

Getting started with AGL using a Raspberry Pi

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- Services company specializing in Embedded Linux and Open Source Software
- Hardware/software build, design, development, and training services
- Based in San Jose, CA with an engineering presence worldwide
- <http://konsulko.com/>

Agenda



- Brief history of AGL on Raspberry Pi
- Building an AGL image for Raspberry Pi
- Overview of AGL specific features and configurations for Raspberry Pi
- Conclusions
- Q&A

Raspberry Pi

- Series of small single-board computers developed by the Raspberry Pi Foundation
- All models feature a Broadcom system on a chip (SoC) and ARM CPU
- Designed primary to promote teaching of basic computer science but also very popular in the maker community for hobby projects and demonstrations
- Supported by AGL since release Brilliant Blowfish

Automotive Grade Linux (AGL)

- Project of the Linux Foundation
- Open source GNU/Linux automotive distribution with In-Vehicle-Infotainment (IVI)
- Based on the Yocto Project and OpenEmbedded
- Founded in 2014



AGL Raspberry Pi Milestones



- 2015 - Mauro Chehab at that time working for Samsung OSG (Open Source Group) ported Tizen based on Yocto/OpenEmbedded to Raspberry Pi 2
- 2016 - GENIVI Dev Platform was ported to Raspberry Pi 2
- 2016 - AGL was ported to Raspberry Pi 2
- 2016 - Support for Raspberry Pi 3 was added in AGL
- 2019 - Support for Raspberry Pi 4 was added in AGL

AGL Core Technologies



Qt/QML HMI

HTML5

GStreamer

Weston with agl-shell-dekstop

Wayland

SOTA Updates: OSTree & Aktualizr

PipeWire

systemd

Linux kernel

Security

AppFW,
Cynagora,
SMACK

The Yocto Project

- Open source collaborative project of the Linux foundation for creating custom Linux-based systems for embedded devices using the OpenEmbedded Build System
- OpenEmbedded Build System includes BitBake and OpenEmbedded Core
- Poky is a reference distribution of the Yocto Project provided as metadata, without binary files, to bootstrap your own distribution for embedded devices
- Bi-annual release cycle

Yocto/OpenEmbedded Layers in AGL

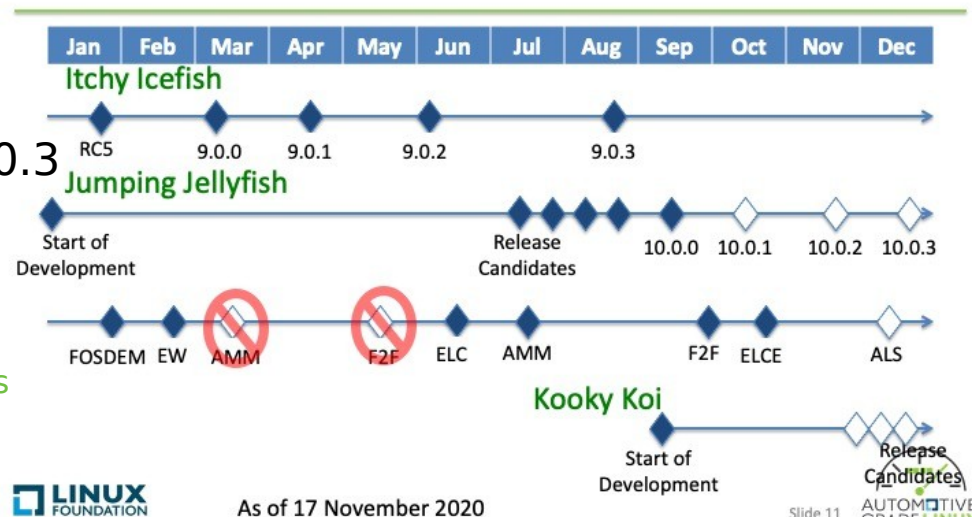
- poky
- meta-agl
- meta-agl-cluster-demo
- meta-agl-demo
- meta-agl-devel
- Meta-agl-extra
- meta-agl-telematics-demo
- meta-openembedded
- meta-security
- meta-virtualization
- meta-qt5
- meta-updater
- meta-spdxscanner
- meta-clang
- BSP layers: [meta-raspberrypi](#), meta-intel, meta-ti, meta-renesas-rcar-gen3, meta-sancloud, etc.

AGL Releases

- Twice per year release cycle
- Releases are named on fishes
- Latest stable release is Itchy Icefish v9.0.3
- Next release: Jumping Jellyfish (based on Yocto Project release Dunfell)

- <https://wiki.automotivelinux.org/agl-distro/release-notes>
- <https://wiki.automotivelinux.org/schedule>

2020 AGL Schedule



Building AGL for Raspberry Pi (1/2)

- Prepare Repo Tool:

```
mkdir -p ~/bin  
export PATH=~/bin:$PATH  
curl https://storage.googleapis.com/git-repo-downloads/repo > ~/bin/repo  
chmod a+x ~/bin/repo
```

- Download source code:

```
mkdir agl-rpi  
cd agl-rpi  
repo init -b master -u https://gerrit.automotivelinux.org/gerrit/AGL/AGL-repo  
repo sync
```

Building AGL for Raspberry Pi (2/2)

- Set up build environment:

```
source meta-agl/scripts/aglsetup.sh -m raspberrypi4 agl-demo agl-appfw-smack
```

- Launch the build process:

```
bitbake agl-demo-platform
```

- The build from scratch takes a significant amount of the time depending on your Internet connection speed and the hardware capabilities of the build machine

AGL Features and Raspberry Pi Models

- Supported Raspberry Pi models in the AGL master as of the moment:

```
raspberrypi4  
raspberrypi3
```

- AGL features:

```
agl-demo  
agl-appfw-smack  
agl-sota  
agl-netboot
```

```
source meta-agl/scripts/aglsetup.sh -h
```

Flashing the Image on MicroSD Card

- Output Image location in build machine for Raspberry Pi 4:

```
tmp/deploy/images/raspberrypi4-64/agl-demo-platform-raspberrypi4-64.wic.xz
```

- Extract the wic.xz and flash it on a microSD card

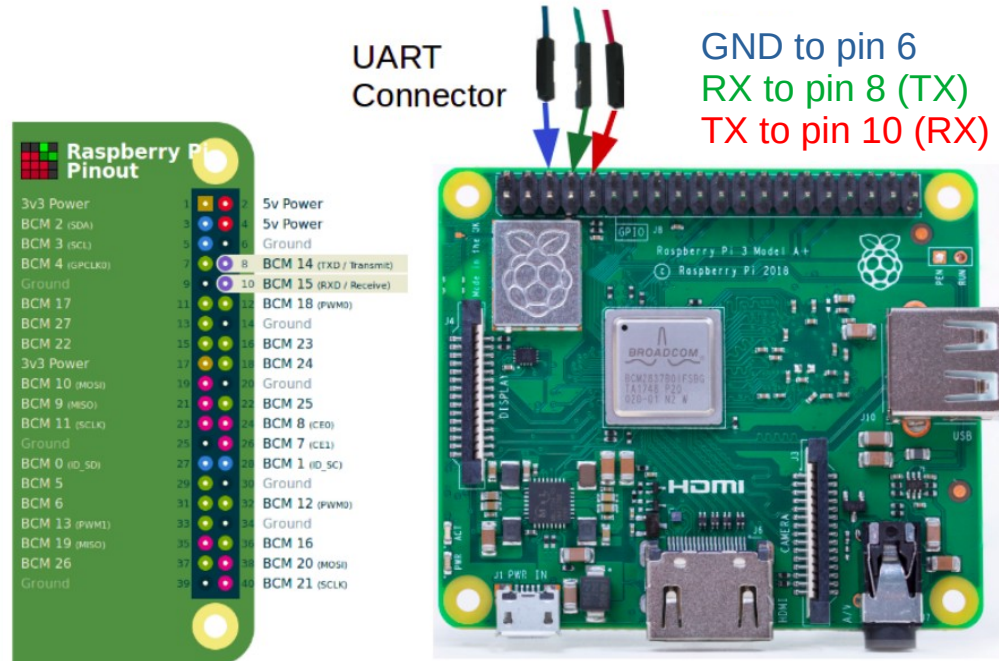
```
sudo umount [sdcard device]  
xzcat [output image] | sudo dd of=[sdcard device] bs=4M status=progress  
sync
```

- Plug the microSD card in the Raspberry Pi and turn in on (the first boot of AGL takes a bit longer)

Common AGL Images

- `agl-demo-platform`
- `agl-image-ivi` - base for IVI targets
- `Agl-cluster-demo-platform` - cluster demo image
- `agl-image-boot` - just enough to boot
- `agl-image-minimal` - minimal filesystem with APIs
- `agl-image-weston` - minimal filesystem with Wayland and Weston

UART to USB for Serial Output



Booting the image

- Serial output from AGL on Raspberry Pi 4:

```
Automotive Grade Linux 9.90.0+snapshot raspberrypi4-64 ttyS0
```

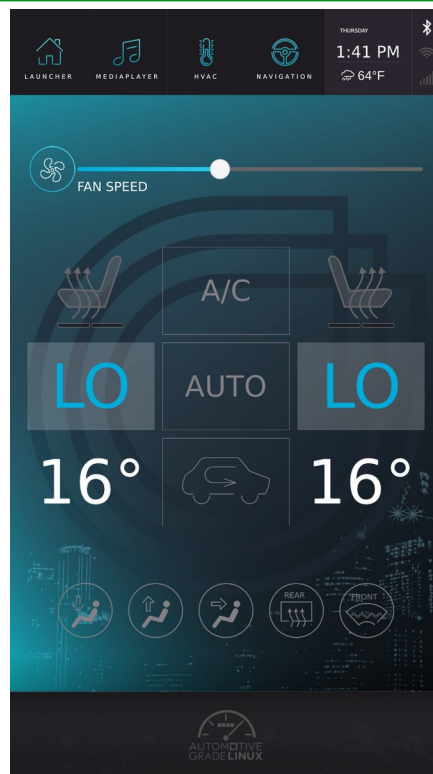
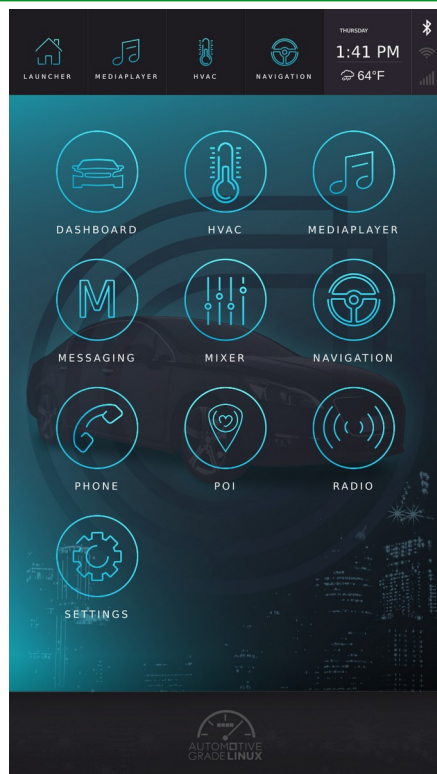
```
raspberrypi4-64 login: root
```

```
raspberrypi4-64:~# uname -a
```

```
Linux raspberrypi4-64 4.19.115-v8 #1 SMP PREEMPT Tue Mar 10 00:00:00 UTC  
2020 aarch64 aarch64 aarch64 GNU/Linux
```

- Serial baud rate: 115200

AGL on Raspberry Pi 4 Screenshots



Weston on AGL

```
[[0;1;32m*[[0m weston@display.service - Weston Wayland Compositor
  Loaded: loaded (/lib/systemd/system/weston@.service; static; vendor preset: disabled)
  Drop-In: /lib/systemd/system/weston@.service.d
           `-weston-init.conf
  Active: [[0;1;32mactive (running)[[0m since Tue 2020-03-10 00:01:47 UTC; 3 months 9 days ago
  Main PID: 768 (weston)
  Tasks: 1 (limit: 1703)
  Memory: 28.8M
  CGroup: /system.slice/system-weston.slice/weston@display.service
           `-768 /usr/bin/weston --idle-time=0 --tty=7 -log=/run/platform/display/weston.log

Mar 10 00:01:46 raspberrypi4-64 systemd[1]: Starting Weston Wayland Compositor...
Mar 10 00:01:47 raspberrypi4-64 systemd[1]: Started Weston Wayland Compositor.
```

Supported Raspberry Pi Peripherals in AGL

- HDMI monitors
- Raspberry Pi official 7" touchscreen display
- WiFi
- Bluetooth
- Various 3rd party add-on boards and HATs

Yocto Project Releases



Codename	Version	Release Date	Support Level
Gatesgarth	3.2	Oct 2020	Dreaming
Dunfell	3.1	April 2020	Long Term Stable
Zeus	3.0	October 2019	Stable
Warrior	2.7	April 2019	Stable
Thud	2.6	Nov 2018	Stable
Sumo	2.5	April 2018	Community
Rocko	2.4	Oct 2017	Community

AGL Repo Manifests

- As of today **default.xml** is based on Yocto release Dunfell:

```
<project name="poky" path="external/poky" remote="yocto"
revision="a44b8d2856a937ca3991cbf566788b0cd541d777" upstream="dunfell" />
<project name="meta-gplv2" path="external/meta-gplv2" remote="yocto"
revision="60b251c25ba87e946a0ca4cdc8d17b1cb09292ac" upstream="dunfell" />
<project name="openembedded/meta-openembedded" path="external/meta-openembedded" remote="github"
revision="b1aa5f785094d25765657f1df7db0748680ae7fb" upstream="dunfell" />
```

- Use other manifest from AGL/AGL-repo for a specific AGL release:
icefish_9.0.0.xml, halibut_8.0.6.xml, guppy_7.0.4.xml, etc.

- General Yocto/OpenEmbedded Board Support Package (BSP) layer for the Raspberry Pi boards
- Depends on layers from meta-openembedded: meta-oe, meta-multimedia, meta-networking, meta-python
- Provides specific variables as knobs to enable/disable hardware specific features: `ENABLE_I2C`, `ENABLE_SPI_BUS`, `RPI_USE_U_BOOT`, `ENABLE_UART`, etc.
- For AGL `VC4DTBO` must be set to `vc4-fkms-v3d` to support Wayland, Weston and the apps on both HDMI and the official Raspberry Pi 7" touch screen display

meta-raspberrypi

- New features and bug fixes are accepted as GitHub pull requests: <https://github.com/agherzan/meta-raspberrypi>
- Maintained by Andrei Gherzan with more than 90 contributors
- Documentation: <https://readthedocs.org/projects/meta-raspberrypi/>

meta-raspberrypi in AGL

- Script `meta-agl/scripts/aglsetup.sh` for Raspberry Pi initializes the build environment with `conf/local.conf` and `conf/bblayers.conf`
- Yocto/OE layer `meta-agl/meta-agl-bsp` contains sub-layers with AGL hardware specific configurations
- Configurations from `conf/include/agl_raspberrypi4.inc` or `conf/include/agl_raspberrypi3.inc` are automatically included in `conf/local.conf` depending on the targeted Raspberry Pi model

AGL on Raspberry Pi

- Uses U-Boot as a bootloader
- GPU memory is set to 256MB
- UART is enabled
- Includes kernel modules
- Includes WiFi and Bluetooth firmware

- To support both HDMI monitors and the 7" official Raspberry Pi touchscreen display, AGL for Raspberry Pi uses firmware KMS instead of full KMS.
- Appropriate Linux kernel version, mesa with VC4 support and binary firmware in bcm2835-bootfiles is required
- Variable VC4DTBO must be set to vc4-fkms-v3d to set appropriate device tree overlay in config.txt while building AGL for Raspberry Pi:

```
VC4DTBO ?= "vc4-fkms-v3d"
```

- For more details:
<https://jira.automotivelinux.org/browse/SPEC-2465>

Software Over the Air (SOTA) Updates

- The **agl-sota** feature enables support for software over the air (SOTA) updates in AGL images
- Libostree (OSTree) and Aktualizr provide a "git-like" model for committing, downloading and automated provisioning of bootable filesystem trees to a fleet of vehicles
- Yocto/OE layers meta-updater and meta-updater-raspberrypi provide the SOTA implementation for AGL on Raspberry Pi
- For more details:
<https://wiki.automotivelinux.org/subsystem/agl-sota/ostree>
<https://docs.ota.here.com/getstarted/dev/raspberry-pi.html>

AGL Developer Tools

- Git & Repo
- Gerrit <https://gerrit.automotivelinux.org/>
- GitHub <https://github.com/automotive-grade-linux>
- JIRA <https://jira.automotivelinux.org/>
- Wiki <https://wiki.automotivelinux.org/>
- Documentation <https://docs.automotivelinux.org/>
- Jenkins for CI and Lava + Fuego for running test

AGL JIRA

Jira Software Dashboards Projects Issues Capture Boards Tests Create

search « All i Create Issue Configure Fields

Choose an epic to assign this issue to.

Sprint

Jira Software sprint field

Contract ID

Begin typing to find and create labels or press down to select a suggested label.
Internal AGL Contract identifier to allow traceability of issues.

Hardware Platform(s) Affected

- ☐ Intel Minnowboard
- ☐ Intel Upsquare
- ☐ NXP i.MX6
- ☐ QEMU ARM
- ☐ QEMU ARM 64
- ☐ QEMU x86_64
- ☒ Raspberry Pi 3
- ☒ Raspberry Pi 4
- ☐ Renesas H3
- ☐ Renesas H3+KF
- ☐ Renesas M3
- ☐ Renesas M3+KF
- ☐ TI Vayu

☐ Create another

Jira Software Dashboards Projects Issues Capture Boards Tests Create

search « All issues EDITED Save as ...

filters

Project: All Type: All Status: All Assignee: All Contains text More Search

Hardware Platform(s) Affected

Search

Clear selected items

- ☒ Raspberry Pi 3
- ☒ Raspberry Pi 4
- ☐ Intel Minnowboard
- ☐ Intel Upsquare
- ☐ NXP i.MX6
- ☐ QEMU ARM
- ☐ QEMU ARM 64
- ☐ QEMU x86_64

AGL Development / SPEC-3400

XEN: MULTICONFIG build for Dom0 Dom0

Edit Comment Assign More Start Progress Resolve

Details

Type: Improvement

Status: OPEN (View Workflow)

Priority: Major

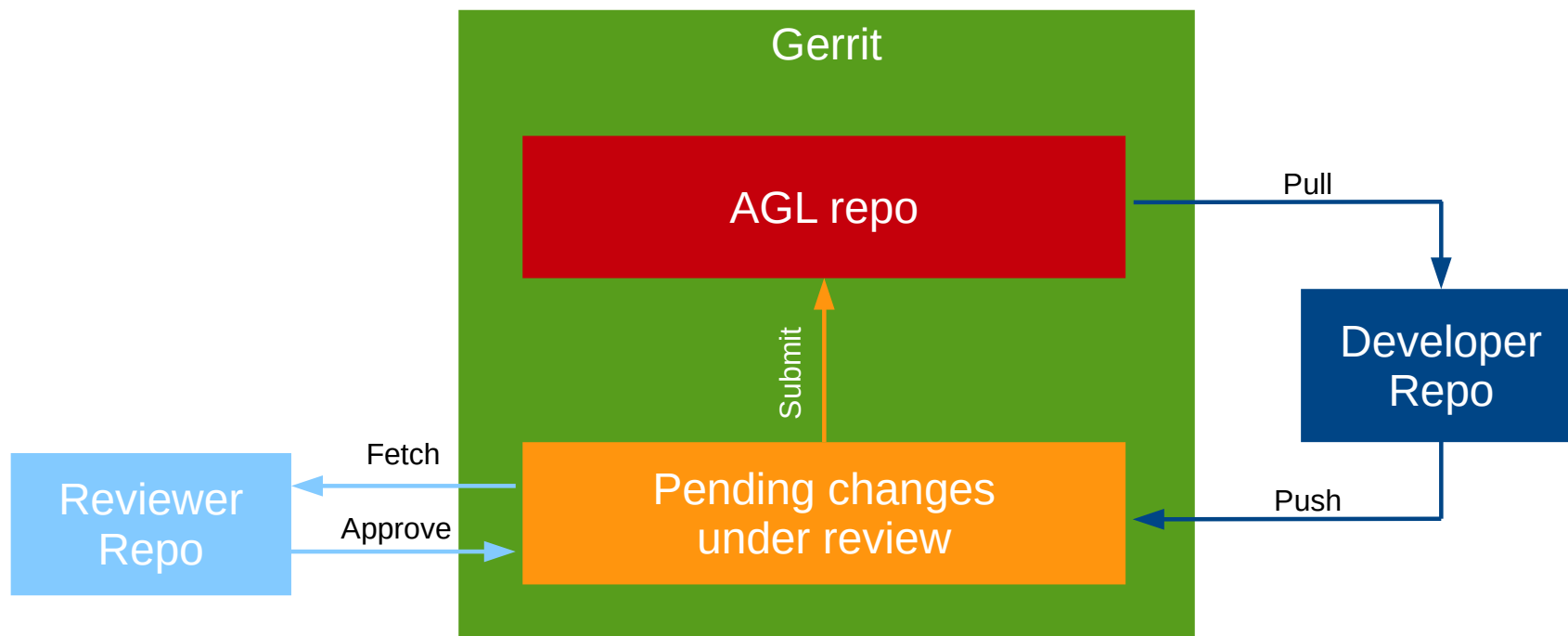
Resolution: Unresolved

Affects Version/s: None

Contributing to AGL

- Report an issue or a new feature in JIRA
- Modify the source code
- Include references to the JIRA issue in the Git commit messages
- Contribute to the upstream following the AGL Gerrit workflow

AGL Gerrit



Merged Change in AGL Gerrit



Gerrit CHANGES ▾ YOUR ▾ DOCUMENTATION ▾ BROWSE ▾

☆ **Merged** as [a8f9814](#) [22872: agl_raspberrypi3.inc: Switch to firmware KMS](#) [REVERT](#) ⋮

Updated Nov 07, 2019

Owner Leon Anavi

Assignee Set assignee...

Reviewers [Jan-Simon Moeller](#)
[Walt Miner](#)
[Tadao Tanikawa](#)
[AND 8 MORE](#)
[ADD REVIEWER](#)

CC [ADD CC](#)

Repo [AGL/meta-agl](#)

Branch [halibut](#)

Parent [0a620f5](#)

Topic No topic

Hashtags [ADD HASHTAG](#)

REPLY

`agl_raspberrypi3.inc: Switch to firmware KMS`

Switch to firmware KMS with appropriate Linux kernel and Mesa version to support both HDMI and the official 7" Raspberry Pi touch screen display on Raspberry Pi 3B/B+ and 4. Device tree changes are not required for firmware KMS.

Bug-AGL: [SPEC-2465](#)

Change-Id: I5f8f62c0151b7eb79ab1f96419d9c62469a1554e
Signed-off-by: Leon Anavi <leon.anavi@konsulko.com>

Relation chain

[raspberrypi*/50_local.conf.inc: Update...](#) (Merged)
→ [agl_raspberrypi3.inc: Switch to firmwar...](#) (Merged)
[bcm2835-bootfiles.bbappend: Update ...](#) (Merged)
[linux-raspberrypi_4.19.bb: Update to 4...](#) (Merged)
[rpi-config: Set max_framebuffers to 2 t...](#) (Merged)

Submitted together

[AGL/meta-agl: halibut: raspberrypi*/50_local.co...](#)
→ [AGL/meta-agl: halibut: agl_raspberrypi3.inc: Swi...](#)
[AGL/meta-agl: halibut: bcm2835-bootfiles.bbap...](#)
[AGL/meta-agl: halibut: linux-raspberrypi_4.19.bb...](#)
[AGL/meta-agl: halibut: rpi-config: Set max_fram...](#)

Cherry picks

[master: agl_raspberrypi3.inc: Switch to firmware...](#)

AGL Communication Channels



- AGL mailing list
<https://lists.automotivelinux.org/g/agl-main>
- Weekly Developer Call
(Tuesday 14:00 - 15:00 UTC)
<https://wiki.automotivelinux.org/dev-call-info>
- IRC
channel #automotive on freenode.net

Conclusion

- Raspberry Pi is a community supported hardware platform compatible with AGL that is useful for getting started and proof of concept demonstrations
- It is recommended to use AGL with Raspberry Pi 4 B with 4 or 8GB RAM
- Be part of the Automotive Grade Linux community by contributing bug fixes and/or new features, testing and/or updating the documentation of the project

Thank You!



Useful links:

- <https://www.automotivelinux.org/>
- <https://docs.automotivelinux.org/>
- https://docs.automotivelinux.org/docs/en/master/getting_started/reference/getting-started/machines/raspberrypi.html
- <https://wiki.automotivelinux.org/agl-distro/agl-raspberrypi>
- Pre-built binary images:
https://wiki.automotivelinux.org/agl-distro?&#supported_hardware