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Android Things Security Research in Developer Preview 2

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Background

- About Android Things Developer Preview 2
  - Released in Feb. 2017
  - Update
    - Added new binary image for Intel Joule
    - Added API to access peripheral I/O via C/C++
    - Added USB audio support for some devices
    - Added samples using TensorFlow library
    - Added commands for inspect to peripheral ports
    - Security updates are not documented in the release notes

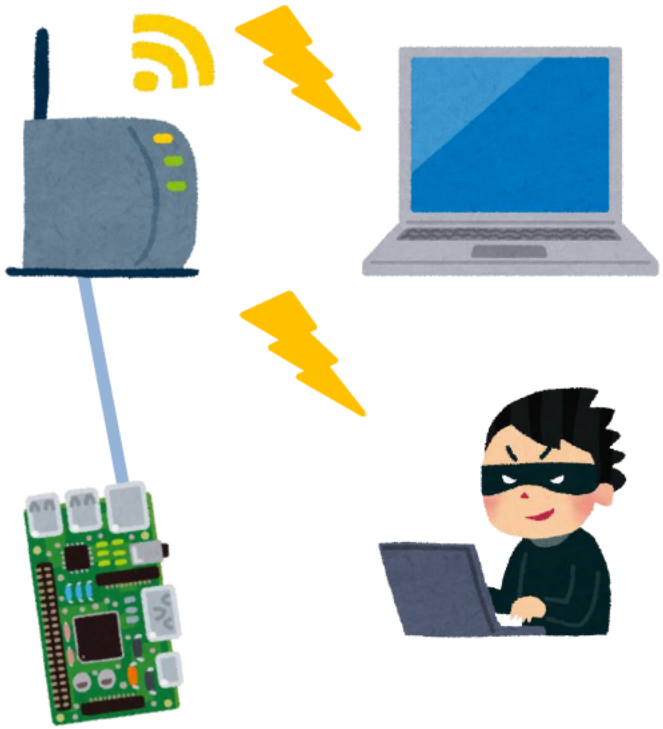
- Point of this research
  - Use case of Android Things
  - Trial settings for security enhancement

Use case and Weave

- Android Things is going to use for smart plug and more
  - Android Things is a smart home platform based on Brillo
  - Android Things will support Weave in the future release

- Google Weave
  - IoT Communication protocol released in 2015
  - It consists of Weave Device SDK and Weave Server
    - Weave Device SDK notify components and traits with device schema
    - Weave Server identifies functions of devices via device schema
  - For many smart home appliances
    - Remote control of air conditioner and more from a mobile app
    - Belkin, WeMo and more vendors are planning to use Weave
  - Resources for IoT device developer
    - Web console and management apps
    - Security guideline
      - TLS basic precautions, encryption and more

Android Things Security Considerations



- Current status of security
  - Everyone can execute arbitrary commands by connecting to adb listening on 5555/tcp without authentication
  - Privilege escalation to root with no password su command
  - App authority
    - All permissions requested by the application are allowed
    - When an application is compromised, there is a possibility of abnormal operation of the device and information leakage
- Assumed threat
  - If the Android Things device with the default setting is connected to the public network, the attacker may be executed arbitrary commands with root privilege

Android Things Version information

- Result of getprop command
  - Release 7.0, SDK 24

```
rpi3:/ # getprop | grep ro.build.version
[...]
[ro.build.version.release]: [7.0]
[ro.build.version.sdk]: [24]
[...]
```

- SDK version by API
  - Source

```
Log.d("Android SDK Version", ""+Build.VERSION.SDK_INT);
```

  - Logcat

```
03-07 08:43:37.075 9756-9756/com.example.test.myapplication D/Android SDK Version: 24
```

- System information by the uname command

```
rpi3:/ # uname -a
Linux localhost 4.4.19-v7+ #1 SMP PREEMPT Thu Feb 9 10:45:31 UTC 2017 armv7l
```

File system information

- Mount states by mount command
  - selinuxfs
    - Filesystem for SELinux

```
rpi3:/ # mount
/dev/root on / type ext4 (rw,seclabel,relatime,data=ordered)
[...]
selinuxfs on /sys/fs/selinux type selinuxfs (rw,relatime)
[...]
```

- Files in root directory
  - /init.rc
    - Android initial settings files

```
rpi3:/ # ls -al
total 2400
[...]
-rwxr-x---   1 root   shell  806624 2016-12-12 21:02 init
-rwxr-x---   1 root   shell     887 2016-12-12 21:02 init.environ.rc
-rwxr-x---   1 root   shell   24183 2016-12-12 21:02 init.rc
[...]
```

Firewall setting

- iptables command exists, but not registered as a service
- Confirm filtering rules

```
rpi3:/ # iptables -L
iptables -L
Chain INPUT (policy ACCEPT)
target     prot opt source               destination
bw_INPUT   all  --  anywhere             anywhere
```

- Add a filtering rule
  - Rules to deny adb connection over Wi-Fi

```
C:¥Users¥test>adb devices
List of devices attached
192.168.0.10:5555       device

C:¥Users¥test>adb shell iptables -A INPUT -i wlan0 -p tcp --destination-port 5555 -j DROP
C:¥Users¥test>adb devices
List of devices attached
```

ADB port setting

- Everyone can find 5555 port(adb port) by nmap port scan
- Modify /init.rc
  - Android Things have not much general network setting file
  - We write setting in "init.rc"
    - init.rc is an initialization file of Android Things
  - We extract the /init.rc and append following sentence in the "on init" method

```
setprop service.adb.tcp.port [modify port]
```

  - (1) We overwrite init file
  - (2) We need fix file permission because permission is changed when overwriting
  - After start-up, default
  - We can reduce the risk of being found service from the port scan

```
C:¥Users¥test>adb root
C:¥Users¥test>adb connect [IP Address]
C:¥Users¥test>adb remount
remount succeeded
C:¥Users¥test>adb push init.rc /init.rc ← (1)
[100%] /init.rc
C:¥Users¥test¥Documents¥17_02>adb shell chmod 750 /init.rc ← (2)
C:¥Users¥test¥Documents¥17_02>adb shell ls -al /init.rc
-rwxr-x---  1 root  root  24249 2017-02-20 12:16 init.rc
```

SELinux setting

- SELinux mode is "permissive" by default
  - We can use “setenforce” command, but reset at reboot
  - “chcon” and “restorecon” exist, but “semanage” does not exist

- Setting for persistent SELinux enforcing
  - Change parameter androidboot.selinux "permissive“ to "enforcing" in CMDLINE.TXT
  - androidboot.selinux=enforcing

- root privilege and password setting
  - Android Things does not have “useradd” and “passwd”
  - We have put /etc/passwd and /etc/shadow, but these have not worked

Conclusions

- Use case
  - Android Things will be targeted at smart home appliances
  - Android Things will support Weave in the future release
  - Weave is a communication protocol between smartphone, appliances and more
- Firewall
  - We can enable firewall by iptables command
  - You should add a rule to deny ADB connections over Wi-Fi
- SELinux
  - We can enable SELinux enforcing

- We think need to add more security enhancement measures

References

- Android Things
  - https://developer.android.com/things/index.html
- Android Things Developer Preview 2
  - https://android-developers.googleblog.com/2017/02/android-things-developer-preview-2.html
- Weave
  - https://developers.google.com/weave/
- Android Debug Bridge
  - https://developer.android.com/studio/command-line/adb.html?hl=ja
- Validating SELinux
  - https://source.android.com/security/selinux/validate.html