IEEE 802.1 AVB and QoE testing

Sam Lefebvre
Supervisor(s): Brecht Vermeulen, Piet Demeester

I. INTRODUCTION

Original 802.3 standards are designed to deliver best-effort data, with no special provisions for time critical aspects of multimedia applications. 802.1q defines a 3-bit Priority Code Point-field (PCP) in the VLAN-header (802.1p). Eight different Classes of Service (CoS) are used to prioritize traffic. 802.1ak Multiple Registration Protocol (MRP) provides registration and resource allocation. For A/V-streams, there is also a constraint on timeliness (<2ms for 7 hops) and packet loss [1]. This research focuses on a timing-aware ethernet. Admission and reservation system rely on 802.1ak. Time sensitive streams are shaped by an 8MHz clock, which is syntonized using the Precise Timing Protocol (PTP). Ongoing standardization is coordinated by the IEEE 802.1 AVB tasking group [2]. Traffic is classified as foreground or background. Traffic observations from Caida and Gloriad form the base for emulating the internet. The QoE of A/V-streams, referred as ‘foreground traffic’, is quantitatively expressed by PEASQ/PEAQ and MOS.

II. ANALYSIS

Network neutrality and dynamical port-assignment have hampered traffic analysis and protocol distribution measurements. Several studies of Caida were based on port/destination host behavior and supervised machine learning techniques [3]. They have shown that the dominant packet-sizes on the internet are 40-552-576-1500B. Protocols such as HTTP, NNTP and FTP were the most common protocols in 2000, and TCP takes about 60-90% of overall traffic. It is claimed that such protocol mix performs some stability on longer term [4]. However, ongoing traces confirm that HTTP/FTP are still popular protocols. Consequently, a fine selected Imix is presented in Table 1.

III. QoE TESTING

Spirent Avalanche and Shenick diversifEye appliances are perfectly suited for traffic generation as well as for foreground traffic analysis. Measurements on Avalanche 2700 (2GB RAM) have shown that one blade reaches an aggregate throughput of 990Mbps and can handle about 66000 concurrent TCP-connections. An IP-range of two million users can be defined without significant performance degradation. Video QoE analysis results in MOS/MDI, or the more recently V-factor which is based on MPQM. Opticom Opera uses PESQ/PSQM to define MOS for speech and PEAQ to calculate the ODG/DI for audio. However, human observation will play an important role to evaluate the overall user satisfaction.

IV. IEEE 802.1 AVB

A listener registration-message floods into the AVB-cloud and the talker answers with a reservation-message\(^1\). Resources are released by deregistering or time-out. Cumulative

<table>
<thead>
<tr>
<th>Internet</th>
<th>Business</th>
<th>File sharing</th>
<th>Multimedia</th>
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<tbody>
<tr>
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<td>NNTP</td>
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Table 1: Proposed protocol distribution

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\(^1\) IEEE 802.1Qat Stream Reservation Protocol, D3.2 Draft standard for local and metropolitan networks
reservation is limited to 75% in order to allow legacy traffic [5].

Cloud discovery is performed by tree steps:

- ANeg or parallel detection checks if the link-speed is \( \geq 100\text{Mbps} \) and full duplex
- LLDP packets inform the neighbors for AVB compliancy
- Link delay measurement checks if no transparent devices are connected (<2\(\mu\)s)

Measuring the link delay is based on accurate time measurement on req/resp messages\(^2\). (Figure 1) Every 10ms, Sync and follow-up messages syntonize the clocks between grandmaster (GM) and Ordinary Clock (OC)/Boundary Clock (BC). The drift may not exceed 0,4ppm.

\[
d = \frac{(p2 - t1) + (t4 - p3)}{2} = \frac{((t2 + \phi s) - t1) + (t4 - (t3 + \phi s))}{2} = \frac{(t2 - t1) + (t4 - t3)}{2}
\]

Figure 1: Delay measurement independent of clock phase shift

Legacy traffic is scheduled in the egress queues using credit based pacing or weighted round robin. A timing aware scheduler aligns isochronous frames on the common 8 MHz clock, using a higher priority in comparison with asynchronous frames\(^3\).

V. CONCLUSIONS AND NEXT STEPS

Specific rules for resource reservation, relation to egress scheduling, network- and security management are still open issues. Refinings will be tested for QoS/QoE with commercial appliances. An Imix emulates the internet and performs as background-traffic. Time sensitive data will be evaluated with quantitative evaluation methods.

VI. REFERENCES


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\(^2\) IEEE 802.1AS/D6.1 Timing and synchronization for time-sensitive applications in bridged LANs (draft)

\(^3\) IEEE 802.1Qav/D7.0 Forwarding and queuing enhancements for time-sensitive streams (draft)