Agricultural IoT based on Edge computing

Speaker: Hoang Trong Minh

Post and Telecommunications Institute of Technology (PTIT), Vietnam

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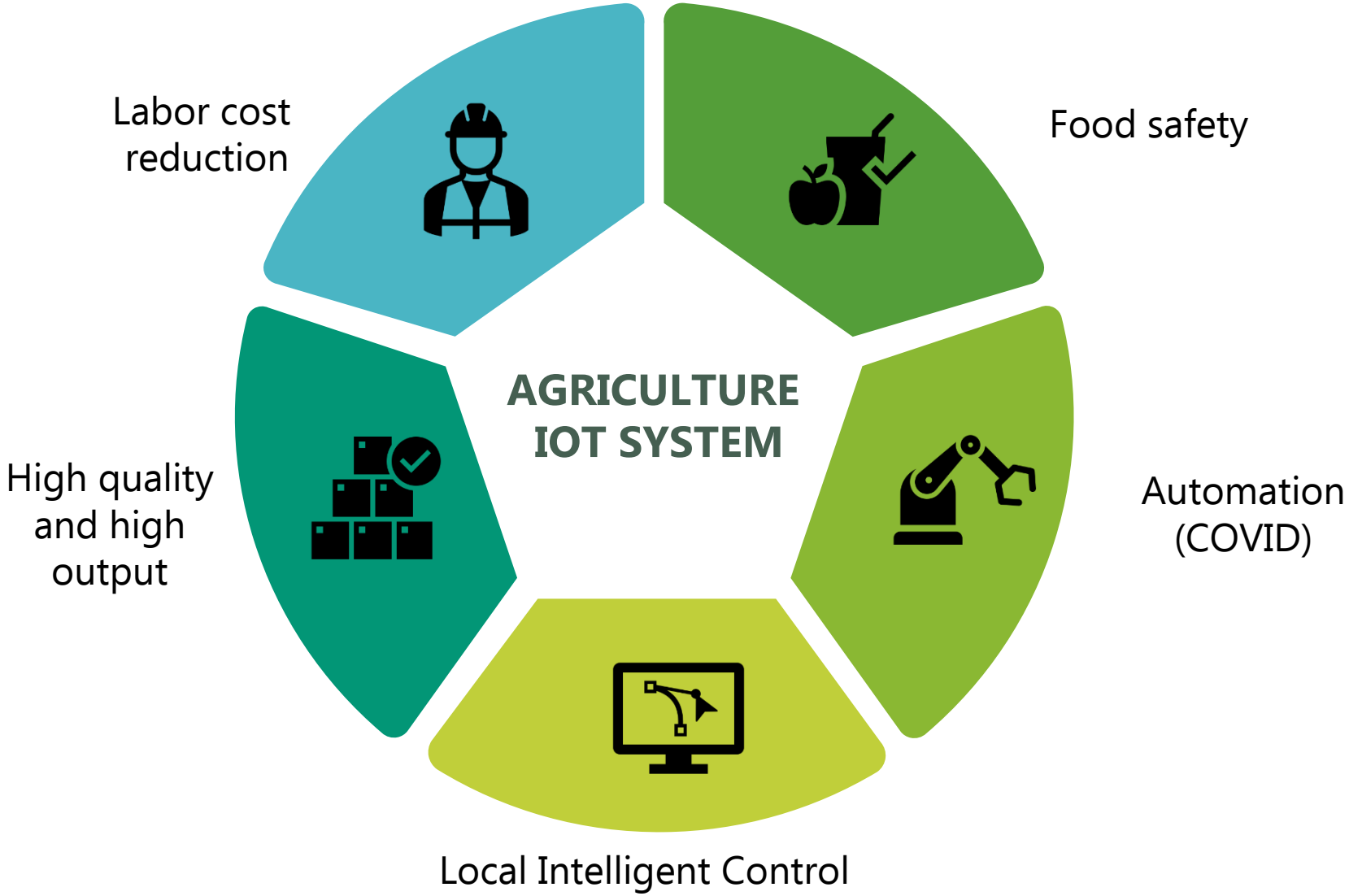
Significance of the study



Significance of the study

Edge Computing/ Mobile Edge Computing

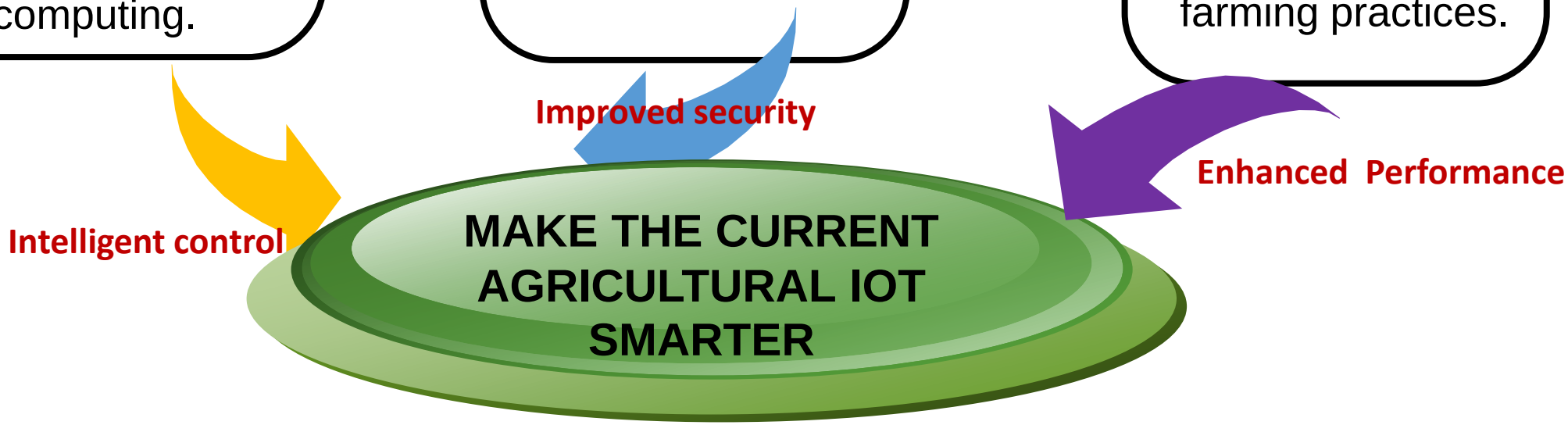
- **5G** — Applying for 5G communications
- **Performance** — Improving the performance of edge devices
- **Quality** — Supporting the service quality for collected data streams
- **AI** — Making intelligent decisions
- **Security** — Ensuring data security and moving toward to digital twins

Concrete objectives

Proposing an intelligent computing solution at the edge of the network for data collection and local response control using the state-of-the art smart edge computing.

Building an IoT device security framework based on authentication, data preservation, and encryption.

Proposing a model/solution for the load distribution and data processing **in association with** crop production and farming practices.



Concrete objectives

Intelligent computing solutions

Agricultural IoT systems have been impacted by the huge growth of new emerging technologies in 5G, AI, and automation

Intelligent computing solutions are required at the edge network to adapt to this development, hence our approach/motivation:

Effective local decision making
Precision enhancement of operated agriculture IoT system
Incorporation of automatic actuators into IoT systems (“new normal” situation)

Propose Intelligent models/solutions based on novel techniques for plant care and disease control

Concrete objectives

IoT security framework

Agricultural IoT systems **are impacted by** massive IoT devices, OS variations, new threats and distributed control

IoT frameworks at the edge network **should be able to deal with**

Different IoT devices, variety OS, new threats and distributed control

Propose a security framework related to IDS based AI/ML/DL approaches and D2D authentication schemes

Concrete objectives

Performance enhancement of agricultural IoT systems

Agricultural IoT systems are practical even in extremely conditions

Actual agriculture IoT system at the edge network is required to deal with

Big data produced by massive IoT devices
Increased sensor traffic leading to large amounts of computation

Propose novel model/solution for offloading tasks and preprocessing data

Proposed solutions

Current System

Vietnam (Indoor)

Automatic Watering System

Malaysia (Outdoor)

Fertilization System based on IoT system

Proposed solutions

Current System

PRODUCTION MANAGEMENT

Production Command

Resource Statistics

IRRIGATION OF INFRASTRUCTURE AND IOT SENSORS MANAGEMENT

Module 1

MONITORING DEVICE ACTIVITIES AND SENSOR DATA

Module 2

DEVICE CONTROL

Module 3

USED RESOURCE STATISTICS

Module 4

RESOURSE OPTIMIZATION (WATER AND & NUTRITION)

CONTROL AND CONNECTION LAYER

Controllers, connected to the software

Watering Command

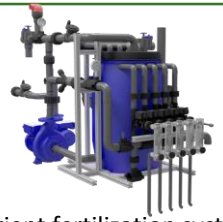
Acquisition Data

Gateway, transfer data from IoT sensors to management software

Control Signal

Acquisition data

IRRIGATION OF INFRASTRUCTURE AND IOT SENSORS



Nutrient fertilization system

Pump

Manual fertilizing devices

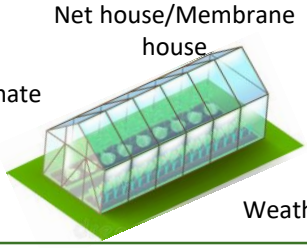
Solenoid valve

Dropper/ Rain sprinkler head

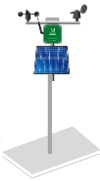
Outdoor

Soil moisture sensor

Microclimate Sensor



Net house/Membrane house



Weather Station

Proposed solutions

Expected System

PRODUCTION MANAGEMENT

Server/Cloud, connected to the system and remote user through Internet

Production Command

Resource Statistics

Security Solutions

INFRASTRUCTURE AND IOT SENSORS MANAGEMENT

Module 1

MONITORING DEVICE ACTIVITIES AND SENSOR DATA

Module 2

DEVICE CONTROL

Security Solutions

CONTROL AND CONNECTION LAYER

Controllers

Command:
Watering, Fertilizing,
Infrastructure Checking (take pictures by robots, drone, smart Camera),
Agricultural harvest, spraying drugs to treat diseases by robots,...

Control Signal

IoT Gateways: NB-IoT/4G/5G/ WiFi/Zigbee

Edge Computing:
- USED RESOURCE STATISTICS (Module 3)
- RESOURSE OPTIMIZATION (WATER AND & NUTRITION) (Module 4)
- Predicting diseases of plants
- Security Solution

Acquisition data

INFRASTRUCTURE AND IOT SENSORS

Nutrient fertilization system

Dropper/ Rain sprinkler head

Fertilizing devices

Autonomous Robots

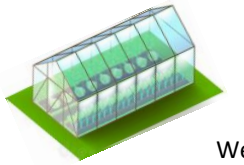
Indoor Drone

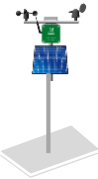
Soil moisture sensor

Smart Camera

Light Sensor

Membrane house

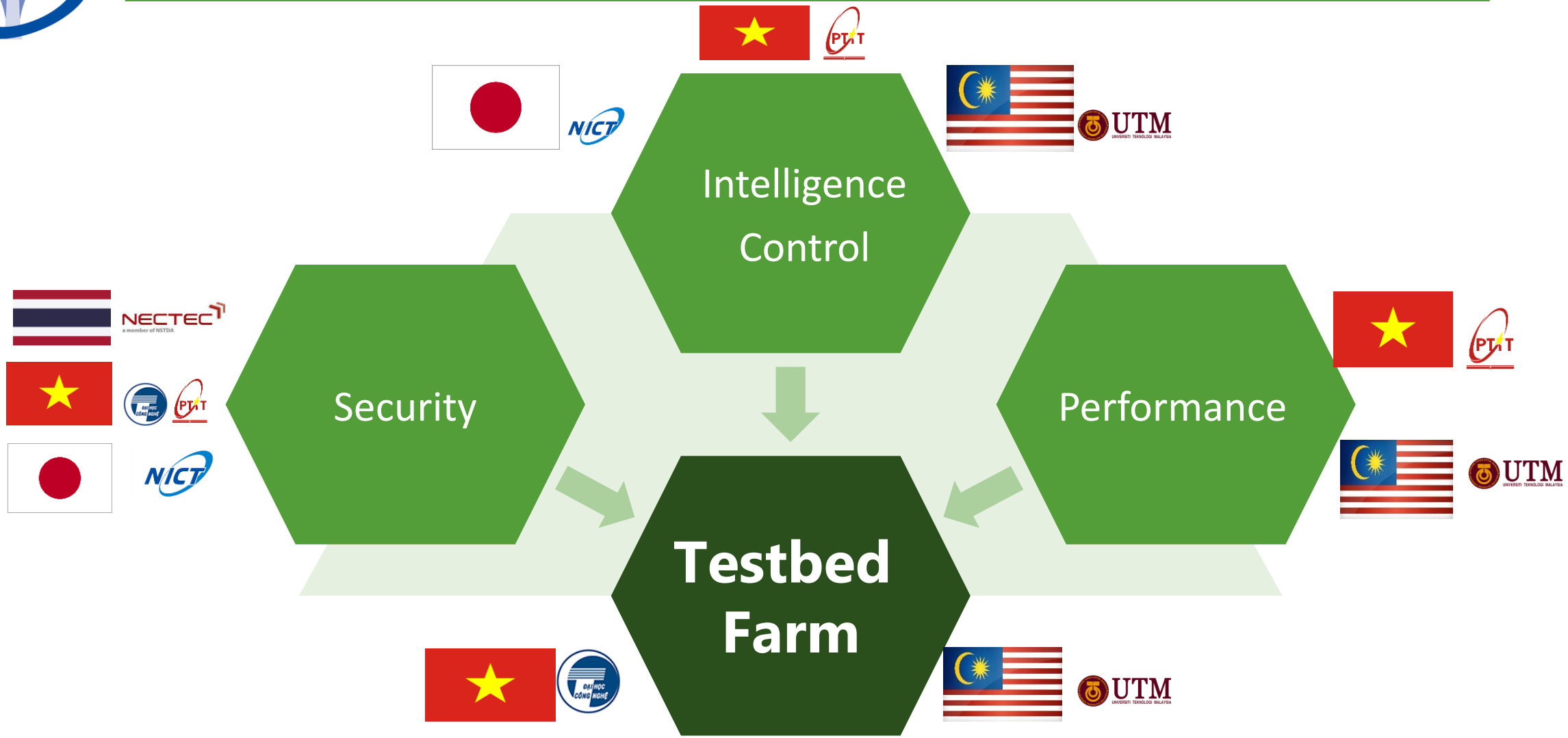




Weather Station

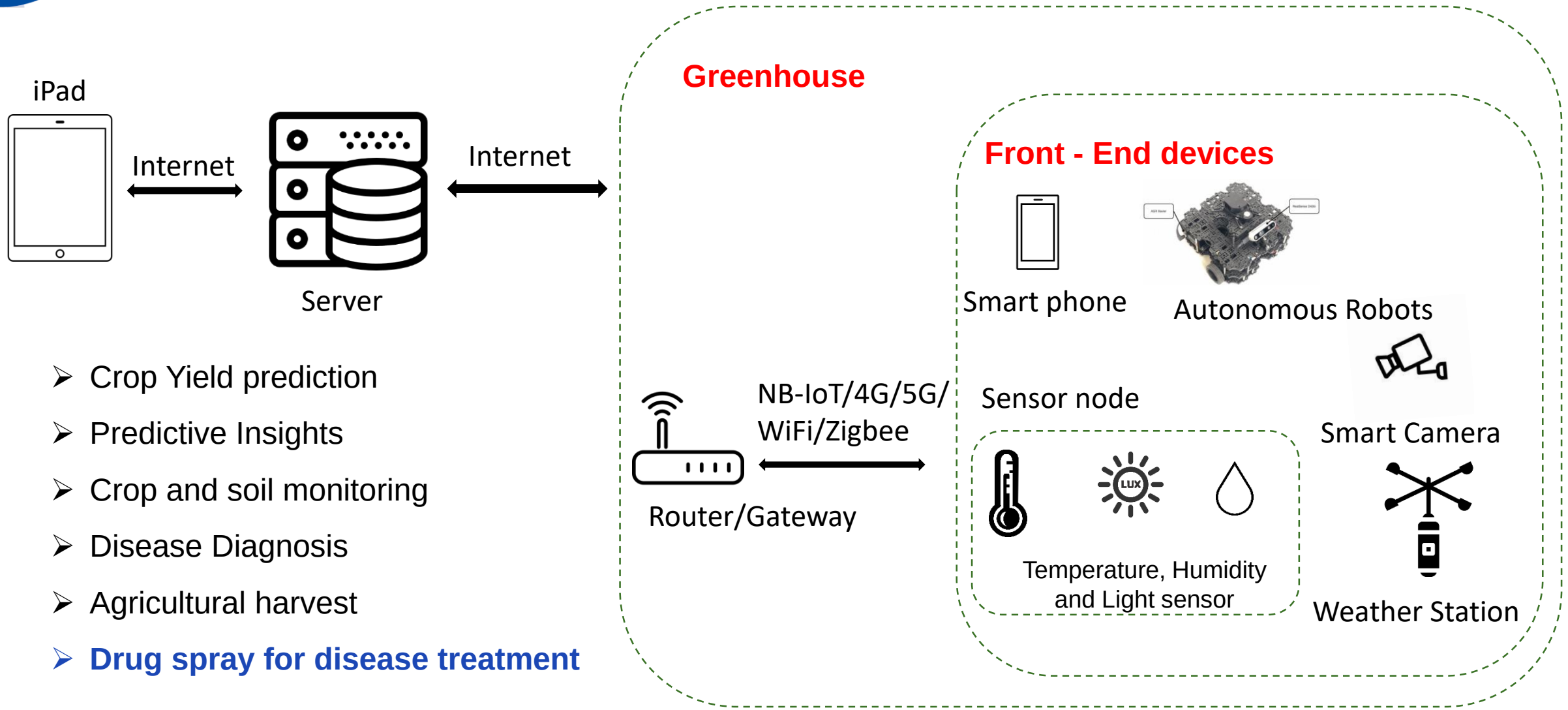
Proposed solutions

Collaboration



VIETNAM - JAPAN

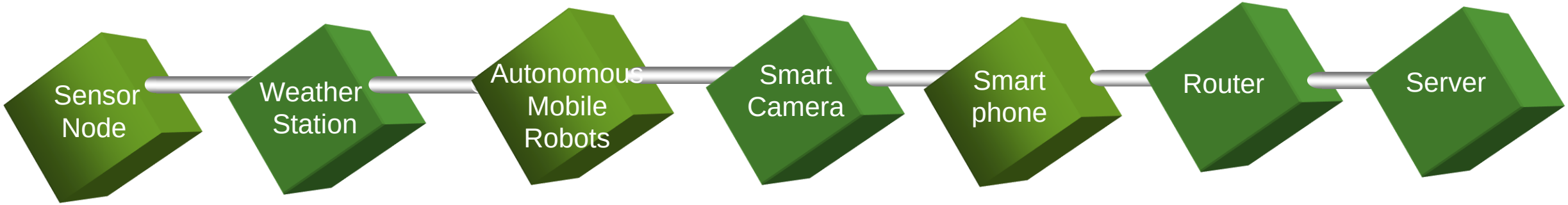
Practical pilot case



- Crop Yield prediction
- Predictive Insights
- Crop and soil monitoring
- Disease Diagnosis
- Agricultural harvest
- **Drug spray for disease treatment**

VIETNAM - JAPAN

Practical pilot case

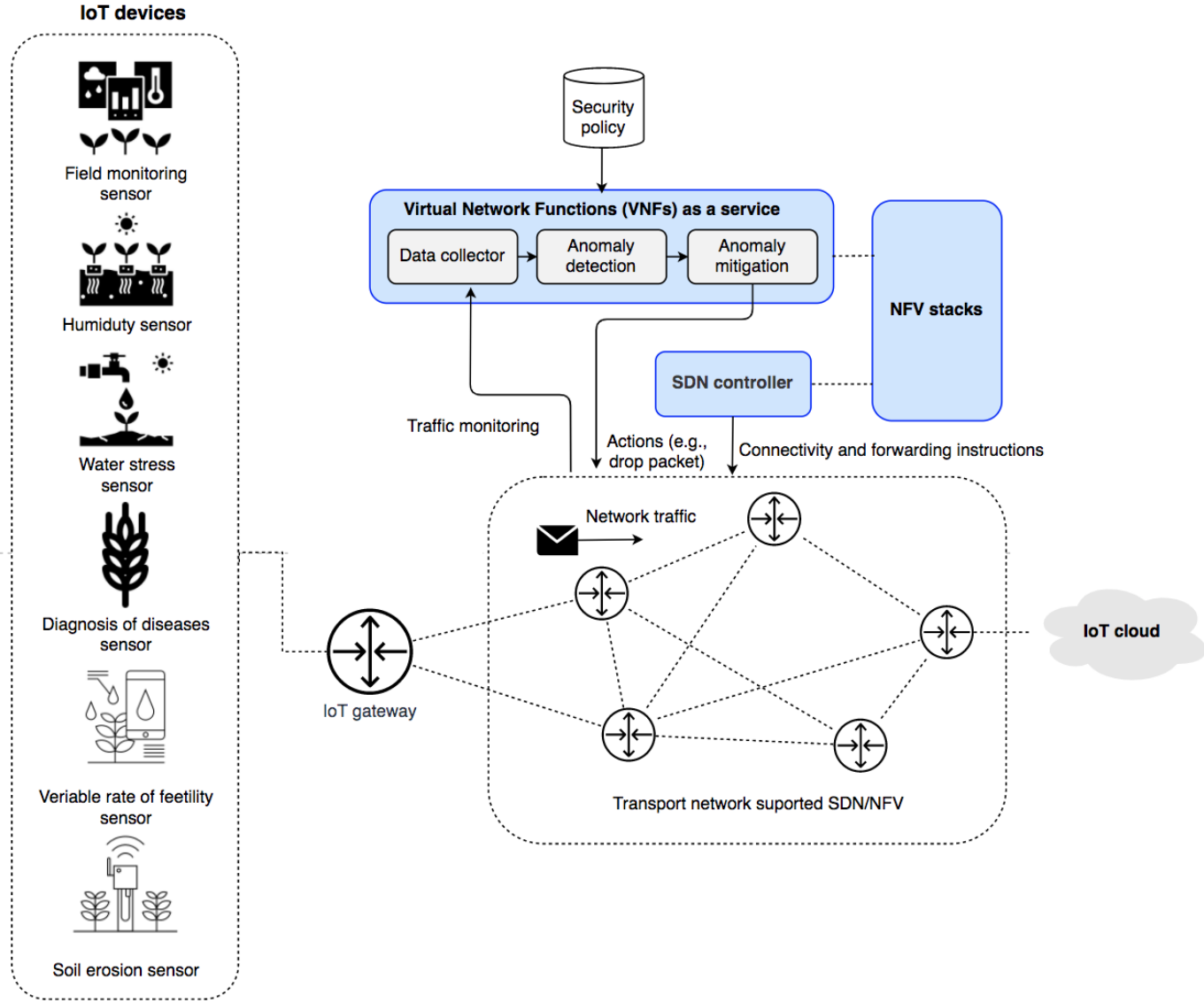


Sensor Node	Weather Station	Autonomous Mobile Robots	Smart Camera	Smart phone	Router	Server
Recognize local farming conditions such as humidity, soil quality, light, and etc.	Monitor the outdoor weather (wind, air pressure, rainfall,…) to support the process of adjusting weather conditions inside the greenhouse	Collect image data at local positions; harvest, spray drug to treat diseases	Collect visual data for an overview of the entire greenhouse to assist drones and detect system anomalies	Collect image data directly by users	Receive data from sensor system using wireless transmissions and send to the server via internet/Edge Computing	Receive, store and analyze data then feedback to actuators

THAILAND

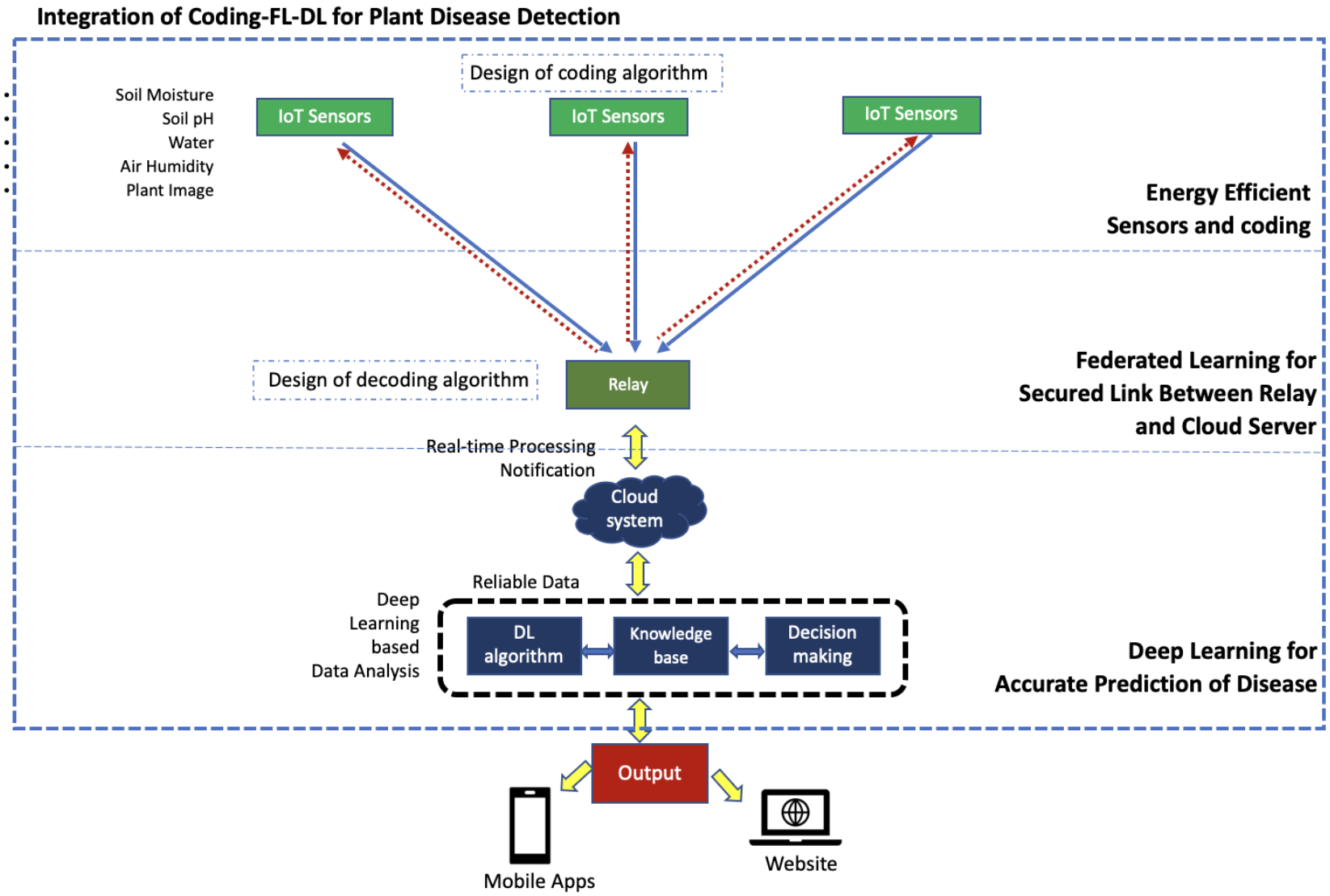
Practical pilot case

- Network traffic related to IoT devices is periodically captured and analyzed by our security framework
- We leverage SDN and NFV technologies to configure the network and deploy the desired security monitoring functions for capturing and analyzing the suspicious events of IoT devices



MALAYSIA

Practical pilot case



Budget Plan

1st YEAR	Frequency/ unit	Cost for 3 members (USD)	TOTAL (USD)
Knowledge sharing activities inclusive Attending Workshop and Conferences (travel and accommodation)			
• Vietnam	1	1,500	
• Japan	1	4,000	8,500
• Thailand	1	1,500	
• Malaysia	1	1,500	
• Autonomous and mobile platform Ex: KMR IIWA	1	>53,700	>53,700
• Jetson AGX Xavier Developer Kit	3	1,100	3,300
• Turtlebot3 Waffle Pi	3	2,000	6,000
2nd YEAR			
Knowledge sharing activities inclusive Attending Workshop and Conferences (travel and accommodation)			
• Vietnam	1	1,500	
• Japan	1	4,000	8,500
• Thailand	1	1,500	
• Malaysia	1	1,500	
TOTAL			**>80,000**

Members

Vietnam

Post and Telecommunications Institute of Technology (PTIT)

Dr. Hoang Trong Minh, Prof. Hoang Dang Hai, Dr. Pham Anh Thu

University of Engineering and Technology, VNUH (VNU-UET)

Prof. Nguyen Linh Trung (AVITECH), Dr. Tran Thi Thuy Quynh (AVITECH), Dr. Dinh Tran Hiep (AVITECH), Dr. Pham Minh Trien (FAT)

MIMOSA TECK company Mr. Nguyen Khac Minh Tri

Malaysia

Universiti Teknologi Malaysia (UTM)

Pro. Norliza Mohd Noor, Dr Hazilah Mad Kaidi, Dr Norulhusna Ahmad

Thailand

National Electronics and Computer Technology Center (NECTEC)

Dr. Chalee Vorakulpipat

Japan

The National Institute of Information and Communications Technology (NICT)

Prof. Takeshi Takahashi

Thank you for your attention!

Hoang Trong Minh