IEEE 802.1 July 2022 Plenary Session

Source Flow Control Design: Caching

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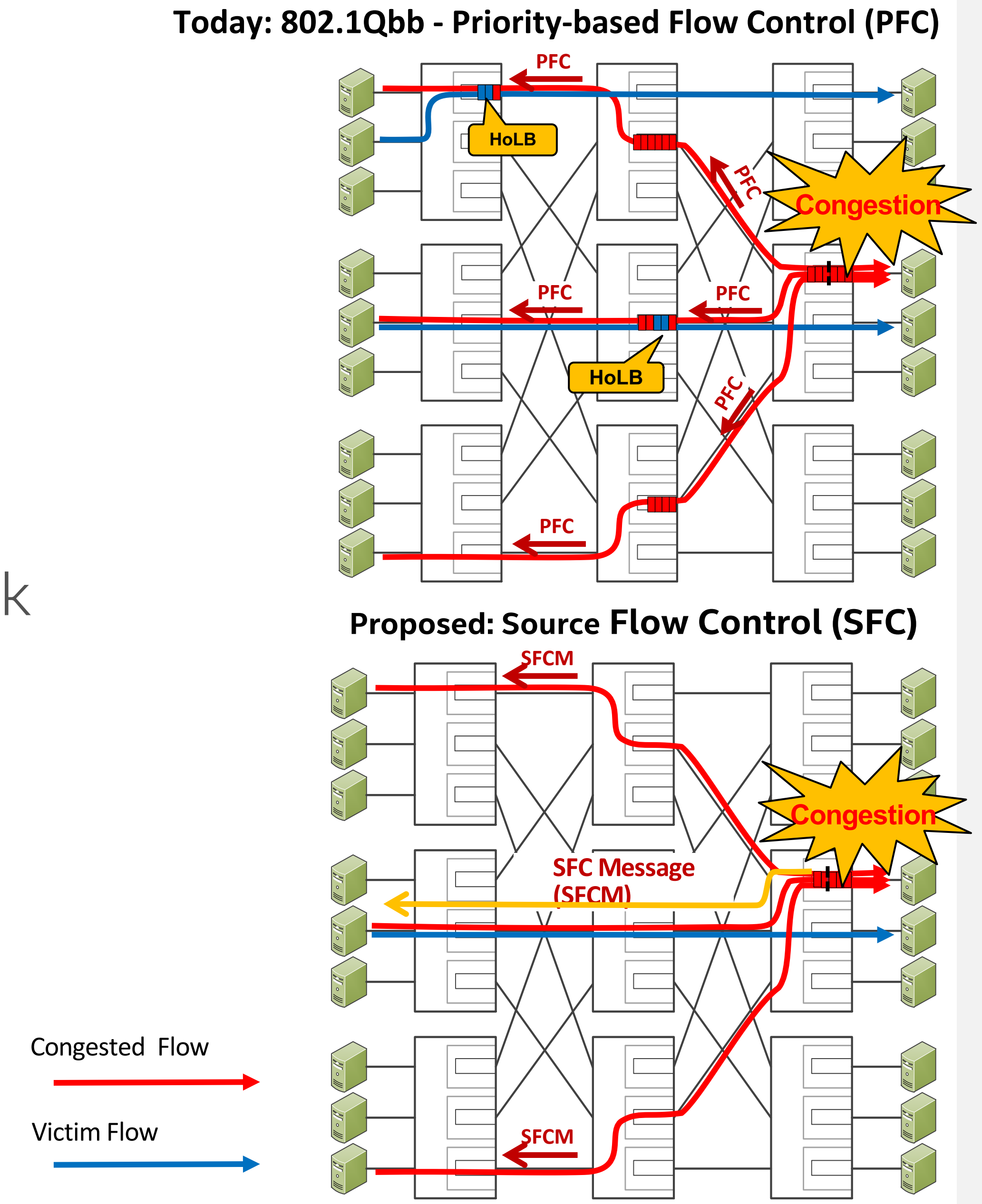
SFC High Level Concept

- Source Flow Control
  - Signal from switch directly to traffic source: per-flow pausing
  - Removes head-of-line blocking from network
  - Simplify deployments compared to PFC
    - Does not require complex buffer tuning
    - Completely remove risk of deadlocks



Today: 802.1Qbb - Priority-based Flow Control (PFC)

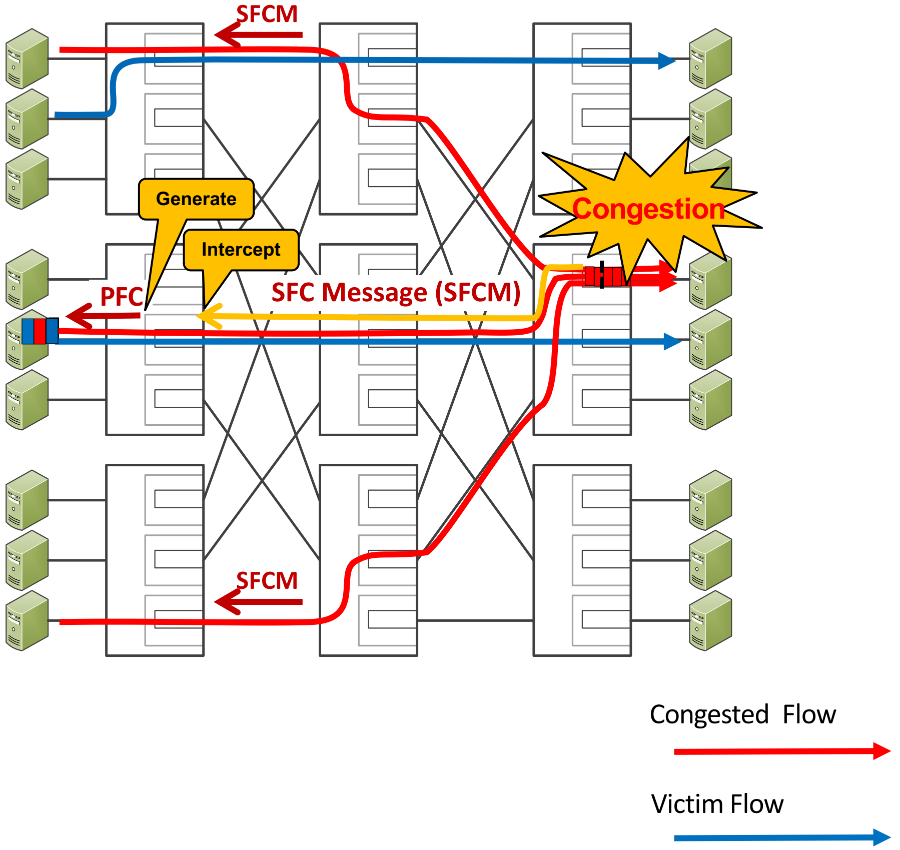
Proposed: Source Flow Control (SFC)

Figure source: https://mentor.ieee.org/802.1/dcn/21/1-21-0068-01-ICne.pdf

SFC w/ ToR Proxy (SFC-P)

- SFC with ToR Proxy
  - Works with today's RDMA NICs
  - SFC proxy converts SFC message to PFC frame at sender ToR
  - Removes congestion from network
    - HolB possible at sender NICs but not in switches

Source Flow Control (w/ ToR Proxy)



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Design Discussion

Topic 3: Contents of SFCM

What needs to be in the SFCM? Should it include Qau 'quantized' parameters?

Explanation/Solution:

- Qau specifies 'quantized' parameter F_b. CNM message carries F_b to host as input of rate calculation.

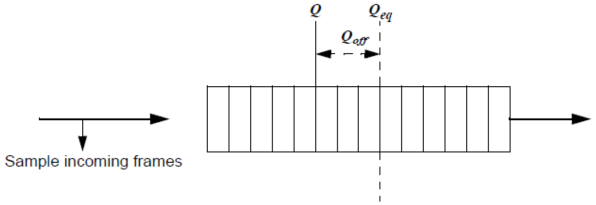


Figure 30-1—Congestion detection in QCN CP

Let Q denote the instantaneous queue size and Q_{old} denote the queue size when the last feedback message was generated. Let $Q_{off} = Q - Q_{eq}$ and $Q_\delta = Q - Q_{old}$.

Then F_b is given by the formula

$$F_b = -(Q_{off} + wQ_\delta)$$

(From 802.1Q -2018 30.2.1 CP algorithm)

Focus of this discussion

- SFC proxy mode generates a PFC frame and does not need F_b. Pause time is neede
- SFCM is sent to the sending host and is interpreted as if a PFC frame was received,
- Source IP address of offending flow is needed to generate SFCM
- Offending flow information is needed so source can map SFCM to appropriate traffic ss. This includes DSCP
- A congestion locator such as Topology Recognition level to identify 'incast' congestion verses 'in-network' congestion.
- An optional PTP timestamp when the message is sent to assist in pause duration adjustments at the source.

Source: SFC Design Team: "SFC Design Team Topics", IEEE March 2022

Topic 4: Identifying the source priority/TC to pause

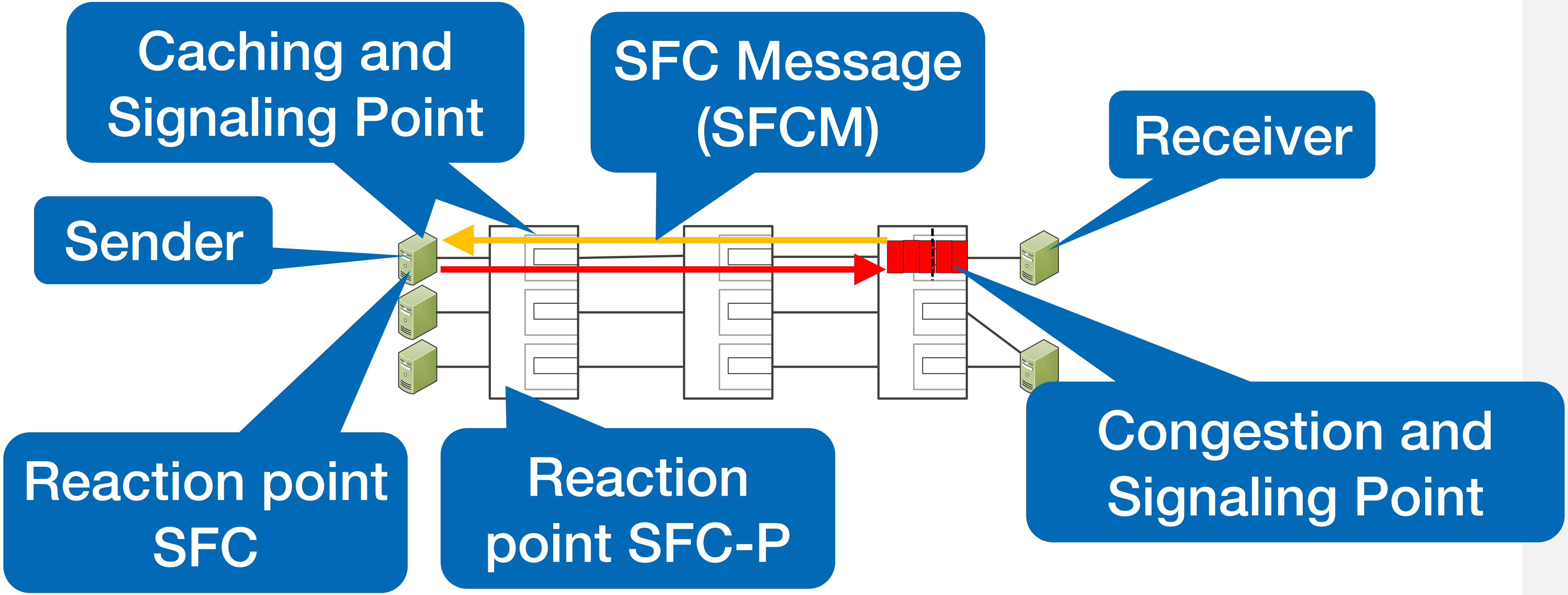
The priority/TC used to send the packet at the source may be different than the priority/TC received at the congestion point. Which priority/TC to pause?

Explanation/Solution:

- SFCM includes information to identify the flow which should be paused, as well as pause time.
- Because of the provided flow information in the SFCM, the source knows which queue (priority) needs to be paused.
- PFC can be generated to the source accordingly.

Source: SFC Design Team: “SFC Design Team Topics”, IEEE March 2022

Terminology used in this Slide Deck

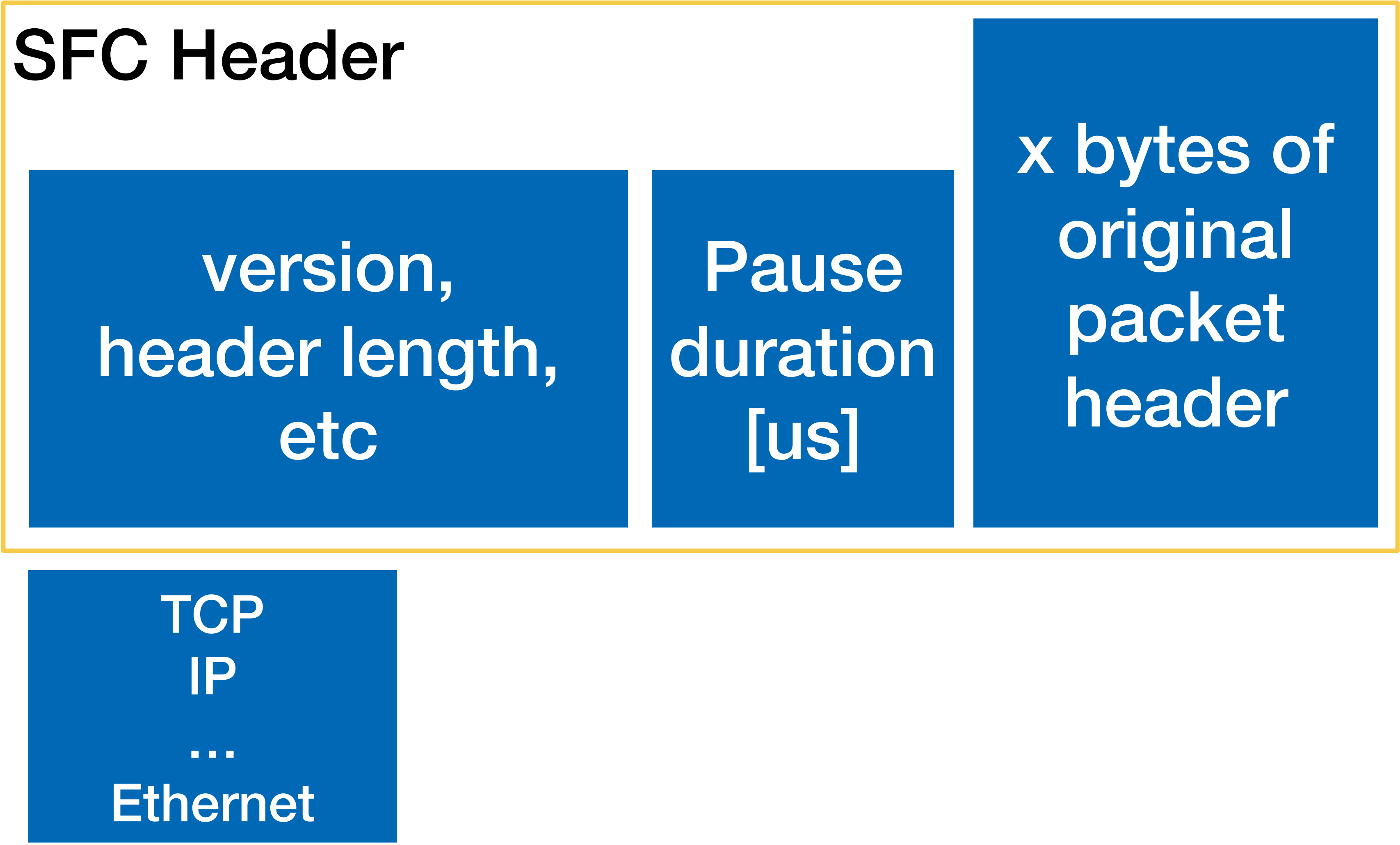


Terminology based on QCN (802.1Qau) and
SFC Design Team: “SFC Design Team Topics”, IEEE March 2022

SFC Message Contents: What to Pause?

- Baseline
  - Use first X bytes of original packet
  - SFC: Reaction point Sender NIC
    - Identify the flow to pause
    - How? Match original packet fields
  - SFC-P: Reaction point Sender ToR
    - Identify the TC to pause
    - How? Use DSCP value from original packet header
  - Simple, yet effective
  - Do not consider caching (details later)

Baseline SFC Message Contents



SFC Header

version, header length, etc

Pause duration [us]

x bytes of original packet header

TCP

IP

...

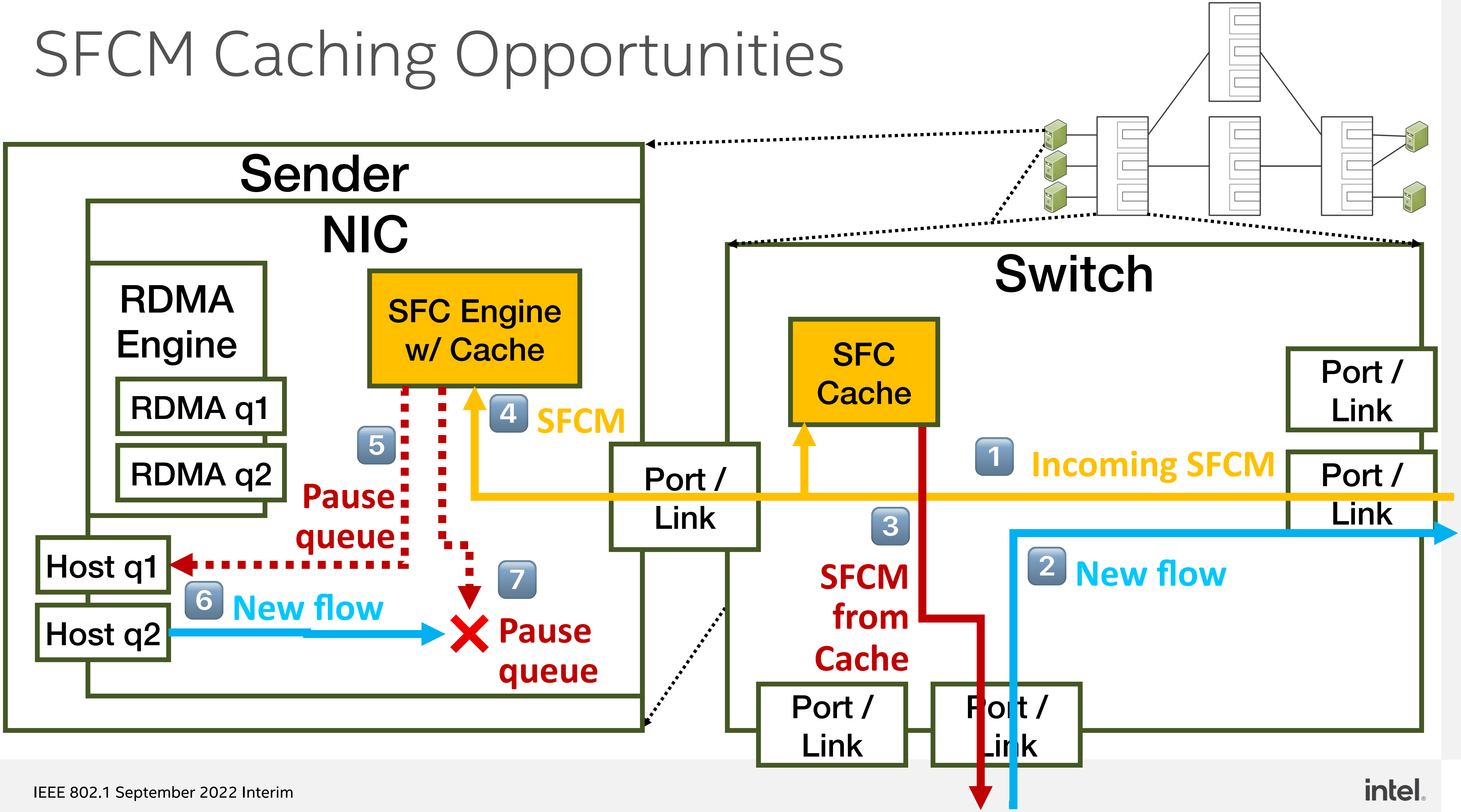
Ethernet

SFC Caching

Caching Overview

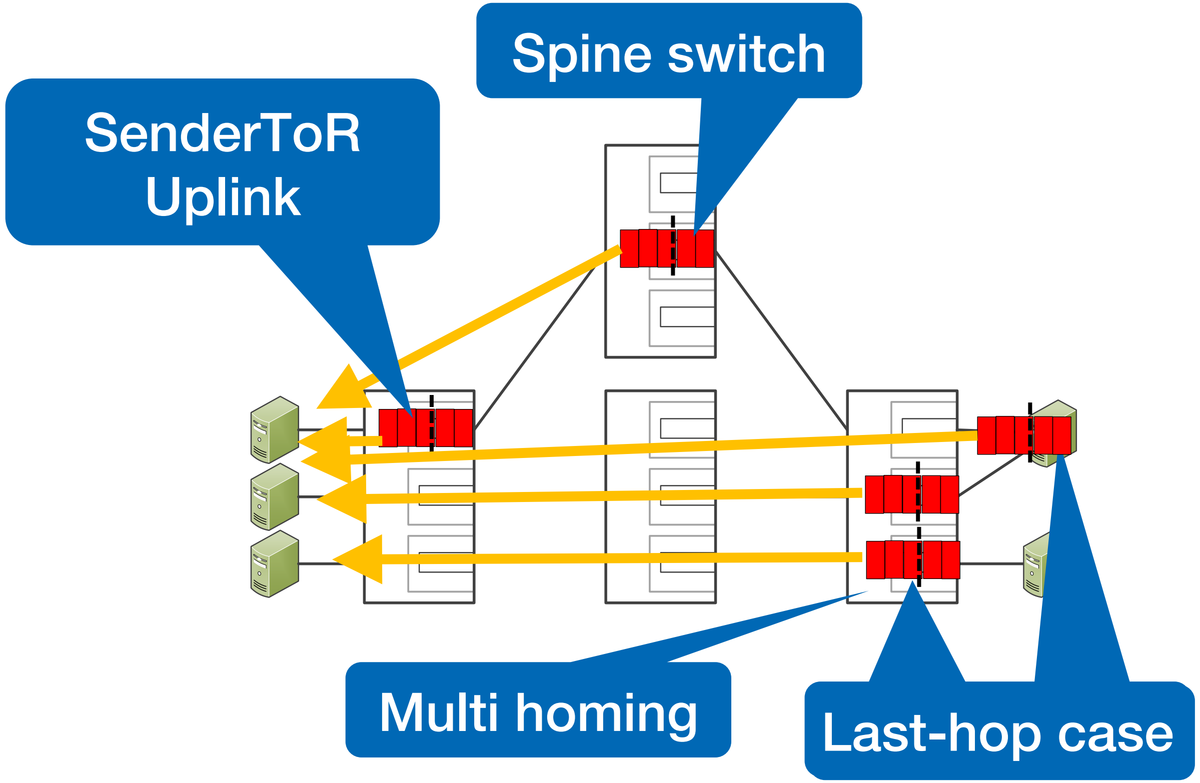
- For incast scenarios, caching is important
  - For some scenarios caching might not be possible
- Caching points (details on next slide)
  - Sender ToR
  - Sender NIC
- Use Congestion Point Locators
  - Specify traffic patterns to pause
  - The original packet header might not be a good fit for all cases
    - When tunneling is used: caching point needs to parse header stack
    - IPv6: destination host might have a /64 prefix assigned
    - Multiple DSCP values might map to TC/congested queue

SFCM Caching Opportunities



Congestion Point Locators

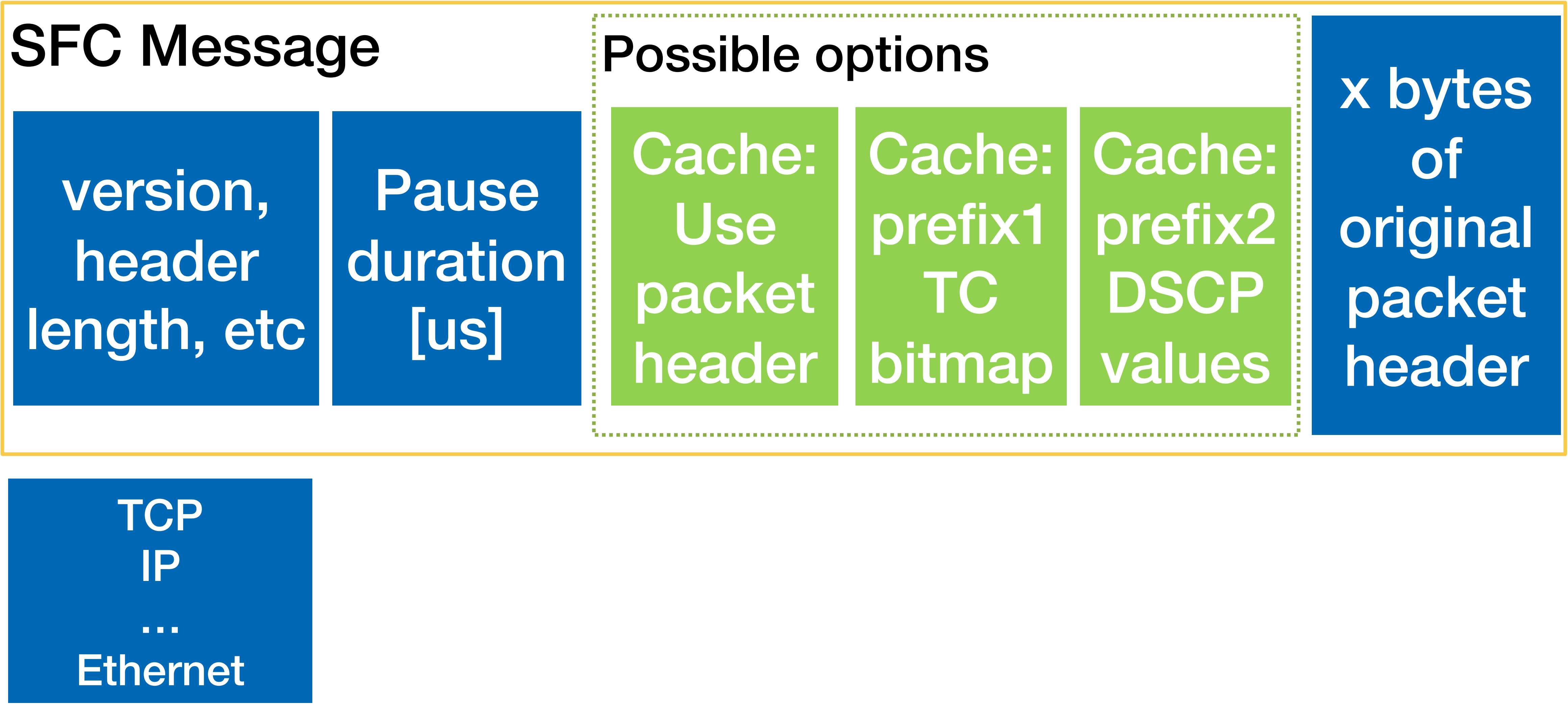
- Specification of congested queue
  - Enable senders to identify traffic going to the congestion point within the pause period
- Last-hop case
  - Congestion point is part of all paths to the receiver
  - Covers incast use cases
- Other cases
  - Congestion point is only part a subset of paths to the receiver



Congestion Point Locator: Last-hop case

- From original packet header: Use inner destination IP and DSCP value
- Specify explicitly in SFCM header
  - Port identification
    - Destination prefix of receiver
  - Queue identification
    - List of PCP/DSCP values that map to the queue on the congested switch
      - Complex header format (list with up to 64 6bit values)
      - PCP/DSCP to TC mappings might be different on different switches
      - No TC mapping synchronization between reaction and signaling point required
    - TC as is used by PFC
      - Simple: can use 8bit one hot encoding
      - Requires consistent traffic to TC mappings in reaction point and signaling point

Our Thoughts SFC Message Contents



SFC Message

version, header length, etc

Pause duration [us]

Possible options

Cache: Use packet header

Cache: prefix1 TC bitmap

Cache: prefix2 DSCP values

x bytes of original packet header

TCP
IP
…
Ethernet

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