7th European Conference on Industrial Engineering and Operations Management
Augsburg, Germany, July 16-18, 2024
Publisher: IEOM Society International, USA DOI: 10.46254/EU07.20240221
Published: July 16, 2024

Abstract: Towards Enabling MQTT for Real-Time Internet of Things

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Abstract

Internet of Things (IoT) and Industrial IoT (IIoT) are key architectural components for several modern digital systems. Publish-subscribe (pub/sub) is an established messaging pattern for (I)IoT. Message Queuing Telemetry Transport (MQTT) is a popular pub/sub-based messaging protocols for (I)IoT. Unfortunately, MQTT insufficiently supports Real-Time (RT) requirements. A computer system is a RT system, when the correctness of its behavior depends not only on the logical results of the computations but also on the physical time when these results are produced. In this work, we propose a minimally intrusive extension to the MQTT protocol in order to render MQTT RT capable. We first define a fourth new time-based Quality of Service (QoS) level for MQTT by using special messages and additional minimal functionalities at the client and broker sides. This QoS level allows publishers and subscribers to negotiate how many messages (m out of n) must be delivered in time. A scheduler on the broker processes received messages depending on (a) agreed message ratio m-out-of-n, (b) the residual lifetime of messages, i.e., time to deadline till desired delivery to destination, and (c) the expected round trip time to the destination. The “m out of n” principle allows to address the various RT classes such as soft-, firm- and hard-RT. In addition, this approach allows to trade-off the system efficiency and the achievable RT class. First simulations confirm that the proposed approach converges to a reasonable message drop-off level without endangering the agreed m-out-of-n messaging ratio, i.e., the targeted RT class.

Keywords
Internet of Things, Message Queuing Telemetry Transport (MQTT), Real-Time Systems, Publish-Subscribe.

Acknowledgements
This work is supported by the German Federal Ministry for Digital and Transport (BMDV) within the 5x5G funding.

Biographies
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Michael Deller received his master degree in computer science in 2019 and his bachelor in Computer Science in 2016, both from Landshut University of Applied Sciences, Germany.

Lobna Badraoui graduated from the higher institute of applied science and technology in Mateur, Tunisia, with a bachelor degree in Industrial Computing Systems in 2020 and received a master degree in Cyber Physical Systems in 2022. She is a Ph.D. candidate at Landshut University of Applied Sciences. Her research interests include Time-Sensitive Internet of Things (IoT).