OWASP APPSEC

APAC 2013

SECURITY CHALLENGES OF HYBRID MOBILE APPLICATIONS

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THIS IS NOT YOUR UNCLE OLAF'S "OWASP TOP 10 MOBILE SECURITY" TALK

AGENDA

- Hybrid Mobile Apps - what are they?
- Hybrid environments mix HTML+JS with "Native" code
- Hybrid environments mix managed code with unmanaged code
- Some difference between a "browser" and a "webview"
- Some ways of 'leaking info by accident'
- Bunch of technical details (small but perhaps important)

ME

- Nokia (since 2001)
- Security Manager for Sales & Marketing services
  - Nokia.com etc.
- Past:
  - Ovi Store, Maps.nokia.com
  - Nokia Account
  - N-Gage v2
- Founded OWASP Helsinki in 2006
- Motto: "the more you learn, the less you seem to know"
- More of a Defender & Breaker than a Builder

POLL

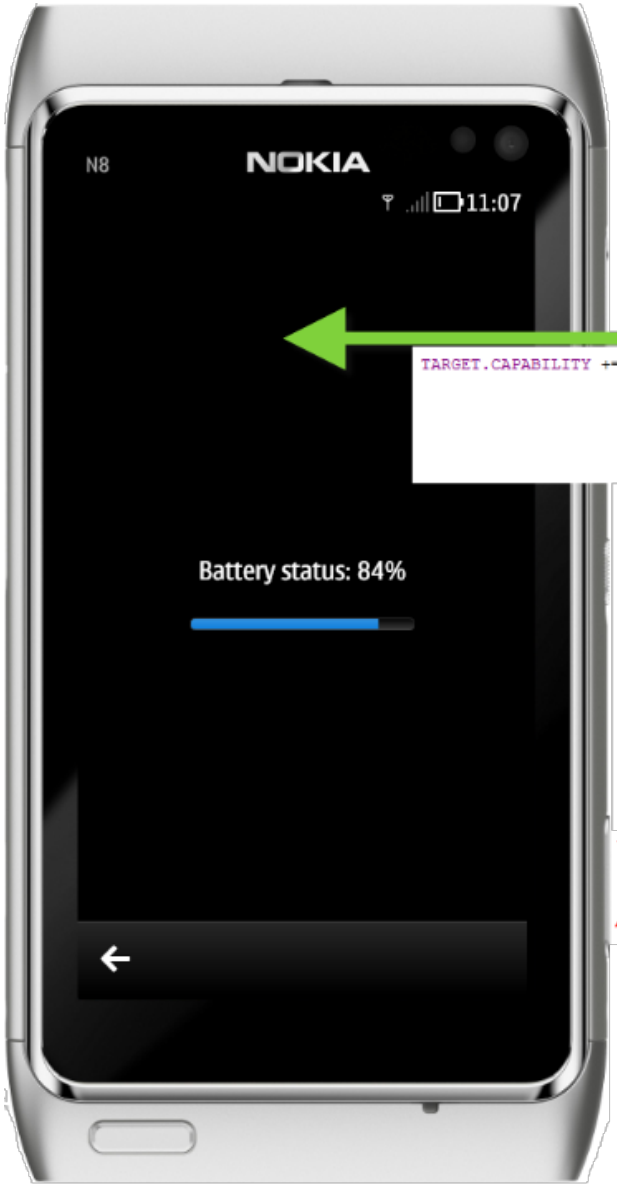
"DISCLAIMER"

- Examples are mainly for Windows Phone 8
- With some Qt (v4.8.x)/QML thrown in (Qt 5 is out, but...)
- Android and iPhone guys - just be cool
  (it's probably not that different)

TRADITIONAL AIR GAP

A PRETTY EFFECTIVE SECURITY CONTROL

WEB HAD NO ACCESS TO DEVICE API



Native

```
TARGET.CAPABILITY +=    NetworkServices \
                        ReadUserData \
                        WriteUserData \
                        LocalServices \
                        UserEnvironment \
                        Location
```

```
void MainWindow::showExpanded()
{
#if defined(Q_OS_SYMBIAN) || defined(Q_WS_SIMULATOR)
    showFullScreen();
#elif defined(Q_WS_MAEMO_5)
    showMaximized();
#else
    show();
#endif
}

void MainWindow::setupGeneral()
 {
     deviceInfo = new QSystemDeviceInfo(this);

     ui->batteryLevelBar->setValue(deviceInfo->batter

     connect(deviceInfo, SIGNAL(batteryLevelChanged(i
             ui->batteryLevelBar, SLOT(setValue(int))
 }
```

HTML

X

```
<!DOCTYPE html>
<html>
<head>
  <title>Battery Status API Example</title>
  <script>
    var battery = navigator.battery;

    battery.onchargingchange = function () {
      document.querySelector('#charging').textConter
    };

    battery.onlevelchange = function () {
      document.querySelector('#level').textContent
    };

    battery.ondischargingtimechange = function () {
      document.querySelector('#dischargingTime').tex
    };
  </script>
</head>
<body>
  <div id="charging">(charging state unknown)</div>
  <div id="level">(battery level unknown)</div>
  <div id="dischargingTime">(discharging time unknow
</body>
</html>
```

SECURITY USED TO BE

SIGNING APPS WITH CAPABILITIES

Permission, privilege, you name it...
So, installation handled the "rights"

BUFFER OVERFLOWS

SMS OF DEATH

MALWARE

AND SO FORTH

AND STILL IS...

THEY DIDN'T DISAPPEAR

There is just more of everything
+ all the legacy code

BRIDGING THE AIR GAP

NATIVE += WEB

HYBRID

LET'S ADD A WEBVIEW

```
import QtWebKit 1.0

WebView {
        url: "https://www.owasp.org"
        preferredWidth: 490
        preferredHeight: 400
        scale: 0.5
        smooth: false
}
```

Code: Qt/QML

MAGIC HAPPENS

A HYBRID ENVIRONMENT

- Native mobile apps utilize Web technologies inside the app
  - HTML, CSS and JavaScript embedded in / utilized by native code (C#, VB, objective-C, C++, "java")
- Typically utilizing

```
/(ui)?Web(View|Browser)/g class
```

  For the rest of us: a "WebBrowser", "uiWebView", or just plain "WebView"

  - Windows Phone 8: WebBrowser control (Windows 8 is very similar)
- Rendering engine without the "chrome" (Browser UI)
- According to Microsoft, nearly all Top 50 WP7 apps used the WebBrowser Control (a.k.a. WebView)

COMMON

- Qt/QML [Qt Quick] multiplatform
- Widgets (W3C)
- Android
- Mac OS X, iOS
- Windows OS / Phone
- Apache Cordova / PhoneGap

HOW NATIVE AND JS TALK (WP)

In native XAML, expose an interface to JS

```
<phone:WebBrowser
        ScriptNotify="alert_ScriptNotify"
        IsScriptEnabled="True"
/>
```

JavaScript calls the parent native app

```
function AlertSilverlight(data)
{
        window.external.notify(data);
}
AlertSilverlight(1);
```

Listener picks it up and executes

```
private void alert_ScriptNotify(object sender, NotifyEventArgs e)
{
        MessageBox.Show(e.Value);
}
```

Code: WinPhone 8 C#/Silverlight/XAML/JavaScript

AND IN QML

In this case, JS can be included in QML (inline or external)

```
WebView {                                // consider this as "<html>"
        javaScriptWindowObjects: QtObject {
                WebView.windowObjectName: "qmlJS" // expose from native to JS

                function qmlFunc() {
                        // native QML or JavaScript code here
                        console.log("Hello from QML!");
                }
        }
}
// e.g. a JS file embedded in the QML project build can refer to an ext JS
Qt.include("http://mydomain/import.js")
```

JavaScript calls the exposed method

```
window.qmlJS.qmlFunc();
```

Code: QML(Qt markup) + HTML/JavaScript

QML JS SANDBOX

Inside QML, imported/inline JavaScript is NOT sandboxed

```
import "http://localhost/mikko/qt/javascript/unsafe.js" as ExtScript
// Beware of evil content
function fakeFunc() {
        var xhr = new XMLHttpRequest;
        xhr.open("GET", "file:///c:/setup.log"); // Read files on the local disk
        xhr.onreadystatechange = function() {
                if (xhr.readyState == XMLHttpRequest.DONE) {
                        var a = xhr.responseText;
                        console.log(a); // Send someplace else
                }
        }
        xhr.send();
}
// Invoke
ExtScript.fakeFunc();
```

WebView JavaScript is sandboxed

```
import QtWebKit 1.0
WebView {
         url: "https://www.owasp.org"
}
```

QML XHR RESULT

Local file was read via XHR

```
[InstallShield Silent]
Version=v7.00
File=Log File
[ResponseResult]
ResultCode=0
[Application]
Name=RICOH Media Driver ver.2.10.00.04
Version=2.10.00.04
Company=RICOH
Lang=0009
```

Need to be EXTRA careful with untrusted JavaScript/QML inside .qml files

IDENTIFYING NATIVE METHODS IN JS

JavaScript is looking for native QML methods

```
for (var i in window) {
       document.write("Window property(" + i +  "): " + window[i]);
}
```

Where we see:

```
Window property(qmlJS): QObject_QML_0(name = "")
```

And then iterating through window.qmlJS:

```
Window property(qmlFunc()): undefined
Window property(qmlFunc2(QVariant)): undefined
Window property(qmlFunc3(QVariant,QVariant)): undefined
```

Code: QML/Qt + JavaScript

A LITTLE REMINDER

Excerpt from Qt documentation reg. QtWebKit Bridge

> Think whether the exposed object enables the web environment access things that shouldn't be open, and whether the web content loaded by that web page comes from a trusted source. In general, when exposing native QObjects that give the web environment access to private information or to functionality that's potentially harmful to the client, such exposure should be balanced by limiting the web page's access to trusted URLs only with HTTPS, and by utilizing other measures as part of a security strategy.

SECURITY FUNDAMENTALS

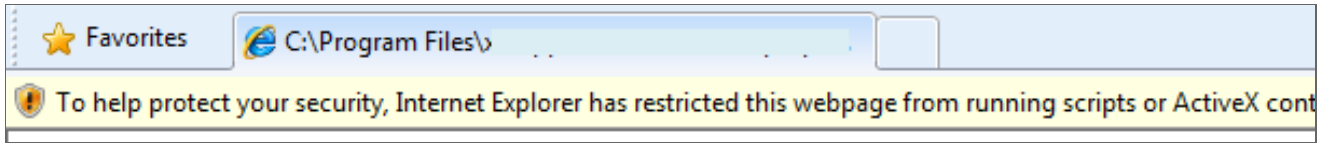
OWASP TOP TEN

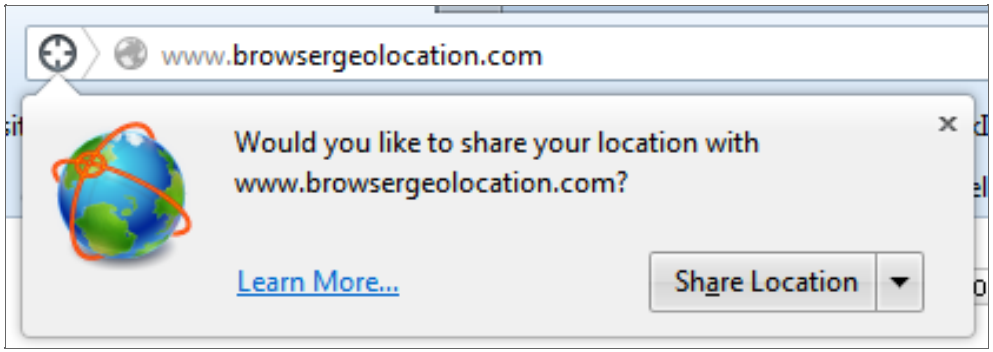
YES, IT'S ALL VERY VALID

BOTH OF THEM

UI CONTROLS

- A lot of the usual UI controls are missing
- E.g. Windows Phone will just fail self-signed or untrusted SSL cert (need to manually import)
- No SSL "lock" visible & no mixed mode (http + https content) in WP
- Warnings (WP gives SSL warning, but prevents from loading page), popups etc.





DO NOT TRACK

Windows Phone 8

- IE 10 "Do Not Track" setting does not apply in WP8 WebBrowser - NO user control over this

DEMO

SAME ORIGIN POLICY

Notes for Windows Phone 8

- Content loaded from isolated storage is not restricted by SOP (file:///)
- Content created via NavigateToString is not restricted by SOP

```
var html = "<html><script>...Something...</script></h
tml>"

webBrowser1.NavigateToString(html);
```

- JavaScript called via native InvokeScript can be loaded from any domain
- Some differences on desktop vs mobile Silverlight

Qt/QML

- Qt WebView has SOP limits on file://

```
Origin: file://
```

- Qt WebView has normal SOP limits for JavaScript

```
<html>   // This runs in the WebKit WebView
<script>xhr();</script>
</html>  // Normal cross-origin (CORS) rules apply
```

- Qt QML inline JavaScript / XMLHttpRequest does not enforce the same origin policy

```
// Script source: http://some_site/some.js
// This is inside filename.qml and inline JavaScript
xhr.open("GET", "http://another_site/?&id=123456");
```

- Imported inline JS has 'full access'

```
import "http://untrusted.com/js/unsafe.js" as ExtScript
```

EVAL IS STILL EVIL

ARE YOU EVAL'ING SOME UNTRUSTED INPUT?

Or native:

```
// QML
WebviewID.evaluateJavaScript("something")

// Qt
QString js = input;
mainFrame()->evaluateJavaScript(something);
```

```
// C#
WP_browserInvokeScript("eval", "something");
```

UTILIZING C/C++

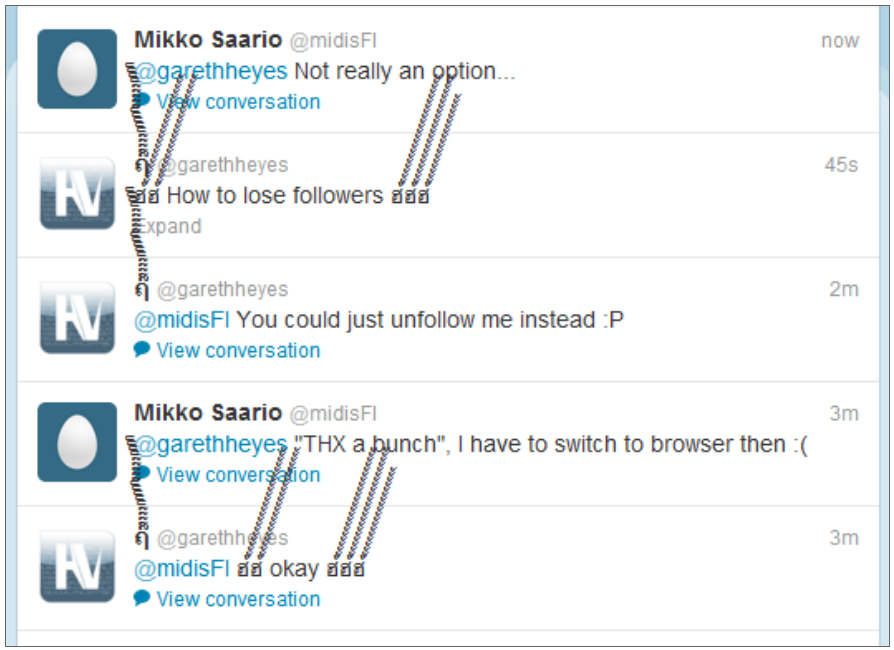
WINDOWS PHONE 8 - "GOING NATIVE"

- Most likely usages are: to redeploy existing code & squeeze out max performance
- I have deliberate use of non-secure versions of functions
- E.g. "strcpy" vs "strcpy_s" (Microsoft)

```
// Call from managed C# code to C++ (file.cs)
OWASP_WP_RT_CPP.StringCharacterCounter sccMain = new OWASP_WP_RT_CPP.StringCharacterCounter();
answer.Text = sccMain.GetLength(answer_text.Text).ToString() + " characters were found!";

// Native C++ (file.cpp)
unsigned int StringCharacterCounter::GetLength(String^ strToParse)
{
        std::wstring stlString = strToParse->Data();
        return stlString.length();
}
```

BUFFER OVERFLOWS



The above killed Nokia N9 (MeeGo) Twitter client (Qt C++)

```
we can't know how much space we need to allocate...
...for this pathological string we are generating
two glyphs for each character.
```

Demo

INJECTIONS

- SQL injection

```
QSqlQuery q("SELECT something FROM " + untrusted_data);
```

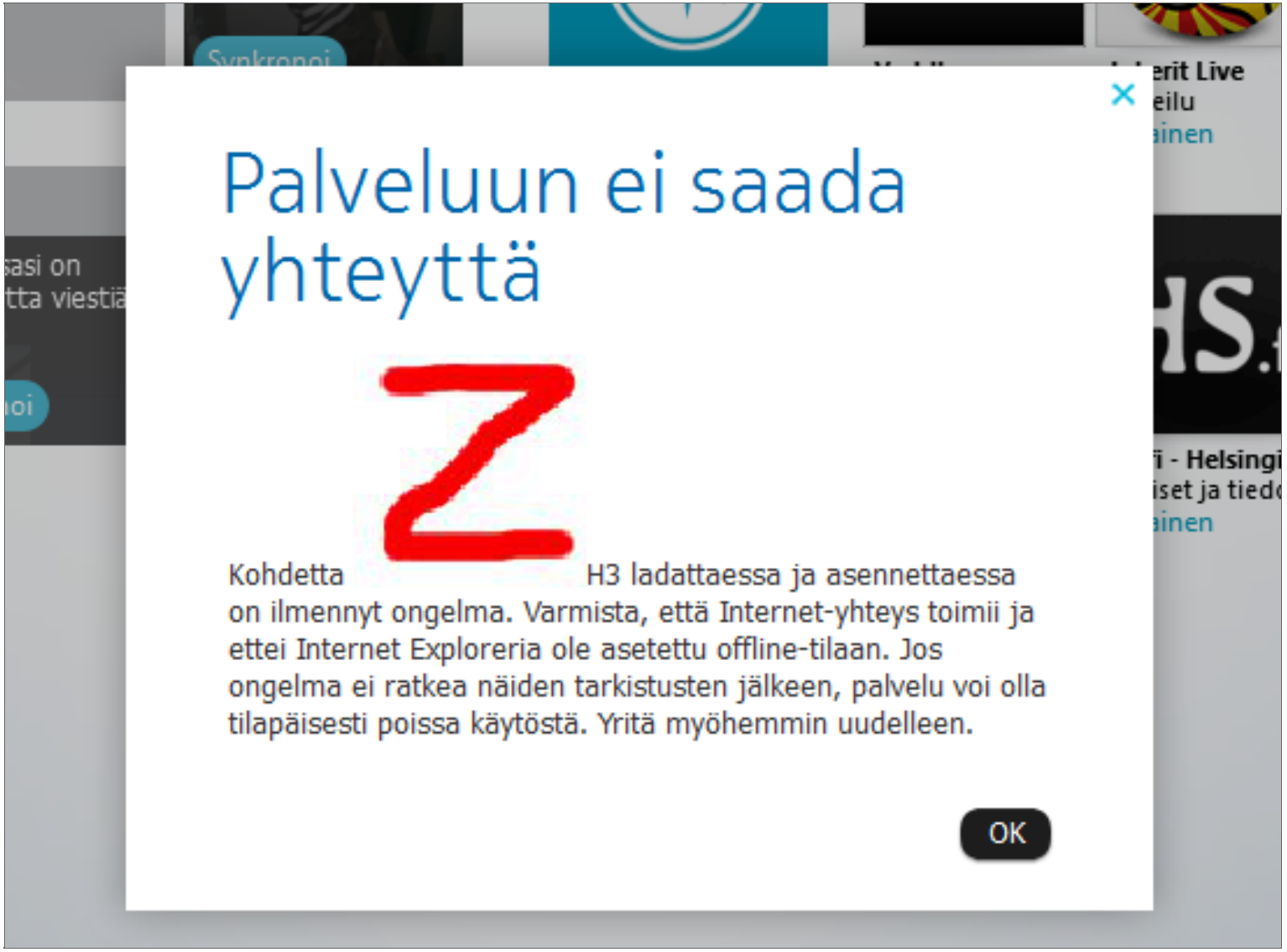
- XML Query / XPath injection
  Dynamic queries with user-supplied input could leave you vulnerable in Qt
  Use parameter binding for XML & SQL
- XSS special cases (Qt rich text)
  QLabel default setting is QLabel::AutoText ['MIME type sniffing']

```
QLabel::AutoText
```

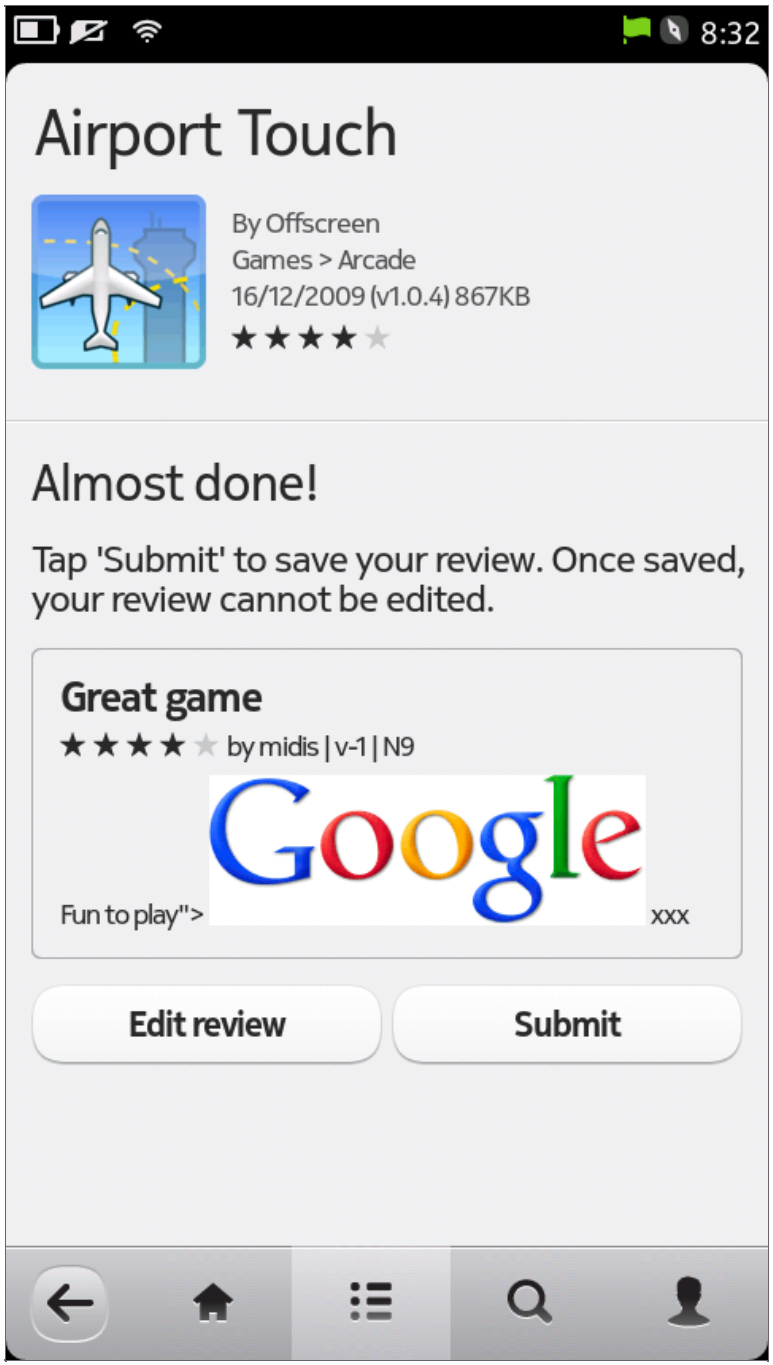
  Output can be manipulated via a limited set of supported HTML tags. Encode output, or use:

```
QLabel::PlainText
```

QT XSS


Palveluun ei saada yhteyttä
Kohdetta H3 ladattaessa ja asennettaessa on ilmennyt ongelma. Varmista, että Internet-yhteys toimii ja ettei Internet Exploreria ole asetettu offline-tilaan. Jos ongelma ei ratkea näiden tarkistusten jälkeen, palvelu voi olla tilapäisesti poissa käytöstä. Yritä myöhemmin uudelleen.
OK

QT XSS


8:32
Airport Touch
By Offscreen
Games > Arcade
16/12/2009 (v1.0.4) 867KB
Almost done!
Tap 'Submit' to save your review. Once saved, your review cannot be edited.
Great game
by midis | v-1 | N9
Google
Fun to play">
xxx
Edit review
Submit

DENIAL OF SERVICE

- Isolated storage on Windows Phone has no size restrictions - single app may consume large amount of space
- Also, HTML5 AppCache can easily consume disk space by caching content locally

```
Content-type: text/cache-manifest
```

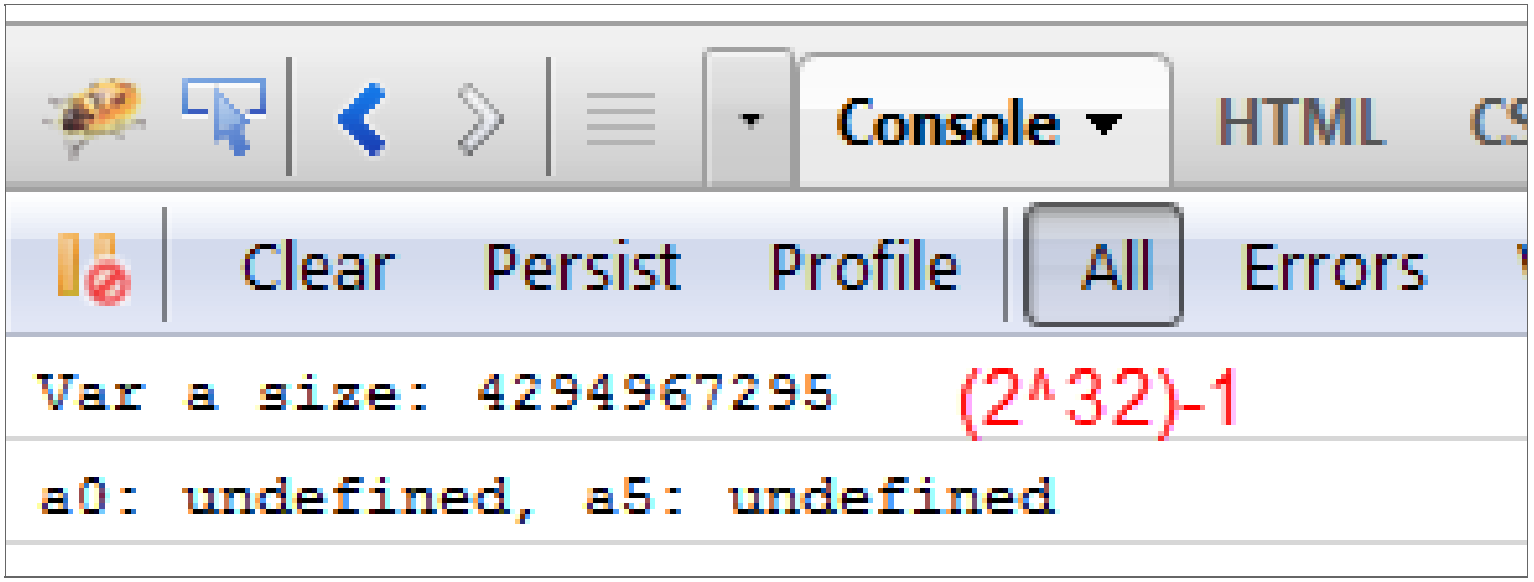
- XML query resource exhaustion attacks in Qt
- Qt 4.8.x also has various JS crash cases in very large arrays (Qt 5.0 & newer WebKit more robust)

QML JavaScript

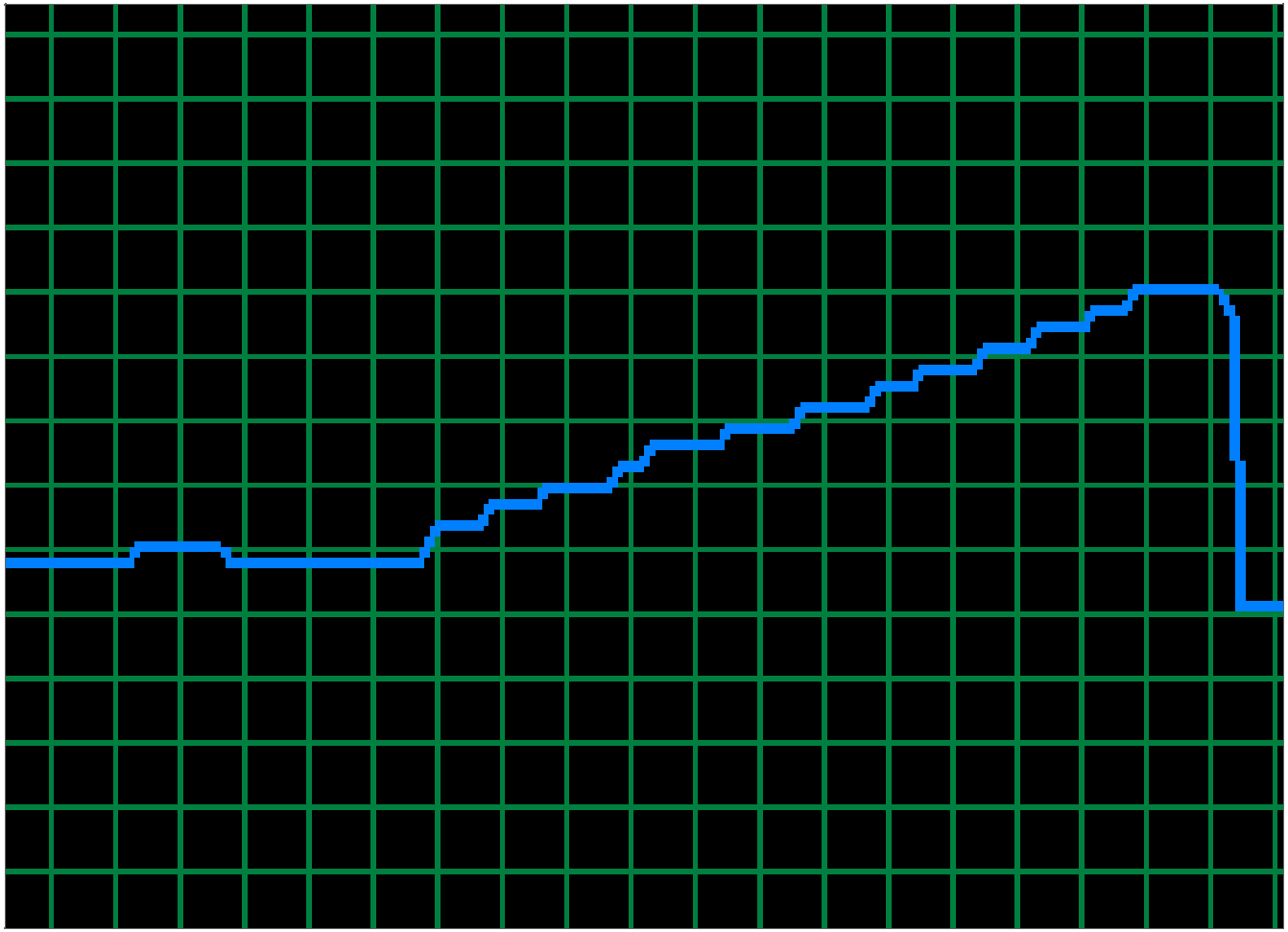
- QMLv1 has problems handling very large JavaScript arrays
- Crashes the app
- Unlikely to be seen in "normal" app use

```
function bigArray() {
        var a = new Array(1000000000); // 1bn or something 'very big'
}
```

Compare to e.g. Firefox, Chrome (no effect)



Memory Leak in Nokia Suite (Qt)



QML DoS Demo

Capabilities

- Platform configurations are your 'enhanced capabilities'
- Your mileage will vary greatly
- Each framework has their own options and defaults

SCRIPTING

```
/* Qt default: true */
QWebSettings::JavascriptEnabled

QWebSettings::JavascriptCanOpenWindows
QWebSettings::JavascriptCanAccessClipboard
```

```
<!-- Windows Phone 8 default: disabled -->
<Grid x:Name="LayoutRoot">
        <phone:WebBrowser Name="mybrowser"
                IsScriptEnabled="True"
                Source="index.html"
                ScriptNotify="pokeMyScript" />
</Grid>
```

PLUGINS

Java, Flash and other plugins (NPAPI, Qt plugins)

```
/* Qt */
QWebSettings::JavaEnabled
QWebSettings::PluginsEnabled

/* No plugins in WP8 */
```

WebKit XSS Auditor

If you have it, why not use it?

```
/* Control the Qt WebKit XSS auditor (not available in QML/Qt Quick 1) */
QWebSettings::XSSAuditingEnabled

    QWebView view;
    view.settings()->setAttribute(QWebSettings::XSSAuditingEnabled, false);
    view.load(QUrl("http://yourdomain/xssauditor.php?xss=<script>alert(1)</script>"));
```

HEADERS

Security header [overall HTML5] support finally becoming up-to-date

With WP8 + IE10 and Qt 5.0 + WebKit2

- Content Security Policy
- X-XSS-Protection
- Strict Transport Security for SSL
- X-Frame-Options to prevent framing

AND SO ON

- File access

```
QWebSettings::LocalContentCanAccessRemoteUrls
QWebSettings::LocalContentCanAccessFileUrls
```

```
Can file: access http:
Can qrc:  access file:
```

- Misc.

```
QWebSettings::PrivateBrowsingEnabled
QWebSettings::DeveloperExtrasEnabled
```

With this setting, any site can access user's location

```
// Windows Phone
IsGeolocationEnabled = "true"
```

DEMO

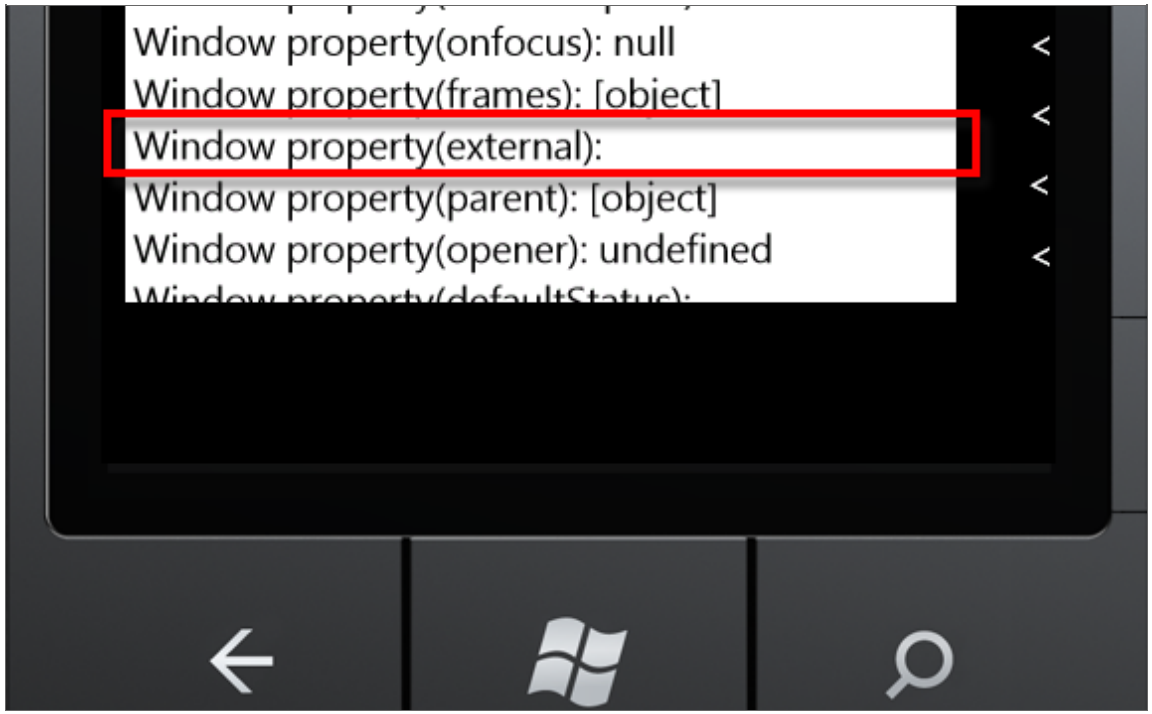
Windows Phone 8 native methods

<iframe> recap

- Unlike Windows Phone, Qt requires you to define to which frame native methods are published

```
// Only myFrame has access to the native object
QWebFrame *myFrame = myWebPage->mainFrame();
myFrame->addToJavaScriptWindowObject("myObject", theObject);
```

- As seen in the demo, any iframe in WP can access exposed native methods
- "Mind your security boundary"
  WP does not advertise available methods (it just takes a string)



QML XHR

You know this

```
var xhr = new XMLHttpRequest();
...
xhr.open("GET", "http://target");
xhr.setRequestHeader("Whatever","ValueHere");
xhr.send();
```

Tried this instead

```
xhr.setRequestHeader("Referer","http://somedomain.com");
```

Obviously fails!

Ok how about this?

```
xhr.setRequestHeader("Origin","http://www.google.fi");
```

```
ORIGIN: http://www.google.fi
Connection: Keep-Alive
Accept-Encoding: gzip
Accept-Language: en-US,*
User-Agent: Mozilla/5.0
```

A Little Tweaking Later

```
xhr.setRequestHeader("anything","buubaa\nReferer: http://www.google.fi/yourpath");
```

```
ANYTHING: buubaa
Referer: http://www.google.fi/yourpath
Connection: Keep-Alive
Accept-Encoding: gzip
Accept-Language: en-US,*
User-Agent: Mozilla/5.0
```

Just needed a newline there ("\n", "\012", "\x0a")

To add "restricted" headers

Call it the 'Power of C++'

The grey area between the mainstream browser and your own apps

WebView uses WebKit - didn't have it

- Changing the Host header is not supported as Qt constructs only a single HTTP request
- This is not sandboxed code
- Currently classified as a **bug (https://bugreports.qt-project.org/browse/QTBUG-27570)**

SUMMARY

Usual secure development practices apply (OWASP etc.)

Hybrid techs are catching up, security-wise

User has less or no control

This is not "a browser" - updates etc. are lagging

HTML5 & new platforms are bridging the air gap

Controls such as Same Origin Policy may function differently

Perform robust checks when exposing sensitive platform features (camera, location)

QUESTIONS?

OWASP APPSEC APAC (HTTPS://TWITTER.COM/SEARCH/OWASP) MOBILE SECURITY (HTTPS://TWITTER.COM/SEARCH/OWASP)

Owasp_Ven (https://twitter.com/intent/user?screen_name=Owasp_Ven) Puedes Descargar las presentaciones del Latam Tour 2012 edición Venezuela en bit.ly/KDNiOE

proggitarticles (https://twitter.com/intent/user?screen_name=proggitarticles) Why you shouldn't use the OWASP Top 10 as a list of software security requirements ·

biosshadow (https://twitter.com/intent/user?screen_name=biosshadow) Here a bit early for the OWASP meet up. Anyone else here early. Also being stuck in a wheelchair

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