

BeagleBone Black Primer

Day 1: BeagleBone Black Pre-Flight Walk Around

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Webinar Logistics

- Turn on your system sound to hear the streaming presentation.
- If you have technical problems, click “Help” or submit a question asking for assistance.
- Participate in ‘Attendee Chat’ by maximizing the chat widget in your dock.

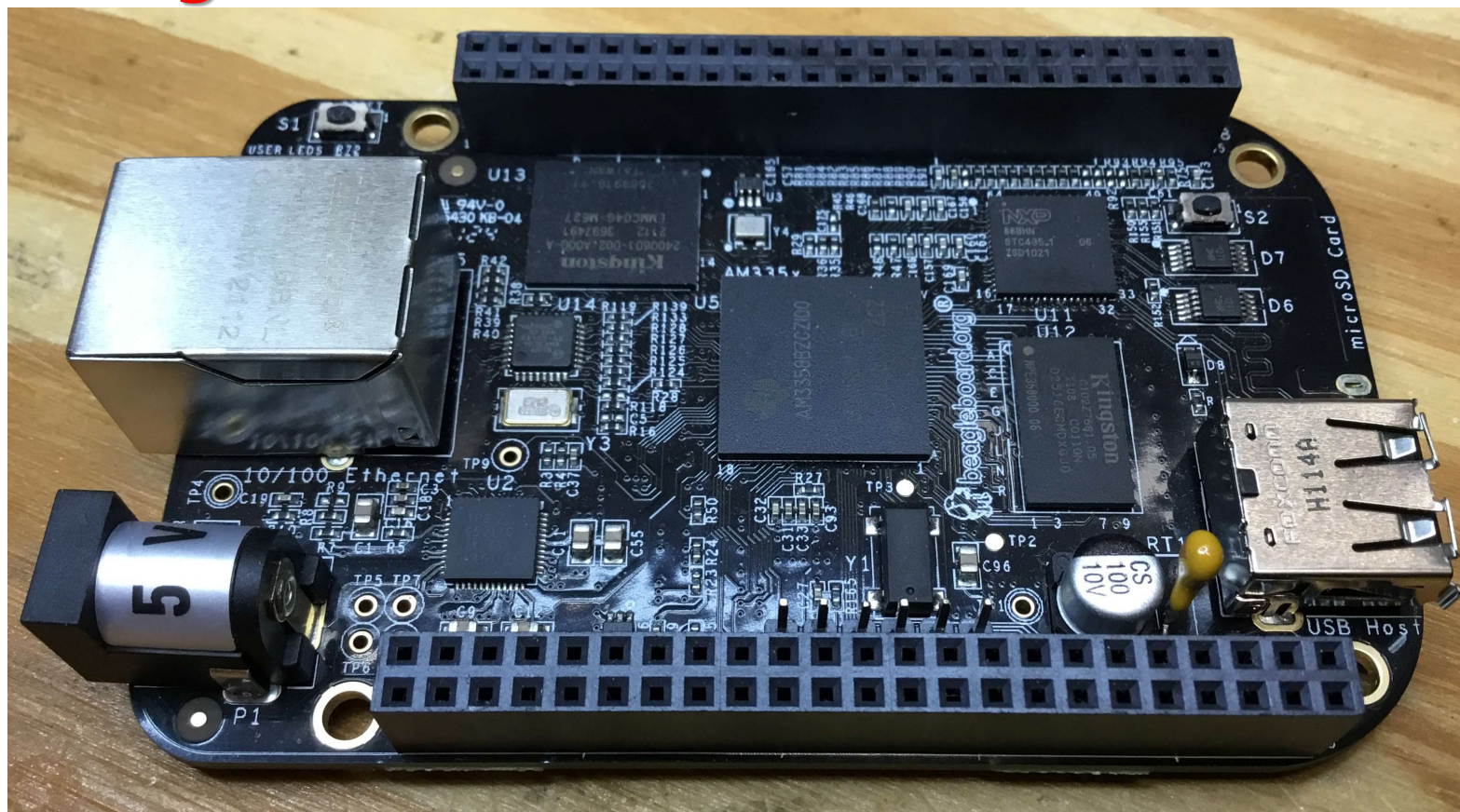


Fred Eady

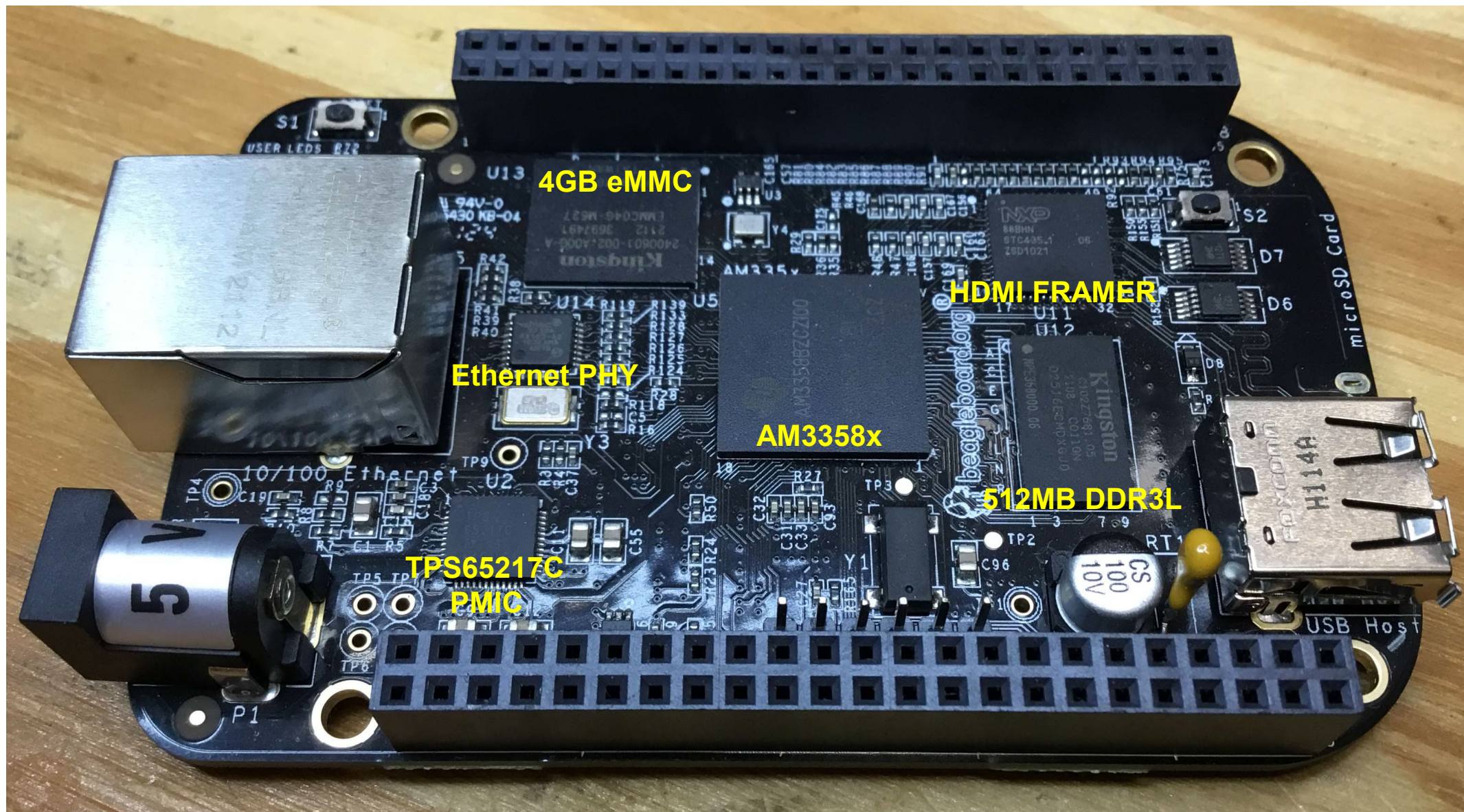
Visit 'Lecturer Profile' in your console for more details.

AGENDA

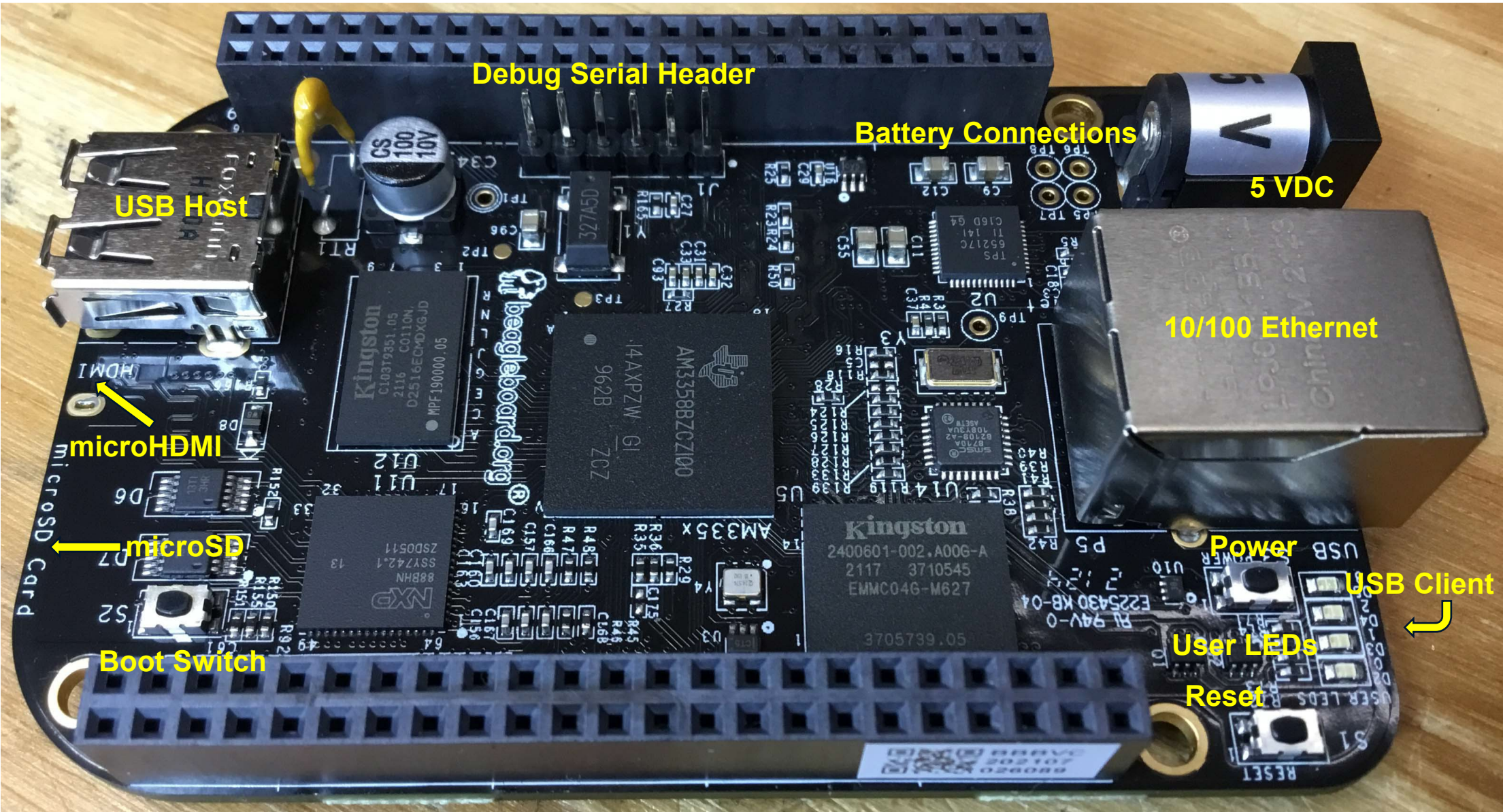
- **BeagleBone Physicals**
- **Dog Food**
- **Throw That Dog a Bone!**



BeagleBone Physicals

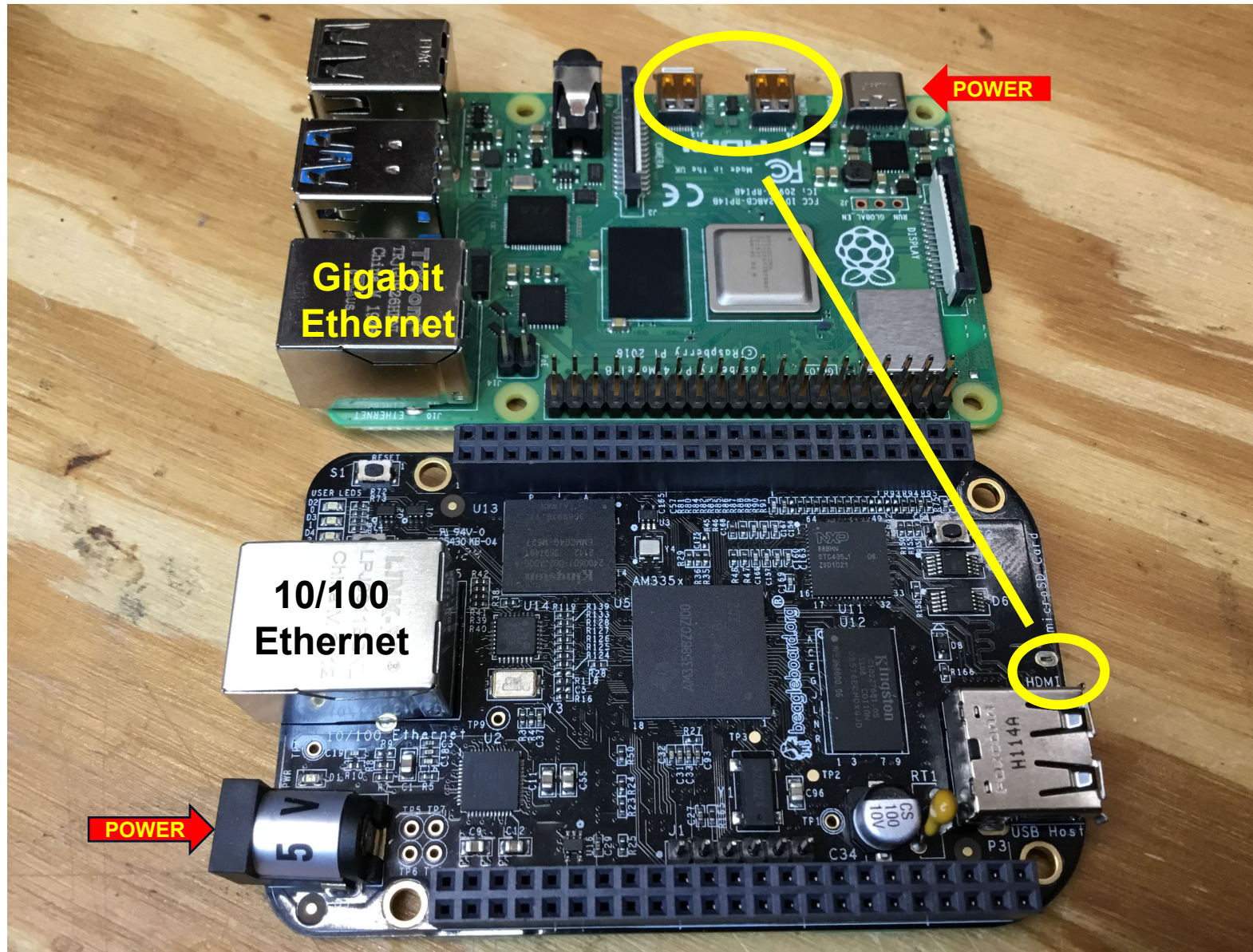


BeagleBone Physicals




BeagleBone versus Raspberry Pi 4B

BeagleBone Black does not natively support Wi-Fi or Bluetooth.



BeagleBone Physicals

P9					P8			
Function	Physical Pins		Function		Function	Physical Pins		Function
DGND	1	2	DGND		DGND	1	2	DGND
VDD 3.3 V	3	4	VDD 3.3 V		MMC1_DAT6	3	4	MMC1_DAT7
VDD 5V	5	6	VDD 5V		MMC1_DAT2	5	6	MMC1_DAT3
SYS 5V	7	8	SYS 5V		GPIO_66	7	8	GPIO_67
PWR_BTN	9	10	SYS_RESET		GPIO_69	9	10	GPIO_68
UART4_RXD	11	12	GPIO_60		GPIO_45	11	12	GPIO_44
UART4_TXD	13	14	EHRPWM1A		EHRPWM2B	13	14	GPIO_26
GPIO_48	15	16	EHRPWM1B		GPIO_47	15	16	GPIO_46
SPI0_CS0	17	18	SPI0_D1		GPIO_27	17	18	GPIO_65
I2C2_SCL	19	20	I2C_SDA		EHRPWM2A	19	20	MMC1_CMD
SPI0_DO	21	22	SPI0_SLCK		MMC1_CLK	21	22	MMC1_DAT5
GPIO_49	23	24	UART1_TXD		MMC1_DAT4	23	24	MMC1_DAT1
GPIO_117	25	26	UART1_RXD		MMC1_DAT0	25	26	GPIO_61
GPIO_115	27	28	SP11_CS0		LCD_VSYNC	27	28	LCD_PCLK
SP11_DO	29	30	GPIO_112		LCD_HSYNC	29	30	LCD_AC_BIAS
SP11_SCLK	31	32	VDD_ADC		LCD_DATA14	31	32	LCD_DATA15
AIN4	33	34	GND_ADC		LCD_DATA13	33	34	LCD_DATA11
AIN6	35	36	AIN5		LCD_DATA12	35	36	LCD_DATA10
AIN2	37	38	AIN3		LCD_DATA8	37	38	LCD_DATA9
AIN0	39	40	AIN1		LCD_DATA6	39	40	LCD_DATA7
GPIO_20	41	42	ECAPWMO		LCD_DATA4	41	42	LCD_DATA5
DGND	43	44	DGND		LCD_DATA2	43	44	LCD_DATA3
DGND	45	46	DGND		LCD_DATA0	45	46	LCD_DATA1

LEGEND	
 	Power, Ground, Reset
 	Digital Pins
 	PWM Output
 	1.8 Volt Analog Inputs
 	Shared I2C Bus
 	Reconfigurable Digital

Dog Food – Flash the Linux Image

"Flasher" Debian images

Buster IoT TIDL (without graphical desktop and with machine learning acceleration tools) for BeagleBone AI on-board eMMC flashing via microSD card

► [AM5729 Debian 10.3 2020-04-06 16GB eMMC IoT TIDL Flasher](#)

image for BeagleBone AI - more info - sha256sum: 1f1eb317e979712b20c4119d63926eb0fc626ace1909f174bc973d915240ebe1

Buster IoT (without graphical desktop) for BeagleBone on-board eMMC flashing via microSD card

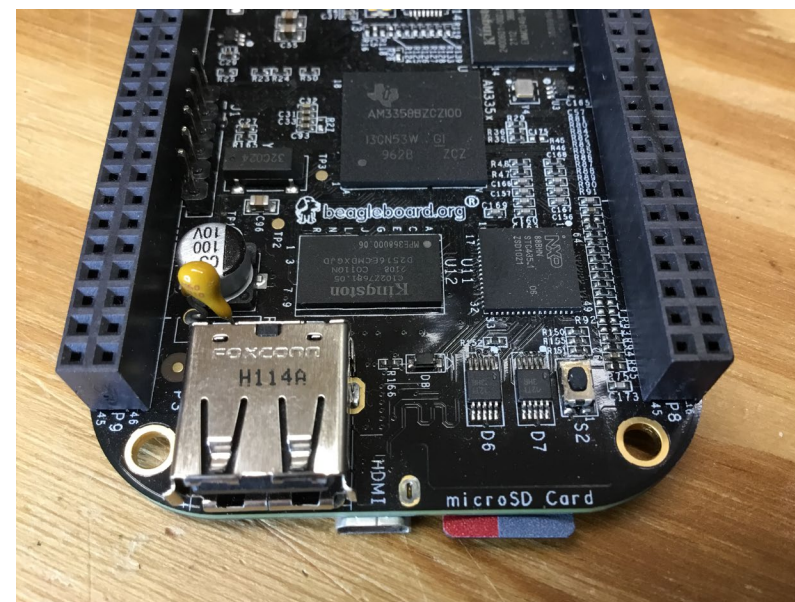
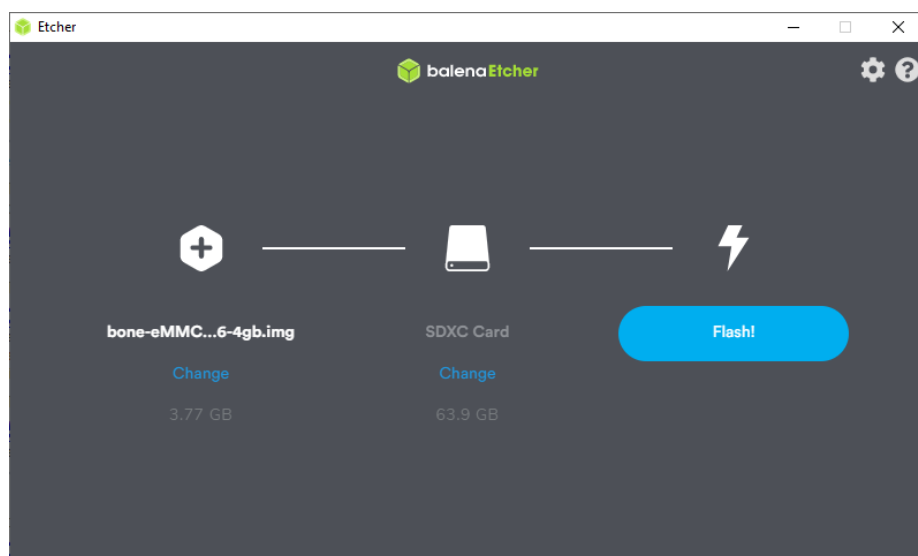
► [AM3358 Debian 10.3 2020-04-06 4GB eMMC IoT Flasher](#)

image for BeagleBone, BeagleBone Black, BeagleBone Black Wireless, BeagleBone Blue, SeeedStudio BeagleBone Green, SeeedStudio BeagleBone Green Wireless, SanCloud BeagleBone Enhanced, element14 BeagleBone Black Industrial, Arrow BeagleBone Black Industrial and Mentorel BeagleBone uSomIQ - more info - sha256sum: e339459077b83f6458cb3432494954582aedad897b9f3b62fa390dfdb010a9df

Buster IoT (without graphical desktop) for BeagleBoard-X15 on-board eMMC flashing via microSD card

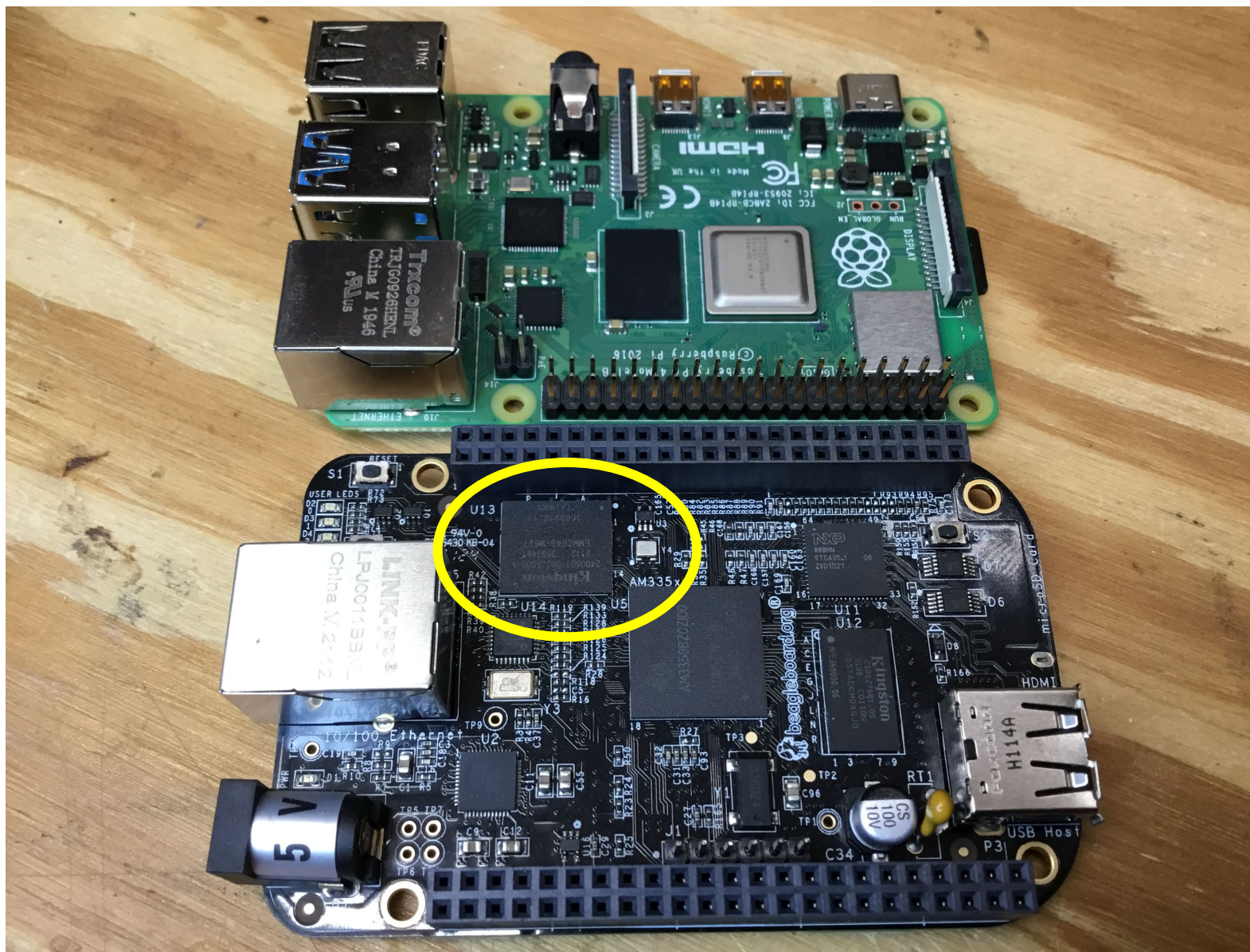
► [AM5729 Debian 10.3 2020-04-06 4GB eMMC IoT Flasher](#)

image for BeagleBoard-X15 and BeagleBone AI - more info - sha256sum: 4aa7d55de3f1c0b6befc9389edaf517e21a22cc19affcc046af429807f20a270



BeagleBone versus Raspberry Pi 4B

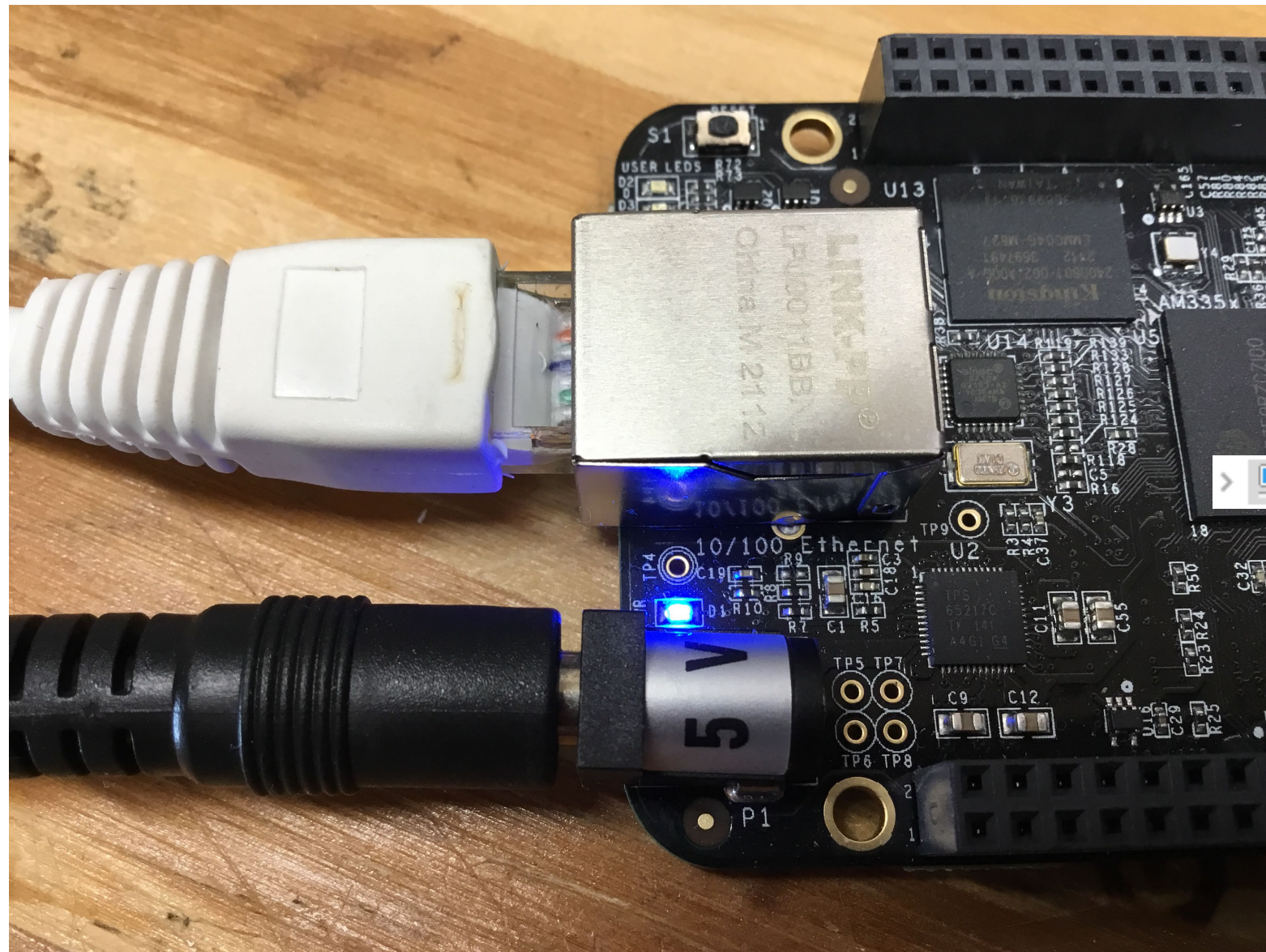
Raspberry Pi 4B
does not natively
support eMMC.



Dog Food – Update the Software

beaglebone:3000



Dog Food – Discover the BBB IP Address

Advanced IP Scanner

File View Settings Help

Scan

192.168.1.1-254 Example: 192.168.0.1-100, 192.168.0.200 Search

Status	Name	IP	Manufacturer	MAC address	Com
>	Linksys00822	192.168.1.1		C4:41:1E:C8:4F:6A	
>	LINKSYSSSHED	192.168.1.2	Belkin International Inc.	C0:56:27:4F:6A:88	
>	amazon-25648d3b0	192.168.1.22	Amazon Technologies...	38:F7:3D:58:4E:AF	
>	android-569744a65178f06b	192.168.1.31	Resideo	B8:2C:A0:90:34:7C	
>	shopcamera	192.168.1.46		6C:94:66:EB:37:46	
>	RokuUltraShop	192.168.1.57		BC:D7:D4:34:D9:FC	
>	HP96BD89	192.168.1.58	Hewlett Packard	3C:52:82:96:BD:8A	
>	Front?Door	192.168.1.60	Amcrest Technologies	9C:8E:CD:23:4B:70	
>	DESKTOP-SHOP	192.168.1.73		DC:FB:48:49:E4:A4	
>	Galaxy-Tab-A	192.168.1.82	Samsung Electronics ...	50:F0:D3:10:B9:F8	
>	Samsung	192.168.1.88	Samsung Electronics ...	84:C0:EF:1D:21:6A	
>	RokuUltra	192.168.1.89		BC:D7:D4:33:9C:50	
>	beaglebone	192.168.1.104		24:76:25:72:24:BE	
>	amazon-01b85b673	192.168.1.100	Amazon Technologies	88:71:65:74:24:EA	

beaglebone 192.168.1.104

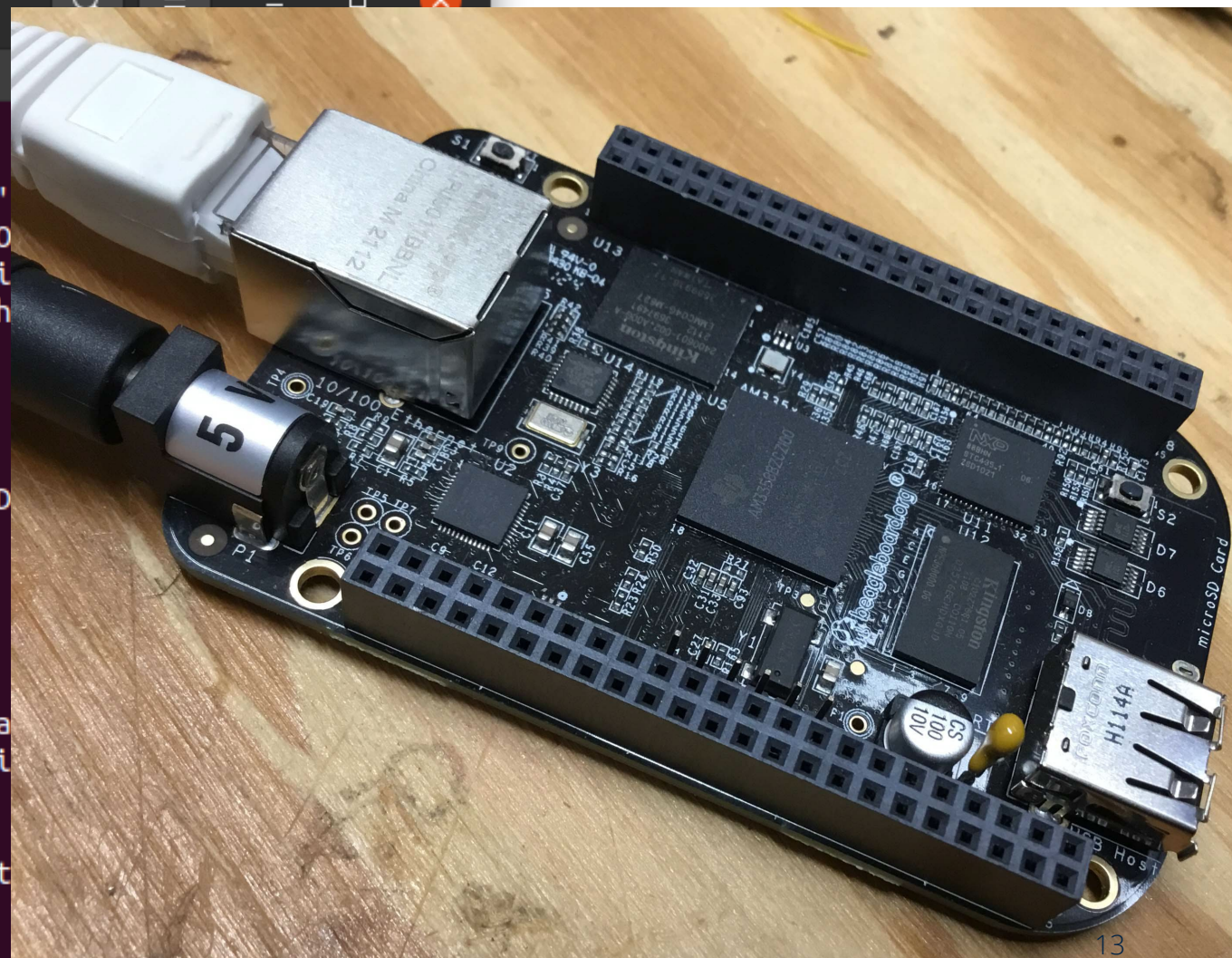
>	192.168.1.127	192.168.1.127	Amcrest Technologies	9C:8E:CD:0C:24:B6	
>	0005CD960886	192.168.1.145	D&M Holdings Inc.	00:05:CD:96:08:86	
>	shopUbuntu885	192.168.1.151			
>	Shop	192.168.1.155	Samsung Electronics ...	54:BD:79:19:D1:90	
>	Samsung	192.168.1.173	Samsung Electronics ...	D8:E0:E1:35:C9:F2	
>	amazon-76b8b2a8f	192.168.1.199	Amazon Technologies...	FC:65:DE:50:D4:F1	
>	RokuUltraHouse	192.168.1.201		BC:D7:D4:34:DA:53	
>	nas-01-69-EC	192.168.1.203	Infrant Technologies, I...	00:0D:A2:01:69:EC	
>	synology1	192.168.1.236	Synology Incorporated	00:11:32:6D:F3:0D	
>	HP1E386E	192.168.1.237	Hewlett Packard	AC:E2:D3:1E:38:6F	
>	Cindy	192.168.1.248	Intel Corporate	F4:96:34:51:C2:3C	

12

6:18 PM 4/22/2022

Dog Food – Connect to the BBB via SSH

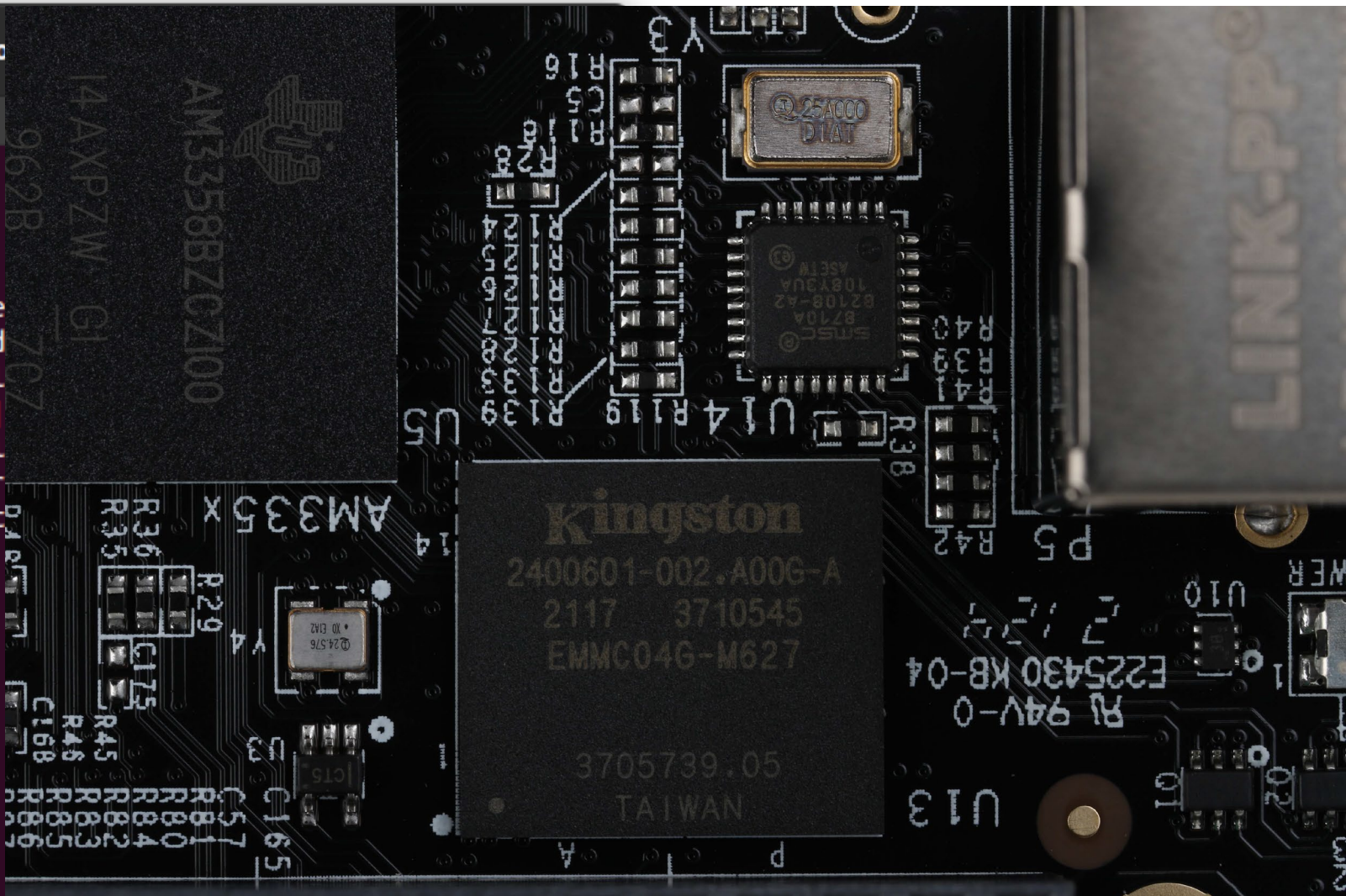
```
debian@beaglebone: ~  
File Edit View Search Terminal Help  
  
fred@shopUbuntu885:~$ ssh debian@192.168.1.104  
The authenticity of host '192.168.1.104 (192.168.1.104)'  
ECDSA key fingerprint is SHA256:eI0RSJ/H4tf+39F0C/d7L290  
Are you sure you want to continue connecting (yes/no/[fi  
Warning: Permanently added '192.168.1.104' (ECDSA) to th  
Debian GNU/Linux 10  
  
BeagleBoard.org Debian Buster IoT Image 2020-04-06  
Support: http://elinux.org/Beagleboard:BeagleBoneBlack\_D  
default username:password is [debian:tempwd]  
  
debian@192.168.1.104's password:  
  
The programs included with the Debian GNU/Linux system a  
the exact distribution terms for each program are descri  
individual files in /usr/share/doc/*/copyright.  
  
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to t  
permitted by applicable law.  
debian@beaglebone:~$
```



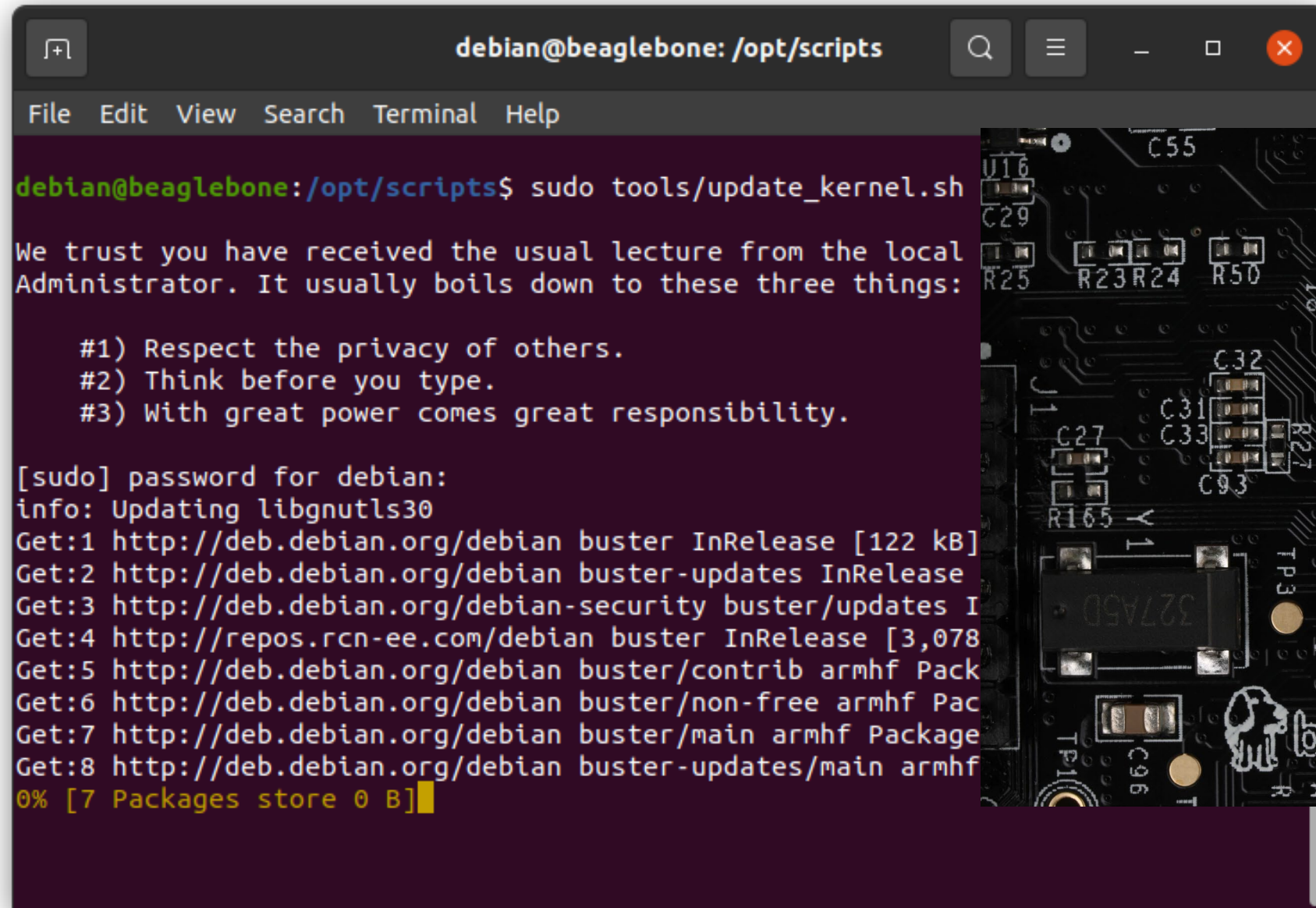
Dog Food – Update the BBB Boot-up Scripts

```
debian@beaglebone: /c
File Edit View Search Terminal Help

debian@beaglebone:~$ cd /opt/scripts
debian@beaglebone:/opt/scripts$ git pull
remote: Enumerating objects: 328, done.
remote: Counting objects: 100% (328/328), done
remote: Compressing objects: 100% (107/107), d
remote: Total 295 (delta 211), reused 264 (del
Receiving objects: 100% (295/295), 34.37 KiB |
Resolving deltas: 100% (211/211), completed wi
From https://github.com/RobertCNelson/boot-scr
    b39ec67..674bb55  master    -> origin/mast
Updating b39ec67..674bb55
Fast-forward
 boot/am335x_evm.sh
 boot/bbai.sh
 boot/bbai_usb_gadget.sh
 boot/beagle_x15.sh
 boot/generic-startup.sh
 .../buster/lxqt/lxqt/globalkeyshortcuts.conf
 desktop-defaults/buster/lxqt/lxqt/panel.conf
 device/bbai64/BBAI64-eeprom.dump
 device/bone/capes/BeagleBoard.org/A1Fan_Cape.dump
 tools/config_checking/docker/check-config.sh
 tools/developers/update_bootloader.sh
```



Dog Food – Update the BBB Kernel



```
debian@beaglebone: /opt/scripts

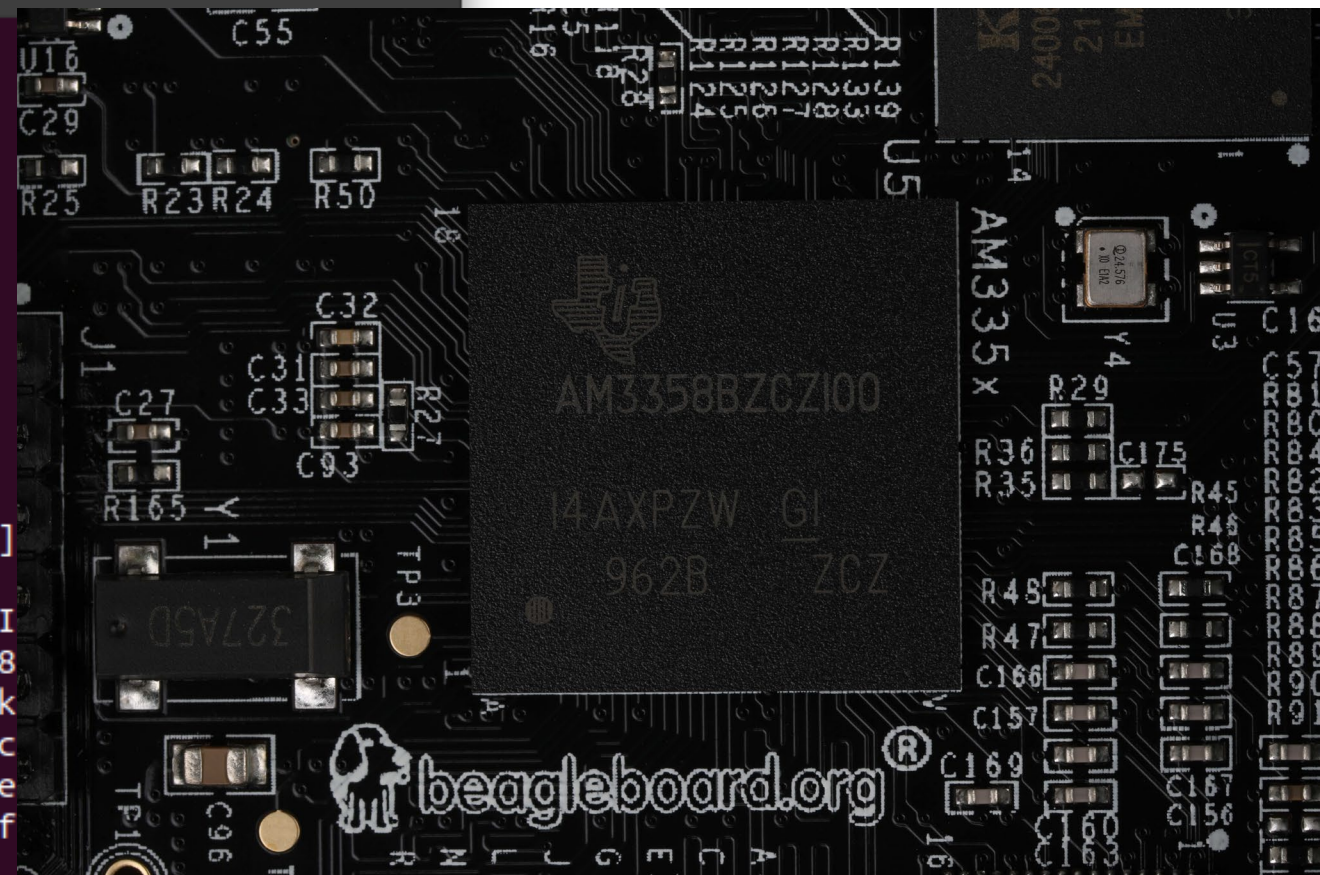
File Edit View Search Terminal Help

debian@beaglebone:/opt/scripts$ sudo tools/update_kernel.sh

We trust you have received the usual lecture from the local
Administrator. It usually boils down to these three things:

#1) Respect the privacy of others.
#2) Think before you type.
#3) With great power comes great responsibility.

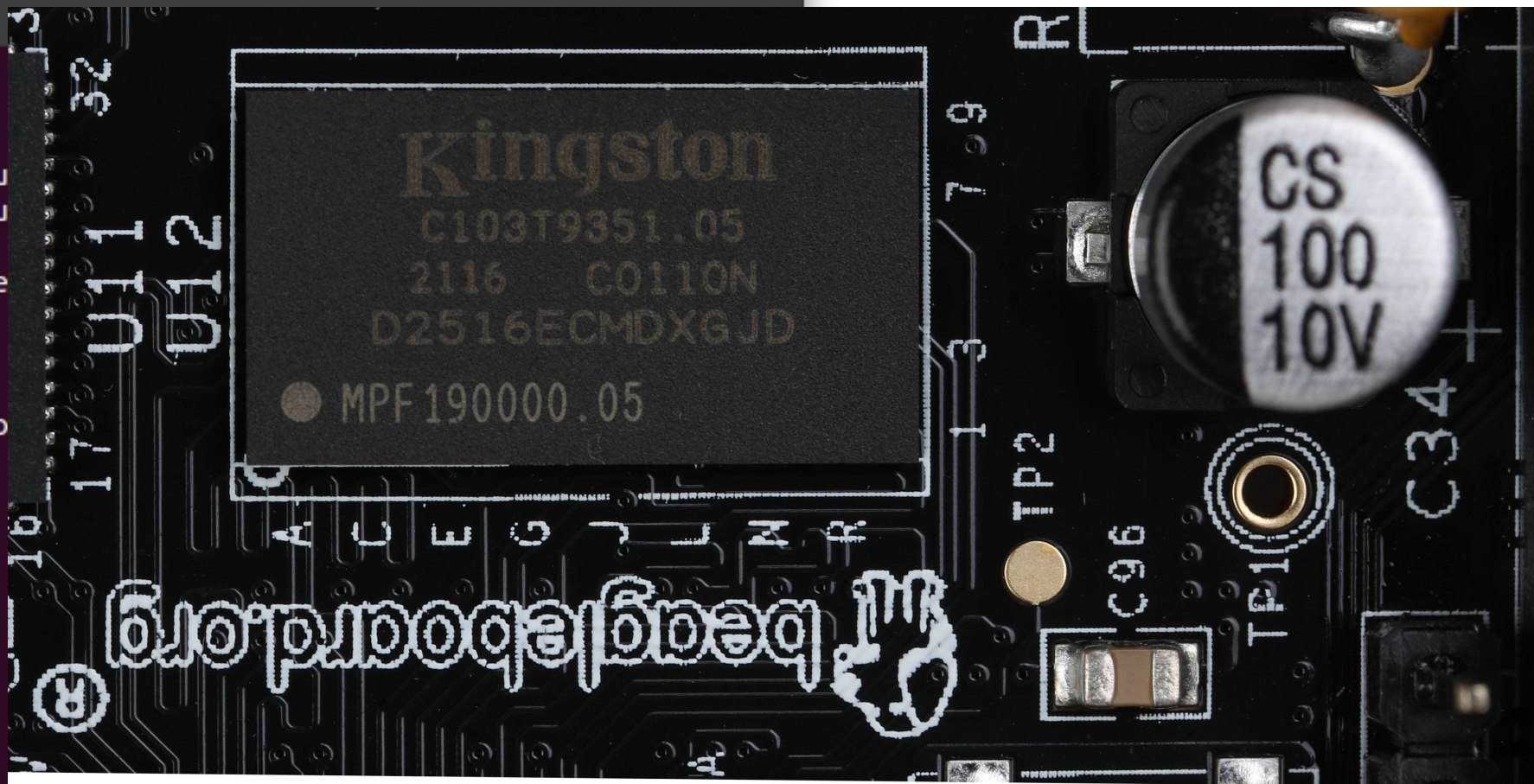
[sudo] password for debian:
info: Updating libgnutls30
Get:1 http://deb.debian.org/debian buster InRelease [122 kB]
Get:2 http://deb.debian.org/debian buster-updates InRelease
Get:3 http://deb.debian.org/debian-security buster/updates I
Get:4 http://repos.rcn-ee.com/debian buster InRelease [3,078
Get:5 http://deb.debian.org/debian buster/contrib armhf Pack
Get:6 http://deb.debian.org/debian buster/non-free armhf Pac
Get:7 http://deb.debian.org/debian buster/main armhf Package
Get:8 http://deb.debian.org/debian buster-updates/main armhf
0% [7 Packages store 0 B]
```



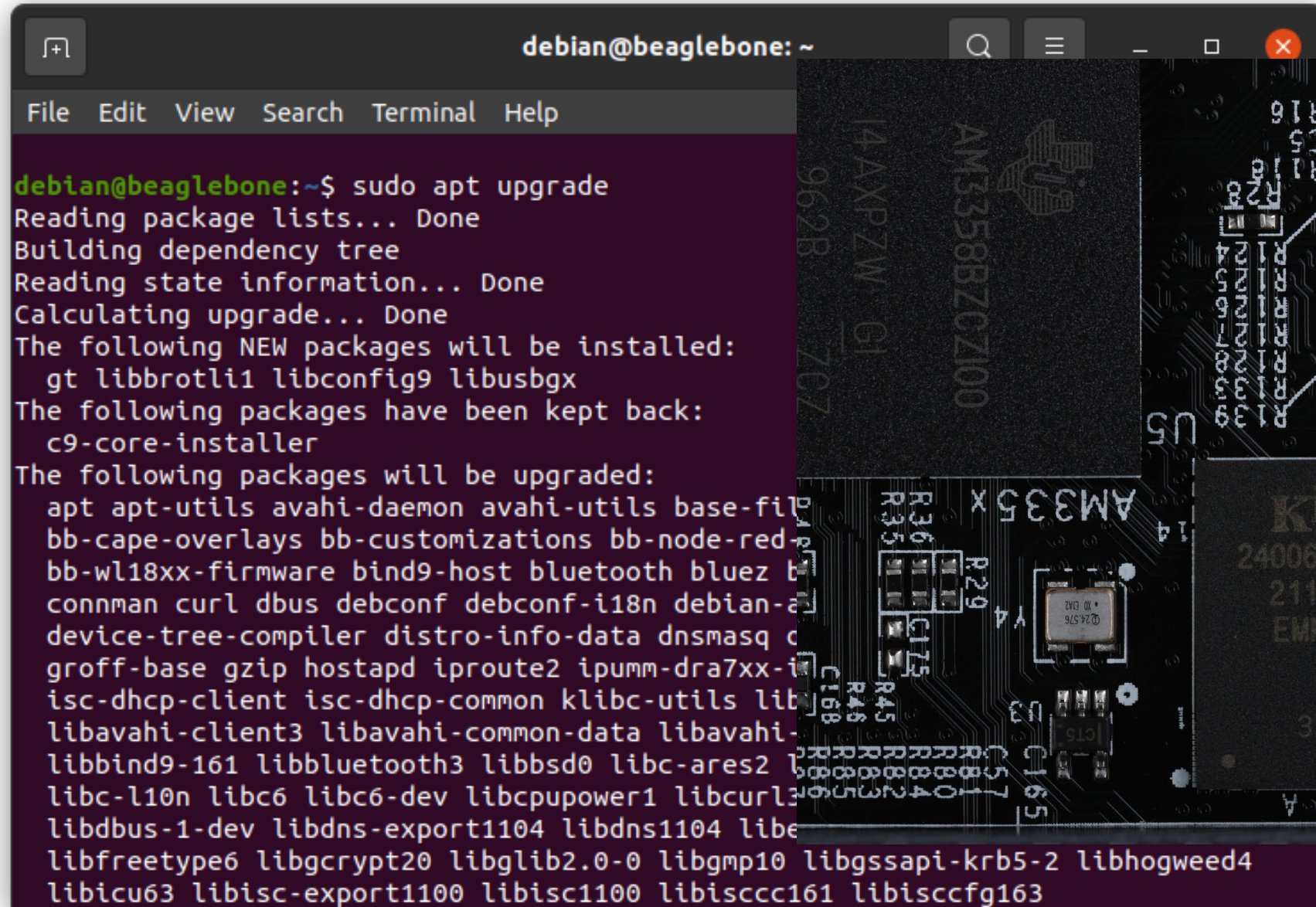
Dog Food – Update Distribution Components



```
debian@beaglebone: ~  
File Edit View Search Terminal Help  
  
debian@beaglebone:~$ sudo apt update  
[sudo] password for debian:  
Hit:1 http://deb.debian.org/debian bu  
Hit:2 http://deb.debian.org/debian bu  
Hit:3 http://repos.rcn-ee.com/debian  
Hit:4 http://deb.debian.org/debian-se  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
167 packages can be upgraded. Run 'ap  
debian@beaglebone:~$
```



Dog Food – Update Distribution Components



```
debian@beaglebone: ~  
File Edit View Search Terminal Help  
  
debian@beaglebone:~$ sudo apt upgrade  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
Calculating upgrade... Done  
The following NEW packages will be installed:  
  gt libbrotli1 libconfig9 libusb1  
The following packages have been kept back:  
  c9-core-installer  
The following packages will be upgraded:  
  apt apt-utils avahi-daemon avahi-utils base-files  
  bb-cape-overlays bb-customizations bb-node-red  
  bb-wl18xx-firmware bind9-host bluetooth bluez  
  connman curl dbus debconf debconf-i18n debian-  
  device-tree-compiler distro-info-data dnsmasq  
  groff-base gzip hostapd iproute2 iputils ipw7xx-f  
  isc-dhcp-client isc-dhcp-common klibc-utils lib  
  libavahi-client3 libavahi-common-data libavahi-  
  libbind9-161 libbluetooth3 libbsd0 libc-ares2  
  libc-l10n libc6 libc6-dev libcpupower1 libcurl  
  libdbus-1-dev libdns-export1104 libdns1104 libe  
  libfontconfig1 libgcrypt20 libglib2.0-0 libgmp10 libgssapi-krb5-2 libhogweed4  
  libicu63 libisc-export1100 libisc1100 libisccc161 libisccfg163
```


Throw That Dog a Bone! – Create a C Project

C Project
Create C project of selected type

Project name:

☒ Use default location
Location:

Choose file system:

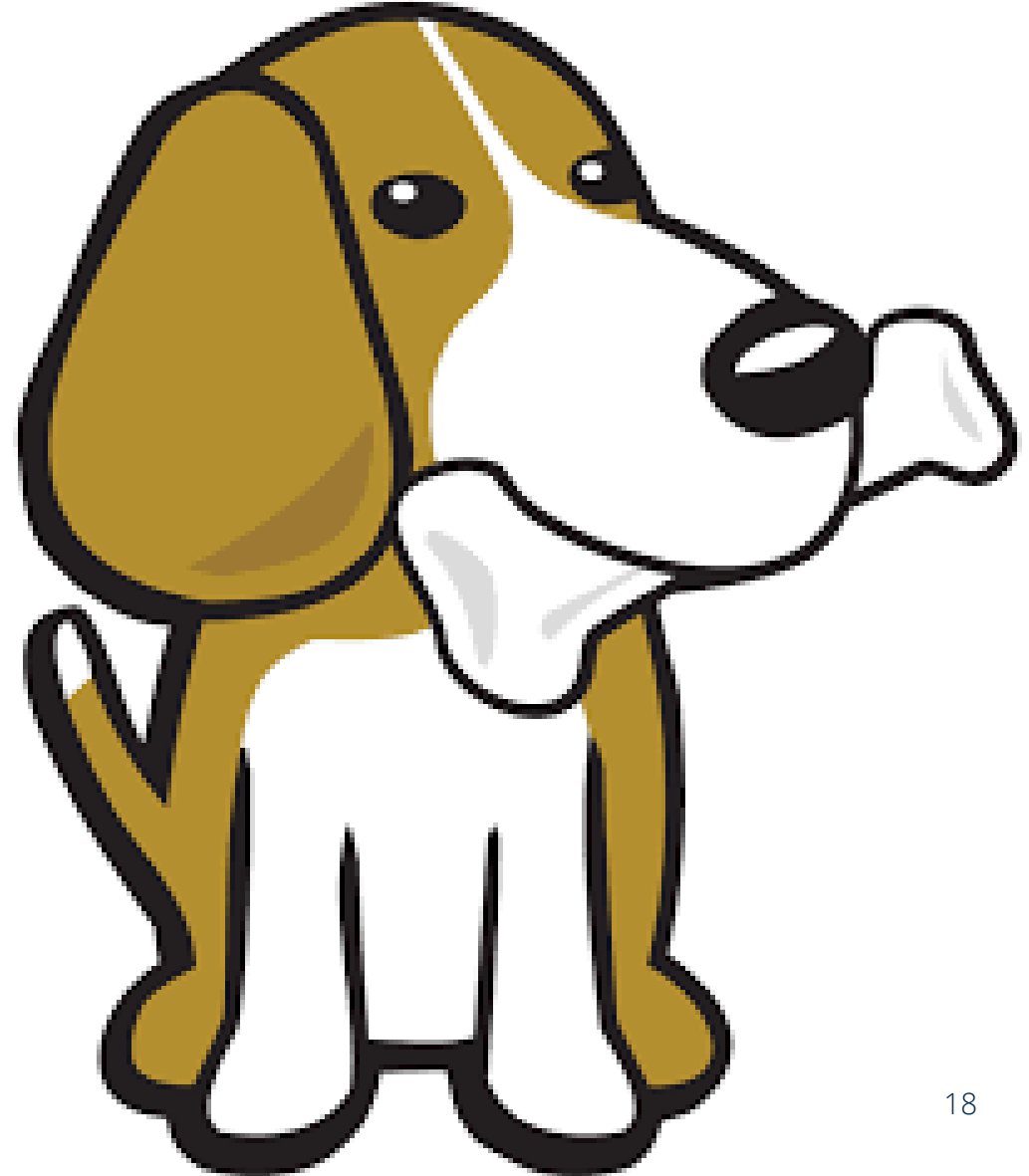
Project type:

- ▶ GNU Autotools
- ▼ Executable
 - Empty Project
 - **Hello World ANSI C Project**
- ▶ Shared Library
- ▶ Static Library
- ▶ Makefile project

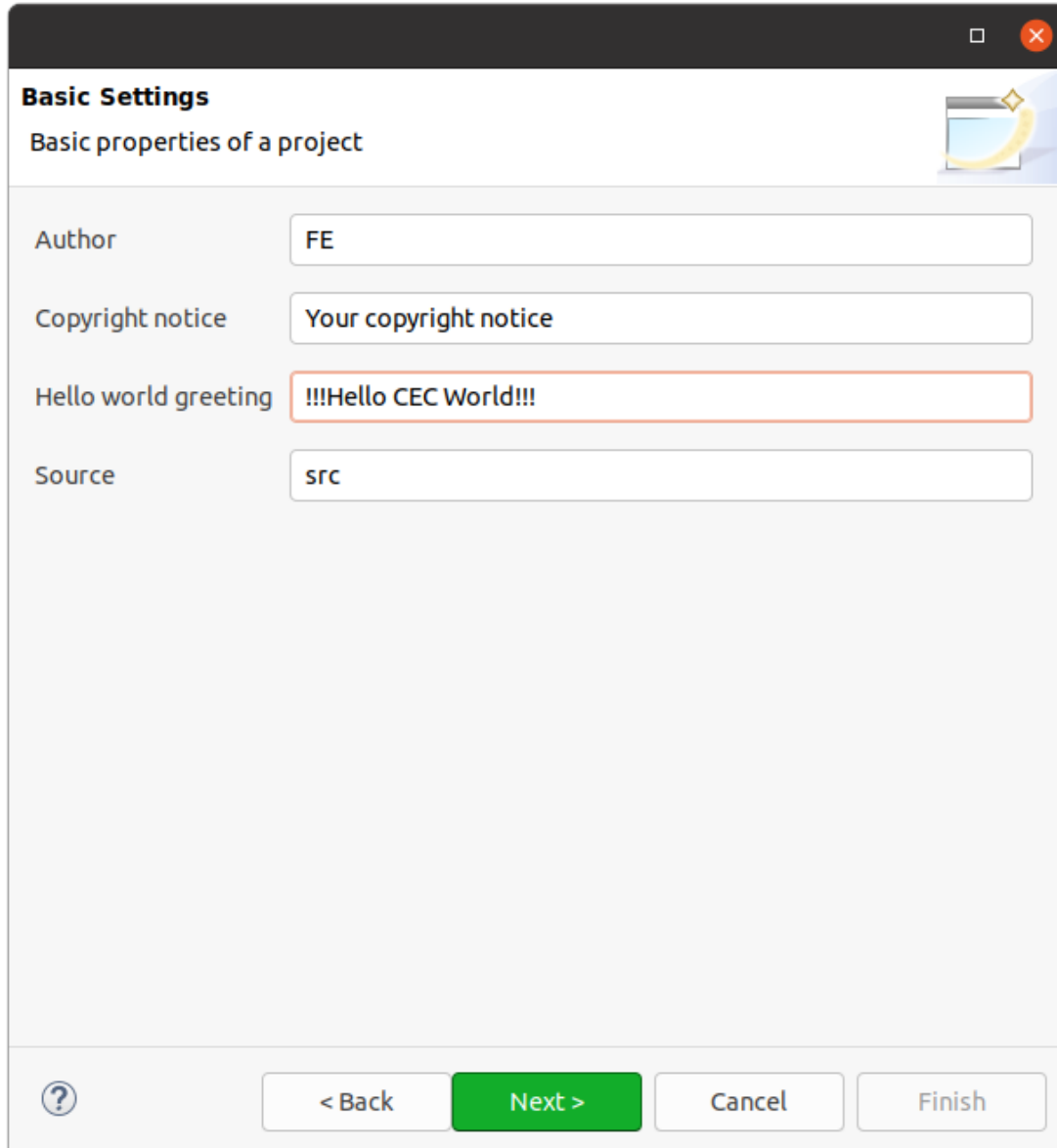
Toolchains:

- Cross GCC**
- Linux GCC

☒ Show project types and toolchains only if they are supported on the platform



Throw That Dog a Bone! – Set Project Basic Properties



The image shows a 'Basic Settings' dialog box with the title 'Basic properties of a project'. It contains four text input fields: 'Author' with 'FE', 'Copyright notice' with 'Your copyright notice', 'Hello world greeting' with '!!!Hello CEC World!!!', and 'Source' with 'src'. The 'Hello world greeting' field is highlighted with a red border. At the bottom, there are four buttons: a help icon (?), '< Back', 'Next >' (highlighted in green), and 'Cancel'. A 'Finish' button is also present at the bottom right.

Field	Value
Author	FE
Copyright notice	Your copyright notice
Hello world greeting	!!!Hello CEC World!!!
Source	src

```
#include <stdio.h>
#include <stdlib.h>

int main(void) {
    puts("!!!Hello CEC World!!!"); /* prints
    !!!Hello CEC World!!! */
    return EXIT_SUCCESS;
}
```

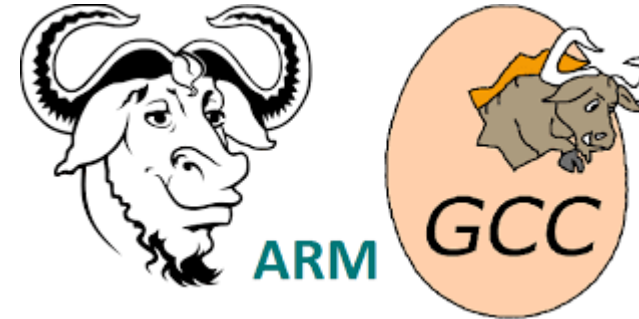

Throw That Dog a Bone! – Configure the Cross GCC Path and Prefix

Cross GCC Command

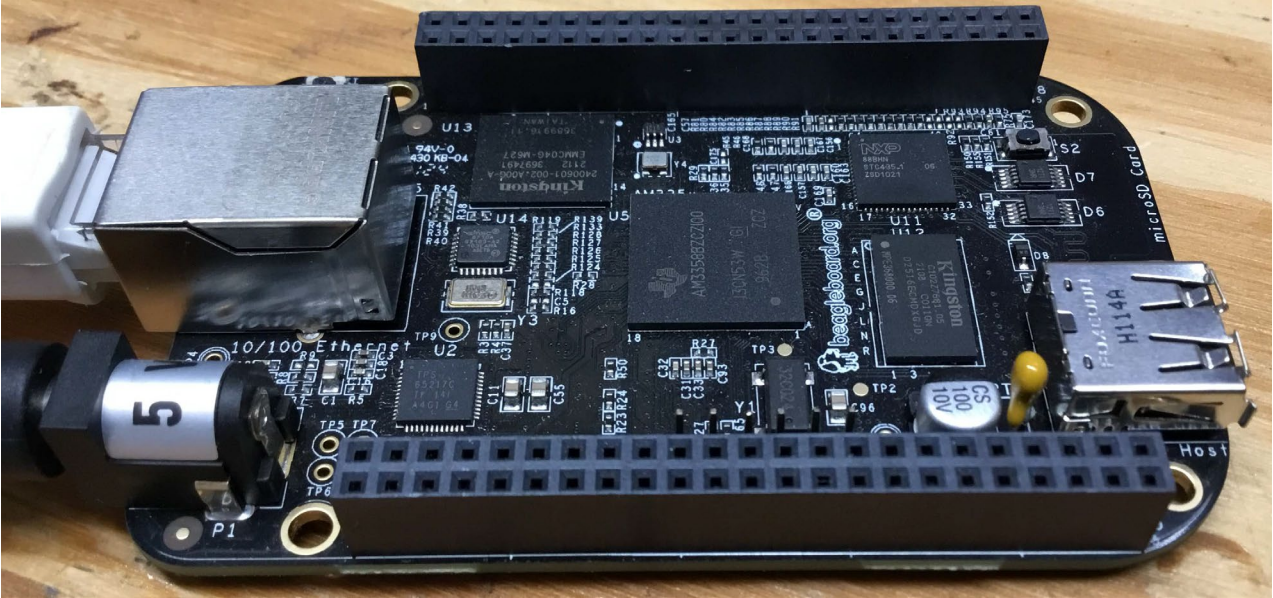
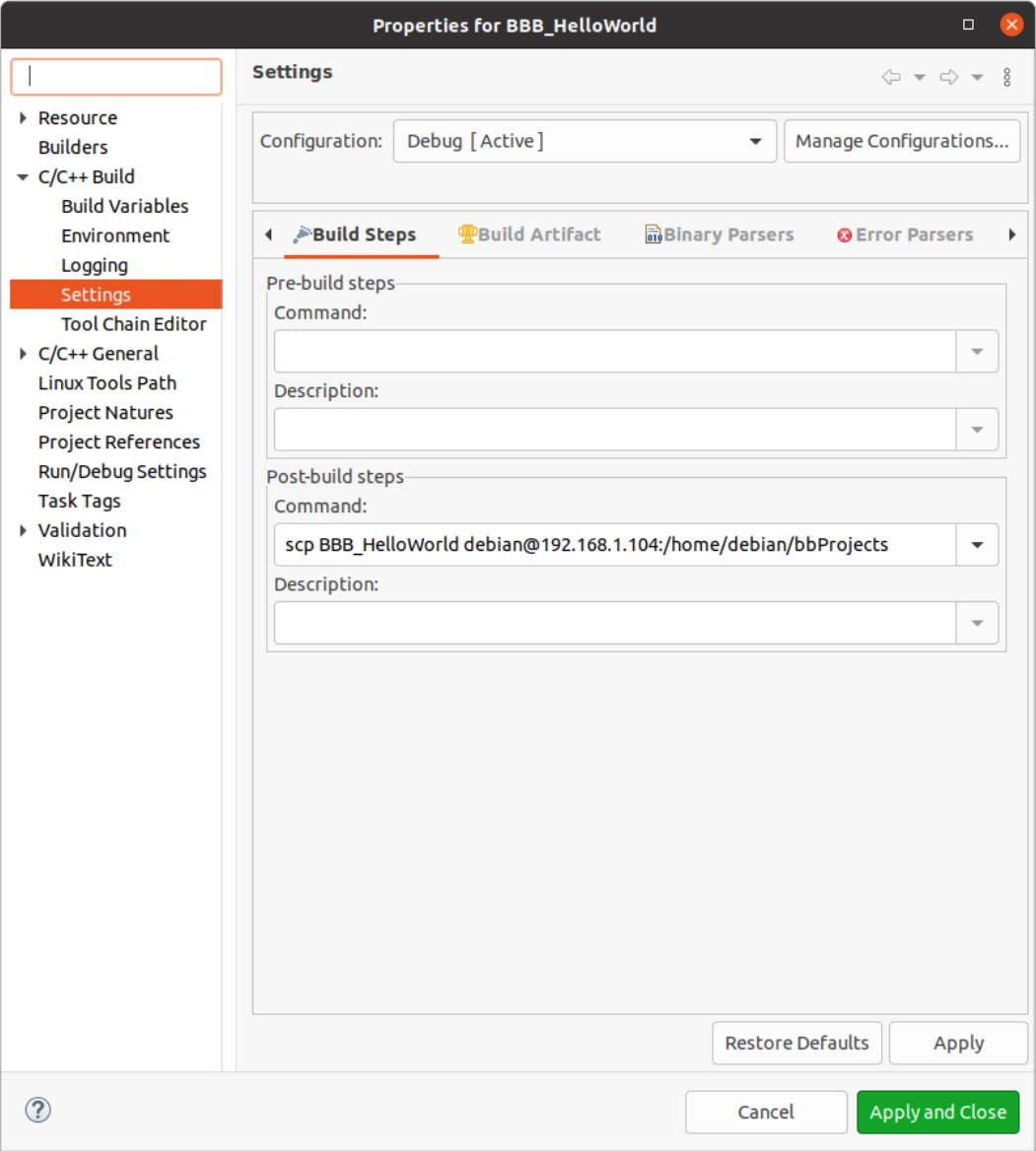
Configure the Cross GCC path and prefix

Cross compiler prefix:

Cross compiler path:



Throw That Dog a Bone! – Edit Post-build Command



Throw That Dog a Bone! – Connect BBB to Eclipse

New Connection

Remote Linux System Connection

Define connection information

Parent profile:

shopUbuntu885

Host name:

192.168.1.104

Connection name:

bb104

Description:

☐ Verify host name

[Configure proxy settings](#)

?

< Back

Next >

Cancel

Finish

Remote Systems

Local

Local Files

Local Shells

bb104

Sftp Files

My Home

Root

/

bin

boot

dev

etc

Throw That Dog a Bone! – Connect BBB to Eclipse

Enter Password

System type:Linux

Host name:192.168.1.104

Connection name:bb104

User ID:

debian

Password (optional):

☒ Save user ID

☒ Save password

Cancel

OK

Throw That Dog a Bone!

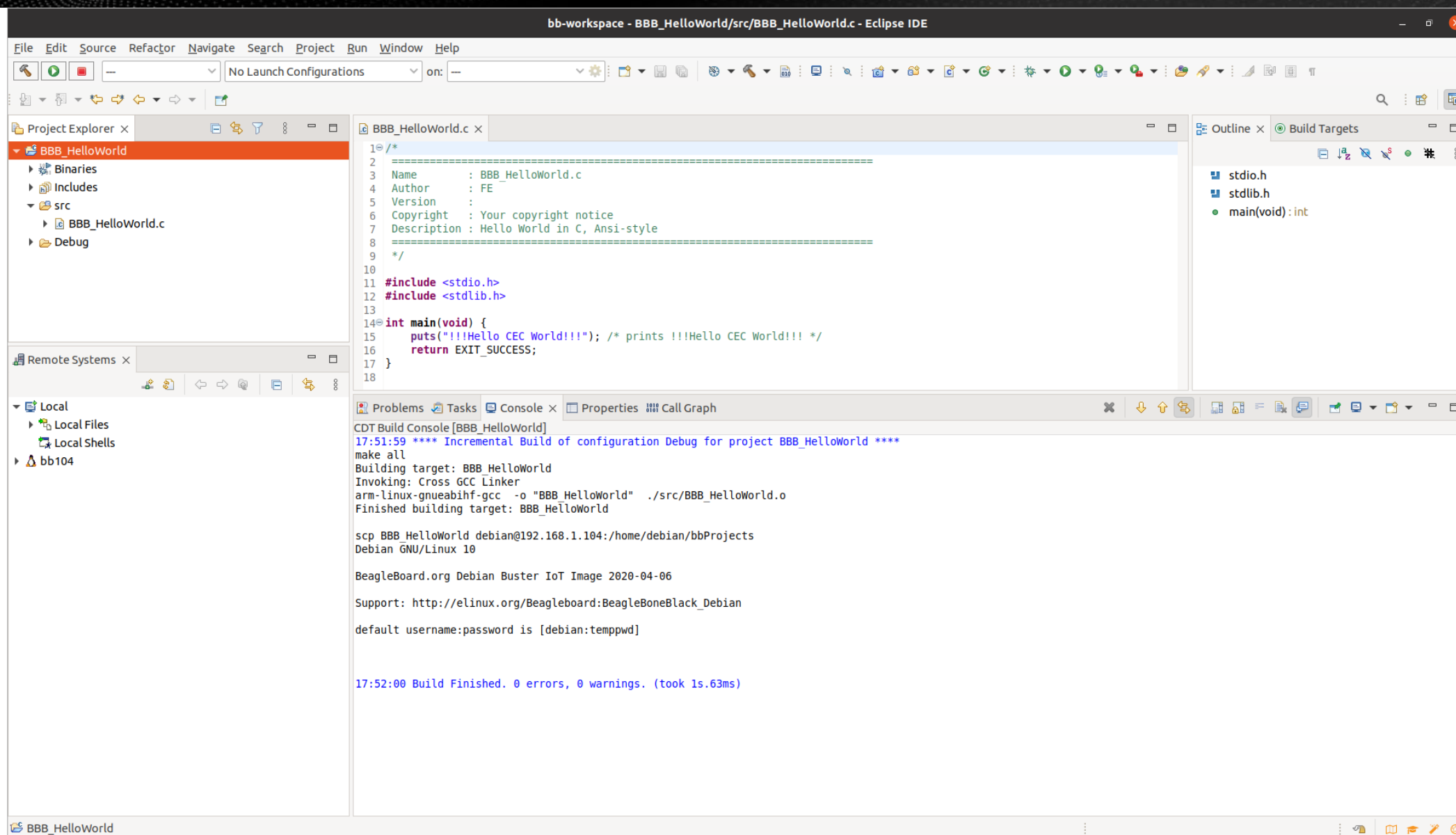
```
/*  
=====
```

Name	: BBB_HelloWorld.c
Author	: FE
Version	:
Copyright	: Your copyright notice
Description	: Hello World in C, Ansi-style

```
=====
```

```
*/  
  
#include <stdio.h>  
#include <stdlib.h>  
  
int main(void) {  
puts("!!!Hello CEC World!!!"); /* prints !!!Hello CEC World!!! */  
return EXIT_SUCCESS;  
}
```


Throw That Dog a Bone!



```
bb-workspace - BBB_HelloWorld/src/BBB_HelloWorld.c - Eclipse IDE

File Edit Source Refactor Navigate Search Project Run Window Help

No Launch Configurations on:

Project Explorer
BBB_HelloWorld
  Binaries
  Includes
  src
    BBB_HelloWorld.c
  Debug

Remote Systems
Local
  Local Files
  Local Shells
  bb104

BBB_HelloWorld.c
1 /*
2  *
3  * Name      : BBB_HelloWorld.c
4  * Author    : FE
5  * Version   :
6  * Copyright : Your copyright notice
7  * Description: Hello World in C, Ansi-style
8  *
9  */
10
11 #include <stdio.h>
12 #include <stdlib.h>
13
14 int main(void) {
15     puts("!!!Hello CEC World!!!"); /* prints !!!Hello CEC World!!! */
16     return EXIT_SUCCESS;
17 }
18

Problems Tasks Console Properties Call Graph
CDT Build Console [BBB_HelloWorld]
17:51:59 **** Incremental Build of configuration Debug for project BBB_HelloWorld ****
make all
Building target: BBB_HelloWorld
Invoking: Cross GCC Linker
arm-linux-gnueabi-gcc -o "BBB_HelloWorld" ./src/BBB_HelloWorld.o
Finished building target: BBB_HelloWorld

scp BBB_HelloWorld debian@192.168.1.104:/home/debian/bbProjects
Debian GNU/Linux 10

BeagleBoard.org Debian Buster IoT Image 2020-04-06

Support: http://elinux.org/Beagleboard:BeagleBoneBlack_Debian

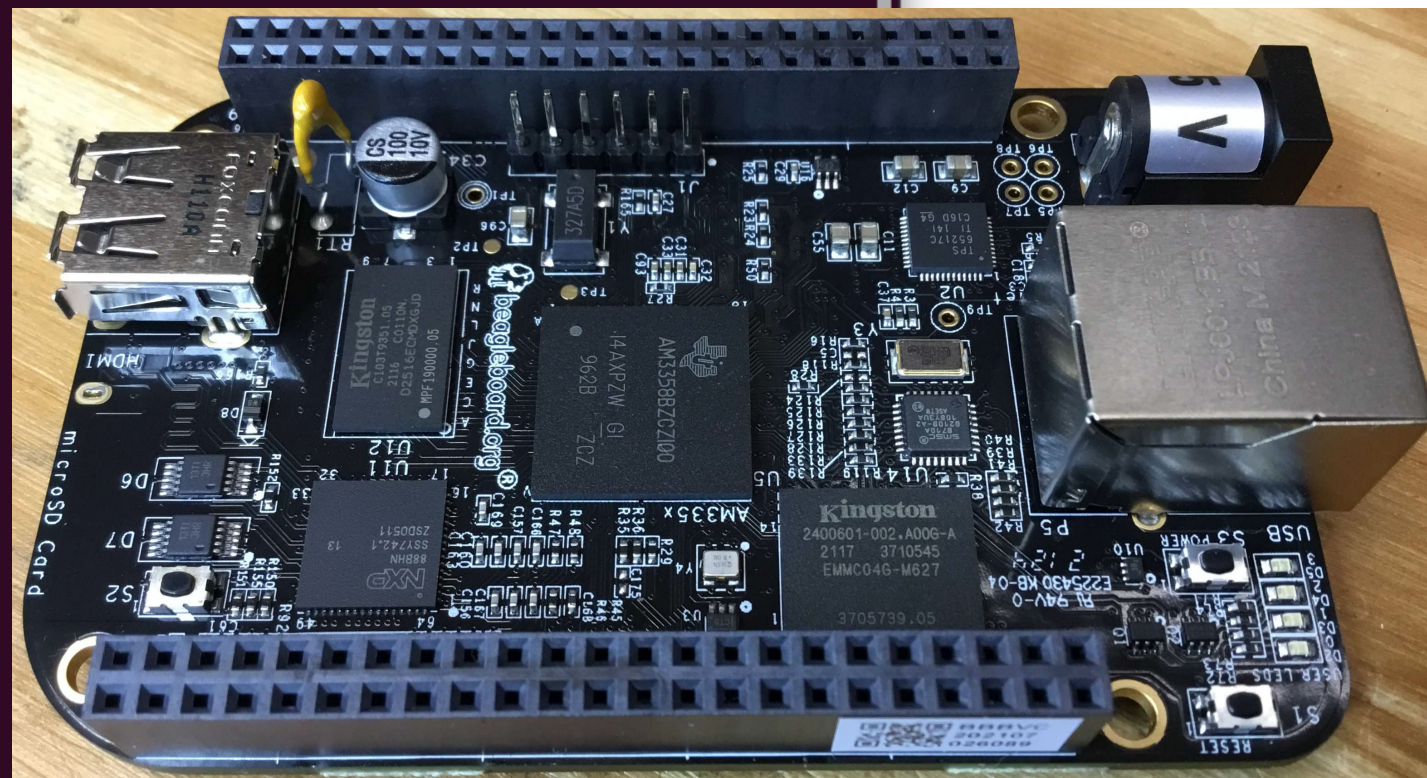
default username:password is [debian:tempwd]

17:52:00 Build Finished. 0 errors, 0 warnings. (took 1s.63ms)
```


Throw That Dog a Bone!

```
debian@beaglebone: ~/bbProjects
File Edit View Search Terminal Help

debian@beaglebone:~/bbProjects$ ls -l
total 44
-rwxr-xr-x 1 debian debian 42836 Apr 25 21:52 BBB_HelloWorld
debian@beaglebone:~/bbProjects$ ./BBB_HelloWorld
!!!Hello CEC World!!!
debian@beaglebone:~/bbProjects$
```



Thank you for attending!!!


Please consider the resources below:

- [BeagleBone Black How-To PDF](#)
- [BeagleBone.org](#)

No Download package today.

MORE TO COME..

P9				P8			
Function	Physical Pins		Function	Function	Physical Pins		Function
DGND	1	2	DGND	DGND	1	2	DGND
VDD 3.3 V	3	4	VDD 3.3 V	MMC1_DAT6	3	4	MMC1_DAT7
VDD 5V	5	6	VDD 5V	MMC1_DAT2	5	6	MMC1_DAT3
SYS 5V	7	8	SYS 5V	GPIO_66	7	8	GPIO_67
PWR_BUT	9	10	SYS_RESET	GPIO_69	9	10	GPIO_68
UART4_RXD	11	12	GPIO_60	GPIO_45	11	12	GPIO_44
UART4_TXD	13	14	EHRPWM1A	EHRPWM2B	13	14	GPIO_26
GPIO_48	15	16	EHRPWM1B	GPIO_47	15	16	GPIO_46
SPIO_CSO	17	18	SPIO_D1	GPIO_27	17	18	GPIO_65
I2C2_SCL	19	20	I2C_SDA	EHRPWM2A	19	20	MMC1_CMD
SPIO_DO	21	22	SPIO_SLCK	MMC1_CLK	21	22	MMC1_DAT5
GPIO_49	23	24	UART1_TXD	MMC1_DAT4	23	24	MMC1_DAT1
GPIO_117	25	26	UART1_RXD	MMC1_DAT0	25	26	GPIO_61
GPIO_115	27	28	SP11_CSO	LCD_VSYNC	27	28	LCD_PCLK
SP11_DO	29	30	GPIO_112	LCD_HSYNC	29	30	LCD_AC_BIAS
SP11_SCLK	31	32	VDD_ADC	LCD_DATA14	31	32	LCD_DATA15
AIN4	33	34	GND_ADC	LCD_DATA13	33	34	LCD_DATA11
AIN6	35	36	AIN5	LCD_DATA12	35	36	LCD_DATA10
AIN2	37	38	AIN3	LCD_DATA8	37	38	LCD_DATA9
AIN0	39	40	AIN1	LCD_DATA6	39	40	LCD_DATA7
GPIO_20	41	42	ECAPWMO	LCD_DATA4	41	42	LCD_DATA5
DGND	43	44	DGND	LCD_DATA2	43	44	LCD_DATA3
DGND	45	46	DGND	LCD_DATA0	45	46	LCD_DATA1



LEGEND

Power, Ground, Reset

Digital Pins

PWM Output

1.8 Volt Analog Inputs

Shared I2C Bus

Reconfigurable Digital



DesignNews

Thank You

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