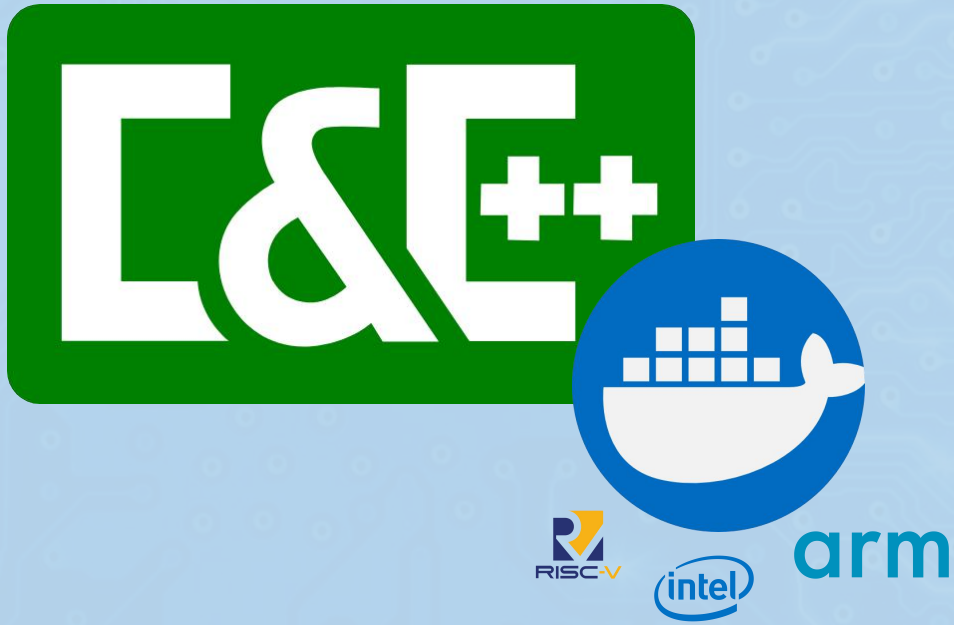
C/C++ CROSS DEVELOPMENT WITH CONTAINERS



Matheus Castello
matheus@castello.eng.br

WHO I AM ?

MATHEUS DE BARROS CASTELLO

28 year old, BS in Computer Science

Embedded SW Engineer

Linux Kernel Developer - v4.18 contributions

Toradex
Embedded. Computing.

SAMSUNG

C&E++

MICRO HOBBY

WHO I AM ?

EMBARCADOS

MICRO HOBBY

FILIPEFLOP

MAKER HERO CLUB

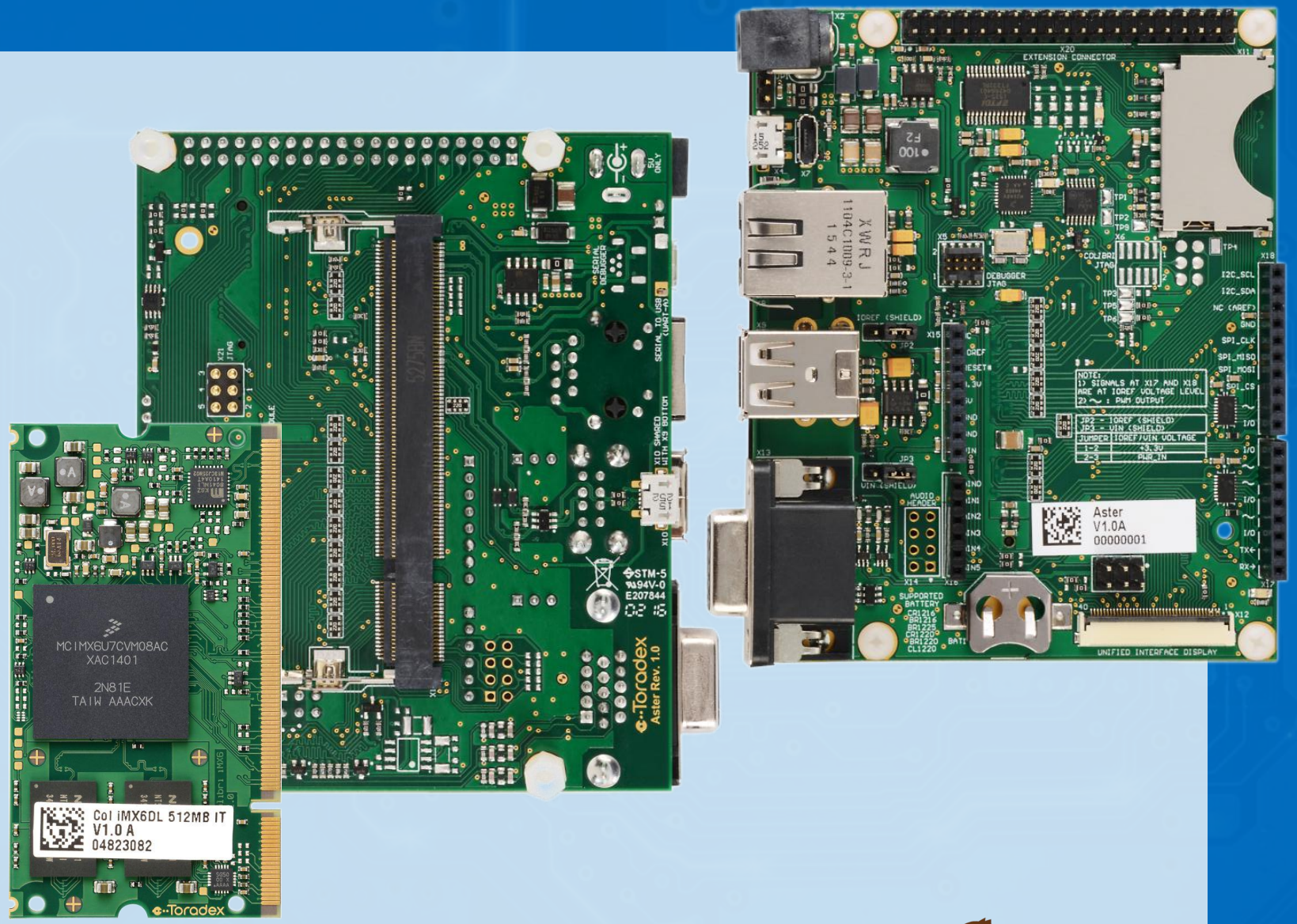
C&E++

MICRO HOBBY

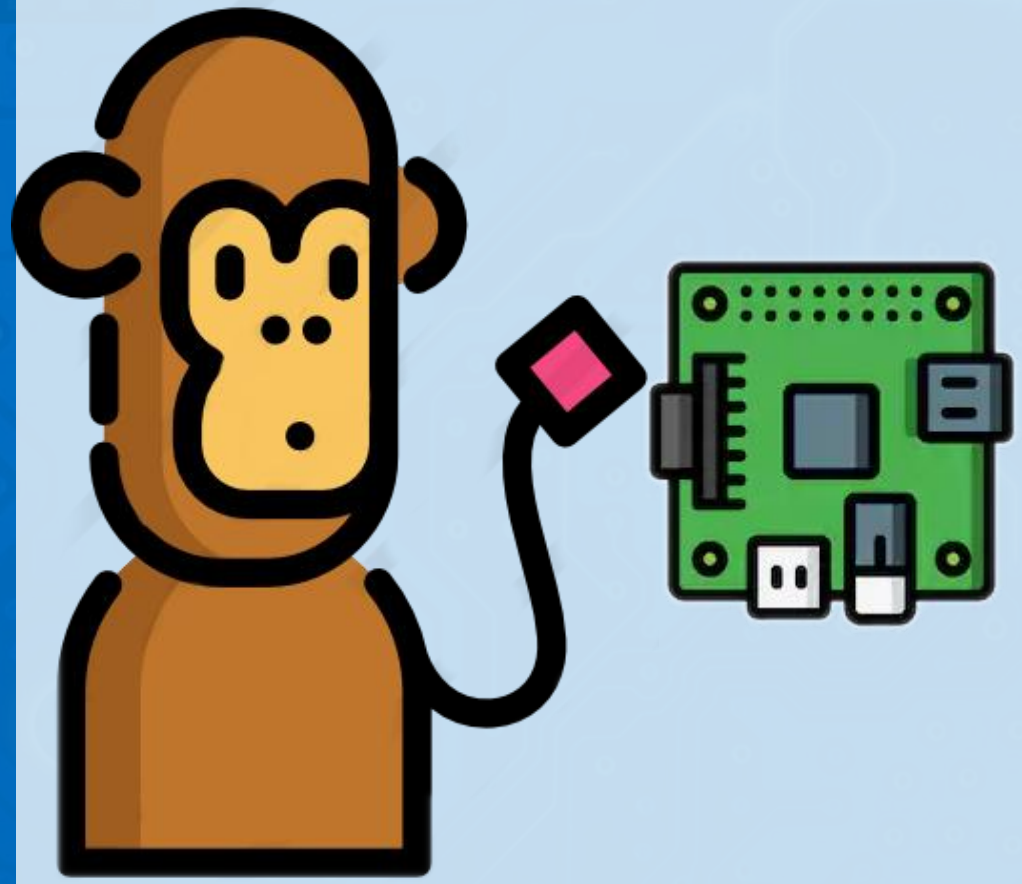
Torizon

- Colibri iMX6DL
  - Dual Core Cortex A9
  - 512MB RAM
  - 4GB eMMC
  - Vivante GC880

- Aster Carrier Board
  - Arduino Pinout
  - Raspberry Pi B Pinout



MICRO HOBBY



DEVELOPMENT CHALLENGES FOR EMBEDDED DEVICES

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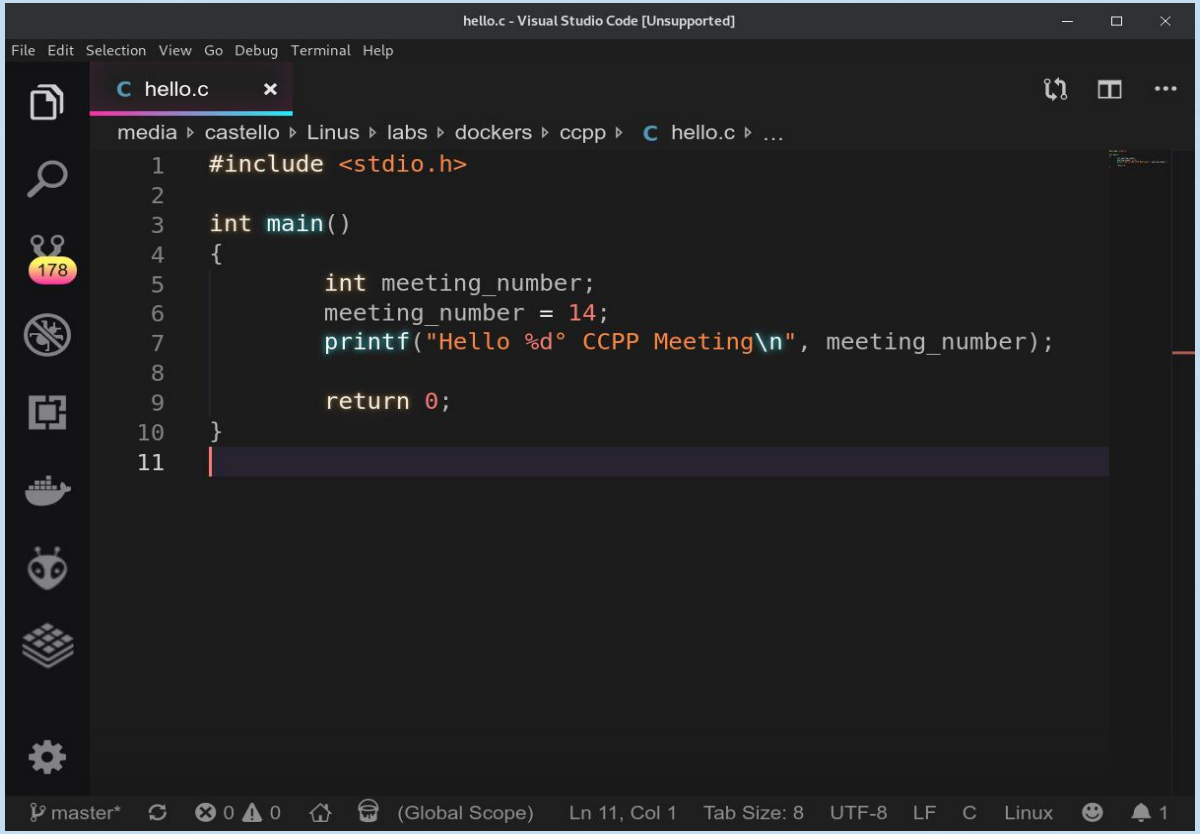
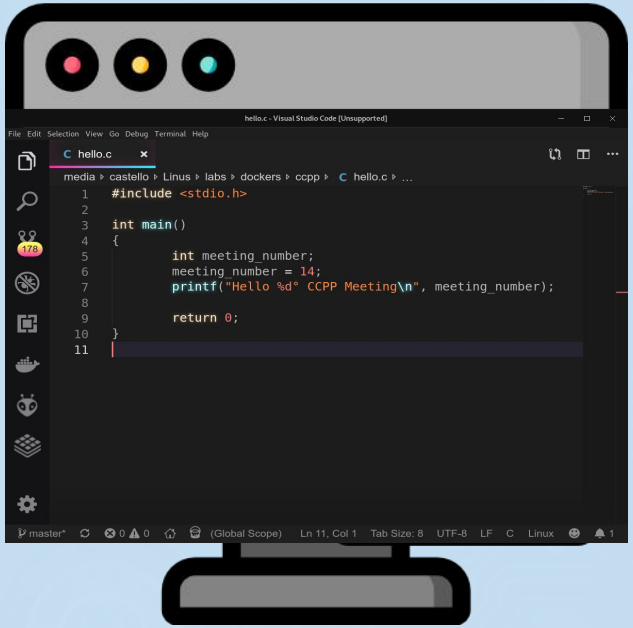
MICRO HOBBY

CROSS DEVELOPMENT - hello.c Example

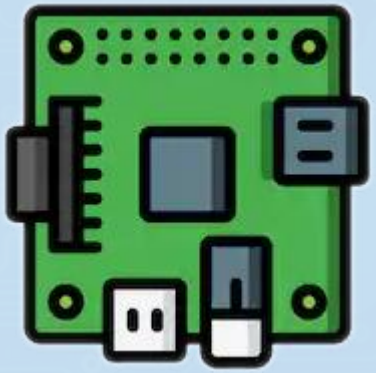


Development x86



intel

Target Device ARMv7

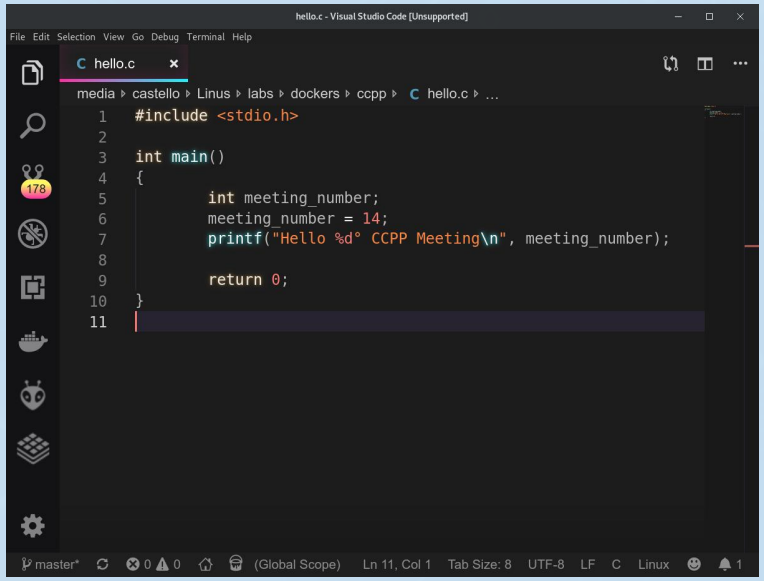


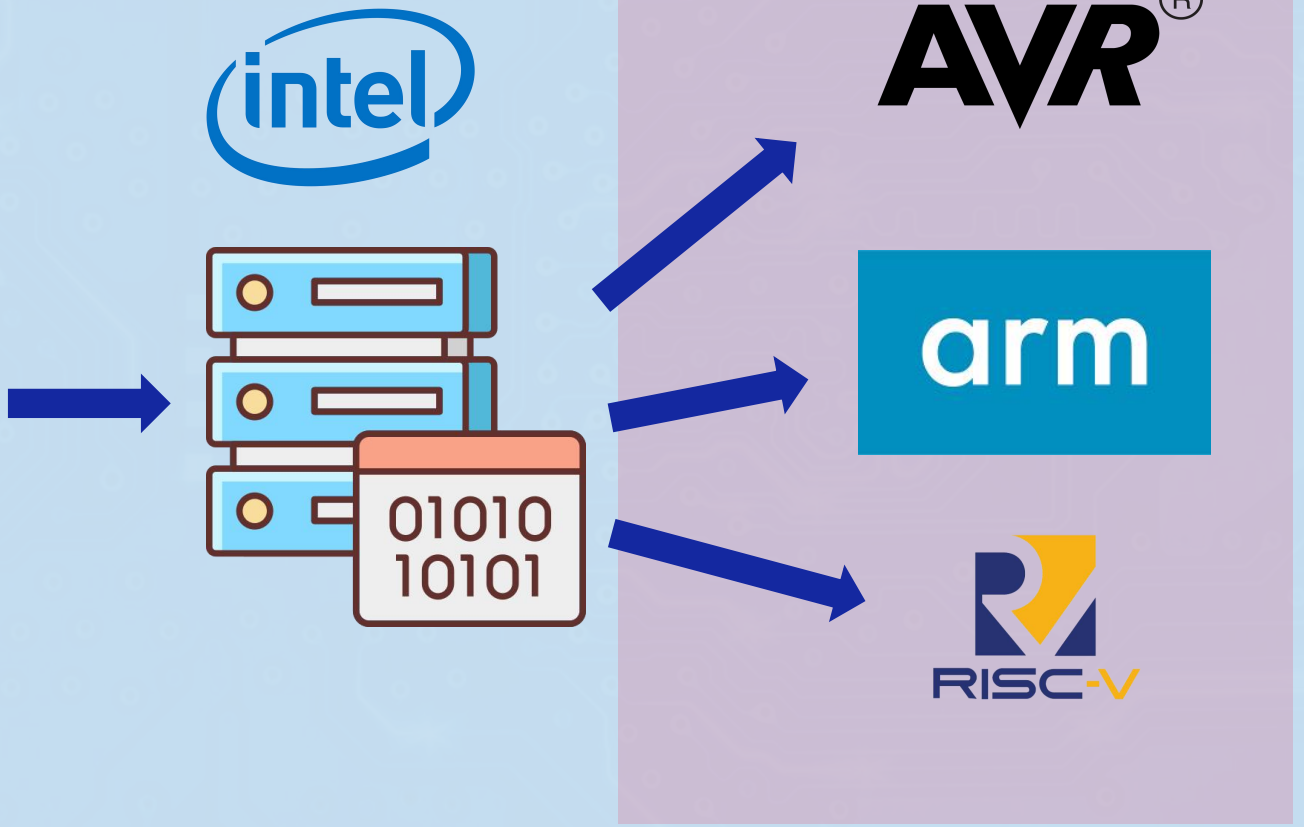
arm

C&E++

MICRO HOBBY

CROSS DEVELOPMENT





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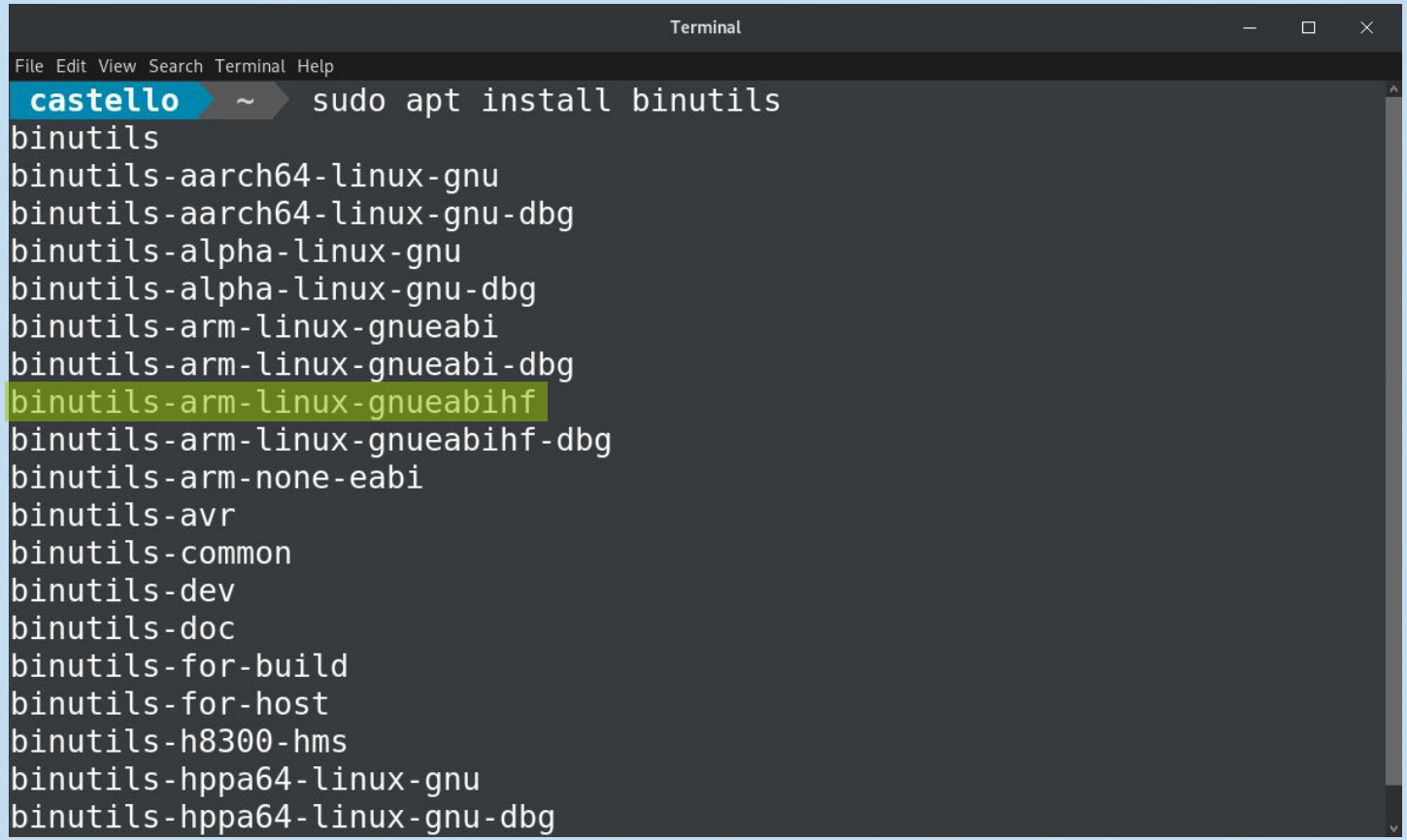
MICRO HOBBY

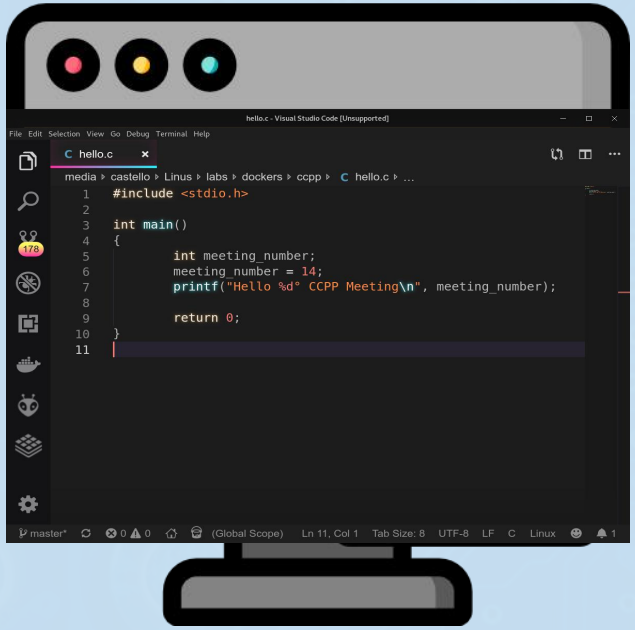
CROSS DEVELOPMENT

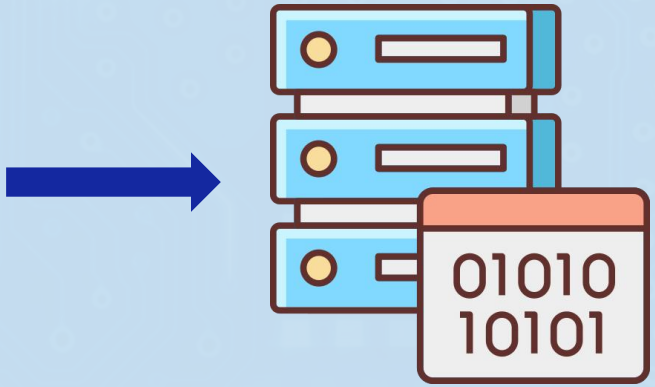


C&E++

MICRO HOBBY

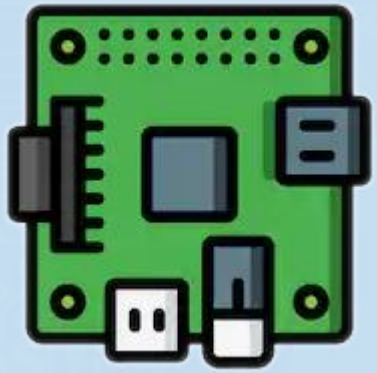
Development x86





arm-linux-gnueabihf-gcc

Target Device ARMv7



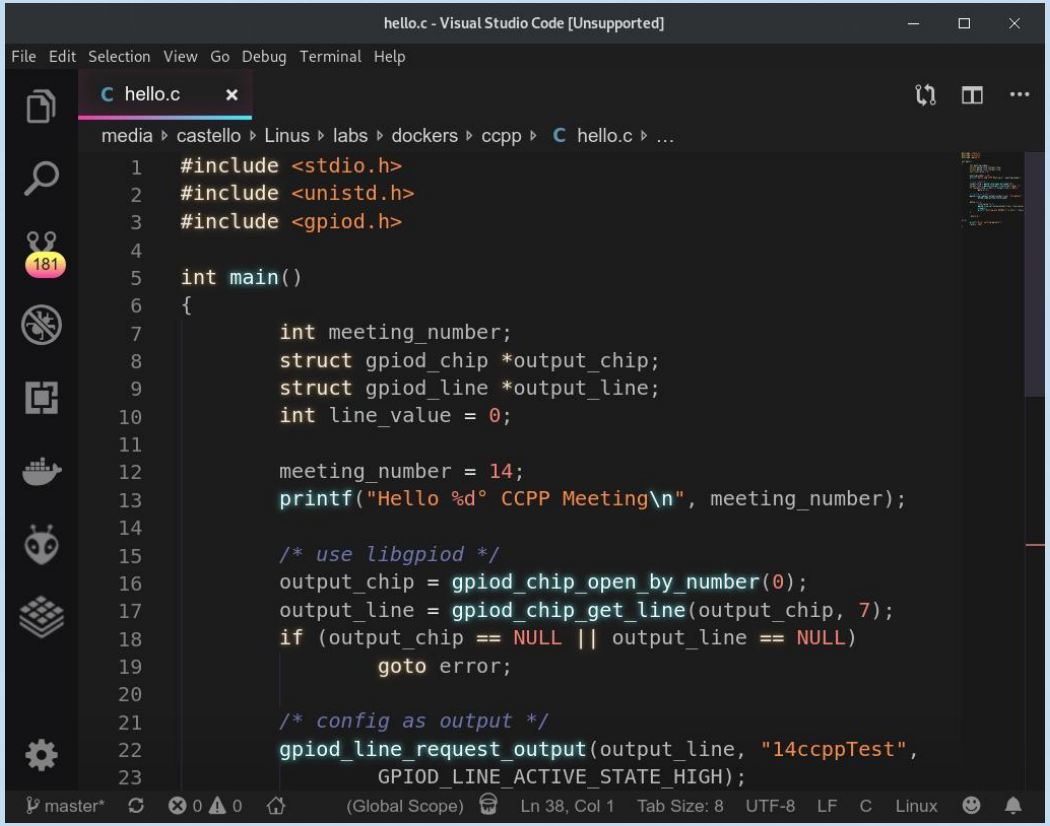
arm

intel

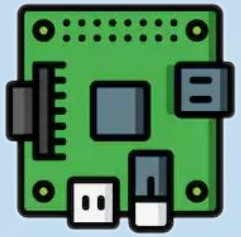
C&C++

MICRO HOBBY

CROSS DEVELOPMENT - libgpiod Example



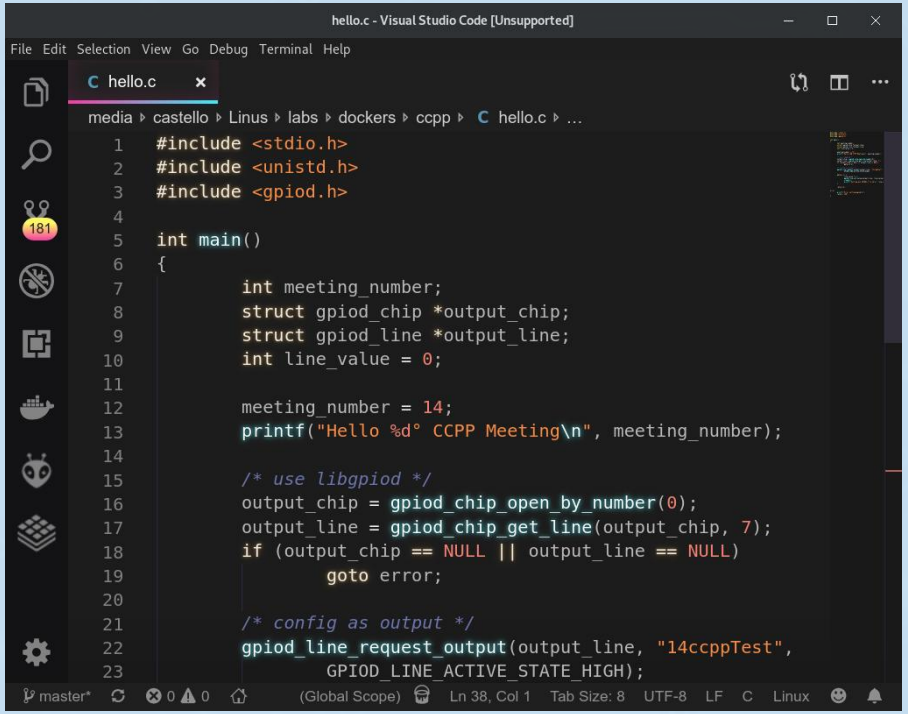
Target Device ARMv7



libgpiod

arm

arm-linux-gnueabihf-gcc



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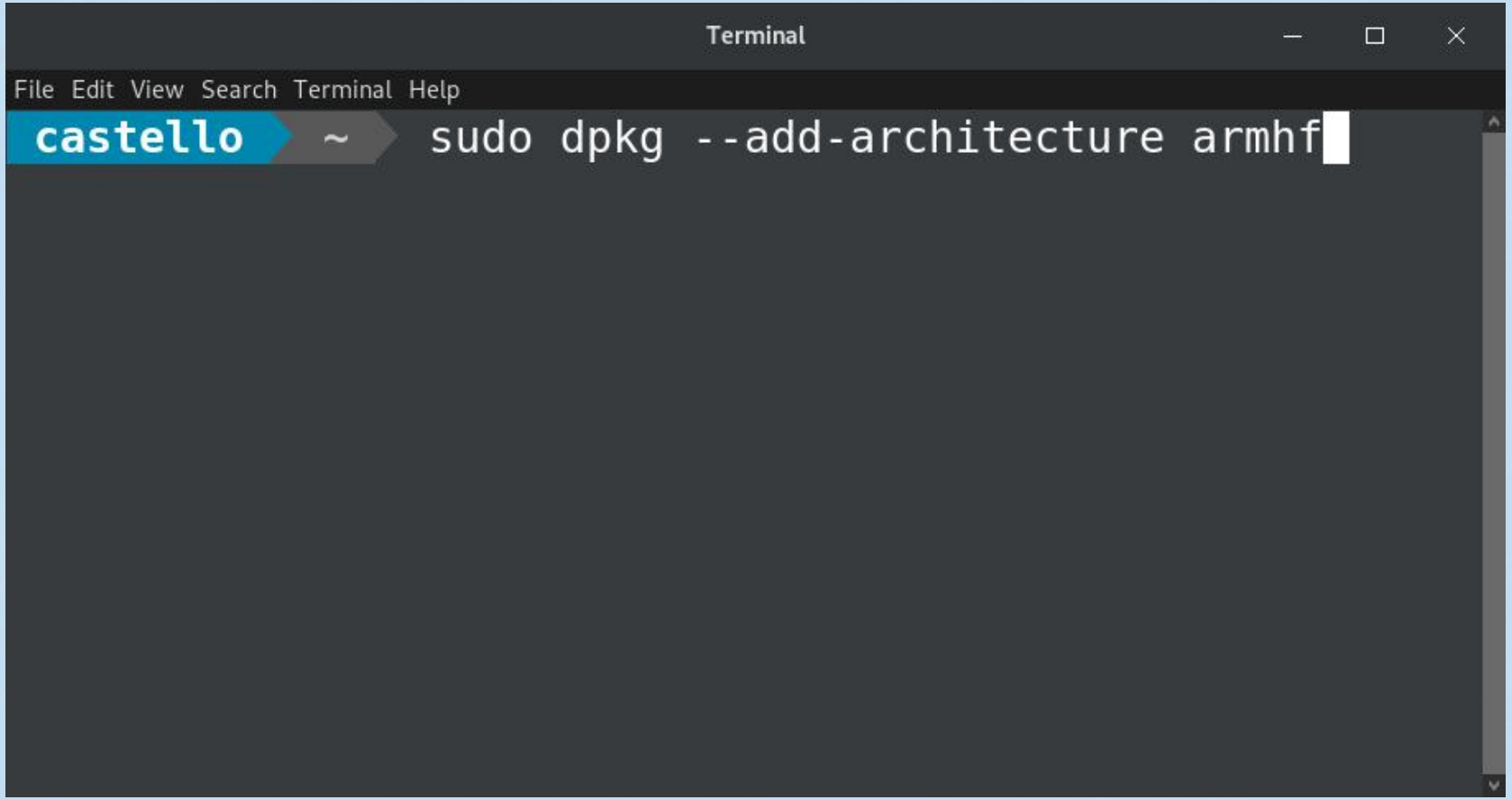
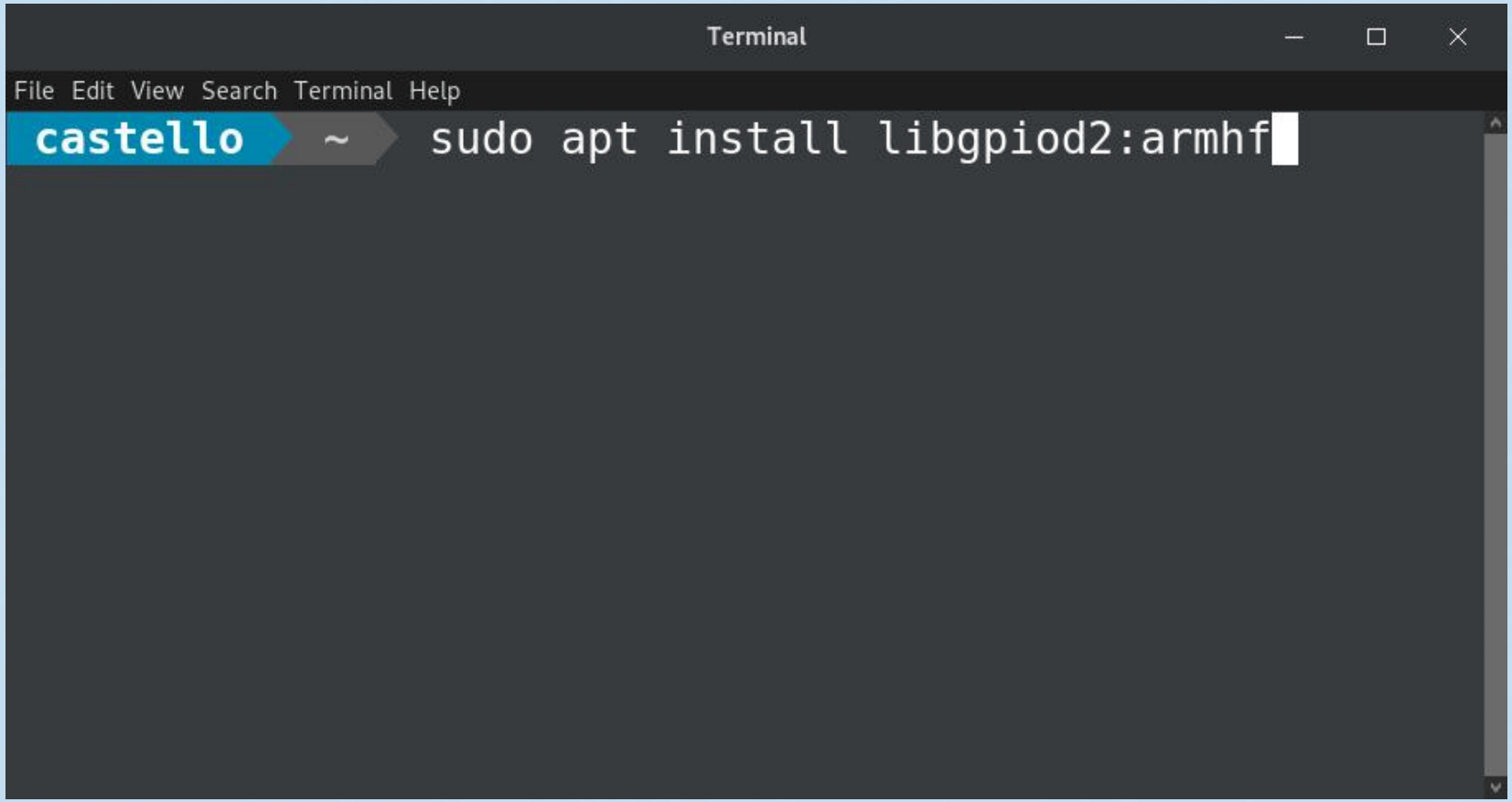
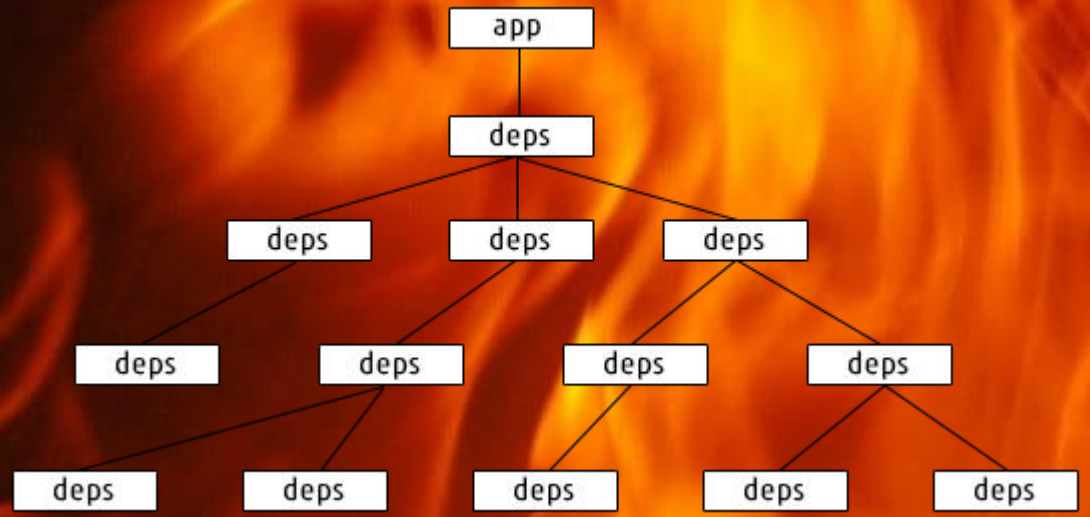
CROSS DEVELOPMENT - Config sysroot



CROSS DEVELOPMENT - Config sysroot



DEPENDENCY HELL




```
pi@raspberrypi:/bin$ ldd systemd
        linux-vdso.so.1 (0x7ef9d000)
        /usr/lib/arm-linux-gnueabihf/libarmmem.so (0x76ecf000)
        libsystemd-shared-232.so => /lib/systemd/libsystemd-shared-232.so (0x76d22000)
        libselinux.so.1 => /lib/arm-linux-gnueabihf/libselinux.so.1 (0x76cef000)
        librt.so.1 => /lib/arm-linux-gnueabihf/librt.so.1 (0x76cd8000)
        libseccomp.so.2 => /lib/arm-linux-gnueabihf/libseccomp.so.2 (0x76ca5000)
        libpam.so.0 => /lib/arm-linux-gnueabihf/libpam.so.0 (0x76c89000)
        libaudit.so.1 => /lib/arm-linux-gnueabihf/libaudit.so.1 (0x76c53000)
        libkmod.so.2 => /lib/arm-linux-gnueabihf/libkmod.so.2 (0x76c2e000)
        libapparmor.so.1 => /lib/arm-linux-gnueabihf/libapparmor.so.1 (0x76c10000)
        libmount.so.1 => /lib/arm-linux-gnueabihf/libmount.so.1 (0x76bbd000)
        libgcc_s.so.1 => /lib/arm-linux-gnueabihf/libgcc_s.so.1 (0x76b90000)
        libpthread.so.0 => /lib/arm-linux-gnueabihf/libpthread.so.0 (0x76b67000)
        libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0x76a28000)
        /lib/ld-linux-armhf.so.3 (0x76fc9000)
        libcap.so.2 => /lib/arm-linux-gnueabihf/libcap.so.2 (0x76a13000)
        liblzma.so.5 => /lib/arm-linux-gnueabihf/liblzma.so.5 (0x769e2000)
        liblz4.so.1 => /usr/lib/arm-linux-gnueabihf/liblz4.so.1 (0x769c1000)
        libgcrypt.so.20 => /lib/arm-linux-gnueabihf/libgcrypt.so.20 (0x768f0000)
        libacl.so.1 => /lib/arm-linux-gnueabihf/libacl.so.1 (0x768d9000)
        libidn.so.11 => /lib/arm-linux-gnueabihf/libidn.so.11 (0x76898000)
        libpcre.so.3 => /lib/arm-linux-gnueabihf/libpcre.so.3 (0x7681f000)
        libdl.so.2 => /lib/arm-linux-gnueabihf/libdl.so.2 (0x7680c000)
        libcap-ng.so.0 => /lib/arm-linux-gnueabihf/libcap-ng.so.0 (0x767f7000)
        libblkid.so.1 => /lib/arm-linux-gnueabihf/libblkid.so.1 (0x767aa000)
        libgpg-error.so.0 => /lib/arm-linux-gnueabihf/libgpg-error.so.0 (0x7678a000)
        libattr.so.1 => /lib/arm-linux-gnueabihf/libattr.so.1 (0x76775000)
        libuuid.so.1 => /lib/arm-linux-gnueabihf/libuuid.so.1 (0x76761000)
pi@raspberrypi:/bin$ ldd /lib/arm-linux-gnueabihf/liblzma.so.5
        linux-vdso.so.1 (0x7ef8f000)
        /usr/lib/arm-linux-gnueabihf/libarmmem.so (0x76eab000)
        libdl.so.2 => /lib/arm-linux-gnueabihf/libdl.so.2 (0x76e98000)
        libpthread.so.0 => /lib/arm-linux-gnueabihf/libpthread.so.0 (0x76e6f000)
        libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0x76d30000)
        /lib/ld-linux-armhf.so.3 (0x76ef2000)
```

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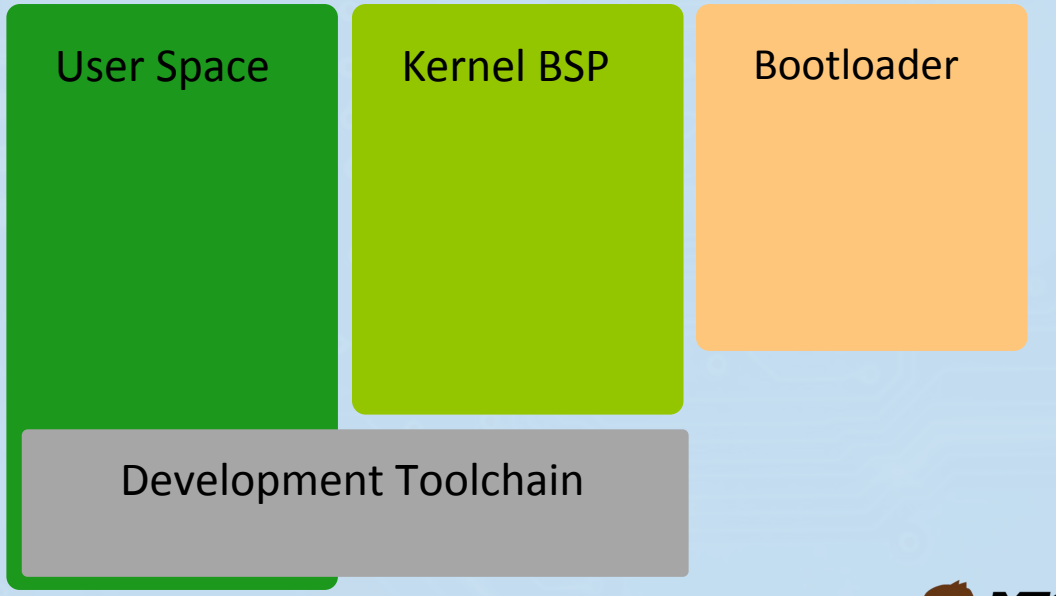
MICRO HOBBY

Yocto - build your own Linux Distro

- [x] Distro optimized for you hardware

yocto PROJECT



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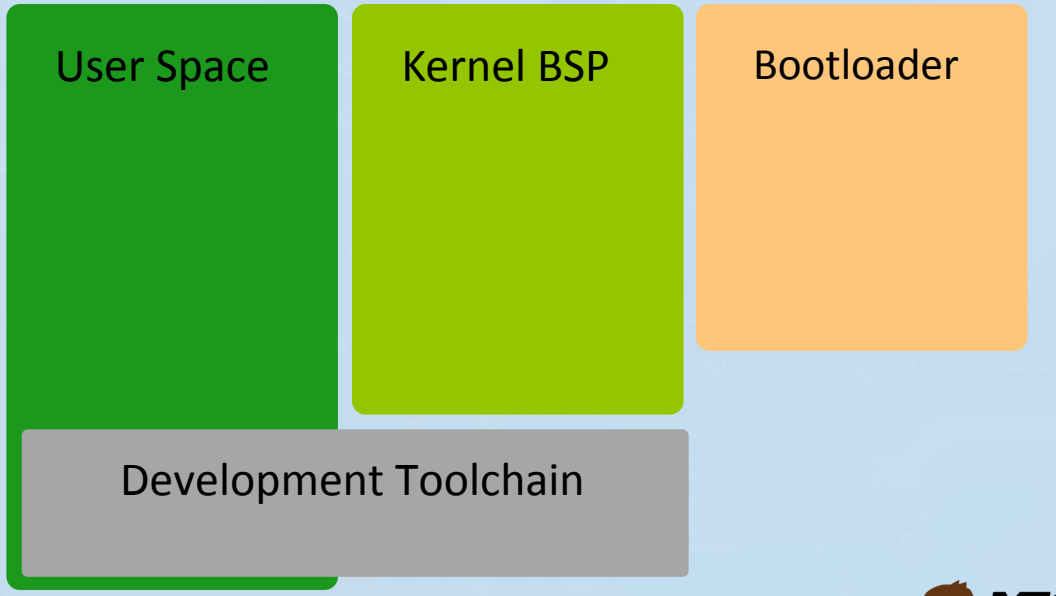
MICRO HOBBY

Yocto - build your own Linux Distro

yocto PROJECT

- ✓ Distro optimized for you hardware
- ✗ Learning Curve



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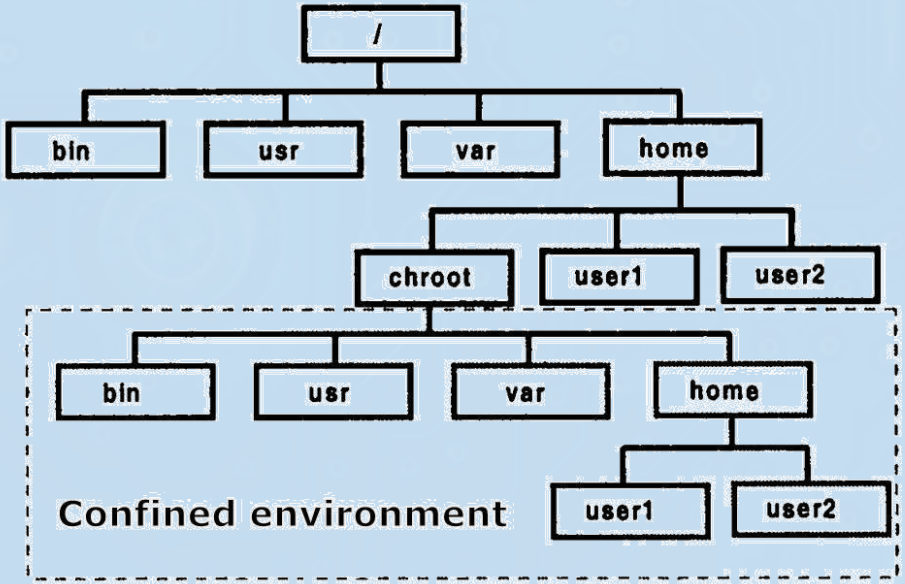
MICRO HOBBY

CHROOT - create/copy/config your sysroot

- [x] Use a ready arm distro base



QEMU

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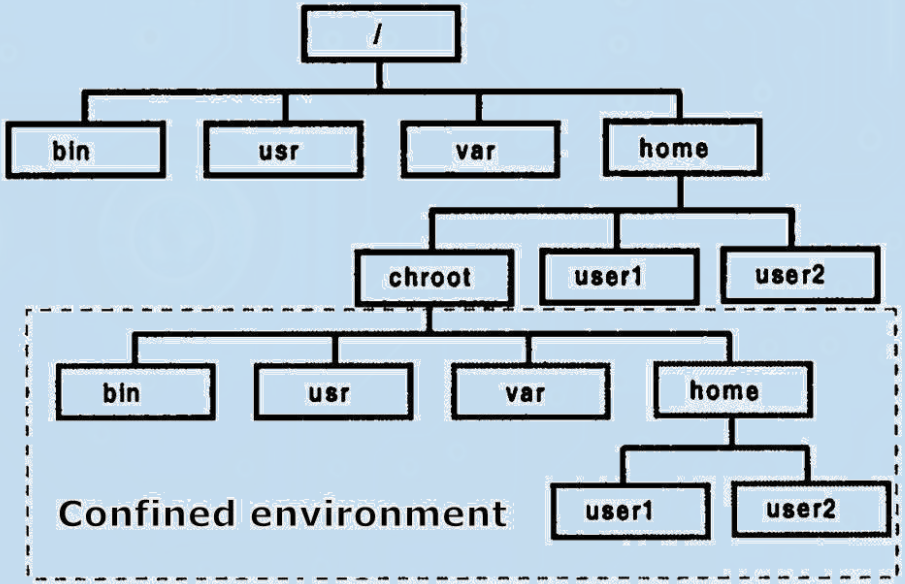
MICRO HOBBY

CHROOT - create/copy/config your sysroot

- ✓ Use a ready arm distro base (gcc --sysroot)
- ✗ It is not so easy to deploy/document/duplicate



QEMU

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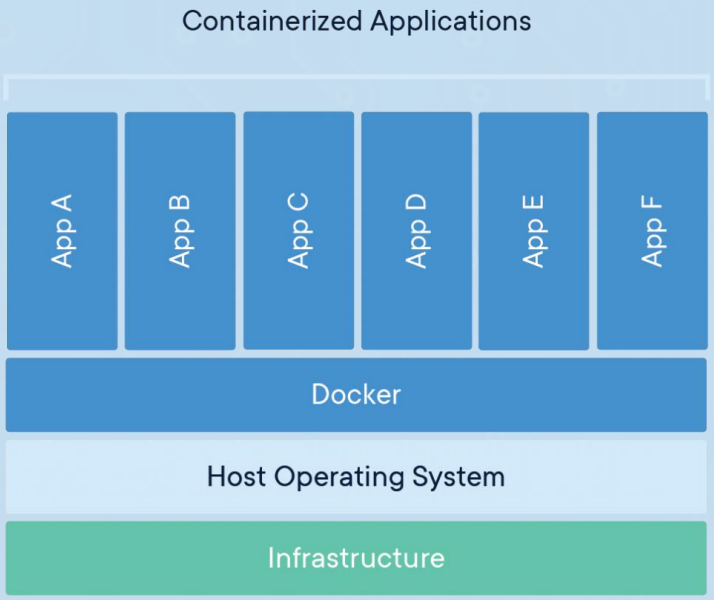
MICRO HOBBY

Docker - package/isolate dependency software

- [x] Easy to deploy/document/duplicate



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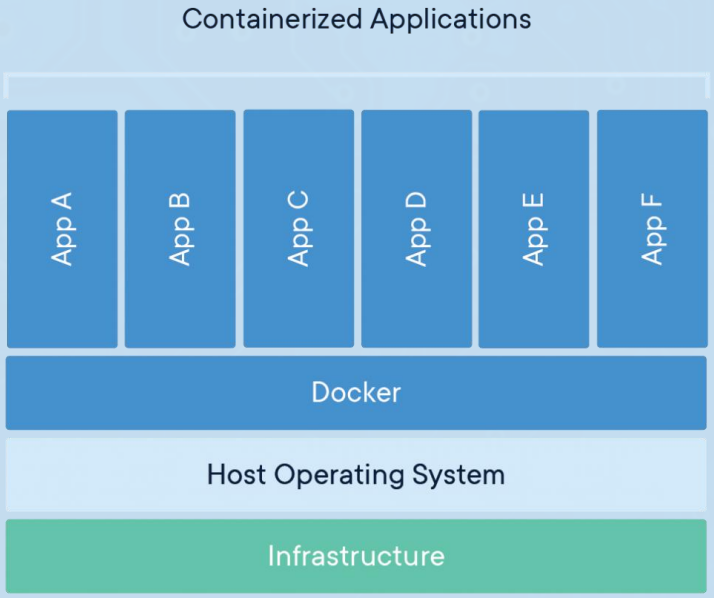
MICRO HOBBY

Docker - package/isolate dependency software

- ✓ Easy to deploy/document/duplicate
- ✗ Increased storage memory spend



QEMU

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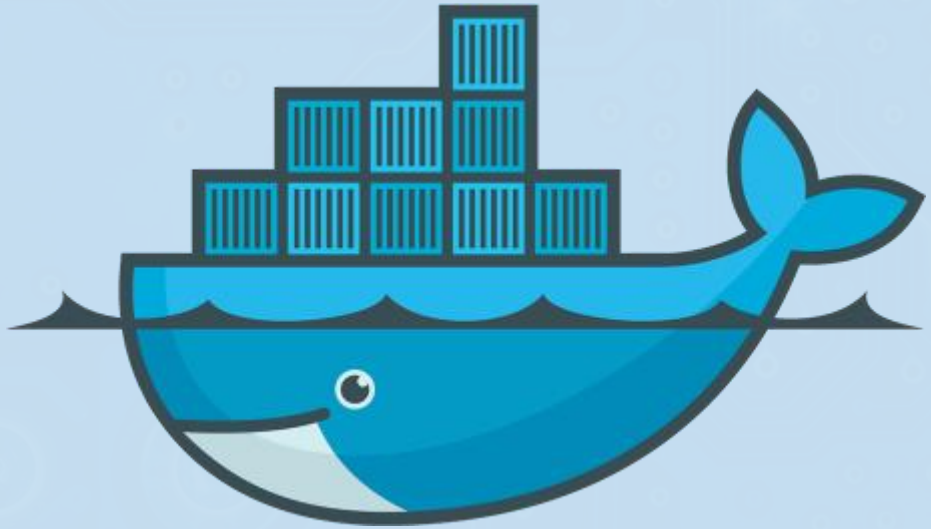
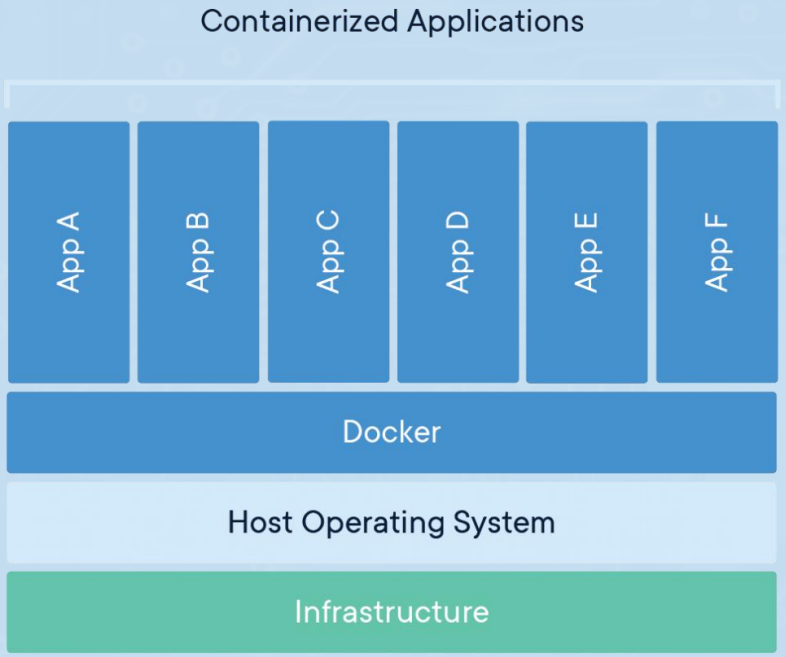
WHAT IS A CONTAINER?

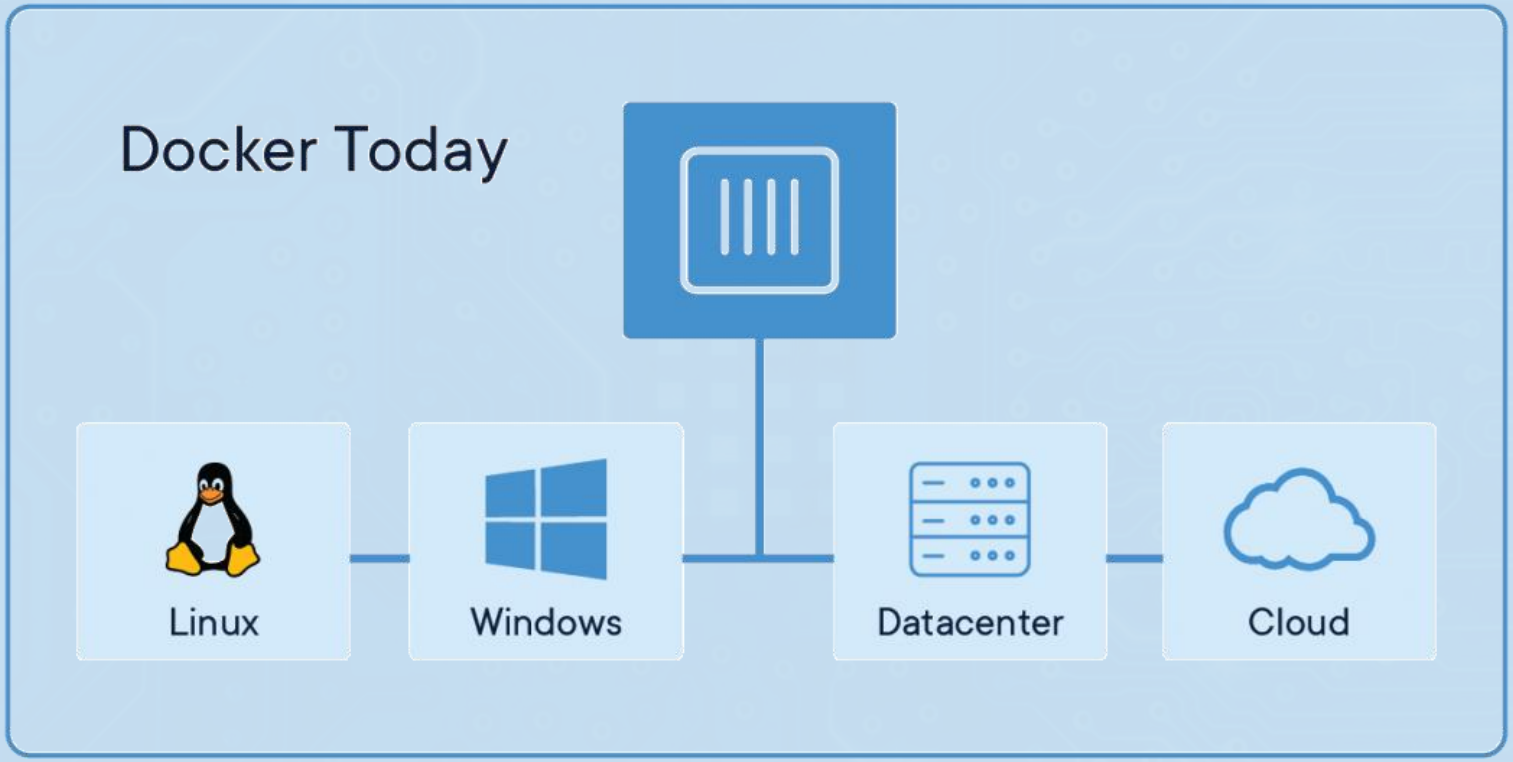
IN REAL LIFE

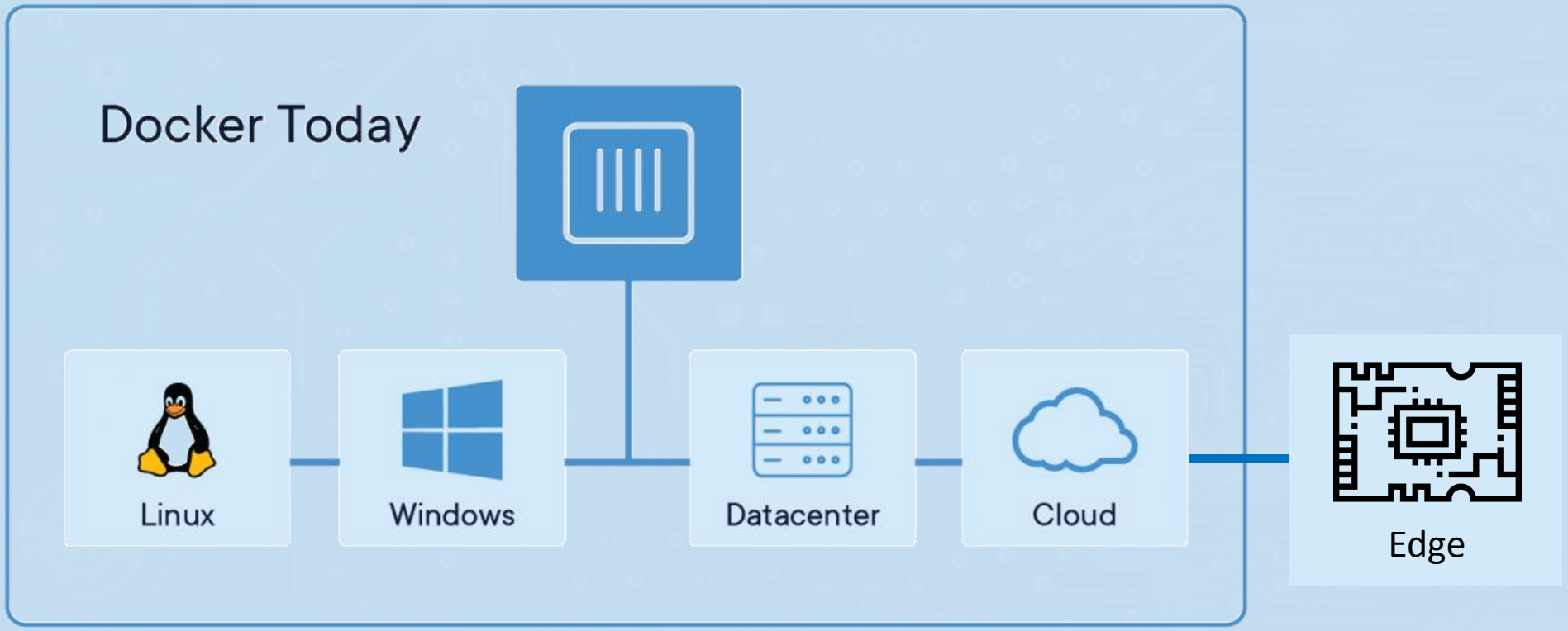


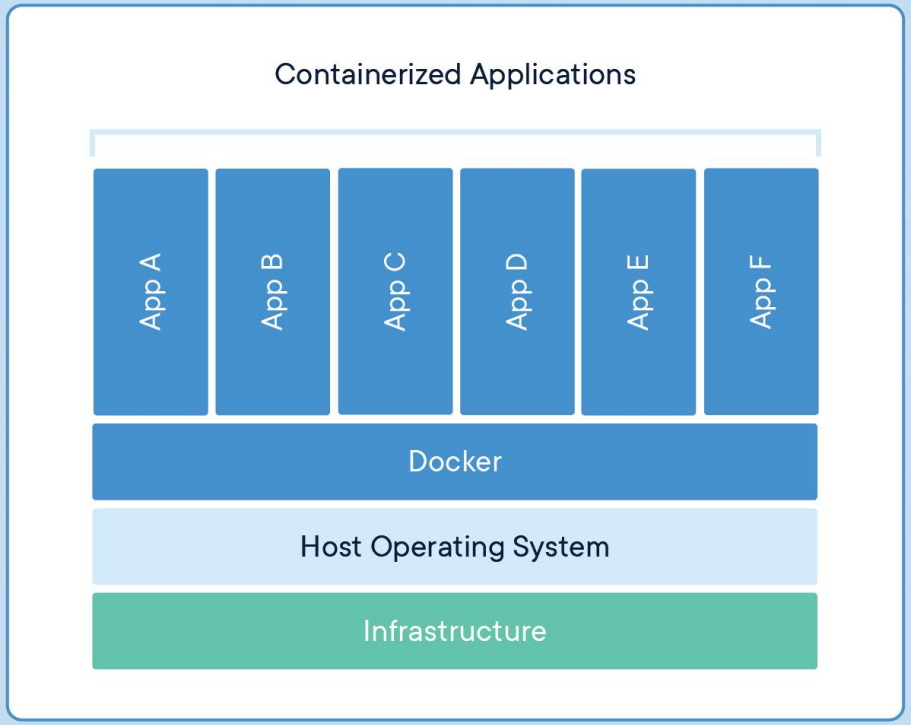
IN VIRTUAL LIFE

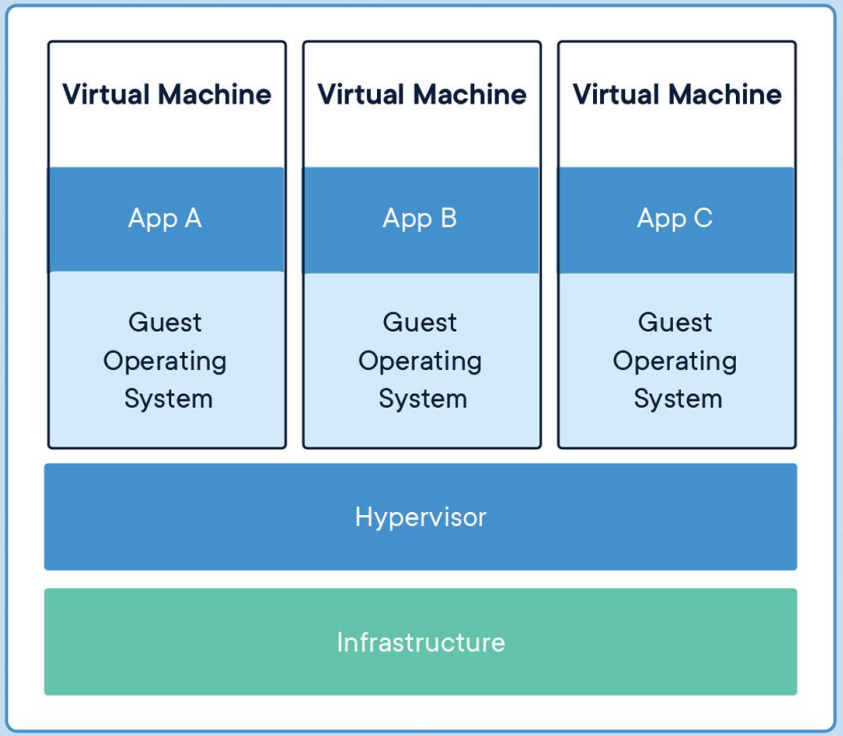
Package Software into Standardized Units for Development, Shipment and Deployment




Docker Today
Linux
Windows
Datacenter
Cloud


Docker Today
Linux
Windows
Datacenter
Cloud
Edge


Containerized Applications
App A
App B
App C
App D
App E
App F
Docker
Host Operating System
Infrastructure


Virtual Machine
Virtual Machine
Virtual Machine
App A
App B
App C
Guest Operating System
Guest Operating System
Guest Operating System
Hypervisor
Infrastructure

MICRO HOBBY

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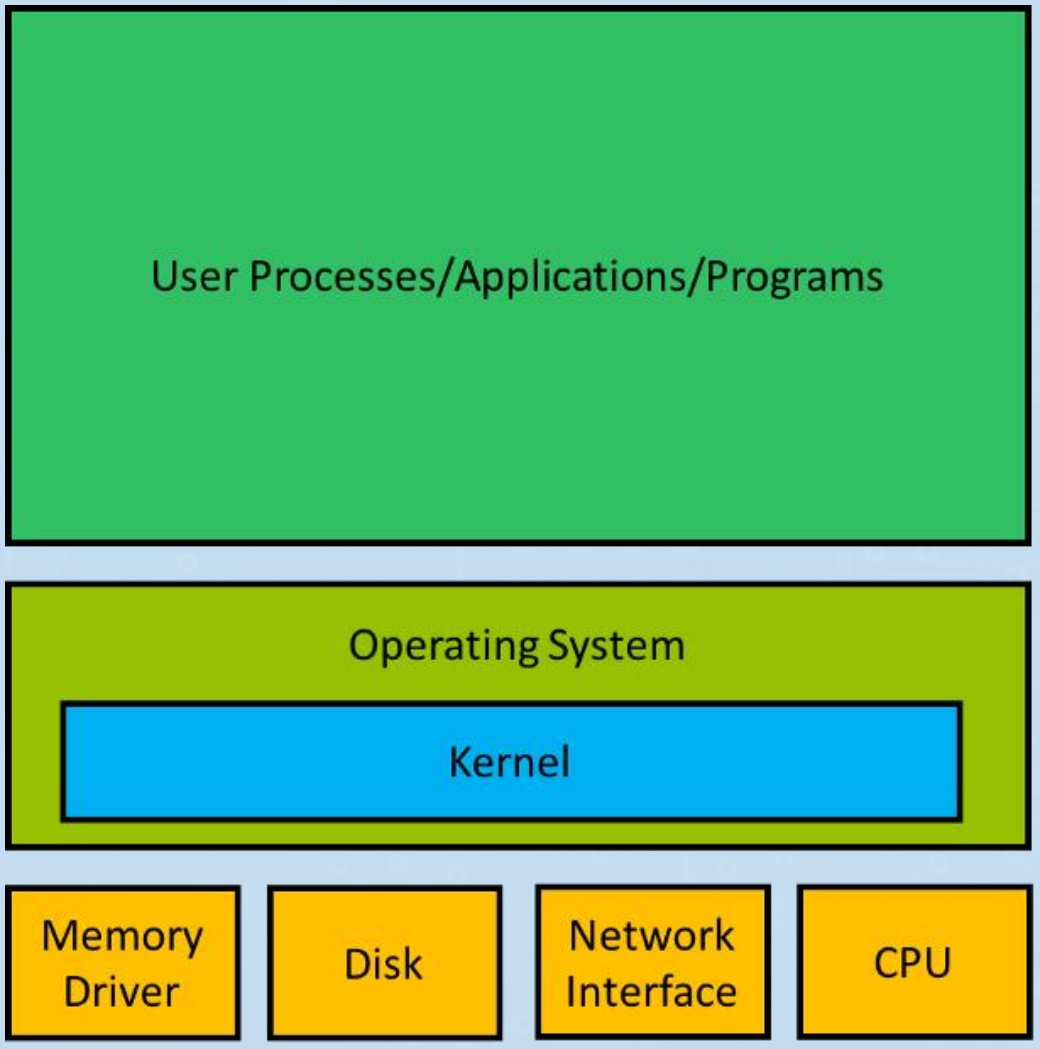
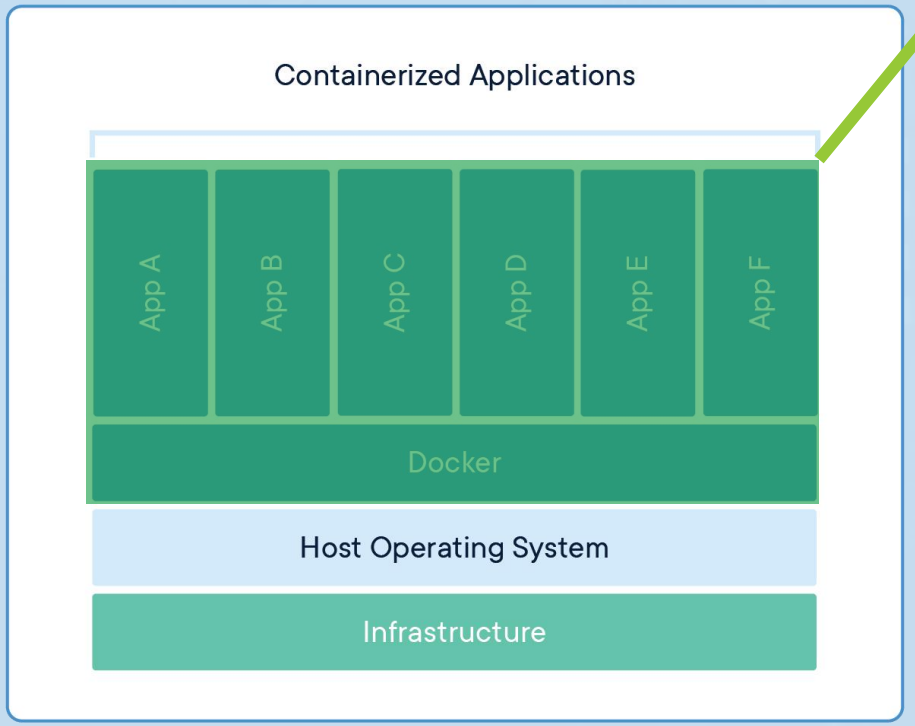
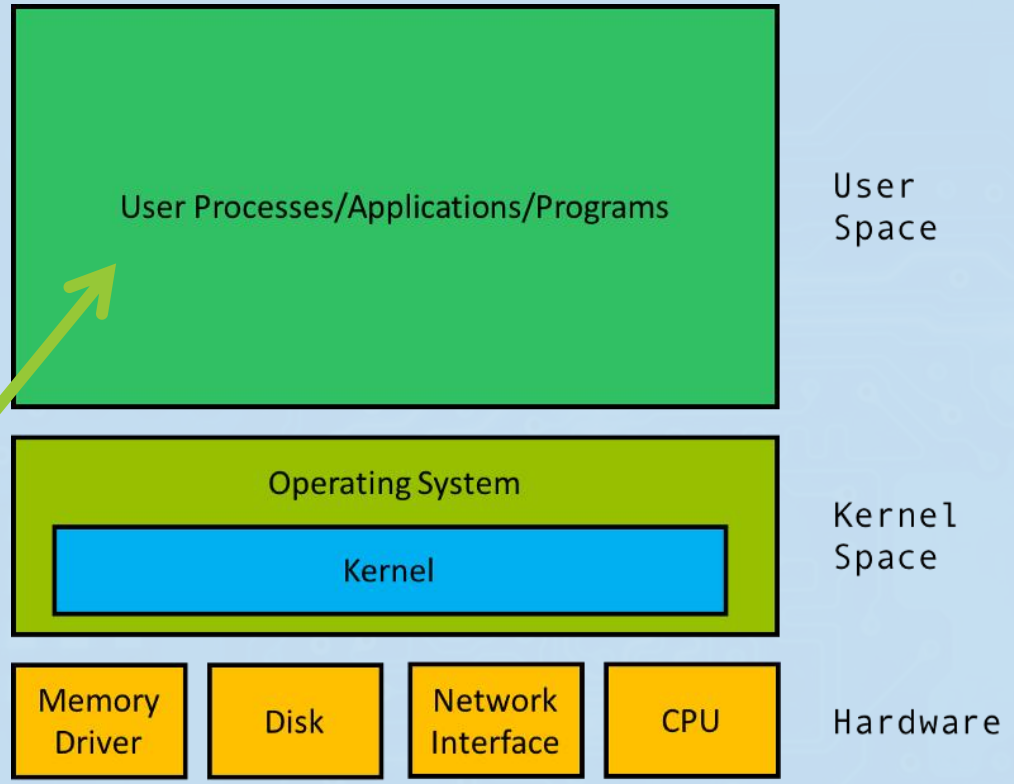
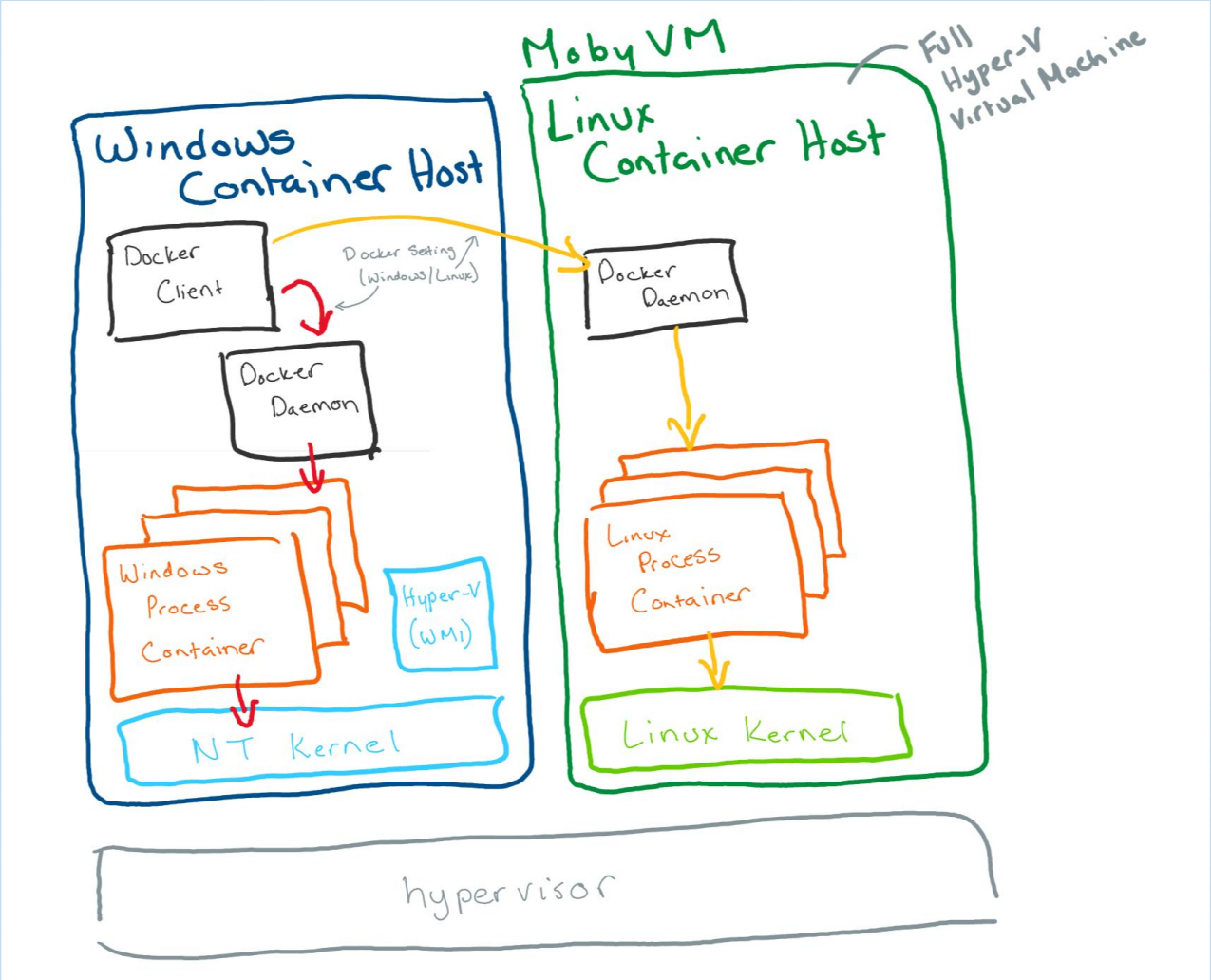

User Processes/Applications/Programs
Operating System
Kernel
Memory Driver
Disk
Network Interface
CPU
User Space
Kernel Space
Hardware

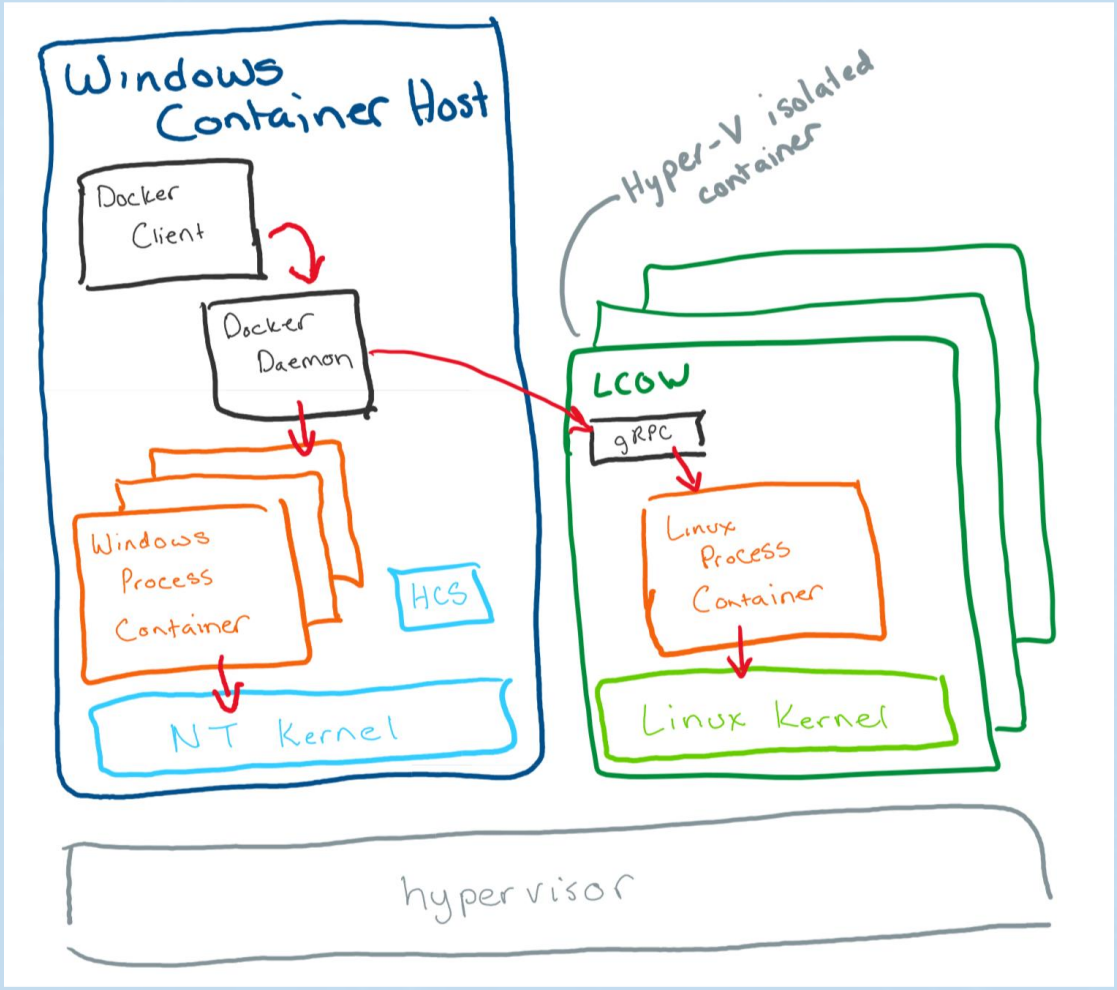

Containerized Applications
App A
App B
App C
App D
App E
App F
Docker
Host Operating System
Infrastructure


User Processes/Applications/Programs
User Space
Operating System
Kernel
Kernel Space
Memory Driver
Disk
Network Interface
CPU
Hardware

https://docs.microsoft.com/en-us/virtualization/windowscontainers/deploy-containers/linux-containers



https://docs.microsoft.com/en-us/virtualization/windowscontainers/deploy-containers/linux-containers



CROSS-DEV WITH CONTAINTER - hello.c example

Development x86

intel

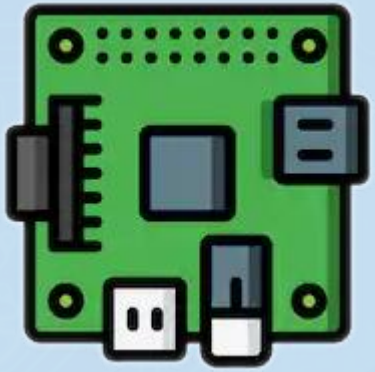
Dockerhub

arm

Docker Image

arm

Target Device ARMv7



Docker Image

Docker container

Torizon

C&E++

MICRO HOBBY

CROSS-DEV WITH CONTAINTER - hello.c example

Development x86

intel

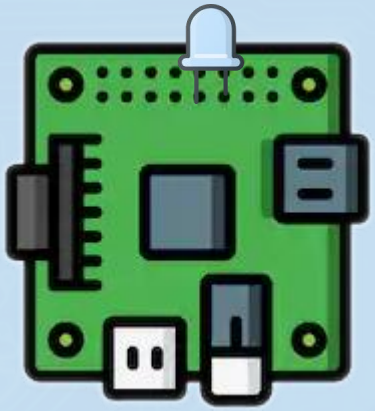
Dockerhub

arm

Docker Image

arm

Target Device ARMv7



Docker Image

Docker container

Torizon

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MICRO HOBBY

Qt

gstreamer

xnor.ai

G
T
K

.NET
Core

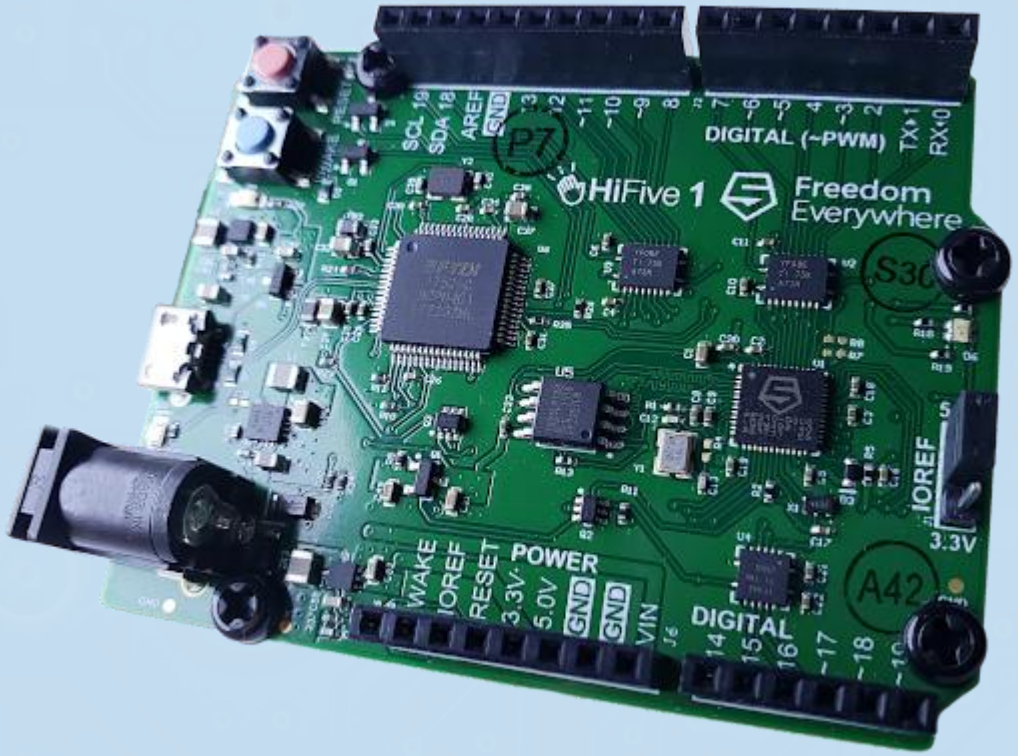
C&C++

MICRO
HOBBY

Q&A

C&E++

MICRO HOBBY



Sabado 20/07
TDC Trilha Arduino, Makers

Javascript em um Microcontrolador RISC-V

C&E++

MICRO HOBBY

Sabado 03/08

/sys/class/gpio IS DEAD

LINUX DEVELOPER CONFERENCE BRAZIL

MICRO HOBBY

C&C++

THANK YOU

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