IoT Edge computing

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Introduction

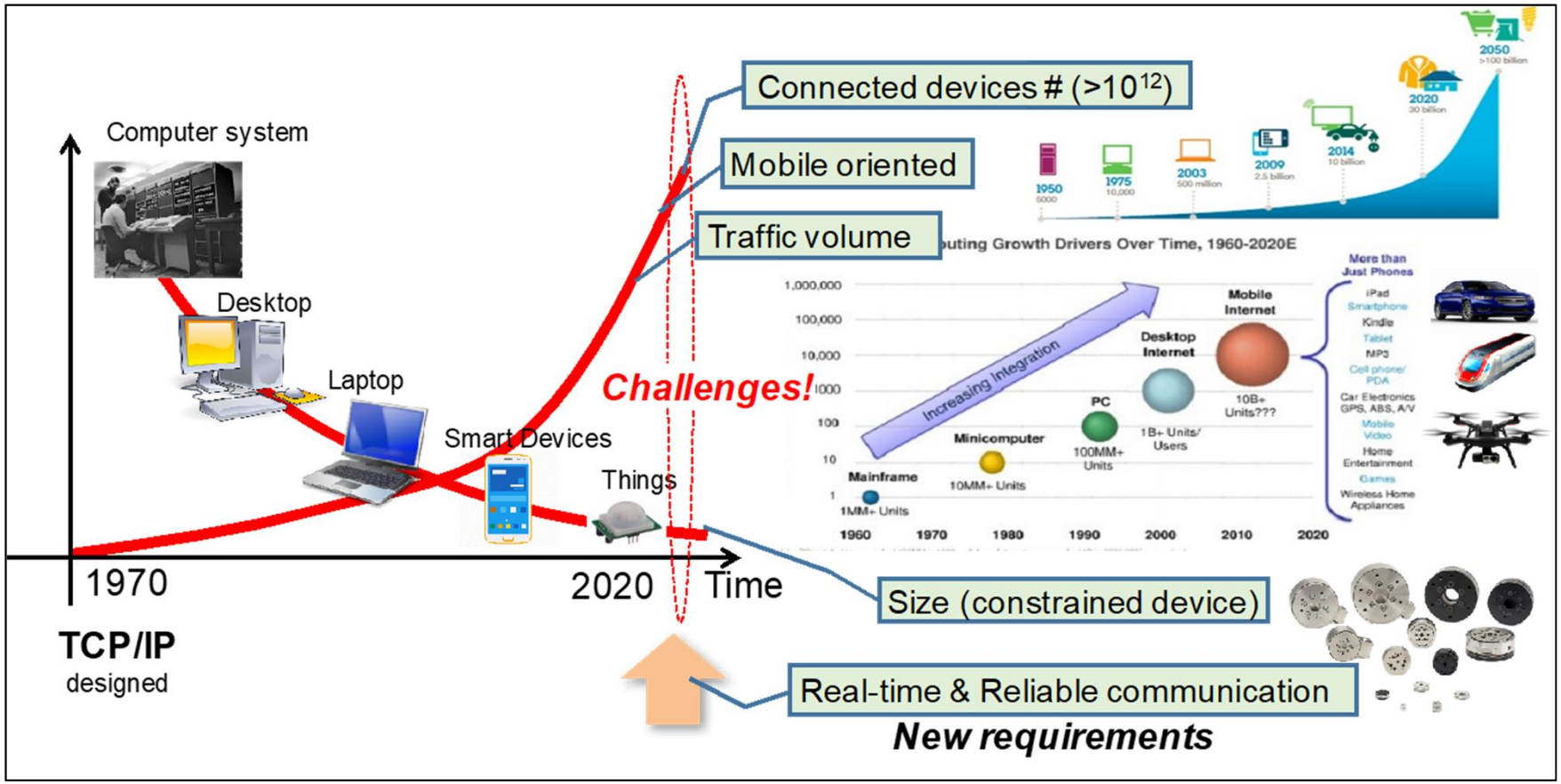
- ***IoT is important paradigm in an ambient way.***
  - We will need *New Big Data paradigm* – to collect, learn and decide all near real-time to use IoT's full potential data.
  - *Converged IoT and BigData* is the best solution to utilize the machine-learning algorithms to make *calculated decisions in mission critical application*.

- ***As extremely increasing huge volume and velocity of data generated from smart things, it is required to handle these data in the middle of Internet such as a local/edge network.***
  - Currently all of them are measured in *zettabytes ($10^{\wedge 21}$)*, and growing *at exponential rates*.
  - One such set of numbers measures *2014 data at 4.4ZB* and estimates *2020 data at 44ZB* from IDC.

Motivation (1/2)

–Development of IoE Network Architecture

- For Hyper-connected IoE environment



Motivation (2/2)

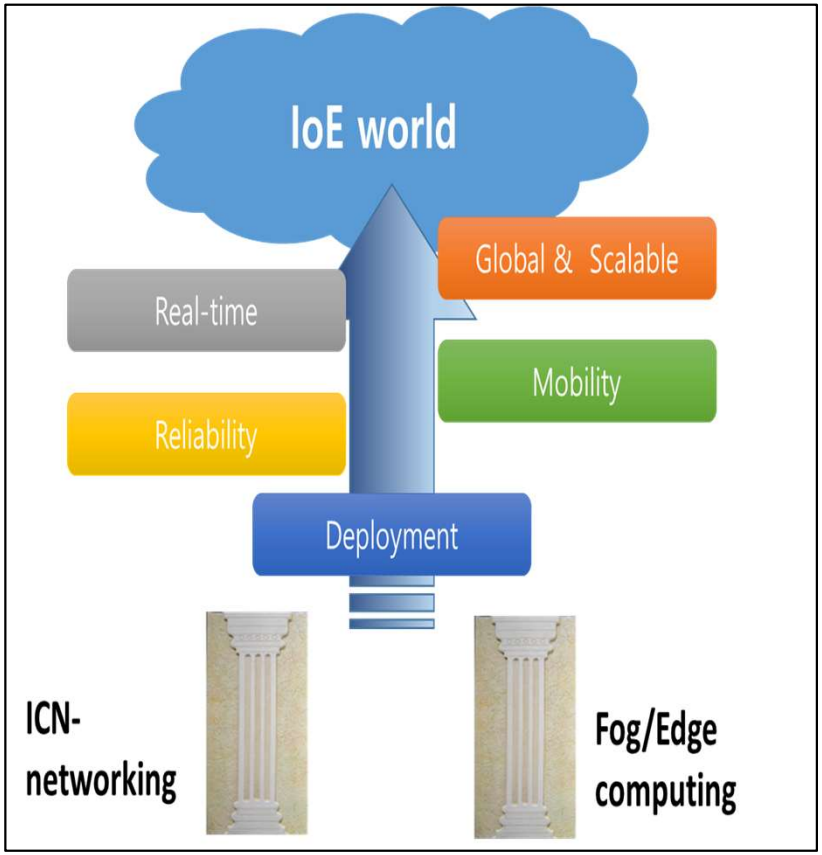
– ***Regarding Edge and Fog computing layer, there are the Edge Computing (EC), the Fog Computing (FC), the Mobile Edge Computing (MEC) and so on.***

- *MEC* is special technology at *the edge of the cellular network*.
- By the way, EC and FC are technology concept supporting various implementation technique.
- For the important *difference between Edge computing and Fog computing*, Edge support computing functionality *in edge network* and Fog support computing functionality *in relation with cloud computing*.
- Therefore, edge locates *in edge of network*, access network and fog locates *near user side in local and edge network* and so on.

– ***For implementing fog computing technical concept, we propose intelligent data processing (and self-machine learning) equipment for converged wireless and wired network providing AI (Artificial Intelligence) service as Intelligent IoE Fog Networking Platform.***

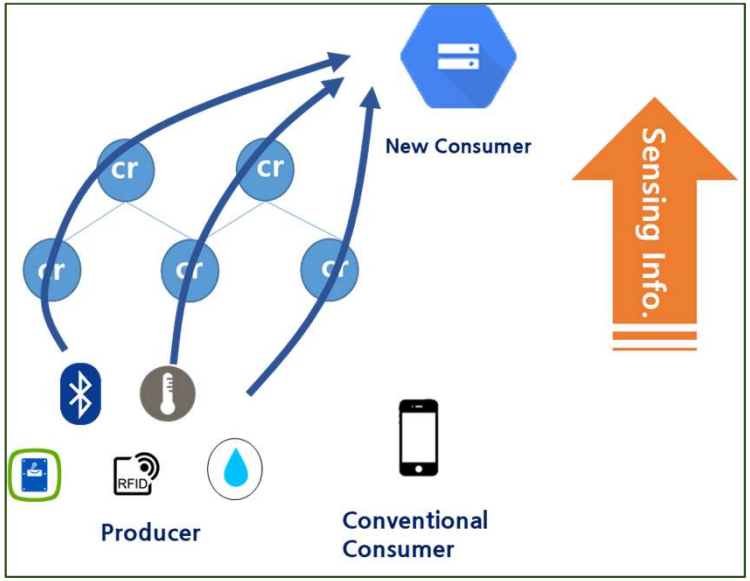
- Recently data for AI service is increasingly exploding.
- If network equipment provides data to cloud computing with simple connectivity, severe data lost or network delay occurs because of network bottleneck.
- Therefore, we need equipment collecting *reliably data and providing valuable data to cloud AI in network sides*. Also through self-machine learning, we can *analyze the data and response promptly*.
- And we will apply mainly *the mission critical service (real-time and high-reliable service)* through processing and analyzing high quality data with this equipment.

Requirements & Principles



- ICN based communication for Inter-networking
- Applied Fog concept to Edge network as domain network
- Information centric reliability support (Information security and privacy)
- Domain specific networking structure
- Name and Information centric Mobility Support
- IP core network consideration
- Global Testbed

Considerations for IoT

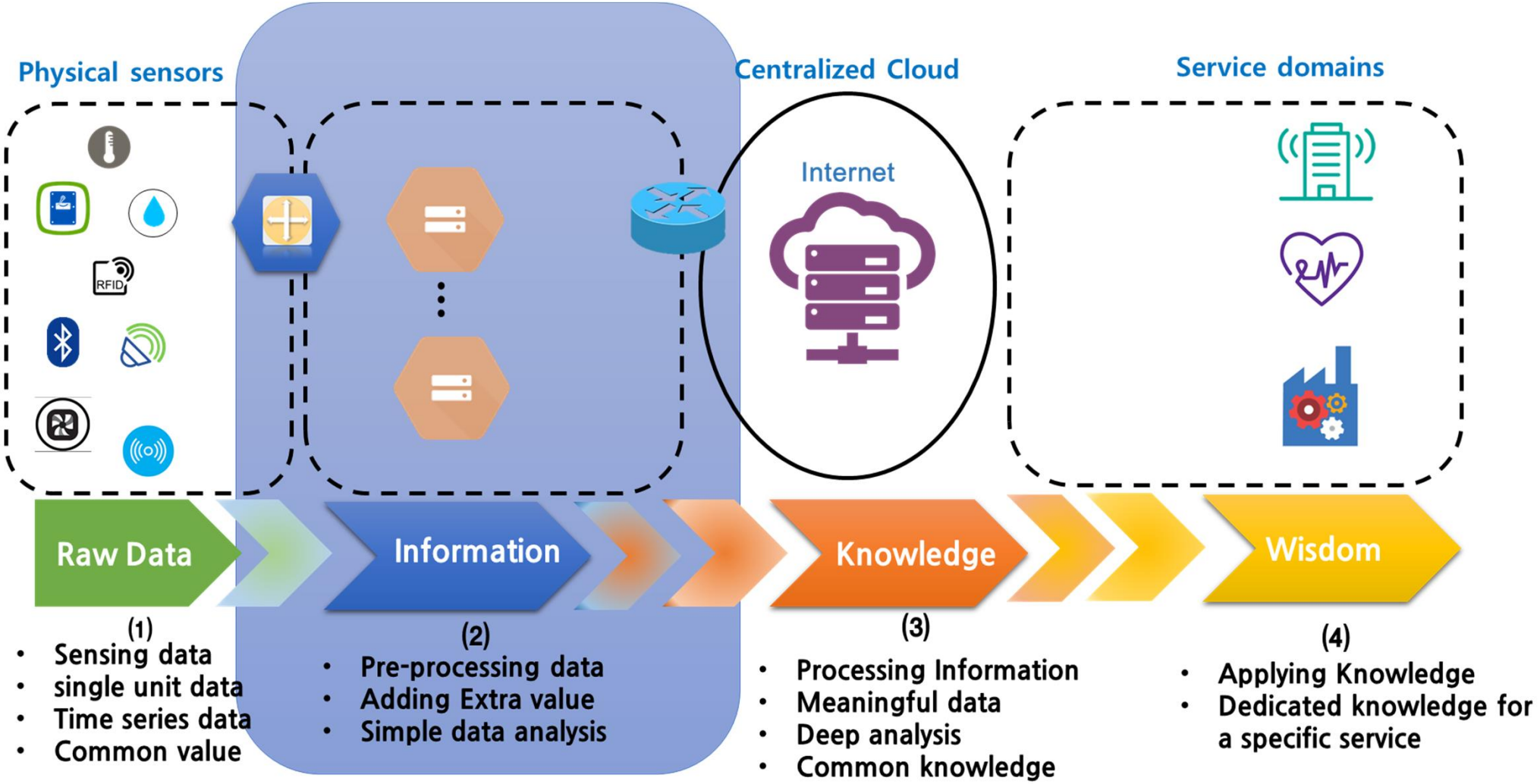


– ***Multiple producers*** model
  - Differ from common ICN model
  - Differ from common consumer
    - Cloud, data server, etc.

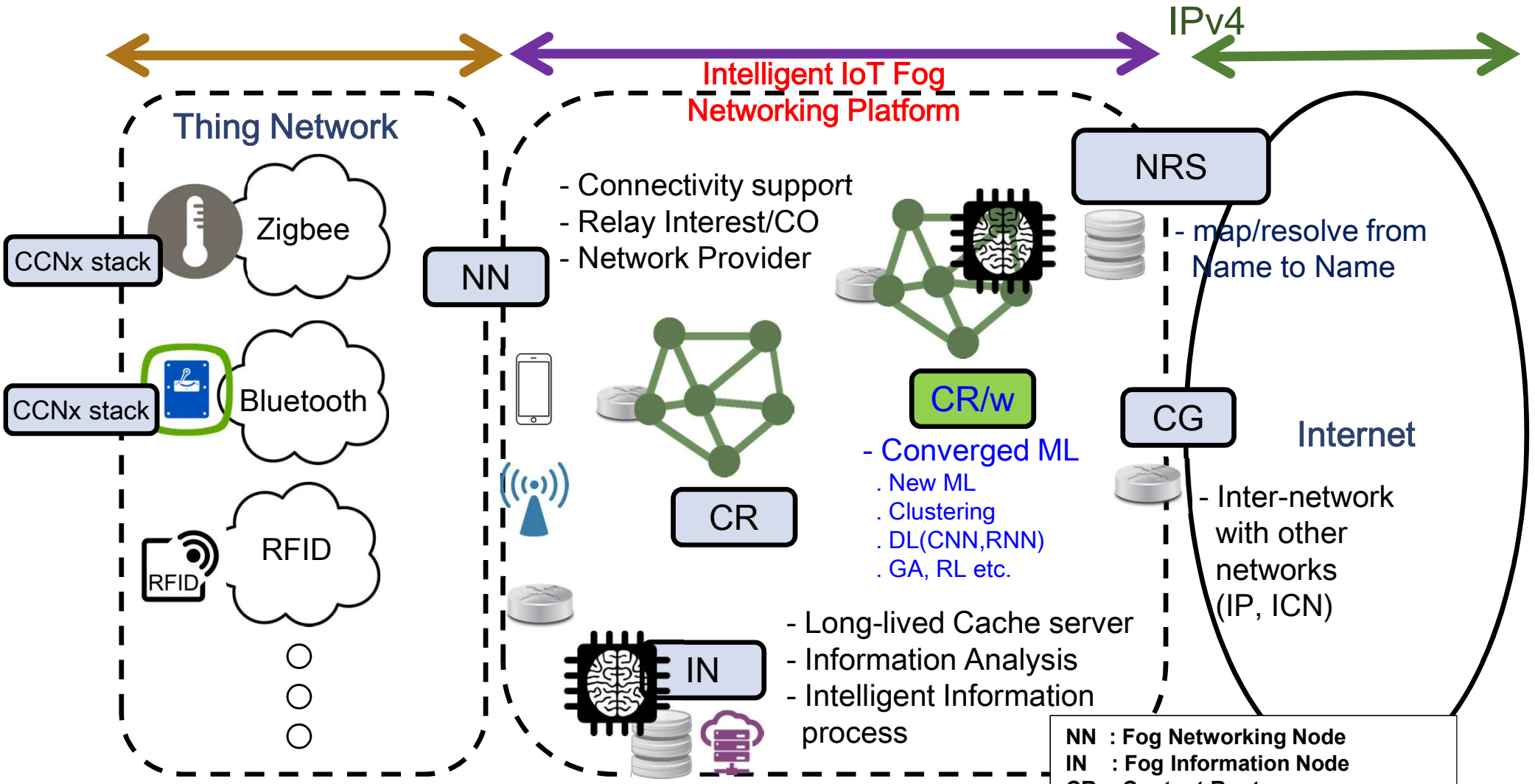
– Producers can ***move out*** commonly
  - Moving producers enabled with People, Car, etc.

– ***Various IoE service*** domains
  - Smart building, home, city, etc.
    - Pre-process Information
  - Information flow according to service domains
    - Non-cache, analyzed information, information push, etc.

Considerations for Information

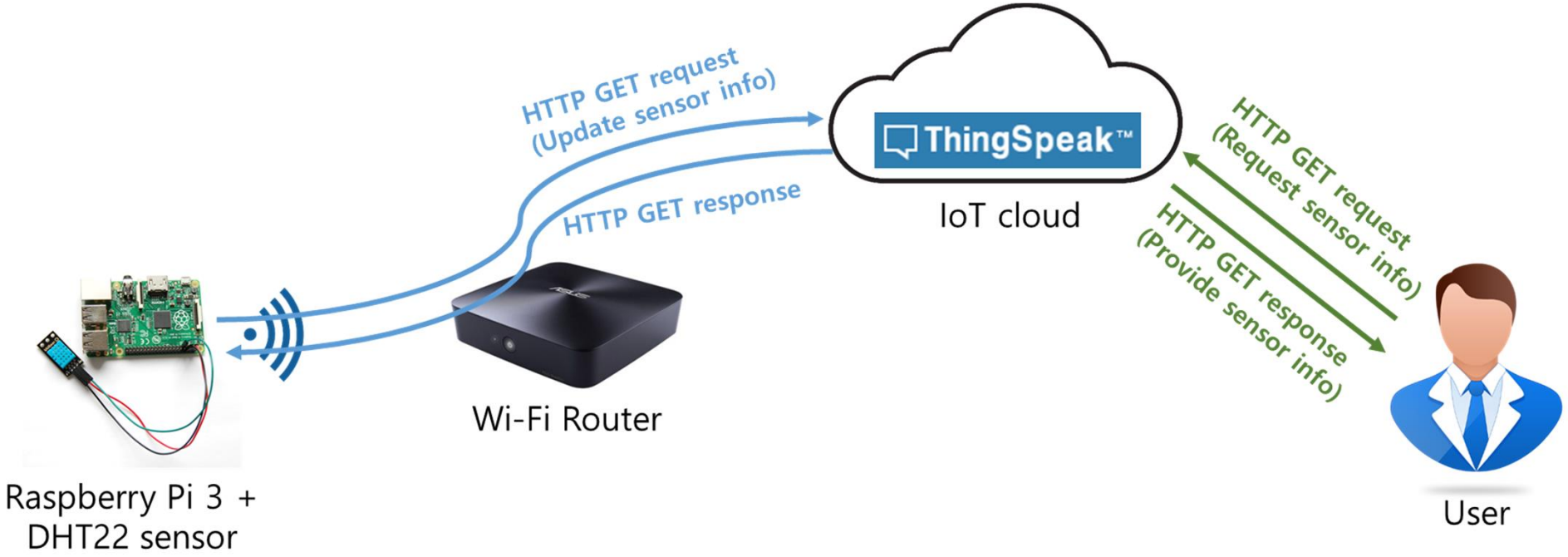


Overall Architecture



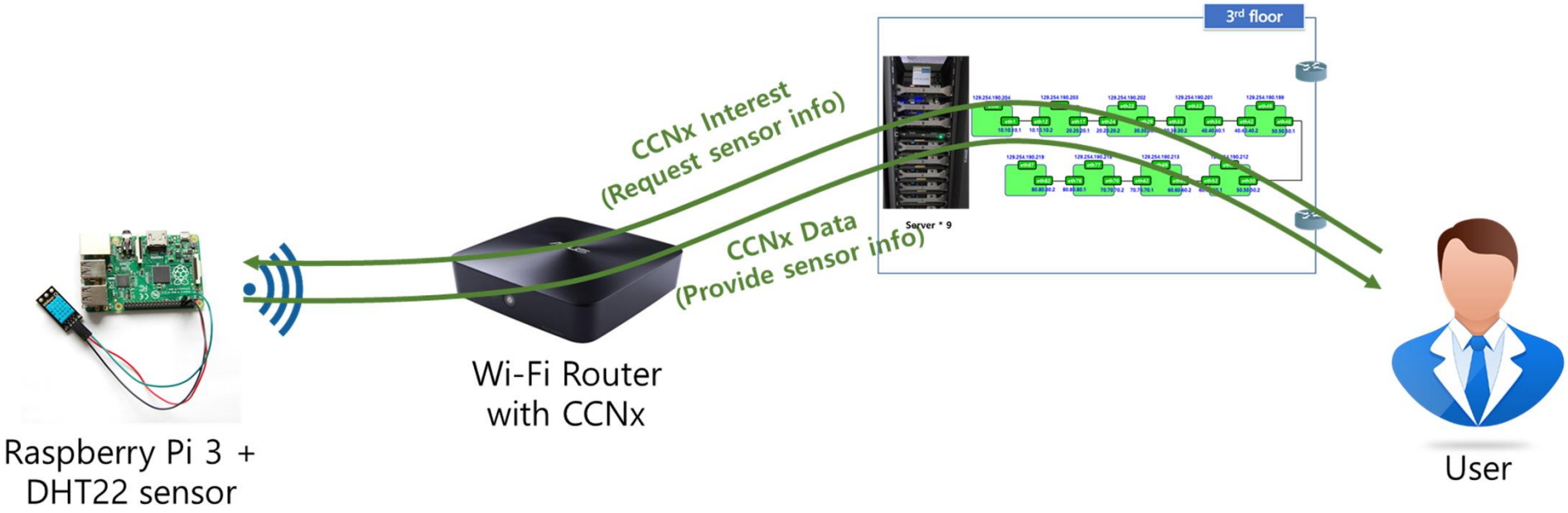
Use cases 1 – ICN-Fog Scenario (1/5)

- IP Cloud Architecture
  - Use open Cloud service
  - Sensors periodically updates its status
  - Communication between user and Cloud



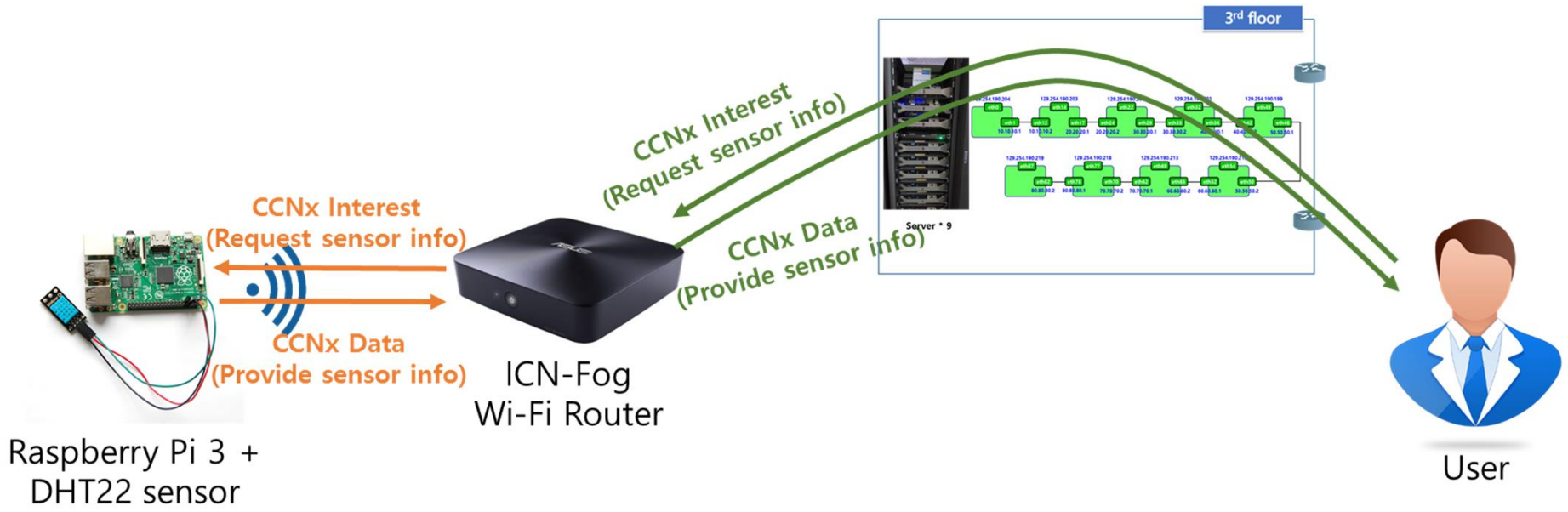
Use cases 1 – ICN-Fog Scenario (2/5)

- Basic ICN architecture
  - Sensors directly respond to interest messages
  - Operate as on-demand
  - Disable caching function in Wi-Fi router (Content router) to avoid stale cache



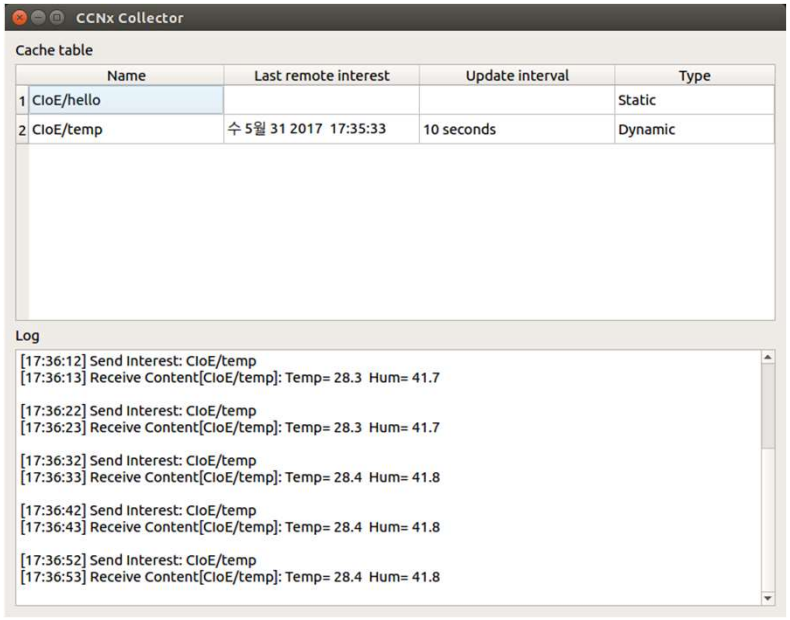
Use cases 1 – ICN-Fog Scenario (3/5)

- Applying Edge/Fog function in ICN
  - Enable intelligent caching function in Wi-Fi router (Content router)
  - Wi-Fi router periodically collects data from sensors after receiving interest messages
  - It controls network overload in a wireless connection



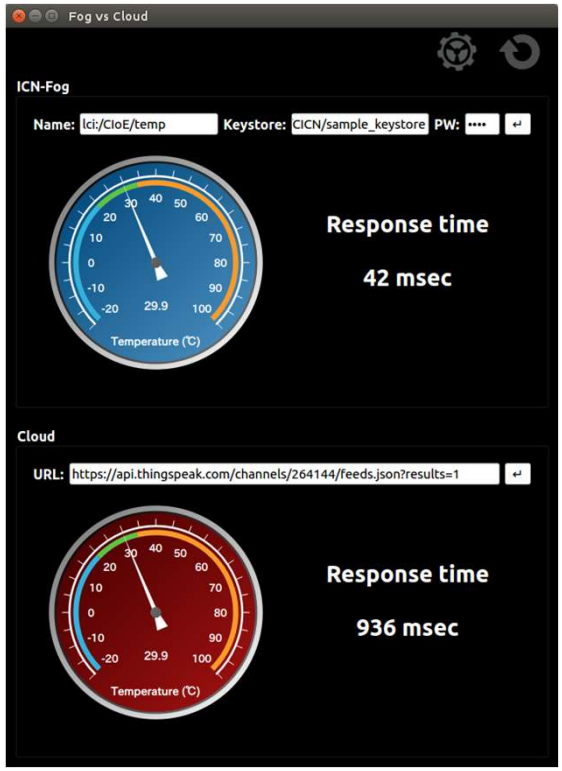
Use cases 1 – ICN-Fog Scenario (4/5)

- Basic CCNx caching function
  - Only On/off
- Intelligent cache function for IoT environments
  - Wi-Fi router detects interest messages
  - Periodically generate interest messages and update cache
    - Enable network overload in wireless
    - Enable management of the period of update of sensor information

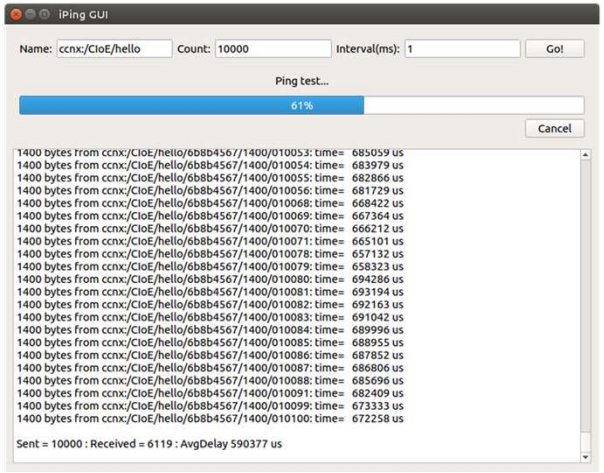


Use cases 1 – ICN-Fog Scenario (5/5)

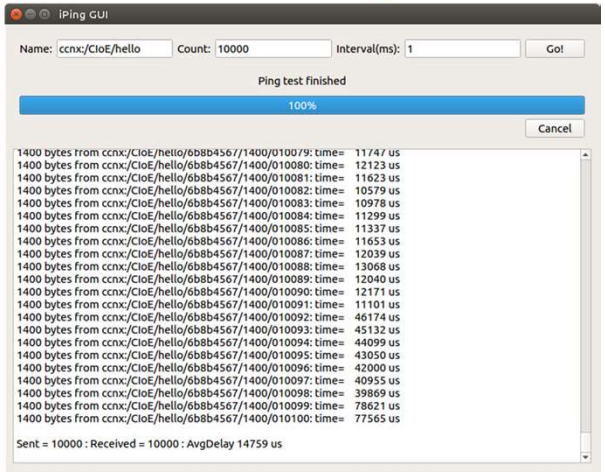
- Comparison between Cloud, CCNx, ICN-Fog



CCNx



ICN-Fog

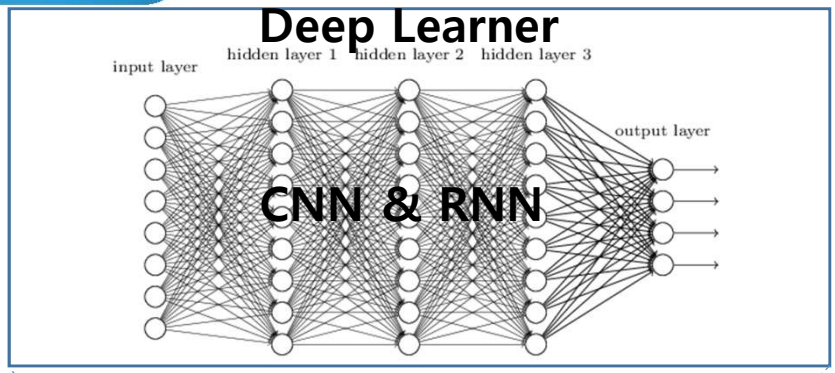


	Cloud		CCNx		ICN-Fog	
	Light	Heavy	Light	Heavy	Light	Heavy
Time to acquire data	1221 msec	-	56 msec	786 msec	**28 msec**	**30 msec**
Ratio of packet loss	0%	-	0%	42%	**0%**	**0%**

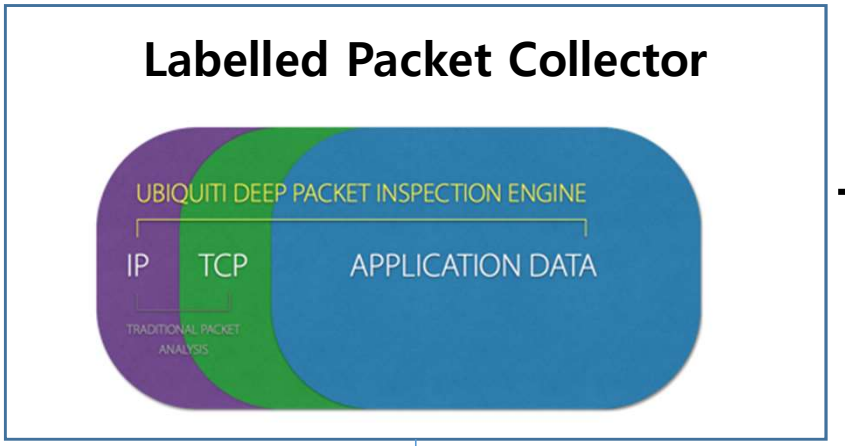
- Light traffic: Transmit 100 interest messages per 1 sec.
- Heavy traffic: Transmit 10^7 interest messages per 100 usec.

Use cases 2 – Traffic Classifier (1/2)

Concept



Model accuracy test & Backtesting



Training/Validation/Test Data

Trained Model

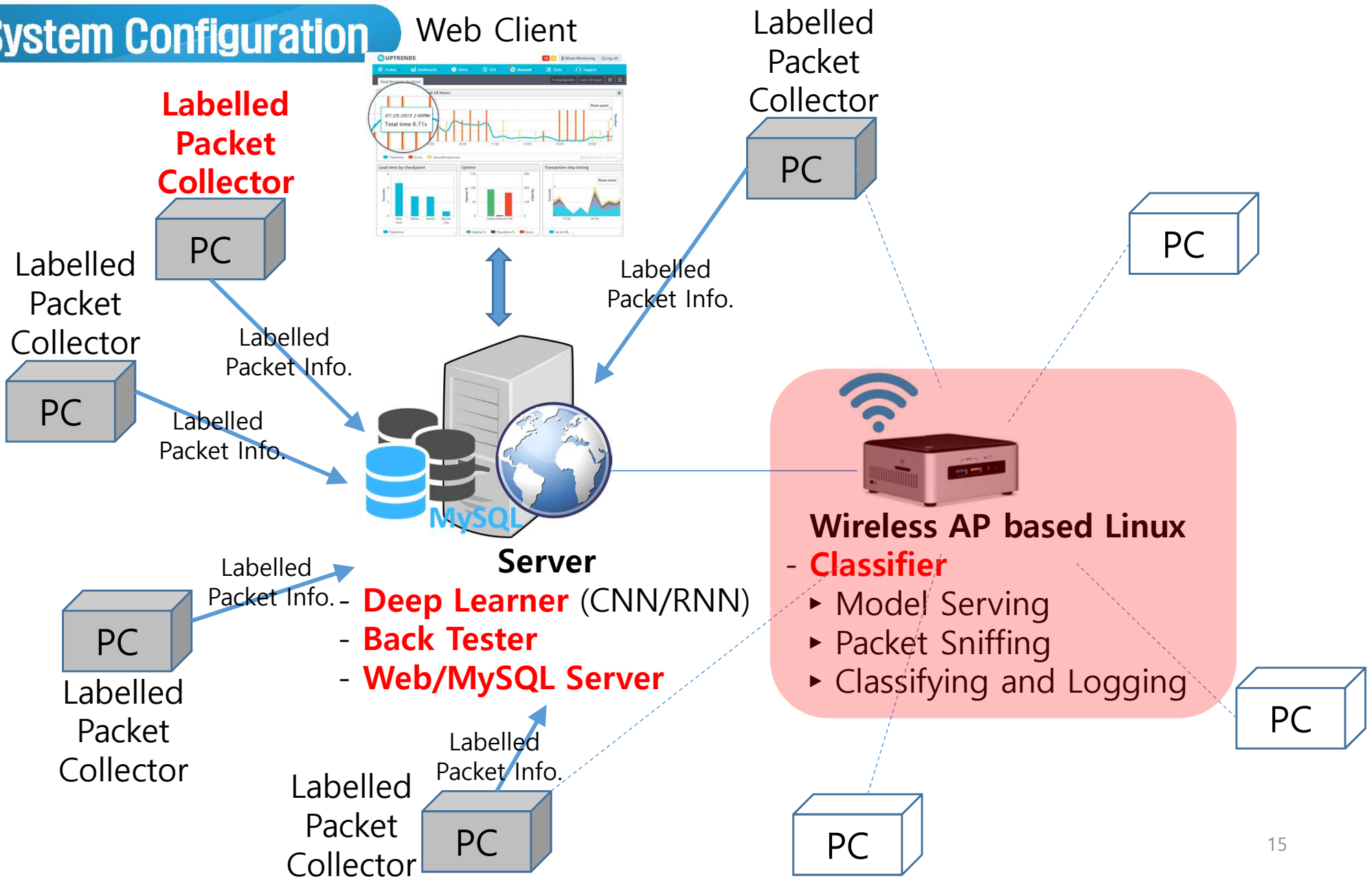
Web-based Feeding, Monitoring & Reporting Tools

Classifier (Model Server)

Traffic to/from IoE

Use cases 2 – Traffic Classifier (2/2)

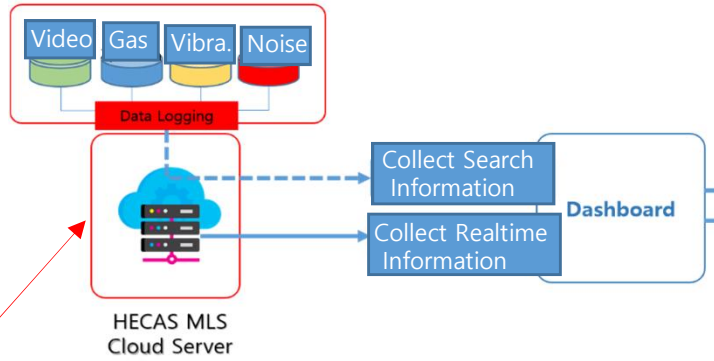
System Configuration

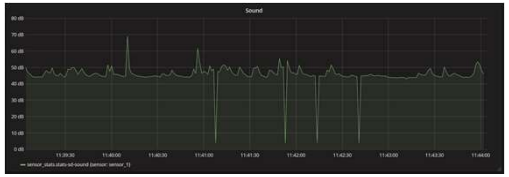


Use cases 3 – Smart Construction (1/2)

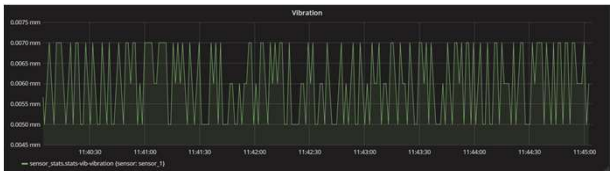
- Construction monitoring data
  - Noise, Vibration, 9 kinds Gas
  - 4 kinds videos : FHD, 360 degree, Drone, FLIR

Construction

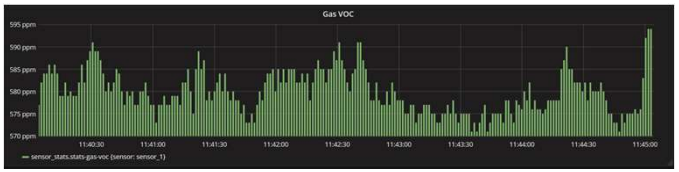




Noise information



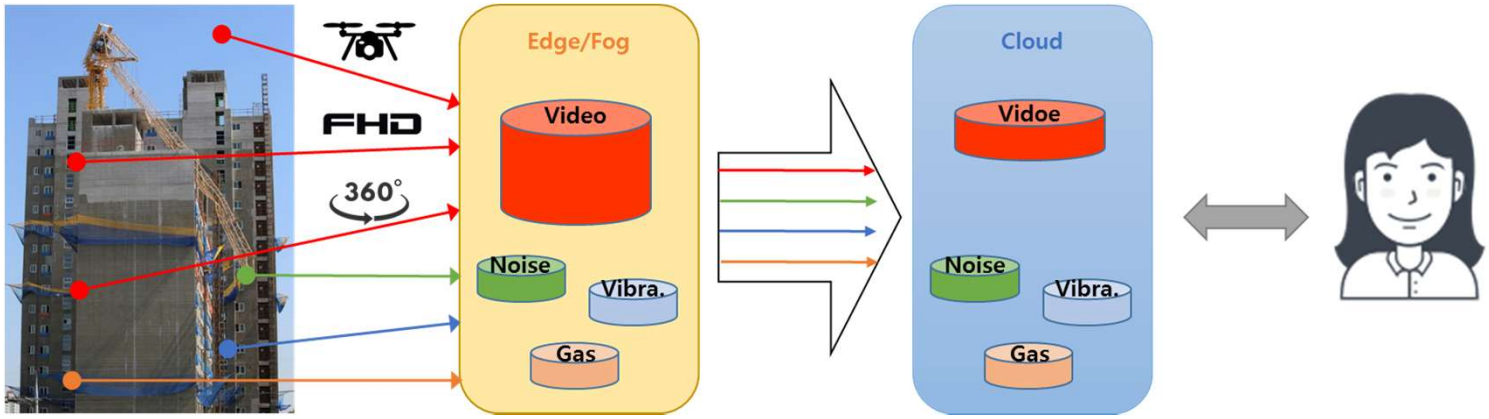
Vibration information



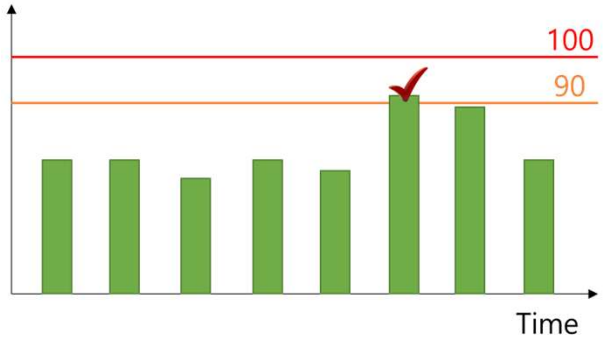
Gas information

Use cases 3 – Smart Construction (2/2)

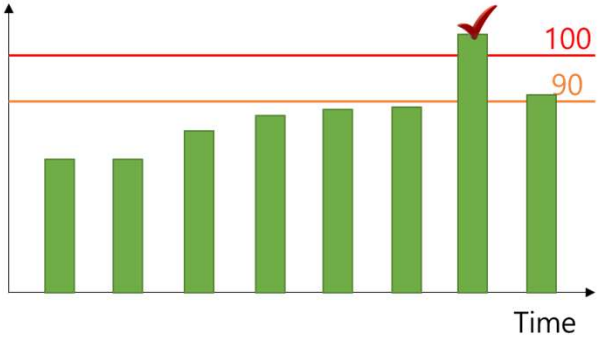
- Transfer Cloud with selective video (quality, type, etc..)



- Predict risk situation ahead in Edge/Fog



False Positive



False Negative

Thanks!!

Questions & Comments