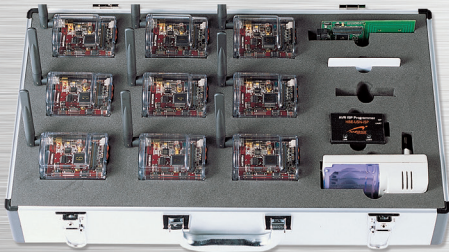# >>Ubiquitous Sensor Network
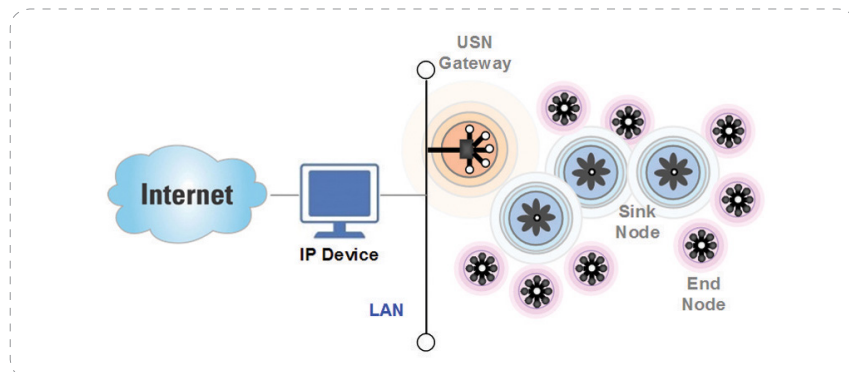
## Ubiquitous Sensor Network System
## HBE-ZigbeX II

- Standard Platform for Ubiquitous Sensor Network Education
- RFID reader basically provided for RFID/USN Interworking Test
- The latest TinyOS 2.x Porting for Ubiquitous Sensor Network
- Separate OS provided by Nano Qplus(ETRI technology transfer)
- Porting Sensor Module provided for Various Application Tests of Home Network and u-Healthcare(option)
- External Antenna mounted for Effective Ubiquitous Sensor Network Test
- Interworking with various Servers of Embedded System and PC
- EasyTinyOS(nesC code Automatic Generation Tool) provided
- Eclipse based Development Environment(ZigbeX Studio™) provided

## Introduction

- Ubiquitous Sensor Network(USN) is a field competed by all countries of the world to secure National Competitiveness for communication environment which transcends time and space by using Ultra Low Power.
- Ubiquitous Sensor Network is being expanded to overall industries such as Intelligent Home Network, Building Management, Environment Monitoring, Disaster Prevention and Healthcare and recently the used range of this is being expanded to the fields for interworking with existing Infras of Electronic Payment, Information Delivery, Voice Communication, P2P and Data Sharing.
- Ubiquitous Sensor Network is a technology which is a base of IT convergence technology and Growth Engine, big new things in recent years, and also this is considered to the heart of strategic positioning for major industries of Automobile, Shipbuilding, Construction and Medical Service.
- HBE-ZigbeX II executes Porting of the latest TinyOS 2.x, Nano Qplus to HBE-ZigbeX leading the education marketplace of domestic Ubiquitous Sensor Network. Also, HBE-ZigbeX II adds various Educational Themes of Healthcare and Environment Monitoring sensor to improve the Industrial Validity of educational institutions.

Block Diagram of Ubiquitous Sensor Network using HBE-ZigbeX II

## Features

- General stable Standard Ubiquitous Sensor Network Platform
  - General Purpose ATmega128 MCU used
  - Various Sensor Data Storages provided(Flash :512KB)
  - Power : under 1.2V Ni-MH 3EA/1.5V 3EA/+5VDC external Power
- More stable Real Time Sensor Network through the latest TinyOS 2.x Porting
- Nano Qplus 2.3 , the Korean Style Ubiquitous Sensor Network Development Environment
- Porting External Antenna mounted for Network of maximum up to 100m
- Temperature/Humidity, Light sensor and Infrared sensor and RTC mounted for basic Sensor Network Test
- RFID Reader/Tag provided basically for Core Sensor Network Test
- Standard Extension Port provided for mounting various Sensor Modules
- Sensor Module provided for applications of Intelligent Home Network and u-Healthcare(option)
- Interworking with various Servers including Serial Interface
- Basic Sample Program data and default Source for various applications provided
- Professional Education Program supported for the faculty members
  (Test and Teaching Fellows included)
- EasyTinyOS tool provided for easy TinyOS programming of beginners
- Eclipse based Development Environment(ZigbeX Studio$^{TM}$) provided

## Specification

### • Hardware Specification

| Items | Descraiption |
|---|---|
| Processor | ATmega128A |
| Memory | 128KB Program FLASH, 4KB RAM |
| RF Device | CC2420(IEEE802.15.4 compliant) |
| Security | DSSS |
| Data Rate | Max. 250Kbps |
| Base Sensor | Temperature, Humidity, intensity of illumination, infrared rays a sensor, RTC |
| Power | 1.2V*3, 1.5V*3, external <+5VDC |
| Size(W*D*H) | 60mm*50mm*30mm (Antenna Connector) |

\* Specifications can be changed without notice

### • Software Specification

| Items | | Descraiption |
|---|---|---|
| Operating System | TinyOS 2.x | Non-preemptive thread OS<br>Low-Power Management<br>Ad-hoc Routing Application<br>nesC : Component Model Language |
| | Nano Qplus | Multi-Threading Model<br>Multi-Tasking based on Priority<br>C Language<br>Static & Dynamic Memory Allocation |
| MAC | | B-MAC, Flooding |
| Development Environment | | Cygwin      EasyTinyOS<br>NesC compiler    USB-ISP Downloader<br>GNU AVR gcc compiler  Eclipse based ZigbeX Studio$^{TM}$ |

\* TinyOS 1.x code is not compatible with TinyOS 2.x code.

# Ubiquitous Sensor Network
## >>HBE-ZigbeX II

### • Main Functions of TinyOS

- Event driven OS for USN
- Building Automatic Communication Network for Sensor Network
- Battery System Power management
- RF data transmission management

- Sensor Data conversion and storage
- RF packet management
- Interrupt and RTC management
- nesC code automated generation using EasyTinyOS

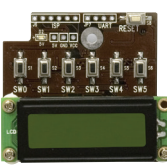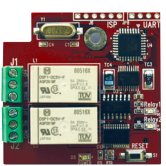### • Specification of RFID Reader and Tag
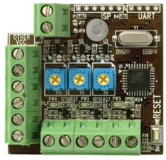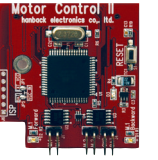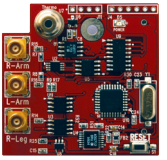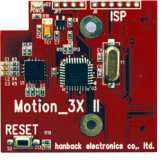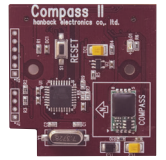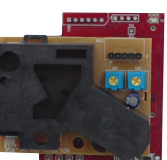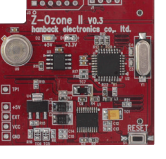
| Item | Description |
|---|---|
| Frequency Bandwidth | 13.56MHz |
| Tag Data Storage | 16*64Byte<br>- Card ID : 1Byte<br>- Key : 16Byte<br>- Data : 1,007Byte |
| Read and Write of Data Field provided | |
| Tag Type | Card type |

## Option Sensor Module

### • Sensor Module Application by Fields

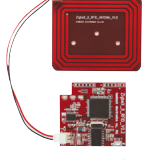| Item | Option Sensor Module |
|---|---|
| 1. Basic Education | ATmega 128A, CC2420 control, LED, Sensor, RTC, MAC, Routing Test |
| 2. Intelligent Home Network | Home Sensor Module Visitor Recognition, Magnetic Switch(door open detected)<br>IR-Remote Control Module : Appliance Control Module replacing Remote Controller<br>LCD Module : Text LCD based Character Output<br>Relay Module : On/Off control using 2ch Relay<br>DIO Module : Digital Input/Output<br>Motor Control Module : 2Ch motor control module |
| 3. u-Healthcare | BIO Sensor Module : Temperature, ECG<br>SpO2 Measuring Module : Blood Oxygen Concentration measurement<br>Triaxial Acceleration Sensor Module : Triaxiality Acceleration  Measurement<br>TN9 Module : Non-contacted temperature measurement |
| 4. u-Environment Monitoring | Weather Sensor Module : Air Pressure, Light, Acceleration<br>$CO_2$ Sensor Module : $CO_2$ measuring module(ppm)<br>Dust Module : Dust/Smoke measurement<br>CO Module : CO (carbon monoxide) measurement<br>Ozone Module : Ozone measurement<br>NO Module : NO measurement<br>VOC Module : VOC measurement |
| 5. Others of Positioning | GPS Module : Positioning(outdoor position recognition)<br>Ultrasonic Sensor Module : Ultrasonic waves(indoor position recognition)<br>Bluetooth Module : Bluetooth data transmission<br>Image Transmission Module : JPEG based Still Image Transmission<br>Compass Module : Electronic compass |

## · Option Sensor Modules

**Ubiquitous Sensor Network**

HBE-Ubi-HomeNet

**HBE- ZigbeX II**

HBE- Ubi Box III

| Home Sensor Module | IR-Remote Control Module | LCD Module | Relay Module |
|---|---|---|---|
| Visitor Recognition Magnetic Switch (door open detected) | Remote controller embedded Appliance Control | Text LCD based Character Output | On/Off Control using 2ch Relay |
| **DIO Module** | **Motor Control Module** | **BIO Sensor Module** | **SpO2 Measuring Module** |
| Connected with Gas detector and Sensor for Digital Input/Output | 2ch Motor Control | Temperature/ECG | Blood Oxygen Concentration Measurement |
| **Triaxial Acceleration Sensor Module** | **Weather Sensor Module** | **CO2 Sensor Module** | **GPS Module** |
| Triaxiality Acceleration Measurement | Air Pressure, Light, Acceleration | CO2 Measuring Module (ppm) | GPS (outdoor position recognition) |
| **Compass Module** | **Bluetooth Module** | **Dust Module** | **CO Module** |
| Electronic Compass | Data Transmission with Bluetooth | Dust Measuring Sensor | CO Measuring Sensor(ppm) |
| **Ozone** | **NO Module** | **TN9 Module** | **Ultrasonic Sensor Module** |
| Ozone Measuring Sensor (ppb) | NO Measuring Sensor (ppm) | Non-Contacted Temperature Measurement | Distance Measurement (indoor position recognition) |
| **RFID Reader** | | | |
| RFID Reader | | | |

# Ubiquitous Sensor Network
## >>HBE-ZigbeX II

## ZigbeX Studio™

### • Introduction to ZigbeX Studio™

To develop TinyOS program operated at the mote for USN , we should install and set the tool chain distributed at TinyOS.net, Cygwin and other tools. This gives us difficulty to precede USN education. ZigbeX Studio™ is a self-developed tool, in which USN development environment is simplified for HBE-ZigbeX/HBE-ZigbeX II mote based product users at Hanback Electronics Co.,Ltd..

### • Hardware Specification and Components

| Items | Description |
|---|---|
| Operating System | Windows XP, Windows 7 32 bit/64 supported |
| Hardware Specification | CPU : Single Core: 3.0GHz, Dual Core: over 2.0GHz recommended<br>RAM : 1G for XP(minimum over 512M),  over 2G recommended for Windows 7<br>HDD : Extra Space of 10G HDD (20G recommended)<br>HDD needs more extra space for Project |
| Package | Eclipse, TinyOS Plug-in, JDK, Cygwin, TinyOS 2.1, other tools |
| Supported Platform | HBE-ZigbeX and HBE-ZigbeX II based Platform |

* Specifications can be changed without notice

### • Characteristics of ZigbeX Studio™

### • Support of Auto Installation Program

ZigbeX Studio™ improves the efficiency to write the program by adding installation simplification of TinyOS tool chain and visualized integrated development environment, and if ZigbeX Studio™ is installed, we do not need to install Development Environment distributed by TinyOS.net separately. Immediately when ZigbeX Studio™ is installed to Host, it is possible to perform the whole processes for TinyOS program development of Project Create, Code Edit, Build, Installation and Message Check in visualized environment like Visual Studio.

### • Simultaneous Support of CUI and GUI

When ZigbeX Studio™ has been installed, which supports CUI and GUI all, Shortcut is created for execution on Wallpaper. GUI executes all works in Eclipse, so if ZigbeX Studio™ shortcut is executed, Eclipse is executed, which is corrected for TinyOS program development.

CUI provides Cmd for TinyOS for users not used to Linux command, and Cygwin for TinyOS, which is Default Development Environment of TinyOS as Command Line based Development Environment. Cmd for TinyOS can execute the command for TinyOS development as Cygwin for TinyOS on Dos command window.

### • GUI based Integrated Development Environment provided

It is possible to perform the whole processes for TinyOS program development of Project Create, Code Edit, Build, Installation and Message Check in visualized environment like Visual Studio.
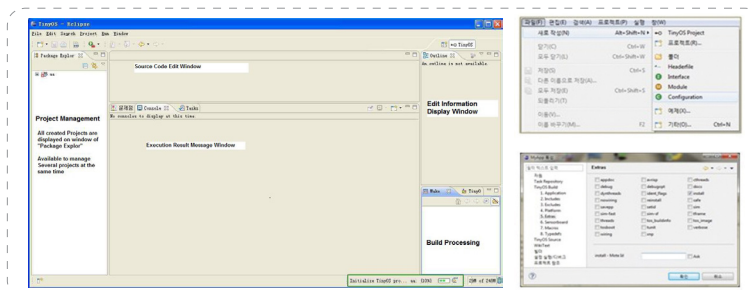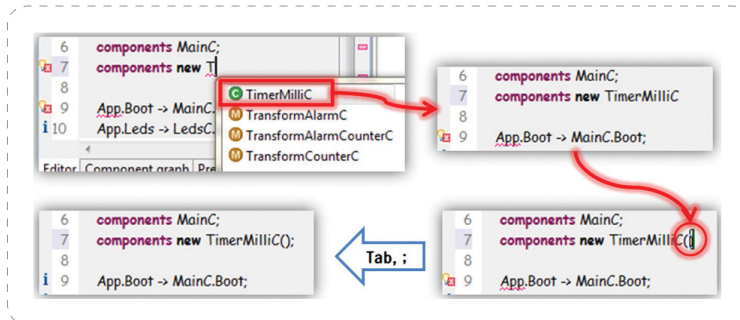
• **Special Tool provided for Program Download and Test**

• **Code Help supported for Code Writing**

Code Help supports to complete the identifier defined when writing nesC syntax on Edit window automatically, which searches the name of identifier started with a specific character and the name included in the path and replaces it to the identifier if selected by a user.



• **Component Graph provided for Source Code**

Component Graph is one of core functions of TinyOS Plug-in with Code Help and analyzes the contents when used for configuration and module file in order to display it to the graph. Module displays the event and module function list implemented and Configuration displays the connection rule between components visually. And Configuration is so useful to know the structure for program configuration.
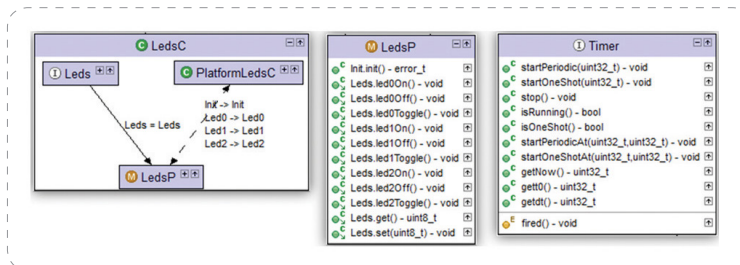


• **Visualized Code Analysis**

Component Graph of Configuration displays the connection relationship and structure of components visually and enables to search the substructure. And if combining this with Outline window which displays Component Information to Tree, this becomes the best Program Analysis tool.
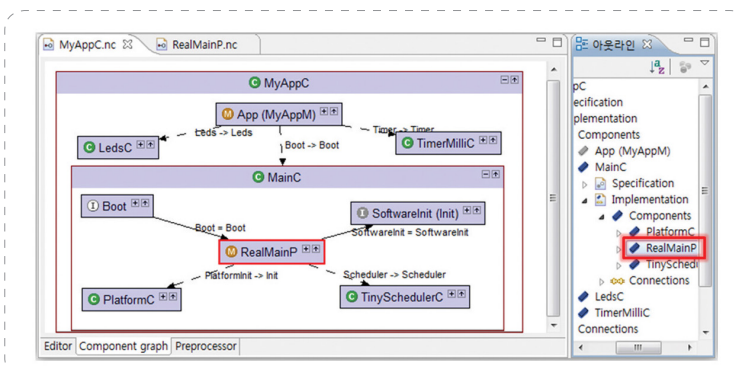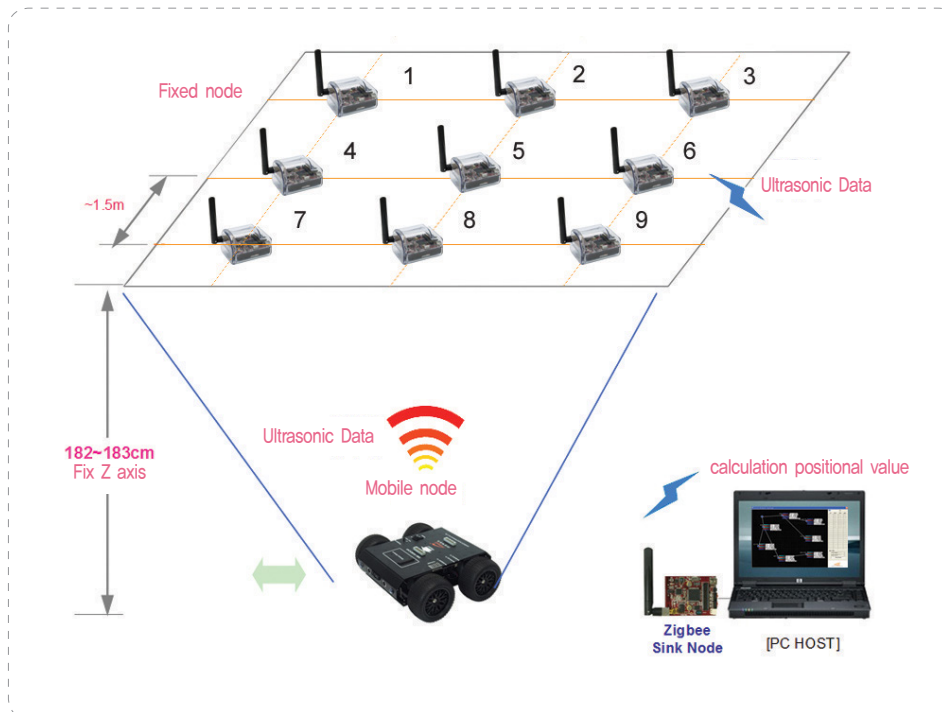
## Applications



**HBE-ZigbeX II + Indoor Positioning using Ultrasonic Sensor Module**
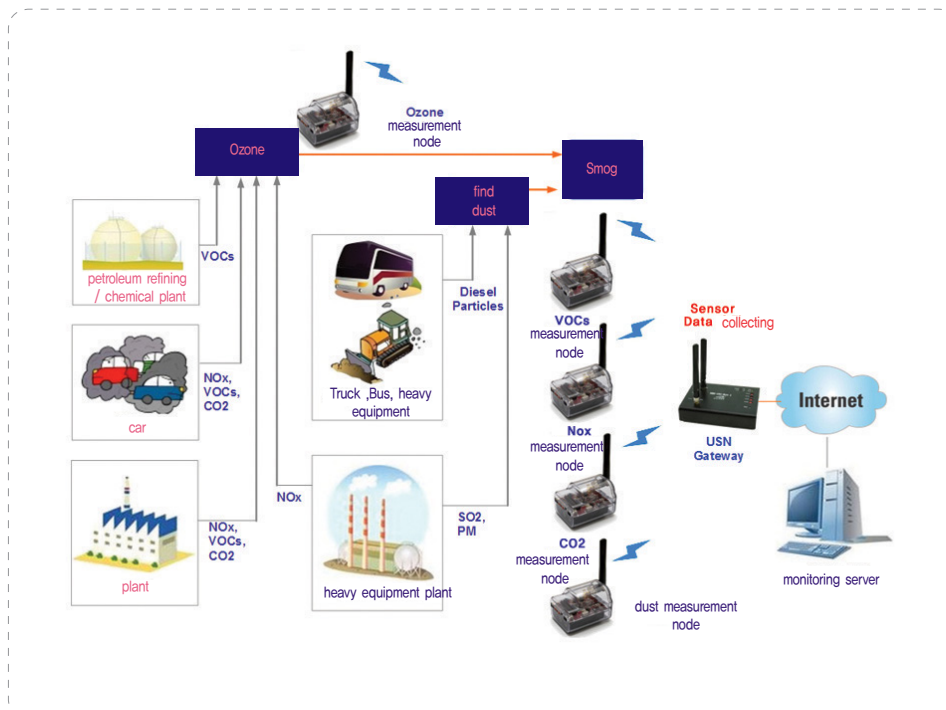


**HBE-ZigbeX II + Monitoring System using Environment Option Sensor Module**

## • Ubiquitous Home Network Demonstration Laboratory

ZigbeX II + Ubiquitous Demonstration Laboratory using Home Network related Option Sensor Module(Example of Korea University of Technology and Education).





## Contents

| Contents of Education | | |
| --- | --- | --- |
| **Learning USN based TinyOS** | 1.TinyOS based WSN Platform<br>1.1.Ubiquitous and TinyOS<br>1.2. Wireless Sensor Network System<br>2.TinyOS Hardware Platform<br>2.1.TinyOS Target Hardware<br>2.2.WSN Hardware Configuration<br>2.3.Understanding WSN hardware<br>3.Developing Environment of TinyOS<br>3.1.Integrated Developing Environment of TinyOS<br>3.2.TinyOS Development Processor and GUI Environment<br>3.3.GUI based Hello LED Project | 4.Implementing TinyOS application from Samples<br>4.1.TinyOS Basic Component<br>4.2.Obtaining Sensor Value<br>4.3.UART Communication<br>4.4.Radio Communication<br>4.5.Building USN with Routing Technology |

## Components



| HBE-ZigbeX II | HBE-USN-ISP Programmer | RFID Reader and Tag(13.56MHz) | USB Cable (A to B Type) | USB Mini Cable | User's Manual and CD |
| --- | --- | --- | --- | --- | --- |