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Speeding up Linux Development with Debian and Open Embedded on DragonBoard™ 410c

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Qualcomm® Snapdragon™ 410E Embedded Platform

Brief Overview

Snapdragon 410E Embedded Platform Overview

Snapdragon 410E

CPU: 1.2 GHz quad-core ARM v8 Cortex-A53, 32/64-bit capable

Connectivity: Integrated Wi-Fi, Bluetooth 4.xLE and GPS

DSP: Qualcomm® Hexagon™ DSP

Graphics: Qualcomm® Adreno™ 306 400MHz GPU

Interfaces: 1x USB2.0, 2x MIPI-CSI, MIPI-DSI, SD3.0 & eMMC v4.5 with DDR support

Qualcomm snapdragon

410E
(APQ8016E)
802.11b/g/n

1920x1080

Up to 13MP

DragonBoard 410c Development Board

ARROW

Linaro

96Boards

- Upstream kernel HW support for graphics, video, audio, IO
- Bootloader loads kernel from Android boot image

Snapdragon 410E Embedded Platform

Path for prototyping today to many years of availability for production

DragonBoard 410c

1.2 GHz quad-core ARM v8 Cortex-A53,
32/64-bit capable

Snapdragon 410E

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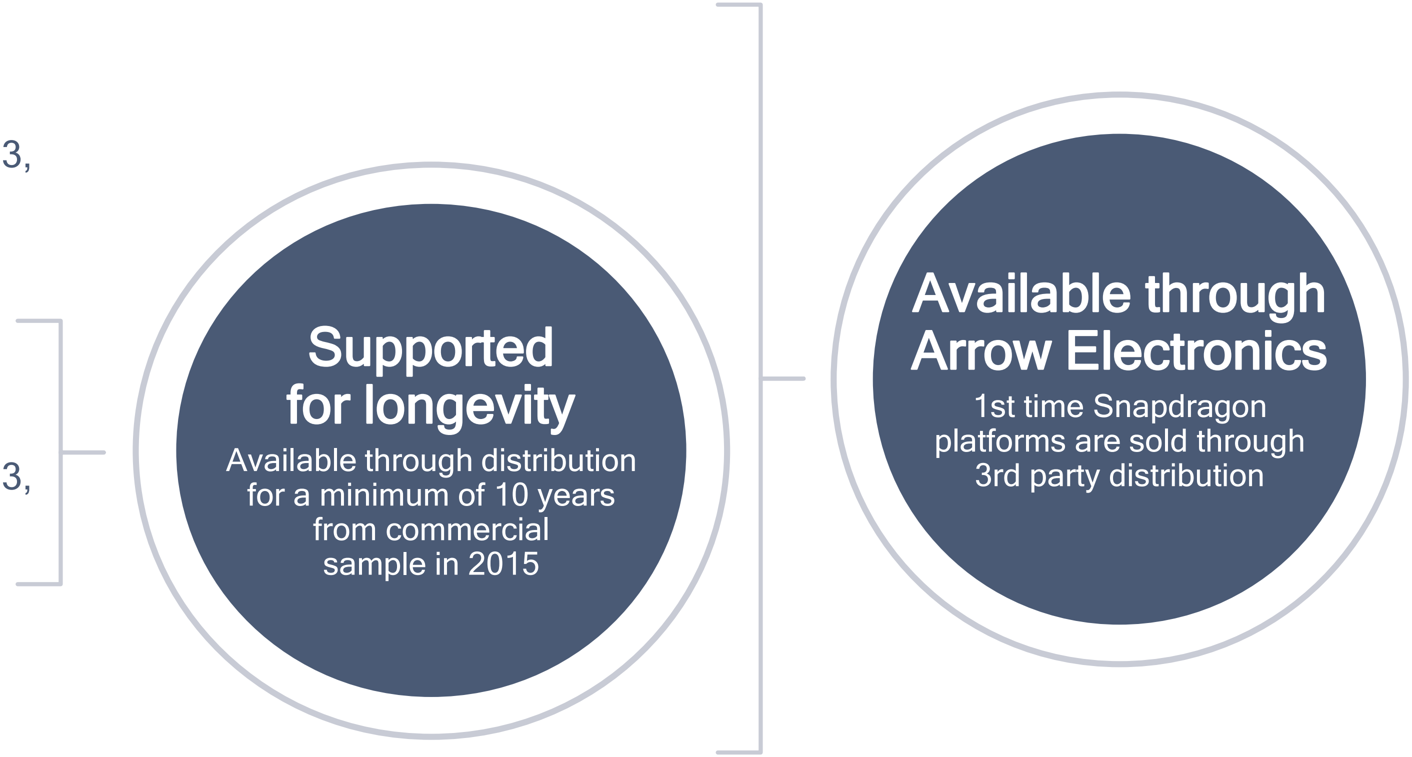


Supported for longevity

Available through distribution for a minimum of 10 years from commercial sample in 2015

Available through Arrow Electronics

1st time Snapdragon platforms are sold through 3rd party distribution

https://developer.qualcomm.com/qfile/33927/snapdragon-e-selection-guide_0817_web.pdf

Debian Development

Pros and Cons of Debian

Huge repository (over 50K) of prebuilt packages for over a dozen architectures

- arm64 and armhf are well supported
  - See https://www.debian.org/mirror/size

Large, active community of supporters and contributors

- https://www.debian.org/intro/why_debian

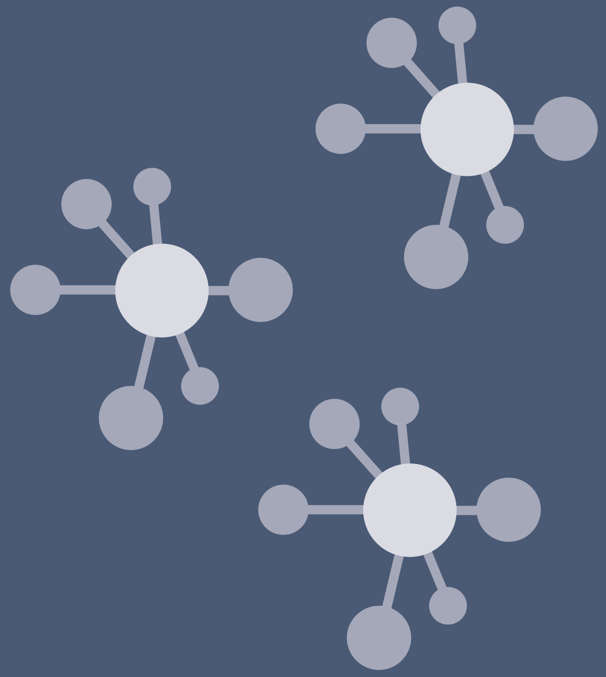
Debian Social Contract

- https://www.debian.org/social_contract
- *contrib* and *non-free* still supported by bug tracking system and mailing lists

Documentation is not particularly newbie friendly IMO

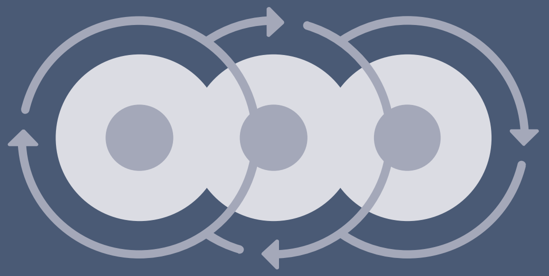
- Packaging and cross build docs assume prior knowledge of Debian specific tools

Vibrant Community



Pros and Cons of Debian

Versions and Support



https://wiki.debian.org/DebianReleases

At any given time, there is one stable release of Debian, which has the support of the Debian security team. When a new stable version is released, the security team will usually cover the previous version for a year or so, while they also cover the new/current version.

https://wiki.debian.org/LTS

Debian Long Term Support (LTS) is a project to extend the lifetime of all Debian stable releases to (at least) 5 years. Debian LTS will not be handled by the Debian security team, but by a separate group of volunteers and companies interested in making it a success.

Debian Development Methodology

- Native build
  - Many autoconf scripts and Makefiles were not designed for cross build
  - Easy to build small packages on target
  - ARM development machines are here now!
- "Native" Build in QEMU
  - Often used to build complex SW projects for Debian/Ubuntu
  - Arm64 sysroot using multistrap
    - Install additional packages into the sysroot
  - Use QEMU linux-user-mode to chroot into sysroot
    - At least 5x slower than native system
- Cross build
  - https://wiki.debian.org/Arm64Port#Building_packages

Debian SW Packaging

Creating src packages and packaging prebuilt binaries

- Deb pkg format
  - https://en.wikipedia.org/wiki/Deb_(file_format)
- Confusing evolution of packaging helpers:
  - See https://www.debian.org/doc/manuals/packaging-tutorial/packaging-tutorial.en.pdf
  - git-buildpackage (most modern)
  - pbuilder
  - sbuild
  - dh (debhelper 7)
- Generate binary package from src package
  - http://man7.org/linux/man-pages/man1/dpkg-buildpackage.1.html
- Packaging prebuilt files
  - Documented workflows expect to create a src deb then build it
  - I Use "dpkg-deb -build" for quick SW testing

Commercial Deployment of Debian

- Friendly terms for commercial deployment
  - https://www.debian.org/doc/manuals/debian-faq/ch-redistrib.en.html
  - Able to pin packages
- License compliance tools
  - https://wiki.debian.org/CopyrightReviewTools
- Commercial Support Options
  - https://www.debian.org/consultants/
- 5 years support of stable branches from LTS Project
- Linaro Debian is based on Testing
  - May align with productization timeframe

Yocto/ OpenEmbedded Development

Yocto vs OpenEmbedded

- Simplest Overview with description of layers
  - https://en.wikipedia.org/wiki/OpenEmbedded
- Good overview of the differences and terminology
  - https://elinux.org/images/d/de/Elc2011_kooi.pdf

TLDR;

- OpenEmbedded (OE) is a build system based on BitBake, it is not a distro
- OE is made up of collections of BitBake build recipes for packages organized in layers
- Yocto provides a reference distro (Poky) using OE (and additional tools and recipes)

Pros and Cons of Yocto/OE

- Best for minimal build, BOM cost sensitive products
- Flexibility and control
  - Choice of toolchain, C library, busybox, etc
- Yocto provides SW Compliance tools and some SPDX tooling
- HUGE learning curve and can be difficult to debug build issues
- Rebuilding a package may mean regenerating the rootfs image
- Large startup time cost, needs lots of storage and processing power

Flexible

and Complex

Yocto and OE Development Methodology

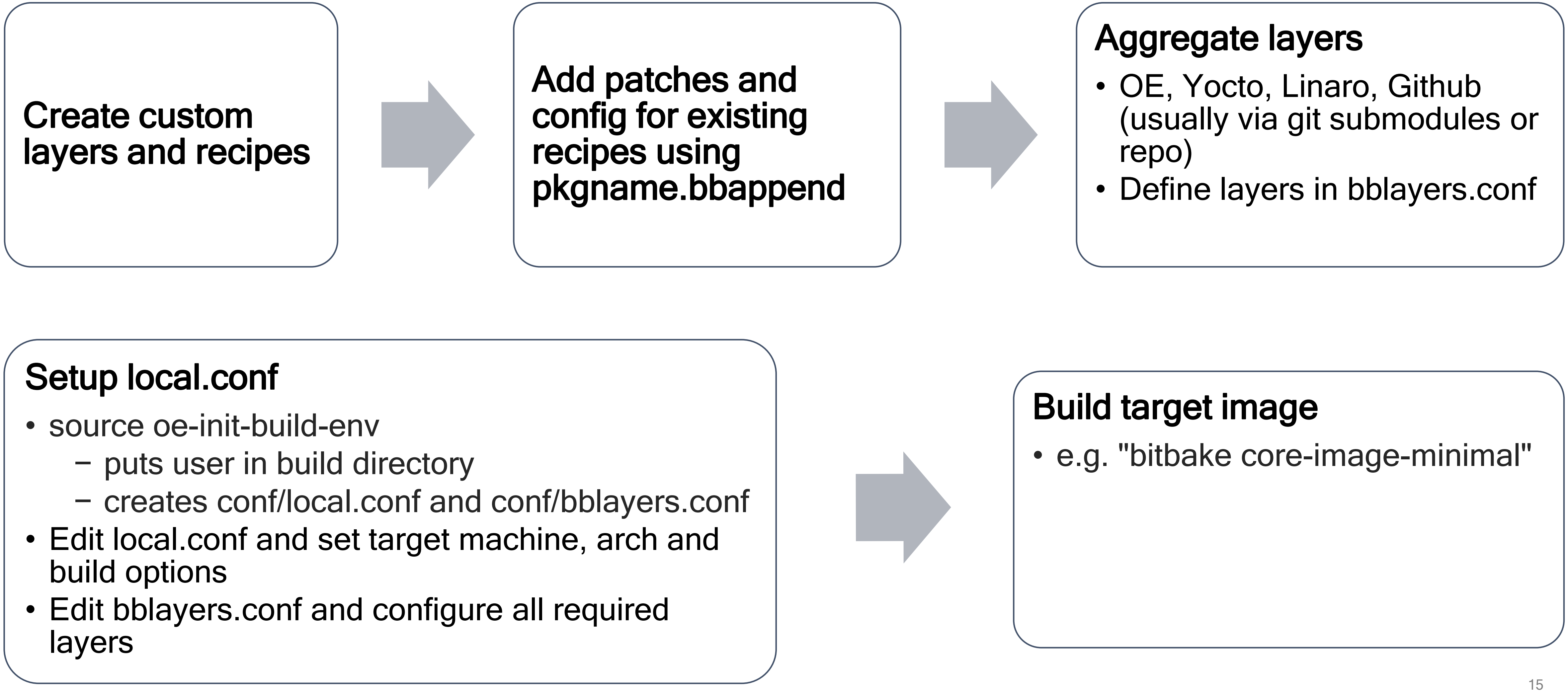
Wait, What? I'm a Distro Maintainer!?

- With OE you are building a Linux Distro
  - You control system updates, SW upgrades, critical fixes, user installable packages, (or not...)
  - No 3rd party SW ecosystem unless you create it
  - You manage the SDK for your distro

- Yocto SDK vs Extensible SDK
  - External developers require SDK to make compatible SW
  - Standard SDK
    - No packaging option using standard SDK, just sysroot
  - Extensible SDK
    - Richer (and more complicated) developer experience, and more work for distro maintainer
    - Great overview from previous ELC - https://www.youtube.com/watch?v=d3xanDJuXRA

Yocto and OE Development Methodology

Distro build process



Create custom layers and recipes

Add patches and config for existing recipes using pkgname.bbappend

Aggregate layers

- OE, Yocto, Linaro, Github (usually via git submodules or repo)
- Define layers in bblayers.conf

Setup local.conf

- source oe-init-build-env
  - puts user in build directory
  - creates conf/local.conf and conf/bblayers.conf
- Edit local.conf and set target machine, arch and build options
- Edit bblayers.conf and configure all required layers

Build target image

- e.g. "bitbake core-image-minimal"

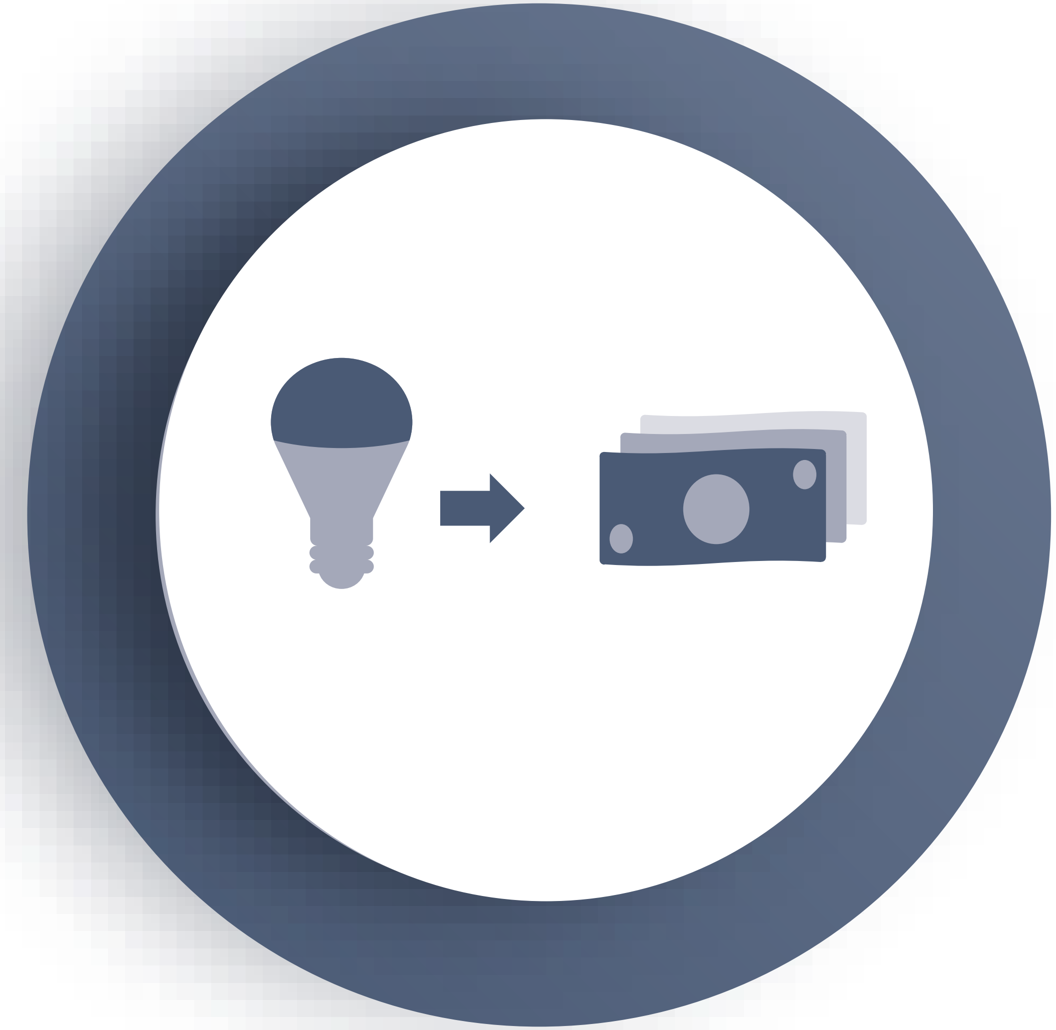
Alternative Yocto/OE Debian Hybrid Approaches

- https://elinux.org/images/6/67/Isar-Deby_jamboree61_r1.pdf
  - ISAR vs Deby
- https://www.cip-project.org/blog/2017/10/23/cip-launches-cip-core
  - The implementation of the CIP Core is based on the Deby distribution, a reproducible and maintainable embedded Linux distribution based on poky. Deby overlays meta-debian on top of poky to build file system images out of Debian long-term supported source code packages.

Commercial Deployment of OE/Yocto

- Yocto defines a reference Poky Distro
  - Not used for Linaro OE RPB
- Yocto makes 2 releases a year and each release is supported for one year
  - https://wiki.yoctoproject.org/wiki/Releases
  - Community may provide additional support for older releases
- Commercial support for Options for Yocto/OE from 3rd parties
  - e.g. Intrinsyc, TimeSys other OSVs
  - https://www.openembedded.org/wiki/CommercialSupport

Prototyping to Productization



Planning for Productization

Potential Gotcha's

- Moving from upstream to downstream kernel based BSP (or vice versa)
  - Proprietary middleware and HW acceleration
  - Not a problem on DragonBoard 410c (unless you were using Android)
- Conflicting prebuilt libs and system toolchain with different C++ ABI
  - Pre gcc 5 vs post (and pre 3.8 clang)
    - _GLIBCXX_USE_CXX11_ABI - non-zero value means use the new C++11-conforming ABI introduced in GCC 5, vs the previous ABI
- Commercial support and SW updates
  - LTS Kernels
  - Frozen vs rolling OS and kernel versions
- Open Source License Compliance
  - SPDX Report

Software ecosystem

Supporting great flexibility for architecting IoT solutions

OS*

- Linux
  - Debian
  - Yocto/ OpenEmbedded
  - Ubuntu Core
- Windows 10 IoT Core

Middleware

- AWS Greengrass
- IBM Watson IoT
- ROS
  (Robotics Operating System)

Cloud

- AT&T M2X
- AWS IoT
- IBM Bluemix
- Microsoft Azure IoT

*Android supported on DragonBoard 410c for hobbyist projects, not for commercial use in Snapdragon 410E and 600E designs

Useful Links

- Main SW page for DragonBoard 410c
  - https://www.96boards.org/product/dragonboard410c/
    - Links to Debian and OpenEmbedded pages
- Qualcomm® Developer Network projects
  - https://developer.qualcomm.com/project
- Debian Resources
  - https://www.debian.org/support
- OpenEmbedded
  - https://github.com/96boards/documentation/blob/master/consumer/guides/open_embedded.md
- Yocto
  - https://www.yoctoproject.org/docs/2.4.1/dev-manual/dev-manual.html
- Arrow Electronics: DragonBoard 410C and/or accessories
  - https://www.arrow.com/en/campaigns/the-dragonboard-is-here

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