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 300µs every 1000µs = 30% bandwidth
- Future shapers likely to provide similar
Relationship to Egress: 802.1Q Fig 8-10

- Reception Port
  - Active topology enforcement (8.6.1)
  - Ingress (8.6.2)
  - Frame filtering (8.6.3)
  - Egress (8.6.4)
  - Flow metering (8.6.5)
    
  Queuing frames (8.6.6)
  
  Queue management (8.6.7)
  
  Transmission selection (8.6.8)
  
  Transmission Port

- Filtering Database
  - Ingress policing
  - Egress shaping
Relationship to Egress: Example

- Reserve two streams, each 20% bandwidth

  stream 1 = 20%
  stream 2 = 20%

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

  stream 1 = 35%
  stream 2 = 20%

- 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

- “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

Packet arrives

Is the packet length less than the number of tokens in the bucket?

Yes

Declare packet conformant and remove the packet length worth of tokens from the bucket.

No

Declare Packet Non-conformant

CIR

Tokens are sourced at a fixed rate (the "information rate").

Tokens go into a bucket with a fixed capacity (the "bucket size").

Tokens that overflow the bucket either disappear, or flow into another bucket.

More info by 802.1 Interworking chair, January 2013

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