Early-stage Activity in IEEE 802.1 Working Group and Nendica

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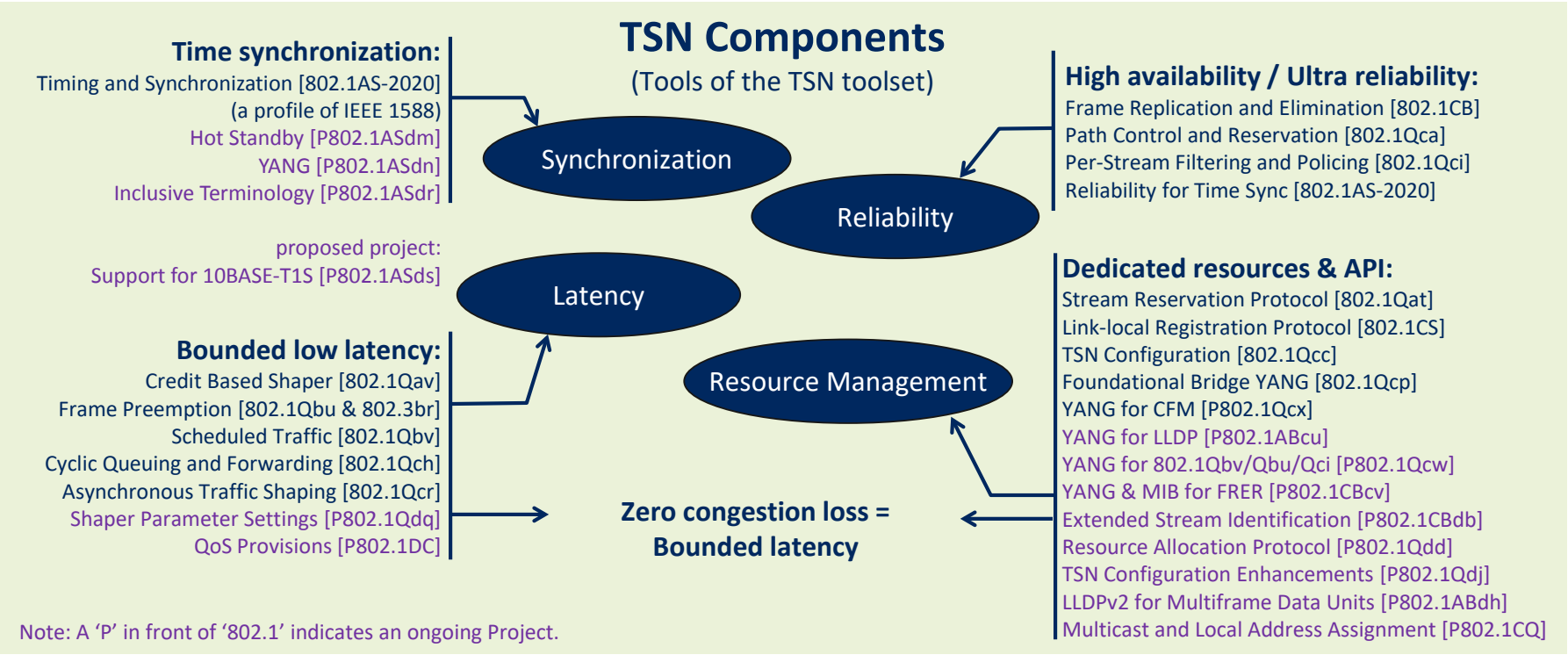
802.1 Time-Sensitive Networking (TSN)

- Central focus of current activity in IEEE 802.1 WG
  - deterministic connectivity through IEEE 802 networks
    - guaranteed packet transport with bounded latency, low packet delay variation, and low packet loss

Time-Sensitive Networking (TSN) Profiles (Selection and Use of TSN tools)

Audio Video Bridging [802.1BA/Revision]	Fronthaul [802.1CM/de]	Industrial Automation [IEC/IEEE 60802]	Automotive In-Vehicle [P802.1DG]	Service Provider [P802.1DF]	Aerospace Onboard [IEEE P802.1DP / SAE AS6675]



More on TSN standards and ongoing projects at: https://www.ieee802.org/1/tsn

Nendica Overview

- IEEE 802 "Network Enhancements for the Next Decade" Industry Connections Activity (ICA)
  - ICAs are authorized IEEE SA Industry Connections Committee
    - "complement, supplement, or be precursors of IEEE Standards projects"
- Housed in 802.1 WG with 802-wide focus
  - organized within IEEE 802.1 Working Group
    - *802 LAN/MAN architecture, internetworking among 802 LANs, MANs and other wide area networks, 802 Security, 802 overall network management, and protocol layers above the MAC & LLC layers*
- Nendica Voting
  - no members; anyone attending may vote on all motions
- Nendica Web site
  - https://1.ieee802.org/802-nendica/
- Nendica Meetings
  - Weekly, Thursday 09:00–11:00 ET
  - Averaging around 20 people recently

Nendica “Motivation and Goal”

- *The goal of this activity is to document emerging requirements and directions for IEEE 802 networks, identify commonalities, gaps, and trends not currently addressed by IEEE 802 standards and projects, and facilitate building industry consensus towards proposals to initiate new standards development efforts. Encouraged topics include enhancements of IEEE 802 communication networks and vertical networks as well as enhanced cooperative functionality among existing IEEE standards in support of network integration. Topics concerning higher-layer applications related to new standards development in the IEEE 802.1 Working Group are also specifically expected and encouraged. Findings related to existing IEEE 802 standards and projects are forwarded to the responsible working groups for further considerations.*

Published Nendica Reports

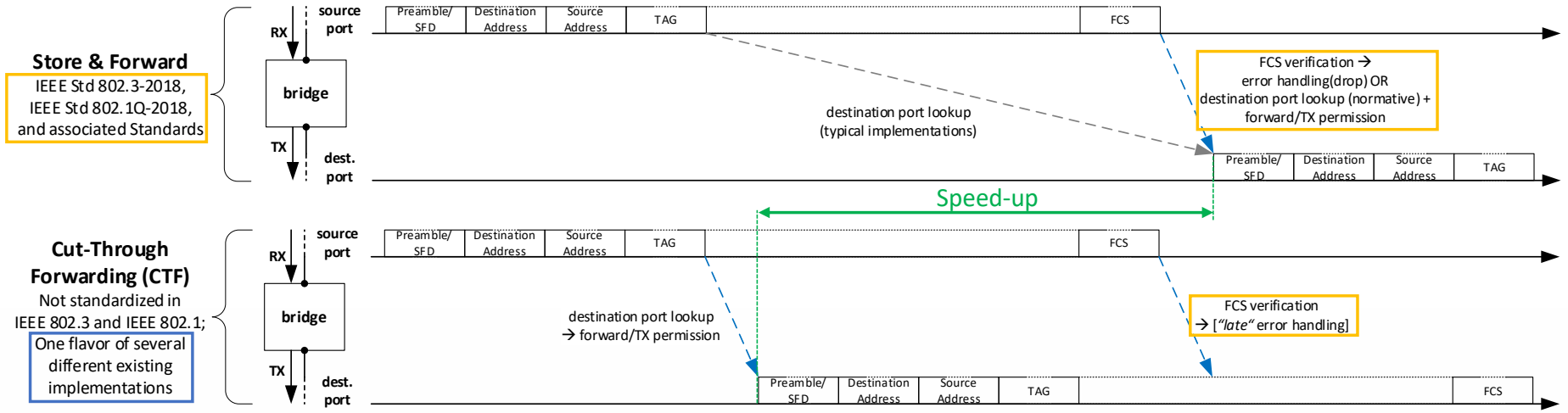
Nendica "Work Items" produce Nendica Reports:

- IEEE 802 Nendica Report: The Lossless Network for **Data Centers** (ISBN 978-1-5044-5102-4)
  - Editor: Paul Congdon
  - Published 2018-08-17
- IEEE 802 Nendica Report: Flexible **Factory IoT** — Use Cases and Communication Requirements for Wired and Wireless Bridged Networks (ISBN 978-1-5044-6229-7)
  - Editor: Nader Zein
  - Published 2020-04-17
- IEEE 802 Nendica Report: Intelligent Lossless **Data Center Networks** (ISBN 978-1-5044-7741-3)
  - Editor: Liang Guo and Paul Congdon
  - Published 2021-06-22

Current Nendica Activity

- Cut-Through Forwarding [CTF]
- Evolved Link Layer Architecture [ELLA]
- New 802.1 topics

Cut-Through Forwarding [CTF]



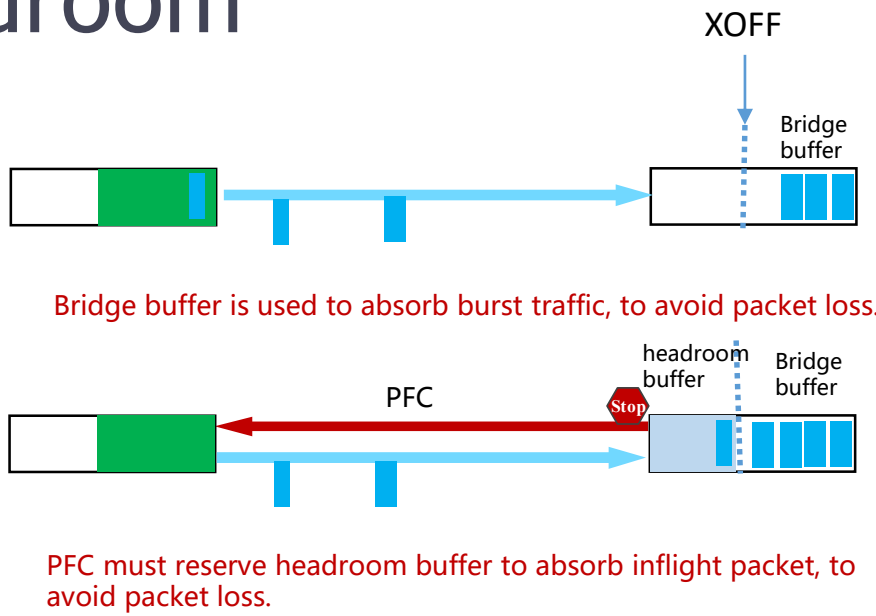
- forwarding frames before reception is complete
- Opened Study Item in March 2021
  - https://1.ieee802.org/nendica-ctf/
- IEEE 802 Tutorial on Cut-Through Forwarding (July 2021)
  - https://mentor.ieee.org/802.1/dcn/21/1-21-0037-00-ICne.pdf
- Work towards standardizing CTF
  - Nendica as venue for cross-WG discussion (802.1 and 802.3)
  - Proposal towards a new IEEE 802.1 base standard for CTF
    - https://mentor.ieee.org/802.1/dcn/21/1-21-0051-07-ICne.pptx

Evolved Link Layer Architecture [ELLA]

- Opened Study Item in July 2021
  - https://1.ieee802.org/nendica-ella/
- support IEEE 802 activities to revise IEEE Std 802 ("Overview and Architecture" of IEEE 802)
- plan to produce an informal report documenting:
  - Summary of aspects missing from current IEEE 802 Architecture
  - Potential benefits enabled by additional architectural details
  - Impact of new and evolving technologies on architecture
  - Architectural optimization in specific network environments
  - Possible standardization recommendations
- See:
  - Potential Nendica Study Item: Evolving IEEE 802 Architecture Requirements
    - https://mentor.ieee.org/802.1/dcn/21/1-21-0014-03-ICne.pdf
  - ELLA: What is the IEEE 802 Link Layer Service?
    - https://mentor.ieee.org/802.1/dcn/21/1-21-0060-02-ICne.pdf

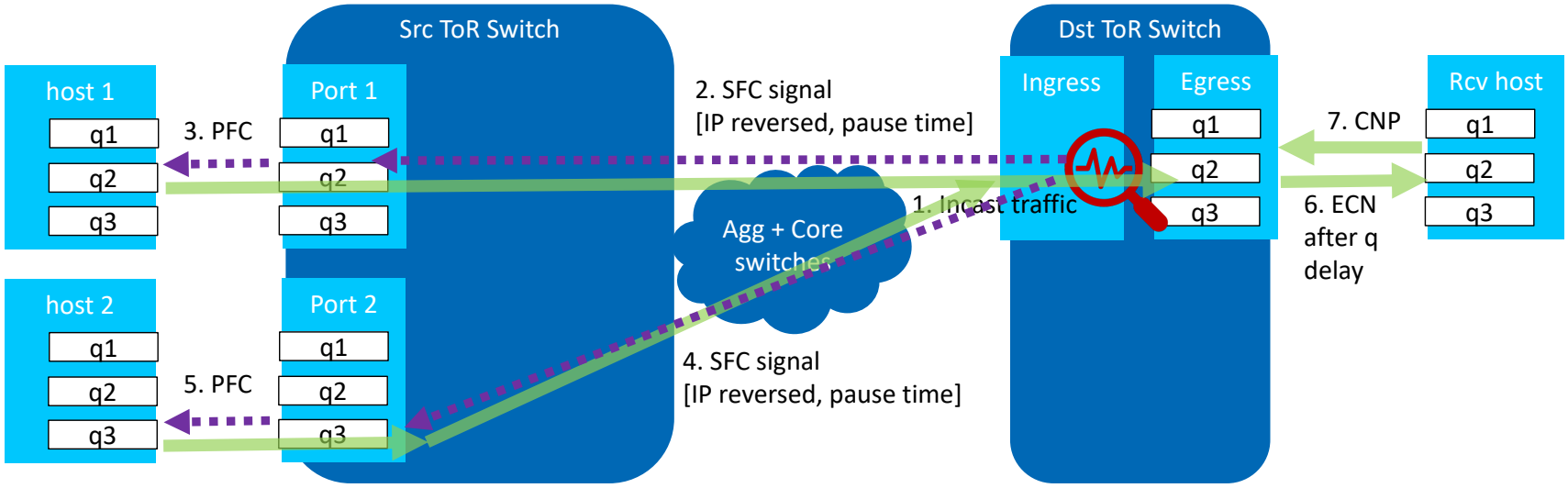
New Topic: PFC Headroom

- Improving Priority-based Flow Control (per IEEE Std 802.1Q) by:
  - automatically calculating and configuring PFC headroom
  - allowing MACsec-protected PFC frames
- Useful in low-latency Ethernet networking environments, such as high-performance data center networks and data center interconnects



- Contributions (January 2021 to present)
  - https://www.ieee802.org/1/files/public/docs2021/new-lv-adaptive-pfc-headroom-0121-v02.pdf
  - https://www.ieee802.org/1/files/public/docs2021/new-congdon-a-pfc-h-Q-changes-0521-v01.pdf
  - https://www.ieee802.org/1/files/public/docs2021/new-lv-adaptive-pfc-headroom-and-PTP-0602-v03.pdf
  - https://www.ieee802.org/1/files/public/docs2021/cz-finn-pfc-headroom-0629-v01.pdf
  - https://www.ieee802.org/1/files/public/docs2021/new-lv-PFC-Headroom-Project-Proposal-0721-v01.pdf
  - https://mentor.ieee.org/802.1/dcn/21/1-21-0048-00-ICne-pfc-headroom-with-macsec.pdf
  - https://mentor.ieee.org/802.1/dcn/21/1-21-0050-00-ICne-pfc-enhancements-project-proposal.pdf
  - https://mentor.ieee.org/802.1/dcn/21/1-21-0052-00-ICne-pfc-enhancements-next-steps.pdf
  - https://mentor.ieee.org/802.1/dcn/21/1-21-0062-00-ICne-pfc-headroom-project-planning.pdf
- Goals:
  - Amendment to IEEE 802.1Q with limited changes to support PFC auto-configuration

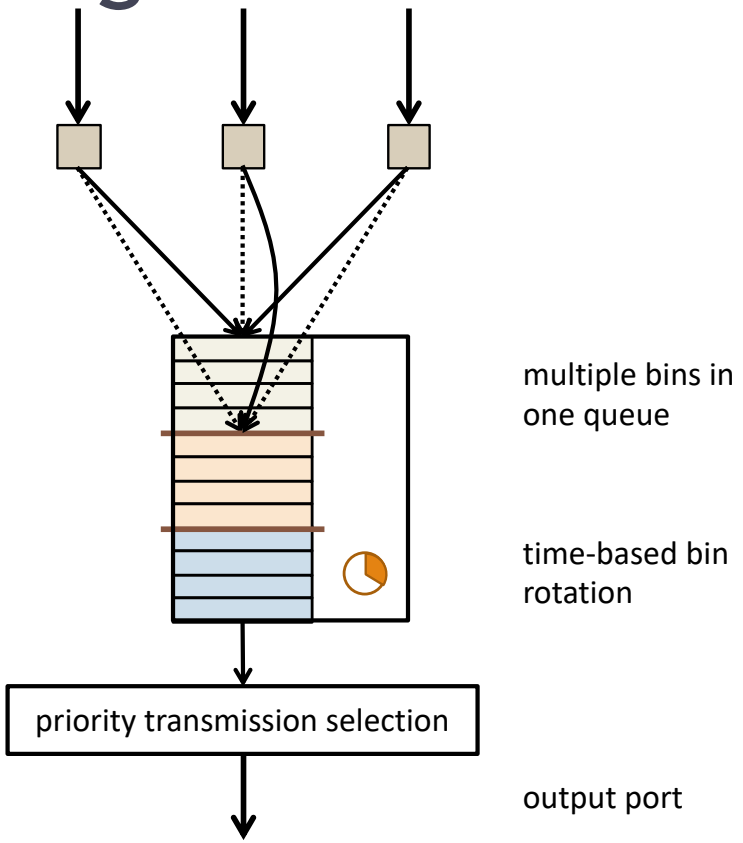
New Topic: Source (remote) PFC



- Pause congestion-creating flows directly at the source
- Useful in low-latency Ethernet networking environments such as large-scale data center networks
- See:
  - Source Flow Control (15 Sep)
    - https://mentor.ieee.org/802.1/dcn/21/1-21-0055-00-ICne.pdf
  - Source (remote) PFC test (12 Oct)
    - https://mentor.ieee.org/802.1/dcn/21/1-21-0061-00-ICne.pdf

New Topic: Pulsed Queuing

- Cyclic Queuing and Forwarding (CQF) is a TSN tool for bounded latency, per IEEE Std 802.1Qch-2017
- This topic would generalize CQF:
  - Increase bandwidth efficiency for high link delays.
  - Extend support for multiple traffic classes; multiple queues at different frequencies for different services.
  - Extend support for additional inter-device synchronization mechanisms.



- Contributions
  - new-specht-non-fifo-queues-0721-v01 (26 August)
  - new-finn-pulsed-queuing-0821-v03 (26 August)
  - new-yizhou-small-cycle-impact-0914-v01 (16 Sep)
  - Input Synchronization for Cyclic Queueing and Forwarding (22 Sep)
  - Multiple Cyclic Queuing and Forwarding (27 Sep, 28 Oct)

Summary

- Nendica produces IEEE 802 Nendica Reports for publication, and less formal deliverables
  - Focus on enhanced cooperative functionality among existing IEEE standards in support of network integration
- Contributions on new topics related to any IEEE 802 network activities are welcome
  - Nendica includes review of new work proposals intended for IEEE 802.1 Working Group standardization
- IEEE 802.1 WG is the home for TSN and its ongoing development
- 802.1 includes other activities, including Security TG and IEEE 802 YANGsters