System on a Chip (SoC)

How to Use These Tiny but Powerful Linux Devices

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at Sector67

Overview
• Meet the SoCs
• Beginning Steps: What you need
• Updating SD memory
• SSH: Necessary Tool
• Updating Debian
• Linux Basics
• Remote Access, (LXTerm, VNC)
• Hands-On: Your Turn

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• Hands-On: Your Turn

What is A SoC?
A System on a Chip (SoC) is a method of placing all necessary electronics for running a computer on a single chip. Instead of having an individual chip for the CPU, GPU, USB controller, RAM, Northbridge, Southbridge, etc., everything is compressed down into one tidy package — Raspberry Pi.org

Raspberry Pi 2
• A 900MHz quad-core ARM Cortex-A7 CPU, 1GB RAM
• 4 USB ports
• 40 GPIO pins
• Full HDMI port
• Ethernet port
• Combined 3.5mm audio jack ar
• Camera interface (CSI)
• Display interface (DSI)
• Micro SD card slot
• VideoCore IV 3D graphics core

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Beaglebone Black
• 1GHz ARM® Cortex-A8 (AM335x)
• 3D graphics accelerator
• NEON floating-point accelerator
• 2x PRU 32 bit microcontrollers
• USB client: power, debug and device
• USB host
• Ethernet
• Micro-SD
• Micro HDMI output
• 2x 46 pin headers: 2x I2C, 5x UART, 12S, SPI, CAN, 66x 3.3V GPIO, 7x ADC
• 4Gb Embedded eMMC Flash
• Debian Distribution

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I/O Board Add-Ons

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WARNING: Either Capes or Shields may not be compatible together. Check before buying...
Stand-Alone System

Raspberry Pi 2
- 5V Power Supply
- USB Keyboard
- USB Mouse
- HDMI Monitor
- HDMI Cable
- Micro SD (8GByte)

Beaglebone Black
- 5V Power Supply
- USB Keyboard
- USB Mouse
- USB Hub (Note 1)
- HDMI Monitor
- HDMI Cable
- Micro SD (8GByte)

Note 1: Some keyboards have a USB mouse or USB port for a mouse

Minimum System

Raspberry Pi 2
- 5V Power Supply
- Ethernet Cable
- Switch/Router/Firewall
- Micro SD (8GByte)

Beaglebone Black
- USB Cable (provided)

Both require a Laptop/Desktop with Monitor/Mouse/Keyboard for programming and configuration.

It should support SSH (Secure Shell) remote access (and optionally VNC).

OS Updating

Program The Compact Flash
1. Plug the SD into an adapter and plug the adapter into your computer.
2. Download the SD image to flash to a computer.
3. Decompress the image (tool depends on the chip image).
4. Erase the SD using recommended tools.
5. Flash the SD from your computer using the recommended tool.

Place the SD into your SoC and Boot!

Try Other Operating Systems with a New SD

BBB Optional: Use a “flasher” image on a 4GByte SD card and have the BBB flash it to the on-board eMMC memory.

SSH: Secure Shell

Secure Shell, or SSH is a cryptographic (encrypted) network protocol for initiating text-based sessions on remote machines in a secure way. SSH has replaced Telnet as the way we make a connection to a remote computer. It is available free for most platforms. The client is built in for Linux/Unix/OSX. The most common Windows version is PuTTY.

**SSH to BeagleBone Remote**

```bash
[tjk@phenom20 ~]$ ssh debian@192.168.2.10
The authenticity of host '192.168.2.10 (192.168.2.10)' can't be established.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.2.10' (ECDSA) to the list of known hosts.
Debian GNU/Linux 7
BeagleBoard.org Debian Image 2015-07-17
default username:password is [debian:temppwd]
debian@192.168.2.10's password:
Last login: Wed 5 02:44:05 2015 from 192.168.2.127
debian@beaglebone:$
```

**SSH Over USB**

```bash
[tjk@phenom20 ~]$ ssh debian@192.168.7.2
The authenticity of host '192.168.7.2 (192.168.7.2)' can't be established.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.7.2' (RSA) to the list of known hosts.
Debian GNU/Linux 7
BeagleBoard.org Debian Image 2015-07-17
default username:password is [debian:temppwd]
debian@192.168.7.2's password: temppwd
Last login: Tue 4 02:46:53 2015 from 192.168.1.130
debian@beaglebone:$
```
What Is My IP Address?

Headless:
- Use Bonjour
- Use Nmap
- Use your Router
- Use "ping" guesses

Tom Kaminski's MacBook-Pro:~ tjk$ nmap -nA 192.168.2.0/24
Password: 
Starting Nmap 6.47 ( http://nmap.org ) at 2015-08-05 21:25 CDT
Nmap scan report for 192.168.2.10
Host is up (0.00061s latency).
PORT   STATE      SERVICE
22/tcp  unfiltered    ssh
MAC Address: D0:39:72:54:73:39 (Texas Instruments)

My IP Address?

Headed: Open a Terminal and:
- Use "sudo ifconfig"
- Use "ip route"

debian@beaglebone:~$ sudo ifconfig
eth0 Link encap:Ethernet  HWaddr d0:39:72:54:73:39
inet addr:192.168.2.10  Bcast:192.168.2.255  Mask:255.255.255.0
inet6 addr: fe80::d239:72ff:fe54:7339/64 Scope:Link
UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
RX packets:34491 errors:0 dropped:0 overruns:0 frame:0
TX packets:17783 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
Interrupt:40

Linux Command Line

Unix/Linux Command Reference

File Commands
- ls -l - list directory
- cd - change directory
- rm - remove file
- mv - move file
date - show current date
lsblk - list block devices
df - show disk size
du - show file size

Linux Text Editor

Screen Editors:
- LEAFPAD (also runs as remote X window)

Terminal Editors:
- VI - System hacker's choice.
- NANO - simple syntax
- EMACS - extreme version for coders. Lots of built in syntax checking.

Updating Debian OS

Updating Debian using apt-get
(you must be connected to the Internet for this)

First, update your system's package list by entering the following command in LXTerminal or from the command line:
sudo apt-get update

Next, upgrade all your installed packages to their latest versions with the command:
sudo apt-get upgrade

X-Windows Remote

Running a remote GUI
To do this, you need an X server on your machine. There is a free one available for Windows and Mac. Two Xservers for Windows are Cygwin (which has a lot more besides) and Xming. For a Mac, either install Gimp for Lion 10.7 or earlier or install X11 from Xquartz. Linux has one built in.

The command uses the X switch to tell ssh to send the X commands to the X server on your host. For Beaglebone (over USB) do:

  ssh -X 192.168.7.2 -l debian
If that gives you errors then try this:

  ssh -Y 192.168.7.2 -l debian

For RaspberryPi, determine your IP address and set the login to "pi".
VNC Remote

In computing, Virtual Network Computing (VNC) is a graphical desktop sharing system that uses the Remote Frame Buffer protocol (RFB) to remotely control another computer.

VNC Servers (installed on the Soc)
- x11vnc
- tightvncserver

VNC Clients (Installed on your PC/Laptop)
- UltraVNC
- TightVNC
- RealVNC
- Others (Mac ScreenSharing App works)

Your Turn

1. Get a Beaglebone or RaspberryPi
2. For BBB, use the USB connection and follow the quickstart guide.
3. For RaspberryPi, we will use the HDMI port and keyboard to set it up from the NOOBS 1.4.1 SD card.
4. After setting it up, we will register the IP address and connect to it from the terminal using PuTTY.

Pi:
https://www.raspberry.org/help/quick-start-guide/

BBB:
http://beagleboard.org/getting-started/