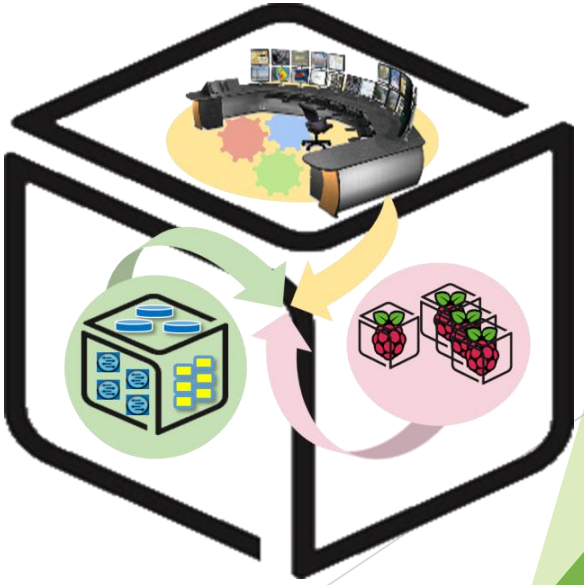
# SmartX Labs
## for Computer Systems

### Build Lab
(2016, Spring)



NetCS Lab

# History and Contributor of Box Lab (2016. 05. 01.)

| Version | Updated Date | Updated Contents | Contributor |
|---|---|---|---|
| - | 2016/04 | (구) Playground Lab 최종본 작성 | 김 병 돈 |
| v1.0 | 2016/05 | Build Lab 초안 작성<br>(Outline 및 Control Tower 추가) | 김 승 룡 |
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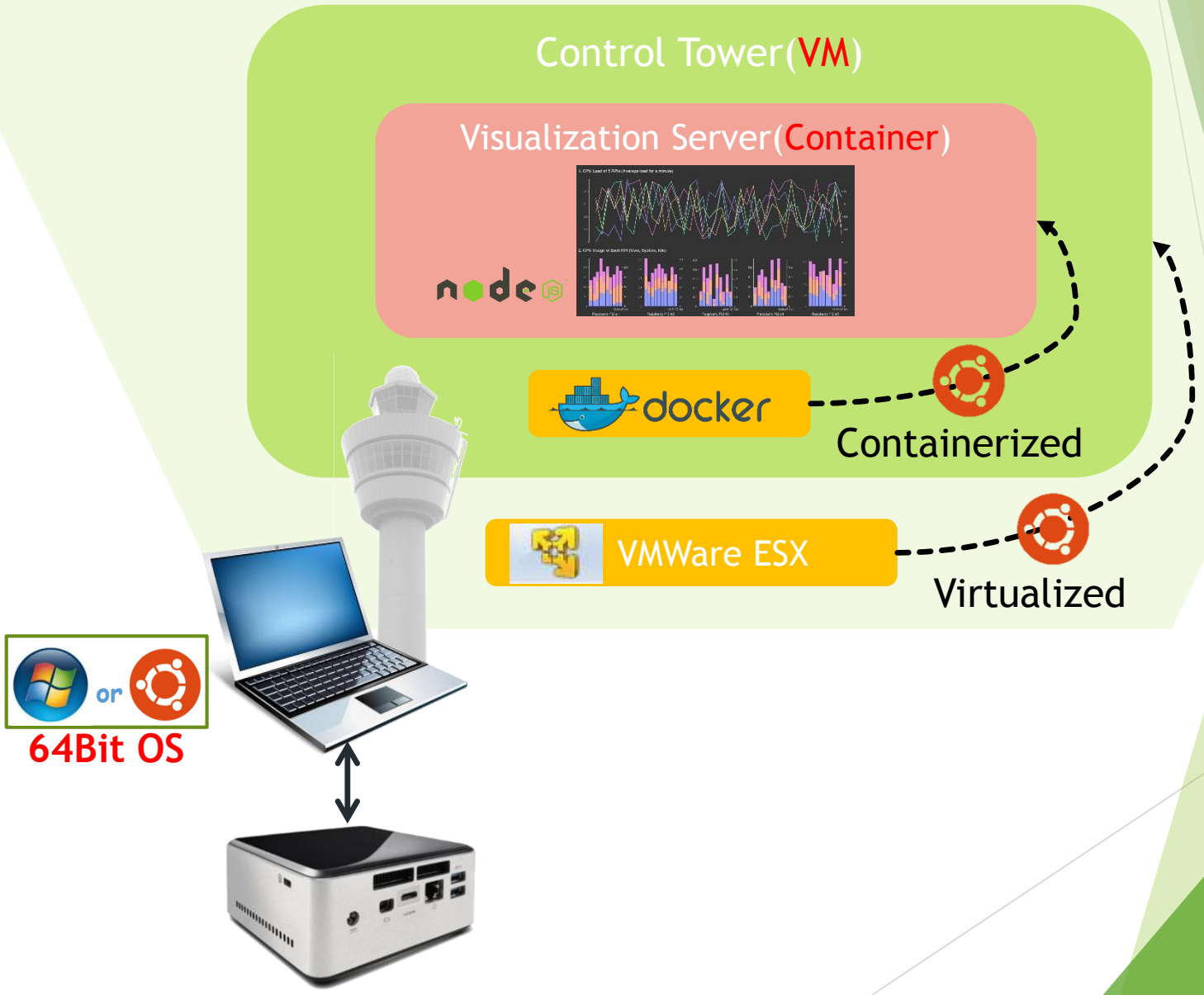
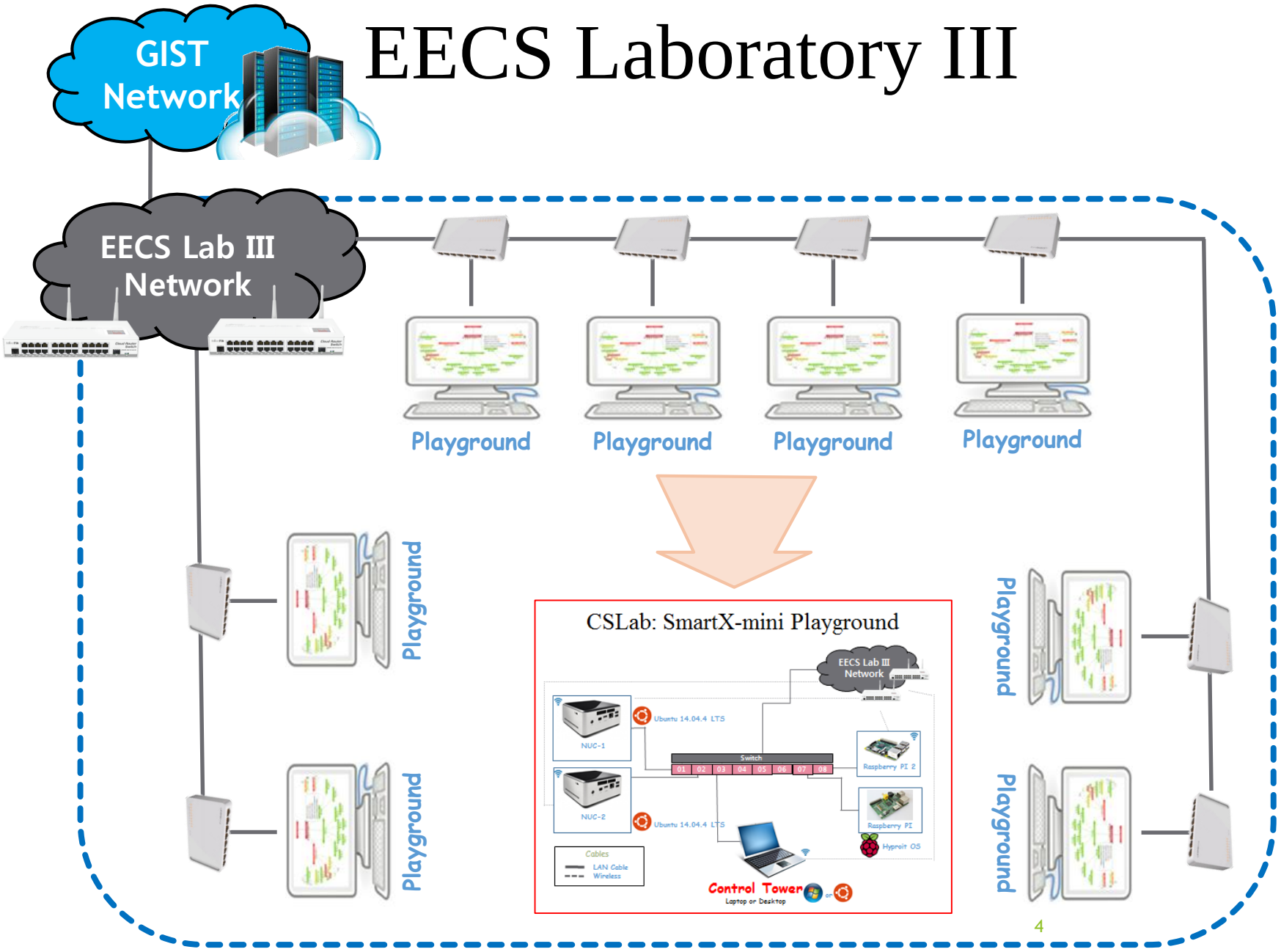
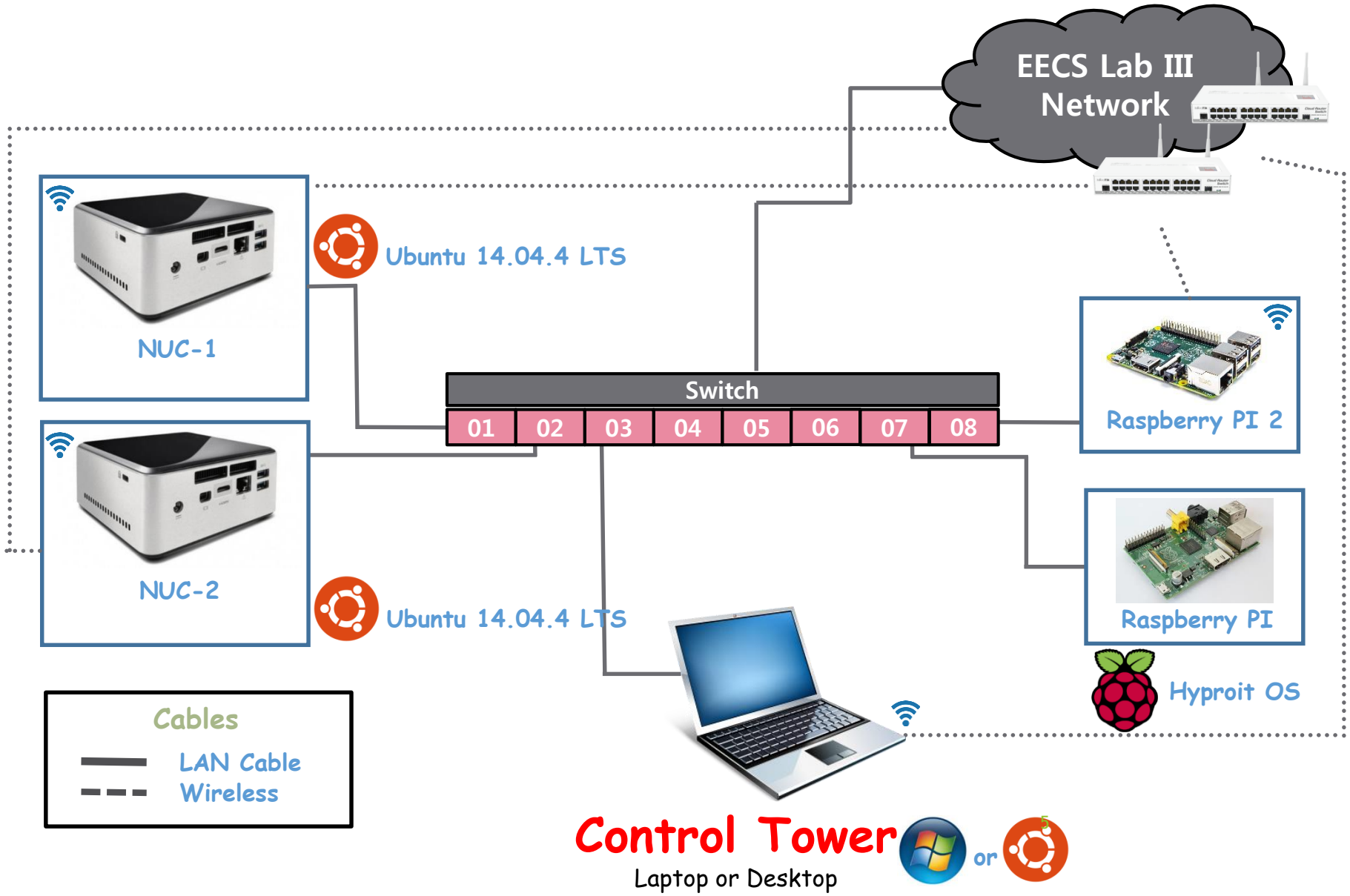
# Build Lab: Outline



# EECS Laboratory III



# CSLab: SmartX-mini Playground

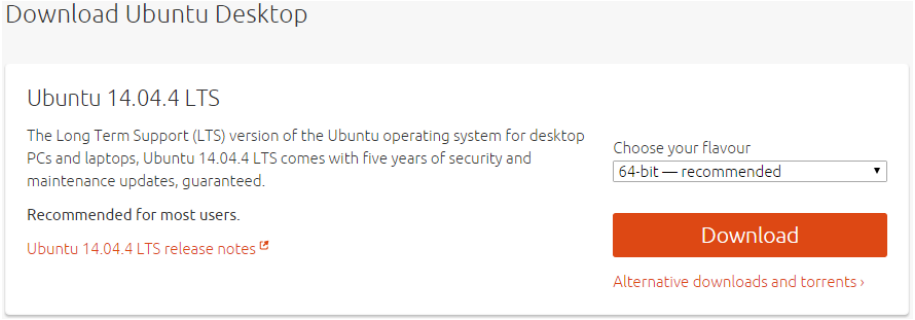


# NUC OS Setting

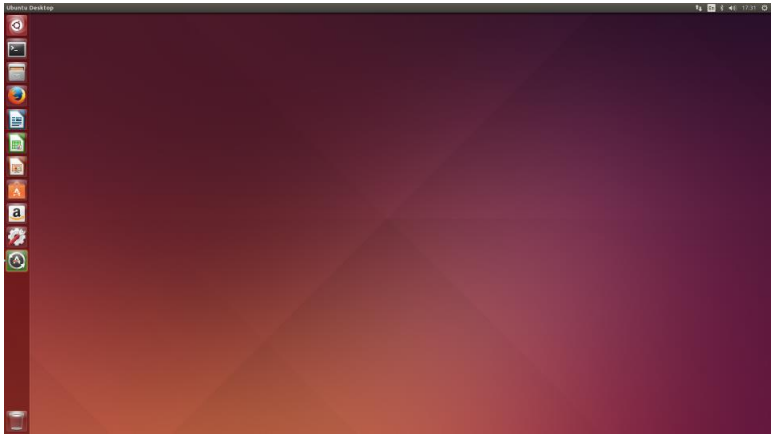
- BIOS Setting (64bit OS 설치시 필요)
  - Booting 후 F2 버튼을 통해 BIOS Setting 화면으로 접속
  - UEFI boot 체크 해제, (Legacy 방식으로 부팅)

# NUC OS Setting

- OS : Ubuntu Desktop 14.04.4 LTS(64bit)
  - Download Site : http://www.ubuntu.com/download/desktop




  - OS 설치를 위해 download 된 파일(ubuntu-14.04.4-desktop-amd64.iso, 0.99Gb)을 이용하여 bootable USB 구성(bootable CD 는 불가능, NUC에 CD-Rom이 없음)
  - NUC에 설치



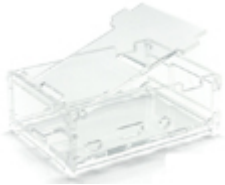


설치 완료 후
Ubuntu 초기화면

# Raspberry Pi2 Start Kit

- Component

**Raspberry Pi2 Model B**



**Pi2 case**

**5V adapter**


**SD card**

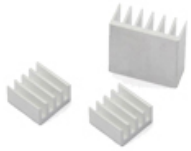
**SD card reader**

**Wi-Fi dongle**

**Lan cable**

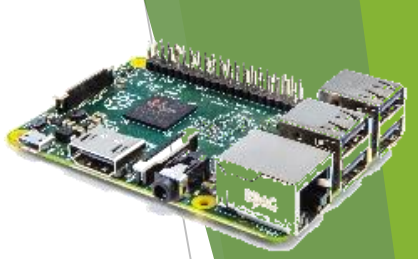
**Micro USB cable**

**HDMI-DVI cable**



**Heat sink**

# Raspberry Pi2 OS Setting



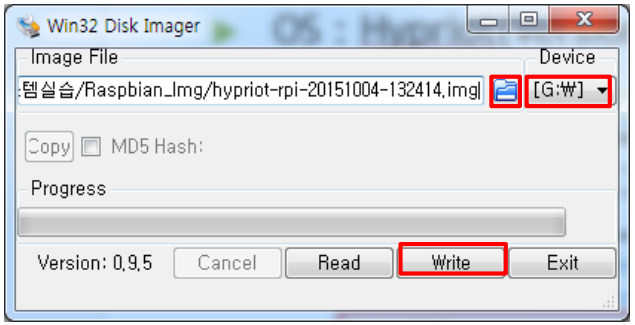
- OS : Hypriot(Version : 0.5 Will, 07.10.2015 published)
  - Download Site : http://blog.hypriot.com/downloads/

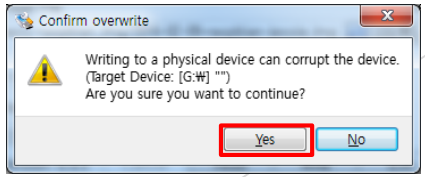
**Hypriot Docker Image for Raspberry Pi**

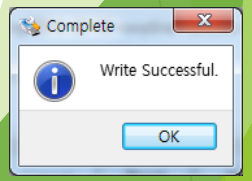
Download and flash this image to your SD card.
Start your Pi with the flashed SD card and enjoy instant Docker awesomeness.

| Description | Download Link | SHA256 Checksum | Published |
|---|---|---|---|
| Version 0.6.1 Hector | hypriot-rpi-20151115-132854.img.zip | Checksum | 15.11.2015 |
| Version 0.6 Hector | hypriot-rpi-20151103-224349.img.zip | Checksum | 03.11.2015 |
| Version 0.5 Will | hypriot-rpi-20151004-132414.img.zip | Checksum | 07.10.2015 |
| Version 0.5 Will (beta) | hypriot-rpi-20150727-151455.img.zip | Checksum | 27.07.2015 |
| Version 0.4 Elizabeth | hypriot-rpi-20150416-201537.img.zip | Checksum | 16.04.2015 |

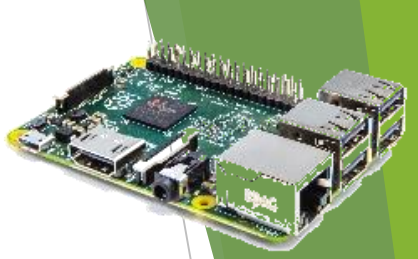
  - 압축을 푼 후 파일(hypriot-rpi-20151004-132414.img, 1.39Gb)은 SD Writer 를 이용하여 Write.
  - SD Writer Download : https://sourceforge.net/projects/win32diskimager/files/latest/download?source=navbar



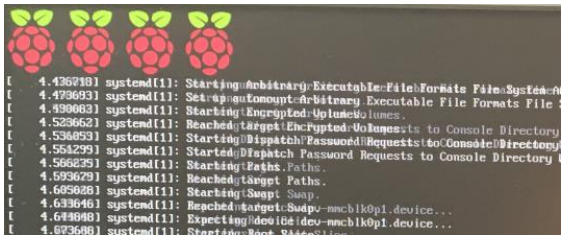



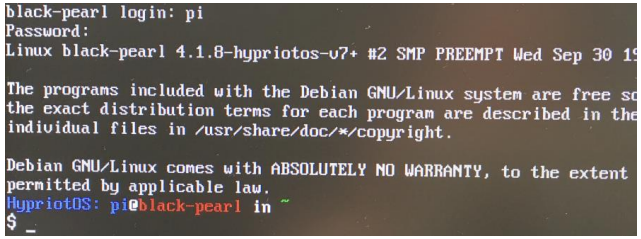
# Raspberry Pi2 Environment Setting



- Micro SD 카드에 Hypriot 설치가 완료되면 Pi2에 삽입 후 부팅



loading 화면




**CUI 환경으로 부팅되면 성공**
**Login ID : pi**
**Password : raspberry**

- Root password 변경
  - package 설치, RPM upgrade, 시스템 관리를 위해 필요

**$sudo passwd root**

```
pi@raspberrypi:~ $ sudo passwd root
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
pi@raspberrypi:~ $
```

  - password 입력시 * 표시가 나오지 않지만 입력되고 있으니 걱정하지 말 것
  - **root password는 꼭 기억할 것!!!**
  - login ID인 pi 계정의 password 도 변경하도록 하자. **$passwd**

# NUC & Pi2 IP address Setting

- Pi2 IP address 설정을 위해 필요한 파일(편집은 root 만 가능)
  - /etc/network/interfaces

**$cd /etc/network**
**$sudo vi interfaces**

```
HypriotOS: pi@black-pearl in ~
$ cd /etc/network/
HypriotOS: pi@black-pearl in /etc/network
$ sudo vi interfaces
```

#iface eth0 inet dhcp ← # 은 주석

auto eth0

iface eth0 inet static

address 172.29.0.X ← ip address

netmask 255.255.255.0 ← subnet mask

gateway 172.29.0.254 ← Gateway

dns-nameservers 203.237.32.100 203.237.32.101

입력 예

```
auto lo
iface lo inet loopback

#allow-hotplug eth0
#iface eth0 inet dhcp

auto eth0
iface eth0 inet static
        address 172.29.1.9
        netmask 255.255.255.0
        gateway 172.29.1.254
        dns-nameservers 203.237.32.100

iface eth0 inet6 auto

allow-hotplug wlan0
iface wlan0 inet dhcp
pre-up /usr/bin/occi
wpa-conf /etc/wpa_supplicant/wpa_suppl
iface default inet dhcp
```

- 일반적으로 dns-nameservers 를 입력하면 9 page 는 필요 없으나, Hypriot OS 는 삽입되지 않으므로 resolv.conf 파일에 직접 nameserver를 입력해야 함!

# NUC & Pi2 IP address Setting

- Pi2 IP address 설정을 위해 필요한 파일
  - /etc/resolv.conf

**$cd /etc/**
**$sudo vi resolv.conf**

```
# nameserver config
nameserver 203.237.32.100
nameserver 203.237.32.101
```

기존의 nameserver 는 #을 추가하여 주석처리

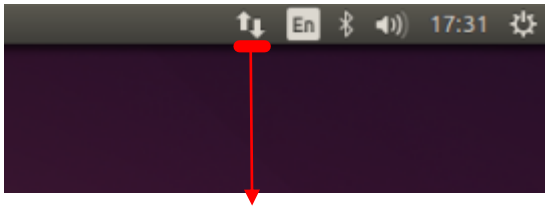
```
# nameserver config
#nameserver 213.133.98.98
#nameserver 213.133.99.99
#nameserver 213.133.100.100

nameserver 203.237.32.100
nameserver 203.237.32.101
```

**$sudo /etc/init.d/networking restart 입력 또는 rebooting 후 network 확인**
**$sudo reboot (rebooting command)**

```
$ sudo /etc/init.d/networking restart
[....] Restarting networking (via systemctl): networking.serviceWarni
ce changed on disk, 'systemctl daemon-reload' recommended.
. ok
HypriotOS: pi@black-pearl in /etc
```

# NUC & Pi IP address Setting

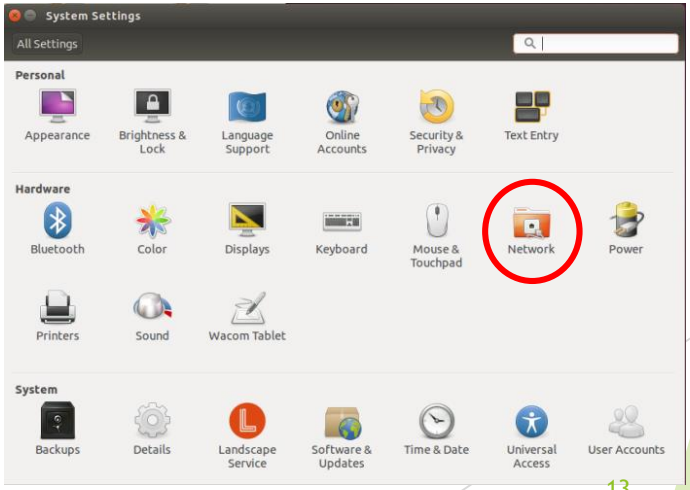
- NUC IP address Setting
  1. Pi와 동일하게 진행
  2. GUI 환경에서 setting




**Network icon**

**Edit Connection.. 선택**

**System Setting icon**



# Linux Setting(NUC & Pi)

- Ubuntu & Hypriot OS : Debian 계열 linux
  - Package 관리 관련 명령어(apt-get : Advanced Packaging Tool)

    **$sudo apt-get update**
    - Update package index 갱신(/etc/apt/sources.list)

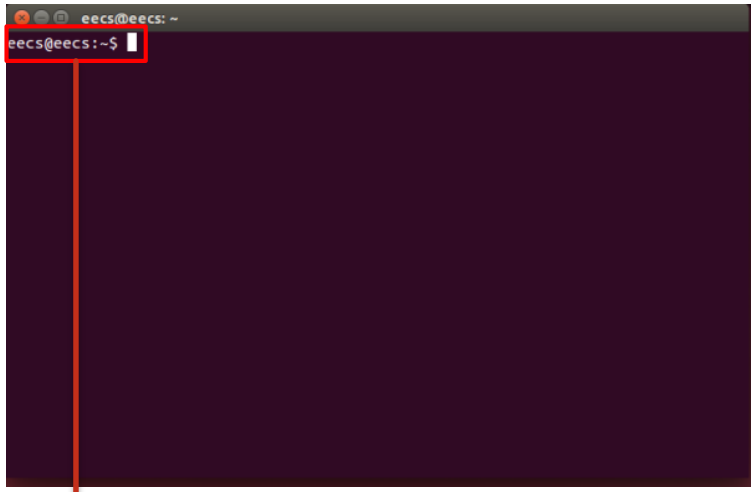
    **$sudo apt-get upgrade**
    - Package 목록을 비교하여 package upgrade 실행

    **$sudo apt-get dist-upgrade**
    - Package 간의 의존성 검사를 하며 upgrade(optional)
  - Package 설치(/var/cache/apt/archive/에 설치)

    **$sudo apt-get install <package_name>**
  - 자신에 맞는 기본적인 package 설치
    - Kernel Lab(Pi2)을 위한 package : gcc-4.9, make
    - Editor : vim(vi iMproved), emacs, gedit, etc.
    - SSH(Secure Shell) : openssh

# Linux Beginner Guide

- Terminal 창




**eecs@eecs:~$**

**user** **hostname** **home directory**

< 간단한 명령어 모음 >

**$pwd** : 현재위치
**$cd** : Change directory
**$ls** : directory 보기
**$mkdir** : directory 생성
**$su** : root 계정으로 이용
**$apt-get** : package 설치 및 삭제
**$poweroff**
**$shutdown –h now**

# Linux Beginner Guide


- gcc-4.9 설치(NUC & Pi2)
  - gcc 설치 **$sudo apt-get install gcc-4.9**
  - gcc version 확인 : **$gcc --version**

```
root@eecs:/home/eecs# clear
root@eecs:/home/eecs# gcc --version
gcc (Ubuntu 4.8.4-2ubuntu1~14.04.1) 4.8.4
Copyright (C) 2013 Free Software Foundation
This is free software; see the source for c
warranty; not even for MERCHANTABILITY or F
```

**< NUC >**

```
HypriotOS: pi@black-pearl in ~
$ gcc --version
gcc (Raspbian 4.9.2-10) 4.9.2
Copyright (C) 2014 Free Software
This is free software; see the s
warranty; not even for MERCHANTA
```

**< pi2 >**

  - NUC 에 gcc 설치를 위해 아래의 command 실행

**$sudo add-apt-repository ppa:ubuntu-toolchain-r/test**
**$sudo apt-get update**
**$sudo apt-get install gcc-4.9**

```
eecs@eecs:~$ sudo add-apt-repository ppa:ubuntu-toolchain-r/test
[sudo] password for eecs:
 Toolchain test builds; see https://wiki.ubuntu.com/ToolChain

 More info: https://launchpad.net/~ubuntu-toolchain-r/+archive/ubuntu/test
Press [ENTER] to continue or ctrl-c to cancel adding it

gpg: keyring `/tmp/tmpkwcjvts6/secring.gpg' created
gpg: keyring `/tmp/tmpkwcjvts6/pubring.gpg' created
gpg: requesting key BA9EF27F from hkp server keyserver.ubuntu.com
gpg: /tmp/tmpkwcjvts6/trustdb.gpg: trustdb created
gpg: key BA9EF27F: public key "Launchpad Toolchain Builds" imported
gpg: Total number processed: 1
gpg:               imported: 1  (RSA: 1)
OK
eecs@eecs:~$
```

# Linux Beginner Guide

- gcc-4.9 설치(NUC & Pi2)

```
eecs@eecs:~$ sudo apt-get install gcc-4.9
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
  cpp-4.9 gcc-4.9-base gcc-5-base lib32gcc1 libasan1 libatomic1 libcilkrts5
  libgcc-4.9-dev libgcc1 libgomp1 libisl15 libitm1 liblsan0 libmpfr4
  libquadmath0 libtsan0 libubsan0 libx32gcc1
Suggested packages:
  gcc-4.9-locales gcc-4.9-multilib gcc-4.9-doc libgcc1-dbg libgomp1-dbg
  libitm1-dbg libatomic1-dbg libasan1-dbg liblsan0-dbg libtsan0-dbg
  libubsan0-dbg libcilkrts5-dbg libquadmath0-dbg
The following NEW packages will be installed:
  cpp-4.9 gcc-4.9 gcc-5-base libasan1 libcilkrts5 libgcc-4.9-dev libisl15
  liblsan0 libubsan0
The following packages will be upgraded:
  gcc-4.9-base lib32gcc1 libatomic1 libgcc1 libgomp1 libitm1 libmpfr4
  libquadmath0 libtsan0 libx32gcc1
10 upgraded, 9 newly installed, 0 to remove and 46 not upgraded.
Need to get 14.7 MB of archives.
After this operation, 49.6 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
```

  - version 확인

```
eecs@eecs:~$ gcc --version
gcc (Ubuntu 4.8.4-2ubuntu1~14.04.1) 4.8.4
Copyright (C) 2013 Free Software Foundation, Inc.
This is free software; see the source for copying conditions.  There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

  - link 설정을 해주면 된다.

# Linux Beginner Guide

- gcc-4.9 link 설정
  - 현재 gcc-4.8 version 이 link 되어 있음
  - 현재의 link 를 지우고 4.9 version으로 재설정

**$sudo rm /usr/bin/gcc** : **link 삭제**
**$sudo ln –s /usr/bin/gcc-4.9 /usr/bin/gcc** : **link 설정**

```
eecs@eecs:~$ ls -al /usr/bin/gcc
lrwxrwxrwx 1 root root 16  3월 14 16:06 /usr/bin/gcc -> /usr/bin/gcc-4.8
eecs@eecs:~$ sudo rm /usr/bin/gcc
eecs@eecs:~$
eecs@eecs:~$ sudo ln -s /usr/bin/gcc-4.9 /usr/bin/gcc
eecs@eecs:~$
eecs@eecs:~$ ls -al /usr/bin/gcc
lrwxrwxrwx 1 root root 16  3월 14 16:07 /usr/bin/gcc -> /usr/bin/gcc-4.9
eecs@eecs:~$
eecs@eecs:~$ gcc --version
gcc (Ubuntu 4.9.3-8ubuntu2~14.04) 4.9.3
Copyright (C) 2015 Free Software Foundation, Inc.
This is free software; see the source for copying conditions.  There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

# Vi/vim editor 명령어 모음

- 입력 모드 : 원하는 글자를 입력
  - **a** : 현재 위치의 다음부터 입력 시작
  - **i** : 현재 위치의 앞에서부터 입력 시작
- 명령 모드 : 문서 편집을 할 수 있으며, 입력 모드 상태에서 ESC키를 누르면 명령모드로 전환됨
  - **x** : 커서가 있는 문자 삭제
  - **dd** : 현재 줄 전체 삭제
- 라인 모드 : ESC 키를 누른 후 colon(:) prompt 에서 명령을 입력하며 저장, 편집, 검색 기능 제공
  - **:q** : 그대로 종료하기
  - **:q!** : 변경된 내용을 저장하지 않고 종료하기
  - **:wq** : 변경된 내용을 저장하고 종료하기
- 보다 다양한 명령어가 있으며, 직접 실습을 하는 것이 좋은 방법

# Control Tower Setting


- VMWare Workstation Player Install
  - 노트북 혹은 NUC에 VM으로 Control Tower를 구축
  - 환경에 맞는 링크를 통해 VMWare Workstation Player 다운로드
    https://my.vmware.com/web/vmware/free#desktop_end_user_computing/vmware_workstation_player/12_0
  - 실행 후 옵션 변경 없이 모두 Next 클릭하여 설치 완료

# Control Tower Setting

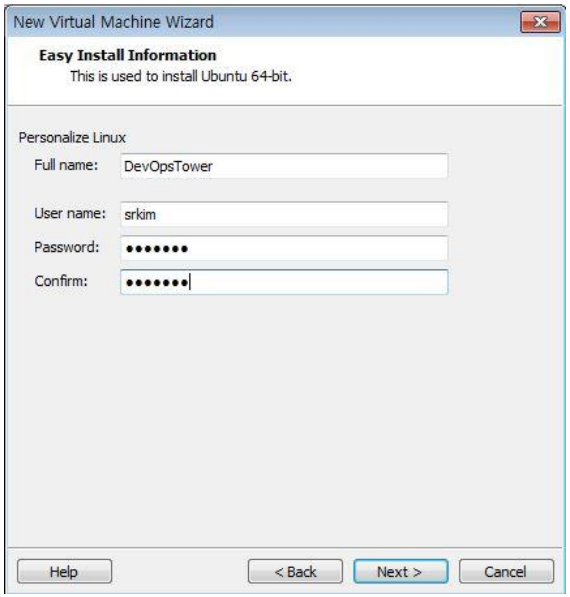

- VMWare Workstation Player Start
  - 실습 목적의 무료 사용을 위해 유효한 메일 주소 입력 후 Continue
  - 메인 화면에서 새로운 가상 머신 추가 버튼을 클릭하여 가상 머신 생성


# Control Tower Setting

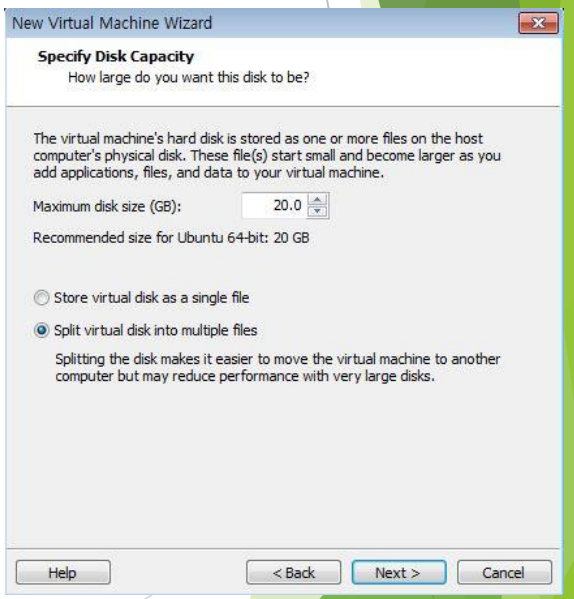

- Create a New Virtual Machine for Control Tower
  - Control Tower OS : Ubuntu Desktop 14.04.4 LTS(64bit)
  - Download Link : http://ftp.daumkakao.com/ubuntu-releases/14.04/ubuntu-14.04.4-desktop-amd64.iso
  - VMWare Workstation Player에서 Virtual Machine 생성에 사용할 Ubuntu Image 다운로드 한 뒤 해당 파일의 경로 지정

# Control Tower Setting


- Create a New Virtual Machine for Control Tower
  - 이후 계정 생성 및 저장 공간 및 위치 지정은 상황에 맞게 설정함으로써 가상 머신 생성

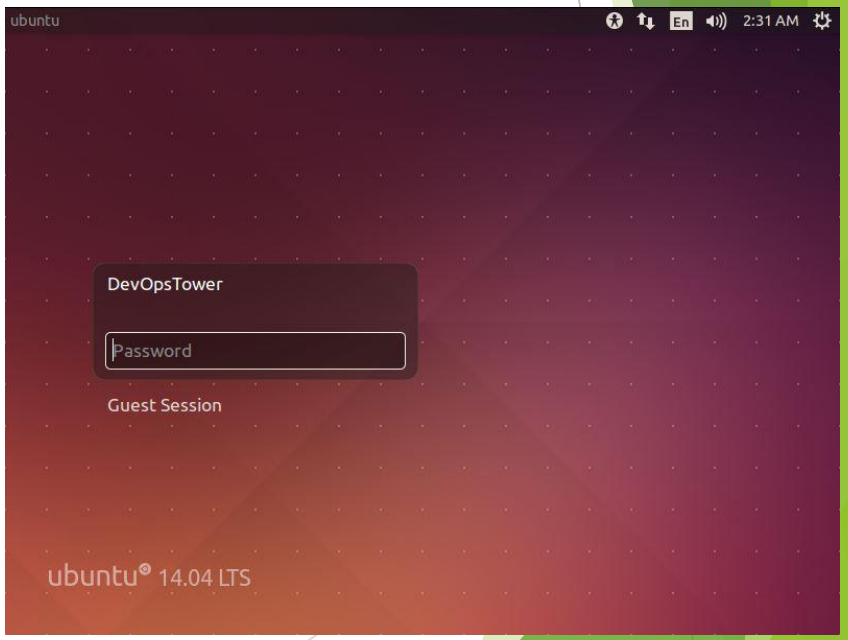






# Control Tower Setting


- Create a New Virtual Machine for Control Tower
  - OS 설치 작업이 끝나면 설정에서 지정한 계정 정보로 로그인하여 Control Tower를 활용

# Visualization Server Environments Setting

- Change apt-get sources
  - $sed –i 's/us.archive.ubuntu.com/ftp.daum.net/g' /etc/apt/sources.list
  - $sudo apt-get update
  - $sudo apt-get upgrade
- Install Docker
  - curl -fsSL https://get.docker.com/ | sh
  - sudo usermod -aG docker [username]
  - sudo service docker restart

# Visualization Server Setting

- Run Base Image for Visualization Container
  - docker pull ubuntu:14.04

```
Unable to find image 'ubuntu:14.04' locally
14.04: Pulling from library/ubuntu
943c334059c7: Downloading 3.227 MB/65.69 MB
a1acf99303d2: Download complete
27616aacb7b3: Download complete
35d12cd1c9fc: Download complete
a3ed95caeb02: Waiting
```

  - docker run -it --net=host --name visualization ubuntu:14.04

- Change apt-get sources in Visualization Container
  - sed –i 's/archive.ubuntu.com/ftp.daum.net/g' /etc/apt/sources.list
  - apt-get update
  - apt-get install -y curl vim

# Visualization Server Setting

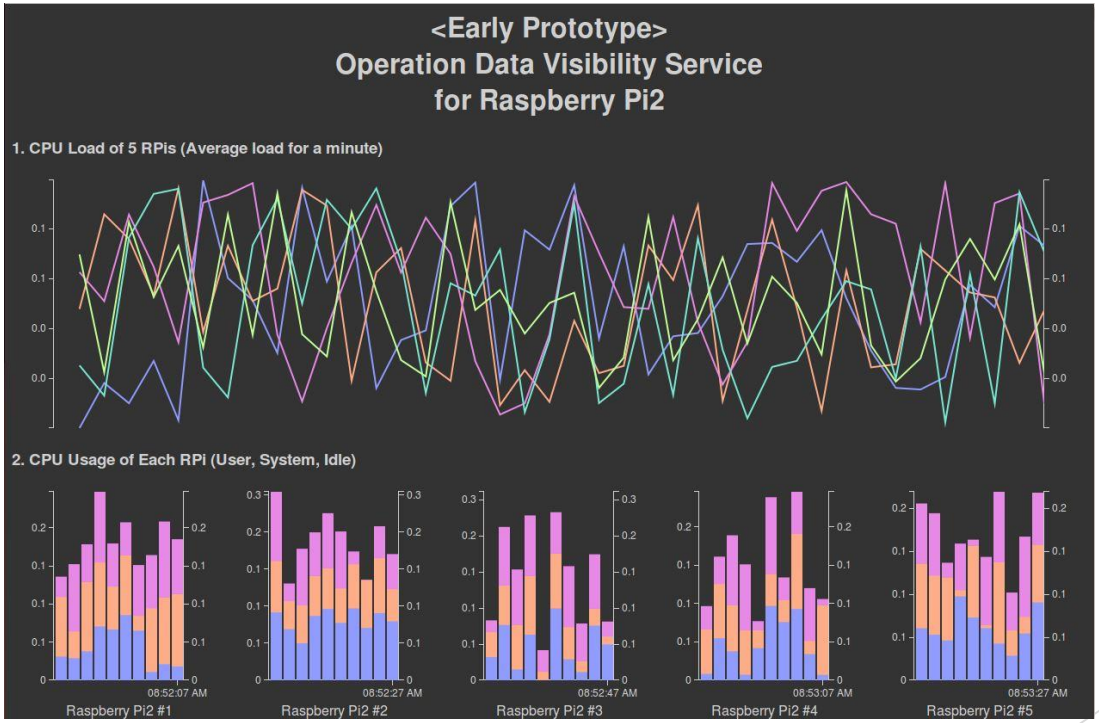
- Install Node.js
  - curl -sL https://deb.nodesource.com/setup_5.x | sudo -E bash -
  - apt-get install -y nodejs
  - node --version

```
root@ubuntu:/# node --version
v5.11.0
```

- Download Visualization Server Sources
  - Download Link: https://www.dropbox.com/sh/n8bkus92w7mvsnj/AABFCQhkX_LqwYRyd7TtOZ05a?dl=0
  - 컨테이너가 아닌 **VM** 상에서 해당 파일들을 다운 받은 뒤, Docker의 cp 명령을 활용해 컨테이너 내부로 복사
    - Ctrl+P+Q
    - docker cp visualization visualization:/opt/visualization
    - docker attach visualization
    - cd /opt/visualization

# Visualization Server Setting

- Run Visualization Server
  - node node.js
  - 이 후 VM 상에서 웹 브라우저 실행 후 http://localhost:3000/ 접속




  - 브라우저에서 샘플 차트가 표시되고 터미널 창에서 message consume이 반복 표시되면 정상적으로 설치 완료

# Visualization Server Setting

- Commit Container
  - 컨테이너 내의 변경사항을 반영하여 새로운 컨테이너 이미지 작성
  - Ctrl+P+Q
  - docker commit -a "srkim" -m "add visualization server based node.js" visualization visualization:0.1

```
srkim@ubuntu:~$ docker commit -a "srkim" -m "add visualization server based node.js" visualization visualization:0.1
sha256:b5ca7015908b7438e1d47f372ab0b03627baed08fa1f8e11c88366f0c1c3dfda
srkim@ubuntu:~$ docker images
REPOSITORY          TAG                 IMAGE ID            CREATED             SIZE
visualization       0.1                 b5ca7015908b        4 seconds ago       325 MB
<none>              <none>              867c578dd875        58 seconds ago      325 MB
ubuntu              14.04               8fa7f61732d6        5 days ago          188 MB
```

- Restart Container
  - Stop했던 컨테이너를 Restart하면 이전 작업 내용을 유지한 채로 다시 컨테이너를 시작할 수 있다.
  - docker stop visualization
  - docker restart visualization

# Appendix

NUC : Ubuntu Server version(64bit) install guide

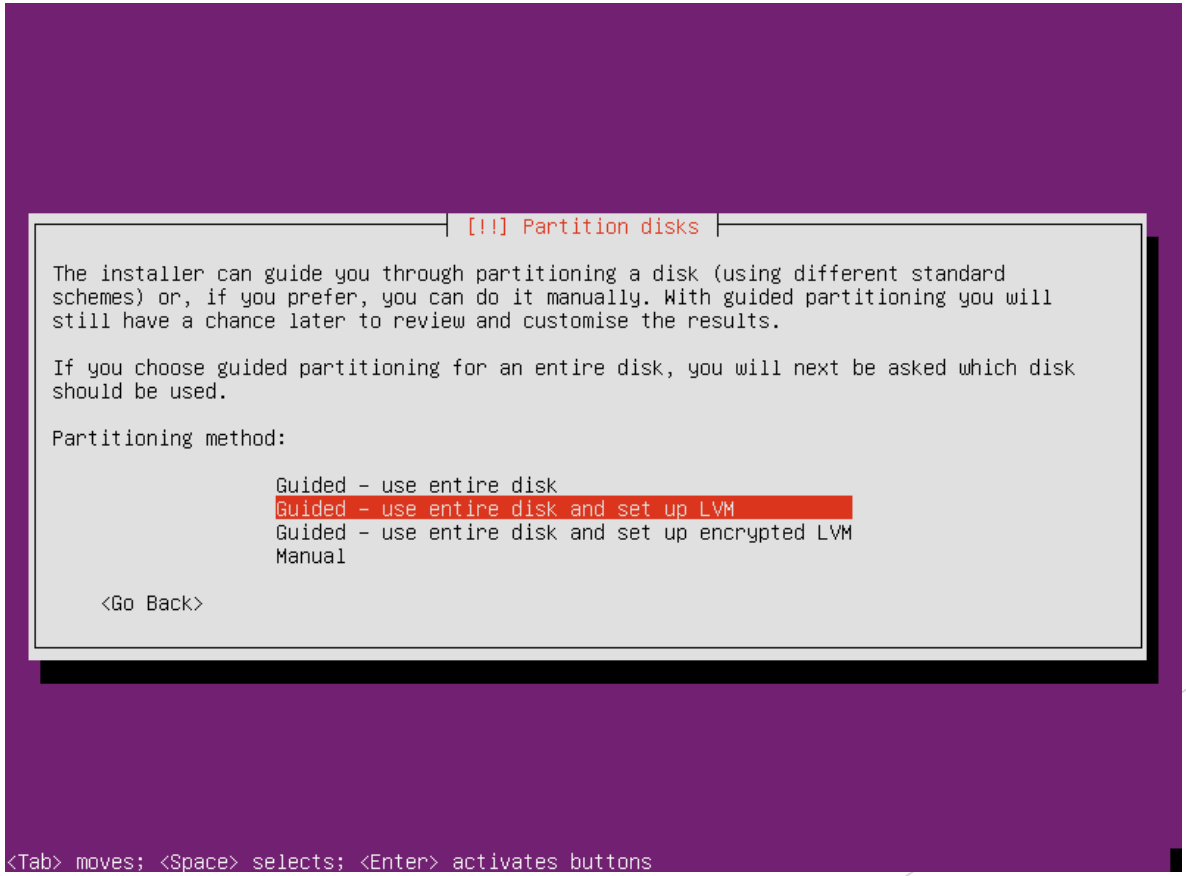
Pi2 : Raspbian Jessie  install guide

# NUC OS Setting

- 설치 가이드라인
  - ubuntu-14.04.4-server-amd64.img 다운 후 진행(4page 참조)
  - 제시된 화면 이외의 부분은 기본 값으로 진행
  - Encrypt your home directory? <No>

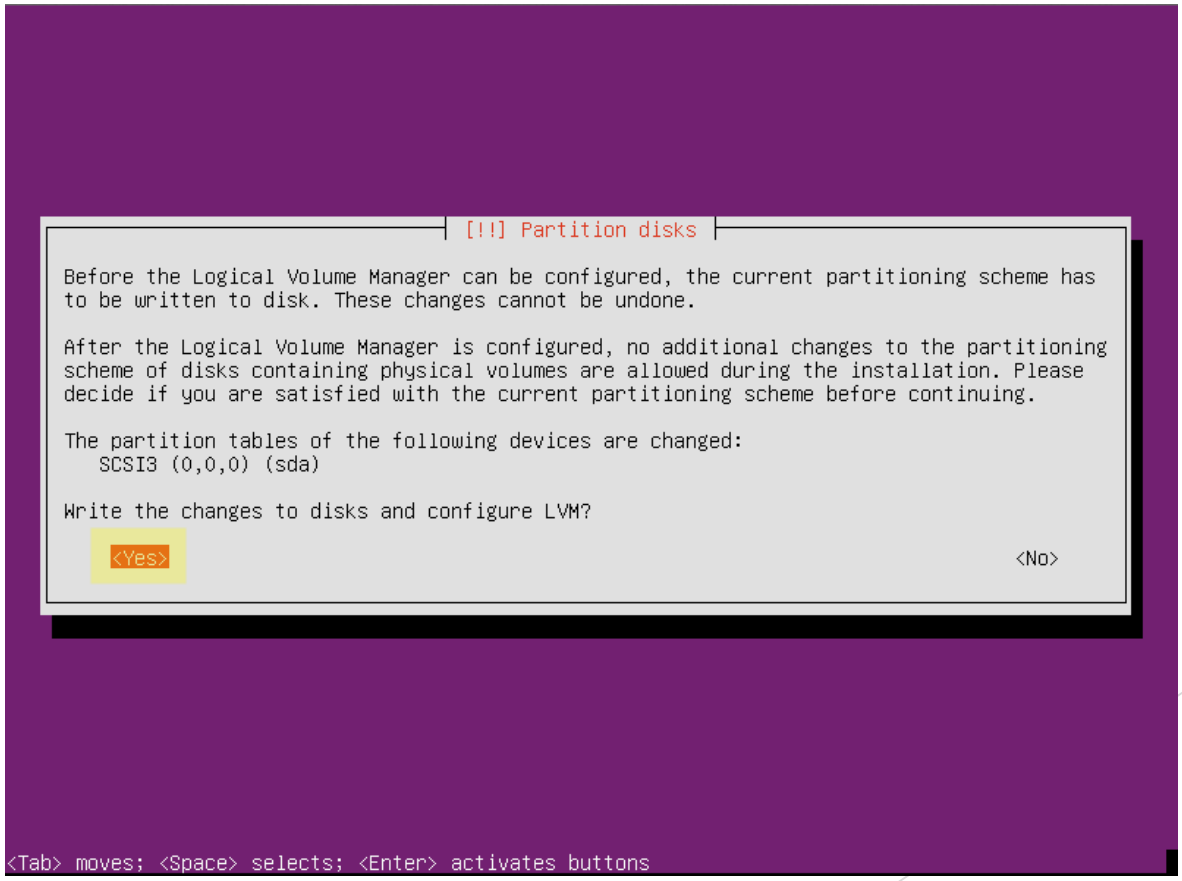
# NUC OS Setting

- 설치 가이드라인
  - 제시된 화면 이외의 부분은 기본 값으로 진행
  - Guided – use entire disk and set up LVM



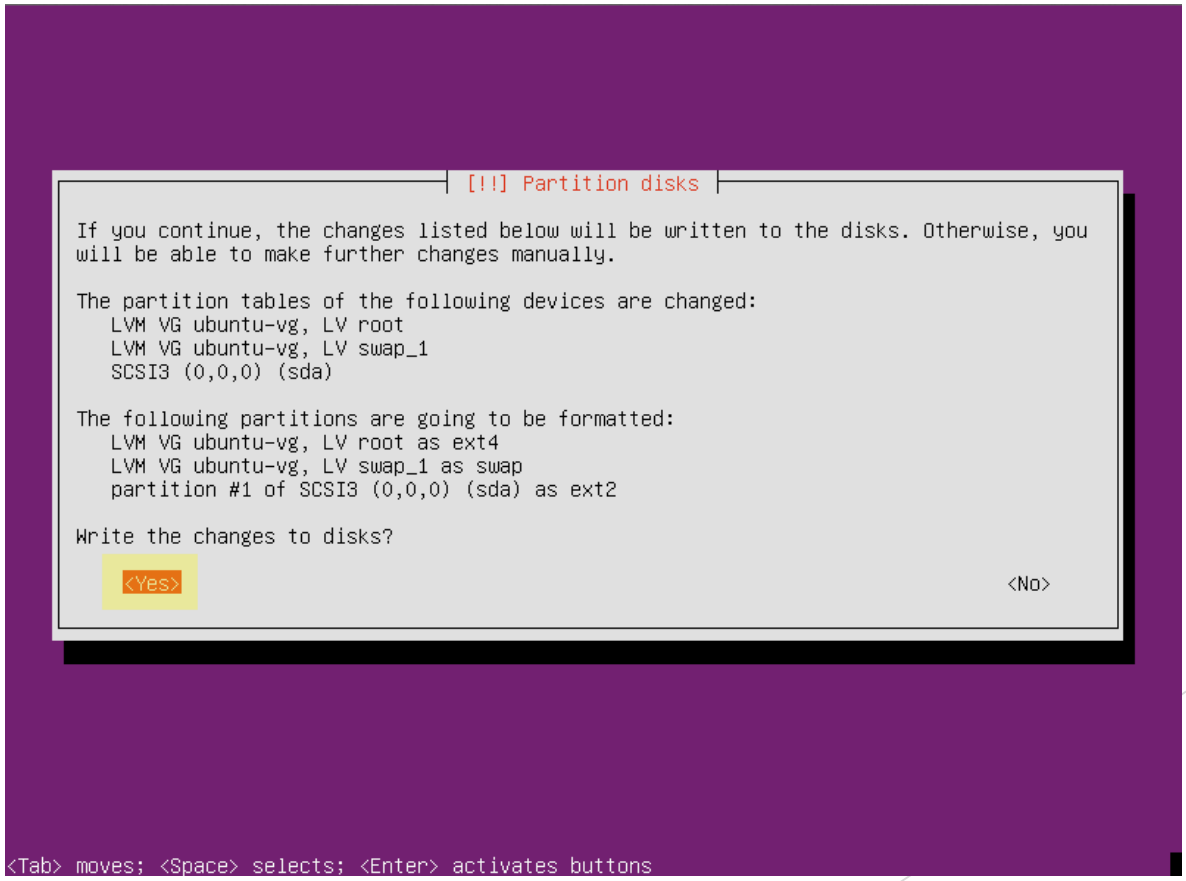
# NUC OS Setting

- 설치 가이드라인
  - 제시된 화면 이외의 부분은 기본 값으로 진행
  - Write the changes to disks and configure LVM? <Yes>



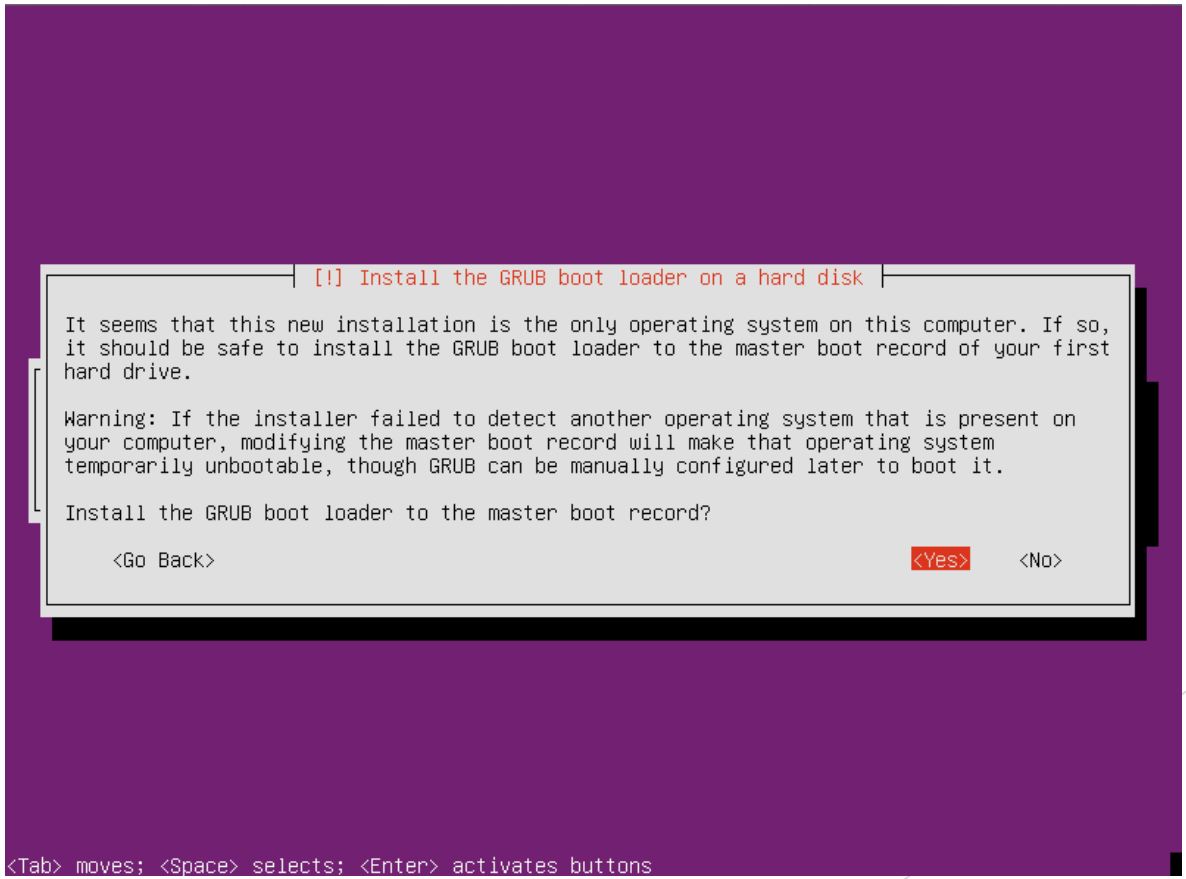
# NUC OS Setting

- 설치 가이드라인
  - 제시된 화면 이외의 부분은 기본 값으로 진행
  - Write the changes to disks? <Yes>



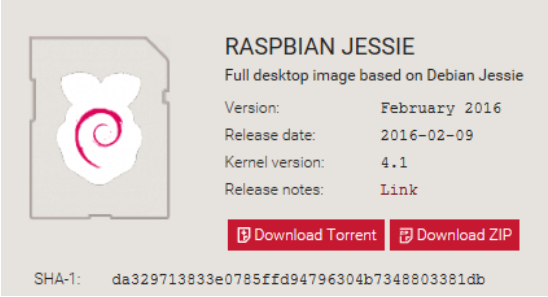
# NUC OS Setting

- 설치 가이드라인
  - 제시된 화면 이외의 부분은 기본 값으로 진행
  - Install the GRUB boot loader to the master boot record? <Yes>

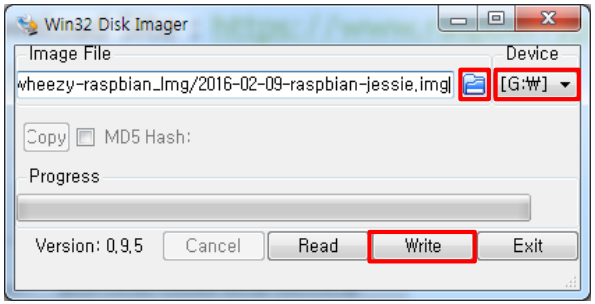


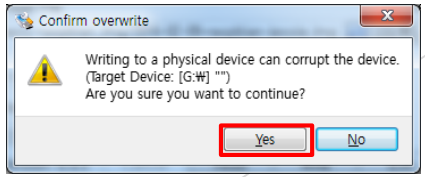
# Raspberry Pi2 OS Setting

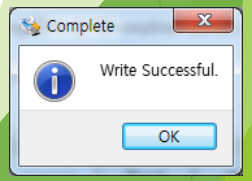
- OS : Raspbian Jessie
  - Download Site : https://www.raspberrypi.org/downloads/raspbian/



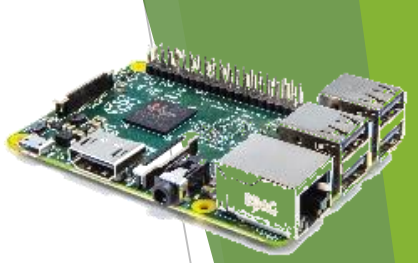

  - Download 된 파일(2016-02-09-raspbian-jessie.img, 3.84Gb)은 SD Writer 를 이용하여 Write.
  - SD Writer Download : https://sourceforge.net/projects/win32diskimager/files/latest/download?source=navbar



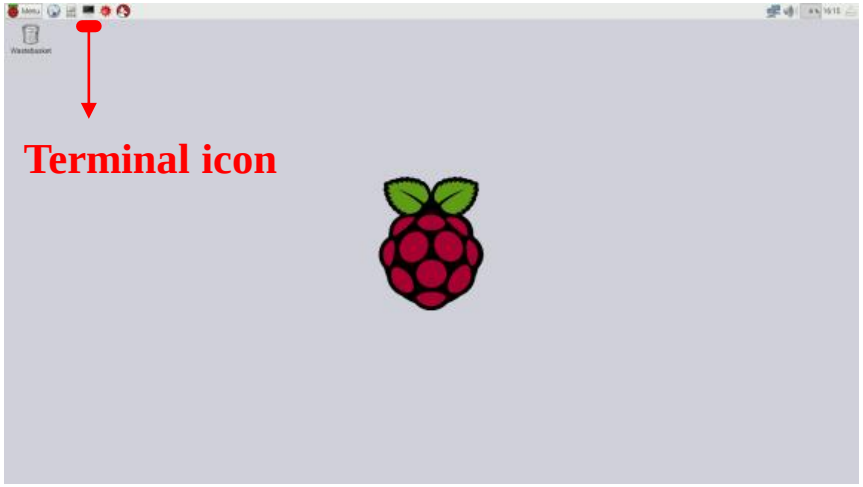



# Raspberry Pi2 Environment Setting



- Micro SD 카드에 raspbian 설치가 완료되면 PI2에 삽입 후 부팅




GUI 환경으로
부팅되면 성공

- Root password 변경
  - package 설치, RPM upgrade, 시스템 관리를 위해 필요

**$sudo passwd root**

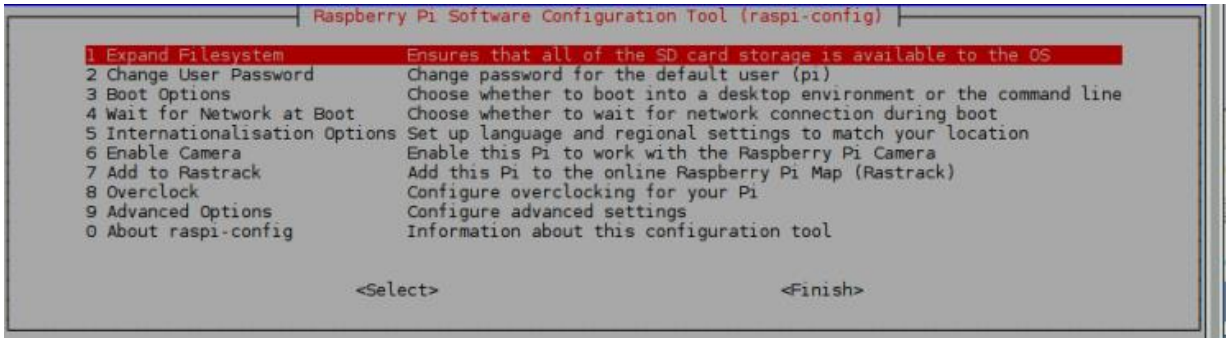
```
pi@raspberrypi:~ $ sudo passwd root
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
pi@raspberrypi:~ $
```

  - password 입력시 * 표시가 나오지 않지만 입력되고 있으니 걱정하지 말 것

# Raspberry Pi2 Environment Setting

- Pi 기본 설정을 위해 Configuration Tool 실행

  **$sudo raspi-config**




- 주요 내용

  1. Expand Filesystem : SD 카드의 전체용량을 사용할 수 있게 함
  2. Change User password : ‘pi’ 계정의 password 변경(초기 password : raspberry)
  3. Boot Options : 부팅 환경 설정(console or GUI)
  4. Wait for Network at Boot : 부팅시 네트워크 접속 여부 설정
  5. Internationalisation Options : 언어, 키보드, timezone 설정
  6. Enable Camera : Pi 전용 카메라 사용 여부 결정

# Raspberry Pi2 Environment Setting

- 필수 설정 사항
  - 1. Expand Filesystem(체크 & 해제 : space bar , 이동 : 방향키, tab키)
    - SD 카드를 복사해서 사용하면 사용 용량이 2G 로 설정되어 있으므로 전체 용량을 사용하기 위해 실행

```
Root partition has been resized.
The filesystem will be enlarged upon the next reboot
```

  - 2. Change User Password
    - ‘pi’ 계정의 보안을 위해 password 변경

```
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
```



```
Password changed successfully
```

  - 3. Boot Options
    - 작업 환경에 따라 부팅 설정 변경

```
B1 Console           Text console, requiring user to login
B2 Console Autologin Text console, automatically logged in as 'pi' user
B3 Desktop           Desktop GUI, requiring user to login
B4 Desktop Autologin Desktop GUI, automatically logged in as 'pi' user
```

# Raspberry Pi2 Environment Setting

- 필수 설정 사항
  - 5. internationalisation Options : 언어, 키보드, timezone 설정

```
I1 Change Locale          Set up language and regional settings to match your location
I2 Change Timezone        Set up timezone to match your location
I3 Change Keyboard Layout Set the keyboard layout to match your keyboard
```

    - I1 Change Locale : default keyboard 설정이 en_GB.UTF.8로 되어 있어 키보드 사용에 불편하므로 변경
      - en_GB.UTF.8 UTF-8 제거, en_US.UTF-8 UTF8 과 ko_KR.UTF8 UTF8 체크

```
[ ] en_US.ISO-8859-15 ISO-8859-15
[*] en_US.UTF-8 UTF-8
[ ] en_ZA ISO-8859-1
[ ] en_ZA.UTF-8 UTF-8
```

    - I2 Change Timezone : Asia → Seoul 설정
    - I3 Change Keyboard Layout
      - Generic 105-Key (Intel) PC → Other → Korean 설정
  - 설정이 모두 끝나면 <Finish> 선택 후 재부팅

    **$sudo reboot**

  - 이후 setting 은 8page 참조