Smart Phones Dumb Apps

How Bad Guys View Your Mobile Apps

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ADC 13
APP DEVELOPERS CONFERENCE

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EXPO DATES: NOV 5-6
LOS ANGELES, CA

ADConf.com

UBM Tech

Denim Group Background

- Professional services firm that builds & secures enterprise applications
  - *External application assessments*
    - Web, mobile, and cloud
  - *Software development lifecycle development (SDLC) consulting*
- Classroom and e-Learning for PCI compliance
- Secure development services:
  - *Secure .NET and Java application development*
  - *Post-assessment remediation*
- Deep penetration in Energy, Financial Services, Banking, Insurance, Healthcare and Defense market sectors
- Customer base spans Fortune 500
- Contributes to industry best practices through the Open Web Application Security Project (OWASP)

Dan Cornell

- Dan Cornell, founder and CTO of Denim Group
- Software developer by background (Java, .NET, etc..)
- OWASP San Antonio
- 15 years experience in software architecture, development and security
- Heads Denim Group's application security team

Agenda

- Generic Smartphone Threat Model
- Sample Application
- What an Attacker Sees (Android Edition)
- What About iPhones/iPads?
- Special Topic: Browser URL handling
- Closing Thoughts
- Questions

Tradeoffs: Value versus Risk

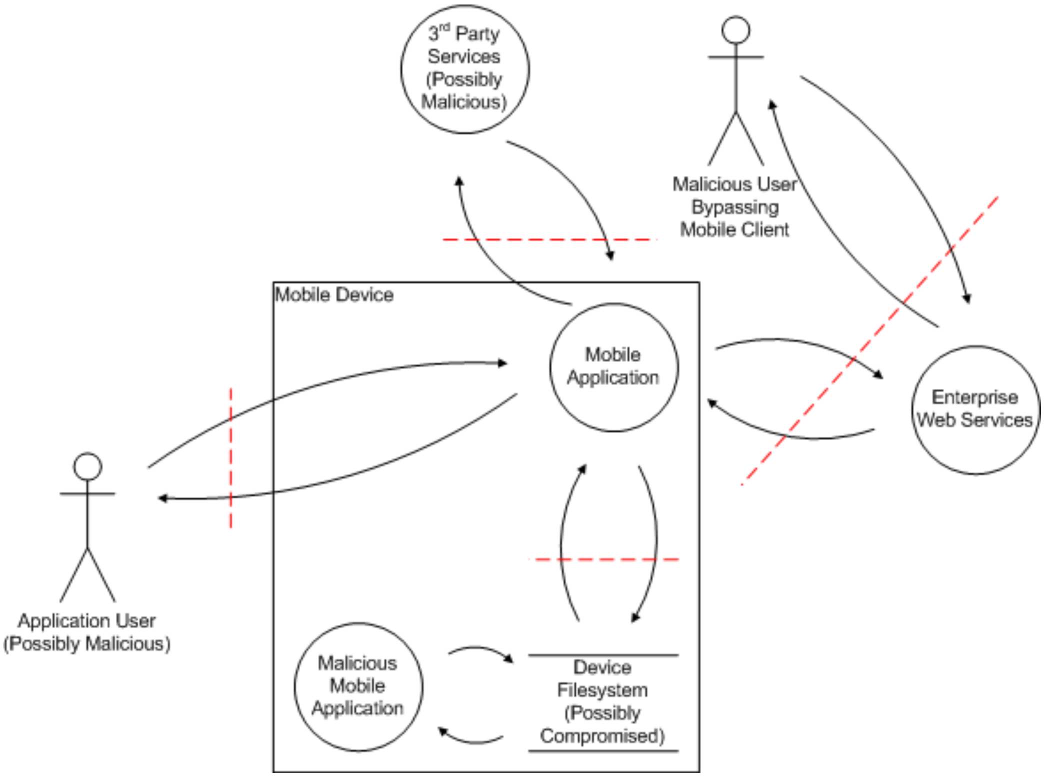
- Mobile applications can create tremendous value for organizations
  - *New classes of applications utilizing mobile capabilities: GPS, camera, etc..*
  - *Innovating applications for employees and customers*
- Mobile devices and mobile applications can create tremendous risks
  - *Sensitive data inevitably stored on the device (email, contacts)*
  - *Connect to a lot of untrusted networks (carrier, WiFi)*

- Most developers are not trained to develop secure applications
  - *Fact of life, but slowing getting better*
- Most developers are new to creating mobile applications
  - *Different platforms have different security characteristics and capabilities*

Smart Phones, Dumb Apps

- Lots of media focus on device and platform security
  - *Important because successful attacks give tremendous attacker leverage*
- Most organizations:
  - *Accept realities of device and platform security*
  - *Concerned about the security of their custom applications*
  - *Concerned about sensitive data on the device because of their apps*
  - *Concerned about network-available resources that support their apps*
- Who has smartphone application deployed for customers?
- Who has had smartphone applications deployed without their knowledge?
  - **$!%$# marketing department…*

Generic Mobile Application Threat Model

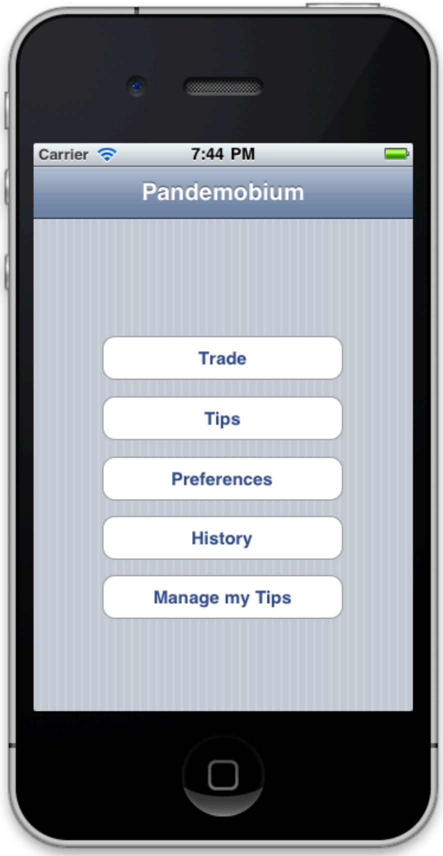

3rd Party Services (Possibly Malicious)
Malicious User Bypassing Mobile Client
Mobile Device
Mobile Application
Enterprise Web Services
Application User (Possibly Malicious)
Malicious Mobile Application
Device Filesystem (Possibly Compromised)

Some Assumptions for Developers

- Smartphone applications are essentially thick-client applications
  - *That people carry in their pockets*
  - *And drop in toilets*
  - *And put on eBay when the new iPhone comes out*
  - *And leave on airplanes*
  - *And so on…*
- Attackers will be able to access:
  - *Target user (victim) devices*
  - *Your application binaries*
- What else should you assume they know or will find out?

Let' s Take Apart Some Apps

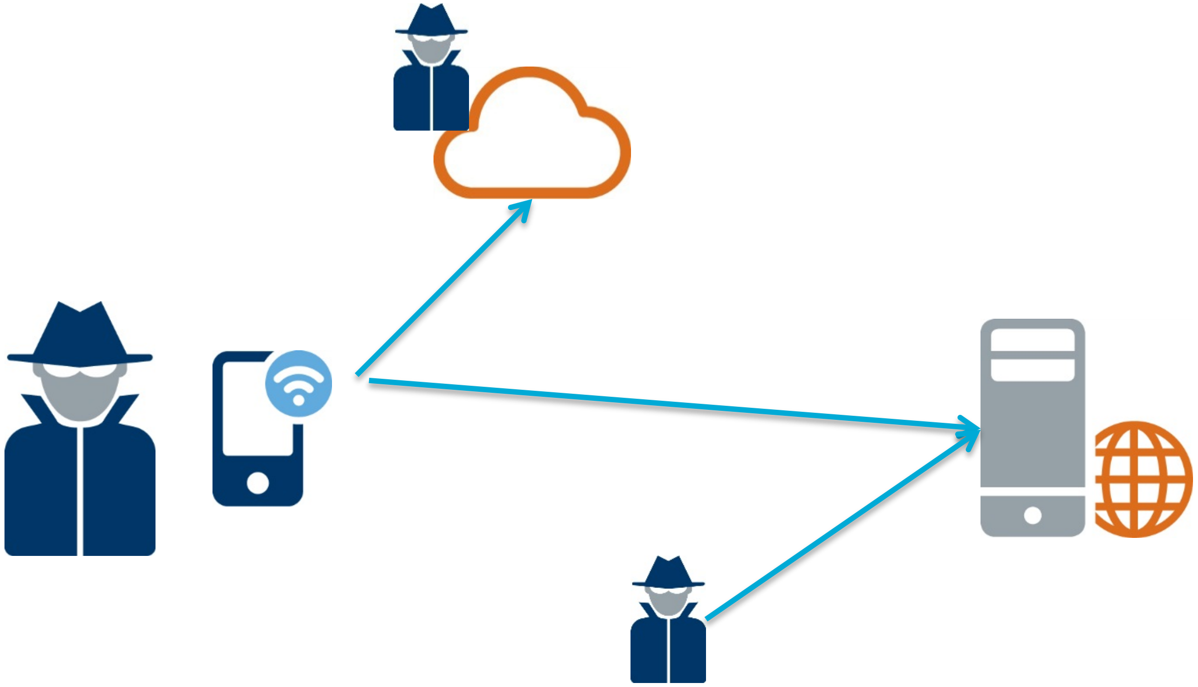
- Pandemobium Stock Trader Application
- Android and iOS versions
- Functionality
  - *Log in*
  - *Track stock tips*
  - *Make stock trades*
  - *Get stock tips*
  - *Share stock tips*



Pandemobium Stock Trader Application

- We will use as an example through the class
- Available for free online
  - *https://code.google.com/p/pandemobium/*
  - *Look for updates! Share with your friends!*
- Components:
  - *iPhone application*
  - *Android application*
  - *Supporting web services (Java/JSP web application)*
  - *User manual (HTML)*
  - *Vulnerability list (HTML)*

Pandemobium Stock Trader Application

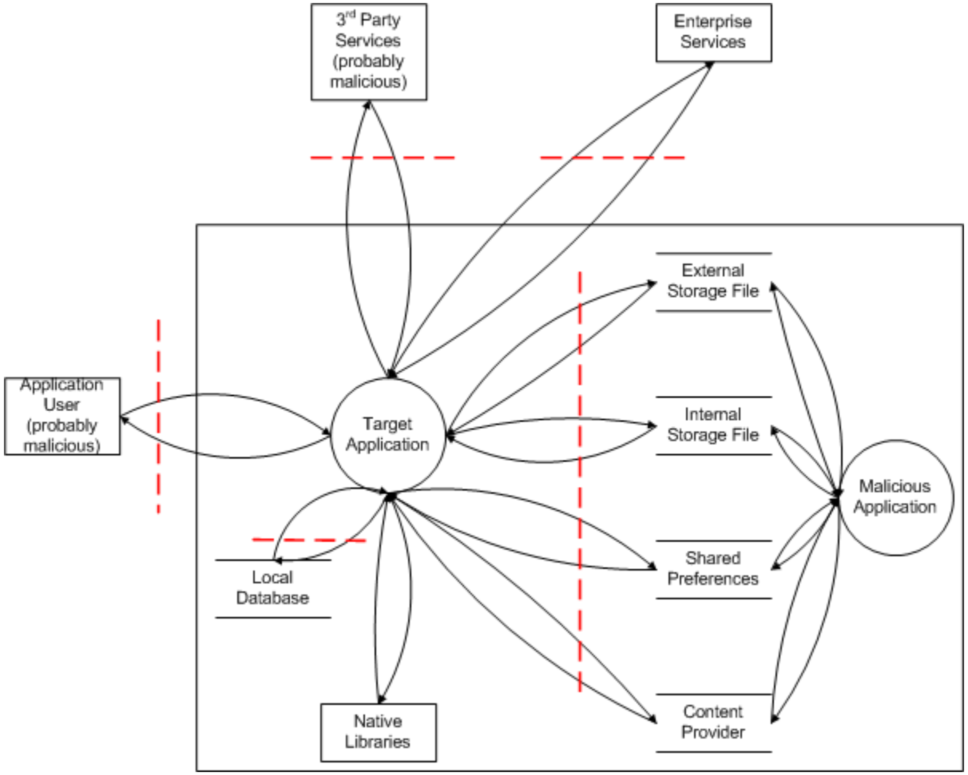


So What Does a Bad Guy See? (Android Edition)

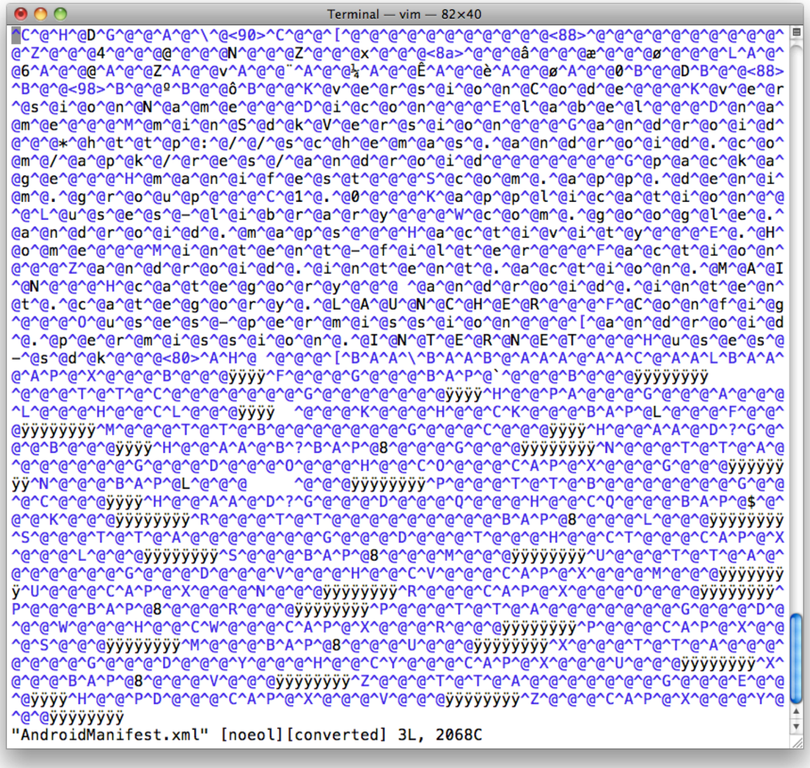
- Install the application onto a device
- Root the device
- Pull the application's APK file onto a workstation for analysis

- APK files are ZIP files
- They contain:
  - *AndroidManifest.xml*
  - *Other binary XML files in res/*
  - *classes.dex DEX binary code*

Generic Android Application Threat Model



What’s Up With My XML Files?



```
^C^@^H^@D^G^@^@^A^@^\^@<90>^C^@^@^[^@^@^@^@^@^@^@^@^@^@^@<88>^@^@^@^@^@^@^@^@^@^@^
@^Z^@^@^@4^@^@^@@^@^@^@N^@^@^@Z^@^@^@x^@^@^@<8a>^@^@^@â^@^@^@æ^@^@^@ø^@^@^@^L^A^@^
@6^A^@^@@^A^@^@Z^A^@^@v^A^@^@¨^A^@^@¼^A^@^@Ê^A^@^@è^A^@^@ø^A^@^@0^B^@^@D^B^@^@<88>
^B^@^@<98>^B^@^@º^B^@^@ô^B^@^@^K^@v^@e^@r^@s^@i^@o^@n^@C^@o^@d^@e^@^@^@^K^@v^@e^@r
^@s^@i^@o^@n^@N^@a^@m^@e^@^@^@^D^@i^@c^@o^@n^@^@^@^E^@l^@a^@b^@e^@l^@^@^@^D^@n^@a^
@m^@e^@^@^@^M^@m^@i^@n^@S^@d^@k^@V^@e^@r^@s^@i^@o^@n^@^@^@^G^@a^@n^@d^@r^@o^@i^@d^
@^@^@*^@h^@t^@t^@p^@:^@/^@/^@s^@c^@h^@e^@m^@a^@s^@.^@a^@n^@d^@r^@o^@i^@d^@.^@c^@o^
@m^@/^@a^@p^@k^@/^@r^@e^@s^@/^@a^@n^@d^@r^@o^@i^@d^@^@^@^@^@^@^@^G^@p^@a^@c^@k^@a^
@g^@e^@^@^@^H^@m^@a^@n^@i^@f^@e^@s^@t^@^@^@^S^@c^@o^@m^@.^@a^@p^@p^@.^@d^@e^@n^@i^
@m^@.^@g^@r^@o^@u^@p^@^@^@^C^@1^@.^@0^@^@^@^K^@a^@p^@p^@l^@i^@c^@a^@t^@i^@o^@n^@^@
^@^L^@u^@s^@e^@s^@-^@l^@i^@b^@r^@a^@r^@y^@^@^@^W^@c^@o^@m^@.^@g^@o^@o^@g^@l^@e^@.^
@a^@n^@d^@r^@o^@i^@d^@.^@m^@a^@p^@s^@^@^@^H^@a^@c^@t^@i^@v^@i^@t^@y^@^@^@^E^@.^@H^
@o^@m^@e^@^@^@^M^@i^@n^@t^@e^@n^@t^@-^@f^@i^@l^@t^@e^@r^@^@^@^F^@a^@c^@t^@i^@o^@n^
@^@^@^Z^@a^@n^@d^@r^@o^@i^@d^@.^@i^@n^@t^@e^@n^@t^@.^@a^@c^@t^@i^@o^@n^@.^@M^@A^@I
^@N^@^@^@^H^@c^@a^@t^@e^@g^@o^@r^@y^@^@^@ ^@a^@n^@d^@r^@o^@i^@d^@.^@i^@n^@t^@e^@n^
@t^@.^@c^@a^@t^@e^@g^@o^@r^@y^@.^@L^@A^@U^@N^@C^@H^@E^@R^@^@^@^F^@C^@o^@n^@f^@i^@g
^@^@^@^O^@u^@s^@e^@s^@-^@p^@e^@r^@m^@i^@s^@s^@i^@o^@n^@^@^@^[^@a^@n^@d^@r^@o^@i^@d
^@.^@p^@e^@r^@m^@i^@s^@s^@i^@o^@n^@.^@I^@N^@T^@E^@R^@N^@E^@T^@^@^@^H^@u^@s^@e^@s^@
-^@s^@d^@k^@^@^@<80>^A^H^@ ^@^@^@^[^B^A^A^\^B^A^A^B^@^A^A^A^@^A^A^C^@^A^A^L^B^A^A^
@^A^P^@^X^@^@^@^B^@^@^@ÿÿÿÿ^F^@^@^@^G^@^@^@^B^A^P^@`^@^@^@^B^@^@^@ÿÿÿÿÿÿÿÿ
^@^@^@^T^@^T^@^C^@^@^@^@^@^@^@^G^@^@^@^@^@^@^@ÿÿÿÿ^H^@^@^P^A^@^@^@^G^@^@^@^A^@^@^@
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^@^C^@^@^@ÿÿÿÿ^H^@^@^A^A^@^D^?^G^@^@^@^D^@^@^@^Q^@^@^@^H^@^@^C^Q^@^@^@^B^A^P^@$^@^
@^@^K^@^@^@ÿÿÿÿÿÿÿÿ^R^@^@^@^T^@^T^@^@^@^@^@^@^@^@^@^B^A^P^@8^@^@^@^L^@^@^@ÿÿÿÿÿÿÿÿ
^S^@^@^@^T^@^T^@^A^@^@^@^@^@^@^@^G^@^@^@^D^@^@^@^T^@^@^@^H^@^@^C^T^@^@^@^C^A^P^@^X
^@^@^@^L^@^@^@ÿÿÿÿÿÿÿÿ^S^@^@^@^B^A^P^@8^@^@^@^M^@^@^@ÿÿÿÿÿÿÿÿ^U^@^@^@^T^@^T^@^A^@^
@^@^@^@^@^@^G^@^@^@^D^@^@^@^V^@^@^@^H^@^@^C^V^@^@^@^C^A^P^@^X^@^@^@^M^@^@^@ÿÿÿÿÿÿÿ
ÿ^U^@^@^@^C^A^P^@^X^@^@^@^N^@^@^@ÿÿÿÿÿÿÿÿ^R^@^@^@^C^A^P^@^X^@^@^@^O^@^@^@ÿÿÿÿÿÿÿÿ^
P^@^@^@^B^A^P^@8^@^@^@^R^@^@^@ÿÿÿÿÿÿÿÿ^P^@^@^@^T^@^T^@^A^@^@^@^@^@^@^@^G^@^@^@^D^@
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^@^S^@^@^@ÿÿÿÿÿÿÿÿ^M^@^@^@^B^A^P^@8^@^@^@^U^@^@^@ÿÿÿÿÿÿÿÿ^X^@^@^@^T^@^T^@^A^@^@^@^
@^@^@^@^G^@^@^@^D^@^@^@^Y^@^@^@^H^@^@^C^Y^@^@^@^C^A^P^@^X^@^@^@^U^@^@^@ÿÿÿÿÿÿÿÿ^X^
@^@^@^B^A^P^@8^@^@^@^V^@^@^@ÿÿÿÿÿÿÿÿ^Z^@^@^@^T^@^T^@^A^@^@^@^@^@^@^@^G^@^@^@^E^@^@
^@ÿÿÿÿ^H^@^@^P^D^@^@^@^C^A^P^@^X^@^@^@^V^@^@^@ÿÿÿÿÿÿÿÿ^Z^@^@^@^C^A^P^@^X^@^@^@^Y^@
^@^@ÿÿÿÿÿÿÿÿ
"AndroidManifest.xml" [noeol][converted] 3L, 2068C
```
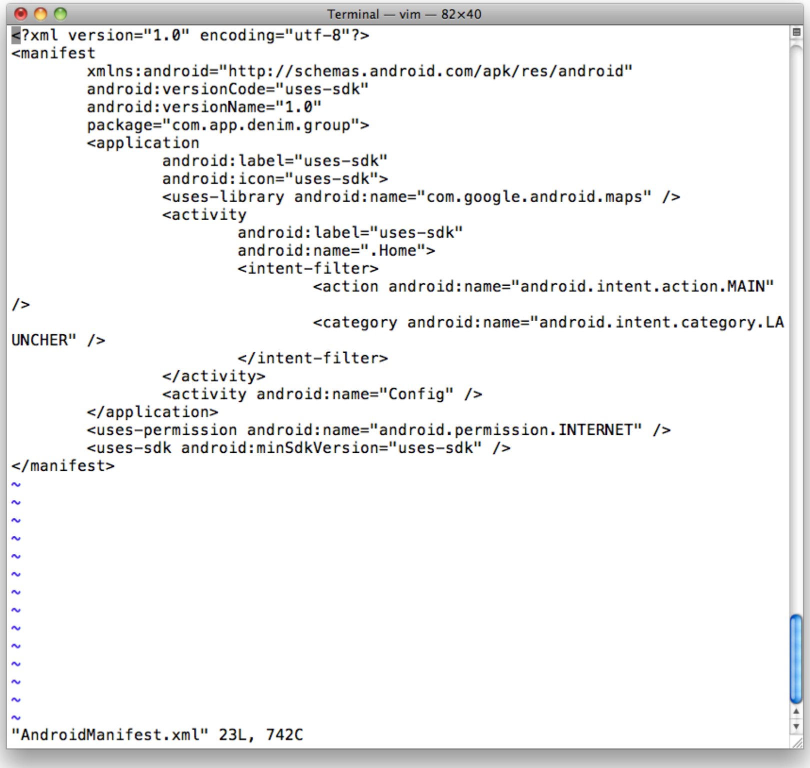

- Binary encoding
- Use axml2xml.pl to convert them to text

http://code.google.com/p/android-random/downloads/detail?name=axml2xml.pl

Much Better

- Now we see:
  - *Screens in application*
  - *Permissions required by the application*
  - *Intents applications is registered to consume*
  - *And so on*



```
<?xml version="1.0" encoding="utf-8"?>
<manifest
        xmlns:android="http://schemas.android.com/apk/res/android"
        android:versionCode="uses-sdk"
        android:versionName="1.0"
        package="com.app.denim.group">
        <application
                android:label="uses-sdk"
                android:icon="uses-sdk">
                <uses-library android:name="com.google.android.maps" />
                <activity
                        android:label="uses-sdk"
                        android:name=".Home">
                        <intent-filter>
                                <action android:name="android.intent.action.MAIN"
/>
                                <category android:name="android.intent.category.LA
UNCHER" />
                        </intent-filter>
                </activity>
                <activity android:name="Config" />
        </application>
        <uses-permission android:name="android.permission.INTERNET" />
        <uses-sdk android:minSdkVersion="uses-sdk" />
</manifest>
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"AndroidManifest.xml" 23L, 742C
```

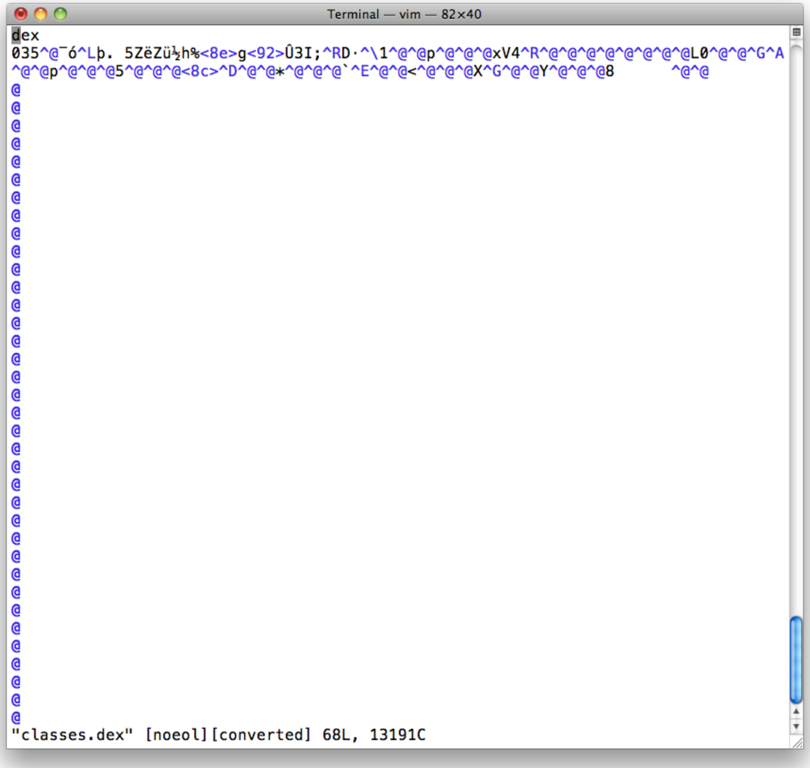
Do the Same Thing With the Rest of Them

- Recurse through the res/ subdirectory
- UI layouts, other resources

What About the Code?

- All of it is stuffed in classes.dex
- Android phones use DEX rather than Java bytecodes
  - *Register-based virtual machine rather than stack-based virtual machine*
- Options:
  - *Look at DEX assembly via de-dexing*
  - *Convert to Java bytecode and then to Java source code*

De-Dex to See DEX Assembly



```
dex
035^@¯ó^Lþ. 5ZëZü½h%<8e>g<92>Û3I;^RD·^\1^@^@p^@^@^@xV4^R^@^@^@^@^@^@^@L0^@^@^G^A
^@^@p^@^@^@5^@^@^@<8c>^D^@^@*^@^@^@`^E^@^@<^@^@^@X^G^@^@Y^@^@^@8      ^@^@
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"classes.dex" [noeol][converted] 68L, 13191C
```
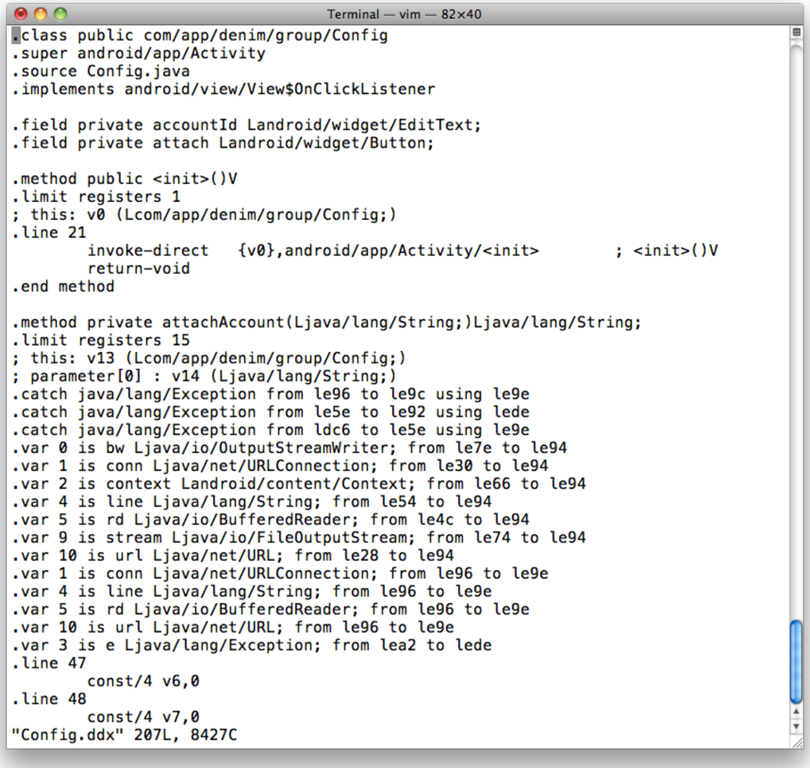

- DEX bytecode ~= Java bytecode
- All code goes in one file
- Disassemble to DEX assembly with dedexer

http://dedexer.sourceforge.net/

Lots of Information

- Like the fun-fun world of Java disassembly and decompilation
  - *(We'll get to the DEX decompilation in a moment)*
- LOTS of information available



```
.class public com/app/denim/group/Config
.super android/app/Activity
.source Config.java
.implements android/view/View$OnClickListener

.field private accountId Landroid/widget/EditText;
.field private attach Landroid/widget/Button;

.method public <init>()V
.limit registers 1
; this: v0 (Lcom/app/denim/group/Config;)
.line 21
        invoke-direct   {v0},android/app/Activity/<init>        ; <init>()V
        return-void
.end method

.method private attachAccount(Ljava/lang/String;)Ljava/lang/String;
.limit registers 15
; this: v13 (Lcom/app/denim/group/Config;)
; parameter[0] : v14 (Ljava/lang/String;)
.catch java/lang/Exception from le96 to le9c using le9e
.catch java/lang/Exception from le5e to le92 using lede
.catch java/lang/Exception from ldc6 to le5e using le9e
.var 0 is bw Ljava/io/OutputStreamWriter; from le7e to le94
.var 1 is conn Ljava/net/URLConnection; from le30 to le94
.var 2 is context Landroid/content/Context; from le66 to le94
.var 4 is line Ljava/lang/String; from le54 to le94
.var 5 is rd Ljava/io/BufferedReader; from le4c to le94
.var 9 is stream Ljava/io/FileOutputStream; from le74 to le94
.var 10 is url Ljava/net/URL; from le28 to le94
.var 1 is conn Ljava/net/URLConnection; from le96 to le9e
.var 4 is line Ljava/lang/String; from le96 to le9e
.var 5 is rd Ljava/io/BufferedReader; from le96 to le9e
.var 10 is url Ljava/net/URL; from le96 to le9e
.var 3 is e Ljava/lang/Exception; from lea2 to lede
.line 47
        const/4 v6,0
.line 48
        const/4 v7,0
"Config.ddx" 207L, 8427C
```

But Can I Decompile to Java?

- Yes
- We
- Can

- Convert to Java bytecodes with dex2jar
  - *http://code.google.com/p/dex2jar/*
  - *(Now you can run static analysis tools like Findbugs)*

- Convert to Java source code with your favorite Java decompiler
  - *Everyone has a favorite Java decompiler, right?*

DEX Assembly Versus Java Source Code

- De-DEXing works pretty reliably
- DEX assembly is easy to parse with grep
- DEX assembly is reasonably easy to manually analyze

- Java decompilation works most of the time
- Java source code can be tricky to parse with grep
- Java source code is very easy to manually analyze

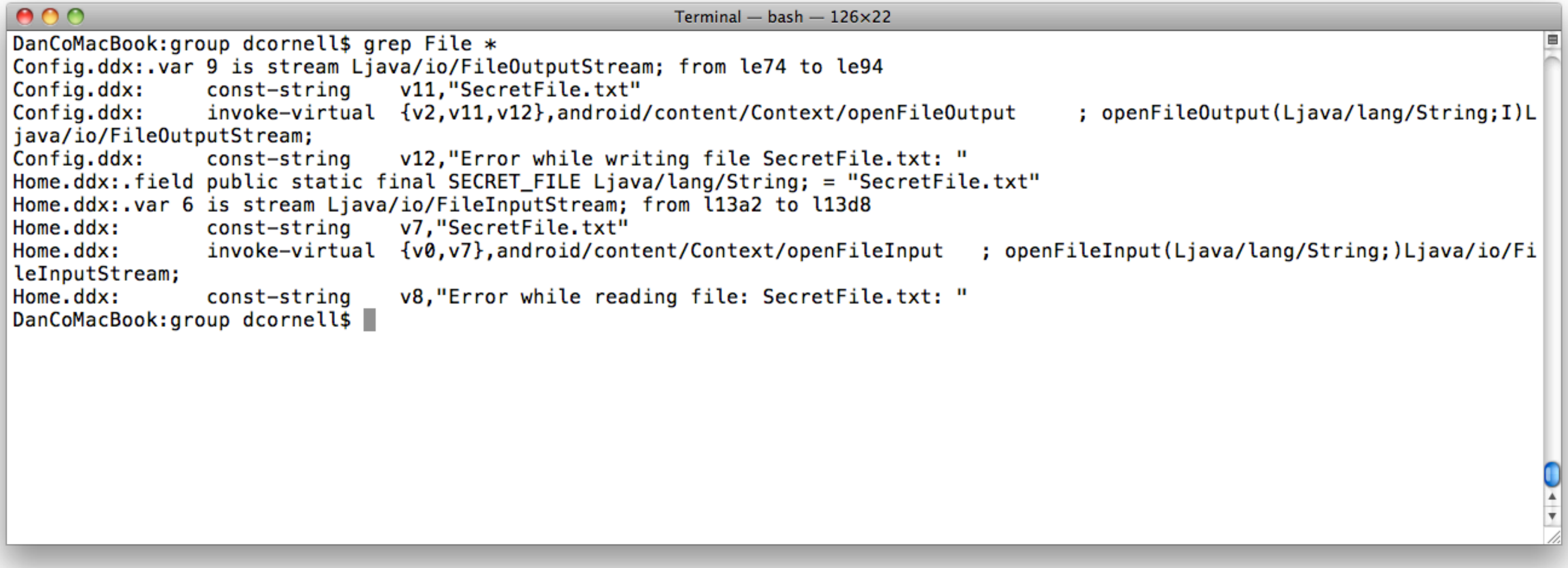
- Verdict:
  - *Do both!*
  - *Grep through DEX assembly to identify starting points for analysis*
  - *Analyze Java source in detail*

So What Did We Learn?

- Look at the string constants
  - *URLs, hostnames, web paths*
- Look at the de-DEXed assembly
  - *Method calls*
  - *Data flow*
- Developers: BAD NEWS
  - *The bad guys have all your code*
  - *They might understand your app better than you*
  - *How much sensitive intellectual property do you want to embed in your mobile application now?*

Is There Sensitive Data On the Device?

- Look at the disassemled DEX code
- Grep for "File"



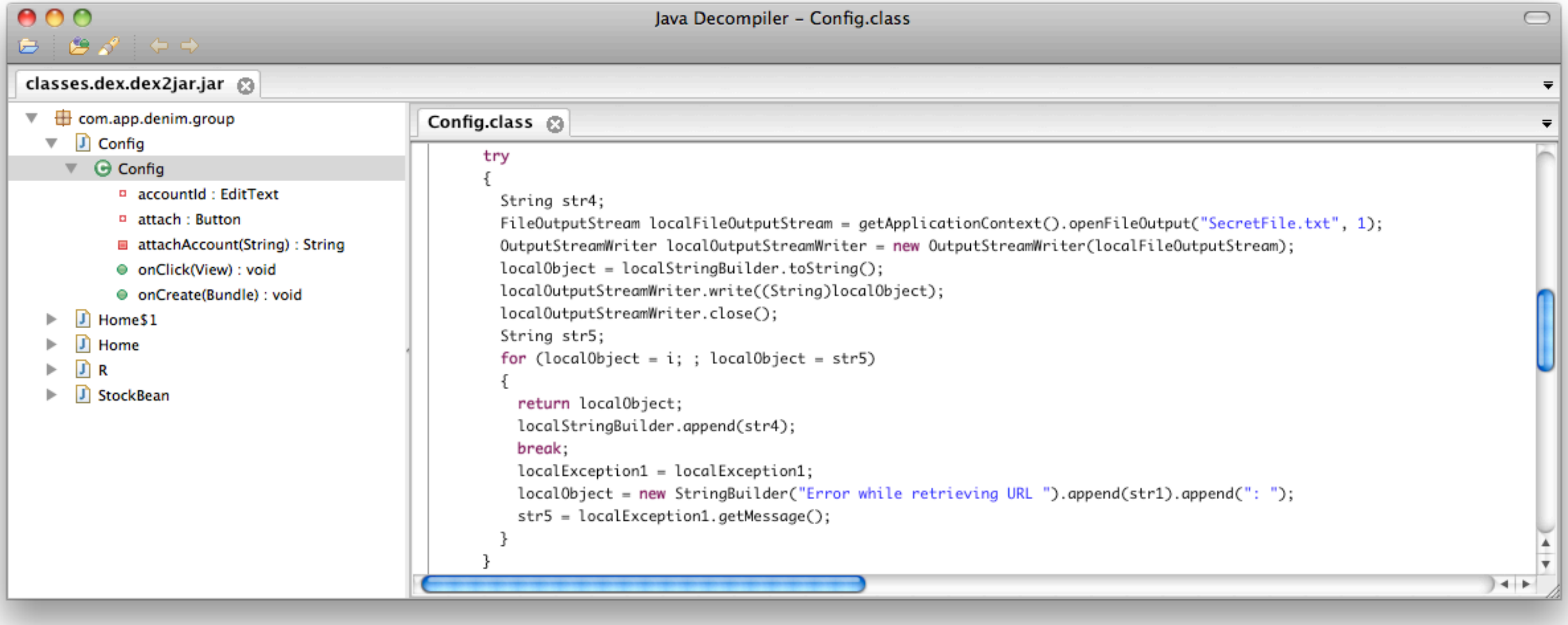
```
DanCoMacBook:group dcornell$ grep File *
Config.ddx:.var 9 is stream Ljava/io/FileOutputStream; from le74 to le94
Config.ddx:     const-string    v11,"SecretFile.txt"
Config.ddx:     invoke-virtual  {v2,v11,v12},android/content/Context/openFileOutput     ; openFileOutput(Ljava/lang/String;I)L
java/io/FileOutputStream;
Config.ddx:     const-string    v12,"Error while writing file SecretFile.txt: "
Home.ddx:.field public static final SECRET_FILE Ljava/lang/String; = "SecretFile.txt"
Home.ddx:.var 6 is stream Ljava/io/FileInputStream; from l13a2 to l13d8
Home.ddx:       const-string    v7,"SecretFile.txt"
Home.ddx:       invoke-virtual  {v0,v7},android/content/Context/openFileInput   ; openFileInput(Ljava/lang/String;)Ljava/io/Fi
leInputStream;
Home.ddx:       const-string    v8,"Error while reading file: SecretFile.txt: "
DanCoMacBook:group dcornell$ 
```

What About Java Source Code?

- Get the source code with JD-Gui
  - *http://java.decompiler.free.fr/*

Look for Files With Bad Permissions

- Look for file open operations using
  - *Context.MODE_WORLD_READABLE*
  - *(translates to "1")*



```
try
{
  String str4;
  FileOutputStream localFileOutputStream = getApplicationContext().openFileOutput("SecretFile.txt", 1);
  OutputStreamWriter localOutputStreamWriter = new OutputStreamWriter(localFileOutputStream);
  localObject = localStringBuilder.toString();
  localOutputStreamWriter.write((String)localObject);
  localOutputStreamWriter.close();
  String str5;
  for (localObject = i; ; localObject = str5)
  {
    return localObject;
    localStringBuilder.append(str4);
    break;
    localException1 = localException1;
    localObject = new StringBuilder("Error while retrieving URL ").append(str1).append(": ");
    str5 = localException1.getMessage();
  }
}
```

Next: What Is On the Server-Side

- To access sensitive data on a device:
  - *Steal a device*
  - *Want more data?*
  - *Steal another device*
- To access sensitive data from web services
  - *Attack the web service*
- String constants for URLs, hostnames, paths
- Examples:
  - *3rd party web services*
  - *Enterprise web services*

So Now What?

- 3rd Party Web Services
  - *Is data being treated as untrusted?*
  - *Google promised to "not be evil"*
    - For everyone else…
- Enterprise Web Services
  - *Did you know these were deployed?*
  - *Have these been tested for possible security flaws?*
  - *Stealing records en-masse is preferable to stealing them one-at-a-time*

Web Services Example

- Trumped up example, but based on real life
- Given a web services endpoint, what will a bad guy do?
- Sequence:
  - *Request a junk method "abcd"*
  - *Get a "No method 'abcd' available"*
  - *Request a method "<script>alert('hi');</script>"*
  - *Hilarity ensues…*

What Is Wrong With the Example Application?

- Sensitive data stored on the device unprotected
- Trusts data from 3rd party web services
- Exposes enterprise web services to attackers
- Enterprise web services vulnerable to reflected XSS attacks
- And so on…

- This is a trumped-up example with concentrated vulnerabilities, but…

- All of these reflect real-world examples of vulnerabilities
  - *Public breaches*
  - *Application assessments*

What About iPhones/iPads?

- Objective-C compiled to ARMv6, ARMv7 machine code
  - *Not as fun (easy) as Java compiled to DEX bytecode*
  - *But … subject to buffer overflows, memory handling issues, other native code fun*

- Apps from iTunes Store
  - *Encrypted*
  - *Used to be "easy" (well, mechanical) to break encryption with a jailbroken phone and a debugger*
  - *Now trickier (but likely not insurmountable)*
  - *And the default apps are not encrypted…*

Run “strings” on the Binary

- Web services endpoints: URLs, hostnames, paths

- Objective-C calling conventions:

```
[myThing doStuff:a second:b third:c];
```

becomes

```
obj_msgsend(myThing, “doStuff:second:third:”, a, b, c);
```

Run “otool” on the Binary

- otool –l <MyApp>
  - View the load commands
  - Segment info, encryption info, libraries in use
- otool –t –v <MyApp>
  - Disassemble the text segment to ARM assembly
  - If run on an encrypted application you get garbage
- otool –o <MyApp>
  - Print the Objective-C segment
- And so on…

Net Result for iPhone/iPad

- More obscure
  - *But does that mean more secure?*

- Can still retrieve a tremendous amount of information
- Can still observe a running application

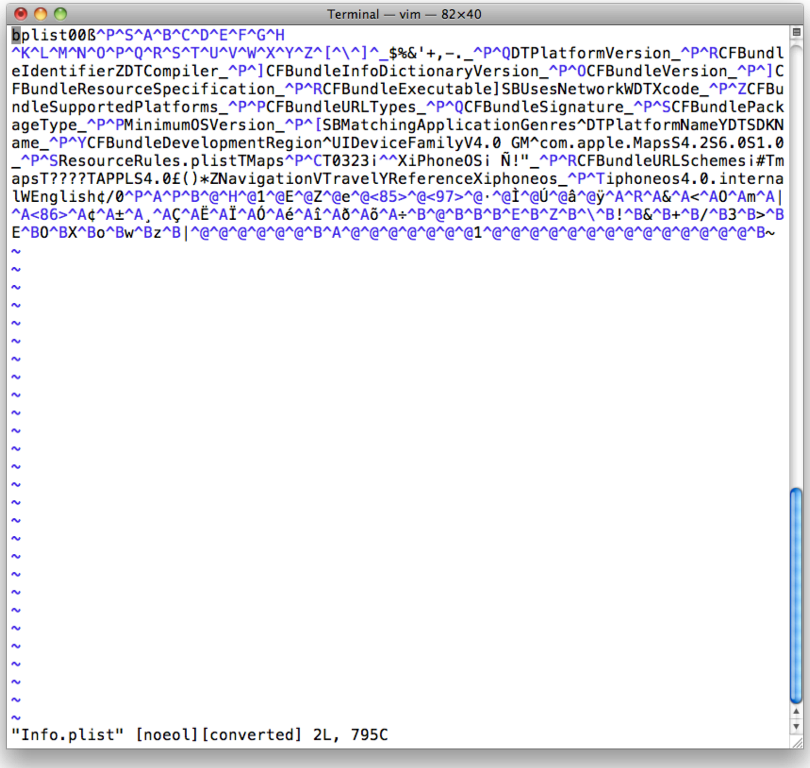
- "Security" based on obscurity is not durable

Mobile Browser Content Handling

- Many mobile platforms allow you to designate applications to handle content found in web pages
  - *By URI protocol*
  - *By content type*
- Provide a "premium" experience for users who have the target app installed
- Examples:
  - *tel:// URLs initiating phone calls*
  - *maps:// URLs to display maps*

iPhone/iPad URL Schemes

- iOS applications can be set up to “handle” certain URL schemes
- Defined in the application’s Info.plist
- Binary format: ***annoying***



```
bplist00ß^P^S^A^B^C^D^E^F^G^H
^K^L^M^N^O^P^Q^R^S^T^U^V^W^X^Y^Z^[^\^]^_$%&'+,-._^P^QDTPlatformVersion_^P^RCFBundl
eIdentifierZDTCompiler_^P^]CFBundleInfoDictionaryVersion_^P^OCFBundleVersion_^P^]C
FBundleResourceSpecification_^P^RCFBundleExecutable]SBUsesNetworkWDTXcode_^P^ZCFBu
ndleSupportedPlatforms_^P^PCFBundleURLTypes_^P^QCFBundleSignature_^P^SCFBundlePack
ageType_^P^PMinimumOSVersion_^P^[SBMatchingApplicationGenres^DTPlatformNameYDTSDKN
ame_^P^YCFBundleDevelopmentRegion^UIDeviceFamilyV4.0 GM^com.apple.MapsS4.2S6.0S1.0
_^P^SResourceRules.plistTMaps^P^CT0323¡^^XiPhoneOS¡ Ñ!"_^P^RCFBundleURLSchemes¡#Tm
apsT????TAPPLS4.0£()*ZNavigationVTravelYReferenceXiphoneos_^P^Tiphoneos4.0.interna
lWEnglish¢/0^P^A^P^B^@^H^@1^@E^@Z^@e^@<85>^@<97>^@·^@Ì^@Ú^@â^@ÿ^A^R^A&^A<^AO^Am^A|
^A<86>^A¢^A±^A¸^AÇ^AË^AÏ^AÓ^Aé^Aî^Að^Aõ^A÷^B^@^B^B^B^E^B^Z^B^\^B!^B&^B+^B/^B3^B>^B
E^BO^BX^Bo^Bw^Bz^B|^@^@^@^@^@^@^B^A^@^@^@^@^@^@1^@^@^@^@^@^@^@^@^@^@^@^@^@^B~
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"Info.plist" [noeol][converted] 2L, 795C
```
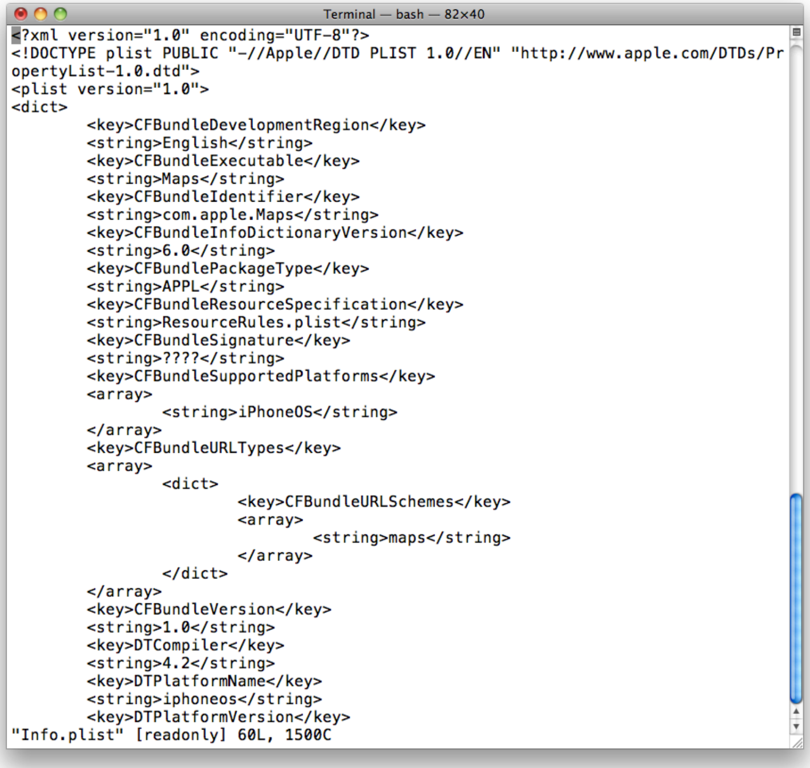

Decoding plist Files



```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple//DTD PLIST 1.0//EN" "http://www.apple.com/DTDs/Pr
opertyList-1.0.dtd">
<plist version="1.0">
<dict>
        <key>CFBundleDevelopmentRegion</key>
        <string>English</string>
        <key>CFBundleExecutable</key>
        <string>Maps</string>
        <key>CFBundleIdentifier</key>
        <string>com.apple.Maps</string>
        <key>CFBundleInfoDictionaryVersion</key>
        <string>6.0</string>
        <key>CFBundlePackageType</key>
        <string>APPL</string>
        <key>CFBundleResourceSpecification</key>
        <string>ResourceRules.plist</string>
        <key>CFBundleSignature</key>
        <string>????</string>
        <key>CFBundleSupportedPlatforms</key>
        <array>
                <string>iPhoneOS</string>
        </array>
        <key>CFBundleURLTypes</key>
        <array>
                <dict>
                        <key>CFBundleURLSchemes</key>
                        <array>
                                <string>maps</string>
                        </array>
                </dict>
        </array>
        <key>CFBundleVersion</key>
        <string>1.0</string>
        <key>DTCompiler</key>
        <string>4.2</string>
        <key>DTPlatformName</key>
        <string>iphoneos</string>
        <key>DTPlatformVersion</key>
"Info.plist" [readonly] 60L, 1500C
```

- plutil -convert xml1 Info.plist
- Much nicer

iOS URL Handlers

- XPath: Look for:

/plist/dict/array/dict[key='CFBundleURLSchemes']/array/string

- Now you know the URL Schemes the app handles

- SANS blog post on this issue in iOS:
  - http://software-security.sans.org/blog/2010/11/08/insecure-handling-url-schemes-apples-ios/?utm_source%253Drss%2526utm_medium%253Drss%2526utm_campaign%253Dinsecure-handling-url-schemes-apples-ios
  - Too long to type? http://bit.ly/ezqdK9

Android Intents

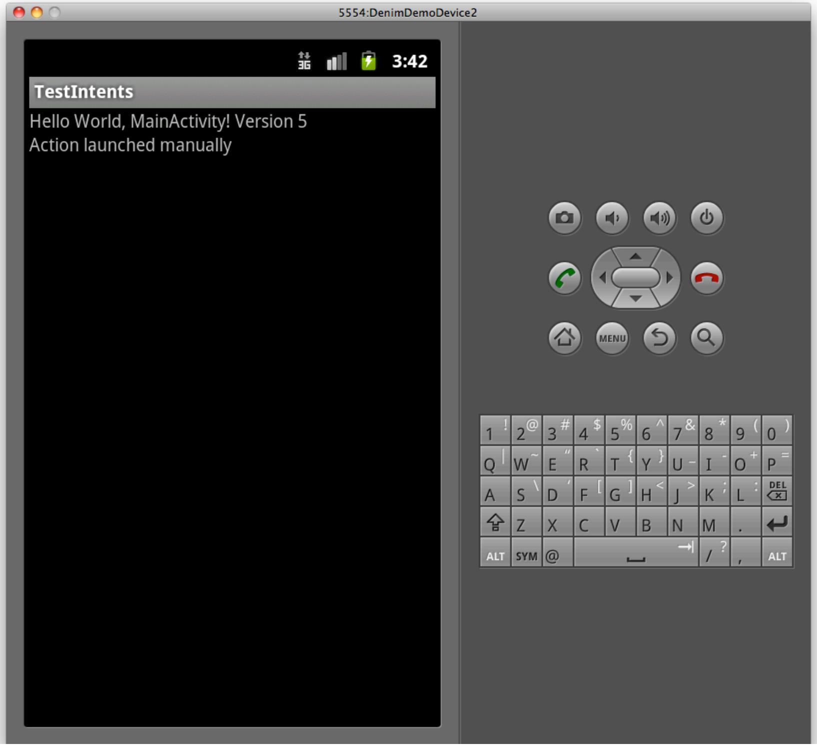
- Intents are facilities for late-binding messaging between applications
  - *http://developer.android.com/guide/topics/intents/intents-filters.html*
- One use is to allow applications to register to receive messages from the Browser when certain types of content are received
  - *Like iOS URL Schemes but an even more comprehensive IPC mechanism*

Intent Filter Example

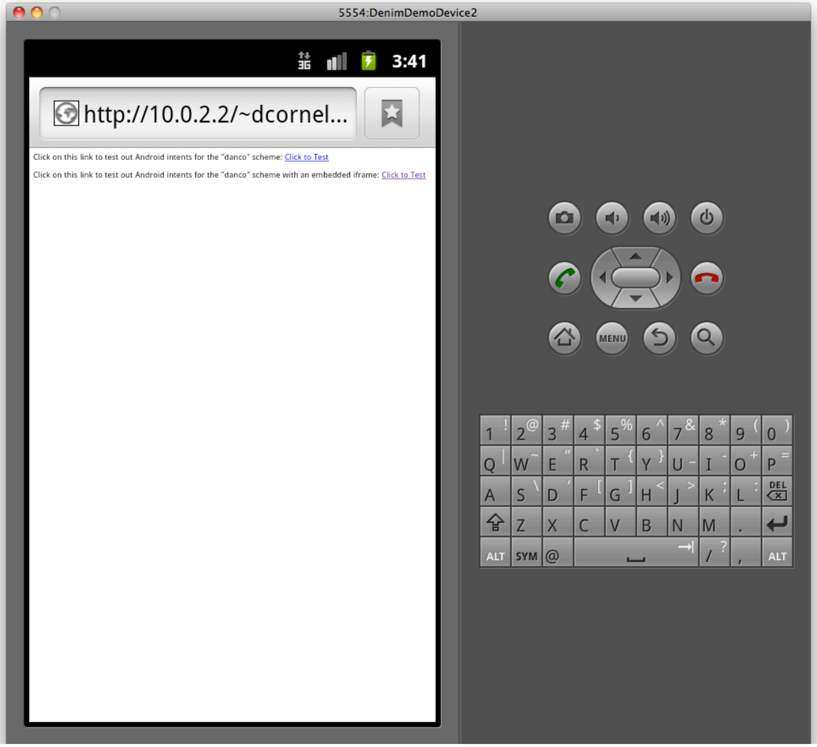
```
<intent-filter>
   <action android:name="android.intent.action.VIEW" />
   <category
   android:name="android.intent.category.DEFAULT" />
   <category
   android:name="android.intent.category.BROWSABLE" />
   <data android:scheme="danco" />
</intent-filter>
```

- Action: What to do?
- Data: Scheme is URI "protocol" to handle
- Category BROWSABLE: Allow this Action to be initiated by the browser

Intent Filter Demo – Manual Launch, HTML Page



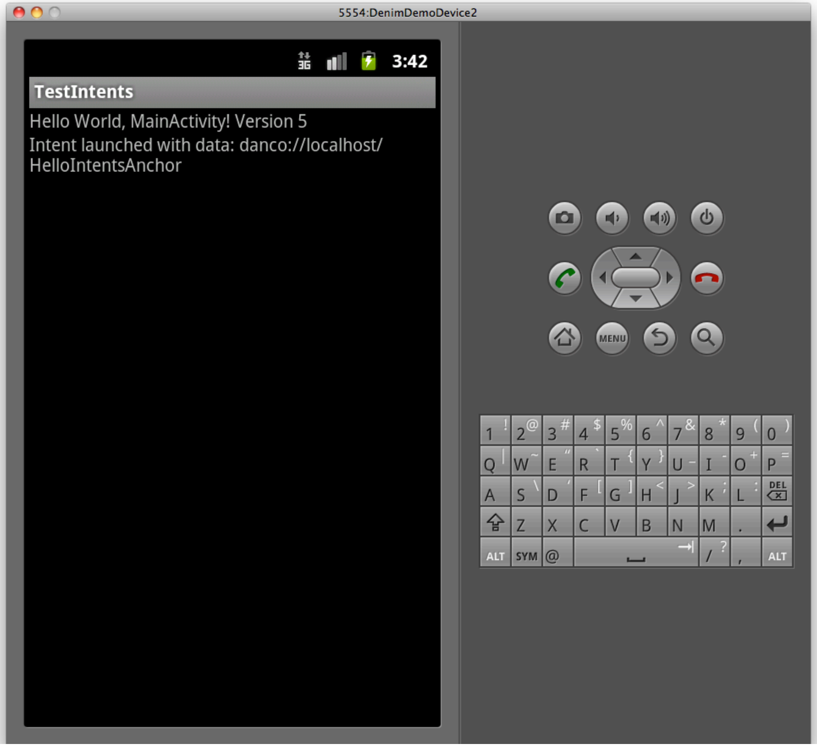
Hello World, MainActivity! Version 5
Action launched manually



Click on this link to test out Android intents for the "danco" scheme: Click to Test

Click on this link to test out Android intents for the "danco" scheme with an embedded iframe: Click to Test

Intent Filter Demo – Anchor Launch, IFrame Launch

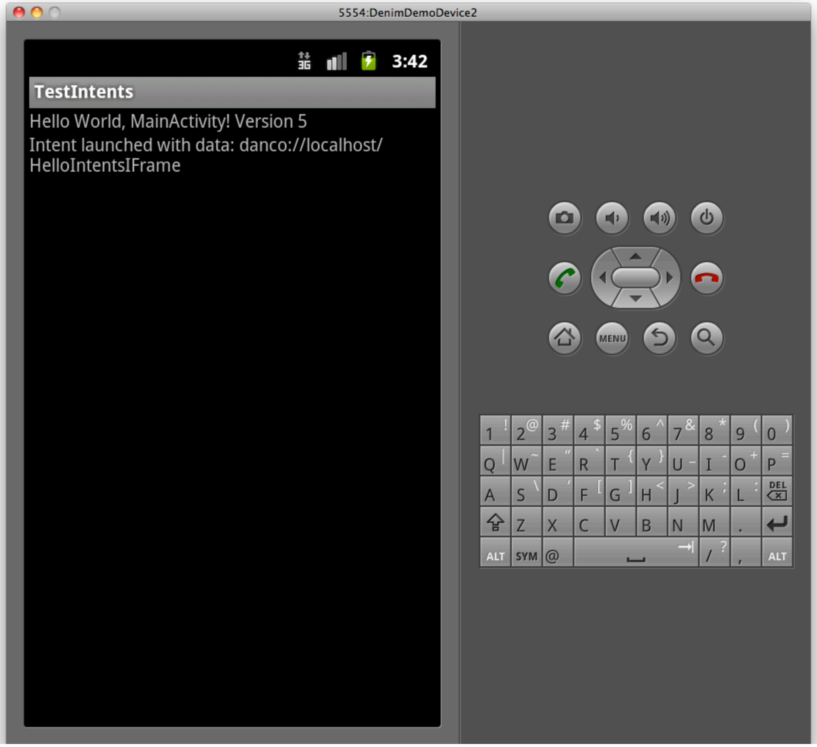


5554:DenimDemoDevice2

3:42

TestIntents

Hello World, MainActivity! Version 5
Intent launched with data: danco://localhost/HelloIntentsAnchor



5554:DenimDemoDevice2

3:42

TestIntents

Hello World, MainActivity! Version 5
Intent launched with data: danco://localhost/HelloIntentsIFrame

I’m a Security Tester. Why Do I Care?

- URL handlers are remotely-accessible attack surface

- This is a way for you to “reach out and touch” applications installed on a device if you can get a user to navigate to a malicious page
- Send in arbitrary URLs via links or (easier) embedded IFRAMEs

- Example: iOS Skype application used to automatically launch the Skype application and initiate a call when it encountered a skype:// URL
  - *Apple’s native Phone handle for tel:// URLs would confirm before a call was made*

I’m a Developer. Why Do I Care?

- See the previous slide. Bad guys care. So should you. Please.

- Content passed in via these handlers must be treated as untrusted
  - *Positively validate*
  - *Enforce proper logic restrictions*

- All:
  - *Should a malicious web page be able to cause this behavior?*
    - Make phone call, transmit location, take photo, start audio recording, etc.
- iOS:
  - *Validate inputs to* `handleOpenURL:` *message*
- Android:
  - *Validate data brought in from* `Action.getIntent()` *method*

So What Should Developers Do?

- Threat model your smartphone applications
  - *More complicated architectures -> more opportunities for problems*
- Watch what you store on the device
  - *May have PCI, HIPAA implications*
- Be careful consuming 3rd party services
  - *Who do you love? Who do you trust?*
- Be careful deploying enterprise web services
  - *Very attractive target for bad guys*
  - *Often deployed "under the radar"*

Secure Mobile Development Reference

- Platform-specific recommendations
- Key topic areas

- Provide specific, proscriptive guidance to developers building mobile applications

Specific Platforms

- iOS (iPhone, iPad)
- Android
- Blackberry (in progress)
- Windows Phone 7 (in progress)
  - Windows Mobile 6.5 (?)
- Symbian (?)
- Others (?)

- Will be guided by demand, which is focused by new development activity

Topics Areas

- Topic Areas
  - *Overview of Application Development*
  - *Overview of Secure Development*
  - *Defeating Platform Environment Restrictions*
  - *Installing Applications*
  - *Application Permissions Model*
  - *Local Storage*
  - *Encryption APIs*
  - *Network Communications*
  - *Protecting Network Communications*
  - *Native Code Execution*
  - *Application Licensing and Payments*
  - *Browser URL Handling*

So What Should Security People Do?

- Find out about smartphone projects
  - *Not always done by your usual development teams*
  - *R&D, "Office of the CTO," Marketing*
- Assess the security implications of smartphone applications
  - *What data is stored on the device?*
  - *What services are you consuming?*
  - *Are new enterprise services being deployed to support the application?*

Resources

- axml2xml.pl (Convert Android XML files to normal XML)
  - http://code.google.com/p/android-random/downloads/detail?name=axml2xml.pl
- Dedexer (Convert DEX bytecodes into DEX assembler)
  - http://dedexer.sourceforge.net/
- Dex2jar (Convert DEX bytecode in Java bytecode)
  - http://code.google.com/p/dex2jar/
- JD-GUI (Convert Java bytecode to Java source code)
  - http://java.decompiler.free.fr/
- otool (Get information about iPhone binaries)
  - http://developer.apple.com/library/mac/#documentation/Darwin/Reference/ManPages/man1/otool.1.html

Online

- Code, slides and videos online:

www.smartphonesdumbapps.com

Questions?

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