ANDROID THINGS AND VOICE ASSISTANT

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Agenda

• Android Things Overview
• Android Things RoadMap
• NXP Android Things Solution
• NXP Voice Assistant Solution
ANDROID THINGS OVERVIEW
Brillo 1.0

- **Is** an embedded OS based on Android for the IoT market

- **Has** a small memory footprint that makes it ideal for smart connected devices (32MB of RAM minimum)

- **Targets** home and office devices such as Thermostats, fire alarms, connected camera, smart lighting systems (Google OnHub)

- **Core Services** provide the ability to manage and monitor devices in the field (WEAVE, OTA, Metrics/Crash Reporting)
Brillo 1.0

- C/C++ Environment
- Binder IPC
- No Java Application, Framework or Runtime
- No Graphics
- 32 or 64 Memory Footprint (minimum)
- Development Application like writing Device HAL in Android

```c
int ret = hw_get_module(LIGHTS_HARDWARE_MODULE_ID, &module);
if (ret || !module)
    err(1, "Failed to load %s", LIGHTS_HARDWARE_MODULE_ID);
ret = module->methods->open(module,
    LIGHT_ID_NOTIFICATIONS,
    reinterpret_cast<struct hw_device_t**>(&light_device));
if (ret || !light_device)
    err(1, "Failed to open %s", LIGHT_ID_NOTIFICATIONS);
```
What is Weave

- A communications platform for IoT devices
- Device setup, phone-to-device-to-cloud communication
- User interaction from mobile devices and the web
- Transports: 802.15.4 (zigbee, threads), BLE, WiFi, Ethernet, Others possible
- Schema Driven (json) Associates Weave XMPP requests with application function invocations
- Web apps may be written with Google API support
- OAuth 2.0 Authentication, Google as AS
Android Things (Brillo 2.0)

• Based on Nougat 7.0
  - Totally different vs Brillo 1.0
  - Java Framework, Runtime, App has been kept.
• The Android ecosystem
  - Leverage existing Android development tools, APIs, resources, and a thriving developer community.
• New APIs for IoT devices
  - Develop with new Android framework APIs that provide low level I/O and libraries for common components like temperature sensors, display controllers, and more.
• Trusted security
  - Take advantage of regular best-in-class security updates by building on top of the Android OS.
Android Things (vs Android)

- Displays are optional (no status or navigation bar)
- Home activity support (auto launch on boot)

Remove some standard suite of system apps and content providers: CalendarContract, ContactsContract, DocumentsManager, DownloadManager, MediaStore, Settings, Telephony, UserDictionary, VoicemailContract

Peripheral I/O API
- The Peripheral I/O APIs let your apps communicate with sensors and actuators using industry standard protocols and interfaces. The following interfaces are supported: GPIO, PWM, I2C, SPI, UART.

User Driver API
- User drivers extend existing Android framework services and allow apps to inject hardware events into the framework that other apps can access using the standard Android APIs. E.g., GPS, HID, Sensors.

Supports a subset of the Google APIs for Android
## Android Things API’s & services

### Hardware
- Camera
- Microphone
- Audio
- Touchpad
- Peripheral IO
- Accelerometer
- Temperature
- Compass
- Gyroscope
- Light
- Pressure
- Humidity
- Infrared

### Networking
- Bluetooth
- WiFi
- WiFi Direct
- NFC
- Cellular

### Interaction
- Step counter/detector
- Tilt/orientation detector
- Glance, pick-up, wake-up gesture detector
- Magnetic field sensor
- Heart rate sensor
- Media playback/encode
- Text-to-speech translator
- Proximity detector

### GCore*
- Account/Login
- Location/Places
- Activity Recognition
- Mobile Vision
- Nearby
- Analytics
- Cloud Messaging
- Drive
- Firebase
- Google Fit
- Wear

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Everything on Android and some more
Android Things

- **Faster Time to Market**
  - Write code once, runs on all devices
  - Tap rich Android ecosystem & services

- **Predicatable Scaling Costs**
  - Certified hardware
  - Production ready HW & SW
  - Buffered from security issues & upgrade cycles

- **Security at Scale**
  - Google managed updates
  - Verified boot & hardened platform
  - Analytics of crash

Android Things makes building devices as easy as creating Android Apps
Engagement Model

• Development

Get Certified Hardware (TechNexion, VVDN, Murata) → Download latest version of Android Things from Google → Set up development environment, test features and functionality → Optimize design for final production, certify with Google

• Management

Google makes updates available for testing → OEM has X weeks to test → Google pushes the update → OEM has ability to block updates and continue to fix issues if needed
ANDROID THINGS ROADMAP
Android things Roadmap

- Unveils Brillo Google I/O
  - May 2015

- Brillo website launched
  - Nov 2015

- Brillo 2.0 development started
  - May 2016

- Development Preview
  - Dec 2016

- NXP i.MX6UL PICO/Argon boards certificated with Android Things logo
  - Open Source
    - Aug 2017 (TBD)

- Open Source
  - Aug 2017 (TBD)
NXP ANDROID THINGS SOLUTION
NXP Android Things

- NXP one of the lead SoC partners
- Two NXP partner boards are approved and carry the Android Things logo:
  - PICO-IMX6UL (Made by TechNexision)
  - ARGON-IMX6UL (Make by VVDN Technologies)

Launch
NXP Android Things

• PICO-IMX7D board would be available by end of April, certificated by Google. It features:
  - i.MX7D. Dual ARM Cortex-A7 (up to 1.2GHz) + Cortex-M4 (Heterogeneous Multicore Processing architecture)
  - 2G DDR3L, 4G eMMC
  - BCM4339 Wifi+BT combo
  - Raspberry PI compatible General Purpose I/O header
Google shares the unreleased code with NXP

NXP ports the code to target i.MX based platforms

NXP submits the code changes back to Google.

Google checks & accepts changes

Google updates the board specific image on their web site

Q: How do I gain access to the developer kit and console?

Q: Where do I get support:
A: Level 1: via the Android Things G+ community at [g.co/iotdev](https://g.co/iotdev)
Level 2: NXP will support customers using the i.MXCommunity.com
Level 3: FAE’s and apps engineers for targeted projects
Level 4: Professional services and support

Q: Is there any licensing or certification associated with Android Things:
A: Android Things source code posted to the AOSP will follow the same license structure as Android. There is a certification process for devices that want to go to production. This requires meeting the parameters of the Compatibility Test Suite, similar to the current Android certification model.
VOICE ASSISTANT SOLUTIONS
Voice Ecosystem Choices

Amazon Alexa

Siri

Google

Cortana

Microsoft
Breakdown of the Voice Control Technology

- **Microphone array, two or more**
- **Hardware**
  - Audio Codec/ADC
- **Beamforming**
- **Dereverberation**
- **AEC**
- **Trigre Phrase/Hot Word Detection**
- **Voice Recognition**
- **Voice Assistant**

Front End
- DSP Companion
- DSP Companion OR Integrated SW

Back End
- MCU Today
- MPU Today

Processing In the Cloud (“Ecosystem Play”)
Voice System with Hardware Front End

- Microphone Array
- Audio Codec with DSP
- Lower Perf i.MX
- Voice Assistant

Advantages:
- Available now
- Does not require additional i.MX throughput
Voice System with Software Front End

Beamforming, Dereverberation, AEC, Trigger Phrase Detection, Voice Recognition/Control

Advantages:
- More flexible and upgradeable
- Reduced system cost
i.MX Solution Details

Microphone Options → Beamforming Dereverberation AEC → Trigger Phrase/Hot Word Detection → Voice Recognition → Voice Assistant

Front End (DSP, Integrated SW) → Back End (ANY i.MX) → Processing In the Cloud (Amazon, Google)

<table>
<thead>
<tr>
<th>NXP Options</th>
<th>#Mics</th>
<th>Local Acoustic Processing (DSP Chip, Algorithm)</th>
<th>Trigger Phrase/Hotword</th>
<th>Cloud Service/Assistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon Solution</td>
<td>7</td>
<td>DSP (ADI, Amazon) <strong>AMZ Reference</strong></td>
<td>Amazon or 3rd Party</td>
<td>Amazon Alexa</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>DSP (Conexant, Conexant)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>2-3</td>
<td>DSP (Knowles, Knowles)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>2-8</td>
<td>SW (N/A, Limes Audio)</td>
<td>Amazon or 3rd Party</td>
<td>Amazon Alexa</td>
</tr>
<tr>
<td>Google Solution</td>
<td>2</td>
<td>N/A (Cloud) <strong>Google Reference</strong></td>
<td>Google (w/ or w/o 3rd Party)</td>
<td>Google Assistant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/A (Cloud) <strong>Google Reference</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DSP Front End + i.MX Backend System Block Diagram

Audio Sources

Front End System

- GbE PHY (optional)
- SD Card (optional)
- USB 2.0 (optional)
- Microphone Array
- ADC or h/w codec
- 2x-7x Mic Array

Back End System Components

- Wi-Fi BT Combo
- PMIC or Discretes
- PCIe or SDIO
- TDM I2S
- SPI or I2C
- x16, x32, or x64
- SDIO
- LPDDR2/3 or DDR3(L)
- eMMC

Output Paths

- MIPI DSI (Local display)
- Audio DACs (optional)
- Analog Audio (on base board)

DSP Options:

- Analog Devices, Conexant, Knowles
- Handles AEC, etc., Hotword
- Handles System and Cloud Service
Software Front End + Back End System Block Diagram (using i.MX)

Audio Sources
- GbE PHY (optional)
- SD Card (optional)
- USB 2.0 (optional)
- ADC or h/w codec
- Microphone Array

2x-7x Mic Array

Module System Components
- Wi-Fi BT Combo
- PCIe or SDIO
- PMIC or Discretes
- RGMII
- SDIO
- USB
- TDM I2S
- LPDDR2/3 or DDR3(L)
- eMMC

Output Paths
- MIPI DSI (Local display)
- Analog Audio (on base board)

FE Code Options: Limes Audio
Front & Back End code run within i.MX

Analog Audio
(on base board)
GOOGLE CAST &
GOOGLE ASSISTANT
OPTIONS
Google Cast + Google “Home” System Block Diagram

Audio Sources

- GbE PHY (optional)
- SD Card (optional)
- USB 2.0 (optional)
- ADC or h/w codec
- 2x Microphones

Module System Components

- Wi-Fi BT Combo
- PCIe or SDIO
- PMIC or Discretes
- RGMII
- SDIO
- USB
- TDM I2S
- x16 or x32
- 4 Gbit LPDDR2/3 or DDR3(L)
- 4+ Gbit eMMC

Output Paths

- MIPI DSI (Local display)
- Analog Audio (on base board)
Google “Home” System Block Diagram

Module System Components

Audio Sources

Wi-Fi BT Combo

PCIe or SDIO

PMIC or Discretes

Audio DACs (optional)

Output Paths

MIPI DSI (Local display)

Analog Audio (on base board)

i.MX 6UL/ULL

528 MHz +

2x Microphones

ADC or h/w codec

4 Gbit LPDDR2/3 or DDR3(L)

4+ Gbit eMMC

SDIO

TDM I2S

TDM I2S

x16 or x32

PCIe or SDIO

30  PUBLIC
# Google Cast Systems Resource Comparison

<table>
<thead>
<tr>
<th>Component</th>
<th>Google Cast only</th>
<th>Google Cast + Google Assistant</th>
<th>Google Assistant only</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.MX Processor</td>
<td>i.MX 7D @ 1.0 GHz</td>
<td>i.MX 7D @ 1.2 GHz</td>
<td>i.MX 6UL/ULL @ 528MHz +</td>
</tr>
<tr>
<td>LPDDR2/3 or DDR3</td>
<td>2 Gbit</td>
<td>4 Gbit</td>
<td>4 Gbit</td>
</tr>
<tr>
<td>eMMC</td>
<td>2 Gbit</td>
<td>4 Gbit</td>
<td>4 Gbit</td>
</tr>
<tr>
<td>Microphones (qty)</td>
<td>No</td>
<td>Yes (2)</td>
<td>Yes (2)</td>
</tr>
<tr>
<td>Local Music Media/Interfaces</td>
<td>Yes</td>
<td>Yes</td>
<td>None (simple?)</td>
</tr>
<tr>
<td>Audio Output System</td>
<td>Mono or multi-channel</td>
<td>Mono or multi-channel</td>
<td>Mono only</td>
</tr>
<tr>
<td>Operating System</td>
<td>Linux</td>
<td>Linux/Android Things</td>
<td>Android Things</td>
</tr>
</tbody>
</table>
**NXP Solutions**

**DSP-based Options:** (all use i.MX 7D Sabre Board)

1) “Amazon Reference Platform”: Mics + DSP (ADI) + i.MX
2) i.MX DSP Platform 2: Mics + DSP (Conexant) + i.MX
3) i.MX DSP Platform 3: Knowles (Mics + DSP) + i.MX

**Integrated Software Options:** (all use i.MX 7D Sabre Board)

4) “Google Reference Platform”: Mics + i.MX