OGST Case • Monku R4 • Media Center • ESP 32 • Android Things

ODROID Magazine

Year Seven
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THE NEWEST GENERATION OF HARDKERNEL'S MOST POPULAR HANDHELD COMPUTER

ODROID GO *Advance*

KUBERNETES: EXTENSIBLE OPEN SOURCE CONTAINER ORCHESTRATION PLATFORM

CAN BUS: MICROCONTROLLERS

VIDEO SURVEILLANCE: ADVANCED VISUAL MONITORING USING AN ODROID-C2

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January 1, 2020

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How to enable the CAN bus on ODROID-N2 via HW SPI interface. Learn detailed instructions to acquire data via a MCP2515 Bus Monitor board are documented here

ODROID-GO Advance: The Newest Generation of Hardkernel's Most Popular Handheld Computer

January 1, 2020

We continued to hear from users who wanted to play 16-bit or 32-bit retro games on a handheld device, so we now bring you the ODROID-GO Advance!

Monku R4 With An ODROID-N2 and Batocera Linux: The Best Retro Gaming Console You Can Build for Around $100

January 1, 2020

This tutorial covers the process of setting up an ODROID-N2 with 2GB of RAM and iInstalling Batocera Linux so we can use our ODROID-N2 as a TV retro gaming console.

Kernel 5.4 Development Party

January 10, 2020

Let's start the 5.4 kernel development party.

The G Spot: Your Goto Destination for All Things That are Android Gaming: Google Drops the Ball; Giphy is a Ball; and ODROID-N2 Wins it ALL!

January 1, 2020

Well that was special, wasn't it? If you're one of the thousands of Google Stadia Founder's Edition subscribers, then you know exactly how Google dropped the ball on launch day. This official Google Stadia Tweet pretty much sums up the entire mess: "Here's the latest update: If you ordered and ▶

Kubernetes On An ODROID-N2 Cluster

January 1, 2020

Overview Kubernetes (or k8s for short) is an extensible open source container orchestration platform designed for managing containerized workloads and services at scale. It helps in automated deployment, scaling, and management of container centric application workloads across a cluster of nodes (bare-metal, virtual, or cloud) by orchestrating compute, network, and ▶

Pearl Linux Motion Video Surveillance System With Kodi: Advanced Visual Monitoring Using An ODROID-C2

January 10, 2020

@pearllinux created a video surveillance image based on Ubuntu 18.04 using the 3.16.75 kernel, featuring pre-installed and active upon first boot Motion Video Surveillance Software running in User Mode. Come check it out!

Android Things

January 10, 2020

Have you ever tried to connect a peripheral device to the GPIO pins on your ODROID SBC with the Android OS?

Building an ODROID GameStation Turbo (OGST) Case For Your ODROID-XU4

January 1, 2020 By Brian Ree Gaming, ODROID-XU4, Tinkering

The reason why we want to use the larger OGST case is because it comes with an expansion board that allows you to add power and reset buttons to the case and a place to hold an external USB harddrive. This will allow you to increase the available storage space on your harddrive size. This tutorial will show you how to quickly and easily assemble the case and secure the harddrive to the case. Needless to say, if you are building a retro gaming console this really opens up the door for storing a ton more games.

Parts Needed

- A Working Monku Retro 3 / ODROID-XU4: https://bit.ly/3658Jrp - An OGST ODROID-XU4 Case: https://bit.ly/2Q6maC9

Tools Needed

- Small Screwdriver Set - Velcro® Strip Permanent or Removable Velcro Strip - External USB 3 Hard-drive

Reviewing the Parts

Let us take a look at the parts we will be working with. The following image shows the hardware needed for using the ODROID-XU4 with OGST as a retro gaming case.

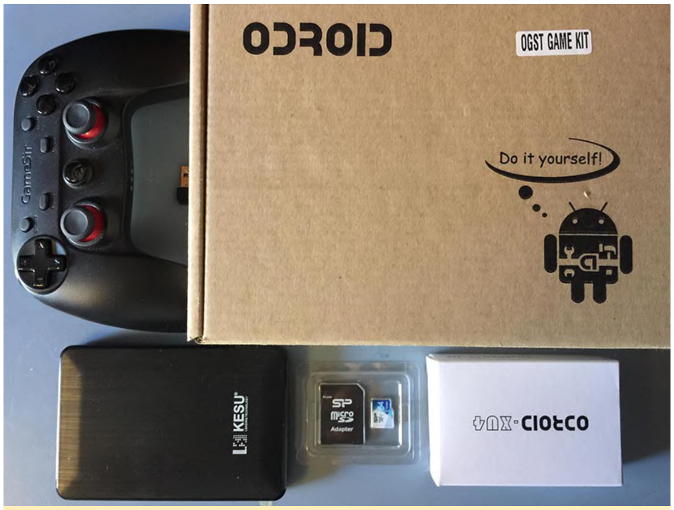


Figure 1

The setup I will be working on, shown above, during this tutorial is an ODROID-XU4 running Lakka. You can actually use any setup you want on your ODROID-XU4. If you want more storage space then the OGST and this tutorial are for you. A wireless Game Sir controller. A 64GB micro SD for the boot drive. A KESU external USB 3 harddrive with 250GB of storage. Now I could have gone bigger but the drive is $40, so this is the perfect setup for the retro console builder on a budget. I will post some links for ODROID-XU4 building tutorials and parts below.

- Wired Game Sir Wired Controller (Hard Kernel) $17 - Wired Game Sir Wired Controller (Amazon) $17 - Wired Game Sir Wireless Controller $17 - KESU 250GB USB 3 External Hard-drive $37

Now to hold the drive securely in the case we need some Velcro® strips. This will give us a secure but easily detachable way to store the harddrive in the case. You have two options, super strong permanent strips or strong but removable strips. If you want to potentially reuse the hard-drive without having Velcro strips on it, then you might want to go for the second option. Here are the links for the two types of strips.

- Heavy Duty Velcro Strips $3 - Removable Velcro Strips $3

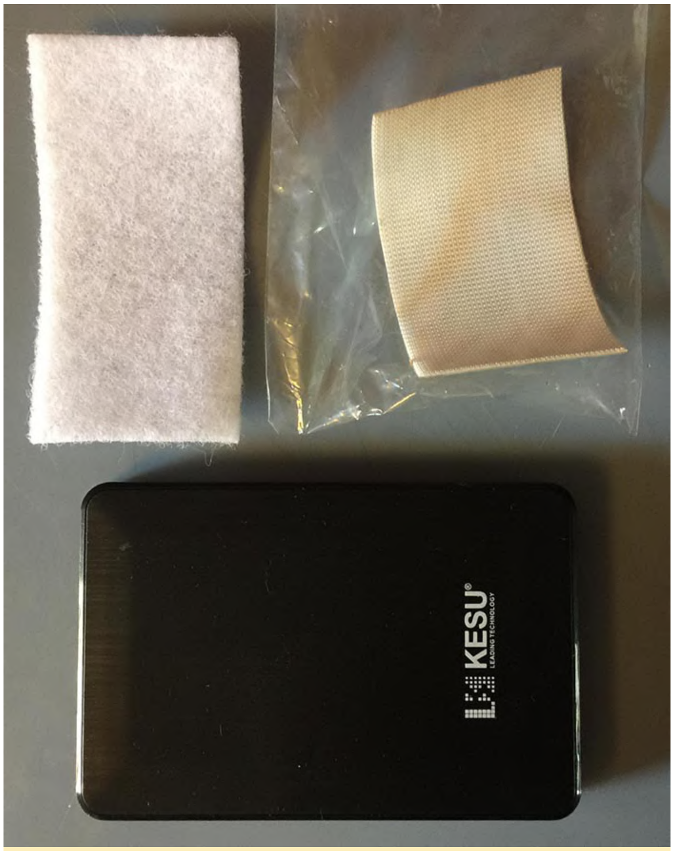


Figure 2

Once you have got that all sorted out you will be ready to build your advanced case. Remember you can always go bigger on the harddrive. As long as it has a similar size to the link provided above it will fit in the case fine. I chose to use the super strong version of the Velcro tape because I wanted the drive to be firmly held in place and have very little chance of coming off. I also do not intend to use the harddrive for something else as it was purchased solely for this console project. Next let us open up our OGST case and see what is inside.

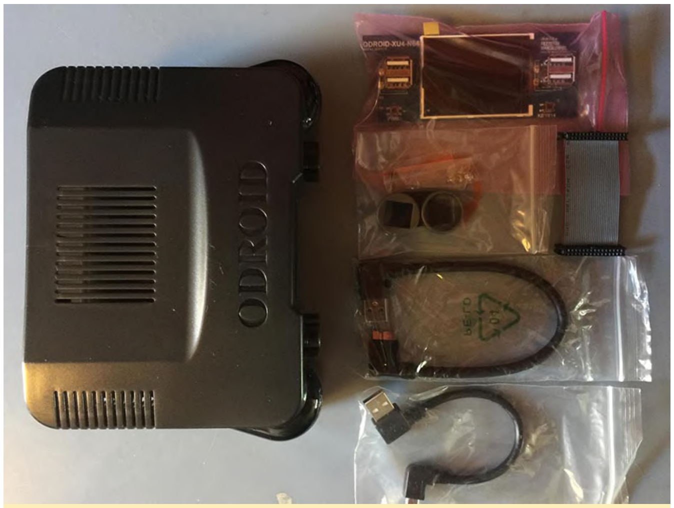


Figure 3

In the case you will find an expansion board with a small screen. A set of plastic caps, a ribbon cable, 2 USB cables, and some screws; oh and, of course, a case. The cables are important! They USB A to USB Micro B cable is perfect for the external USB drive. 7 It has a 90 degree connector that will make it much, much easier to house the drive in the OGST case. Let us take a look at our ODROID-XU4 hardware.

Figure 4

Again, we are using the ODROID-XU4 with a 64GB micro SD card. You will need a screwdriver at this point. A standard electronics screwdriver set should do the trick. Now if you do not know how to setup your ODROID-XU4 with an OS you can follow the links below.

- Munku R3/ODROID-XU4 Ubuntu with Retroarch Multi-use Console - Tutorial Part 1 - Munku R3/ODROID-XU4 Lakka Retro Gaming Console - Tutorial Part 1

From this point on, I will assume you have your ODROID-XU4 device all setup. Because I am building this case for a retro gaming console and I want to use every last drop of the device's resources for emulation I decided not to setup the second screen on the expansion board. If you want to set yours up, this may depend on the OS you are using on your device. You can find more information at these links:

- OGST Case Second Screen Info (https://bit.ly/2tdvwTl) - OGST Case Second Screen Info (https://bit.ly/2MCbNDP)

Prepping The Case Top

The board mounts upside down on the top side of the case. This is perhaps a bit unusual but as you will soon see the case is wonderfully designed and very easy to use. The two pictures below depict the mounted ODROID-XU4 board on the top side of the OGST case. TIP: Take your time with the screws. The fit is a little strange due to the larger threading on the screws. Just take your time and carefully tighten them until the board is secure. Try not to over tighten them. The picture shows the ODROID-XU4 board, screws, case top, and the screwdriver I am using.

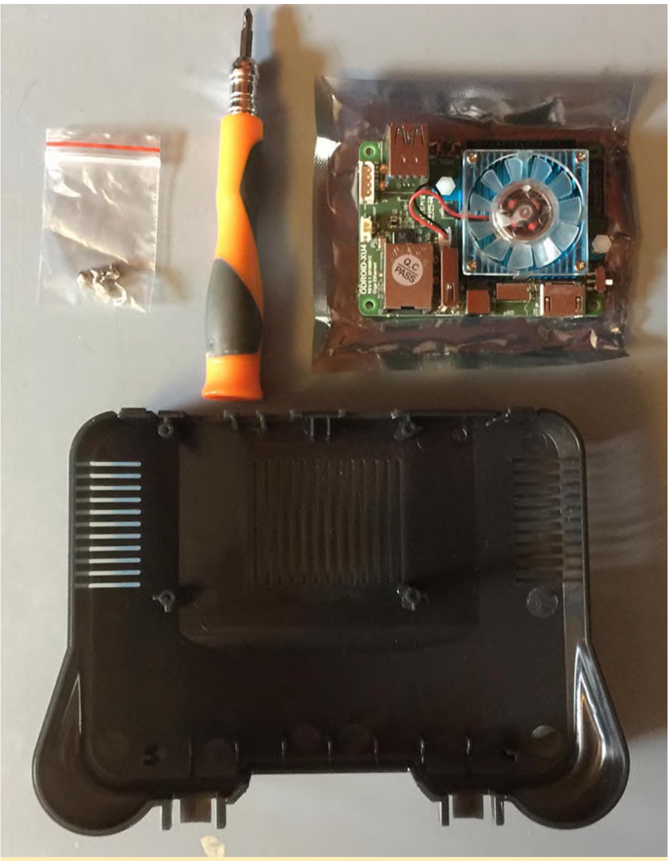


Figure 5

The following pictures depict the board in position and properly screwed into the case top.

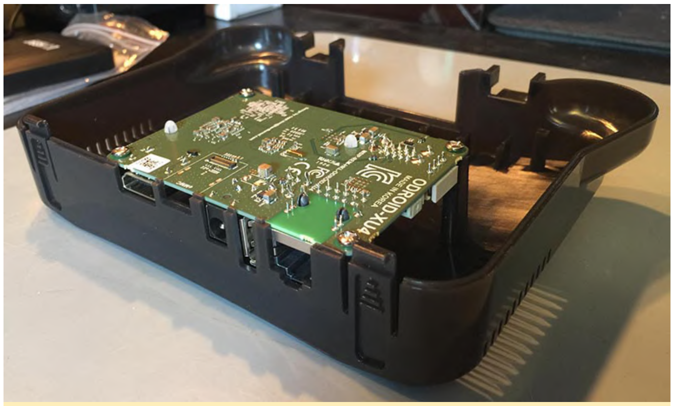


Figure 6

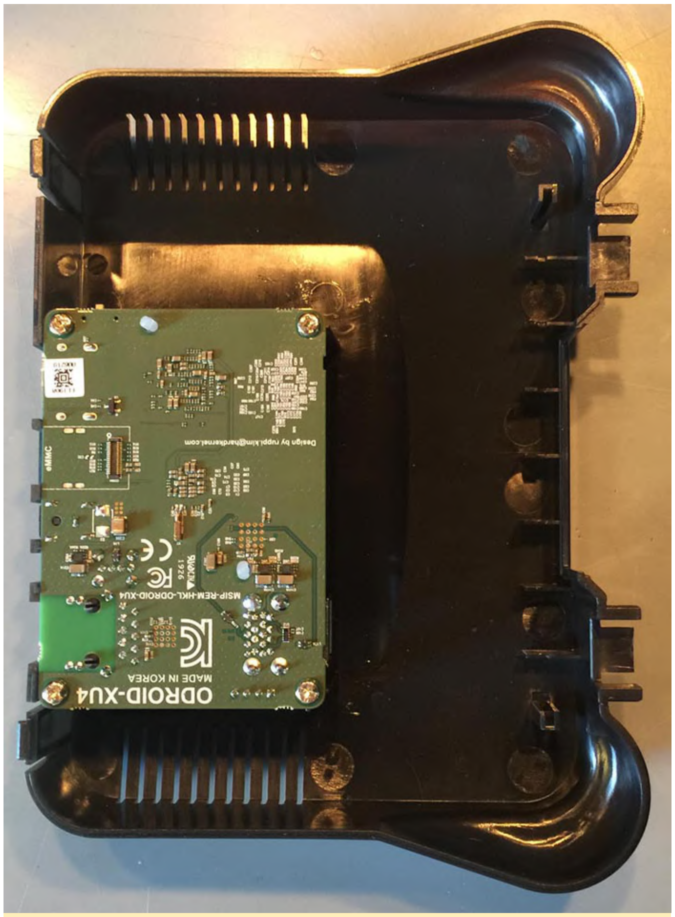


Figure 7

Next up we will be setting up the expansion board and ribbon cable. The picture below depicts the parts you will need for this step.

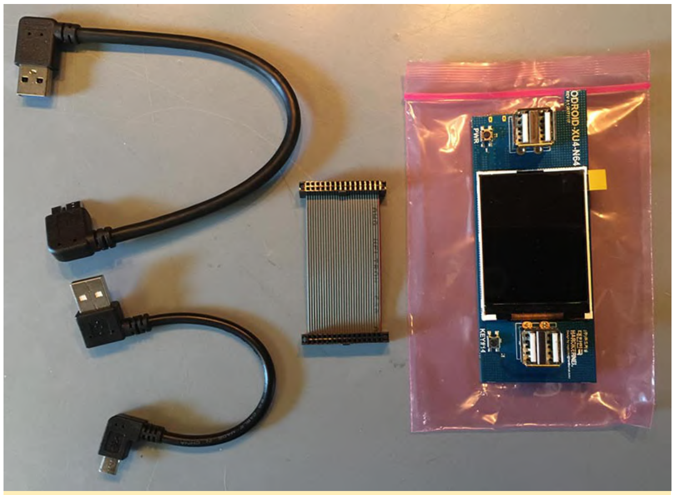


Figure 8

We want to connect the ribbon cable to the mounted board first. Make sure you have the direction marker facing the correct way. The marker requires a slot in the ribbon cable connector. Line up the slot on the ribbon cable connector with the mark on the cable itself. Carefully make sure that the ribbon cable is all the way into the connector. You may need to take your time and push it down evenly. TIP: Do not put too much pressure on the board when you are attaching the ribbon cable.

Next you will want to attach the expansion board. Again make sure the ribbon cable mark is properly aligned with the slot on the ribbon cable connector. Be extra careful when attaching the ribbon cable to the expansion board as it is very easy to end up pressing on the screen and potentially cracking it. After the ribbon is connected take off the screen protection sticker and let the screen sit in the two guide slots built into the case as shown below. Do not push it all the way into the case top just yet.

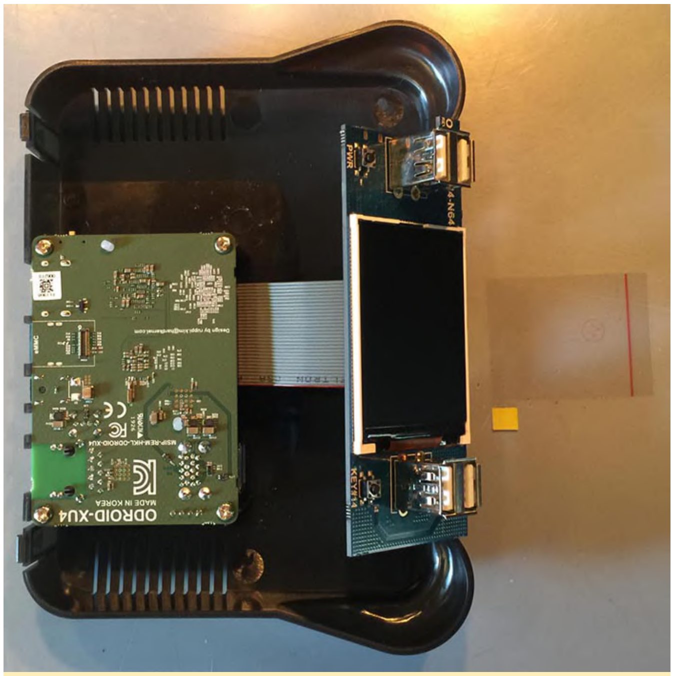


Figure 9

Now we want to connect the USB-to-USB cable. This splits one USB port on the ODROID-XU4 board into 4 USB ports that are available on the front of the OGST case. Notice that we want the USB cable to sit on top of the ribbon cable as shown below. We are working on the top of the case so everything we are doing will be flipped upside down when we are done. The USB cable should be below the ribbon cable this will make it easier to access in case you want to take apart the case.

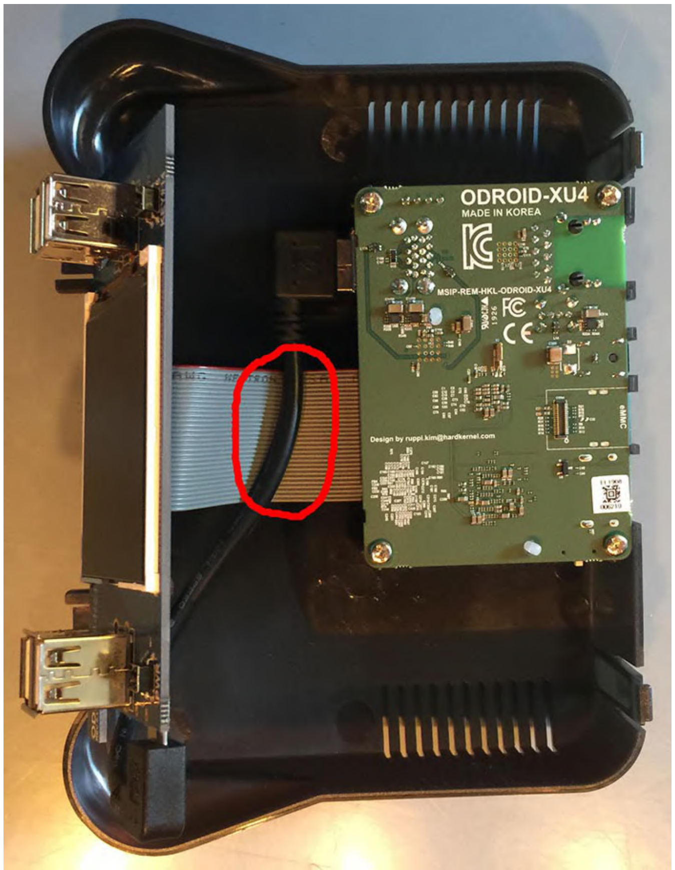


Figure 10

Finishing Up

Now we are going to prepare the harddrive. Holding the harddrive upside down use the included drive USB cable to connect the harddrive to the expansion board. Notice that we are bending the cable and sort of visualizing how the harddrive will sit in the case. This is a good time to make sure that the drive can fit and that the cables all behave nicely. Take a look at the picture below. In this shot I'm double checking how the cable works with the drive's cable connection. It looks like it will play nicely with the case.

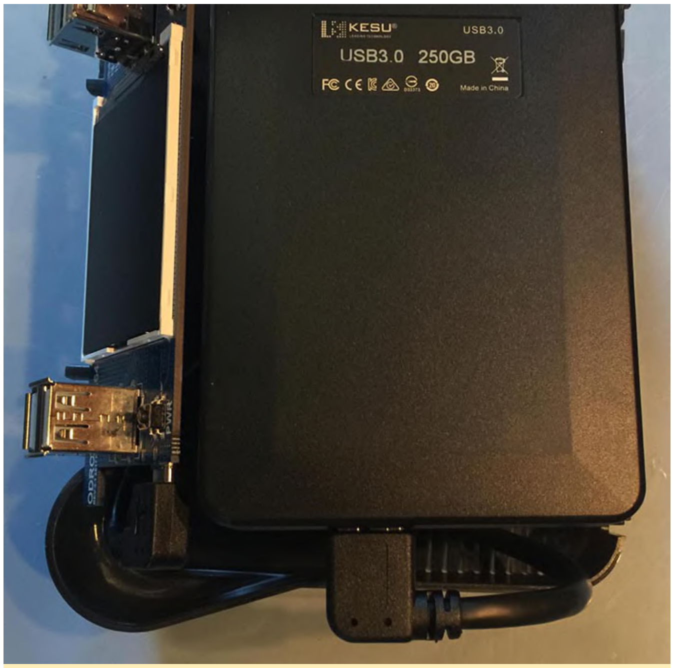


Figure 11

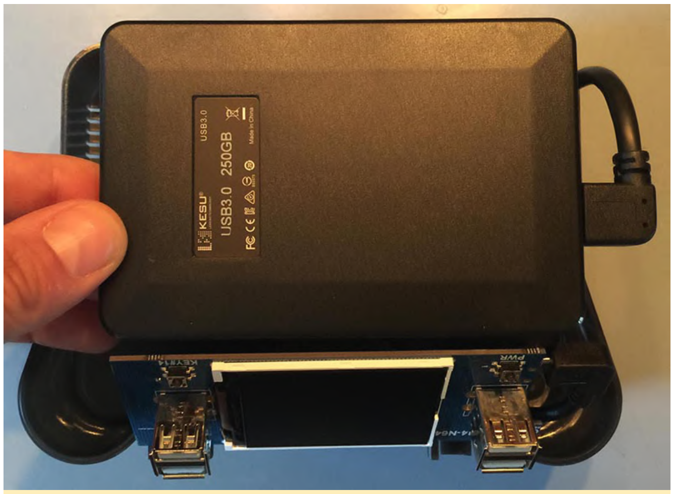


Figure 12

Ok, so we still have not put anything together yet. We need to do a little more work to make sure the drive sits on the bottom of the case properly. While leaving the top of the case as is, put the bottom of the case next to it and place, but do not adhere, the Velcro strips where you want them. I usually put the loop part on the drive. You can set it up any way you like. If you use wider strips the hold will be stronger and you will have more flexibility in how you place the harddrive on the bottom of the case. The photo below shows my first attempt at placing the velcro strips. I eventually doubled up on the strips to make the contact surface bigger. TIP: Make sure that the drive's cable is taken into account when setting up the Velcro strips on the case bottom.

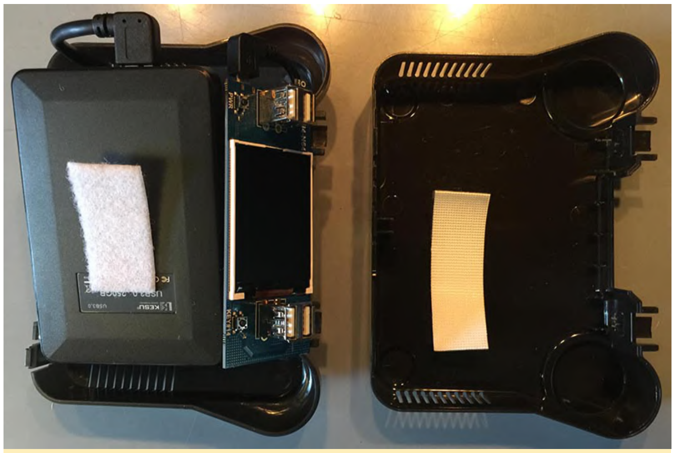


Figure 13

Next up you will want to set the expansion board firmly in place. Be careful to make sure it goes in evenly. If one side is farther down the plastic guides you will not be able to seat the board properly. Resist the urge to apply a lot of pressure during this step. Just apply enough force to get it set properly. Now you can place the top of the case vertically on your work surface and place the drive and the bottom part of the case next to it with the USB drive cable attached as shown below. This should be the final check before we begin to close up the case.

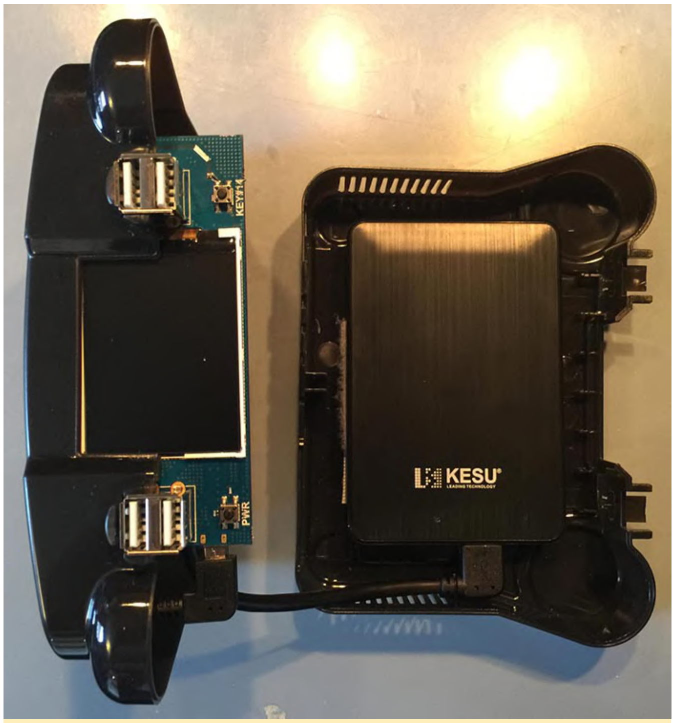


Figure 14

Finally, it is time to close the case! Bring the two sides together. Make sure the USB cables are below the expansion board's ribbon cable. Make sure the harddrive's USB cable is looped and set properly and that the drive is secured with Velcro strips. Close the case and put the two grey plastic caps over the front USB ports. TIP: Make sure to align the two small ridges on one side of the cap. These line up with small ridges on the case itself.

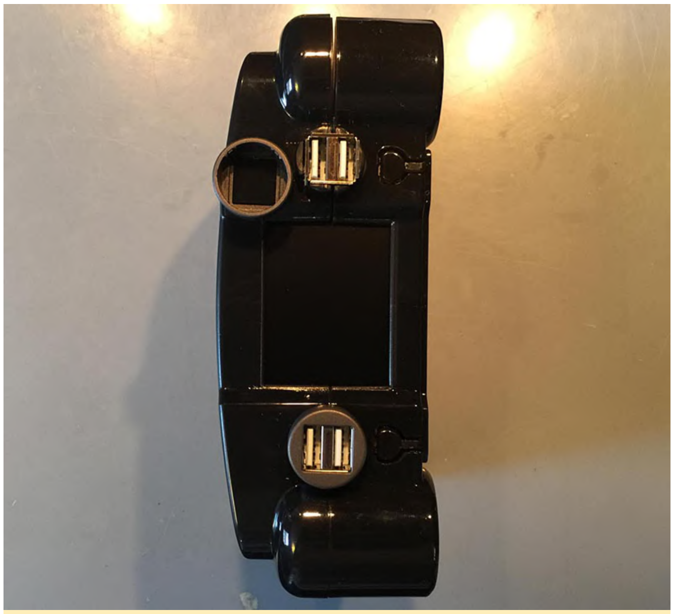


Figure 15

Congratulations! You are done. You have now added larger drive storage to your ODROID-XU4 build! The pictures below depict the completed setup. Enjoy!

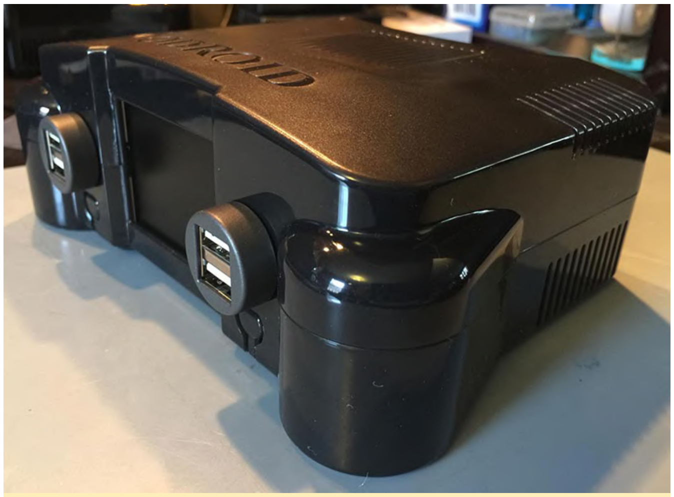


Figure 16

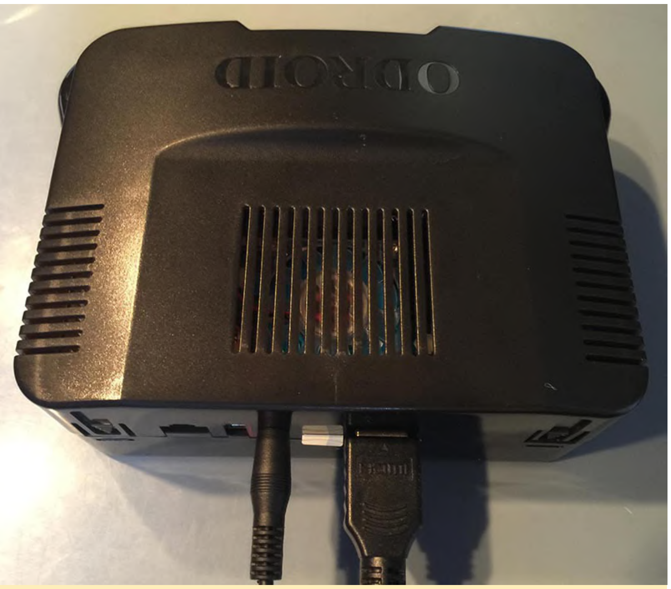


Figure 17

References

http://middlemind.net/tutorials/odroid_go/mfb_build.html

Retro ESP32: The Ultimate Emulation Image for Your ODROID-GO

January 1, 2020 By @32teeth Gaming, ODROID-GO

Retro ESP32 is the ultimate feature-packed launcher for the ODROID-GO. The launcher includes color schemes and theming by drawing inspiration from the popular RetroArch emulator front end. We packed 11, at the time of publication, pre-bundled emulators including ROM / Game manager. Additionally, each emulator includes an in game menu for further ROM management.

Figure 1 - ESP32 Launch in action on the ODROID-GO

Installation

Installation of Retro ESP32 was made to be very simple.

1. Download the latest release: https://github.com/retro-esp32/RetroESP32/releases
2. Unzip the file
3. Copy RetroESP32.fw to the odroid/firmware folder of your prepared SD card (https://github.com/retro-esp32/RetroESP32/blob/Software/SD%20Card/SDCARD.zip)
4. Mount the SD Card back into your ODROID-GO
5. Restart and hold down the B button
6. Select Retro ESP32 from the firmware list
7. Sit back and relax while your ODROID-GO flashes the new firmware

Supported Emulators

Retro ESP32 supports a wide range of emulators for you to play on the ODROID-GO. Below is a list of all the support emulators:

Nintendo Entertainment System Nintendo Game Boy Nintendo Game Boy Color Sega Master System Sega Game Gear Colecovision Sinclair Zx Spectrum 48k Atari 2600 Atari 7800 Atari Lynx PC Engine

User Request

Have a great idea? Want to see a feature added to an upcoming release? Or, you ran into a problem? Use our Project (https://github.com/retro-esp32/RetroESP32/projects/1) and Issue (https://github.com/retro-esp32/RetroESP32/issues) sections to submit your information.

References

This project was the work done by the following authors:

- Eugene Yevhen Andruszczenko - Initial and Ongoing Work - 32teeth
- Fuji Pebri - Espressif IOT Consultant - pebri86

This overview was adapted from the README.md of the project's GitHub page. For more information please visit the repo at: https://github.com/retro-esp32/RetroESP32/

How To Configure And Use The CAN Bus: Using the ODROID-N2 With Microcontrollers

January 1, 2020 By Justin Lee, CEO of Hardkernel ODROID-N2, Tinkering, Tutorial

This article explains how to enable the CAN bus on ODROID-N2 via HW SPI interface. The detailed instructions to acquire data via a MCP2515 Bus Monitor board are documented here, as well.

Fig. 01

H/W connection

The following products are required to configure the hardware:

- ODROID-N2
- Tinkering kit
- MCP2515 CAN module

Fig. 02

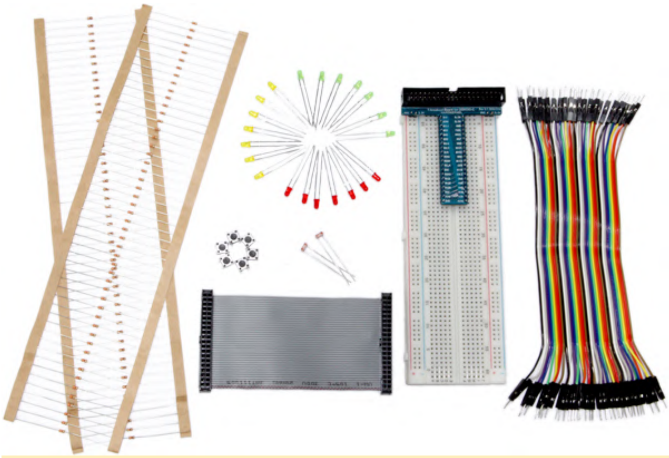


Fig. 03

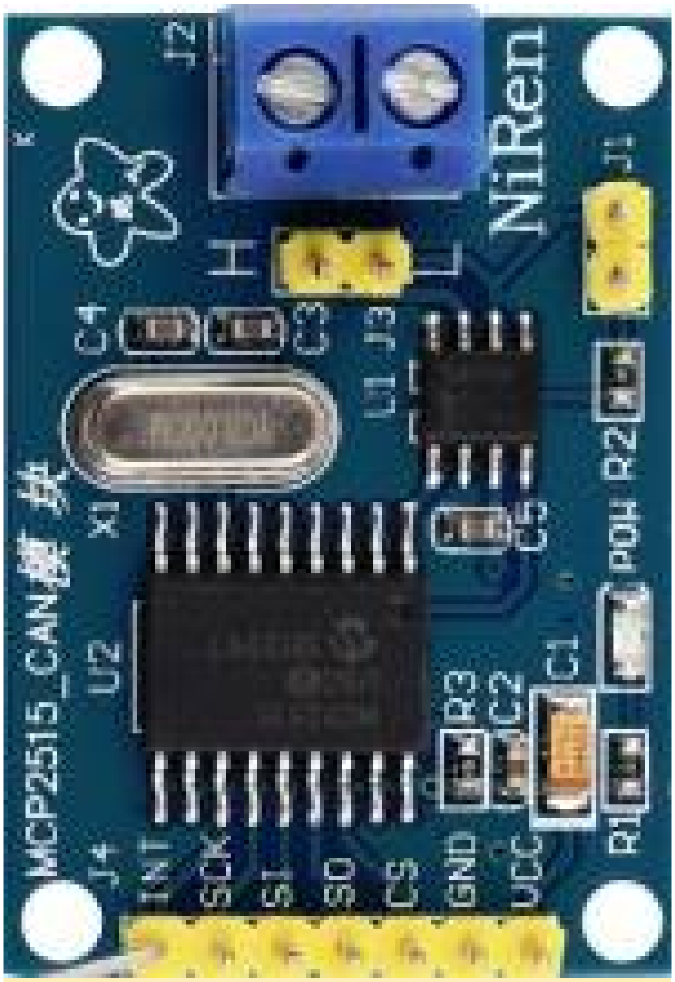


Fig. 04

Reference circuit

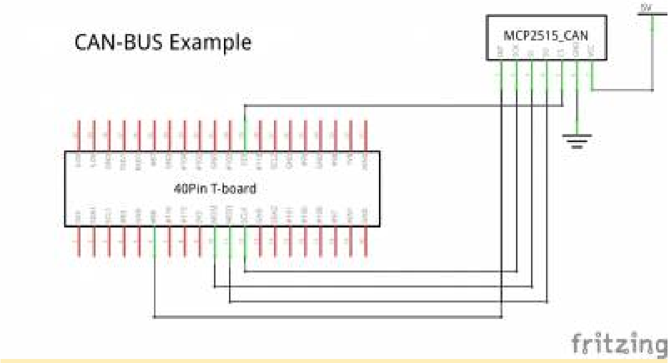


Fig. 05

With tinkering kit

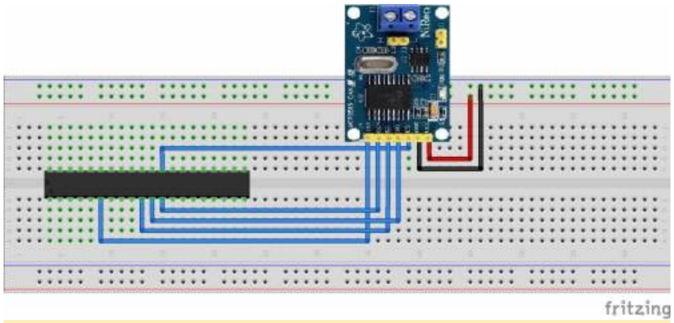


Fig. 06

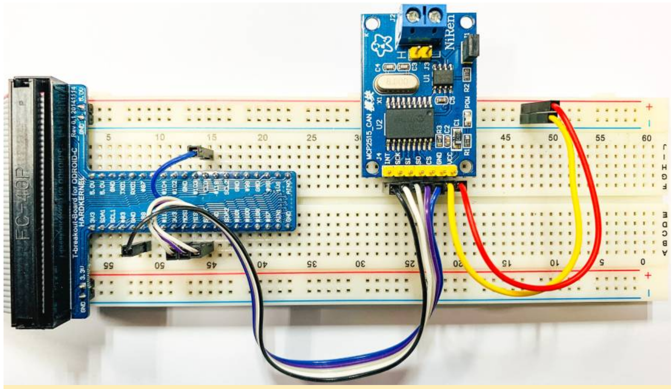


Fig. 07

Software installation

Note:

- Operation confirmed with ODROID-N2 Ubuntu minimal image on 4.9.205-64 kernel.
- The can-bus example uses the same cs-pin as spidev, so both must not be enabled at the same time.
- If spidev is enabled, the can-bus may not work properly.

Updating of the kernel is highly recommended. This is available with Linux odroid 4.9.205-64 or higher version

```
root@odroid:~# apt update && apt full-upgrade
```

Enable the modules using **device-tree-compiler**

```
root@odroid:~# apt install device-tree-compiler
```

Change the status to **okay** on the SPI nodes of the device tree.

```
# SPICC0
root@odroid:~# fdtput -t s
/media/boot/meson64_odroidn2.dtb
                 /soc/cbus@ffd00000/spi@13000
[status okay
root@odroid:~#
# can0
root@odroid:~# fdtput -t s
/media/boot/meson64_odroidn2.dtb

/soc/cbus@ffd00000/spi@13000/can@0
status okay
root@odroid:~#
```

Check if the status changed.

```
# SPICC0
root@odroid:~# fdtget
/media/boot/meson64_odroidn2.dtb
                 /soc/cbus@ffd00000/spi@13000
Status okay
root@odroid:~#
# can0
root@odroid:~# fdtget
/media/boot/meson64_odroidn2.dtb

/soc/cbus@ffd00000/spi@13000/can@0
Status okay
root@odroid:~#
```

Then reboot to apply the changes. you can also check if the modules were correctly loaded.

```
root@odroid:~# lsmod | grep spi
spi_meson_spicc      20480  0
root@odroid:~# lsmod | grep mcp251x
mcp251x              24576  0
can_dev              24576  1 mcp251x
root@odroid:~#
```

Verifying CAN support configuration

Verify the CAN host driver is registered correctly.

```
root@odroid:~# ls /sys/class/net/
can0  eth0  lo
root@odroid:~# ifconfig can0
can0: flags=128  mtu 16
      unspec 00-00-00-00-00-00-00-00-00-00-00-00-
00-00-00-00  txqueuelen 10  (UNSPEC)
      RX packets 0  bytes 0 (0.0 B)
      RX errors 0  dropped 0  overruns 0  frame 0
      TX packets 0  bytes 0 (0.0 B)
      TX errors 0  dropped 0 overruns 0  carrier 0
collisions 0

root@odroid:~#
```

Power on the CAN hardware. Set the bitrate before performing all operations Example: Set the bitrate of the can0 interface to 125kbps:

```
root@odroid:~# ip link set can0 type can bitrate
125000 triple-sampling on
root@odroid:~# ifconfig can0 up
root@odroid:~# ifconfig
can0: flags=193<UP,RUNNING,NOARP>  mtu 16
      unspec 00-00-00-00-00-00-00-00-00-00-00-00-
00-00-00-00  txqueuelen 10  (UNSPEC)
      RX packets 0  bytes 0 (0.0 B)
      RX errors 0  dropped 0  overruns 0  frame 0
      TX packets 0  bytes 0 (0.0 B)
      TX errors 0  dropped 0 overruns 0  carrier 0
collisions 0

eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>
mtu 1500
      inet 192.168.10.8  netmask 255.255.255.0
broadcast 192.168.10.255
      inet6 fe80::e160:7710:5360:f82a  prefixlen
64  scopeid 0x20
      ether 02:00:00:0d:1d:01  txqueuelen 1000
(Ethernet)
      RX packets 24  bytes 6066 (6.0 KB)
      RX errors 0  dropped 0  overruns 0  frame 0
      TX packets 54  bytes 6420 (6.4 KB)
      TX errors 0  dropped 0 overruns 0  carrier 0
collisions 0
      device interrupt 22

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
      inet 127.0.0.1  netmask 255.0.0.0
      inet6 ::1  prefixlen 128  scopeid 0x10
      loop  txqueuelen 1  (Local Loopback)
      RX packets 129  bytes 10117 (10.1 KB)
      RX errors 0  dropped 0  overruns 0  frame 0
      TX packets 129  bytes 10117 (10.1 KB)
      TX errors 0  dropped 0 overruns 0  carrier 0
collisions 0
```

```
root@odroid:~#
```

Install the SocketCAN utils.

The can-utils package is a collection of CAN drivers and networking tools for Linux. It allows interfacing with CAN bus devices in a similar fashion as other network devices.

```
sudo apt install can-utils
```

We need to perform the Loopback test on a single CAN port. Set loopback mode on can0

```
ifconfig can0 down
ip link set can0 type can bitrate 125000 loopback
on
ifconfig can0 up
ip -details link show can0

root@odroid:~# ifconfig can0 down
root@odroid:~# ip link set can0 type can bitrate
125000 loopback on
root@odroid:~# ifconfig can0 up
root@odroid:~# ip -details link show can0
3: can0: <NOARP,UP,LOWER_UP,ECHO> mtu 16 qdisc
fq_codel state UNKNOWN mode DEFAULT group default
qlen 10
  link/can  promiscuity 0
  can <LOOPBACK,TRIPLE-SAMPLING> state ERROR-
ACTIVE restart-ms 0
        bitrate 125000 sample-point 0.850
        tq 400 prop-seg 8 phase-seg1 8 phase-seg2
3 sjw 1
        mcp251x: tseg1 3..16 tseg2 2..8 sjw 1..4
brp 1..64 brp-inc 1
        clock 5000000numtxqueues 1 numrxqueues 1
gso_max_size 65536 gso_max_segs 65535
root@odroid:~#
```

The following command shows the received message from the CAN bus

```
candump can0
```

On a second terminal, The following command sends 3 bytes on the bus (0x11, 0x22, 0x33) with the identifier 500.

```
cansend can0 500#11.22.33
```

How to test CAN-bus link between 2 ODROID-N2 boards

Connect CANL, CANH pins between two ODROID-N2 boards

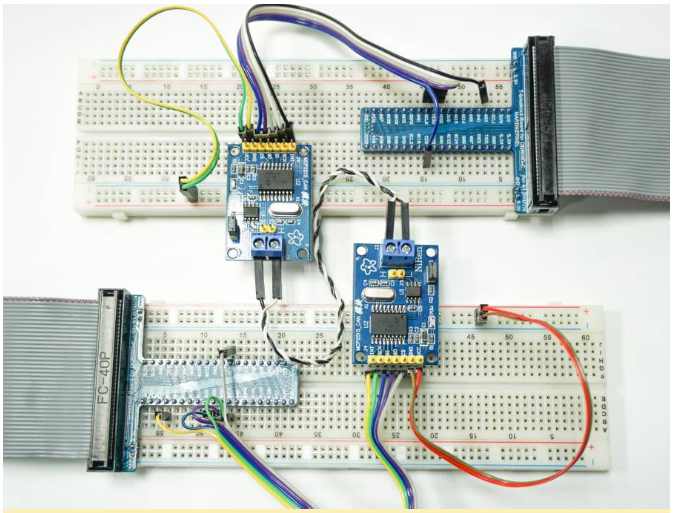


Fig. 08

Power-up both boards and type the following into the shell of both boards for configuring the CAN bus device:

```
ip link set can0 type can bitrate 125000 triple-
sampling on
ifconfig can0 up
```

Type the following into the shell of board 1 (which is used for testing/receiving over the can0 device):

```
candump can0
```

Type the following into the shell of board 2 (which is used for testing/sending data packets over the can0 device):

```
cansend can0 500#11.22.33
```

At this point, board 1 will receive the data packet sent from board 2:

```
root@odroid:~# candump can0
  can0  500   [3]  11 22 33
  can0  500   [3]  11 22 33
```

References

https://wiki.odroid.com/odroid-n2/application_note/gpio/can-bus

ODROID-GO Advance: The Newest Generation of Hardkernel's Most Popular Handheld Computer

January 1, 2020 By Justin Lee, CEO of Hardkernel Gaming, ODROID-GO, ODROID-GO Advance

We announced the ODROID-GO in 2018 June to celebrate our 10th birthday. It was amazing and fun to be able to emulate old-school 8-bit retro games with more than expected performance with only the MCU, rather than a high-end MPU. The device has been very popular not only for gaming but also for education.

Figure 1 - ODROID-GO Advance

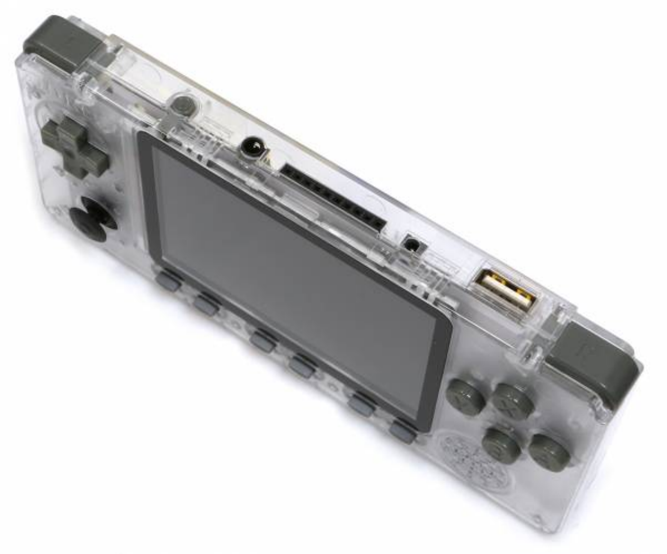


Figure 2 - ODROID-GO Advance

We continued to hear from users who wanted to play 16-bit or 32-bit retro games on a handheld device with more advanced features and capabilities. Therefore, we researched a new platform this year and found a suitable solution, so we've spent several months developing a new 64-bit Linux-powered device. This new device, called the ODROID-GO Advance, has a modern 64bit ARM low-power quad-core processor as well as wide-viewing-angle 3.5inch LCD.

ODROID-GO Advanced specifications

Processor	CPU : RockChip RK3326(Quad-Core ARM Cortex-A35 1.3GHz) GPU : Mali-G31 Dvalin
Memory	1GB (DDR3L 786Mhz, 32 Bits bus width)
Storage	SPI Flash(16Mbytes Boot), Micro SD Card slot(UHS-1 Capable interface)
Display	3.5inch 320×480 TFT LCD (ILI9488, MIPI interface)
Audio	Earphone Jack, 0.5Watt 8Ω Mono
Battery	Li-Polymer 3.7V/3000mAh, Up to 10 hours of continuous game playing time
DC Jack	2.5mm diameter DC plug: A USB charging cable is included in the package
External I/O	USB 2.0 Host x 1, 10Pin port(I2C, GPIO, IRQ at 3.3Volt)
Input Buttons	F1, F2, F3, F4, F5, F6, A, B, X, Y, Direction Pad, Left Shoulder, Right Shoulder, Analog joystick
Power consumption	Power consumption Game emulation: 100~115mA, Sleep mode: 5.3~5.8mA, Power off: 0.1mA

At this moment, the trial BSP image supports the following systems:

- Atari 2600
- Atari 5200
- Atari 7800
- Atari Lynx
- Gamegear
- Gameboy
- Gameboy Advance
- Gameboy Color
- Sega Master System
- Sega Genesis
- Nintendo
- PC Engine
- PC Engine CD
- Sony PlayStation
- Sega CD
- Super Nintendo
- Sony PlayStation Portable

You can check out some videos of the ODROID-GO Advance in action at https://youtu.be/okVJe6ywc4c and https://youtu.be/im46rlz0Nwg. It will be available for USD $55 starting at the end of January 2020.

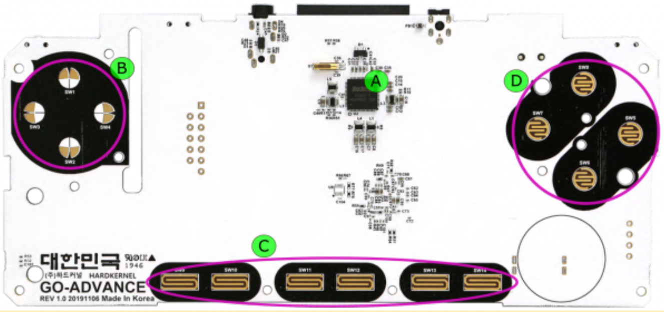


Figure 3 - ODROID-GO Advance external annotated diagram

A PMIC(RK817) including a charger and audio features. B D-pad buttons C I ~ VI buttons (F1, F2, F3, F4, F5, F6) D X, Y, A, B buttons

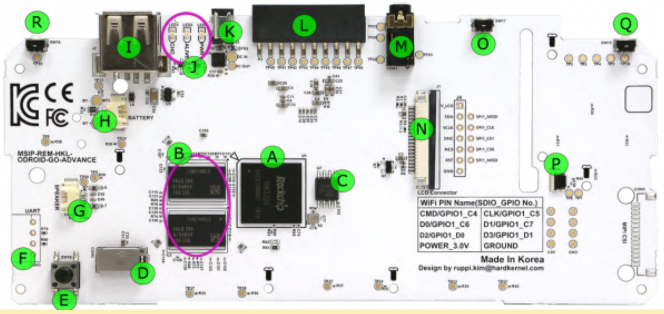

R
I
J
K
L
M
O
Q
H
N
B
A
C
P
G
F
D
E
MSIP-REM-HKL-ODROID-GO-ADVANCE
LCD Connector
Made In Korea
Design by ruppi.kim@hardkernel.com

Figure 4 - ODROID-GO Advanced internal annotated diagram

A CPU : Rockchip RK3326 B RAM : 1GB DDR3L C SPI Flash(16Mbytes Boot) D MicroSD card slot E Forced SD card boot(without spirom) F UART port(But not mounted default) G Speaker connector H Battery connector I USB 2.0 type-A Host J Statue LED(charger, alive, power) K DC Power Jack L 10pin expansion port M Audio jack N 20pin LCD connector O PWR switch P Analog joystick connector Q Left trigger button R Right trigger button

How to use it

The following links provide information on how to to use the ODROID-GO Advance:

- Building with ODROID-GO-Advance kit
- Installing OS image on your SD card

Transferring game roms via SD card reader (Linux HOST-PC)

Insert your SD card which you have installed to your HOST-PC and then copy game ROMs to /roms folder, as shown in Figure 5.. You can copy your game ROMs into the /roms folder without any permission.

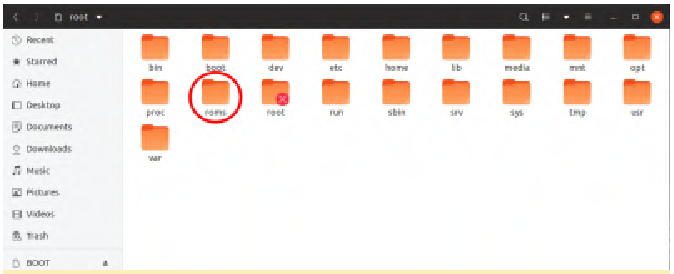


Figure 5 - The ODROID-GO Advance /roms folder

Since the SD card data partition file system is EXT4, you can't access it from a Windows PC, so we need to prepare a way to transfer ROM files from a USB storage on the system. First of all, you can check your network environment. If you have any USB network module, follow this instructions at Connecting your GO-Advance to an wireless network with an extra USB WiFi adapter. Compatible WiFi dongles are sold separately (WiFi module 0, WiFi module 3, WiFi module 5A) After that, you can send your game ROMs to the GO-Advance with the “scp” command on your HOST-PC:

```
$ sudo apt install ssh
$ scp  odroid@:/roms//
```

For example:

```
$ ping 192.168.0.10
$ scp test.gba odroid@192.168.0.10:/roms/gba/
```

For more information, please visit the ODROID Wiki at https://wiki.odroid.com/odroid_go_advance/start.

Monku R4 With An ODROID-N2 and Batocera Linux: The Best Retro Gaming Console You Can Build for Around $100

January 1, 2020 By Brian Ree Gaming, ODROID-N2, Tutorial

Parts Needed

Before we begin you need to gather the following items. All these items can be ordered from Hardkernel:

- ODROID-N2 (2GB of RAM) - ODROID-N2 Case - 64GB Micro SD Card x2 - HDMI Cable x1 - Power Supply 12V/2A x1 - GameSir Wired Controller x1 - A 16GB or 32GB eMMC Memory Module - A Micro SD to USB Adapter - An eMMC to Micro SD Adapter

Introduction and Tutorial Goals

This tutorial covers the process of setting up an ODROID-N2 with 2GB of RAM and iInstalling Batocera Linux so we can use our ODROID-N2 as a TV retro gaming console. I lovingly call this device the Monku R4. I will cover setting up the operating system, setting up the ROMs and BIOS files, and I'll cover getting box art and screenshots for your ROMs. In my opinion this is the BEST retro gaming console you can build for your money. It runs a ton of emulators and it runs them all very well. Let's take a look at some of the emulators it will run. I've personally set one up to run the following emulators.

- Atari 2600
- Atari 5200
- Atari 7800
- C64
- Colecovision
- DOOM
- Dreamcast
- FBA MAME
- Game Boy
- Game Boy Advance
- Game Boy Color
- Intellivision
- Jaguar

- Lynx
- Magnavox Odyssey
- MAME
- MS-DOS
- MSX 1/2
- N64
- NES
- NEO-GEO Pocket
- NEO-GEO Pocket Color
- PSP
- PS1
- ScummVM
- Sega 32X
- Sega CD
- Sega GameGear
- Sega Genesis
- Sega Master System
- Sega SG-1000
- SNES
- Turbo Grafx 16
- Turbo Grafx 16 CD
- Virtual Boy
- WonderSwan
- WonderSwan Color
- ZX Spectrum

A note about cost: I say in the title that this is the best retro gaming console you can build for under $100, however, you would have to get only one 64GB SD card, and the smaller eMMC module to keep the price around $100. I do recommend getting the dual pack of 64GB SD cards because you can make a backup. Now that you have an idea of what you're working with, and just to be clear the ODROID-N2 is much more powerful than the ODROID-XU4 (Sorry ODROID-XU4 fans), I'm tailoring this tutorial to use an eMMC module as the bootable OS drive to get even more performance out of the ODROID-N2. You can decide to run things entirely off a micro SD card or a larger eMMC module, if you see fit. I won't cover these in detail but you can take different parts of the tutorial and apply them to an SD-card-only or eMMC-only implementation. The separation we have between the OS and the ROMs allows us to keep the SD card separate from the OS and on a Fat32 filesystem. This means we can pop out the SD card and plug it into any computer and edit it, as needed. It is a bit more difficult to do the same thing with a bootable ext4 Linux filesystem for the Mac OS or Windows PC. TIP: If you are opting for a single storage install, only eMMC or only SD, then you will most likely have to login to your device via SSH at some point in the setup process to configure it. The default root password for the device is Linux.

Setting Up the eMMC Module

Let's take a look at the hardware we'll need to write to the eMMC module. Below is a picture of the eMMC to micro SD adapter. Below that is a picture of the adapter and the eMMC module. I'll be using a 32GB module, but you really only need a 16GB module because we're going to use it to house the OS. If you want to perform a more advanced setup with ROMs in multiple locations, eMMC and SD, then you'll probably want a 32GB or larger eMMC.

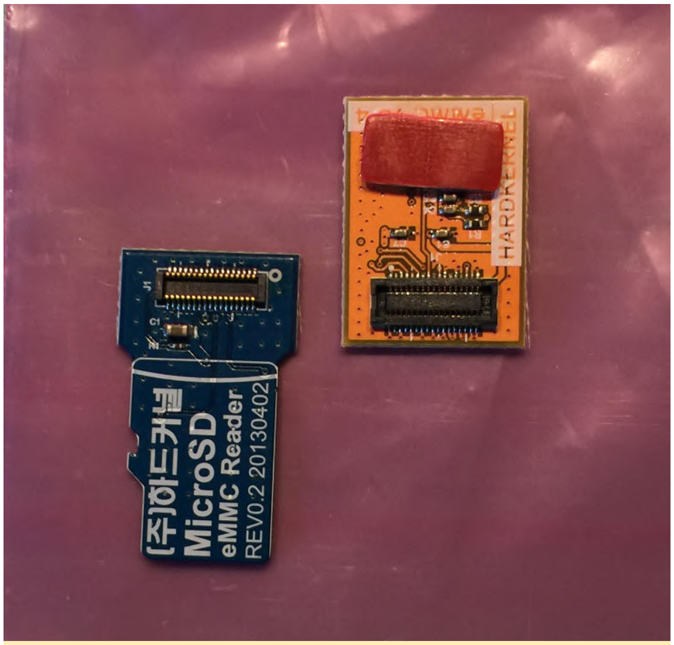


Figure 1 - eMMC module and SD adapter

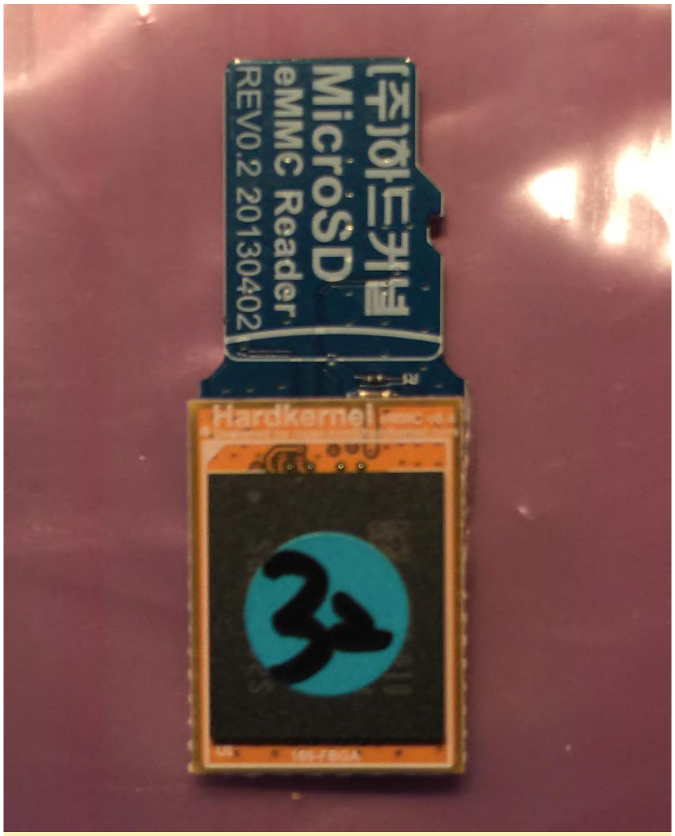


Figure 2 - eMMC module mounted in the SD card adapter

If you are new to eMMC modules I recommend going through the following tutorial as I'll only cover the image writing process here and not any eMMC specific steps.

- Working with eMMC Modules Tutorial

You'll want to get a copy of the latest version of Batocera Linux for the ODROID-N2. Batocera Linux is based on Recalbox Linux so if you're familiar with RecalBox then you are ahead of the game. Use the links below to locate the latest version of Batocera Linux for the ODROID-N2 and download it. TIP: While this tutorial focuses on the ODROID-N2 you can use it as a general guide for installing Batocera Linux on other hardware like the ODROID-XU4.

- Batocera: General Download Page

- Batocera: ODROID-N2 Specific Download Page

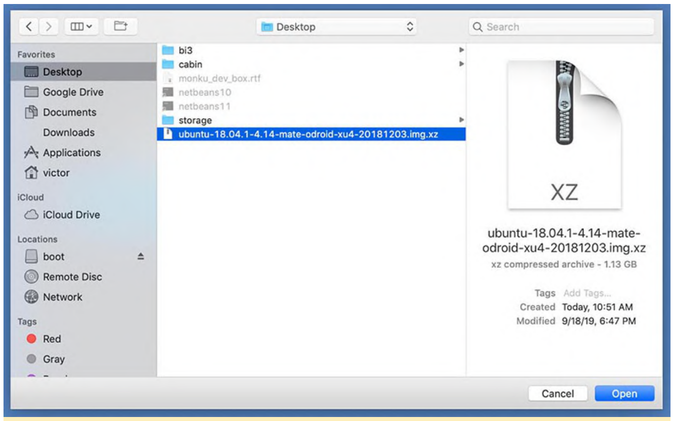
Once you've got your image ready it's time to get some software that you can use to flash the eMMC module. If you are using a Mac I recommend getting Balena Etcher. It works great and I highly recommend it. If you're using Windows you can grab a copy of Win32 Disk Imager. Though not as pretty as Balena Etcher, Win32 Disk Imager gets the job done. For Linux users you'll have to perform the following steps. Don't worry it's not too bad.

1. Insert your SD card into your computer. 2. Locate the device, by running sudo fdisk -l. It will probably be the only disk about the right size. Note down the device name; let us suppose it is /dev/sdx. If you are in any doubt, remove the card, run sudo fdisk -l again and note down what disks are there. Insert the SD card again, run sudo fdisk -l and it is the new disk. 3. Unmount the partitions by running sudo umount /dev/sdx*. It may give an error saying the disk isn't mounted - that's fine. Copy the contents of the image file onto the SD card by running

```
$ sudo dd bs=1M if=your_image_file_name.img
of=/dev/sdx
```

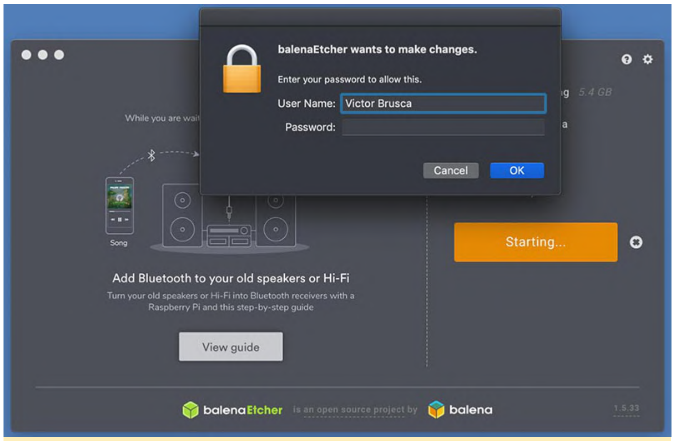
Of course, you'll need to change the name of the image file, as appropriate. You'll also need to adjust the destination argument, of, to match the target device in your environment. ALERT: Ensure the drive, device, drive letter you are flashing are correct. Make sure you are not overwriting another important drive! I'll include images of the process as it looks on Mac. You may be prompted to gain admin privileges on Mac and Windows.

Select the image file that you want to flash to the eMMC module. The image file depicted below is not the file you'll be using for this tutorial. You'll be using your Batocera Linux ODROID-N2 image file.



ubuntu-18.04.1-4.14-mate-odroid-xu4-20181203.img.xz
xz compressed archive - 1.13 GB
Tags Add Tags...
Created Today, 10:51 AM
Modified 9/18/19, 6:47 PM

Figure 3 - The compressed image file



balenaEtcher wants to make changes.

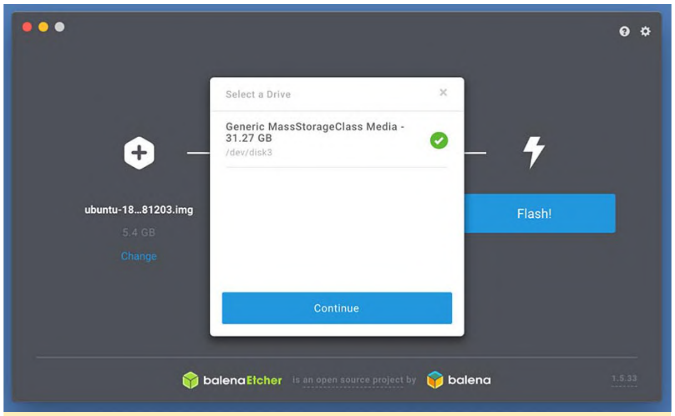
Enter your password to allow this.

User Name: Victor Brusca

Password:

Cancel
OK
While you are wai
5.4 GB
Song
Starting...
Add Bluetooth to your old speakers or Hi-Fi
Turn your old speakers or Hi-Fi into Bluetooth receivers with a Raspberry Pi and this step-by-step guide
View guide
balenaEtcher is an open source project by balena
1.5.33

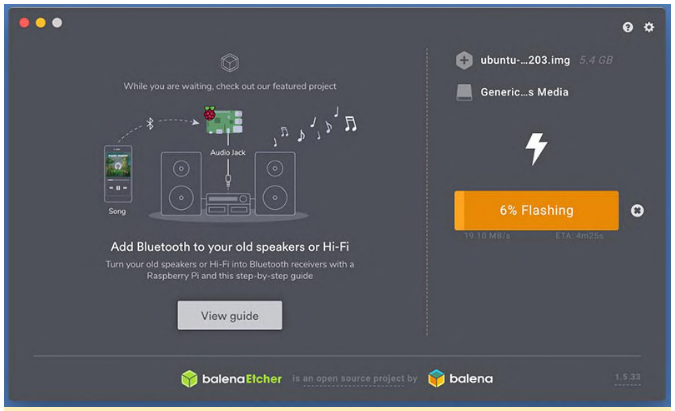
Figure 4 - Answer any prompts for admin privilege



Select a Drive

Generic MassStorageClass Media - 31.27 GB
/dev/disk3

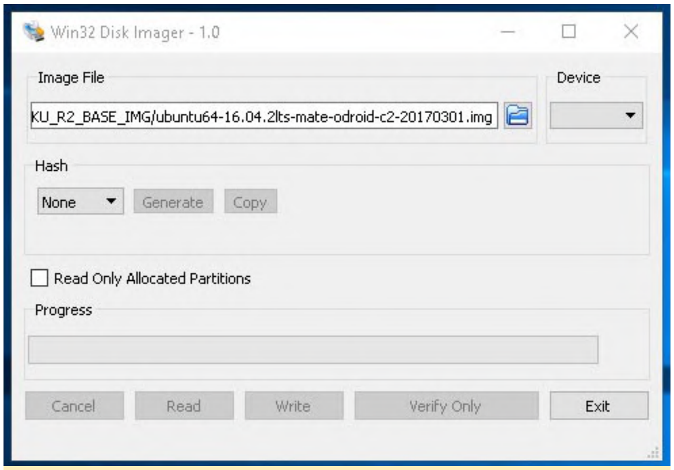
Figure 5 - Double check that you're indeed flashing the correct device and that it is the correct approximate size.



While you are waiting, check out our featured project
Audio Jack
Song
ubuntu-...203.img 5.4 GB
Generic...s Media
6% Flashing
19.10 MB/s
ETA: 4m25s
Add Bluetooth to your old speakers or Hi-Fi
Turn your old speakers or Hi-Fi into Bluetooth receivers with a Raspberry Pi and this step-by-step guide
View guide
balenaEtcher is an open source project by balena
1.5.33

Figure 6 - Start flashing the device and wait for the process to complete.

On a Windows PC, if you're using the software tool listed above, you would see something like the following before clicking the Write button. Again wait for the tool to finish writing the image to the eMMC module. Also, the image file depicted below is not the file you'll be using for this tutorial. You'll be using your Batocera Linux ODROID-N2 image file. ALERT: Make sure that you choose the correct drive letter. Triple check the letter so you don't overwrite another important drive!!



Win32 Disk Imager - 1.0

Image File: KU_R2_BASE_IMG/ubuntu64-16.04.2lts-mate-odroid-c2-20170301.img

Device:

Hash: None

□ Read Only Allocated Partitions

Progress

Figure 7 - Win32 Disk Imager

Next let's boot up the device and test out the OS. The image below shows the ODROID-N2 with a red arrow next to the eMMC module slot and a blue arrow next to the SD card slot. If you're going the micro SD card route you'll need to remove the card while setting up the case.

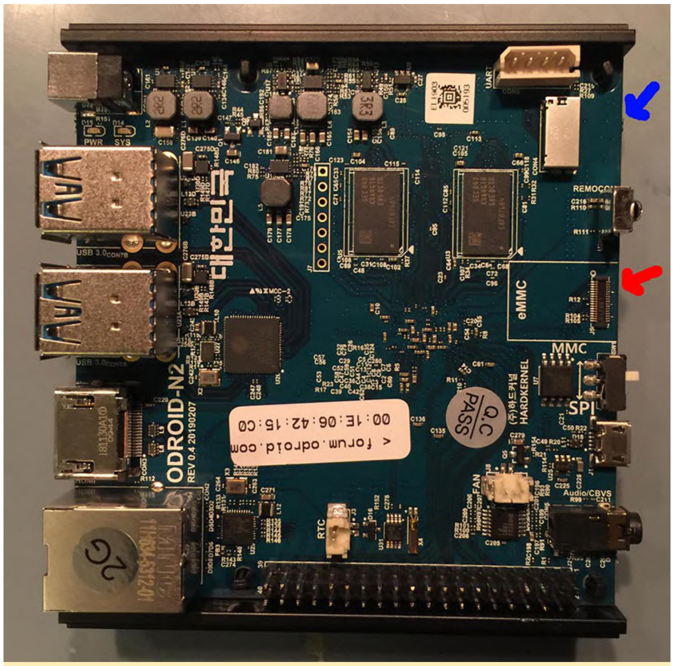


Figure 8 - eMMC in red, and SD Card is blue

Connect the eMMC module to the ODROID-N2 as shown below and prepare a static free surface for the device. You'll want to get your 12V/2A power supply ready.

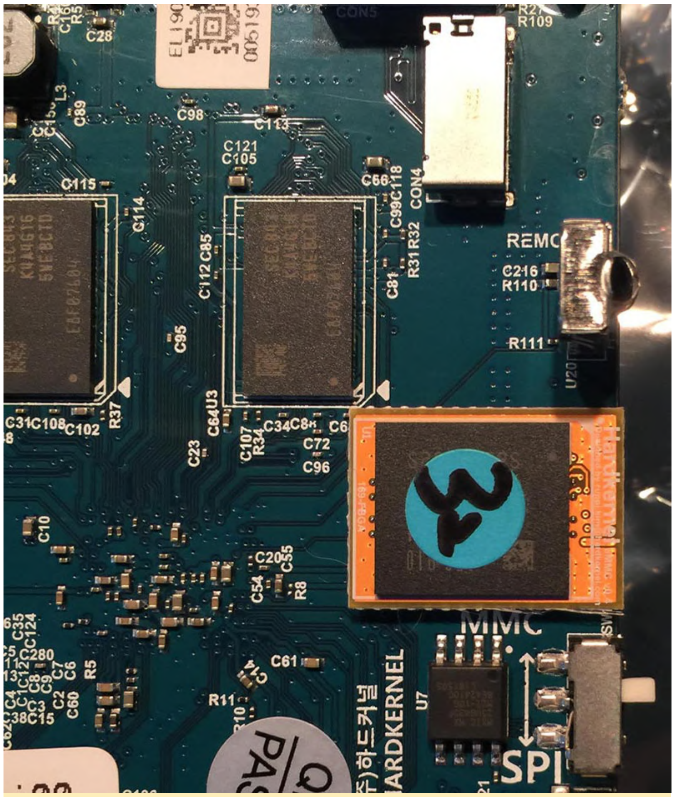


Figure 9 - 32GB eMMC module loaded onto N2

Make sure you have the white switch on the back of the ODROID-N2 pushed all the way to the right to boot off of the eMMC module. Push it all the way to the left to boot off of the micro SD card. In our case we'll be going with pushing it to the right to boot off of the eMMC module. We'll still be able to access the micro SD card as a drive.

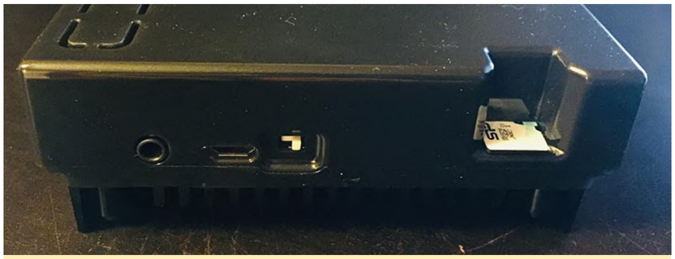


Figure 10 - white switch is set to the right, and SD card is inserted

Plug in the power supply, plug in the HDMI cable, hold your breath and with any luck you'll be looking at a screen similar to the one depicted below. Nice!

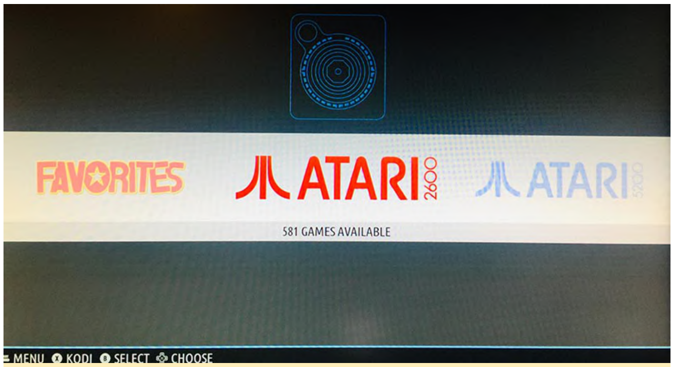


Figure 11 - Menu up and running

Turn off the ODROID-N2 by exiting out of the device using a keyboard. Or, if you have your game controller handy you can configure it via the Batocera Linux UI and then power down the device. I'll be covering how to configure things in detail in just a bit. That brings us to the end of this section of the tutorial next up we'll be setting up the case and then moving on to some configuration and customization topics.

Putting Together the Case

The case is actually ingeniously designed as you'll come to see. One thing that is cool is that the whole thing rests on a heat sink. That's right, the bottom of the N2 is a big heatsink but it also acts as a really solid base for the device. TIP: Use black electrical tape and place 4 pieces on the base of the ODROID-N2's heatsink, the two main pieces of metal that actually touch the surface it's resting on. Place one piece near each of the four corners. This will create a softer contact with different surfaces and also prevents sliding. Lay out the ODROID-N2 and the parts of the case as shown below.

There is a little ridge on the left and right edge of the ODROID-N2, take the smaller case top - the one on the left in the image above - and slide it onto the ODROID-N2 being careful to keep it on the guide ridges. The image below shows the smaller front part of the case in position and the guide ridges.

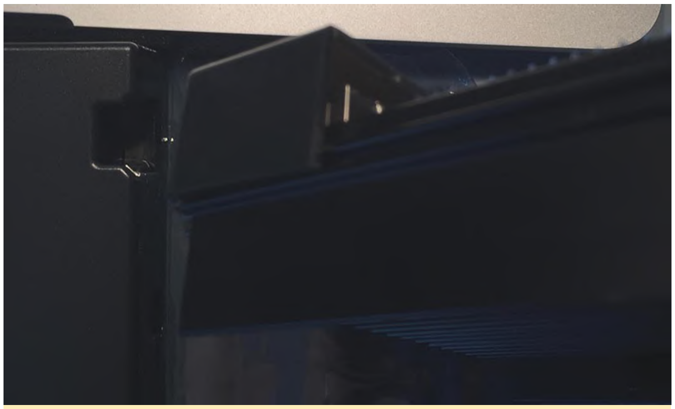


Figure 12 - little ridge on the left and right edge of the N2

Next slide in the larger case top till the two meet. Make sure to keep it straight while pushing it gently along the guide ridges. The two case top pieces will meet and click together with a small clasp. Viola, the case is done!

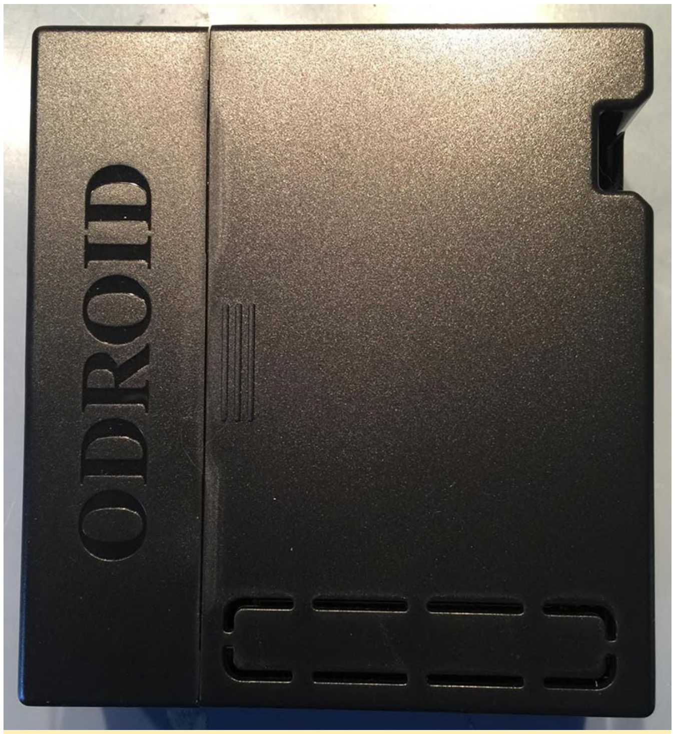


Figure 13 - Finished case

Figure 14 - Glamour shot

Case closed, lol. Ok so now that we have the ODROID-N2 properly housed and protected, replace your SD card, if you're using that method, in the slot on the back of the case. Boot up the device one more time to make sure everything is in order. That brings us to the end of this section. Next up we're going to work on configuring our micro SD card as an external filesystem that Batocera Linux uses for accessing ROMs. I'll also cover setting up controllers, advanced Batocera Linux configuration options, and grabbing ROM box art in this tutorial.

Configuring the Controller and Micro SD Card

First let's get the controller configured. If your controller isn't working the way you expect, you can use a USB keyboard to navigate the main menu. Try pressing the start button or equivalent on your controller this will bring up the main menu. You can also use a keyboard and press the spacebar to bring up the main menu. The GameSir controller we recommend here has a start button. You should see something similar to what's depicted in the image below. Select the Controller Settings menu option. TIP: If you are using a keyboard to navigate the menu system, the enter key is used to make selections, the esc key is used to go back to a previous menu, and the space bar is used to close/open the menu system. Next you'll want to select the Configure a Controller menu option. Selecting this option will bring up a controller configuration screen. You can exit this screen by hitting the start button or the space bar a second time if you already have your controller configured or you accidentally selected this option again after configuration. You will be prompted to hit certain buttons on the controller in series and then you're all set. That's it. It's very easy to do. Below is a picture of the controller configuration prompt. TIP: Pressing the blue GameSir controller button and the start button at the same time will exit out of the current running emulator. You may need to configure this differently for different controllers. TIP: If your wired GameSir controller isn't being recognized by the system hold the blue button down for a few seconds until the little red square on the front of the controller moves over to the second position. If it still isn't recognized try position three, then position four.

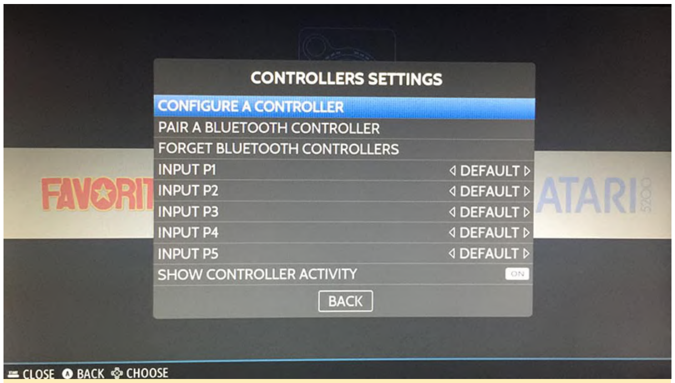


Figure 15

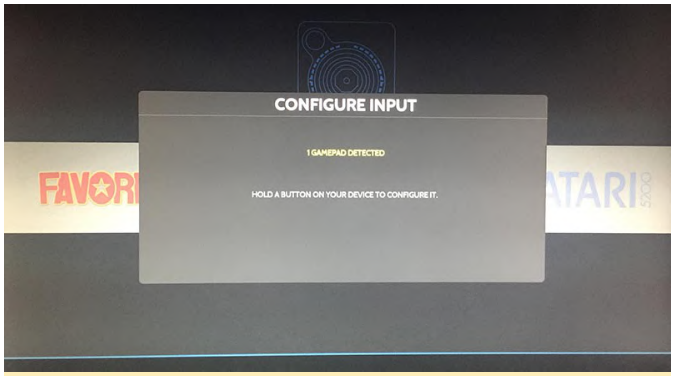


Figure 16

Next thing we're going to do is setup the micro SD card to work with Batocera Linux. I recommend using a 64GB card and getting a pack of two. There are links above for the ones I use. They are affordable and reliable. Plug in the micro SD card and then bring up the main menu using the start button or space bar. Select the System Settings options as depicted below.

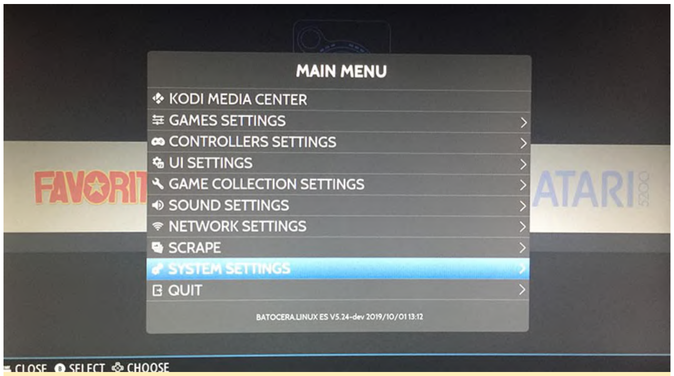


Figure 17 - Navigate down to the Storage Device menu option as depicted below.

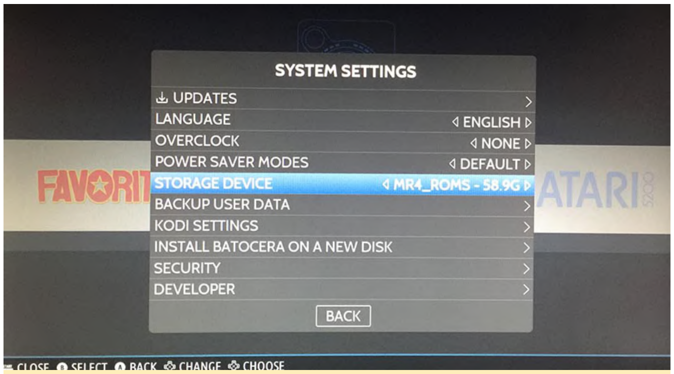
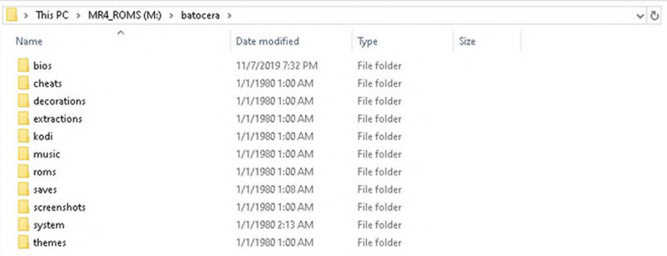

SYSTEM SETTINGS
UPDATES
LANGUAGE ◁ ENGLISH ▷
OVERCLOCK ◁ NONE ▷
POWER SAVER MODES ◁ DEFAULT ▷
STORAGE DEVICE ◁ MR4_ROMS - 58.9G ▷
BACKUP USER DATA
KODI SETTINGS
INSTALL BATOCERA ON A NEW DISK
SECURITY
DEVELOPER
BACK
CLOSE SELECT BACK CHANGE CHOOSE

Figure 18

This will bring up a selection box that lets you choose from a few different storage locations. Pick the entry that has the same name as the micro SD card you put into the ODROID-N2. The system will now reboot after you select the drive. During this reboot Batocera Linux will create, on your micro SD card, a new filesystem that will hold all the ROMs, BIOS files, and configurations for the emulators you want to set up. That brings us to the conclusion of this section of the tutorial. We now have a bootable version of Batocera Linux running on our ODROID-N2 device. We have a configured game controller, and we know how to navigate the menu system. We also have an external file system, our micro SD card, prepped and ready for ROMs and BIOS files.

Adding ROMs and BIOS Files

Now we are ready to add ROMs and BIOS files to the micro SD card that we set up with the Batocera Linux external filesystem in the last section of the tutorial. You will need an adapter to connect the micro SD card to your PC or Mac so that you can copy and paste the files into the proper directory. Below is a picture of the contents of the root folder which is named batocera.

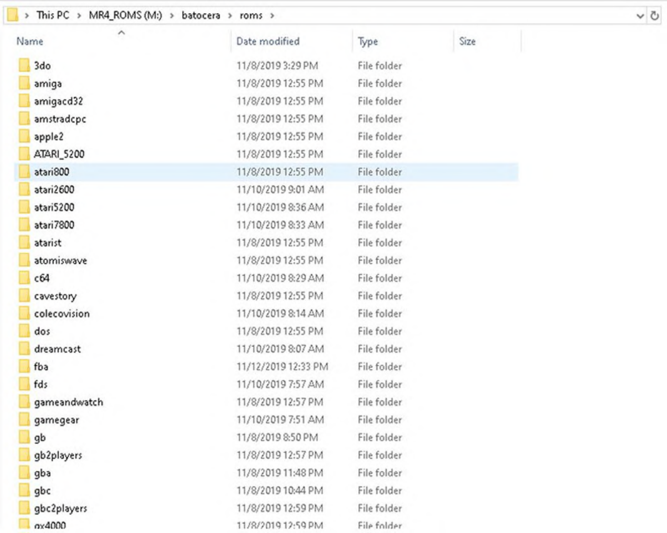


This PC › MR4_ROMS (M:) › batocera ›

Name	Date modified	Type	Size
bios	11/7/2019 7:32 PM	File folder	
cheats	1/1/1980 1:00 AM	File folder	
decorations	1/1/1980 1:00 AM	File folder	
extractions	1/1/1980 1:00 AM	File folder	
kodi	1/1/1980 1:00 AM	File folder	
music	1/1/1980 1:00 AM	File folder	
roms	1/1/1980 1:00 AM	File folder	
saves	1/1/1980 1:08 AM	File folder	
screenshots	1/1/1980 1:00 AM	File folder	
system	1/1/1980 2:13 AM	File folder	
themes	1/1/1980 1:00 AM	File folder	

Figure 19

Notice that you have some other options to use on your Batocera Linux device like Kodi for music and videos. For our purposes though we're mostly concerned with the ROMs folder. Open up the ROMs folder and you will see a directory for each supported system. Now I'm not 100% sure if every emulator runs on every piece of hardware that Batocera Linux can be installed on but certainly all the best ones do. Copy and paste your ROMs into their corresponding directory. If you have a question about where to place ROMs for a certain system just look it up online and you should be able to locate the proper folder. You can also read the _info.txt file in each ROM folder to see what system it supports.

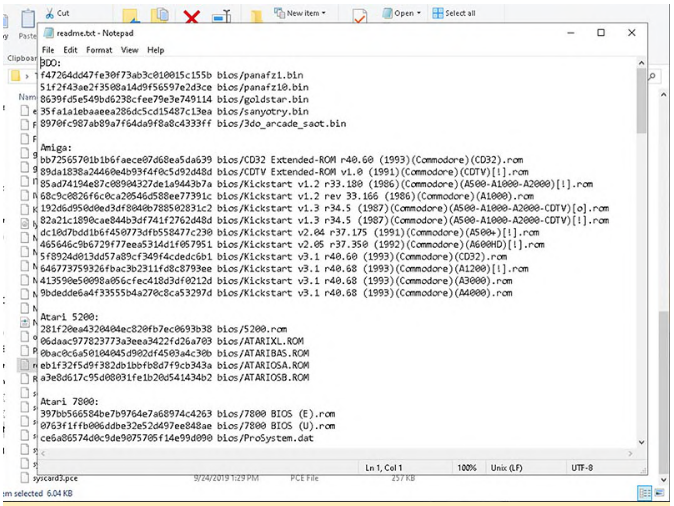


This PC › MR4_ROMS (M:) › batocera › roms ›

Name	Date modified	Type	Size
3do	11/8/2019 3:29 PM	File folder	
amiga	11/8/2019 12:55 PM	File folder	
amigacd32	11/8/2019 12:55 PM	File folder	
amstradcpc	11/8/2019 12:55 PM	File folder	
apple2	11/8/2019 12:55 PM	File folder	
ATARI_5200	11/8/2019 12:55 PM	File folder	
atari800	11/8/2019 12:55 PM	File folder	
atari2600	11/10/2019 9:01 AM	File folder	
atari5200	11/10/2019 8:36 AM	File folder	
atari7800	11/10/2019 8:33 AM	File folder	
atarist	11/8/2019 12:55 PM	File folder	
atomiswave	11/8/2019 12:55 PM	File folder	
c64	11/10/2019 8:29 AM	File folder	
cavestory	11/8/2019 12:55 PM	File folder	
colecovision	11/10/2019 8:14 AM	File folder	
dos	11/8/2019 12:55 PM	File folder	
dreamcast	11/10/2019 8:07 AM	File folder	
fba	11/12/2019 12:33 PM	File folder	
fds	11/10/2019 7:57 AM	File folder	
gameandwatch	11/8/2019 12:57 PM	File folder	
gamegear	11/10/2019 7:51 AM	File folder	
gb	11/8/2019 8:50 PM	File folder	
gb2players	11/8/2019 12:57 PM	File folder	
gba	11/8/2019 11:48 PM	File folder	
gbc	11/8/2019 10:44 PM	File folder	
gbc2players	11/8/2019 12:59 PM	File folder	
gx4000	11/8/2019 12:59 PM	File folder	

Figure 20

Next you're going to have to locate the proper BIOS files for each system. I can't post them here but they are easy enough to find online with a little searching. Back out of the roms folder and open up the bios folder. In the folder there will be a text file called readme.txt. Open it up to see what BIOS files go where in the bios folder. Most should be placed directly into the bios folder, some will be placed into the same directory as the ROMs, the readme.txt file will tell where to place them and what files you need. TIP: Not every emulator is finicky about BIOS files and will run fine with good files even if they don't have the same MD5 hash. Test each system to see which ones are having a problem. For the problem systems, carefully review your BIOS files. You'll have to find an online tool or utility to get an MD5 hash, Mac and Linux users should have an MD5 CLI command. Once you locate the correct files place them into the proper folder and retry that system until it works.



readme.txt - Notepad

```
3DO:
f47264dd47fe30f73ab3c010015c155b bios/panafz1.bin
51f2f43ae2f3508a14d9f56597e2d3ce bios/panafz10.bin
8639fd5e549bd6238cfee79e3e749114 bios/goldstar.bin
35fa1a1ebaaeea286dc5cd15487c13ea bios/sanyotry.bin
8970fc987ab89a7f64da9f8a8c4333ff bios/3do_arcade_saot.bin

Amiga:
bb72565701b1b6faece07d68ea5da639 bios/CD32 Extended-ROM r40.60 (1993)(Commodore)(CD32).rom
89da1838a24460e4b93f4f0c5d92d48d bios/CDTV Extended-ROM v1.0 (1991)(Commodore)(CDTV)[!].rom
85ad74194e87c08904327de1a9443b7a bios/Kickstart v1.2 r33.180 (1986)(Commodore)(A500-A1000-A2000)[!].rom
68c9c0826f6c0ca20546d588ee77391c bios/Kickstart v1.2 rev 33.166 (1986)(Commodore)(A1000).rom
192d6d950d0ed3df8040b788502831c2 bios/Kickstart v1.3 r34.5 (1987)(Commodore)(A500-A1000-A2000-CDTV)[o].rom
82a21c1890cae844b3df741f2762d48d bios/Kickstart v1.3 r34.5 (1987)(Commodore)(A500-A1000-A2000-CDTV)[!].rom
dc10d7bdd1b6f450773dfb558477c230 bios/Kickstart v2.04 r37.175 (1991)(Commodore)(A500+)[!].rom
465646c9b6729f77eea5314d1f057951 bios/Kickstart v2.05 r37.350 (1992)(Commodore)(A600HD)[!].rom
5f8924d013dd57a89cf349f4cdedc6b1 bios/Kickstart v3.1 r40.60 (1993)(Commodore)(CD32).rom
646773759326fbac3b2311fd8c8793ee bios/Kickstart v3.1 r40.68 (1993)(Commodore)(A1200)[!].rom
413590e50098a056cfec418d3df0212d bios/Kickstart v3.1 r40.68 (1993)(Commodore)(A3000).rom
9bdedde6a4f33555b4a270c8ca53297d bios/Kickstart v3.1 r40.68 (1993)(Commodore)(A4000).rom

Atari 5200:
281f20ea4320404ec820fb7ec0693b38 bios/5200.rom
06daac977823773a3eea3422fd26a703 bios/ATARIXL.ROM
0bac0c6a50104045d902df4503a4c30b bios/ATARIBAS.ROM
eb1f32f5d9f382db1bbfb8d7f9cb343a bios/ATARIOSA.ROM
a3e8d617c95d08031fe1b20d541434b2 bios/ATARIOSB.ROM

Atari 7800:
397bb566584be7b9764e7a68974c4263 bios/7800 BIOS (E).rom
0763f1ffb006ddbe32e52d497ee848ae bios/7800 BIOS (U).rom
ce6a86574d0c9de9075705f14e99d090 bios/ProSystem.dat
```

Ln 1, Col 1 | 100% | Unix (LF) | UTF-8

Figure 21

You can actually ask Batocera Linux which BIOS files are missing. Go to the Game Settings option of the main menu as shown below.

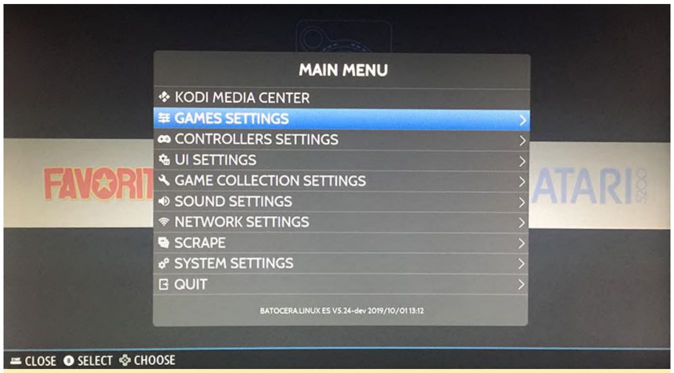
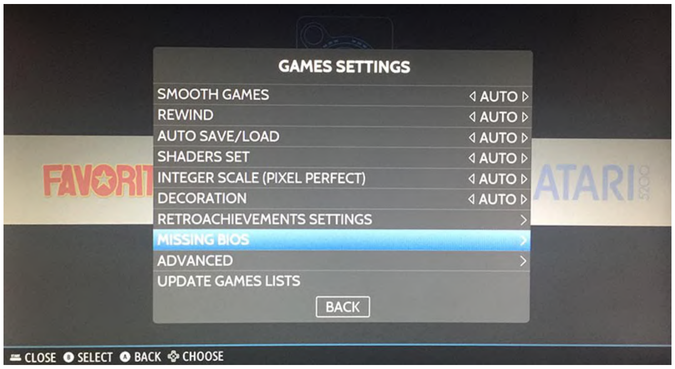


Figure 22

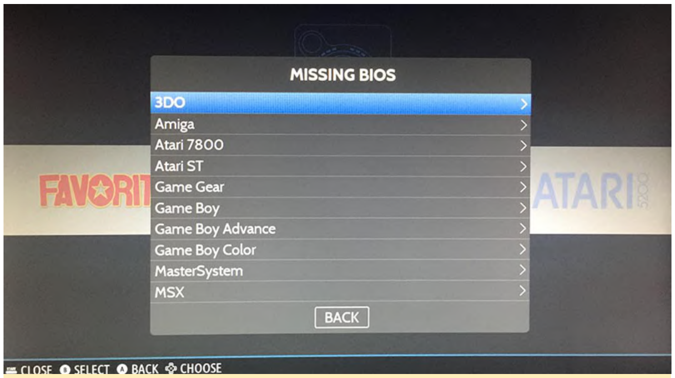
Scroll down the Game Settings menu option and locate the Missing Bios menu option as shown below.



GAMES SETTINGS

SMOOTH GAMES ◁ AUTO ▷
REWIND ◁ AUTO ▷
AUTO SAVE/LOAD ◁ AUTO ▷
SHADERS SET ◁ AUTO ▷
INTEGER SCALE (PIXEL PERFECT) ◁ AUTO ▷
DECORATION ◁ AUTO ▷
RETROACHIEVEMENTS SETTINGS >
MISSING BIOS >
ADVANCED >
UPDATE GAMES LISTS

A popup will appear with a break down of the missing BIOS files for each system. You can use it as a reference for the systems that you are having trouble with.



MISSING BIOS

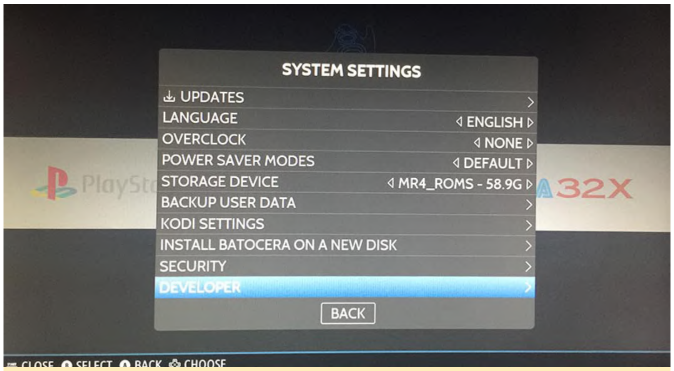
3DO >
Amiga >
Atari 7800 >
Atari ST >
Game Gear >
Game Boy >
Game Boy Advance >
Game Boy Color >
MasterSystem >
MSX >

Figure 24

There is just one other thing I want to cover in this section of the tutorial, advanced system settings. If you navigate back to the System Settings menu. Navigate down to the Developer menu and select it and you'll be taken to a menu where you can adjust some lower level settings. I recommend the following settings.

VRAM: 50MB Show Framerate: OFF VSYNC: OFF Preload UI: OFF Threaded Loading: OFF Async Image Loading: OFF Optimize Images VRAM Use: ON Optimize Video VRAM Use: ON

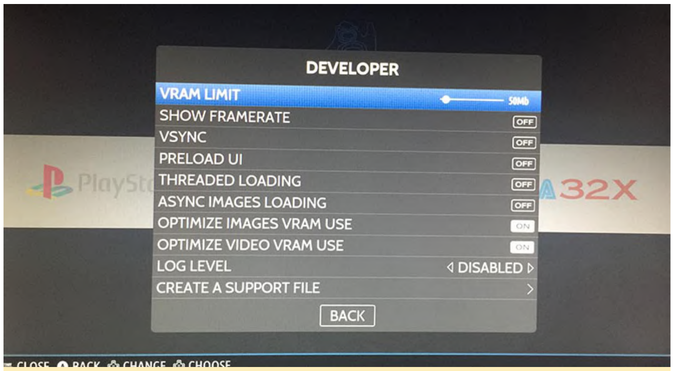
The images below show the Developer menu and the advanced configuration options.



SYSTEM SETTINGS

UPDATES >
LANGUAGE ◁ ENGLISH ▷
OVERCLOCK ◁ NONE ▷
POWER SAVER MODES ◁ DEFAULT ▷
STORAGE DEVICE ◁ MR4_ROMS - 58.9G ▷
BACKUP USER DATA >
KODI SETTINGS >
INSTALL BATOCERA ON A NEW DISK >
SECURITY >
DEVELOPER >

Figure 25



DEVELOPER

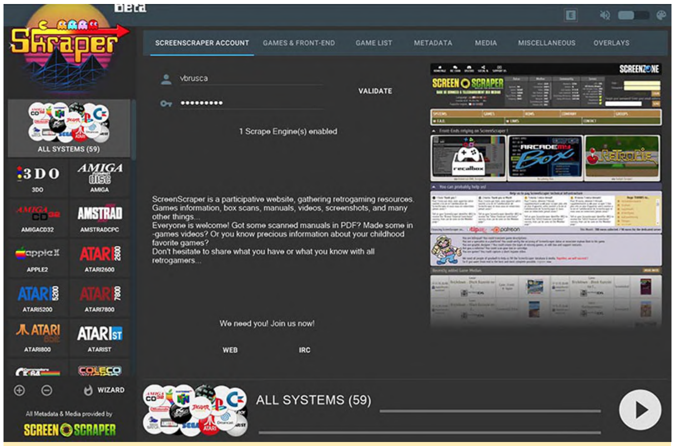
VRAM LIMIT 50Mb
SHOW FRAMERATE OFF
VSYNC OFF
PRELOAD UI OFF
THREADED LOADING OFF
ASYNC IMAGES LOADING OFF
OPTIMIZE IMAGES VRAM USE ON
OPTIMIZE VIDEO VRAM USE ON
LOG LEVEL ◁ DISABLED ▷
CREATE A SUPPORT FILE >

Figure 26

I've found that without using some of the above settings the system can crash sometimes during fast scrolling. Also I decided to use a smaller amount of RAM so that the emulators have more RAM to use. The UI seems to run fine with 50MB, background music and ROM art work great.

Getting ROM Box Art and Screenshots

The next step in our project is to setup all the ROM box art and screenshots. Go to https://www.skraper.net/ and download the latest copy of the software. You'll also need to get an account at https://www.screenscraper.fr/. Please donate to both sites, if possible. They are awesome and really help make retro gaming consoles even more amazing by providing access to box art and screenshots for a ton of games. Once you have your account setup fire up the Skraper UI program and enter in your screenscraper.fr account information. Test the account to make sure that it is working properly. You should have a screen similar to the one depicted below.



SCREENSCRAPER ACCOUNT | GAMES & FRONT-END | GAME LIST | METADATA | MEDIA | MISCELLANEOUS | OVERLAYS

vbrusca

••••••••••

VALIDATE

1 Scrape Engine(s) enabled

ScreenScraper is a participative website, gathering retrogaming resources. Games information, box scans, manuals, videos, screenshots, and many other things...
Everyone is welcome! Got some scanned manuals in PDF? Made some in-games videos? Or you know precious information about your childhood favorite games?
Don't hesitate to share what you have or what you know with all retrogamers...

We need you! Join us now!

WEB IRC

ALL SYSTEMS (59)

All Metadata & Media provided by SCREENSCRAPER

Figure 27

Click on the wizard button on the lower right hand side of the program's UI. You will be prompted to enter in your screenscraper.fr, and select the target ROMs folder you want to process. You should have your micro SD card connected to your computer and you'll want to find and select the roms folder where you pasted in your ROM files. The software will automatically determine each system that has ROMs and run a check against each game to see if there is any artwork available for that game. TIP: Don't run the wizard against all your systems. Things can break and then you won't get the proper results. Run the software one system at a time. Sometimes if you don't get ROM art results wait a few hours and try that system again. This approach worked for me and I was able to get nice results for all of my systems. The wizard button is depicted below.

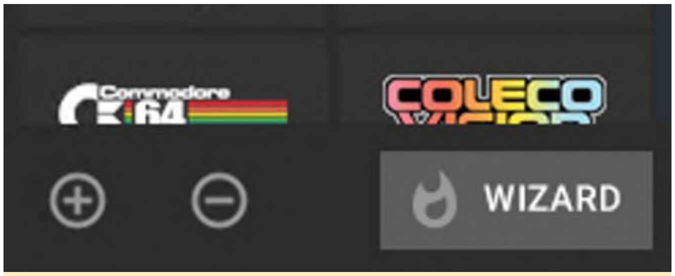
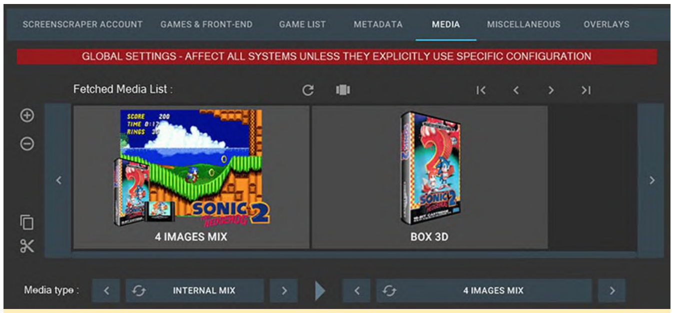


Figure 28

The type of artwork that the software builds is really quite awesome. Take a look below at a sample of the default graphic it will generate for you.



SCREENSCRAPER ACCOUNT | GAMES & FRONT-END | GAME LIST | METADATA | MEDIA | MISCELLANEOUS | OVERLAYS

GLOBAL SETTINGS - AFFECT ALL SYSTEMS UNLESS THEY EXPLICITLY USE SPECIFIC CONFIGURATION

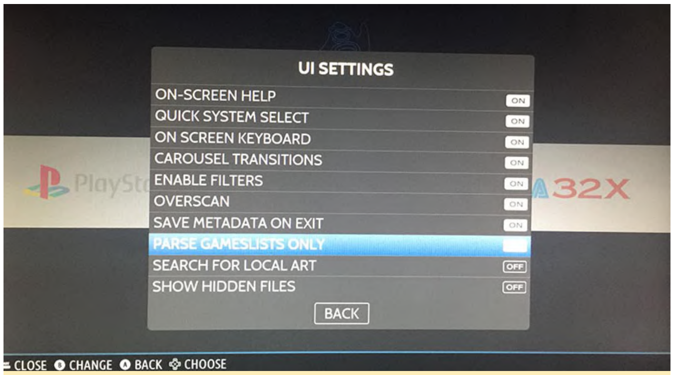
Fetched Media List :

4 IMAGES MIX | BOX 3D

Media type : INTERNAL MIX | 4 IMAGES MIX

Figure 29

Once you have collected all the ROM box art and screenshots you have to adjust one UI Settings option. Select the UI Settings main menu option and scroll down to the Parse Gamelists Only option and set it to on. This will make it so that the UI only shows the games in the gamelist.xml file. If you use the box art scraping software you will have good XML files and should use this option. You can always adjust the games in the XML files by hand if necessary.



UI SETTINGS

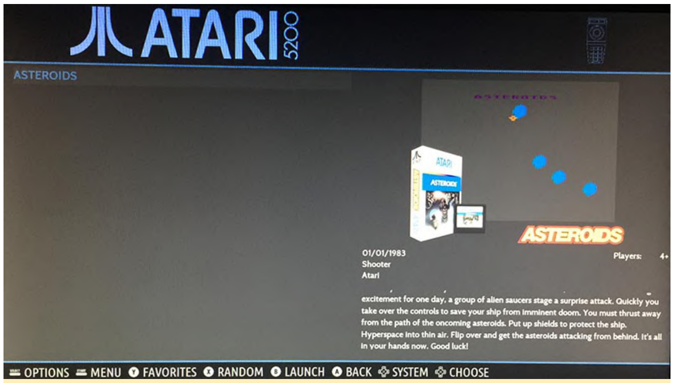
ON-SCREEN HELP ON
QUICK SYSTEM SELECT ON
ON SCREEN KEYBOARD ON
CAROUSEL TRANSITIONS ON
ENABLE FILTERS ON
OVERSCAN ON
SAVE METADATA ON EXIT ON
PARSE GAMESLISTS ONLY
SEARCH FOR LOCAL ART OFF
SHOW HIDDEN FILES OFF

BACK

CLOSE CHANGE BACK CHOOSE

Figure 30

That wraps up our build tutorial for the Monku R4 / ODROID-N2 retro gaming console. A screenshot of what the UI looks like is shown below. I hope you enjoyed it and that it helps you to build an awesome retro gaming system. For advanced emulator configurations look at the next section in the tutorial.



ASTEROIDS

01/01/1983
Shooter
Atari

Players: 4+

excitement for one day, a group of alien saucers stage a surprise attack. Quickly you take over the controls to save your ship from imminent doom. You must thrust away from the path of the oncoming asteroids. Put up shields to protect the ship. Hyperspace into thin air. Flip over and get the asteroids attacking from behind. It's all in your hands now. Good luck!

OPTIONS MENU FAVORITES RANDOM LAUNCH BACK SYSTEM CHOOSE

Figure 31

Advanced Emulator Settings

This section is an add on and contains information on how to get specific emulators up and running and ensure they are stable. Sega CD: Problem: Games start to load up and then crash after a few seconds. Solution: Get the US set of BIOS files and make sure they have the same hash code as required by Batocera Linux. You can check BIOS issues using the menu options listed in the tutorial above to see which files the system expects. Atari 5200: Problem: Games either crash with no display or they get to an emulator error screen saying there was a loading issue. Solution: Use a single game to get into the emulator menu where you can then load different ROMs and change the cartridge type. For me the game that worked the best was Asteroids. It will error out but in the emulator menu you can select the directory to look for ROMs, this should be a separate directory than the Batocera Linux one. You should only have your launch title in the Batocera aware directory. You can also change what cartridge type should be used to load in a ROM using the emulator options. Choosing the Atari standard usually fixes any ROM loading issues. It is a bit strange but setting it up this way will ensure that games load and you have control over how they are loaded up. Commodore 64: Problem: The emulator runs in a small square on the bottom left hand side of the screen. Solution: Cancel out the game load by hitting the B button. You should be able to get into the emulator options. Under the video/screen settings choose full screen. Then back out to the main menu and go to the settings management option to save your settings. This will ensure that the emulator will start off in full screen mode every time. Sega Genesis: Problem: Your Sega Genesis games are crashing and are not stable. Solution: Load up the SD card on a Windows machine or a Mac. Go to the folder batocera/system/batocera.conf. Scroll to the bottom of the file until you see megadrive entries. Add in the following lines: megadrive.core=picodrive megadrive.emulator-libretro This will force the system to run the ROMs using a different emulator that isn't selectable from the UI menus. Your games will be more stable and you should have no more issues. Nintendo 64: Problem: Your Nintendo 64 emulator crashes on exit and Batocera Linux fails to load up again. Solution: Set the default emulator and core for Nintendo 64 ROMs to emulator libretro and core parallel_n64. This combination has worked great for me. I can exit out of the N64 emulator and get back into Batocera Linux to choose a new system to run. SSH Login: You can login into your box over the network using the default root login, username: root, password: linux.

This article was adapted from middlemind.net, for more information or to view the original source please see: **http://middlemind.net/tutorials/odroid_go/mr4_build.html**

Kernel 5.4 Development Party

January 10, 2020 By @memeka Development, Linux, ODROID-XU4

Let's start the 5.4 kernel development party. I pushed my 5.4 branch based on 5.4.0 at https://github.com/mihailescu2m/linux/tree/odroidxu4-5.4.y.

HC-1 sd-card test: * write

```
64+0 records in
64+0 records out
536870912 bytes (537 MB, 512 MiB) copied, 22.0655 s, 24.3 MB/s
```

* read

```
64+0 records in
64+0 records out
536870912 bytes (537 MB, 512 MiB) copied, 6.36601 s, 84.3 MB/s
```

HC-1 SSD test: * write

```
64+0 records in
64+0 records out
536870912 bytes (537 MB, 512 MiB) copied, 5.72404 s, 93.8 MB/s
```

* read

```
64+0 records in
64+0 records out
536870912 bytes (537 MB, 512 MiB) copied, 1.39248 s, 386 MB/s
```

1. Download the official Ubuntu image from either of the following two links:

- Mate: https://wiki.odroid.com/odroid-xu4/os_i ... 4/20190929
- Minimal: https://wiki.odroid.com/odroid-xu4/os_images/linux/ubuntu_4.14/20190910-minimal

2. Flash the image using Etcher to your SD card / eMMC.

3. Insert that card to your Odroid XU4 for the initial boot sequence. It will resize its root file system to fit into your flash memory capacity. Then, do the package upgrade:

```
$ apt update && apt full-upgrade -y
```

If it fails with a message mentioning a locking problem, wait for about 5~10 minutes and try again.

4. Mark the linux-kernel-5422 package as “not to be upgraded”:

```
$ apt-mark hold linux-odroid-5422.
```

5. Reboot, then power off and connect your SD card / eMMC to your PC.

Building the 5.4 kernel

1. Setup build environment by referring to this guide: https://wiki.odroid.com/odroid-xu4/soft … ross-build, then download the proper toolchain. Export the environment variables using the toolchain.

2. Mount boot, rootfs partitions of SD card / eMMC to your PC. It should be mounted automatically on Ubuntu.

3. Clone @memeka's 5.4 kernel:

```
$ git clone
https://github.com/mihailescu2m/linux.git --depth
1 -b odroidxu4-5.4.y linux-kernel-odroidxu4-5.4.y.
```

4. Move to the cloned directory:

```
$ cd linux-kernel-odroidxu4-5.4.y.
```

5. Build 5.4 kernel:

```
$ make odroidxu4_defconfig
$ make -j $(nproc)
```

6. Copy kernel image and device tree blob to the media card's boot partition. Replace target path with yours:

```
$ sudo cp -f arch/arm/boot/zImage
/media/joshua/boot
$ sudo cp -f arch/arm/boot/dts/exynos5422-
odroidxu4.dtb /media/joshua/boot
```

7. Install modules:

```
$ sudo make -j $(nproc) modules_install ARCH=arm
INSTALL_MOD_PATH=/media/joshua/rootfs
$ sync
```

8. Unmount your boot media card and insert it into the ODROID-XU4:

```
# uname -a
Linux odroid 5.4.0+ #2 SMP Wed Nov 27 08:17:23 UTC
2019 armv7l armv7l armv7l GNU/Linux
# lsb_release -a
No LSB modules are available.
Distributor ID: Ubuntu
Description:    Ubuntu 18.04.3 LTS
Release:        18.04
Codename:       bionic
```

For comments, questions, and suggestions, please visit the original article at https://forum.odroid.com/viewtopic.php?f=184&t=36947.

The G Spot: Your Goto Destination for All Things That are Android Gaming: Google Drops the Ball; Giphy is a Ball; and ODROID-N2 Wins it ALL!

January 1, 2020 By Dave Prochnow Android, Gaming

Well that was special, wasn't it? If you're one of the thousands of Google Stadia Founder's Edition subscribers, then you know exactly how Google dropped the ball on launch day. This official Google Stadia Tweet pretty much sums up the entire mess:

"Here's the latest update: If you ordered and paid for Founder's Edition, you should now have your Stadia access code. Pre-orders and access codes for Premiere Edition will start shipping early next week. Thanks for sticking with us!"

Figure 1 - A game logo with a bright future. Image courtesy of Google Stadia.

On the surface, that sounds innocuous enough, but this Tweet was issued three days after launch day. As you probably have now learned, or might have guessed from reading this article's title, a huge swath of early Stadia adopters were left holding the streaming game service bag with no games to stream. Sure everything eventually worked out, but this wasn't the only hiccup to mar Google's attempt at "providing AAA gaming on any device, any time, anywhere."

In another Tweet (later deleted) from the official Google Stadia there was a claim that the upcoming AAA thriller, Red Dead Redemption 2, would run at 4K quality. Likewise, Google Stadia head honcho, Phil Harrison has stated in previous comments to this column, that ALL games would be running in 4K quality at 60 fps. The only catch here is that at least two game developers (Destiny 2 and Red Dead Redemption 2) have clearly and explicitly stated that their titles do NOT run at those specifications. In fact, these two titles are actually upscaled to mimic 4K at 60fps.

While this isn't a smoking gun for conspiracy mongers to embrace, it does clearly indicate how this type of technology is in its infancy and, as such, there will be some growing pangs and hiccups along the path to a viable streaming gaming service that truly works on any device, any time, and anywhere.

Giphy Gaming

If you're looking for an alternative to streamed 4K, 60 fps gaming, then how about some retro-like arcade-like gaming? Sponsored by the online GIF search engine website, Giphy, a new game service features short, micro-sized versions of some arcade classics. For example, a Giphy version of Asteroids (called "Blast 20 Asteroids" inside the "Gimme Space" Featured Playlist) accompanied by music and sound effects can be played inside most browsers on any web-connected device.

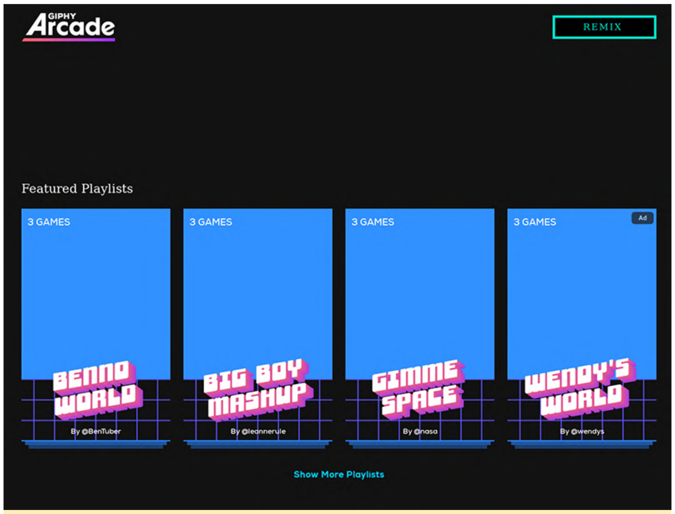
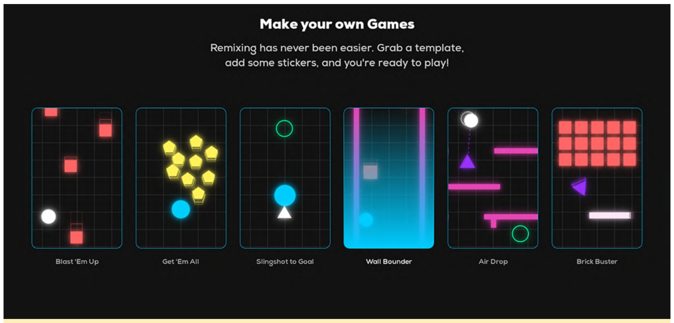


Figure 2 - GIF arcade gaming.

Called Giphy Arcade, the game-play on this new service is ridiculously short and the graphics are heavily influenced by GIFs and emojis. For example, returning to the previously mentioned "Blast 20 Asteroids" game, the movable laser-firing cannon found in Asteroids is replaced by a spacewalking astronaut GIF with a laser-firing fist.



Make your own Games

Remixing has never been easier. Grab a template, add some stickers, and you're ready to play!

Figure 3 - Roll your own arcade game with the help of some templates.

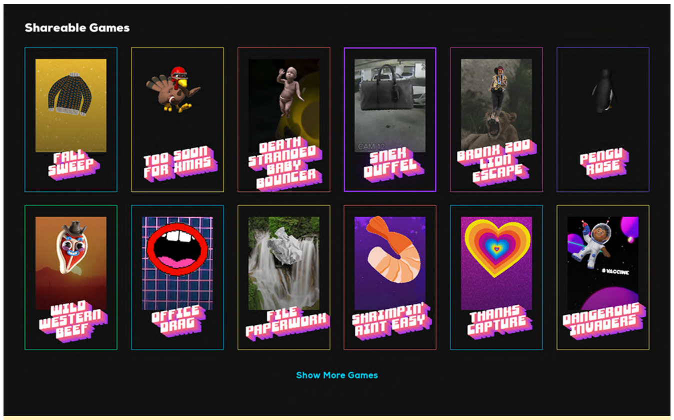


Figure 4 - When you've finished your game masterpiece, share it with the world.

Once you get tired of playing these playlist-featured games, you can try your hand at making your own game. More like a mashup of GIFs, music, emojis, and templates, these handmade masterpieces can be played and shared with other Giphy visitors. Currently, the options for game making are a little rough around the edges, but you can get in on the ground floor of retro-like, arcade-like gaming right now and become a "rockstar" in Giphy Arcade gaming.

An ODROID Gaming Honor

Anyone who follows retro-gaming, gaming emulators, and handheld gaming devices knows the name ETA Prime. Operating as a major gaming presence on YouTube and with over 350K subscribers, ETA Prime is also one of the most prolific video publishers on YouTube with multiple uploads every week.

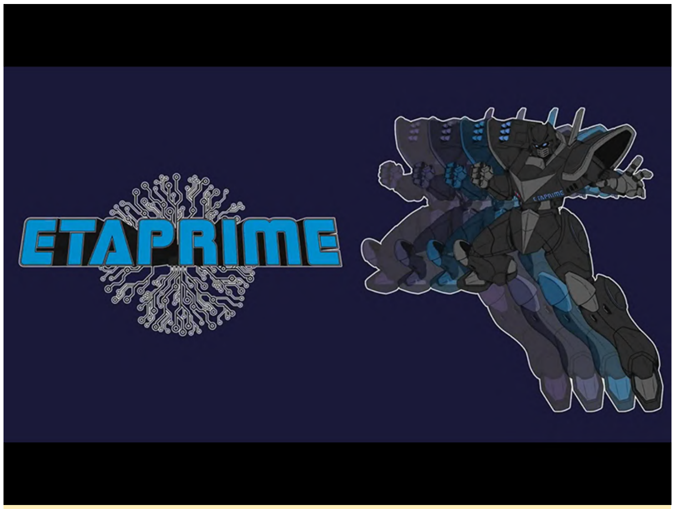


Figure 5 - ETA Prime is a video powerhouse for SBC commentary.

Suffice it to say, that when ETA Prime publishes a video, a LOT of people pay attention. This was the case in mid-November when a video titled, "What's the Best Single Board Computer for Android" appeared on his channel.

What's the Best Single Board Computer...

Although the video's title mentioned "... for Android," this is ETA Prime-speak for generalized "Android Gaming" or more specifically, Android multimedia consumption—a one-stop video, movie, and gaming marketplace operating under the guise of Android.

During the course of this video, ETA Prime compares 12 different single board computers (SBCs). Each of these models are powerful contemporary SBCs that are popular with today's hobbyists, system designers, and industrial-grade researchers. Watching the 7 minute 33 second video is a great high-level summary of the current state of SBCs. There are a total of 12 SBCs that ETA Prime highlights and each one is topnotch in its specifications and performance.

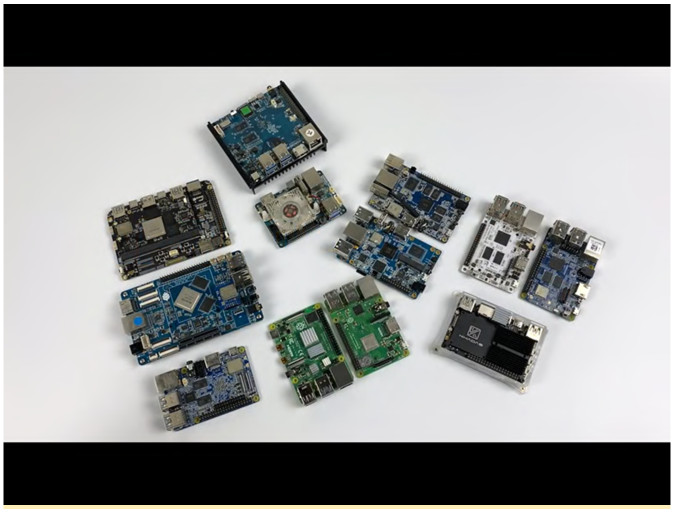


Figure 6 - The 12 featured SBCs; can you ID them all?

The excitement mounts as the video nears its midway point, where at about the 3 minute 38 second mark, the "2019, best board for running Android" is announced. And that SBC is the ODROID-N2. In his typical and methodical fashion, ETA Prime then devotes the remainder of the video to supporting his claim with benchmarks, third-party OS releases, and game testing.

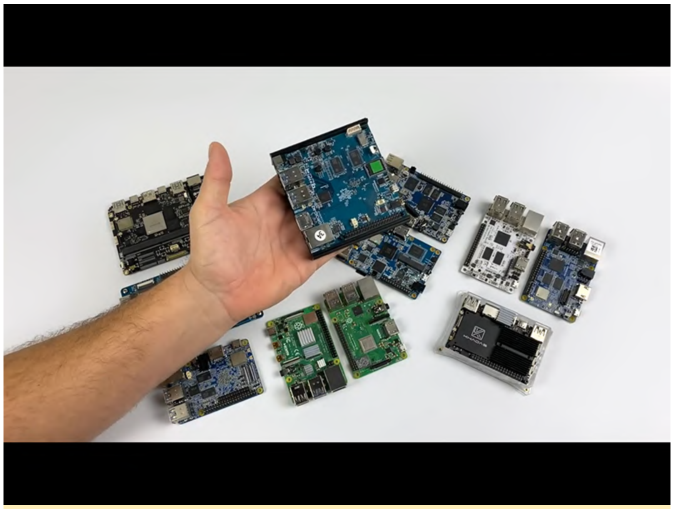


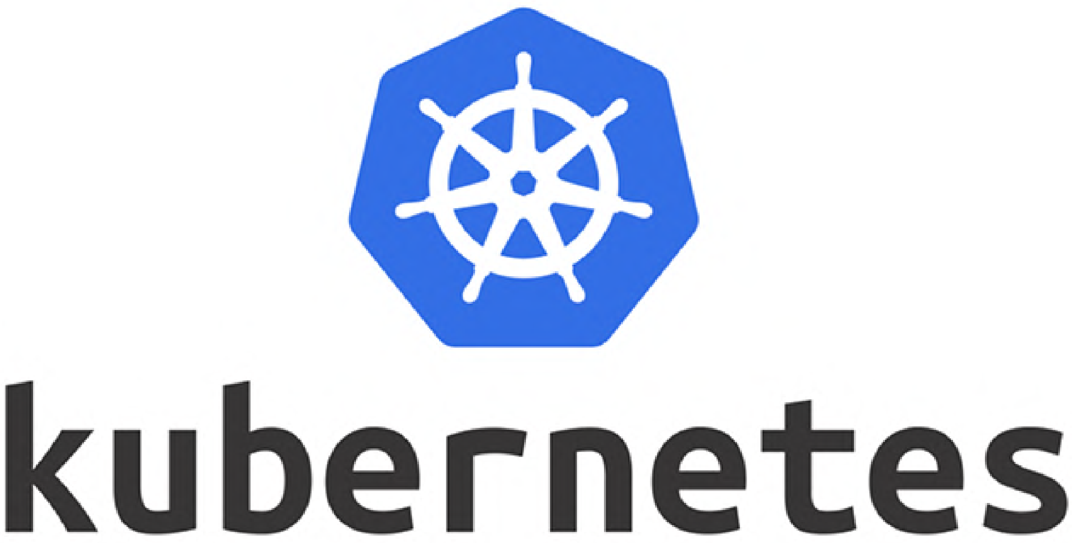
Figure 7 - And the winner is ... ODROID-N2.

(Figure 7 - And the winner is ... ODROID-N2.)

Therefore, if you're looking for an Android SBC look no further than the ODROID-N2.

Kubernetes On An ODROID-N2 Cluster

January 1, 2020 By Swaminathan Bhaskar Development, ODROID-N2, Tutorial



Overview

Kubernetes (or k8s for short) is an extensible open source container orchestration platform designed for managing containerized workloads and services at scale. It helps in automated deployment, scaling, and management of container centric application workloads across a cluster of nodes (bare-metal, virtual, or cloud) by orchestrating compute, network, and storage infrastructure on behalf of those user workloads.

The two main types of nodes in a Kubernetes cluster are:

Master: this node acts as the Control Plane for the cluster. It is responsible for all application workload deployment, scheduling, and placement decisions as well as detecting and managing changes to the state of deployed applications. It is comprised of a Key-Value Store, an API Server, a Scheduler, and a Controller Manager.

Worker Node(s): node(s) that actually run the application containers. They are also on occasions referred to as Minion(s). The Master is also a node, but is not targeted for application deployment. It is comprised of an agent called kubelet, a network proxy called kube-proxy, and a Container Engine.

The following Figure-1 illustrates the high-level architectural overview of Kubernetes:

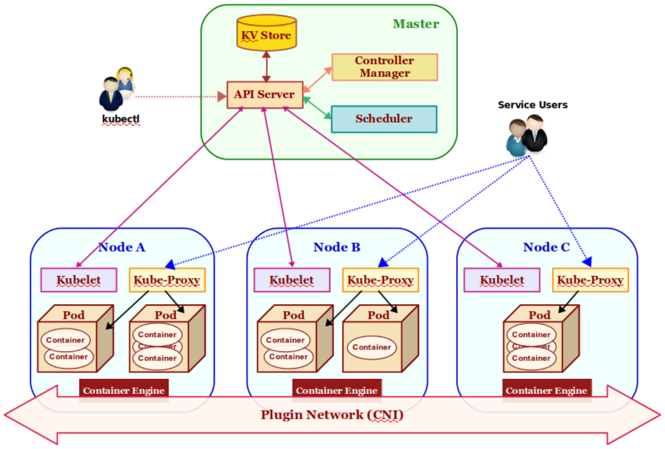


Figure 1

The core components that make a Kubernetes cluster are described as follows:

KV Store: a highly reliable, distributed, and consistent key-value data store used for persisting and maintaining state information about the various components of the Kubernetes cluster. By default, Kubernetes uses etcd as the key-value store.

API Server: acts as the entry point for the Control Plane by exposing an API endpoint for all interactions with and within the Kubernetes cluster. It is through the API Server that requests are made for deployment, administration, management, and operation of container based applications. It uses the key-value store to persist and maintain state information about all the components of the Kubernetes cluster.

Pod(s): it is the smallest unit of deployment in Kubernetes . One or more containers run inside it. Think of it as a logical host with shared network and storage. Application pods are scheduled to run on different worker nodes of the Kubernetes cluster based on the resource needs and application constraints. Every pod within the cluster gets its own unique ip-address. The application containers within a pod communicate with each other using localhost. Pod(s) are also the smallest unit of scaling in Kubernetes. In addition, Pod(s) are ephemeral - they can come and go at any time.

Scheduler: responsible for scheduling application pod(s) to run on the selected worker node(s) of the Kubernetes cluster based on the application resource requirements as well as application specific affinity constraints.

Service: provides a stable, logical networking endpoint for a group of pod(s) (based on a label related to an application pod) running on the wor2ker node(s) of the Kubernetes cluster. They enable access to an application via service-discovery and spread the requests through simple load-balancing. To access an application, each service is assigned a cluster-wide internal ip-address:port.

Controller Manager: manages different types of controllers that are responsible for monitoring and detecting changes to the state of the Kubernetes cluster (via the API server) and ensuring that the cluster is moved to the desired state. The different types of controllers are:

- Node Controller => responsible for monitoring and detecting the state & health (up or down) of the worker node(s) in the Kubernetes cluster.
- ReplicaSet => previously referred to as the Replication Controller and is responsible for maintaining the desired number of pod replicas in the cluster.
- Endpoints Controller => responsible for detecting and managing changes to the application service access endpoints (list of ip-address:port).

Plugin Network: acts as the bridge (overlay network) that enables communication between the pod(s) running on different worker node(s) of the cluster. There are different implementations of this component by various 3rd-parties such as calico, flannel, weave-net, etc. They all need to adhere to a common specification called the Container Network Interface or CNI for short.

kubelet: an agent that runs on every worker node of the Kubernetes cluster. It is responsible for creating and starting an application pod on the worker node and making sure all the application containers are up and running within the pod. In addition, it is also responsible for reporting the state and health of the worker node, as well as all the running pods to the master via the API server.

kube-proxy: a network proxy that runs on each of the worker node (s) of the Kubernetes cluster and acts as an entry point for access to the various application service endpoints. It routes requests to the appropriate pod (s) in the cluster.

Container Engine: a container runtime that runs on each of the worker node(s) to manage the lifecycle of containers such as getting the images, starting and stopping containers, etc. The commonly used container engine is Docker.

kubectl: command line tool used for interfacing with the API Server. Used by administrators (or operators) for deployment and scaling of applications, as well as for the management of the Kubernetes cluster.

Installation and System Setup

The installation will be on a 5-node ODROID-N2 Cluster running Armbian Ubuntu Linux.

The following Figure-2 illustrates the 5-node ODROID-N2 cluster in operation:

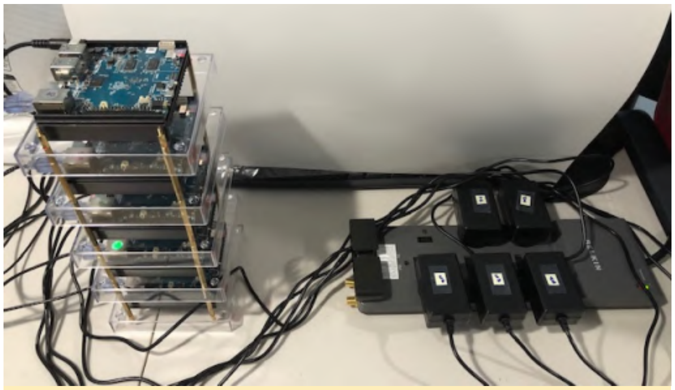


Figure 2

For this tutorial, let us assume the 5-nodes in the cluster to have the following host names and ip addresses: Host name IP Address

```
my-n2-1 192.168.1.51
my-n2-2 192.168.1.52
my-n2-3 192.168.1.53
my-n2-4 192.168.1.54
my-n2-5 192.168.1.55
```

Open a Terminal window and open a tab for each of the 5 nodes my-n2-1 thru my-n2-5. In each of the Terminal tabs, ssh into the corresponding node.

Each of the nodes my-n2-1 thru my-n2-5 need to have a unique identifier for the cluster to operate without any collisions. The unique node identifier is located in the file /etc/machine-id and we see all the nodes my-n2-1 thru my-n2-5 having the same value. This needs to be * FIXED*. On each of the nodes my-n2-1 thru my-n2-5, execute the following commands:

```
$ sudo rm -f /etc/machine-id
$ sudo dbus-uuidgen --ensure=/etc/machine-id
$ sudo rm /var/lib/dbus/machine-id
$ sudo dbus-uuidgen --ensure
$ sudo reboot now
```

Once again, in each of the Terminal tabs, ssh into the corresponding node.

Next, we need to setup the package repository for Docker. On each of the nodes my-n2-1 thru my-n2-5, execute the following commands:

```
$ sudo apt-get update
$ sudo apt-get install apt-transport-https ca-
certificates curl
software-properties-common -y
$ curl -fsSL
https://download.docker.com/linux/ubuntu/gpg |
sudo
apt-key add -
$ sudo apt-get update
$ sudo add-apt-repository "deb [arch=arm64]
-https://download.docker.com/linux/ubuntu xenial
stable"
$ sudo apt-get update
```

For version 1.16 of Kubernetes (the version at the time of this article), the recommended Docker version is 18.09.

ATTENTION: For Docker CE 19.xx (and above) Ensure the version of Docker installed is *18.09*. Else will encounter the following error: [ERROR SystemVerification]: unsupported docker version: 19.xx

We need to check for the latest package of Docker 18.09 in the repository. On any of the nodes (we will pick my-n2-1), execute the following command:

```
$ apt-cache madison docker-ce
```

The following would be a typical output:

```
<span style="font-weight: 400;">Output.1</span>

<span style="font-weight: 400;">docker-ce |
5:19.03.5~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:19.03.4~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:19.03.3~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:19.03.2~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>
```

```
<span style="font-weight: 400;">docker-ce |
5:19.03.1~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:19.03.0~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:18.09.9~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:18.09.8~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:18.09.7~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:18.09.6~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:18.09.5~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:18.09.4~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:18.09.3~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:18.09.2~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:18.09.1~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
5:18.09.0~3-0~ubuntu-xenial |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
18.06.3~ce~3-0~ubuntu |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
18.06.2~ce~3-0~ubuntu |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
18.06.1~ce~3-0~ubuntu |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
18.06.0~ce~3-0~ubuntu |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
18.03.1~ce-0~ubuntu |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
18.03.0~ce-0~ubuntu |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
17.12.1~ce-0~ubuntu |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
17.12.0~ce-0~ubuntu |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>

<span style="font-weight: 400;">docker-ce |
17.09.1~ce-0~ubuntu |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>
```

```
<span style="font-weight: 400;">docker-ce |
17.09.0~ce-0~ubuntu |
https://download.docker.com/linux/ubuntu
xenial/stable arm64 Packages</span>
```

From the Output.1 above, we see the latest package for Docker 18.09 is 5:18.09.9~3-0~ubuntu-xenial.

Next, we need to install the chosen version of Docker. On each of the nodes my-n2-1 thru my-n2-5, execute the following command:

```
$ sudo apt-get install docker-ce=5:18.09.9~3-
0~ubuntu-xenial -y
```

The following would be a typical output:

```
Output.2
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be
installed:
aufs-tools cgroupfs-mount containerd.io docker-ce-
cli git git-man liberror-perl pigz
Suggested packages:
git-daemon-run | git-daemon-sysvinit git-doc git-
el git-email git-gui gitk gitweb git-cvs git-
mediawiki git-svn
The following NEW packages will be installed:
aufs-tools cgroupfs-mount containerd.io docker-ce
docker-ce-cli git git-man liberror-perl pigz
0 upgraded, 9 newly installed, 0 to remove and 0
not upgraded.
Need to get 61.3 MB of archives.
After this operation, 325 MB of additional disk
space will be used.
Get:1 https://download.docker.com/linux/ubuntu
xenial/stable arm64 containerd.io arm64 1.2.10-3
[14.5 MB]
Get:2 http://ports.ubuntu.com/ubuntu-ports
bionic/universe arm64 pigz arm64 2.4-1 [47.8 kB]
Get:3 http://ports.ubuntu.com/ubuntu-ports
bionic/universe arm64 aufs-tools arm64
1:4.9+20170918-1ubuntu1 [101 kB]
Get:4 http://ports.ubuntu.com/ubuntu-ports
bionic/universe arm64 cgroupfs-mount all 1.4 [6320
B]
Get:5 http://ports.ubuntu.com/ubuntu-ports
bionic/main arm64 liberror-perl all 0.17025-1
[22.8 kB]
Get:6 http://ports.ubuntu.com/ubuntu-ports bionic-
updates/main arm64 git-man all 1:2.17.1-1ubuntu0.4
[803 kB]
Get:7 http://ports.ubuntu.com/ubuntu-ports bionic-
updates/main arm64 git arm64 1:2.17.1-1ubuntu0.4
[2941 kB]
Get:8 https://download.docker.com/linux/ubuntu
xenial/stable arm64 docker-ce-cli arm64
5:19.03.5~3-0~ubuntu-xenial [29.6 MB]
Get:9 https://download.docker.com/linux/ubuntu
xenial/stable arm64 docker-ce arm64 5:18.09.9~3-
0~ubuntu-xenial [13.3 MB]
Fetched 61.3 MB in 5s (11.6 MB/s)
Selecting previously unselected package pigz.
(Reading database ... 156190 files and directories
currently installed.)
Preparing to unpack .../0-pigz_2.4-1_arm64.deb ...
Unpacking pigz (2.4-1) ...
Selecting previously unselected package aufs-
tools.
Preparing to unpack .../1-aufs-
tools_1%3a4.9+20170918-1ubuntu1_arm64.deb ...
Unpacking aufs-tools (1:4.9+20170918-1ubuntu1) ...
Selecting previously unselected package cgroupfs-
mount.
Preparing to unpack .../2-cgroupfs-
mount_1.4_all.deb ...
Unpacking cgroupfs-mount (1.4) ...
Selecting previously unselected package
containerd.io.
Preparing to unpack .../3-containerd.io_1.2.10-
3_arm64.deb ...
Unpacking containerd.io (1.2.10-3) ...
Selecting previously unselected package docker-ce-
cli.
Preparing to unpack .../4-docker-ce-
cli_5%3a19.03.5~3-0~ubuntu-xenial_arm64.deb ...
Unpacking docker-ce-cli (5:19.03.5~3-0~ubuntu-
xenial) ...
Selecting previously unselected package docker-ce.
Preparing to unpack .../5-docker-ce_5%3a18.09.9~3-
0~ubuntu-xenial_arm64.deb ...
Unpacking docker-ce (5:18.09.9~3-0~ubuntu-xenial)
...
Selecting previously unselected package liberror-
perl.
Preparing to unpack .../6-liberror-perl_0.17025-
1_all.deb ...
Unpacking liberror-perl (0.17025-1) ...
Selecting previously unselected package git-man.
Preparing to unpack .../7-git-man_1%3a2.17.1-
1ubuntu0.4_all.deb ...
Unpacking git-man (1:2.17.1-1ubuntu0.4) ...
Selecting previously unselected package git.
Preparing to unpack .../8-git_1%3a2.17.1-
```

```
1ubuntu0.4_arm64.deb ...
Unpacking git (1:2.17.1-1ubuntu0.4) ...
Setting up aufs-tools (1:4.9+20170918-1ubuntu1)
...
Setting up git-man (1:2.17.1-1ubuntu0.4) ...
Setting up containerd.io (1.2.10-3) ...
Created symlink /etc/systemd/system/multi-
user.target.wants/containerd.service â†’
/lib/systemd/system/containerd.service.
Setting up liberror-perl (0.17025-1) ...
Setting up cgroupfs-mount (1.4) ...
Setting up docker-ce-cli (5:19.03.5~3-0~ubuntu-
xenial) ...
Setting up pigz (2.4-1) ...
Setting up git (1:2.17.1-1ubuntu0.4) ...
Setting up docker-ce (5:18.09.9~3-0~ubuntu-xenial)
...
update-alternatives: using /usr/bin/dockerd-ce to
provide /usr/bin/dockerd (dockerd) in auto mode
Created symlink /etc/systemd/system/multi-
user.target.wants/docker.service â†’
/lib/systemd/system/docker.service.
Created symlink
/etc/systemd/system/sockets.target.wants/docker.so
cket â†’ /lib/systemd/system/docker.socket.
Processing triggers for systemd (237-3ubuntu10.33)
...
Processing triggers for man-db (2.8.3-2ubuntu0.1)
...
Processing triggers for libc-bin (2.27-3ubuntu1)
...
```

Next, we need to ensure we are able to execute the Docker commands as the logged in user without the need for sudo. On each of the nodes my-n2-1 thru my-n2-5, execute the following commands:

```
$ sudo usermod -aG docker $USER
$ sudo reboot now
```

Once again, in each of the Terminal tabs, ssh into the corresponding node.

To verify the Docker installation, on each of the nodes my-n2-1 thru my-n2-5, execute the following command:

```
$ docker info
```

The following would be a typical output:

```
Output.3
Client:
Debug Mode: false

Server:
Containers: 0
Running: 0
Paused: 0
Stopped: 0
Images: 0
Server Version: 18.09.9
Storage Driver: overlay2
Backing Filesystem: extfs
Supports d_type: true
Native Overlay Diff: true
Logging Driver: json-file
Cgroup Driver: cgroupfs
Plugins:
Volume: local
Network: bridge host macvlan null overlay
Log: awslogs fluentd gcplogs gelf journald json-
file local logentries splunk syslog
Swarm: inactive
Runtimes: runc
Default Runtime: runc
Init Binary: docker-init
containerd version:
b34a5c8af56e510852c35414db4c1f4fa6172339
runc version:
3e425f80a8c931f88e6d94a8c831b9d5aa481657
init version: fec3683
Security Options:
seccomp
Profile: default
Kernel Version: 4.9.196-meson64
Operating System: Ubuntu 18.04.3 LTS
OSType: linux
Architecture: aarch64
CPUs: 6
Total Memory: 3.623GiB
Name: my-n2-1
ID:
QF32:QDZN:IQDM:34HX:NK3C:O3AP:Y6JZ:74DV:XXXL:KCBL:
7K5D:36B4
Docker Root Dir: /var/lib/docker
Debug Mode: false
Registry: https://index.docker.io/v1/
Labels:
Experimental: false
Insecure Registries:
127.0.0.0/8
Live Restore Enabled: false
Product License: Community Engine
```

Next, we need to setup the package repository for Kubernetes. On each of the nodes my-n2-1 thru my-n2-5, execute the following commands:

```
$ curl -s
https://packages.cloud.google.com/apt/doc/apt-
key.gpg | sudo apt-key add -
$ echo "deb http://apt.kubernetes.io/ kubernetes-
xenial main" | sudo tee
/etc/apt/sources.list.d/kubernetes.list
$ sudo apt-get update
```

Next, we need to install Kubernetes. On each of the nodes my-n2-1 thru my-n2-5, execute the following command:

```
$ sudo apt-get install -y kubeadm
```

The following would be a typical output:

```
Output.4
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be
installed:
conntrack cri-tools ebtables kubectl kubelet
kubernetes-cni socat
The following NEW packages will be installed:
conntrack cri-tools ebtables kubeadm kubectl
kubelet kubernetes-cni socat
0 upgraded, 8 newly installed, 0 to remove and 1
not upgraded.
Need to get 48.3 MB of archives.
After this operation, 280 MB of additional disk
space will be used.
Get:2 http://ports.ubuntu.com/ubuntu-ports
bionic/main arm64 conntrack arm64
1:1.4.4+snapshot20161117-6ubuntu2 [27.3 kB]
Get:7 http://ports.ubuntu.com/ubuntu-ports bionic-
updates/main arm64 ebtables arm64 2.0.10.4-
3.5ubuntu2.18.04.3 [74.2 kB]
Get:8 http://ports.ubuntu.com/ubuntu-ports
bionic/main arm64 socat arm64 1.7.3.2-2ubuntu2
[322 kB]
Get:1 https://packages.cloud.google.com/apt
kubernetes-xenial/main arm64 cri-tools arm64
1.13.0-00 [7965 kB]
Get:3 https://packages.cloud.google.com/apt
kubernetes-xenial/main arm64 kubernetes-cni arm64
0.7.5-00 [5808 kB]
Get:4 https://packages.cloud.google.com/apt
kubernetes-xenial/main arm64 kubelet arm64 1.16.3-
00 [18.5 MB]
Get:5 https://packages.cloud.google.com/apt
kubernetes-xenial/main arm64 kubectl arm64 1.16.3-
00 [8025 kB]
Get:6 https://packages.cloud.google.com/apt
kubernetes-xenial/main arm64 kubeadm arm64 1.16.3-
00 [7652 kB]
Fetched 48.3 MB in 5s (9383 kB/s)
Selecting previously unselected package conntrack.
(Reading database ... 157399 files and directories
currently installed.)
Preparing to unpack .../0-
conntrack_1%3a1.4.4+snapshot20161117-
6ubuntu2_arm64.deb ...
Unpacking conntrack (1:1.4.4+snapshot20161117-
6ubuntu2) ...
Selecting previously unselected package cri-tools.
Preparing to unpack .../1-cri-tools_1.13.0-
00_arm64.deb ...
Unpacking cri-tools (1.13.0-00) ...
Selecting previously unselected package ebtables.
Preparing to unpack .../2-ebtables_2.0.10.4-
3.5ubuntu2.18.04.3_arm64.deb ...
Unpacking ebtables (2.0.10.4-3.5ubuntu2.18.04.3)
...
Selecting previously unselected package
kubernetes-cni.
Preparing to unpack .../3-kubernetes-cni_0.7.5-
00_arm64.deb ...
Unpacking kubernetes-cni (0.7.5-00) ...
Selecting previously unselected package socat.
Preparing to unpack .../4-socat_1.7.3.2-
2ubuntu2_arm64.deb ...
Unpacking socat (1.7.3.2-2ubuntu2) ...
Selecting previously unselected package kubelet.
Preparing to unpack .../5-kubelet_1.16.3-
00_arm64.deb ...
Unpacking kubelet (1.16.3-00) ...
Selecting previously unselected package kubectl.
Preparing to unpack .../6-kubectl_1.16.3-
00_arm64.deb ...
Unpacking kubectl (1.16.3-00) ...
Selecting previously unselected package kubeadm.
Preparing to unpack .../7-kubeadm_1.16.3-
00_arm64.deb ...
Unpacking kubeadm (1.16.3-00) ...
Setting up conntrack (1:1.4.4+snapshot20161117-
6ubuntu2) ...
Setting up kubernetes-cni (0.7.5-00) ...
Setting up cri-tools (1.13.0-00) ...
Setting up socat (1.7.3.2-2ubuntu2) ...
Setting up ebtables (2.0.10.4-3.5ubuntu2.18.04.3)
...
```

```
Created symlink /etc/systemd/system/multi-
user.target.wants/ebtables.service â†’
/lib/systemd/system/ebtables.service.
update-rc.d: warning: start and stop actions are
no longer supported; falling back to defaults
Setting up kubectl (1.16.3-00) ...
Setting up kubelet (1.16.3-00) ...
Created symlink /etc/systemd/system/multi-
user.target.wants/kubelet.service â†’
/lib/systemd/system/kubelet.service.
Setting up kubeadm (1.16.3-00) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1)
...
Processing triggers for systemd (237-3ubuntu10.33)
...
```

We need to reboot all the nodes. On each of the nodes my-n2-1 thru my-n2-5, execute the following command:

```
$ sudo reboot now
```

Once again, in each of the Terminal tabs, ssh into the corresponding node.

To verify the Kubernetes installation, on each of the nodes my-n2-1 thru my-n2-5, execute the following command:

```
$ kubeadm version
```

The following would be a typical output:

```
Output.5
kubeadm version: &version.Info{Major:"1",
Minor:"16", GitVersion:"v1.16.3",
GitCommit:"b3cbbae08ec52a7fc73d334838e18d17e851274
9", GitTreeState:"clean", BuildDate:"2019-11-
13T11:20:25Z", GoVersion:"go1.12.12",
Compiler:"gc", Platform:"linux/arm64"}
```

Next, we need to ensure the packages for Docker and Kubernetes are not updated in the future by the software update process. On each of the nodes my-n2-1 thru my-n2-5, execute the following command:

```
$ sudo apt-mark hold kubelet kubeadm kubectl
docker-ce
```

The following would be a typical output:

```
Output.6
kubelet set on hold.
kubeadm set on hold.
kubectl set on hold.
docker-ce set on hold.
```

By default, Docker uses cgroupfs as the cgroup driver. Kubernetes prefers systemd as the cgroup driver. We need to modify the Docker daemon configuration by specifying options in a JSON file called /etc/docker/daemon.json. On each of the nodes my-n2-1 thru my-n2-5, create the configuration file /etc/docker/daemon.json with the following contents:

```
/etc/docker/daemon.json
{
"exec-opts": ["native.cgroupdriver=systemd"],
"log-driver": "json-file",
"log-opts": {
"max-size": "100m"
},
"storage-driver": "overlay2"
}
```

Next, we need to restart the Docker daemon for the configuration to take effect. On each of the nodes my-n2-1 thru my-n2-5, execute the following commands:

```
$ sudo mkdir -p
/etc/systemd/system/docker.service.d
$ sudo systemctl daemon-reload
$ sudo systemctl restart docker
```

Note: Not using the systemd cgroup driver will cause the following error: [preflight] Running pre-flight checks [WARNING IsDockerSystemdCheck]: detected "cgroupfs" as the Docker cgroup driver. The recommended driver is "systemd". Please follow the guide at https://kubernetes.io/docs/setup/cri/

To verify the Docker daemon started ok, on each of the nodes my-n2-1 thru my-n2-5, execute the following command:

```
$ journalctl -u docker
```

The following would be a typical output:

```
Output.7
-- Logs begin at Sat 2019-12-14 21:14:19 EST, end
at Sat 2019-12-14 21:49:26 EST. --
Dec 14 21:14:26 my-n2-1 systemd[1]: Starting
Docker Application Container Engine...
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.806496732-05:00" level=info
msg="systemd-resolved is running, so using
```

```
resolvconf: /run/systemd/res
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.821800611-05:00" level=info
msg="parsed scheme: "unix"" module=grpc
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.822661404-05:00" level=info
msg="scheme "unix" not registered, fallback to
default scheme" module
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.824226106-05:00" level=info
msg="parsed scheme: "unix"" module=grpc
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.824838344-05:00" level=info
msg="scheme "unix" not registered, fallback to
default scheme" module
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.828116839-05:00" level=info
msg="ccResolverWrapper: sending new addresses to
cc: [{unix:///run/cont
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.828945714-05:00" level=info
msg="ClientConn switching balancer to
"pick_first"" module=grpc
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.828101672-05:00" level=info
msg="ccResolverWrapper: sending new addresses to
cc: [{unix:///run/cont
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.830093104-05:00" level=info
msg="ClientConn switching balancer to
"pick_first"" module=grpc
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.832076285-05:00" level=info
msg="pickfirstBalancer: HandleSubConnStateChange:
0x400014e610, CONNECT
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.844251802-05:00" level=info
msg="pickfirstBalancer: HandleSubConnStateChange:
0x40001343a0, CONNECT
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.846949059-05:00" level=info
msg="pickfirstBalancer: HandleSubConnStateChange:
0x40001343a0, READY"
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.851896887-05:00" level=info
msg="pickfirstBalancer: HandleSubConnStateChange:
0x400014e610, READY"
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.857097768-05:00" level=info msg="
[graphdriver] using prior storage driver:
overlay2"
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.886090322-05:00" level=info
```

```
msg="Graph migration to content-addressability
took 0.00 seconds"
Dec 14 21:14:27 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:27.893602818-05:00" level=info
msg="Loading containers: start."
Dec 14 21:14:28 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:28.821256841-05:00" level=info
msg="Default bridge (docker0) is assigned with an
IP address 172.17.0.0
Dec 14 21:14:29 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:29.134364234-05:00" level=info
msg="Loading containers: done."
Dec 14 21:14:29 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:29.374311397-05:00" level=info
msg="Docker daemon" commit=039a7df
graphdriver(s)=overlay2 version=18.0
Dec 14 21:14:29 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:29.376444960-05:00" level=info
msg="Daemon has completed initialization"
Dec 14 21:14:29 my-n2-1 systemd[1]: Started Docker
Application Container Engine.
Dec 14 21:14:29 my-n2-1 dockerd[3347]: time="2019-
12-14T21:14:29.444607195-05:00" level=info
msg="API listen on /var/run/docker.sock"
Dec 14 21:49:11 my-n2-1 dockerd[3347]: time="2019-
12-14T21:49:11.323542665-05:00" level=info
msg="Processing signal 'terminated'"
Dec 14 21:49:11 my-n2-1 dockerd[3347]: time="2019-
12-14T21:49:11.328379659-05:00" level=info
msg="stopping event stream following graceful
shutdown" error="" m
Dec 14 21:49:11 my-n2-1 systemd[1]: Stopping
Docker Application Container Engine...
Dec 14 21:49:11 my-n2-1 systemd[1]: Stopped Docker
Application Container Engine.
Dec 14 21:49:11 my-n2-1 systemd[1]: Starting
Docker Application Container Engine...
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.499488062-05:00" level=info
msg="systemd-resolved is running, so using
resolvconf: /run/systemd/res
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.502141612-05:00" level=info
msg="parsed scheme: "unix"" module=grpc
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.502209240-05:00" level=info
msg="scheme "unix" not registered, fallback to
default scheme" module
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.502278577-05:00" level=info
msg="parsed scheme: "unix"" module=grpc
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.502295786-05:00" level=info
```

```
msg="scheme "unix" not registered, fallback to
default scheme" module
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.505887217-05:00" level=info
msg="ccResolverWrapper: sending new addresses to
cc: [{unix:///run/cont
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.506035600-05:00" level=info
msg="ClientConn switching balancer to
"pick_first"" module=grpc
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.506181190-05:00" level=info
msg="ccResolverWrapper: sending new addresses to
cc: [{unix:///run/cont
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.506446245-05:00" level=info
msg="ClientConn switching balancer to
"pick_first"" module=grpc
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.506671465-05:00" level=info
msg="pickfirstBalancer: HandleSubConnStateChange:
0x40007a2230, CONNECT
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.506255319-05:00" level=info
msg="pickfirstBalancer: HandleSubConnStateChange:
0x40008b0710, CONNECT
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.509814706-05:00" level=info
msg="pickfirstBalancer: HandleSubConnStateChange:
0x40008b0710, READY"
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.511738887-05:00" level=info
msg="pickfirstBalancer: HandleSubConnStateChange:
0x40007a2230, READY"
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.525913142-05:00" level=info
msg="Graph migration to content-addressability
took 0.00 seconds"
Dec 14 21:49:11 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:11.529808838-05:00" level=info
msg="Loading containers: start."
Dec 14 21:49:12 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:12.258591473-05:00" level=info
msg="Default bridge (docker0) is assigned with an
IP address 172.17.0.0
Dec 14 21:49:12 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:12.540886055-05:00" level=info
msg="Loading containers: done."
Dec 14 21:49:12 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:12.614462758-05:00" level=info
msg="Docker daemon" commit=039a7df
graphdriver(s)=overlay2 version=18.0
Dec 14 21:49:12 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:12.614718313-05:00" level=info
msg="Daemon has completed initialization"
Dec 14 21:49:12 my-n2-1 dockerd[9629]: time="2019-
12-14T21:49:12.640530153-05:00" level=info
msg="API listen on /var/run/docker.sock"
Dec 14 21:49:12 my-n2-1 systemd[1]: Started Docker
Application Container Engine.
```

Next, we need to disable disk based swap. For that we need to perform two actions.

First action, on each of the nodes my-n2-1 thru my-n2-5, edit the file /etc/default/armbian-zram-config and change the line ENABLED=true to ENABLED=false.

Second action, on each of the nodes my-n2-1 thru my-n2-5, execute the following commands:

```
$ sudo systemctl disable armbian-zram-config
$ sudo reboot now
```

Once again, in each of the Terminal tabs, ssh into the corresponding node.

This completes the installation and system setup of the cluster nodes. Next stop - Kubernetes setup.

Kubernetes Setup

To get started, we will designate the node my-n2-1 as the master node and setup the control plane. To do that, execute the following command on my-n2-1:

```
$ sudo kubeadm init
```

The following would be a typical output:

```
Output.8
[init] Using Kubernetes version: v1.16.3
[preflight] Running pre-flight checks
[preflight] Pulling images required for setting up
a Kubernetes cluster
[preflight] This might take a minute or two,
depending on the speed of your internet connection
[preflight] You can also perform this action in
beforehand using 'kubeadm config images pull'
[kubelet-start] Writing kubelet environment file
with flags to file "/var/lib/kubelet/kubeadm-
flags.env"
[kubelet-start] Writing kubelet configuration to
file "/var/lib/kubelet/config.yaml"
[kubelet-start] Starting the kubelet
[certs] Using certificateDir folder
"/etc/kubernetes/pki"
[certs] Generating "ca" certificate and key
```

```
[certs] Generating "apiserver" certificate and key
[certs] apiserver serving cert is signed for DNS
names [my-n2-1 kubernetes kubernetes.default
kubernetes.default.svc
kubernetes.default.svc.cluster.local] and IPs
[10.96.0.1 192.168.1.51]
[certs] Generating "apiserver-kubelet-client"
certificate and key
[certs] Generating "front-proxy-ca" certificate
and key
[certs] Generating "front-proxy-client"
certificate and key
[certs] Generating "etcd/ca" certificate and key
[certs] Generating "etcd/server" certificate and
key
[certs] etcd/server serving cert is signed for DNS
names [my-n2-1 localhost] and IPs [192.168.1.51
127.0.0.1 ::1]
[certs] Generating "etcd/peer" certificate and key
[certs] etcd/peer serving cert is signed for DNS
names [my-n2-1 localhost] and IPs [192.168.1.51
127.0.0.1 ::1]
[certs] Generating "etcd/healthcheck-client"
certificate and key
[certs] Generating "apiserver-etcd-client"
certificate and key
[certs] Generating "sa" key and public key
[kubeconfig] Using kubeconfig folder
"/etc/kubernetes"
[kubeconfig] Writing "admin.conf" kubeconfig file
[kubeconfig] Writing "kubelet.conf" kubeconfig
file
[kubeconfig] Writing "controller-manager.conf"
kubeconfig file
[kubeconfig] Writing "scheduler.conf" kubeconfig
file
[control-plane] Using manifest folder
"/etc/kubernetes/manifests"
[control-plane] Creating static Pod manifest for
"kube-apiserver"
[control-plane] Creating static Pod manifest for
"kube-controller-manager"
W1215 11:58:08.359442 4811 manifests.go:214] the
default kube-apiserver authorization-mode is
"Node,RBAC"; using "Node,RBAC"
[control-plane] Creating static Pod manifest for
"kube-scheduler"
W1215 11:58:08.366477 4811 manifests.go:214] the
default kube-apiserver authorization-mode is
"Node,RBAC"; using "Node,RBAC"
[etcd] Creating static Pod manifest for local etcd
in "/etc/kubernetes/manifests"
[wait-control-plane] Waiting for the kubelet to
boot up the control plane as static Pods from
directory "/etc/kubernetes/manifests". This can
take up to 4m0s
[apiclient] All control plane components are
healthy after 25.513764 seconds
[upload-config] Storing the configuration used in
ConfigMap "kubeadm-config" in the "kube-system"
Namespace
[kubelet] Creating a ConfigMap "kubelet-config-
1.17" in namespace kube-system with the
configuration for the kubelets in the cluster
[upload-certs] Skipping phase. Please see --
upload-certs
[mark-control-plane] Marking the node my-n2-1 as
control-plane by adding the label "node-
role.kubernetes.io/master=''"
[mark-control-plane] Marking the node my-n2-1 as
control-plane by adding the taints [node-
role.kubernetes.io/master:NoSchedule]
[bootstrap-token] Using token:
zcp5a6.w03lcuhx068wvkqv
[bootstrap-token] Configuring bootstrap tokens,
cluster-info ConfigMap, RBAC Roles
[bootstrap-token] configured RBAC rules to allow
Node Bootstrap tokens to post CSRs in order for
nodes to get long term certificate credentials
[bootstrap-token] configured RBAC rules to allow
the csrapprover controller automatically approve
CSRs from a Node Bootstrap Token
[bootstrap-token] configured RBAC rules to allow
certificate rotation for all node client
certificates in the cluster
[bootstrap-token] Creating the "cluster-info"
ConfigMap in the "kube-public" namespace
[kubelet-finalize] Updating
"/etc/kubernetes/kubelet.conf" to point to a
rotatable kubelet client certificate and key
[addons] Applied essential addon: CoreDNS
[addons] Applied essential addon: kube-proxy
```

Your Kubernetes control-plane has initialized successfully!

To start using your cluster, you need to run the following as a regular user:

```
mkdir -p $HOME/.kube
sudo cp -i /etc/kubernetes/admin.conf
$HOME/.kube/config
sudo chown $(id -u):$(id -g) $HOME/.kube/config
```

You should now deploy a pod network to the cluster. Run "kubectl apply -f [podnetwork].yaml" with one of

the options listed at:
https://kubernetes.io/docs/concepts/cluster-administration/addons/

Then you can join any number of worker nodes by running the following on each as root:

kubeadm join 192.168.1.51:6443 --token zcp5a6.w03lcuhx068wvkqv --discovery-token-ca-cert-hash sha256:d2e38957f46a9eb089671924bca78ac4e02cdc c8db27e89677a014fe587b67c6

In order to use the kubectl command-line tool as a non-root user on the master node (my-n2-1), execute the following commands on my-n2-1:

```
$ mkdir -p $HOME/.kube
$ sudo cp -i /etc/kubernetes/admin.conf
$HOME/.kube/config
$ sudo chown $(id -u):$(id -g) $HOME/.kube/config
```

To list all the node(s) in Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl get nodes
```

The following would be a typical output:

```
Output.9
NAME STATUS ROLES AGE VERSION
My-n2-1 NotReady master 2m37s v1.16.3
```

To verify the Kubernetes cluster started ok, execute the following command on the master node (my-n2-1):

```
$ kubectl get pods -n kube-system -o wide
```

The following would be a typical output (This one for example, Rob. A lot of "none"s that get edited out):

```
Output.10
NAME READY STATUS RESTARTS AGE IP NODE NOMINATED
NODE READINESS GATES
coredns-6955765f44-4gk4f 1/1 Running 0 40m
10.32.0.3 my-n2-1
coredns-6955765f44-wskl4 1/1 Running 0 40m
10.32.0.2 my-n2-1
etcd-my-n2-1 1/1 Running 0 40m 192.168.1.51 my-n2-
1
kube-apiserver-my-n2-1 1/1 Running 0 40m
192.168.1.51 my-n2-1
kube-controller-manager-my-n2-1 1/1 Running 0 40m
192.168.1.51 my-n2-1
kube-proxy-tklp7 1/1 Running 0 40m 192.168.1.51
my-n2-1
kube-scheduler-my-n2-1 1/1 Running 0 40m
192.168.1.51 my-n2-1
```

From the Output.10 above, we can see all the core components (api server, controller manager, etcd, and scheduler) are all up and running.

Now, we need to install an overlay Plugin Network for inter-pod communication. For our cluster, we will choose the weave-net implementation. To install the overlay network on the master node (my-n2-1), execute the following command:

```
$ kubectl apply -f
"https://cloud.weave.works/k8s/net?k8s-
version=$(kubectl version | base64 | tr -d '
')"
```

The following would be a typical output:

```
Output.11
serviceaccount/weave-net created
clusterrole.rbac.authorization.k8s.io/weave-net
created
clusterrolebinding.rbac.authorization.k8s.io/weave
-net created
role.rbac.authorization.k8s.io/weave-net created
rolebinding.rbac.authorization.k8s.io/weave-net
created
daemonset.apps/weave-net created
```

To verify the Weave overlay network started ok, execute the following command on the master node (my-n2-1):

```
$ kubectl get pods -n kube-system -l name=weave-
net -o wide
```

The following would be a typical output:

```
Output.12
NAME READY STATUS RESTARTS AGE IP NODE NOMINATED
NODE READINESS GATES
weave-net-2sjh4 2/2 Running 0 10m 192.168.1.51 my-
n2-1
```

Additionally, to check the logs for the Weave overlay network, execute the following command on the master node (my-n2-1):

```
$ kubectl logs -n kube-system weave-net-ktjnv
weave
```

The following would be a typical output:

```
Output.13
INFO: 2019/12/08 17:07:12.422554 Command line
options: map[conn-limit:200 datapath:datapath db-
prefix:/weavedb/weave-net docker-api: expect-
npc:true host-root:/host http-addr:127.0.0.1:6784
ipalloc-init:consensus=0 ipalloc-
range:10.32.0.0/12 metrics-addr:0.0.0.0:6782
name:9a:59:d0:9a:83:f0 nickname:my-n2-1 no-
dns:true port:6783]
INFO: 2019/12/08 17:07:12.422876 weave 2.6.0
INFO: 2019/12/08 17:07:12.780249 Bridge type is
bridged_fastdp
INFO: 2019/12/08 17:07:12.780350 Communication
between peers is unencrypted.
INFO: 2019/12/08 17:07:12.804023 Our name is
9a:59:d0:9a:83:f0(my-n2-1)
INFO: 2019/12/08 17:07:12.804267 Launch detected -
using supplied peer list: []
INFO: 2019/12/08 17:07:12.844222 Unable to fetch
ConfigMap kube-system/weave-net to infer unique
cluster ID
INFO: 2019/12/08 17:07:12.844324 Checking for pre-
existing addresses on weave bridge
INFO: 2019/12/08 17:07:12.853900 [allocator
9a:59:d0:9a:83:f0] No valid persisted data
INFO: 2019/12/08 17:07:12.866497 [allocator
9a:59:d0:9a:83:f0] Initialising via deferred
consensus
INFO: 2019/12/08 17:07:12.866684 Sniffing traffic
on datapath (via ODP)
INFO: 2019/12/08 17:07:12.872570 Listening for
HTTP control messages on 127.0.0.1:6784
INFO: 2019/12/08 17:07:12.873074 Listening for
metrics requests on 0.0.0.0:6782
INFO: 2019/12/08 17:07:13.540248 [kube-peers]
Added myself to peer list &{[{9a:59:d0:9a:83:f0
my-n2-1}]}
DEBU: 2019/12/08 17:07:13.558983 [kube-peers]
Nodes that have disappeared: map[]
INFO: 2019/12/08 17:07:13.661165 Assuming quorum
size of 1
10.32.0.1
DEBU: 2019/12/08 17:07:13.911144 registering for
updates for node delete events
```

For this tutorial, we designate that nodes my-n2-2 thru my-n2-5 to be the worker nodes of this Kubernetes cluster. From Output.8 above, we can determine the kubeadm join command to use on each worker node . For each of the nodes my-n2-2 thru my-n2-5 (in their respective Terminal tab), execute the following command:

```
$ sudo kubeadm join 192.168.1.51:6443 --token
zcp5a6.w03lcuhx068wvkqv --discovery-token-ca-cert-
hash
sha256:d2e38957f46a9eb089671924bca78ac4e02cdcc8db2
7e89677a014fe587b67c6
```

The following would be a typical output:

```
Output.14
[preflight] Running pre-flight checks
[preflight] Reading configuration from the
cluster...
[preflight] FYI: You can look at this config file
with 'kubectl -n kube-system get cm kubeadm-config
-oyaml'
[kubelet-start] Downloading configuration for the
kubelet from the "kubelet-config-1.17" ConfigMap
in the kube-system namespace
[kubelet-start] Writing kubelet configuration to
file "/var/lib/kubelet/config.yaml"
[kubelet-start] Writing kubelet environment file
with flags to file "/var/lib/kubelet/kubeadm-
flags.env"
[kubelet-start] Starting the kubelet
[kubelet-start] Waiting for the kubelet to perform
the TLS Bootstrap...
```

This node has joined the cluster: * Certificate signing request was sent to apiserver and a response was received. * The Kubelet was informed of the new secure connection details.

Run 'kubectl get nodes' on the control-plane to see this node join the cluster.

To list all the active nodes in this Kubernetes cluster, execute the following command on the master node (my-n2-1) (after waiting for about 30 secs):

```
$ kubectl get nodes -o wide
```

The following would be a typical output:

```
Output.15
NAME STATUS ROLES AGE VERSION INTERNAL-IP
EXTERNAL-IP OS-IMAGE KERNEL-VERSION CONTAINER-
RUNTIME
my-n2-1 Ready master 51m v1.17.0 192.168.1.51
```

```
Ubuntu 18.04.3 LTS 4.9.196-meson64 docker://18.9.9
my-n2-2 Ready  2m58s v1.17.0 192.168.1.52  Ubuntu
18.04.3 LTS 4.9.196-meson64 docker://18.9.9
my-n2-3 Ready  2m38s v1.17.0 192.168.1.53  Ubuntu
18.04.3 LTS 4.9.196-meson64 docker://18.9.9
my-n2-4 Ready  2m35s v1.17.0 192.168.1.54  Ubuntu
18.04.3 LTS 4.9.196-meson64 docker://18.9.9
my-n2-5 Ready  2m21s v1.17.0 192.168.1.55  Ubuntu
18.04.3 LTS 4.9.196-meson64 docker://18.9.9
```

That is it! This completes all the necessary setup for this Kubernetes cluster.

Hands-on with Kubernetes

To list all the pod(s) running in Kubernetes cluster (including the system pods), execute the following command on the master node (my-n2-1):

```
$ kubectl get pods --all-namespaces -o wide
```

The following would be a typical output:

```
Output.16
NAMESPACE NAME READY STATUS RESTARTS AGE IP NODE
NOMINATED NODE READINESS GATES
kube-system coredns-6955765f44-4gk4f 1/1 Running 0
52m 10.32.0.3 my-n2-1
kube-system coredns-6955765f44-wskl4 1/1 Running 0
52m 10.32.0.2 my-n2-1
kube-system etcd-my-n2-1 1/1 Running 0 52m
192.168.1.51 my-n2-1
kube-system kube-apiserver-my-n2-1 1/1 Running 0
52m 192.168.1.51 my-n2-1
kube-system kube-controller-manager-my-n2-1 1/1
Running 0 52m 192.168.1.51 my-n2-1
kube-system kube-proxy-9zxfj 1/1 Running 0 3m36s
192.168.1.55 my-n2-5
kube-system kube-proxy-c7mns 1/1 Running 0 3m53s
192.168.1.53 my-n2-3
kube-system kube-proxy-dv52p 1/1 Running 0 4m13s
192.168.1.52 my-n2-2
kube-system kube-proxy-mpwkb 1/1 Running 0 3m50s
192.168.1.54 my-n2-4
kube-system kube-proxy-tklp7 1/1 Running 0 52m
192.168.1.51 my-n2-1
kube-system kube-scheduler-my-n2-1 1/1 Running 0
52m 192.168.1.51 my-n2-1
kube-system weave-net-2sjh4 2/2 Running 0 21m
192.168.1.51 my-n2-1
kube-system weave-net-68lcd 2/2 Running 0 3m50s
192.168.1.54 my-n2-4
kube-system weave-net-7fh98 2/2 Running 1 4m13s
192.168.1.52 my-n2-2
kube-system weave-net-krdtz 2/2 Running 1 3m36s
192.168.1.55 my-n2-5
kube-system weave-net-ljm6k 2/2 Running 0 3m53s
192.168.1.53 my-n2-3
```

As is evident from Output.16 above, we see an instance for API Server, etcd, Controller Manager, Scheduler, and Plugin Network (weave-net) all up and running.

To display detailed information about any pod (say the Controller Manager) in the Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl describe pod kube-controller-manager-my-
n2-1 -n kube-system
```

The following would be a typical output (Rob, I first noticed output seventeen missing "none"):

```
Output.17
Name: kube-controller-manager-my-n2-1
Namespace: kube-system
Priority: 2000000000
Priority Class Name: system-cluster-critical
Node: my-n2-1/192.168.1.51
Start Time: Sun, 15 Dec 2019 11:58:39 -0500
Labels: component=kube-controller-manager
tier=control-plane
Annotations: kubernetes.io/config.hash:
536dc7132dfd0d2ca1d968c9ede1e024
kubernetes.io/config.mirror:
536dc7132dfd0d2ca1d968c9ede1e024
kubernetes.io/config.seen: 2019-12-
15T11:58:35.86446527-05:00
kubernetes.io/config.source: file
Status: Running
IP: 192.168.1.51
IPs:
IP: 192.168.1.51
Controlled By: Node/my-n2-1
Containers:
kube-controller-manager:
Container ID:
docker://63b0d105457f52849afa38d2e914b53e68b7e2178
6fc41cda322bb21bc5b86a4
Image: k8s.gcr.io/kube-controller-manager:v1.17.0
Image ID: docker-pullable://k8s.gcr.io/kube-
controller-
manager@sha256:0438efb5098a2ca634ea8c6b0d804742b73
3d0d13fd53cf62c73e32c659a3c39
Port:
```

```
Host Port:
Command:
kube-controller-manager
--authentication-
kubeconfig=/etc/kubernetes/controller-manager.conf
--authorization-
kubeconfig=/etc/kubernetes/controller-manager.conf
--bind-address=127.0.0.1
--client-ca-file=/etc/kubernetes/pki/ca.crt
--cluster-signing-cert-
file=/etc/kubernetes/pki/ca.crt
--cluster-signing-key-
file=/etc/kubernetes/pki/ca.key
--controllers=*,bootstrapsigner,tokencleaner
--kubeconfig=/etc/kubernetes/controller-
manager.conf
--leader-elect=true
--requestheader-client-ca-
file=/etc/kubernetes/pki/front-proxy-ca.crt
--root-ca-file=/etc/kubernetes/pki/ca.crt
--service-account-private-key-
file=/etc/kubernetes/pki/sa.key
--use-service-account-credentials=true
State: Running
Started: Sun, 15 Dec 2019 11:58:22 -0500
Ready: True
Restart Count: 0
Requests:
cpu: 200m
Liveness: http-get https://127.0.0.1:10257/healthz
delay=15s timeout=15s period=10s #success=1
#failure=8
Environment:
Mounts:
/etc/ca-certificates from etc-ca-certificates (ro)
/etc/kubernetes/controller-manager.conf from
kubeconfig (ro)
/etc/kubernetes/pki from k8s-certs (ro)
/etc/ssl/certs from ca-certs (ro)
/usr/libexec/kubernetes/kubelet-
plugins/volume/exec from flexvolume-dir (rw)
/usr/local/share/ca-certificates from usr-local-
share-ca-certificates (ro)
/usr/share/ca-certificates from usr-share-ca-
certificates (ro)
Conditions:
Type Status
Initialized True
Ready True
ContainersReady True
PodScheduled True
Volumes:
ca-certs:
Type: HostPath (bare host directory volume)
Path: /etc/ssl/certs
HostPathType: DirectoryOrCreate
etc-ca-certificates:
Type: HostPath (bare host directory volume)
Path: /etc/ca-certificates
HostPathType: DirectoryOrCreate
flexvolume-dir:
Type: HostPath (bare host directory volume)
Path: /usr/libexec/kubernetes/kubelet-
plugins/volume/exec
HostPathType: DirectoryOrCreate
k8s-certs:
Type: HostPath (bare host directory volume)
Path: /etc/kubernetes/pki
HostPathType: DirectoryOrCreate
kubeconfig:
Type: HostPath (bare host directory volume)
Path: /etc/kubernetes/controller-manager.conf
HostPathType: FileOrCreate
usr-local-share-ca-certificates:
Type: HostPath (bare host directory volume)
Path: /usr/local/share/ca-certificates
HostPathType: DirectoryOrCreate
usr-share-ca-certificates:
Type: HostPath (bare host directory volume)
Path: /usr/share/ca-certificates
HostPathType: DirectoryOrCreate
QoS Class: Burstable
Node-Selectors: < none >
Tolerations: :NoExecute
Events: < none >
```

To list all the application pod(s) running in Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl get pods
```

The following would be a typical output:

```
Output.18
No resources found in default namespace.
```

To list all the service(s) running in Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl get services
```

The following would be a typical output:

```
Output.19
NAME TYPE CLUSTER-IP EXTERNAL-IP PORT(S) AGE
```

```
kubernetes ClusterIP 10.96.0.1  443/TCP 64m
```

We will create a simple Python web application to display the host name as well as the ip-address when invoked via HTTP. The following are the contents of the simple Python web application stored under the /tmp directory on the master node (my-n2-1):

```
web-echo.py
from flask import Flask
import socket

app = Flask(__name__)

@app.route("/")
def index():
host_name = socket.gethostname()
host_ip = socket.gethostbyname(host_name)
return 'Hello from container -> ' + host_name + '
[' + host_ip + ']'

if __name__ == "__main__":
app.run(host='0.0.0.0', port=8888)
```

The following are the contents of the Dockerfile to create a Docker image for the the simple Python web application stored under the /tmp directory on the master node (my-n2-1):

```
Dockerfile
FROM python:3.7.5-alpine3.9
RUN pip install flask
ADD web-echo.py /web-echo.py
CMD ["python", "/web-echo.py"]
```

To build a Docker image called py-web-echo with the tag v1.0, execute the following commands on the master node (my-n2-1):

```
cd /tmp
docker build -t "py-web-echo:v1.0" .
```

The following would be a typical output:

```
Output.20
Sending build context to Docker daemon 3.072kB
Step 1/4: FROM python:3.7.5-alpine3.9
3.7.5-alpine3.9: Pulling from library/python
0362ad1dd800: Pull complete
9b941924aae3: Pull complete
fd7b3613915d: Pull complete
078d60b9b97e: Pull complete
7059e1dd9bc4: Pull complete
Digest:
sha256:064d9ce3e91a59535c528bc3c38888023791d9fc78b
a9e5070f5064833f326ff
Status: Downloaded newer image for python:3.7.5-
alpine3.9
---> 578ec6233872
Step 2/4: RUN pip install flask
---> Running in d248e23dd161
Collecting flask
Downloading
https://files.pythonhosted.org/packages/9b/93/6285
09b8d5dc749656a9641f4caf13540e2cdec85276964ff8f43b
bb1d3b/Flask-1.1.1-py2.py3-none-any.whl (94kB)
Collecting Jinja2>=2.10.1
Downloading
https://files.pythonhosted.org/packages/65/e0/eb35
e762802015cab1ccee04e8a277b03f1d8e53da3ec3106882ec
42558b/Jinja2-2.10.3-py2.py3-none-any.whl (125kB)
Collecting Werkzeug>=0.15
Downloading
https://files.pythonhosted.org/packages/ce/42/3aed
a98f96e85fd26180534d36570e4d18108d62ae36f87694b476
b83d6f/Werkzeug-0.16.0-py2.py3-none-any.whl
(327kB)
Collecting itsdangerous>=0.24
Downloading
https://files.pythonhosted.org/packages/76/ae/44b0
3b253d6fade317f32c24d100b3b35c2239807046a4c953c7b8
9fa49e/itsdangerous-1.1.0-py2.py3-none-any.whl
Collecting click>=5.1
Downloading
https://files.pythonhosted.org/packages/fa/37/4518
5cb5abbc30d7257104c434fe0b07e5a195a6847506c074527a
a599ec/Click-7.0-py2.py3-none-any.whl (81kB)
Collecting MarkupSafe>=0.23
Downloading
https://files.pythonhosted.org/packages/b9/2e/64db
92e53b86efccfaea71321f597fa2e1b2bd3853d8ce658568f7
a13094/MarkupSafe-1.1.1.tar.gz
Building wheels for collected packages: MarkupSafe
Building wheel for MarkupSafe (setup.py): started
Building wheel for MarkupSafe (setup.py): finished
with status 'done'
Created wheel for MarkupSafe: filename=MarkupSafe-
1.1.1-cp37-none-any.whl size=12629
sha256=8a200864ca113d03b4de2d951ae4a1d0806a3ff8412
8349770dfe3fb018a6458
Stored in directory:
/root/.cache/pip/wheels/f2/aa/04/0edf07a1b8a5f5f1a
ed7580fffb69ce8972edc16a505916a77
Successfully built MarkupSafe
Installing collected packages: MarkupSafe, Jinja2,
Werkzeug, itsdangerous, click, flask
```

```
Successfully installed Jinja2-2.10.3 MarkupSafe-
1.1.1 Werkzeug-0.16.0 click-7.0 flask-1.1.1
itsdangerous-1.1.0
Removing intermediate container d248e23dd161
---> 4ee40e66a655
Step 3/4: ADD web-echo.py /web-echo.py
---> 31a0341bf9d7
Step 4/4: CMD ["python", "/web-echo.py"]
---> Running in 1ee52ea10ad3
Removing intermediate container 1ee52ea10ad3
---> 7cd037d24ef7
Successfully built 7cd037d24ef7
Successfully tagged py-web-echo:v1.0
```

To list all the Docker images on the master node (my-n2-1), execute the following command on the master node (my-n2-1):

```
$ docker images
```

The following would be a typical output:

```
Output.21
REPOSITORY TAG IMAGE ID CREATED SIZE
py-web-echo v1.0 7cd037d24ef7 3 minutes ago 119MB
k8s.gcr.io/kube-proxy v1.17.0 ac19e9cffff5 7 days
ago 114MB
k8s.gcr.io/kube-apiserver v1.17.0 aca151bf3e90 7
days ago 166MB
k8s.gcr.io/kube-controller-manager v1.17.0
7045158f92f8 7 days ago 156MB
k8s.gcr.io/kube-scheduler v1.17.0 0d5c120f87f3 7
days ago 93.7MB
python 3.7.5-alpine3.9 578ec6233872 4 weeks ago
109MB
weaveworks/weave-npc 2.6.0 1c672c2f5870 5 weeks
ago 36.6MB
weaveworks/weave-kube 2.6.0 81393394d17d 5 weeks
ago 111MB
k8s.gcr.io/coredns 1.6.5 f96217e2532b 5 weeks ago
39.3MB
k8s.gcr.io/etcd 3.4.3-0 ab707b0a0ea3 7 weeks ago
363MB
k8s.gcr.io/pause 3.1 6cf7c80fe444 24 months ago
525kB
```

Note that we built the Docker image on the master node (my-n2-1). Since the pod(s) will be deployed on the worker node(s), we need to ensure the requisite docker images are present in the worker node(s).

For each of the worker nodes my-n2-2 thru my-n2-5 (in their respective Terminal tab), execute the following command:

```
$ docker pull python:3.7.5-alpine3.9
```

For each of the worker nodes my-n2-2 thru my-n2-5, execute the following command on the master node (my-n2-1):

```
$ docker save py-web-echo:v1.0 | bzip2 | ssh
polarsparc@192.168.1.52 'bunzip2 | docker load'
$ docker save py-web-echo:v1.0 | bzip2 | ssh
polarsparc@192.168.1.53 'bunzip2 | docker load'
$ docker save py-web-echo:v1.0 | bzip2 | ssh
polarsparc@192.168.1.54 'bunzip2 | docker load'
$ docker save py-web-echo:v1.0 | bzip2 | ssh
polarsparc@192.168.1.55 'bunzip2 | docker load'
```

!!! WARNING !!!

Not having the Docker images in the worker node(s) will cause the pod(s) to be stuck in the ContainerCreating status

In Kubernetes, a pod is what encapsulates Docker container(s). To deploy our web application Docker image py-web-echo:v1.0 in our Kubernetes cluster, we need a pod manifest file in YAML format .

The following are the contents of the pod manifest file called web-echo-pod.yaml stored under the /tmp directory on the master node (my-n2-1):

```
web-echo-pod.yaml
---
apiVersion: v1
kind: Pod
metadata:
name: web-echo-pod
labels:
app: web-echo
spec:
containers:
- name: web-echo
image: py-web-echo:v1.0
imagePullPolicy: Never
ports:
- containerPort: 8888
```

The following section explains the elements of the web-echo-pod.yaml manifest file:

- apiVersion: specifies the version of the API (v1 in this example)

- kind: specifies the type of Kubernetes object to deploy (Pod in this example)
- metadata: associates a name (web-echo-pod in this example) with the type of Kubernetes object. Also, allows one to tag some labels, which are simple key-value pairs, with the Kubernetes
- object. In this example, we have one label with the key app that has a value of web-echo
- spec: specifies what is in the pod. In this example, we want to deploy the Docker image py-web-echo:v1.0 which is exposed via the network port 8888
- imagePullPolicy: indicates to Kubernetes not to pull the container image

To deploy the pod to our Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl apply -f /tmp/web-echo-pod.yaml
```

The following would be a typical output:

```
Output.22
pod/web-echo-pod created
```

To list all the application pod(s) running in Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl get pods -o wide
```

The following would be a typical output:

```
Output.23
1
```

From Output.23, we see that our application pod have been deployed on the node my-n2-2 of our Kubernetes cluster.

To display detailed information about the deployed application pod web-echo-pod, execute the following command on the master node (my-n2-1):

```
$ kubectl describe pods web-echo-pod
```

The following would be a typical output:

```
Output.24
Name: web-echo-pod
Namespace: default
Priority: 0
Node: my-n2-2/192.168.1.52
Start Time: Sun, 15 Dec 2019 14:58:21 -0500
Labels: app=web-echo
Annotations: kubectl.kubernetes.io/last-applied-
configuration:
{"apiVersion":"v1","kind":"Pod","metadata":
{"annotations":{},"labels":{"app":"web-
echo"},"name":"web-echo-
pod","namespace":"default"},"spe...
Status: Running
IP: 10.44.0.1
IPs:
IP: 10.44.0.1
Containers:
web-echo:
Container ID:
docker://0af2c99fd074b5ee3c0b9876eb9ad44ca446400c2
190b4af6fa1a18543bff723
Image: py-web-echo:v1.0
Image ID:
docker://sha256:7cd037d24ef7c842ffe005cfcb548a802f
c13661c08c8bb4635c365f77e5a3aa
Port: 8888/TCP
Host Port: 0/TCP
State: Running
Started: Sun, 15 Dec 2019 14:58:23 -0500
Ready: True
Restart Count: 0
Environment:
Mounts:
/var/run/secrets/kubernetes.io/serviceaccount from
default-token-tvl5x (ro)
Conditions:
Type Status
Initialized True
Ready True
ContainersReady True
PodScheduled True
Volumes:
default-token-tvl5x:
Type: Secret (a volume populated by a Secret)
SecretName: default-token-tvl5x
Optional: false
QoS Class: BestEffort
Node-Selectors:
Tolerations: node.kubernetes.io/not-
ready:NoExecute for 300s
node.kubernetes.io/unreachable:NoExecute for 300s
Events:
Type Reason Age From Message
---- ------ ---- ---- -------
Normal Scheduled 7m39s default-scheduler
Successfully assigned default/web-echo-pod to my-
n2-2
```

```
Normal Pulled 7m38s kubelet, my-n2-2 Container
image "py-web-echo:v1.0" already present on
machine
Normal Created 7m38s kubelet, my-n2-2 Created
container web-echo
Normal Started 7m37s kubelet, my-n2-2 Started
container web-echo
```

From the Output.23 (as well as Output.24) above, we see the ip-address of the deployed web application to be 10.44.0.1.

To test the deployed web application using the curl command, execute the following command on any of the nodes my-n2-1 through my-n2-5:

```
$ curl http://10.44.0.1:8888
```

The following would be a typical output:

```
Output.25
Hello from container -> web-echo-pod [10.44.0.1]
```

To display the logs of the deployed web application web-echo-pod, execute the following command on the master node (my-n2-1):

```
$ kubectl logs web-echo-pod
```

The following would be a typical output:

```
Output.26
* Serving Flask app "web-echo" (lazy loading)
* Environment: production
WARNING: This is a development server. Do not use
it in a production deployment.
Use a production WSGI server instead.
* Debug mode: off
* Running on http://0.0.0.0:8888/ (Press CTRL+C to
quit)
10.32.0.1 - - [15/Dec/2019 20:11:33] "GET /
HTTP/1.1" 200 -
10.36.0.0 - - [15/Dec/2019 20:11:58] "GET /
HTTP/1.1" 200 -
```

To delete the deployed web application web-echo-pod, execute the following command on the master node (my-n2-1):

```
$ kubectl delete pod web-echo-pod
```

The following would be a typical output:

```
Output.27
pod "web-echo-pod" deleted
```

It is *NOT* that common to deploy a single Pod. It is more common to deploy a higher level Kubernetes object called a ReplicaSet . A ReplicaSet defines how many replicas of a Pod need to be deployed and maintained in the Kubernetes cluster.

The following are the contents of the ReplicaSet manifest file called web-echo-rs.yaml stored under the /tmp directory on the master node (my-n2-1):

```
web-echo-rs.yaml
---
apiVersion: apps/v1
kind: ReplicaSet
metadata:
name: web-echo-rs
spec:
replicas: 3
selector:
matchLabels:
app: web-echo
template:
metadata:
labels:
app: web-echo
spec:
containers:
- name: web-echo
image: py-web-echo:v1.0
imagePullPolicy: Never
ports:
- containerPort: 8888
```

The following section explains some of the elements of the web-echo-rs.yaml manifest file:

apiVersion: specifies the version of the API (apps/v1 in this example) replicas: indicates the desired instances of the Pod to be running in the Kubernetes cluster selector: identifies and selects a group of Kubernetes objects with the same key-value label (key app and value web-echo in this example) template: is the embedded specification for a Pod

To deploy the ReplicaSet to our Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl apply -f /tmp/web-echo-rs.yaml
```

The following would be a typical output:

```
Output.28
replicaset.apps/web-echo-rs created
```

To list all the deployed ReplicaSet(s) running in Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl get replicasets -o wide
```

The following would be a typical output:

```
Output.29
NAME DESIRED CURRENT READY AGE CONTAINERS IMAGES
SELECTOR
web-echo-rs 3 3 3 7m web-echo py-web-echo:v1.0
app=web-echo
```

To display detailed information about the deployed ReplicaSet named web-echo-rs, execute the following command on the master node (my-n2-1):

```
$ kubectl describe replicasets web-echo-rs
```

The following would be a typical output:

```
Output.30
Name: web-echo-rs
Namespace: default
Selector: app=web-echo
Labels:
Annotations: kubectl.kubernetes.io/last-applied-
configuration:
{"apiVersion":"apps/v1","kind":"ReplicaSet","metad
ata":{"annotations":{},"name":"web-echo-
rs","namespace":"default"},"spec":
{"replicas":3,...
Replicas: 3 current / 3 desired
Pods Status: 3 Running / 0 Waiting / 0 Succeeded /
0 Failed
Pod Template:
Labels: app=web-echo
Containers:
web-echo:
Image: py-web-echo:v1.0
Port: 8888/TCP
Host Port: 0/TCP
Environment:
Mounts:
Volumes:
Events:
Type Reason Age From Message
---- ------ ---- ---- -------
Normal SuccessfulCreate 14m replicaset-controller
Created pod: web-echo-rs-xn94l
Normal SuccessfulCreate 14m replicaset-controller
Created pod: web-echo-rs-9x9b9
Normal SuccessfulCreate 14m replicaset-controller
Created pod: web-echo-rs-tbd49
```

To list all the application pod(s) running in Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl get pods -o wide
```

The following would be a typical output:

```
Output.31
NAME READY STATUS RESTARTS AGE IP NODE NOMINATED
NODE READINESS GATES
web-echo-rs-9x9b9 1/1 Running 0 63s 10.42.0.1 my-
n2-4
web-echo-rs-tbd49 1/1 Running 0 63s 10.44.0.1 my-
n2-2
web-echo-rs-xn94l 1/1 Running 0 63s 10.36.0.1 my-
n2-3
```

From Output.31, we see that our application pod(s) have been deployed on the 3 nodes my-n2-2, my-n2-3, and my-n2-4 with unique ip-addresses of 10.44.0.1, 10.36.0.1, and 10.42.0.1 respectively.

As indicated early on, application pod(s) are ephemeral. They can come up and go at any time. This means their ip-address(es) can change any time. We need a higher level abstraction that provides a stable ip-address for other application pod(s) to use. This is where a Service object comes in handy. It provides a single stable ip-address for other applications to use and distributes the load across the different backend application pod(s) it is fronting.

There are 3 types of Service(s) in Kubernetes:

- ClusterIP: exposes the Service on an ip-address that is internal to the Kubernetes cluster. This means the Service is accessible from *ONLY* within the Kubernetes cluster. This is the default type
- NodePort: exposes the Service on each worker node's ip-address at a high port in the range 30000 to 32767. Applications external to the Kubernetes cluster are be able to access the Service at the worker node's ip-address and the assigned node port

- LoadBalancer: 1exposes the Service externally using a cloud providers Load Balancer such as AWS, Azure, or Google Cloud

The following are the contents of the ClusterIP based Service manifest file called web-echo-svc-cip.yaml stored under the /tmp directory on the master node (my-n2-1):

```
web-echo-svc-cip.yaml
---
apiVersion: v1
kind: Service
metadata:
name: web-echo-svc-cip
spec:
selector:
app: web-echo
ports:
- name: http
protocol: TCP
port: 8888
```

To deploy the Service to our Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl apply -f /tmp/web-echo-svc-cip.yaml
```

The following would be a typical output:

```
Output.32
service/web-echo-svc created
```

To list all the Service(s) running in Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl get services -o wide
```

The following would be a typical output:

```
Output.33
NAME TYPE CLUSTER-IP EXTERNAL-IP PORT(S) AGE
SELECTOR
kubernetes ClusterIP 10.96.0.1  443/TCP 9h
web-echo-svc ClusterIP 10.96.238.16  8888/TCP 105s
app=web-echo
```

From the Output.33 above, we see the application web-echo can be accessed from anywhere in the cluster via the ip-address 10.96.238.16 and port 8888.

To test the deployed Service endpoint using the curl command, execute the following command 5 times on any of the nodes my-n2-1 through my-n2-5:

```
$ curl http://10.96.238.16:8888
```

The following would be a typical output:

```
Output.34
Hello from container -> web-echo-rs-xn94l
[10.36.0.1]
Hello from container -> web-echo-rs-9x9b9
[10.42.0.1]
Hello from container -> web-echo-rs-tbd49
[10.44.0.1]
Hello from container -> web-echo-rs-9x9b9
[10.42.0.1]
Hello from container -> web-echo-rs-tbd49
[10.44.0.1]
```

To display detailed information about the Service endpoint labeled web-echo-svc, execute the following command on the master node (my-n2-1):

```
$ kubectl describe service web-echo-svc
```

The following would be a typical output:

```
Output.35
Name: web-echo-svc
Namespace: default
Labels:
Annotations: kubectl.kubernetes.io/last-applied-
configuration:
{"apiVersion":"v1","kind":"Service","metadata":
{"annotations":{},"name":"web-echo-
svc","namespace":"default"},"spec":{"ports":
[{"name":"ht...
Selector: app=web-echo
Type: ClusterIP
IP: 10.96.238.16
Port: http 8888/TCP
TargetPort: 8888/TCP
Endpoints:
10.36.0.1:8888,10.42.0.1:8888,10.44.0.1:8888
Session Affinity: None
Events:
```

To delete the deployed web-echo-svc object, execute the following command on the master node (my-n2-1):

```
$ kubectl delete service web-echo-svc
```

The following would be a typical output:

```
Output.36
service "web-echo-svc" deleted
```

The following are the contents of the NodePort based Service manifest file called web-echo-svc-nop.yaml stored under the /tmp directory on the master node (my-n2-1):

```
web-echo-svc-nop.yaml
---
apiVersion: v1
kind: Service
metadata:
name: web-echo-svc
spec:
type: NodePort
selector:
app: web-echo
ports:
- name: http
protocol: TCP
port: 8888
```

To deploy the Service to our Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl apply -f /tmp/web-echo-svc-nop.yaml
```

The following would be a typical output:

```
Output.37
service/web-echo-svc created
```

To list all the Service(s) running in Kubernetes cluster, execute the following command on the master node (my-n2-1):

```
$ kubectl get services -o wide
```

The following would be a typical output:

```
Output.38
NAME TYPE CLUSTER-IP EXTERNAL-IP PORT(S) AGE
SELECTOR
kubernetes ClusterIP 10.96.0.1  443/TCP 9h
web-echo-svc NodePort 10.96.144.75  8888:32546/TCP
38m app=web-echo
```

To display detailed information about the Service endpoint labeled web-echo-svc, execute the following command on the master node (my-n2-1):

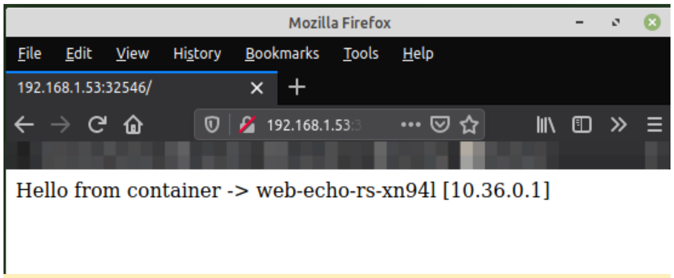
```
$ kubectl describe service web-echo-svc
```

The following would be a typical output:

```
Output.39
Name: web-echo-svc
Namespace: default
Labels:
Annotations: kubectl.kubernetes.io/last-applied-
configuration:
{"apiVersion":"v1","kind":"Service","metadata":
{"annotations":{},"name":"web-echo-
svc","namespace":"default"},"spec":{"ports":
[{"name":"ht...
Selector: app=web-echo
Type: NodePort
IP: 10.96.144.75
Port: http 8888/TCP
TargetPort: 8888/TCP
NodePort: http 32546/TCP
Endpoints:
10.36.0.1:8888,10.42.0.1:8888,10.44.0.1:8888
Session Affinity: None
External Traffic Policy: Cluster
Events:
```

From the Output.39 above, we see the deployed Service node port is 32546.

Open a browser and access the url http://192.168.1.53:32546. The following illustration in Figure-3 below would be a typical browser display:



Hello from container -> web-echo-rs-xn94l [10.36.0.1]

Figure 3

BINGO - it works as expected!

And this concludes the basic exercises we performed on our Kubernetes cluster.

References

https://kubernetes.io/docs/home/?path=browse
https://www.weave.works/docs/net/latest/overview/
https://docs.docker.com/
https://www.polarsparc.com/xhtml/Practical-K8S-N2.html

Pearl Linux Motion Video Surveillance System With Kodi: Advanced Visual Monitoring Using An ODROID-C2

January 10, 2020 By @pearllinux ODROID-C2, Tutorial

I created a video surveillance image based on Ubuntu 18.04 using the 3.16.75 kernel, featuring pre-installed and active upon first boot Motion Video Surveillance Software running in User Mode not root. It includes a pre-installed Apache Web Server and WebMin to manage your system through web interface, and boots into Pearl's Lightweight MATE desktop with most features from Pearl's 7.0 release.

Features

- Odroid C2 Pearl Linux Image with Kernel 3.16.75
- Motion Video Surveillance preinstalled and active upon boot
- Webmin and Apache Web Server preconfigured and active upon boot
- latest MATE desktop envirnoment

First, download the image then use Etcher (https://etcher.io) to write the image to your SD card or eMMC module. Upon first boot, the system will automatically resize and use all of the available space of your device. Give the system 2-3 minutes after the screen goes blank, then remove power to C2 then reapply power.

To use KODI, logout and log back into a Kodi session rather than Mate. No password is required to log in under the lightdm display manager. The username is either “root” or “odroid”, and the password is “odroid”. You may change the password from the command prompt or in control panel.

Video Surveillance

This Pearl release comes with Motion Video Surveillance version 4.2.2-1pearl7.3 We made a Debian .deb package and added a Basic Camera Viewer (one 2 up, and one for 4 up). The image is ready out of the box, with the only exception that your actual IP address for your computer may not be the same as the one set up on our LAN. We are using the 192.168.1.0 network, which is one of the most common (others are may be 10.0.0.1 or 192.168.0.1).

The location of the camera monitor is at /opt/pearl/mcm. There, you will find 2 files for the 2 up monitor and 2 files for the 4 up. The HTML file is where you will change the IP address if it is not the same. The 2 up and 4 up monitoring are both set to monitor only one camera that is attached to the ODROID-C2 itself. The others are being pulled from other computers on your LAN running the motion software. You can download and install our version of Motion from our repositories at **http://apt.pearllinux.com/pool/main/m/motion/motion_4.2.2-1pearl7.3_arm64.deb**. Other images are available at **http://apt.pearllinux.com/pool/main/m/motion/**.

Release notes

Because the video surveillance starts at boot, the directory /var/lib/motion will be Add pictures and short video clips to that directory automatically. If using a 16GB Micro SD card, you will want to watch that directory because it can fill up the card quickly. You can change any directives including turning the automatic creation of these files in the main Motion config file located at /etc/motion/montion.conf.

For comments, questions, and suggestions, please visit the original post at **https://sourceforge.net/projects/odroid-c2-motionvideo/** or the Pearl Linux website at **https://www.pearllinux.com**.

Android Things

January 10, 2020 By @Luke.go Android, Development, Tutorial

Have you ever tried to connect a peripheral device to the GPIO pins on your ODROID SBC with the Android OS? For example, you wished to connect a switch to launch an application or you wanted to connect a dimming sensor. The first problem you will face would be the difficulty to handle the GPIO pins from your Android application or service and maybe you would be faced with permission problems to access a GPIO, PWM or I2C, since a general Android application is denied access to a hardware resource. The alternative solution is to port a low-level library such as wiringPi based on C/C++, but it will be required to interface to your application through JNI (Java Native Interface) using NDK. Still, you have to figure out the permission problem.

Google has introduced yet another Operating System (OS) known as "Android Things", that is designed to run on light embedded devices and offers the framework with Java to handle peripherals. My idea was to incorporate the Android Things framework into ODROID software and let users use the expansion pins easily. However, the problem is that this OS is not open source, therefore, I had to implement the code in the Android for ODROID. Fortunately, Google opens the framework APIs with its document and Android Things SDK. This fact encouraged me to implement the full stack of the framework that works like Android Things, from bottom to top.

I used some APIs from the Android Things' Peripheral managing parts. It has many other features, but these are not needed for our task. I made interfaces for using the Android Things API. For processing and managing the request from user-layer via API, I built the server and client architecture and connected it to the hardware layer via wiringPi to control real hardware. Initially, GPIO, I2C and PWM features were implemented, because people use them more often than other features like SPI and UART. Explaining all of the implementation is best, but I will just show you how to use it. This tact will be more useful.

Since I utilized the process of reverse engineering. My solution can become incompatible with the real Android Things OS and/or degrade its performance. However, I expect that users who previously wanted to use GPIO pins on Android will be relieved from some of the difficulty of working in C through my work. Let me show you an example of Android Things about GPIO, I2C and PWM to learn how to use it.

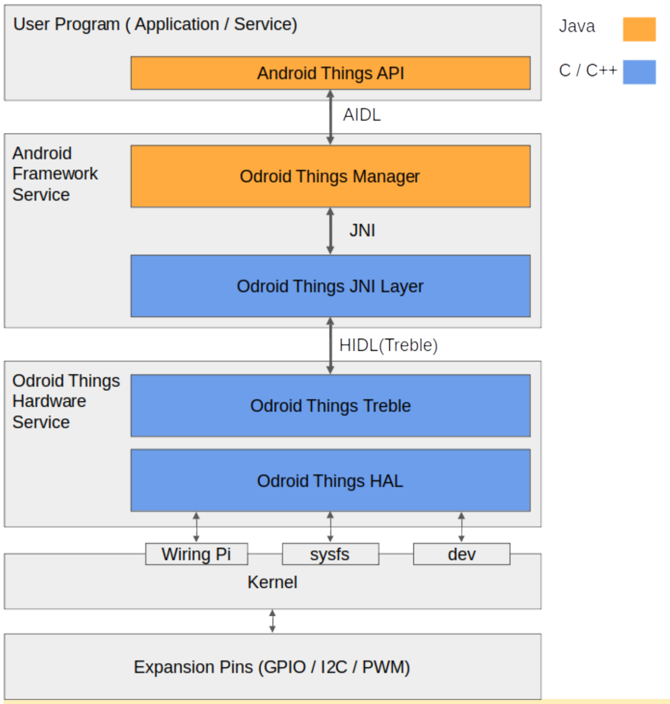


Fig. 01 - Architecture

There is nothing as simple as using the Android Studio to create, compile, and test an application or service that contains Android Things. You just need to install the Android Studio, and add official option and official code to use Android Things, and install a package to ODROID via otg port. and execute a package. It just works! That is all. you do not need to do anything else.

I uploaded all of the example code to my github repository (https://github.com/xiane/thingsGpioExample). And each of the examples is separated by branches. On the master branch, you can control the GPIO pin. On the i2c_16x4 branch, you can use 16x4 lcd through I2C. On the PWM branch, you can control the PWM. and on the i2c_weather_board branch, you can use a weatherboard. Please use and test it for your own projects.

All of the behind code is based on the Android Things official site. Please check the official site at: https://developer.android.com/things.

Manifest

Before you try my examples, you should add the following lines to your manifest:

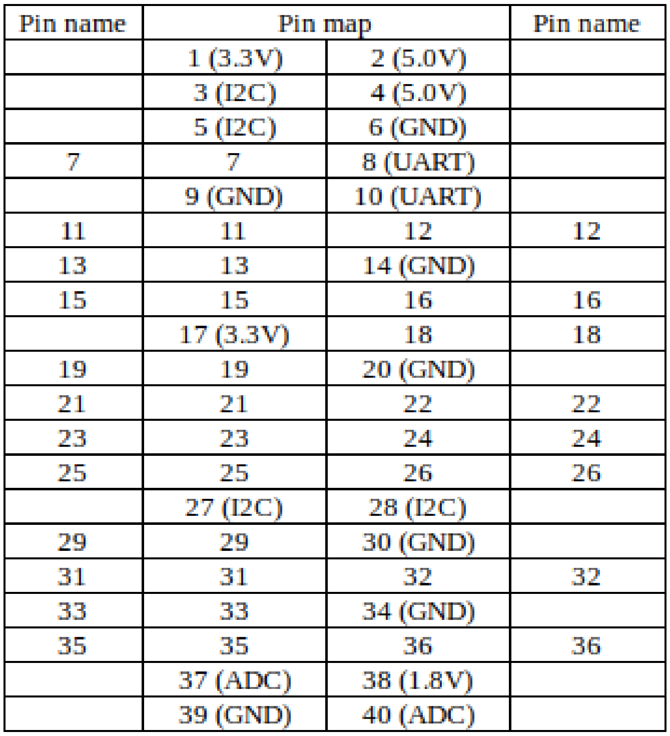
For example, in here, https://bit.ly/2spndDW.

You should add dependencies to a build.gradle file:

```
compileOnly
'com.google.android.things:androidthings:1.0'
```

GPIO

Following is the GPIO Pin # and Pin Map.



Pin name	Pin map		Pin name
	1 (3.3V)	2 (5.0V)	
	3 (I2C)	4 (5.0V)	
	5 (I2C)	6 (GND)	
7	7	8 (UART)	
	9 (GND)	10 (UART)	
11	11	12	12
13	13	14 (GND)	
15	15	16	16
	17 (3.3V)	18	18
19	19	20 (GND)	
21	21	22	22
23	23	24	24
25	25	26	26
	27 (I2C)	28 (I2C)	
29	29	30 (GND)	
31	31	32	32
33	33	34 (GND)	
35	35	36	36
	37 (ADC)	38 (1.8V)	
	39 (GND)	40 (ADC)	

Fig. 02 - GPIO Pin map

The above map table is based on the wiki at: https://bit.ly/37dXwFi.

First, you should get PeripheralManager. You can get a GPIO instance and available list of GPIO from the manager instance.

```
import
com.google.android.things.pio.PeripheralManager;
```

```
import com.google.android.things.pio.Gpio;
…
PeripheralManager manager =
PeripheralManager.getInstance();
```

You can get an available GPIO list via the getGpioList method. This method provides an available GPIO name list. So you can select from the list to use. Each pin has a name that comes from a physical pin number. Yes, the GPIO pin name is pin number. You can get GPIO instance through openGpio method with pin name by parameter.

```
List gpioList = manager.getGpioList();

Gpio gpio = manager.openGpio(gpioList.get(0));
// or Gpio gpio = manager.openGpio(“7”);
```

In this example, I will introduce to you how to use a GPIO pin as an output. In the example, I want to use pin #7 as output and if I push the button in my application, an LED that is connected to GPIO pin #7 will be lit. Like above, after getting a GPIO instance, you can set the direction IO of the GPIO pin. You can set direction by setDirection method and direction values are DIRECTION_IN, DIRECTION_OUT_INITIALLY_HIGH and DIRECTION_OUT_INITIALLY_LOW. I chose DIRECTION_OUT_INITIALLY_LOW to make the GPIO value low.

Then you can set value via the setValue method. If you want to make output value high or 1, you should pass the True parameter or you can pass the false parameter as low or 0. In this example, I get input from the application's button. So when you click the button an LED lights up.

```
gpio.setDirection(Gpio.DIRECTION_OUT_INITIALLY_LOW
);
Switch gpioSwitch = find
ViewById(R.id.gpio_switch);

gpioSwitch.setOnClickListener(new
View.OnClickListener() {
  @Override
  public void onClick(View v) {
    try {
      Switch gpioSwitch = (Switch) v;
      if (gpioSwitch.isChecked()) {
        gpio.setValue(true);
      } else {
        gpio.setValue(false);
      }
    } catch (IOException io) {
      io.printStackTrace();
    }
  }
});
```

Android Things also provides other methods like getValue, setActiveType, setEdgeTriggerType and registerGpioCallback. You can learn about it from the official web page. However, the ODROID still does not provide registerGpioCallback properly. In particular, Callback configuration using Handler has not been implemented yet. I hope it will be implemented.

GPIO method reference - https://bit.ly/2tXHUHI.

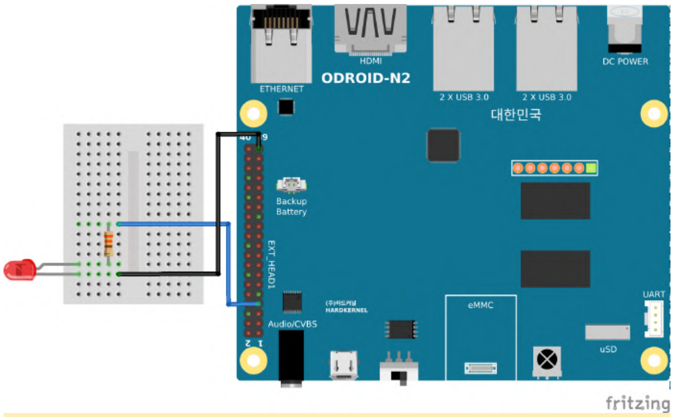


Fig. 03

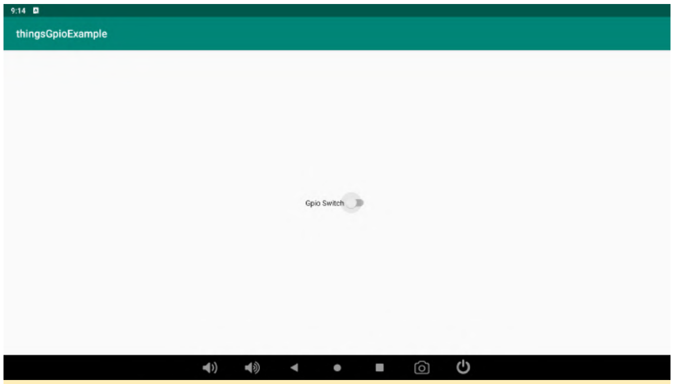


Fig. 04

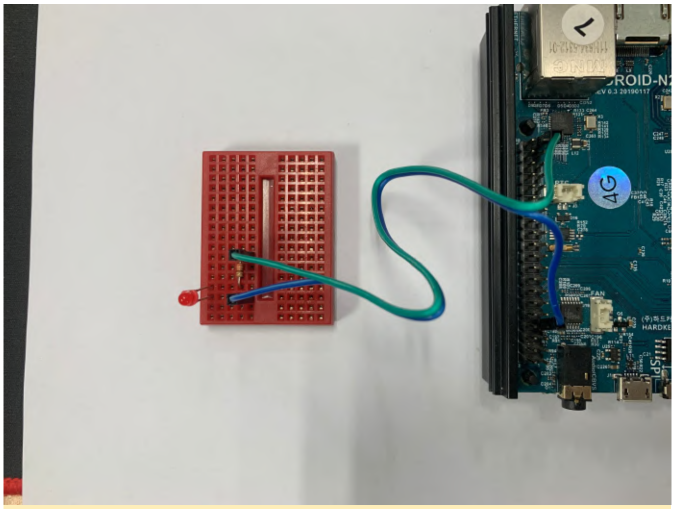


Fig. 05

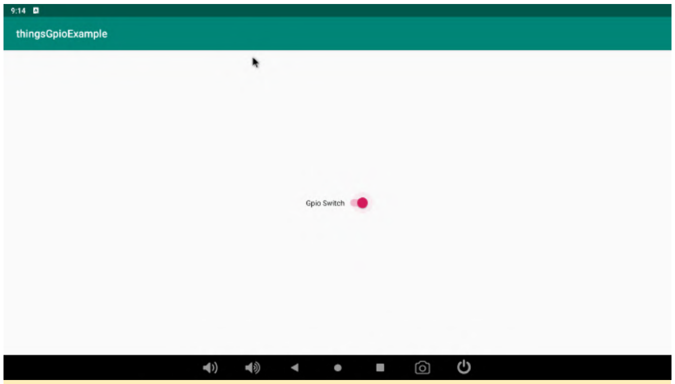


Fig. 06

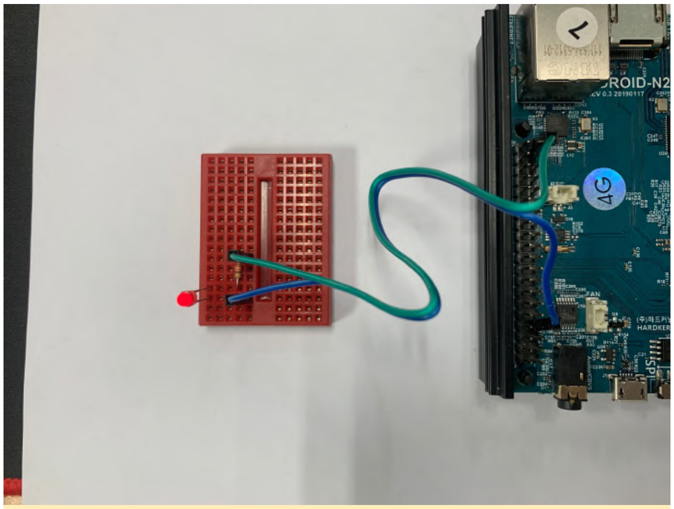


Fig. 07

You can control I2C and PWM by checking an example from my github. Also, you can learn about each peripheral API from the Web site.

I2C - https://developer.android.com/things/sdk/pio/i2c
PWM - https://developer.android.com/things/sdk/pio/pwm

I hope it will help you better utilize your Android peripherals!

References

https://developer.android.com/things
https://forum.odroid.com/viewtopic.php?f=178&t=37101