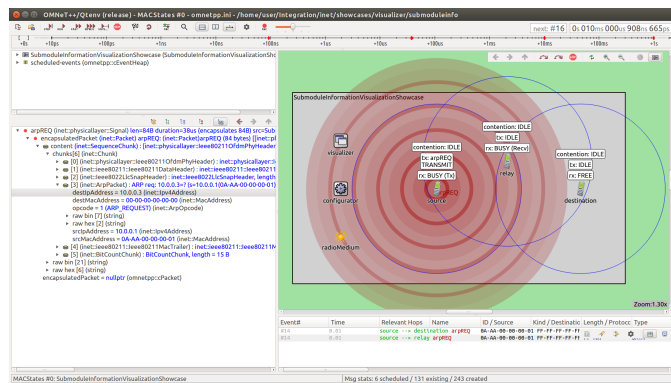# Time-Sensitive Networking Extensions for Future Industrial 5G Systems

Project Topic for Student/Master/Diploma Thesis

Source: Wikipedia[Link]

Source: OMNeT++[Link]

Description

Time-Sensitive Networking (TSN) is a set of IEEE standards to achieve deterministic[Link] communication over Ethernet networks. This is especially relevant for industrial domains, such as medical, banking, avionics, or automotive. The communication is characterized by strict requirements on delay, packet delay variations, and packet loss. In order to achieve certain guarantees, the TSN standards provide different algorithms, metrics and tools.

The 5G System (5GS) on the other hand is itself very complex. With enhancements for Ultra-Reliable Low-Latency Communication (URLLC) in Release 15 (R15), the 5GS paved the path for a latency-aware communication. The 5GS already provides possibilities to treat packets in a similar way as in TSN. In Release 16 (R16) and with ongoing work in Release 17 (R17), there will be now extensions to leverage the 5GS as virtual TSN bridge.

OMNeT++ is a discrete event simulator. With its help, it is possible to evaluate the performance characteristics of a communication system. In this thesis, the integration of the TSN domain and the 5GS should be investigated. There are existing TSN and 5GS extensions for OMNeT++, as well as combinations of both, but they are either lacking latest 5G features or they don't incorporate all necessary TSN parts. Because there is no complete solution, this thesis should research the 5G-TSN integration more thoroughly.

Tasks

- get familiar with the topic: TSN, 5GS, and OMNeT++
- literature study
- setup testbed based on OMNeT++ network simulator
- develop 5G-TSN integration
- evaluate and discuss your results

Keywords

Time-Sensitive Networking, 5G System, Programming, Networking, Performance Evaluation

Resources and Material

- General information of Time-Sensitive Networking
    - Wikipedia[Link]
    - A. Nasrallah et al.: *"Ultra-Low Latency (ULL) Networks: The IEEE TSN and IETF DetNet Standards and Related 5G ULL Research"*[Link]
- OMNeT++ – Discrete Event Simulator[Link]
    - OMNeT++ for 5G System
        * G. Nardini et al.: *"Simu5G–An OMNeT++ Library for End-to-End Performance Evaluation of 5G Networks"*[Link]
        * GitHub[Link]
    - OMNeT++ for TSN
        * J. Falk et al.: *"NeSTiNg: Simulating IEEE Time-sensitive Networking (TSN) in OMNeT++"*[Link]
        * GitLab[Link]

Requirements

- visited courses: ComNets1, ComNets2, optional: basics of cellular communication
- very good understanding of packet-based networking
- program language: C++ (for OMNeT++)

- motivation(!) to work on the topic; ability to work independently and communicate with supervisors; solve emerging problems (we provide a good supervision but we expect that the student can work on his/her own)

Contact

- Supervisors: Stefan Senk, Hosein K. Nazari, How-Hang Liu
- Language: German or English
- Start: as soon as possible