Embedded Linux Conference 2017:
Beagle BoF

Jason Kridner
Drew Fustini
Robert C. Nelson

Twitter: @beagleboardorg

Beagle BoF outline

- ELC tomorrow: talks and showcase
- BeagleBone OSHW ecosystem
- New: BB Wireless, BB Blue, BB X15
- Debian images
- Debian 9 (“Stretch”) planning
- U-Boot Overlays
- Development resources

ELC 2017: tomorrow!

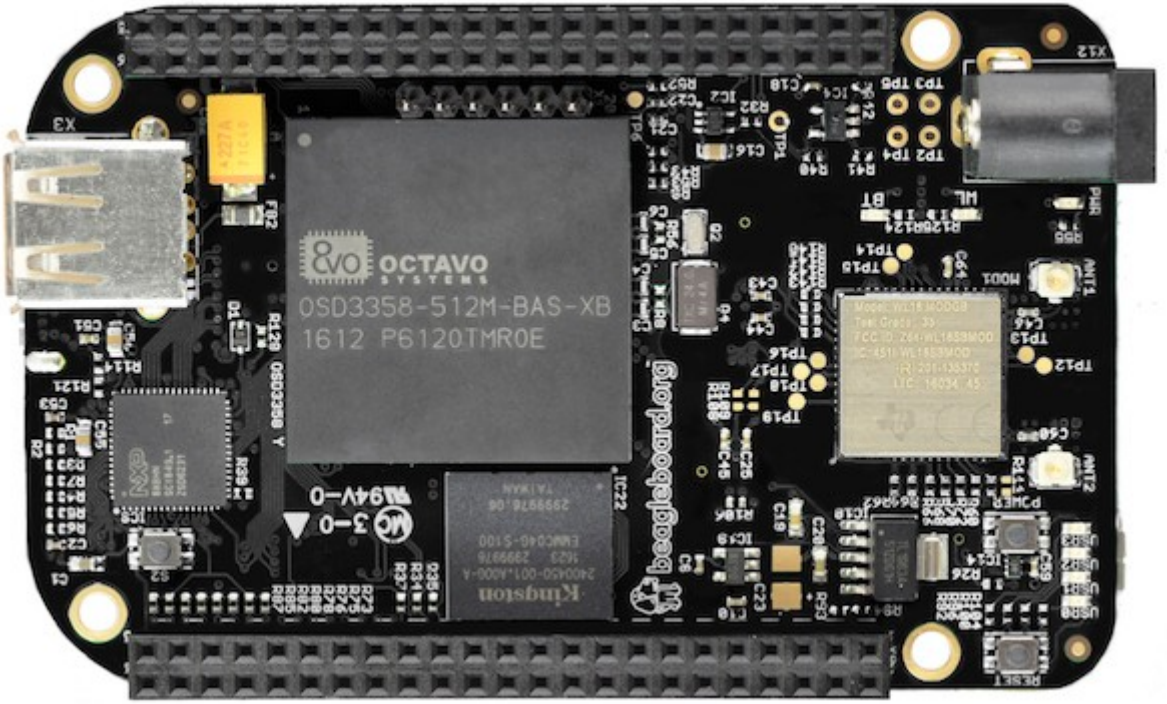
- ELC Technical Showcase
  - BeagleBoard X15 & BeagleBone Blue
  - Wednesday, February 22, 5:10 pm - 7:00 pm
- Educational Robotics Critical for the Future of Linux
  - Jason Kridner, Texas Instruments
  - Wednesday, February 22 • 10:30am - 11:20am
- Google Summer of Code and BeagleBoard.org
  - Drew Fustini, BeagleBoard.org Foundation
  - Wednesday, February 22 • 11:30am - 12:20pm

Open Source Hardware
BeagleBone derivatives

	Capes	HDMI	Flash	Special
BeagleBoard.org BeagleBone	Y	N	N	JTAG
BeagleBoard.org BeagleBone Black	Y	Y	Y	-
Arrow BeagleBone Black Industrial	Y	Y	Y	Industrial
Element14 BeagleBone Black Industrial	Y	Y	Y	Industrial
SeeedStudio BeagleBone Green	Y	N	Y	Grove
SanCloud BeagleBone Enhanced	Y	Y	Y	1GB, 1Gbit, wireless
BeagleBoard.org BeagleBone Blue	N	N	Y	Robotics
BeagleBoard.org BeagleBoard-X15	N	Y	N	Big jump in CPUs and I/O

beagleboard.org

BeagleBone Black Wireless



- **WiFi 802.11b/g/n and Bluetooth 4.1 with BLE**
- **1st Beagle with Octavo System-in-Package (SiP)**
- **Designed in EAGLE *(BBB was OrCad/Allegro)***

BeagleBoard.org BeagleBone Blue preview

Jason Kridner

What is demonstrated

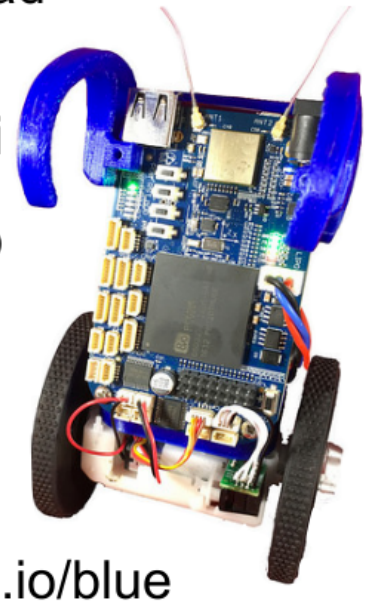
Open hardware Linux computer
➡ Self-hosted web IDE
➡ Debian Linux system

Self-balancing robot run as a userspace task written in C
➡ 5ms inner-loop, <25% load

Connected USB camera
➡ mjpg-streamer over WiFi

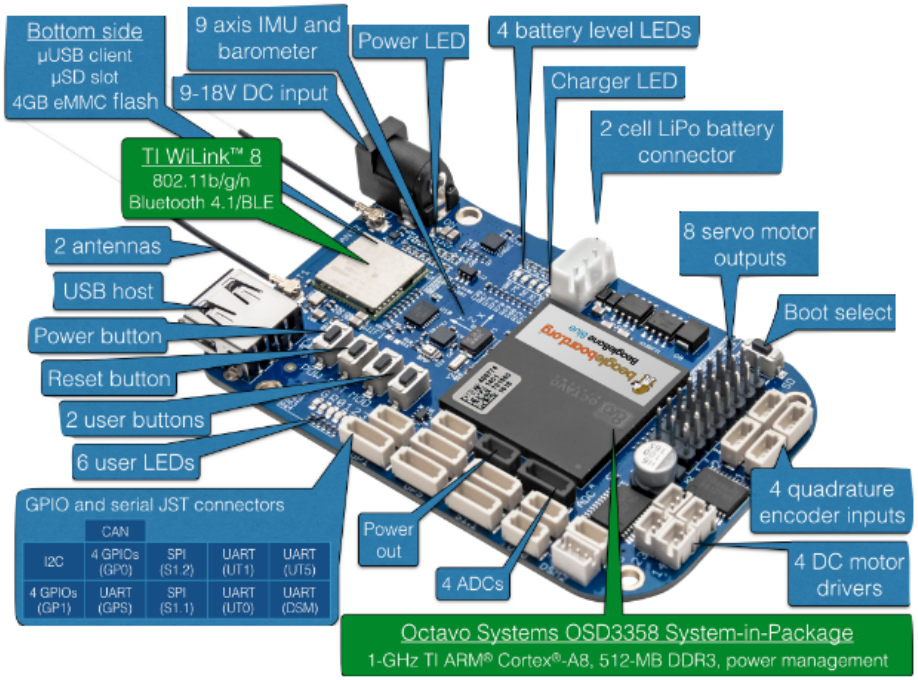
Bluetooth speaker for audio

ROS interface



What was improved

Pre-integrated H/W elements for robotics
➡ pre-integrated software: Ardupilot, …
4-layer PCB design
Quick connections for individual interfaces



Hardware Information

https://bbb.io/blue

1-GHz ARM Cortex-A8, programmable real-time units, 4×DC motor drive, 8×servo motor, WiFi/BT, USB, IMU, 2 cell LiPo battery mgmt, 4×quad enc, barometer

Source code or detail technical information availability

https://github.com/jadonk/beaglebone-blue
https://github.com/beagleboard/linux
https://github.com/beagleboard/image-builder

BeagleBoard.org BeagleBoard-X15

Jason Kridner

What is demonstrated

Open hardware computer
- ➡ Debian Linux system
- ➡ Open source 2D graphics acceleration
- ➡ Video acceleration
- ➡ OpenCL C66 DSP support
- ➡ Mainline kernel support
- ➡ GCC compiler support
  - ✓ ARM Cortex-A15
  - ✓ ARM Cortex-M4
  - ✓ TI C66x
  - ✓ TI PRU

What was improved

Fastest BeagleBoard available
More cores and more types of cores
Lots more I/O capability and bandwidth
More RAM (2GB)

Great open hardware ARM build platform

Hardware Information

https://bbb.io/x15

Dual-core ARM Cortex-A15, dual C66x DSPs, quad programmable real-time units, 3×USB 3.0, PCIe, 2×gigE, 2GB RAM, 4GB eMMC flash, ...

Source code or detail technical information availability

https://github.com/beagleboard/beagleboard-x15
https://github.com/beagleboard/linux
https://github.com/beagleboard/image-builder

Debian images

- BeagleBoard.org Latest Firmware Images
  - 2016-11-06: Debian 8.6 (“Jessie”)
- Debian Image Testing Snapshots
  - 2017-02-12
    - Machinekit
    - Jessie Snapshot LXQT *(full desktop)*
    - Jessie Snapshot IoT *(smaller size)*
    - Jessie Snapshot console *(minimum size)*
    - Stretch testing *(the future!)*

Debian 9 (“Stretch”)

- root: password <blank> -> password "root"
- root: ssh access -> ssh access disabled
- debian: sudo doesn't ask for password -> sudo asks
- Device-tree-compiler: our v1.4.2-fork -> dtc git mainline
- Kernel: v4.4.x-ti/v4.9.x-ti
- U-boot: v2017.03+ with device tree overlays.
- U-Boot overlays by default with cape-universal overlay applied

U-Boot Overlays

- U-Boot now has Device Tree Overlay support
  - debian testing: 2017-01-03 (U-Boot Cape Manager edition)
- U-Boot Overlays is currently under development, while the items below may work on "last weeks" version
- Please report bugs to: beagleboard/bb.org-overlays/issues
  - Always double check the version you are using for comparison.

U-Boot Overlays

- **Migration Guide: U-Boot Overlays**
- U-Boot /boot/uEnv.txt configuration
  - enable_uboot_overlays=1
- U-Boot Disable onboard devices
  - Disable eMMC: disable_uboot_overlay_emmc=1
  - Disable HDMI VIDEO & AUDIO: disable_uboot_overlay_video=1
  - Disable HDMI AUDIO: disable_uboot_overlay_audio=1
  - Disable WL1835: disable_uboot_overlay_wireless=1

U-Boot Overlays

- U-Boot Override external capes
  - Cape device tree overlays: beagleboard/bb.org-overlays
  - uboot_overlay_addr0=/lib/firmware/<file0>.dtbo
  - uboot_overlay_addr1=/lib/firmware/<file1>.dtbo
  - uboot_overlay_addr2=/lib/firmware/<file2>.dtbo
  - uboot_overlay_addr3=/lib/firmware/<file3>.dtbo
  - Plus one custom cape: dtb_overlay=/lib/firmware/<file4>.dtbo
- U-Boot Cape Universal
  - Utilize beaglebone-universal-io config-pin
  - Enable in /boot/uEnv.txt: enable_uboot_cape_universal=1

U-Boot Overlays

- U-Boot overlay white list will continue to grow
  - 0002-U-Boot-BeagleBone-Cape-Manager.patch
- If you have a cape, please test, and let's make sure everyone has a good out of box experience!

Development resources

- Mailing lists: bbb.io/discuss
- IRC: bbb.io/chat
- Kernel build:
  - RobertCNelson/ti-linux-kernel-dev
- Kernel repo:
  - beagleboard/linux
- DTB Rebuilder
  - RobertCNelson/dtb-rebuilder
- Device Tree Overlays for bb.org boards
  - beagleboard/bb.org-overlays