In this paper we are interested in safety-critical real-time applications implemented on distributed architectures supporting the Time-Sensitive Networking (TSN) standard. The ongoing standardization of TSN is an IEEE effort to bring deterministic real-time capabilities into the IEEE 802.1 Ethernet standard supporting safety-critical systems and guaranteed Quality-of-Service. TSN will support Time-Triggered (TT) communication based on schedule tables, Audio-Video-Bridging (AVB) flows with bounded end-to-end latency as well as Best-Effort messages. We first present a survey of research related to the optimization of distributed cyber-physical systems using real-time Ethernet for communication. Then, we formulate two novel optimization problems related to the scheduling and routing of TT and AVB traffic in TSN. Thus, we consider that we know the topology of the network as well as the set of TT and AVB flows. We are interested to determine the routing of both TT and AVB flows as well as the scheduling of the TT flows such that all frames are schedulable and the AVB worst-case end-to-end delay is minimized. We have proposed an Integer Linear Programming (ILP) formulation for the scheduling problem and a Greedy Randomized Adaptive Search Procedure (GRASP)-based heuristic for the routing problem. The proposed approaches have been evaluated using several test cases.

General information
Publication status: Published
Organisations: Department of Applied Mathematics and Computer Science, Embedded Systems Engineering, TTTech Computertechnik AG, Technical University of Denmark
Contributors: Pop, P., Lander Raagaard, M., Craciunas, S. S., Steiner, W.
Number of pages: 21
Pages: 86-94
Publication date: 2016
Peer-reviewed: Yes

Publication information
Journal: IET Cyber-Physical Systems: Theory and Applications
Volume: 1
Issue number: 1
ISSN (Print): 2398-3396
Original language: English
Electronic versions:
paupo_ietcps16_v3_1.pdf
DOIs:
10.1049/iet-cps.2016.0021

Bibliographical note
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Source: PublicationPreSubmission
Source ID: 127146953
Research output: Contribution to journal › Journal article – Annual report year: 2016 › Research › peer-review