

Ingress Policing

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What is Ingress Policing?

- Relative to an Ethernet bridge (switch)
 - Ingress = frames received on port(s)
 - Egress = frames transmitted on port(s)
- Ingress Policing: Ensure ingress flows meet their specs
 - Mark (color) frames that are out-of-spec
 - Options for handling marked frames
 - Drop, count for diagnostics, shutdown flow, ...
- Out-of-spec flows due to any cause
 - Malicious, faulty hardware, faulty software, ...

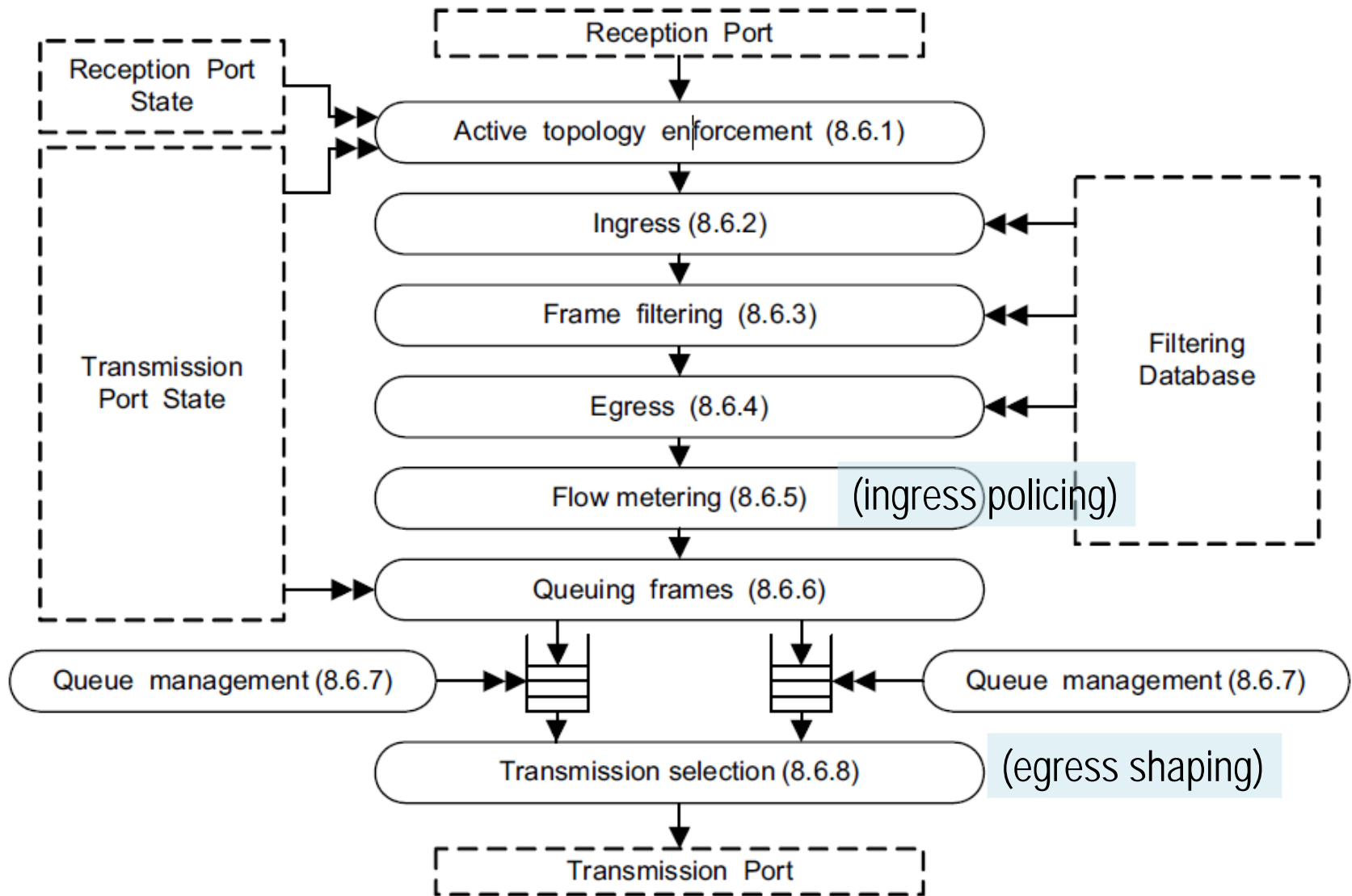
Related Features

- Security
 - Authentication, encryption, ...
- Filtering: Drop based on frame's header (not flow)
 - Ingress Filtering: Drop if VLAN ID (VID) not allowed for port
 - Frame Filtering: Decide set of egress ports based on
 - Destination MAC Address
 - VID
- Ingress Policing in Software (CPU)
 - Focus for this presentation is hardware
- Egress shaping / scheduling

Relationship to Egress: Shaping

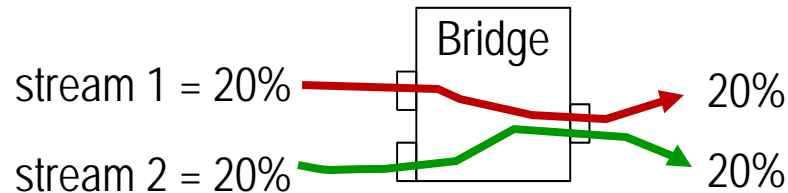
- 802.1 TSN shaping operates **per-class** on egress
 - Priority in frame maps to class, which maps to egress queue
- Credit-based shaper
 - Bandwidth of all streams for class (A/B) cannot be exceeded
- Scheduling (802.1Qbv thus far)
 - Repeating gates for each egress queue
 - Implicitly specify bandwidth
 - E.g. Priority 3 open $300\mu\text{s}$ every $1000\mu\text{s}$ = 30% bandwidth
- Future shapers likely to provide similar

Relationship to Egress: 802.1Q Fig 8-10

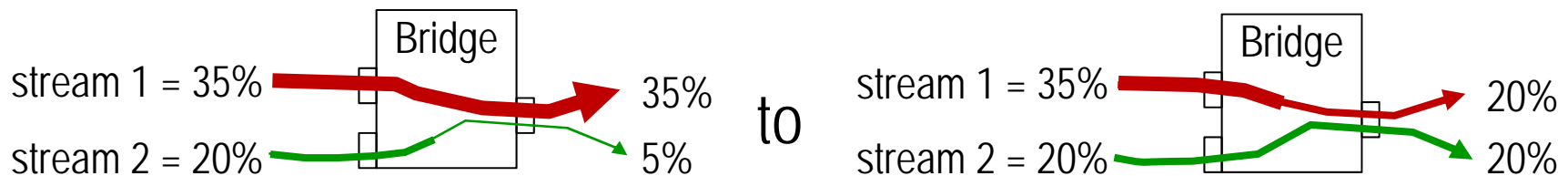


Relationship to Egress: Example

- Reserve two streams, each 20% bandwidth



- If stream 1 violates with 35%, egress shaping only (no ingress policing) ranges from...



- Shaping does not specify out-of-spec frames to drop

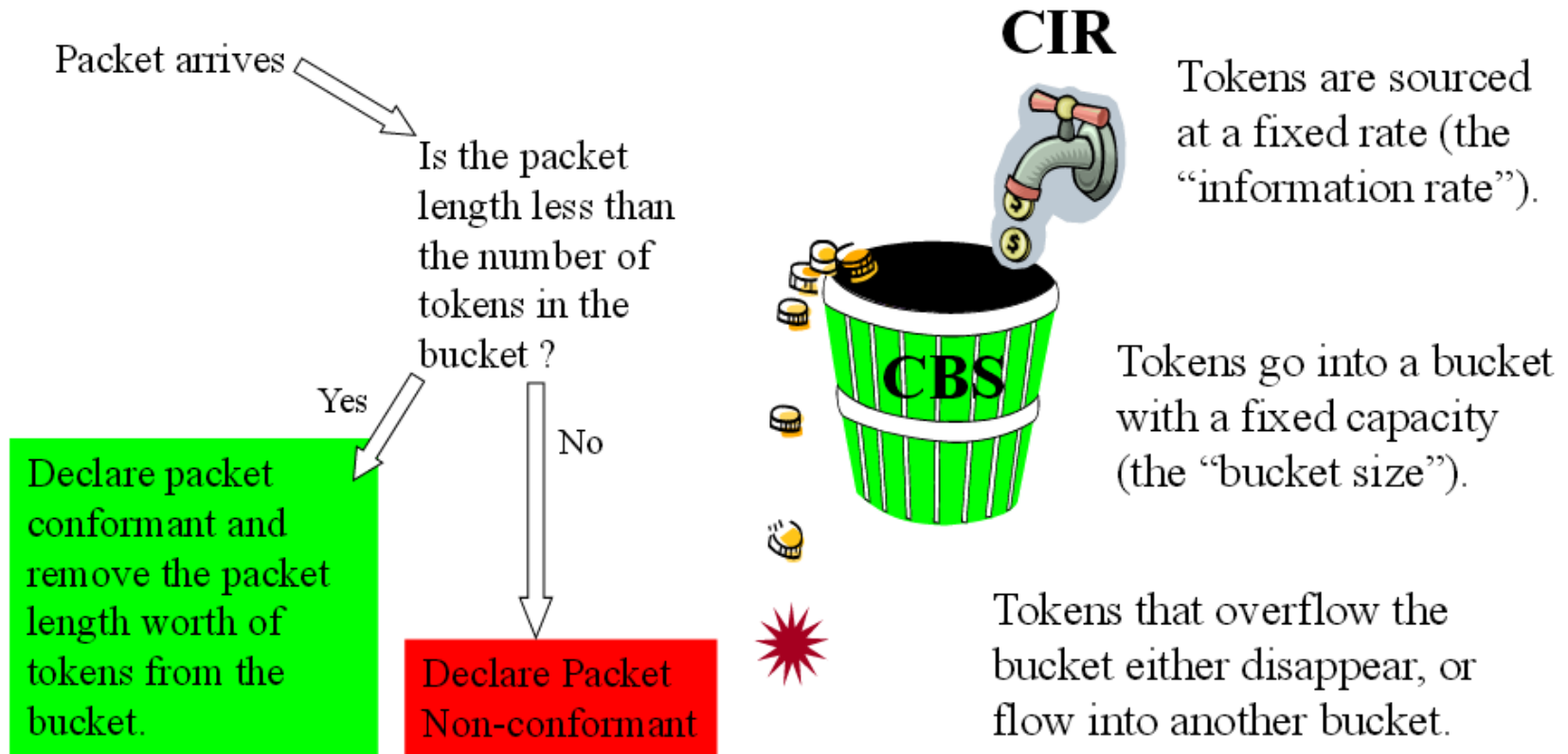
Ingress Policing in 802.1Q-2011

- Sub-clause 8.6.5, Flow classification and metering
 - <http://standards.ieee.org/findstds/standard/802.1Q-2011.html>
- “may” = “is permitted to” (optional)
- Classification identifies subset of traffic: **per-flow**
 - Uses header elements; all optional
 - Source MAC address
 - Destination MAC address (e.g. TSN stream)
 - VID, priority, higher layers (IP protocol, TCP connection)
- Metering algorithm applied to each flow
 - Marks (colors) frames according to flow’s spec

802.1Q Metering Algorithm

- “Metering algorithm described in Metro Ethernet Forum Technical Specification MEF 10.2 should be used”
 - http://metroethernetforum.org/PDF_Documents/technical-specifications/MEF10.2.pdf
- “should” = “is recommended that”
 - Other industry-specific implementations possible
- MEF 10.2 sub-clause 7.11.2, Ingress Bandwidth Profile
 - Commonly known as Token Bucket algorithm
 - Token Bucket’s concept of ‘color’ supported by 802.1 Drop Eligible feature

Token Bucket Metering: Basics



- More info by 802.1 Interworking chair, January 2013
 - <http://www.ieee802.org/1/files/public/docs2013/new-tsn-haddock-flow-metering-in-Q-0113-v01.pdf>

Typical Availability

- Ingress policing is optional, but commonly available
- Classification typically relevant to TSN using Layer 2...
 - Priority: Meter all streams of a given class
 - Destination MAC address: Meter a specific stream (flow)
- Meters typically use Token Bucket algorithm
- Meters are a hardware resource: typically < 10
 - Metering 100's of specific streams would be new requirement
- Policing by priority has benefits over shaping
 - Example: Multiple ingress ports, one egress port, identify out-of-spec ingress port, ultimately to end-station

Example Using Typical Features

- Example
 - 200 total streams in network; 6 considered safety-related
 - All bridges have at least 6 ingress policing meters
 - Classify by Priority or by Destination Address (DA)
- Priority 3 for all 200, meter ingress port by priority?
 - Protected: Identifies babbling end-station, but not stream
- Priority 3 for all 200, meter 6 safety-related DA only?
 - Not protected: One non-safety babbler breaks safety
- Priority 3 for safety (meter 6 DA), priority 2 for rest?
 - Protected: Identifies babbling stream

Summary

- Ingress policing commonly available in today's products
- 802.1Q, 8.6.5 references service-provider industry
 - MEF provided specific requirements for their industry
 - 802.1Q designed to allow for future industry requirements
- 802.1 TSN welcomes requirements from AVnu AAA2C
 - Including ingress policing