Root Cause Analysis for TSN

Time Sensitive Networks aim to provide for mechanisms and methods for deterministic delay and jitter in industrial networks. Sources of delay and jitter in a TSN can be numerous, e.g., misconfigured or incorrectly dimensioned TAS schedules, congested egress ports, large clock jitter in distributed time synchronization, congestion at egress / ingress ports of the end-stations, variable switch backplane delays etc. are all possible causes of poor end-to-end performance.

In this work, an existing approach to end-to-end monitoring of transmission delay and jitter will be extended to support for quick identification of source of the anomaly in a TSN scenario (i.e., the root cause). Two or more approaches will be proposed to cater for end-to-end monitoring of TSN streams, relying on:

1) intermediate, pre-placed network TAPs;
2) hardware / software data plane agents capable of telemetry and dynamic re-programming to support the quick identification of anomaly sources for individual streams.

Any resulting overhead of the intermediary monitoring solution will be quantified for consideration in the TSN stream planning. The work will hence implement and validate the monitoring mechanisms in an existing TSN testbed that relies on a Linux-based control plane, and will optionally involve P4-based middlebox devices to serve as intermediate monitoring entities.

[1] 802.1Qbv - Enhancements for Scheduled Traffic
[2] Improving Network Monitoring and Management with Programmable Data Planes

Prerequisites

- Good knowledge of networking concepts and architectures
- Good knowledge and practical experiences with Linux networking
- Good knowledge of Python, C or Rust
- Any prior experience with TSN, P4, SDN is a plus but not mandatory

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