Problem Statement of IoT integrated with Edge Computing

(draft-hong-t2trg-iot-edge-computing-00)

IETF105 T2TRG meeting in Montreal

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Contents

- History and major updates on draft

- IoT Edge computing demo show
  - To support the draft

History of the draft

- IETF 103
  - Presented first in T2TRG side meeting
  - draft-hong-iot-edge-computing-01
  - Showed two demo videos as use cases of IoT Edge computing
    - Smart constructions providing a monitoring service of construction site
    - Real-time control monitoring system by Rotary Inverted Pendulum system

- IETF 104
  - Presented in Pre IETF 104 work meeting
  - draft-hong-iot-edge-computing-02

Major Updates

- Changed the filename to specify it under T2TRG
  - draft-hong-t2trg-iot-edge-computing-00
    - It was draft-hong-iot-edge-computing-02

- Integrated with *Survey and gap analysis*
  - It was presented and discussed at IETF100 T2TRG

- New authors are added
  - Xavier de Foy (InterDigital Communications)
  - Matthias Kovatsch (Huawei Technologies Duesseldorf GmbH)
  - Eve Schooler (Intel)
  - Dirk Kutscher (University of Applied Sciences Emden/Leer)

Changes of each chapters (1/3)

<draft-hong-iot-edge-computing-02>

<draft-hong-t2trg-iot-edge-computing-00>

Changes of each chapters (2/3)

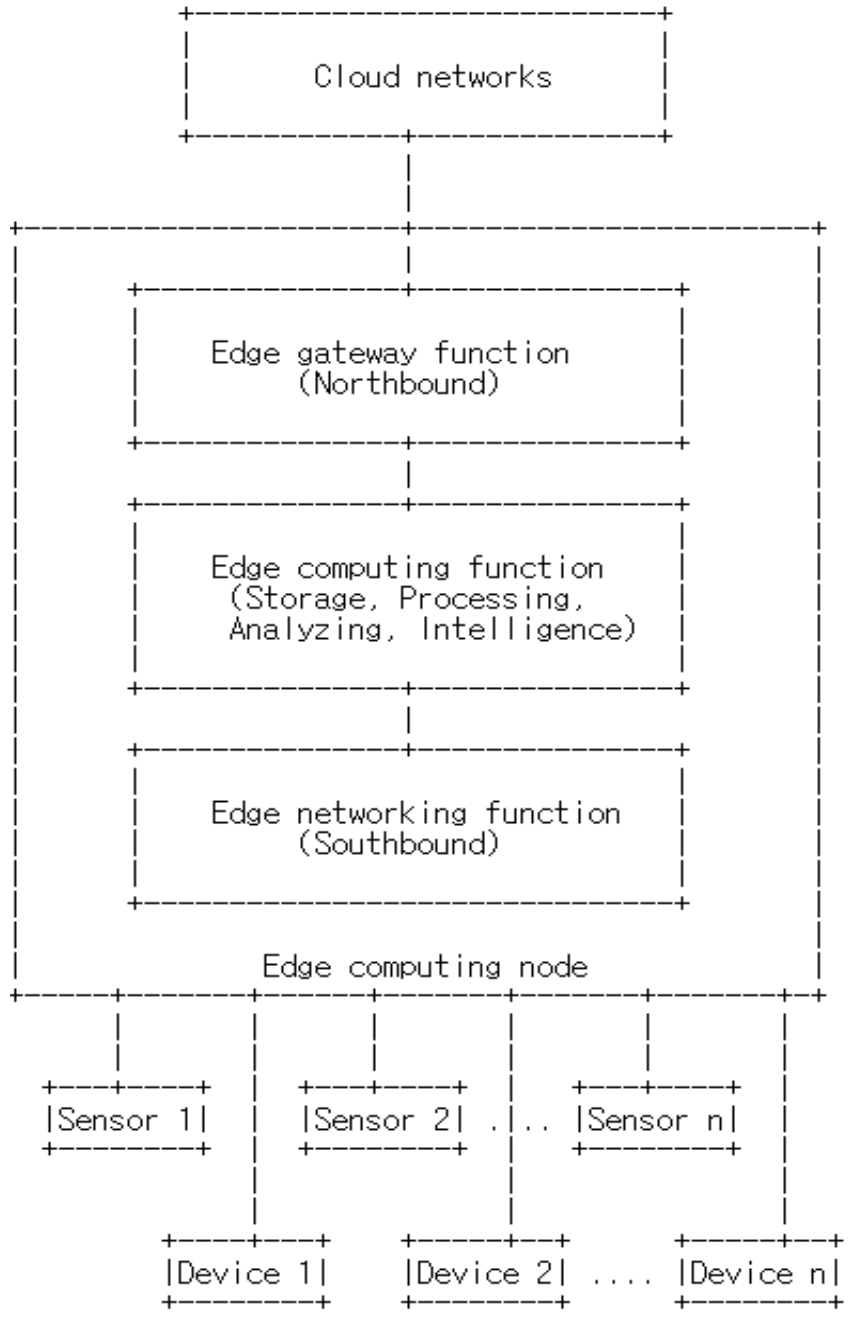
<draft-hong-iot-edge-computing-02>

<draft-hong-t2trg-iot-edge-computing-00>

Changes of each chapters (3/3)

Gateway-based architecture of IoT Edge Computing

- This is one particular way of doing Edge computing
- Provides
  - downside connectivity to IoT sensors and devices (southbound connectivity)
  - upside connectivity to cloud networks (northbound connectivity)
  - function of data storage
  - computing function such as data processing, data analyzing, and intelligence



Next revision & Direction

- Provides the different Edge computing approaches
  - edge cloud, edge gateway, distributed edge nodes, device-embedded edge nodes, etc.

- T2TRG adoption?

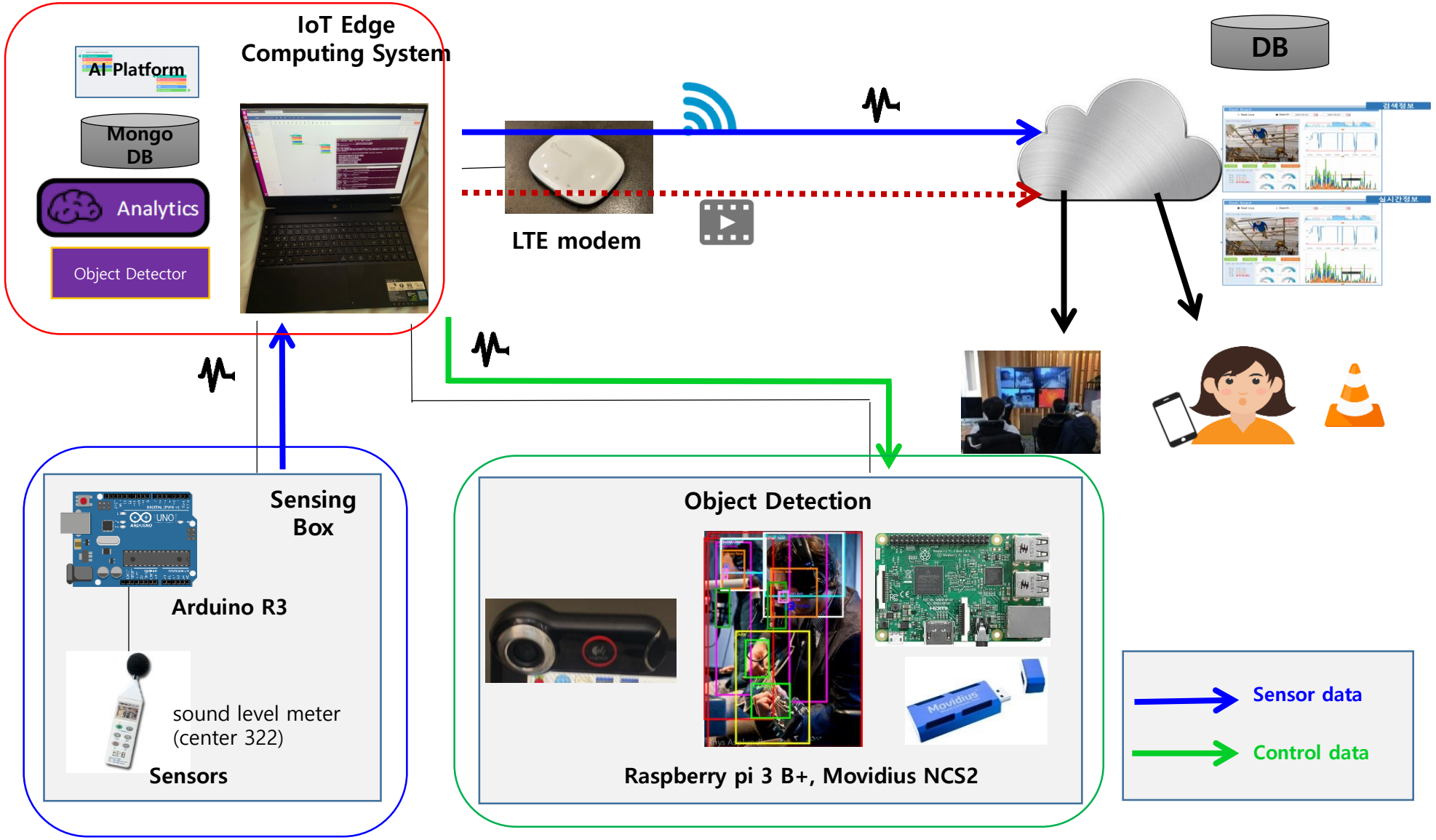
IoT Edge computing demo

- ETRI implementation -

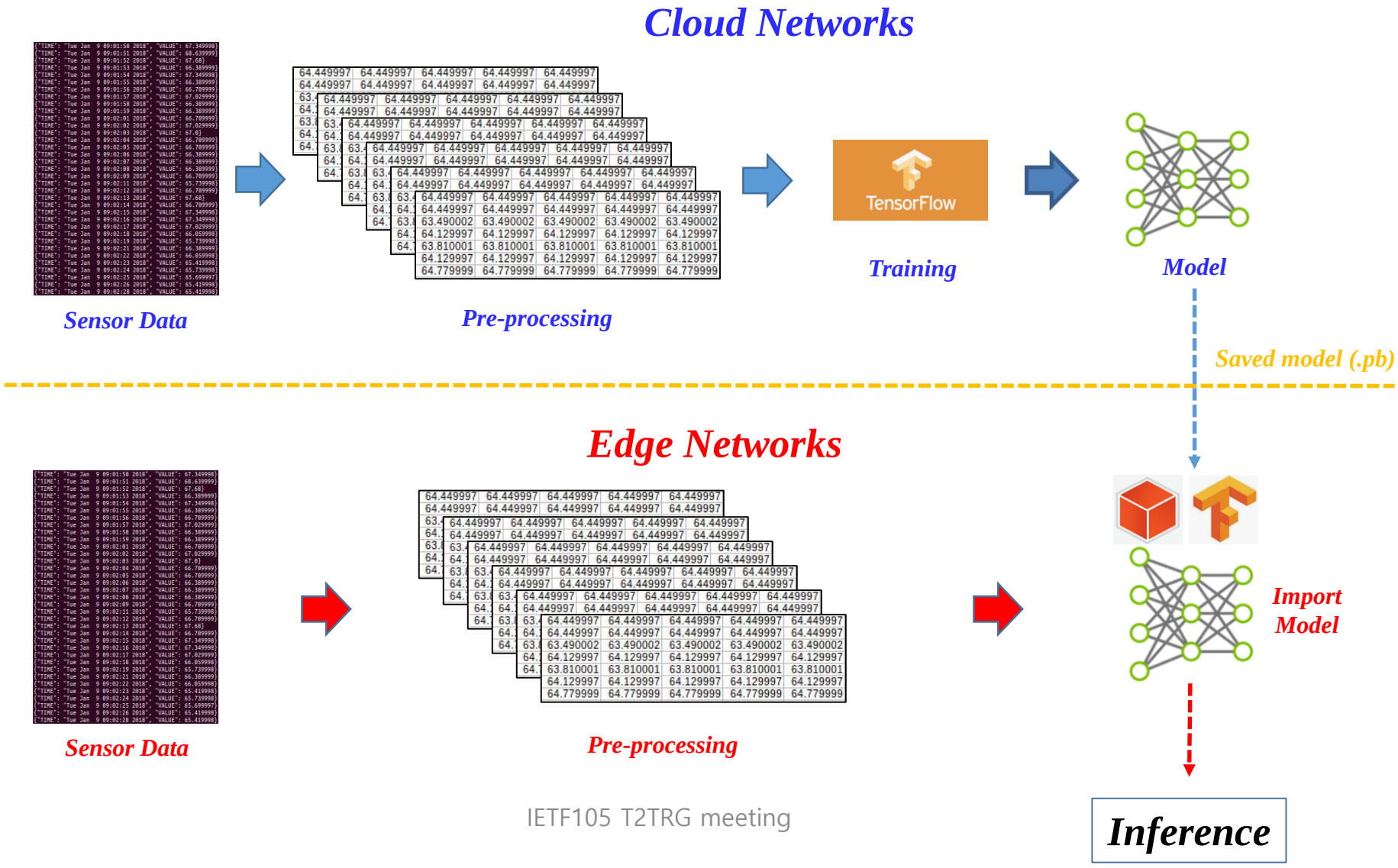
Object of demonstration

- Show an implementation of Edge computing based on open source EdgeX
- Provide a mapping between implementation & architecture in the draft
- T2TRG adoption support

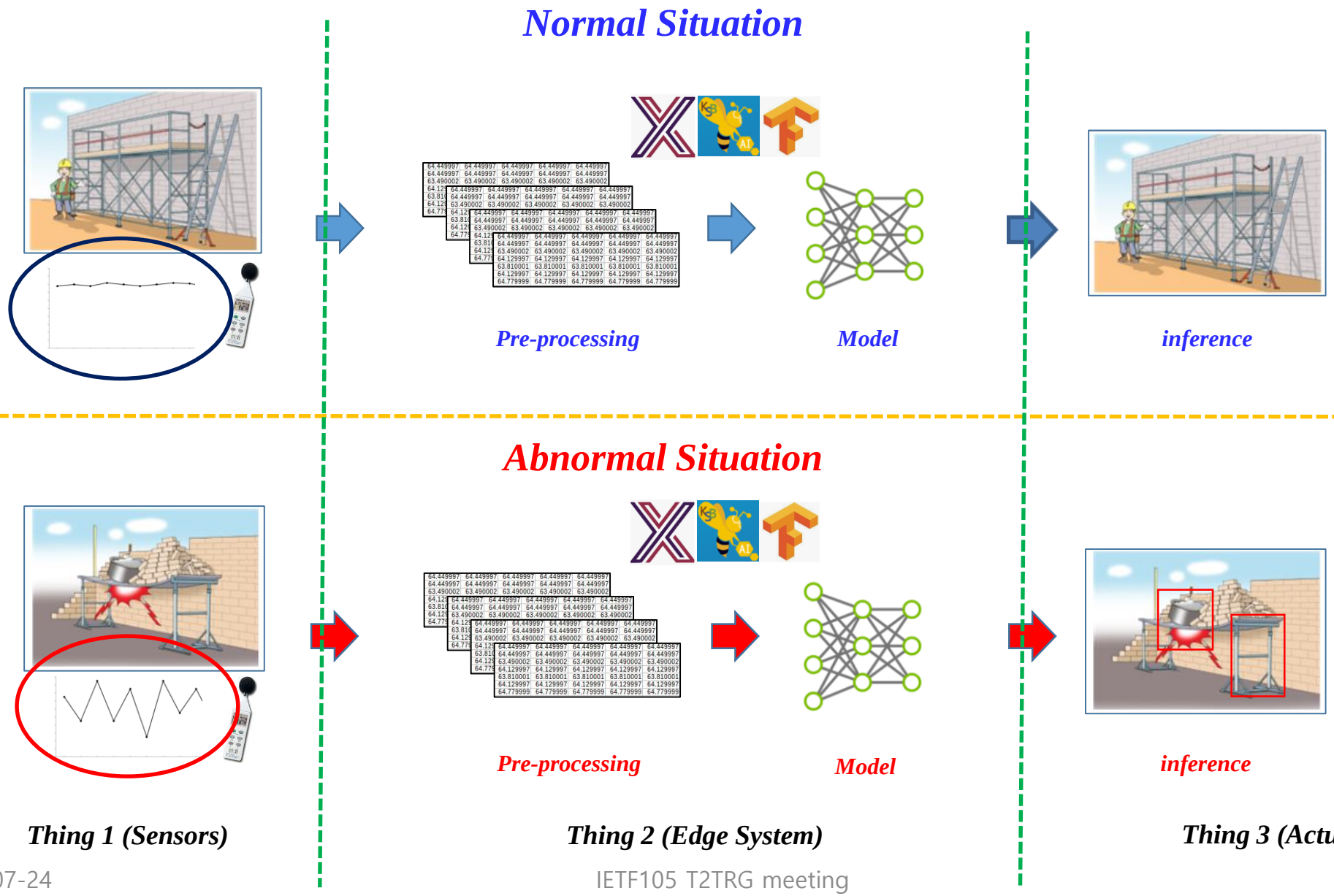
Service Scenario



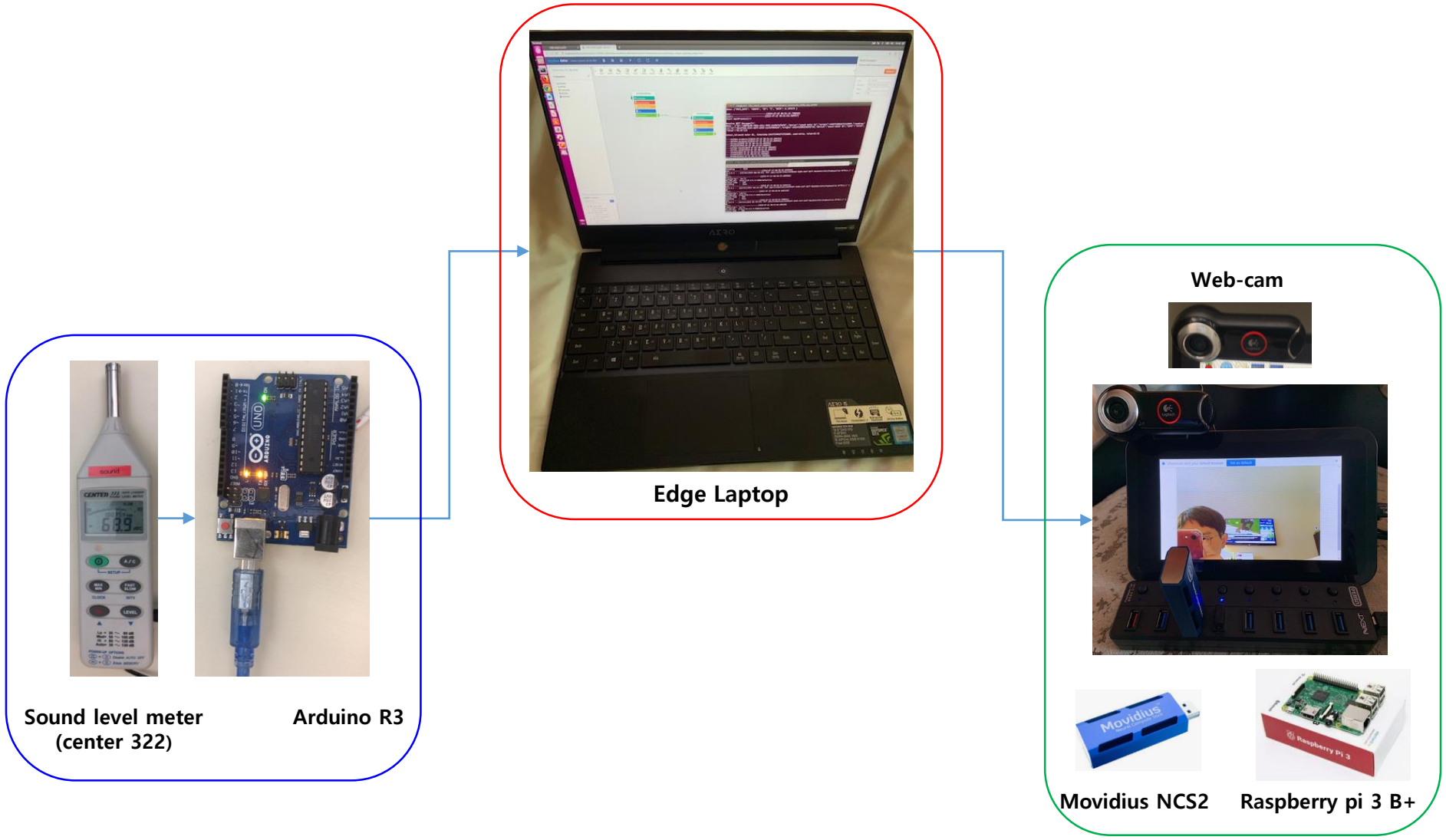
Example of Edge computing function : Intelligence - Preprocessing, Prediction, Analyze & Control



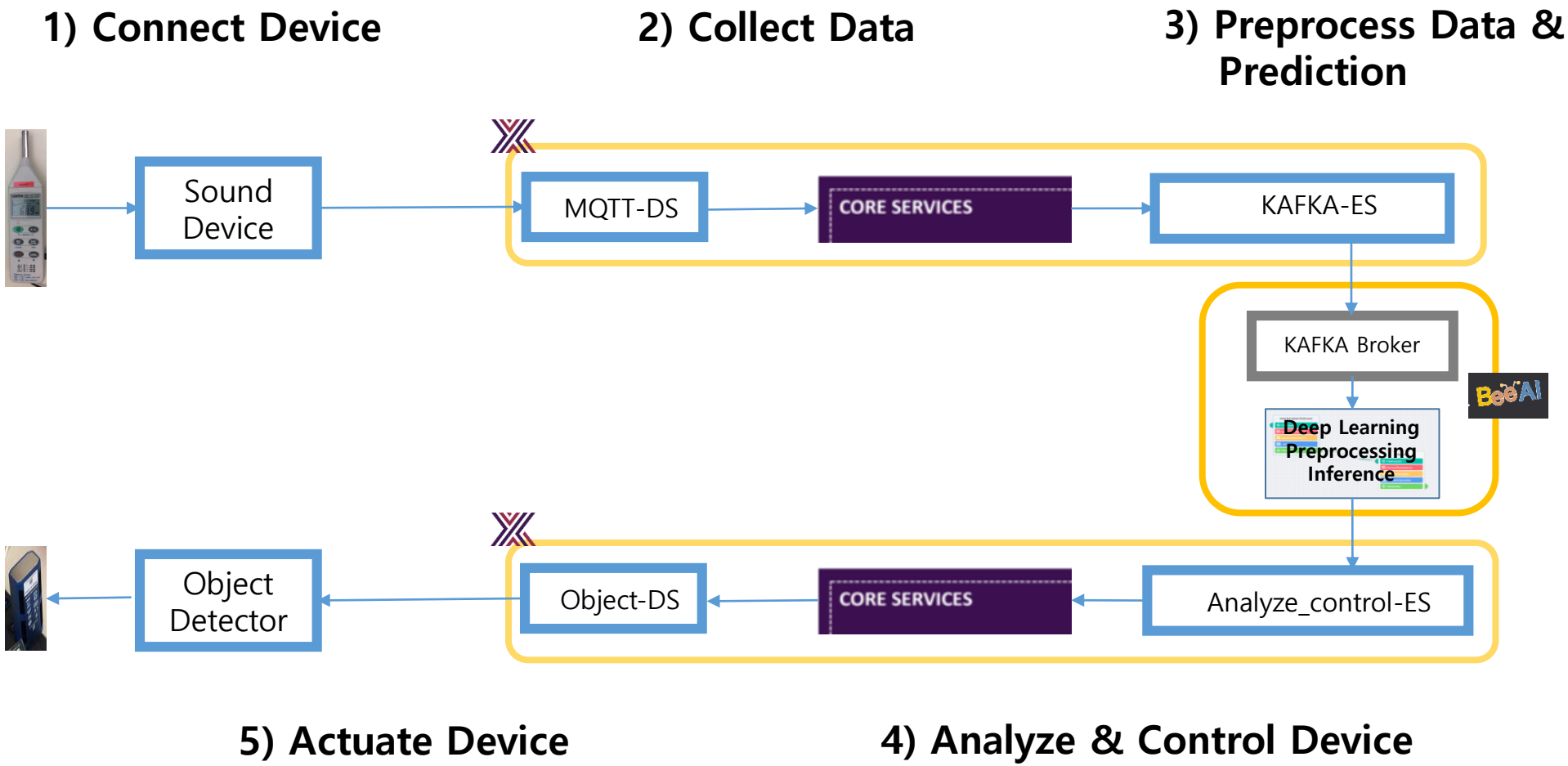
Service Scenario – Normal vs. Abnormal



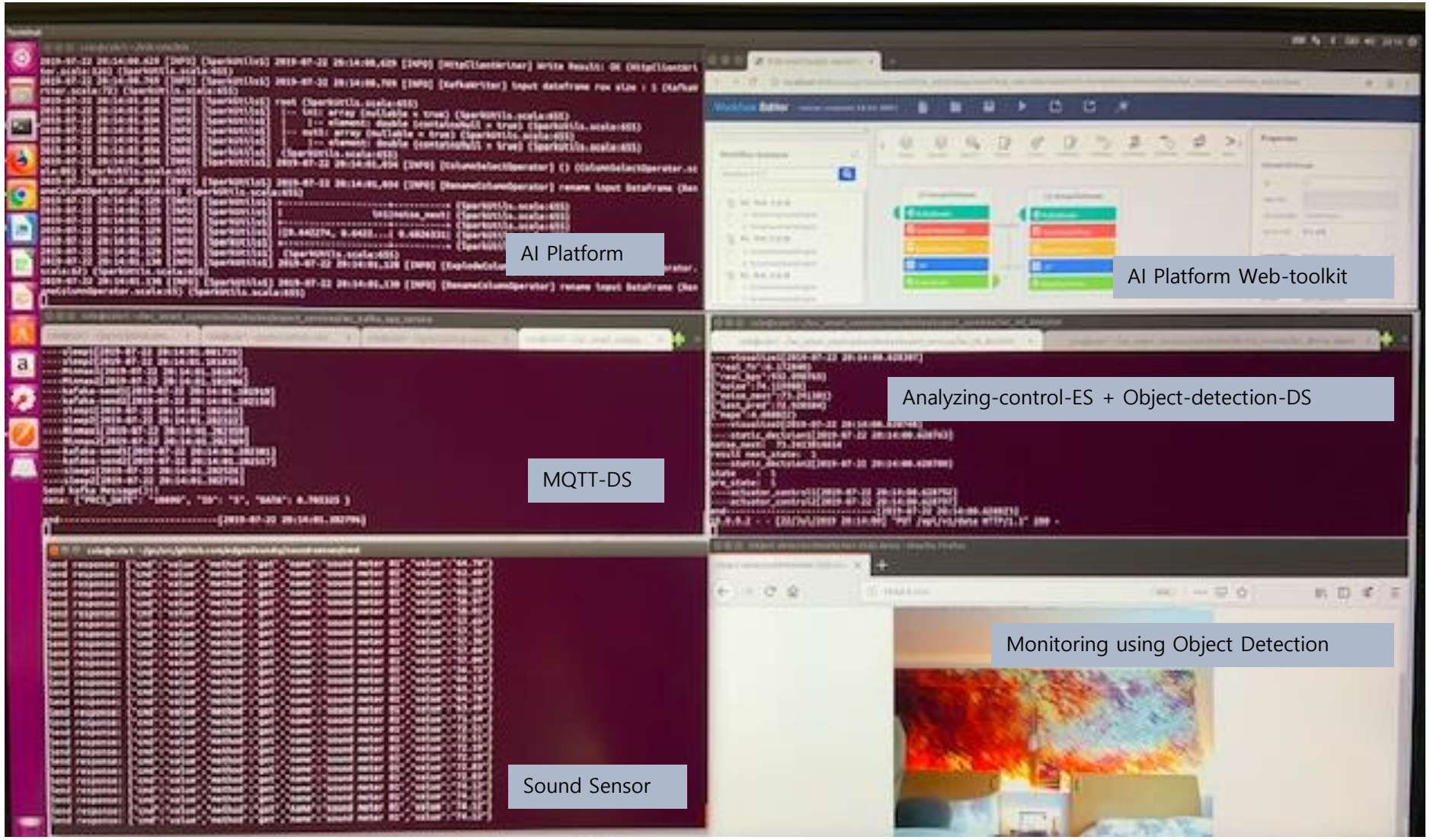
Testbed Configuration



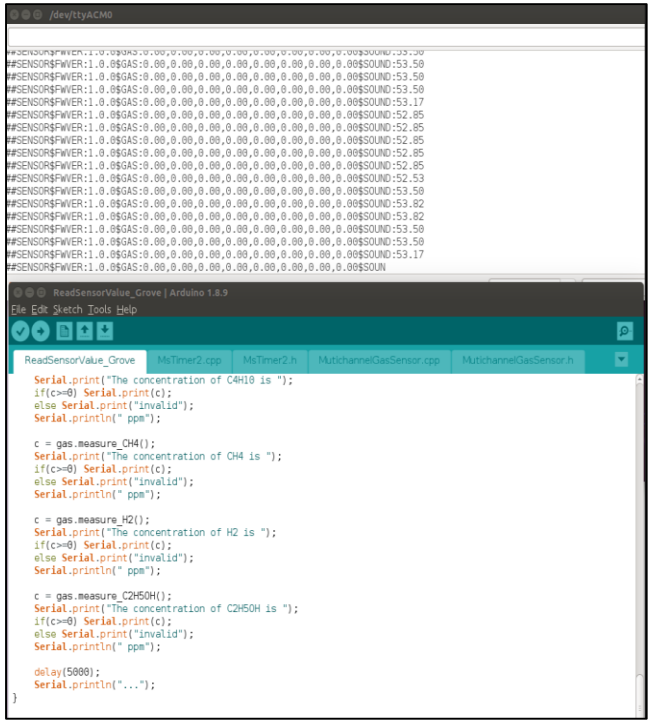
Software Configuration (based on EdgeX)

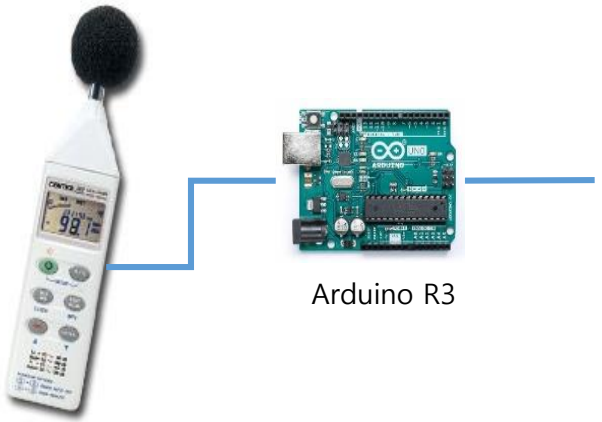


Screenshot of each process



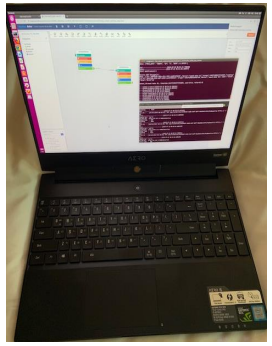
1) Connect Device





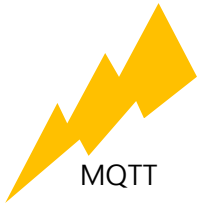
sound level meter (center 322)

Arduino R3



Linux

- MQTT Producer programing



MQTT

EMQ MQTT Broker

EdgeX

- MQTT data processing

2) Collect Data

##SENSOR$FWVER:1.0
:GAS:0.0,
:SOUND: 65.32\r\n

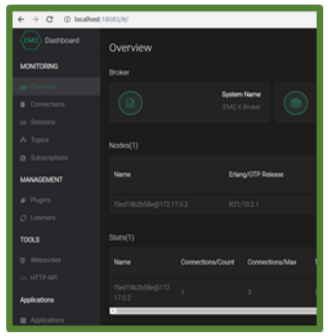
{
ID: adfb32432dbf3
Name: sound-meter-01
Value: 65.34
}

{
Topic: DataTopic
Payload: data
}

reading/
{
Origin: 124d56fad
Name: Value
Value: 65.34
}

read_sensor.c

sensor.go



EMQ Broker Manager

Sound-meter

Sensor

EMQ Broker

Get:
/api/v1/reading

CORE SERVICES

Subscribe:
/DataTopic, get value

MQTT-DS

Publish:
/DataTopic, value

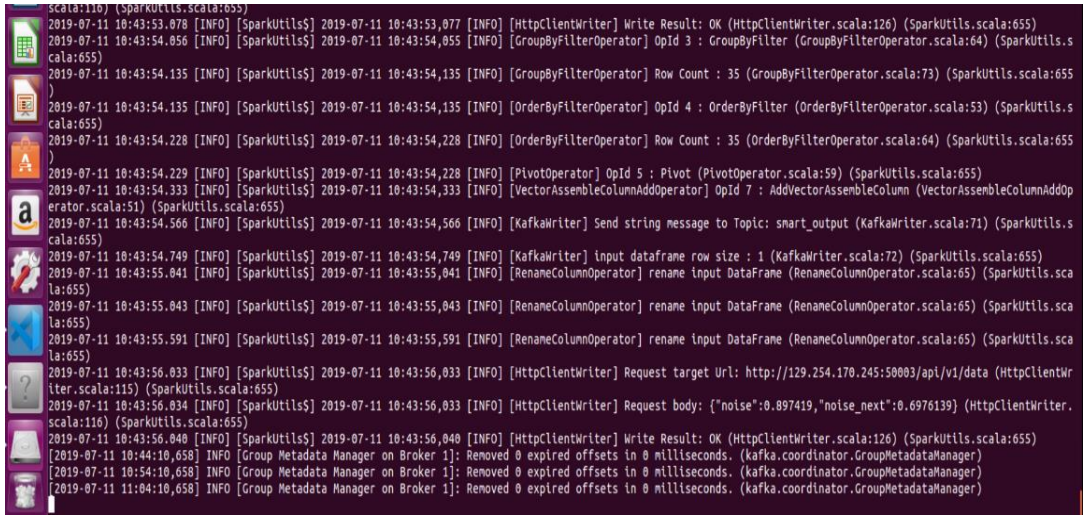
mqtt-device-profile.yaml

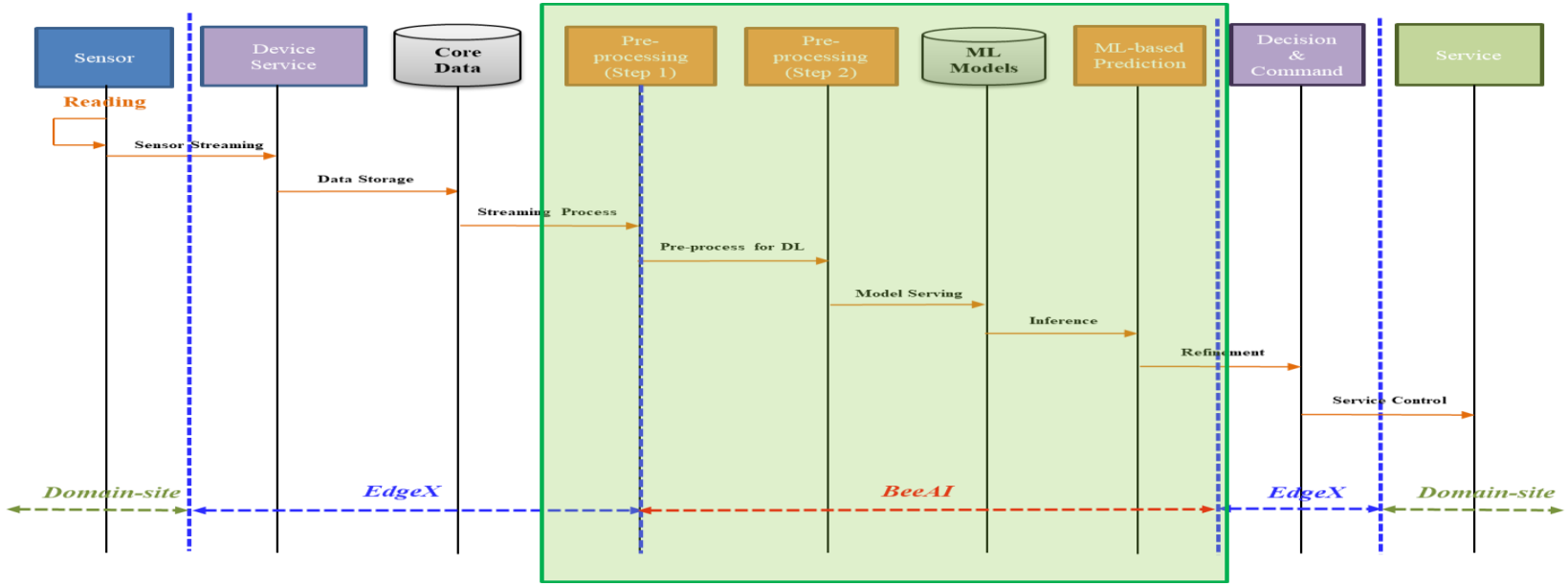
Configuration.toml

driver.go

incominglistener.go

3) Preprocess Data & Prediction





4) Analyze & Control Device

Analyze

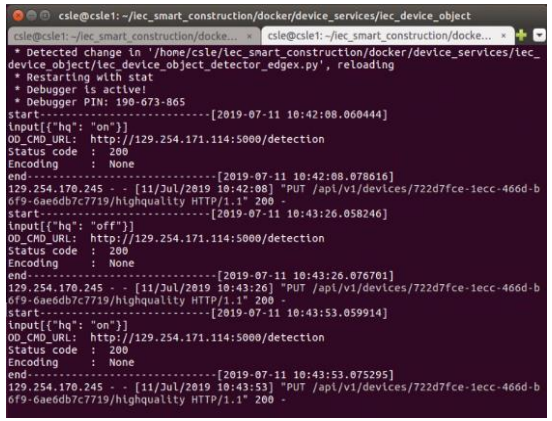
Visualize

Control Device

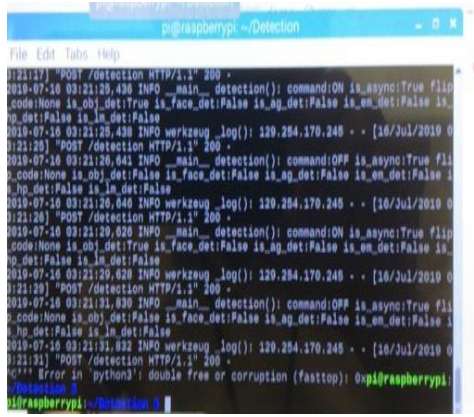
```
csle@csle1: ~/iec_smart_construction/docker/export_services/iec_ml_decision
csle@csle1: ~/iec_smart_construction/docker/exp...  ×  csle@csle1: ~/iec_smart_construction/docker/exp...  ×
start--------------------------[2019-07-16 16:19:40.371760]
received REST message()!!

{'noise': 0.642274, 'noise_next': 0.5807184}
noise      :  72.18999714
noise_next :  70.30578022399999
----analyze1[2019-07-16 16:19:40.372573]
============================================
analyze start!!
============================================
hq_video: 0 hq_sample: 317 lq_sample: 10650
HIGH - noise: 72.18999714 SS: 69.0 warn_sample: 740
f_neg: 527 f_pos: 103
============================================
Now: 72.18999714 Pred: 68.90266986099999 MAPE new: 4.553715762898297 MAPE total: 3.8826323443
86367 MAPE sum: 42580.82892088529
Total: 10967 CC: 0.95 HQ period: 317 LQ period: 10650
HQ rate: 2.890489650770493
False Neg: 527 False Pos: 103
----analyze2[2019-07-16 16:19:40.372777]
----visualize1[2019-07-16 16:19:40.372795]
{"real_fn":4.805325}
{"real_bps":572.262241}
{"noise":72.189997}
{"noise_next":70.305780}
{"last_pred":68.902670}
{"mape":3.882632}
----visualize2[2019-07-16 16:19:40.373686]
----static_decision1[2019-07-16 16:19:40.373724]
noise_next:  70.30578022399999
result next_state:  1
----static_decision2[2019-07-16 16:19:40.373766]
state    :  1
pre_state:  0
----actuator_control1[2019-07-16 16:19:40.373812]
MS_CMD_URL:  http://129.254.170.245:48082/api/v1/device/722d7fce-1ecc-466d-b6f9-6ae6db7c7719/
command/dbbd3fb8-bb8c-4347-ae39-951e9c73bb0e
Status code  :  200
Encoding     :  None
----actuator_control2[2019-07-16 16:19:40.414911]
end----------------------------[2019-07-16 16:19:40.414950]
129.254.170.245 - - [16/Jul/2019 16:19:40] "PUT /api/v1/data HTTP/1.1" 200 -
```

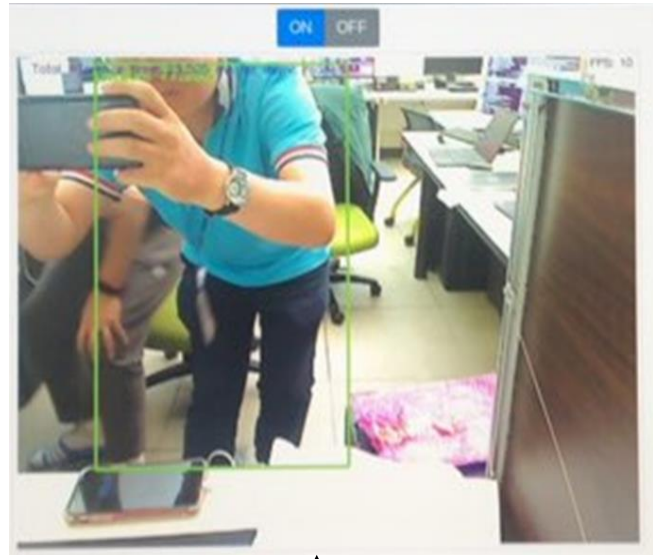
5) Actuate Device

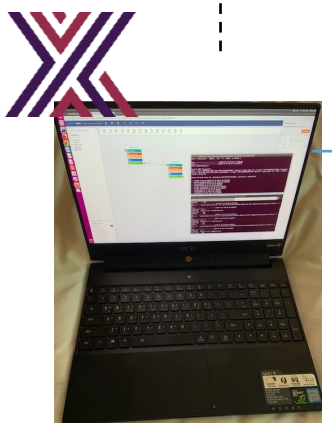


Object-DS



Object-Detector



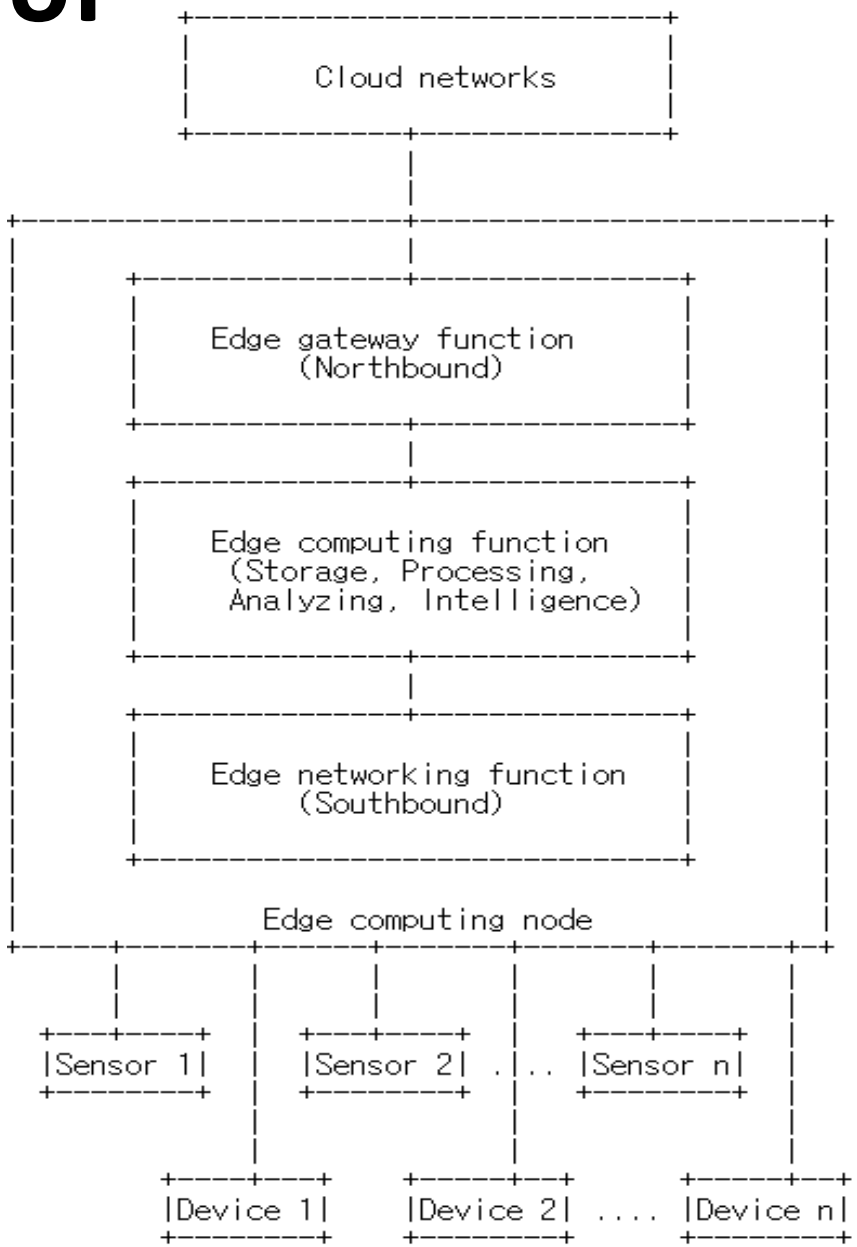


Raspberry pi 3 B+

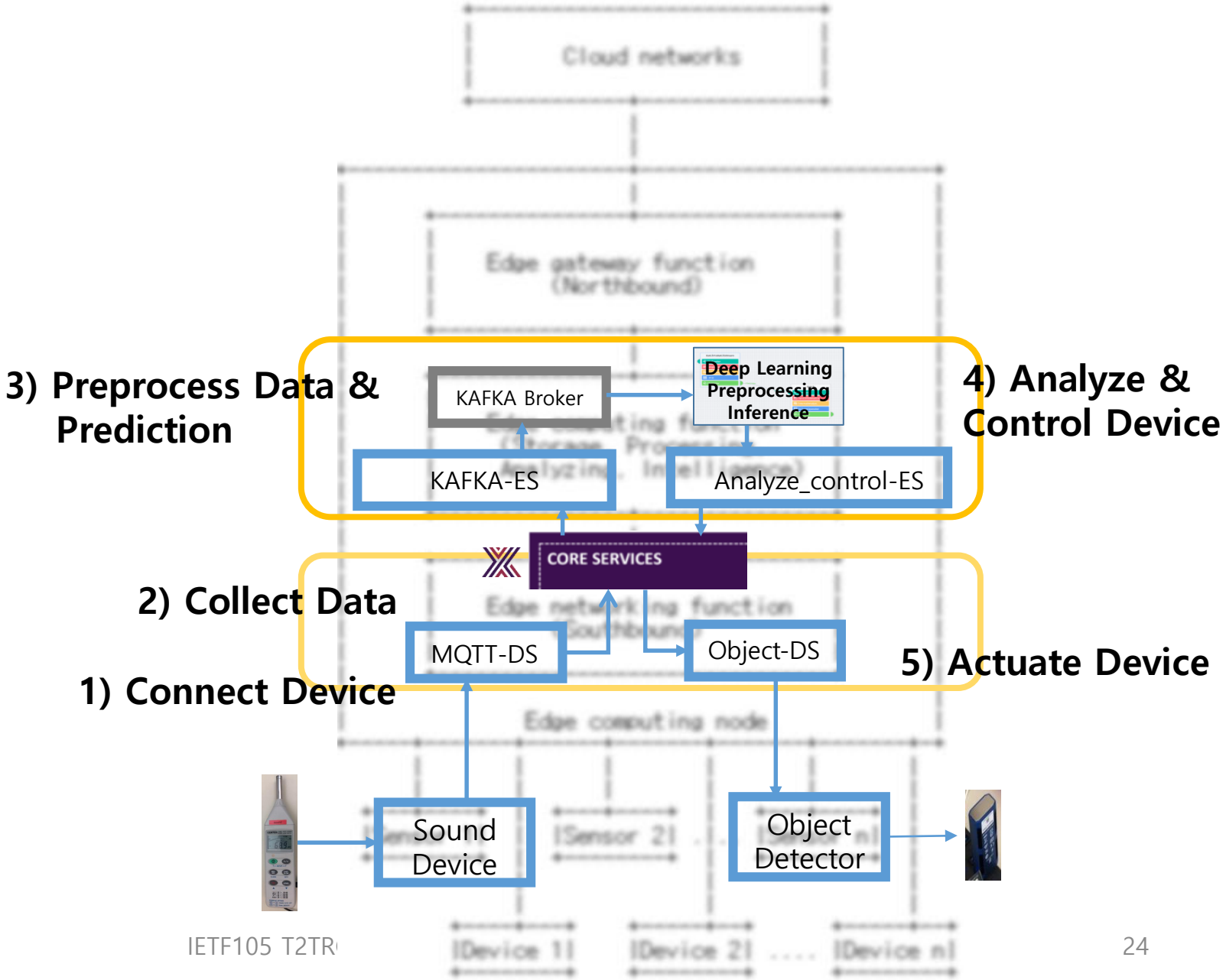
Movidius NCS2

Logitech camera

Gateway-based architecture of IoT Edge computing



How our implementation is related to the draft



Thanks!!

Questions & Comments