# Introduction to Asi@Connect's Project on IoTcloudServe@TEIN (Data-Centric IoT-Cloud Service Platform for Smart Communities)

**Associate Prof Dr Chaodit Aswakul**

*Wireless Network and Future Internet Research Unit*
*Department of Electrical Engineering, Faculty of Engineering*
*Chulalongkorn University, Bangkok, Thailand*

**Asi@Connect National Launch Event in Thailand**
**Bangkok, 27 November 2018**

# About IoTcloudServe@TEIN

- **Approved in 2nd call for proposals for Asi@Connect**
- **WP4: Deployment of Specialised Network Products, Services and Applications and Associated Capacity Development**
- **Co-Principal Investigators:**
  - **Associate Prof Dr Chaodit Aswakul**
    **Chulalongkorn University: Financial corresponding**
  - **Prof JongWon Kim**
    **Gwanju Institute of Science and Technology, South Korea**
- **22 months (20 June 2018 - 19 April 2020)**

**IoTcloudServe @TEIN Collaborating Institutes**

- **Thailand:**
  Chaodit Aswakul, PhD (Chulalongkorn University)
  Krerk Piromsopa, PhD (Chulalongkorn University)
  Panita Pongpaibool, PhD (NECTEC)
  Aimaschana.Niruntasukrat, PhD (NECTEC)
  Panjai Tantatsanawong, PhD (UNINET, ThaiREN)

- **Laos:**
  Khamphao Sisaat, PhD (NUOL)
  Khamxay Leevangtou, MEng (NUOL)
  Senglathsamy Chanthaminavon, MEng (NUOL)

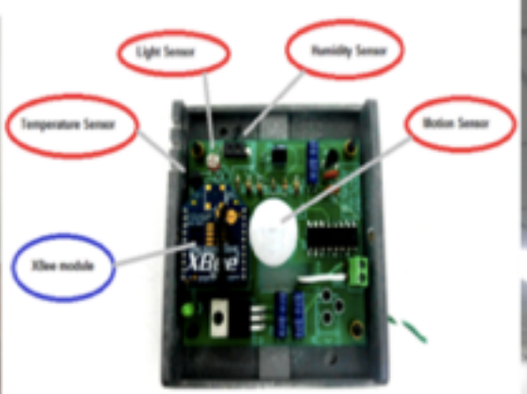
- **Malaysia:** Teck Chaw Ling, PhD (University of Malaya)

- **Japan:** Hideya Ochiai, PhD (University of Tokyo)

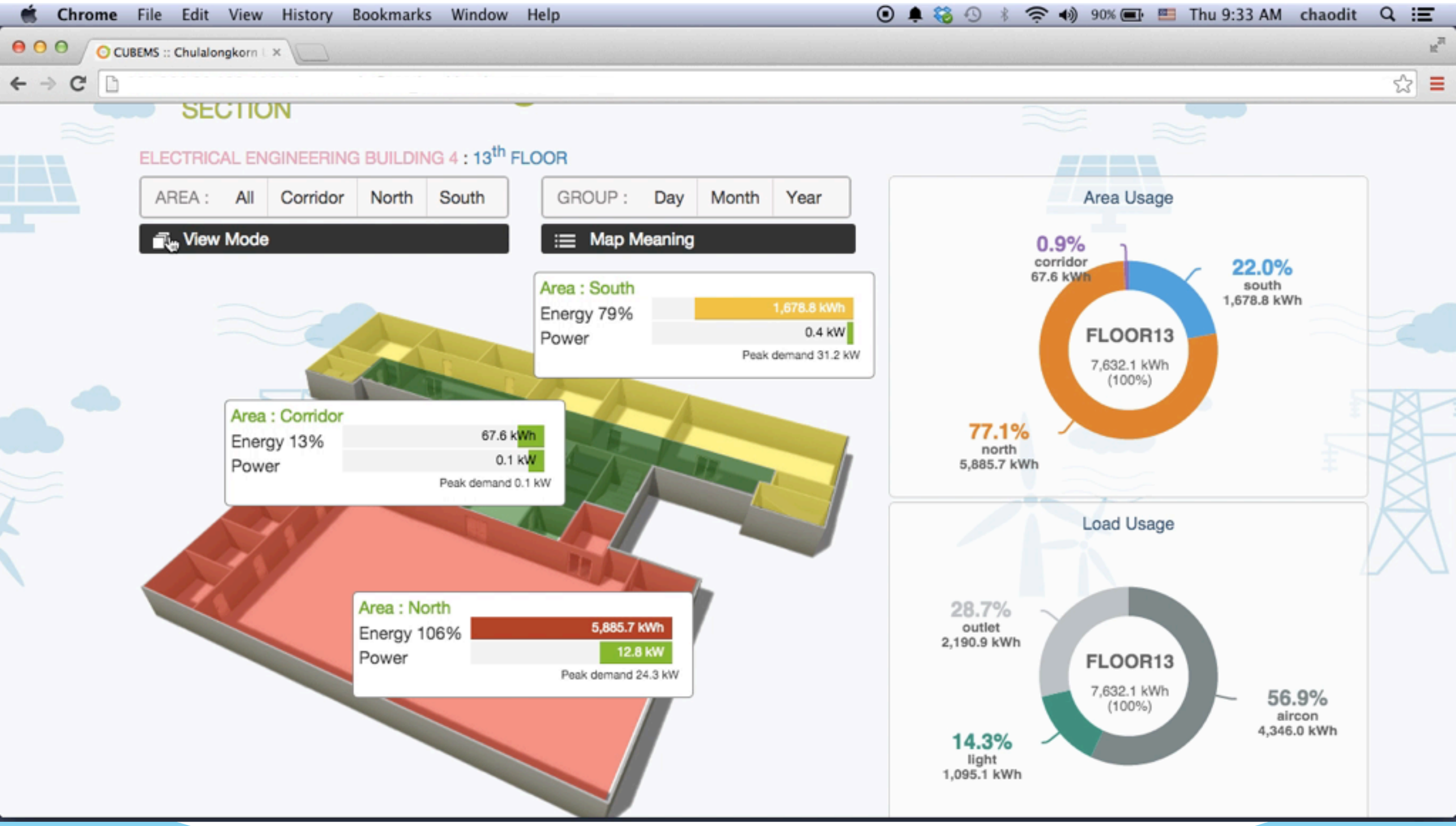
- **Korea:** JongWon Kim (GIST)

**Example of IoT sensors in CU-BEMS project (supported by Thailand's Energy Conservation Promotion Fund under the Energy Policy and Planning Office, Ministry of Energy) available at Chulalongkorn University**






# BEMS Software Demo



# Example of IoT sensors in Sathorn Model project (supported by Toyota Mobility Foundation) available at Chulalongkorn University


CHULA ENGINEERING
Foundation toward Innovation

GIST

NECTEC
a member of NSTDA

UNIVERSITY OF MALAYA

Asi@Connect

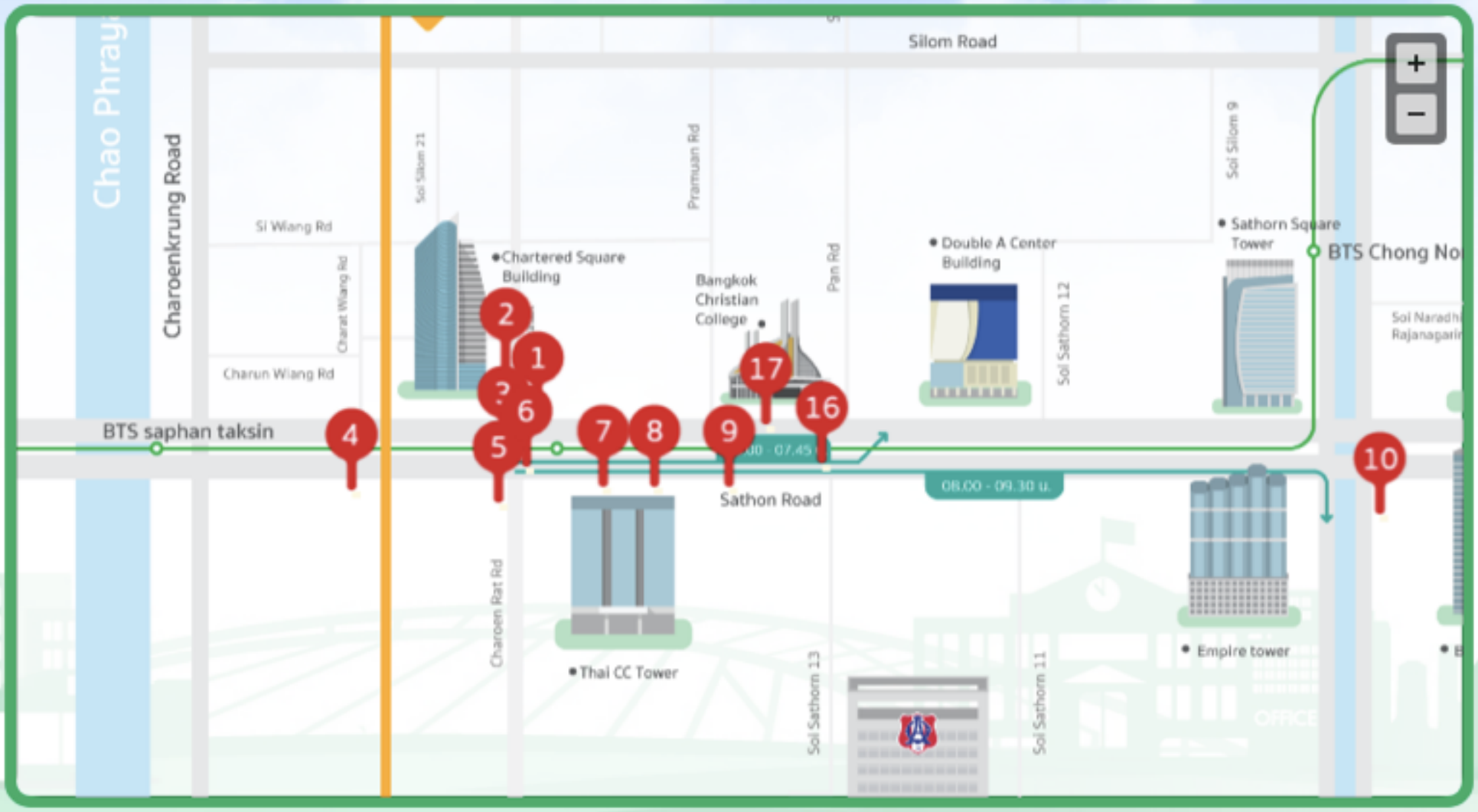
TEIN CC
COOPERATION CENTER

stmwin.gusarea.com/traffic/

# TRAFFIC MANAGEMENT

## Measure

1. Traffic Signal Operation
2. Traffic Simulator (Sumo)
3. Loop Coil Sensor
4. Manage bus stop
5. Manage Turn Left
6. Prohibit Traffic Violation
7. Manage entering car from Thai CC
8. Prohibit road side parking near intersections
9. Move bus stop
10. Prohibit road side parking Narinthorn intersection
11. Improve capacity of toll gate (Rama4)
12. Prohibit road side parking Rama 4
13. Additional U-Turn
14. Draw lane guidelines edited

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TRAFFIC MANAGE

## Measure

1. Traffic Signal Operation
2. Traffic Simulator (Sumo)
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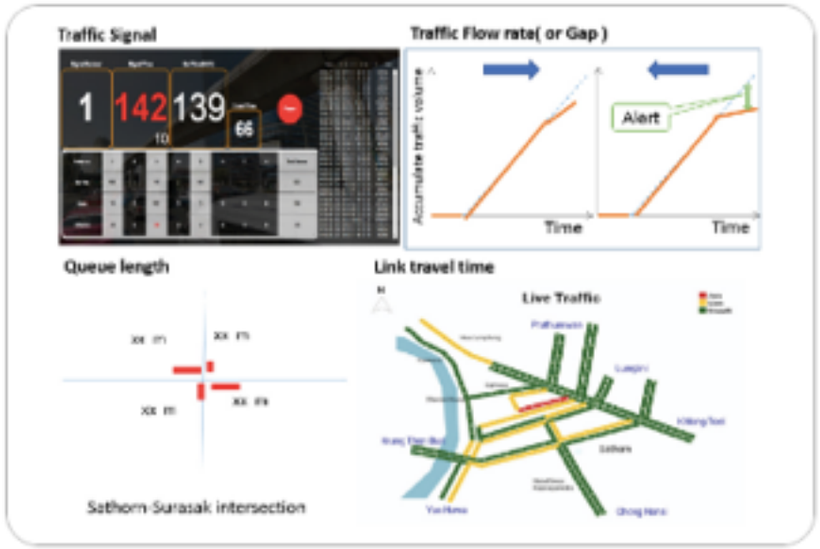
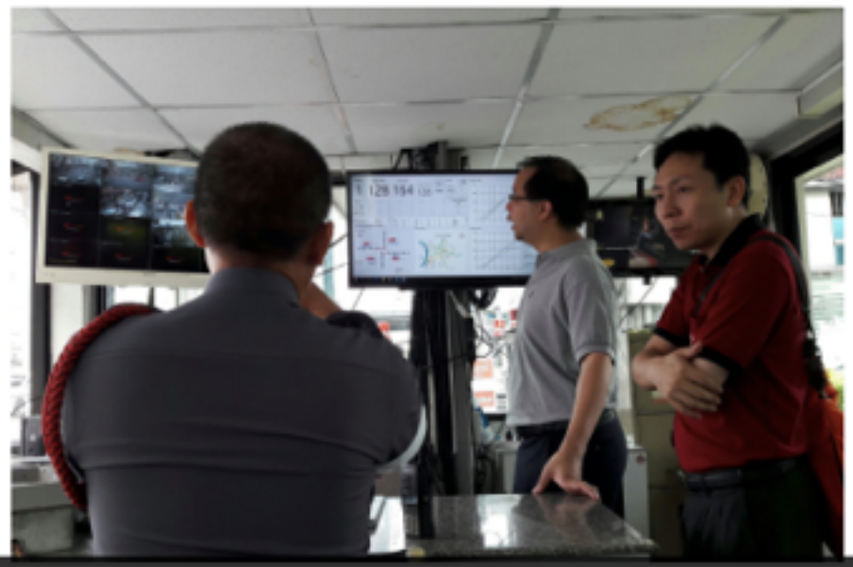
8. Prohibit road side parki… intersections
9. Move bus stop
10. Prohibit road side park… Narinthorn intersection
11. Improve capacity of tol… (Rama4)
12. Prohibit road side park… 4
13. Additional U-Turn
14. Draw lane guidelines edited

# 1. Traffic Signal Operation




Display additional traffic data to assist police in making traffic light decision through a new comprehensive application that shows the flow, queue length, and overall traffic condition.



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***Local traffic control display at Sathorn Intersection***

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TRAFFIC MANAGE

Measure

1. Traffic Signal Operation
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4
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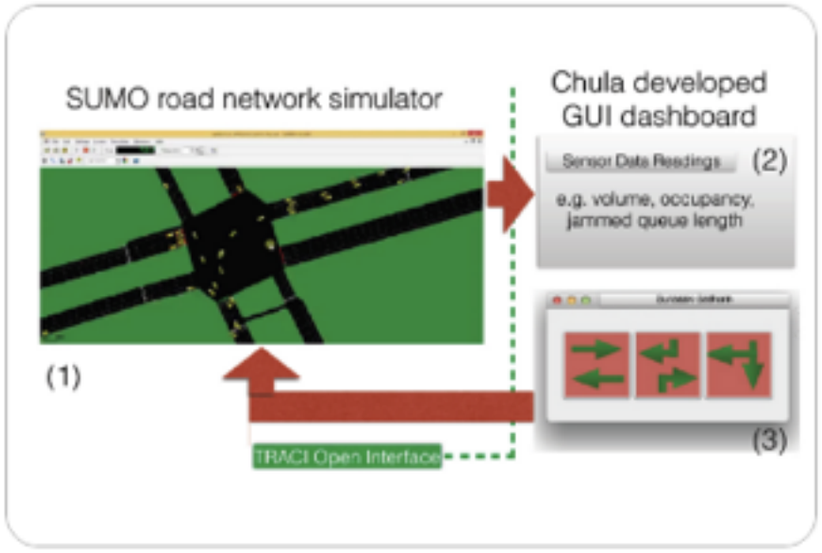
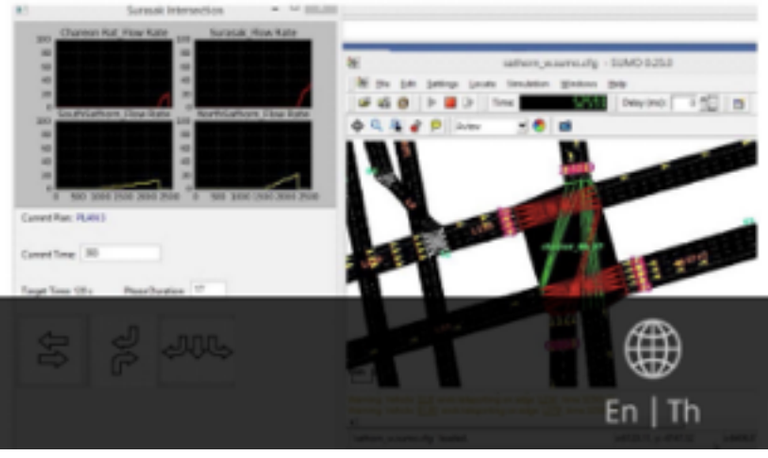
14. Draw lane guidelines e

# 2. Traffic Simulator (Sumo)




Faculty of Engineering, Chulalongkorn University, develops the Chula-Sathorn SUMO Simulator (Chula-SSS) based on SUMO, an open source software. The simulator allows officer to try various strategies to deal with traffic conditions before deployment.

Chula-Sathorn SUMO Simulator - Running on Single PC



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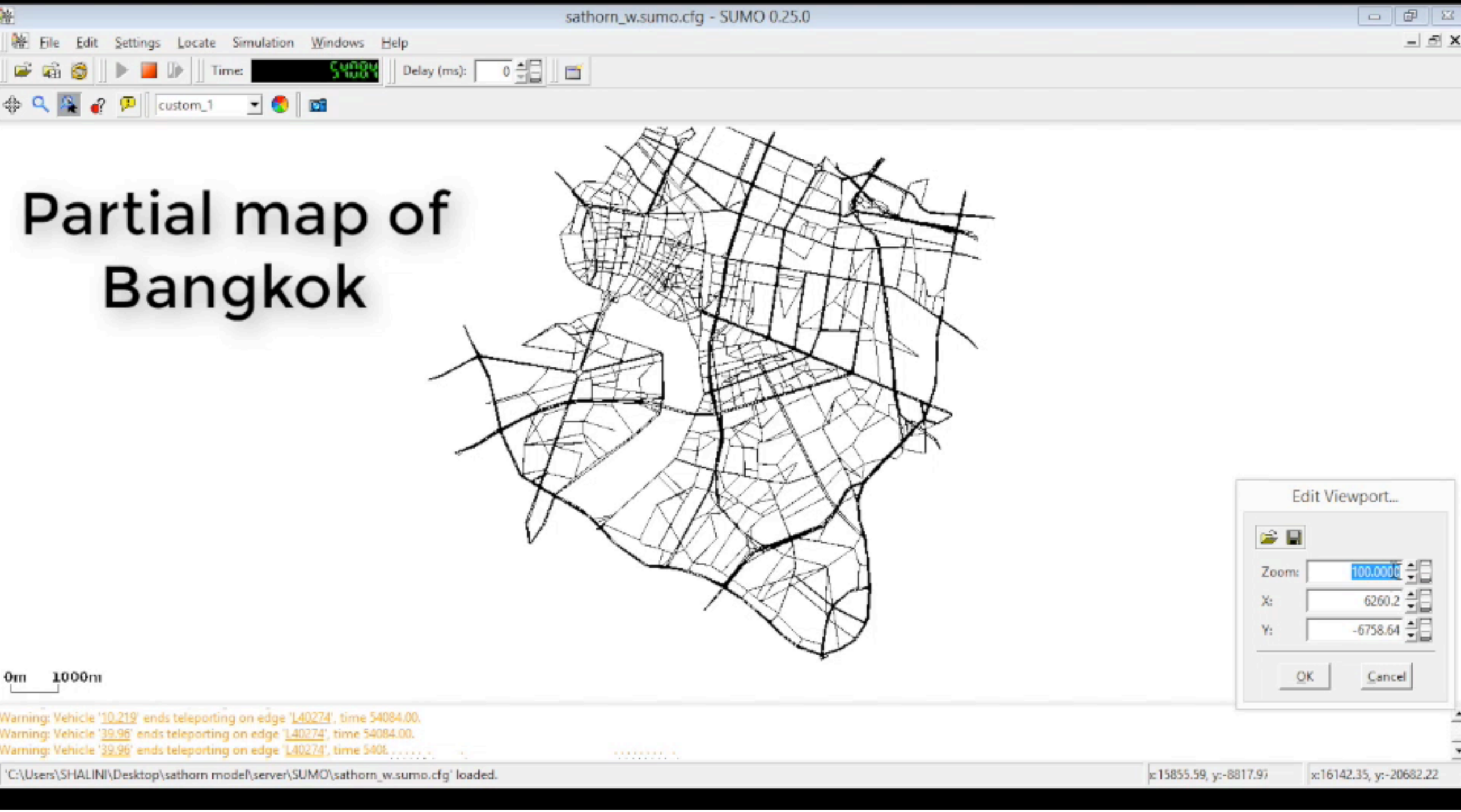
Building
08.00 - 09.30 u.




***Sathorn Road Network in SUMO***

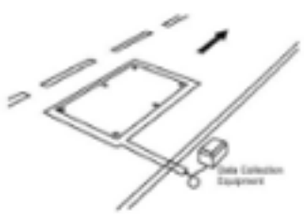
# 3. Loop Coil Sensor

Loop coil | Image processing

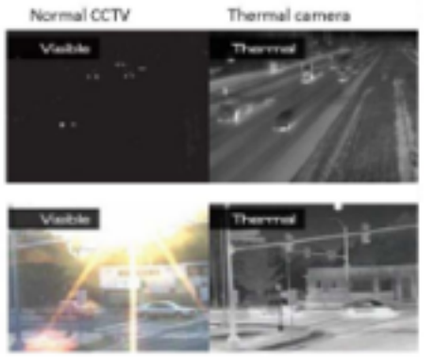
Sathorn Model installs several kinds of traffic sensors around Sathorn intersection to provide additional traffic data to support police.

Sathorn-Surasak intersection – Install 2 type of sensor

① Loop coil

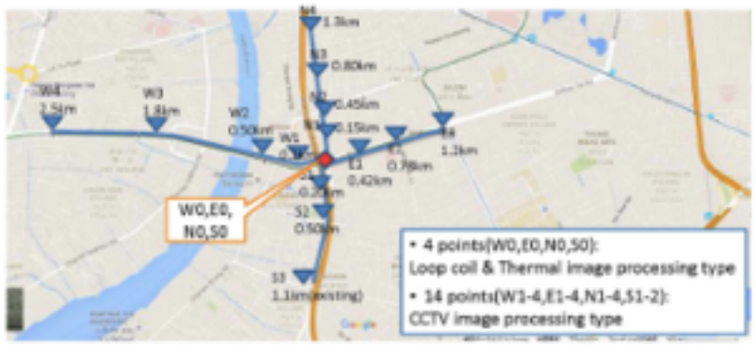


② Thermal camera with image processing




Location of installing traffic sensors

-West : 2.5km (BTS Wongwian Yai)
-East :1.2km(Nararinthon intersection)
-North :1.3km(Mahesak – Surawong)
-South : 1.1km (Thanon chan)



13

# ผลลัพธ์ของโครงงาน

14

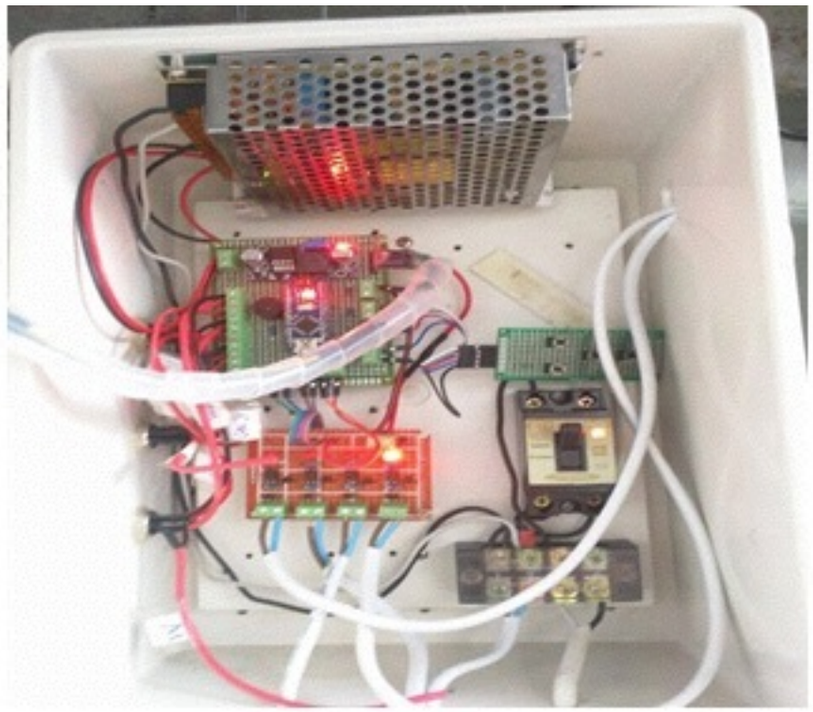
# ผลลัพธ์ของโครงงาน



| Date | Lane 1 | Lane 2 | Lane 3 | Lane 4 |
|---|---|---|---|---|
| 20/03/61 | 23.26% | 17.83% | 19.67% | 26.41% |

$$\%\ \text{ความผิดพลาด} = \frac{|N_{escam\ video}(t) - N_{portable}(t)|}{N_{portable}(t)}$$

# Example of locally initiated IoT project of smart mushroom farming at NUOL, Laos



# IoTcloudServe@TEIN Objectives

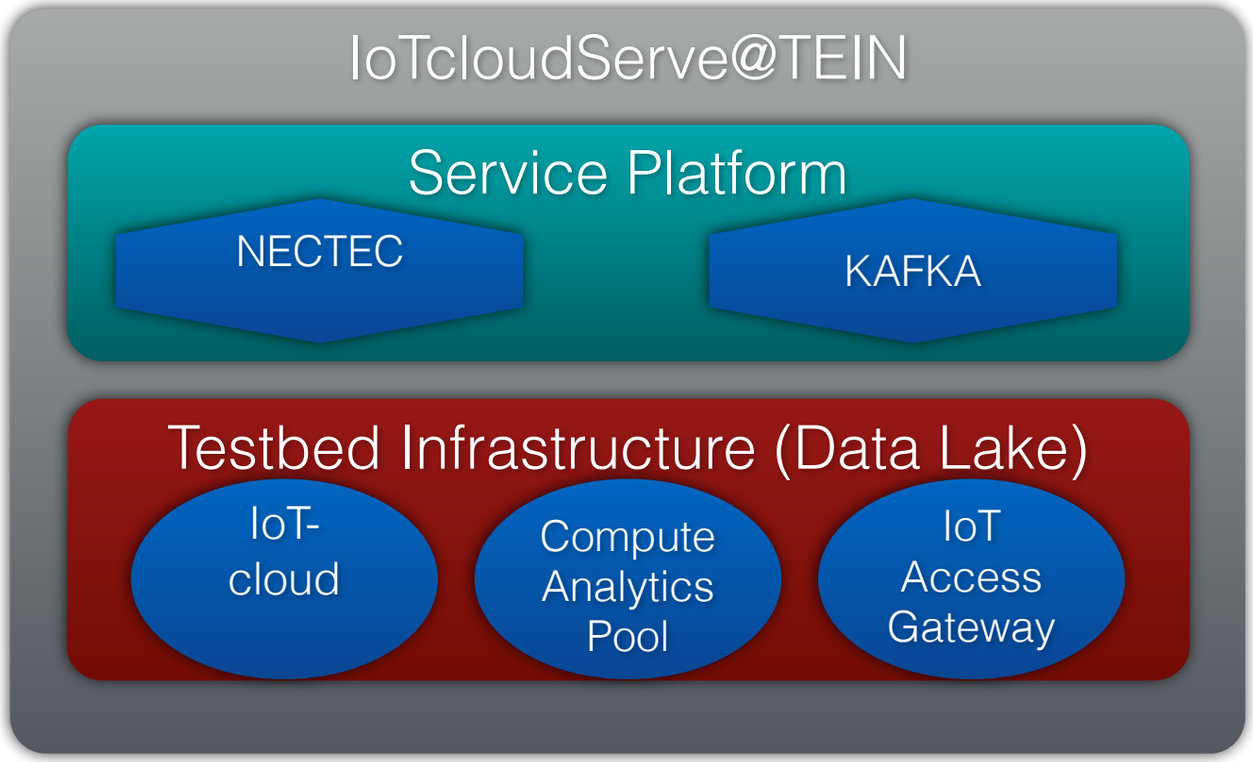
To gather & learn together

To establish and operate IoTcloudServe@TEIN
**testbed infrastructure**

To design, develop and operate IoTcloudServe@TEIN
**service platform**

To demonstrate "**data-centric**" IoT-cloud services running with **IoTcloudServe@TEIN**

# Overall Design of IoTcloudServe@TEIN



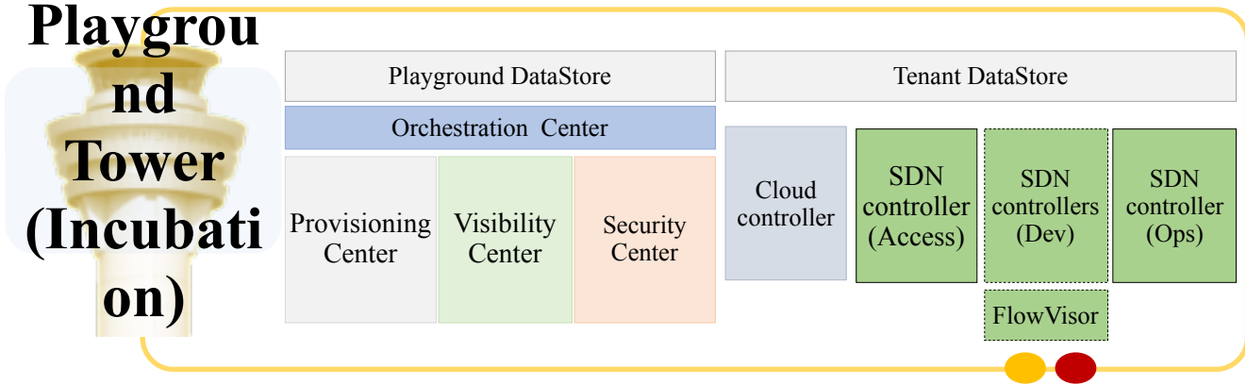

THAIREN (UNINET)

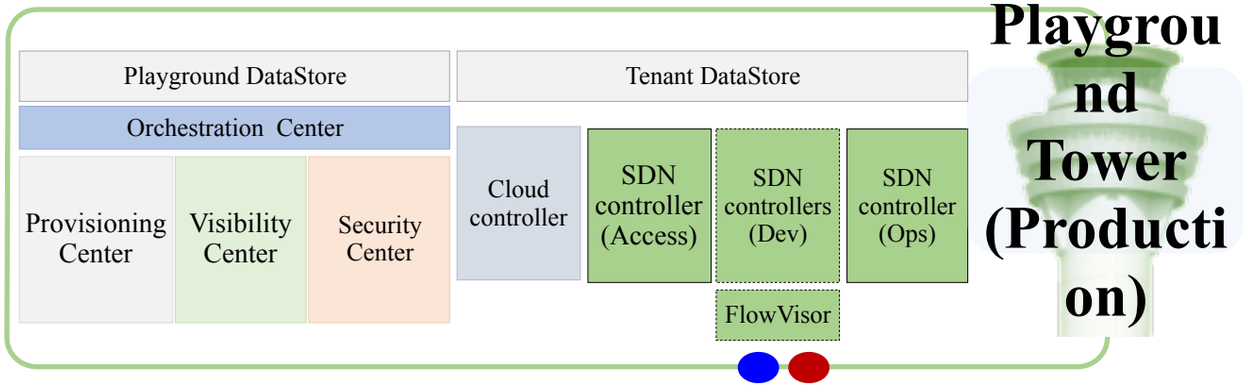
TEIN WAN
OF@TEIN+ Infrastructure

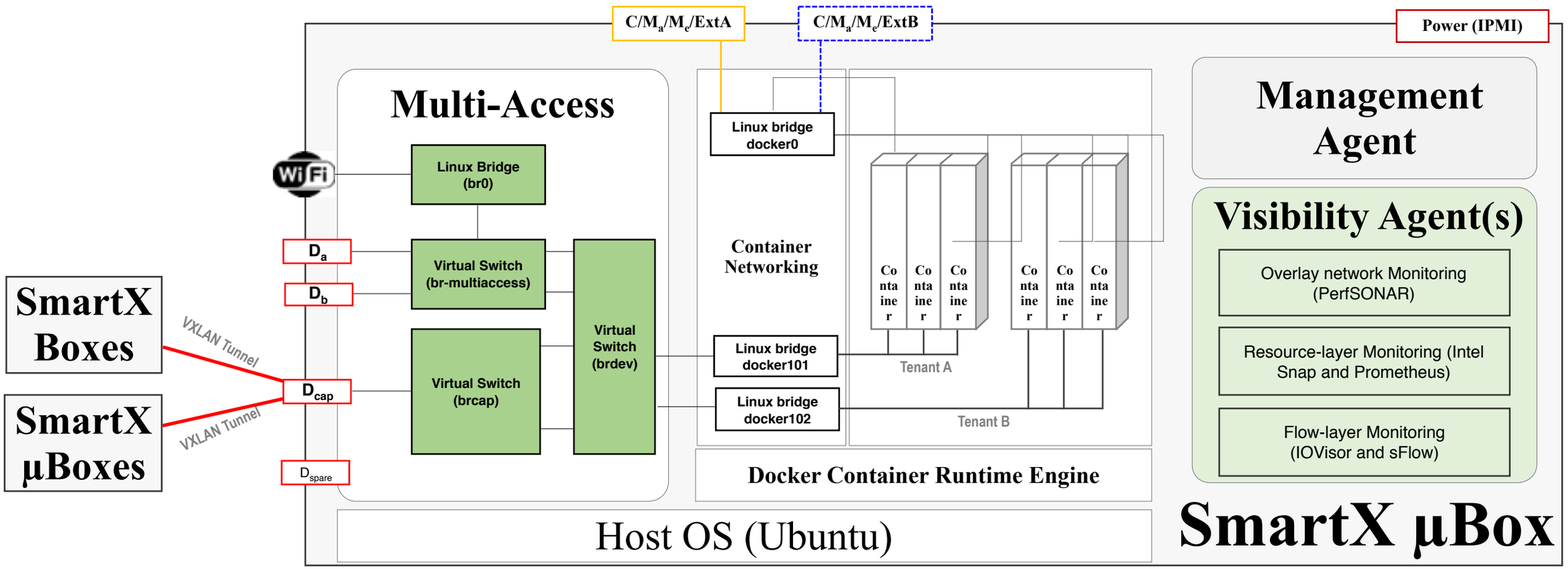
Local IoT Developments

TEIN IoT Developments

# OF@TEIN+ Infrastructure



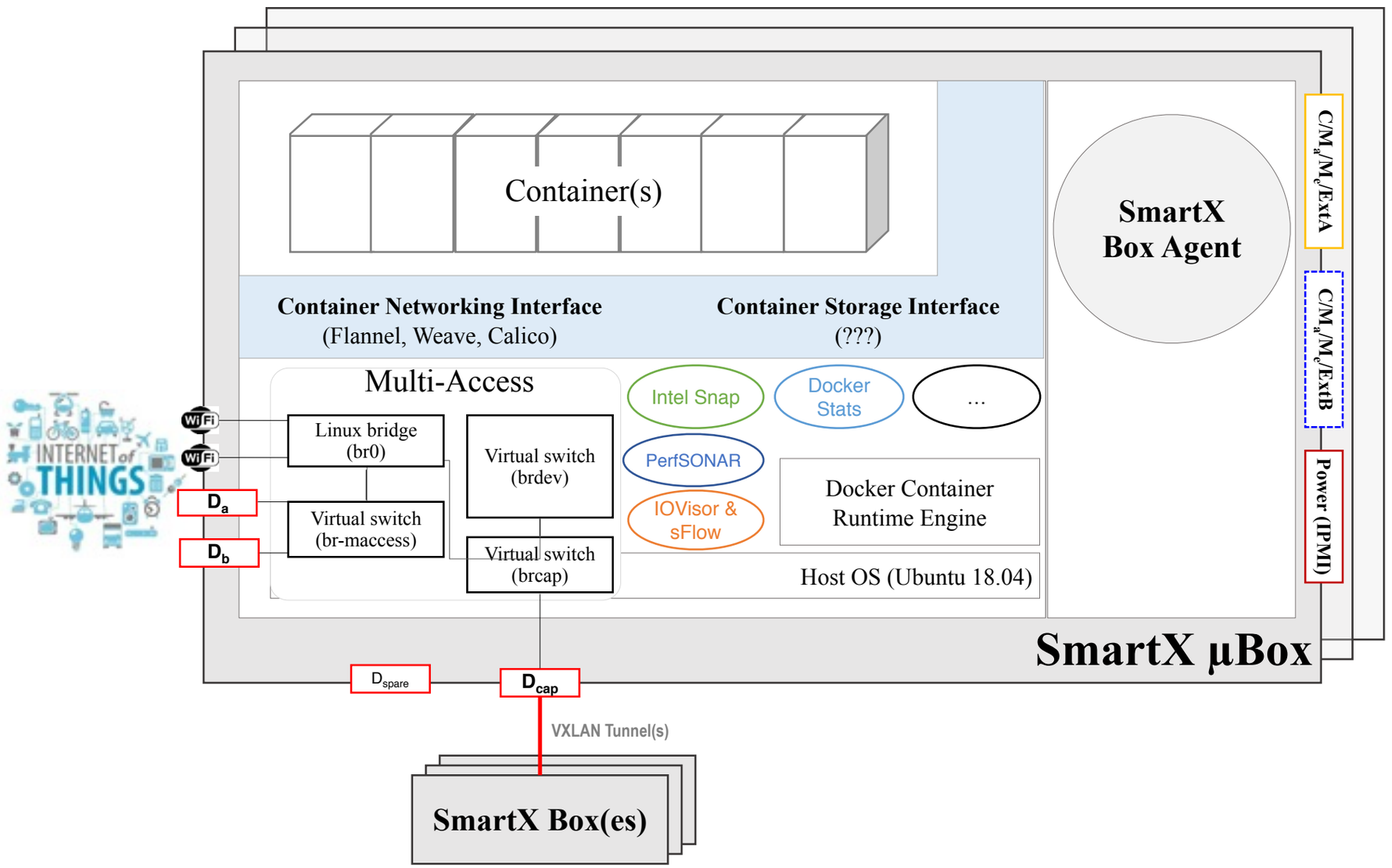



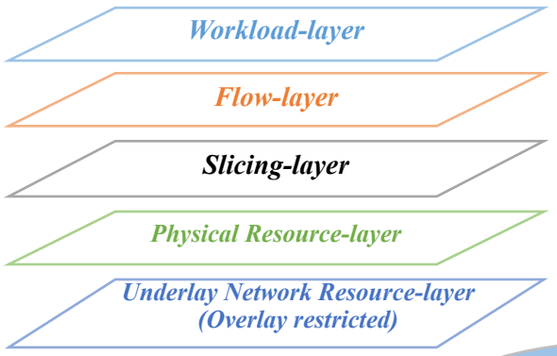

Updated: 2018-06-14

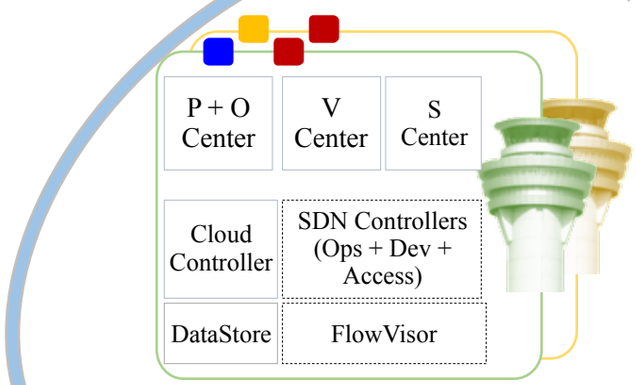
# OF@TEIN+ Infrastructure

## SmartX Micro-Box Coordinated with SmartX Playground Towers: Preliminary Design v1.3




**SmartX Play Room** (Dev)

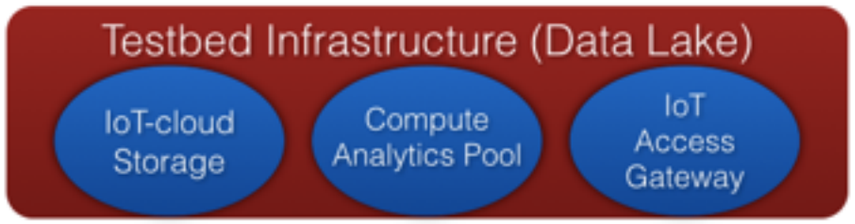



SmartX Playground Towers(Ops)

# Testbed Infrastructures in This Project

## IoTcloudServe@TEIN Testbed Infrastructure




To be established and jointly operable by **Chula & NECTEC (Thailand)** & accessible to TEIN communities with supports of OF@TEIN+ project run by **UM (Malaysia) / GIST (Korea)**

## Domain Customised IoT Devices

Extensible from already invested facilities (250 ambient sensors+smart meters, 25 cctvs+19 loop-coil car detectors) in CU-BEMS/Sathorn Model Projects **@ Chula (Thailand)** & ongoing trials @ **NUOL (Laos)**

# Service Platforms in This Project

## IoTcloudServe@TEIN Service Platform

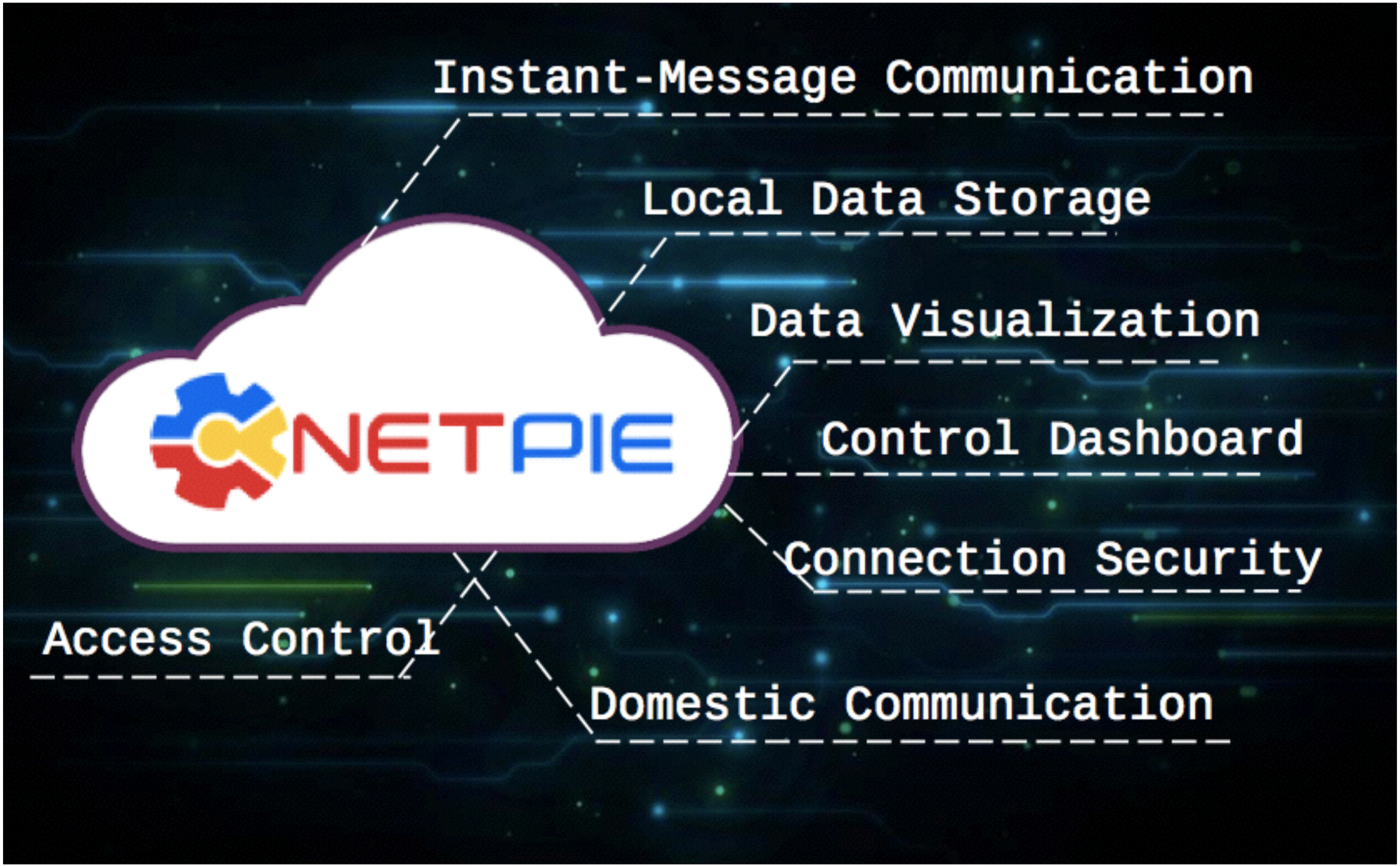
NECTEC NETPIE

KAFKA

(NETPIE by **NECTEC (Thailand)** for message-type IoT data & KAFKA framework @ **Chula/GIST** for streaming-type IoT data)

## Data-Centric IoT Analytics & Applications

Extensible from currently deployed programs in CU-BEMS/Sathorn Model projects @ **Chula (Thailand)** with CU-BEMS IEEE1888-protocol server supported by **Univ of Tokyo (Japan)** & ongoing trials @ **NUOL (Laos)**


Instant-Message Communication
Local Data Storage
Data Visualization
NETPIE
Control Dashboard
Connection Security
Access Control
Domestic Communication

CHULA ENGINEERING
Foundation toward Innovation

GIST

NECTEC
a member of NSTDA

UNIVERSITY OF MALAYA

Asi@Connect

TEIN CC
COOPERATION CENTER

NETPIE
where things chat

# Join us today for an opportunity to become the world's IoT leader

http://netpie.io

NETPIE

GitHub netpieio

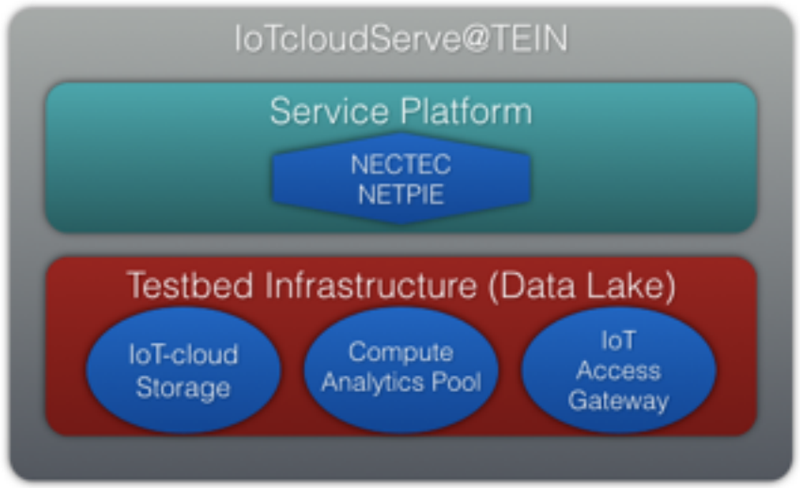
ThaiREN

MQTT

IEEE1888 conversion to MQTT


DATA ANALYTICS FOR USER AWARENESS ENHANCEMENTS

WASTED ENERGY ANALYSIS IN AIR CONDITIONING SYSTEM USING MOTION SENSOR

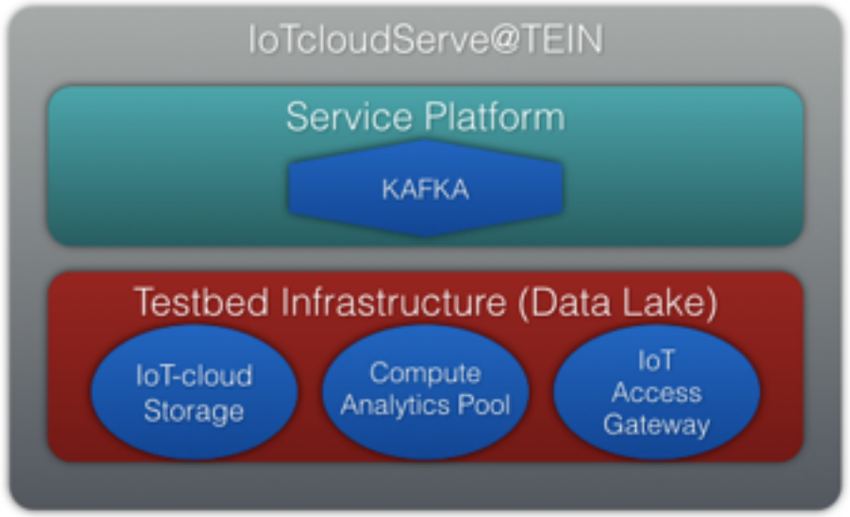


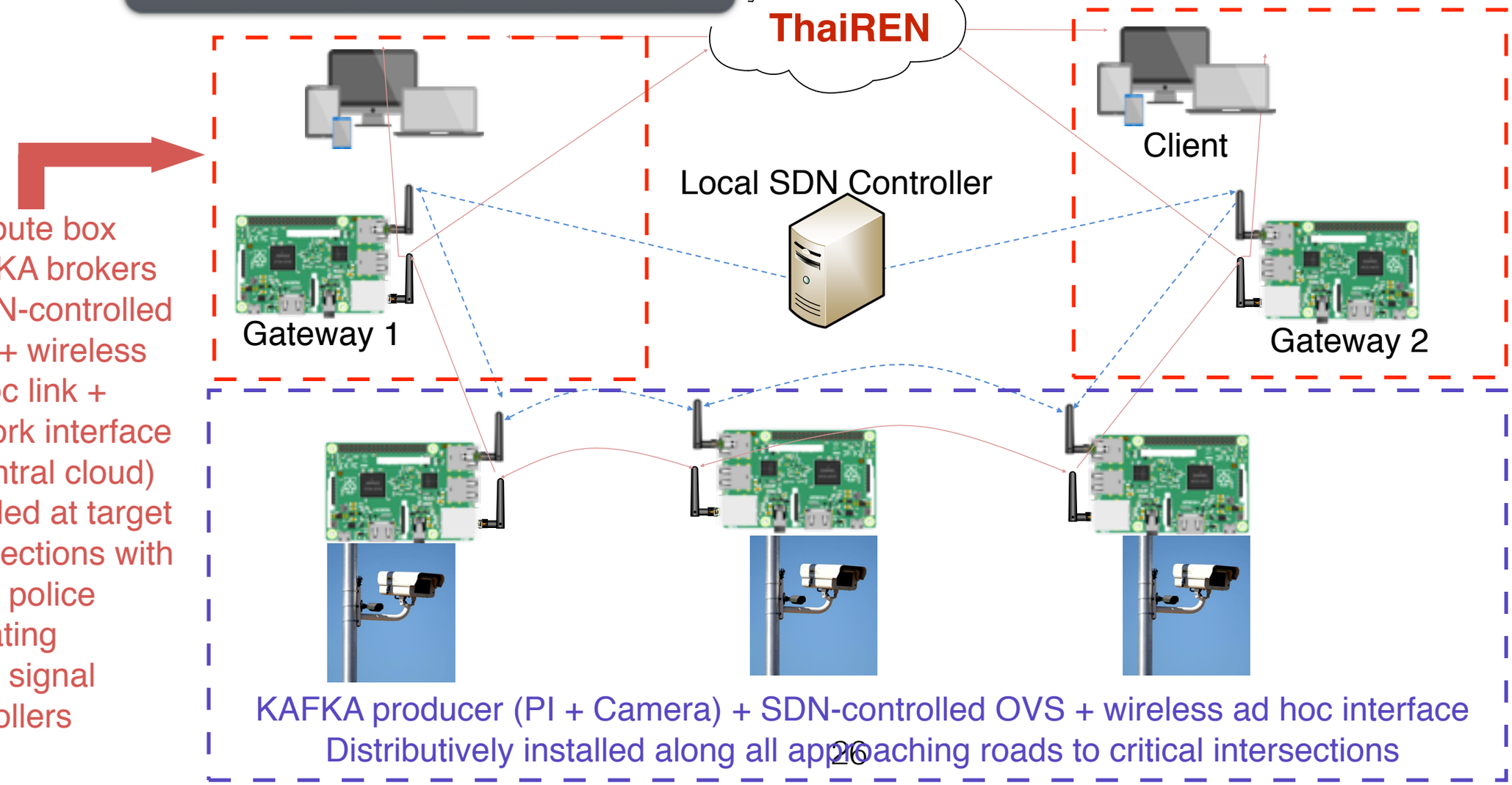

Smart-energy@Chula (Thailand)
Using CU-BEMS IEEE1888-protocol server by Univ of Tokyo (Japan) & NETPIE by NECTEC (Thailand)

**Demo-Site Architecture of Smart-Energy@Chula in IoTcloudServe@TEIN Project**

# Demo-Site Architecture of Smart-Mobility@Chula in IoTcloudServe@TEIN Project

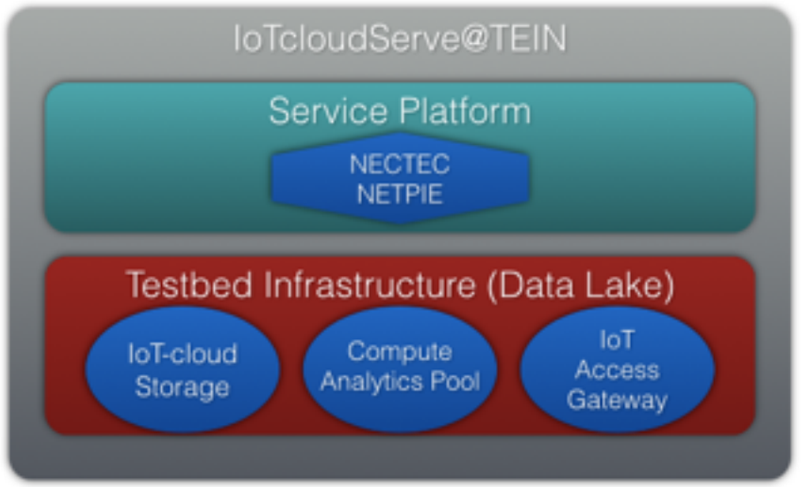
## Smart-mobility@Chula Analytics (Road Deadlock Detection)



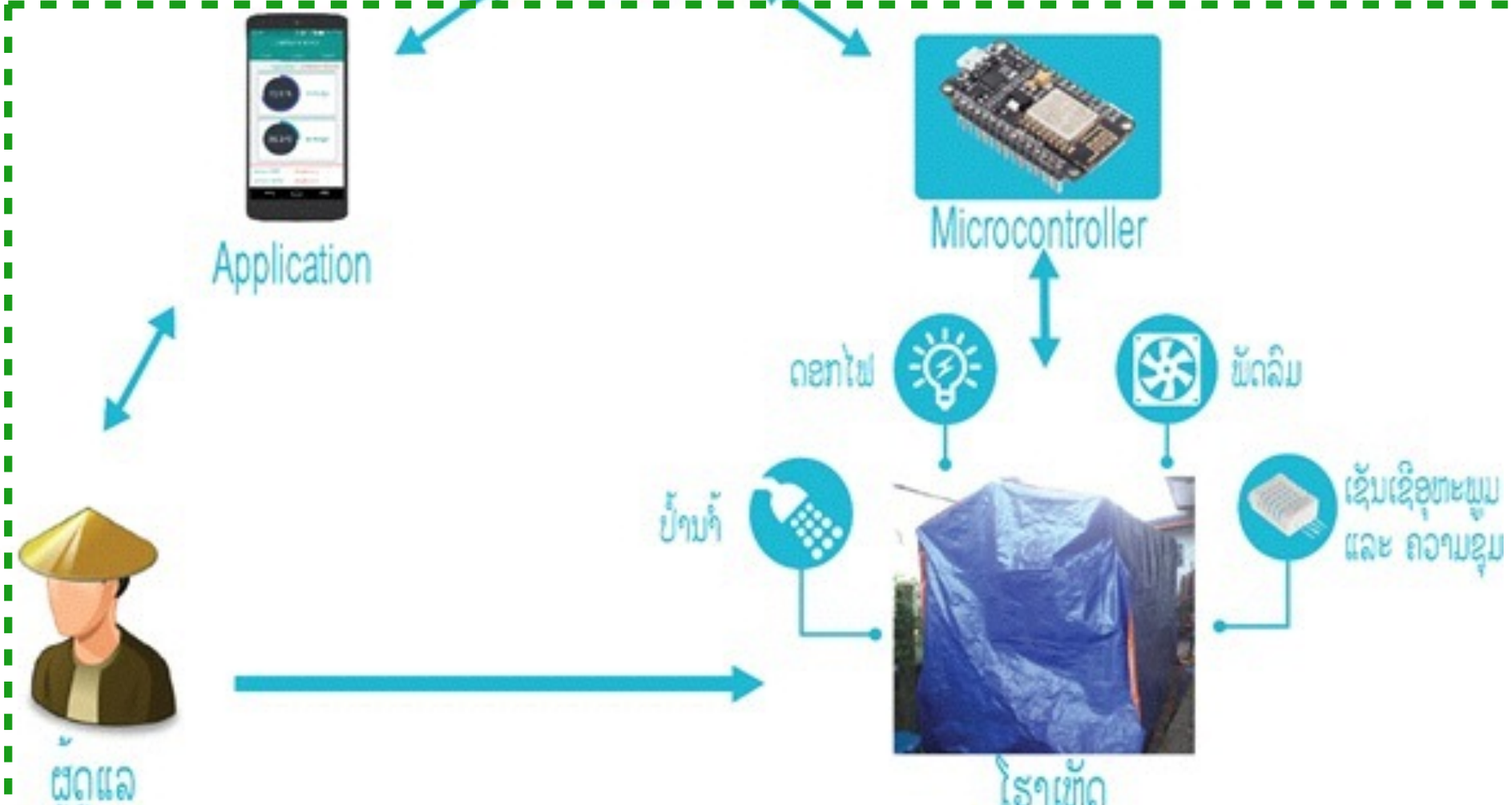
# Demo-Site Architecture of Smart-Agriculture@NUOL in IoTcloudServe@TEIN Project

## Smart-agriculture@NUOL Analytics and App Server




Backends in Thailand

**TEIN**
**Wide Area Network Infrastructure**




Frontend Applications & IoT Devices in Laos

Data-Centric

IoT-Cloud Service Platform

for Smart Communities

(IoTcloud Serve@TEIN)

To demonstrate "**data-centric**" IoT-cloud services running with IoTcloudServe@TEIN

Smart-energy@Chula (Thailand)
Supported by Todai (Japan)

Smart-mobility@Chula (Thailand)
Supported by GIST (Korea)

Smart-agriculture@NUOL (LAO)
Supported by NECTEC (Thailand)

To design, develop and operate IoTcloudServe@TEIN **service platform**

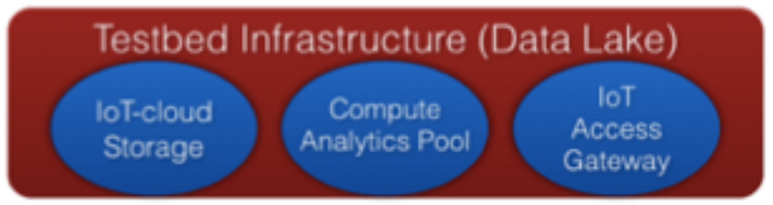
NECTEC NETPIE

KAFKA

Chula / NECTEC (Thailand)

Supported by
GIST (Korea) / Todai (Japan)

To establish and operate IoTcloudServe@TEIN **testbed infrastructure**



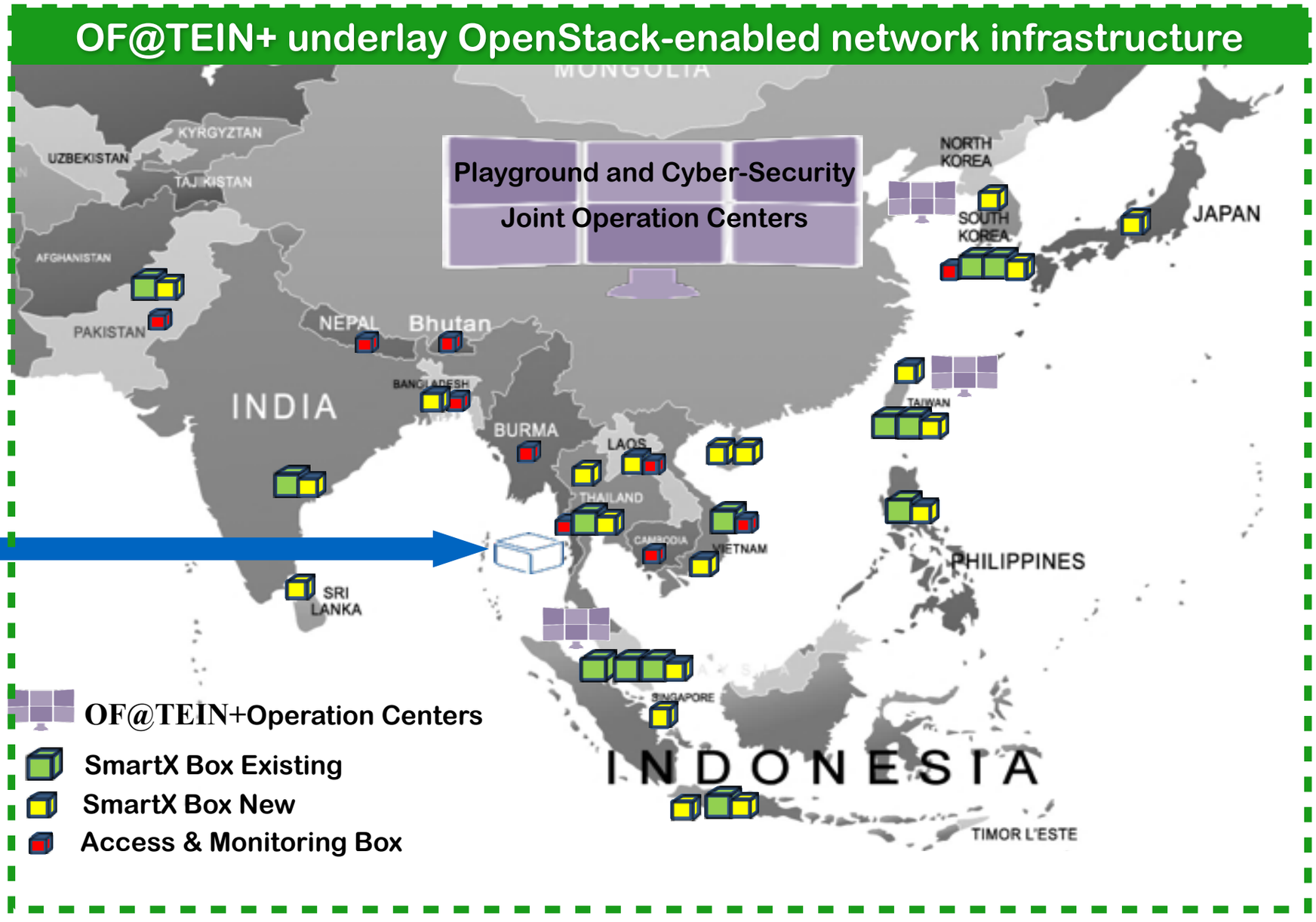

Chula / NECTEC (Thailand)

Supported by
UM (Malaysia) / GIST (Korea)

## IoTcloudServe@TEIN "Data Lake"

(IoT-cloud storage, compute analytics pool and IoT access gateway)

To be established and jointly operated by Chula & NECTEC (Thailand) for resource sharing accessible by TEIN R&E communities




**IoTcloudServe@TEIN testbed infrastructure in Thailand, that is accessible over TEIN communities with the supports from the OF@TEIN+ underlay**

# THANK YOU

**Associate Prof Dr Chaodit Aswakul**
**Email: chaodit.a@chula.ac.th**

*Wireless Network and Future Internet Research Unit*
*Department of Electrical Engineering, Faculty of Engineering*
*Chulalongkorn University, Bangkok, Thailand*