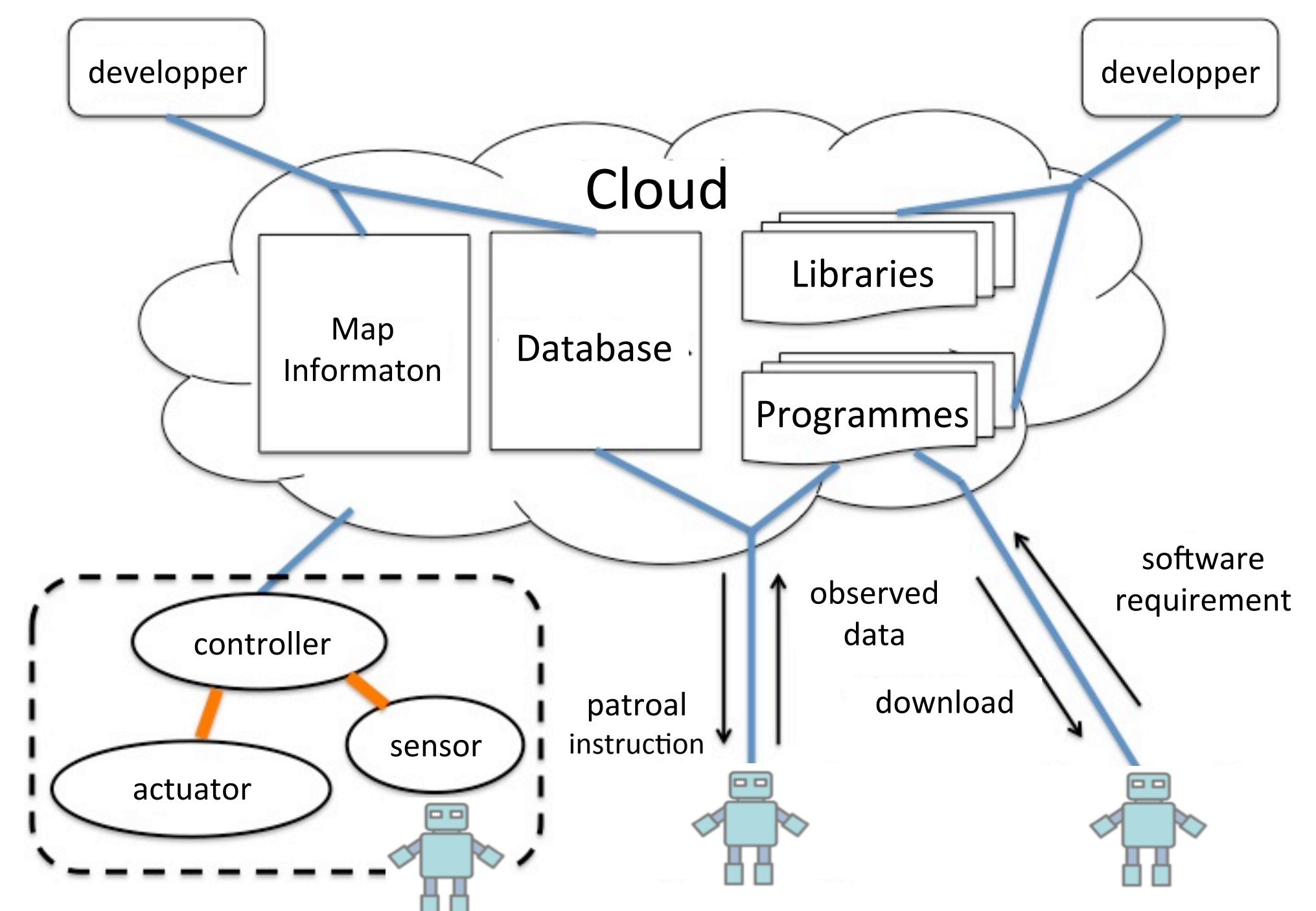
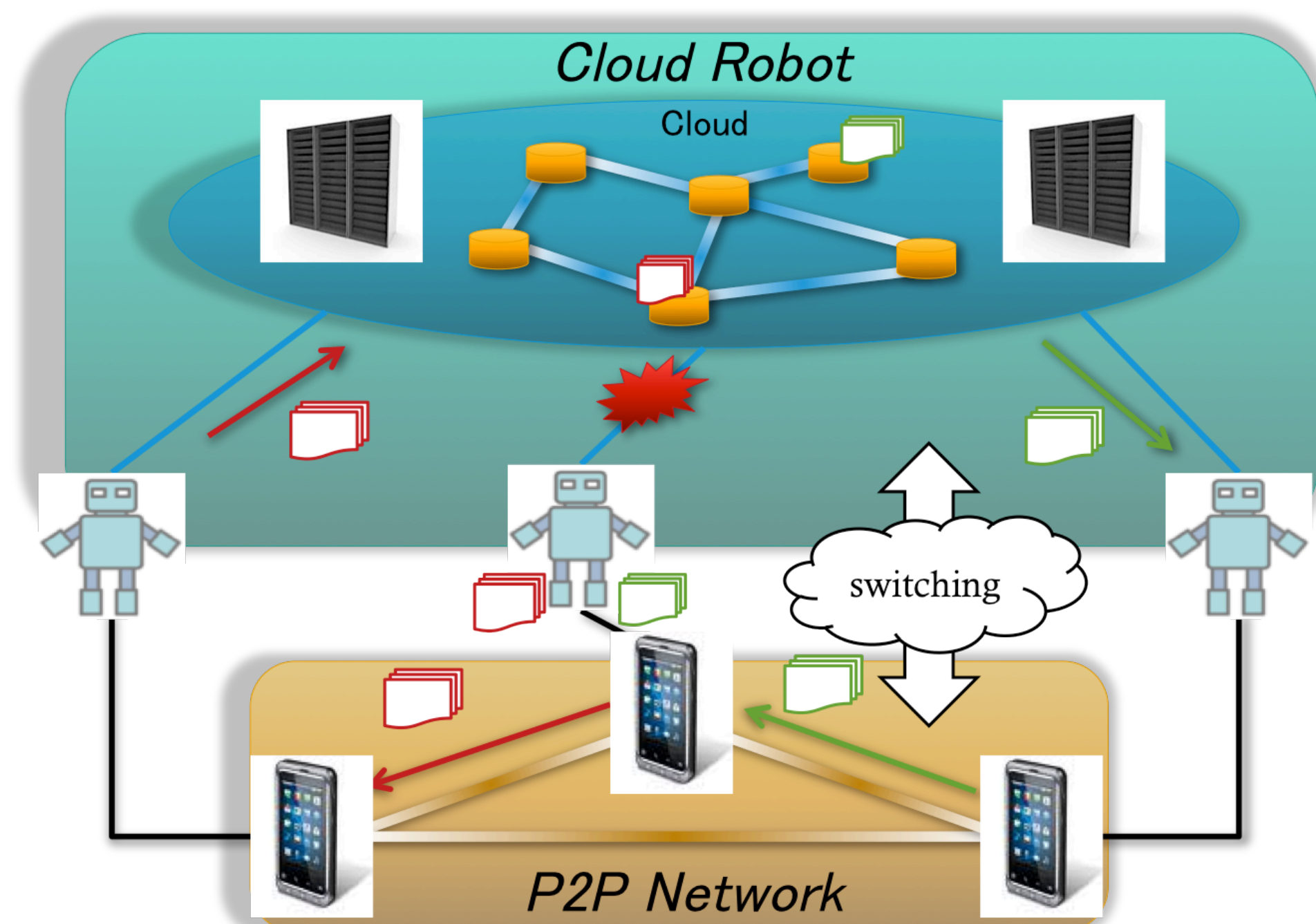


# A Delay Tolerant Network Extension of Dependable Cloud Robot System with ROS

Kotaro Takaura\*, Manabu Higashida\*, Yuichi Teranishi\*\*, Yoshimasa Ishi\*, Kaname Harumoto\*, Naoko Toyokawa\*, Shinji Shimojo\* (\*Osaka University, \*\*NICT)

## • Background and Purpose

In this research, we focus on “Cloud Robot”, the concept of coordination between robots and cloud as a crowd of web services. Cloud Robots enable to process large volumes of data that is acquired by robots with cloud computing. This brings some benefits, high-speed processing, sharing of large volumes of data from robots, operating robots based on processed data autonomously and scalability of service. Based on this thought, we implemented a prototype of the data center environmental monitoring system as a case study that uses cloud robots. However, when we implement such as this system, we realized we should consider the case of disconnection between robots and cloud.



## • Approach

To handle such disconnection, we integrate delay tolerant network (DTN) into modular's network of cloud robot system. DTN is a communication system for bad connection environment such as cases that disruption or disconnection happens. In our proposing system, robots can switch DTN and conventional cloud robot system (Wi-Fi) depending on the situation, and robots have more opportunities to receive and send essential data for operation or monitoring environment.

## • Implementation

We choose P2P Interactive Agent eXtensions (PIAX) platform to integrate DTN. PIAX is an open source framework for P2P communication system and has DTN function. Our prototype cloud robot system are adopting Robot Operating System (ROS), which has Topic-Based Publish/Subscribe (TBPS) as a transmission method. To integrate TBPS and DTN seamlessly, we create proxy and interface of ROS TBPS and PIAX DTN.

We named the proxy ROSProxy and the interface on Android PIAXInterface. Each of them has some classes as follows.

### ROSProxy

- ROSDTNProxy runs PublishRequestListener, SubscribeProxy and ADBBridge.
- PublishRequestListener receives publish request and create PublishProxy.
- PublishProxy sends publish msg to DTN.
- SubscribeProxy receive subscribe msg from DTN.
- ADBBridge establishes communication between robot and Android.

### PIAXInterface

- USBSend runs USBSendService and receive intent from RecvData.
- USBSendService generates port for socket communication.
- RecvData sends intent when message comes to port.

