

Is it an app?
Is it a thing?

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DroidDev CPH - April 2017

What to cover?

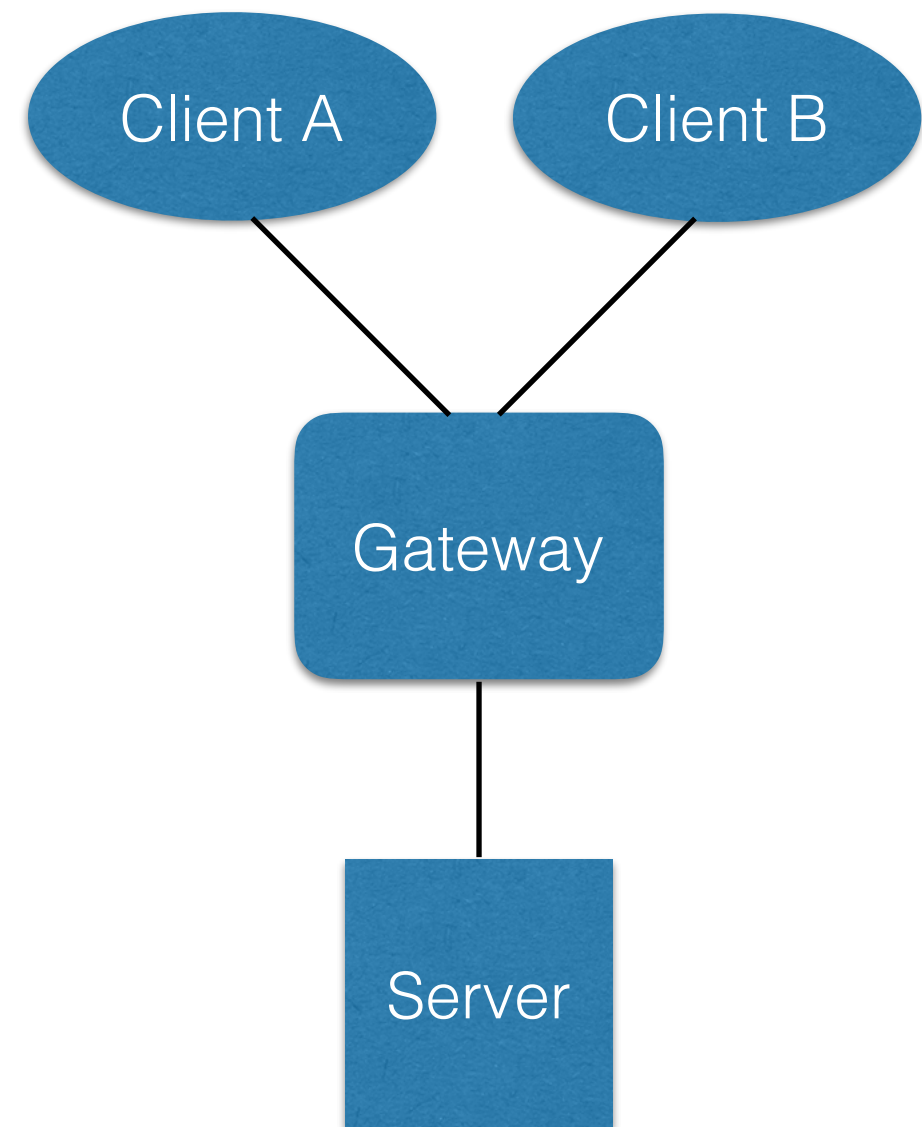
- What is IoT?
- How will Google get into it?
- Android Things - what's included in Preview 3?
- Demo

About me

- Education
 - B.Sc., computer science
 - M.Sc. in chemistry
 - Ph.D. in soft material science
 - Studied at Univ. of Copenhagen, Prague Institute of Chemical Technology, Roskilde University, Univ. of Colorado at Boulder
- Work
 - bioinformatics, web development, credit card payments, 4GL modernisation, medical imaging
 - Currently member of Realm's Android team
- Fun facts
 - took guitar lessons as teenager: didn't become a rock star
 - bought a Commodore 64 as teenager: became a programmer

Internet of Things (IoT)

- Home appliances are connected to the Internet
 - washing machine, refrigerator, thermostat, weather station
- Embedded devices
 - low energy consumption
- Transferring data is the corner-stone
- IoT is a distributed computing problem



IoT frameworks

- MQTT (messaging protocol)
 - runs on top of TCP/IP
 - many client libraries
- openHAB (gateway)
 - develop in Java
- Wind River Linux/Yocto project (operating system)
 - primarily C/C++
- PlatformIO (IDE)
 - mBED (ARM) and Arduino



IoT hardware

- Arduino
 - development using a subset of C++
 - many models, many add-ons (shields)
- Raspberry Pi
 - fully fledged Linux
- Intel NUC
 - Wind River Linux
- Microchip's PIC
 - development in C
- ESP32 (has WiFi)
 - development in Arduino IDE



Why Google's interest?

- Because of the hype? And Google is nerdy?
- Home appliances generate data
- Data can be analysed (hey TensorFlow)
- Google can help users to make decisions
 - OR is it just an advertising network?

Privacy and security



- Who owns data from IoT devices?
- Merging data from different sources
 - your refrigerator will not order bacon before your scale says your BMI < 25?
 - your wine bottle opener orders a taxi as it has been used to many times this evening?
- Monthly (weekly?) reports about security vulnerabilities
 - sending data unencrypted (meter report 0 water consumption = family on vacation)
- Real example 1: Remotely control We-Vibe product
 - <https://www.theguardian.com/technology/2016/aug/10/vibrator-phone-app-we-vibe-4-plus-bluetooth-hack>
- Real example 2: Nest thermostats leak location
 - <http://gizmodo.com/nest-thermostats-leaked-user-data-but-dont-freak-out-qu-1754123565>



Android Things

- Current version: preview 3
- Based on Android 7.0
- Using known tools and technologies
 - Android Studio, Java, Gradle, ...
- Adds specialised APIs for IoT devices
- Buy a developer kit for get started

Not quite Android (API)

- Display is not required
 - no status bar, no navigation
- Many Google services are supported
 - Firebase, Location, Maps, Search, Sign-in, ...
- Additional I/O
 - General Purpose I/O (GPIO): binary value (motion detection, ...)
 - Pulse Width Modulation (PWM): motors, lights, ...
 - Serial communication (I2C, SPI, UART)

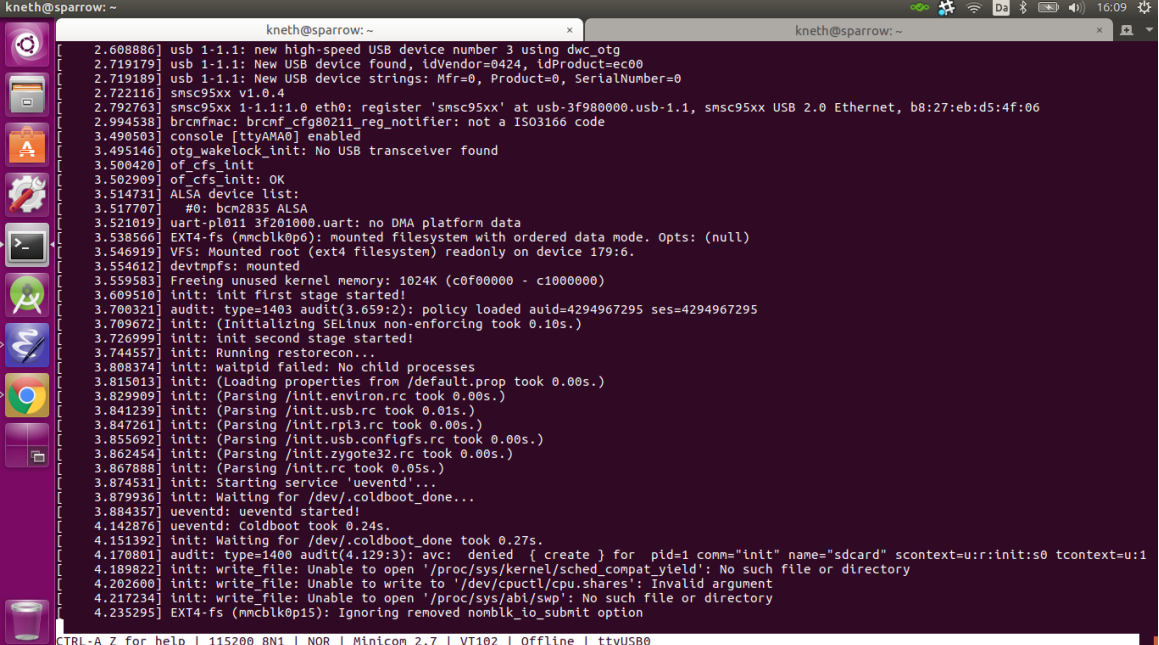
My device

- Raspberry Pi 3
- 8 GB SD card
- TTL/USB serial cable
- Rainbow HAT
 - multicolour LEDs,
 - alphanumeric display,
 - temperature/pressure sensor



Setting up the device

- Connect RPi with wired Ethernet
- Connect TTL/USB cable (optional)
 - black (GND), green (RX), white (TX)
 - minicom is still great 😊



```
kneht@sparrow:~  
kneht@sparrow:~  
2.608886] usb 1-1.1: new high-speed USB device number 3 using dwc_otg  
2.719179] usb 1-1.1: New USB device found, idVendor=0424, idProduct=ec00  
2.719189] usb 1-1.1: New USB device strings: Mfr=0, Product=0, SerialNumber=0  
2.722116] smsc95xx v1.0.4  
2.792763] smsc95xx 1-1.1.0 eth0: register 'smsc95xx' at usb-3f980000.usb-1.1, smsc95xx USB 2.0 Ethernet, b8:27:eb:d5:4f:06  
2.994538] brcnfmac: brcnf_cfg80211_reg_notifier: not a ISO3166 code  
3.490503] console [ttyAMA0] enabled  
3.495146] otg_wakelock_init: No USB transceiver found  
3.500420] of_cfs_init  
3.502909] of_cfs_init: OK  
3.514731] ALSA device list:  
3.517707] #0: bcm2835 ALSA  
3.521019] uart-pl011 3f201000.uart: no DMA platform data  
3.538566] EXT4-fs (mmcblk0p6): mounted filesystem with ordered data mode. Opts: (null)  
3.546919] VFS: Mounted root (ext4 filesystem) readonly on device 179:6.  
3.554612] devtmpfs: mounted  
3.559583] Freeing unused kernel memory: 1024K (c0f00000 - c1000000)  
3.609510] init: init first stage started!  
3.700321] audit: type=1403 audit(3.659:2): policy loaded auid=4294967295 ses=4294967295  
3.709672] init: (Initializing SELinux non-enforcing took 0.10s.)  
3.726999] init: init second stage started!  
3.744557] init: Running restorecon...  
3.808374] init: waitpid failed: No child processes  
3.815013] init: (Loading properties from /default.prop took 0.00s.)  
3.829909] init: (Parsing /init.envirom.rc took 0.00s.)  
3.841239] init: (Parsing /init.usb.rc took 0.01s.)  
3.847201] init: (Parsing /init.rpl3.rc took 0.00s.)  
3.855692] init: (Parsing /init.usb.configfs.rc took 0.00s.)  
3.862454] init: (Parsing /init.zygote32.rc took 0.00s.)  
3.867888] init: (Parsing /init.rc took 0.05s.)  
3.874531] init: Starting service 'ueventd'...  
3.879936] init: Waiting for /dev/.coldboot_done...  
3.884357] ueventd: ueventd started!  
4.142876] ueventd: Coldboot took 0.24s.  
4.151392] init: Waiting for /dev/.coldboot_done took 0.27s.  
4.170801] audit: type=1400 audit(4.129:3): avc: denied { create } for pid=1 comm="init" name="sdcard" scontext=u:r:init:s0 tcontext=u:1  
4.189822] init: write_file: Unable to open '/proc/sys/kernel/sched_compat_yield': No such file or directory  
4.202600] init: write_file: Unable to write to '/dev/cpuctl/cpu.shares': Invalid argument  
4.217234] init: write_file: Unable to open '/proc/sys/abi/swp': No such file or directory  
4.235295] EXT4-fs (mmcblk0p15): Ignoring removed nonblk_io_submit option  
CTRL-A Z for help | 115200 8N1 | NOR | Minicom 2.7 | VT102 | Offline | ttyUSB0
```

- Download image and unzip
- Transfer to SD card:

```
sudo dd if=iot_rpi3.img of=/dev/sdb bs=4M
```

- Boot and find IP address (it is broadcasting hostname `Android.local`)
- Connect ADB over TCP

```
adb connect 192.168.1.178
```

Create an app

- You can't create an app from Android Studio yet
- Download a project template
 - <https://github.com/androidthings/new-project-template>
- Unzip and rename
- Rename packages
- Open in Android Studio
- RUN!!!!

Random links

- My demo app: <https://drive.google.com/open?id=0B6d4MYyxNNY5S1FMcWpRX1N6VTA>
- Official site: <https://developer.android.com/things/index.html>
- Android Things community: <https://plus.google.com/communities/107507328426910012281>
- Samples: <https://github.com/androidthings>
- How to use Arduino libraries with Android Things: <https://www.androidthings.rocks/2017/03/28/how-to-use-android-libraries-with-android-things>