

## JGN2plus Workshop on Sensor Networking

### The 3<sup>rd</sup> Live E! Workshop

In the 10<sup>th</sup> APNG Camp 2008/08/14 09:30 – 12:30

-- Asian Institute of Technology --



#### 1. Introduction

The Internet has enabled real time collection and distribution of environmental sensor readings. Environmental, especially weather, information which densely covers wide range of areas are expected to be useful for a number of applications such as disaster management, public transportation and various businesses. It is said from statistical point of view that densely covering is more important than accuracy. Thus, many sensors with reasonable prices are more preferable than a single quite accurate sensor of extraordinary higher prices.

Live E! project has been developing a platform of wide-area sensor networking, aiming at this goal. Figure 1 shows the scenario in the project. The scenario considers three layered architecture: i.e., sensor, data management and application. The sensors usually have Internet connectivity and submit the observed environmental data periodically: e.g., every 20 seconds. The data management layer, which is organized as an overlay network, receives the submitted data, archives them and provides them for applications with search functionality. The applications retrieve interested data from the platform and use them for their own purpose.

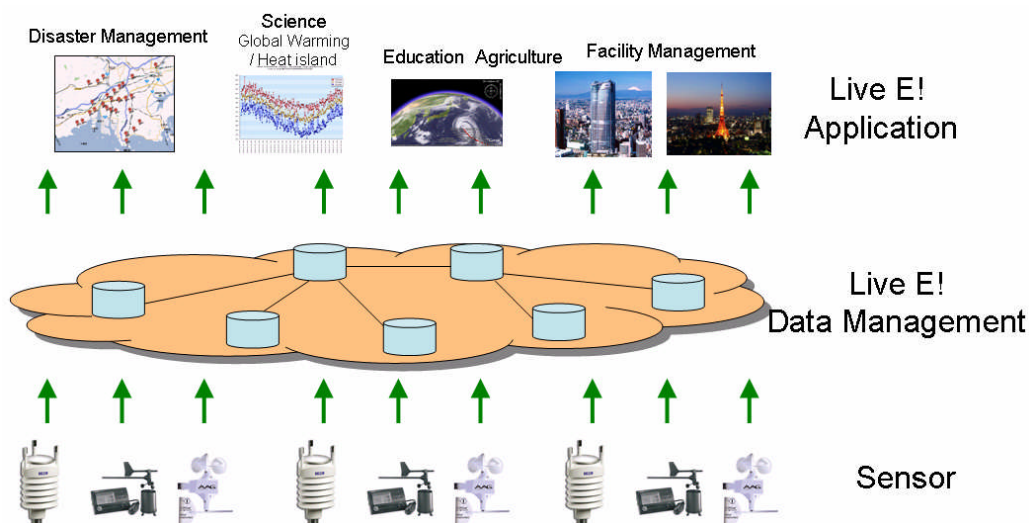
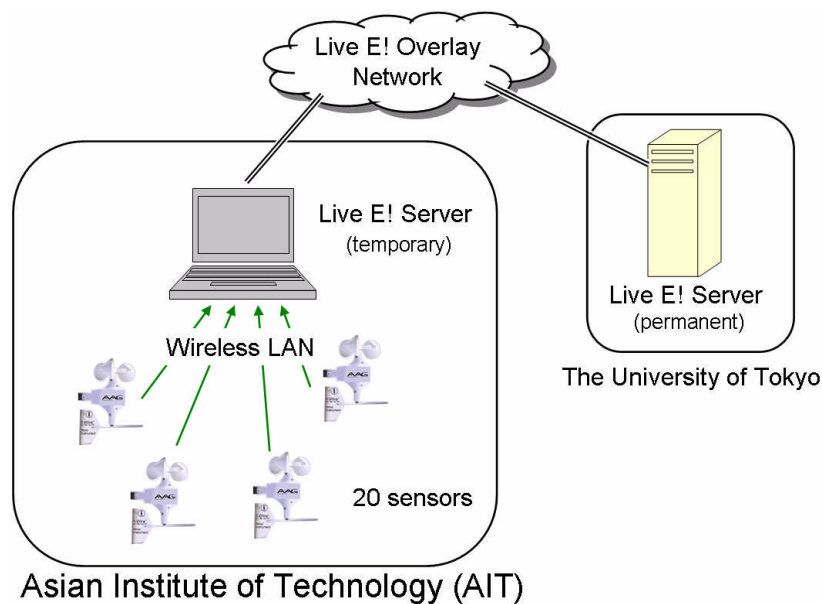


Figure 1: Wide area sensor networking architecture

In today's workshop, we assemble twenty weather stations and configure them to submit sensor readings to Live E! platform via wireless LAN. Figure 2 shows the scenario of the workshop. A temporal Live E! server is installed in AIT, which collects sensor readings from our assembling sensors and works as a node in Live E! overlay network. The permanent server setup in the University of Tokyo is a Live E! server which collects the sensor readings from our sensors after the workshop. When you take the sensor back to your home, please consider about installing the sensor in your university or somewhere in your country (we are going to give you those weather stations if you are anxious about working on it).



**Figure 2: Workshop environment overview**

We have setup temporal Live E! server in AIT (just for the workshop).

A permanent Live E! server has been also setup for data collection after the camp.

## 2. Workshop Schedule

09:40 - 09:50 Workshop overview

09:50 - 09:55 Grouping into 20 groups (3-5 people each)

09:55 - 10:10 Assembling weather stations

10:10 - 10:30 Login and configuration of OpenWRT

10:30 - 11:00 Coffee break

11:00 - 11:10 Data read trial

11:20 - 11:40 Data upload

11:40 - 11:50 Change configuration to the permanent server

11:50 - 12:30 Discussion and advanced topic

### 3. Assembling Weather Station

Figure 3 shows the complete set of an assembled weather station. OpenWrt-based embedded host and sensors are connected by RJ-11 modular cable (1-wire protocol). Here, the anemometer sensor contains a temperature sensor in it. Wind vane and windmill must be correctly set up as figure 4 illustrates.

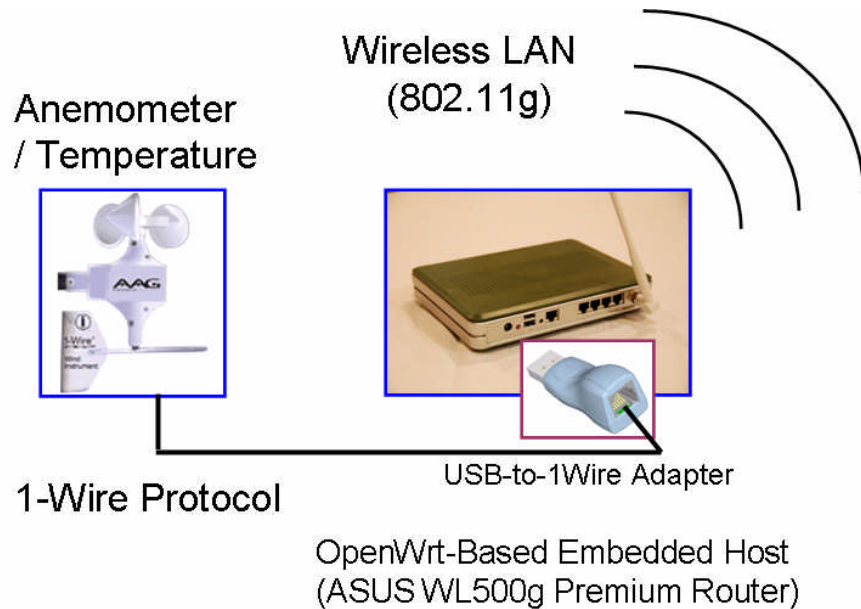


Figure 3: One-wire weather station and communication host

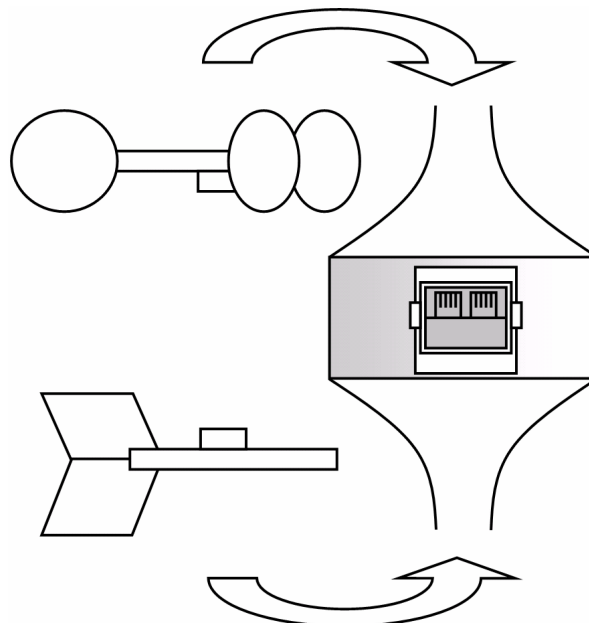


Figure 4: Be sure to correctly setup windmills

Note: when we setup the sensors outside permanently, we must make it **waterproof**.

## 4. Login and Configuration of OpenWrt-Based Router

At first, connect your laptop to the router as figure 5 illustrates. In this section, we login to the router and configure the network and sensors.

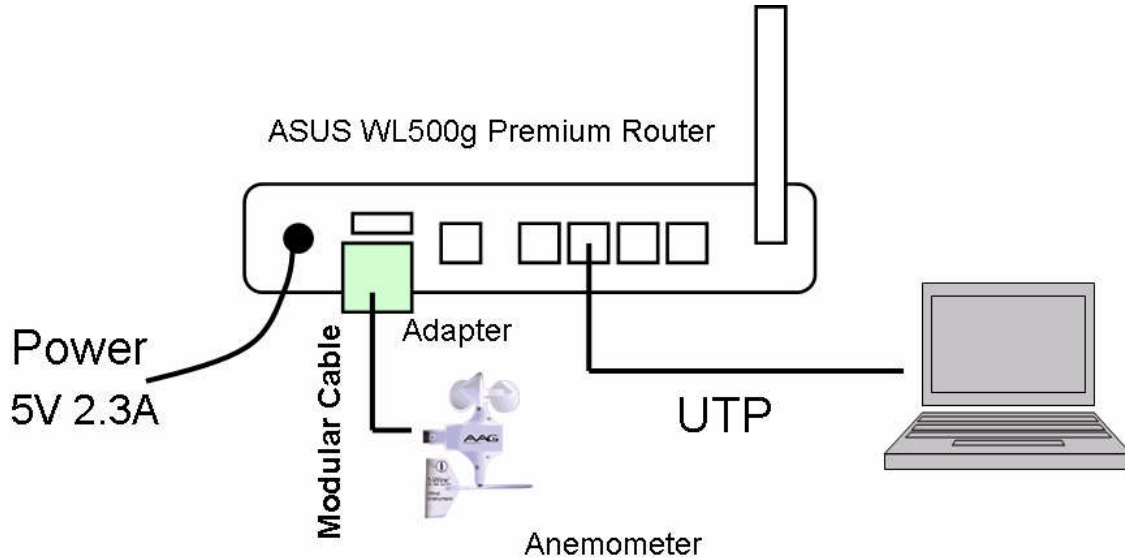


Figure 5: Connect your PC to ASUS router

### 4.1. Login to the Router

We can login to the router with telnet client. In default, password is not set.

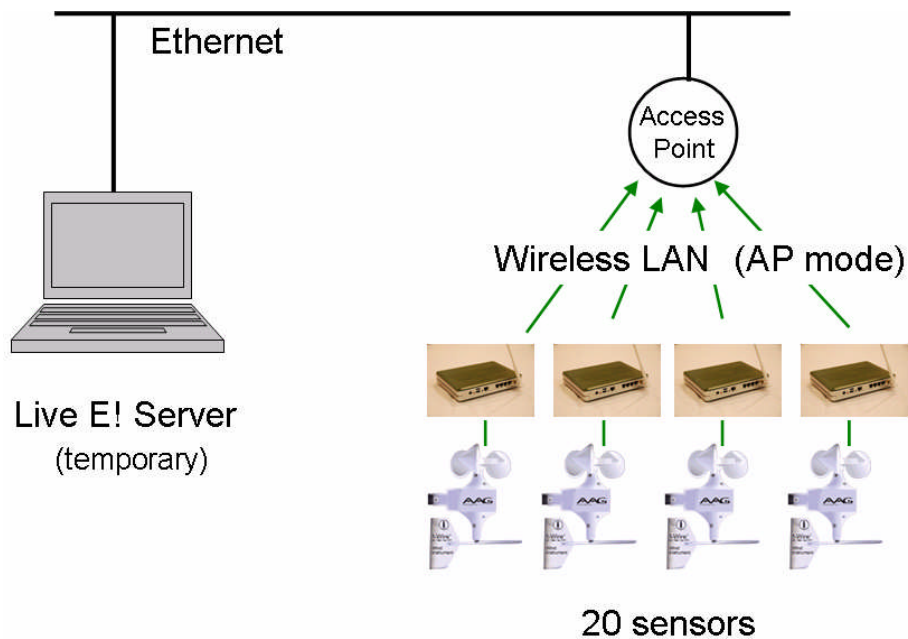
```
$ telnet 192.168.1.1
```

Once you have setup a password for user “root”, we cannot login to the router by telnet. Instead we can login by ssh.

```
$ ssh root@192.168.1.1
```

### 4.2. Wireless Network Configuration

During the workshop, we configure sensors to submit data via a wireless access point. Figure 6 shows the network environment.



**Figure 6: Wireless network configuration**

In OpenWRT, configuration is managed by nvram. To see the configuration of the router, type,

```
# nvram show
```

To erase the configuration (never erase during the workshop),

```
# mtd -r erase nvram
```

The followings are the configuration for Live E! workshop.

```
# nvram set wlo_mode=sta
# nvram set lan_ifname=br0
# nvram set lan_ifnames=vlan0
# nvram set wan_ifname=eth2
# nvram set lan_ipaddr=192.168.1.1
# nvram set lan_proto=static
# nvram set wan_proto=dhcp
# nvram commit
# reboot
```

Then, wait until the reboot completes.

```
# ifdown wan
# nvram set wlo_wep=enabled
```

```
# nvram set wl0_key=1
# nvram set wl0_key1=<WEP KEY>
# nvram set wl0_ssid=<SSID>
# nvram set wl0_channel=<CHANNEL_NUMBER>
# ifup wan; /sbin/wifi
```

Ping to somewhere outside the network to test the configuration.

E.g., `$ ping www.live-e.org`

### 4.3. OWW Setup

One-Wire Weather (OWW) is software for getting data from the sensors. OWW is already installed in the router before the workshop begins. However, configuration of OWW is needed to actually use and the configuration is not difficult!! The configuration is automatically made by carrying out the following procedure.

(1) Execute `ownogui` with `-i` option (interactive mode) as follows,

```
# /rom/livee/ownogui -i
```

It may give many messages, but ignore them.

(2) After waiting about 10 seconds, just type “devices driver USB” and enter (without killing `ownogui`). It will reply “done”.

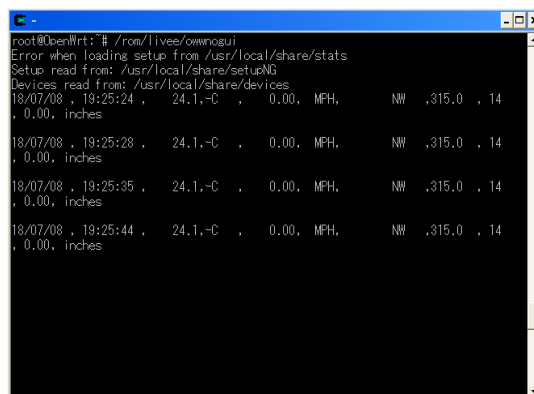
(3) After that, type “save devices” and enter. Then, it will reply “saved devices”.

(4) Kill the `ownogui` process by “Ctrl-C”.

(5) Restart `ownogui` by

```
# /rom/livee/ownogui
```

If it reads and displays the right value as shown in figure 7, please proceed to data upload configuration.



```
root@OpenWrt: # /rom/livee/ownogui
Error when loading setup from /usr/local/share/stats
Setup read from: /usr/local/share/setupNG
Devices read from: /usr/local/share/devices
18/07/08 , 18:25:24 , 24.1,-C , 0.00, MPH, NW ,315.0 , 14
, 0.00, inches
18/07/08 , 18:25:28 , 24.1,-C , 0.00, MPH, NW ,315.0 , 14
, 0.00, inches
18/07/08 , 18:25:35 , 24.1,-C , 0.00, MPH, NW ,315.0 , 14
, 0.00, inches
18/07/08 , 18:25:44 , 24.1,-C , 0.00, MPH, NW ,315.0 , 14
, 0.00, inches
```

Figure 7: Sensor data read test by `ownogui`

Note: one wire weather (OWW) is provided at <http://oww.sourceforge.net/>

#### 4.4. Data Upload Configuration

Now let's configure the router to upload sensor readings to the server in the conference room. We have only to configure the host name of the server and our sensor ID. The configuration is directly written in crontab script (do not use "crontab -e", it did not work collect). Configure it by,

```
# vim /etc/crontab/root
-----
*/1 * * * * /rom/livee/get_csv.sh /rom/livee/ownogui > /tmp/data.csv
*/1 * * * * sleep 52; killall ownogui; /rom/livee/csv_to_temperature.sh
/tmp/data.csv >> /tmp/temperature; /rom/livee/csv_to_winddir.sh
/tmp/data.csv >> /tmp/winddir; /rom/livee/csv_to_windspeed.sh
/tmp/data.csv >> /tmp/windspeed; rm /tmp/data.csv;
/rom/livee/upload_data live-e2.hongo.wide.ad.jp(HOSTNAME)
axis/services/DataUpload200703 hongo.wide.ad.jp/WXT510/test/(SENSORID)
MDAwMDAwMDA= /tmp /rom/livee
5 * * * * ntpclient -h mail.hongo.wide.ad.jp -s
-----
```

At first, the first two lines are commented out by "#". Remove "#" to make them enable. Set the upload host name and your ID in the script. The host name will be announced during the workshop and your sensor ID will be given by a piece of paper. Save the script after setting the information.

Sensor data reading and uploading will be carried out in the background.

To change the time zone setting, see /etc/profile.

#### 5. Data Upload Confirmation

By browsing the web of the Live E! server, we can check the upload status of the sensor. The URL will be announced during the workshop. Your group name will be appeared on the web, if the sensor has worked correctly.

## Local Sensor List

This page only shows locally managed sensors which have been alive for recent three days.

Name	Time	Temperature	Humidity	Pressure	RainFall	DayRainFall	WindDir	WindSpeed	CO2	SolarPower
Centre for Network Research, Prince of Songkla University	2008-08-04 06:15:37	<a href="#">25.9</a>	<a href="#">40</a>	<a href="#">1004</a>	<a href="#">0</a>		<a href="#">126</a>	<a href="#">0</a>		
Esaki lab Test 3	2008-08-04 06:16:03	<a href="#">26.9</a>	<a href="#">73.3</a>	<a href="#">1002.7</a>			<a href="#">327</a>	<a href="#">0.5</a>		
KEIO UNIVERSITY K2 TOWN CAMPUS	2008-08-03 18:03:48	<a href="#">30.3</a>	<a href="#">71.6</a>	<a href="#">1003.5</a>	<a href="#">0</a>	<a href="#">0</a>	<a href="#">185</a>	<a href="#">2.8</a>		
LSIIT, Roof building C, Illkirch, France	2008-08-04 06:16:01	<a href="#">19.7</a>	<a href="#">87</a>	<a href="#">994</a>	<a href="#">0</a>		<a href="#">191</a>	<a href="#">0</a>		
YANNY	2008-08-04 06:13:58	<a href="#">28.6</a>	<a href="#">77</a>	<a href="#">1001</a>	<a href="#">0</a>		<a href="#">27</a>	<a href="#">1.2</a>		

Figure 8: Checking data upload status on the web.

If your group name does not appear in the list (even after five minutes), check the following settings.

- Configuration of crontab (especially, host name and sensor ID)
- System time of the router

## 6. Transmission to the permanent Live E! server

After the workshop, when you take this back to your country, please setup the sensor outside and configure to submit data to the Live E! platform. We have assigned a permanent Live E! server for this purpose. The sensors have been already registered in the server.

The name of the server is "live-e2.hongo.wide.ad.jp". Please configure the crontab so that it sends sensor readings to the server,

```
# vim /etc/crontab/root
-----
*/1 * * * * /rom/livee/get_csv.sh /rom/livee/ownogui > /tmp/data.csv
*/1 * * * * sleep 52; killall ownogui; /rom/livee/csv_to_temperature.sh
/tmp/data.csv >> /tmp/temperature; /rom/livee/csv_to_winddir.sh
/tmp/data.csv >> /tmp/winddir; /rom/livee/csv_to_windspeed.sh
/tmp/data.csv >> /tmp/windspeed; rm /tmp/data.csv; /rom/livee/upload_data
live-e2.hongo.wide.ad.jp axis/services/DataUpload200703 SENSOR_ID
MDAwMDAwMDA= /tmp /rom/livee
5 * * * * ntpclient -h mail.hongo.wide.ad.jp -s
```



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We can check the uploading status on the web of “live-e2.hongo.wide.ad.jp”.

## 7. Live E! Current Status

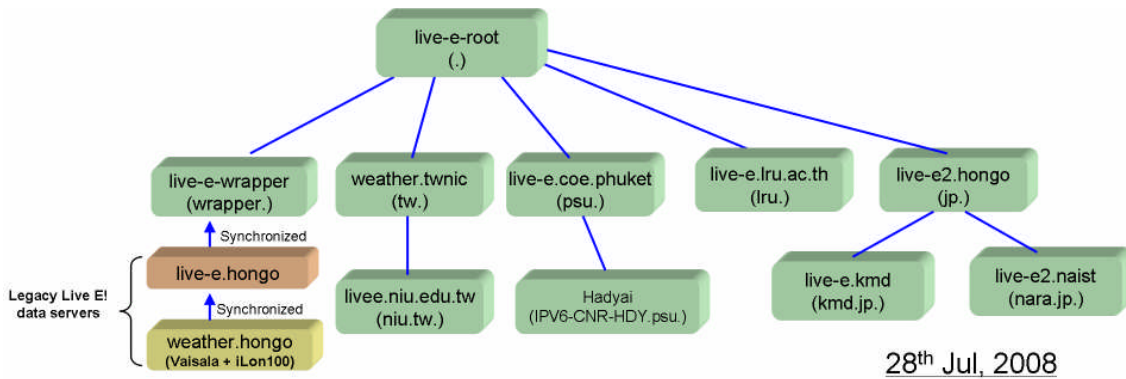


Figure 9: Live E! data management overlay network

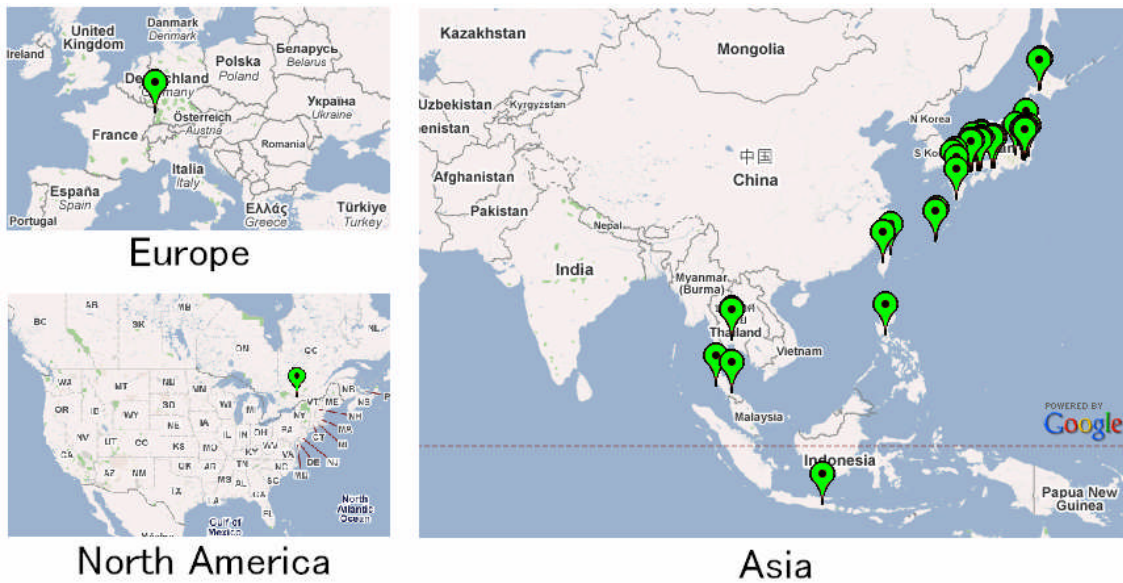


Figure 10: Live E! sensor deployment status

## 8. Advanced Topics

### 8.1. Ad Hoc Wireless Configuration and OLSR Installation

By setting wireless device to ad hoc mode and carrying out OLSR daemon, the router can work as an OLSR node.

## 8.2. Sensor Data Retrieval from the Server via SOAP Web Services

<http://live-e-dev.naist.jp/document/howto/>

See, data-retrieval-webservice.ppt for detail.

## 8.3. Development of a Live E! sensor from the scratch

### 8.3.1. Preparation

- ASUS WL500g Premium Router
- 1-wire weather sensor node (<http://www.aagelectronica.com/aag/>).

### 8.3.2. Installation of OpenWrt Image File

Download the image from:

<http://downloads.openwrt.org/whiterussian/rc5/bin/openwrt-brcm-2.4-jffs2-4MB.trx>

, and save it to an empty USB memory. Push the USB memory to the ASUS router and power on with pushing the reset button.

If you'd also like to set up a development environment for ASUS router: see,

<http://www.osoite.jp/isi/tassimo/index.php>

### 8.3.3. Installation of OWW and Live E! related files

Download the application files from and install it into /rom/livee

Please make a directory /usr/local/share before running OWW software.

Change the crond execution level.

```
# mv /etc/init.d/S60cron /etc/init.d/S50cron
```

And set crontab as section 4.4 and section 6. describe.

Change the timestamp setting by setting TZ environment variable in /etc/profile.

```
export TZ=JST-9 # Japan Standard Time (JST)
```

## 8.4. Live E! Server Installation and Operation

See, <http://live-e.hongo.wide.ad.jp/dist/>

## 9. Support

Live E! project has decided to donate the sensors to the workshop participants in order to enhance research activity in Asia Pacific regions. However, please remember that the sensor is not free; we expect your contribution by setting up the weather sensor at your university or college. It is allowed to re-organize the sensor node (e.g. to install other application software) as long as it makes any advantages to your research and Live E!. For example, if you'd install OLSR software, it works as an OLSR node, and this may help your research.

Please kindly tell us the following information when you apply for the sensor and after you get the sensor. Any questions are always welcome at the mail addresses in the next section.

- Contact information of the person in charge
  - Name
  - E-Mail Address
  - Telephone and Fax number
  - University or College Name
  - Address
- Status of sensor deployment
  - Is it connected to the Internet?
  - Is remote login allowed? If allowed, how? (If remote login is available, we are easier to support your sensor deployment.)
  - Under NAT or Firewall?
  - Photo of the deployed sensor
- Application scenario (for what purpose do you use?)
- Progress Report (when you have made any progress)

## 10. Contact and Reference for Further Information

Live E! Project: <http://www.live-e.org/>

PIAX: <http://www.piax.org/>

Live E! Data Web Portal:

<http://live-e2.hongo.wide.ad.jp/>

<http://live-e.naist.jp/>

<http://live-e.naist.jp/weatherChecker/>

Live E! Server Distribution: <http://live-e.hongo.wide.ad.jp/dist/>

Live E! Document Repository: <http://live-e-dev.naist.jp/document/>

**General Contact** Address: [live-e-global@hongo.wide.ad.jp](mailto:live-e-global@hongo.wide.ad.jp)

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Satoshi Matsuura: [matsuura@is.naist.jp](mailto:matsuura@is.naist.jp)

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