

A Research on KOREN '12

IoT-Silo: An Agent-Based Service Platform for IoT



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PUSAN NATIONAL UNIVERSITY



WASEDA University



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Objectives

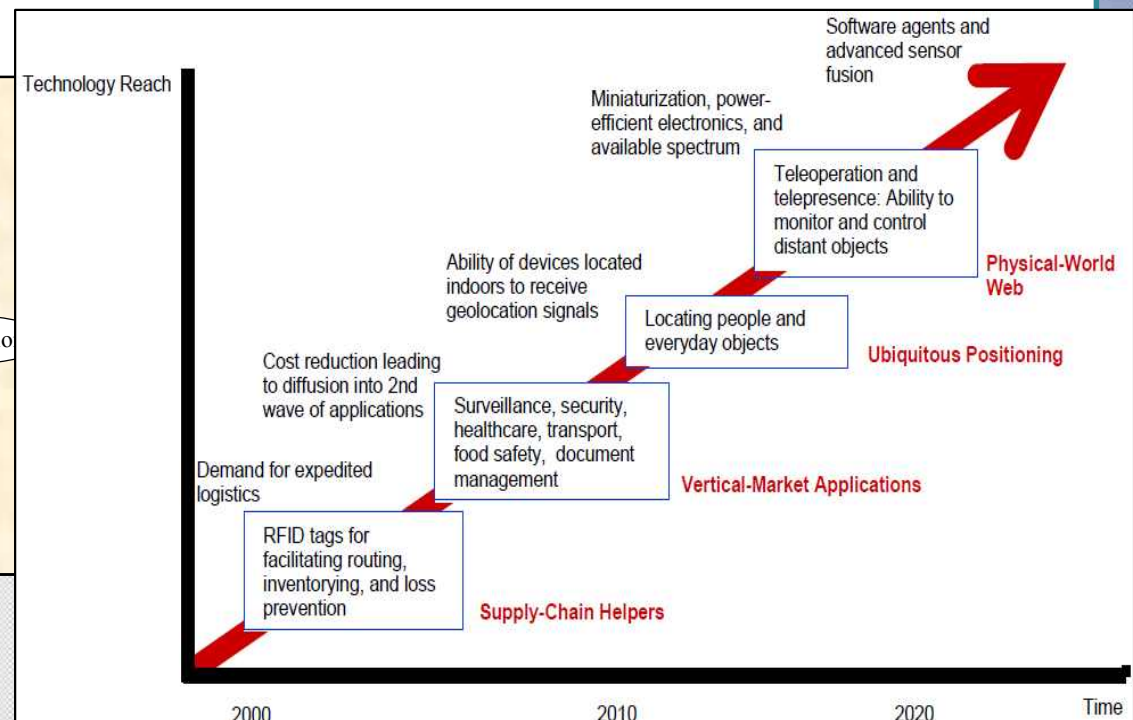
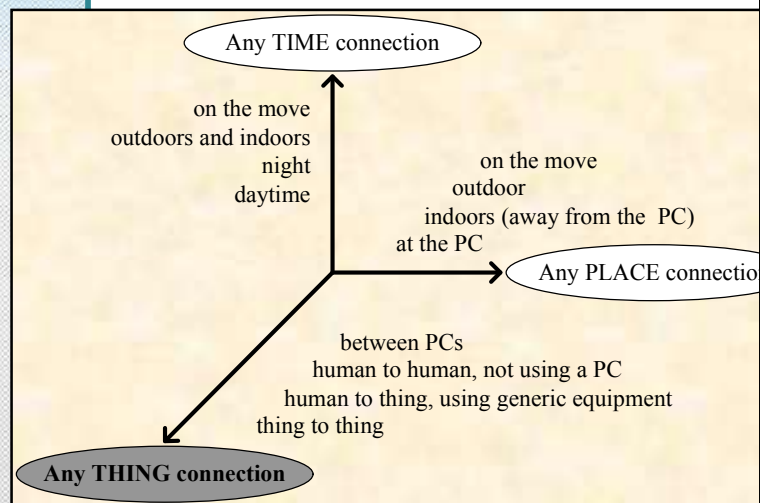
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Research Details

I -1. Research Overview

Introduction of IoT

- Provides information service by accessing data via connected network; **ANYTIME, ANYWHERE, and ANYTHING**,
- Internet is evolving into **object** oriented from **human** oriented.
 - various object oriented based network technologies are shown and competed such as RFID, WSN, IP-USN, M2M and so on.



Significance of Research

- Pursuing innovated structures in technical environment, living territories, public service, economy, community, and cultural perspective.
- It is mandatory technologies to achieve industrial advance and expecting potential demand surge.

I -2. Emerging of IoT Data Platform

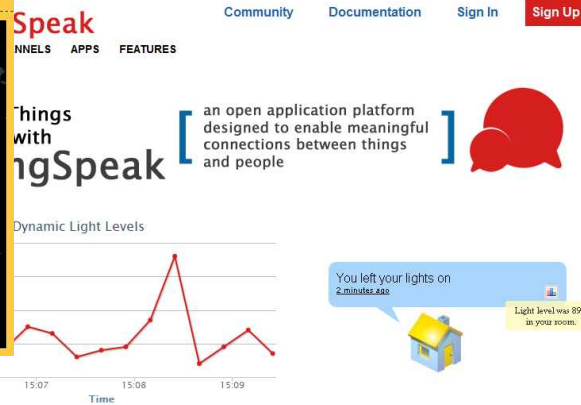
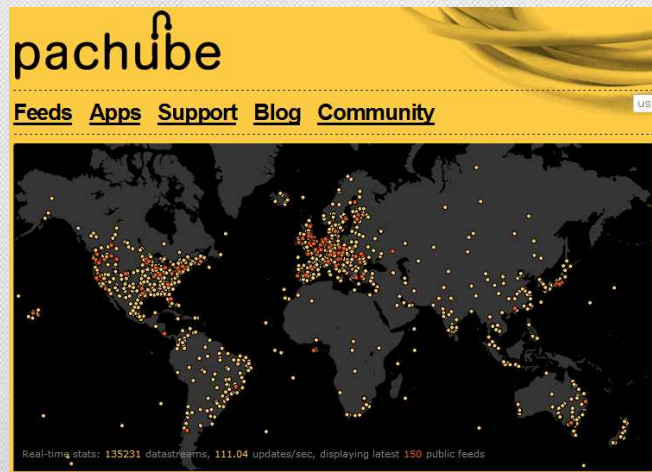
IoT Confused Stage

- Various points of view of IoT fulfillment
 - Concept or Technology?
 - Diversity of approaching plans and perspectives in conceptual establishing period
 - standardizing is in progress; 'Y.2060 Overview of IoT' by ITU-T in 2012
- End-to-end telecommunication within heterogeneous hardware, distinguishing systems, networks, and protocols.



IoT Data Platform

- Decoupling data from differences of IoT device, then retention of interoperability in data



I-3. Limit of IoT Data Platform and CPS

IoT Data Platform

- Decoupling in device and data
- Application of mesh-up

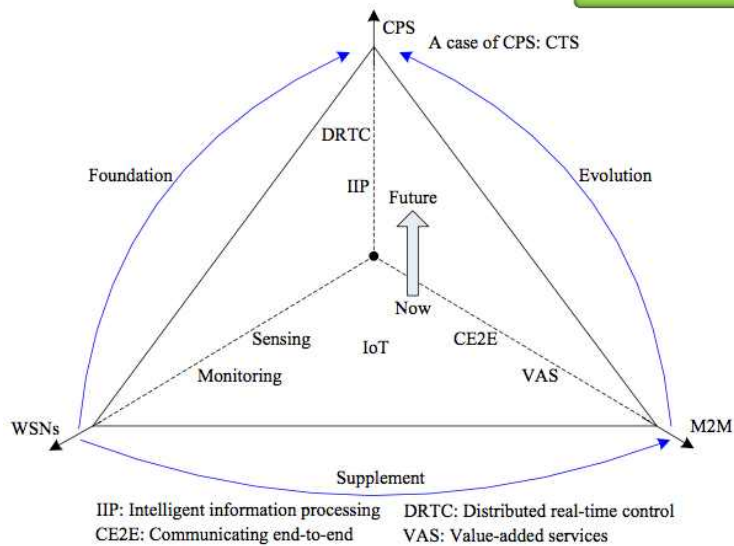
Cyber-Physical System

- 🍌 **Accepting heterogeneous devices**
- 🍌 **Device communication and cooperation**

Distributed CPS

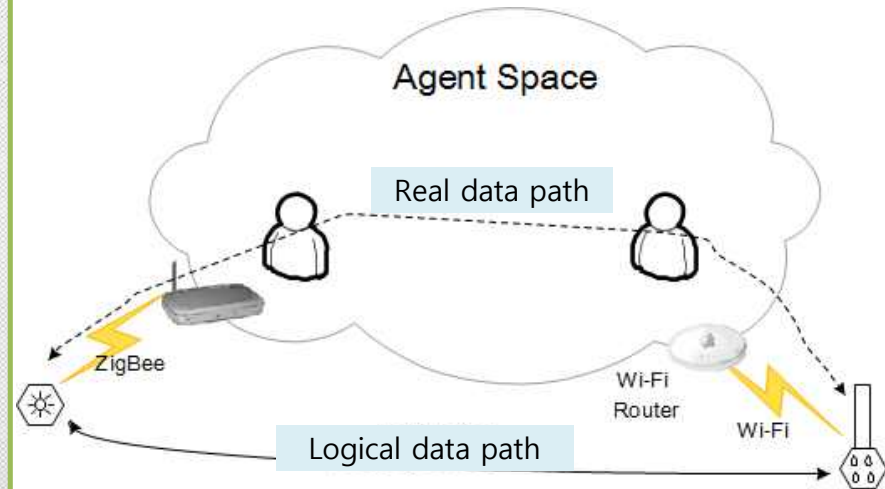
- Scalability
- Security

Cyber-Physical System



- 🍌 Providing IoT services by interworking elements of information system and objects with M2M, USN, RFID technologies.
- 🍌 CPS is possible to be fulfillment of IoT

- ## 🌟 Design IoT Framework applied with CPS's AGENT concept



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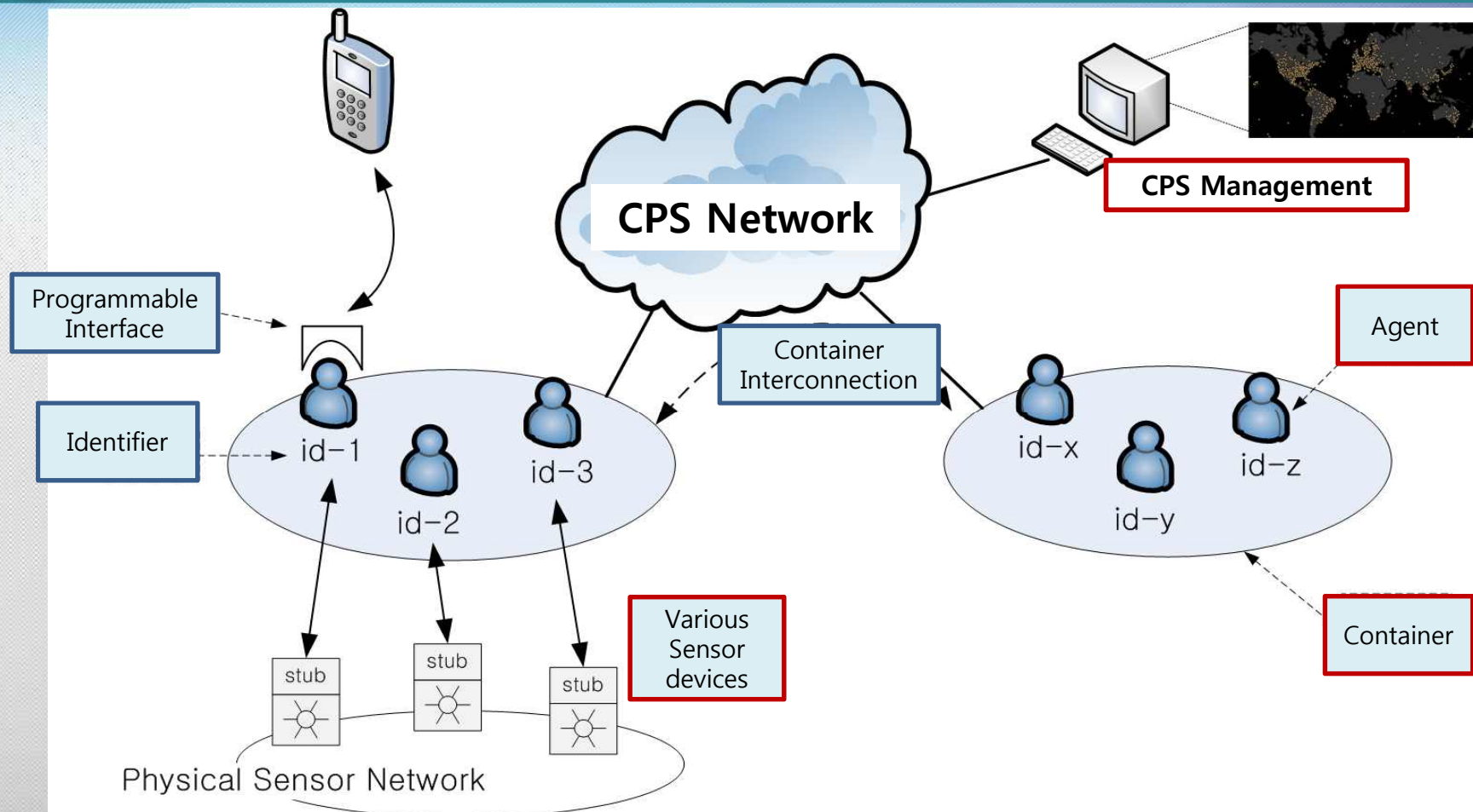
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Research Details

II-1. Research Objectives

Objectives in Phase

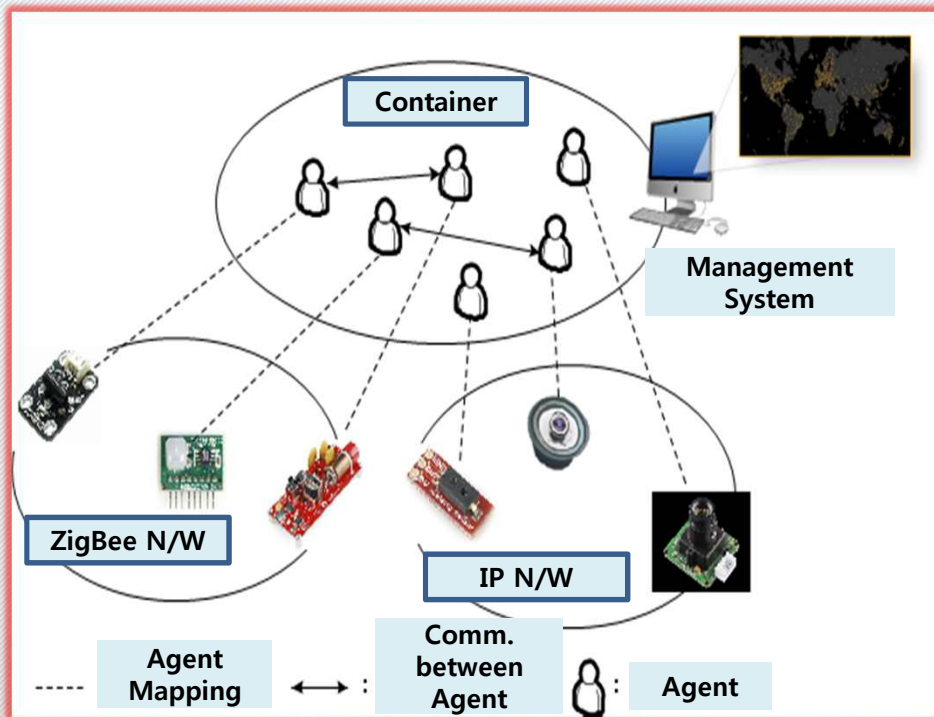
- 1st Phase : In IoT environment, transferring devices to Cyber World, then develop/test the CPS based IoT Framework which provides IoT service consistently.
- 2nd Phase : Designe/Develop/Test of Massive Distributed CPS System



II-2. Research Objectives

1st Phase Goal

In IoT environment, transferring devices to Cyber World, then develop/test the **CPS based IoT Framework** which **provides IoT service consistently**.



Developing various Devices

- Develop sensors/actuators with various functions
- Materialize heterogeneous access network

Developing Agent

- An **Agent system** with **dematerializing** the IoT devices
- **Stub Interfaces** that could interwork with heterogeneous IoT devices

Developing Agent Container

- **Agent Container System** that is in charge of adding/managing/deleting agents
- Develop a **management system** that can be accessed from the outside

Test on KOREN/APII

- Developed Agent is installed at AnYang Univ.
- IoT devices will be installed and tested at **AnYang Univ., PuSan Univ. and Waseda Univ.**

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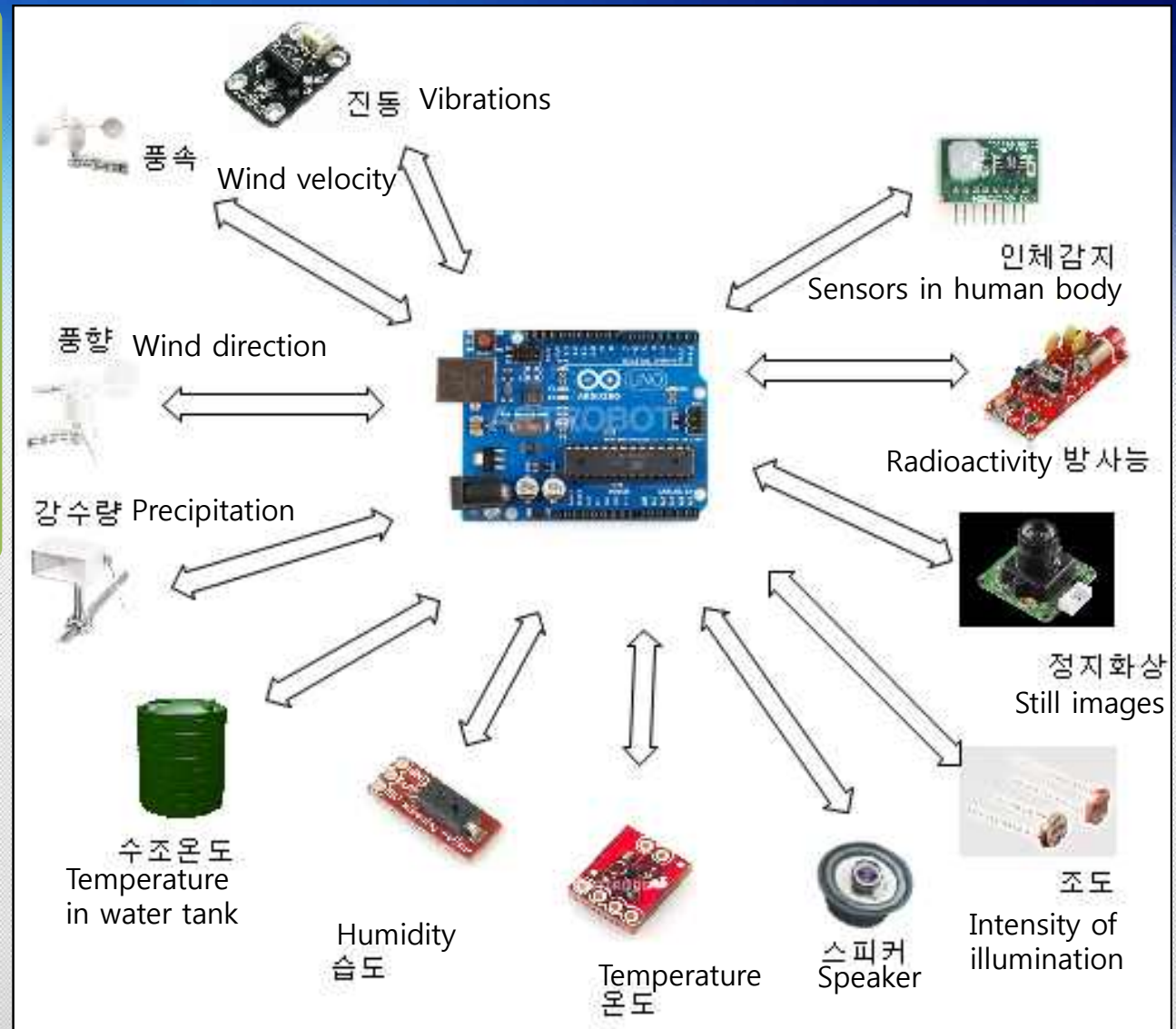
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Research Details

III-1. Develop Heterogeneous IoT Devices (1)

Implementation using Arduino

- Lego Block
- Heterogeneous Sensor
- Heterogeneous network IF

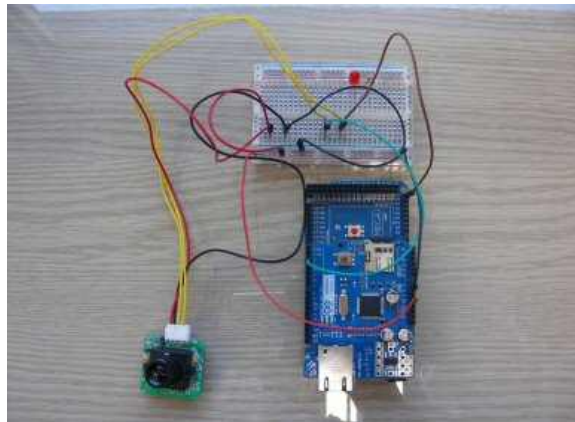


III-1. Develop Heterogeneous IoT devices (2)

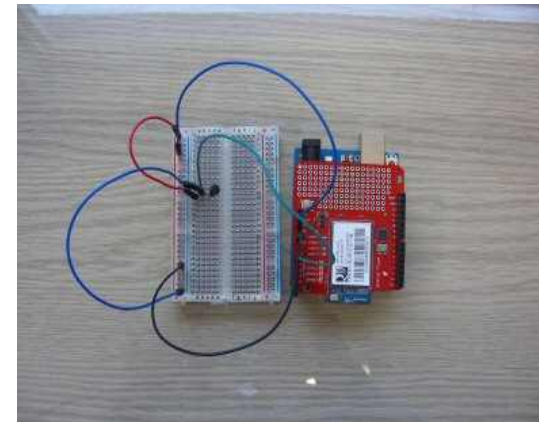
● Sensor for Wind velocity/wind direction/



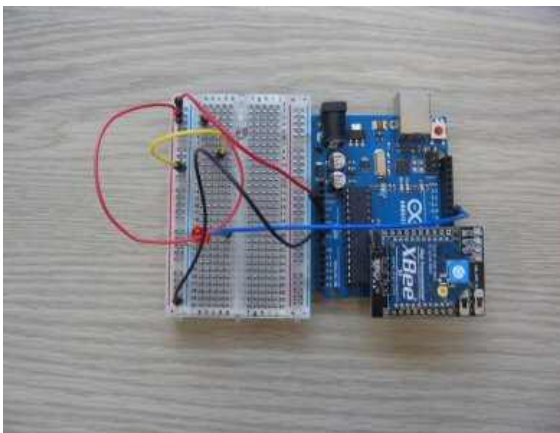
● Still images sensor



● Temperature sensor



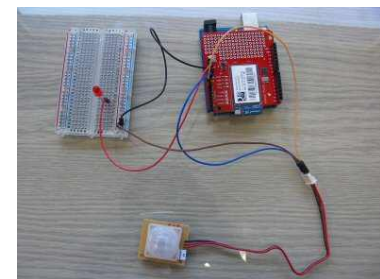
● Intensity of illumination sensor



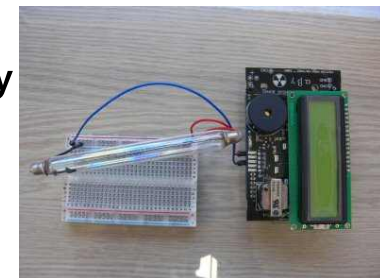
● Speaker Actuator



● Sensor for human body

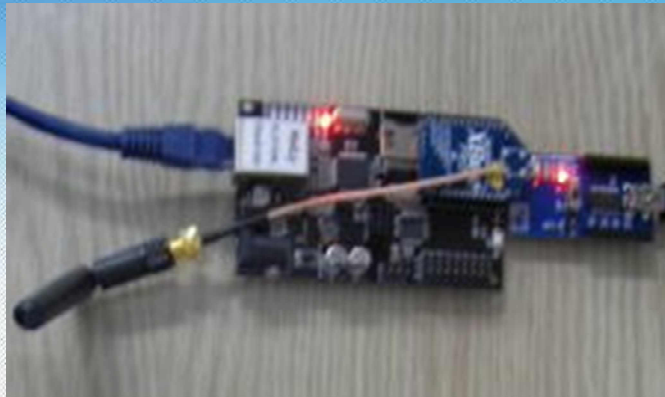


● Sensor for radioactivity

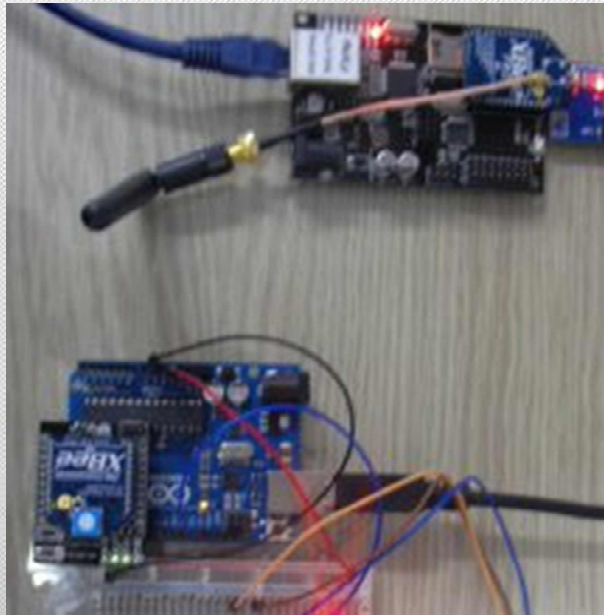


III-1. Develop heterogeneous IoT devices (3)

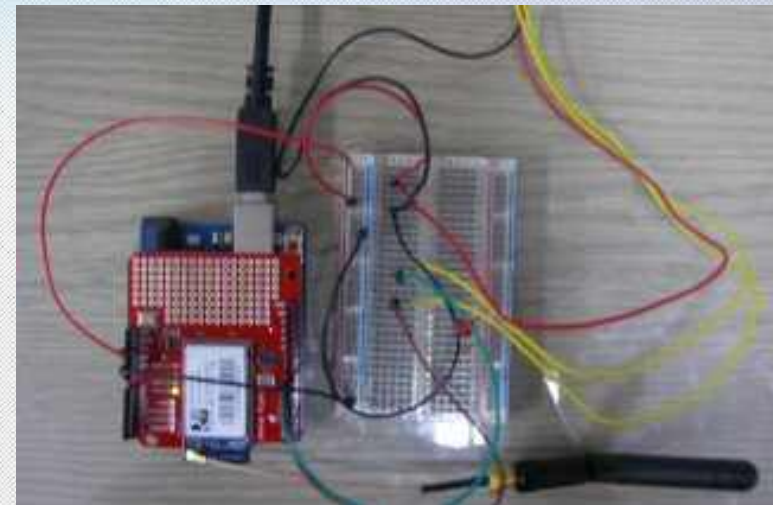
● Ethernet



● ZigBee



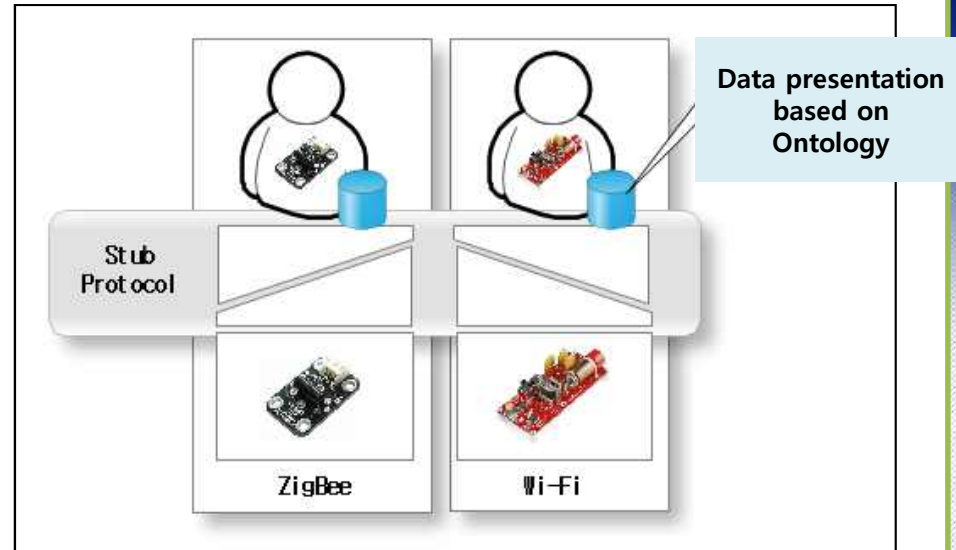
● WiFi



III-2. Development of Agent (1)

Direction of Designing Agent with dematerialized IoT devices

- Agents have different characters and functions according to design and information type of heterogeneous device.
- A structure that covers up types of heterogeneous devices and differences of network, then provides a singular interface to the outside.



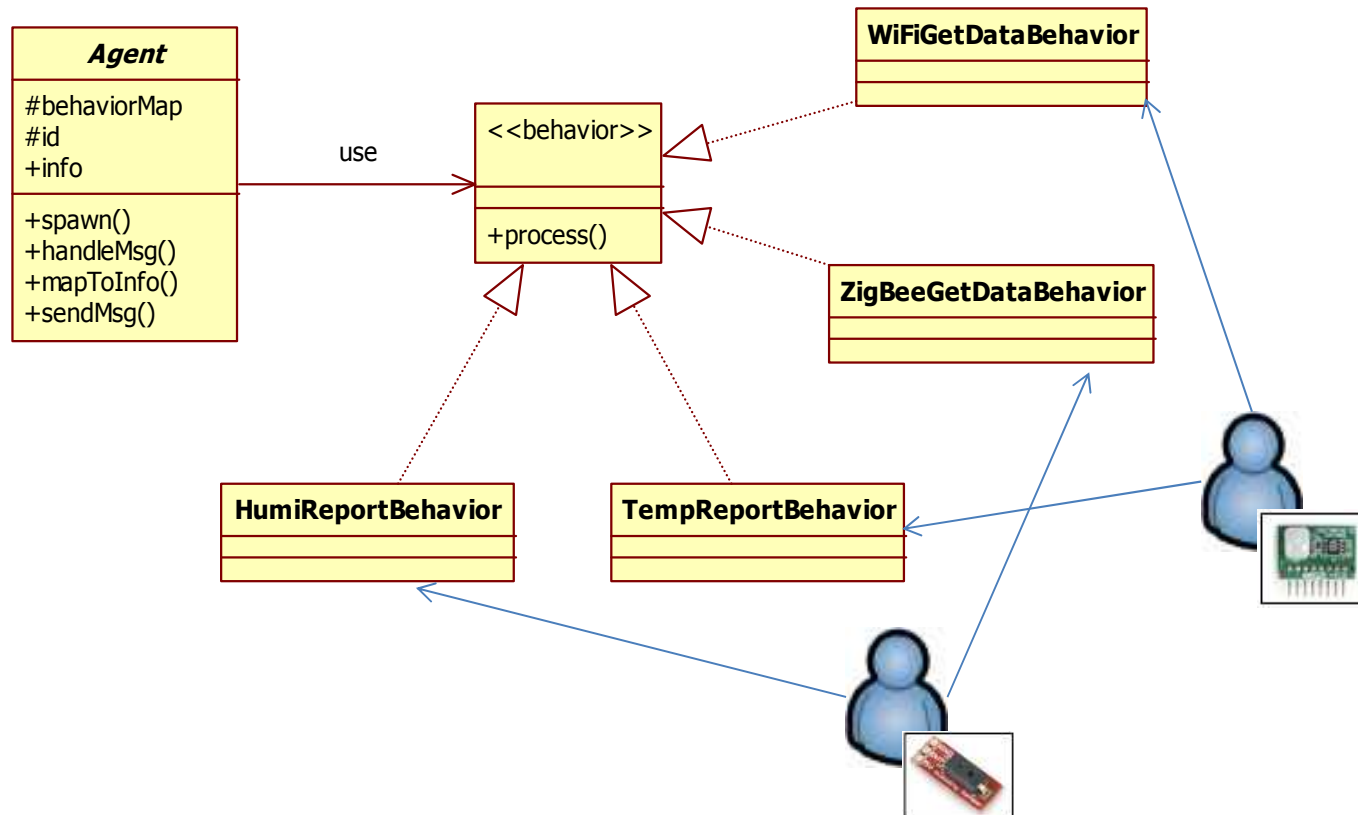
Direction of Stub Interface Development

- The role of Stub interface is mapping heterogeneous devices and Agents
- Stub interface designs a lightweight protocol that communicates within any network between devices and agents.
- Define a only protocol frame (no detail) that using JSON data format;
A real implementation of Stub structure is separated from the network interface for independency of access network technologies

III-2. Development of Agent (2)

● Strategy Pattern

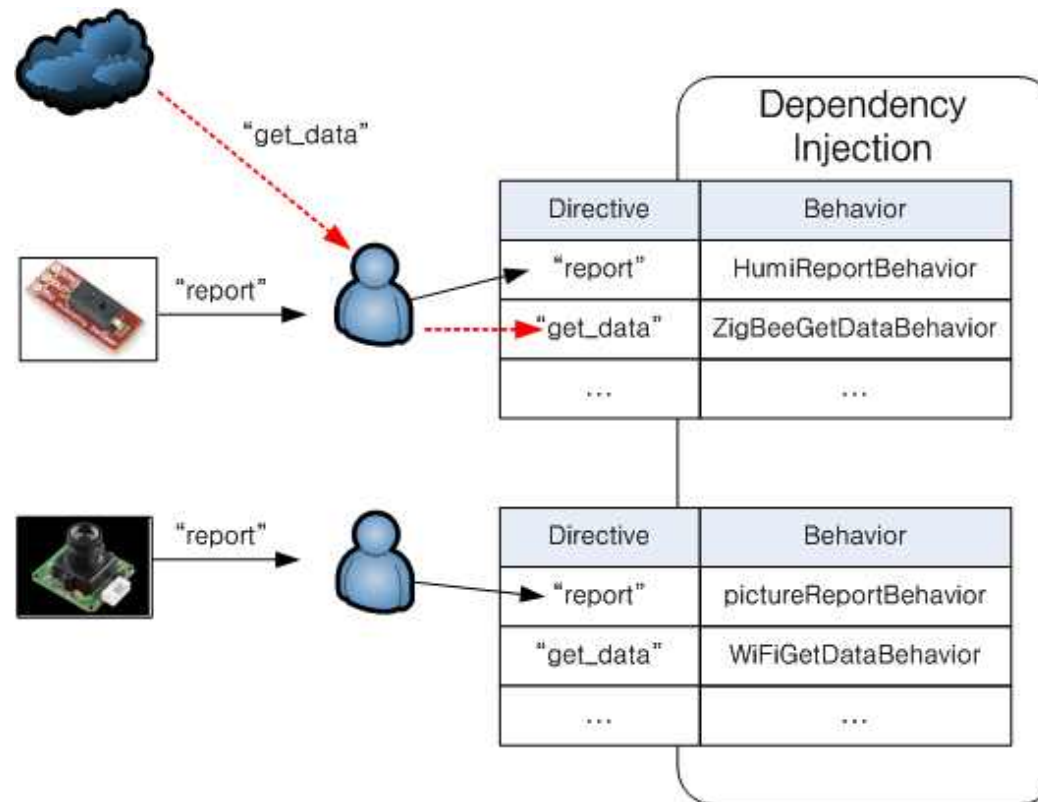
- Can't dematerialize all of the IoT devices on a single Agent
- Agent is materialized with only basic/general functions;
However, using strategy pattern, authorize specific functions on each devices to corresponding agent objects.



III-2. Development of Agent (3)

● Dependency Injection

- Devices with same type could have different functions or network connections.
- Therefore, Agent could be authorized, but not Hard Coded.
- Dependency is a obstacle to expand and overcoming heterogeneity. Then implement using dependency injection (dynamic binding of behavior)

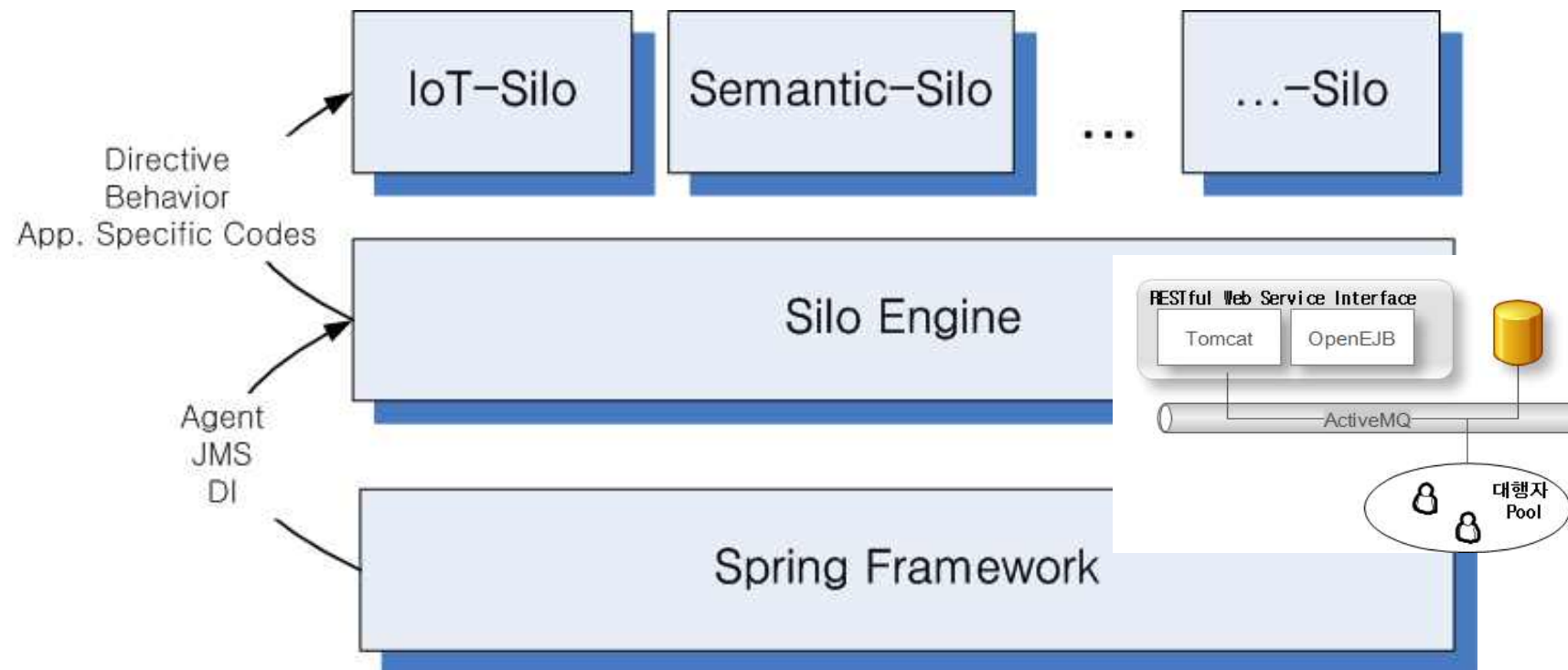


III-3. Development of Agent Container

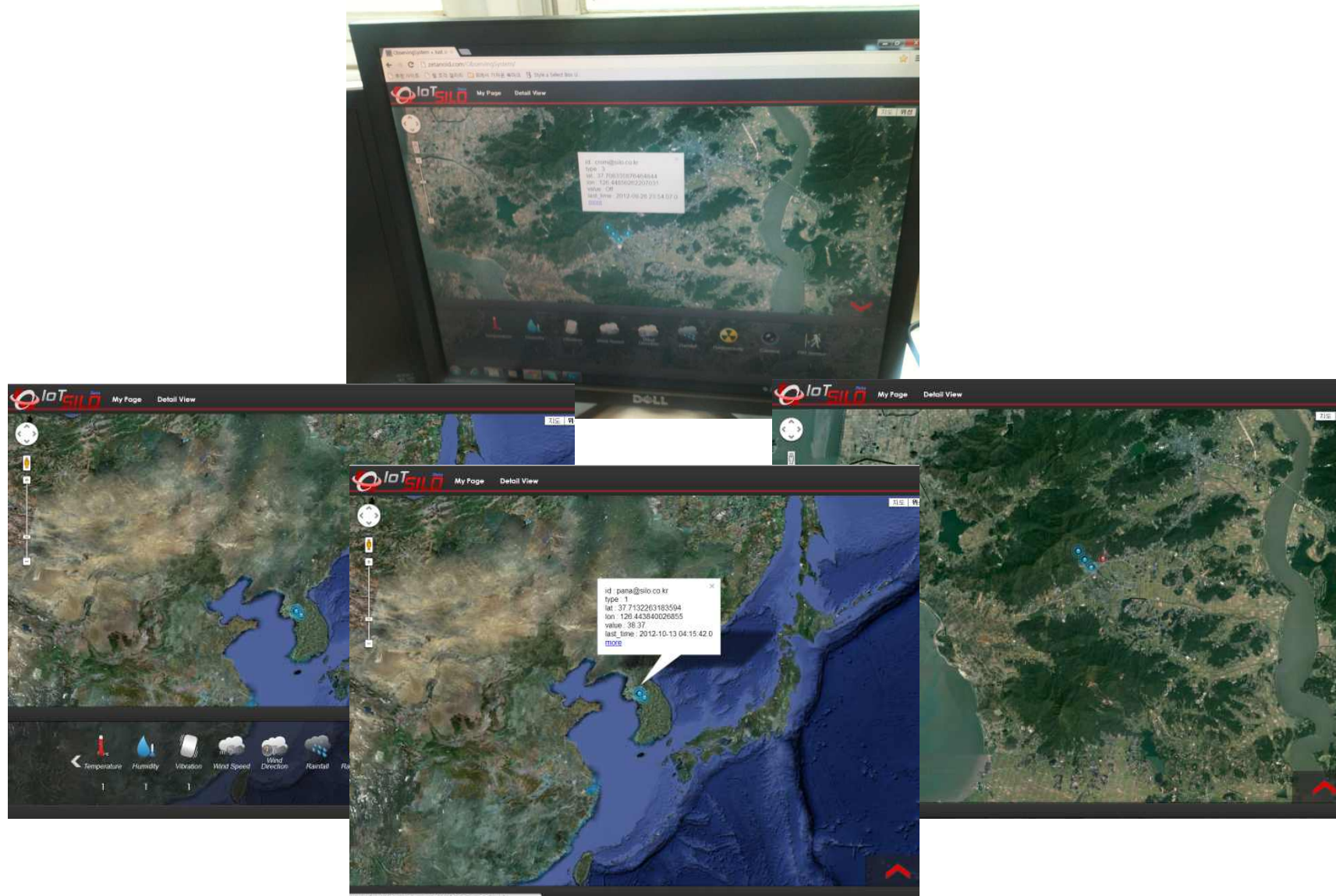
● Silo Engine

- ✓ Foundation – Java Spring Framework
- ✓ Implement Agent with Spring Framework-based DI(Dependency Injection)
- ✓ Asynchronous comm. Channel between Agents through JMS(Java Message Service)

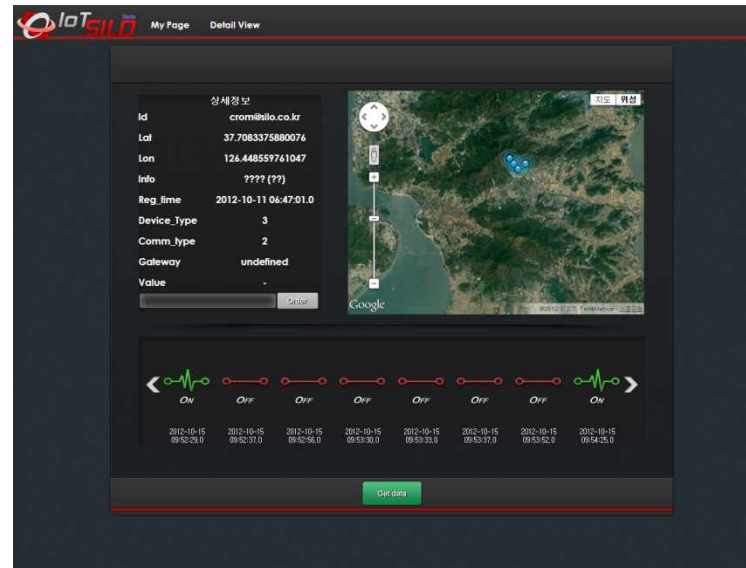
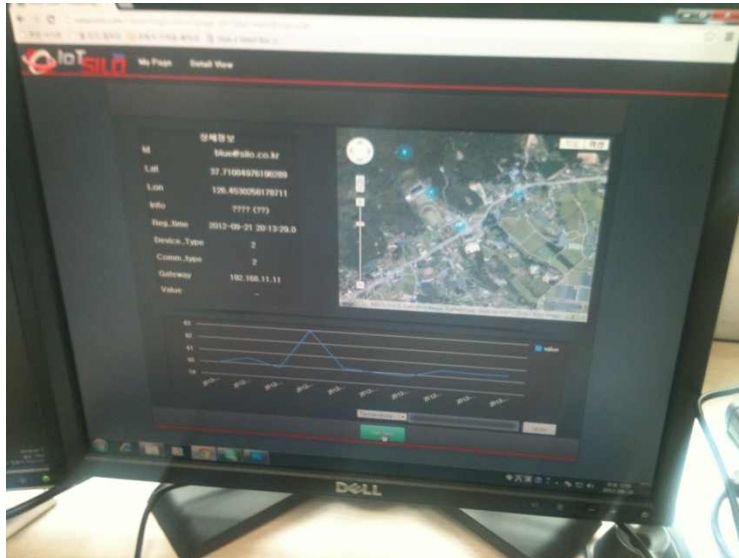
● IoT Service Platform: IoT-Silo (+ Management System, Mashup application)



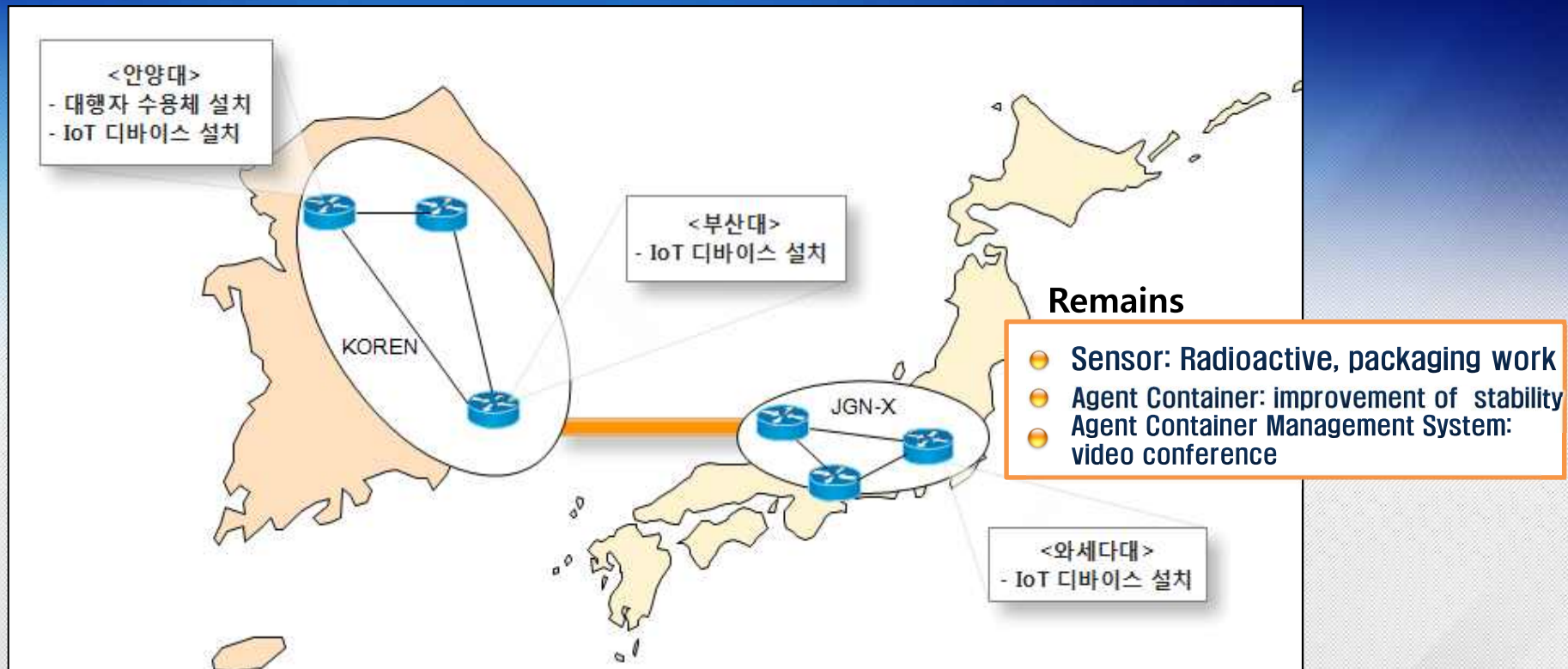
III-4. Management System of IoT-Silo (1)



III-4. Management System of IoT-Silo (2)



III-2. Design of Experiment on APII



● Anyang-U

- IoT-Silo
- IoT Devices

● Pusan-U

- IoT Devices

● Waseda-U

- IoT Devices

KOREN

APII

JGN-X



Thank You

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