BeerTalk – Windows Phone 8.1

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Agenda

Introduction

The Windows View

- Windows Environment
- Attack Surface
- Breaking Out

The Mobile View

- Sandboxing & Encryption

Findings

- MDM Integration
- WiFi Sense
- Low Level Storage API

Conclusion

Introduction – Why Windows Phone 8.1?

Third player, investing in it

Microsoft is a major player on the business desktop, servers and software

- Just missing the mobile part
- But attempting to catch up with the acquisition of Nokia
- Still understands / answers best companies' needs

Global convergence

- Business & private
- Mobile & fix

Something new to look at (and maybe break? ;-)

- Our focus was the Windows Phone platform itself

Personal feeling: Microsoft is never as good as when it's challenged

Introduction – Alexandre Herzog

Vaudois exilé d'abord en Valais, then Wellington (NZ) und jetzt Zürich

- CTO of Compass Security Schweiz AG
- Former sysadmin & developer for banks

Strong interest in Windows security

- MAS thesis about "Crypto-based security mechanism in Windows and .NET"
- One of the first to publish about the Group Policy Preferences (GPP) flaw
- Security advisory about serialization in the .NET framework (CVE-2013-1330 patched in MS13-067 (SharePoint), MS13-105 (Outlook Web Access) etc)
- Invited by Microsoft to BlueHat back in December 2013
- …

More of a server / workstation than mobile guy

- But always ready to break (out of) Windows / Microsoft technologies!

Introduction – Cyrill Bannwart

Joined Compass Security in 2013

- IT Security Analyst
- Security trainings teacher
- Mobile apps developer

Electrical Engineer with a strong interest in

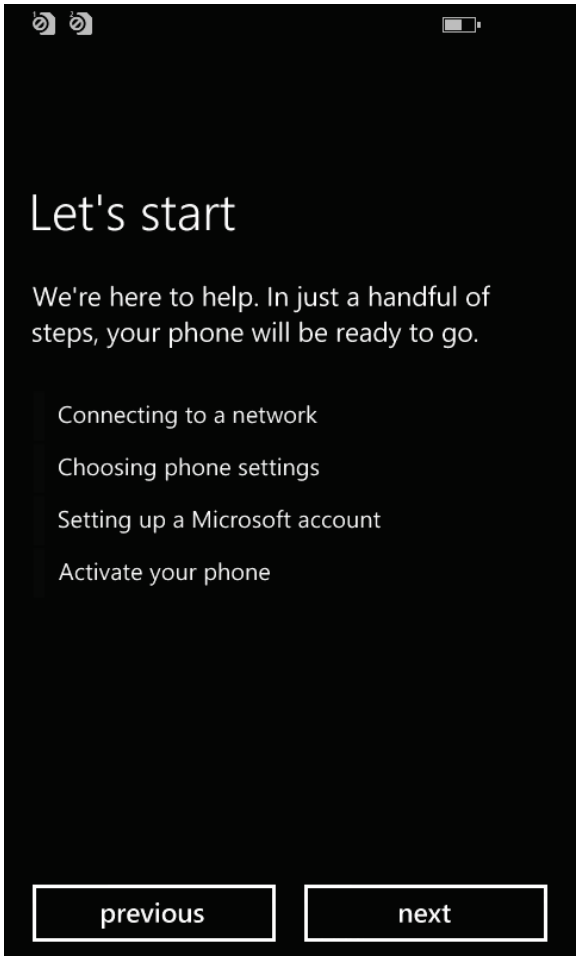
- Embedded devices
- Network communications

Mostly dealing with Network, Unix and (iOS) Mobile apps

Giving Security Trainings for

- Secure Mobile Apps
- iPhone & iPad Security

Let’s get started



The Windows View

Crash dumps are always useful and a good start…

```
ALLUSERSPROFILE=C:\Data\ProgramData
APPDATA=C:\Data\Users\DefApps\AppData\Roaming
CommonProgramFiles=C:\Program Files\Common Files
COMPUTERNAME=Windows Phone
ComSpec=C:\windows\system32\cmd.exe
FP_NO_HOST_CHECK=NO
LOCALAPPDATA=C:\Data\Users\DefApps\APPDATA\Local\Packages\8dd8d60d-8b28-4e52-b113-
c2aac34b9ac3_yhxz8gp8y0q0t\AC
NUMBER_OF_PROCESSORS=4
OS=Windows_NT
Path=C:\windows\system32;C:\windows;C:\Programs\CommonFiles\System;C:\wtt;C:\data\test\bin;
PATHEXT=.COM;.EXE;.BAT;.CMD;.VBS;.VBE;.JS;.JSE;.WSF;.WSH;.MSC
PROCESSOR_ARCHITECTURE=ARM
…
ProgramData=C:\Data\ProgramData
ProgramFiles=C:\Program Files
PUBLIC=C:\Data\Users\Public
SystemDrive=C:
SystemRoot=C:\windows
TEMP=C:\Data\Users\DefApps\APPDATA\Local\Packages\8dd8d60d-8b28-4e52-b113-
c2aac34b9ac3_yhxz8gp8y0q0t\AC\Temp
TMP=C:\Data\Users\DefApps\APPDATA\Local\Packages\8dd8d60d-8b28-4e52-b113-
c2aac34b9ac3_yhxz8gp8y0q0t\AC\Temp
USERDOMAIN=Windows Phone
USERNAME=DefApps
USERPROFILE=C:\Data\Users\DefApps
windir=C:\windows
```

Windows part – Overview

We focused on 3 aspects for the Windows part:

(Ab)Use of Windows Utilities and Features

- Can I gather information or perform undesired actions using built-in features?

Application Attack Surface

- Or how can I misuse Internet Explorer to run unwanted code?

Development and APIs

- List the documented APIs and see what a developer might run as code

(Ab)Use of Windows Utilities and Features

A Windows desktop is user (and attacker) friendly

- Lots of information (eventlogs, detailed error messages, …)
- Lots of settings to influence (Control Panel, file & registry access, …)
- Built-in programs and features (notepad, sticky keys for accessibility, …)
- Various ways to execute code (bat, vbs, WMI, PowerShell, compilers, …)

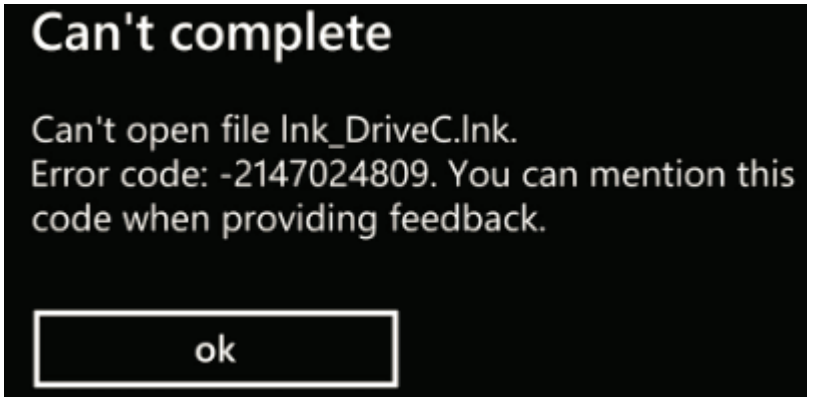
This regardless of the target (workstation, app / Citrix server, ATM, …)

Windows Phone exposes only

- Very little information or settings are available
- No interesting default app (you have to download e.g. app «files» separately)
- No possibility to «run» stuff
- No sticky keys
- It's so impossible to e.g. get the UEFI settings details of the phone...

Application Attack Surface

Internet Explorer is the most interesting app on the phone



All failed abuse scenarios (so good for the security)

- Run VBScript within the browser
- Browse the local file system using file:///
- SMB connect-back from the phone to the attacker
- No way to download and execute e.g. .bat, .exe, .vbs, … files
- The VB/XSLT <msxsl:script> bypass of Spartan[VB_XSLT] (but crashes IE when the page is shared)
- Link files (.lnk) are not executed as well…

Development and APIs

If no app provide me the desired feature, let's code my own!

The C++ and.NET APIs are trimmed down & restricted,
preventing breaking out / unwanted actions

All failed abuse scenarios (so good for the security)

- Controlling processes or threats to fork new content within an application
- Running arbitrary commands using Shell.Execute
- Accessing WMI (Windows Management Instrumentation) to gather information and execute arbitrary commands
- Running PowerShell for the same reasons

Open Questions

Of course, not all options have been explored so far, e.g.

- Is arbitrary execution of commands possible, via e.g. Lambda expressions?
- Can the restricted APIs be misused?
  (e.g. attempt to load an assembly not present within the Windows Phone SDK)
- In-depth audit of the Protected Data / Vault feature
- Study of the AppContainer and SIDs separation
- Understand the steps involved in the application signing process
  (and their capabilities restrictions
- Subversion of accorded capabilities
  (capabilities seem to be labels assigned to a given process).
- Content of C:\WTT
- Corruption via the video driver e.g. within the browser (WebGL)
- …

Summary

So Windows guru, what did you actually achieve on this device?

…really not much…

Some information leaks from application crash dumps, e.g.

- User running the app (or let's call it rather the App Container context)
- List of defined drives:
  - C:\
  - D:\ (probably SD card)
  - U:\ (probably a mapping to C:\data\.
  - PATH variable contains unknown folder C:\WTT\.
  - Data seems shared via C:\Data\Share
  - C:\windows\system32\cmd.exe does not exist

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The Mobile View

http://www.microsoft.com/silverlight/windows-phone/

Windows Mobile Security Controls

Sandboxing

- Attack Surface Reduction (Least Privilege)
- User consent and control (Capabilities)
- Isolation (AppContainer, dedicated SIDs)

Malware Resistance

- UEFI, Trusted / Secure Boot
- System and App Integrity (Code Signing)
- Windows Phone Store (Automated Malware Scan)

Exploit Mitigation

- Address Space Layout Randomization (ASLR)
- Data Execution Prevention (DEP)

Encryption

- BitLocker (AES-128, TPM)

Sandboxing

AppContainer

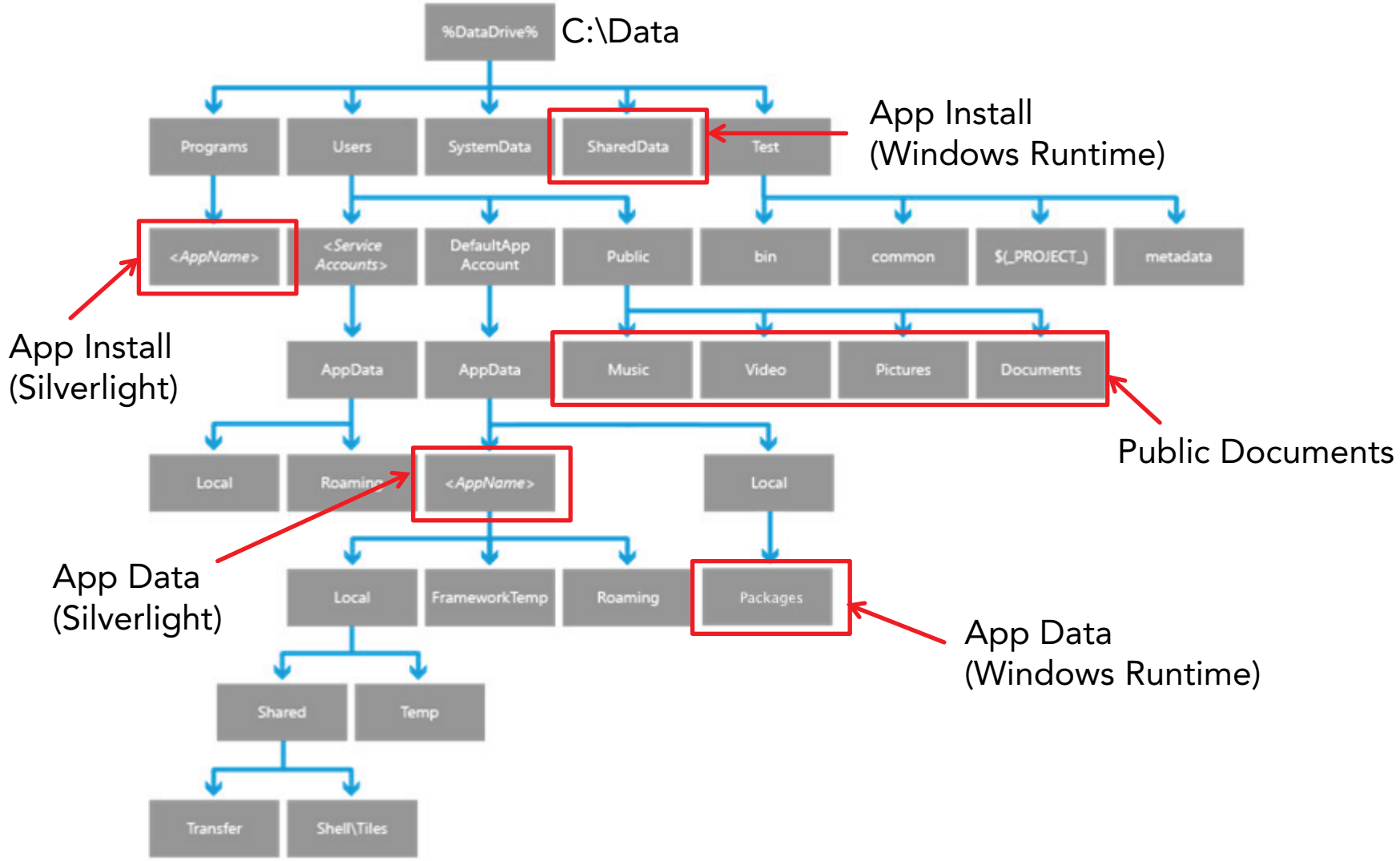
- Isolation
- Data Access
- Credentials
- Roaming
- Sharing Data
- Encrypting data

Capabilities

Restricted APIs

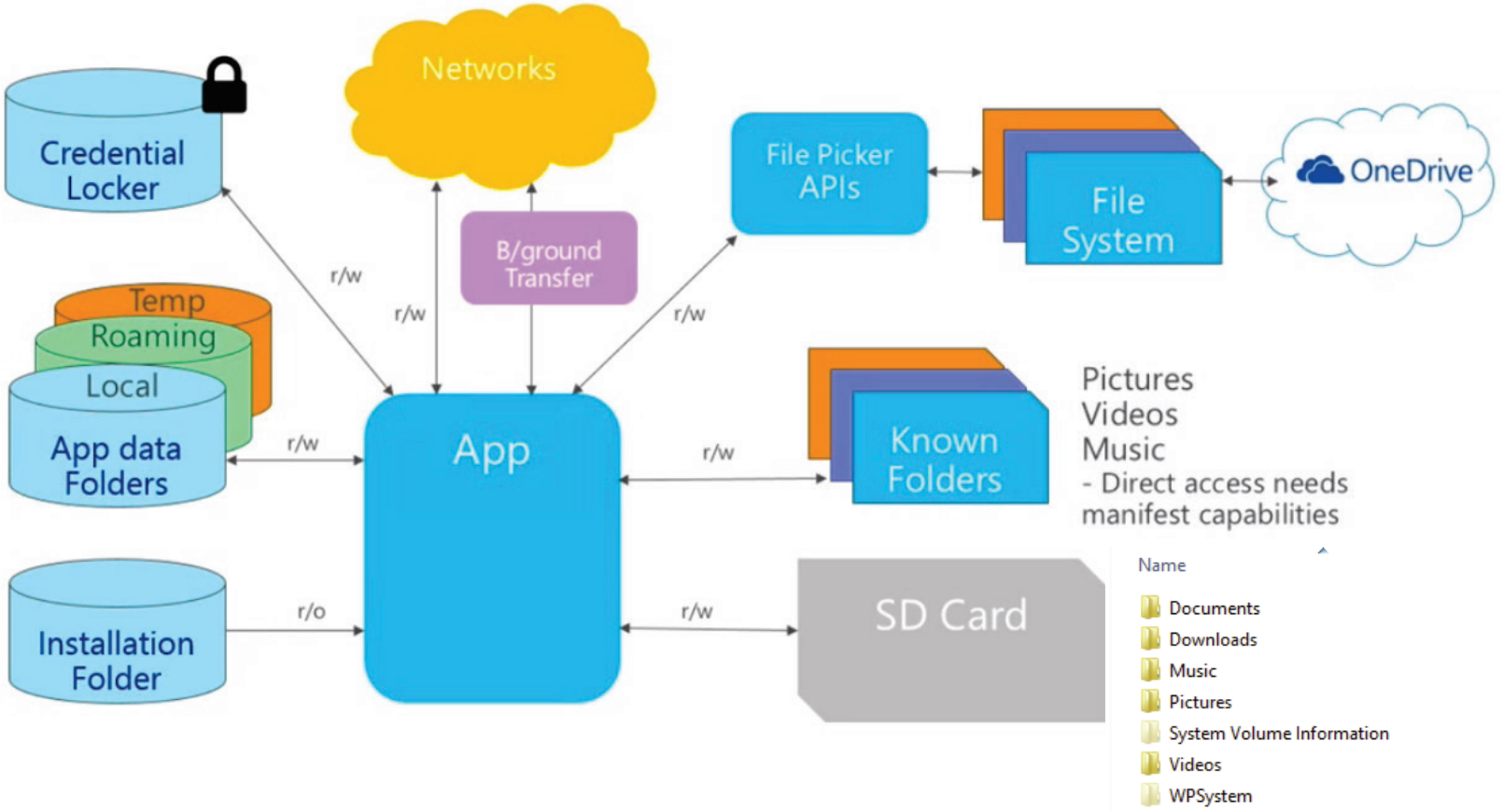
- Isolated Storage

File System Overview



Data Access

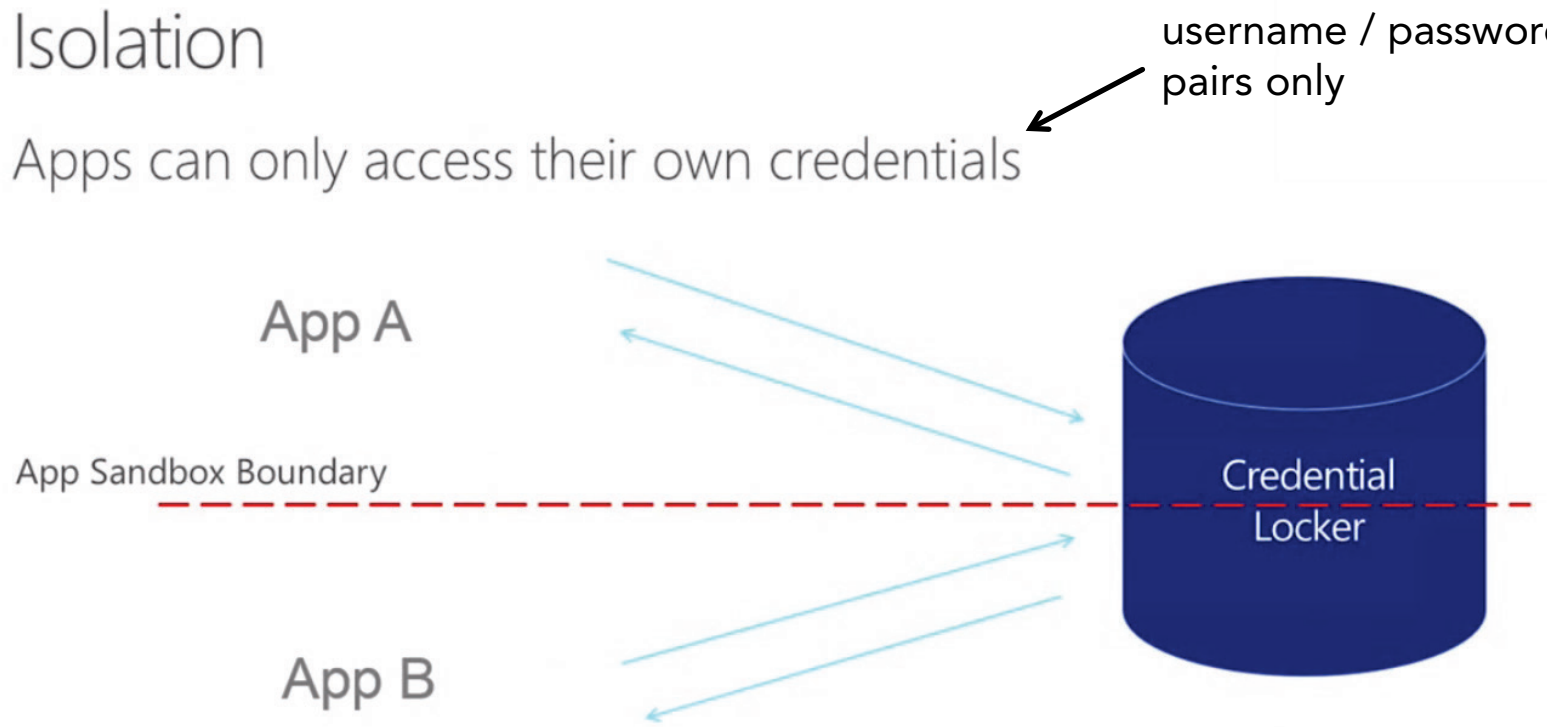
Locations where apps can access data



http://channel9.msdn.com/Series/Building-Apps-for-Windows-Phone-8-1/09

Storing Credentials

Secure Storage & Roaming of Credentials



Example:

```
var vault = new PasswordVault();
PasswordCredential cred = new PasswordCredential("account", username, password);
vault.Add(cred);
```

Roaming

Credentials roam across trusted devices

Sharing Data

Sharing data between apps works using:

- URI Association, where the registered app obtains the data stored in the URI

- File Association, where the registered app obtains the file content

- Share Contract, allowing custom DataPackages to be shared

Encrypting Data

Disk Encryption using BitLocker is disabled by default.

- End-user cannot enable or disable encryption.
- Can only be activated through ActiveSync or MDM Policy.

Applications can use DPAPI to protect confidential data.

- DPAPI (Data Protection API) generates and stores a cryptographic key by using the user and device credentials.
- Every app gets it own decryption key, which is created when the app is run for the first time.
- The keys will persist across updates to the app.

https://msdn.microsoft.com/en-us/windows/apps/hh487164.aspx

Capabilities

Software capabilities

- Capability elements are entries in the manifest file that notify the user while installing the app of special software capabilities that your app receives.
- E.g. Provide access to location services

Hardware requirements

- A requirement element is an optional entry in the app manifest file that is used to specify hardware requirements and limit the exposure of an app to users that have a phone with the necessary hardware to run the app.
- E.g. Requiring Near Field Communication (NFC)

Functional capabilities

- A functional capability is an optional entry in the app manifest file that indicates that your app is requesting a hardware capability of the phone which is present, but not automatically granted.
- E.g. Requesting higher memory limits (in Windows Phone 8.0 only)

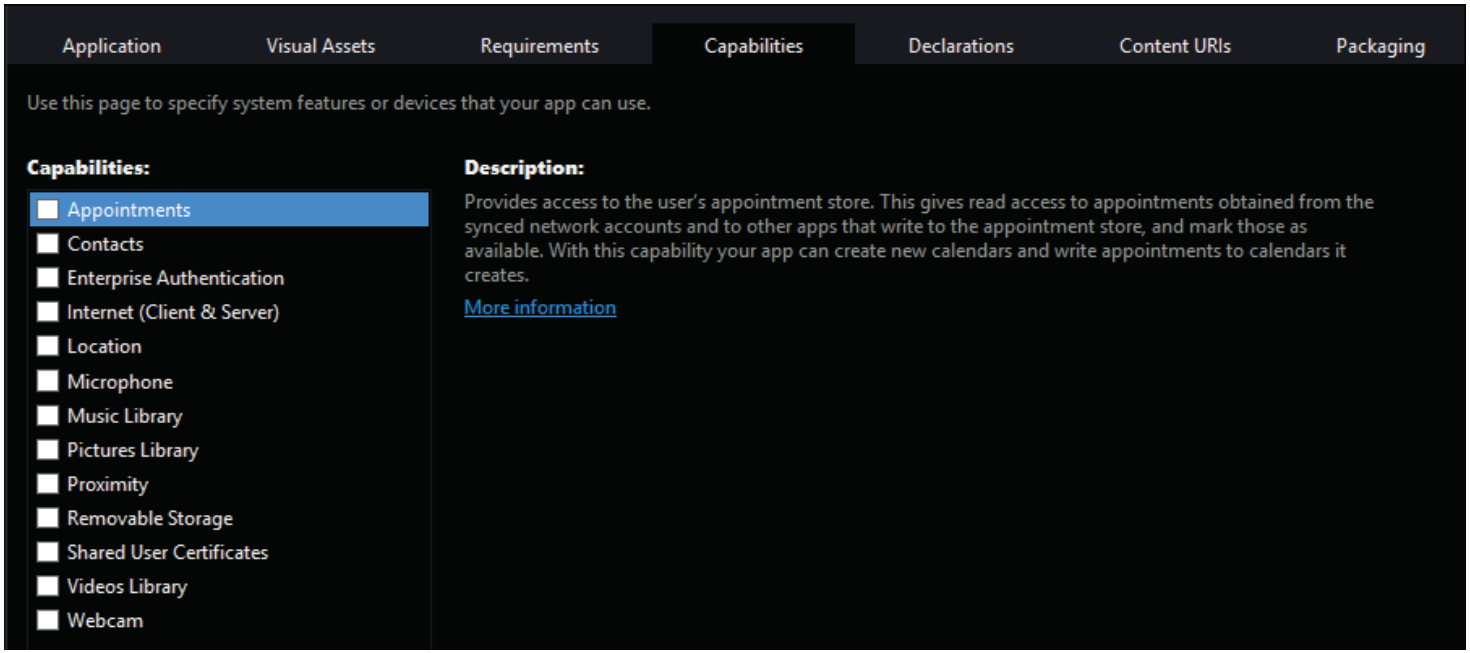
Software capabilities

The capabilities listed in the app manifest are disclosed to a user when they view an app for purchase in Windows Phone Store.

Some capabilities, such as location, are displayed so the user is fully aware that a location information.

Setting Capabilities

Setting capabilities using Microsoft Visual Studio 2013 Express:



Note: When testing apps using the Windows Phone emulator the capabilities are granted automatically, even when not included in the app manifest.

Capabilities Overview

Appointments
Allows an app to access the calendar and appointment info.

Camera
Allows an app to access the built-in camera.

Compass
Allows an app to access the built-in compass, if available.

Contacts
Allows an app to access the contact info.

Data services
Your phone's cellular data or Wi-Fi connection.

Gyroscope
Allows an app to access the built-in gyroscope, if available.

Location services
The approximate location.

Libraries
Allows an app to access all photos, music, and videos on your phone.

Microphone
Allows an app to record audio and to use Speech features.

Movement sensor
Allows an app to access the motion sensor.

Proximity
Allows access to the Bluetooth, Wi-Fi, and near field communication (NFC) capabilities.

Owner identity
An anonymous identifier that allows an app to distinguish one person from another, but provides no personal info.

Phone identity
A unique device identifier that allows an app to distinguish one phone from another.

Push notification service
Notifications that an app automatically sends to your phone.

Ringtones
Allows an app to access the ringtones.

SD card
Allows an app access to the SD card.

Speech recognition
Allows an app to access Speech features.

Wallet
Allows an app to access items in your Wallet or to make payments.

Web browser
Allows an app to access the web browser.

Xbox
Allows an app to access the Xbox service or your account info.

Capabilities – WhatsApp

social

WhatsApp

Free

★★★½☆
29190 reviews

By installing you agree to the Terms of Use and other terms

App requires

appointments
contacts
phone identity
owner identity
video and still capture
location services
maps
music library
photos library
media playback
microphone
data services
phone dialer
push notification service
movement and directional sensor
VOIP calling
web browser component
HD720P (720x1280)
WVGA (480x800)
WXGA (768x1280)
appointments
Proximity
SD card
internet connection
videos library
photo, music, and video libraries
camera

Restricted APIs – File Access

Locations all apps can access:

Application install directory

- The folder where your app is installed on the user's system. (read only)

Application data locations

- The folders where your app can store data. These folders (local, roaming and temporary) are created when your app is installed.

Removable devices (SD Card)

- Access is limited to specific file types

User's Downloads folder

Restricted APIs – File Access

Locations requiring additional capabilities in the app manifest:

Libraries

- Documents
- Music
- Pictures
- Videos

Removable devices (SD Card)

Homegroup libraries

Media server devices (DLNA)

Universal Naming Convention (UNC) folders

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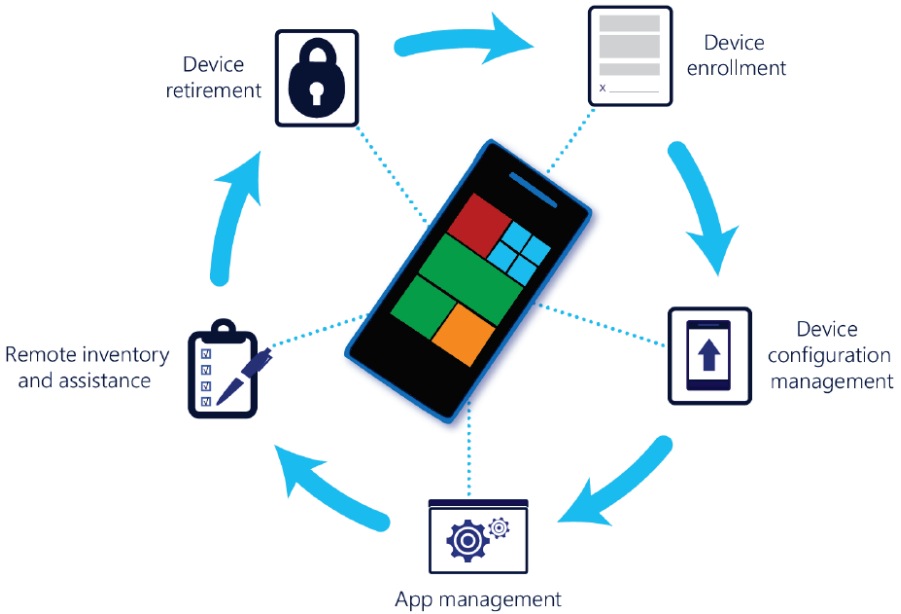
MDM Integration

Windows Phone 8.1 introduces push communication to distribute policies and configuration standards.

Periodically contacts the MDM server to download configurations, apps, updates and to upload asset information.



Microsoft: Windows Phone 8.1 Mobile Device Management Overview

MDM Integration – Functionality

Device Configuration Management

- Configuration Policies
- Access Management
- Storage Management
- Wi-Fi Network / VPN / Certificate Management
- Email Account / Message Management

App Management

- Windows Phone Store Apps
- Sideloaded Apps
- Allow / Deny Apps

Remote Inventory

- Remote Inventory / Assistance (Lock / PIN Reset)

Device Retirement

MDM Integration – Policies

Policies that MDM and EAS support	Policies that only MDM supports
Simple password	Disable cellular data roaming
Alphanumeric password	Disable Location
Minimum password length	Disable NFC
Minimum password complex characters	Disable Microsoft Account
Password expiration	Disable roaming between Windows devices
Password history	Disable custom email accounts
Device wipe threshold	Disable screen capture
Inactivity timeout	Disable copy & paste functionality
Device encryption	Disable share and save as
Disable removable storage card	App Allow/Deny list
Disable Camera	Disable Microsoft Store
Disable Bluetooth	Disable development unlock (side loading)
Disable Wi-Fi	Disable Internet Explorer
Disable Sync via USB	Disable Internet Sharing over Wi-Fi
	Disable Wi-Fi Off loading
	Disable Manual Configuration of Wi-Fi Profiles
	Disable Wi-Fi Hotspot reporting
	Disable VPN when Roaming over Cellular
	Disable VPN over Cellular
	Disable mdm un-enrollment and soft factory reset
	Disable Wi-Fi credential sharing
	Lock screen notification controls
	Disable telemetry data submission

Microsoft: Windows Phone 8.1 Mobile Device Management Overview

Wi-Fi Sense

Automatically connects you to Wi-Fi networks around you.

- Open Wi-Fi networks known by crowdsourcing e.g. other Windows Phone users have connected to.
- Accept the Terms of Use on your behalf.
- Provide additional information such as e-mail address or phone number on your behalf. (In some countries generic info will be used by default)
- Shares your Wi-Fi credentials with your Facebook friends, Outlook.com or Skype contacts.

Can I prevent my users from sharing their credentials?

- Yes, if you don't mind adding "_optout" to your Wi-Fi SSID
- What about Google's "_nomap" suffix then?

https://www.windowsphone.com/en-us/how-to/wp8/connectivity/wi-fi-sense-faq

Low Level Storage API

Win32 storage APIs supported on Windows Phone 8

Windows Phone 8 supports the following Win32 storage APIs for working with the local folder. For the full list of supported Win32 APIs, see Supported Win32 APIs for Windows Phone 8.

- CopyFile2
- CreateDirectoryW
- CreateFile2
- DeleteFileW
- FindClose
- FindFirstFileExW
- FindNextFileW
- FlushFileBuffers

Local folder only?

Demo

Findings Overview

Device has to be registered / developer unlocked to deploy apps locally.

Our test app can now access files / pipes etc. outside of the «official» folders.

The app can also access documents stored by another app when knowing the path.

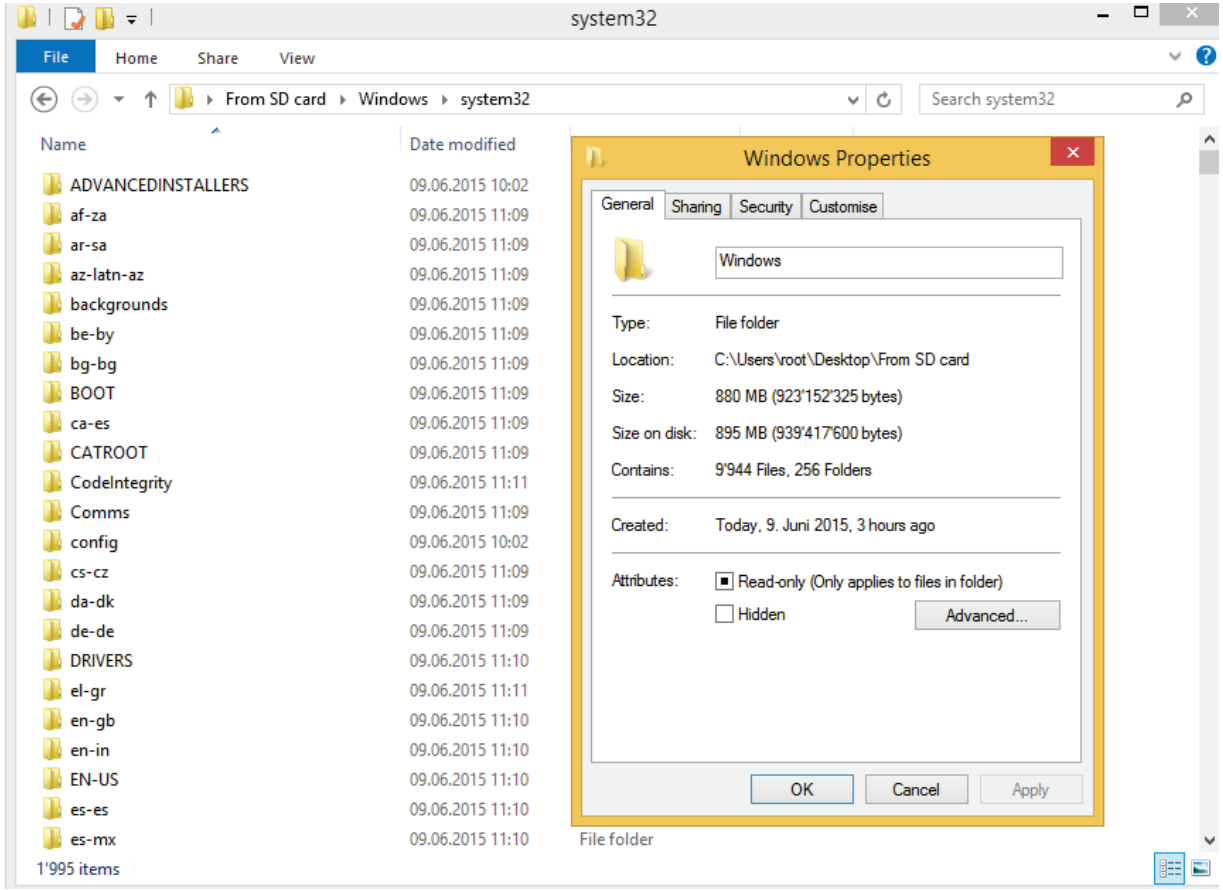
Does not work anymore when app is signed and distributed via Windows App Store.

We managed to brick our test phone and had to perform a full reset…

Open Research

Analysis of extracted information

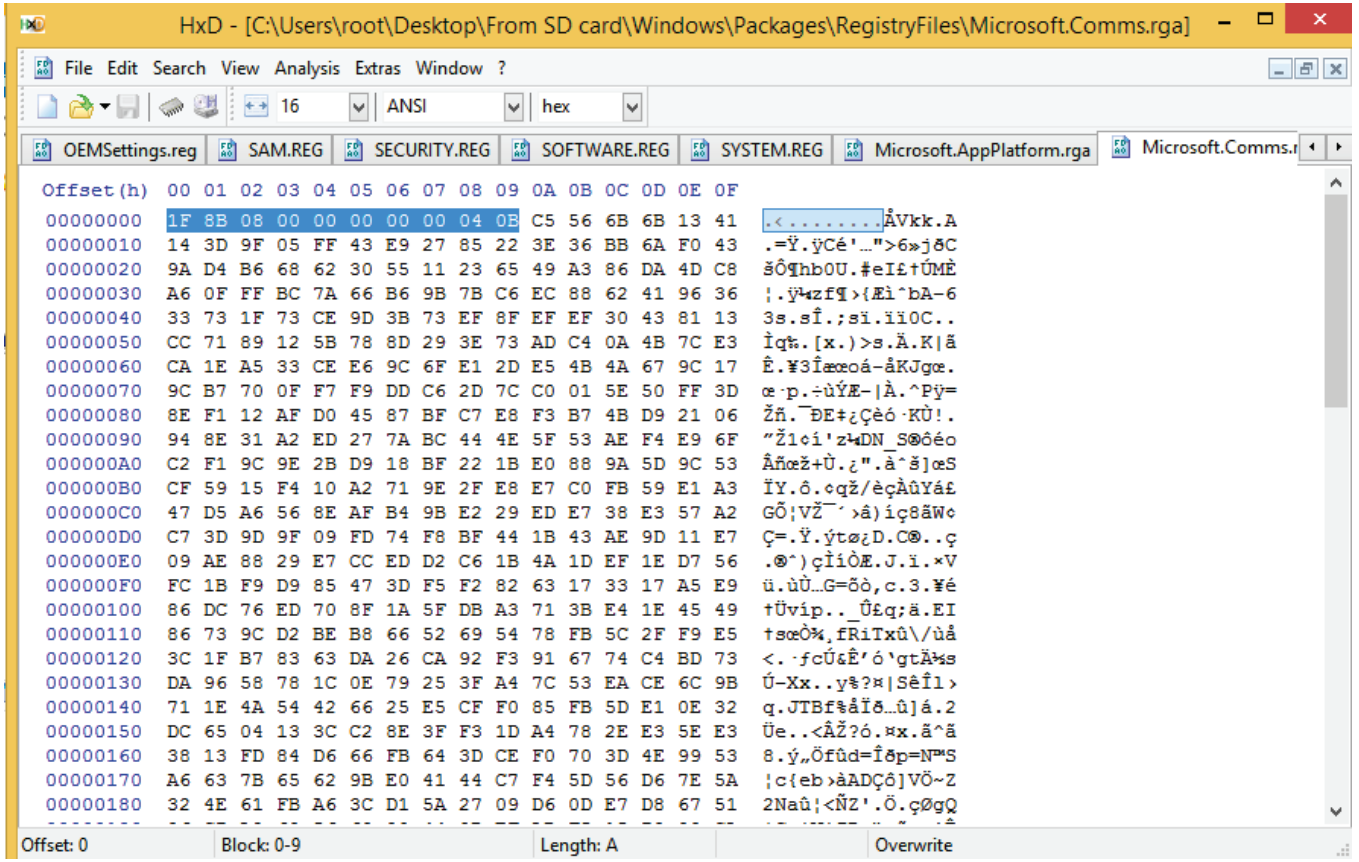
Extracted ~10’000 operating system files



Open Research

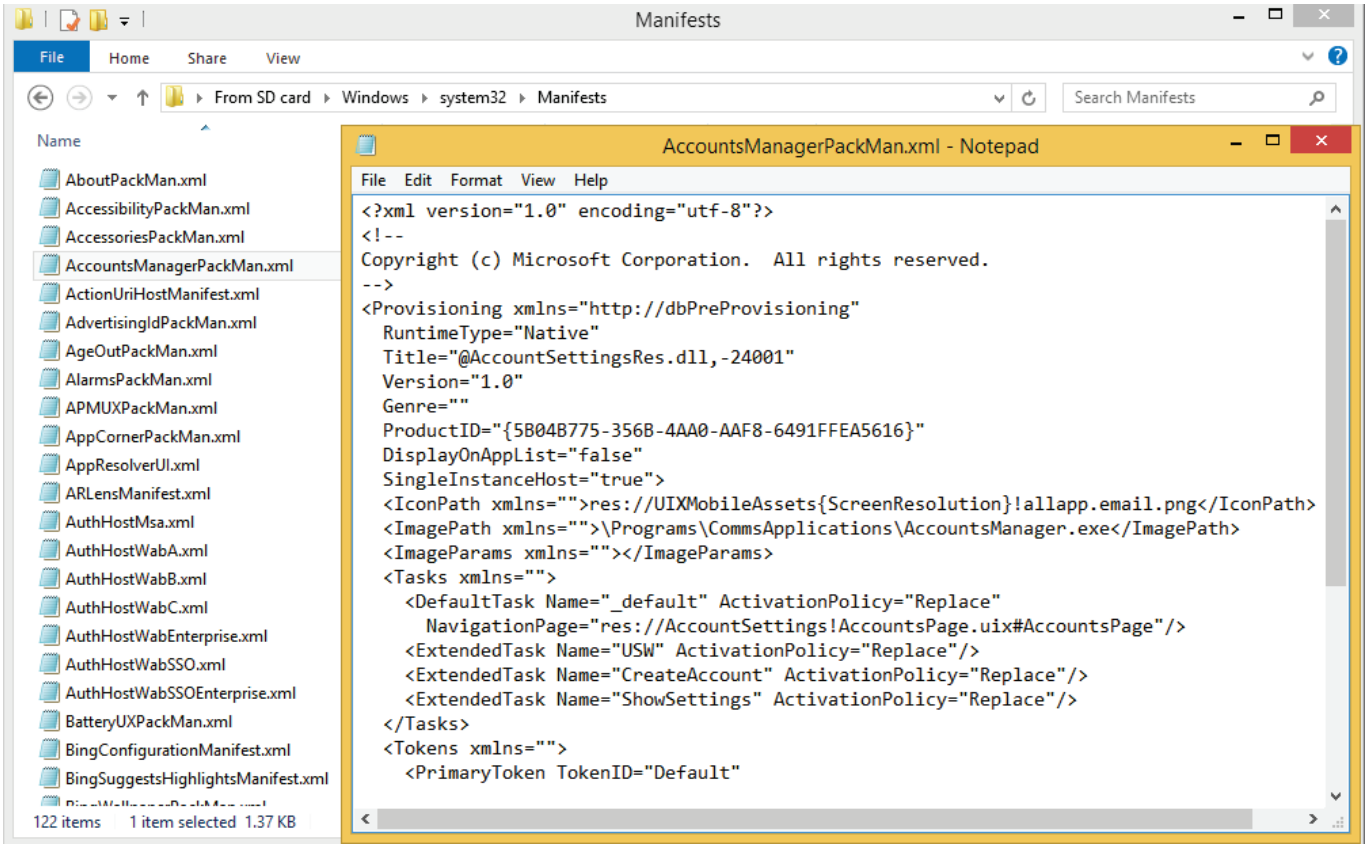
Analysis of extracted information

Some documents seem to be encrypted …



Open Research

Analysis of extracted information



While others are not …

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Windows 8.1 versus Windows 10

- Windows 10 released end of July this year
  (but probably not with for the phone)
- New version called Windows 10 Mobile Enterprise
- Private versus business containers, providing isolation between contexts
  (probably using Microsoft Advanced Threat Analytics – ATA)

Windows Phone 8.1

- Is more a phone similar to iOS and Android than a Windows desktop
- Is based on secure and proven good security technologies
- Is a first step into a more mature Windows 10 eco-system
- Is as business ready as your current MDM solution is…

Questions?