

# Performance Evaluation of IoT Protocols on HD-PLC

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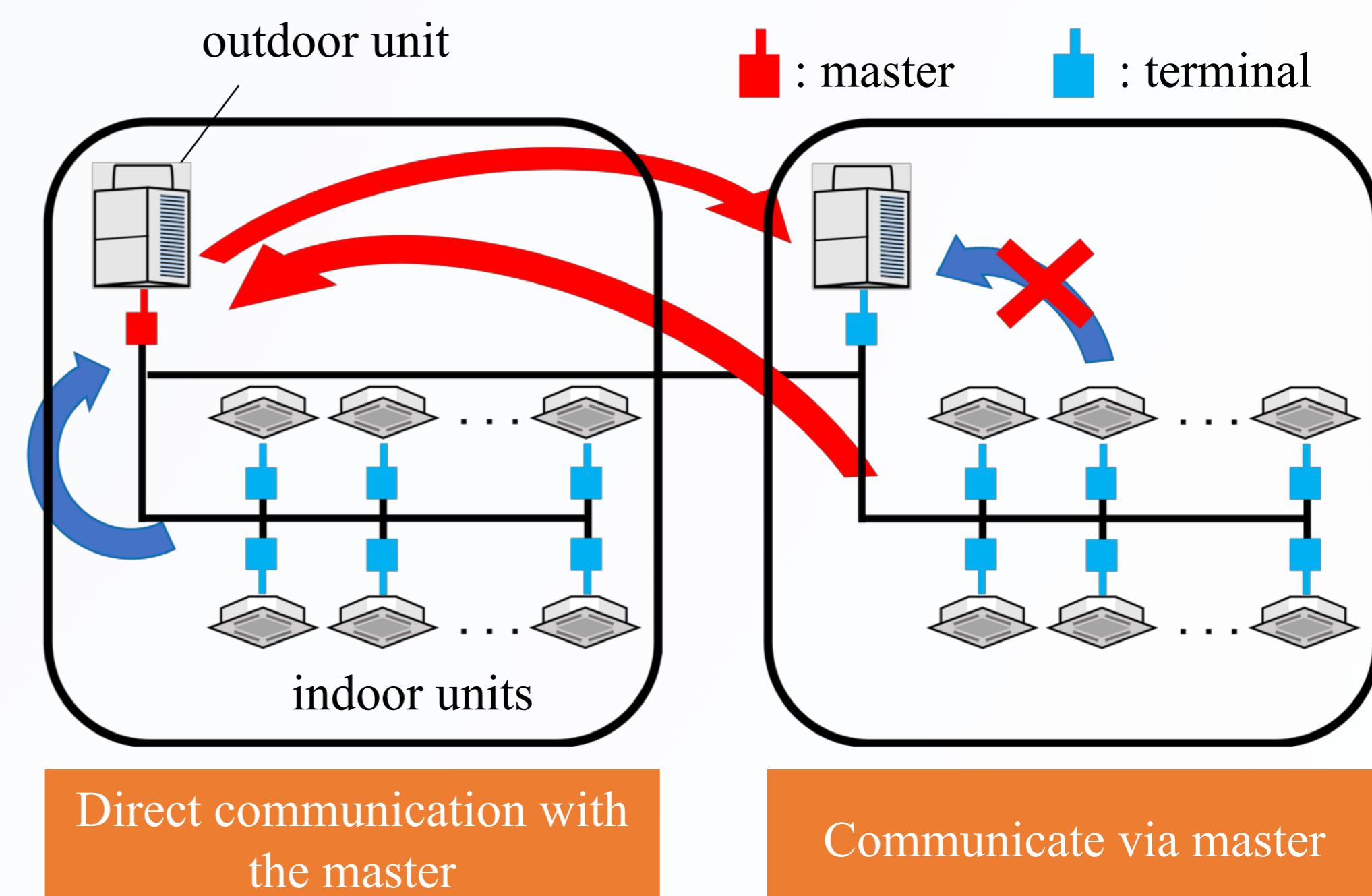
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## Introduction

In order to reduce energy consumption in office buildings, researches aiming at efficient operation of air conditioners by collecting and analyzing sensor data from IoT devices are increasing. From such background, High Definition Power Line Communication (HD-PLC), which carries out high-speed communication using some existing lines like power lines, attracts attention as a facility system network in the IoT era.

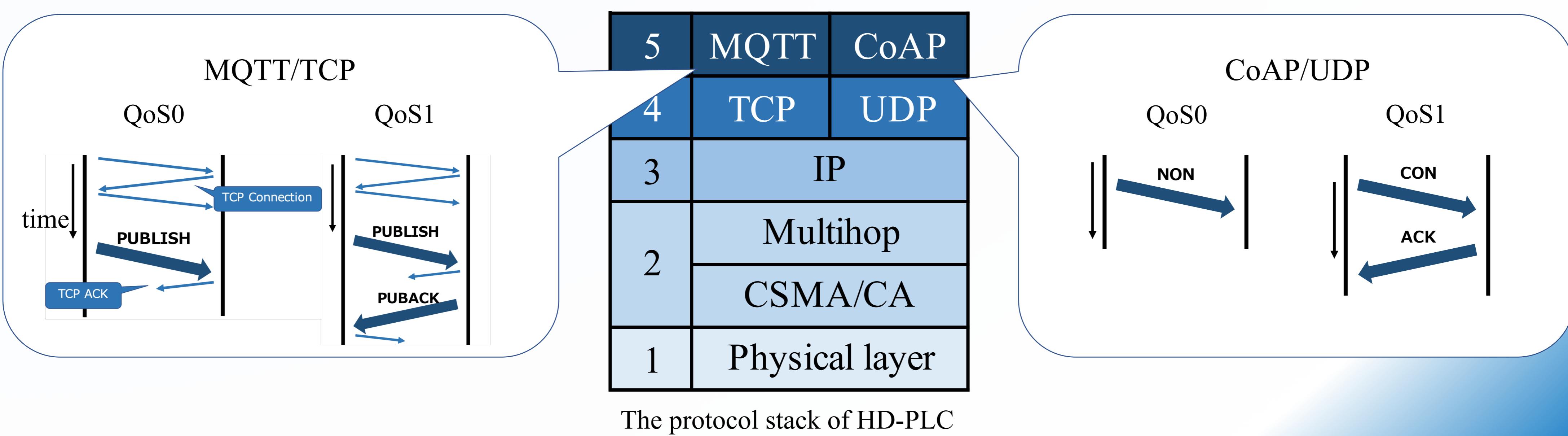
The protocol stack of HD-PLC consists of a physical layer, CSMA / CA protocol, a Multihop function, a TCP / IP and an application layer. In the multihop function, it is assumed that there are multiple terminals (the indoor units) and one master (an outdoor unit) and each terminal must transmit a packet via the master.

In this research, we aim at improving the communication quality by applying the retransmission protocols in the upper layer of the HD-PLC in case of congestion.



## IoT Protocols

As protocol candidates, we choose MQTT / TCP and CoAP / UDP since they are popular in the IoT applications. In MQTT, three types of retransmission methods are provided: In QoS 0, a sender does not retransmit a packet and requires no ack. In QoS 1, when a sender does not receive an ack packet from the receiver, it may send packets multiple times allowing duplication of retransmission messages. In QoS 2, a sender and a receiver negotiate for guaranteeing message delivery only once without allowing duplication. In our performance evaluation, we investigate QoS 0 and QoS 1 on MQTT/TCP while in CoAP, we implement retransmission mechanism same as QoS 0 and QoS 1 on UDP. In case of MQTT on TCP, retransmission in the upper layer and in the lower layer may overlap and congestion may occur.



## Evaluation

To evaluate the performance of the communication of air conditioners using HD-PLC in office buildings, we conduct simulation using ns-3, an open source simulation package. We compare the delay and the packet loss ratio over the number of simultaneously communicating indoor unit at two congestion levels ( $\rho$ ) . Simulation results are shown in the figure.

From the simulation results, we could conclude that the CoAP/UDP is a superior method in the multi-access IoT environment

