ICN 기반 자동화 산업 네트워크 구조

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ICN-based Automated Industrial Network Structure

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Abstract

Various 5G network services are being commercialized and converged to expedite the process of industrialization. Industries in 5G networks are expected to be automated as much as possible, and automated industry infrastructures such as smart factories and smart cities require ultra-low latency in order to provide real-time response to varying demands and circumstances. Additionally, to support transmitting large amounts of data in a fast manner, Information-Centric Networking (ICN) paradigm uses an in-network caching function that identifies required contents based on the content names and caches the retrieved content. In this paper, we examine how the benefits of ICN can be leveraged to provide efficient and flexible networking solutions for an automated industry infrastructure.

Ⅰ. Introduction

5G networks require automation to support complex networking operations such as multi-domain and multi-vendor technologies as services, including network slicing. Industrial automation indicates the use of computers or robots, and information technologies for handling different processes and machinery in industry instead of a human being. The advantages include significantly lower operating costs, high productivity, high quality, high flexibility, high information accuracy, high safety, albeit having a high initial cost. Although automated industries, including smart factories and smart cities, do not produce a large amount of data traffic per sensor, the computation of all that information requires ultra-low latency in a real-time and caching facility to support the low powered sensors. Information-Centric Networking (ICN) paradigm provides the necessary packet-level security to that information and can deliver it faster by employing an in-network caching mechanism that locates the information by name. Here, we propose to utilize an ICN-based automated industrial network structure that is scalable and improves the operations by increasing the transmission efficiency and reducing the latency of data transmission [1].

Ⅱ. ICN-based Automated Industrial Network Structure

Industrial devices and sensors generate small-sized data at a time; however, that data needs to be processed within ultra-low latency for safe and smooth operation. The legacy industrial infrastructure consumes high power for collecting and delivering the data that should be assessed periodically. However, a critical characteristic of the automated industry network's data traffic is that it has a short life span, and it is not necessary to report all the data. By exploiting the caching function of the ICN paradigm, efficiency can be achieved by storing the information that does not need immediate attention and can be delivered all together at a later time, thus reducing the power consumption. Besides, specific data that needed to be sent quickly without being stalled can be delivered using the ICN mechanism in a fast manner, and data security can also be assured [2]. Therefore, we propose an ICN functionality along with the current automated industrial network infrastructure, as shown in Figure 1.
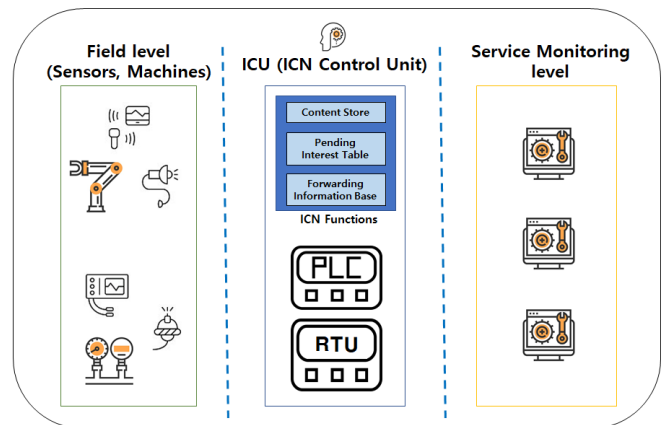

Figure 1. ICN-based Automated Industrial Network Structure

The caching function of ICN can be used to increase efficiency by delivering the necessary data faster, and saving power consumption of the devices and the sensors of the automated industries by creating a separate caching policy that considers the volatility of the generated data and the limited resources of sensors by taking into account the criticality and the life span of the data, the distance between the sensors and the information server, and the number of hops required to deliver the information.

Ⅲ. Concluding Remarks

In this paper, we analyzed the possibility of solving problems of the existing automated industry network by utilizing the ICN-based infrastructure. Our future work includes the detailed analysis of the performance of the structure.

Acknowledgment

References

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[2] A. H. Nagaraj, M. P. Tahiliani, D. Tandur, and H. Satheesh, "Leveraging Named Data Networking for Industrial Automation: Opportunities and Challenges," 2020 IEEE International Conference on Communications Workshops (ICC Workshops), Dublin, Ireland, 2020, pp. 1-6.