

GOTHAM :

오픈소스 메쉬 네트워킹 소프트웨어 패키지

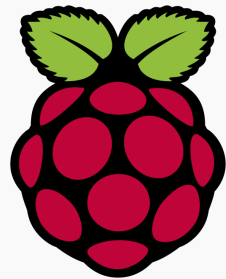
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개발내용 및 목표

개발내용 및 목표

- 짧은 시간내에 네트워크 구축
 - 미팅장소, 콘서트홀, 위급상황 등 임시 네트워크가 필요할 때
 - 음성, 텍스트, 자료 등 멀티미디어 전송 지원
- 선 없는 네트워크 구축
 - 학교의 방송시설을 대체
 - 어떻게 네트워크가 구축되었는지 visualization 기능 지원

개발내용 및 목표

- Mesh(Ad-hoc) Network

- BATMAN algorithm을 사용한 batman-adv를 pi(8개) & laptop computer(2개) 구축
- 선 없는 무선 네트워크를 빠르게 형성

- GOTHAM & TOX

- GOTHAM(visualization program) 개발
- TOX(qtox)를 pi에 구축 – P2P messenger
- 배트맨 메쉬로 연결되어 있는 노드 끼리 P2P 통신이 가능

관련연구 및 기술

Mesh & Ad-hoc Network

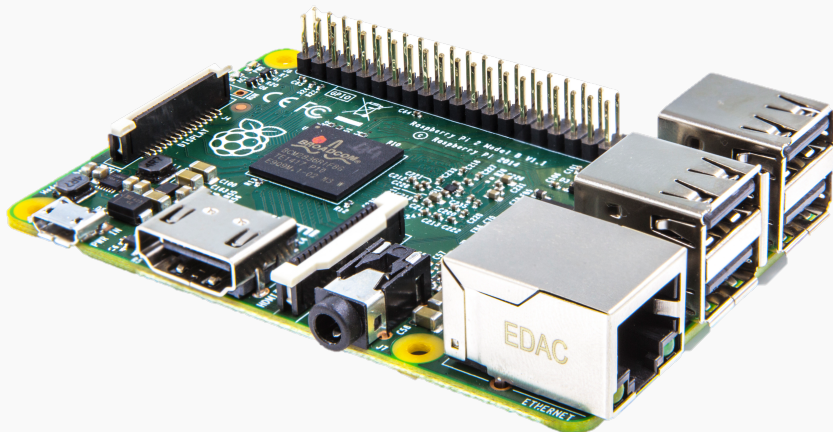
- Mesh Network & Ad-hoc Network

- 고정된 유선망을 가지지 않고 단말로만 이루어져 있는 통신망
- 서로서로 무선으로 연결 (mesh : [명]그물망, 철망, 망사)

- 차이점

- 같은 개념이나 각 노드의 역할의 차이가 존재
- Mesh -> Client & Router가 존재 (Client는 routing function이 없고 중간에 고정되어있는 Router가 routing을 함)
- Ad-hoc -> Client만 존재 (Client가 스스로 routing function을 수행)

Pi & Bluetooth Beacon & WLAN



Raspberry Pi 2



Bluetooth Beacon Dongle

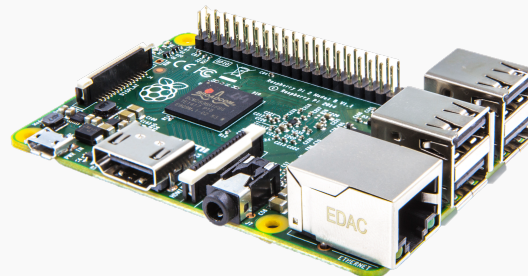


Wireless LAN Card

Pi & Bluetooth Beacon & WLAN

- Raspberry Pi

- 영국 라즈베리파이 재단에서 만든 교육용 보드
- 약 35불 정도면 구매 가능
- O/S : 라즈비안, 데비안, 우분투 등 다양한 O/S지원
- 종류 : Pi 1, Pi 2, Pi Zero, Pi 3
- Pi2 model B기준 H/W
 - 900MHz quad-core ARM Cortex-A7 CPU
 - 1GB RAM
 - 4 USB ports, 40 GPIO pins
 - FULL HDMI port, Ethernet port



Raspberry Pi 2

Pi & Bluetooth Beacon & WLAN

- Bluetooth Beacon (iBeacon, BLE)

- Bluetooth 4.0 기반의 BLE(Bluetooth Low Energy)사용
- 약 50m ~ 150m까지 인식 가능
- Apple에서 실내 측위 시스템을 위해 개발(GPS 대신)
- 고유 식별자 UUID에 사용자가 필요한 정보를 넣을 수 있다.
- 페어링(연결)이 필요 없음



iBeacon



Bluetooth Beacon Dongle

- WLAN Card

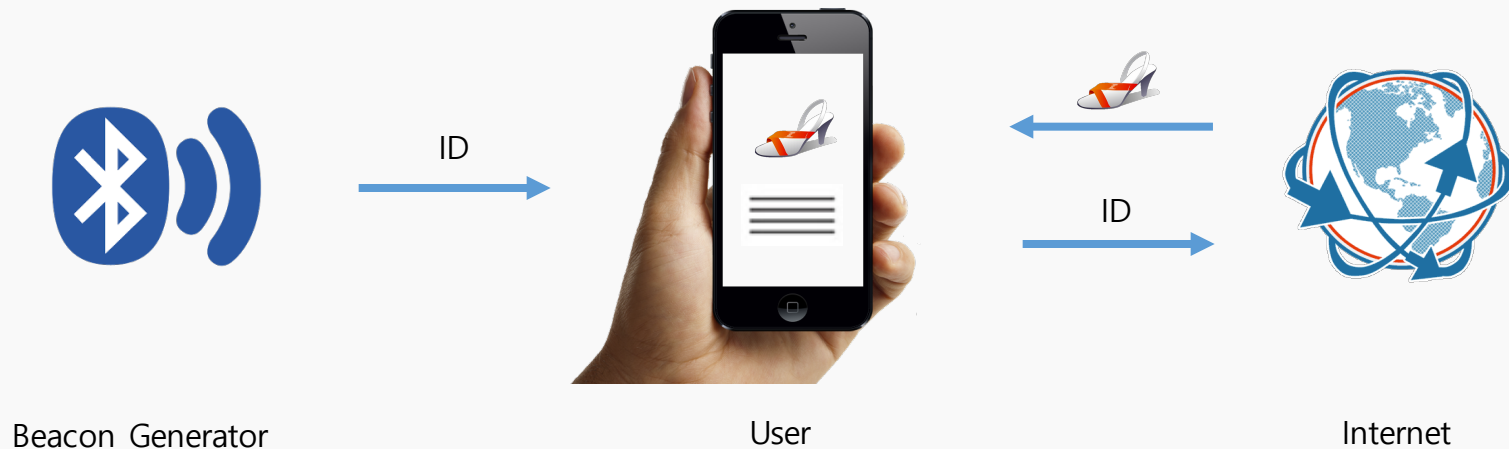
- Wireless LAN Card
- 무선 인터넷이 가능하게 함



Wireless LAN Card

Pi & Bluetooth Beacon & WLAN

- Bluetooth Beacon Workflow



BATMAN(Algorithm)

1. BATMAN(Better Approach To Mobile Ad hoc Network)

- Routing protocol

2. 기존 Routing protocol과 다름

- 기존의 routing protocol은 wireless ad-hoc network에 맞지 않다. (OLSR*)
 - Wireless ad-hoc network
 - Unstructured, Dynamically change topology, Unreliable

3. 전체 경로는 기억 X -> 노드 사이의 가장 좋은 링크 정보만 기억

- Routing 시 무조건 좋은 쪽으로 보냄(목적지에 따라)

4. OGM(OriGinator Message)

- 각 노드에서 OGM을 broadcast, 이웃 노드가 OGM을 받으면 source를 자기 자신의 주소로 바꾼 뒤 다시 re-broadcast

* A simple pragmatic approach to mesh routing using BATMAN (2008)

BATMAN(Open Source)

1. **BATMAN daemon(batmand)**

- First implementation of BATMAN routing protocol (Layer 3)

2. **BATMAN-adv (batman-adv)**

- Substantive implementation of BATMAN routing protocol (Layer 2)

3. **BATCTL (batctl)**

- Managing, Debugging tool

4. **ALFRED (alfred)**

- User space daemon (vis, hostname, DNS information, local weather forecast etc.)

BATMAN(batmand)

1. **Start on layer 3(IP layer)**
2. **개발 중지(현재) – 현재 batman-adv로 개발 중**
 - 처음 테스트 용으로 개발
3. **Internet connection**
 - <http://www.open-mesh.org/projects/batmand/wiki/InternetTuning>
4. **Visualization**
 - Vis server 생성
 - 각 노드의 local view들을 모아 graph 생성
 - 동작 X
 - s3d.berlios.de – 최신버전 : 2011.01.05
 - <http://s3d.sourceforge.net>

BATMAN(batman-adv)

1. BATMAN routing protocol 구현물

- 현재 BATMAN 0.3(BATMAN IV) – default routing algorithm

2. 2007년부터 개발 시작

- 개발 인원 : 6명
- open-mesh 단체에서 개발 중

3. batmand와 구별하기 위해 -adv 명명

4. Layer 2에서 동작

5. Implementation as a kernel module

- overhead를 줄이기 위해

6. BATMAN-adv를 설치하지 않아도 mesh-network에 들어 올 수 O

- 다른 기능 들은 지원 X
- 우분투 머신만 가능

BATMAN(batman-adv 기능)

1. Gateways

- 인터넷 연결, bandwidth 조절 가능

2. Ap Isolation

3. Network Coding

- Relay node가 두 개 이상의 packer을 한번에 전송하는 것

4. Roaming Improvements

5. ELP(Echo Location Protocol)

- 새로운 neighbors을 찾을 때 OGM이 아닌 ELP를 사용해서 찾는다.

6. Bridge Loop Avoidance

7. Network Wide Multi Link Optimization

BATMAN(batctl)

1. Configuration tool

- Mesh network에 interface 추가 및 제거
- batman-adv 설정 변경 및 확인 (OGM interval setting etc.)
- batman-adv 기능 변경 및 확인 (gateway announcement etc.)

2. Debugging tool

- Ping & traceroute nodes(MAC address)
- Parse log files
- Retrieve live information from the batman-adv module
- List 확인(Originator, client, available gateway etc.)
- <http://downloads.open-mesh.org/batman/manpages/batctl.8.html>

BATMAN(alfred)

1. ALFRED(Almighty Lightweight Fact Remote Exchange Daemon)

- user space daemon
- 각 노드에서 필요한 정보들을 모은다.
- batman-adv visualization을 위해 설계
- hostname, phone books, administration info, DNS info 할당 가능
- unix daemon background system.

2. batadv-vis

- alfred를 통해 neighbor 정보와 자신의 local 정보를 가져와 네트워크 구조를 json, graphviz로 나타낸다.
- graphviz(프로그램)를 통해 그림을 그림

3. alfred-gpsd

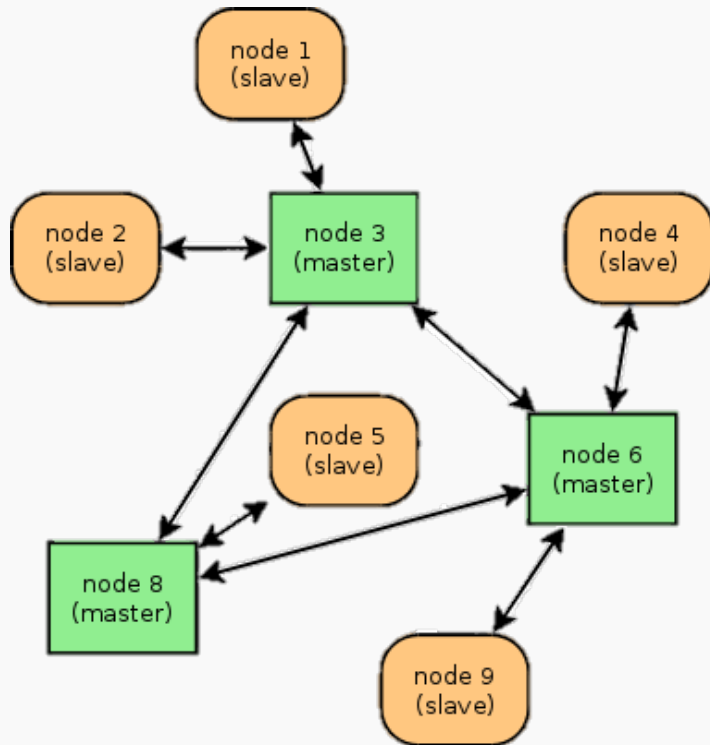
- GPS 정보를 받아와 그림을 그림.

4. alfredA

- Android에서 돌아가는 alfred
- slave server 역할을 할 수 있다. Mobile Convergence Laboratory

BATMAN(alfred)

1. Structure



node – alfred가 돌고 있는 device

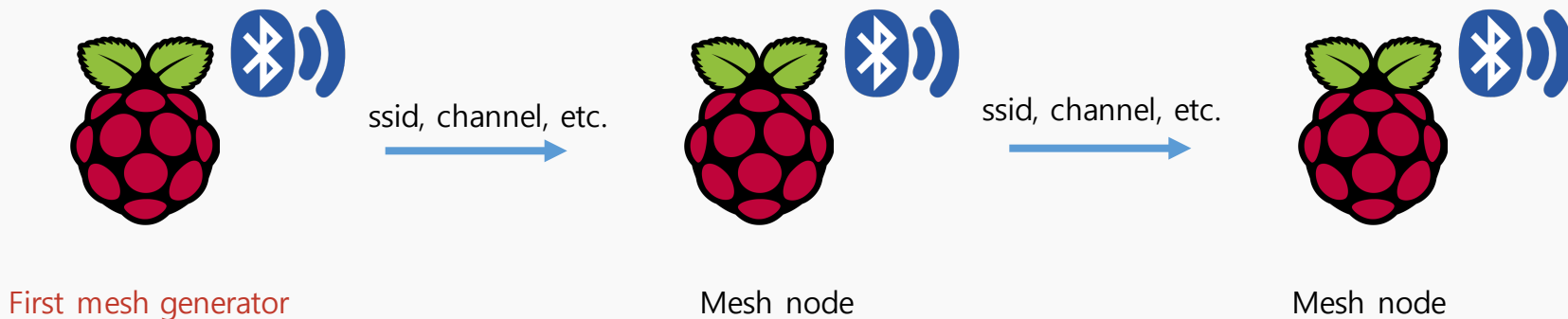
master – alfred server로써, 주위의 다른 master들과 함께 주기적으로 들어오는 정보를 저장하고 synchronize를 맞추며 slave에게 정보를 제공하는 device

slave – alfred server로써, 주기적으로 데이터를 master에게 보내며, 필요시 master에 정보를 request

slave는 주위에 있는 master중 가장 TQ가 좋은 node만을 알고 있다.

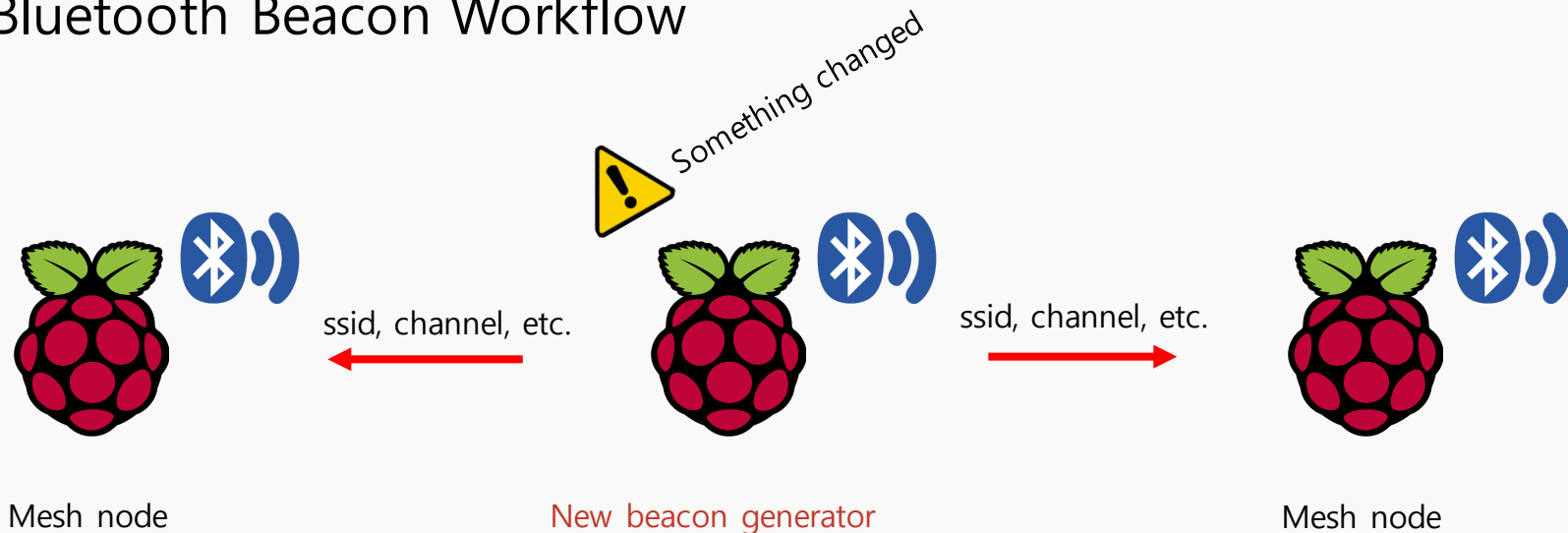
Self-organizing mesh agent

- Bluetooth Beacon Workflow



Self-organizing mesh agent

- Bluetooth Beacon Workflow



Self-organizing mesh agent

- 16byte uuid 구성

00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
version	master ip				ssid		channel								

-> 현재는 단순히 비콘을 발생시키거나 주위에 있는 비콘을 읽어 똑같은 비콘을 발생시킴

Self-organizing mesh agent

- 목적 & 효과
 - 디바이스간 네트워크 형성 가능
 - 네트워크 변화를 version으로 check 후 실시간 업데이트 가능
 - Self-organizing network 가능

TOX

- TOX 란?
 - 중앙 서버가 없는 P2P 방식의 메신저
 - ID만으로 Client끼리 connection 생성
 - 메시지, 파일, 소리, 영상 등 다양한 포맷 지원
 - 여러 OS 지원



TOX

1. Free, **Peer to Peer**, Distributed, Multimedia, **Secured**

- centralized server 가 없음

2. 2013년 부터 개발 시작

3. Easy to configure

- ID만 가지고 사용자들끼리 연결
 - Torrent-style DHT(Distributed Hash Table)
 - ID & IP address

4. Local & Public Network

- 인터넷이 사용 가능한 public network에서도 가능
- 인터넷이 사용 불가능한 local network내에서도 가능
 - 인터페이스 마다 broadcast

5. 개발 중

- binary file error, wiki 자료 업데이트 중

TOX

1. TOX core

- TOX의 핵심 코드

2. 다양한 O/S 지원

- Windows, Mac OS X, GNU/Linux, Android, iOS

	qTox	Antidote	Antox	Isotoxin	gTox	Toxy	Toxic	XwinTox	μTox
Interface	Desktop	Mobile	Mobile	Desktop	Desktop	Desktop	CLI	Desktop	Desktop
Linux	Yes	No	No	No	Yes	No	Yes	Yes	Yes
OSX	Yes	No	No	No	No	No	Yes	Untested	Yes
Windows	Yes	No	No	Yes	Yes	Yes	No	Untested	Yes
BSD	Yes	No	No	No	No	No	Yes	Yes ³⁾	Yes
Android	Minimal ⁴⁾	No	Yes	No	No	No	No	No	Minimal ⁵⁾
iOS	No	Yes	No	No	No	No	No	No	No
SailfishOS	No	No	No	No	No	No	Yes	No	No

GOTHAM

1. GOTHAM(Gathering of Organization Treating Humble Ad-hoc Map)

- batman-adv visualization을 위해 설계(경희대학교)
- Slave & Master 노드(프로그램)로 구분
- 각 노드의 프로그램의 상태, 연결 강도, 연결 상태 등 확인 가능
- Java program with websocket and d3 javascript

2. Master (java)

- Web server가 노드 상황을 요청하면 실시간으로 보내준다.
- 현재 노드 상태 및 Slave program의 상태를 가지고 있다.

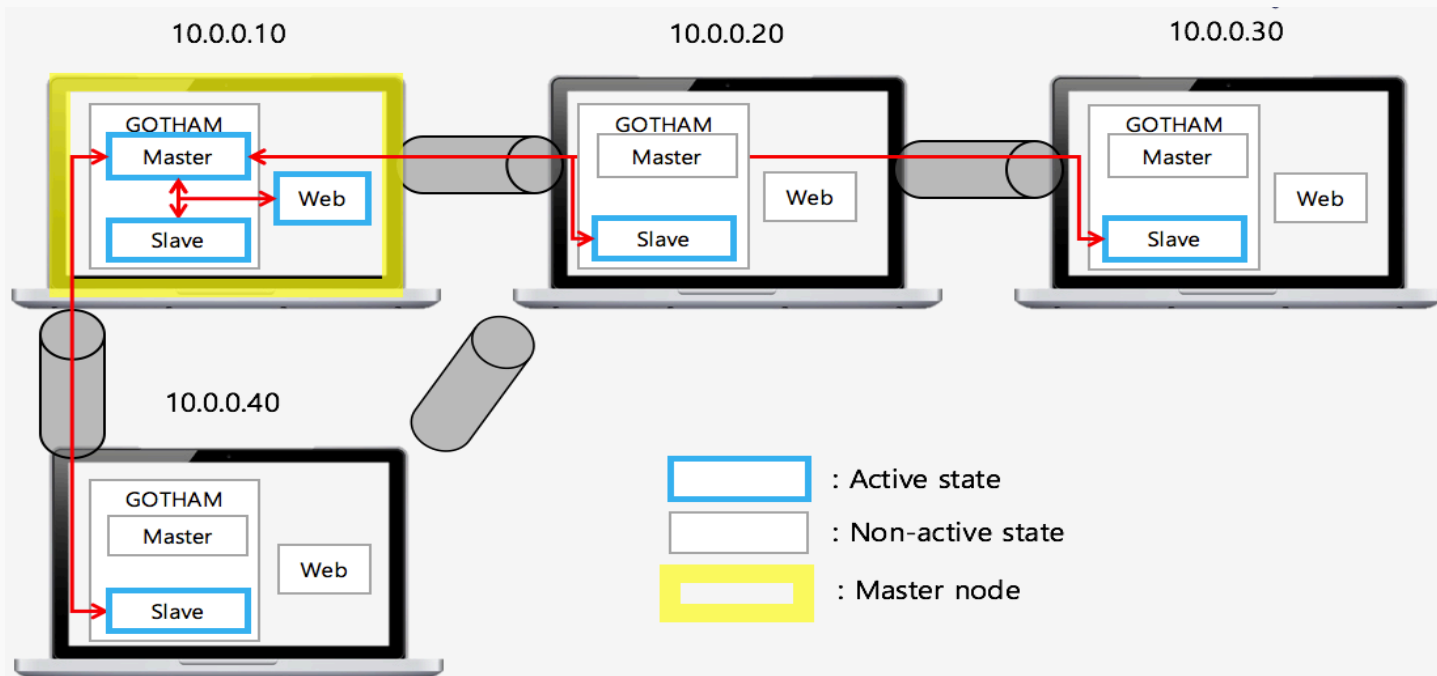
3. Slave (java)

- batctl을 통해 next hop 정보를 실시간으로 받아와서 Master에게 정보를 보낸다.

4. Web Server (java + tomcat8)

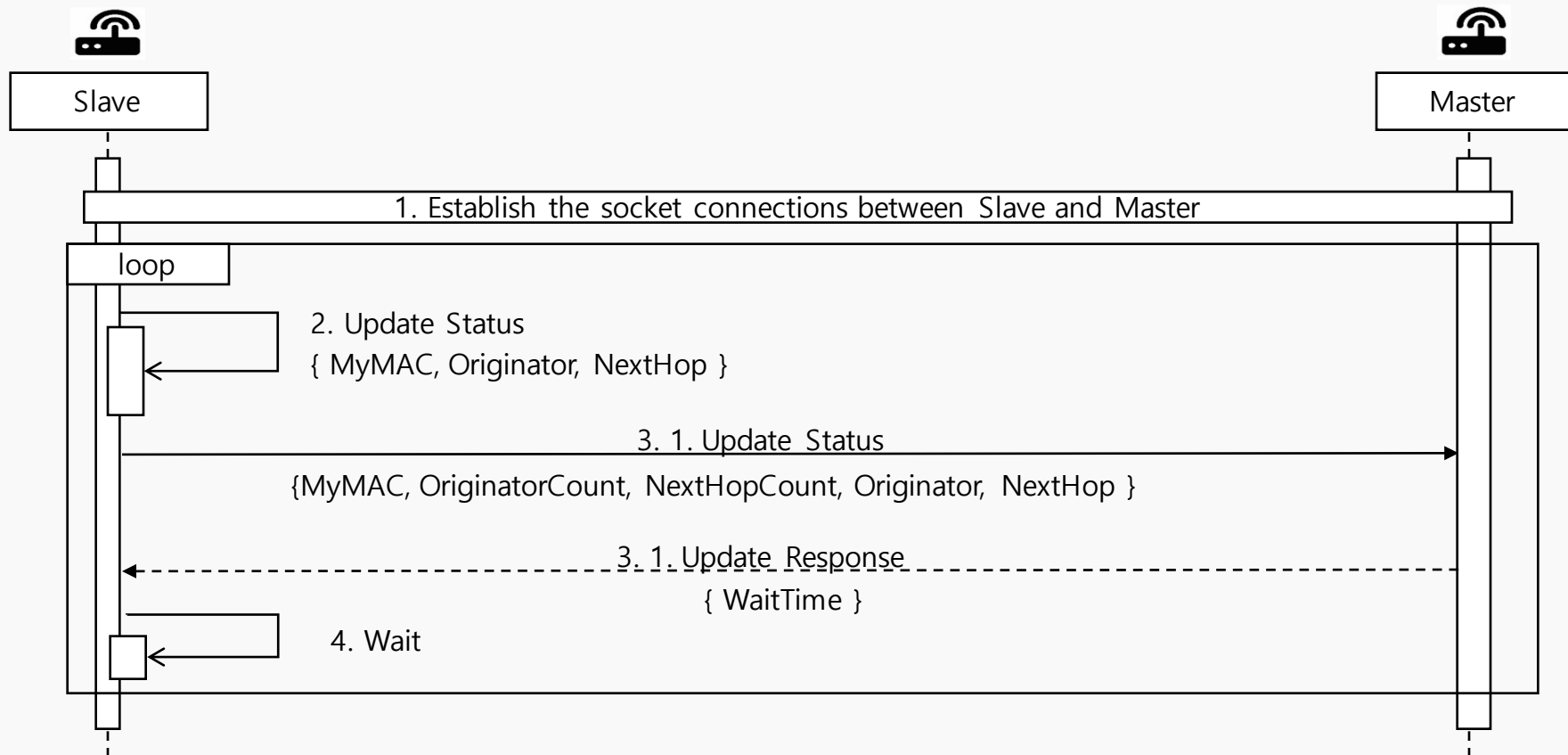
- Websocket으로 주기적으로 Master에게 정보를 받아온다.
- Client가 요청 시 현재 노드 상황을 그려준다.

GOTHAM (Architecture)



1. Slave 주기적으로(5초) Master에게 Originator와 NextHop 정보 전송
2. Master는 각 노드 별 thread로 관리 및 정보 업데이트
3. 추후 마스터 노드가 사라질 경우 다른 노드가 마스터 노드를 대체하게 할 예정

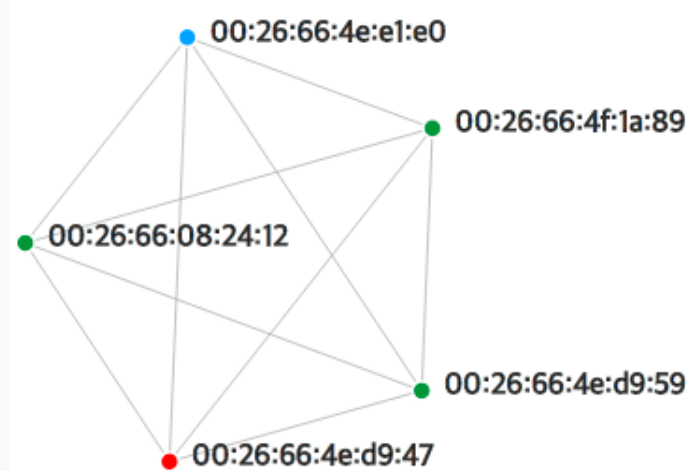
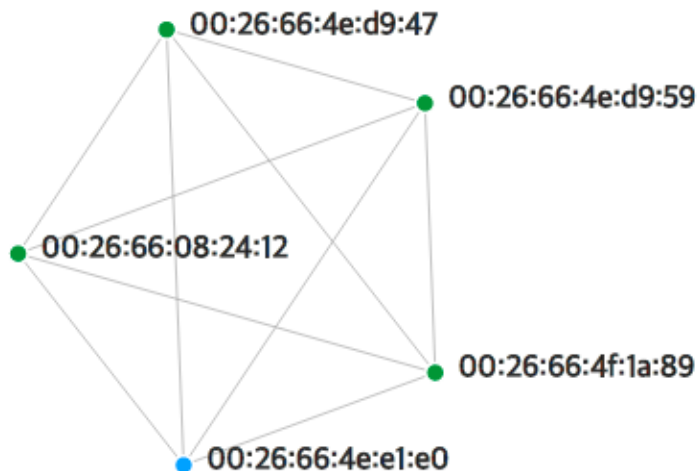
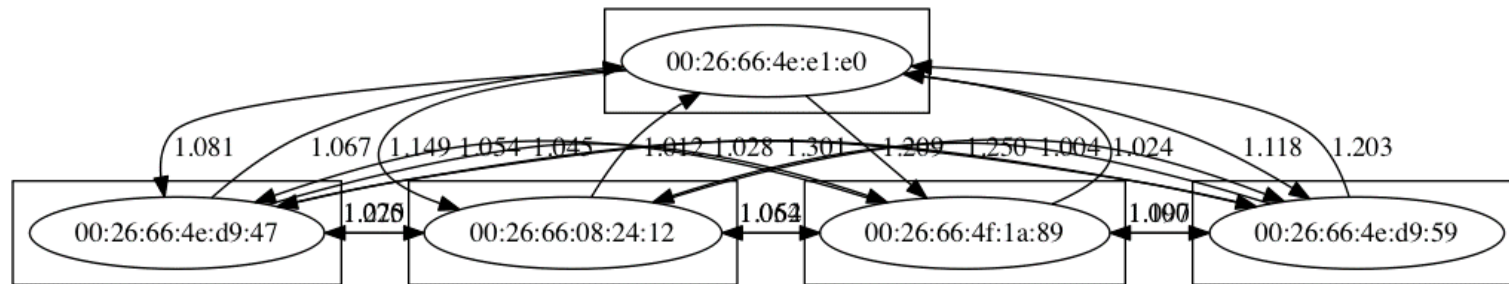
GOTHAM (Sequence Chart)



GOTHAM (vs ALFRED)

	ALFRED(batadv-vis)	GOTHAM
언어	C	JAVA
정보 출처	ALFRED server	batctl
Master node 수	여러 개	1개
GUI	Graphviz	Web(d3.js)
보조 프로그램	Graphviz	JAVA ,Tomcat 8
노드 관계 표시	좋음	보통
서버 현황 파악	알수없음	알수있음
각 노드 당 서버 수	2개(alfred, batadv-vis)	2개(GOTHAM, web-server)

GOTHAM (vs ALFRED)



설치 과정

개발 환경

1. 개발 환경(Raspberry Pi)

- Raspberry Pi 2 model B
- Ubuntu mate 15.04
- Linux-kernel version 3.18.0-20-rpi2
- BATMAN-adv version : 2014.4.0
- BATCTL version : 2014.3.0-2
- JAVA version : 1.9.0-ea
- Web server : TOMCAT8
- ipTIME N100UM USB WLAN card
- NEXT 204BT Bluetooth CSR 4.0 Dongle

2. 개발 환경(lap-top computer)

- Intel i5 CPU & 4GB RAM
- Ubuntu mate 15.04
- 내장 무선랜
- 이하 Pi와 동일

개발 환경

3. GOTHAM 개발 및 빌드 Computer

- Mac OS X El Capitan
- Netbeans IDE 8.1
- JAVA version : 1.8.0_40

기초 Pi 세팅

- SD card 포맷

SD Interface Devices

The following interface devices can be used to access SD/SDHC/SDXC memory cards:

- SD slot on computer
- USB SD reader
- PC Card, CardBus or ExpressCard SD adapter

Always confirm that the device is compatible with the SD, SDHC or SDXC memory card before formatting.

SD Formatter 4.0 for Windows and Mac

Download SD Formatter for Windows >

Download SD Formatter for Mac >

Released on January 30, 2013

Released on January 30, 2013

SD Formatter 4.0 for Windows User's Manual

Download the SD Formatter 4.0 for Windows User's Manual from the buttons below:

English
(337k)

Japanese
(332k)

Traditional Chinese
(517k)

Simplified Chinese
(423k)

https://www.sdcard.org/downloads/formatter_4/

SD fomatter 설치

기초 Pi 세팅

- SD card 포맷

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The rights granted to Licensee hereunder will be automatically terminated if Licensee contravenes of any of the terms and conditions of this Agreement. In the event, Licensee must destroy the Software and related documentation together with all the copies thereof at Licensee's own expense.

Back



Decline



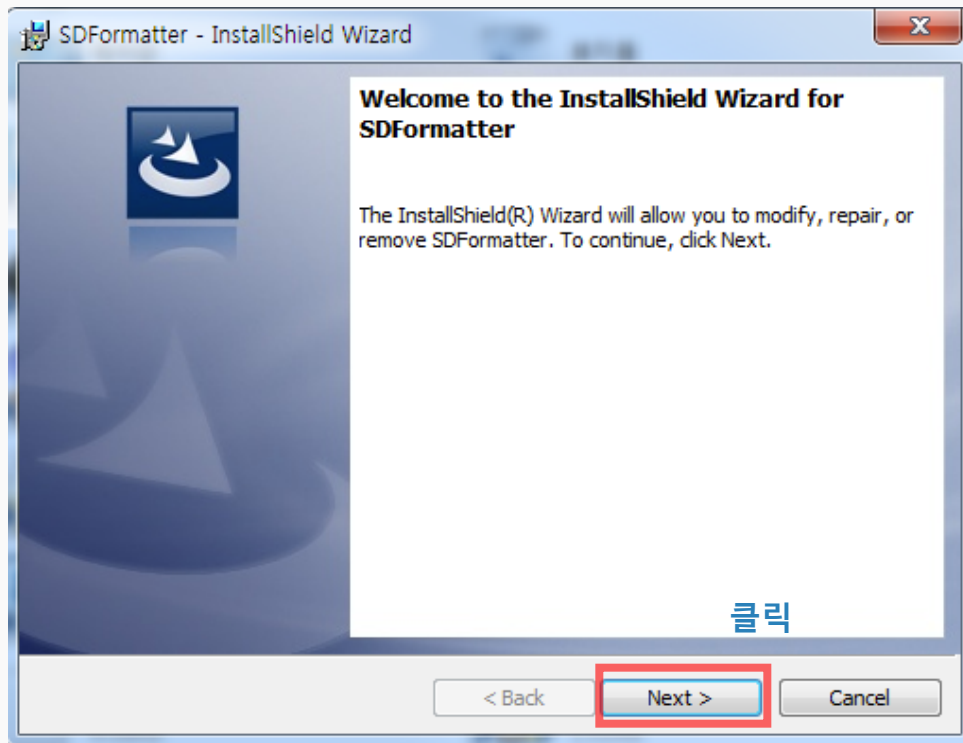
Accept



클릭

기초 Pi 세팅

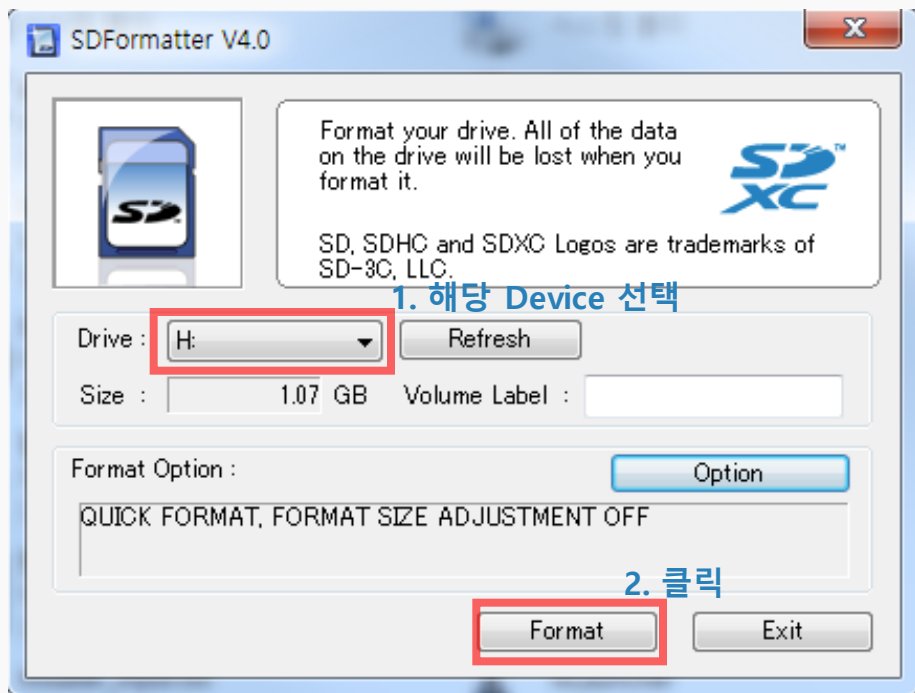
- SD card 포맷



SDFormatter 설치

기초 Pi 세팅

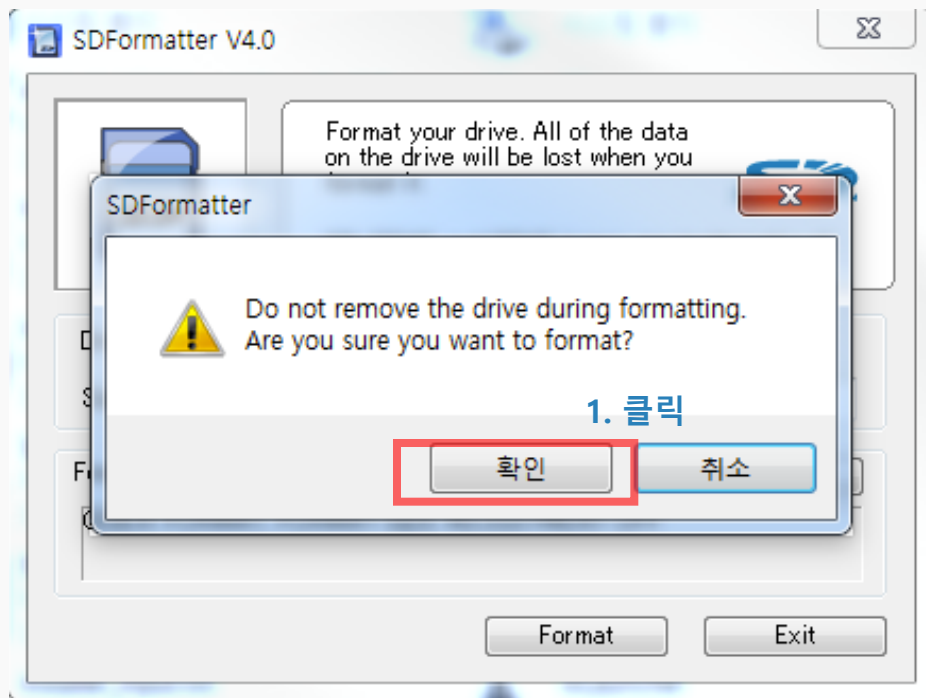
- SD card 포맷



SDFormatter 실행화면

기초 Pi 세팅

- SD card 포맷

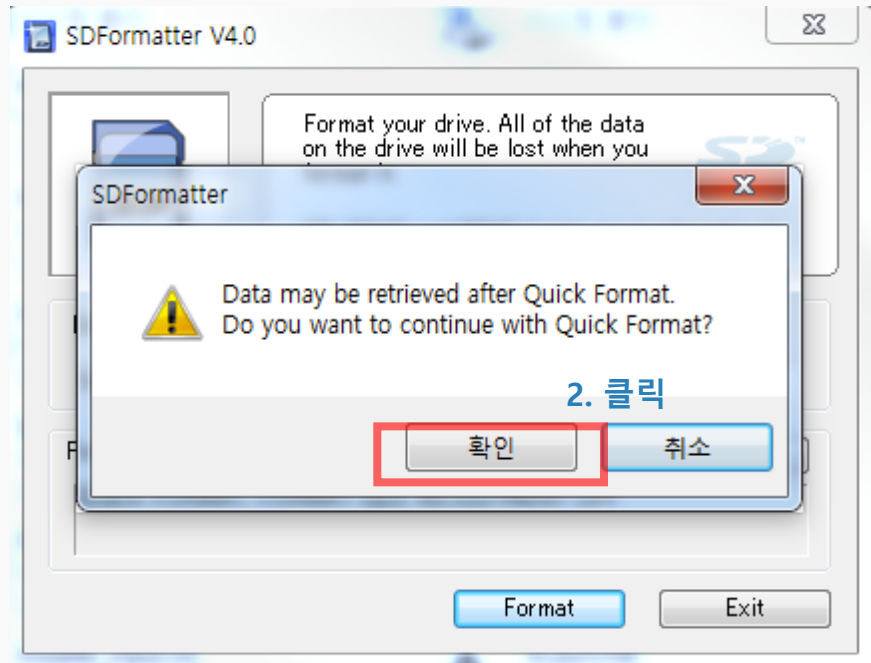
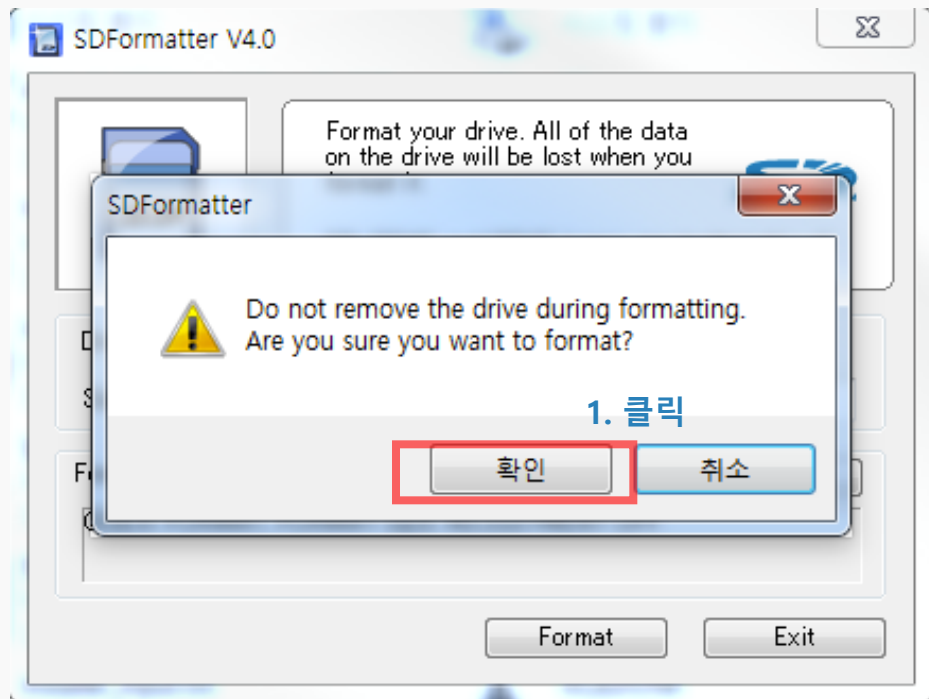


Warning message 출력

1. 클릭

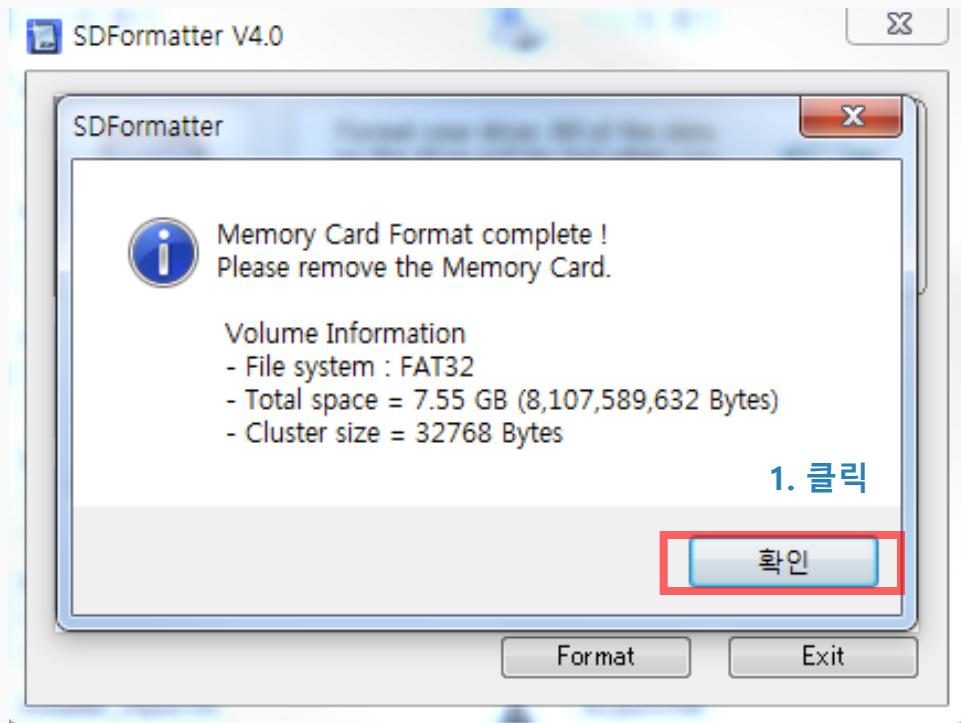
기초 Pi 세팅

- SD card 포맷



기초 Pi 세팅

- SD card 포맷



포맷 완료 화면

1. 클릭

기초 Pi 세팅

- Ubuntu mate 이미지 올리기(Laptop)

HTTP direct download

In addition to the recommended BitTorrent downloads above, the .iso images can also be downloaded via HTTP.



Ubuntu MATE 15.04
32-bit (i386)



Ubuntu MATE 15.04
64-bit (amd64)



Ubuntu MATE 15.04
PowerPC-based Macs and IBM-PPC (POWER5)

1. 클릭

If you direct download the .iso image please make sure the appropriate MD5 hash matches.

<https://ubuntu-mate.org/vivid/>

현재 배포중인 버전은 15.10

이 발표자료에서 사용되고 있는 버전은 15.04

기초 Pi 세팅

- Ubuntu mate 이미지 올리기(Pi)

Download

A pre-built image of Ubuntu MATE 15.10.1 for the Raspberry Pi 2 and Raspberry Pi 3 is available via BitTorrent and direct download. If you can spare the bytes, please download via BitTorrent and leave the client open after your download is finished, so you can seed it back to others. *A web-seed capable client is recommended for fastest download speeds.*

Many thanks to [First Colo](#) for contributing the hosting and bandwidth for the Ubuntu MATE downloads.



Ubuntu MATE 15.10.3
via BitTorrent

Raspberry Pi 2 and Raspberry Pi 3



Ubuntu MATE 15.10.3 from
European CDN

Raspberry Pi 2 and Raspberry Pi 3



Ubuntu MATE 15.10.1 from
Canadian mirror

Raspberry Pi 2 and Raspberry Pi 3



Ubuntu MATE 15.10.1 from
French mirror

Raspberry Pi 2 and Raspberry Pi 3

중요!

**- 라즈베리파이용
이미지로 다운!**

1. 아무거나 클릭

<https://ubuntu-mate.org/raspberry-pi/>

현재 배포중인 버전은 15.10

이 발표자료에서 사용되고 있는 버전은 15.04 (이버전은 공식 홈페이지에 나와있지 않습니다.)

이미지가 필요하시면 junhoya942@khu.ac.kr로 연락부탁드립니다.

기초 Pi 세팅

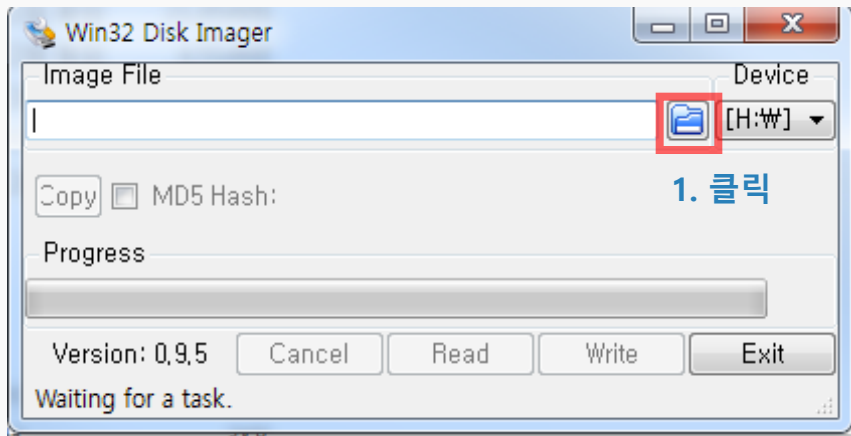
- Ubuntu mate 이미지 올리기



<https://sourceforge.net/projects/win32diskimager/>



기초 Pi 세팅

- Ubuntu mate 이미지 올리기



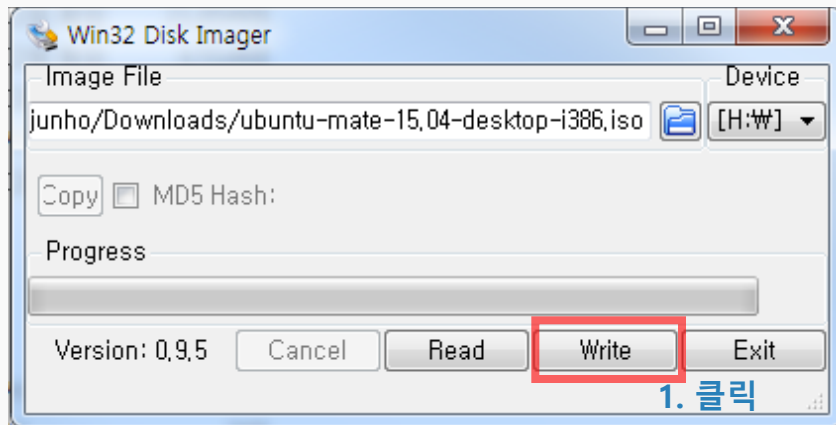
<https://sourceforge.net/projects/win32diskimager/>

2. 이미지 선택 (pi용 lap-top용 확인 필요)

	ubuntu-mate-15.04-desktop-armhf-raspberry-pi-2.img	2015-10-20 오후...	디스크 이미지 파일	3,840,000..
	ubuntu-mate-15.04-desktop-i386.iso	2016-03-30 오후...	ISO 파일	1,132,320..

기초 Pi 세팅

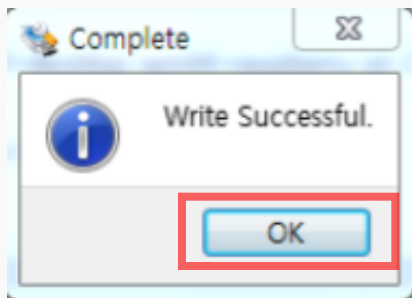
- Ubuntu mate 이미지 올리기



이미지 올리기 완료

lap-top -> usb로 부팅 시작

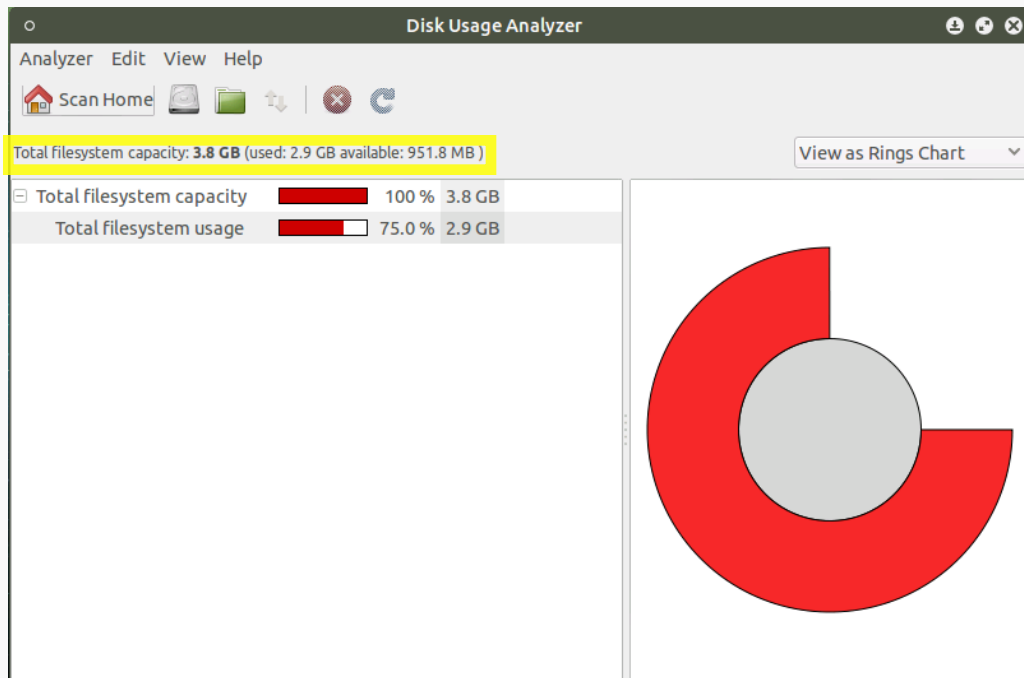
pi -> sd card 꼽으면 바로 사용 가능



2. 클릭

기초 Pi 세팅

- Resizing



-> 16GB micro SD card지만
16기가로 인식을 못함

-> Resizing 필요!

기초 Pi 세팅

- Resizing

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo fdisk /dev/mmcblk0  
[sudo] password for junho:  
  
Welcome to fdisk (util-linux 2.25.2).  
Changes will remain in memory only, until you decide to write them.  
Be careful before using the write command.  
  
Command (m for help): p  
Disk /dev/mmcblk0: 14.9 GiB, 16003366912 bytes, 31256576 sectors  
Units: sectors of 1 * 512 = 512 bytes  
Sector size (logical/physical): 512 bytes / 512 bytes  
I/O size (minimum/optimal): 512 bytes / 512 bytes  
Disklabel type: dos  
Disk identifier: 0x00000000  
  
Device      Boot  Start      End  Sectors  Size Id Type  
/dev/mmcblk0p1 *    2048   133119   131072    64M  c W95 FAT32 (LBA)  
/dev/mmcblk0p2      133120  7679999  7546880   3.6G  83 Linux  
  
Command (m for help):
```

`sudo fdisk /dev/mmcblk0`

`p`

-> 현재 메모리 상태 확인

기초 Pi 세팅

- Resizing

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
Command (m for help): d  
Partition number (1,2, default 2): 2  
  
Partition 2 has been deleted.  
  
Command (m for help): n  
Partition type  
  p  primary (1 primary, 0 extended, 3 free)  
  e  extended (container for logical partitions)  
Select (default p): p  
Partition number (2-4, default 2): 2  
First sector (133120-31256575, default 133120):  
Last sector, +sectors or +size{K,M,G,T,P} (133120-31256575, default 31256575):  
  
Created a new partition 2 of type 'Linux' and of size 14.9 GiB.  
  
Command (m for help): w  
The partition table has been altered.  
calling ioctl() to re-read partition table.  
re-reading the partition table failed.: Device or resource busy  
  
The kernel still uses the old table. The new table will be used at the next reboot or after you run partprobe(8) or kpartx(8).
```

d

2

-> 2번째 파티션을 지움

n

p

2

엔터 두번

-> (first sector, last sector 결정)

-> Enter가 default로 세팅

w

-> Warning message 출력 무시

기초 Pi 세팅

- Resizing

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo reboot
```

sudo reboot

-> 재부팅

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo resize2fs /dev/mmcblk0p2  
[sudo] password for junho:  
resize2fs 1.42.12 (29-Aug-2014)  
Filesystem at /dev/mmcblk0p2 is mounted on /; on-line resizing required  
old_desc_blocks = 1, new_desc_blocks = 1  
The filesystem on /dev/mmcblk0p2 is now 3890432 (4k) blocks long.  
  
junho@junho-desktop:~$  
junho@junho-desktop:~$ sudo reboot
```

sudo resize2fs /dev/mmcblk0p2

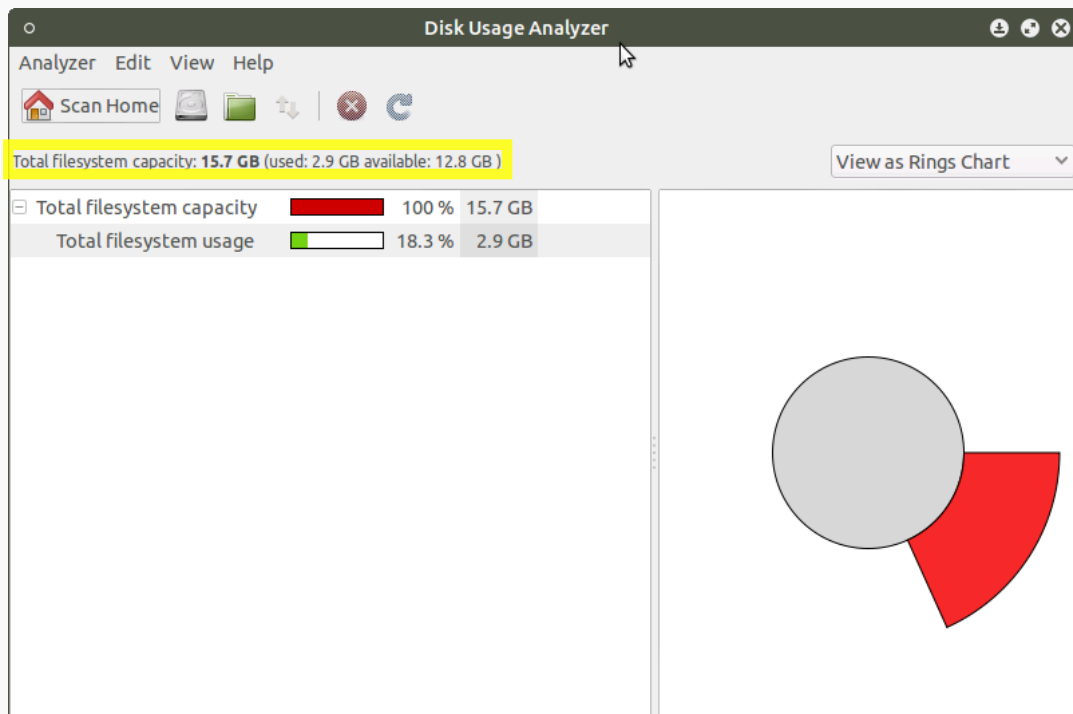
sudo reboot

-> 재부팅

-> 완료

기초 Pi 세팅

- Resizing



-> 완료

기초 Pi 세팅

- 고정 IP Internet 연결

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ ifconfig  
eth0      Link encap:Ethernet  HWaddr b8:27:eb:1b:14:a1  
          inet6 addr: fe80::ba27:ebff:fe1b:14a1/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:21948 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:36 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:1828995 (1.8 MB)  TX bytes:8144 (8.1 KB)  
  
lo        Link encap:Local Loopback  
          inet addr:127.0.0.1  Mask:255.0.0.0  
          inet6 addr: ::1/128 Scope:Host  
          UP LOOPBACK RUNNING  MTU:65536  Metric:1  
          RX packets:569 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:569 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:50234 (50.2 KB)  TX bytes:50234 (50.2 KB)  
  
wlan0     Link encap:Ethernet  HWaddr 00:26:66:08:24:12  
          UP BROADCAST MULTICAST  MTU:1500  Metric:1  
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
```

ifconfig

-> Network interface 확인

-> **eth0**

(ethernet 0번 포트를 고정 ip로
주고 싶다)

기초 Pi 세팅

- 고정 IP Internet 연결

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo apt-get update  
[sudo] password for junho:  
Err http://ports.ubuntu.com vivid InRelease  
Err http://ppa.launchpad.net vivid InRelease  
Err http://ports.ubuntu.com vivid-updates InRelease  
Err http://ports.ubuntu.com vivid-security InRelease  
Err http://ports.ubuntu.com vivid-backports InRelease  
Err http://ppa.launchpad.net vivid Release.gpg  
Temporary failure resolving 'ppa.launchpad.net'  
Err http://ports.ubuntu.com vivid Release.gpg  
Temporary failure resolving 'ports.ubuntu.com'  
Err http://ports.ubuntu.com vivid-updates Release.gpg  
Temporary failure resolving 'ports.ubuntu.com'  
Err http://ports.ubuntu.com vivid-security Release.gpg  
Temporary failure resolving 'ports.ubuntu.com'  
Err http://ports.ubuntu.com vivid-backports Release.gpg  
Temporary failure resolving 'ports.ubuntu.com'  
^Cjunho@junho-desktop:~$ 6%  
junho@junho-desktop:~$
```

sudo apt-get update

-> 패키지 목록 업데이트

-> 인터넷이 필요

-> 고정 IP 문제로 인터넷 불가

기초 Pi 세팅

- 고정 IP Internet 연결

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo vi /etc/network/interfaces
```

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
# interfaces(5) file used by ifup(8) and ifdown(8)  
# Include files from /etc/network/interfaces.d:  
source-directory /etc/network/interfaces.d  
  
# The loopback network interface  
auto lo  
iface lo inet loopback  
  
auto eth0  
iface eth0 inet static  
address 163.180.118.38  
netmask 255.255.255.0  
network 163.180.118.0  
broadcast 163.180.118.255  
gateway 163.180.118.1  
dns-nameservers 163.180.96.54 163.180.16.53  
  
~  
~  
:wq
```

sudo vi /etc/network/interfaces

-> network interface 설정 변경

-> vi : 텍스트파일 변경 툴

auto eth0

iface eth0 inet static

address ~.~.~.

netmask ~.~.~.

network ~.~.~.

broadcast ~.~.~.

gateway ~.~.~.

dns-nameservers ~.~.~.

:wq -> 저장 및 종료

기초 Pi 세팅

- 고정 IP Internet 연결

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo reboot
```

sudo reboot
-> 재부팅

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ ifconfig  
eth0      Link encap:Ethernet  HWaddr b8:27:eb:1b:14:a1  
          inet addr:163.180.118.38  Bcast:163.180.118.255  Mask:255.255.255.0  
          inet6 addr: fe80::ba27:ebff:fe1b:14a1/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:15639 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:319 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:1278816 (1.2 MB)  TX bytes:45515 (45.5 KB)  
  
lo        Link encap:Local Loopback  
          inet addr:127.0.0.1  Mask:255.0.0.0  
          inet6 addr: ::1/128 Scope:Host  
          UP LOOPBACK RUNNING  MTU:65536  Metric:1  
          RX packets:258 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:258 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:47510 (47.5 KB)  TX bytes:47510 (47.5 KB)  
  
wlan0     Link encap:Ethernet  HWaddr 00:26:66:08:24:12
```

ifconfig

-> **eth0에 IP가 할당된 것을 확인할 수 있음**

기초 Pi 세팅

- 고정 IP Internet 연결

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo apt-get update  
[sudo] password for junho:  
Get:1 http://ports.ubuntu.com vivid InRelease [218 kB]  
Get:2 http://ppa.launchpad.net vivid InRelease  
Get:3 http://ppa.launchpad.net vivid Release.gpg [316 B]  
Get:4 http://ppa.launchpad.net vivid Release [15.1 kB]  
Get:5 http://ports.ubuntu.com vivid-updates InRelease [65.9 kB]  
Get:6 http://ppa.launchpad.net vivid/main armhf Packages [9,787 B]  
Get:7 http://ports.ubuntu.com vivid-security InRelease [65.9 kB]  
Get:8 http://ports.ubuntu.com vivid-backports InRelease [64.5 kB]  
Get:9 http://ppa.launchpad.net vivid/main Translation-en [3,643 B]  
Get:10 http://ports.ubuntu.com vivid/main armhf Packages [1,327 kB]  
Get:11 http://ports.ubuntu.com vivid/restricted armhf Packages [7,128 B]  
Get:12 http://ports.ubuntu.com vivid/universe armhf Packages [6,312 kB]  
Get:13 http://ports.ubuntu.com vivid/multiverse armhf Packages [112 kB]  
Get:14 http://ports.ubuntu.com vivid/main Translation-en [793 kB]  
Get:15 http://ports.ubuntu.com vivid/multiverse Translation-en [103 kB]  
Get:16 http://ports.ubuntu.com vivid/restricted Translation-en [4,228 B]  
Get:17 http://ports.ubuntu.com vivid/universe Translation-en [4,456 kB]  
Get:18 http://ports.ubuntu.com vivid-updates/main armhf Packages [265 kB]  
Get:19 http://ports.ubuntu.com vivid-updates/restricted armhf Packages [7,701 B]  
Get:20 http://ports.ubuntu.com vivid-updates/universe armhf Packages [135 kB]  
Get:21 http://ports.ubuntu.com vivid-updates/multiverse armhf Packages [2,647 B]  
Get:22 http://ports.ubuntu.com vivid-updates/main Translation-en [136 kB]
```

sudo apt-get update

-> 패키지 목록 업데이트

-> 인터넷이 필요

-> 인터넷에서 패킷을 받아옴

-> 완료

batman-adv & batctl 설치 및 실행

- batman-adv & batctl

```
junho@junho-desktop:~$ sudo apt-get install batctl
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  apt-clone archdetect-deb dmeventd dmraid dpkg-repack gir1.2-json-1.0
  gir1.2-timzone-1.0 gir1.2-xkl-1.0 kpartx kpartx-boot
  libdebian-installer4 libdevmapper-event1.02.1 libdmraid1.0.0.rc16
  liblvm2cmd2.02 libparted-fs-resize0 libtimezonemap-data libtimezonemap1 lvm2
  os-prober python3-icu python3-pam rdate watershed
Use 'apt-get autoremove' to remove them.
The following NEW packages will be installed:
  batctl
0 upgraded, 1 newly installed, 0 to remove and 275 not upgraded.
Need to get 45.4 kB of archives.
After this operation, 120 kB of additional disk space will be used.
0% [Connecting to ports.ubuntu.com]
```

sudo apt-get install batctl

-> batctl 설치

-> (error 발생시
sudo apt-get update 후 실행)

-> batman-adv는
따로 설치할 필요X

batman-adv & batctl 설치 및 실행

- batman-adv 실행

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo service network-manager stop  
junho@junho-desktop:~$ sudo ifconfig wlan0 down  
junho@junho-desktop:~$ ifconfig  
eth0      Link encap:Ethernet  HWaddr b8:27:eb:1b:14:a1  
          inet addr:163.180.118.38  Bcast:163.180.118.255  Mask:255.255.255.0  
          inet6 addr: fe80::ba27:ebff:fe1b:14a1/64  Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:53661 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:5929 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:18887759 (18.8 MB)  TX bytes:495198 (495.1 KB)  
  
lo        Link encap:Local Loopback  
          inet addr:127.0.0.1  Mask:255.0.0.0  
          inet6 addr: ::1/128  Scope:Host  
          UP LOOPBACK RUNNING  MTU:65536  Metric:1  
          RX packets:268 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:268 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:48344 (48.3 KB)  TX bytes:48344 (48.3 KB)  
  
junho@junho-desktop:~$
```

sudo service network-manager stop

-> 디폴트로 작동되고 있는 network manager 서비스 끄기

sudo ifconfig wlan0 down

-> wlan0(usb로 삽입한 무선 랜카드)
(wlan0는 wlan1, wlan2와 같이
숫자가 변경될 수 있다. ifconfig
명령어로 해당 인터페이스 확인)

ifconfig

-> 현재 네트워크 인터페이스 확인

-> wlan0이 없는 것을 확인

batman-adv & batctl 설치 및 실행

- batman-adv 실행

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo iwconfig wlan0 mode ad-hoc essid junho_mesh channel 8  
junho@junho-desktop:~$ sudo ifconfig wlan0 up  
junho@junho-desktop:~$ ifconfig  
eth0      Link encap:Ethernet  HWaddr b8:27:eb:1b:14:a1  
          inet addr:163.180.118.38  Bcast:163.180.118.255  Mask:255.255.255.0  
          inet6 addr: fe80::ba27:ebff:fe1b:14a1/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:76843 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:6010 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:20838629 (20.8 MB)  TX bytes:503118 (503.1 KB)  
  
lo        Link encap:Local Loopback  
          inet addr:127.0.0.1  Mask:255.0.0.0  
          inet6 addr: ::1/128 Scope:Host  
          UP LOOPBACK RUNNING  MTU:65536  Metric:1  
          RX packets:274 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:274 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:48890 (48.8 KB)  TX bytes:48890 (48.8 KB)  
  
wlan0     Link encap:Ethernet  HWaddr 00:26:66:08:24:12  
          UP BROADCAST MULTICAST  MTU:1500  Metric:1  
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)  
  
junho@junho-desktop:~$
```

sudo iwconfig wlan0 mode ad-hoc essid junho_mesh channel 8

- > wlan0 설정
(ad-hoc 모드로 essid는 junho_mesh, 채널은 8번을 사용)
- > junho_mesh 는 임의 값 (essid)
- > 8 또한 임의 값 (channel)

sudo ifconfig wlan0 up

- > wlan0 인터페이스 작동

ifconfig

- > 현재 네트워크 인터페이스 확인

- > wlan0이 작동중임을 확인할 수 있음

batman-adv & batctl 설치 및 실행

- batman-adv 실행

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo modprobe batman-adv  
junho@junho-desktop:~$ sudo batctl if add wlan0  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$ sudo cat /sys/class/net/wlan0/batman_adv/iface_status  
active  
junho@junho-desktop:~$  
junho@junho-desktop:~$
```

sudo modprobe batman-adv

-> batman-adv를 커널에 올림

-> 기존에는 비활성 상태

sudo batctl if add wlan0

-> wlan0 인터페이스를 배트맨용 인터페이스로 추가(batctl 사용)

sudo cat

/sys/class/net/wlan0/batman-adv/iface_status

-> wlan0가 batman-adv로 동작중인지 확인

-> **active** 표시를 확인

- modprobe 안했을 시

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo batctl if add wlan0  
Error - batman-adv module has not been loaded  
junho@junho-desktop:~$
```

-> **Error – batman-adv module has not been loaded**

batman-adv & batctl 설치 및 실행

- batman-adv 실행

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo ifconfig bat0 up  
junho@junho-desktop:~$ ifconfig  
bat0      Link encap:Ethernet  HWaddr 0a:90:cc:77:80:c5  
          inet6 addr: fe80::890:ccff:fe77:80c5/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:1 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:0 errors:0 dropped:26 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:42 (42.0 B)  TX bytes:0 (0.0 B)  
  
eth0      Link encap:Ethernet  HWaddr b8:27:eb:1b:14:a1  
          inet addr:163.180.118.38  Bcast:163.180.118.255  Mask:255.255.255.0  
          inet6 addr: fe80::ba27:ebff:fe1b:14a1/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:322671 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:6480 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:41139745 (41.1 MB)  TX bytes:547574 (547.5 KB)  
  
lo        Link encap:Local Loopback  
          inet addr:127.0.0.1  Mask:255.0.0.0  
          inet6 addr: ::1/128 Scope:Host  
          UP LOOPBACK RUNNING  MTU:65536  Metric:1  
          RX packets:295 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:295 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:50945 (50.9 KB)  TX bytes:50945 (50.9 KB)  
  
wlan0     Link encap:Ethernet  HWaddr 00:26:66:08:24:12  
          inet6 addr: fe80::226:66ff:fe08:2412/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:178 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:0 (0.0 B)  TX bytes:18870 (18.8 KB)  
  
junho@junho-desktop:~$
```

sudo ifconfig bat0 up

-> bat0 가상 인터페이스를 활성화시킴

ifconfig

-> 현재 네트워크 인터페이스 확인

-> bat0이 작동중임을 확인할 수 있음

batman-adv & batctl 설치 및 실행

- batman-adv 실행

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo batctl o  
[B.A.T.M.A.N. adv 2014.4.0, MainIF/MAC: wlan0/00:26:66:08:24:12 (bat0 BATMAN_IV)]  
Originator      last-seen (#/255)      Nexthop [outgoingIF]:  Potential nexthops ...  
No batman nodes in range ...  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$  
junho@junho-desktop:~$ sudo batctl o  
[B.A.T.M.A.N. adv 2014.4.0, MainIF/MAC: wlan0/00:26:66:08:24:12 (bat0 BATMAN_IV)]  
Originator      last-seen (#/255)      Nexthop [outgoingIF]:  Potential nexthops ...  
00:26:66:4e:d9:47 1.704s ( 34) 00:26:66:4e:d9:47 [ wlan0]: 00:26:66:4e:d9:47 ( 34)  
junho@junho-desktop:~$
```

sudo batctl o

- > 현재 연결된 노드가 보인다.
- > 자기 자신만 동작 상태
- > 다른 노드가 아무것도 없다.

-> 다른 한 노드에서 동작

sudo batctl o

- > 현재 연결된 노드가 보인다.
- > 자신과 연결된 다른 노드가 보인다.

-> batman-adv 동작
확인 완료

batman-adv & batctl 설치 및 실행

- batctl o 확인 법

```

no batman nodes in range ...
junho@junho-desktop:~$ sudo batctl o
[B.A.T.M.A.N. adv 2014.4.0, MainIF/MAC: wlan0/00:26:66:08:24:12 (bat0 BATMAN IV)]
Originator      last-seen (#/255)      Nexthop [outgoingIF]      Potential nexthops ...
00:26:66:4e:d9:47  1.704s      ( 34) 00:26:66:4e:d9:47 [wlan0] 00:26:66:4e:d9:47 ( 34)
junho@junho-desktop:~$
  
```

Originator	last-seen	TQ	Nexthop	ourgoingIF	Potential nexthops
목적지, 노드	마지막 확인 후 경과시간	Quality	해당 노드로 가기위한 best next hop	outgoing interface	잠재적인 nexthop (현재는 노드가 하나밖에 없어서 하나만 나옴)
해당 노드 맥 주소	초	0 ~ 255	해당 노드 맥 주소	interface name	해당 노드 맥 주소(TQ)
00:26:66:4e:d9:47	1.794s	34	00:26:66:4e:d9:47	wlan0	00:26:66:4e:d9:47 (34)

dhcpcd 설치 및 실행

- dhcpcd 설치 (master node)

```
junho@junho-desktop:~$ sudo apt-get install isc-dhcp-server
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  apt-cclone archdetect-deb dmeventd dmraid dpkg-repack gir1.2-json-1.0
  gir1.2-timzone-1.0 gir1.2-xkl-1.0 kpartx kpartx-boot libdebian-installer4
  libdevmapper-event1.02.1 libdmraid1.0.0.rc16 liblvm2cmd2.02 libparted-fs-resize0
  libtimezonemap-data libtimezonemap1 lvm2 os-prober python3-icu python3-pam rdate
  watershed
Use 'apt-get autoremove' to remove them.
The following extra packages will be installed:
  isc-dhcp-client isc-dhcp-common
Suggested packages:
  isc-dhcp-server-ldap
The following NEW packages will be installed:
  isc-dhcp-server
The following packages will be upgraded:
  isc-dhcp-client isc-dhcp-common
2 upgraded, 1 newly installed, 0 to remove and 273 not upgraded.
Need to get 709 kB of archives.
After this operation, 733 kB of additional disk space will be used.
Do you want to continue? [Y/n]
```

sudo apt-get install isc-dhcp-server
-> dhcp server download

-> Do you want to continue?
Y enter

dhcpcd 설치 및 실행

- dhcpcd 실행 (master node)

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo vi /etc/dhcp/dhcpd.conf
```

```
junho@junho-desktop: ~/Documents  
File Edit View Search Terminal Help  
96 #shared-network 224-29 {  
97 #   subnet 10.17.224.0 netmask 255.255.255.0 {  
98 #     option routers rtr-224.example.org;  
99 #   }  
100 #   subnet 10.0.29.0 netmask 255.255.255.0 {  
101 #     option routers rtr-29.example.org;  
102 #   }  
103 #   pool {  
104 #     allow members of "foo";  
105 #     range 10.17.224.10 10.17.224.250;  
106 #   }  
107 #   pool {  
108 #     deny members of "foo";  
109 #     range 10.0.29.10 10.0.29.230;  
110 #   }  
111 #}  
112  
113 subnet 192.168.0.0 netmask 255.255.255.0 {  
114     range 192.168.0.20 192.168.0.200;  
115     option routers 192.168.0.10;  
116 }
```

sudo vi /etc/dhcp/dhcpd.conf

-> dhcpcd 설정파일 변경

-> vi : 텍스트파일 변경 툴

**subnet 192.168.0.0 netmask 255.255.255.0 {
 range 192.168.0.20 192.168.0.200;
 option routers 192.168.0.10;
}**

-> bat0(192.168.0.0/24 대역) 으로 들어오는 request 에 대하여 192.168.0.20 ~ 200에 해당하는 ip 부여

-> 해당 파일 맨 마지막에 작성

dhcpcd 설치 및 실행

- dhcpcd 실행 (master node)

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo ifconfig bat0 192.168.0.10/24  
junho@junho-desktop:~$ sudo ifconfig  
bat0      Link encap:Ethernet  HWaddr b2:d5:c7:8a:81:f6  
          inet addr:192.168.0.10  Bcast:192.168.0.255  Mask:255.255.255.0  
          inet6 addr: fe80::b0d5:c7ff:fe8a:81f6/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:18 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:6 errors:0 dropped:58 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:1925 (1.9 KB)  TX bytes:657 (657.0 B)  
  
eth0      Link encap:Ethernet  HWaddr b8:27:eb:1b:14:a1  
          inet addr:163.180.118.38  Bcast:163.180.118.255  Mask:255.255.255.0  
          inet6 addr: fe80::ba27:ebff:fe1b:14a1/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:60061 errors:0 dropped:1 overruns:0 frame:0  
          TX packets:459 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:4910142 (4.9 MB)  TX bytes:56241 (56.2 KB)  
  
lo        Link encap:Local Loopback  
          inet addr:127.0.0.1  Mask:255.0.0.0  
          inet6 addr: ::1/128 Scope:Host  
          UP LOOPBACK RUNNING  MTU:65536  Metric:1  
          RX packets:308 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:308 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:0  
          RX bytes:50641 (50.6 KB)  TX bytes:50641 (50.6 KB)  
  
wlan0     Link encap:Ethernet  HWaddr 00:26:66:08:24:12  
          inet6 addr: fe80::226:66ff:fe08:2412/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1527  Metric:1  
          RX packets:869 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:1400 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:63078 (63.0 KB)  TX bytes:127291 (127.2 KB)  
  
junho@junho-desktop:~$
```

sudo ifconfig bat0 192.168.0.10/24

- > bat0에 임의로 IP 할당
- > 전 슬라이드에서 dhcpcd.conf 설정 시 192.168.0.0/24 대역으로 설정 따라서 똑같은 대역으로 할당
- > dhcp server가 돌아가는 노드에서만 설정

ifconfig

- > 현재 네트워크 인터페이스 확인

- > bat0의 IP가 할당되었음을 확인할 수 있음

dhcpcd 설치 및 실행

- dhcpcd 실행 (master node)

```
junho@junho-desktop:~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo ifconfig wlan0 10.0.0.10/24  
junho@junho-desktop:~$ ifconfig  
bat0    Link encap:Ethernet  HWaddr b2:d5:c7:8a:81:f6  
        inet addr:192.168.0.10  Bcast:192.168.0.255  Mask:255.255.255.0  
        inet6 addr: fe80::b0d5:c7ff:fe8a:81f6/64 Scope:Link  
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
        RX packets:59 errors:0 dropped:0 overruns:0 frame:0  
        TX packets:28 errors:0 dropped:73 overruns:0 carrier:0  
        collisions:0 txqueuelen:0  
        RX bytes:7150 (7.1 KB)  TX bytes:2637 (2.6 KB)  
  
eth0    Link encap:Ethernet  HWaddr b8:27:eb:1b:14:a1  
        inet addr:163.180.118.38  Bcast:163.180.118.255  Mask:255.255.255.0  
        inet6 addr: fe80::ba27:ebff:fe1b:14a1/64 Scope:Link  
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
        RX packets:107012 errors:0 dropped:1 overruns:0 frame:0  
        TX packets:1097 errors:0 dropped:0 overruns:0 carrier:0  
        collisions:0 txqueuelen:1000  
        RX bytes:9589753 (9.5 MB)  TX bytes:108690 (108.6 KB)  
  
lo      Link encap:Local Loopback  
        inet addr:127.0.0.1  Mask:255.0.0.0  
        inet6 addr: ::1/128 Scope:Host  
        UP LOOPBACK RUNNING  MTU:65536  Metric:1  
        RX packets:346 errors:0 dropped:0 overruns:0 frame:0  
        TX packets:346 errors:0 dropped:0 overruns:0 carrier:0  
        collisions:0 txqueuelen:0  
        RX bytes:54067 (54.0 KB)  TX bytes:54067 (54.0 KB)  
  
wlan0   Link encap:Ethernet  HWaddr 00:26:66:08:24:12  
        inet addr:10.0.0.10  Bcast:10.0.0.255  Mask:255.255.255.0  
        inet6 addr: fe80::1226:66ff:fe08:2412/64 Scope:Link  
        UP BROADCAST RUNNING MULTICAST  MTU:1527  Metric:1  
        RX packets:2548 errors:0 dropped:0 overruns:0 frame:0  
        TX packets:3317 errors:0 dropped:0 overruns:0 carrier:0  
        collisions:0 txqueuelen:1000  
        RX bytes:184113 (184.1 KB)  TX bytes:302012 (302.0 KB)
```

sudo ifconfig wlan0 10.0.0.10/24

- > wlan0에 임의로 IP 할당
- > dhcp server가 동작하려면 모든 인터페이스에 static IP가 있어야 한다.
- > dhcp server가 돌아가는 노드에서만 설정

ifconfig

- > 현재 네트워크 인터페이스 확인

- > wlan0의 IP가 할당되었음을 확인할 수 있음

dhcpcd 설치 및 실행

- dhcpcd 실행 (master node)

```
junho@junho-desktop: ~/Documents
File Edit View Search Terminal Help
junho@junho-desktop:~/Documents$ sudo service isc-dhcp-server restart
junho@junho-desktop:~/Documents$ sudo service --status-all
[ - ] alsa-utils
[ - ] anacron
[ + ] apparmor
[ + ] appport
[ + ] avahi-daemon
[ - ] avahi-dnsmconfd
[ + ] bluetooth
[ - ] bootmisc.sh
[ - ] brltty
[ - ] checkfs.sh
[ - ] checkroot-bootclean.sh
[ - ] checkroot.sh
[ - ] console-setup
[ + ] cpufrequtils
[ + ] cron
[ + ] cups
[ + ] cups-browsed
[ + ] dbus
[ + ] dns-clean
[ - ] hostname.sh
[ - ] hwclock.sh
[ + ] irqbalance
[ + ] isc-dhcp-server
[ + ] kernetools
[ - ] killprocs
[ - ] kmod
[ + ] lightdm
[ + ] loadcpufreq
[ - ] lvm2
^Cjunho@junho-desktop:~/Documents$
```

sudo service isc-dhcp-server restart

-> dhcp server restart

sudo service --status-all

-> 모든 서비스 상태 확인

-> **isc-dhcp-server가 [+]로 바뀌어 있어야 함**

-> [-] 인 경우 모든 network interface가 static IP 인지, dhcpcd.conf 파일을 잘못 작성한 경우를 확인

dhcpcd 설치 및 실행

- dhcpcd 실행(master node)

```
junho@junho-desktop: ~/Documents
File Edit View Search Terminal Help
junho@junho-desktop:~/Documents$ sudo batctl gw
off
junho@junho-desktop:~/Documents$ sudo batctl gw server
junho@junho-desktop:~/Documents$ sudo batctl gw
server (announced bw: 10.0/2.0 MBit)
junho@junho-desktop:~/Documents$
```

sudo batctl gw

-> 현재 자기자신의 gw 상태 확인

-> 꺼져있는 상태(default)

sudo batctl gw server

-> 자신 노드를 gw server모드로 설정

sudo batctl gw

-> 현재 자기자신의 gw 상태 확인

-> server모드로 동작 중

dhcpcd 설치 및 실행

- IP 받아오기(slave node)

```
junho@junho-desktop: ~/Documents
File Edit View Search Terminal Help
junho@junho-desktop:~/Documents$ ifconfig
bat0    Link encap:Ethernet  HWaddr ba:66:07:7e:3e:fe
        inet6 addr: fe80::b866:7ff:fe7e:3efe/64 Scope:Link
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:10 errors:0 dropped:0 overruns:0 frame:0
        TX packets:7 errors:0 dropped:28 overruns:0 carrier:0
        collisions:0 txqueuelen:0
        RX bytes:2017 (2.0 KB)  TX bytes:931 (931.0 B)

eth0    Link encap:Ethernet  HWaddr b8:27:eb:1b:14:a1
        inet addr:163.180.118.38  Bcast:163.180.118.255  Mask:255.255.255.0
        inet6 addr: fe80::ba27:ebff:fe1b:14a1/64 Scope:Link
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:10324 errors:0 dropped:0 overruns:0 frame:0
        TX packets:430 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:894694 (894.6 KB)  TX bytes:51686 (51.6 KB)

lo      Link encap:Local Loopback
        inet addr:127.0.0.1  Mask:255.0.0.0
        inet6 addr: ::1/128 Scope:Host
        UP LOOPBACK RUNNING  MTU:65536  Metric:1
        RX packets:331 errors:0 dropped:0 overruns:0 frame:0
        TX packets:331 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:0
        RX bytes:59885 (59.8 KB)  TX bytes:59885 (59.8 KB)
```

ifconfig

-> 현재 네트워크 인터페이스 확인

-> bat0 ipv4 없는 상태

-> wlan0은 나타나지 않아있음
(밑에 짤림)

dhcpcd 설치 및 실행

- IP 받아오기(slave node)

```
junho@junho-desktop: ~/Documents
File Edit View Search Terminal Help
junho@junho-desktop:~/Documents$ sudo batctl gw
off
junho@junho-desktop:~/Documents$ sudo batctl gw client
junho@junho-desktop:~/Documents$ sudo dhclient bat0
junho@junho-desktop:~/Documents$
```

sudo batctl gw

- > 현재 자기자신의 gw 상태 확인
- > 꺼져있는 상태(default)

sudo batctl gw client

- > 자신 노드를 gw client모드로 설정
- > dhcp 등 internet packet을 server gw에서 받아옴

```
junho@junho-desktop: ~/Documents
File Edit View Search Terminal Help
junho@junho-desktop:~/Documents$ ifconfig
bat0
Link encap:Ethernet Hwaddr ba:66:07:7e:3e:fe
inet addr:192.168.0.34 Bcast:192.168.0.255 Mask:255.255.255.0
inet6 addr: fe80::b866:7ff:fe7e:3efe/64 Scope:Link
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:100 errors:0 dropped:0 overruns:0 frame:0
TX packets:160 errors:0 dropped:40 overruns:0 carrier:0
collisions:0 txqueuelen:0
RX bytes:20593 (20.5 KB) TX bytes:34303 (34.3 KB)
```

sudo dhclient bat0

- > bat0 IP를 받아오는 명령어

ifconfig

- > 현재 네트워크 인터페이스 확인
- > bat0 IP를 받아옴

- > wlan0, eth0 등은 나타나지 않아있음 (밑에 찔림)

TOX 설치 및 실행

- TOX 설치(apt-get 방법) - laptop

```
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B: ~  
File Edit View Search Terminal Help  
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B:~$ sudo echo "deb https://pkg.tox.chat/debi  
an nightly $(lsb_release -cs)" | sudo tee /etc/apt/sources.list.d/tox.list  
deb https://pkg.tox.chat/debian nightly vivid  
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B:~$  
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B:~$ sudo wget -qO - https://pkg.tox.chat/deb  
ian/pkg.gpg.key | sudo apt-key add -  
OK  
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B:~$  
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B:~$
```

sudo echo "deb https://pkg.tox.chat/debian nightly \$(lsb_release -cs)" | sudo tee /etc/apt/sources.list.d/tox.list

-> package 소스 추가

-> 추가된 사이트 표시

sudo wget -qO - https://pkg.tox.chat/debian/pkg.gpg.key | sudo apt-key add -

-> 인증키를 받아옴

-> 정상적으로 받아오면 OK

-> 현재 방법은 공식 홈페이지에 나와있는 방법입니다.

TOX 설치 및 실행

- TOX 설치(apt-get 방법) - laptop

```
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B: ~  
File Edit View Search Terminal Help  
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B:~$ sudo apt-get install apt-transport-https  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following extra packages will be installed:  
  libapt-pkg4.12  
The following packages will be upgraded:  
  apt-transport-https libapt-pkg4.12  
2 upgraded, 0 newly installed, 0 to remove and 275 not upgraded.  
Need to get 716 kB of archives.  
After this operation, 5,120 B of additional disk space will be used.  
Do you want to continue? [Y/n] y
```

```
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B: ~  
File Edit View Search Terminal Help  
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B:~$ sudo apt-get update
```

sudo apt-get install apt-transport-https

-> apt-transport-https 다운

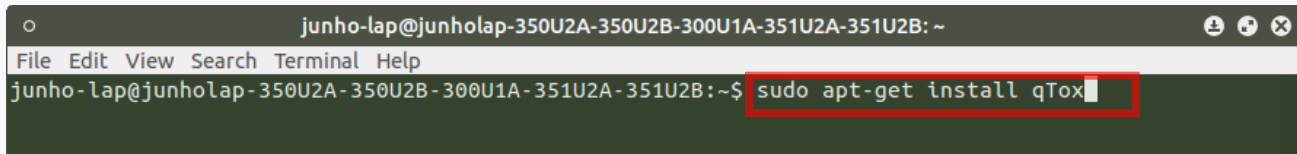
sudo apt-get update

-> 패키지 목록 업데이트

-> 현재 방법은 공식 홈페이지에 나와있는 방법입니다.

TOX 설치 및 실행

- TOX 설치(apt-get 방법) - laptop



```
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B: ~  
File Edit View Search Terminal Help  
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B:~$ sudo apt-get install qTox
```

sudo apt-get install qTox

OR

sudo apt-get install qtox

-> qtox 다운로드

- > 현재 방법은 공식 홈페이지에 나와있는 방법입니다.
- > Raspberry Pi의 경우 위의 방법으로 다운이 되지 않습니다.
(직접 바이너리 파일을 다운 받아야함)

TOX 설치 및 실행

- TOX 설치(wget 방법) – laptop & pi

```
junho@junho-desktop: ~/Downloads
File Edit View Search Terminal Help
junho@junho-desktop:~$ cd Downloads/
junho@junho-desktop:~/Downloads$
junho@junho-desktop:~/Downloads$ sudo wget https://build.tox.chat/view/Clients/job/qTox_build_linux_armhf_release/lastSuccessfulBuild/artifact/qTox_build_linux_armhf_release.tar.xz
```

cd Downloads

-> 다운로드 directory로 이동(선택 사항)

`sudo wget https://build.tox.chat/view/Clients/job/qTox_build_linux_armhf_release/lastSuccessfulBuild/artifact/qTox_build_linux_armhf_release.tar.xz`

-> linux_armhf용 qtox다운로드(pi용)

`sudo wget https://build.tox.chat/view/Clients/job/qTox_build_linux_x86_release/lastSuccessfulBuild/artifact/qTox_build_linux_x86_release.tar.xz`

-> x86용 qtox다운로드(lap-top용)

-> 위의 사진은 Pi에서 캡처한 사진입니다.

-> 현재 방법은 공식 홈페이지에 나와있지 않은 방법입니다.

TOX 설치 및 실행

- TOX 설치(wget 방법) – laptop & pi

```
junho@junho-desktop: ~/Downloads
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads$ ls
qTox_build_linux_armhf_release.tar.xz
junho@junho-desktop:~/Downloads$
junho@junho-desktop:~/Downloads$
junho@junho-desktop:~/Downloads$ sudo xz -d qTox_build_linux_armhf_release.tar.xz
[sudo] password for junho:
junho@junho-desktop:~/Downloads$
junho@junho-desktop:~/Downloads$ sudo tar -xvf qTox_build_linux_armhf_release.tar
qtox
```

ls -> 다운 받은 파일이 보임

sudo xz -d qTox_build_linux_armhf_release.tar.xz
-> xz 압축해제(pi용)

sudo -xvf qTox_build_linux_armhf_release.tar
-> tar 압축해제(pi용)

-> qtox라는 실행파일이 나옴

sudo xz -d qTox_build_linux_x86_release.tar.xz
-> xz 압축해제(lap-top용)

sudo -xvf qTox_build_linux_x86_release.tar.xz
-> tar 압축해제(lap-top용)

TOX 설치 및 실행

- TOX 실행(apt-get & wget 방법) – laptop & pi

```
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B: ~  
File Edit View Search Terminal Help  
junho-lap@junholap-350U2A-350U2B-300U1A-351U2A-351U2B:~$ sudo qtox  
[18:04:47.923] src/persistence/settings.cpp:117 : Debug: No settings file found, using defaults  
[18:04:47.923] src/persistence/settings.cpp:121 : Debug: "Loading settings from :/conf/qtox.ini"  
[18:04:47.925] src/ipc.cpp:46 : Debug: Our global IPC ID is 3512848330788124993  
[18:04:47.926] src/main.cpp:196 : Debug: built on: 22:49:19 Mar 29 2016 ( 1459291367 )  
[18:04:47.926] src/main.cpp:197 : Debug: commit: built without git  
[18:04:47.926] src/nexus.cpp:81 : Debug: Starting up
```

sudo qtox

-> apt-get 방법의 실행

-> 옆의 사진은 lap-top에서
캡처한 사진입니다.

```
junho@junho-desktop:~/Downloads$ sudo ./qtox  
[17:36:44.445] src/persistence/settings.cpp:116 : Debug: No settings file found,  
using defaults  
[17:36:44.447] src/persistence/settings.cpp:120 : Debug: "Loading settings from :  
/conf/qtox.ini"  
[17:36:44.451] src/ipc.cpp:46 : Debug: Our global IPC ID is 3580438927555016603  
[17:36:44.453] src/main.cpp:143 : Debug: built on: 09:27:56 Dec 5 2015 ( 144930  
7415 )  
[17:36:44.454] src/main.cpp:144 : Debug: commit: a6bbd31b1268e8d4552b8ec88ed64f5  
8991f19e9
```

sudo ./qtox

-> wget 방법의 실행

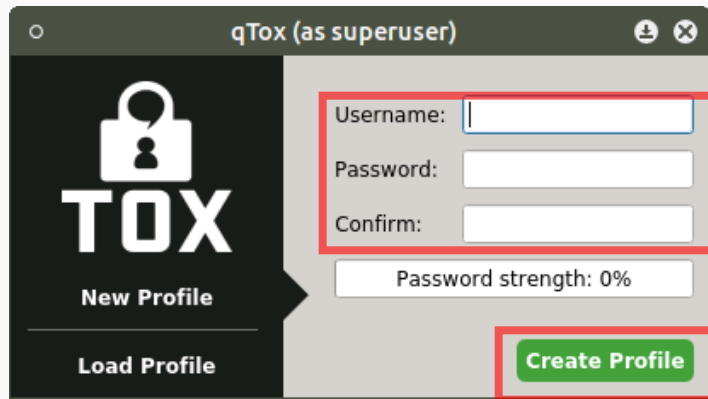
-> 압축을 푼 곳에서 실행

-> 옆의 사진은 pi에서
캡처한 사진입니다.

-> 주의사항 : qtox는 graphic 출력장치가 있어야 실행됩니다 (모니터 등).

TOX 설치 및 실행

- TOX 실행 – laptop & pi

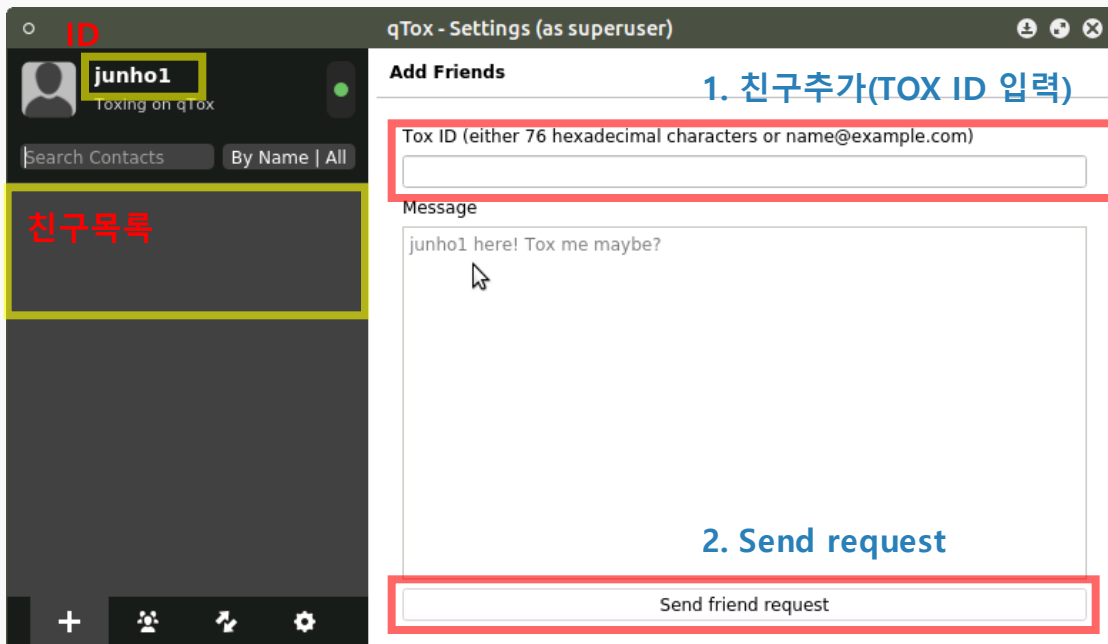


회원 가입

클릭

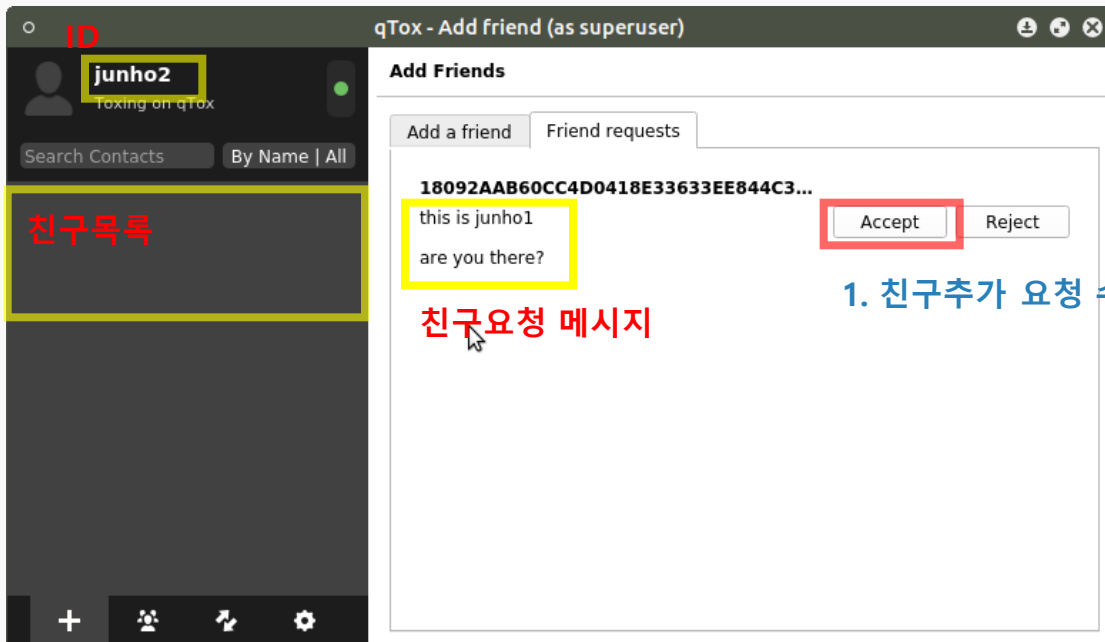
TOX 설치 및 실행

- TOX 실행 – laptop & pi



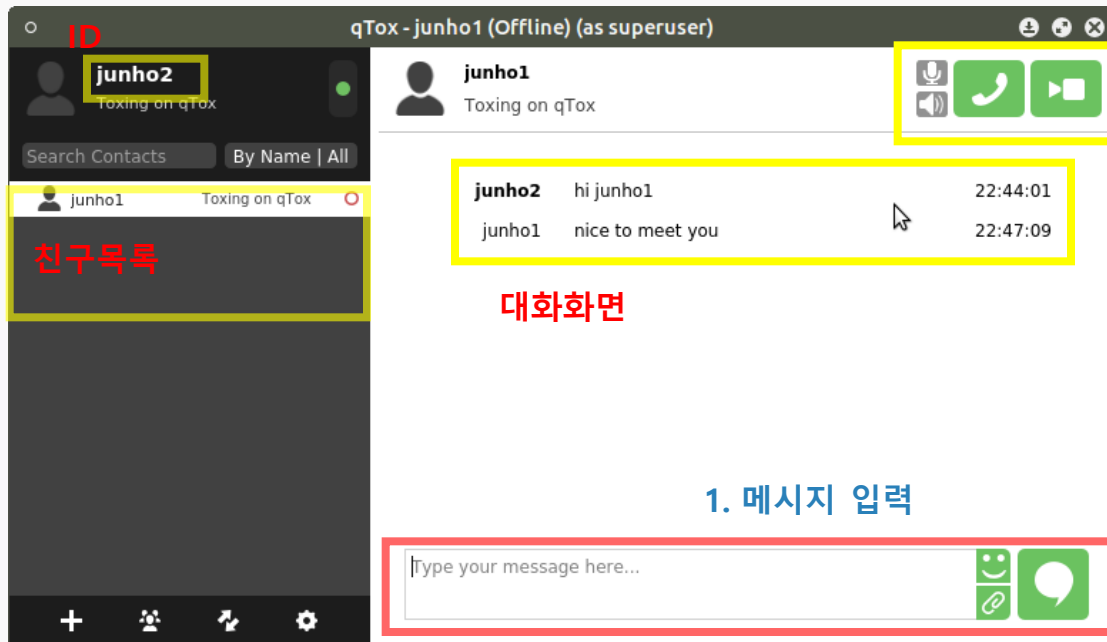
TOX 설치 및 실행

- TOX 실행 – laptop & pi



TOX 설치 및 실행

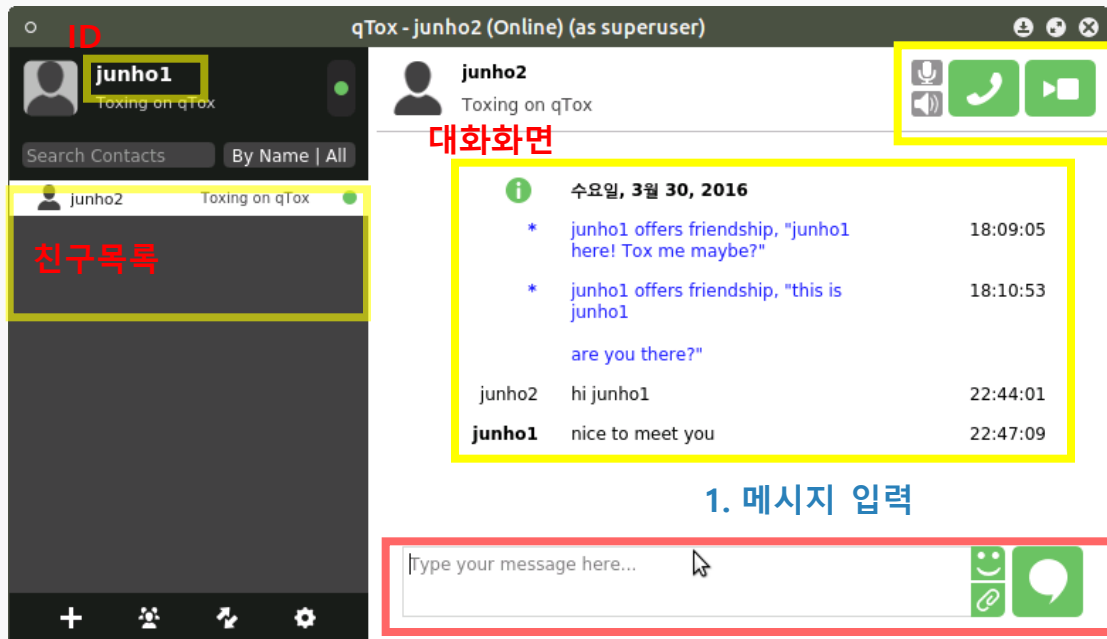
- TOX 실행 – laptop & pi



통화 및 화상채팅 가능

TOX 설치 및 실행

- TOX 실행 – laptop & pi



통화 및 화상채팅 가능

GOTHAM 설치 및 실행

• java 설치

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo add-apt-repository ppa:webupd8team/java  
Oracle Java (JDK) Installer (automatically downloads and installs Oracle JDK7 /  
JDK8 / JDK9). There are no actual Java files in this PPA.  
  
More info (and Ubuntu installation instructions):  
- for Oracle Java 7: http://www.webupd8.org/2012/01/install-oracle-java-jdk-7-in-ubuntu-via.html  
- for Oracle Java 8: http://www.webupd8.org/2012/09/install-oracle-java-8-in-ubuntu-via-ppa.html  
  
Debian installation instructions:  
- Oracle Java 7: http://www.webupd8.org/2012/06/how-to-install-oracle-java-7-in-debian.html  
- Oracle Java 8: http://www.webupd8.org/2014/03/how-to-install-oracle-java-8-in-debian.html  
  
Important!!! For now, you should continue to use Java 8 because Oracle Java 9 is  
available as an early access release (it should be released in 2016)! You should  
only use Oracle Java 9 if you explicitly need it, because it may contain bugs  
and it might not include the latest security patches! Also, some Java options were  
removed in JDK9, so you may encounter issues with various Java apps. More information  
and installation instructions (Ubuntu / Linux Mint / Debian): http://www.webupd8.org/2015/02/install-oracle-java-9-in-ubuntu-linux.html  
More info: https://launchpad.net/~webupd8team/+archive/ubuntu/java  
Press [ENTER] to continue or ctrl-c to cancel adding it
```

sudo add-apt-repository ppa:webupd8team/java

-> 패키지 repository 추가

-> ppa:webupd8team/java

enter 한번

GOTHAM 설치 및 실행

- java 설치

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo apt-get update
```

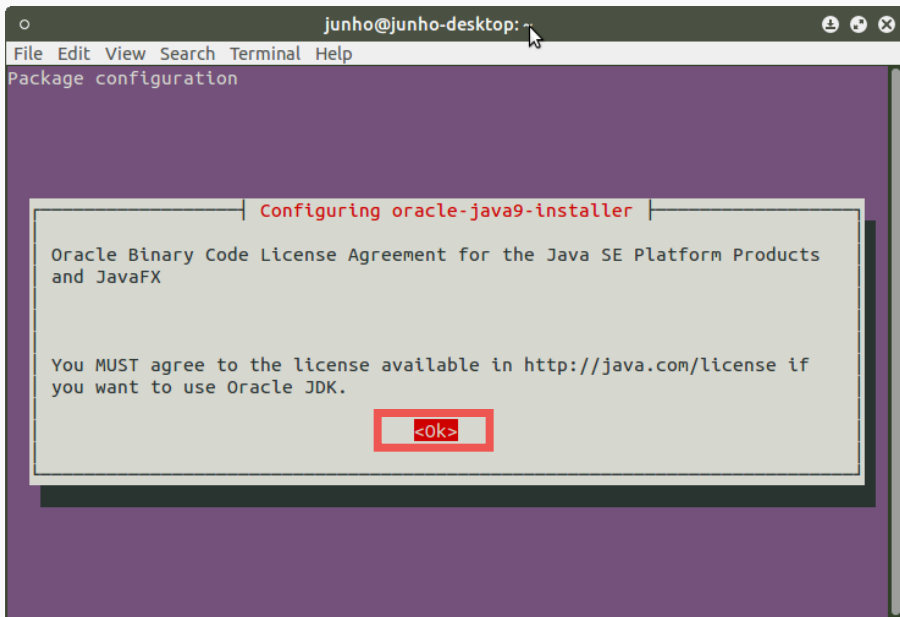
sudo apt-get update
-> 패키지 목록 업데이트

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo apt-get install oracle-java9-installer
```

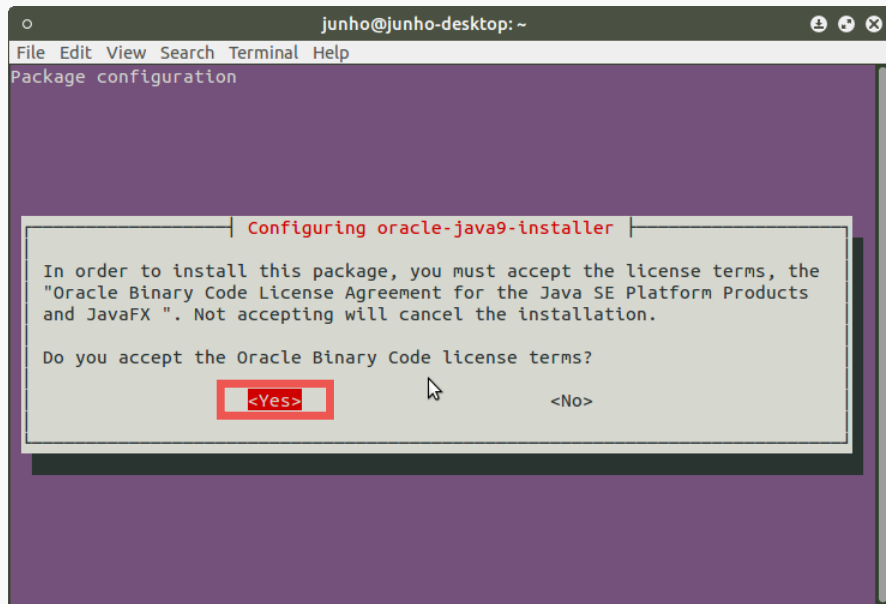
sudo apt-get install oracle-java9-installer
-> java 다운로드

GOTHAM 설치 및 실행

- java 설치



OK(enter)



Yes(enter)

GOTHAM 설치 및 실행

- java 설치 & git 설치 & tomcat 설치

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo apt-get install openjdk-8-jdk
```

sudo apt-get install openjdk-8-jdk
-> jdk다운로드

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo apt-get install git  
[sudo] password for junho: 
```

sudo apt-get install git
-> java 다운로드

```
junho@junho-desktop: ~  
File Edit View Search Terminal Help  
junho@junho-desktop:~$ sudo apt-get install tomcat8
```

sudo apt-get install tomcat8
-> tomcat8 다운로드
-> master node만 설치

GOTHAM 설치 및 실행

- GOTHAM 다운

```
junho@junho-desktop: ~/Downloads
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads$ sudo git clone https://github.com/OpenWinCon/OpenWinNet.git
```

```
junho@junho-desktop: ~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads$ ls
OpenWinNet  qtox  qTox_build_linux_armhf_release.tar
junho@junho-desktop:~/Downloads$
junho@junho-desktop:~/Downloads$
junho@junho-desktop:~/Downloads$ cd OpenWinNet/Mesh/GOTHAM(vis)/settingFile/
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile$
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile$ ls
convergence  master  masterWebServer.war  slave
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile$
```

sudo git clone https://github.com/OpenWinCon/OpenWinNet.git

-> GOTHAM이 있는 OpenWinCon/OpenWinNet.git 다운로드

-> OpenWinNet 다운 확인

cd OpenWinNet/Mesh/GOTHAM(vis)/settingFile

-> GOTHAM setting 파일 디렉토리

GOTHAM 설치 및 실행

- Master web server 실행(Master node만)

```
junho@junho-desktop: ~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile
File Edit View Search Terminal Help
junho@junho-desktop:~$ cd Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile/
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile$
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile$ ls
convergence master masterWebServer.war slave
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile$ sudo cp masterWebServer.war
/var/lib/tomcat8/webapps/
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile$
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile$ sudo service tomcat8 restart
```

-> 현재 convergence directory안의 내용과 masterWebServer.war을 사용

sudo cp masterWebServer.war /var/lib/tomcat8/webapps

-> tomcat서버에 추가하기 위해 파일을 복사

sudo service tomcat8 restart

-> tomcat8 restart

GOTHAM 설치 및 실행

• GOTHAM 실행

```
junho@junho-desktop: ~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile/convergence
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile/convergence$
ls
GOTHAM.jar lib README.TXT
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile/convergence$
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile/convergence$
sudo java -jar GOTHAM.jar wlan0 1 192.168.0.10
wlan0      Link encap:Ethernet  HWaddr 00:26:66:08:24:12
          inet addr:10.0.0.30  Bcast:10.255.255.255  Mask:255.0.0.0
          UP BROADCAST MULTICAST  MTU:1527  Metric:1
          RX packets:86 errors:0 dropped:0 overruns:0 frame:0
          TX packets:113 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:6544 (6.5 KB)  TX bytes:11969 (11.9 KB)

00:26:66:08:24:12
waiting web client
waiting slave client
/192.168.0.10(slave) connection request came
waiting slave client
[B.A.T.M.A.N. adv 2014.4.0, MainIF/MAC: wlan0/00:26:66:08:24:12 (bat0 BATMAN_IV)]
  Originator      last-seen (#/255)      Nexthop [outgoingIF]:  Potential nexth
ops ...
00:26:66:4e:d9:47    0.420s    (179) 00:26:66:4e:d9:47 [    wlan0]: 00:26:66:4e:d9:47
(179)
```

-> 현재 convergence directory안의
내용 확인

**sudo java -jar GOTHAM.jar wlan0
1 192.168.0.10**

-> GOTHAM 실행

-> master node를 먼저 실행(필수)

-> GOTHAM 실행화면

GOTHAM 설치 및 실행

- GOTHAM 실행

```
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/GOTHAM(vis)/settingFile/convergence$  
sudo java -jar GOTHAM.jar wlan0 1 192.168.0.10
```

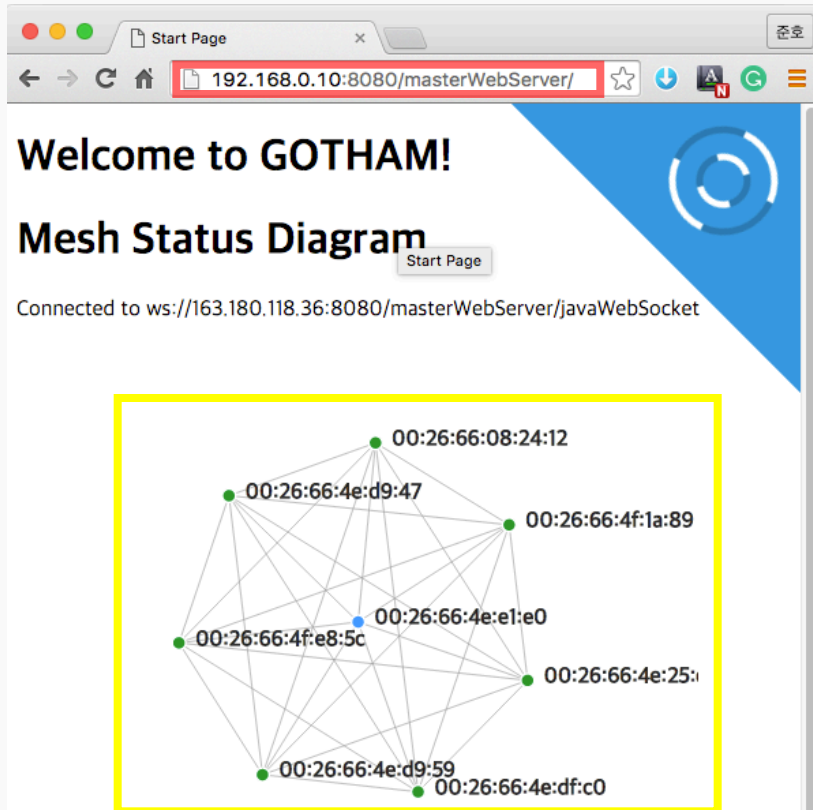
`sudo java -jar GOTHAM.jar wlan0 1 192.168.0.10`
-> GOTHAM 실행(master 일 경우)

[`java -jar GOTHAM.jar (interface name) (1: master, 2: slave) (master ip)`]

`sudo java -jar GOTHAM.jar wlan0 2 192.168.0.10`
-> GOTHAM 실행(slave 일 경우)

GOTHAM 설치 및 실행

• GOTHAM 실행



192.168.0.10:8080/masterWebServer

-> web browser를 통해

`http://[masterip]:8080/masterWebServer` 접근

-> 현재 동작중인 mesh network topology 확인

-> 초록색은 GOTHAM이 동작중인 slave node

-> 파란색은 GOTHAM이 동작중인 master node

-> 빨간색은 GOTHAM이 동작중이지 않은 node

Self-organizing Network (Beacon)

- 필요 라이브러리 다운

```
junho@junho-desktop: ~/Downloads
File Edit View Search Terminal Help
junho@junho-desktop:~$ cd Downloads/
junho@junho-desktop:~/Downloads$
junho@junho-desktop:~/Downloads$ sudo wget http://launchpadlibrarian.net/214461570/bluez-hcidump_5.33-0ubuntu2_armhf.deb
[sudo] password for junho:
--2016-04-04 15:14:03-- http://launchpadlibrarian.net/214461570/bluez-hcidump_5.33-0ubuntu2_armhf.deb
Resolving launchpadlibrarian.net (launchpadlibrarian.net)... 91.189.89.228, 91.189.89.229
Connecting to launchpadlibrarian.net (launchpadlibrarian.net)|91.189.89.228|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 127982 (125K) [application/x-debian-package]
Saving to: 'bluez-hcidump_5.33-0ubuntu2_armhf.deb'

bluez-hcidump_5.33-0ubuntu2_ar 100%[=====>] 124.98K 133KB/s in 0.9s

2016-04-04 15:14:05 (133 KB/s) - 'bluez-hcidump_5.33-0ubuntu2_armhf.deb' saved [127982/127982]

junho@junho-desktop:~/Downloads$ ls
bluez-hcidump_5.33-0ubuntu2_armhf.deb OpenWinNet qtox qTox_build_linux_armhf_release.tar
```

cd Downloads

sudo wget http://launchpadlibrarian.net/214461570/bluez-hcidump_5.33-0ubuntu2_armhf.deb

-> hcidump program 다운로드

-> apt-get install으로 다운이 안됨

-> bluez-hcidump_5.33-0ubuntu2_armhf.deb 파일을 확인할 수 있다.

Self-organizing Network (Beacon)

- 필요 라이브러리 다운

```
junho@junho-desktop: ~/Downloads
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads$ sudo dpkg -i bluez-hcidump_5.33-0ubuntu2_armhf.deb
Selecting previously unselected package bluez-hcidump.
(Reading database ... 134414 files and directories currently installed.)
Preparing to unpack bluez-hcidump_5.33-0ubuntu2_armhf.deb ...
Unpacking bluez-hcidump (5.33-0ubuntu2) ...
Setting up bluez-hcidump (5.33-0ubuntu2) ...
Processing triggers for man-db (2.7.0.2-5) ...
junho@junho-desktop:~/Downloads$
```

sudo dpkg -i bluez-hcidump_5.33-0ubuntu2_armhf.deb

-> hcidump program 설치

-> 미설치 시 실행프로그램 에러

Self-organizing Network (Beacon)

- 필요 라이브러리 다운

```
junho@junho-desktop: ~/Downloads
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads$ sudo apt-get install libglib2.0-dev
```

sudo apt-get install libglib2.0-dev

```
junho@junho-desktop: ~/Downloads
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads$ sudo apt-get install libudev-dev
```

sudo apt-get install libudev-dev

```
junho@junho-desktop: ~/Downloads
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads$ sudo apt-get install libical-dev
```

sudo apt-get install libical-dev

```
junho@junho-desktop: ~/Downloads
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads$ sudo apt-get install libreadline-dev
```

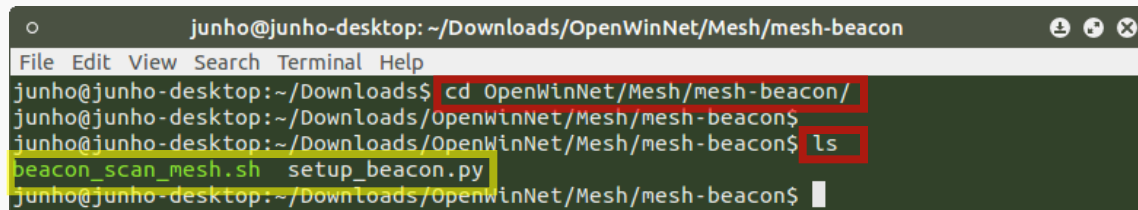
sudo apt-get install libreadline-dev

```
junho@junho-desktop: ~/Downloads
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads$ sudo apt-get install bluez-tools
```

sudo apt-get install bluez-tools

Self-organizing Network (Beacon)

- 소스코드 다운



```
junho@junho-desktop: ~/Downloads/OpenWinNet/Mesh/mesh-beacon
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads$ cd OpenWinNet/Mesh/mesh-beacon/
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/mesh-beacon$
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/mesh-beacon$ ls
beacon_scan_mesh.sh  setup_beacon.py
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/mesh-beacon$
```

cd ~/Downloads/OpenWinNet/Mesh/mesh-beacon

-> 이전 챕터의 GOTHAM 소스코드 다운시 받았던 OpenWinNet project directory 사용

ls

-> beacon setting file을 확인할 수 있다.

Self-organizing Network (Beacon)

- 소스코드 실행 (다른 beacon이 있을 때)

```
junho@junho-desktop: ~/Downloads/OpenWinNet/Mesh/mesh-beacon
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/mesh-beacon$ sudo python setup_beacon.py F
-----searching_beacon-----
-----check_mesh_beacon start-----
chcking mesh : True
['00', 'A3 B4 76 26', '3F B7', '02']
beacon detecting
-----setting_beacon & command-----
version : 00
masterIP : A3 B4 76 26
ssid : 3F B7
channel : 02
< HCI Command: ogf 0x08, ocf 0x0008, plen 32
  1E 02 01 1A 1A FF 00 FF 02 15 00 A3 B4 76 26 3F B7 02 00 00
  00 00 00 00 00 00 0F 00 0F 00 C8 00
> HCI Event: 0x0e plen 4
  01 08 20 00
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/mesh-beacon$
```

sudo python setup_beacon.py F

-> F는 필수(미래를 위한 input parameter)

-> 다른 beacon이 detecting하면 detecting하는 내용을 바탕으로 비콘을 발생시킨다.

Self-organizing Network (Beacon)

- 소스코드 실행 (다른 beacon이 없을 때)

```
junho@junho-desktop: ~/Downloads/OpenWinNet/Mesh/mesh-beacon
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/mesh-beacon$ sudo python setup_beacon.py F
-----searching_beacon-----
LE set advertise enable on hci0 returned status 12
Set scan parameters failed: Input/output error
-----check_mesh_beacon start-----
['False', 'False']
beacon is not detecting
-----get my ip-----
-----setting_beacon & command-----
version : 00
masterIP : A3 B4 76 26
ssid : 49 E6
channel : 07
< HCI Command: ogf 0x08, ocf 0x0008, plen 32
  1E 02 01 1A 1A FF 00 FF 02 15 00 A3 B4 76 26 49 E6 07 00 00
  00 00 00 00 00 00 0F 00 0F 00 C8 00
> HCI Event: 0x0e plen 4
  01 08 20 00
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/mesh-beacon$
```

sudo python setup_beacon.py F

-> F는 필수(미래를 위한 input parameter)

-> 다른 beacon이 없으면 랜덤으로 비콘을 발생시킨다.

간편 실행

- batman-adv 간편 실행

```
junho@junho-desktop: ~/Downloads/OpenWinNet/Mesh/batman-adv-install/settingFile_pi
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads$ cd OpenWinNet/Mesh/batman-adv-install/settingFile_pi/
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/batman-adv-install/settingFile_pi$
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/batman-adv-install/settingFile_pi$ ls
first_setting_master.py first_setting_slave.py
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/batman-adv-install/settingFile_pi$
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/batman-adv-install/settingFile_pi$
```

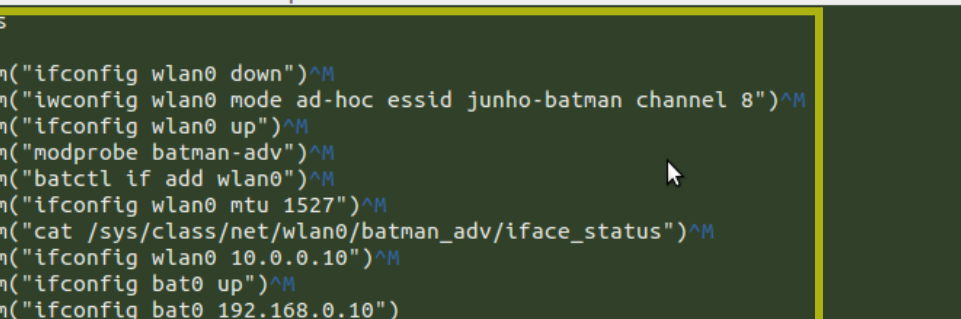
cd OpenWinNet/Mesh/batman-adv-install/settingFile_pi

-> 이전 챕터의 GOTHAM 소스코드 다운시 받았던 OpenWinNet project directory 사용

ls

-> 간편 실행 file을 확인할 수 있다.

- batman-adv 간편 실행



junho@junho-desktop: ~/Downloads/OpenWinNet/Mesh/batman-adv-install/settingFile_pi

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```
import os

os.system("ifconfig wlan0 down")^M
os.system("iwconfig wlan0 mode ad-hoc essid junho-batman channel 8")^M
os.system("ifconfig wlan0 up")^M
os.system("modprobe batman-adv")^M
os.system("batctl if add wlan0")^M
os.system("ifconfig wlan0 mtu 1527")^M
os.system("cat /sys/class/net/wlan0/batman_adv/iface_status")^M
os.system("ifconfig wlan0 10.0.0.10")^M
os.system("ifconfig bat0 up")^M
os.system("ifconfig bat0 192.168.0.10")
os.system("batctl gw server")

~
~
~
~
~
~
~
~
~
~
~

"first_setting_master.py" [readonly][Incomplete last line] 13 lines, 455 characters
```

-> 이전의 세팅 내용을
python code로 만들어
놓은 것이다.

간편 실행

- batman-adv 간편 실행

```
junho@junho-desktop: ~/Downloads/OpenWinNet/Mesh/batman-adv-install/settingFile_pi
File Edit View Search Terminal Help
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/batman-adv-install/settingFile_pi$
sudo python first_setting_master.py
[sudo] password for junho:
active
junho@junho-desktop:~/Downloads/OpenWinNet/Mesh/batman-adv-install/settingFile_pi$
```

sudo python first_setting_master.py

-> master node에서 실행

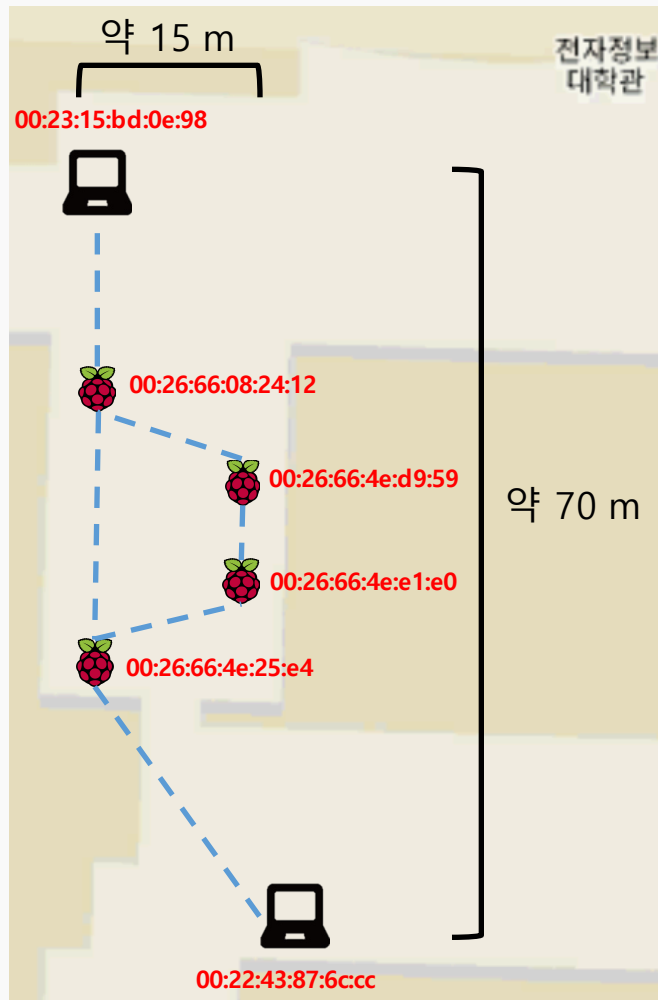
sudo python first_setting_slave.py

-> slave node에서 실행

-> batman-adv가 실행중임을 알 수 있다.

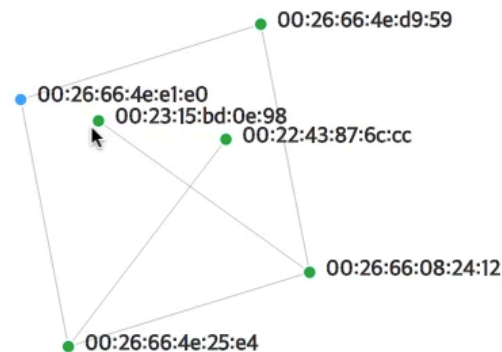
데모

데모



Welcome to GOTHAM!

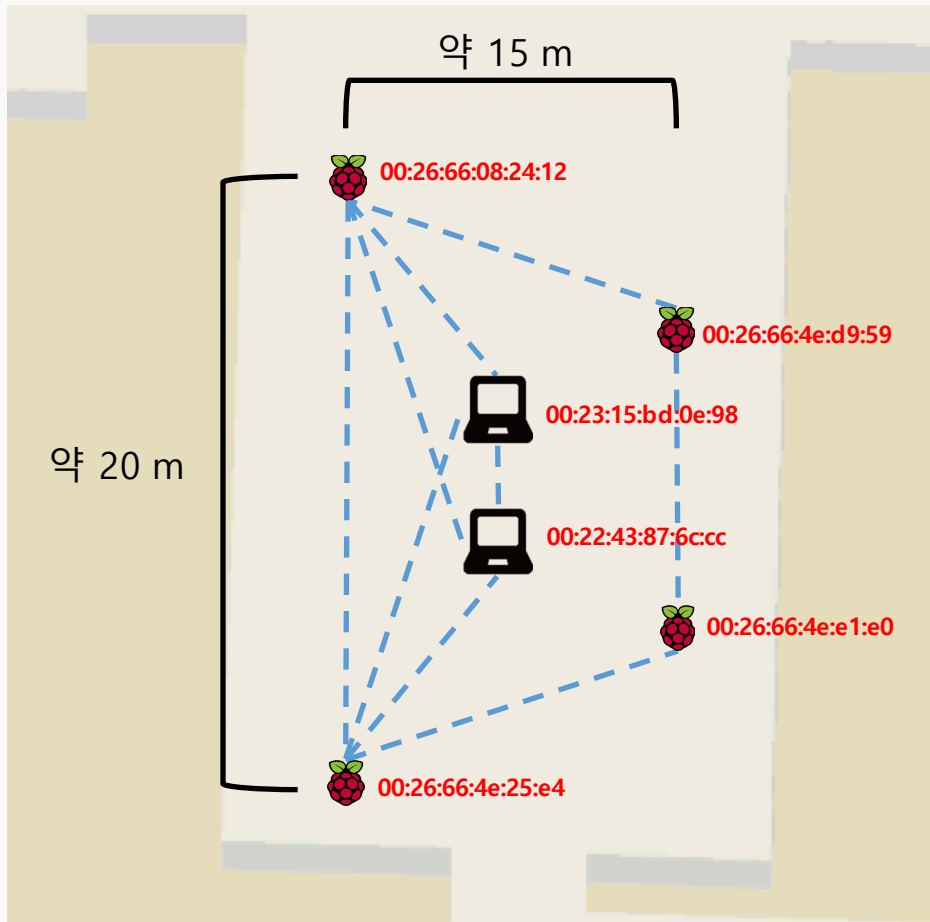
Mesh Status Diagram



데모

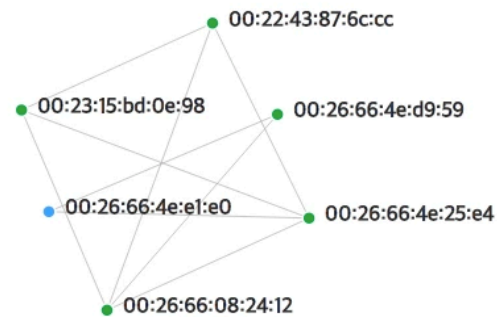


데모



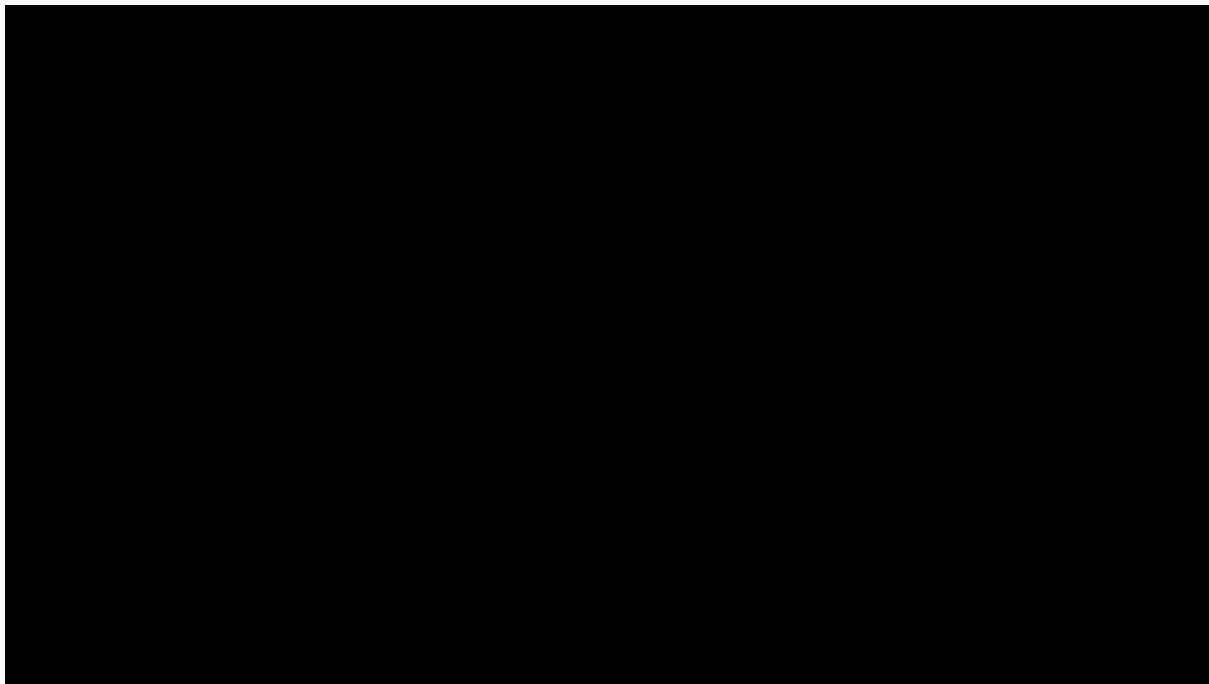
Welcome to GOTHAM!

Mesh Status Diagram



데모

- <https://www.youtube.com/watch?v=SUQlSh0tMI8>



연구방향

연구방향

- 통합 모듈 생성

- GOTHAM + beacon + batman-adv 통합 실행 모듈 제작
- Device가 동작시작하면 자동으로 모든 프로그램을 시작하고 network를 형성
- self-organizing network 구축

- GOTHAM 기능 추가

- GOTHAM에 SDN(Software Defined Network) 기능 추가
- GOTHAM 기타 기능 확장

참조

<https://github.com/OpenWinCon/OpenWinNet/tree/master/Mesh>

Thank you