Dual Latency in xDSL

IEEE 802.3ah, Ethernet in the First Mile

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Saint-Louis, March 11-14 2002

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

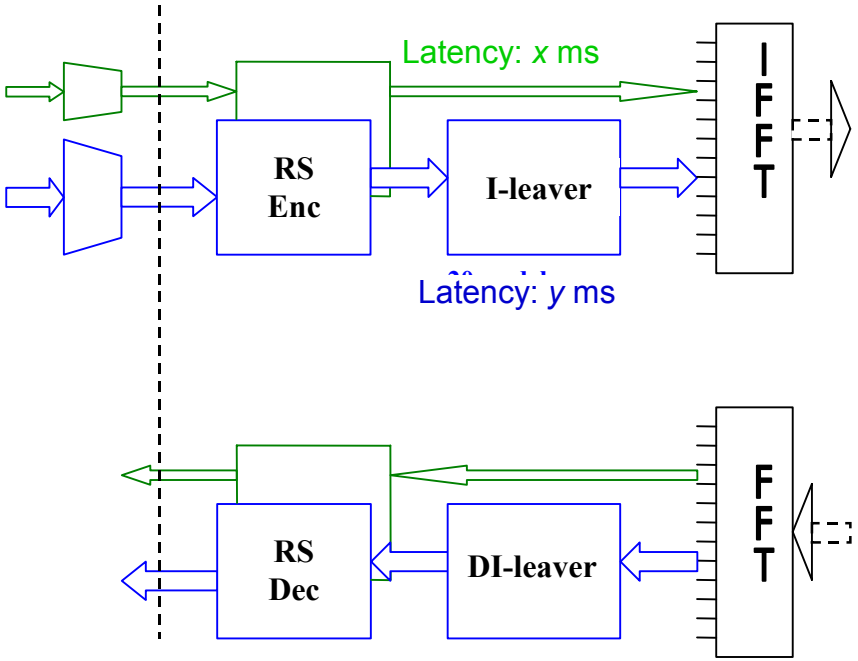
- The applications might have contradictory requirements:

Application	Delay sensitive	BER sensitive
data	/	Yes
video	No	Yes
voice	Yes	No
gaming	Yes	Yes

- 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)

Dual Latency and packets

- 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

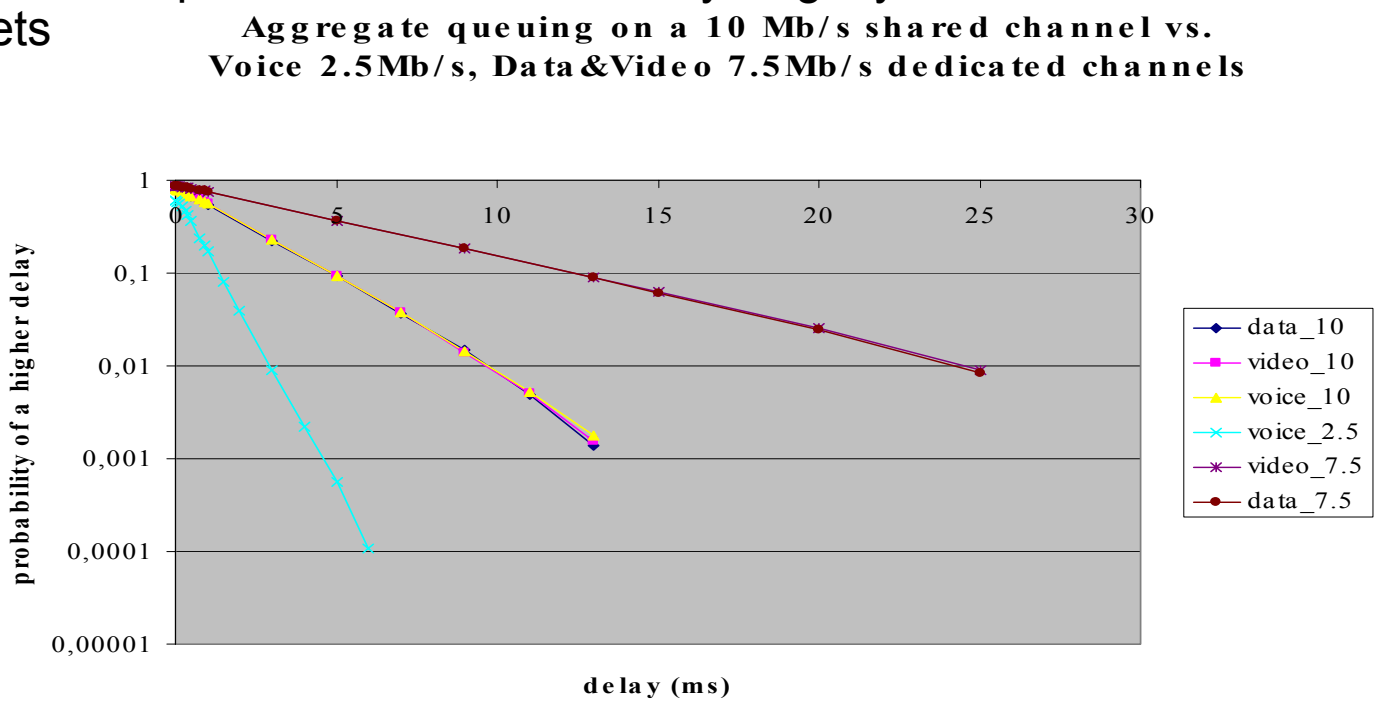
- Assumption – different sources have different traffic-patterns
- Voice
  - small packets (100 - 400 bytes/packet)
  - generated at a constant rate
- Video
  - packet-size limited only by maximum segment size
  - high variation of the rate of the traffic
- Multiple paths
  - solve the preemptability 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

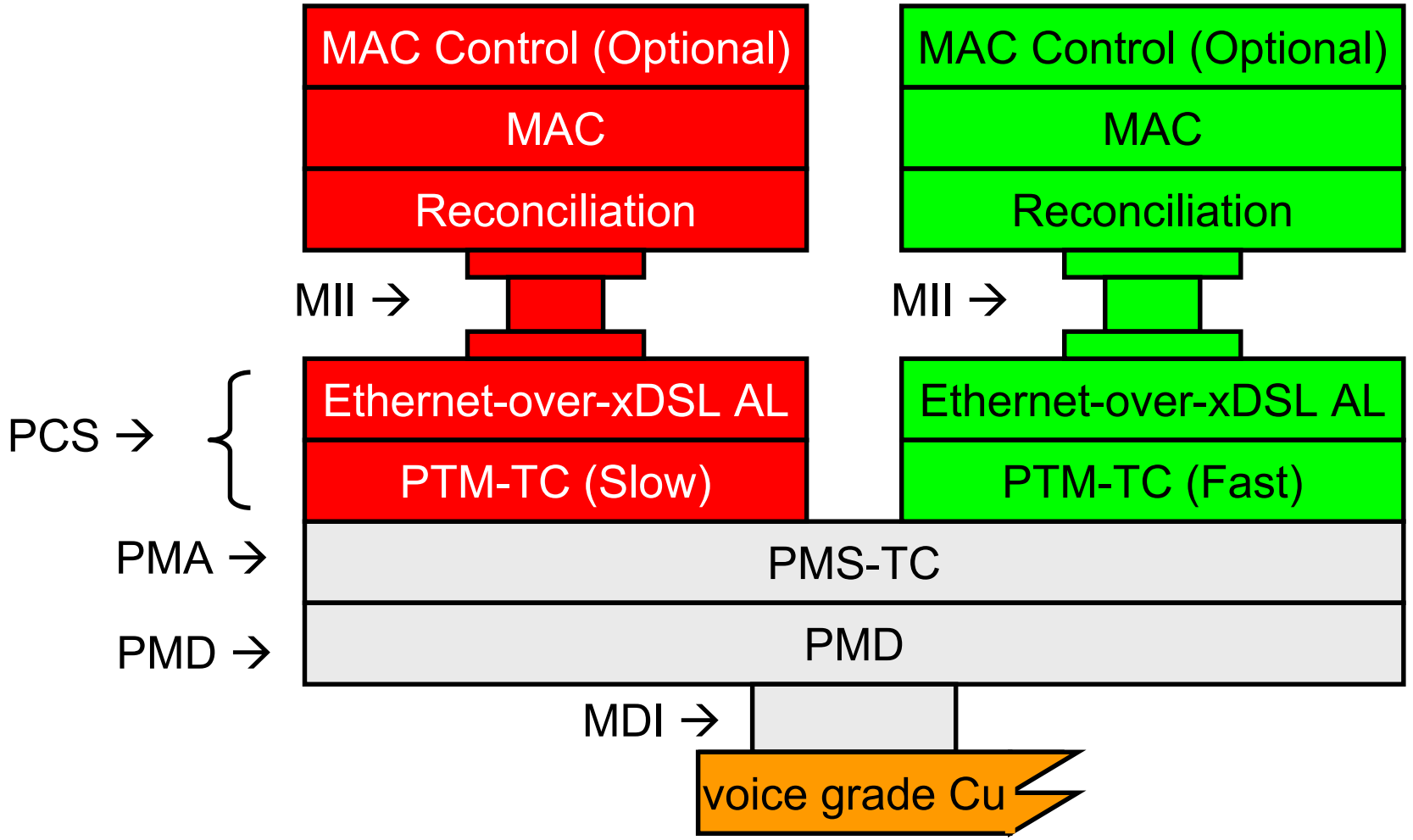
Results

- Single Path
  - all packets experiences the same delay, slightly worse for the voice packets



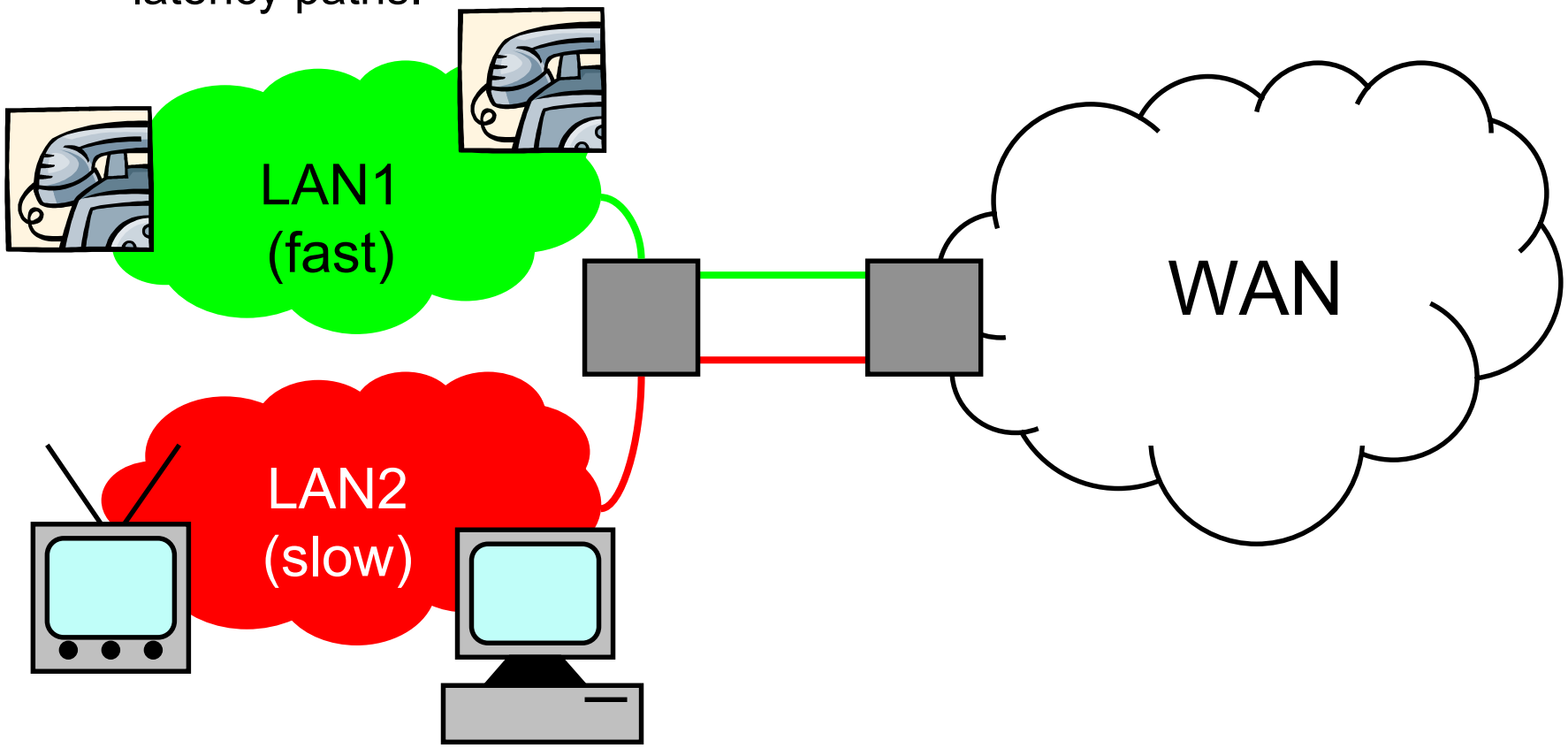
- Two Paths
  - guarantees the voice channel won't be affected by a bursty data-source

An Ethernet PHY with two MIIs?



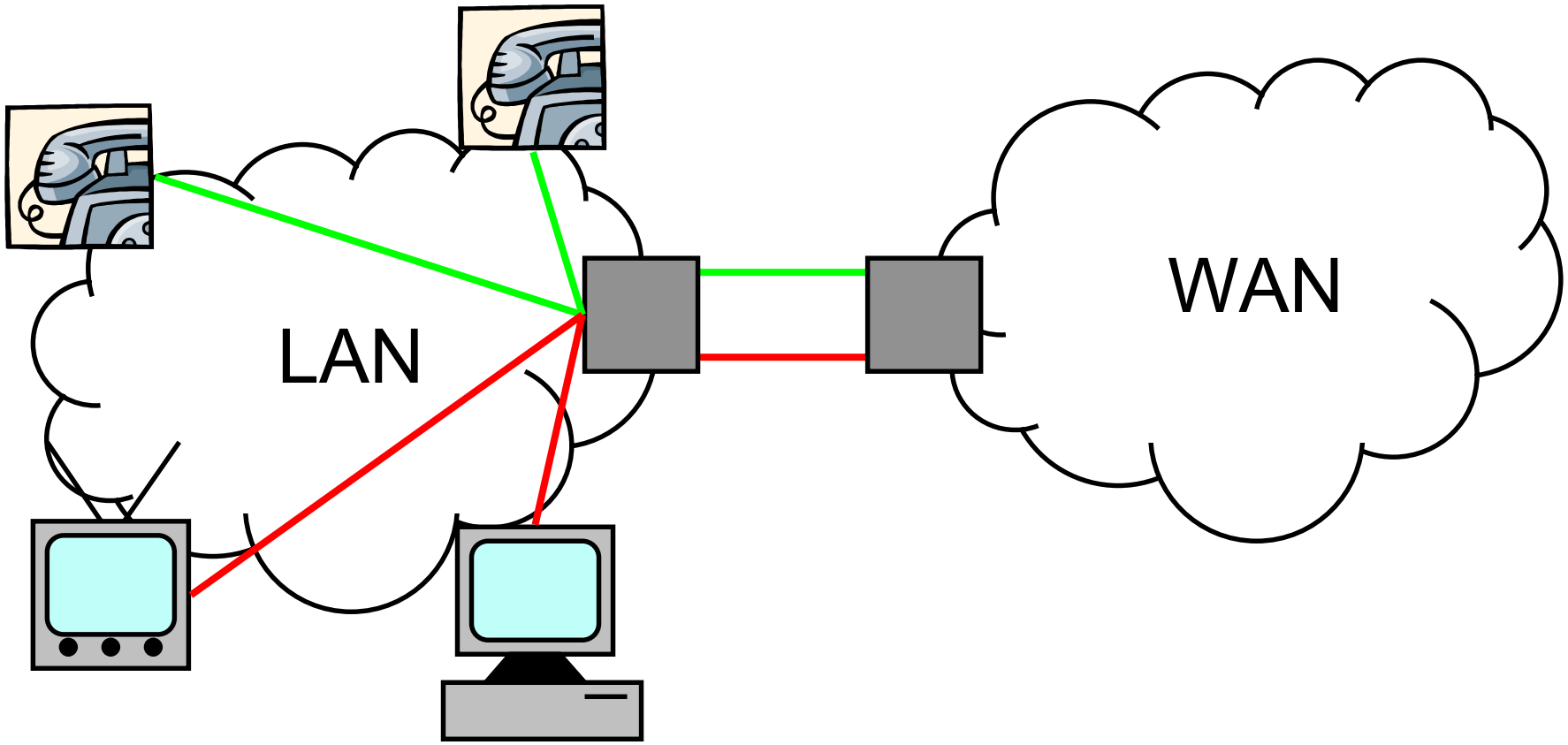
Two Separate LANs

- Latency-sensitive equipment is kept in a separate LAN.
- Different ports on the CPE device correspond to the different latency paths.



VLAN Tagging

- Similar to ATM VP/VC labelling; all devices are on the same LAN, but VLAN tags differentiate between latency paths.

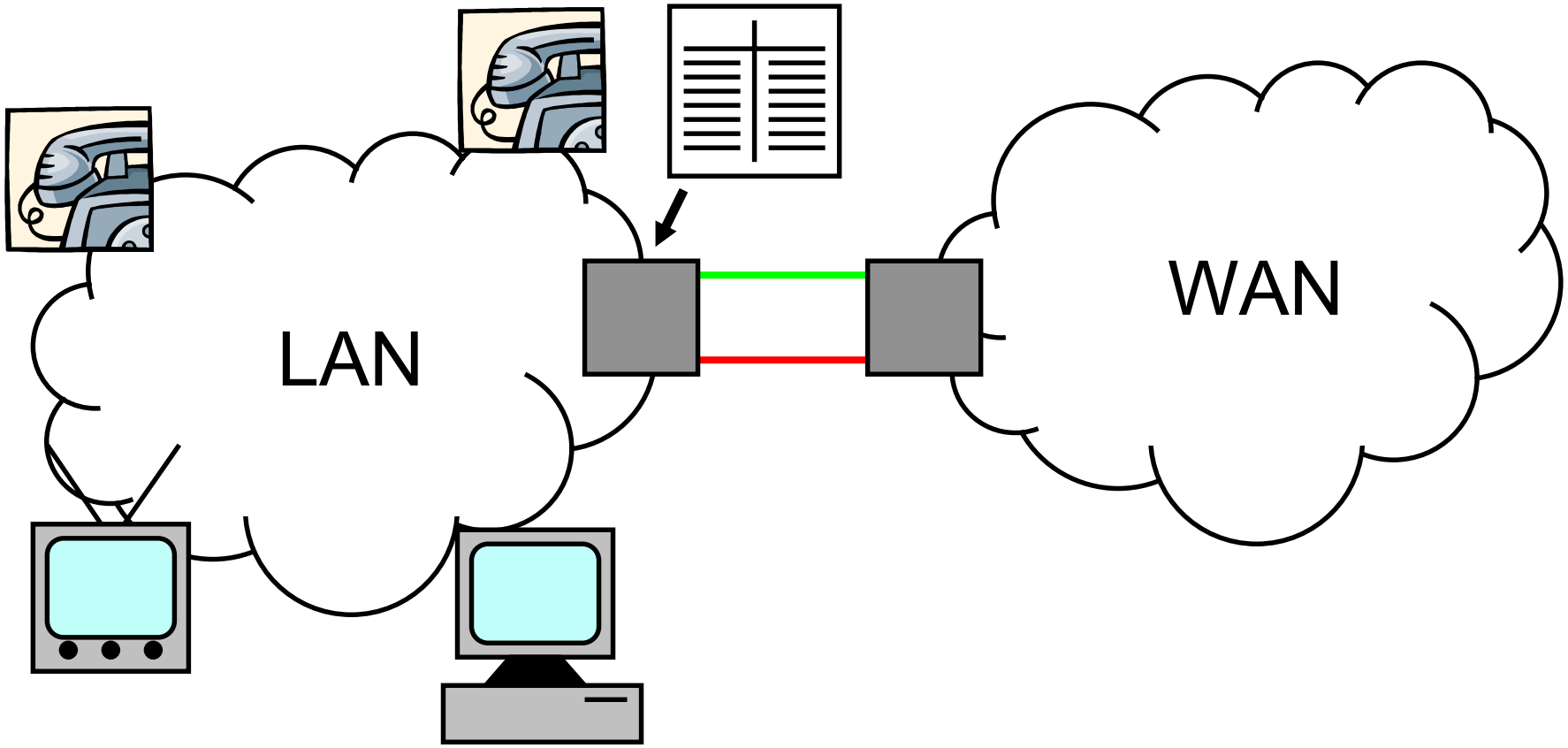


Slow/Fast Aggregation

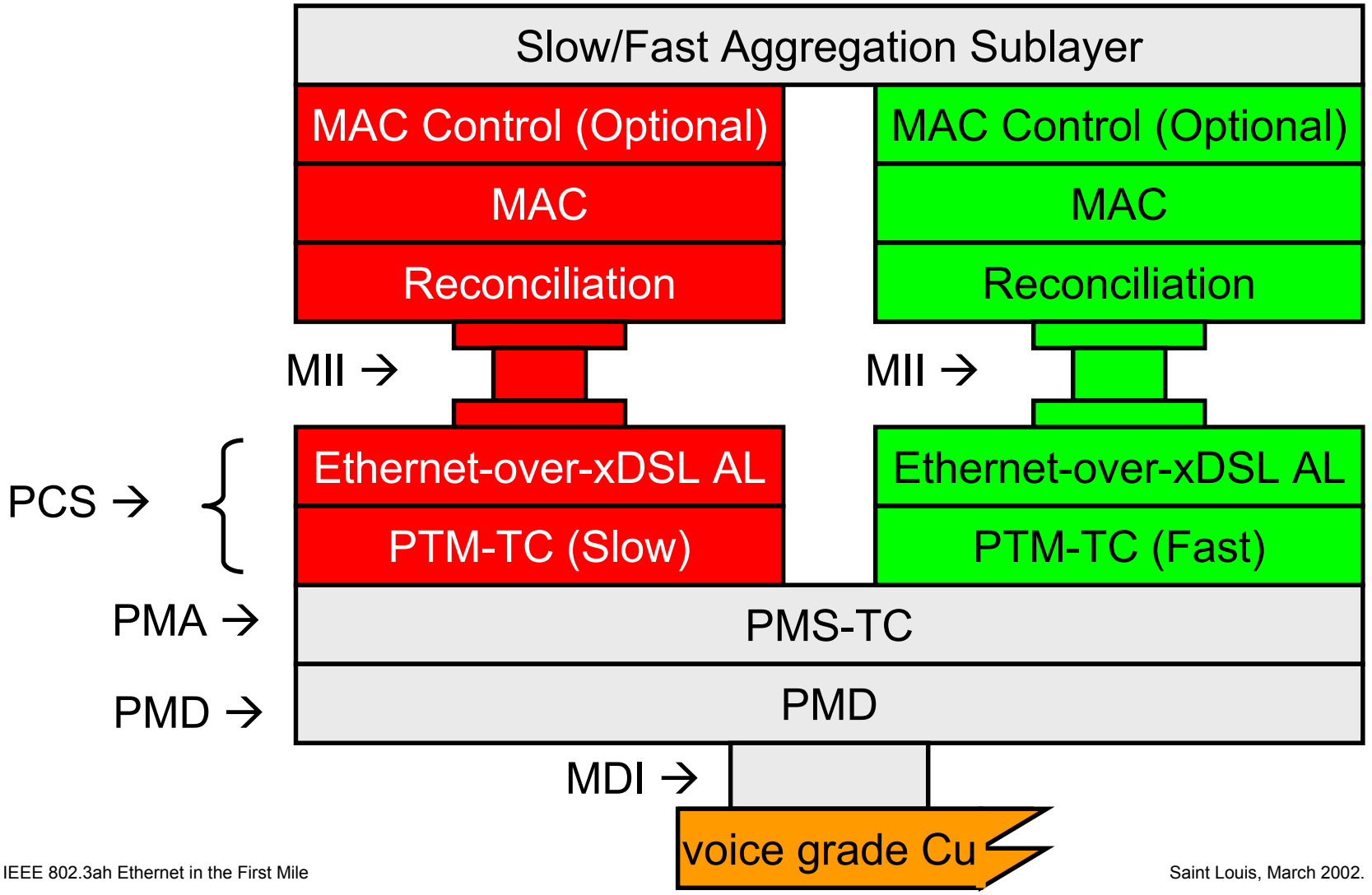
- Based on the concept of “conversations” (Clause 43):
  - Some conversations are latency-sensitive, others are not.
  - An “aggregator” looks at SA and DA to determine the conversation.
  - A look-up table associates certain conversations with a certain path; all others go to the default path.
  - At the receiver side, slow path and fast path are muxed into a single stream again.

Slow/Fast Aggregation (continued)

- 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



Overview

	PRO	CONTRA
Separate LANs	Robust and straight-forward	Need to physically maintain two LANs.
VLAN Tagging	No new equipment needs to be specified.	All devices need to be VLAN enabled.
Aggregation	No changes to LAN.	Aggregation layer must be specified and implemented.

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.