# The information transfer and sharing platform for remote control over B5G infrastructure

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***Abstract***: Recently, the broadband mobile infrastructure has been discussed actively to promote various IoT services. This paper proposes a lightweight platform for remote control in industry applications across this infrastructure. This platform consists of three parts, i.e., lightweight information transfer by named base communication, abstraction by Open EL, and information sharing by unified data models. This paper also provides direction for this platform for actual deployment and a roadmap of international standardization.

***Keywords***: Beyond 5G, Society 5.0, IoT platform, Low latency communication

## 1. Introduction

IoT services have been planned actively. One of these services is remote monitoring in the industrial fields. To support this service, the broadband mobile infrastructures, e.g., 5G, private 5G, and beyond 5G, will play an important role. Regarding these infrastructures, target requirements seem to be aggressively specified in IMT-2020 and beyond, e.g., [1] and [2]. As the next step, information processing should catch up with these transmission requirements. For this purpose, IoT platforms with functional commonality over these infrastructures have been discussed. For instance, architectural classification and functional definitions have been summarized in [3].

This paper proposes the framework of an IoT platform for information access and sharing over these infrastructures. The authors have proposed the IoT platform for information access named the IoT data exchange platform (IoT DEP), e.g., [4]. They also have promoted international standardization of this platform in ISO/IEC JTC1/SC41 [5], and have achieved publication of international standards as ISO/IEC 30161 series. This paper proposes low latency processing and abstraction of information through the reinforcement of IoT DEP.

## 2. Overview of IoT-DEP

The architecture of IoT DEP is shown as in Figure 1. IoT DEP is operated over transport infrastructure including broadband mobile infrastructures. IoT DEP includes endpoints, e.g., end devices and servers, and nodal points.

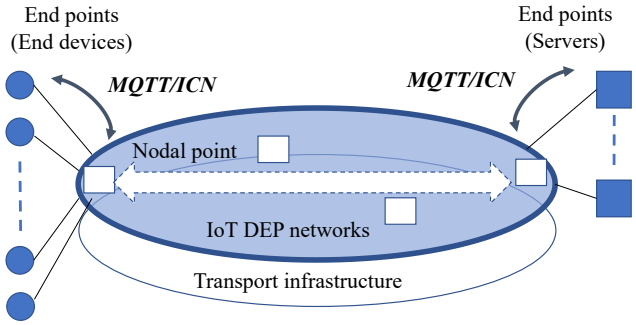
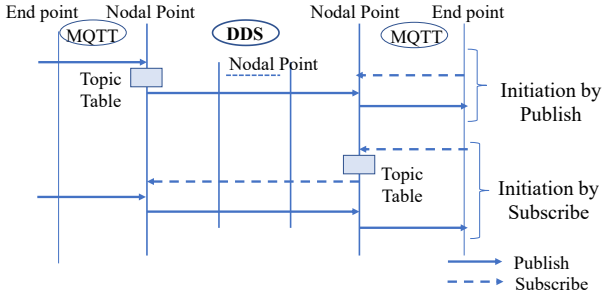
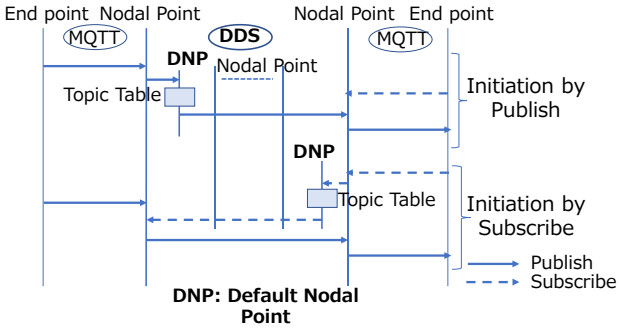



Figure 1 Architecture of IoT DEP

In IoT DEP, access from/to endpoints will be connected by the Information Centric Network (ICN) [6] or MQTT. In these protocols, simplified sequences and the format of the datagram are specified. Connections among Nodal points are provided by data distribution service (DDS) [7] and have multiple options. In DDS, direct access among nodal points with various QoS is provided. These options are summarized in [8]. The typical sequences in the case of MQTT access are shown in Figure 2.




(a) Option 1: Distributed interwork




(b) Option 2: Centered interwork

Figure 2 Interwork architecture among Nodal points

## 3. Directions of reinforcement in IoT DEP

The previous section describes the architecture and simple transfer mechanisms of information in IoT DEP. This section gives directions for low latency processing in end and nodal points and abstraction of end devices as functional reinforcement of IoT DEP.

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### 3.1 Performance metrics for industry services

Industry services are one of the attractive applications for the broadband mobile infrastructures. Their required performance metrics are summarized in several articles, e.g., [8]. For instance, required latency and transfer cycle is less than 10 or 20ms in factory services.

### 3.2 Direction to low latency processing

To provide low latency transfer, the communication sequences should be specified. IoT DEP complies with this requirement. However, internal processing should be also considered. Therefore, it is proposed that IoT DEP is implemented on the smart network interface card (NIC) [10]. Figure 3 shows the block diagram of implementation in a Nodal Point of IoT DEP.

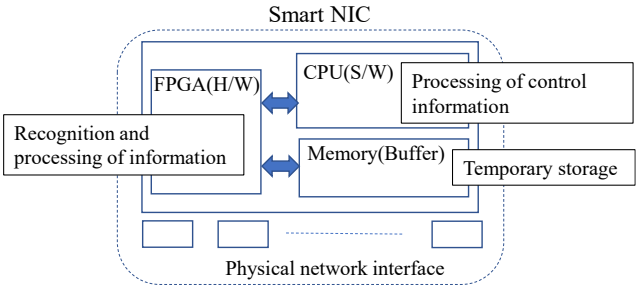


Figure 3 Implementation of Nodal point on smart NIC

Smart NIC includes a field-programmable gate array (FPGA). To reduce the number of buffer copy, information is decoded and processed by FPGA. Only control information is processed by the CPU. Therefore, low latency processing can be achieved.

### 3.3 Direction to the abstraction of end devices

To provide remote control, various end devices are connected to IoT networks, i.e., IoT DEP. In this case, these devices are abstracted, and then information from these devices is shared among servers. For this purpose, it is proposed that IoT DEP accommodates the middleware platform named OpenEL [11]. OpenEL is applied to robotics and control systems for abstraction of devices. The system configuration is shown in Figure 4.

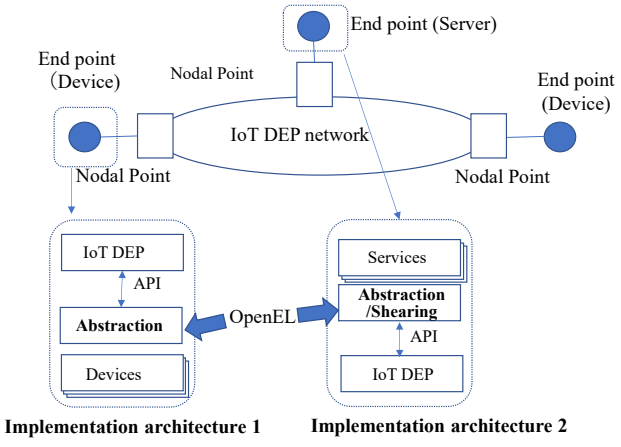


Figure 4 Incorporation of OpenEL to IoT DEP

For implementation, the architectures 1 and/or 2 are applied. In the architecture 1, information from devices are abstracted, and are transfer with unified structure. In the architecture 2, information across IoT DEP is abstracted and can be shared with multiple services.

## 4. Conclusions

To catch up increasing transmission capacity in the broadband mobile infrastructures, performance of information access and processing should be also expanded. This paper introduces IoT DEP which is a lightweight IoT platform, and proposes abstraction and sharing functions are incorporated in the IoT DEP.

The IoT DEP has been standardized as ISO/IEC 30161 series in ISO/IEC JTC1/SC41. In next step, additional standard focusing this proposal should be promoted.

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