Comparison of Voice Assistant SDKs for Embedded Linux

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Agenda

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- Introduction to smart speakers
- Overview of Amazon Alexa, Google Assistant and Mycroft SDK for integration in embedded Linux devices
- Showcases and conclusions

Virtual assisnts

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- AliGenie
- Amazon Alexa
- Yandex Alice
- Samsung Bixby
- Braina
- Clova
- Mirosoft Cortana
- Google Assistant
- Mycroft
- Apple Siri
- Voice Mate
- More ...

Technologies in Smart Speakers

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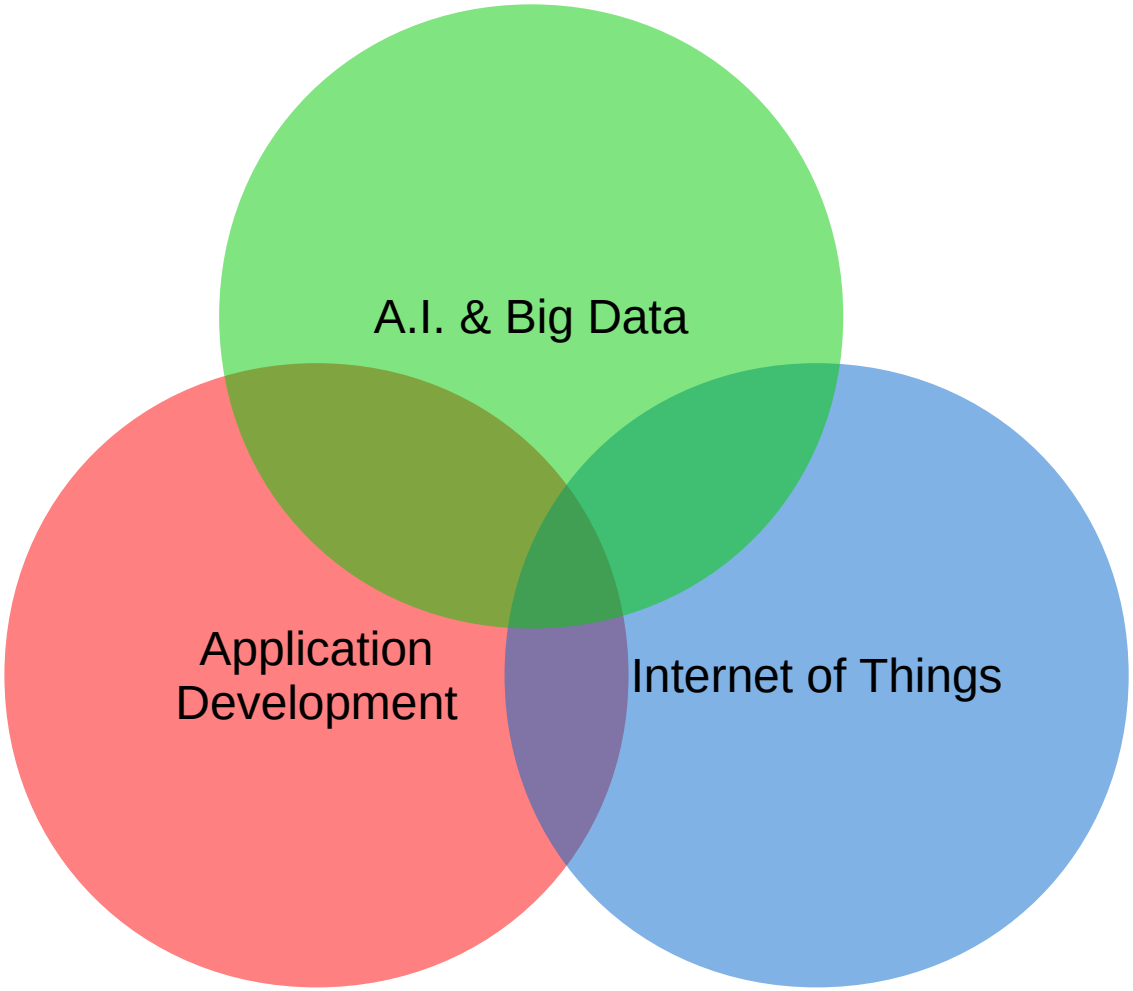
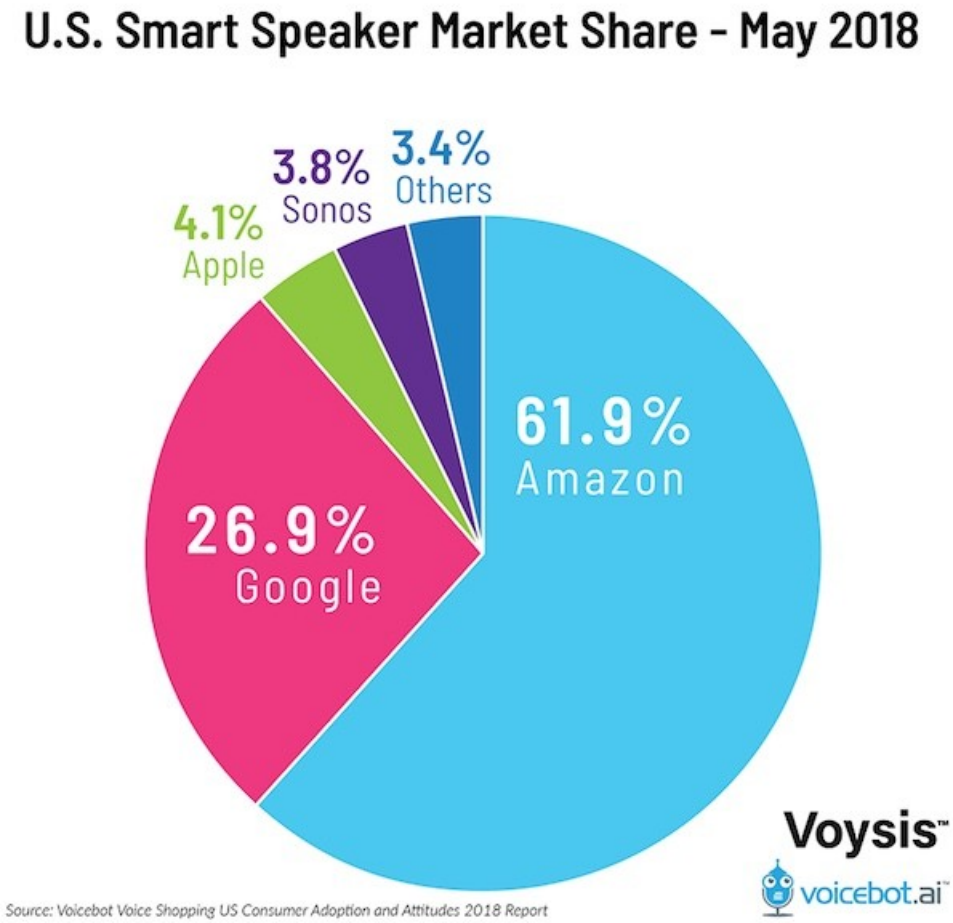
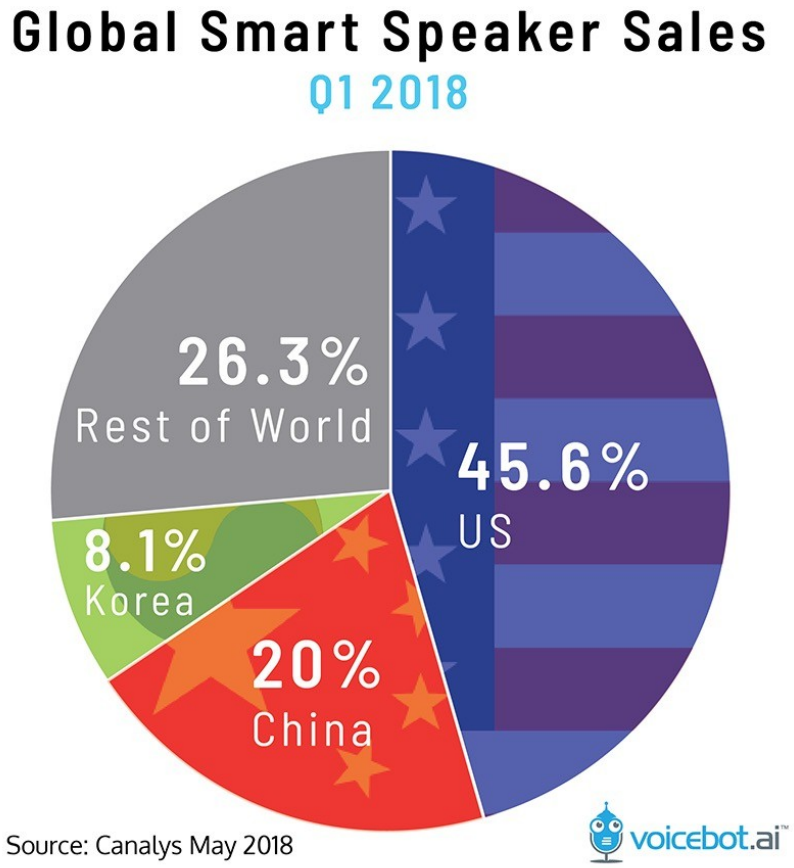


Smart Speaker Market





Public statistics from https://voicebot.ai/

Amazon Alexa

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Amazon Alexa

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- Virtual assistant powered by AI and developed by Amazon
- Available for Fire OS, iOS and Android
- Powers Amazon devices such as Echo smart speakers
- Initial release November 2014
- Requires Amazon Alexa app on a smartphone to setup the smart devices

Alexa Features

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- Multilingual support
- Voice profile for personalized experience
- Alexa to Alexa calling and messaging
- Mobile or landline calls in the US, Canada, and Mexico

Developer opportunities with Amazon Alexa

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- Integration of Amazon Alexa in custom hardware devices using an **SDK**
- Extend the functionality of Alexa compatible devices by developing software applications called **Skills**

Amazon Smart Speakers

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- Amazon Echo
- Amazon Echo Dot
- Amazon Echo Spot
- Amazon Echo Tap
- Amazon Echo Show
- Amazon Echo Plus

3rd Party Devices with Alexa

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- Ecobee4 Smart Thermostat
- Element EL4KAMZ17 (Amazon Fire TV Edition)
- Eufy Genie
- Fabriq Chorus and Riff
- Garmin Speak
- C by GE Sol Smart Lamp
- iHome AVS16 Alarm Clock
- LG Hub Robot
- More ...

Amazon Smart Speakers

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	SoC	RAM	Internal memory
Amazon Echo (1st Generation)	TI DM3725 ARM Cortex-A8 Core Digital Media Processor	256MB	4GB
Amazon Echo Dot (1nd Generation)	Texas Instruments DM3725 ARM Cortex-A8 Core Digital Media Processor	256MB	4GB
Amazon Echo Dot (2nd Generation)	MEDIATEK ARM MT8163V 1636-KBCAH CCMKYRHS 64-bit ARMv8	256MB	4GB

Google Assistant

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Google Assistant

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- Virtual assistant powered by AI and developed by Google
- Available for numerous platforms, mobile and smart home devices
- Initial release 18 May 2016
- Written in C++
- Requires Google Home app on a smartphone to setup a smart speaker with Google Assistant

Google Assistant Features

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- Multilingual support
- Six different voice options (including both male and female)
- Continued conversation for follow-up questions without repeating the activation word
- Voice match feature to setup up to 6 users of the smart speaker
- Google Duplex extension for accomplishing real-world tasks through natural conversations over the phone

Developer opportunities with Google Assistant

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- Integration of Google Assistant in custom hardware devices using an **SDK**
- Extend the functionality of Google Assistant by developing software applications called **Actions**

Google Smart Speakers

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- Google Home - released on 4 November 2016
- Google Home Mini – announced on October 4, 2017, released on the market on October 19, 2017
- Google Home Max – announced on 4 October 2017, released on the market on 11 December 2017
- Google Home Max – announced on 9 October 2018

3rd Party Devices with Google Assistant

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- Panasonic GA10
- Sony LF-S50G
- TicHome Mini
- Polk Assist
- Hogar Milo
- LG ThinQ WK7
- JBL Link
- Lenovo Smart Display
- More...

Hardware Specifications

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Device	SoC	RAM	Internal memory
Google Home	Marvell ARMADA 1500 Mini Plus (88DE3006) 1.2GHz dual core ARM Cortex A7	512MB	256 MB
Google Home Mini	Marvell ARMADA 1500 Mini Plus (88DE3006) 1.2GHz dual core ARM Cortex A7	4GB	256MB
Google Home Max	1.5GHz 64-bit quad-core ARM Cortex A53	?	?

Building Your Own Device (1/5)

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Low cost hardware options using off-the-shelf components for proof of concept demo:

- Google Voice Kit for Raspberry Pi: https://aiyprojects.withgoogle.com/voice/
- Raspberry Pi, Adafruit I2S MEMS Microphone Breakout – SPH0645LM4H and Adafruit I2S 3W Class D Amplifier Breakout – MAX98357A
  https://www.adafruit.com/product/3421
  https://www.adafruit.com/product/3006
- OrangePi Zero Set 6 (includes a case and an expansion board with mic and audio input) + Speaker
  http://www.orangepi.org/orangepizero/

Building Your Own Device (2/5)

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- Create new project in Google Platform Console
- Enable Google Assistant API
- Create credentials for OAuth Client ID and download JSON file
- On Debian distribution install Python:

```
export LC_ALL="en_US.UTF-8"
export LC_CTYPE="en_US.UTF-8"
sudo dpkg-reconfigure locales
sudo apt-get update
sudo apt-get install -y python3-dev python3-venv
python3 -m venv env
env/bin/python -m pip install --upgrade pip setuptools
```

Building Your Own Device (3/5)

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- Activate virtual Python environment and install Google Assistant SDK:
  python -m pip install --upgrade google-assistant-library
- Install and run Google authorization tool:

  python -m pip install --upgrade google-auth-oauthlib[tool]
  google-oauthlib-tool --client-secrets
  ~/client_secret_xxxx.apps.googleusercontent.com.json --scope
  https://www.googleapis.com/auth/assistant-sdk-prototype --
  save --headless
- Start Google Assistant:
  google-assistant-demo --device_model_id "my-speaker"

Building Your Own Device (4/5)

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- Create systemd service **/etc/systemd/system/google-assistant-demo.service** to launch Google Assistant automatically at startup:

```
[Unit]
Description=google assistant service
After=network.target ntpdate.service
[Service]
Type=simple
Environment=VIRTUAL_ENV=/home/pi/env/
Environment=PATH=/home/pi/env/bin:/usr/local/sbin:/usr/local
ExecStart=/home/pi/env/bin/google-assistant-demo --device_model_id "orangepi"
WorkingDirectory=/home/pi
StandardOutput=inherit
StandardError=inherit
Restart=always
User=pi
[Install]
WantedBy=multi-user.target
Alias=google-assistant.service
```

Building Your Own Device (5/5)

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- Enable the systemd service and start it automatically at boot:

```
sudo systemctl daemon-reload
sudo systemctl enable google-assistant-demo.service
sudo systemctl start google-assistant-demo.service
```

Mycroft

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Mycroft

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- Entirely open source project for a voice assistant
  https://mycroft.ai/
- Git repositories in GitHub
  https://github.com/MycroftAI
- Open source software available under Apache License 2.0
- Open source hardware available under CERN Open Hardware Licence
  https://github.com/MycroftAI/hardware-mycroft-mark-1
- Certified open source hardware UID US000049

Mycroft AI Inc.

- US start-up company from Kansas City founded in 2015 by Joshua Montgomery
- Initially products were crowdfunded through Kickstarted and IndieGoGo
- Currently is accepting investments at StartEngine

Mycroft Pulse

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Mycroft Core, the Mycroft Artificial Intelligence platform
https://github.com/MycroftAI/mycroft-core

- Written in Python
- 2820 commits, 90 releases, 89 contributors
- 8 contributors with more that 100 commits

Skills, repository for sharing and collaboration for 3rd party Mycroft skills development
https://github.com/MycroftAI/mycroft-skills

- 965 commits, 65 contributors (as of 17 October)

Mycroft Features

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- Officially available only in English, community support for other languages
- Supports extension of the functionality by developing software applications called skills
- Mycroft Skills Manager (msm) and a repository with 3rd party skills
- Optional device and account management system known as Mycroft Home
- Allows using devices without Mycroft Home service

Mycroft Devices

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- Mycroft Mark 1 (crowdfunded in 2015, shipped in 2017)
- Mycroft Mark 2 (expected in December 2018)
- DIY smart speakers with Raspberry Pi 2 & 3 (expected support for 3 B+) with PiCroft GNU/Linux distribution based on Raspbian Jessie Lite

Showcases

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Google Voice Kit

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- Do-it-yourself artificial intelligence voice for Raspberry Pi https://aiyprojects.withgoogle.com/voice/
- Two versions, the first was distributed free with the MagPi magazine
- Cardboard case

Google Voice Kit

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- Orange Pi Zero with Allwinner H2 SoC and 512MB RAM
- Expansion board with audio input, mic, IR receiver and two additional USB ports
- Speaker
- Case
- Armbian GNU/Linux distribution
  https://www.armbian.com/orange-pi-zero/

Home Assistant

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- Open-source home automation platform running on Python 3
- Perfect to run on a Raspberry Pi
- More than 950 components for integration with popular Internet of Things such as IKEA Trådfri, Philips Hue, Google Assistant, Alexa / Amazon Echo, Nest, KODI, etc.
- Started in 2013 by Paulus Schoutsen
- Huge community, more than 830 contributors
- Source code available at GitHub under Apache 2.0 license
- https://home-assistant.io/

Simple Voice Control with Alexa

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- Home assistant is compatible with Alexa and Amazon Echo
- Basic integration using the Emalutated Hue Bridge component of Home Assistant
- Emalutated Hue Bridge allows non-Philips Hue devices to be controlled though with voice the built-in support of Amazon Echo

```
emulated_hue:
  type: alexa
  expose_by_default: true
```

Simple Voice Control with Alexa

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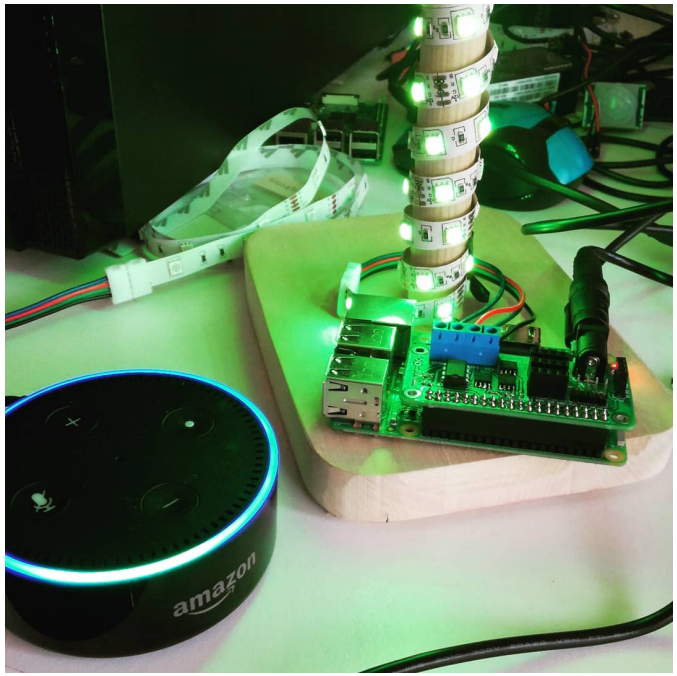
- Example voice commands for MQTT JSON Light component configured with name “ANAVI Light pHAT” in **configuration.yaml**:



Alexa, turn **ON** ANAVI Light pHAT

Alexa, turn **OFF** ANAVI Light pHAT

How Does it Work?

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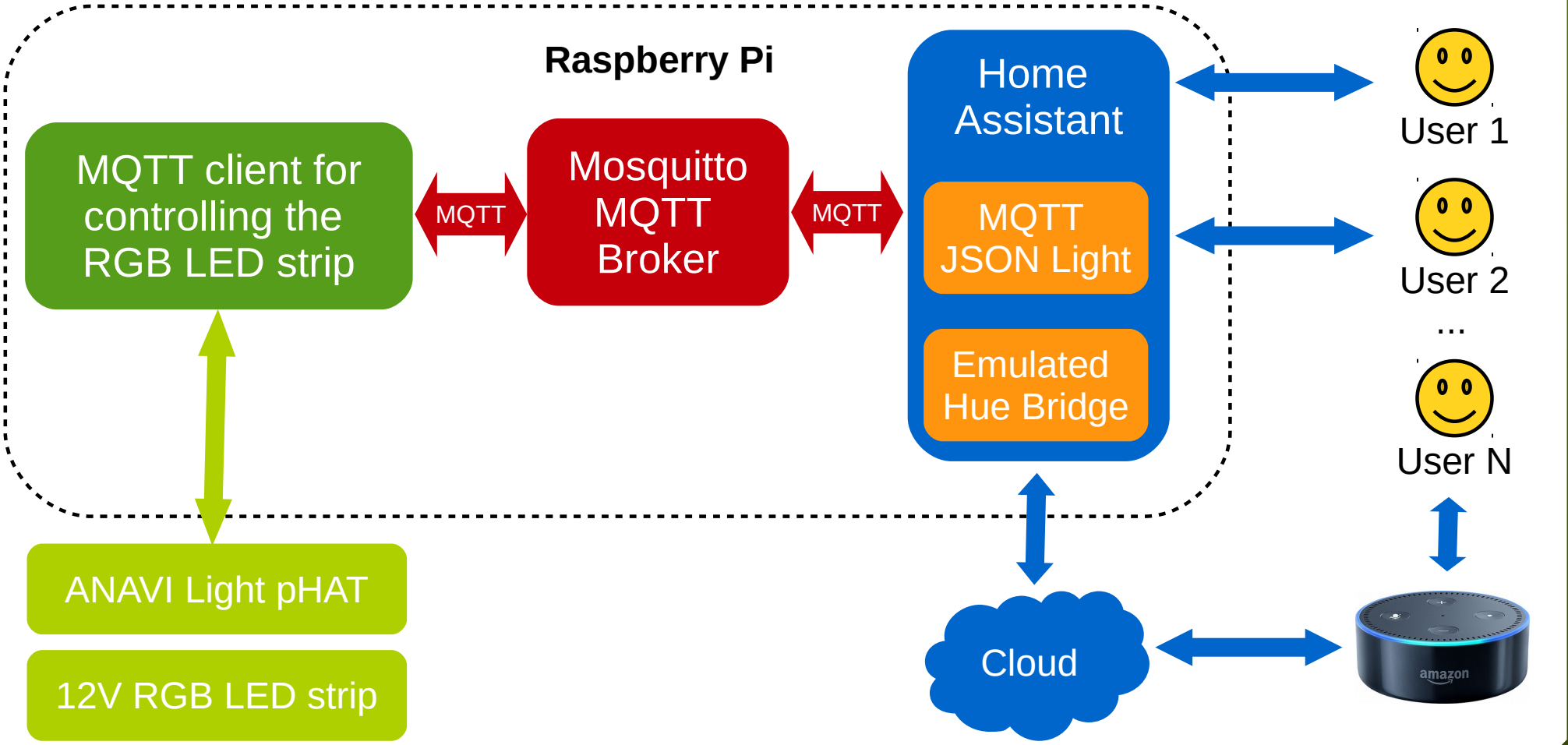

Conclusions

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Conclusions

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- There is a huge demand on the market for integrating AI and voice assistants in end-consumer devices as well as for development of 3rd software applications and services for them
- The market leaders Amazon and Google provide turn-key solutions for integration in embedded Linux devices with ARMv7 or x86-64 architecture but require difficult certifications for end-consumer devices
- Mycroft is an entirely open source voice assistant that combines open source hardware with free and open source software
- Apart from Mycroft, alternative solutions require connection to the cloud and mobile applications for setup

Thank You!

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Useful links:

- https://developer.amazon.com/alexa/devices
- https://developer.amazon.com/alexa-skills-kit
- https://developer.amazon.com/docs/ask-overviews/build-skills-with-the-alexa-skills-kit.html
- https://developers.google.com/actions/
- https://developers.google.com/assistant/sdk/
- https://mycroft.ai/
- https://www.armbian.com/