Performance Goals of AVB and Observation Intervals

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IEEE 802.1 AVB TG

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Performance Goals

- Max Latency (802.1Qav – MAC to MAC, not analog source to sync eg., microphone to speaker or hard drive to display)
  - 802.3: AVB Class 5: Less than 2 mSec over 7 Hops
  - 802.3: AVB Class 4: Less than 8 or 16 mSec over 7 Hops?
    - Prefer binary numbers
- Latency Variation (Jitter)
  - 802.3: Need to discuss objectives – effects shaper
- Class Observation Interval
  - AVB Class 5 is 125 uSec
  - AVB Class 4 is 1-5 mSec?

Ref : avb-pannell-assumptions-0607-v6

Design Problems of the AVB Forwarding

- Maximum Frame Size
  - 802.3: 1088 bytes for AVB Class 5? 1522 bytes? Or 2000 bytes?
- Talkers do per stream shaping?
- Minimum size frame issues on reservations for low bandwidth streams?
- Observation intervals name – token bucket solutions… What are we really doing here?
- Problem formulation
  - Given assumptions
  - Objectives with Cost functions
  - Constraints
- On above questions, what are given environments, cost functions, and constraints?

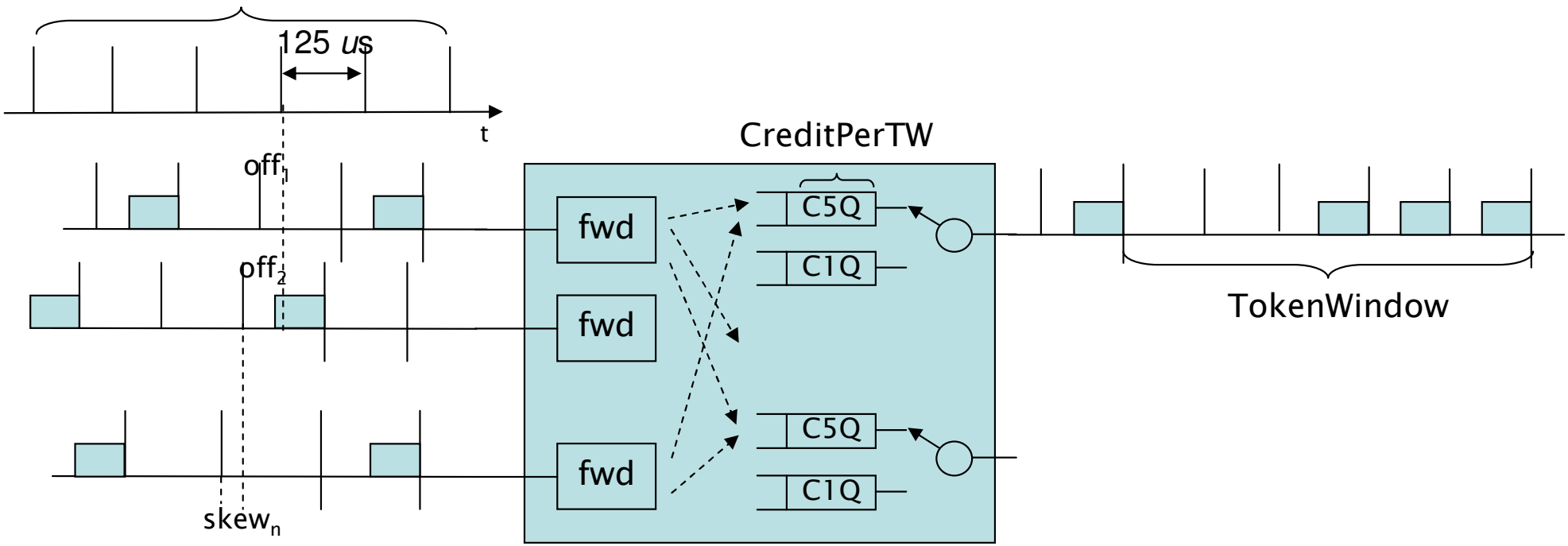
Problem Formulation of the AVB Forwarding

- What is the AVB forwarding process design problem?
  - Find operations on ingress port and egress port of AV bridge
  - Minimize
    - the gap between AV service requirements and served performance
    - the cost for added or changed functions to the 802.1Q forwarding process
  - Performance goals
    - Bounded latency & bounded delivery variation
  - Measurements of complexity on architecture
- What are the constraints on the solution
  - Reserve 25% of bandwidth for the legacy frames at least
- What are the given environments or assumptions
  - +-100ppm clock
  - Bandwidth reservation protocol
  - Traffic models

Possible solutions

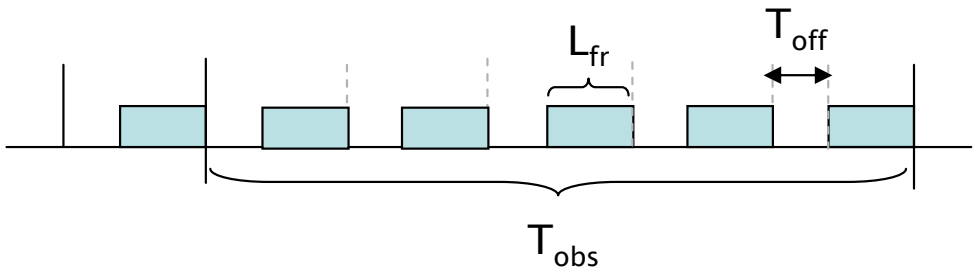
- A solution
  - Isochronously shaped de-queuing with token bucket algorithm
    - *TokenWindow* in *us*
    - *CreditPerTokenWindow* in octet
  - Cost functions
    - w_1*$f(latency_{goal}) + w_2$*$g(jitter_{goal}) + w_3$*h(ingress filtering, egress shaping, …)
- Constraints
  - *CreditPerTokenWindow <= 0.75*link speed/8*
- Given environments, assumptions
  - .1AS, .1Qat
  - Traffic model
    - CBR-like source
      - for VBR, reserve the peak bandwidth
    - frames with certain restrictions on
      - uniformly distributed inter-arrival, shaped stream
      - the size for supporting 100Mbps link

Observation Interval



- Isochronously shaped stream
  - Given 1AS and 1Qat protocols, possible to regulate the stream isochronously
- Observation Interval
  - Reference duration for uniformly shaping a stream
  - Measuring unit time for reserving bandwidth for an AVB stream
    - (max rate for a unit time, burst rate for a unit time)
  - Measuring unit time for scheduling the service of legacy frames
    - 25% amount of time reserved for the service of legacy frames
  - Measuring unit time for policing an input stream
  - In any cases, all the same value?

Shaping Interval for Uniformly Distributed Stream



- **Attributes**
  - Average size of AVB frames and legacy frames in byte : L_{fr}
  - Required peak bandwidth in bps : B_{peak}
  - Link speed in bps : R_{lk}
- **Case : arrival with uniform distribution**
  - Number of frame appeared in 1 sec : $N_{fr} = B_{peak} / 8*L_{fr}$
  - Uniformly distributed with T_{off} in *us* : $T_{off} = 10^6/N_{fr} - 10^6*8*L_{fr}/R_{lk}$
  - Constraints for reserving bandwidth for legacy frames : $T_{off}*N_{fr} >= 0.25*10^6$
  - Number of shaped or served frames in T_{obs} : $N_{sv} = T_{obs}*10^{-6}*N_{fr}$
  - Minimum shaping interval for serving 1 frame at least :
    $T_{obs} >= 10^6/N_{fr}$ *AND* $B_{peak}/R_{lk} <= 0.75$
  - Shaping interval depends on L_{fr}, B_{peak}, R_{lk}
    - *(500byte, 15Mbps, 100Mbps) → for serving 1 frame, watching 2,099us*

More reasonable approach

- **Performance goals from service requirements**
  - **Class 5**
    - **Latency <= 2ms**
    - **Jitter, how much allowed for serving AV services?**
  - **Class 4**
    - **What kinds of service for class 4?**
    - **Bounded latency, Jitter?**
- **Realistic traffic models**
  - **Close to the real-situation**
    - **Lognormal distribution on the length of burst frame train**
  - **Remove restriction on frame size**
    - **Why not 250*u*s for the class 5 observation interval on 100Mbps link?**
- **Select a solution with measuring the cost**
  - *Minimize C(solution) = w_1*f(latency$_{goal}$) + w_2*g(jitter$_{goal}$) + w_3*h(ingress filtering, egress shaping, …)*

Questions or Comments ?

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