Universität Rostock

Traditio et Innovatio

FAKULTÄT FÜR INFORMATIK UND ELEKTROTECHNIK

Thesis Topic: Time-Sensitive Networking Switch Configuration

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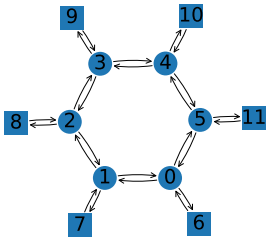
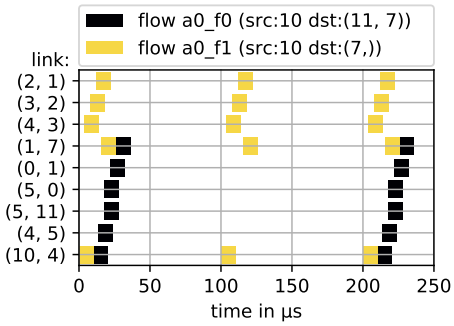


In todays smart factories and vehicles (cars, airplanes), the communication network has become an essential infrastructure to connect distributed systems. In factories and vehicles, several of the distributed systems have to transmit critical messages over the communication network, i.e., the respective message must be transmitted with high reliability and within a certain time span. If the deadline of a critical message is violated, this may cause damage to the whole system (i.e., vehicle or production facility). With Time-Sensitive Networking (TSN), which refers to the latest extensions of the IEEE 802.1 standard, Ethernet technology allows the reliable and timely message delivery by the application of a time-triggered communication principle. Here, critical messages are transmitted over the different links in the network according to a given schedule, which is computed before the system is taken into operation (so-called offline scheduling). For example, consider the network of 6 switches and 6 end devices, given in the figure above, and two critical messages *a0_f0* and *a0_f1* which have to be transmitted every 100 µs and 200 µs, respectively, from a predefined source node *src* to one or more destinations given as *dst*. A possible transmission schedule is shown below. The computation of such schedules is an NP-hard mathematical problem and the TSN standards do not suggest any solution to this problem. Therefore, the development of efficient routing and scheduling algorithms has become an important research question.



Task: Mapping of schedules to TSN-compatible switch configurations

The computation of transmission schedules is performed by a centralized network controller with sufficient computational resources. Afterwards, configuration messages have to be sent over the network to every switch and end device to configure their transmission behavior accordingly. In TSN, this configuration is done by means of the Simple Network Management Protocol (SNMP). Moreover, it is not trivial to derive the required switch configuration and corresponding SNMP configuration messages from a given schedule, as TSN switches use FIFO queues to buffer packets. Thus, it is not possible to transmit an arbitrary buffered packet at any time, but only packets at the head of one of the FIFO queues can be transmitted.

Therfore, this topic, appropriate for **Bachelor Thesis** and **Specialization Module**, includes the following tasks:

- Literature study about TSN switch capabilities and SNMP configuration interfaces
- Development of a concept to derive required SNMP configuration messages from a given schedule with or without switch queue assignments
- Prototypical implementation of a network controller that is able to read a given schedule and send corresponding configuration messages to TSN switches
- *(Optional)* Integration of the network controller with existing routing and scheduling software
- Documentation of concept and prototype

Prerequisites:

- Must Have
  - Basic programming skills (any language)
  - Ability for self-sufficient and independent working
  - Basic understanding of Ethernet technology and network protocols
- Should Have
  - Advanced programming skills and basic programming skills with a socket API for network communication

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