Secure Android Applications
The OWASP Way

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Overview

- Who I am/ What we do
- OWASP Mobile Security Project
- Mobile World Meets Security World
- Android Crash Course
- Threat Modeling Android Apps
- Risks and Controls
- Where Do We Go From here?
- Q&A, Resources

Who I Am/ What We Do/ Where We Are

- Who I am
  - Jack Mannino
  - Company co-founder
  - Co-leader of the OWASP Mobile Security Project
  - Has a lot of phones…..
- What we do:
  - Mobile Application Security
  - Web Application Security
  - Penetration Testing
  - Secure Development Training
- Where we are:
  - Northern Virginia

OWASP Mobile Security Project

OWASP Mobile Security Project

- Began in 2010
- Current state of mobile application security: **bad**

- We are aiming to make it: **good**

- How do we plan to achieve this?

OWASP Mobile Security Project

Disclaimer

- We support OWASP by contributing expertise to the security community
- OWASP does not support or endorse our business and services
- Why am I mentioning this?
- https://www.owasp.org/index.php/OWASP_brand_usage_rules

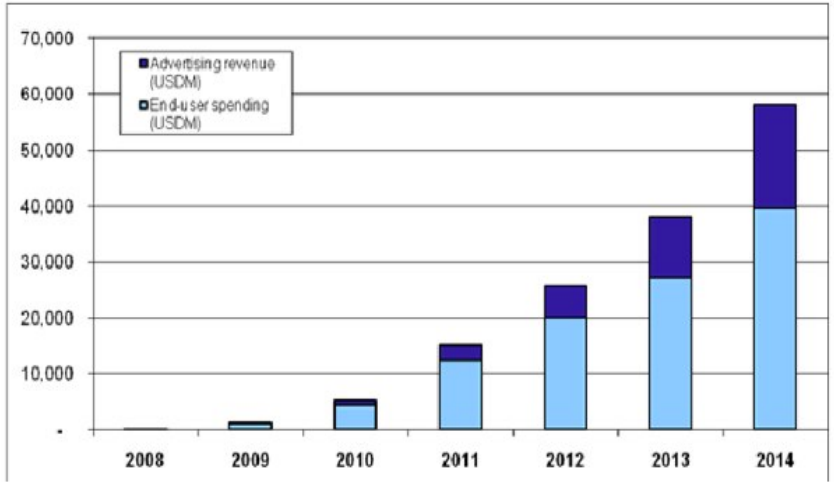
Mobile World Meets Security World

Mobile World Meets Security World

- Once upon a time, all phones could do was make phone calls….
- And then, the world changed
- Today's mobile devices do things like
  - Make phone calls
  - Send SMS messages
  - Browse the web
  - VPN into corporate assets
  - Video conferencing
  - Track our location
  - Tap our phones to pay for things (soon)
- Is anyone making money?
- Do people use these things and their "apps"?

Mobile World Meets Security World- Show Me The Money!!

"Gartner Forecasts Mobile App Store Revenues Will Hit $15 Billion in 2011" *(http://techcrunch.com/2011/01/26/mobile-app-store-15-billion-2011/)*



"Industry first: Smartphones pass PCs in sales" *(http://tech.fortune.cnn.com/2011/02/07/idc-smartphone-shipment-numbers-passed-pc-in-q4-2010/)*

Top Five Smartphone Vendors, Shipments, and Market Share, Q4 2010 (Units in Millions)

Vendor	4Q10 Units Shipped	4Q10 Market Share	4Q09 Units Shipped	4Q09 Market Share	Year-over-year growth
Nokia	28.3	28.0%	20.8	38.6%	36.1%
Apple	16.2	16.1%	8.7	16.1%	86.2%
Research In Motion	14.6	14.5%	10.7	19.9%	36.4%
Samsung	9.7	9.6%	1.8	3.3%	438.9%
HTC	8.6	8.5%	2.4	4.5%	258.3%
Others	23.5	23.3%	9.5	17.6%	147.4%
Total	**100.9**	100.0%	**53.9**	100.0%	**87.2%**

Top 5 Vendors, Worldwide PC Shipments, Fourth Quarter 2010 (Preliminary) (Units Shipments are in thousands)

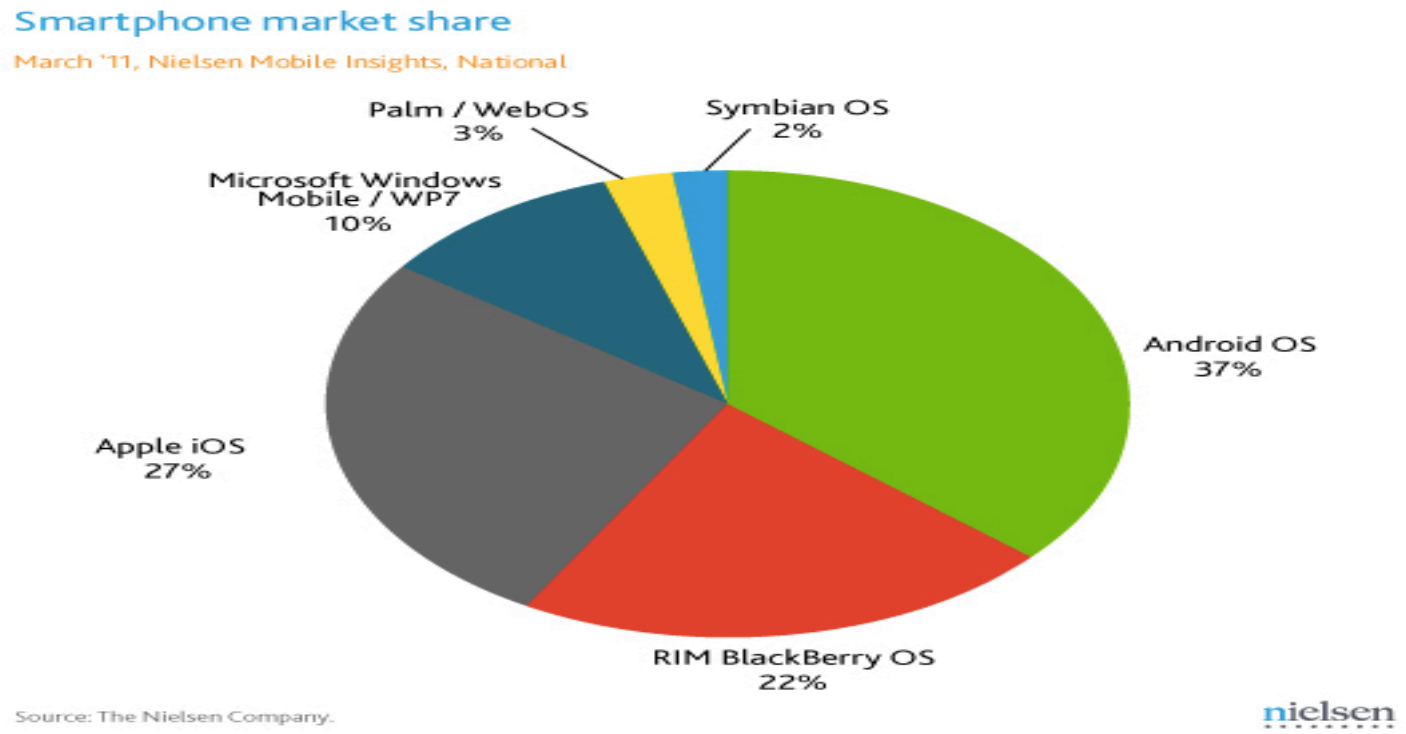
Rank	Vendor	4Q10 Shipments	Market Share	4Q09 Shipments	Market Share	4Q10/4Q09 Growth
1	HP	17,955	19.5%	18,115	20.2%	-0.9%
2	Dell	11,140	12.1%	10,686	11.9%	4.2%
3	Acer Group	9,775	10.6%	11,505	12.8%	-15.0%
4	Lenovo	9,551	10.4%	7,888	8.8%	21.1%
5	Toshiba	5,347	5.8%	4,768	5.3%	12.1%
	Others	38,308	41.6%	36,687	40.9%	4.4%
	All Vendors	92,075	100.0%	89,649	100.0%	2.7%

Source: IDC Worldwide Quarterly PC Tracker, January 12, 2011

Android Crash Course

And Now…Android!

- Debuted in 2008
- Most popular mobile platform around

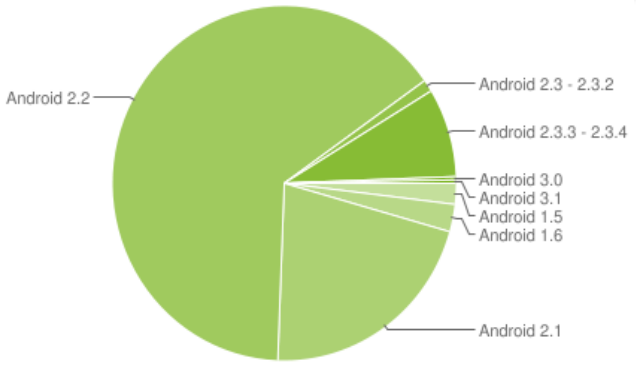


People Use Android….Now What?

- Huge market share + attack monetization = target
- Android Market is OPEN (in a bad way)
- In the past 2 months, 4 times as much Android malware as all of 2010 (Source: Friend @ Lookout Mobile Security)
  - GGTracker- Toll fraud
  - DroidDream- Trojan in over 50 Android apps
  - Plankton- Steals browsing history, credentials, device logs, and more
    - 12 apps undetected in the Android Market for over 2 months!
    - Masqueraded with titles like “Angry Birds Rio Unlock”

It Gets Worse

- Mobile developers are partying like it's 1999
- Android platform is highly fragmented
- Apps are self-signed
- Old vulnerabilities are new vulnerabilities
- New developers, new companies
- Have we learned anything?!

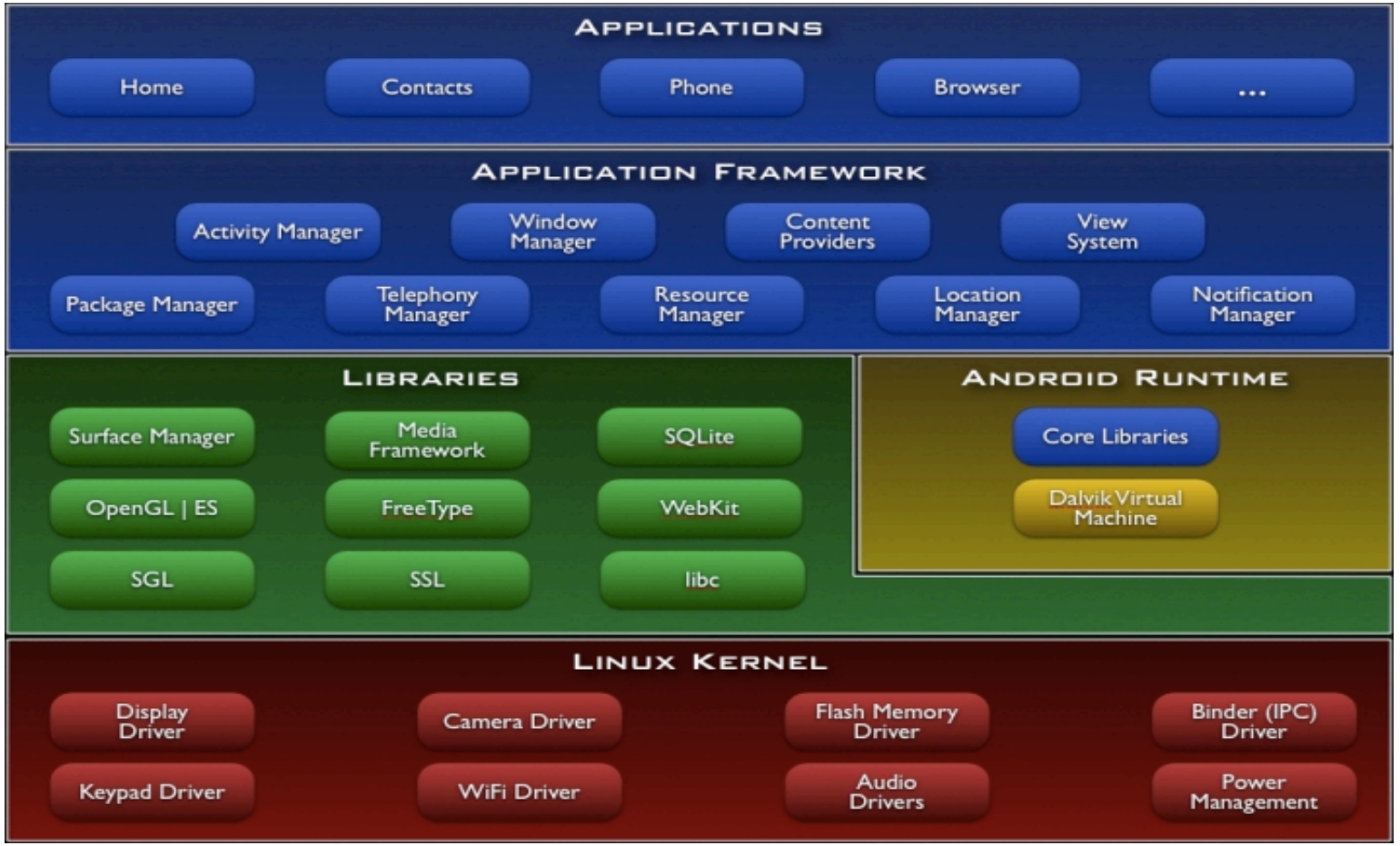


Platform	API Level	Distribution
Android 1.5	3	1.9%
Android 1.6	4	2.5%
Android 2.1	7	21.2%
Android 2.2	8	64.6%
Android 2.3 - Android 2.3.2	9	1.1%
Android 2.3.3 - Android 2.3.4	10	8.1%
Android 3.0	11	0.3%
Android 3.1	12	0.3%

Android Crash Course- Overview

- Linux-based operating system
- Optimized for ARM architecture
- Android runtime and libraries run on top of the OS
- Applications run within the Dalvik Virtual Machine
- Dalvik = optimization, not security
- Each application runs in its own process (with exceptions)
- Permissions model dictates what apps can/can't do (sometimes)

Android Crash Course- Architecture



- **AndroidManifest.xml**
  - Main configuration file
  - Where most components are declared
    - Permissions
    - Activities
    - Intents
    - Content Providers

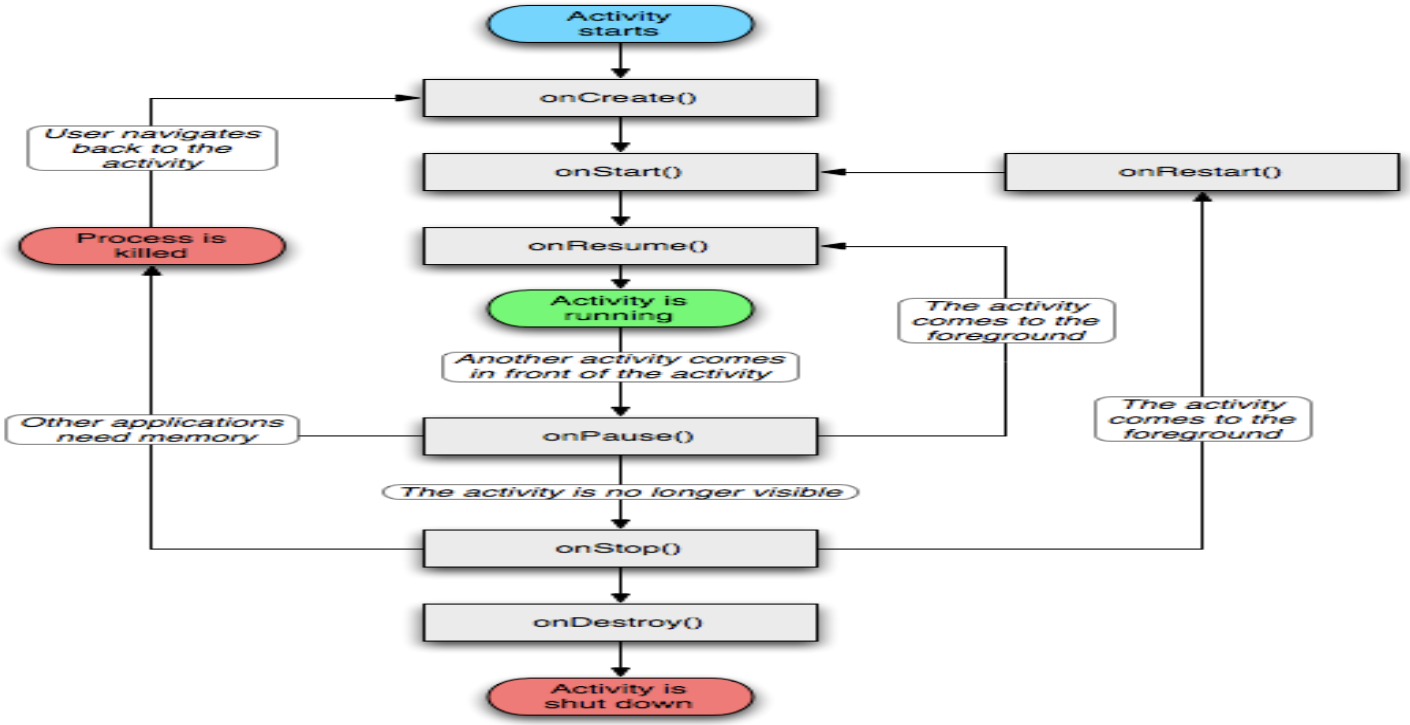
```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.nvisium.tapjacking" android:versionCode="2"
    android:versionName="2.0">
    <uses-sdk android:minSdkVersion="7" />

    <application android:icon="@drawable/n" android:label="@string/app_name">
        <activity android:name=".Main" android:label="@string/app_name">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
        <service android:name=".DialerService">
            <intent-filter>
                <action android:name="com.nvisium.tapjacking.DialerService" />
            </intent-filter>
        </service>
        <service android:name=".BackgroundInstallerService">
            <intent-filter>
                <action android:name="com.nvisium.tapjacking.BackgroundInstallerService" />
            </intent-filter>
        </service>
    </application>

</manifest>
```

- **Permissions**
  - Applications are granted permissions for various actions
  - Declared within AndroidManifest.xml
  - "All or nothing" basis
    - ACCESS_FINE_LOCATION
    - CALL_PHONE
    - WRITE_SETTINGS
    - WRITE_SMS
    - READ_LOGS
    - And many, many more
    - Custom permissions too

- **Permissions**
  - Some developers go overboard
  - Questionable apps often request ridiculous permissions too
    - Example: Justin Bieber Wallpaper

- android.permission.PROCESS_OUTGOING_CALLS
- android.permission.WAKE_LOCK,
- android.permission.READ_PHONE_STATE
- android.permission.INTERNET
- android.permission.RECEIVE_BOOT_COMPLETED
- android.permission.ACCESS_NETWORK_STATE
- android.permission.ACCESS_COARSE_LOCATION
- android.permission.ACCESS_FINE_LOCATION
- com.google.android.googleapps.permission.GOOGLE_AUTH
- com.google.android.googleapps.permission.GOOGLE_AUTH.OTHER_SERVICES
- android.permission.GET_ACCOUNTS

- **Activity**
  - Single, focused thing a user can do (simple definition)

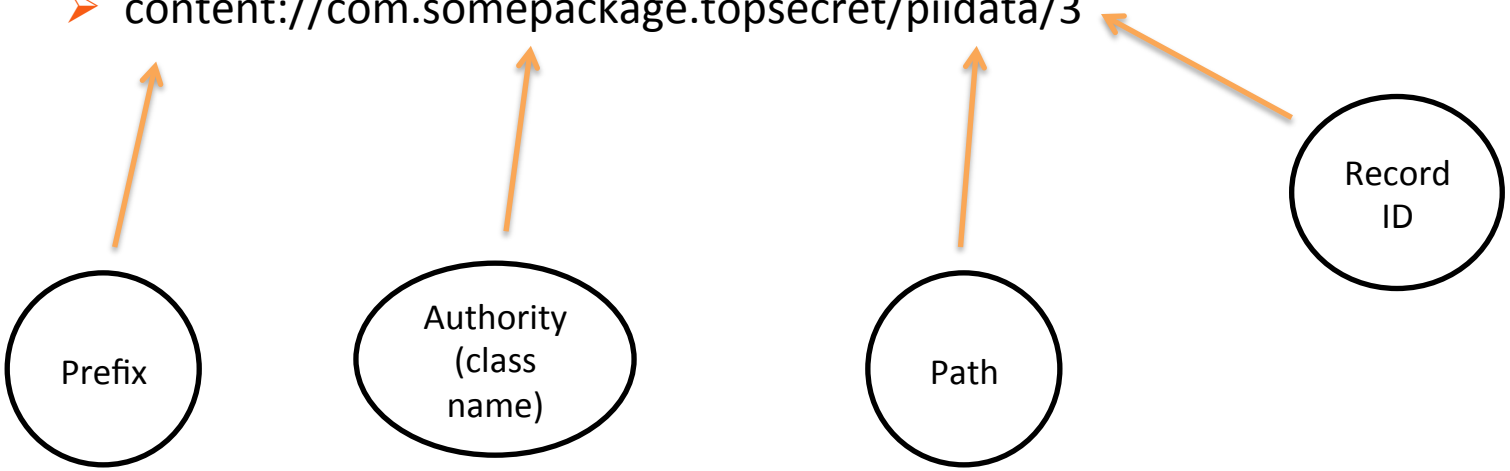


Source: http://developer.android.com/reference/android/app/Activity.html

- **Intent**
  - Used to launch Activities and communicate with other components
  - Primary way of passing around data within Android

```
Intent intent = new Intent(Intent.ACTION_DIAL);
intent.setFlags(Intent.FLAG_ACTIVITY_NEW_TASK);
// showing Google some love
intent.setData(Uri.parse("tel:650-253-0000"));
getApplication().startActivity(intent);
```

- **Content Provider**
  - Used to expose and access data across applications
  - Permissions are declared by provider attribute in AndroidManifest.xml
  - Exposes data using a URI format
  - content://com.somepackage.topsecret/piidata/3

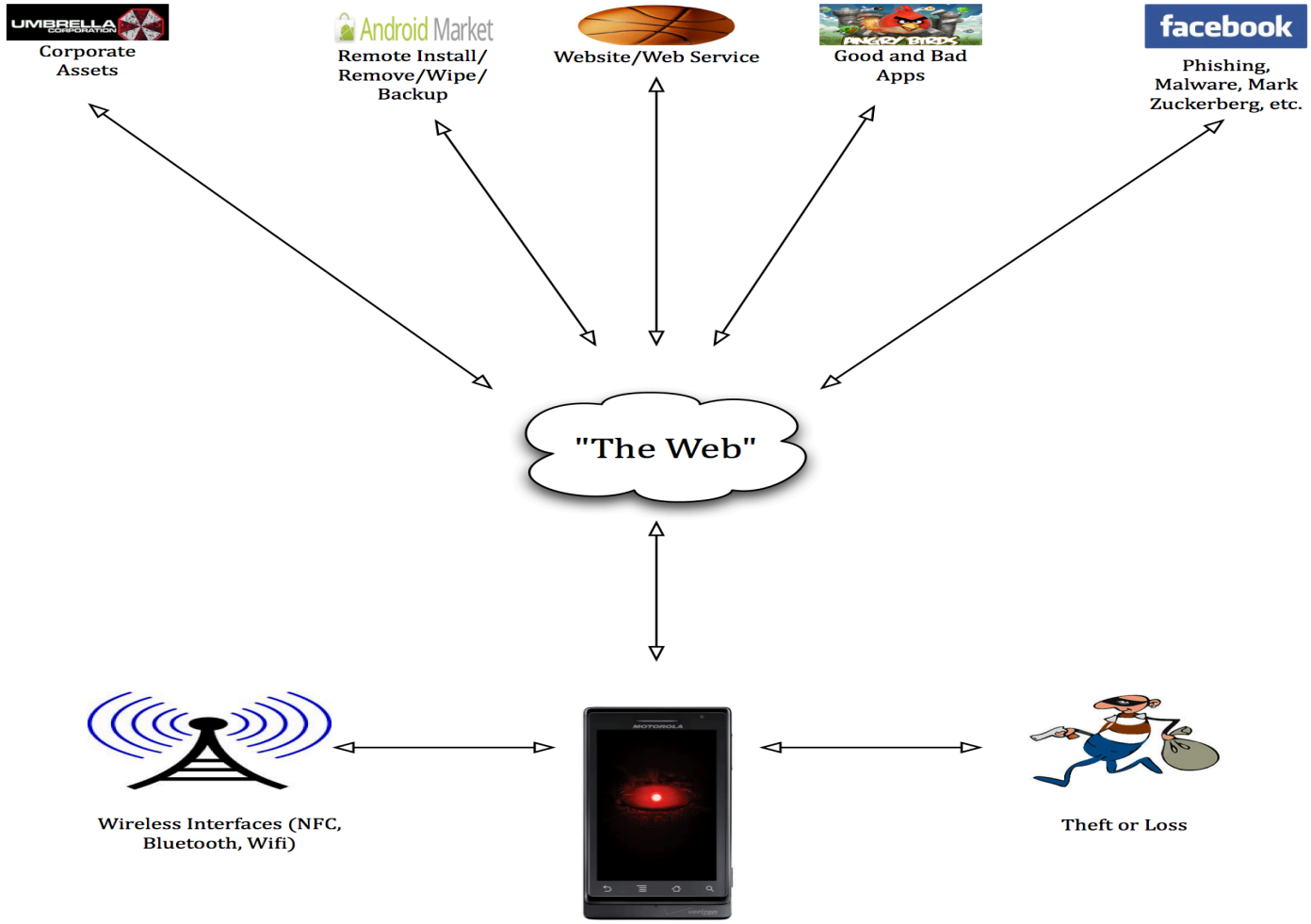


Threat Modeling Android Apps

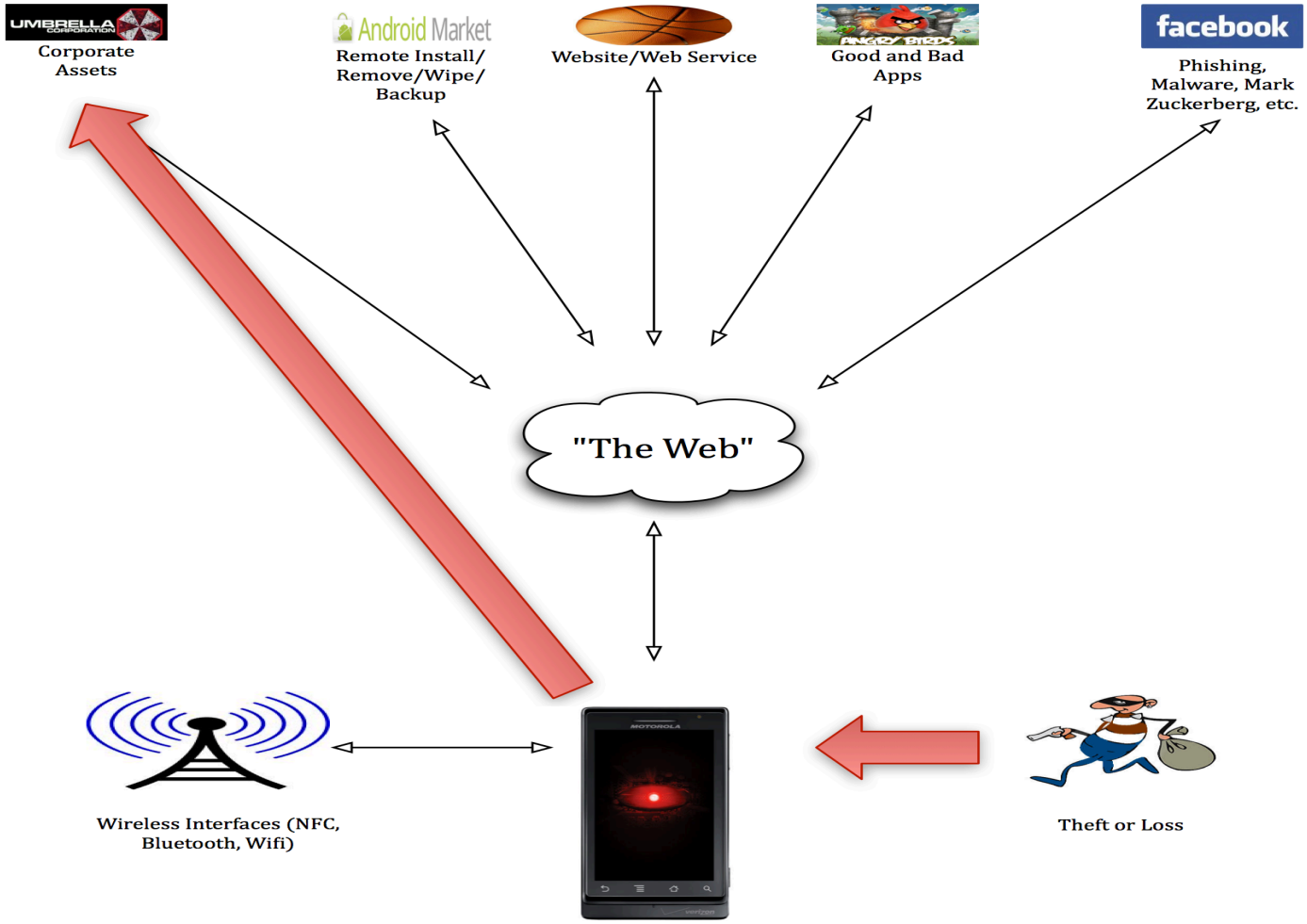
Threat Modeling Android Apps

- Threat modeling is used to better understand an application's surface for attack
- Don't assume the sky is falling…..
- Assume that it already fell
- Users:
  - Root their phones
  - Lose their phones
  - Install things they shouldn't
  - Use public wifi
  - Never listen to security people (ever)…
- Now we can see the bigger picture

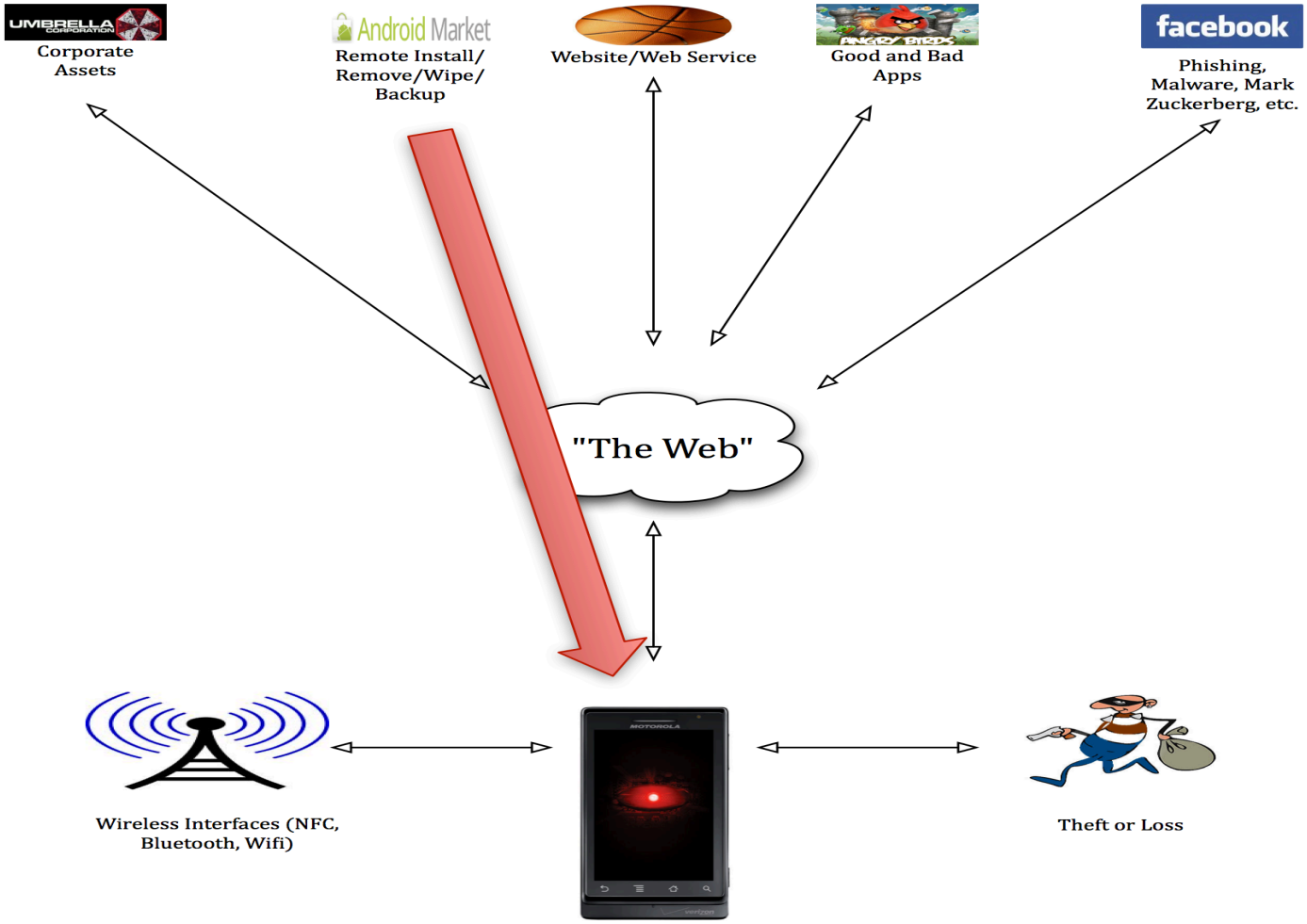
Threat Modeling Android Apps



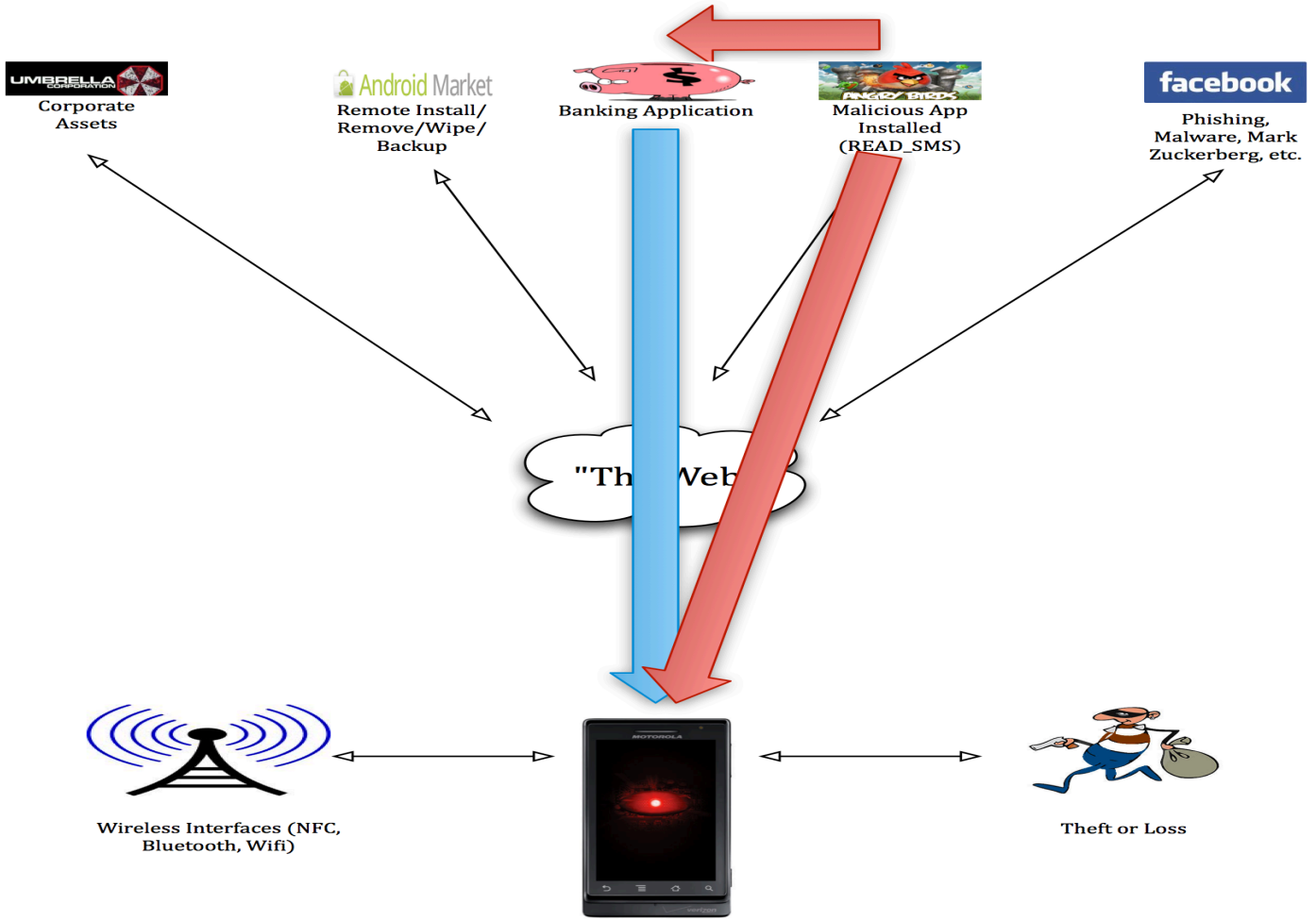
Threat Modeling Android Apps- Loss Or Theft



Threat Modeling Android Apps- Remote Market Attack



Threat Modeling Android Apps- Legacy Architectures



Risks And Controls

Top 10 Risks

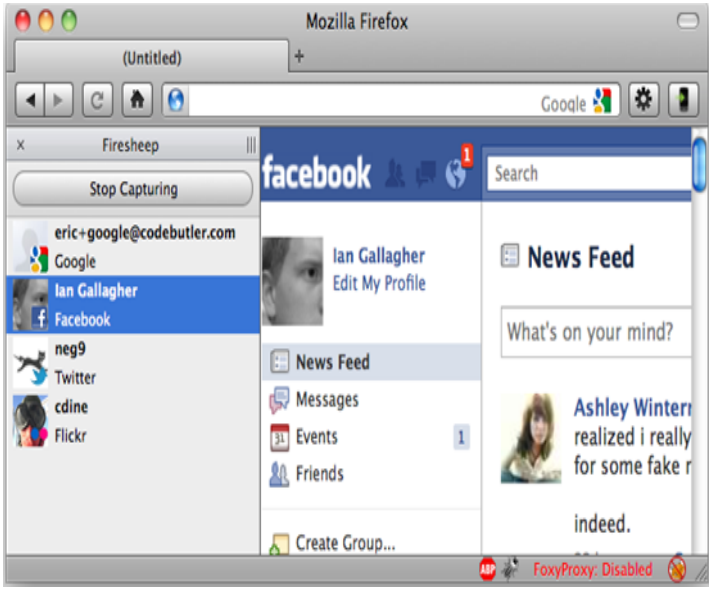
1. Insecure or unnecessary client-side data storage
2. Lack of data protection in transit
3. Personal data leakage
4. Failure to protect resources with strong authentication
5. Failure to implement least privilege authorization policy
6. Client-side injection
7. Client-side Denial Of Service (DoS)
8. Malicious third-party code
9. Client-side buffer overflow
10. Failure to apply server-side controls

- Do I really have to store it?

```
# cd shared_prefs
# ls
com.evernote_preferences.xml
# cat
com.evernote_preferences.xml
<?xml version='1.0' encoding='utf-8' standalone='yes' ?>
<map>
    <string name="serviceHost">
    <string name="username">happy_gilmore</string>
    <boolean name="ACCOUNT_CHECKED" value="true" />
    <string name="password">MyPassword123</string>
    <int name="servicePort" value="0" />
    <boolean name="NotifyUploadStatus" value="true" />
</map>
#
```

#2 Lack of Data Protection in Transit

- No SSL/TLS
- Broken SSL/TLS
  - Ignoring certificate errors to “make apps work”
  - Facilitates Man In The Middle (MITM) attacks
- Near Field Communications (NFC) leaves transport encryption up to the developers to implement correctly



- Controls:
  - Use strong transport encryption when transmitting sensitive information
    - Even over 3G/4G…assume the carrier is compromised too
  - Detect errors and properly handle them
    - Unrecognized CA
    - Certificate name mismatches

#3 Personal Data Leakage

- Logging sensitive information
- Caching sensitive information
  - Browser
  - Search history
  - Location information

- Controls:
  - Use only protected storage areas
    - Never external media!
    - Don't use the global log file
  - Understand the implications of what you are storing and caching
    - Do you really need 3 years of GPS info on the device?

#4 Failure To Protect Resources With Strong Authentication

- This risk presents itself in multiple ways:
  - App-to-app
    - Single Sign On (Google Auth, Facebook)
    - Exposing Content Providers, Broadcasts
  - Client/Server
    - Has overlap with #10- Failure To Apply Server Side Controls

- Controls:
  - Keep small session timeout windows when possible
  - Require re-authentication for sensitive actions
  - Never authenticate based on:
    - Device ID
    - Location

#5 Failure To Implement Least Privilege Authorization Policy

- Overly permissive permissions granted to apps
  - Does an application really need to modify system settings?
  - Does the permission even get used?
- File access
  - MODE_WORLD_READABLE, MODE_WORLD_WRITEABLE
- Overexposing Android components
  - Activities
  - Intents
  - Content Providers
- Controls:
  - Only grant what is needed
  - K.I.S.S.
  - Common sense usually prevails

#6 Client-Side Injection

- Lots of familiar faces
  - Cross Site Scripting (XSS)
  - Client-side SQL Injection
- Multiple entry points
  - Browser
  - App-to-app
  - Server-side initiated attacks
- Controls:
  - Encode data as close to parser boundary as possible
  - Validate input, validate output
  - Database calls should use prepared statements
    - String concatenation = still bad

#7 Client-Side DoS

- Scenarios that cause an application to stop working
  - Application crashes
  - Denies system resources to other apps
    - Dialing 911
- May be triggered
  - Server side
  - Client-side
- Controls:
  - Handle exceptions gracefully
  - Perform load testing to ensure resources are released as intended

#8 Malicious Third-Party Code

- Lots of free to use code
  - Do your due diligence before using it
  - Trustworthy sources only
  - Perform code review before using third party libraries

#9 Client-Side Buffer Overflow

- On Android, applies to native apps
  - If your application uses native libraries, this applies
  - If you are using the standard SDK, less to worry about

- Controls:
  - As insurance, always validate input and output
  - Perform bounds checking on native code you develop

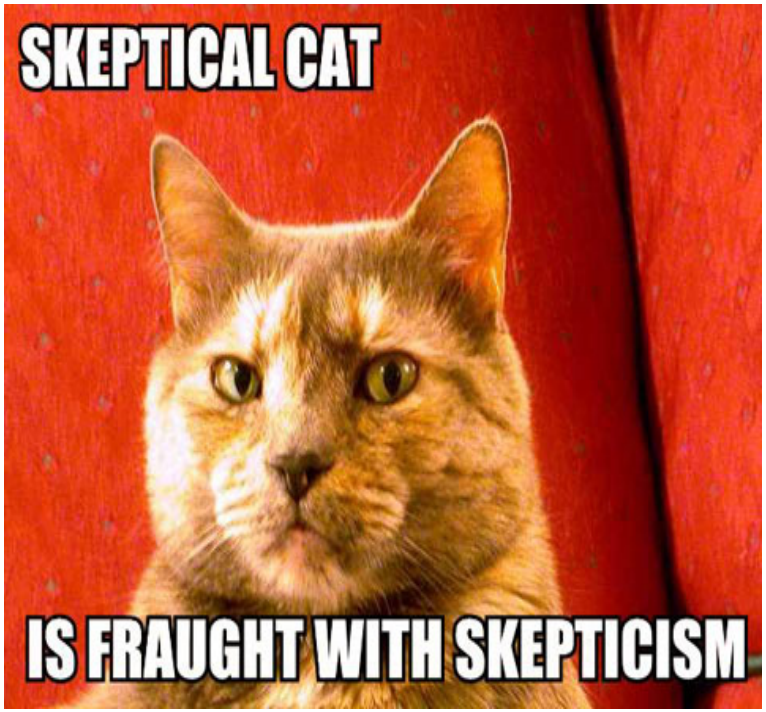
#10 Failure To Apply Server-Side Controls

- This should be familiar territory
  - Anything originating from the client = untrusted
- Parameter manipulation
  - Prices
  - User ID (potential privilege escalation)
- Injection Attacks
  - SQL Injection (against server)
  - Attacking web services
- Controls:
  - Many…
  - OWASP Top 10 for web covers these issues

Where Do We Go From Here?

What Happens Next?

- We haven't seen ANYTHING yet
- Ton of education and awareness needed
- Things will get worse before they get better
- Technology is outpacing security
- Can't fix the hard stuff without fixing easy stuff



Questions?

- Got them? Ask them
- I hope this was useful
- Thank you for attending!
- Contact Information:
  - Jack@nvisiumsecurity.com
  - http://twitter.com/jack_mannino
  - http://www.linkedin.com/pub/jack-mannino/7/2b7/562

Resources

- OWASP Mobile Security Project
  - https://www.owasp.org/index.php/OWASP_Mobile_Security_Project
- Android Developer Resources
  - http://developer.android.com/index.html
- DroidDream
  - http://blog.mylookout.com/2011/03/security-alert-malware-found-in-official-android-market-droiddream/
- Plankton
  - http://www.csc.ncsu.edu/faculty/jiang/Plankton/
- OWASP iGoat Project
  - https://www.owasp.org/index.php/OWASP_iGoat_Project