



IoT Platform

Intel[®] Edison Tutorial 3 : WiFi Interface and Network Access



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Revision history		
Version	Date	Comment
1.0	9/23/2015	Initial release
1.1	10/1/2015	Eduroam is included



Revision history		

Introduction

One of most powerful features of the Intel Edison is the integrated WiFi. With no extra hardware, the Edison can connect to the Internet using the integrated WiFi.

In this tutorial, you will:

1. Learn to enable WiFi on the Edison,
2. Learn to connect to the Edison via SSH, and
3. Try internet-based examples.

Things Needed

- An Intel Edison with Arduino-compatible breakout,
- Two micro USB cables, and
- A PC or Mac

Setting up WiFi

Unlike other popular Linux distributions such as Ubuntu and Debian, the Yocto embedded Linux OS does not use `/etc/network/interfaces` to manage the network. Instead, it comes with a convenient command-line tool to set up WiFi.

1. Establish a serial connection as described in Tutorial 2.
2. In the serial terminal, enter “**configure_edison --wifi**”.
3. A WiFi configuration screen is displayed and it starts scanning for available networks.

```
Configure Edison: WiFi Connection
Scanning: 1 seconds left

0 : Rescan for networks
1 : Exit WiFi Setup
2 : Manually input a hidden SSID
3 : MEDGUEST
4 : HP03A73F
5 : Desmond's Wi-Fi Network
6 : NETGEAR38
7 : MEDWIFI
8 : eduroam
9 : Brant and JP Office
10 : TP-LINK_E79C74
11 : karlin-5G
12 : ShafferLab
13 : LS 5323
14 : karlin
15 : LS5309
16 : NIMS-LS
17 : Lohmueller_Lab_5G
18 : NIMS GT0
19 : Peshkel
20 : Lohmueller_Lab_Guest
21 : Lohmueller_Lab
22 : NIMS
23 : Peshkel 5G

Enter 0 to rescan for networks.
Enter 1 to exit.
Enter 2 to input a hidden network SSID.
Enter a number between 3 to 23 to choose one of the listed network SSIDs: █
```

Figure 1 WiFi Configuration

4. Follow the instructions on the screen.
5. For operation on the UCLA campus, use the select the **eduroam** network [2] and enter your credentials.

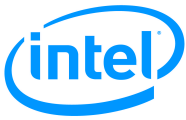
```
Configure Edison: WiFi Connection
Scanning: 1 seconds left

0 : Rescan for networks
1 : Manually input a hidden SSID
2 : James's Wi-Fi Network
3 : MEDGUEST
4 : \x00
5 : ShafferLab
6 : Brant and JP Office
7 : karlin-5G
8 : CTRL-TC2
9 : karlin
10 : MEDWIFI
11 : eduroam
12 : NIMS GT0
13 : Lohmueller_Lab
14 : Lohmueller_Lab_Guest
15 : ImBack

Enter 0 to rescan for networks.
Enter 1 to input a hidden network SSID.
Enter a number between 2 to 15 to choose one of the listed network SSIDs: 11
Is eduroam correct? [Y or N]: Y
Please enter the network username: drfaustus@ucla.edu
What is the network password?: *****
Initiating connection to eduroam. Please wait...
Attempting to enable network access, please check 'wpa_cli status' after a minute to confirm.
Done. Please connect your laptop or PC to the same network as this device and go to http://10.140.135.216 or http://edison.local in your browser.
root@edison:~#
```

Figure 2 eduroam and credentials

6. If you are having issues with WiFi connection, press **Ctrl-C** to quit and enter the following commands. Then, repeat steps 2-5.
 1. **\$ ifconfig usb0 down**
 2. **\$ ifconfig wlan0 down**
 3. **\$ ifconfig usb0 up**



4. **\$ ifconfig wlan0 up**
7. If this does not solve the issue, you may try manual configuration by following the instruction at <http://www.intel.com/support/edison/sb/CS-035234.htm>.

SSH connection

1. Make sure WiFi connection is working. You may enter “**ping google.com**” to check.

```
root@edison:/etc# ping google.com
PING google.com (216.58.216.14): 56 data bytes
64 bytes from 216.58.216.14: seq=0 ttl=53 time=4.561 ms
64 bytes from 216.58.216.14: seq=1 ttl=53 time=20.964 ms
64 bytes from 216.58.216.14: seq=2 ttl=53 time=5.200 ms
```

Figure 3 Check WiFi Connection

2. Press **Ctrl-C** to quit.
3. Make sure your computer and your Edison are connected to the same network. For instance, if your Edison is connected to eduroam, your computer also needs to be connected to eduroam.
4. In order to access via SSH (Secure Shell) [3], you need to set up the password on the Edison.
5. **\$ configure_edison --password**
6. Follow the instructions on the screen.
7. Find out the IP address of the Edison. Three methods are described below.



Note: If you are using eduroam, only method 1 works.

Method 1) Establish serial connection, and then enter “**configure_edison --showWiFiIP**”.

```
root@edison:~# configure_edison --showWiFiIP
10.140.135.216
```

Figure 4 IP address method 1

- In this case, 10.140.135.216 is the IP address of your Edison.

Method 2) In an Internet browser, go to “<http://edison.local>” (Note: If you changed the device name, you need to replace “edison” in the URL with the new device name. For instance, “http://my_device.local”).

- The webpage shows the IP address of the Edison.

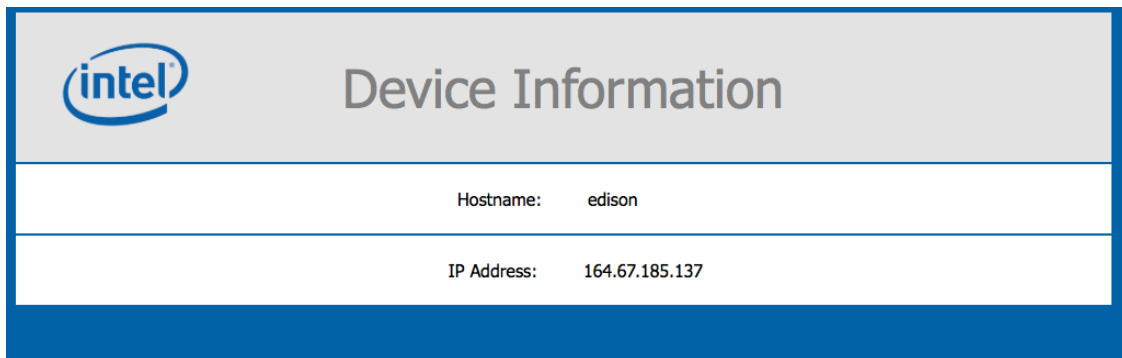


Figure 5 IP address method 2

Method 3) Recommendation: Use “Bonjour Browser” to find the IP address (Other similar software may be available). This will help find the IP addresses of many different devices quickly.

- Look for “edison” on Bonjour Browser (Note: If you changed the device name, the new device name appears on Bonjour Browser instead).
- In this case, the IP address is 164.67.185.137

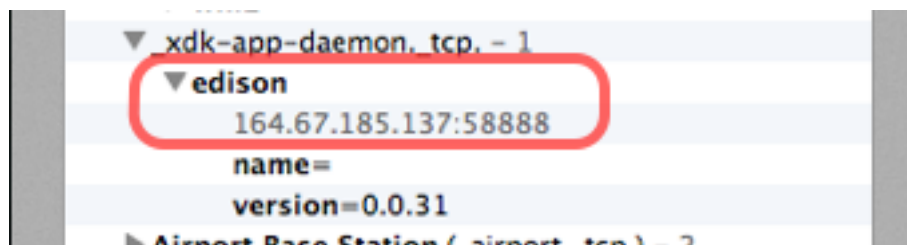
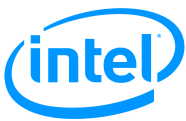


Figure 6 IP address method 3

8. Open a terminal or PuTTY.



- If you are using terminal, enter “**ssh root@164.67.185.137**” (replace 164.67.185.137 with the IP address found).
 - If you are using PuTTY, set the Host Name as the IP address found, Port as 22, and Connection type as SSH.
9. Now, you can connect to the Edison via SSH. From now on, you may no longer need to use serial connection unless 1) no network is available, 2) you can find the IP address with only method 1, or 3) you need to debug the board via serial connection.

Internet-based Example

AT&T (Cingular): PhoneNumber@txt.att.net
Verizon: PhoneNumber@vtext.com
T-Mobile: PhoneNumber@tmomail.net
Boost Mobile: PhoneNumber@myboostmobile.com
Virgin Mobile: PhoneNumber@vmobl.com
Cingular: PhoneNumber@cingularme.com
Sprint Nextel: PhoneNumber@messaging.sprintpcs.com
Nextel: PhoneNumber@messaging.nextel.com
US Cellular: PhoneNumber@email.uscc.net
SunCom: PhoneNumber@tms.suncom.com
Powertel: PhoneNumber@ptel.net
Alltel: PhoneNumber@message.alltel.com
Metro PCS: PhoneNumber@MyMetroPcs.com

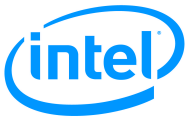
Figure 7 Send message Via email

Sending SMS using Python

This example demonstrates how to send an SMS message from the Edison to your phone. There are many different ways to send an SMS message and the method chosen in this example is sending an SMS message via email. The major carriers provide free email-to-SMS gateways.

Here is the list of gateway domains for major US carriers:
Follow these steps:

1. Log into the Edison.
2. **\$ mkdir tutorial3_examples**
3. **\$ cd tutorial3_examples**



4. \$ vi sms.py

5. Type the following code.

```
#!/usr/bin/python
import smtplib

server = smtplib.SMTP('smtp.gmail.com', 587)
server.ehlo()
server.starttls()
server.ehlo()
server.login("your_email_address@gmail.com", "your_password")
msg = "\nText sent from my Edison!!"
server.sendmail("your_email_address@gmail.com", "your_phone_number@vtext.com", msg)
```

Figure 8 SMS message example

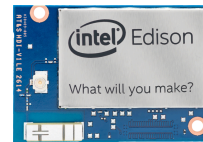
- Replace “your_email_address@gmail.com” with your email address (This example uses Gmail).
 - e.g. chris.inhwan.baek@gmail.com
- Replace “your_password” with your Gmail account password.
- Replace “your_phone_number@vtext.com” with your 10-digit phone number combined with the gateway domain of your phone’s carrier.
 - e.g. “3101234567@txt.att.net”
- Make sure your Gmail account lets remote login.
 - Go to your Gmail account settings.
 - In “Sign-in & Security” settings, turn off “2-Step Verification” and turn on “**Allow less secure apps**”.

6. \$ python sms.py

Controlling The On-board LED on Web Server

This example is a modified version of an example sketch that comes with Arduino IDE. This will create a web server with clickable texts that allow you to turn the Edison’s on-board LED on and off.

1. Open Arduino IDE.
2. Go to **File ->Examples ->WiFi ->SimpleWebServerWifi**.
3. Only if you are using **eduroam** or any network with WPA Enterprise, do the following:
 - a. Make sure your Edison is connected to the network.
 - b. Comment out “**status = WiFi.begin(ssid, pass);**” and add “**status = WL_CONNECTED;**”.



```
// Connect to WPA/WPA2 network. Change this line if using open or WEP network:  
//status = WiFi.begin(ssid, pass);  
status = WL_CONNECTED;  
// wait 10 seconds for connection:  
delay(10000);
```

Figure 9 Remove WiFi.begin()

- c. Skip step 4 and proceed to step 5.
4. Change **yourNetwork** with your network SSID and **secretPassword** with your network password.

```
char ssid[] = "yourNetwork"; // your network SSID (name)  
char pass[] = "secretPassword"; // your network password  
int keyIndex = 0; // your network key Index number (needed only for WEP)
```

Figure 10 Connect to WiFi

5. Change the port number from 80 to another unused port number (In this example, 50).
Note: no one in the same network can use the same port number.

```
int status = WL_IDLE_STATUS;  
WiFiServer server(50);  
  
void setup() {  
  Serial.begin(9600); // initialize serial communication
```

Figure 11 Port Number

6. Change pin numbers to 13 (pin 13 is the on-board LED).

```
int status = WL_IDLE_STATUS;  
WiFiServer server(50);  
  
void setup() {  
  Serial.begin(9600); // initialize serial communication  
  pinMode(13, OUTPUT); // set the LED pin mode  
  
  // check for the presence of the shield:  
  if (WiFi.status() == WL_NO_SHIELD) {  
    Serial.println("WiFi shield not present");  
    while(true); // don't continue  
  }  
}
```

Figure 12 Pin Direction

```
    digitalWrite(13, HIGH); // Turn the LED on (HIGH makes the led glow red)
  }

  // Check to see if the client request was "GET /H" or "GET /L":
  if (currentLine.endsWith("GET /H")) {
    digitalWrite(13, HIGH); // GET /H turns the LED on
  }
  if (currentLine.endsWith("GET /L")) {
    digitalWrite(13, LOW); // GET /L turns the LED off
  }
}
```

Figure 13 Write to Pin

7. Verify and upload the sketch.
8. In the upper right corner, click on **Serial Monitor**.

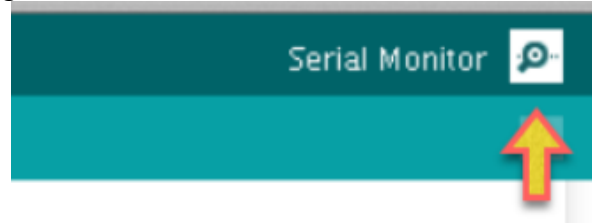


Figure 14 Serial Monitor

9. Wait for the following messages to be displayed.

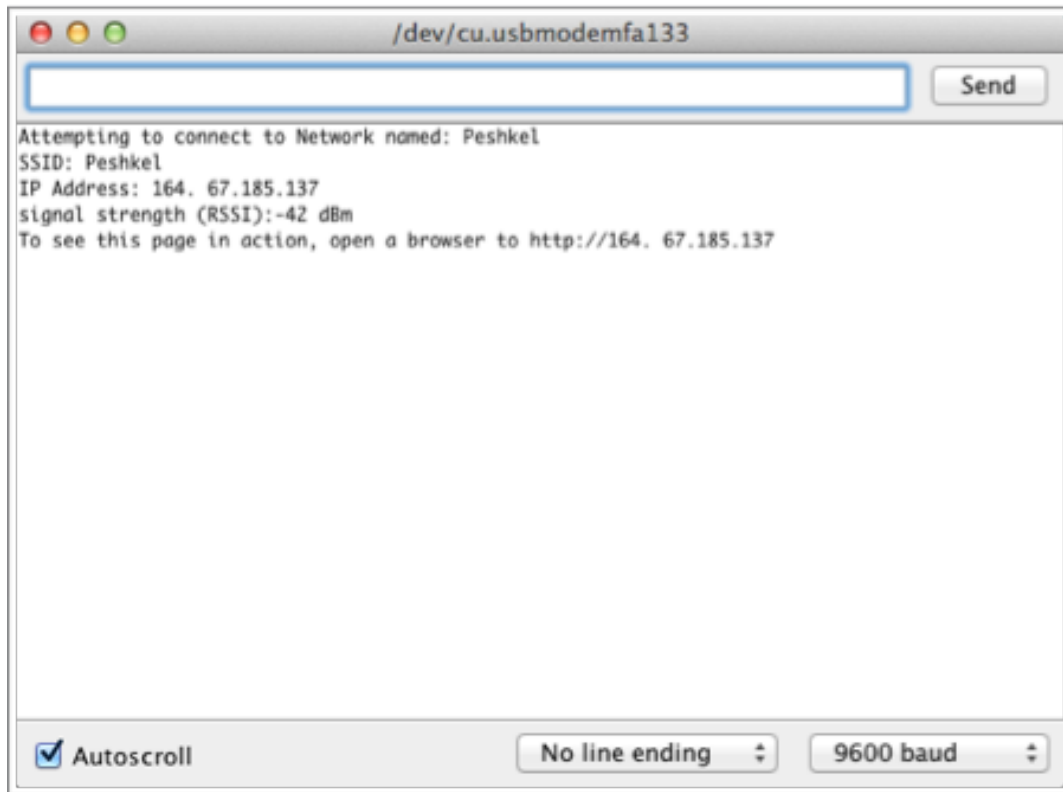


Figure 15 Serial Monitor

Note: If you did step 3, the displayed output does not print the correct IP address.

10. In an Internet browser, go to “http://edison.local:port_number” (In this example, http://edison.local:50).

Note: If you did step 3, go to “http://your_ip_address:port_number” (For example, http://10.140.135.216:50).

11. The following is displayed on the browser. (Note: we are actually controlling the LED on pin 13 not pin 9).

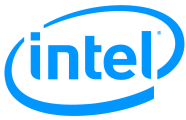
Click [here](#) turn the LED on pin 9 on
Click [here](#) turn the LED on pin 9 off

Figure 16 Display Control

12. Click to turn on/off the on-board LED.

Simple OPKG and Git Example

In this example, we will use OPKG (Open PacKaGe Management) [7] to install a new



package and use git to clone a repository. OPKG is a package manager that is pre-installed in the Yocto Embedded Linux image for the Edison. It is similar to Ubuntu's apt-get. Git is a distributed version control system [8]. Let's learn how to use these utilities.

1. `$ opkg list`

This command prints out all available packages (whether installed or not).

```
root@edison:~/tutorial3_examples# opkg list
alsa-conf-base - 1.0.27.2-r0
alsa-lib - 1.0.27.2-r0
alsa-states - 0.2.0-r4
alsa-utils-alsactl - 1.0.27.2-r0
alsa-utils-alsamixer - 1.0.27.2-r0
alsa-utils-amixer - 1.0.27.2-r0
alsa-utils-aplay - 1.0.27.2-r0
ap-mode-toggle - 0.1-r6
attr - 2.4.47-r0
attr-dev - 2.4.47-r0
autoconf - 2.69-r11
automake - 1.14-r0
base-files - 3.0.14-r86
base-files-dev - 3.0.14-r86
base-passwd - 3.5.29-r0
base-passwd-dev - 3.5.29-r0
bash - 4.3-r0
bcm43340-bt - 1.0-r0
```

Figure 17 Available Packages

2. `$ opkg list-installed`

This command prints out all installed packages.

```
root@edison:~/tutorial3_examples# opkg list-installed
alsa-conf-base - 1.0.27.2-r0
alsa-lib - 1.0.27.2-r0
alsa-states - 0.2.0-r4
alsa-utils-alsactl - 1.0.27.2-r0
alsa-utils-alsamixer - 1.0.27.2-r0
alsa-utils-amixer - 1.0.27.2-r0
alsa-utils-aplay - 1.0.27.2-r0
ap-mode-toggle - 0.1-r6
attr - 2.4.47-r0
attr-dev - 2.4.47-r0
autoconf - 2.69-r11
automake - 1.14-r0
base-files - 3.0.14-r86
base-files-dev - 3.0.14-r86
base-passwd - 3.5.29-r0
base-passwd-dev - 3.5.29-r0
bash - 4.3-r0
bcm43340-bt - 1.0-r0
bcm43340-fw - 6.20.100-r2
```

Figure 18 Installed Packages

3. Let's try to install git. Enter "**opkg install git**".
4. Don't panic yet. It prints out error messages because git is not available on the list.
5. You can add more packages to the list by adding available repositories to /etc/opkg/base-feeds.conf.
6. Let's add more repositories so that git becomes available.
7. **\$ vi /etc/opkg/base-feeds.conf**
8. Type the following:

src all	http://iotdk.intel.com/repos/1.1/iotdk/all
src x86	http://iotdk.intel.com/repos/1.1/iotdk/x86
src i586	http://iotdk.intel.com/repos/1.1/iotdk/i586

Figure 19 Command

9. **\$ opkg update**



```
root@edison:~/tutorial3_examples# opkg update
Downloading http://iotdk.intel.com/repos/1.1/iotdk/all/Packages.
Updated list of available packages in /var/lib/opkg/all.
Downloading http://iotdk.intel.com/repos/1.1/iotdk/x86/Packages.
Updated list of available packages in /var/lib/opkg/x86.
Downloading http://iotdk.intel.com/repos/1.1/iotdk/i586/Packages.
Updated list of available packages in /var/lib/opkg/i586.
Downloading http://iotdk.intel.com/repos/1.1/intelgalactic/Packages.
Updated list of available packages in /var/lib/opkg/iotkit.
```

Figure 20 OPKG Update

10. We can check if git is available now. Enter “**opkg list | grep git**” -“ (grep is used to filter out all other entries except the one that contains “git”).

```
root@edison:~/tutorial3_examples# opkg list | grep git\ -
git - 1.9.0-r0 - Distributed version control system Distributed version control system.
perl-module-config-git - 5.14.3-r1 - perl module config-git perl module config-git
```

Figure 21 Command

11. \$ opkg install git

```
root@edison:~/tutorial3_examples# opkg install git
Installing git (1.9.0-r0) to root...
Downloading http://iotdk.intel.com/repos/1.1/iotdk/i586/git_1.9.0-r0_i586.ipk.
Configuring git.
```

Figure 22 Install Git

12. Now git is successfully installed. You can learn more opkg commands at <http://wiki.openwrt.org/doc/techref/opkg>!
13. Let's try to clone a repository with git.
14. \$ **git clone https://chrisIHbaek@bitbucket.org/chrisIHbaek/tutorial3_example.git**
15. List all files and directories. Enter “ls”.
16. A new “directory” named tutorial3_example is added. It is a cloned repository of https://chrisIHbaek@bitbucket.org/chrisIHbaek/tutorial3_example.git.
17. \$ **cd tutorial3_example**
18. There is a file name README.
19. Git may not be required for IoT development but this example is given to demonstrate another internet-based application. You may learn more about git at <https://git-scm.com>.



References

1. <https://software.intel.com/en-us/connecting-your-intel-edison-board-using-wifi>
2. <https://www.eduroam.us/introduction>
3. https://en.wikipedia.org/wiki/Secure_Shell
4. http://www.example-code.com/python/sms_send.asp
5. http://en.wikibooks.org/wiki/Python_Programming/Email
6. <http://www.intel.com/support/edison/sb/CS-035251.htm>
7. <http://wiki.openwrt.org/doc/techref/opkg>
8. <https://git-scm.com>