Dual Latency in xDSL

IEEE 802.3ah, Ethernet in the First Mile

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Overview

♦ Why Dual Latency: The Video/Voice Dilemma

♦ Dual Latency and Packets
  ■ Why it’s still worth it…

♦ An Ethernet PHY with two MIIs?
  ■ And two segregated LANs?
  ■ Using VLAN tagging?
  ■ Using a smart aggregator?

♦ Conclusions
Why Dual Latency

The applications might have contradictory requirements:

<table>
<thead>
<tr>
<th>Application</th>
<th>Delay sensitive</th>
<th>BER sensitive</th>
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</thead>
<tbody>
<tr>
<td>data</td>
<td>/</td>
<td>Yes</td>
</tr>
<tr>
<td>video</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>voice</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>gaming</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

† Voice
- Latency – up to 150 ms e2e delay
- BER – from $10^{-5}$ to $10^{-2}$, depending on the encoder

† Video
- Latency – seconds! for VoD & broadcasting (broadcast zapping delay)
- BER – from $10^{-7}$ (videophone) to virtually zero ($10^{-13}$ HDTV quality)
Having both latency paths in HW

- BER decreased by the interleaver for error sensitive applications
- non-interleaved path – an alternative for delay-sensitive applications
- makes configuration scalable by varying the interleaver’s depth
- make possible the segregation based on the service-type
Dual Latency and packets

♦ Assumption – different sources have different traffic-patterns

♦ Voice
  ■ small packets (100 - 400 bytes/packet)
  ■ generated at a constant rate

♦ Video
  ■ packet-size limited only by maximum segment size
  ■ high variation of the rate of the traffic

♦ Multiple paths
  ■ solve the preemptability problem – no need for suspend-resume mechanism
Simulations

Source models

- Voice Aggregate – Poisson source
  - packet size: 200 bytes
  - at: 1.5 Mbps
- Video – use a heuristic model for generating synthetic video streams
  - packet size: up to maximum segment size – 1500 bytes
  - at: 4.5 Mbps
- Data – Poisson source (TCP data aggregate is Poisson for high loads, and worse than Poisson at low loads)
  - packet size: 1500 bytes
  - at: 1 Mbps

Hypothesis

1. all sources share a single channel of 10 Mbps
2. voice source on a 2.5 Mbps path; video & data on a 7.5 Mbps path
Results

♦ Single Path

- all packets experience the same delay, slightly worse for the voice packets

Aggregate queuing on a 10 Mb/s shared channel vs. Voice 2.5Mb/s, Data & Video 7.5Mb/s dedicated channels

♦ Two Paths

- guarantees the voice channel won’t be affected by a bursty data-source
An Ethernet PHY with two MIIs?

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Latency-sensitive equipment is kept in a separate LAN.
Different ports on the CPE device correspond to the different latency paths.
Similar to ATM VP/VC labelling; all devices are on the same LAN, but VLAN tags differentiate between latency paths.
Slow/Fast Aggregation

- Based on the concept of “conversations” (Clause 43):
  - Some conversations are latency-sensitive, others are not.
  - An “aggregator” looks at SA and DA to determine the conversation.
  - A look-up table associates certain conversations with a certain path; all others go to the default path.
  - At the receiver side, slow path and fast path are muxed into a single stream again.
All devices are on the same LAN, a look-up table is used to forward frames to slow or fast path, based on SA/DA.
An Ethernet PHY with two MIIs and Slow/Fast Aggregation

- MAC Control (Optional)
- MAC
- Reconciliation

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- MAC
- Reconciliation

- Ethernet-over-xDSL AL
- PTM-TC (Slow)

- Ethernet-over-xDSL AL
- PTM-TC (Fast)

- PMS-TC

- PMD

- MDI

voice grade Cu
<table>
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<tr>
<th></th>
<th>PRO</th>
<th>CONTRA</th>
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<tbody>
<tr>
<td>Separate LANs</td>
<td>Robust and straight-forward</td>
<td>Need to physically maintain two LANs.</td>
</tr>
<tr>
<td>VLAN Tagging</td>
<td>No new equipment needs to be specified.</td>
<td>All devices need to be VLAN enabled.</td>
</tr>
<tr>
<td>Aggregation</td>
<td>No changes to LAN.</td>
<td>Aggregation layer must be specified and implemented.</td>
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Conclusions

- Dual latency was introduced in xDSL to resolve the conflict between latency-sensitive applications and BER-sensitive applications.

- In a packet-based network, a separate path can give better performance guarantees for services such as voice-over-IP.

- A dual-latency device doesn’t necessarily have two different LAN ports; aggregation can be used to separate time-critical packets from the rest.

- The EFM/Copper standard should support dual latency.