Time Aware Shaper

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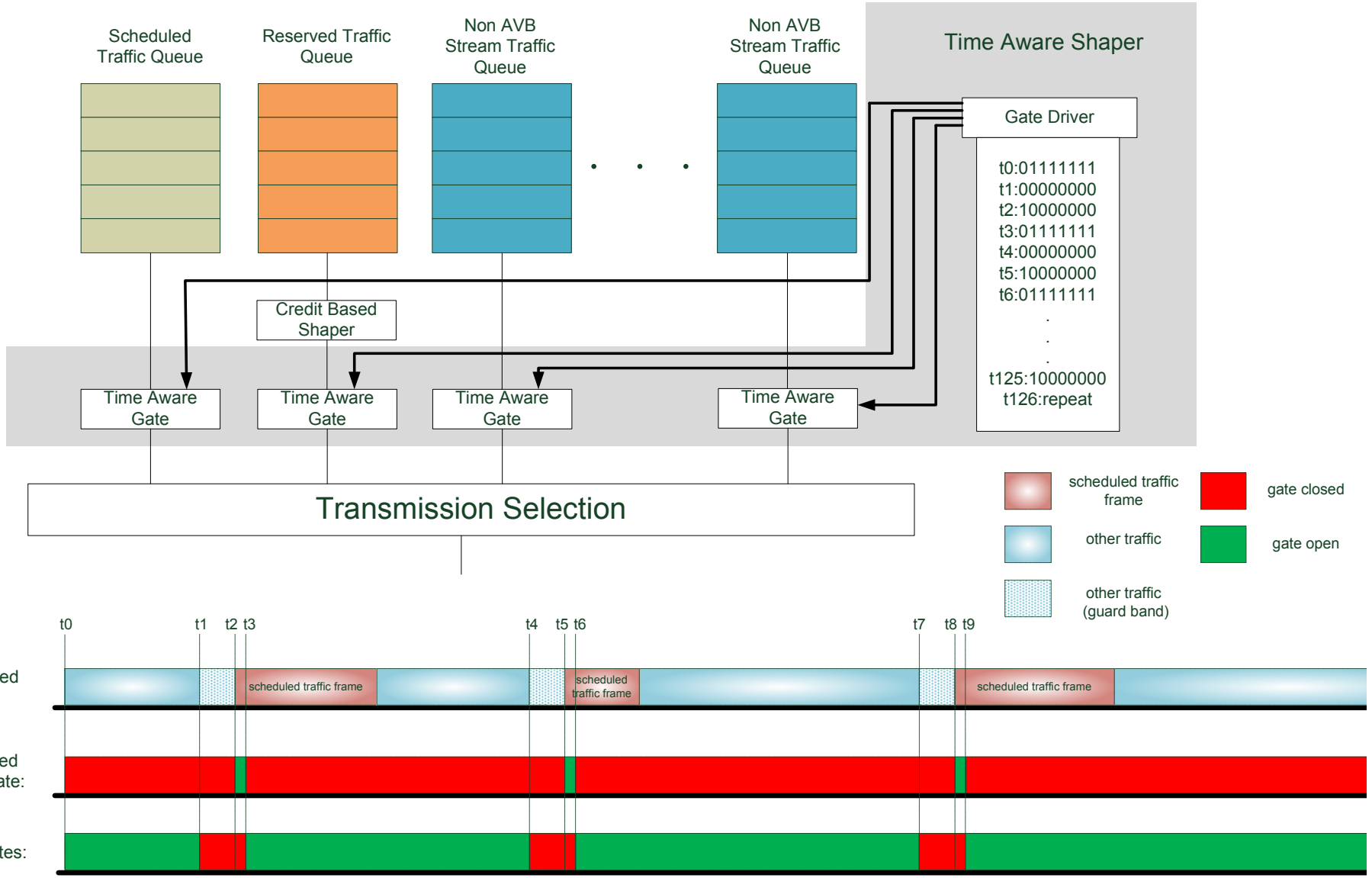


Configuration

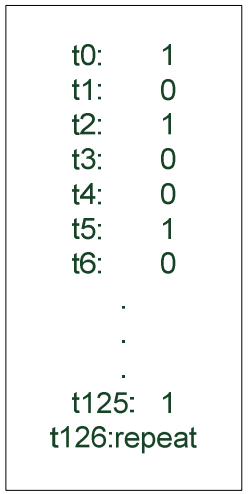
- Necessary information
  - Reference Time
  - List of Events

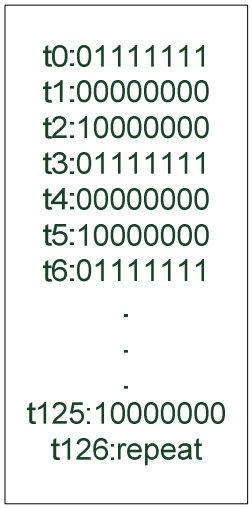
- It seems to be not necessary that all TAS (in all devices) start up simultaneously
- But Talker are not allowed to send streams as long as not all TAS are configured and running

- List of Events
  - Time interval
  - Event

Event List

- Gate events:
  - Gate close event = 0
  - Gate open event = 1
- Other events:
  - Repeat
- How many lists? (One per Port/Queue?)
  - One per port seems to be more efficient
- Reference Time
  - PTP timescale
  - PTP epoch (1 January 1970 00:00:00 TAI)
  - Advantages: no problem with leap seconds
  - IEEE 802.1 AS Timestamp or ExtendedTimestamp format (might be related to the time-interval (see next slide))





Event List

Gate event time:

- Time interval
- Relative to t0/last gate event – last gate event seems to be simpler

  → Chronological event list

  → No risk to have simultaneous gate events

  → Overlapping windows can be easily discovered
- Granularity (Qbv-D0.0 p12,l2): 1µs – should be << 1µs
- IEEE 802.1AS, 6.3.3.3 TimeInterval

"The TimeInterval type represents time intervals, in units of 2^{-16} ns.

```
struct TimeInterval
{
        Integer64 scaledNanoseconds;
};
```

For example: 2.5 ns is expressed as: 0x0000 0000 0002 8000"

Event List

- 32 bit unsigned integer in units of 2^{-16} ns is to small (max = 65.5µs)
- 32 bit unsigned integer in units of 1 ns, max = 4.2s
- How long is the maximum time interval?
- Is 1 ns granularity enough?

  → Seems to be enough to define the start of a window

  → Might be also enough to define the length of a window (1ns = 100 bit times @100GBit/s)

  → Should the granularity depend on the bandwidth?
- There might be difference between the minimum theoretical granularity defined by the type of the MIB variable and the device specific granularity
- The device specific granularity is an important parameter to calculate the schedule

Reference Time

- IEEE 802.1AS, 6.3.3.5 ExtendedTimestamp

"The ExtendTimestamp type represents a positive time with respect to the epoch.

struct ExtendedTimestamp

{

UInteger48 seconds;

UInteger48 fractionalNanoseconds;

};

The seconds member is the integer portion of the timestamp in units of seconds.

The fractionalNanoseconds member is the fractional portion of the timestamp in units of 2^{-16} ns."

- IEEE 802.1AS, 6.3.3.4 Timestamp

"The Timestamp type represents a positive time with respect to the epoch.

struct Timestamp

{

UInteger48 seconds;

UInteger32 nanoseconds;

};

The seconds member is the integer portion of the timestamp in units of seconds.

The nanoseconds member is the fractional portion of the timestamp in units of nanoseconds."

Important Device Specific Parameters

- Device specific latency t_Device

  → Necessary to calculate the schedule

- Time Aware Shaper granularity

  → Necessary to define the minimum window size

- Maximum event list length

Thank You