Use cases and requirements of network intelligence

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January 29. 2018

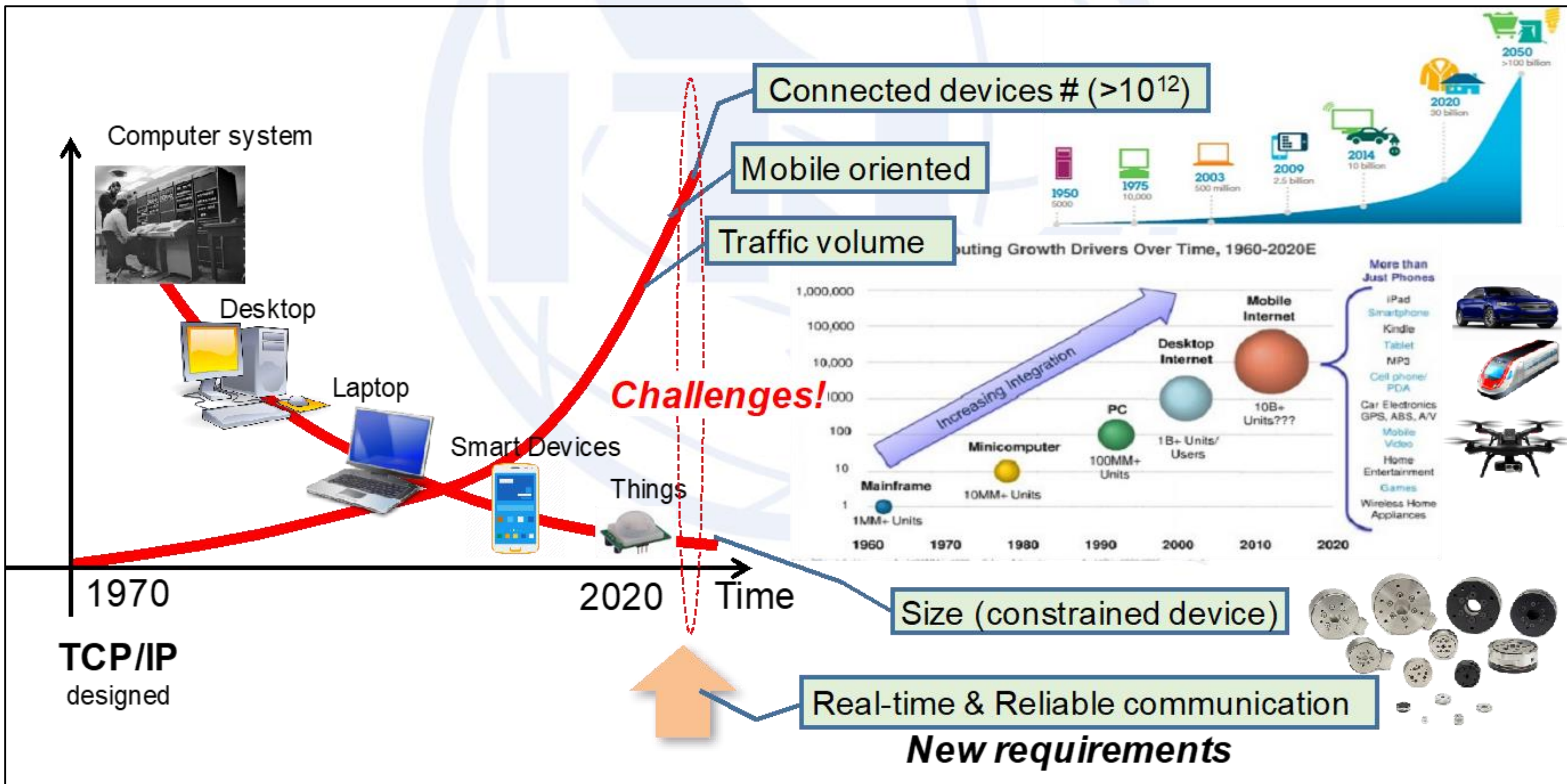
ITU Workshop on "Machine Learning for 5G and beyond"
Geneva, Switzerland, January 29. 2018

Agenda

- Introduction
- Network Intelligence
- Use cases of Network Intelligence
- Requirements of Network Intelligence
- Conclusions

Introduction (1/2)

- Development of IoE Network Architecture

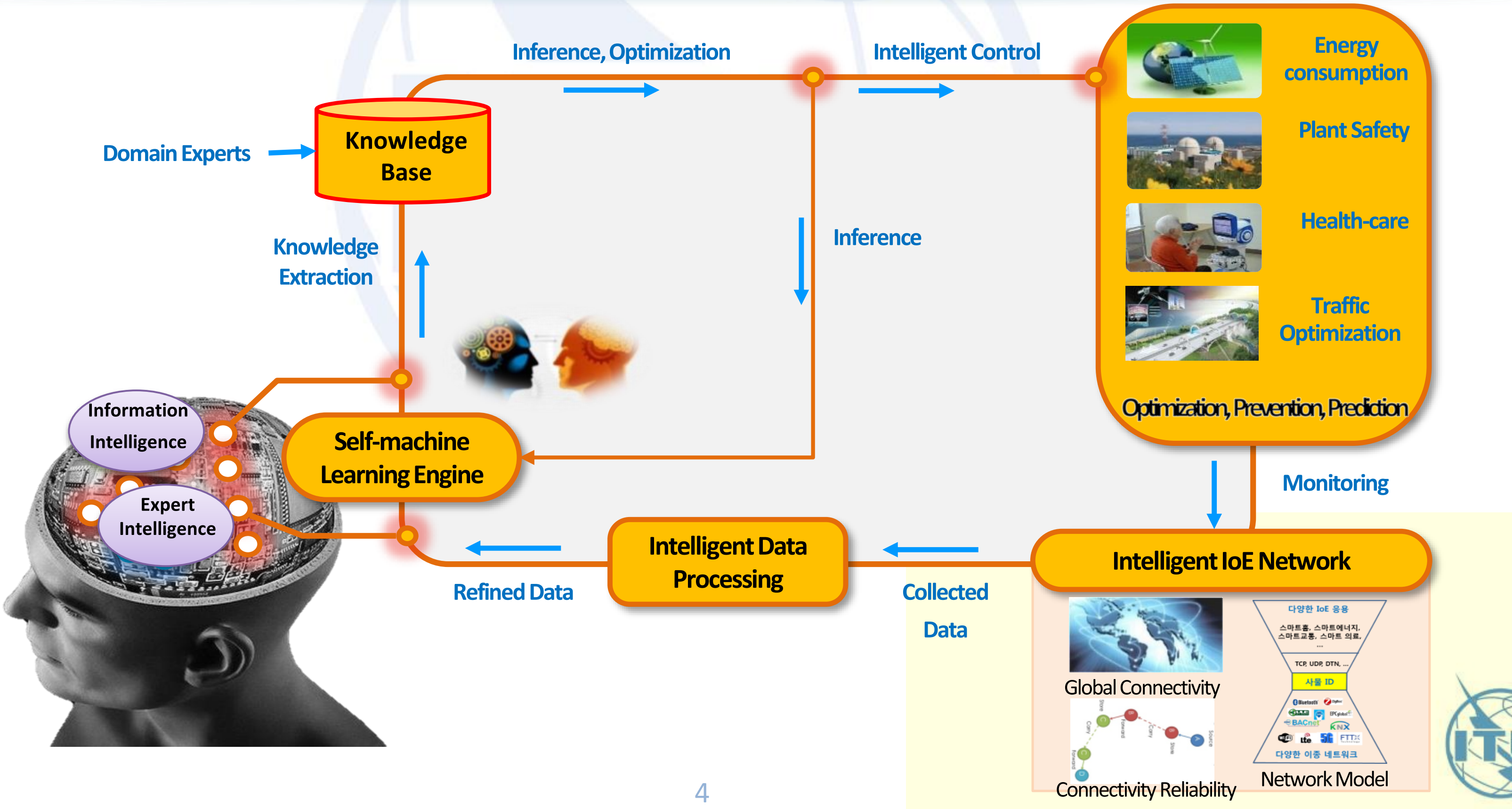


Introduction (2/2)

Knowledge-converged Super-Brain (KSB) Project in ETRI

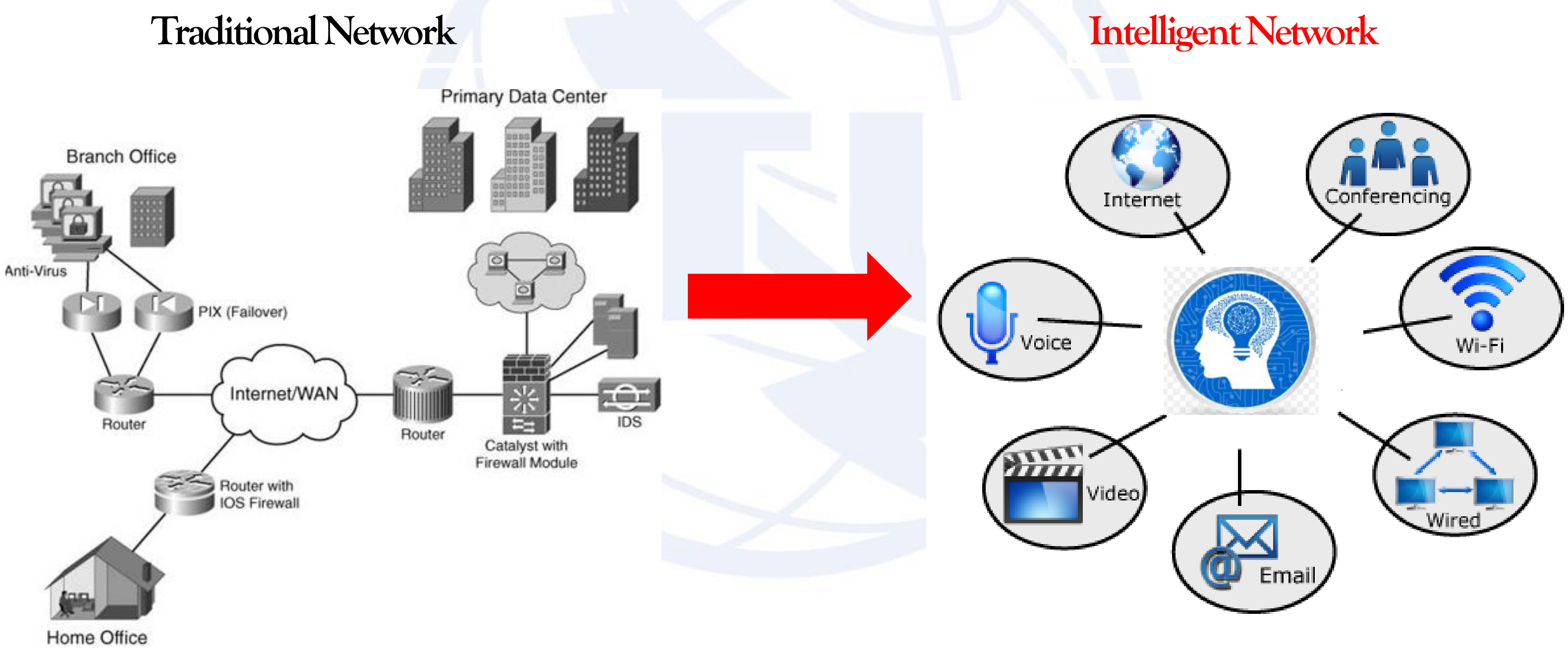
① Monitoring and Data collection ② Data refinement ③ Machine learning and Knowledge extraction

④ Inference and optimization ⑤ Provision of Services



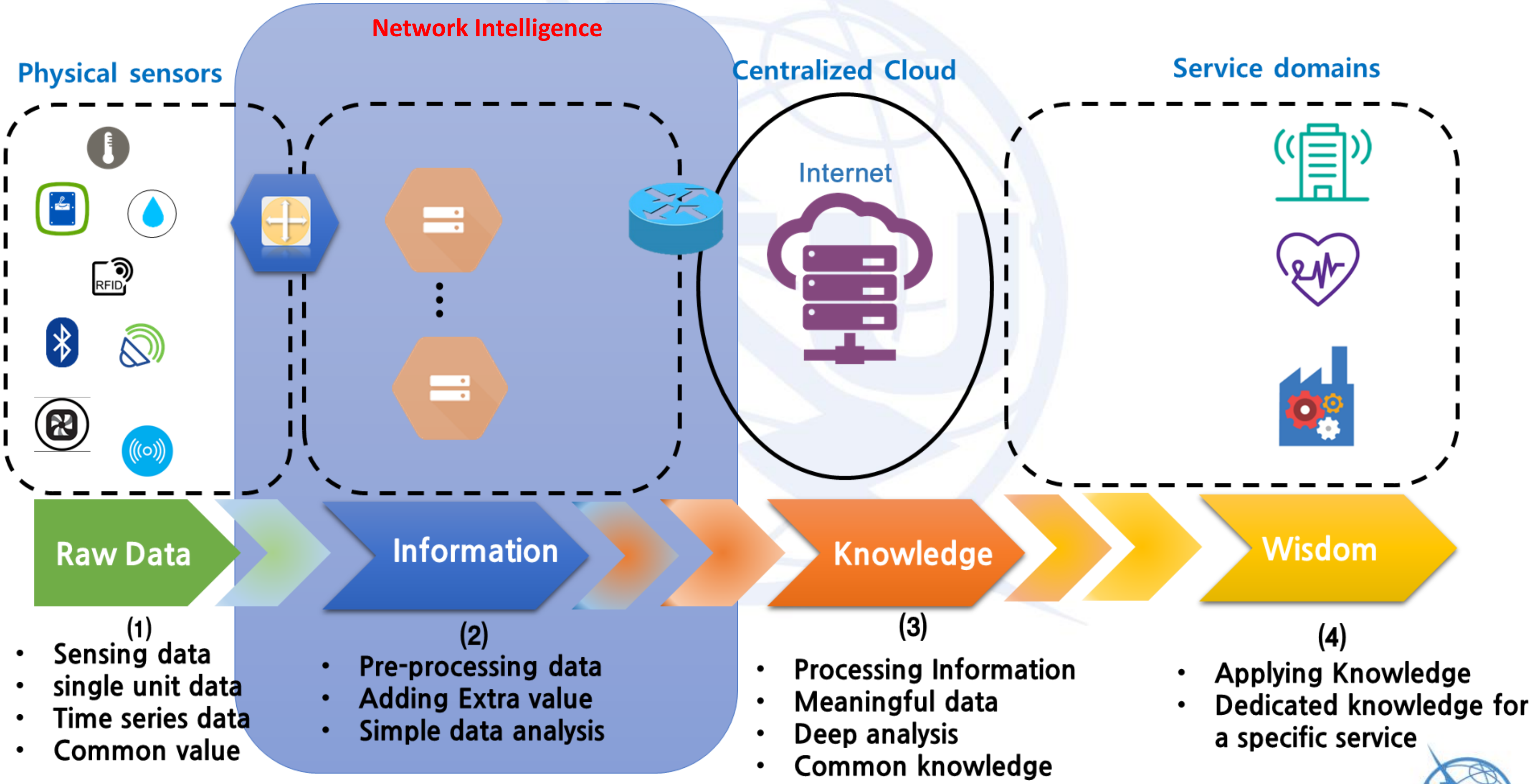
Network Intelligence (1/3)

- Paradigm shift of network

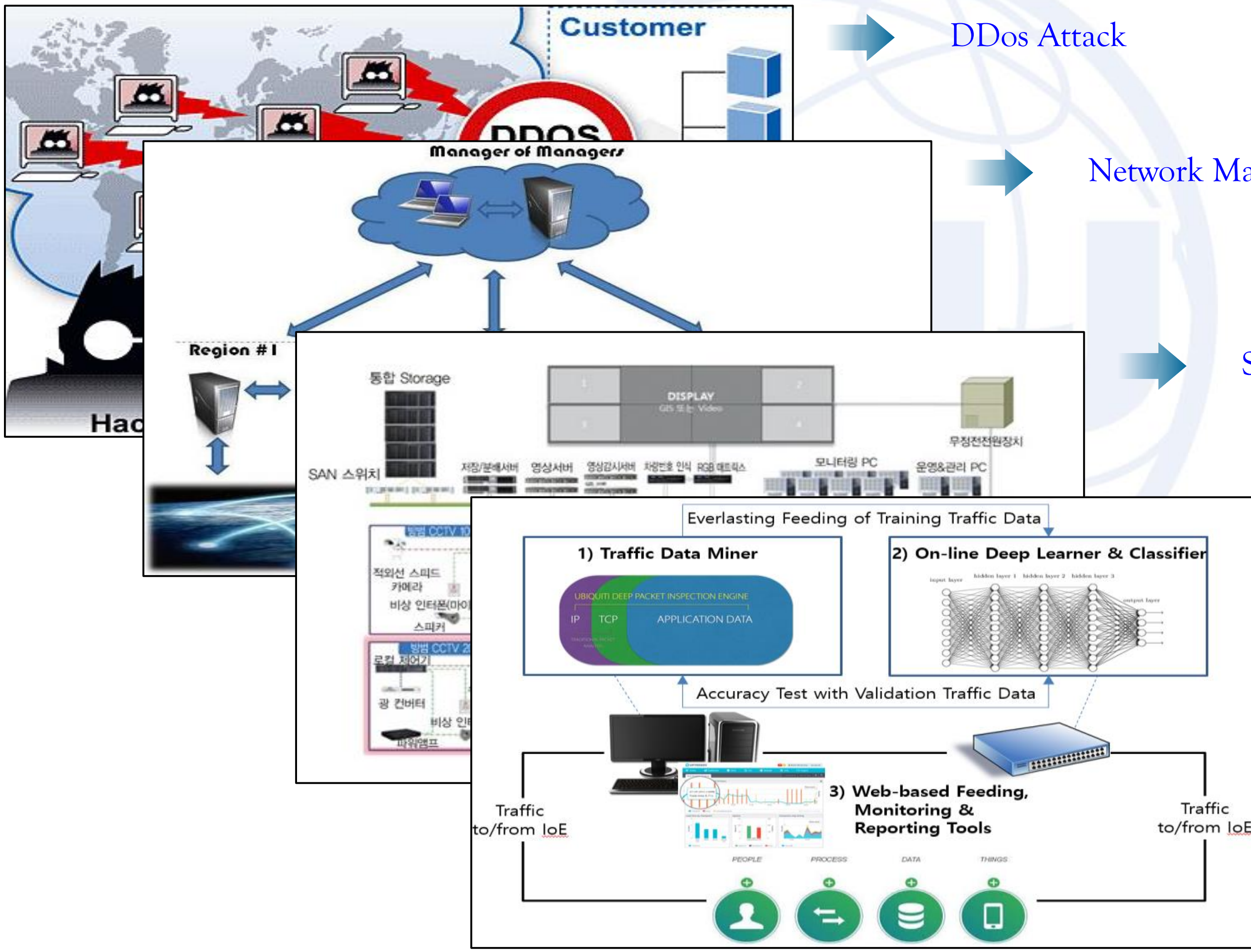


[Source: google images]

Network Intelligence (2/3)



Network Intelligence (3/3)



- DDos Attack
- Network Management
- Self-Organization Network
- Traffic Classification

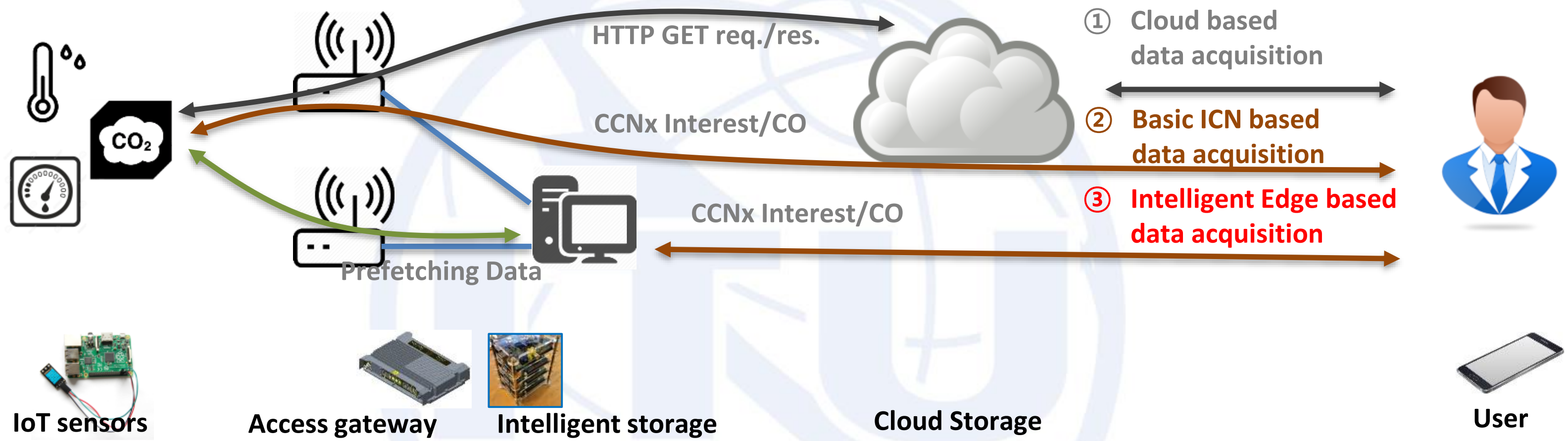
[Ref. IETF nmlrg, idnet]

Use case 1 - Information-Centric Intelligent Edge (1/3)

- Challenges for 5G
  - Information-centric approaches
    - Video as VR (Virtual Reality) and AR (Augmented Reality) is a source of massive network traffic
    - Up to 20 billion IoT devices will be required to transfer enormous data volumes
  - Mobility management
    - Low latency (1 msec) support for Mobility
    - anchorless mobility management for scalability
  - Enabling AI
    - Optimization of network performance for multi-network connectivity, network efficiency, cost per bit, energy consumption
    - Consolidation of service deployment, policy control, resource management, network monitoring and analysis and prediction

- Design of Information-centric Intelligent Edge
  - Information-centric Edge for dynamic data cache/storage via analysis of user, service requests
  - Information-centric Mobility management via analysis of user service types
    - User mobility and producer (data) mobility support
  - Inheritance of advantages of ICN
    - Location-independent name, Data integrity (security), simple communication model (stateless), in-network cache, etc.

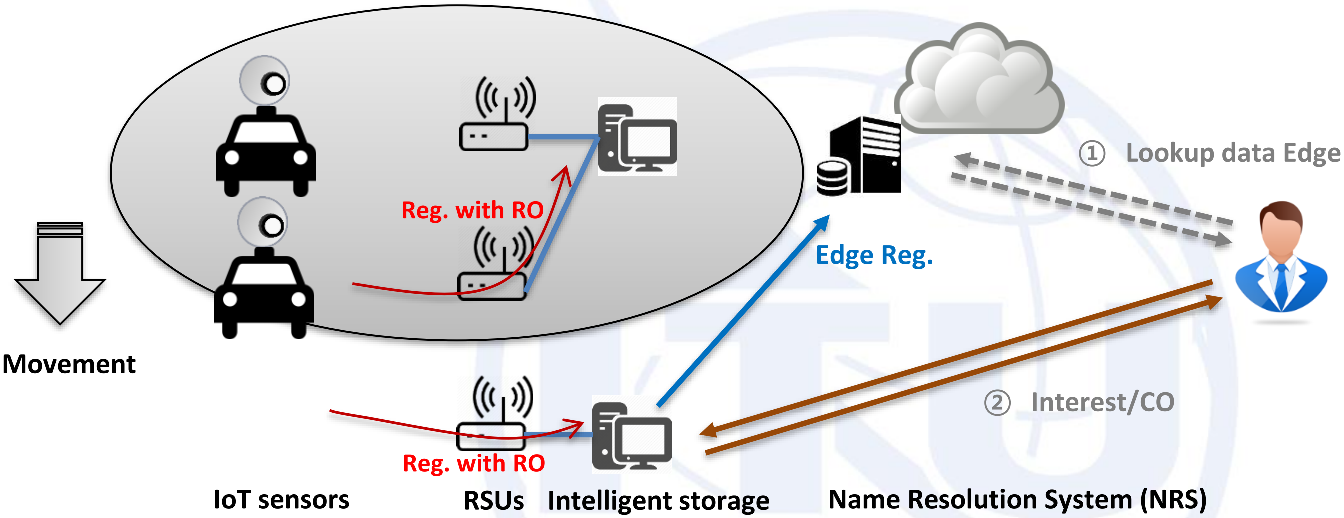
Use case 1 - Information-Centric Intelligent Edge (2/3)

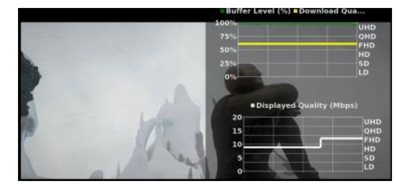


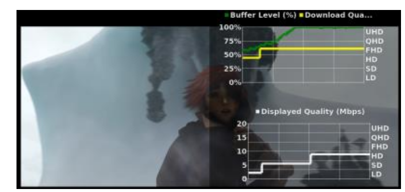
- Intelligent data cache/storage
  - On-demand cache: user requests for Live streaming
  - Prefetching cache: IoT sensing data
  - **Intelligent cache: opportunistic cache via ML classifications of user's requests and producing data types**

	① Cloud		② Basic ICN		③ Intelligent Edge	
	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%**

Use case 1 - Information-Centric Intelligent Edge (3/3)




Steady state in intra-mobility


Streaming in inter-mobility

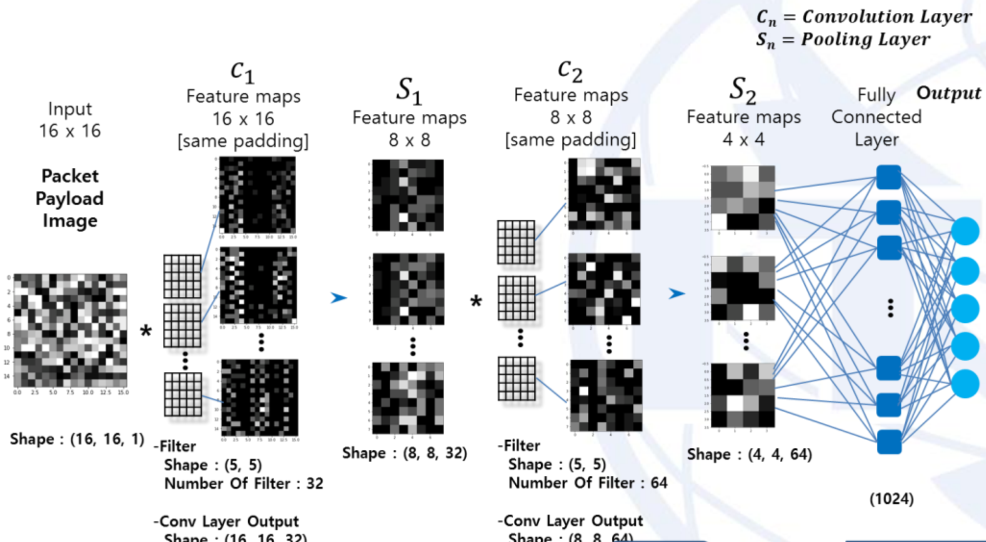
- Mobility management enabled with AI
  - Distributed anchor (edge) based mobility management
  - Edge state management at network
  - Intelligent storage model enabled with ML traffic classifications of user's service types
    - Dynamic cache: IoT data, On-demand video
    - Transparency mode: Live streaming without cache

Use cases 2 – ML-based Traffic Classifier (1/3)

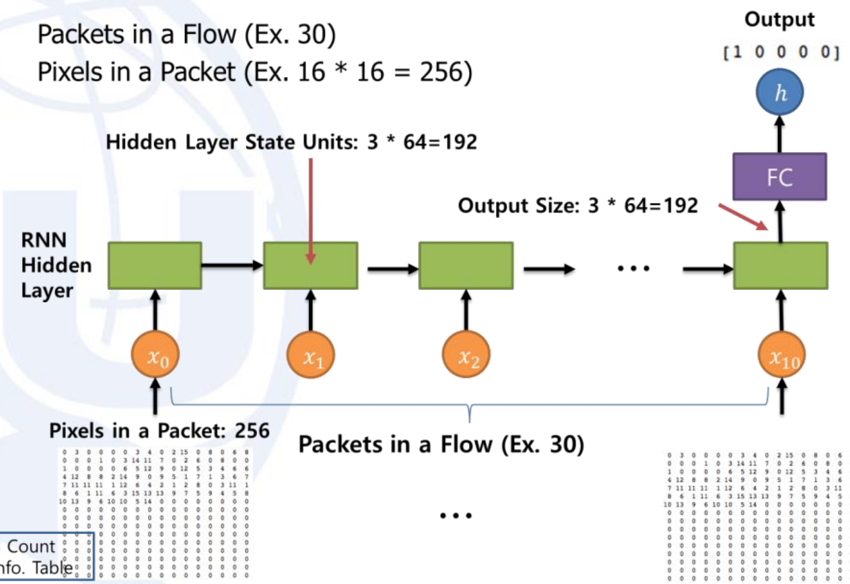
- Purpose
  - Continuously collect traffic data
  - Build traffic classifier model based on collected data and classify
  - Periodically update the generated model
- Key functions of traffic classifier
  - Machine learning model for traffic classier
  - Traffic data miner
  - On-line Data Learner & Classifier
  - Web-based monitoring tools

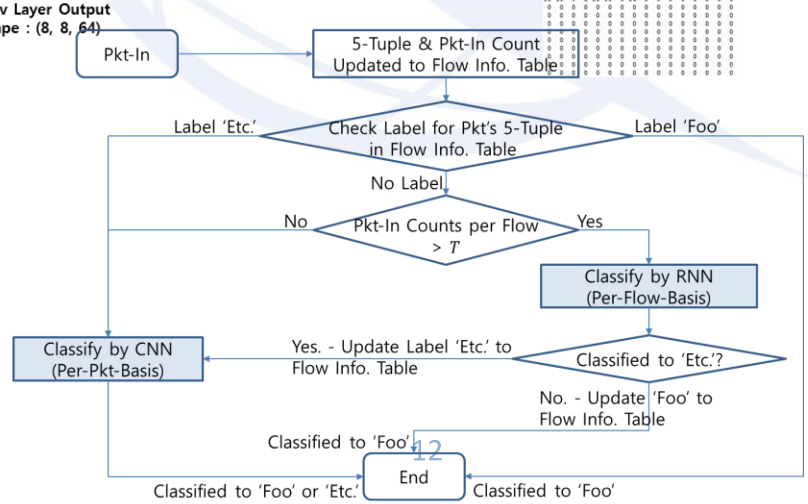
Use cases 2 – ML-based Traffic Classifier (2/3)

CNN: Per-Packet Learning

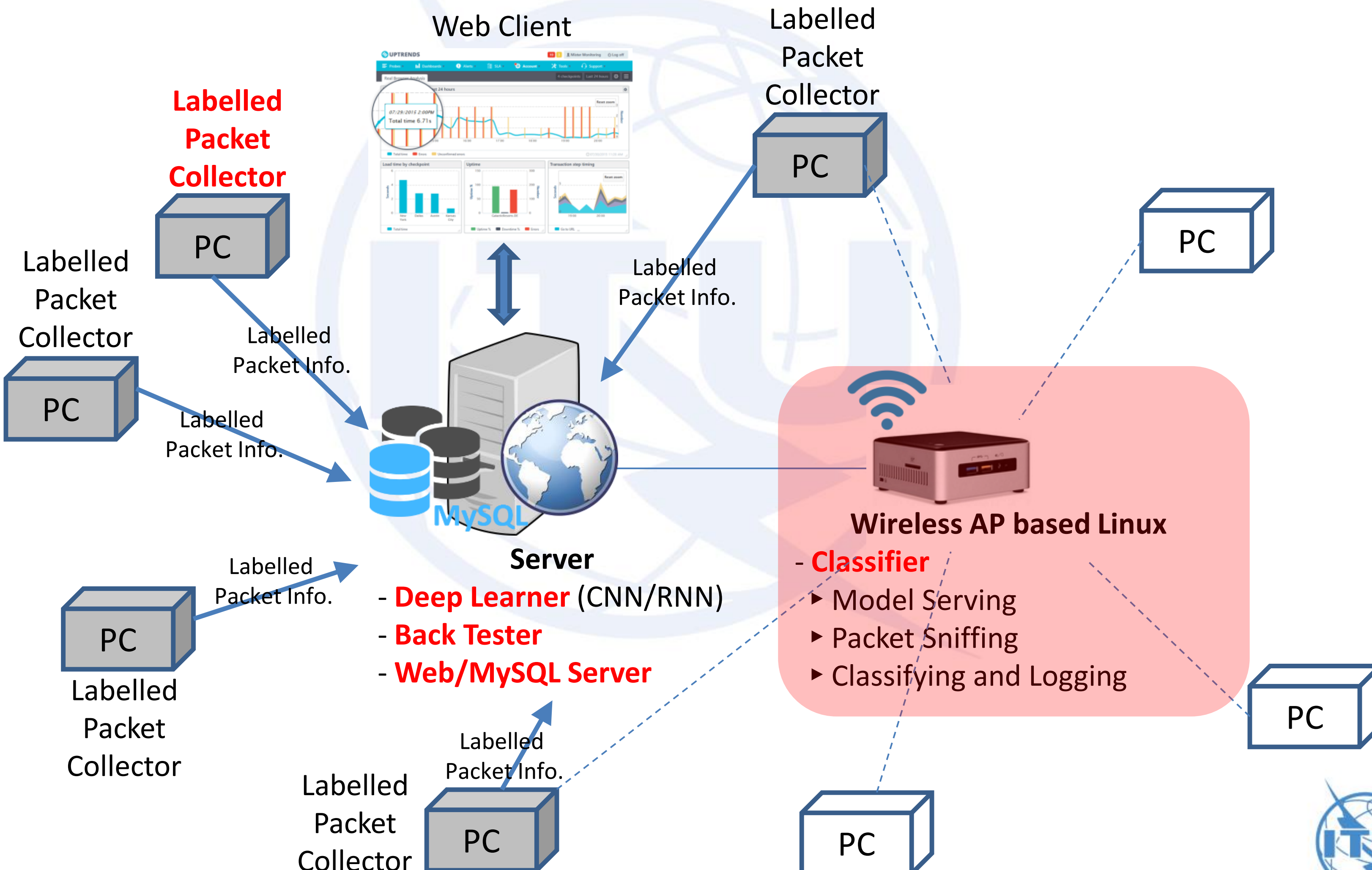


RNN: Flow-based Traffic Classification





Use cases 2 – ML-based Traffic Classifier (3/3)



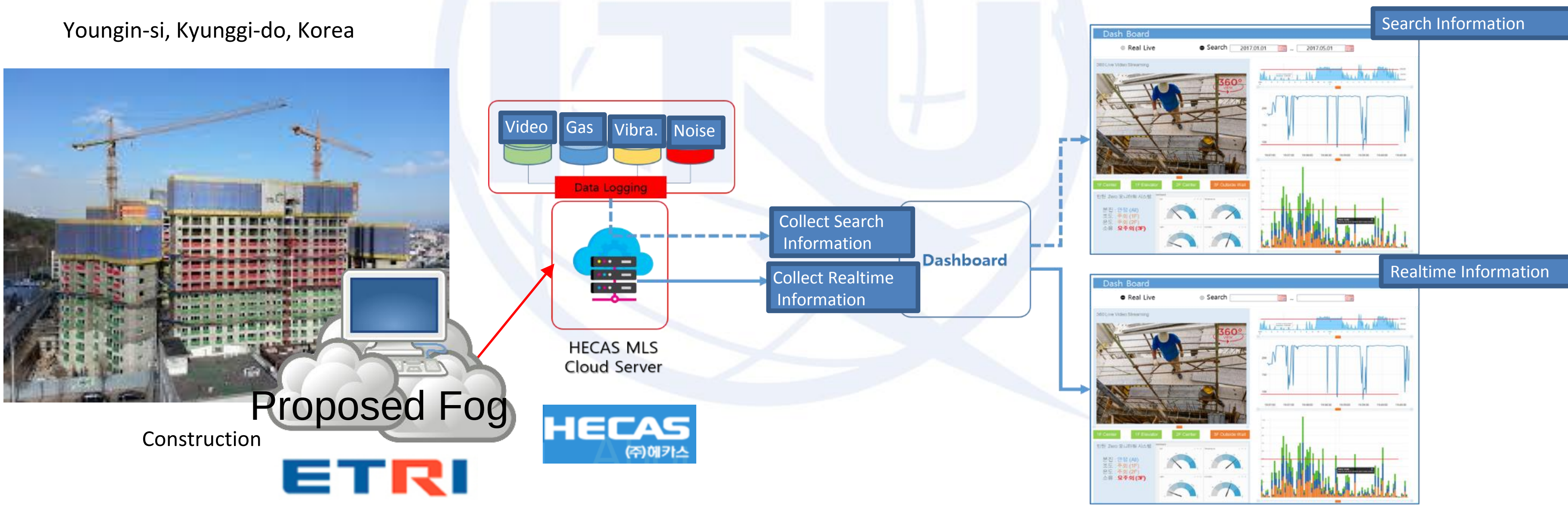
Use cases 3 – Smart construction (1/3)

- Purpose
  - Implementation of monitoring service of construction
  - Characteristic : scalable media data transfer based on alarm
    - We plan to co-work with HECAS (Korean vendor)
- Proposed Fog based Smart Construction Service
  - Collect Construction data (Noise, Vibration, Gas [9 types], video [4 types]) from Proposed Fog equipment
  - Transfer central cloud with selective videos (quality, type, etc.)
    - small amount of video volume

Use cases 3 – Smart construction (2/3)

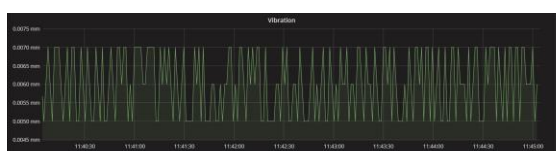
- Testbed setup
  - Noise, Vibration, 9 kinds Gas
  - 4 kinds videos : FHD, 360 degree, Drone, FLIR

Youngin-si, Kyunggi-do, Korea

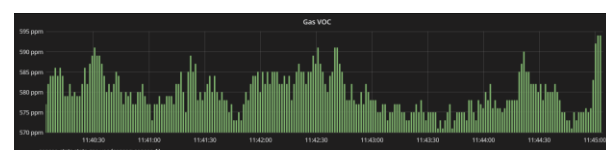


Construction

Noise information



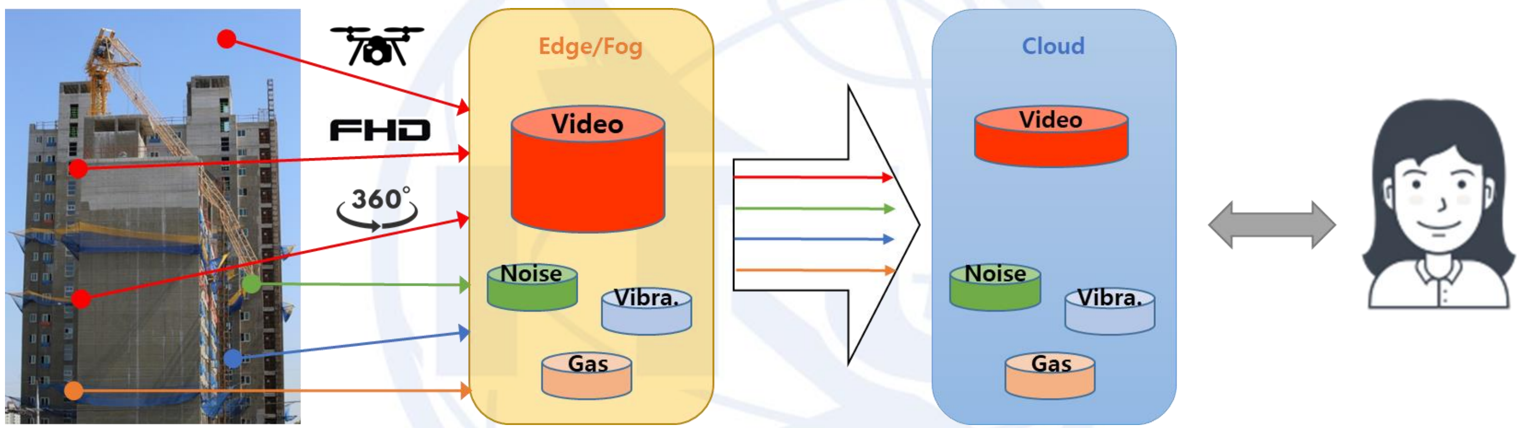
Vibration information

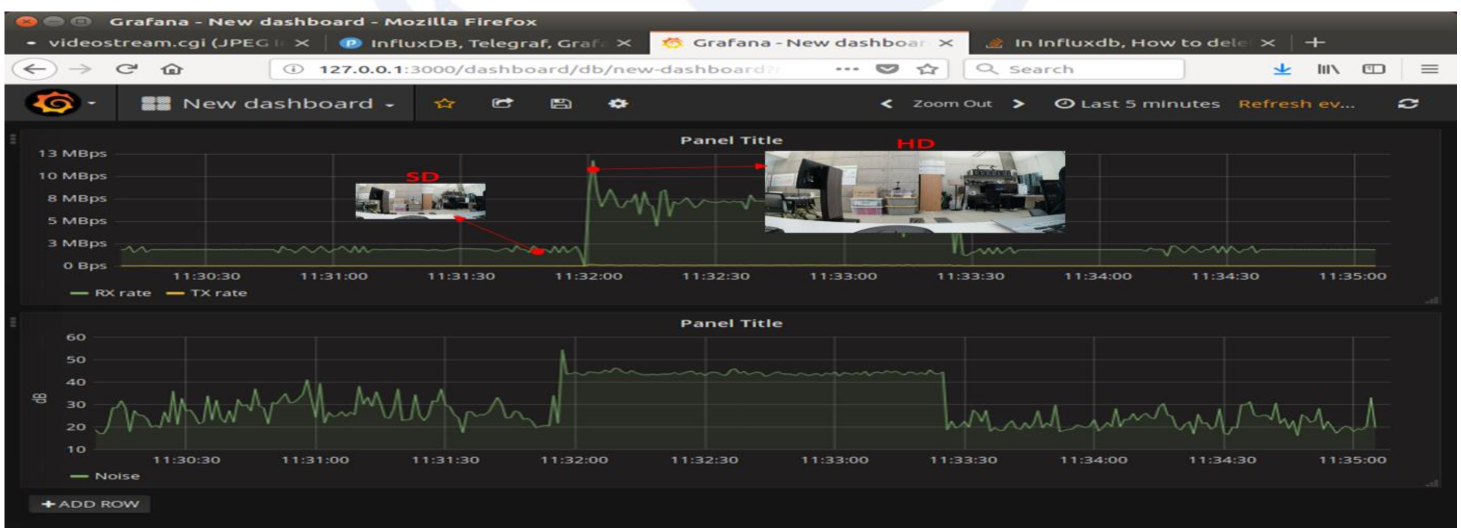


Gas information

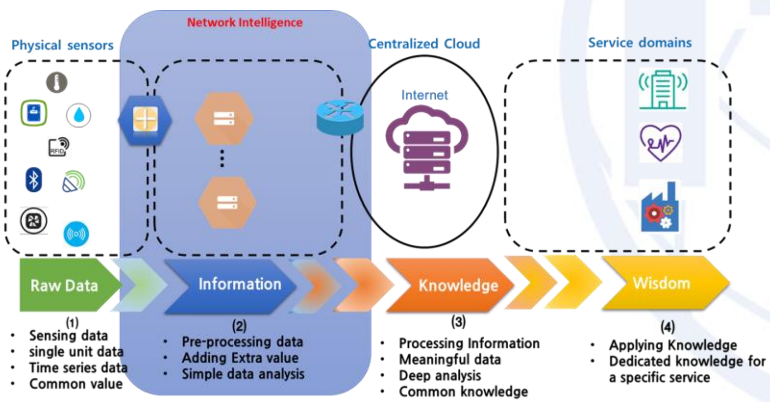
Use cases 3 – Smart construction (3/3)

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





Requirements (1/2)



- Intelligent data processing support
- Mobility support
- Real-time communication support
- Reliable communication support
- Scalability support
- Constrained environment support
- Easy deployment support

[Ref. ITU-T Draft Recommendation Q.IEC-REQ]

Requirements (2/2)

- Need to look at a small scope assuming that behavior of network
- Need data-set and problem with talent pool
- Start using specific field such as SDN-beyond architecture
- Identifying few scenarios
- Need to have a well-documented format
- Need to approach with classical ML-based techniques

[Ref. IETF IDNET]

Conclusions

- Network Machine Learning
  - It is required to support successful IoT and 5G services
- Difficulties of Network Machine Learning
  - Lack of standardized dataset and model
  - Complexity of network behavior
  - Various understanding of network machine learning
- It is the time to start the research and standardization of network machine learning

Thank you.
Questions and Comments!!