The Challenges and opportunities of BDEC systems for Smart Cities

Masaaki Kondo
Graduate School of Information Science and Technology, The University of Tokyo
RIKEN Center for Computational Science

Introduction: It is expected that future BDEC systems will become a key component of a cyber-infrastructure for smart city applications such as intelligent transportation, disaster prevention and mitigation, optimization of an energy supply chain, and smart industry. In these applications, various information obtained in the physical world is processed / optimized in a cyber-world, and then feedback is provided to the physical world in realtime. For example, AI-based anomaly detection systems installed in production lines of smart factories gather the various types of sensor data equipped in target machines, execute inference to predict anomality in time series of data, and control the machines or provide reports to operators accordingly. While these systems need to perform inference at edge devices for lower latency and realtimeness, analyzing whole data corrected from sensors in centralized cloud servers is important to create an efficient inference / optimization engine. Therefore, tight collaboration and autonomous cooperation between edge devices and BDEC system are indispensable.

Challenges for BDEC systems: In order to realize effective and advanced smart city applications with BDEC systems, we need to address several challenges including the following aspects:

- Interoperability: Edge devices are diverse and usually have low performance processing units and small amount of memory capacity, they can perform only a part of the AI and optimization tasks. Interoperability between edge devices and BDEC systems needs to be provided for smart city applications so that some portions of a task can be flexibly assigned to an edge device or a BDEC system depending upon the characteristics of the devices and applications. We need to consider at least tools and an application programming interface for the interoperability.
- Efficient communication protocols: Communications between an edge devices and serves in a datacenter is a key for smart sensor or IoT applications. In these systems, simple communication protocols such as HTTP or MQTT are frequently used but they are not common in HPC systems. It is not clear BDEC systems can offer an efficient data communication performance with these protocols.
- Efficient data handling: While HPC systems are optimized for large data handling or burst data transfer, smart sensor applications usually generate and handle a small chunk of data at a time. When such a small data packet comes to an HPC system asynchronously and periodically, the overall system performance may degrade seriously. Future BDEC systems should have a special mechanism to handle a large amount of small data items.

Though we envision an improve human experience by smart city applications with BDEC systems, community wide discussions to explore the possible solutions for the above mentioned challenges are indispensable.