

# Network Systems Laboratory

Research Areas

- **Current research areas**
  - **Multi-Resource Management**
    - Multi-resource control
    - Mobile computing/networking resource coordination
    - Edge computing
  - **Self-X Network**
    - Cloud resource control by reinforcement learning
    - Learning based resource allocation and congestion control
    - Network anomaly detection
  - **Internet of Things**
    - Resilient and Fault-tolerant IoT networks
    - D2D Link chaining with heterogeneous wireless technologies
    - Wireless network slicing with SDN
    - Testbed Implementation and measurements
  - **Multi-modal reinforcement learning**
    - Multi-modal adaptive reinforcement learning
    - Distributed reinforcement learning for distributed sensing

# Multi-Resource Management

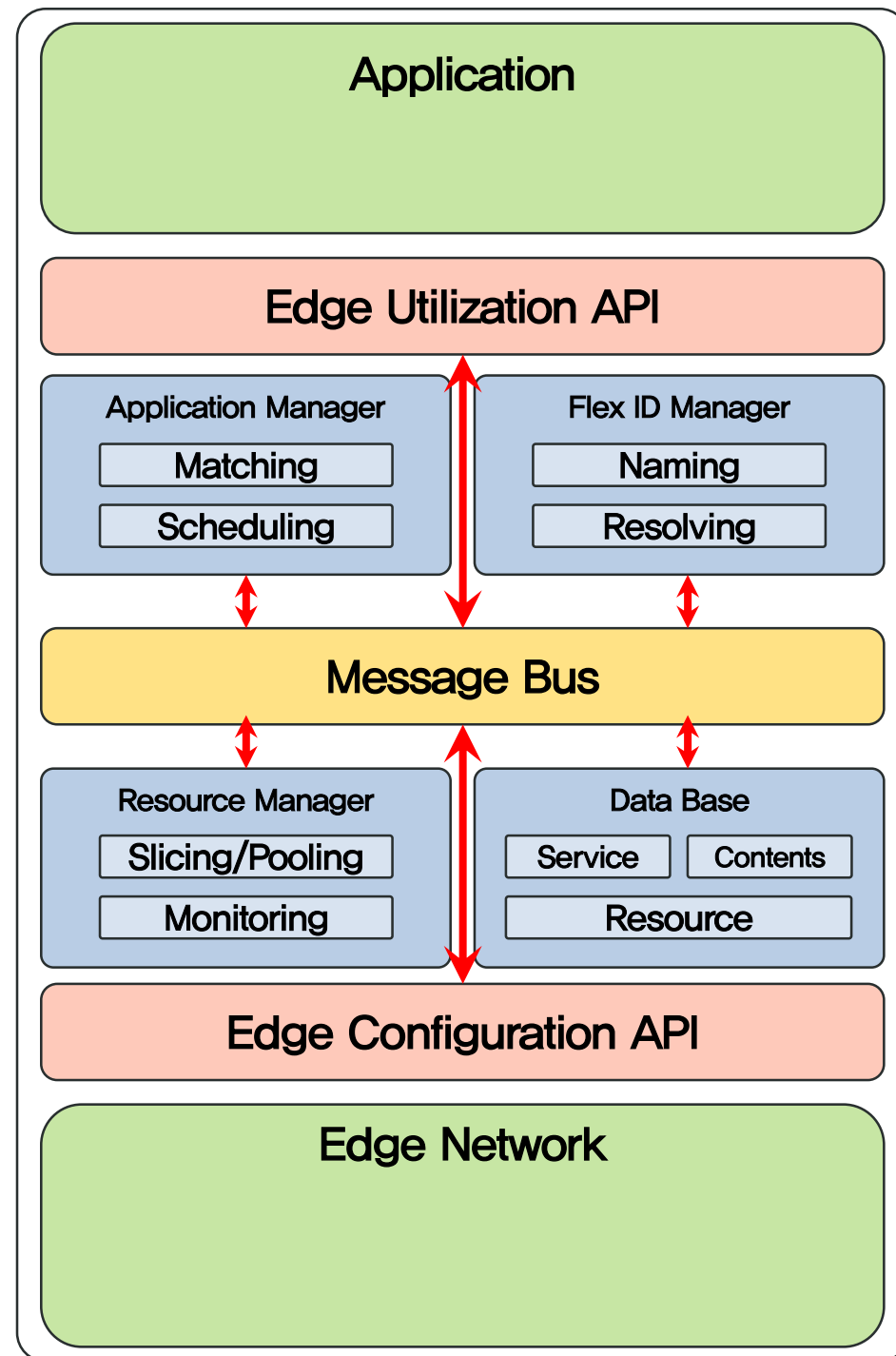
- **Multi-Resource Management**

Current networks systems are composed of various types of resources, such as networking, computing, sensing and information. Moreover, service requirements have become more complex, composed of a set or chain of diverse resources and functions. Our group designs an architecture to support multi-dimensional diversities of resource and service. Also, we focus on implementing cloud/edge resource monitoring and management system called FogOS.

- **On-going Project**

- **Versatile Network System Architecture for Multi-dimensional Diversity**

Sponsor : Ministry of Science, ICT and Future Planning  
Period : 2016. 4 ~ 2020. 12



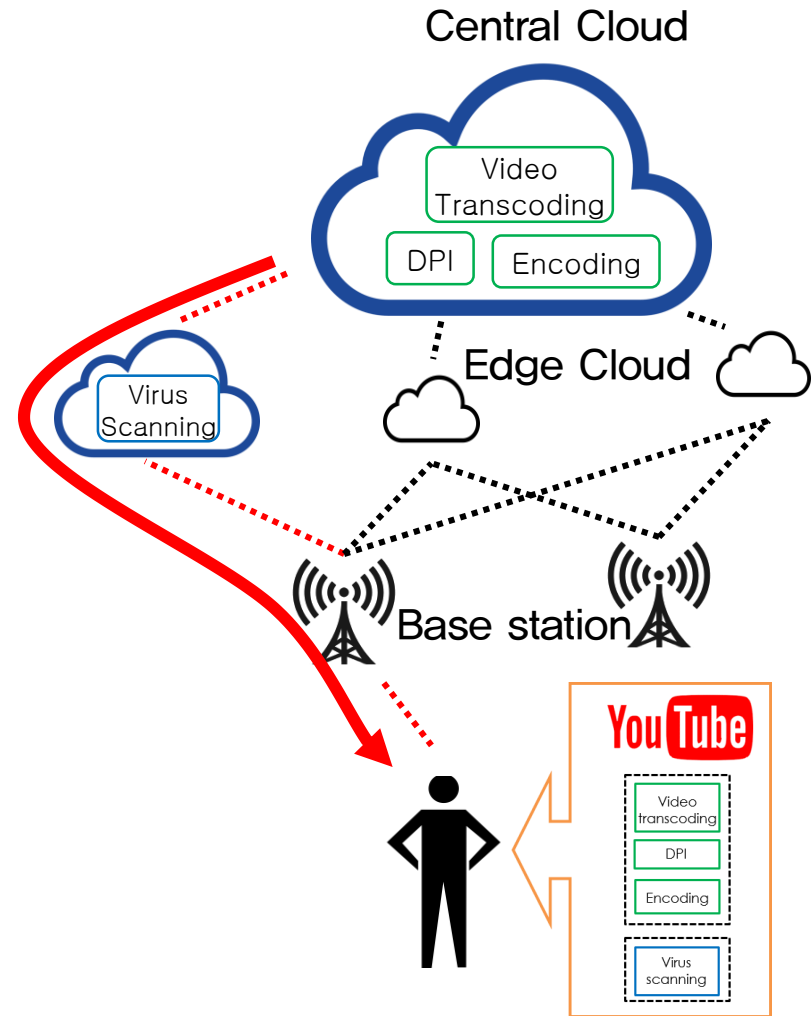
- **Self-X Network**

Conventional networking problem have focused on how to consume networking resources. However, As many pre-processing services are required in networking, it is inevitable to couple networking with computing. In this work, we design [central/edge cloud – Base station – User] downlink model and propose solution to optimize networking problem and computing problem jointly in conventional methods. Also, introducing machine learning technique, especially reinforcement learning(RL), to solve the same problem, we will compare the pros and cons of two solutions.

Additionally, we study network anomaly detection. As machine learning techniques have been known to useful to detect anomaly, there are many chance to improve some performances of network anomaly detection.

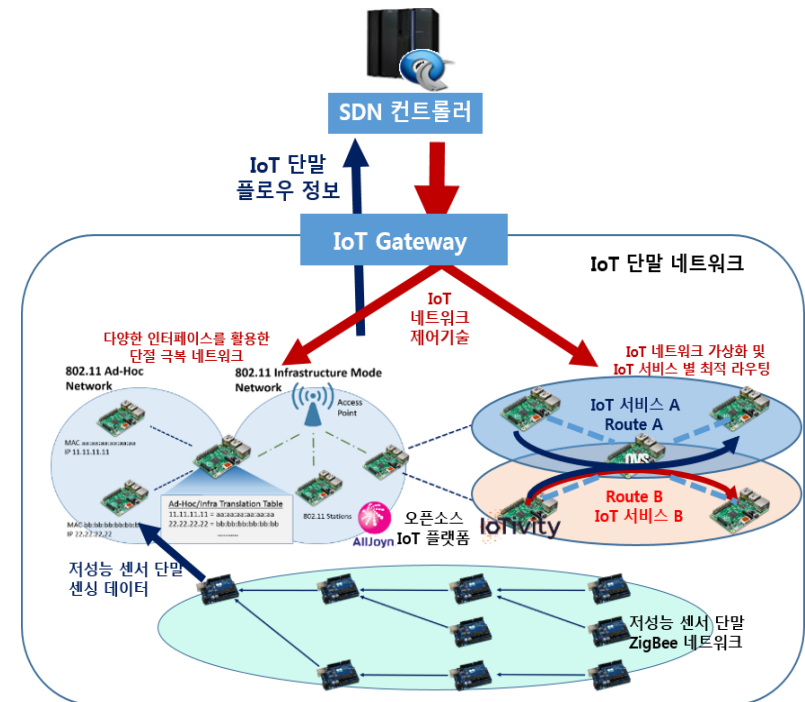
## On-going Project

- Pre-prediction Modeling for Autonomous Network Operation  
Sponsor : ETRI  
Period : 2017. 3 ~ 2017. 11



- **Internet of Things**

Recently, research issues in wireless networks become much more complex and challenging than those in traditional wireless networks due to emerging deployments of internet of things(IoT) networks. The heterogeneities of nodes, wireless link technologies and protocols make it hard to deploy and manage IoT networks in real world. Regarding these issues, we focus on the fault-tolerance/resiliency of IoT networks. More specifically we study D2D link chaining technologies to provide heterogeneous multi-hop link capability in IoT networks, network slicing technologies with software defined networking(SDN) to manage IoT networks. Our goal is to design and improve those networking technologies on the IoT testbed deployed in real environments with measurements.



## On-going Project

- **Resilient/Fault-Tolerant Autonomic Networking Based on Physicality, Relationship and Service Semantic of IoT Devices**  
Sponsor : Ministry of Science, ICT and Future Planning  
Period : 2015. 7 ~ 2017. 7

# Multi-modal reinforcement learning

- **Multi-modal reinforcement learning**

Intelligent AI often faces sequential decision-making process (e.g. selection of road paths), and this series of decision-making is mainly studied through reinforcement learning. The success of AlphaGo recently has brought tremendous progress in the field of reinforcement learning, but still done only in a standardized simulator or given dataset. The actual decision-making process is not simply based on a standardized simulator or dataset, but happens when various types of multimodal data are given in a non-standardized form. The goal of this research is to develop a reinforcement learning method that solves the practical multi-modal environment in sequential decision making problem.

## On-going Project

- Research on Adaptive Machine Learning Technology Development for Intelligent Autonomous Digital Companion  
Sponsor : Ministry of Science, ICT and Future Planning  
Period : 2016. 12 ~ 2017. 8

