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Resurrecting The READ_LOGS Permission On Samsung Devices

Ryan Johnson, George Mason University

Angelos Stavrou, Kryptowire

Agenda

- android.permission.READ_LOGS permission
- Sensitive data written to the Android log
- How to regain the READ_LOGS permission on Samsung devices
- Why certain Samsung builds write notifications to the Android log
- Threat resolution

android.permission.READ_LOGS

- READ_LOGS allows access to various device logs
- Android 4.1 and up, this permission stopped being granted to user apps

```
<!-- @SystemApi Allows an application to read the low-level system log files.
    <p>Not for use by third-party applications, because
    Log entries can contain the user's private information. -->
    <permission android:name="android.permission.READ_LOGS"
        android:permissionGroup="android.permission-group.DEVELOPMENT_TOOLS"
        android:protectionLevel="signature|system|development"
        android:label="@string/permlab_readLogs"
        android:description="@string/permdesc_readLogs" />
```

Android Log

- A shared resource that any process can use
- Google apps, user apps, and Android OS processes can write sensitive data to the log
- android.util.[Log, Slog, EventLog]
- Generally read with logcat
- Full access requires user belong to the log group

Why regain READ_LOGS perm?

- User's email addresses
- Cell-tower ID (which can get an approximation of their location using http://opencellid.org/)
- Raw GPS data
- Non-Google account names (e.g., Twitter)
- Cellular network and Wi-Fi information
- Voicemail number
- The name associated with a Gmail account
- Google IDs (which can be used to view Google+ page)
- Being able to tell whether the user is present or not

Why regain READ_LOGS perm?

- Integrated Circuit Card Identifier (ICCID)
- International Mobile Subscriber Identity (IMSI)
- Mobile Country Code Mobile Network Code (MCCMNC)
- Device serial number
- MAC address
- URLs and GPS coordinates opened via an Intent with the android.intent.action.VIEW action string
- URLs in Chrome for which there are errors
- Which apps the user or system executes and when

Write all the sensitive data to the log

- A certain Fitness & Health app on Google Play writes the following data to the Android log
  - — username, password, cookies, insurance information, your medical procedures, your medications, and your conditions
- 5,000,000 – 10,000,000 installations
- Around 85,000 reviews
- Informed the company

Write all the sensitive data to the log

User Login
MARK : appboy login stuff (my itriage login): 1237397, feelsgoodman@gmail.com

User Password
JOSH : key 1 generated from password: *trap_Door[190*

Cookie
j : Cookie:
_itriage_session_tracker=f1ebcf48939fb7968ebe962ff6c46b55.1414426817;
_itriage_unique_tracker=75a4db35d1bd977ddd3cff3acfe9fc3d.1414426817;
_itriage_session=8aa8c6bf4d5be5f2c83ab523e77130355c4fc3f575da31fef08d8a458f5d4e4bbd5e93c9d65c1463a3cb59541df5550e02148f5ad2f2256094b2f89412f6d0fb;
env=production
j : Cookie2: $Version=1
j : X-CSRF-Token: YmawWVNBGFFvojUTev65opDRme7UB20KFq3r2iScjAs=

Write all the sensitive data to the log

Security Token
REQUEST PAYLOAD : https://healthnews.itriagehealth.com/preferred_articles.json?installation_id=e6608bc8-f652-425c-b02e-512e59b665fb&security_token=704e16fc5d724657e34d1665c83ac39a2da5c121&page=1&per_page=25&last_updated_since=1414165392.879

Medical Procedures
MARK : {"id":340,"item_note":"Finally","procedure_date":"10\/27\/2014","_etag":"","procedure_doctor":"Dr. Robot","_deleted":false,"name":"Buttocks lift"}

Medications
DUCK : {"4d754d1b-dbbe-4d04-8df9-61df080e130f":{"id":609,"medication_doctor":"Dr. Robot","name":"Diazepam","item_note":"","medication_date":"10\/27\/2014","_awaitingUpload":true,"_deleted":false,"dosages":[{"dose_type_id":3,"amount":"100mg","method_type_id":5,"frequency":"All the time"}]}}

Write everything to the Log

Conditions
DUCK : {"0797760b-433b-494d-b5d3-a5b71909b931":{"id": 10,"item_note":"O_o","_awaitingUpload":true,"_deleted":false,"disease_date":"10\/27\/2014","disease_doctor":"Dr. Robot","name":"Acid (LSD) abuse"}}

Insurance Information (Aetna Group Number W3342212105 Member ID: 1234567-123-12345)
z : https://www.itriagehealth.com/api/v1/narrow_network/33/validate_member_info/W3342212105/1234567-231-12345 -> HTTP/1.1 401 Unauthorized

/system/bin/dumpstate

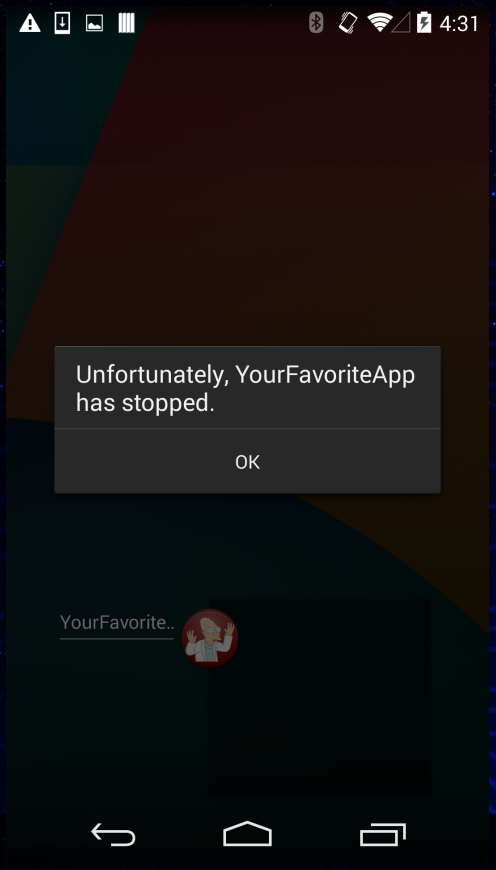
- dumpstate binary collects and writes system-level data when something goes wrong
- Cannot be run by user apps
- Contains Android log, kernel log, system properties, data from the proc file system, etc.
- Generally creates about 3 to 6 MBs of output

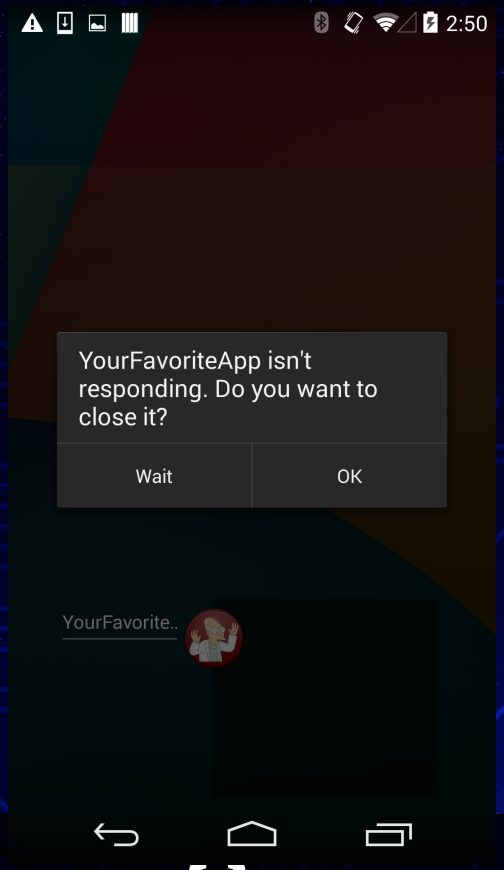
Regaining Android Log Access

- Only appears to work on Samsung devices
- dumpstate gets called when any of the three conditions occur
  - Uncaught exception in app's Dalvik bytecode
  - Application Not Responding (ANR) event
  - Error encountered in an app's native code library
- The first two will generate a system message and the third will not if done properly

Three Different Bricks

- Uncaught exception, ANR, Native code error





Crash in native code

- Java Native Interface (JNI) to call C function
- Call abort() in C function
- Sends SIGABRT signal which is handled by debuggerd and calls dumpstate
- dumpstate will gather system information and write to /data/log/dumpstate_app_native.txt.gz
- Does not generate any error message

Dumpstate Files on Samsung Android

- Dumpstate files written to /data/log

```
-rw-r--r-- shell  log  1007511 2014-10-12 15:51 dumpstate_app_anr.txt.gz
-rw-r--r-- shell  log  605572 2014-10-18 20:54 dumpstate_app_error.txt.gz
-rw-r--r-- shell  log  568151 2014-10-20 23:37 dumpstate_app_native.txt.gz
```

- The dumpstate files are readable by any user on the device

- dumpstate -k -t -z -d -o /data/log/dumpstate_app_native -m 8028

/data/log directory

- From init.rc file from the KOT49H.I9500XXUGNJ1 build (Android 4.4.2)

```
# SA, System SW, SAMSUNG create log directory
  mkdir /data/log 0775 system log
  chown system log /data/log
  mkdir /data/anr 0775 system system
  chown system system /data/anr
  chmod 0775 /data/log
  chmod 0775 /data/anr
  restorecon /data/log
  restorecon /data/anr
```

Android Notifications

- Samsung's android.app.Notification.toString method creates a much more verbose output than the corresponding Android Open Source Project (AOSP) method
  - Samsung's andorid.app.Notificaiton.toString method includes the following instance variables in the string representation of the Notification object
    - contentTitle, contentText, and tickerText

android.app.Notification.toString()

- AOSP
  - Notification(pri=0 contentView=com.kryptowire.bha/0x1090064 vibrate=null sound=null defaults=0x0 flags=0x0 kind=[null])
- Samsung
  - Notification(pri=0 icon=7f020000 contentView=com.kryptowire.bha/0x1090086 vibrate=null sound=null defaults=0x0 flags=0x0 when=1415746428600 ledARGB=0x0 contentIntent=N deleteIntent=N contentTitle=Generic Title contentText=Generic Subject tickerText=Here is a Message kind=[null])

Android Notifications

- com.android.server.NotificationManagerService .enqueueNotificationInternal method snippet

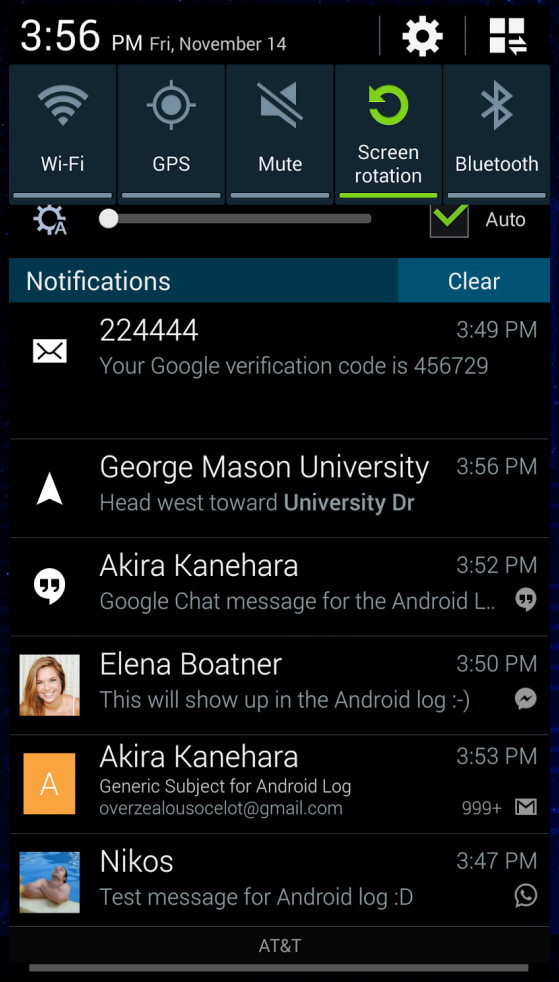
```
// This conditional is a dirty hack to limit the logging done on
// behalf of the download manager without affecting other apps.
if (!pkg.equals("com.android.providers.downloads")
|| Log.isLoggable("DownloadManager", Log.VERBOSE))
{
        EventLog.writeEvent(EventLogTags.NOTIFICATION_ENQUEUE,
pkg, id, tag, userId, notification.toString());
}
```

Android Notifications

- NotificationManagerService writes the toString of notifications to the events buffer of the Android Log by using android.util.EventLog — /dev/log/events

- Forcing dumpstate to run to get Android log data which will contain the text of notifications on vulnerable builds

Notifications in the Android Log




```
11-14 15:50:02.517   813  1391
I notification_enqueue:
[com.facebook.orca,10000,t_mid.
1415995249174:9405c32ed74e69fa7
9,0,Notification(pri=1
icon=7f0207a9
contentView=com.facebook.orca/
0x1090086 vibrate=null
sound=null defaults=0x0
flags=0x1 when=1415998201262
ledARGB=0xff00ff00
contentIntent=Y deleteIntent=N
contentTitle=Elena Boatner
contentText=This will show up
in the Android log :-)
tickerText=Elena Boatner: This
will show up in the Android
log :-) kind=[null] 1 action)]
```

dumpstate file snippet

```
[0,14585,10012,com.android.contacts,broadcast,com.android.contacts/
com.sec.android.app.contacts.ContactsReceiver]
11-14 15:47:29.527   813  1435 I am_create_service:
[0,1170423648,.GoogleAccountDataService,10061,1597]
11-14 15:47:29.547   813   824 I notification_enqueue: [com.whatsapp,1,NULL,
0,Notification(pri=0 icon=7f0205c2 contentView=com.whatsapp/0x1090086
vibrate=null sound=null defaults=0x0 flags=0x0 when=1415998049288 ledARGB=0x0
contentIntent=Y deleteIntent=N contentTitle=Nikos contentText=Test message for
Android log :D tickerText=Message from Nikos kind=[null])]
11-14 15:47:29.567   813  1392 I am_proc_bound: [0,14585,com.android.contacts]
11-14 15:47:29.617   813  1163 I am_proc_start:
[0,14600,10015,com.sec.android.provider.badge,content
provider,com.sec.android.provider.badge/.BadgeProvider]
11-14 15:47:29.657   813  1472 I am_destroy_service: [0,1170423648,1597]
11-14 15:47:29.657   813  1406 I am_destroy_service: [0,1171596560,1597]
11-14 15:47:29.657   813  1461 I am_destroy_service: [0,1173214336,1597]
11-14 15:47:29.667   813   813 I notification_cancel: [android,2,NULL,0,0,0]
11-14 15:47:29.667   813  1438 I am_proc_bound:
[0,14600,com.sec.android.provider.badge]
11-14 15:47:29.738   813 22582 I power_partial_wake_state: [0,ActivityManager-
Launch]
```

Putting it together

- Create app with persistent execution
  — android.permission.RECEIVE_BOOT_COMPLETED
- Start Service application component at boot
- Use JNI to call C code that causes an error in native code at scheduled intervals
- Uncompress and process the dumpstate file
- User should be unaware

Threat Resolution

- Use Android Debug Bridge (ADB) to change the file permissions of the dumpstate files
- Owner is shell and group is log for these files
  - Same as ADB
- touch dumpstate_app_native.txt.gz.tmp
- chmod 000 dumpstate_app_native.txt.gz.tmp
- dumpstate changes from the root user to the shell user
- It uses output redirection to overwrite the file, but it will not be able to write to it due to the file permissions

Vulnerable Builds

- Downloaded firmwares from http://www.sammobile.com/firmwares/
- Flash tar.md5 file to device using Odin
- The notification vulnerability was found in certain Samsung Android 4.3 and 4.4.2 builds, but it was fixed in the Android 4.4.4 FOTA update

Conclusion

- Sanitize sensitive data before writing it to the Android log
- Be careful when extending AOSP code
  — Test and review carefully
- Be mindful of file permissions on files that contain sensitive data

Questions and Discussion

Thank you!

Ryan Johnson

rjohnso8@gmu.edu

rjohnson@kryptowire.com

http://www.kryptowire.com/