



Qualcomm® Snapdragon™ embedded platforms HW and SW Overview

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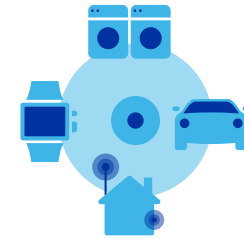
Eco system

Bringing Snapdragon platforms to embedded devices

Identifying the challenges



Mobile OEMs



Embedded Customers

Relationship	○ High touch, 1-1	○ Low-touch, web-based
Primary fulfillment	○ Direct	○ Distribution
Minimum order	○ 10,000s	○ 100
Customers	○ High dependency, few	○ Low dependency, many
Roadmap influence	○ Strong	○ Weak
Engineering capability	○ Strong, large teams	○ Varied, small teams
Primary support	○ Direct	○ Web-based/Contract work
End-product volume	○ High	○ Low
Design type	○ Iterative	○ Clean-slate

Snapdragon 410E and 600E embedded platforms

Drawing from the mobile portfolio for a targeted, tiered offering



Snapdragon 600E

1.5 GHz quad-core Qualcomm® Krait™ 300 CPU



Snapdragon 410E

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

Supported for longevity

- Available through distribution for a minimum of 10 years from Snapdragon 600 and 410 commercial sample in 2015

Available through Arrow Electronics

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

Snapdragon embedded platforms



Snapdragon 410E

Application Processor - APQ8016E

- 12 mm x 14 mm non-PoP package size
- LPDDR2/3 533 MHz single channel
- Quad ARM Cortex A53 at 1.2GHz per core

Power module - PM8916

- Power management and codec IC
- 6.2 mm x 6.2 mm

Connectivity - WCN36x0

- WCN3620/3660B - 802.11 b/g/n
- Bluetooth 4.x/LE
- 3.3 mm x 3.5 mm

Location - WGR7640

- Integrated Location (GNSS, GPS) support
- 2.1 mm x 1.5 mm



Snapdragon 600E

Application Processor - APQ8064E

- 23 mm x 23 mm non-PoP package size
- Dual DDR3/DDR3L up to 533MHz
- Quad core Krait 28LP-LVT up to 1.5GHz

Power module - PMM8920AU

- Power Management
- 13.9 mm x 12.3 mm

Connectivity - QCA9377 module

- QCA9377 - 802.11a/b/g/n/ac 1x1 DB 2.4GHz/5GHz
- Bluetooth 4.1
- 18.0 mm x 17.0 mm module, FCC pre-certified

Location - RGR7640AU

- Integrated Location (GNSS, GPS) support

Audio - WCD9311

- Next Gen Audio Codec
- 6.0 mm x 6.0 mm

Ethernet (optional) - AR8151

- Ethernet connectivity

Snapdragon sub-systems



Chipset Interface

- PMIC / WCN / Codec busses
- Analog interfaces (ADCs / DACs)



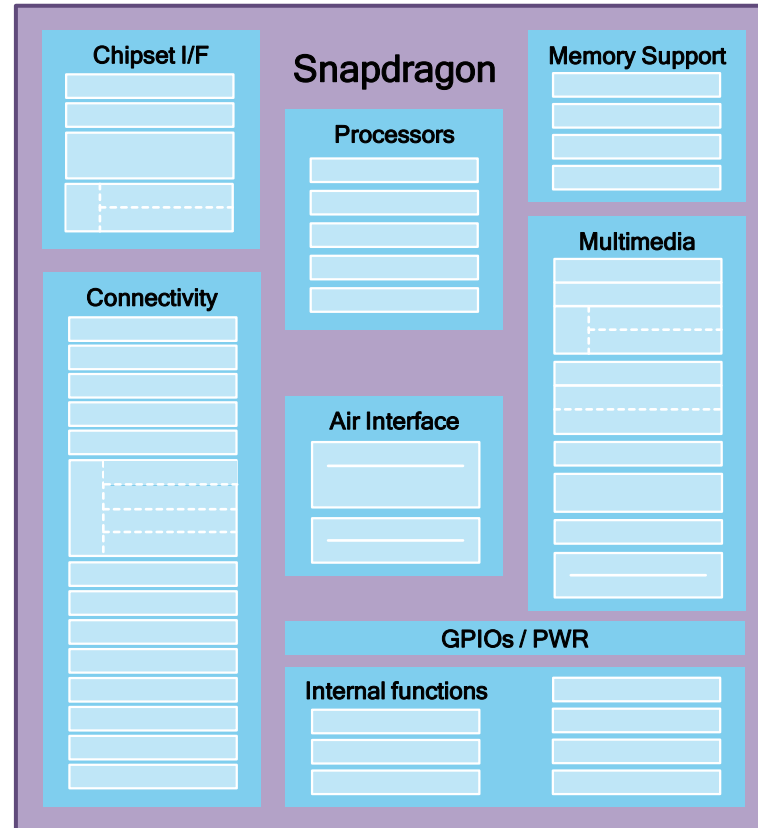
Air Interface

- Integrated GPS modem
- Integrated WLAN / BT modem



Wired Connectivity

- USB
- PCIe
- GPIOs
- Programmable serial interfaces (I2C / SPI / UART)
- Secure Digital (SD)
- I2S



Memory

- DDR
- eMMC
- Internal memory



Multimedia

- GPU
- VFE
- Display controller
- Camera controller
- ISP
- Audio



Internal Functions

- Security
- Debugging (e.g., JTAG)
- Housekeeping
- Clocks & power

Processors and memory

Snapdragon 410E



Application Processor

- Quad core
- 64-bit Cortex A53 (ARM v8) up to 1.2GHz
- 512kB L2 cache

DSP

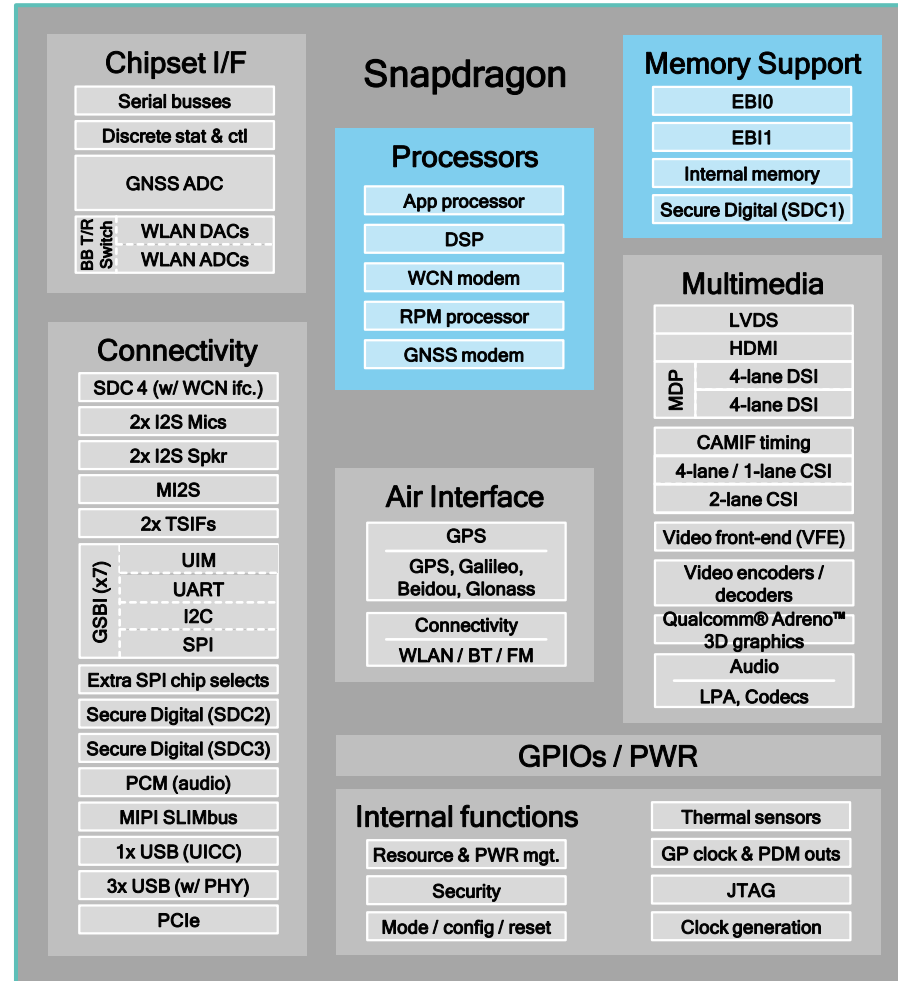
- Qualcomm® Hexagon™ QDSP6 V5 core up to 691MHz

Supporting processors

- RPM, Cortex M3

Memory

- LPDDR2/3, 32-bit, up to 533MHz
- eMMC v4.5
- iMEM 128kB



Snapdragon 600E



Application Processor

- Quad core
- 32-bit Krait uP (ARM v7 compliant) up to 1.5GHz
- 2MB L2 cache

DSP

- Qualcomm® Hexagon™ QDSP6 V4 core up to 500MHz

Supporting processors

- RPM, ARM7
- SPSS, ARM7

Memory

- DDR3, 32-bit, dual channel (4 chip-selects), up to 4GB density, up to 533MHz
- eMMC v4.5
- iMEM 256kB LMEM + 192kB MIMEM

Multimedia

Snapdragon 410E



Display support

- 1080p external displays supported
- HDMI via converter

Image processing

- Up to 2x CSIs
- 4-lane CSI up to 13MP
- 2-lane CSI 8MP web cam

Qualcomm® Adreno™ 306 GPU (400 MHz)

- 3D graphics accelerator
- On-chip graphics memory (128 kB unified SRAM)

Video Decode

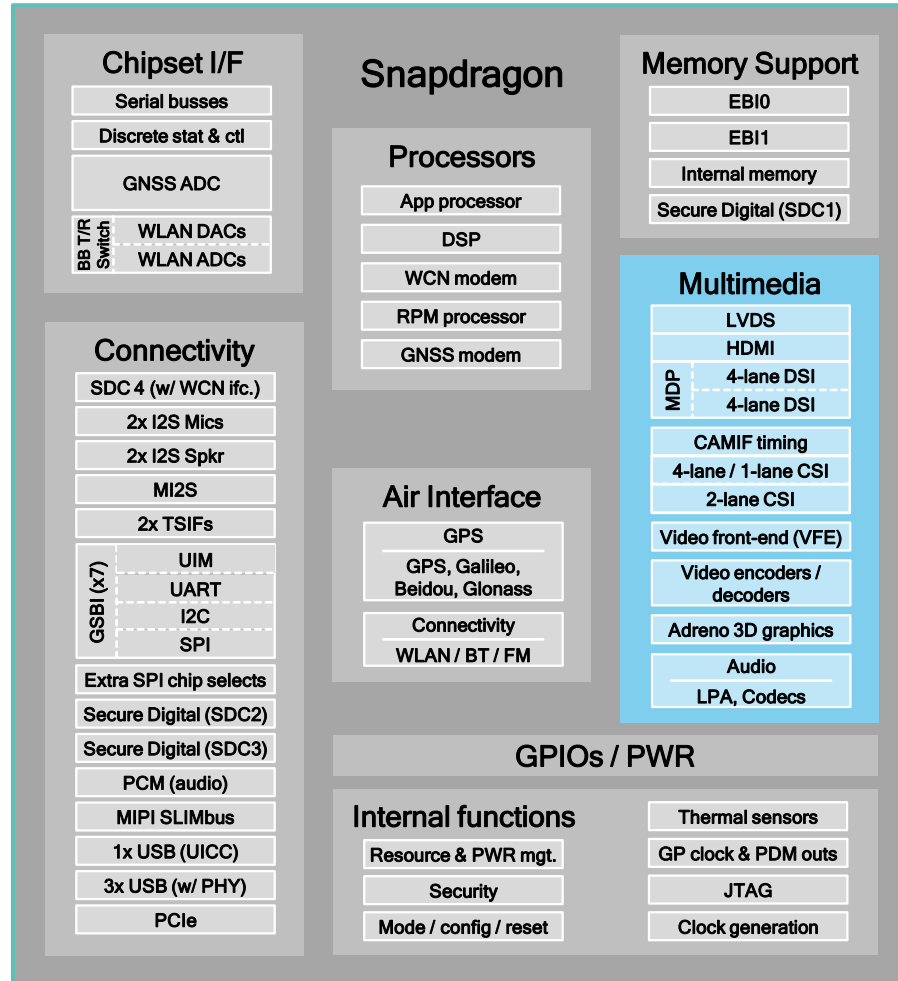
30 fps 1080p (MPEG-4/H.264/H.263/DivX/MPEG2/VC1/Soreson/VP8)

Video Encode

30 fps 1080p (MPEG-4/H.264/VP8/H.263)

Audio

- 5.1 surround sound with Dolby and DTS
- Low Power Audio Core
- DSP Post-Proc programmability



Snapdragon 600E



Display support

- 2560x1600 via 2xDSI
- 2048x1536 via LVDS
- or
- 2048x1560 via 1xDSI
- 1080p HDMI port

Image processing

- Up to 3x CSIs
- 4-lane CSI:
- Up to 20MP in-line JPEG encode at 15 fps
- 60 fps WXGA viewfinder frame rate
- 2-lane CSI 8MP web cam
- 1-lane CSI 3D cam support

Qualcomm® Adreno™ 320 GPU (400+ MHz)

- 200 M peak triangles/sec; 6.4 B vector shader instructions/sec; 3.2 BP/sec; 3.2 B texel/sec
- On-chip graphics memory 512 KB for fast Z, color, and stencil rendering

Video Decode

30fps 1080p (MPEG-4 / MPEG-2 / H.264 / H.263 / DivX / VC-1 / WMV-9)
30fps D1 @ FWVGA (H.263)

Video Encode

30fps @1080p (MP4/H.264)
30fps @ D1 (H.263)

Audio

- Dolby 7.1 surround sound with Digital Plus audio
- Low Power Audio Core
- DSP Programmability

Wired Connectivity



Snapdragon 410E

USB

- 1x USB 2.0 HS ports (w/ build-in PHY)

Secure Digital

- 2x ports
- Supports SD3.0 and MMC, eMMC4.5 NAND flash, SD/eMMC boot
- Different operating voltages

BLSP

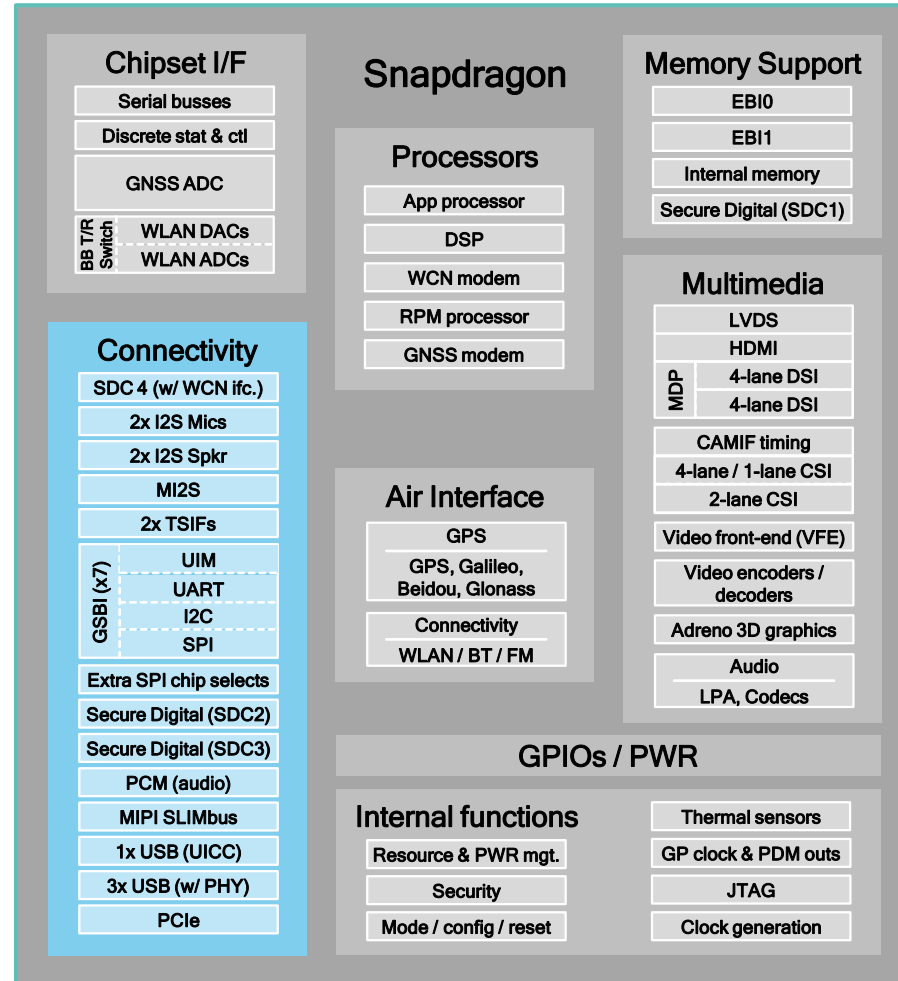
- 6x 4-bit wide ports
- Multiplexed serial interfaces
- UART, I2C, SPI (master), GPIO

GPIOs

- 122x GPIOs
- Top-level mode multiplexer
- Input config: pullup, pulldown, keeper, no-pull
- Output config: drive strength

Audio

- DMIC
- CDC PDM port
- 2x MI2S (2-bit)



Snapdragon 600E

USB

- 3x USB 2.0 HS ports (w/ build-in PHY)
- 1x USB 2.0 FS port
- 1x HSIC

Secure Digital

- 4x ports
- Supports SD3.0 and MMC, eMMC4.5 NAND flash, SD/eMMC boot

PCIe

- 1-lane PCIe 2.0

GSBI

- 7x 4-bit wide ports
- Multiplexed serial interfaces
- UART, UIM, I2C, SPI (master), GPIO

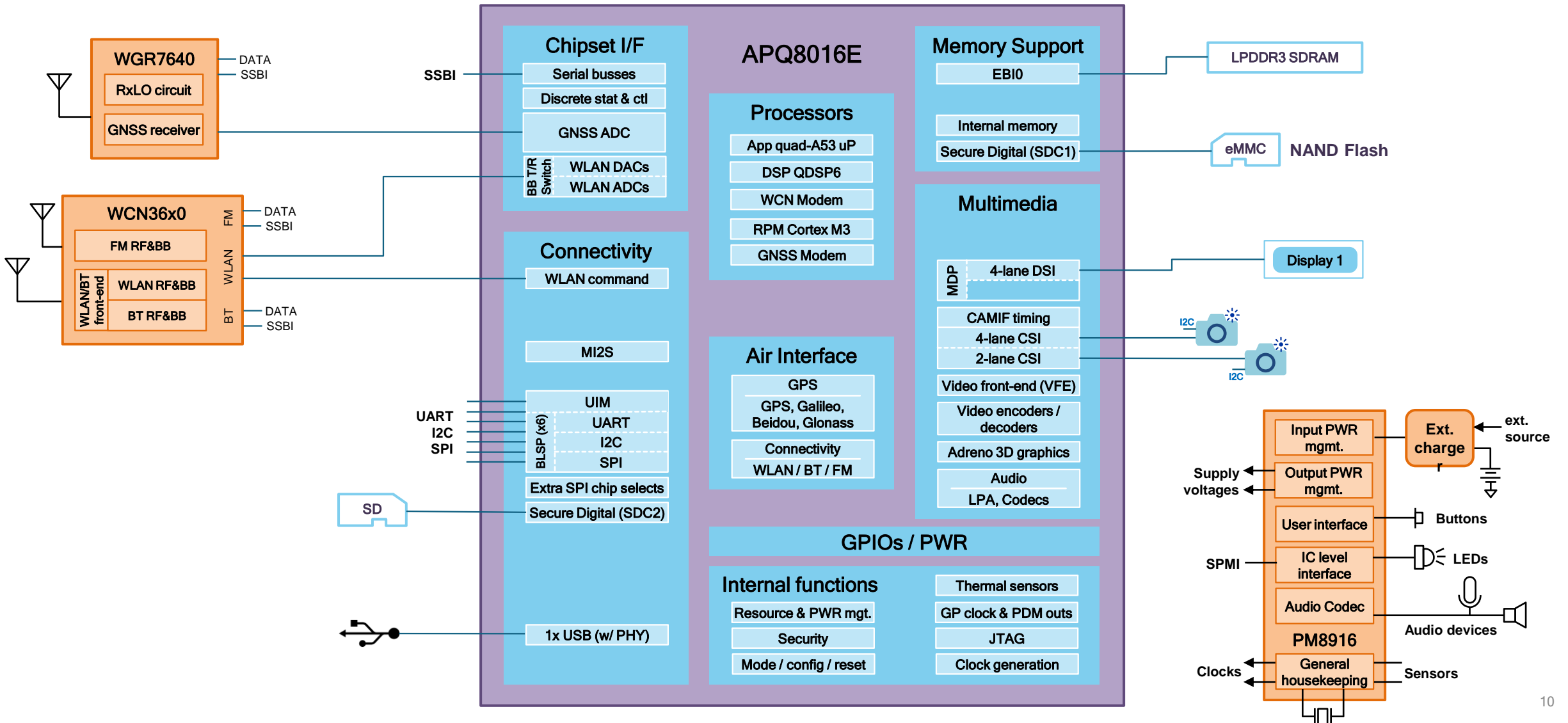
GPIOs

- 90x GPIOs
- Top-level mode multiplexer
- Input config: pullup, pulldown, keeper, no-pull
- Output config: drive strength

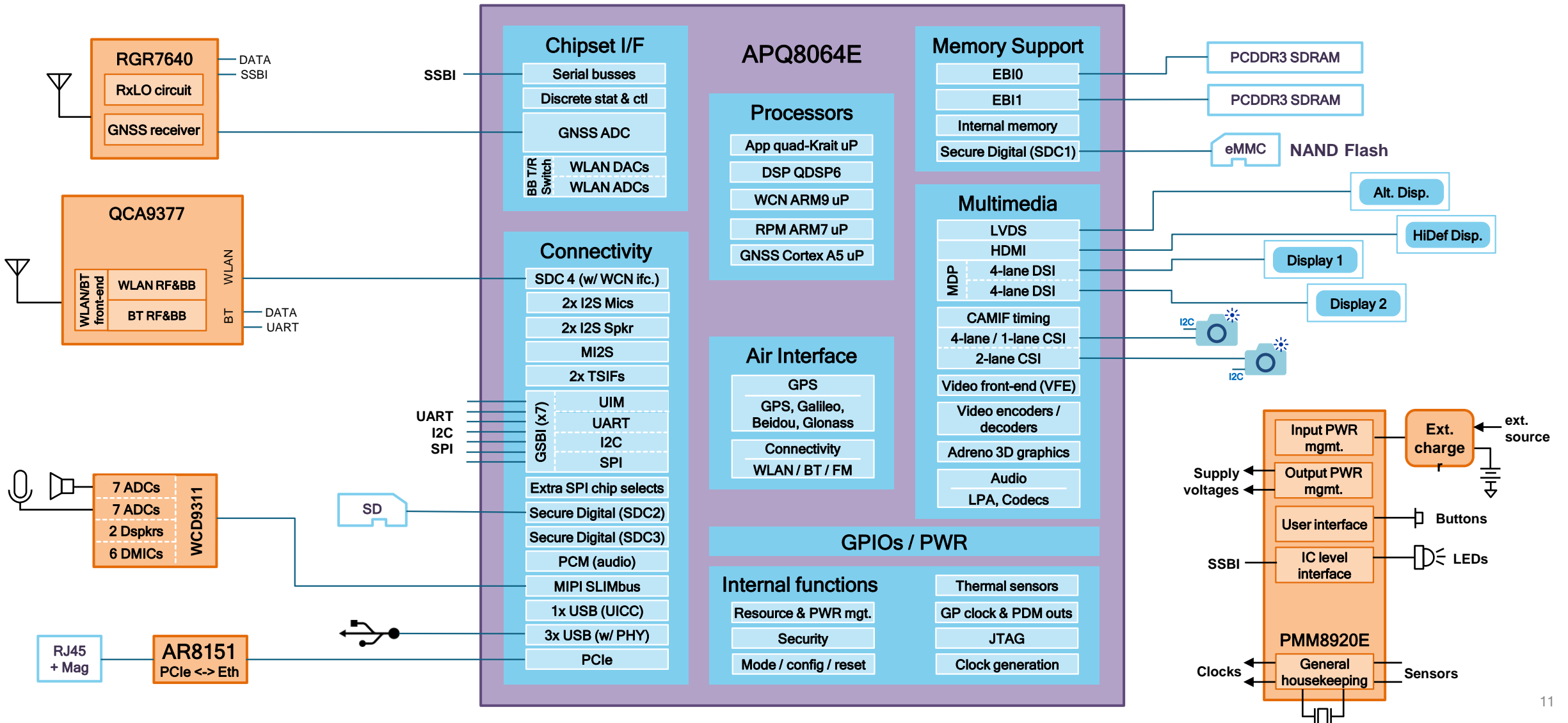
Audio

- 4x I2S / 1x MI2S (4-bit)
- PCM
- SLIMbus

Snapdragon 410E typical application



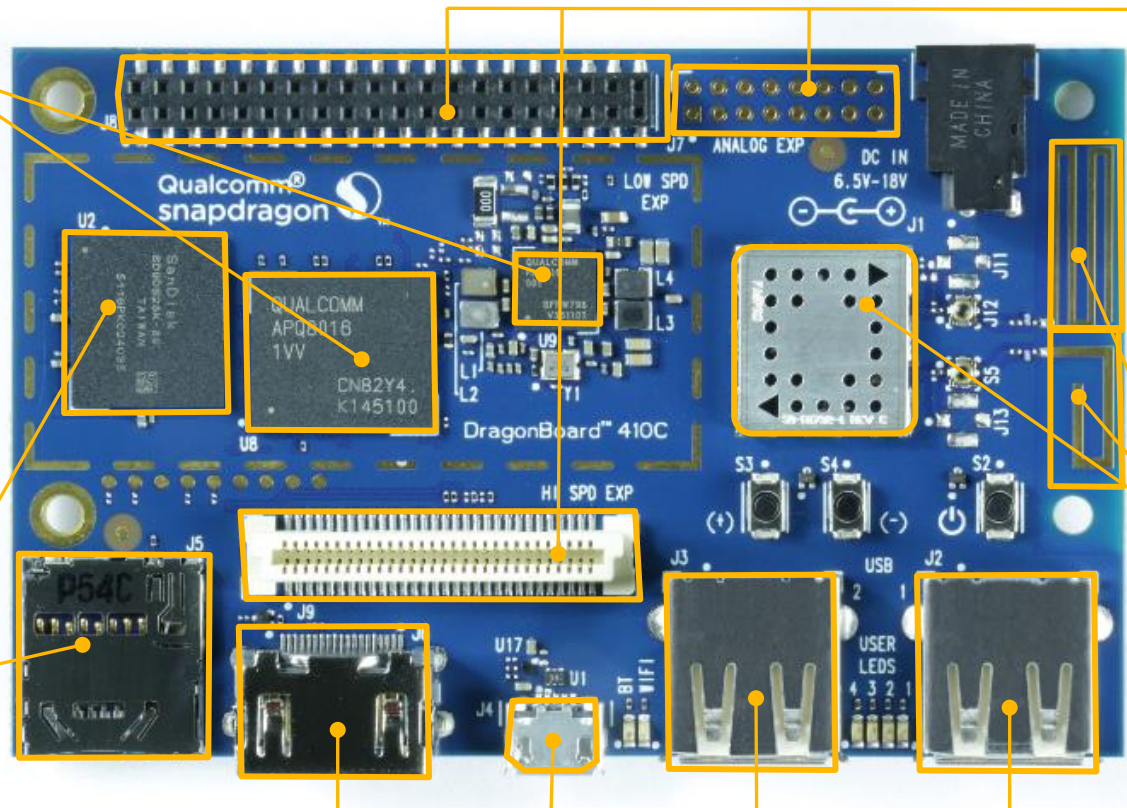
Snapdragon 600E typical application



DragonBoard™ 410c development board overview

Powerful processing and multimedia capabilities

- Snapdragon 410E Processor
- Quad-core ARM Cortex A53
- Adreno 400MHz PC-class graphics
- Power management and audio codec



A wide array of expansion capability

- One 40-pin low-speed (LS) expansion connector
- One 60-pin high-speed (HS) expansion connector
- Footprint for one optional 16-pin analog expansion connector
 - e.g. Stereo headset/line-out, speaker and analog line-in

Integrated connectivity

- Wi-Fi, Bluetooth, GPS
- On-board Wi-Fi & GPS antennas

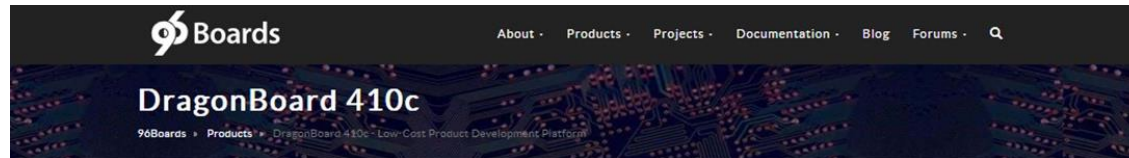
Memory and storage

- 1GB LPDDR3
- 8GB eMMC 4.5
- Micro SD card slot

I/O Interfaces

- HDMI full-size
- USB

DragonBoard™ 410c - an evaluation and enablement tool



[DragonBoard™ 410c \(Arrow\)](#) [Getting Started](#) [Documentation](#) [Tutorials](#) [Support](#)

DragonBoard 410c

The DragonBoard 410c, a product of Arrow Electronics, is the development board based on the mid-tier Qualcomm® Snapdragon™ 410E processor. It features advanced processing power, Wi-Fi, Bluetooth connectivity, and GPS, all packed into a board the size of a credit card.



Additional Information

Component	Description
SoC	Qualcomm Snapdragon 410E
CPU	ARM Cortex-A53 Quad-core up to 1.2 GHz per core
GPU	Qualcomm Adreno 306 @ 400MHz for PC-class graphics with support for Advanced APIs, including OpenGL ES 3.0, OpenCL, DirectX, and content security
RAM	1GB LPDDR3 SDRAM @ 533MHz
Storage	8GB eMMC 4.51 on board storage and MicroSD card slot

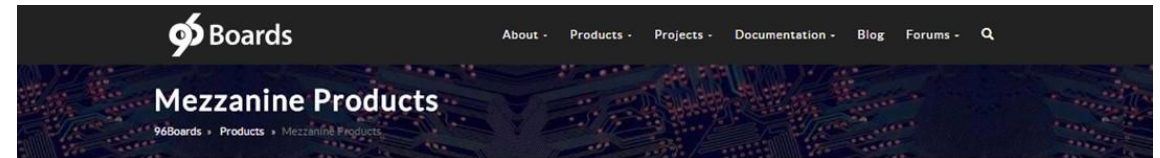
Show 5 More

Buy Now

- DragonBoard410c (Basic Kit)** \$79.00
[Board](#) [Buy from Arrow.com](#)
- DragonBoard410c + Audio Kit** \$89.00
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OS









- Android
- Debian
- OpenEmbedded



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96Boards mezzanine products let you expand your Consumer Edition or Enterprise Edition 96Boards with new interfaces for IoT, industrial control, and other embedded applications. The following mezzanine expansion boards are currently available. Please take some time to review our [mezzanine guidelines document](#) for some helpful design guidelines and resources.



 <p>NeonKey Mezzanine <i>The Neonkey packs a Cortex-M4 chip, 512 Kbytes fla...</i></p> <p>Read More Buy</p>	 <p>STM32 Sensor mezzanine board <i>Coming soon: The STM32 Sensor board is a 96Boards ...</i></p> <p>Read More Buy</p>	 <p>UART Adapter Board <i>Available now: a USB to UART interface to be used ...</i></p> <p>Read More Buy</p>	 <p>Sensors Mezzanine <i>Available now: I/O Expansion board for IoT/Sensor ...</i></p> <p>Read More Buy</p>
 <p>Arrow Link Sprite Mezzanine Kit <i>96Boards starter kit with Linker mezzanine card an...</i></p> <p>Read More Buy</p>	 <p>AeroCore 2 for 96Boards <i>Most technologically advanced AeroCore expansion b...</i></p> <p>Read More Buy</p>	 <p>MIPI Adapter Mezzanine - AiStar-Vision <i>Hardware compatible MIPI mezzanine and GPIO breako...</i></p> <p>Read More Buy</p>	 <p>D3 DesignCore™ Camera Mezzanine <i>D3 Camera Mezzanine Board OV5640 enables up to two...</i></p> <p>Read More Buy</p>

<https://www.96boards.org/product/dragonboard410c/>

<https://www.96boards.org/products/mezzanine/>



Software Overview



HLOS supported for community and commercial use

Commercial Distributions

Linux Open Embedded/Yocto from Qualcomm Technologies

- Recommended for commercial customers
- Tested and packaged by Qualcomm Technologies
- Highly flexible and customizable
- Upstream LTS kernels
- Variety of 3rd parties providing support services

Ubuntu Core

- Recommended for commercial customers
- Supported on Snapdragon 410E embedded platform
- Support via 3rd parties

Windows 10 IOT Core

- Recommended for commercial customers
- Supported on Snapdragon 410E embedded platform
- Support via 3rd parties

Community Distributions

Linux Debian from Linaro

- Developed for community by Linaro
- Out of the box Desktop experience for evaluation and fast prototyping
- Upstream LTS kernels
- Community support through 96boards.org forums

Linux Open Embedded/Yocto from Linaro

- Developed for community by Linaro
- Highly flexible and customizable
- Upstream LTS kernels
- Community support through 96boards.org forums

Android

- For hobbyist projects
- Supported on DragonBoard 410c

Software Features (Snapdragon 410E)

OS

Linux Open Embedded/Yocto Morty, Kernel 4.9 -> 4.14



Wireless Connectivity

WiFi STA and HostAP (supplicant and network manager layers)

Bluetooth via BlueZ Stack

GPS via GPSD



Wired Connectivity

Flash Memory, SD Card (storage and boot)

USB - storage, HID, Camera, Ethernet, Audio, 3G/4G modem

GPIOs, I2C, SPI, UART (96board compliant)



Display/Video/Graphics

HDMI/DSI, Xorg and Wayland, OpenGL, Accelerated Video decoding and encoding (H.264 via V4L2)



Audio

Analog, HDMI, USB, BT via ALSA or pulseaudio



Camera

MIPI CSI YUV, USB



Security

Secure Boot

Other

Chromium Browser (not accelerated)

Fastboot

Qualcomm Technologies tools (QPST, QRCT, QXDM)



Software Features (Snapdragon 600E)



OS

Linux Debian Sid, Kernel 4.14



Wireless Connectivity

WiFi STA and HostAP (supplicant and network manager layers)
Bluetooth via BlueZ Stack



Wired Connectivity

Flash Memory, SD Card
USB - storage, HID, Camera, Ethernet, Audio, 3G/4G modem
GPIOs, I2C, SPI, UART (96board compliant)



Display/Video/Graphics

HDMI, Xorg, OpenGL



Audio

HDMI, USB, BT via ALSA or pulseaudio



Other

Chromium Browser (not accelerated)
Fastboot



Upstream and Software Updates

“Upstream First” Paradigm

- Features are developed and upstreamed as early as possible

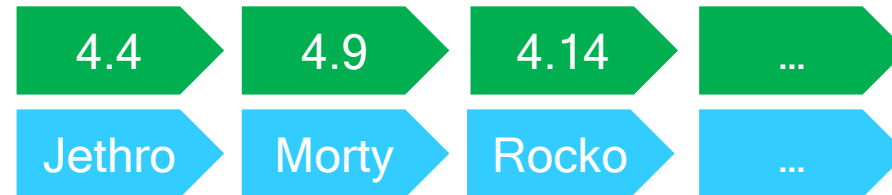
Open Source

Easy to work with

Enables generic Linux developers to work with our products

Major Annual Updates (~March)

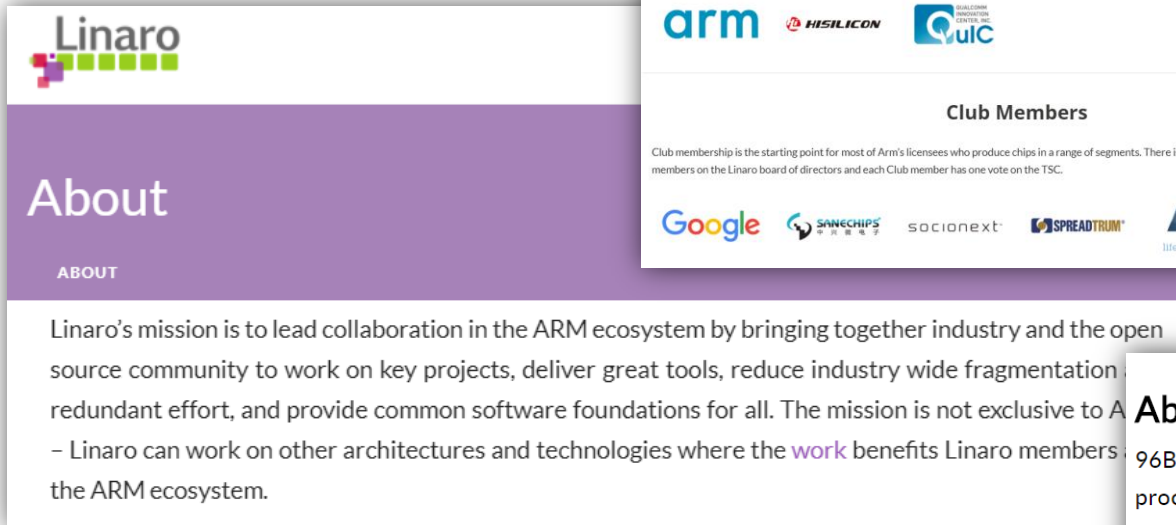
- Long Term Support (LTS) Kernels
- Open Embedded / Yocto Upgrades



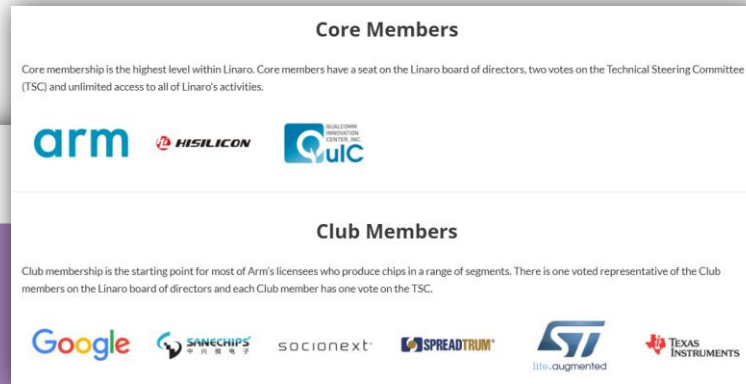
Minor Quarterly Feature and Fixes Updates

- Cadence may be reduced in later stages of the product life

Linaro and 96boards



The screenshot shows the Linaro logo at the top left, followed by the heading 'About' and a sub-heading 'ABOUT'. Below this, the text reads: 'Linaro's mission is to lead collaboration in the ARM ecosystem by bringing together industry and the open source community to work on key projects, deliver great tools, reduce industry wide fragmentation, eliminate redundant effort, and provide common software foundations for all. The mission is not exclusive to ARM - Linaro can work on other architectures and technologies where the work benefits Linaro members and the ARM ecosystem.'



This screenshot details Linaro's membership levels. Under 'Core Members', it states: 'Core membership is the highest level within Linaro. Core members have a seat on the Linaro board of directors, two votes on the Technical Steering Committee (TSC) and unlimited access to all of Linaro's activities.' Logos for arm, HISILICON, and Quic are shown. Under 'Club Members', it states: 'Club membership is the starting point for most of Arm's licensees who produce chips in a range of segments. There is one voted representative of the Club members on the Linaro board of directors and each Club member has one vote on the TSC.' Logos for Google, SANECHIPS, socionext, SPREADTRUM, life:augmented, and TEXAS INSTRUMENTS are shown.

<https://www.96boards.org>

<https://www.linaro.org>

About 96Boards

96Boards is a range of hardware specifications created by Linaro to make the latest ARM-based processors available to developers at a reasonable cost. The specifications are open and define a standard board layout for SoC-agnostic (processor independent) development platforms that can be used by software application, hardware device, kernel and other system software developers. Boards produced to the 96Boards specifications are suitable for rapid prototyping, hobbyist projects or incorporation into new systems for a wide range of applications including desktop and laptop computing, the digital home, digital signage, point of sale (POS), high-end audio, robotics and drones, artificial intelligence, virtual reality, IoT and industrial control.

Standardized expansion buses for peripheral I/O have led to a wide range of compatible add-on mezzanine boards that will work across a variety of 96Boards products. Users have access to a wide range of boards with different features at various price points. In addition, some SoC vendors have announced long term availability of the SoC to encourage their use in products with long life cycles.



Ecosystem

96boards.org Forums

- <https://discuss.96boards.org/c/products/dragonboard410c>



3rd party Software Providers

eInfochips

HW and SW
consulting and support



Intrinsyc

HW and SW
consulting and support



Inforce Computing

HW and SW
consulting and support



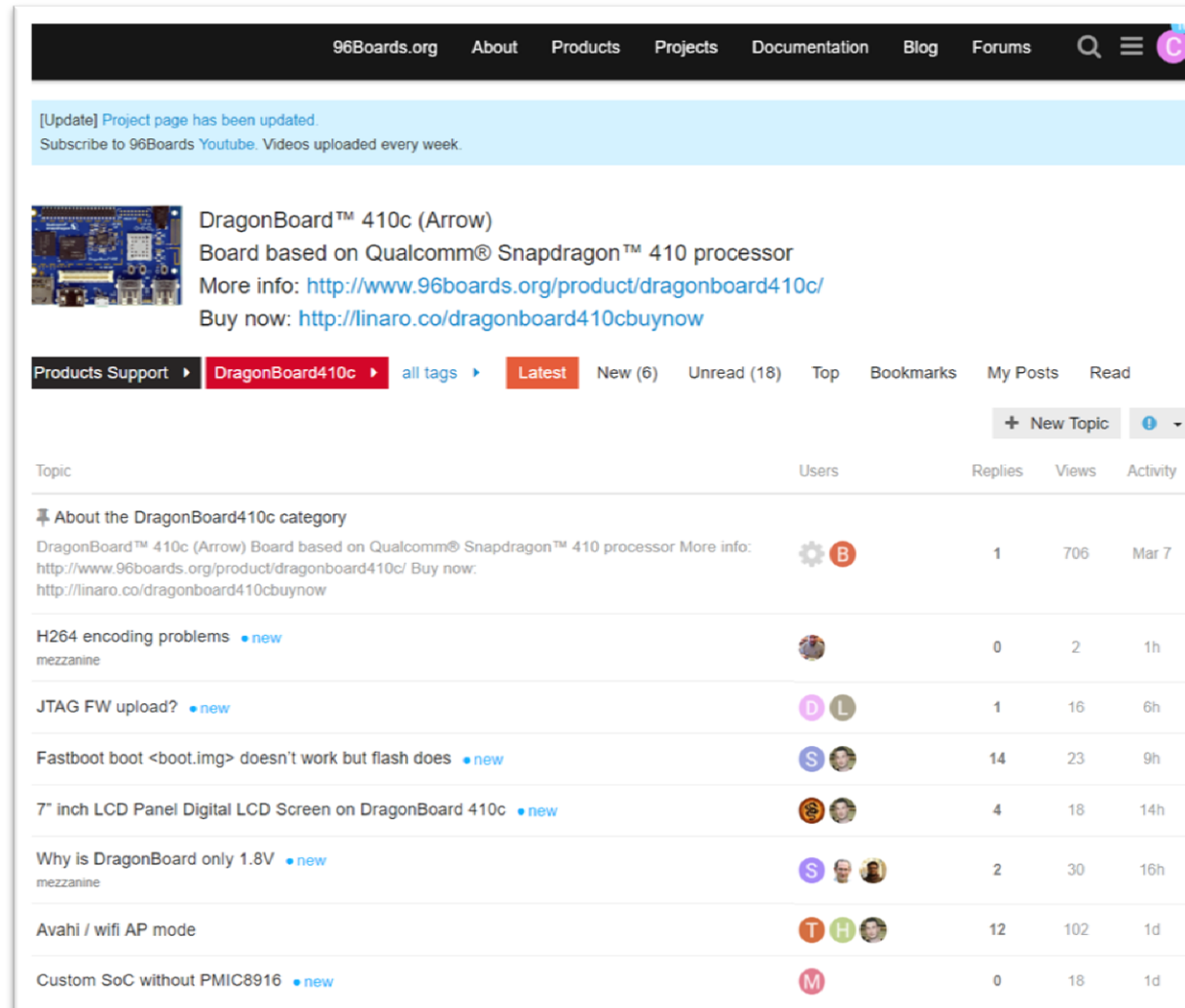
MM Solutions

Camera tuning,
features and support


















Forums @96boards.org

<https://discuss.96boards.org/c/products/dragonboard410c>



The screenshot shows the forum interface for the DragonBoard 410c category. At the top, there is a navigation bar with links for 96Boards.org, About, Products, Projects, Documentation, Blog, and Forums. A search icon and a user profile icon are also present. Below the navigation bar, a light blue banner contains an update message: "[Update] Project page has been updated. Subscribe to 96Boards Youtube. Videos uploaded every week." The main content area features a product card for the DragonBoard™ 410c (Arrow), which includes an image of the board, its name, and a description: "Board based on Qualcomm® Snapdragon™ 410 processor". It also provides links for more information and where to buy the board. Below the product card, there is a breadcrumb trail: "Products Support > DragonBoard410c > all tags > Latest". A navigation bar for the category includes links for "New (6)", "Unread (18)", "Top", "Bookmarks", "My Posts", and "Read". There is also a "New Topic" button. The main forum list is a table with columns for Topic, Users, Replies, Views, and Activity. The first row is a pinned post titled "About the DragonBoard410c category" with 1 reply, 706 views, and a date of Mar 7. The following rows are user posts with titles like "H264 encoding problems", "JTAG FW upload?", "Fastboot boot <boot.img> doesn't work but flash does", "7" inch LCD Panel Digital LCD Screen on DragonBoard 410c", "Why is DragonBoard only 1.8V", "Avahi / wifi AP mode", and "Custom SoC without PMIC8916". Each row includes a user profile picture, the number of replies, views, and the time since the post was made.

Topic	Users	Replies	Views	Activity
📌 About the DragonBoard410c category DragonBoard™ 410c (Arrow) Board based on Qualcomm® Snapdragon™ 410 processor More info: http://www.96boards.org/product/dragonboard410c/ Buy now: http://linaro.co/dragonboard410cbuynow		1	706	Mar 7
H264 encoding problems • new mezzanine		0	2	1h
JTAG FW upload? • new	 	1	16	6h
Fastboot boot <boot.img> doesn't work but flash does • new	 	14	23	9h
7" inch LCD Panel Digital LCD Screen on DragonBoard 410c • new	 	4	18	14h
Why is DragonBoard only 1.8V • new mezzanine	  	2	30	16h
Avahi / wifi AP mode	  	12	102	1d
Custom SoC without PMIC8916 • new		0	18	1d

Online Resources

Webpage Name	URLs	Content / Used for
Qualcomm Developer Network	<ul style="list-style-type: none"> • https://developer.qualcomm.com/hardware/snapdragon-410e • https://developer.qualcomm.com/hardware/snapdragon-410/tools 	Snapdragon 410E documentation
	<ul style="list-style-type: none"> • https://developer.qualcomm.com/hardware/snapdragon-600e • https://developer.qualcomm.com/hardware/snapdragon-600/tools 	Snapdragon 600E documentation
	<ul style="list-style-type: none"> • https://developer.qualcomm.com/hardware/dragonboard-410c • https://developer.qualcomm.com/hardware/dragonboard-410c/software 	DragonBoard 410c documentation, access to public proprietary blobs (FW) for SW build reproduction
96boards.org	<ul style="list-style-type: none"> • http://www.96boards.org/product/dragonboard410c/ 	DragonBoard 410c Product Page
	<ul style="list-style-type: none"> • https://discuss.96boards.org/c/products/dragonboard410c/ 	Community Forums
	<ul style="list-style-type: none"> • https://www.96boards.org/documentation/ConsumerEdition/DragonBoard-410c/ 	Getting started and installation guides
Code Aurora	<ul style="list-style-type: none"> • https://www.codeaurora.org/openembedded-mass-market-and-ioe-qualcomm-snapdragon 	OpenEmbedded for Snapdragon Embedded project code repository

Thank you



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