Performance evaluation about information transfer mechanisms in IoT service

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Abstract: In most of IoT services, a number of data blocks are collected from devices , e.g., sensors, to network facilities. It is an important issue to study on transfer data blocks efficiently. Content-Centric Networking (CCN) is applied to solve this problem. However, CCN shall be modified to support unidirectional communication as status reports from end devices. In this study, we propose the new mechanism based on the piggy-back approach for this purpose. CCN has specified a pair of messages to transfer data blocks across networks, i.e., "Interest" to request data blocks and "Data" containing these blocks themselves. In the proposed mechanism, transferred data blocks are contained in Interest and Data can be omitted. We compare some mechanisms including the proposed mechanism, the legacy mechanism using HTTP on the Internet, and the conventional mechanism using CCN. In one of the conventional mechanisms using CCN, to align CCN message sequences, the dummy Interest is created from the sensor for initiation of normal protocol sequences with a pair of Interest and Data. In short, two Interest messages are transferred to obtain data blocks. It is referred to as "Dummy Interest mechanism". Then, it is concluded that the proposed mechanism is superior to the legacy mechanism and the Dummy Interest mechanism from latency and traffic volume points of view. In this performance evaluation, M/M/1 queueing model is applied. Data blocks are generated randomly. The processing duration presents from the start of control protocols, e.g., SYN in TCP, to end of control protocols, e.g., FIN in TCP, and follows exponential distribution. As the results, in the proposed mechanism, its latency is less than 1/10 of the HTTP case. Its required bandwidth is also reduced to less than 1/10 of the HTTP case. Moreover, its latency is less than 1/2 of the dummy Interest mechanism case. Its required bandwidth is also reduced to less than 1/2 of the dummy Interest mechanism case.

Keywords: *IoT,ICN,CCN,Piggy-back,M/M/1 queueing model*

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Table of Contents

ICFCC2021
Paper ID : F1008-A

Introduction

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Paper ID : F1008-A

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Introduction

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IoT communication form and application to CCN

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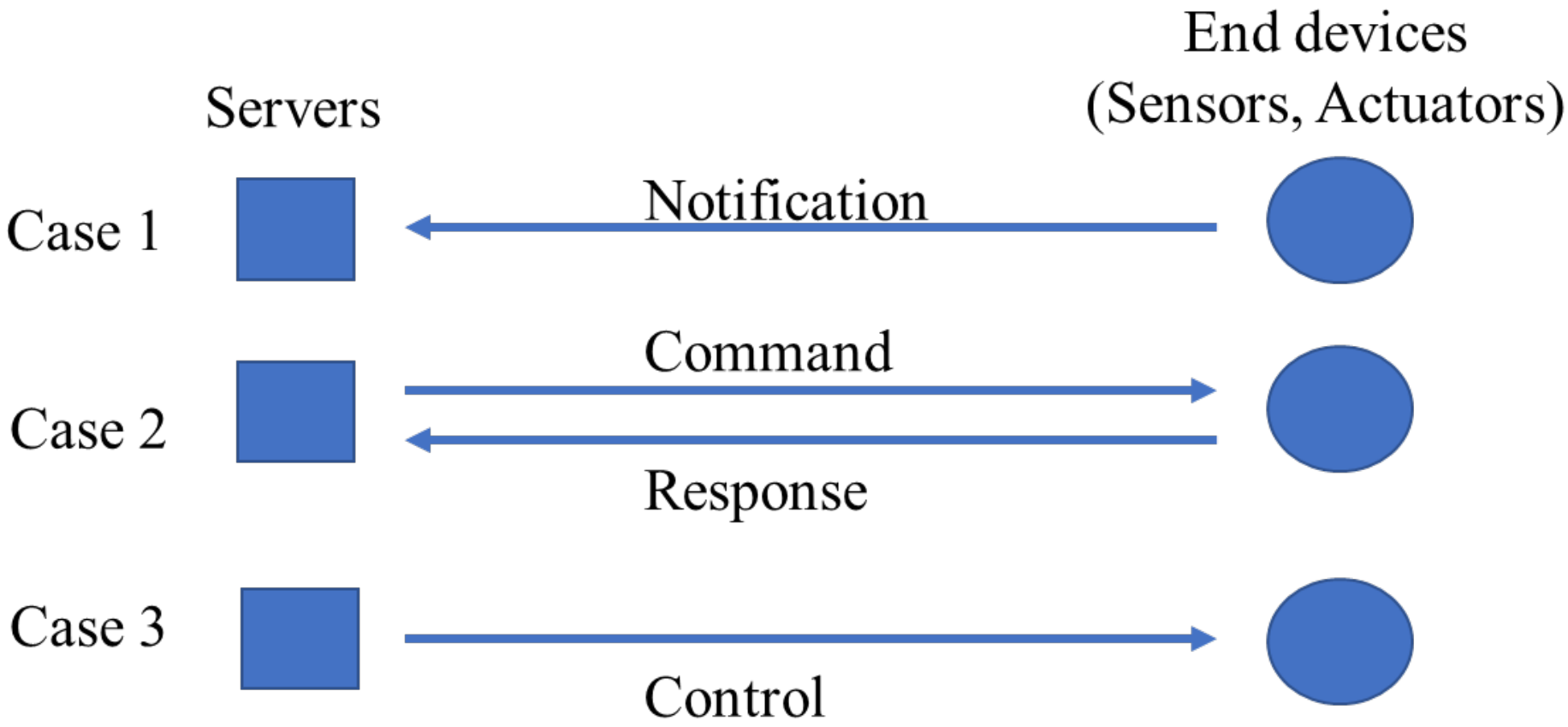

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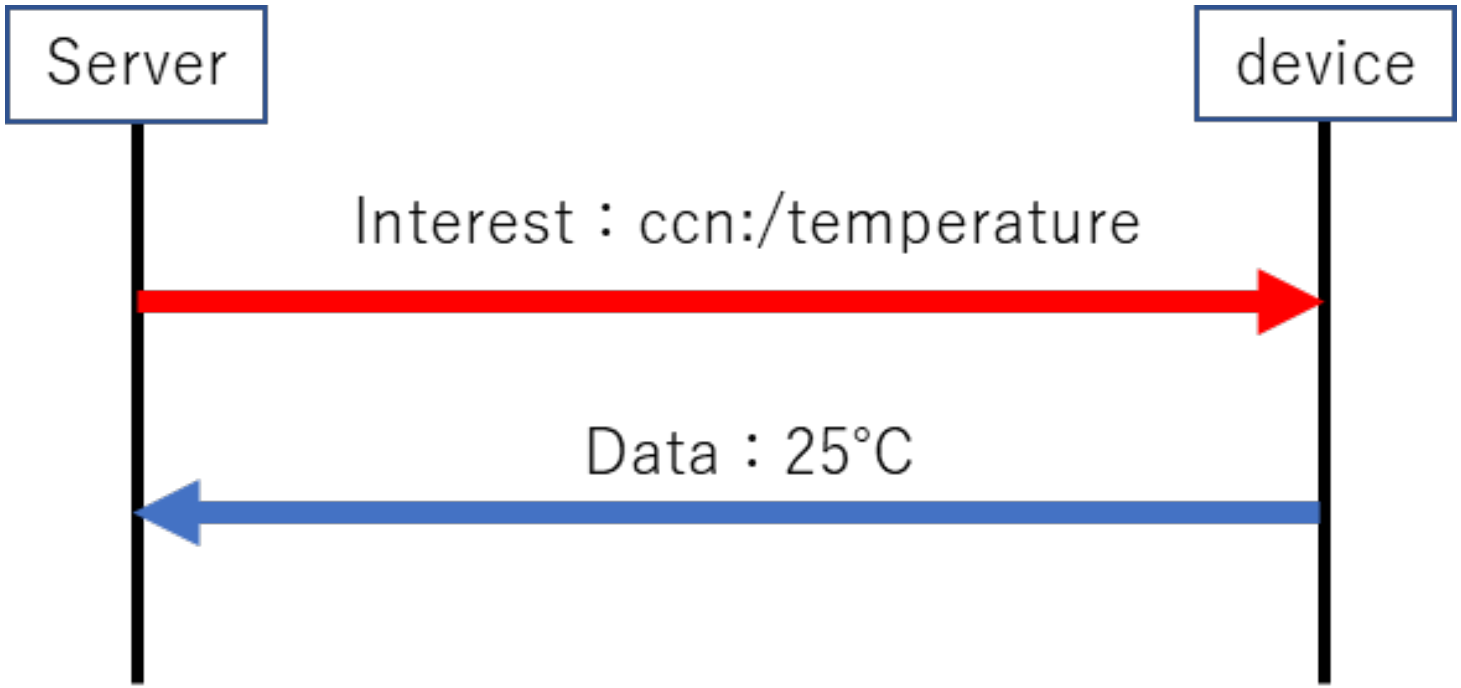

CCN has specified a pair of messages to transfer data blocks across networks, i.e., “Interest” to request data blocks and “Data” containing these blocks themselves. In the proposed mechanism, transferred data blocks are contained in Interest and Data can be omitted.

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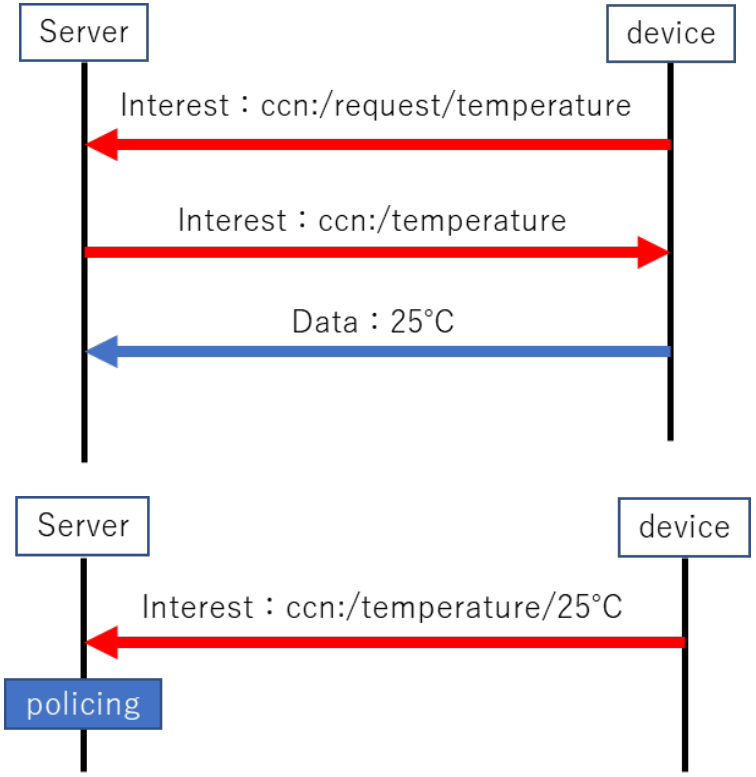

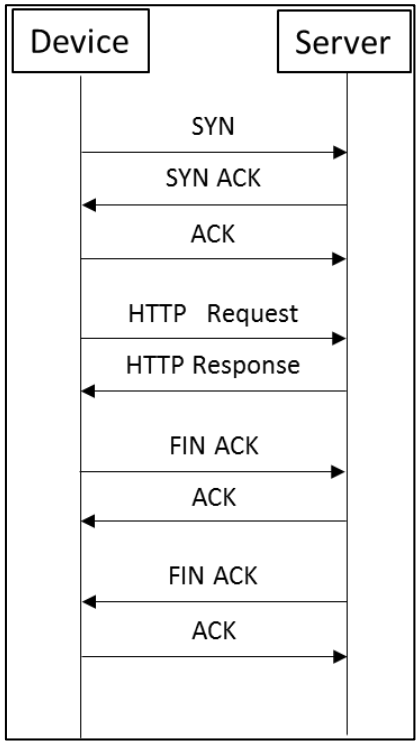

We compare some mechanisms including the proposed mechanism, the legacy mechanism using HTTP on the Internet, and the conventional mechanism using CCN. In one of the conventional mechanisms using CCN, to align CCN message sequences, the dummy Interest is created from the sensor for initiation of normal protocol sequences with a pair of Interest and Data. In short, two Interest messages are transferred to obtain data blocks. It is referred to as “Dummy Interest mechanism”.

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Then, it is concluded that the proposed mechanism is superior to the legacy mechanism and the Dummy Interest mechanism from latency and traffic volume points of view.

In this performance evaluation, M/M/1 queueing model is applied. Data blocks are generated randomly.

$$\text{Average delay} = \frac{h}{1 - \lambda h}$$

Average processing time [s] = overall traffic [bit] / throughput 1 [Mbps]

(Bit needs to be converted to Byte)

method	Total traffic [byte]	Average processing time [s]
HTTP	1500	0.012
Push response method	350	0.0028
Piggy back method	150	0.0012

The processing duration presents from the start of control protocols,
e.g., SYN in TCP, to end of control protocols, e.g., FIN in TCP, and follows exponential distribution.

Results of theobservation

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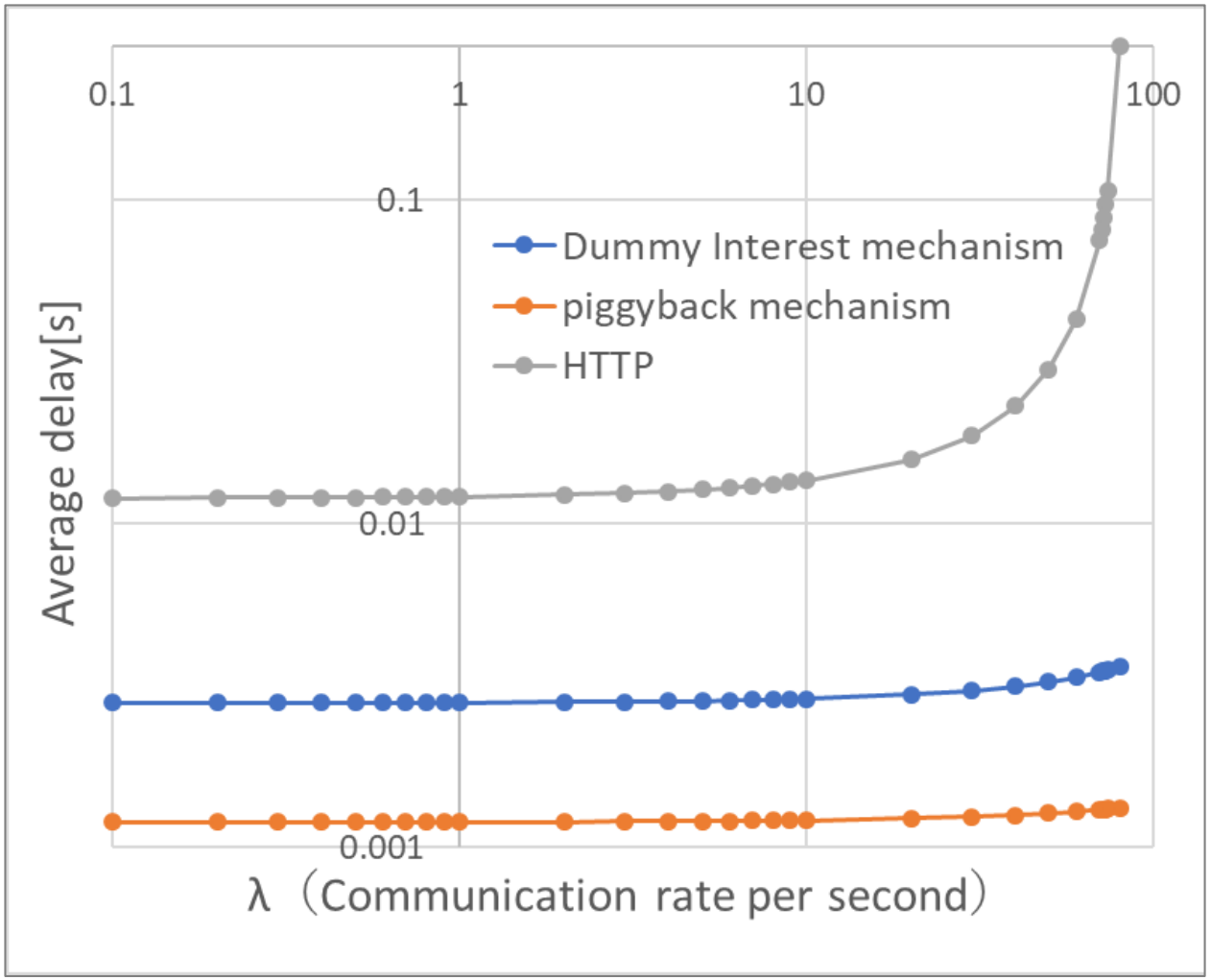

As the results, in the proposed mechanism, its latency is less than 1/10 of the HTTP case.
Its required bandwidth is also reduced to less than 1/10 of the HTTP case.

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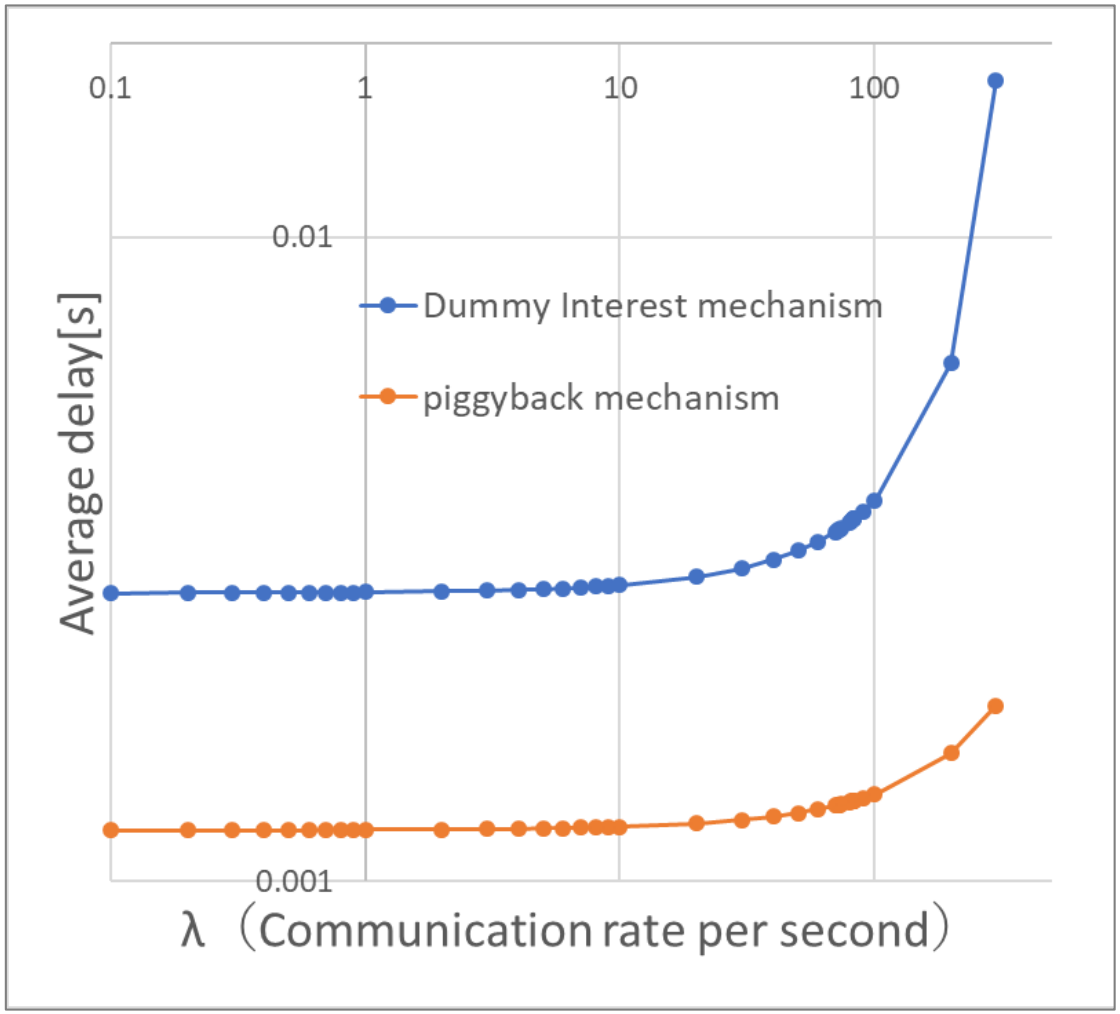

Moreover, its latency is less than 1/2 of the dummy Interest mechanism case.
Its required bandwidth is also reduced to less than 1/2 of the dummy Interest mechanism case.

Conclusions

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- When applying CCN to IoT services, it was shown that it has a higher affinity for IoT services than the conventional Internet.
- We proposed a piggyback method for information transfer mechanisms when using CCN technology, and compared Dummy Interest mechanism using CCN technology with HTTP, which is widely used as a communication protocol.
- Based on the evaluation results, it is considered effective to use the piggyback mechanism in the information transfer mechanisms for IoT services.

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https://www.h-cloud.eu/euj-projects/fed4iot/

Thank you for your attention.