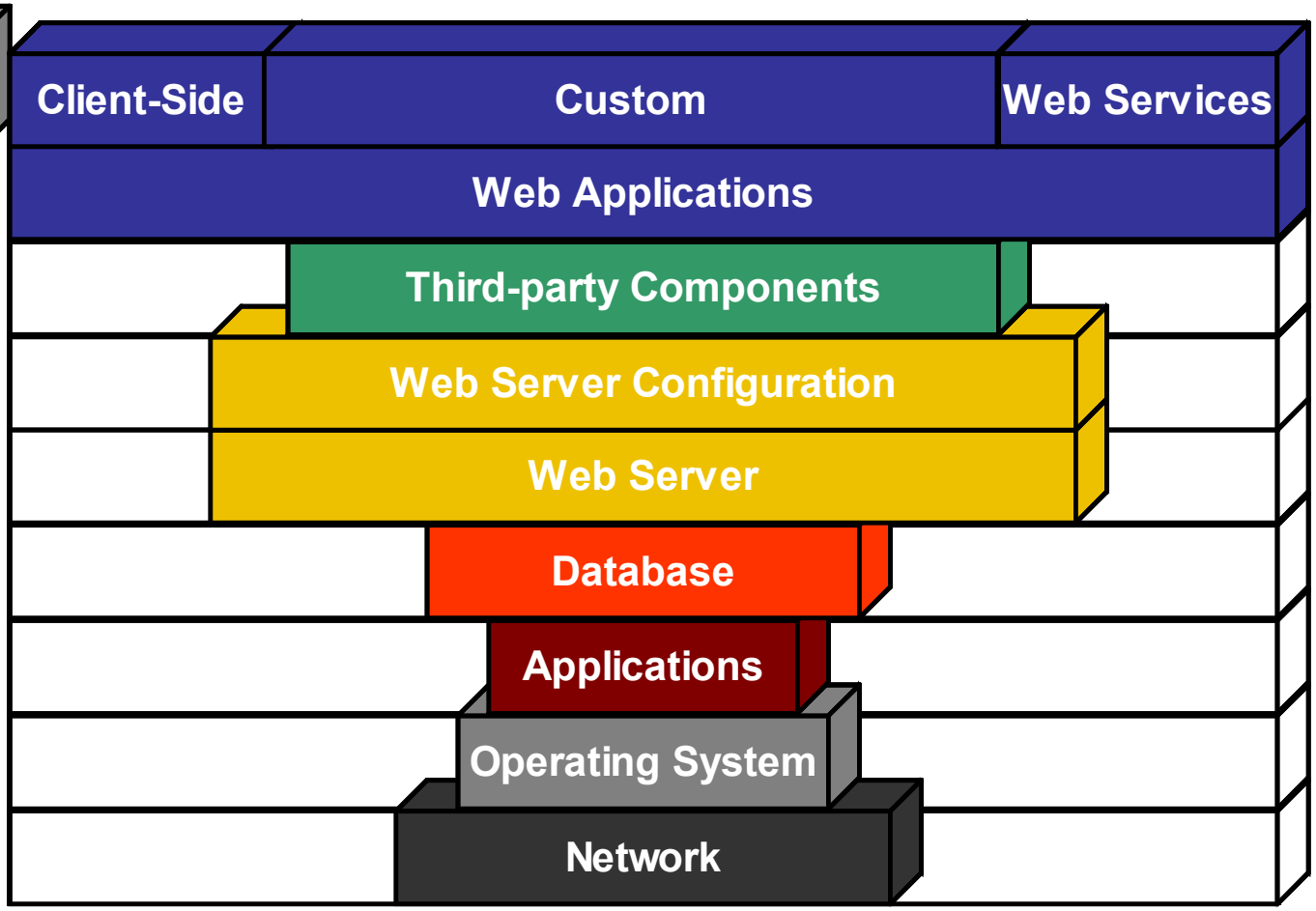
Security

Where are the Vulnerabilities?

Code Scanning Emerging Tech

AppScan DE/BE
Fortify
Ounce Labs
Klockwork
Parasoft®



Security

The Myth: “Our Site Is Safe”

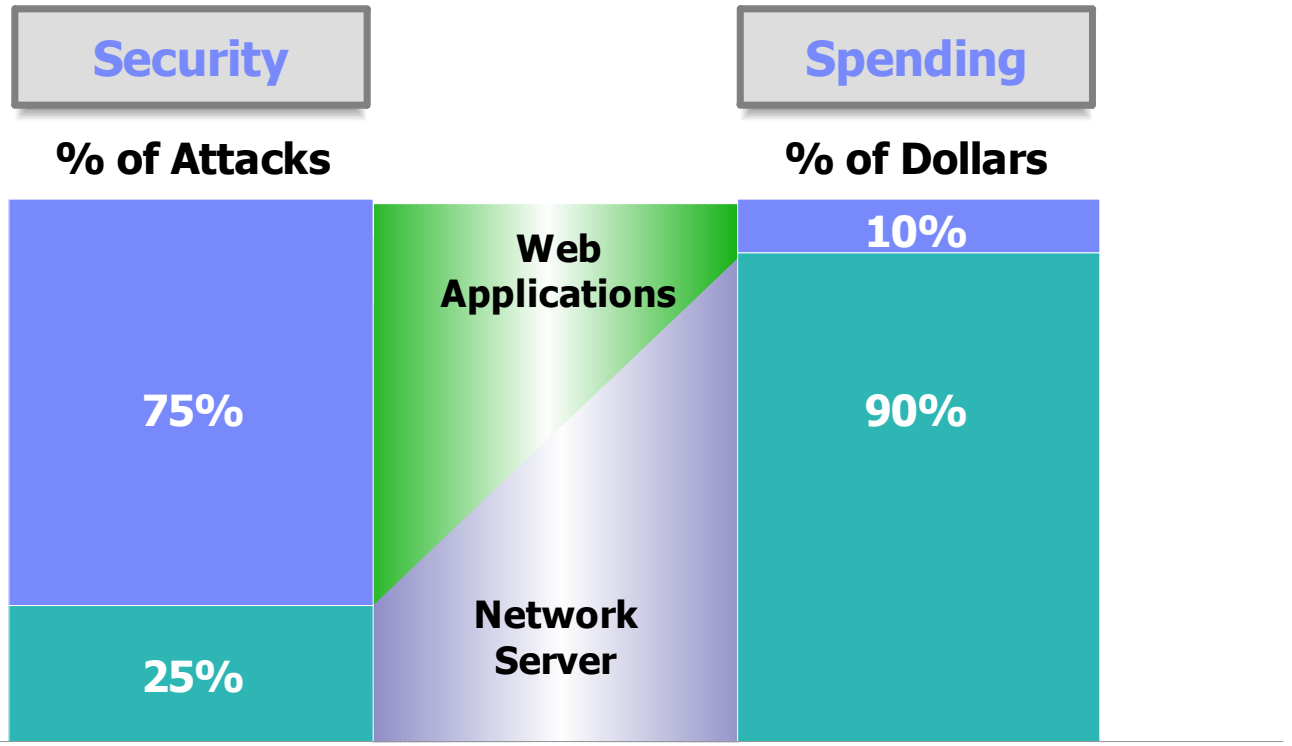
We Have Firewalls in Place

We Audit It Once a Quarter with Pen Testers

We Use Network Vulnerability Scanners

Security

The Reality: Security and Spending Are Unbalanced



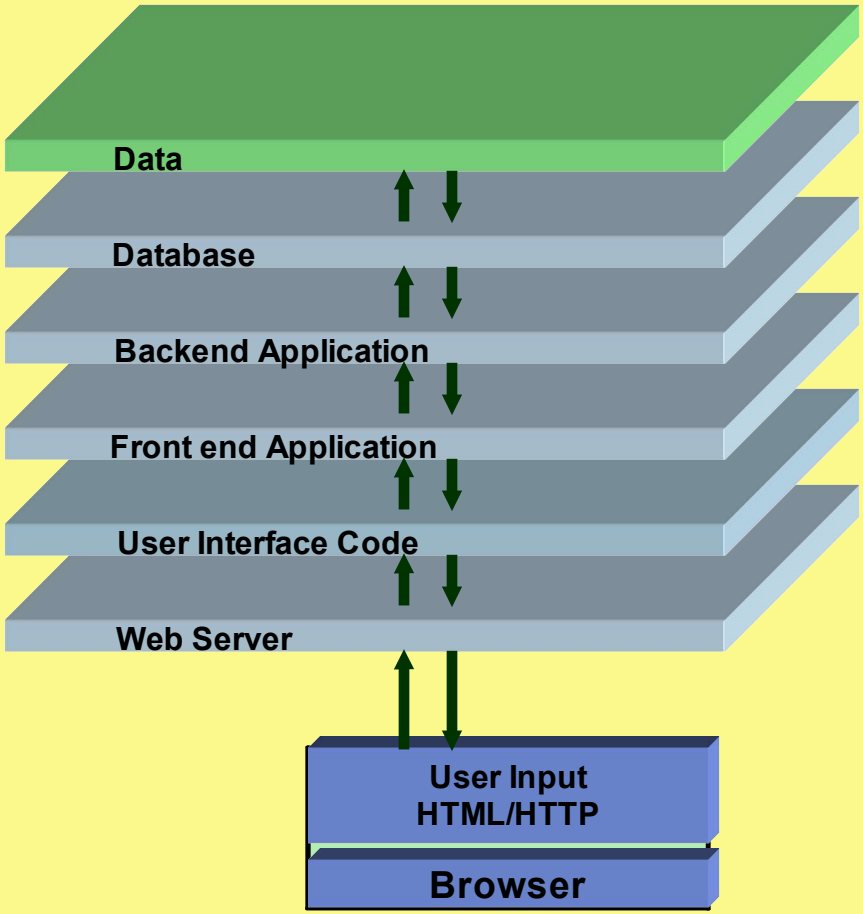
75% of All Attacks on Information Security Are Directed to the Web Application Layer

2/3 of All Web Applications Are Vulnerable

Gartner

Sources: Gartner, Watchfire

What is a Web Application?



- **The business logic that enables:**
  - User's interaction with Web site
  - Transacting/interfacing with back-end data systems (databases, Change and Release Management(CRM), Packaged Applications etc)
- **In the form of:**
  - 3rd party packaged software; i.e. Web server, application server, software packages etc.
  - Code developed in-house / Web builder / system integrator

Input and Output flow through each layer of the application

A break in any layer breaks the whole application

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Security Defects: Those I manage vs. Those I own

	Infrastructure Vulnerabilities or Common Web Vulnerabilities (CWVs)	**Application Specific Vulnerabilities (ASVs)**
Cause of Defect	Insecure application development by **3rd party SW**	Insecure application development **In-house**
Location within Application	3rd party **technical building blocks or infrastructure** (Web servers,)	**Business logic** - dynamic data consumed by an application
Type(s) of Exploits	Known vulnerabilities (patches issued), misconfiguration	SQL injection, path tampering, Cross site scripting, Suspect content & cookie poisoning
Detection	Match signatures & check for known misconfigurations.	Requires application specific knowledge
Business Risk	Patch latency primary issue	Requires automatic application lifecycle security
Cost Control	As secure as 3rd party software	Early detection saves $$$

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Open Web Application Security Project (OWASP) and the OWASP Top 10 list

- Open Web Application Security Project (OWASP) – an open organization dedicated to fight insecure software
- “The OWASP Top Ten document represents a broad consensus about what the most critical Web application security flaws are”
- We will use the Top 10 list to cover some of the most common security issues in Web applications

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The OWASP Top 10 list

Application Threat	Negative Impact	Example Impact
Cross-Site® scripting	Identity Theft, Sensitive Information Leakage, …	Hackers can impersonate legitimate users, and control their accounts.
Injection Flaws	Attacker can manipulate queries to the DB / LDAP / Other system	Hackers can access backend database information, alter it or steal it.
Malicious File Execution	Execute shell commands on server, up to full control	Site modified to transfer all interactions to the hacker.
Insecure Direct Object Reference	Attacker can access sensitive files and resources	Web application returns contents of sensitive file (instead of harmless one)
Cross-Site Request Forgery	Attacker can invoke “blind” actions on Web applications, impersonating as a trusted user	Blind requests to bank account transfer money to hacker
Information Leakage and Improper Error Handling	Attackers can gain detailed system information	Malicious system reconnaissance may assist in developing further attacks
Broken Authentication & Session Management	Session tokens not guarded or invalidated properly	Hacker can “force” session token on victim; session tokens can be stolen after logout
Insecure Cryptographic Storage	Weak encryption techniques may lead to broken encryption	Confidential information (SSN, Credit Cards) can be decrypted by malicious users
Insecure Communications	Sensitive info sent unencrypted over insecure channel	Unencrypted credentials “sniffed” and used by hacker to impersonate user
Failure to Restrict URL Access	Hacker can access unauthorized resources	Hacker can forcefully browse and access a page past the login page

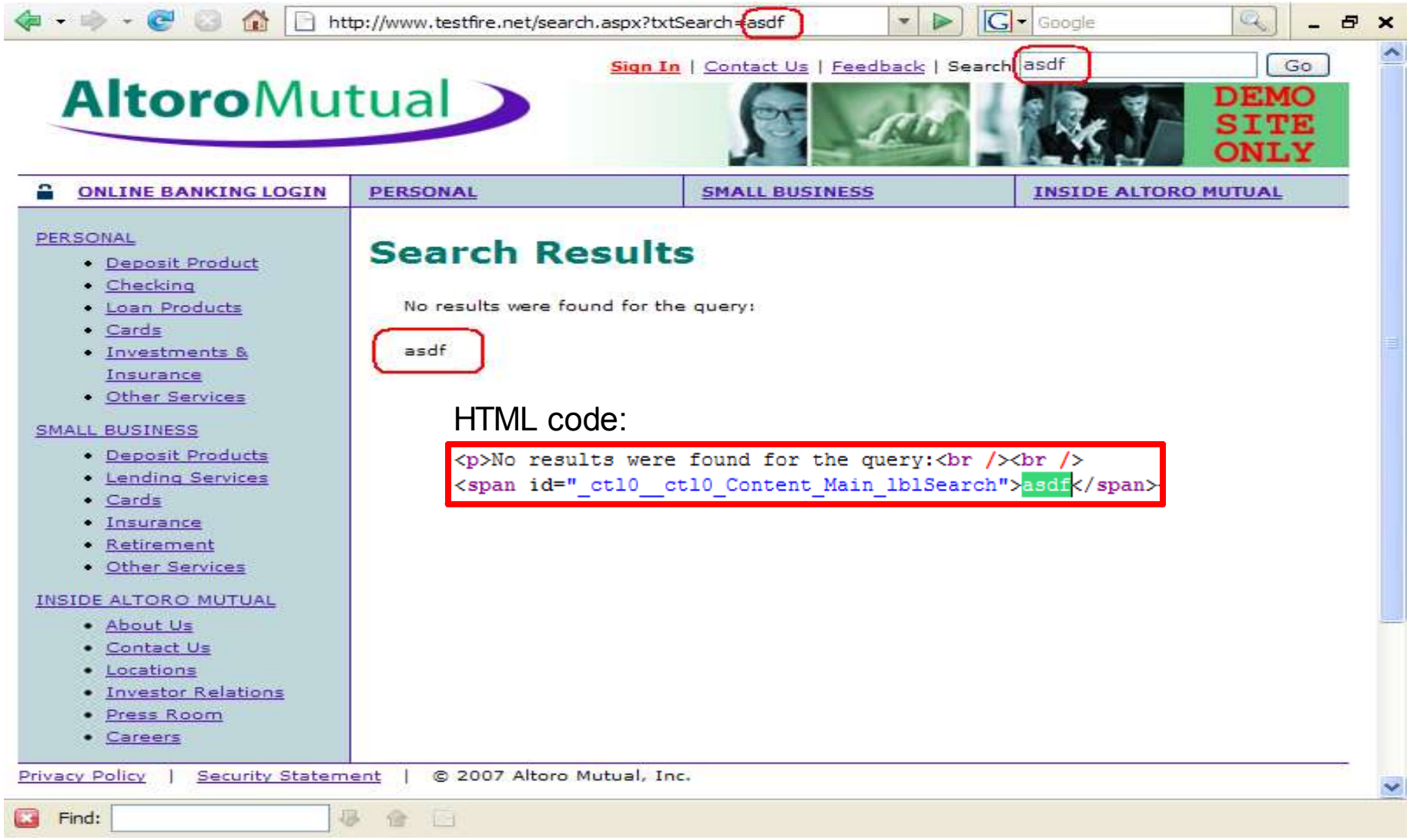
1. Cross-Site Scripting (XSS)

- What is it?
  - Malicious script echoed back into HTML returned from a trusted site, and runs under trusted context
- What are the implications?
  - Session Tokens stolen (browser security circumvented)
  - Complete page content compromised
  - Future pages in browser compromised

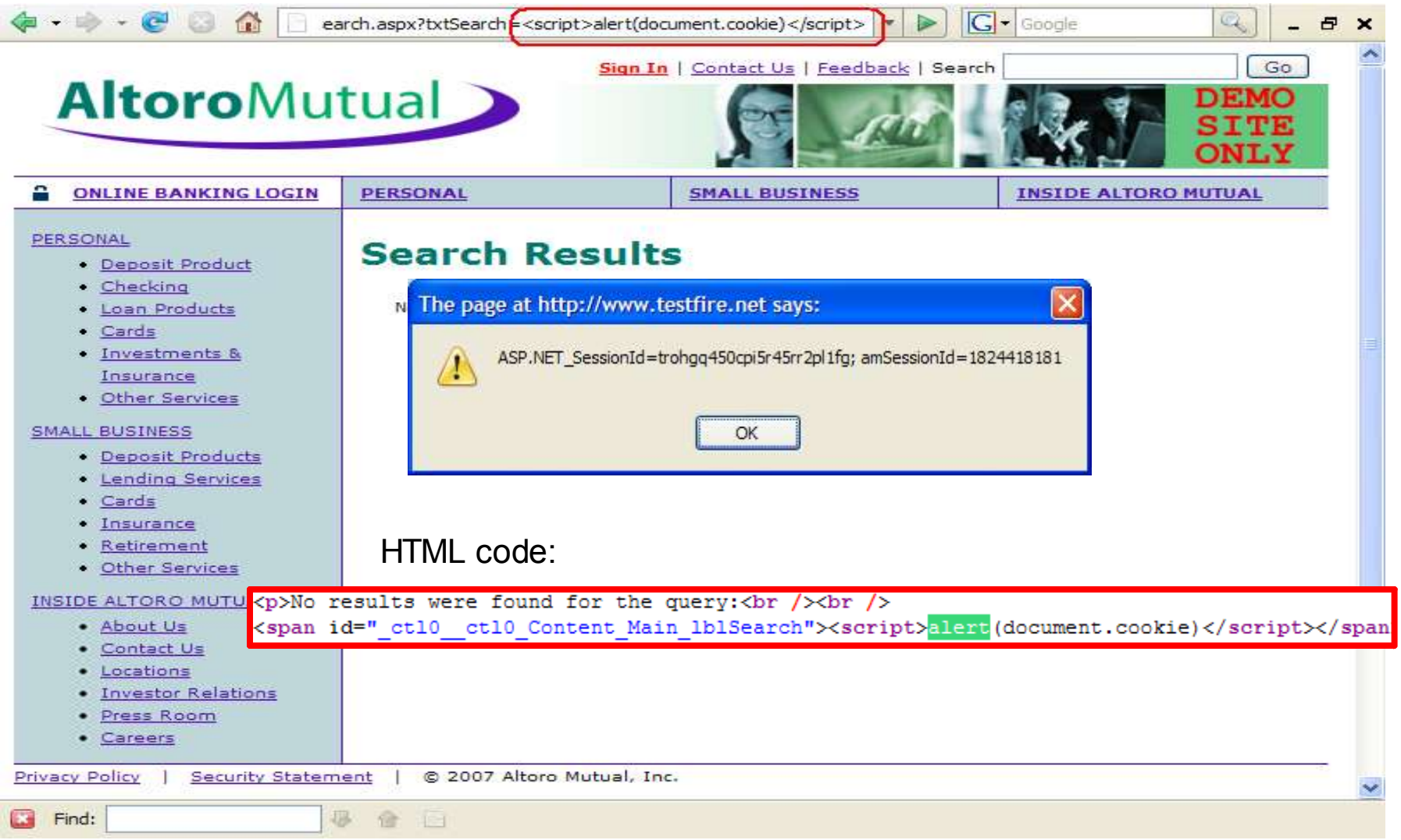
Demonstration – Cross Site Scripting

- Main points covered in the demo:
  - Locating an a place where user input which is echoed back to the browser
  - Seeing if the user input is echoed back ‘as-is’ or if it is properly encoded
  - Exploiting the vulnerability

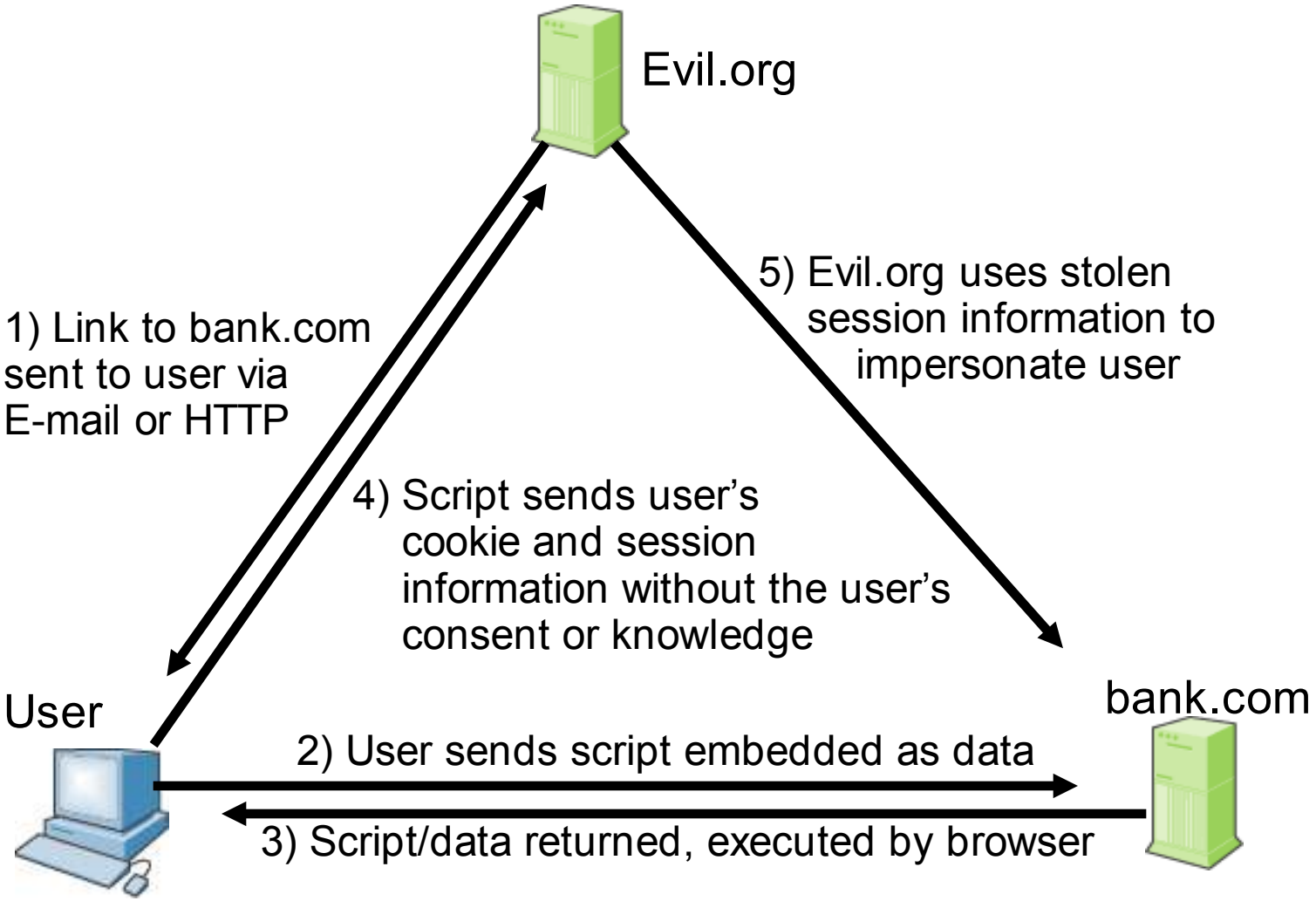
XSS Example I



XSS Example II



Cross-Site Scripting – The Exploit Process



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Lab 1 Profile Web Application and XSS

- The Goal of this lab is to:
  - profile the demo.testfire.net application
  - utilize a Cross-Site Scripting vulnerability on the demo.testfire.net application in order to access cookies on a target user's browser

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2 - Injection Flaws

- What is it?
  - User-supplied data is sent to an interpreter as part of a command, query or data.
- What are the implications?
  - SQL Injection – Access/modify data in DB
  - SSI Injection – Execute commands on server and access sensitive data
  - LDAP Injection – Bypass authentication

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SQL Injection

- User input inserted into SQL Command:
  - Get product details by id:
    Select * from products where id='$REQUEST["id"]';
  - Hack: send param id with value ' or '1'='1
  - Resulting executed SQL:
    Select * from products where id='' or '1'='1'
  - All products returned

Demonstration – SQL Injection

- Main points covered in the demo or video:
  - How to find a SQL injection vulnerability
  - How to exploit a SQL injection vulnerability

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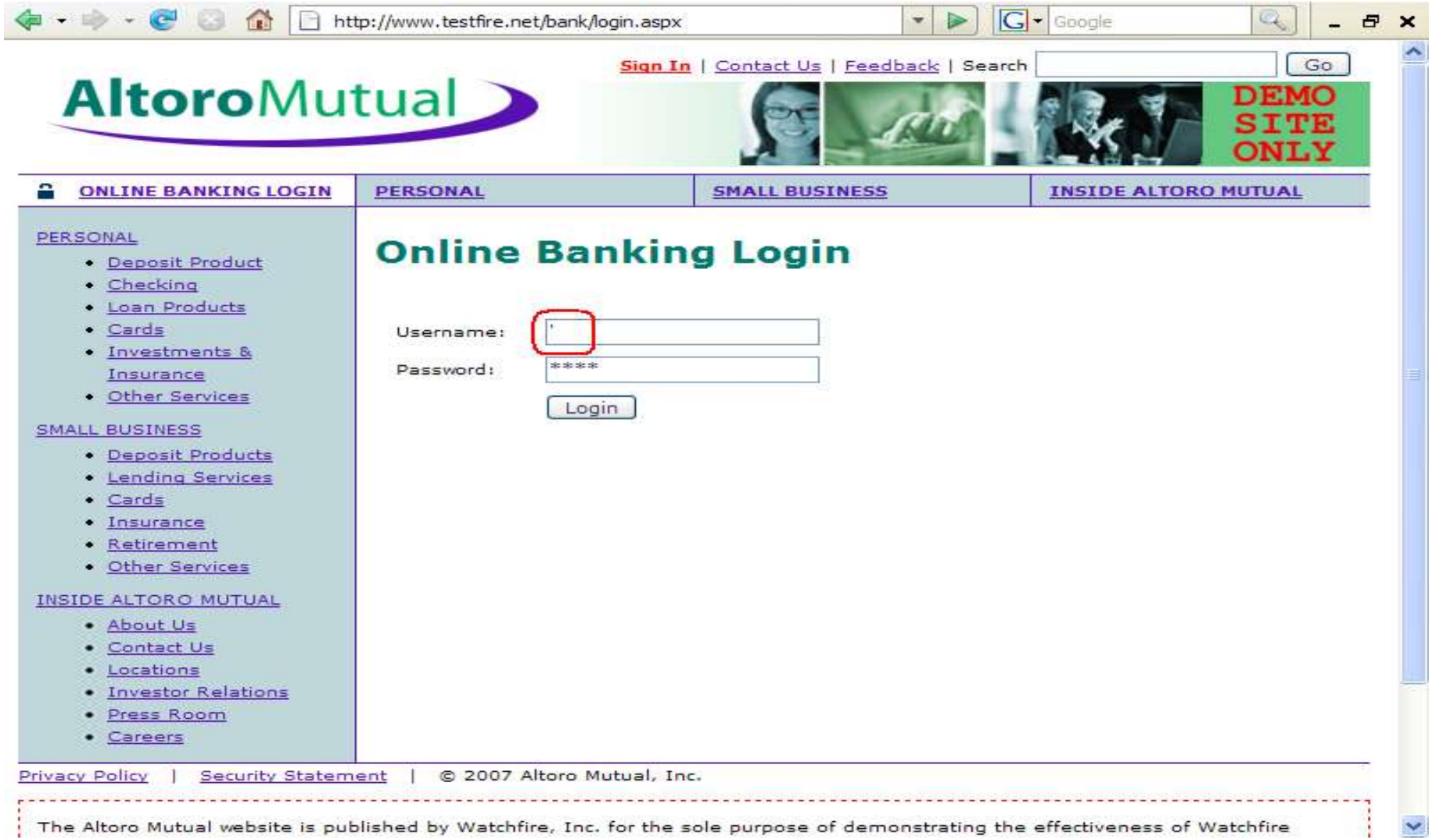
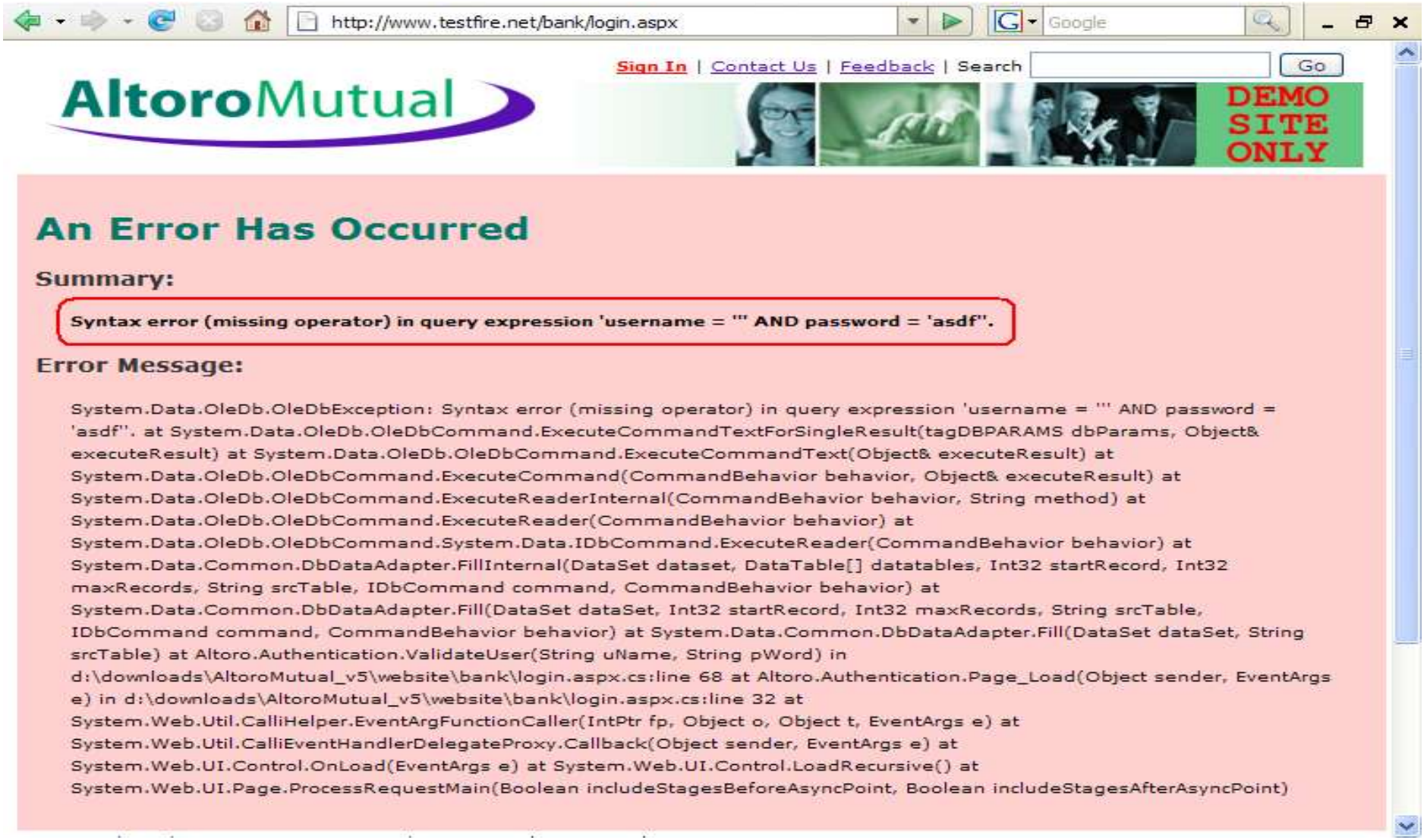
SQL Injection Example I



SQL Injection Example II



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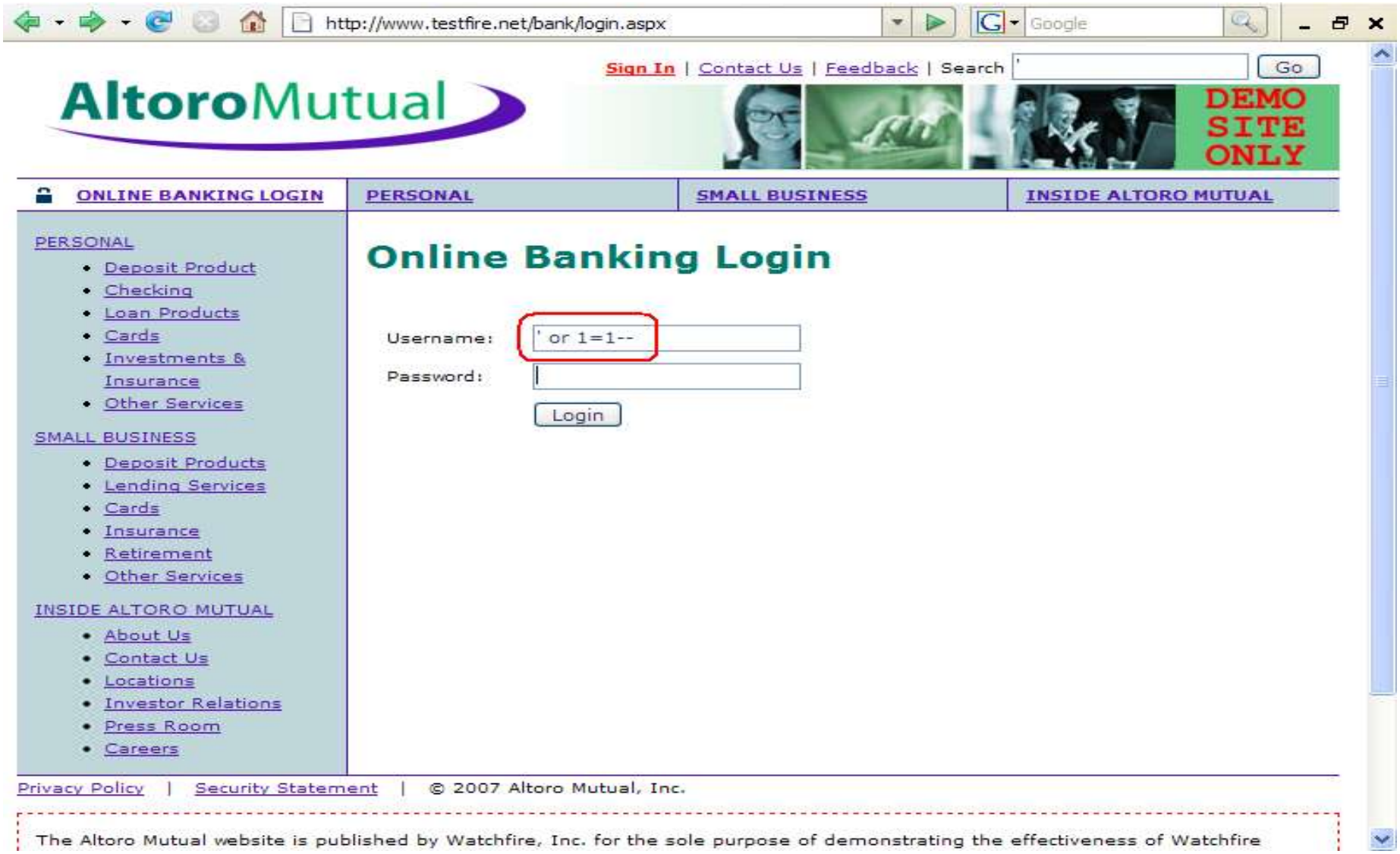
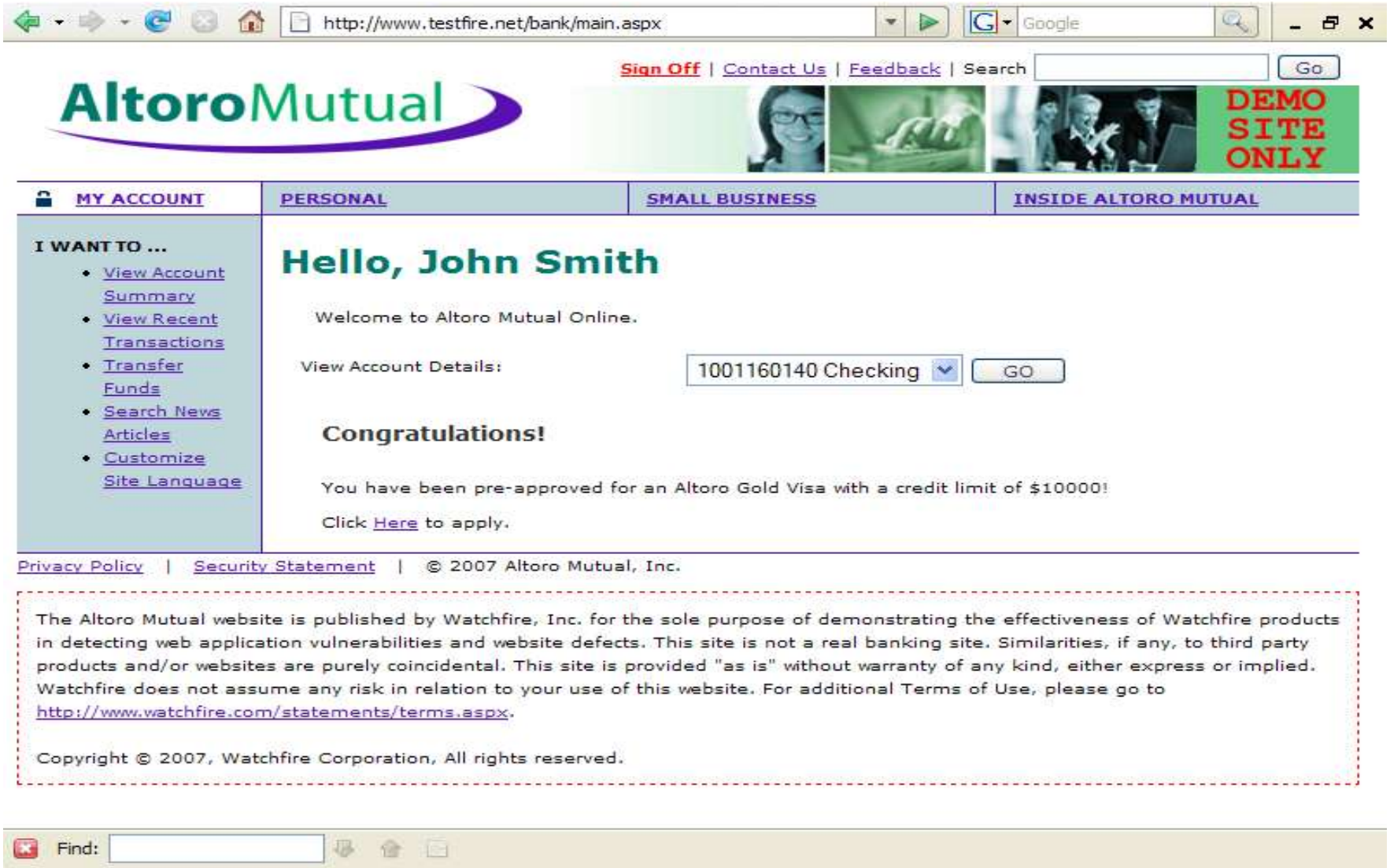
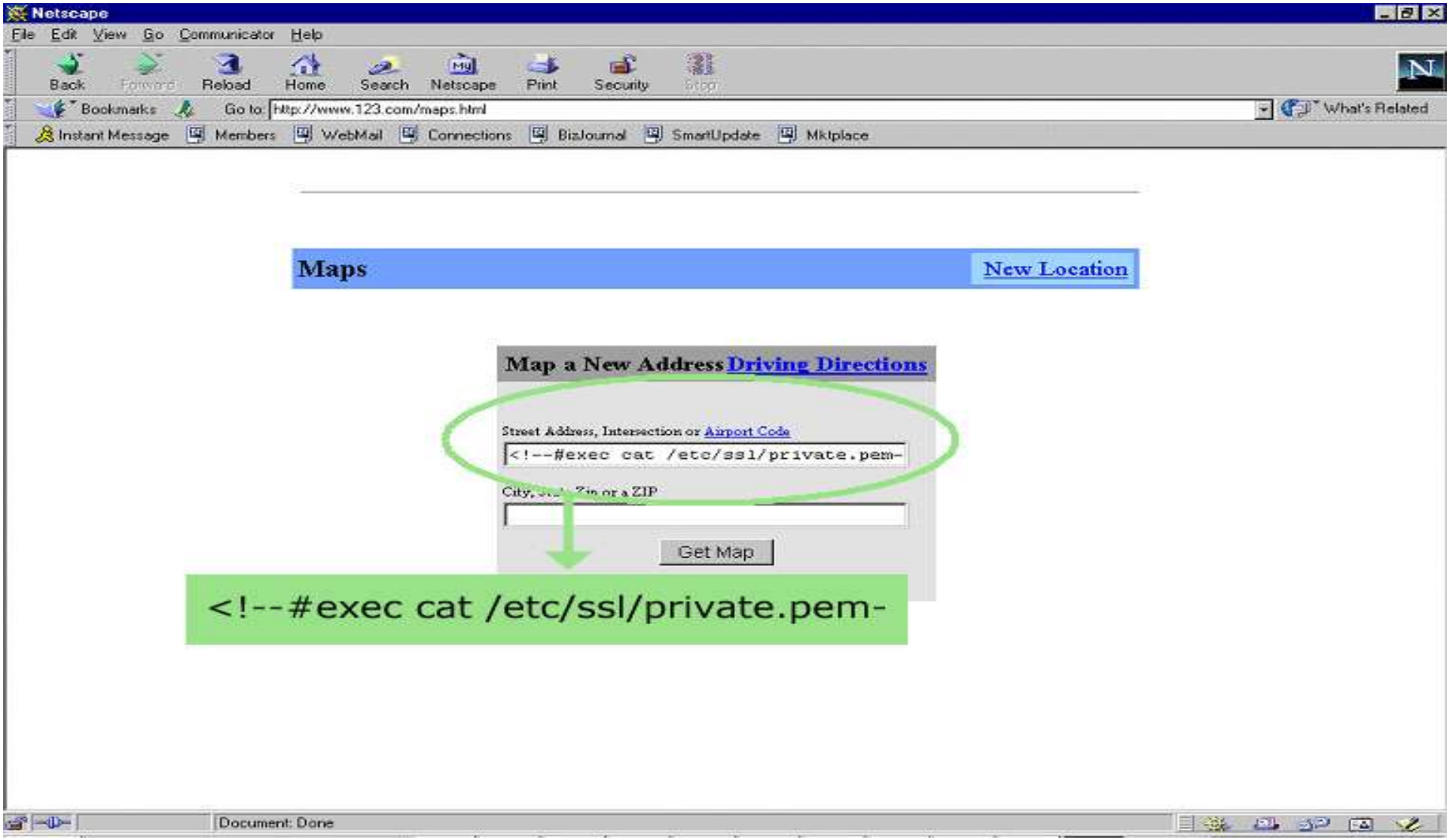
SQL Injection Example - Exploit



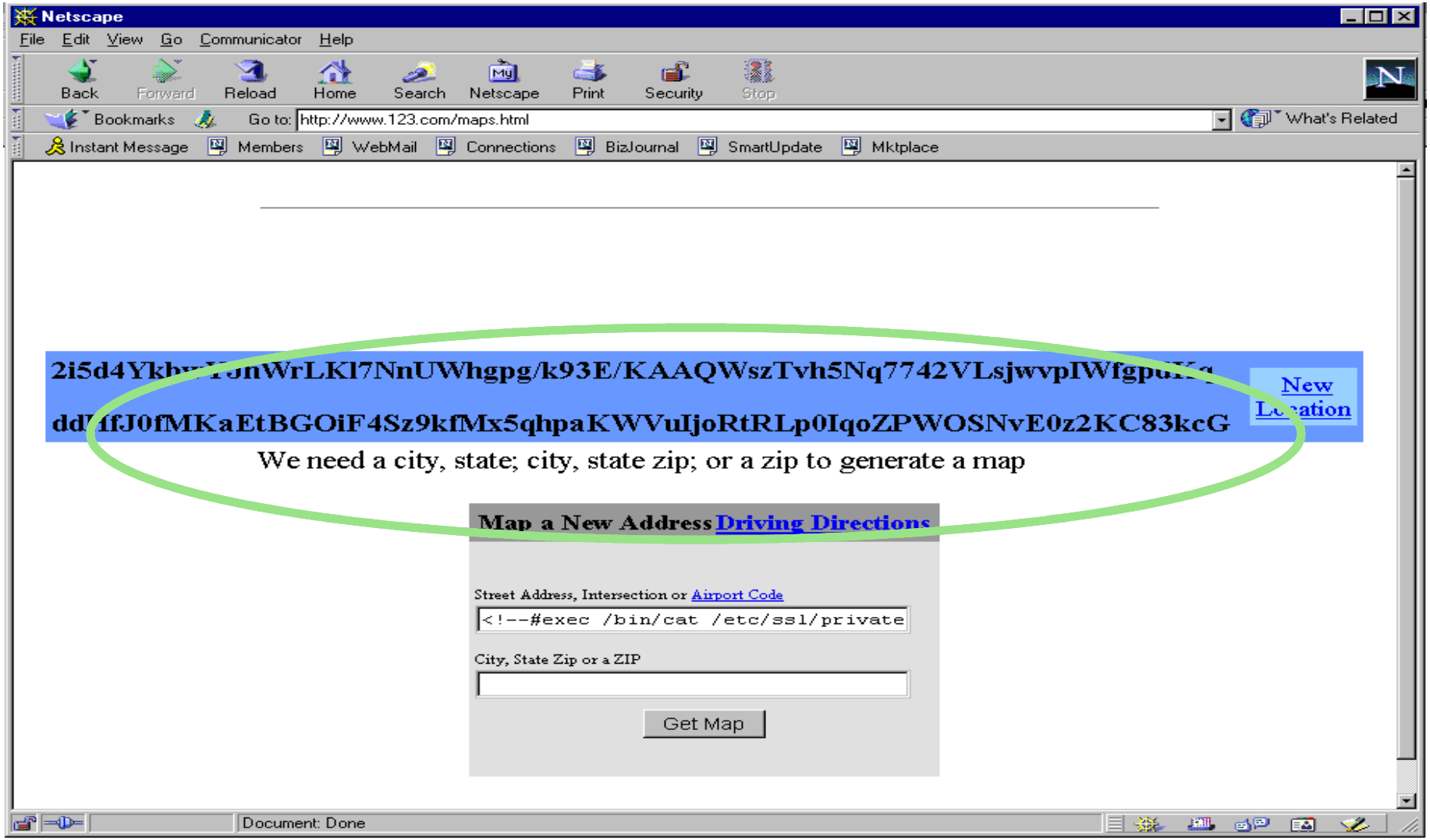
SQL Injection Example - Outcome



Injection Flaws (SSI Injection Example)
Creating commands from input



The return is the private SSL key of the server



3 - Malicious File Execution

- What is it?
  - Application tricked into executing commands or creating files on server
- What are the implications?
  - Command execution on server – complete takeover
  - Site Defacement, including XSS option

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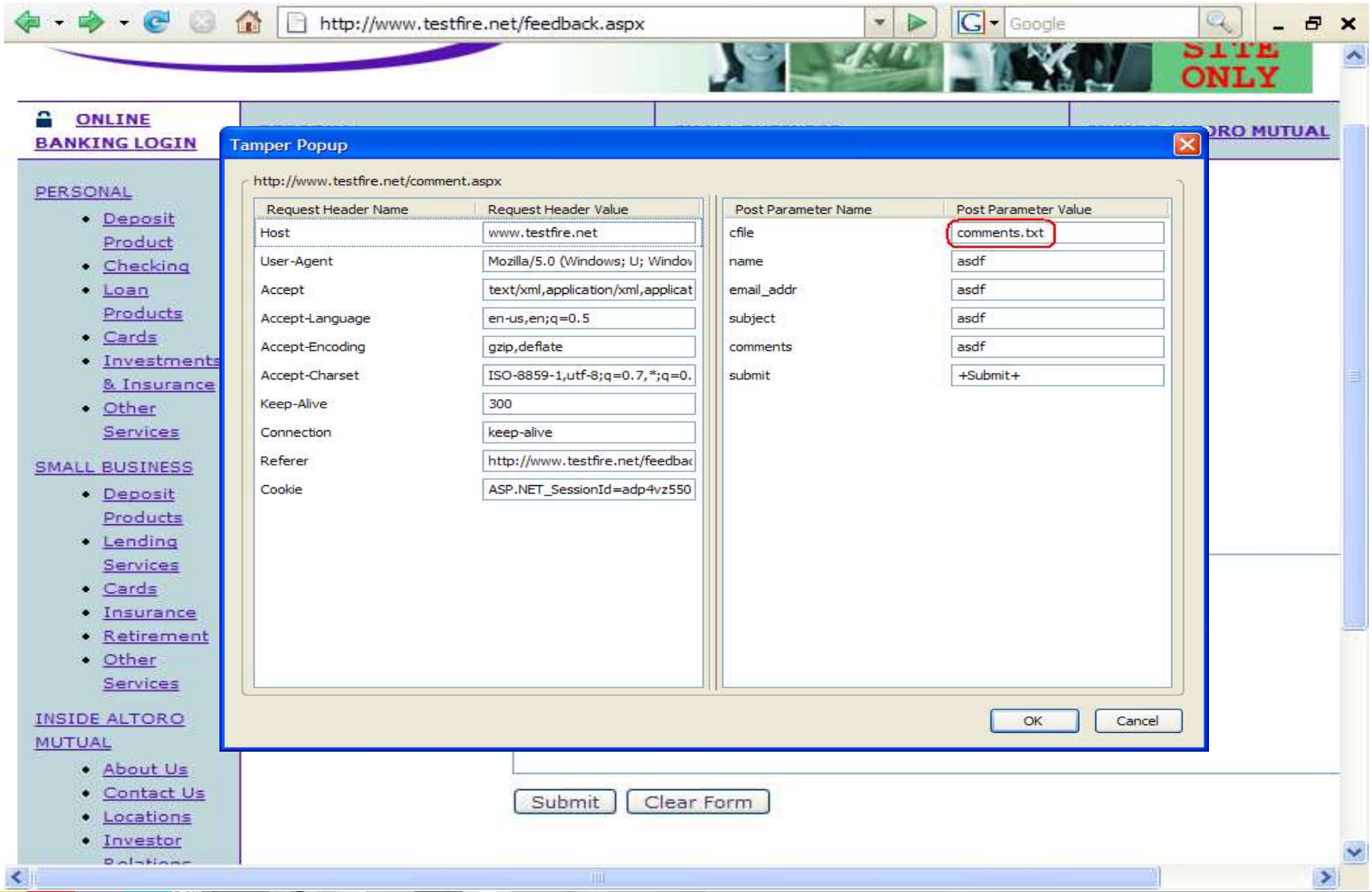
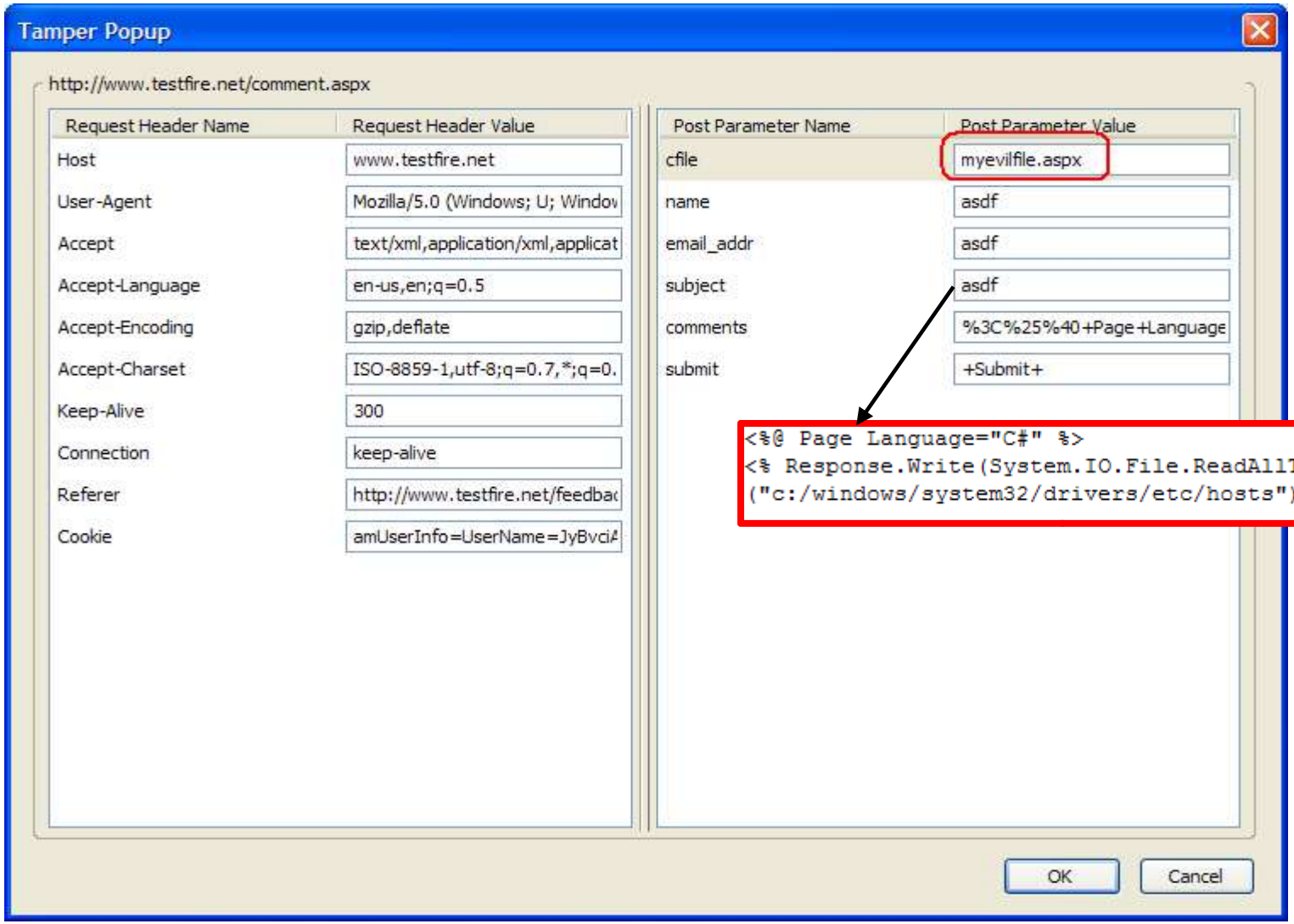
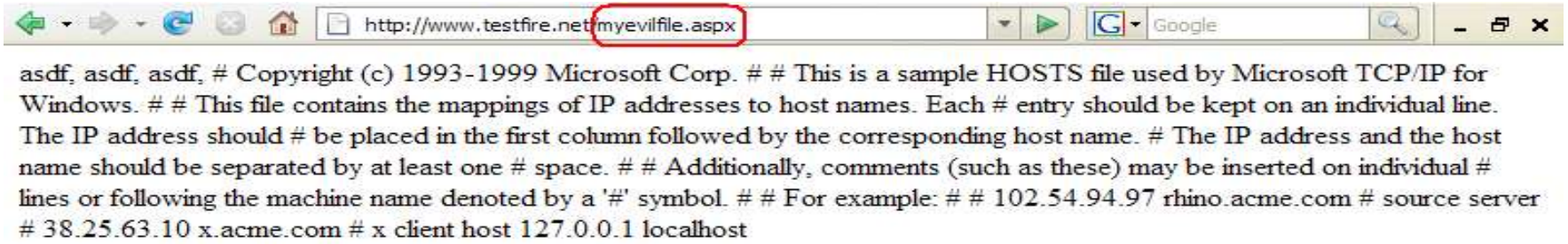
Malicious File Execution – Example I



Malicious File Execution – Example cont.



Malicious File Execution – Example cont.



4 - Insecure Direct Object Reference

- What is it?
  - Part or all of a resource (file, table, etc.) name controlled by user input.
- What are the implications?
  - Access to sensitive resources
  - Information Leakage, aids future hacks

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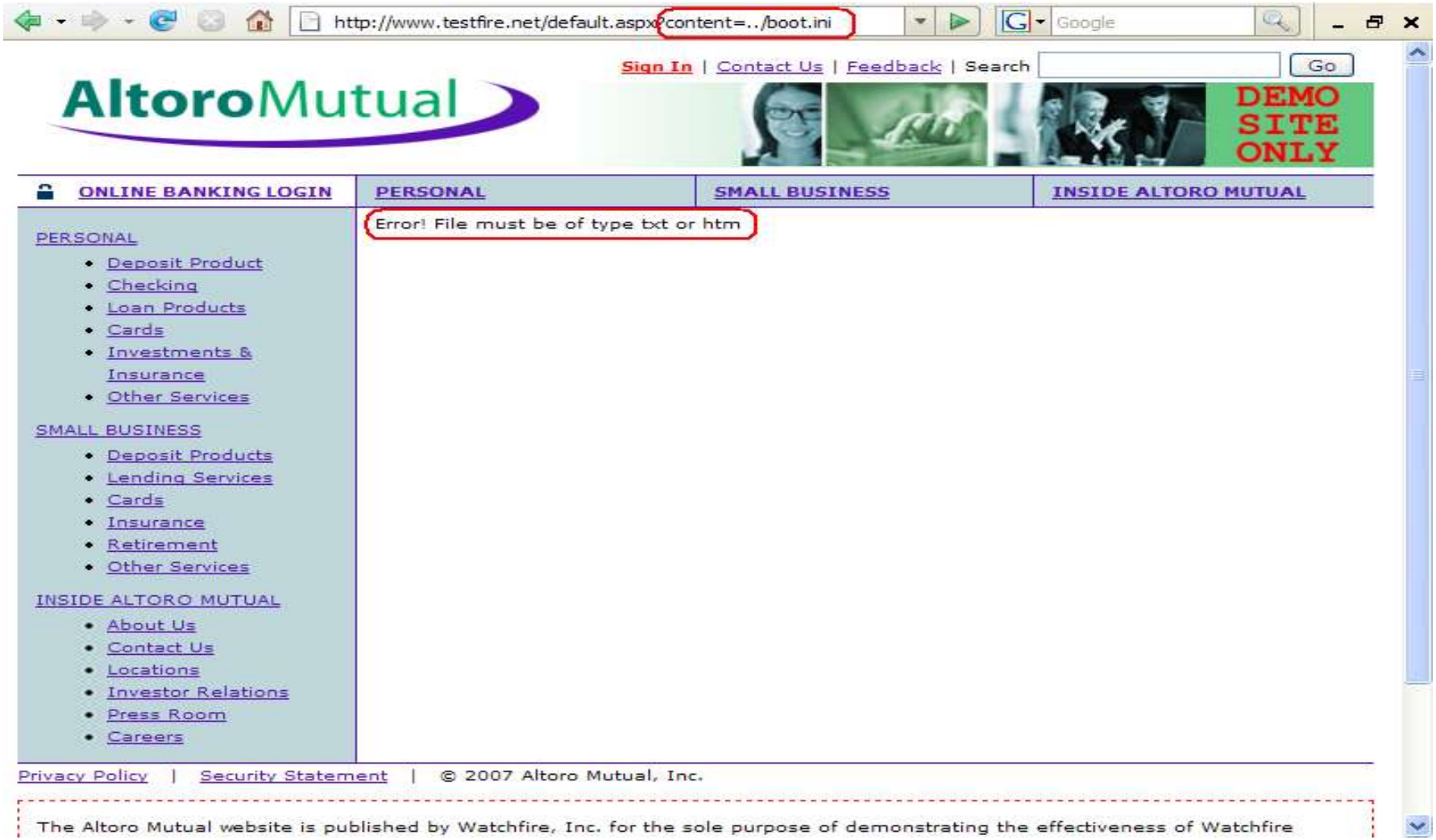
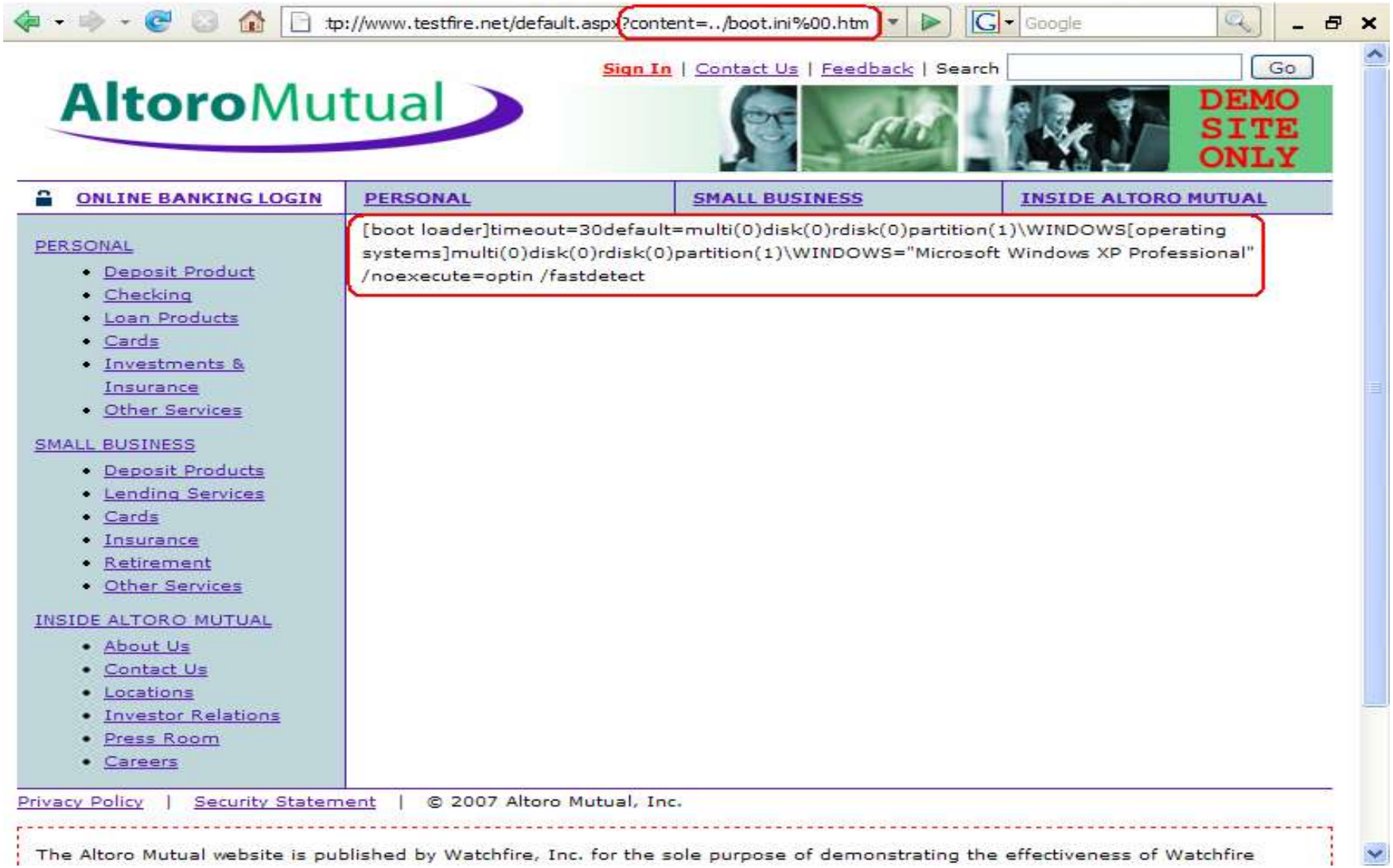
Insecure Direct Object Reference - Example

Insecure Direct Object Reference – Example Cont.



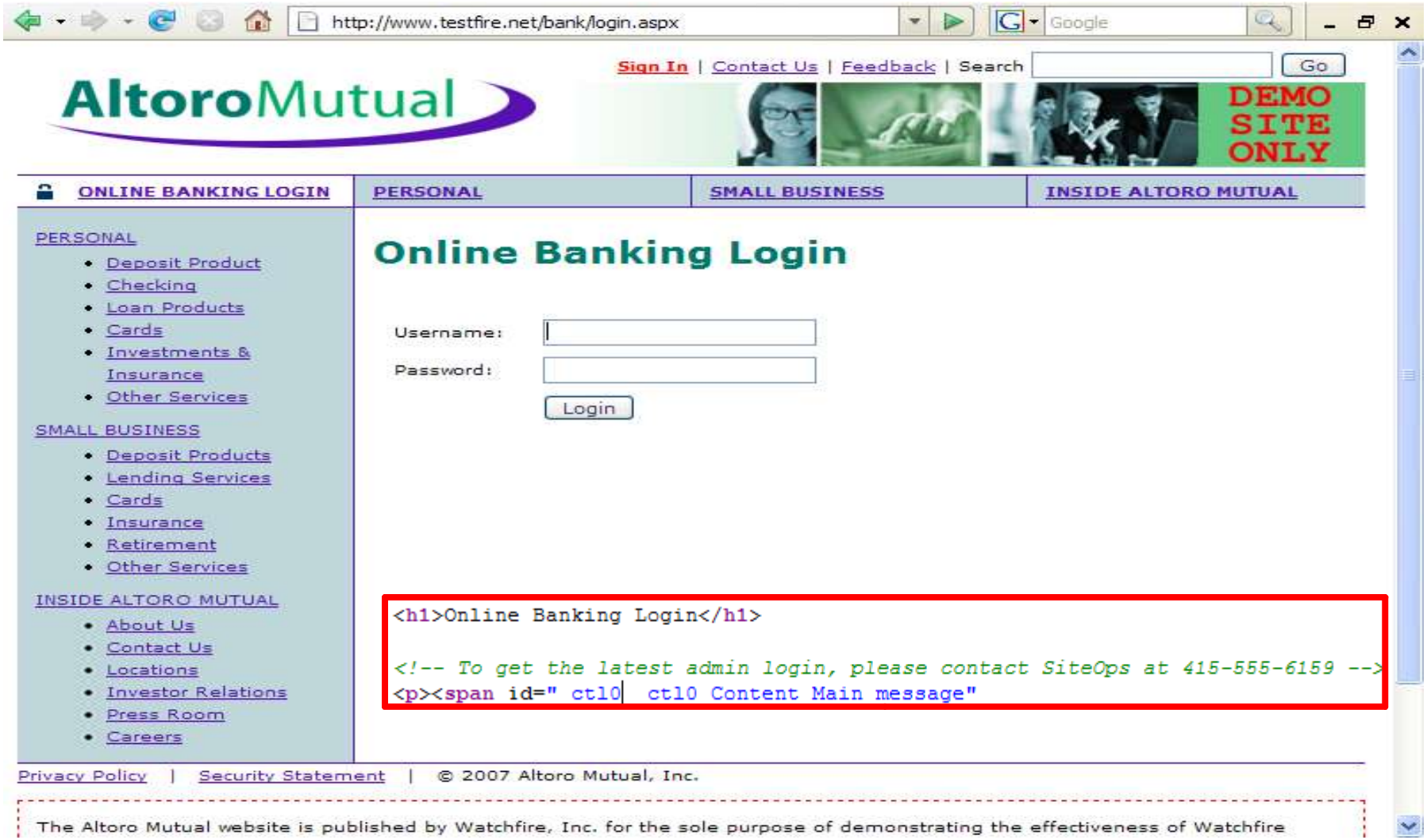
Insecure Direct Object Reference – Example Cont.



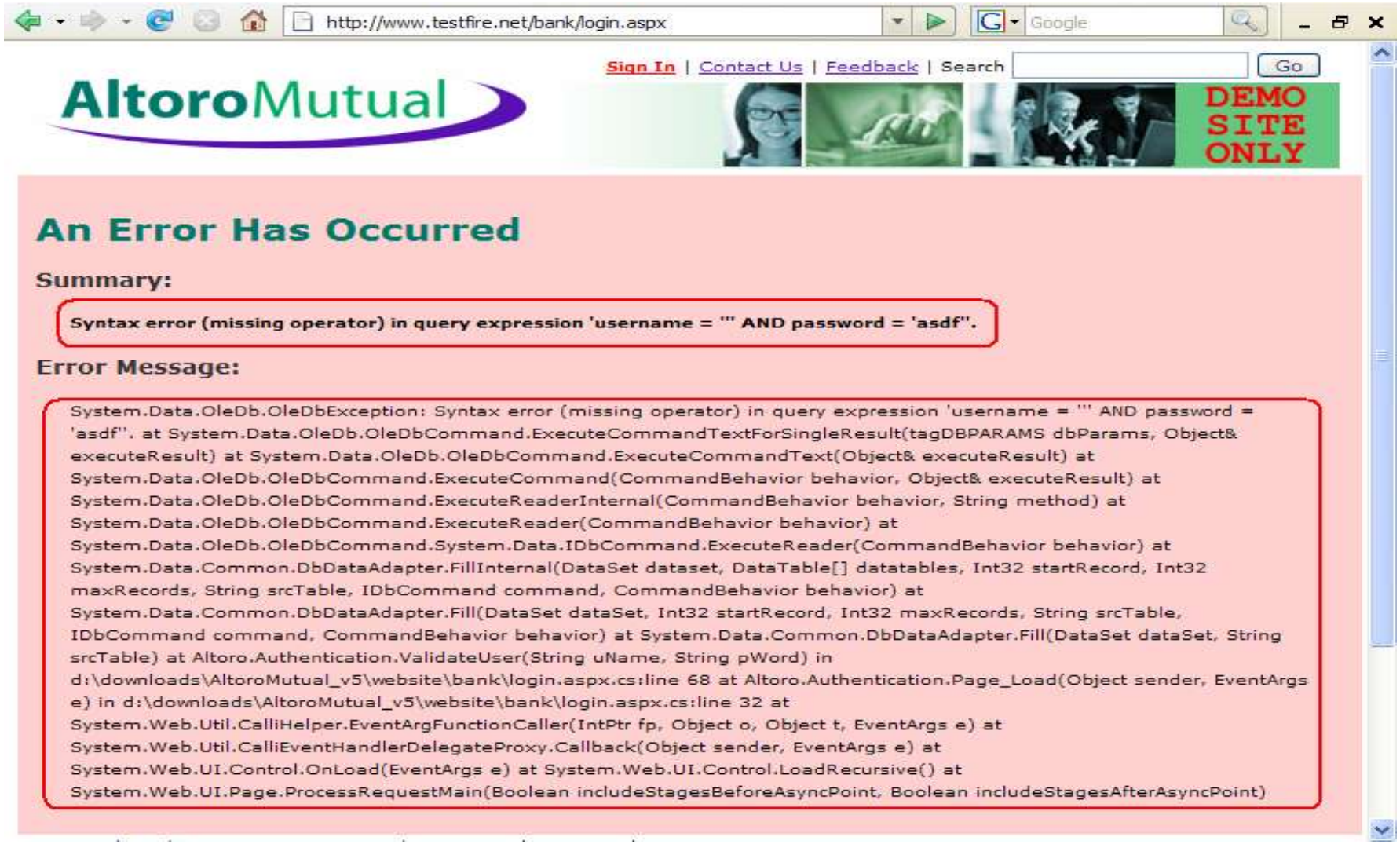
5 - Information Leakage and Improper Error Handling

- What is it?
  - Unneeded information made available via errors or other means.
- What are the implications?
  - Sensitive data exposed
  - Web App internals and logic exposed (source code, SQL syntax, exception call stacks, etc.)
  - Information aids in further hacks

Information Leakage - Example



Improper Error Handling - Example

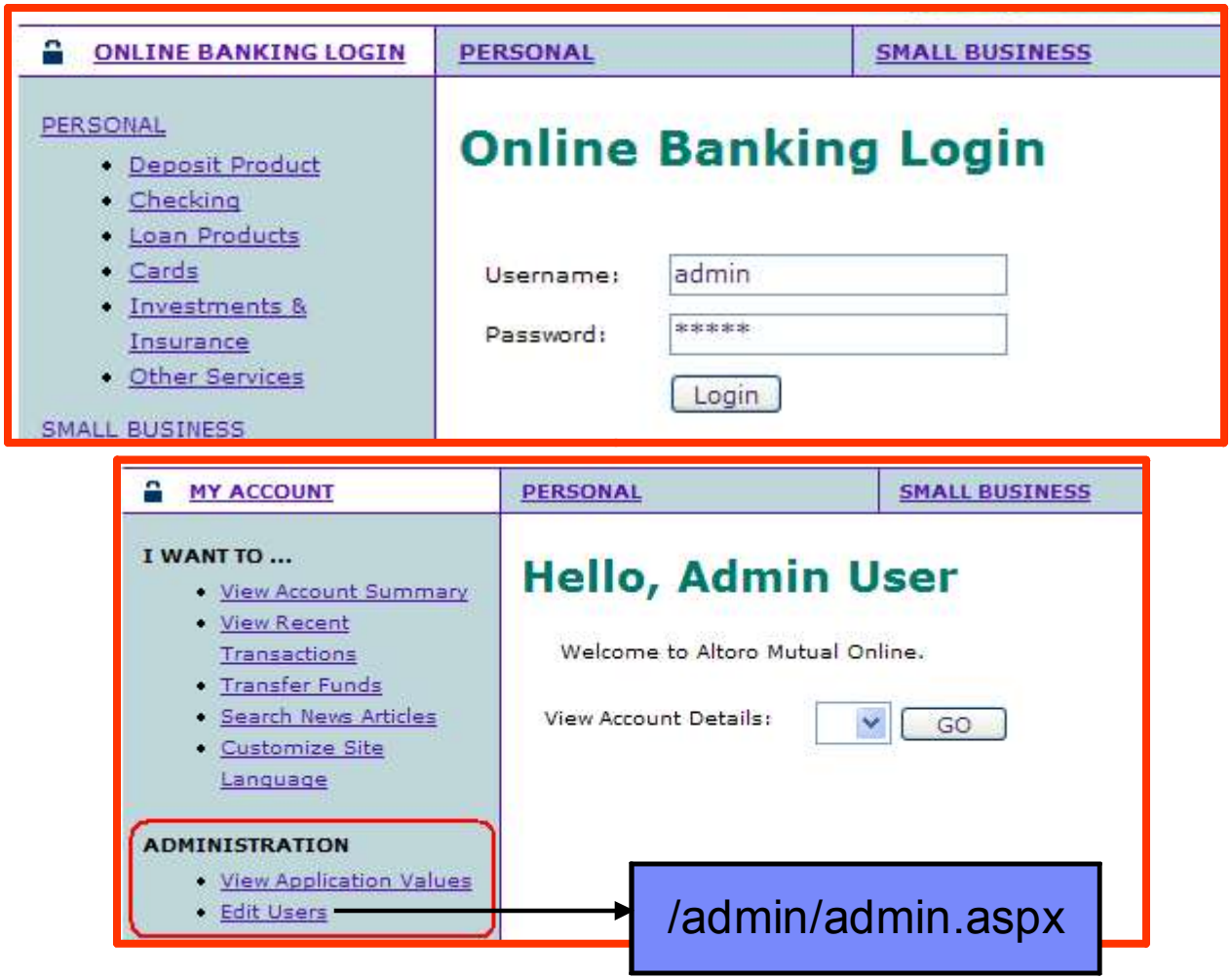


Information Leakage – Different User/Pass Error

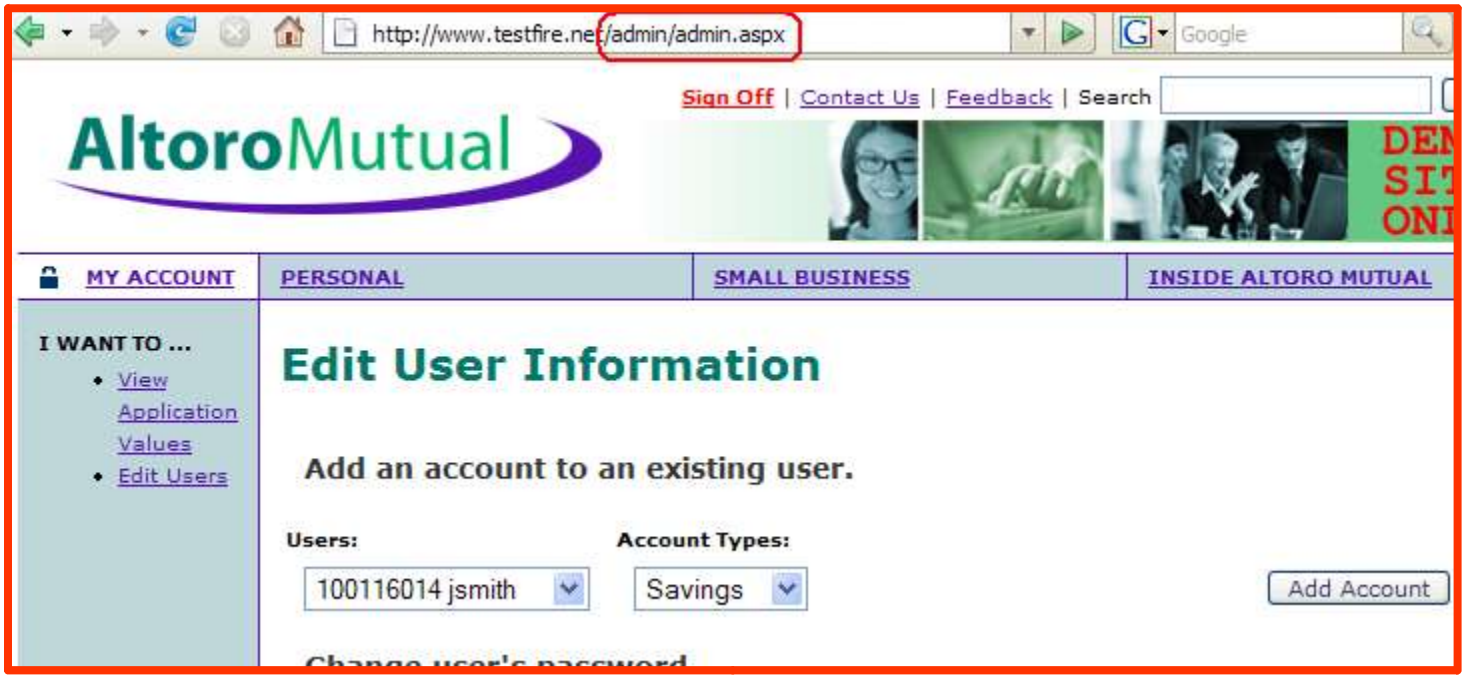
6 - Failure to Restrict URL Access

- What is it?
  - Resources that should only be available to authorized users can be accessed by forcefully browsing them
- What are the implications?
  - Sensitive information leaked/modified
  - Admin privileges made available to hacker

Failure to Restrict URL Access - Admin User login



Simple user logs in, forcefully browses to admin page



Failure to Restrict URL Access: Privilege Escalation Types

- Access given to completely restricted resources
  - Accessing files that shouldn't be served (*.bak, "Copy Of", *.inc, *.cs, ws_ftp.log, etc.)
- Vertical Privilege Escalation
  - Unknown user accessing pages past login page
  - Simple user accessing admin pages
- Horizontal Privilege Escalation
  - User accessing other user's pages
  - Example: Bank account user accessing another's

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Lab 2

Lab 1 – Profile Web Application, Steal Cookies

Lab 2 – Login without Credentials, Steal Usernames and Passwords, Logging into the Administrative Portal

Lab 3 – Automated Scan of Website

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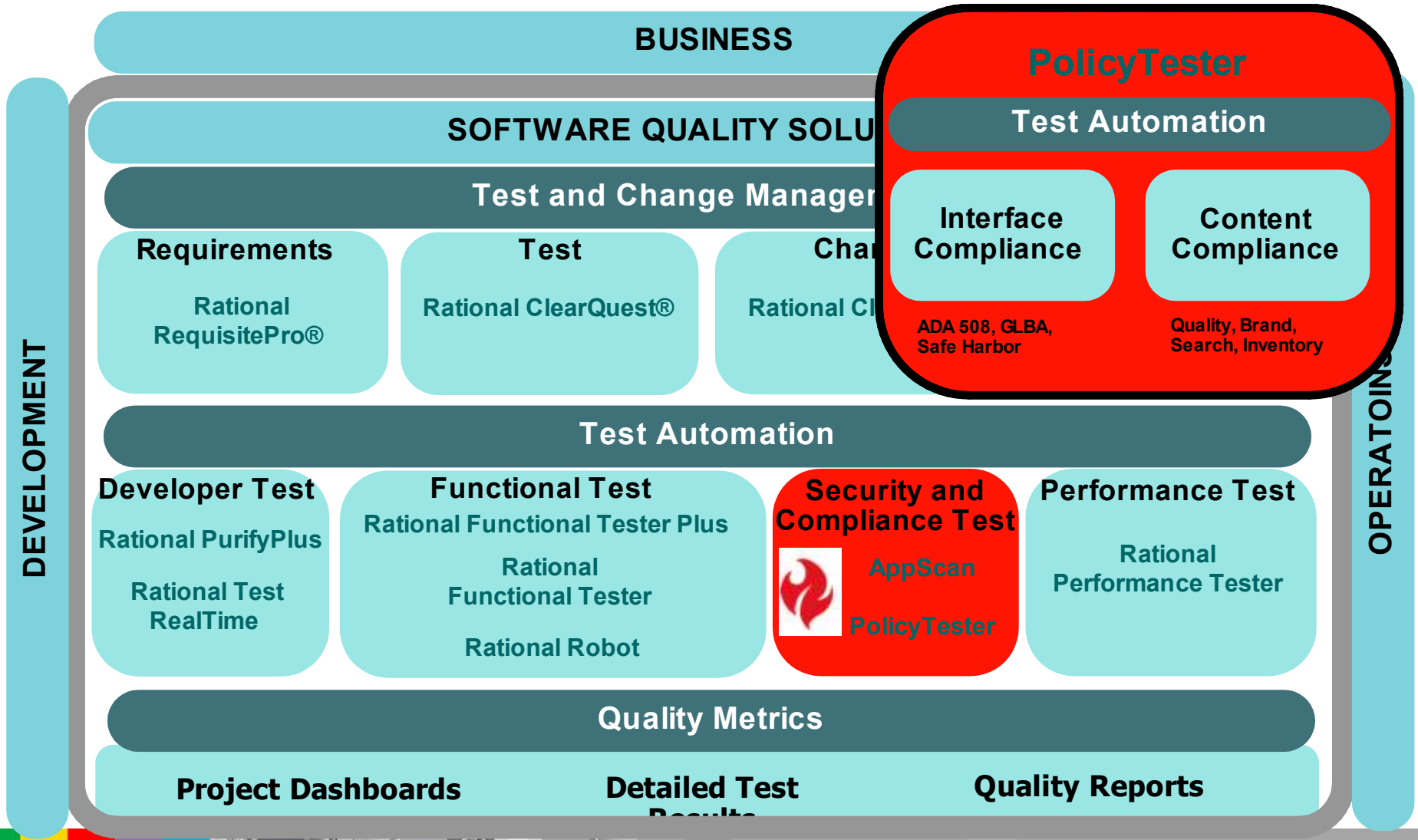
Watchfire in the Rational Portfolio



AppScan

- What is it?
  - AppScan is an automated tool used to perform vulnerability assessments on Web Applications
- Why do I need it?
  - To simplify finding and fixing Web application security problems
- What does it do?
  - Scans Web applications, finds security issues and reports on them in an actionable fashion
- Who uses it?
  - Security Auditors – main users today
  - QA engineers – when the auditors become the bottle neck
  - Developers – to find issues as early as possible (most efficient)

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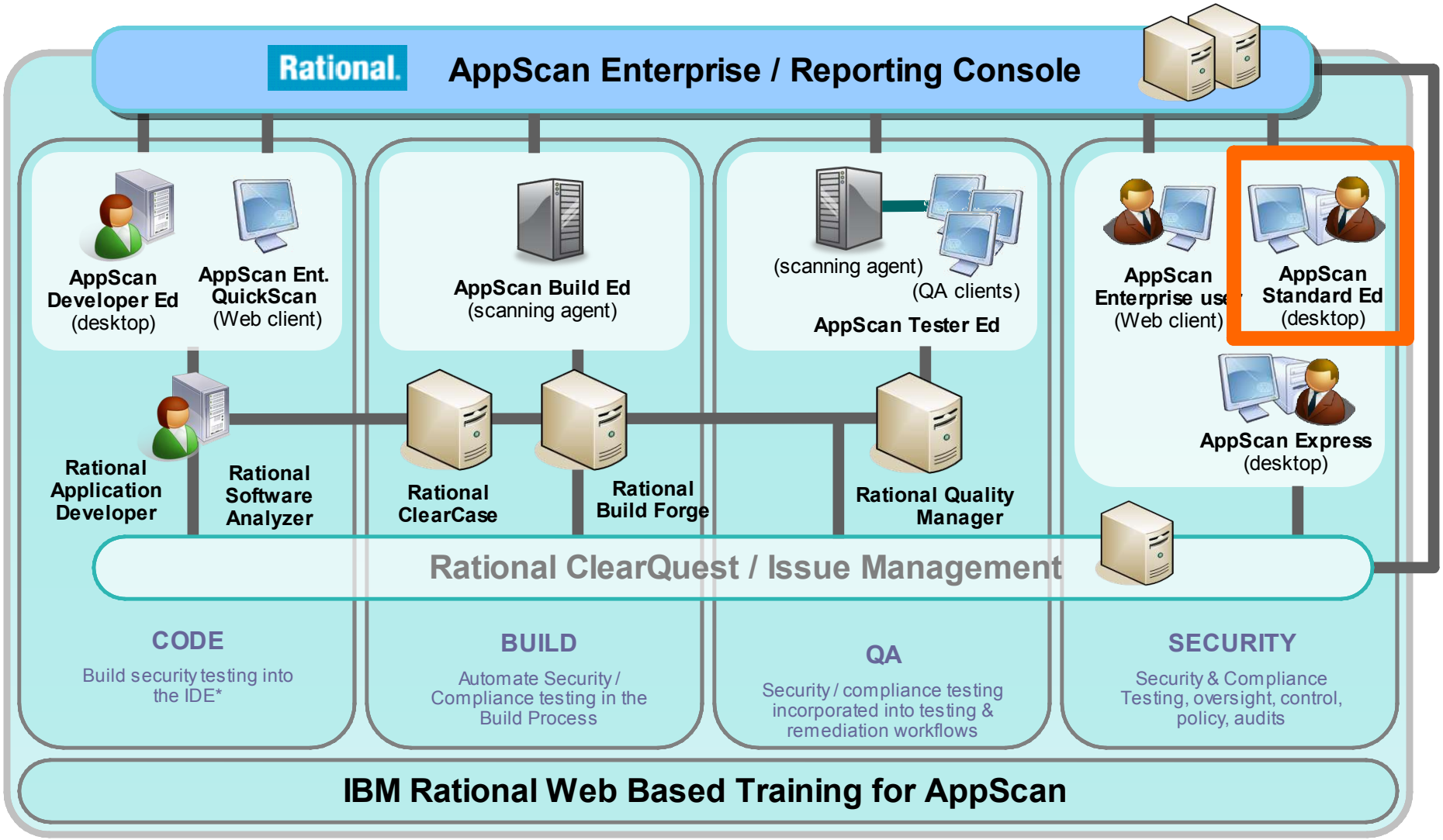
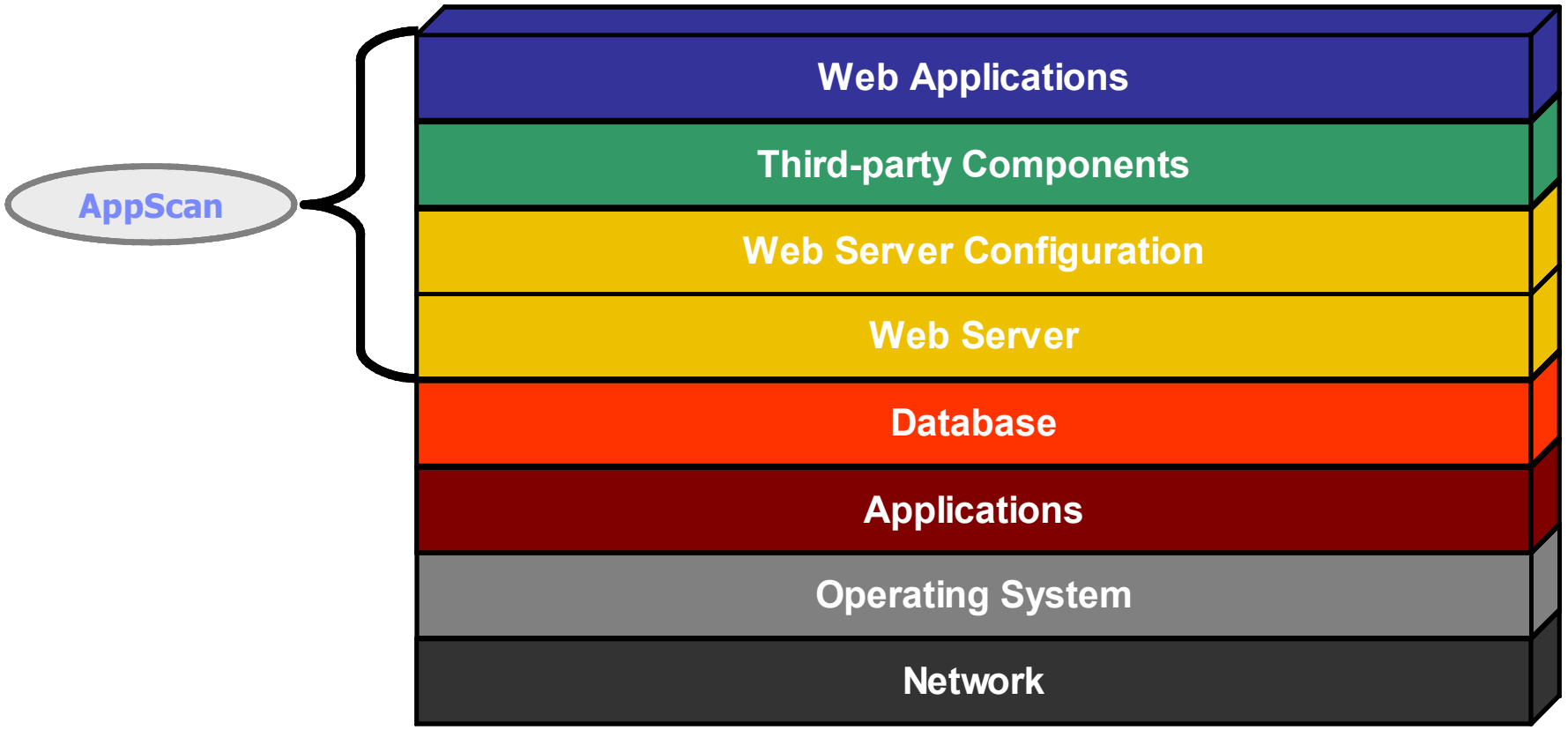
IBM Rational AppScan Ecosystem

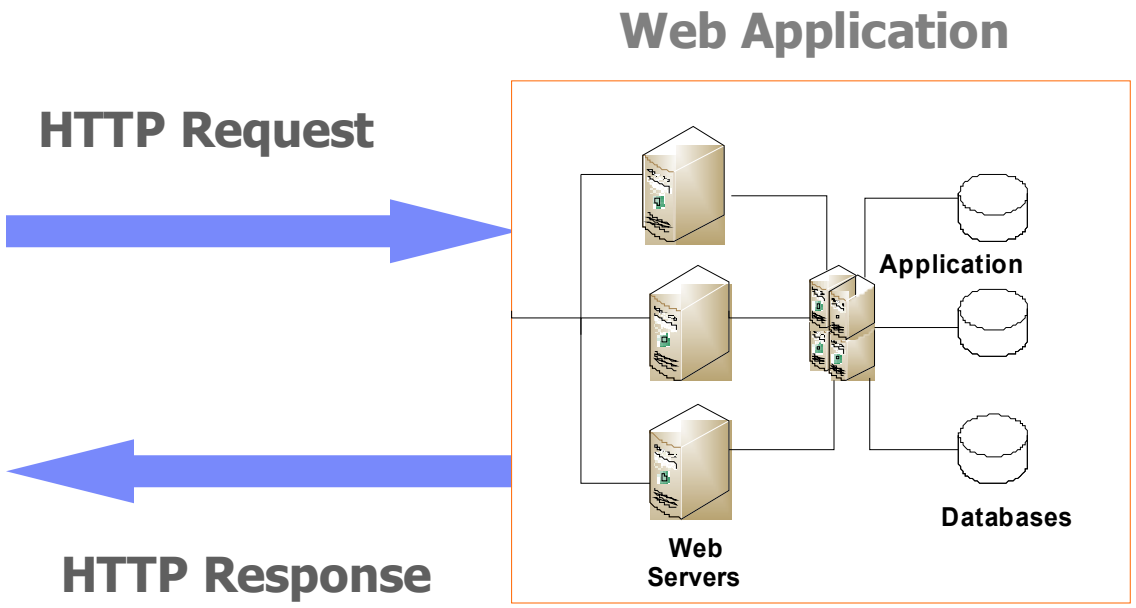


What does AppScan test for?

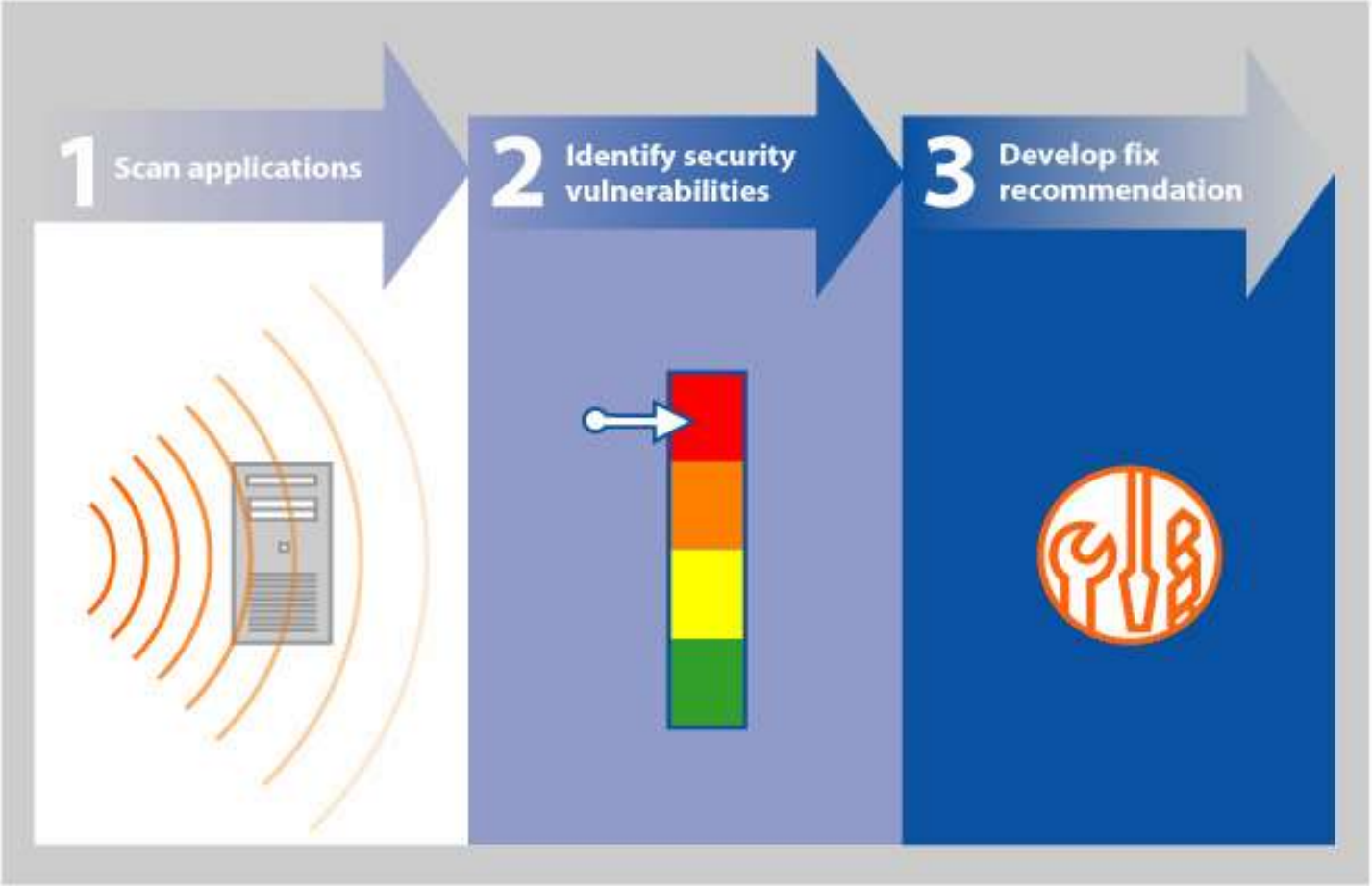


How does AppScan work?

- Approaches an application as a black-box
- Traverses a Web application and builds the site model
- Determines the attack vectors based on the selected Test policy
- Tests by sending modified HTTP requests to the application and examining the HTTP response according to validate rules



AppScan Goes Beyond Pointing out Problems



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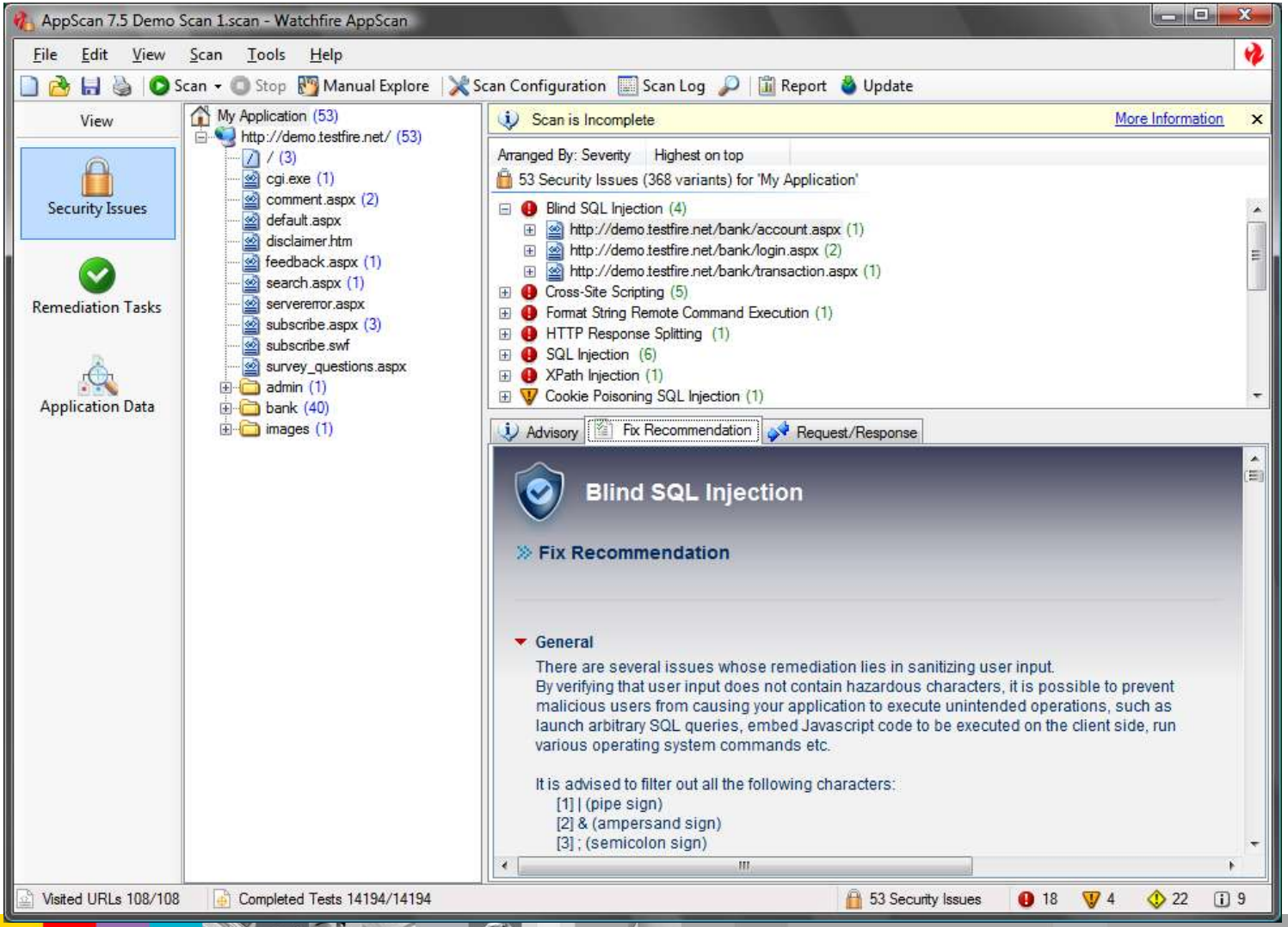
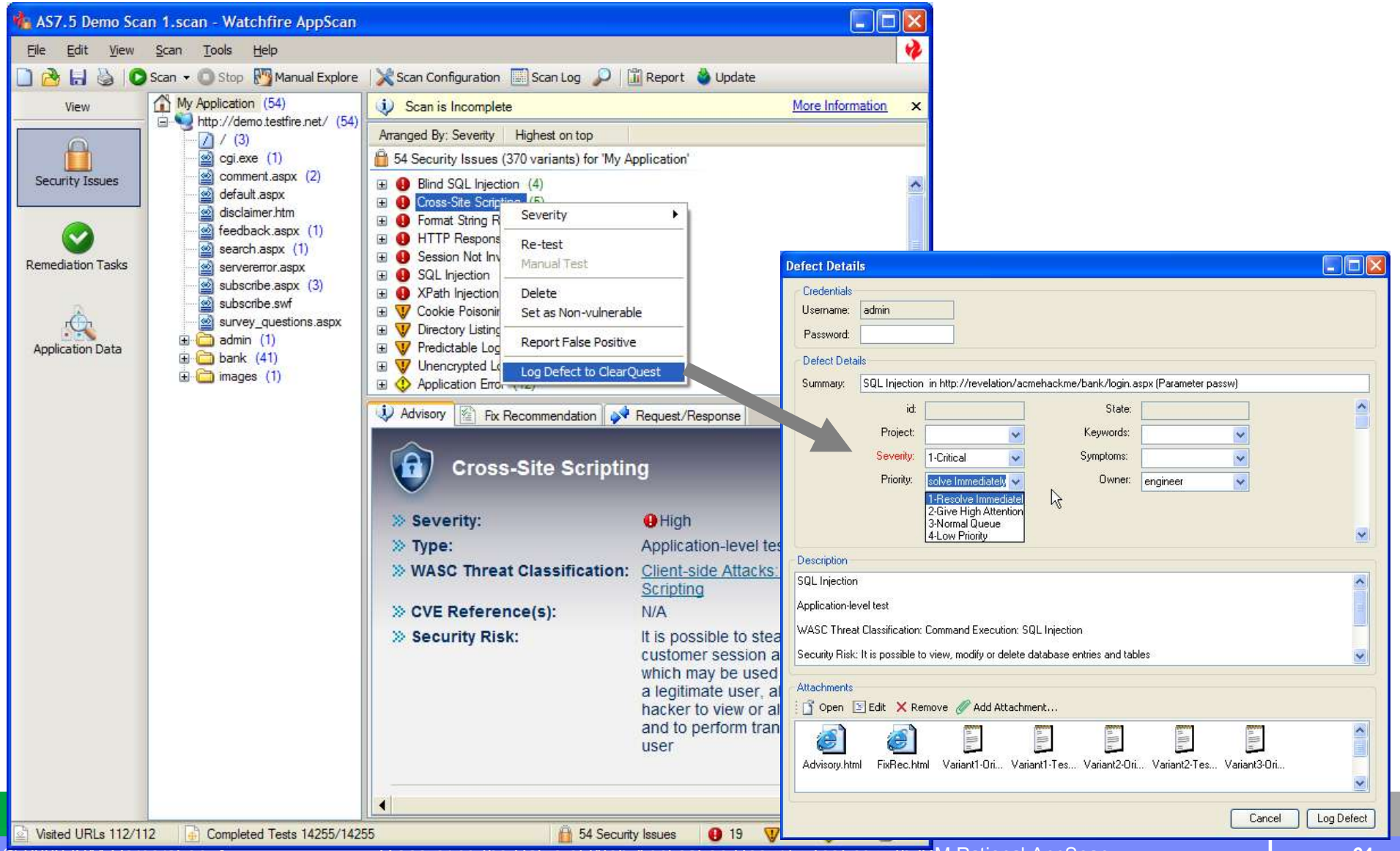
Actionable Fix Recommendations



AppScan with QA Defect Logger for ClearQuest



Lab 3 overview

- The goal of this lab is to use AppScan in order to automate the detection of vulnerabilities within a Web application

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Session summary

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Session summary

- Understand the Web application environment
- Understand and differentiate between network and application level vulnerabilities
- Understand where the vulnerabilities exist
- Hands on exercises to understand types of vulnerabilities
- Hands on exercise to leverage automated scan for vulnerabilities

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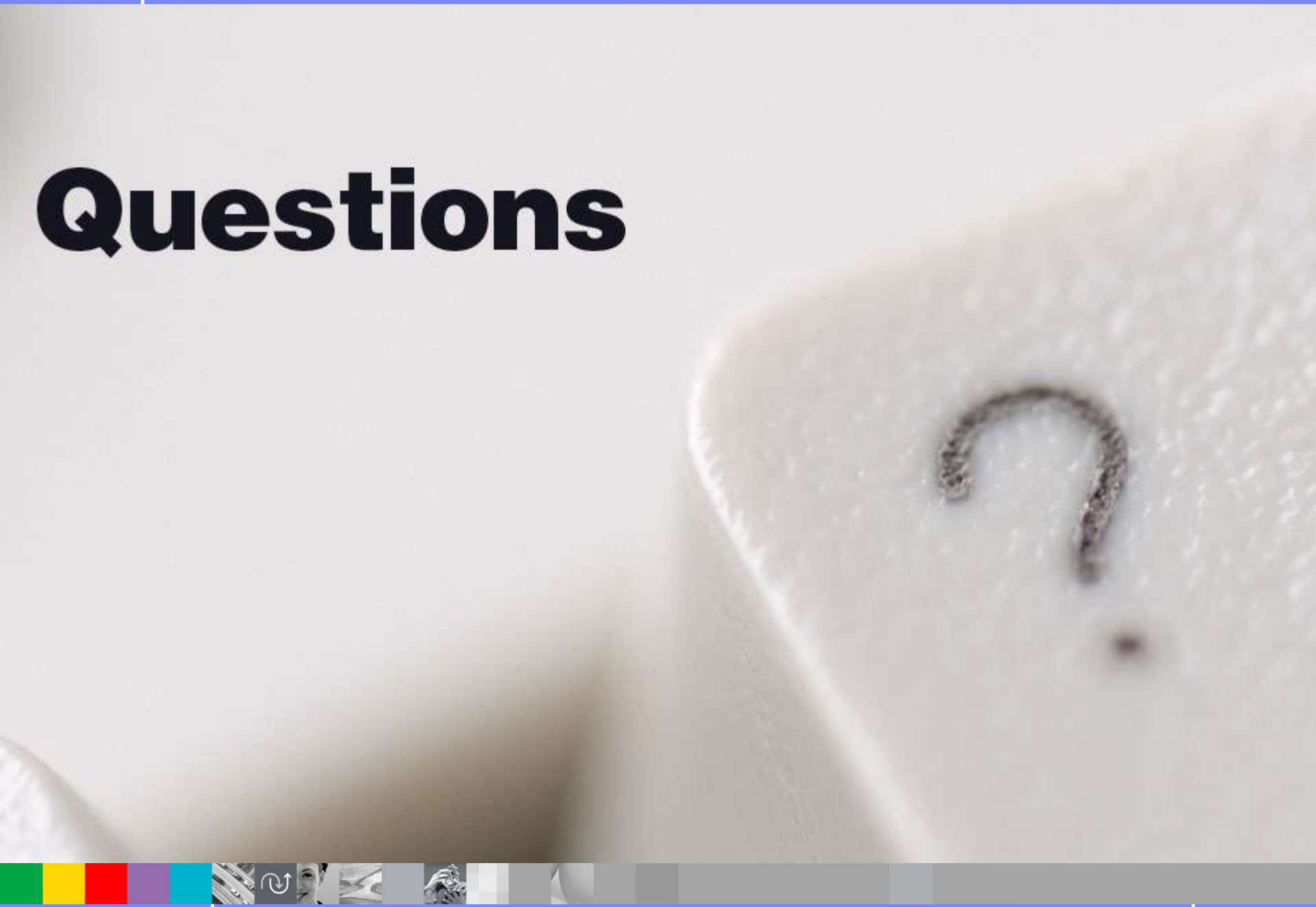
Questions



Next steps

- We can schedule a Vulnerability Assessment of one our your Applications -

Reference materials

- IBM.com
  - http://www-306.ibm.com/software/rational/welcome/watchfire/products.html

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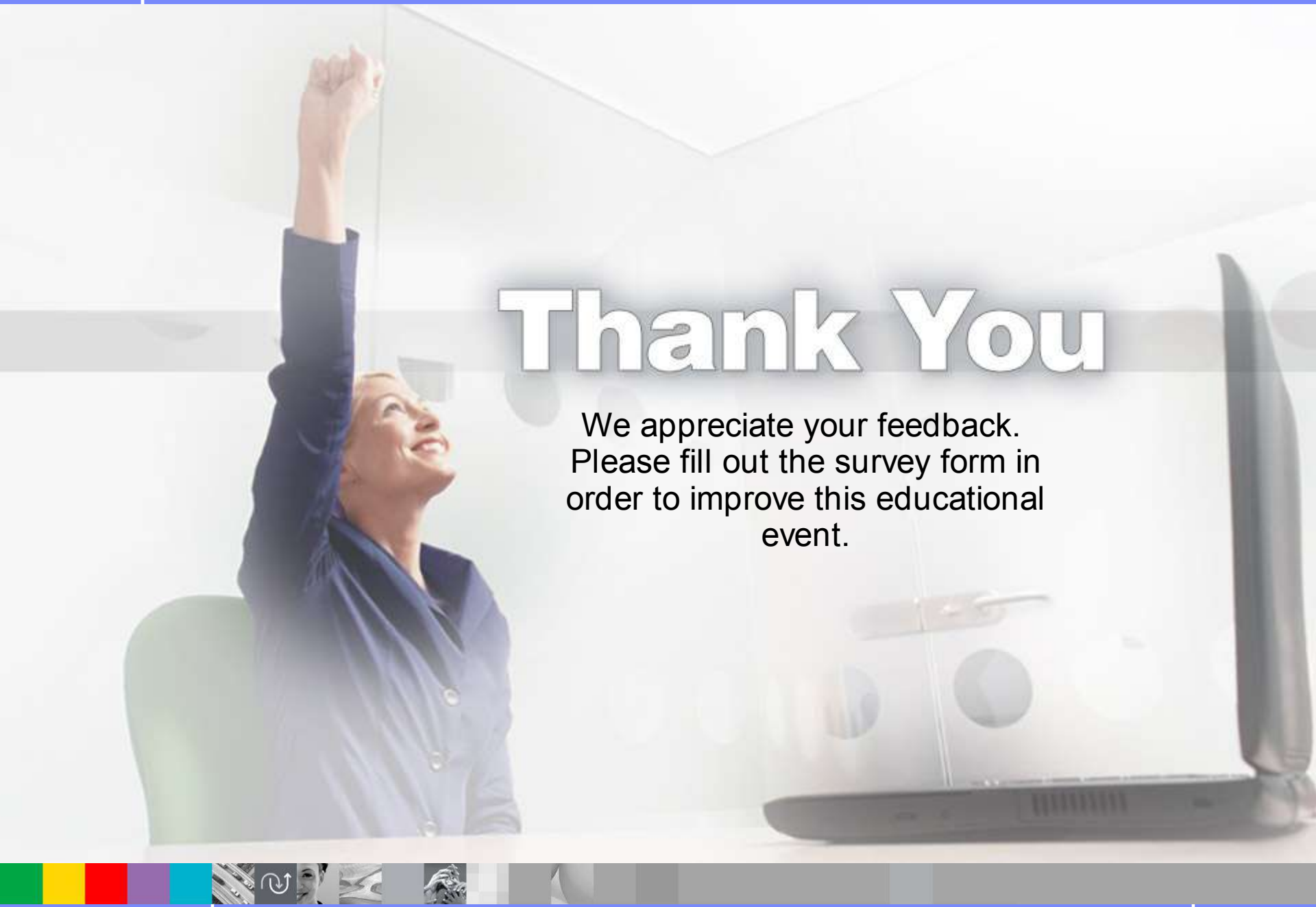
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