

iSilo: Agent Service Platform for Internet of Things

May. 2013

Euihyun Jung

Dept. of Computer Science
Anyang University
jung@anyang.ac.kr



안양대학교
ANYANG UNIVERSITY

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Background (1)

□ Water me please...



Background (2)

□ A world in which things are **smart** and **connected to the Internet**



Everyday things get connected for smarter tomorrow

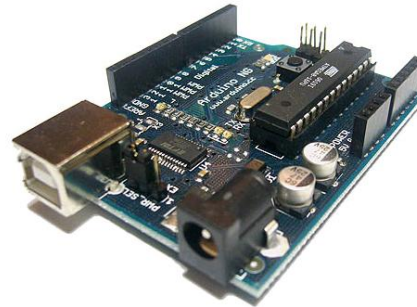


Background (3)

- Smart enough, but how to be connected



Arduino Diecimila

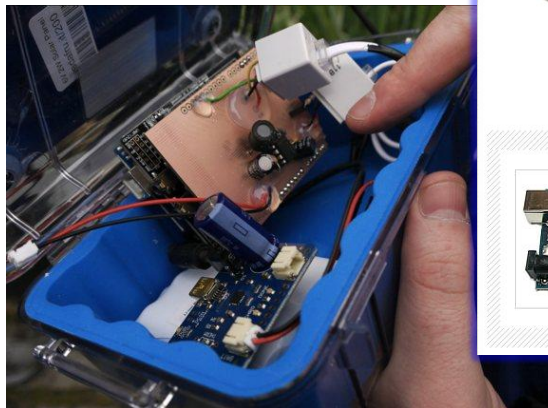
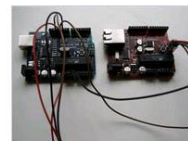


DESCRIPTION

It's the main Arduino board currently in production. This board is used by designers, artists, architects and more to do creative rapid prototyping with electronics. More details on the [Arduino community site](#)

BUY

[Buy it here](#)



<http://www.ladyada.net/make/eshield/>

Issues in IoT Realization (1)



□ Ambiguity of IoT

- Its Beginning Stage
- Debate of related technologies
 - ▶ M2M, M2C, WSN, RFID and etc.
- Lack of Standards



□ Thing-to-Thing

- End-to-End Communication
- Cooperation between Things



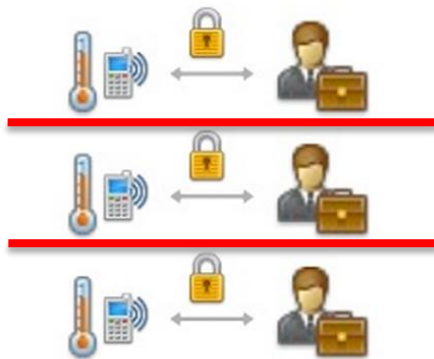
□ Heterogeneity

- Different Hardware, Different OS, Different Protocol, Different Network Connectivity, Different Identifier, Different ...

Issues in IoT Realization (2)

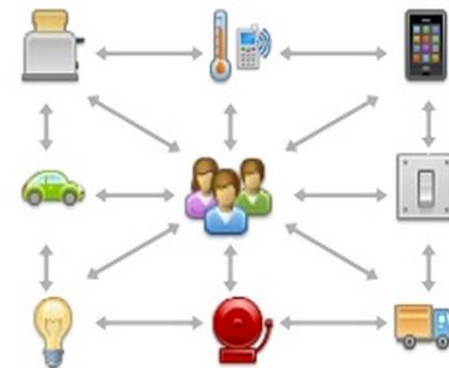
□ Why Heterogeneity?

WSN/M2M



**Everything is fine in
its closed domain**

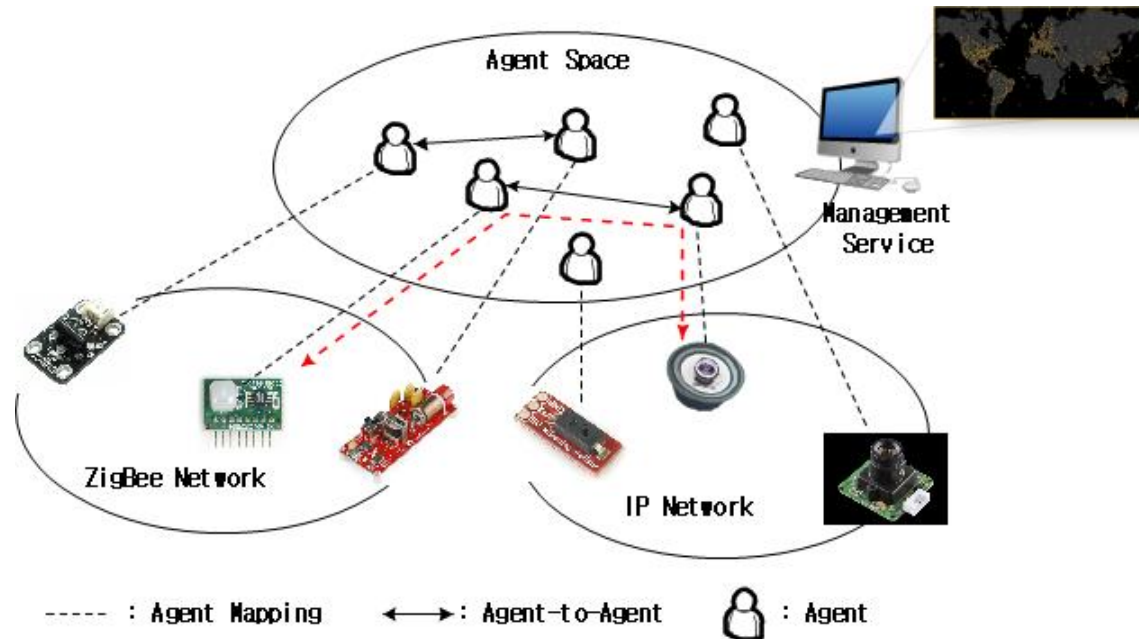
IoT



**Needs Openness for the
collaboration of things**

Agent-Based Approach (1)

- ❑ A radioactivity sensor in ZigBee WSN can notify alarm to a speaker device in IP network?



- ❑ How about Agent?

- Agent delegates for its corresponding device(thing)
- Hide the heterogeneity of things
- Maps all things to virtual entity that can cooperate with each other

Agent-Based Approach (2)



□ How to hide the heterogeneity of Things

- Agent has to hold all code within itself?
- Nobody can model every feature and situation of real world
- Too “Fat” Agent
- What if new devices or network technology are came up after deployment?

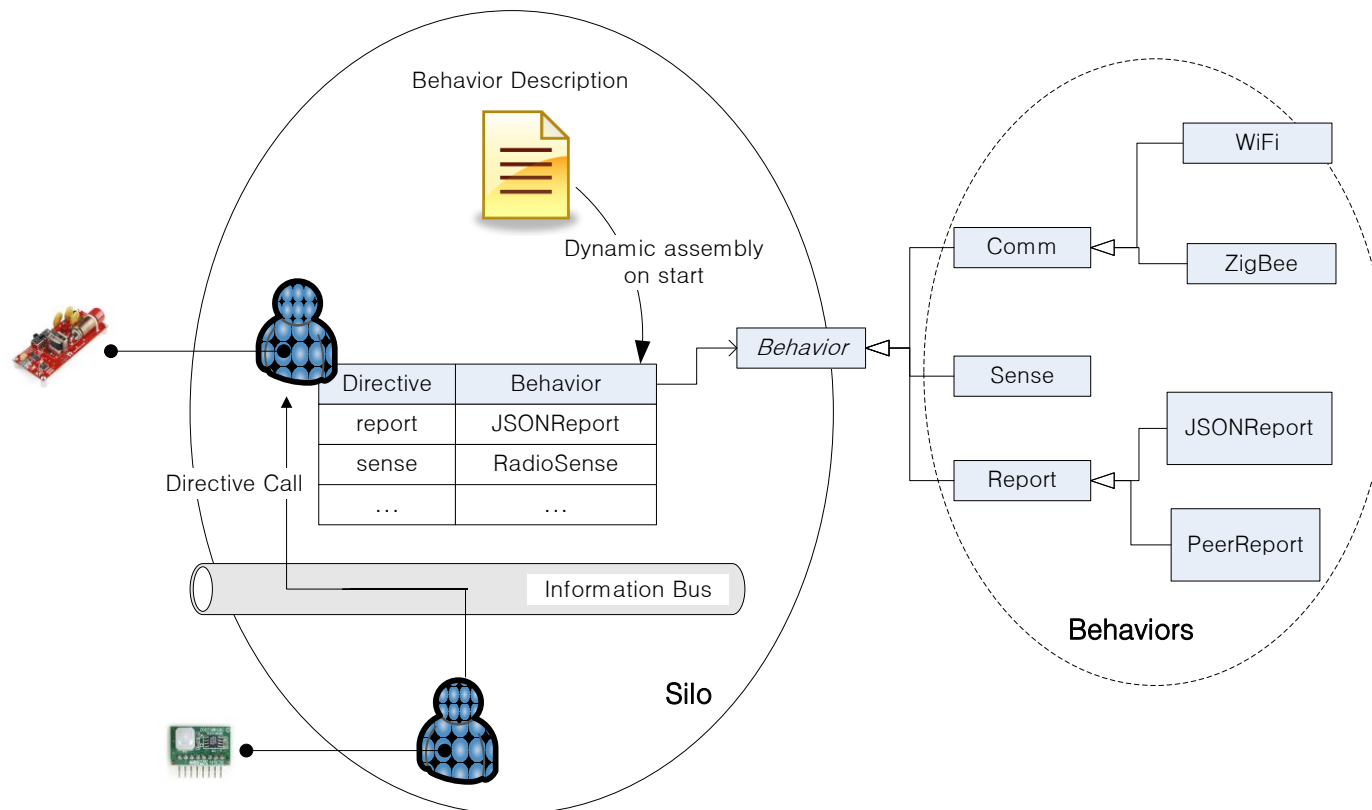
□ Behavior Delegation

- Agent is responsible only for basic tasks such as communication, ID management, and data manipulation
- With the Design pattern, agent’s functional parts can be separated and delegated to outer part

Agent-Based Approach (3)

□ Silo is an Agent Engine

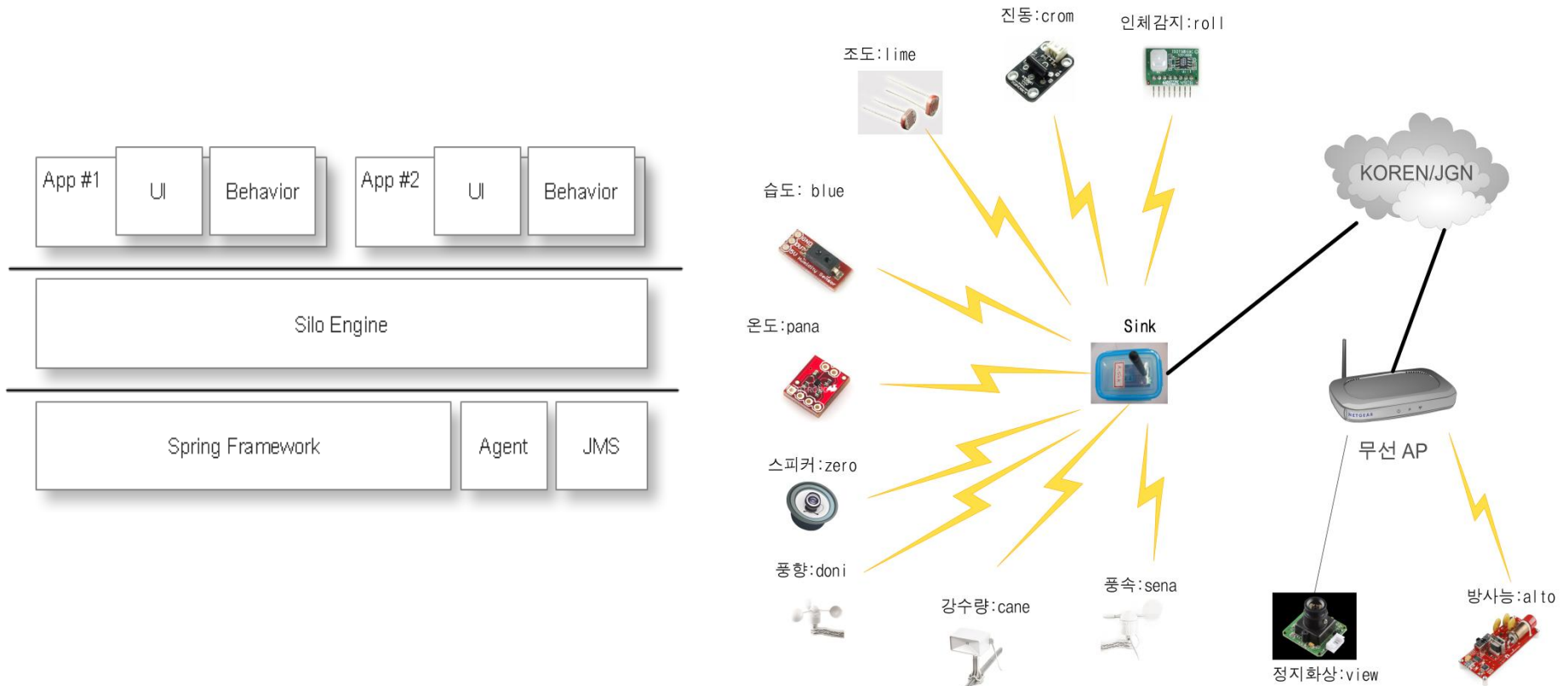
- Constructed on Spring Framework
- Delegate any kind of physical and virtual entity



iSilo: A Service Platform for IoT (1)

□ Silo Engine + Application Specific Codes

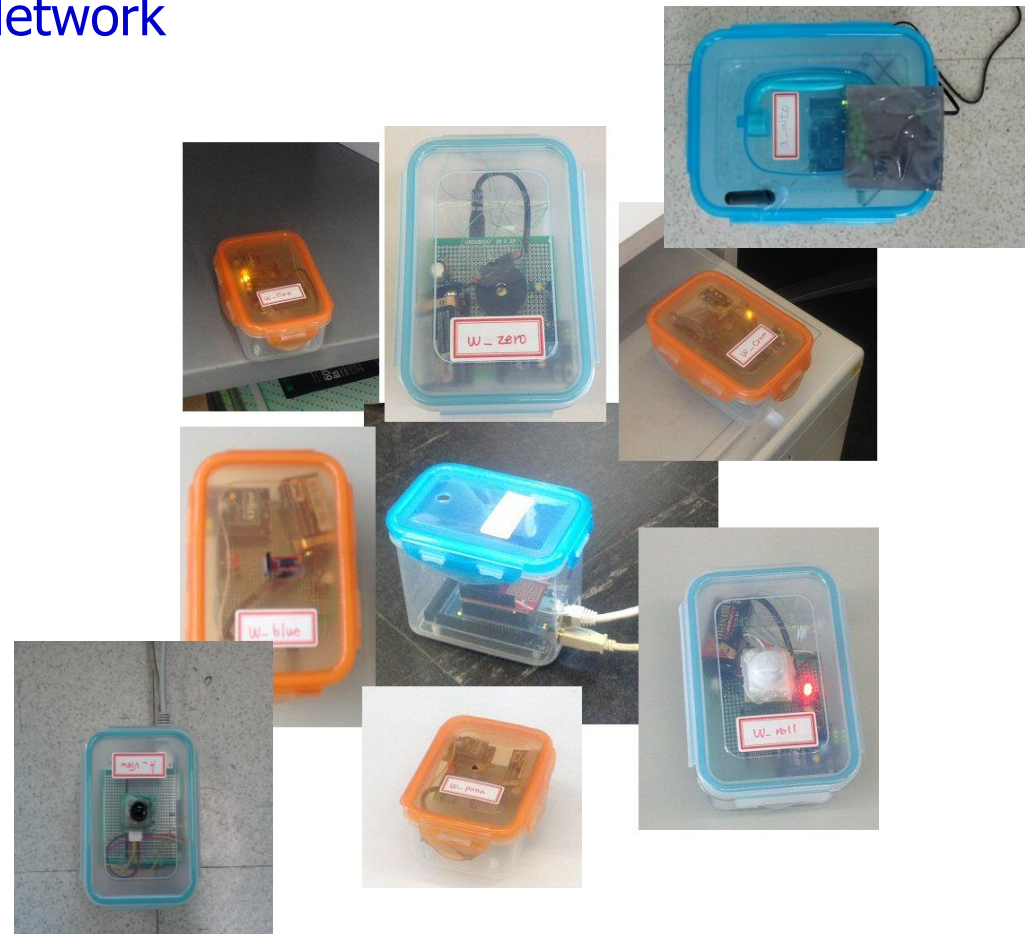
- Directive + Behavior for mapping devices to agents
- Management Console



iSilo: A Service Platform for IoT (2)

❑ Developed Devices with Arduino

- Various sensors and actuators
- Support WiFi, IP, ZigBee Network



iSilo: A Service Platform for IoT (3)



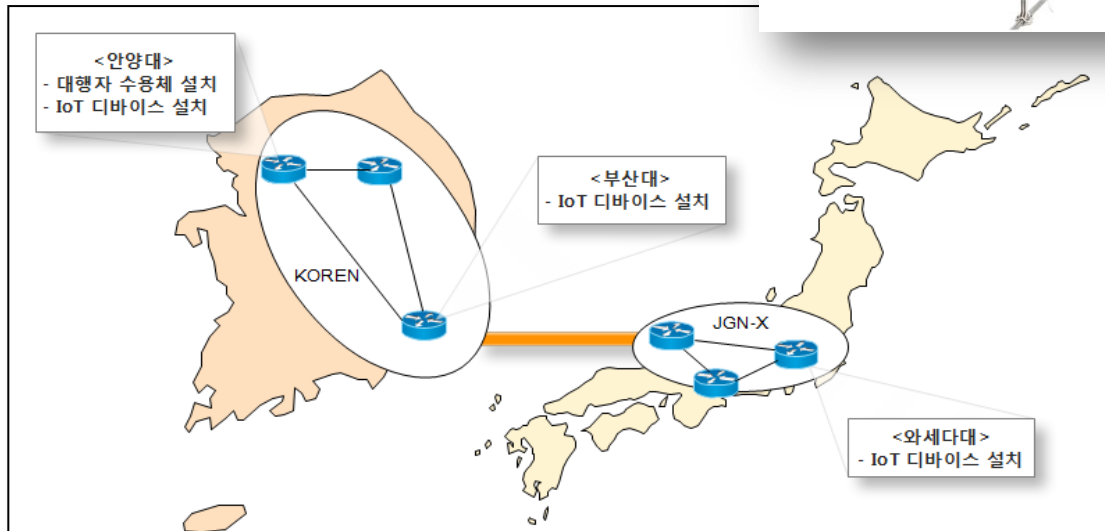
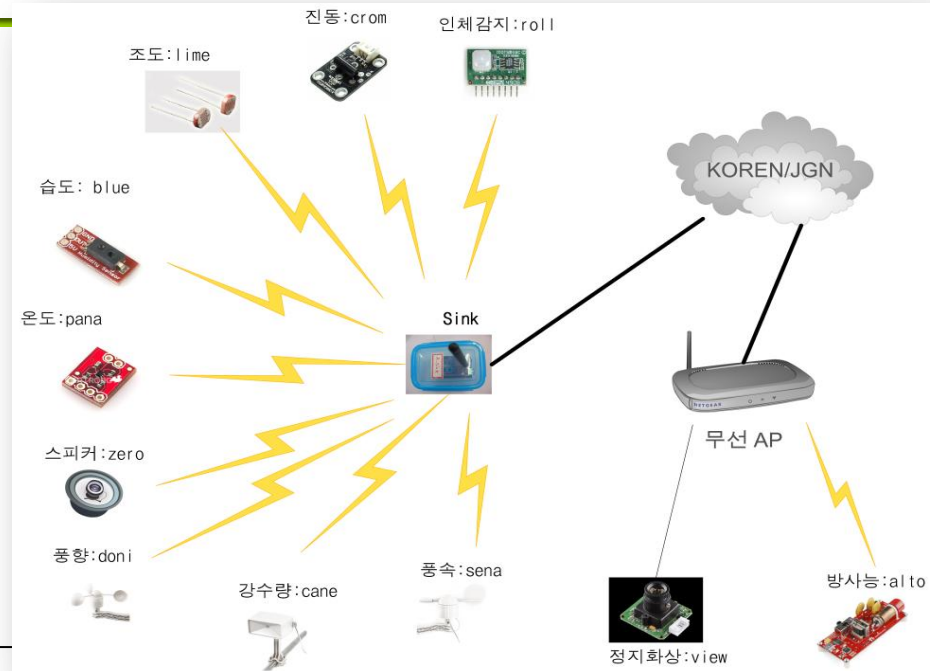
Management Console

The image displays a collage of screenshots from the iSilo Management Console, illustrating the user interface for monitoring various IoT devices. Each screenshot shows a 'Detail Information' panel with fields for Id, Lat, Lon, Info, Reg_Time, Device_Type, Comm_Type, Gateway, Value, and Last_Time. The devices shown include:

- w_view@iotsilo.net**: Waseda Camera, Gateway (192.168.11.5), Last Time: 2012-12-27 13:48:03. Includes a live video feed.
- w_rori@iotsilo.net**: Waseda Perceive, NAT_Gateway (192.168.11.6), Last Time: 2012-12-26 17:55:44.
- w_crom@iotsilo.net**: Waseda Vibration, NAT_Gateway (192.168.11.6), Last Time: 2012-12-27 13:57:31.
- w_gallo@iotsilo.net**: Waseda Geiger, Radioactivity, NAT_IP (192.168.11.13), Last Time: 2012-12-27 14:28:11.
- p_seno@iotsilo.net**: Busan Wind Speed, Gateway (164.125.37.34), Last Time: 2012-12-27 11:47:46.
- w_doni@iotsilo.net**: Waseda Wind Direction, NAT_Gateway (192.168.11.6), Last Time: 2012-12-27 13:58:03.
- w_seni@iotsilo.net**: Waseda Illuminometer, Illumination, NAT_Gateway (192.168.11.6), Last Time: 2012-12-28 12:02:54.

Each dashboard also features a Google Map showing the device location, a status bar with 'On'/'Off' indicators, and a 'Command' button. The interface is consistent across all device views, with a dark theme and a navigation menu at the top.

iSilo: A Service Platform for IoT (4)



- **KOREN**
 - 안양대: iSilo & 실험네트워크 설치
 - 부산대: 실험 네트워크 설치
- **JGN-X**
 - 와세다대: 실험 네트워크 설치
- **2012. 12월 실험**

iSilo: A Service Platform for IoT (5)

안양대



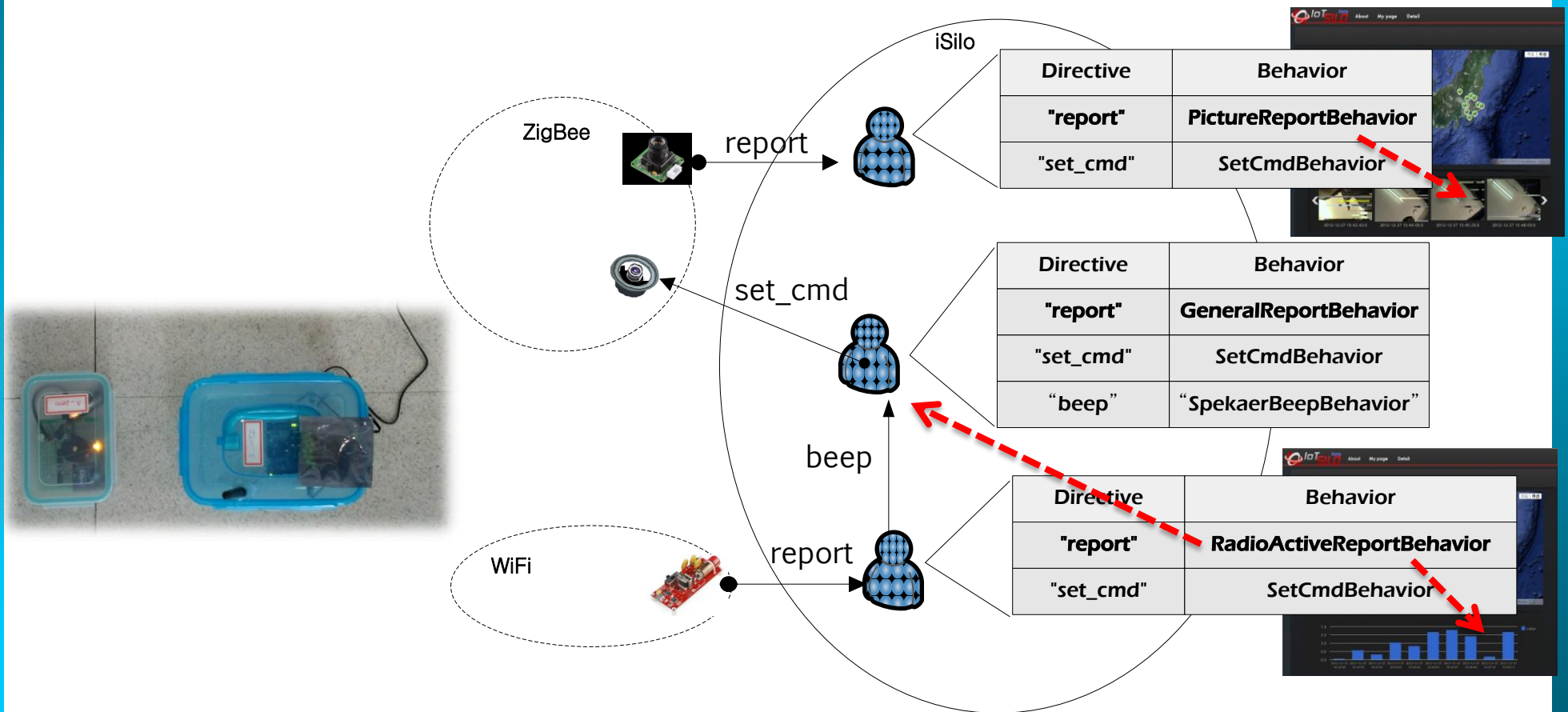
부산대



와세다대

iSilo: A Service Platform for IoT (6)

- ❑ Collaboration of devices having different networks, protocols, identifiers and hardware.



Conclusion and Future Work



❑ IoT Realization

- IoT could be the mainstream of future ICT, but IoT realization is would be a long and winding road
- **Heterogeneity** is the Diablo in IoT realization

❑ Agent-based approach

- Can handle the heterogeneity issue effectively
- Not Silver bullet, but it could be an off-the-shelf method

❑ Proof of Concept

- The project has just begun ten months ago
- Currently, Silo is under Refactoring
 - ▶ Limit of Strategy pattern for diverse behavior
 - ▶ Behavior replacement on runtime
 - ▶ Semantic Directive for intelligent behaviors