# Gates vs. Windows and Scheduled Traffic

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# Terminology “Scheduled Traffic”

# Terminology

- What is Scheduled Traffic?
- To call everything scheduled is on the one hand correct, but people might think they have to engineer / schedule their best effort traffic
- In reality the "schedule for best effort" is a consequence of the schedule for the Scheduled Traffic
- 802.1 Qbv PAR:

  "Virtual Local Area Network (VLAN) tag encoded priority values are allocated allowing simultaneous support of scheduled traffic, credit-based shaper traffic and other bridged traffic over Local Area Networks (LANs)."

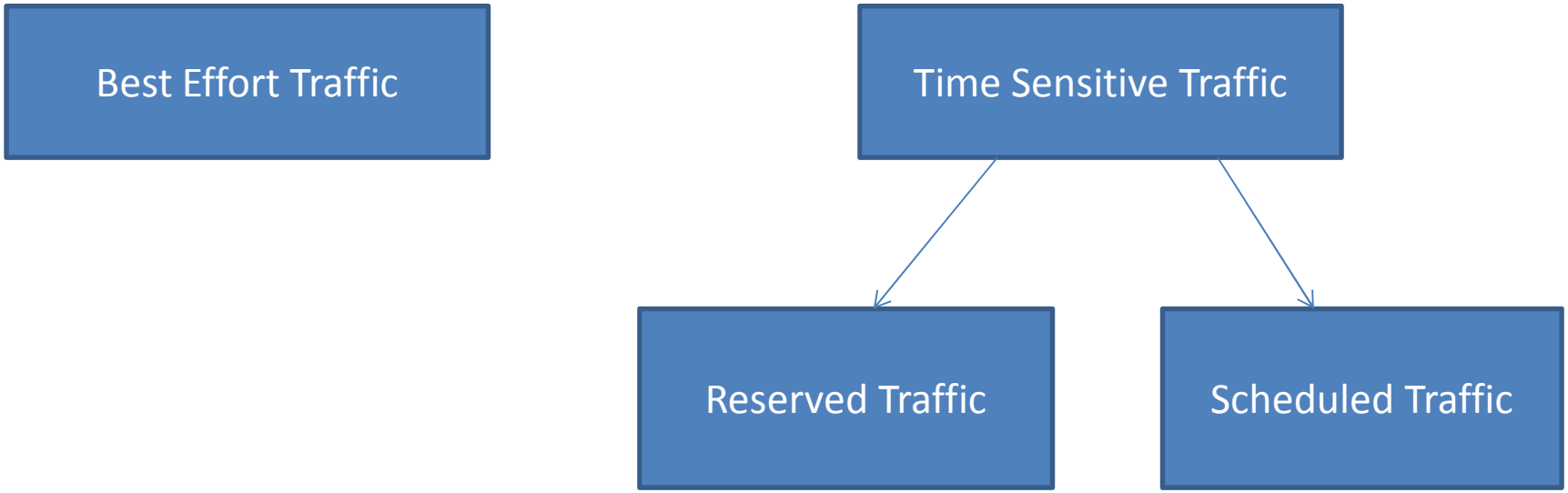
# Terminology

- I think we should stick to Best Effort, Reserved and Scheduled Traffic

- What does Scheduled Traffic distinguish from other traffic?
  - It is scheduled in the end station on a per stream basis
  - It has the highest priority/priorities
  - It is registered in bridges (domain concept, priority regeneration, no flooding, …)

- How do we call the TSN traffic in general?

# Possible Solution



# Gates and Transmission Windows

# Background

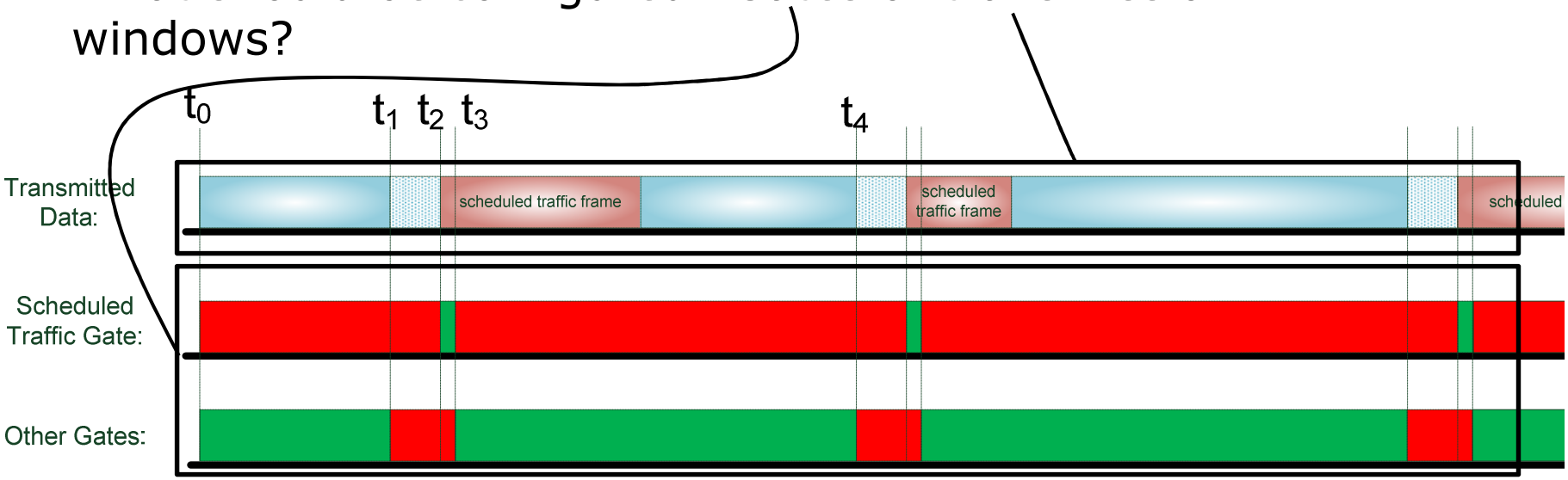
In Santa Cruz we had a discussion about alternative ways to configure the Time Aware Shaper

➔ Configuration of the Scheduled Traffic windows instead of the configuration of the gates in order to allow a floating guard band

# Impacts on the Time Aware Shaper

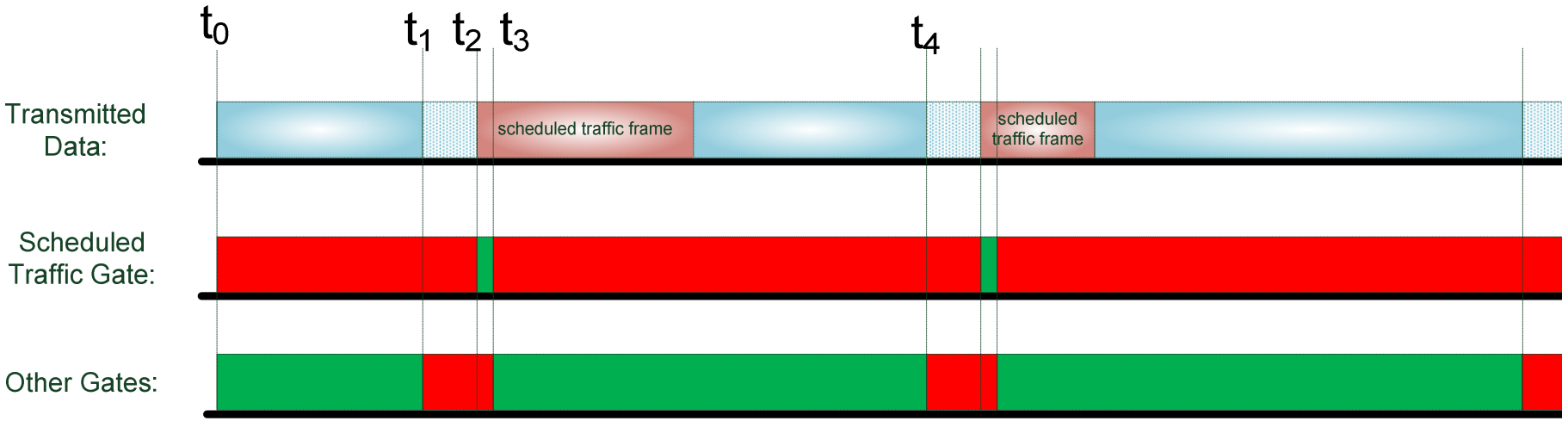
- The general question is:

  What should be configured? Gates or transmission windows?



# Configuring Gates

- Configuring gates is complicated in combination with an intelligent guard band usage (i.e. transmitting lower priority frames during the guard band if they end before the start of the Scheduled Traffic transmission)
- If the gate events are defined as the points in time when the queues are getting (dis)connected from/to the transmission selection it is not possible to transfer frames during the guard band



# How it is specified in IEEE 802.1Qbv-D0.2

- "… frames are selected from the corresponding queue for transmission if and only if

  …

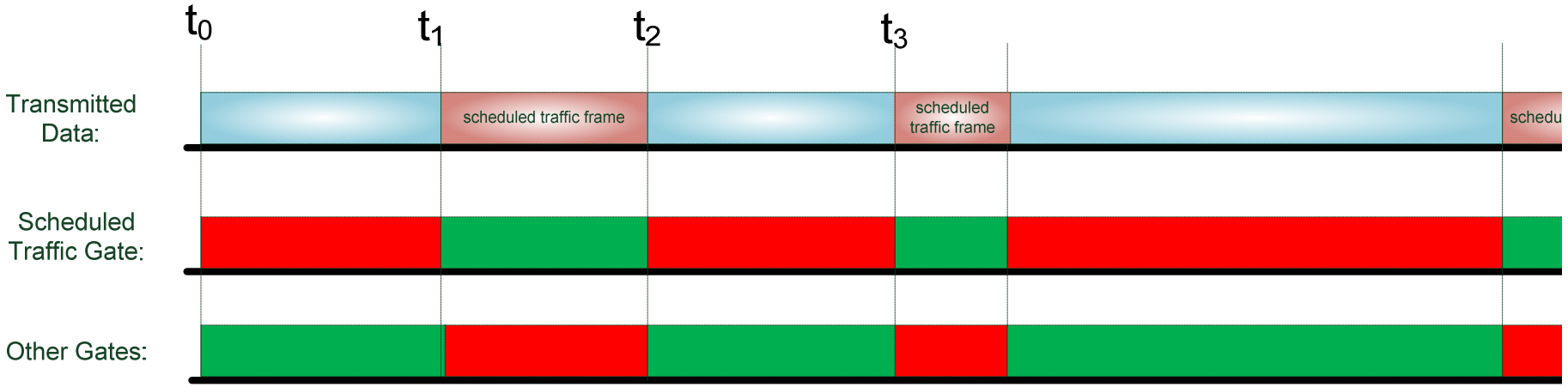
- b) The transmission gate (8.6.8.4) associated with that queue is in the *open state; and*
- c) If there are gate events associated with that queue, then there is sufficient time available to transmit the entirety of that frame before the next gate-close event associated with that queue;"

# Implications of the Current Definition

- The gate-closing event is not really defining the time when the queue is disconnected from the transmission selection
- It is not possible to start the transmission of a scheduled traffic frame when the corresponding gate is in the open state, if it is not possible to transmit the frame until the closing event
- The idea to open the gate only a very short time in order to reschedule the traffic is not possible anymore
- But now it is possible to reschedule the frames with the gate-closing events
- The usage of the term gates in D0.2 is not really compatible with the definition of gates, it seems to be the definition of transmission windows
- Should we change the name?

# IEEE 802.1Qbv D0.1

- The example (slide 8) with the D0.2 shaper would look like this:




- The queues get disconnected before the gate-closing event, the exact time depends on the frame size of the frames in the other queues.
- The gates define now the transmission windows rather than the connection or disconnection from the transmission selection

# Pros and Cons of the IEEE 802.1Qbv D0.2 Shaper

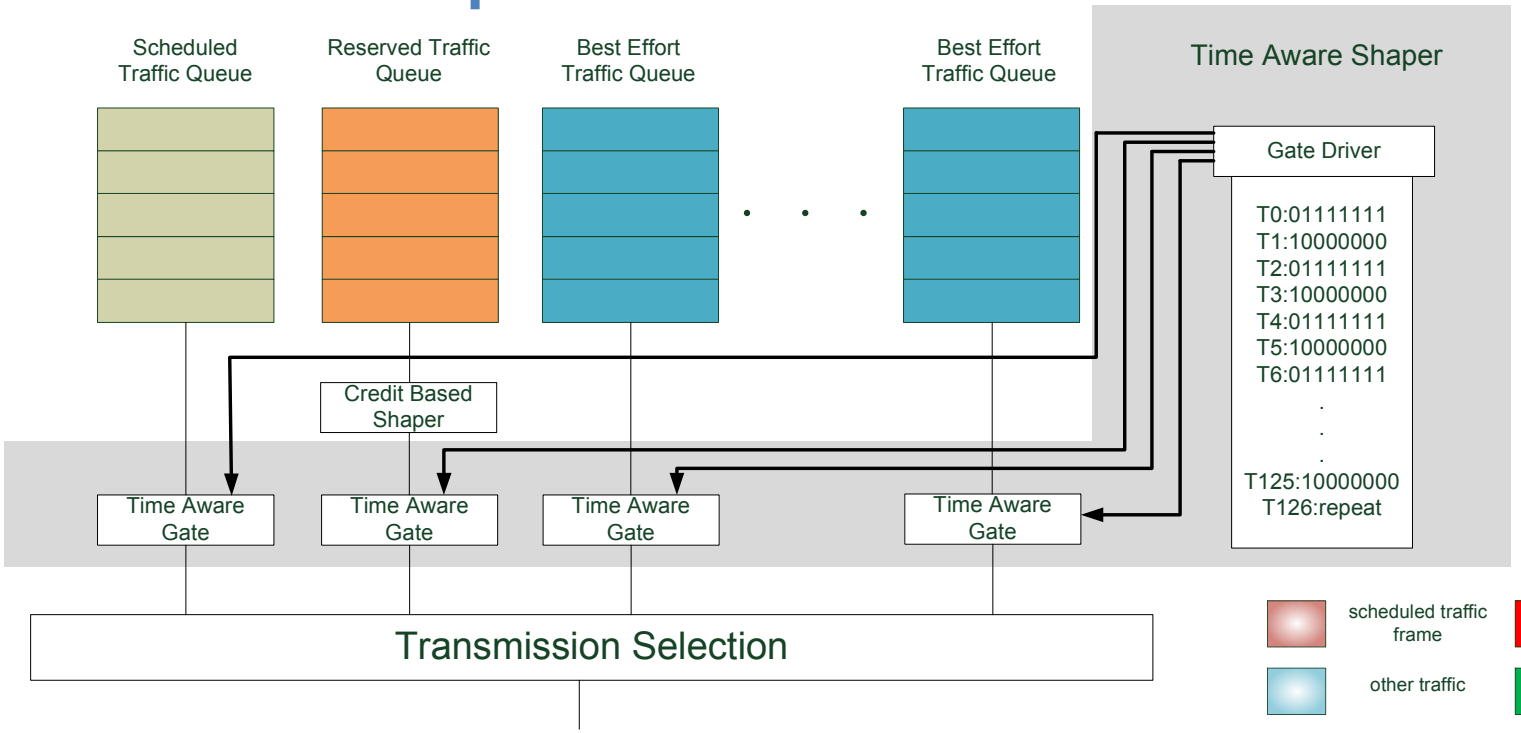
Pros:

- Not necessary to define a guard band
- Flexible configuration
- Gate-closing event allows to reschedule the traffic

Cons:

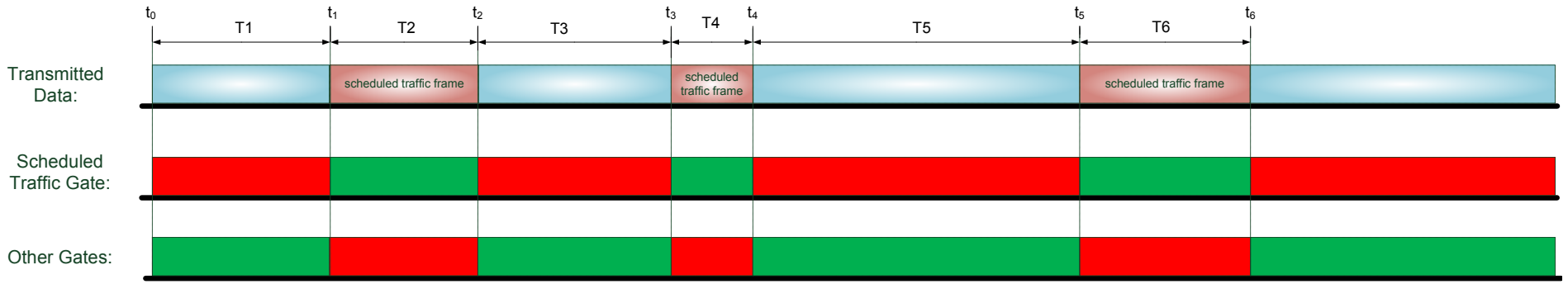
- If the scheduled traffic windows are smaller than a max frame (this might be the usual case) and a frame bigger than the transmission window enters the queue (a talker sends a too big frame (fault)) the queue is blocked (“for ever”)

# Time Aware Shaper – Gate Model

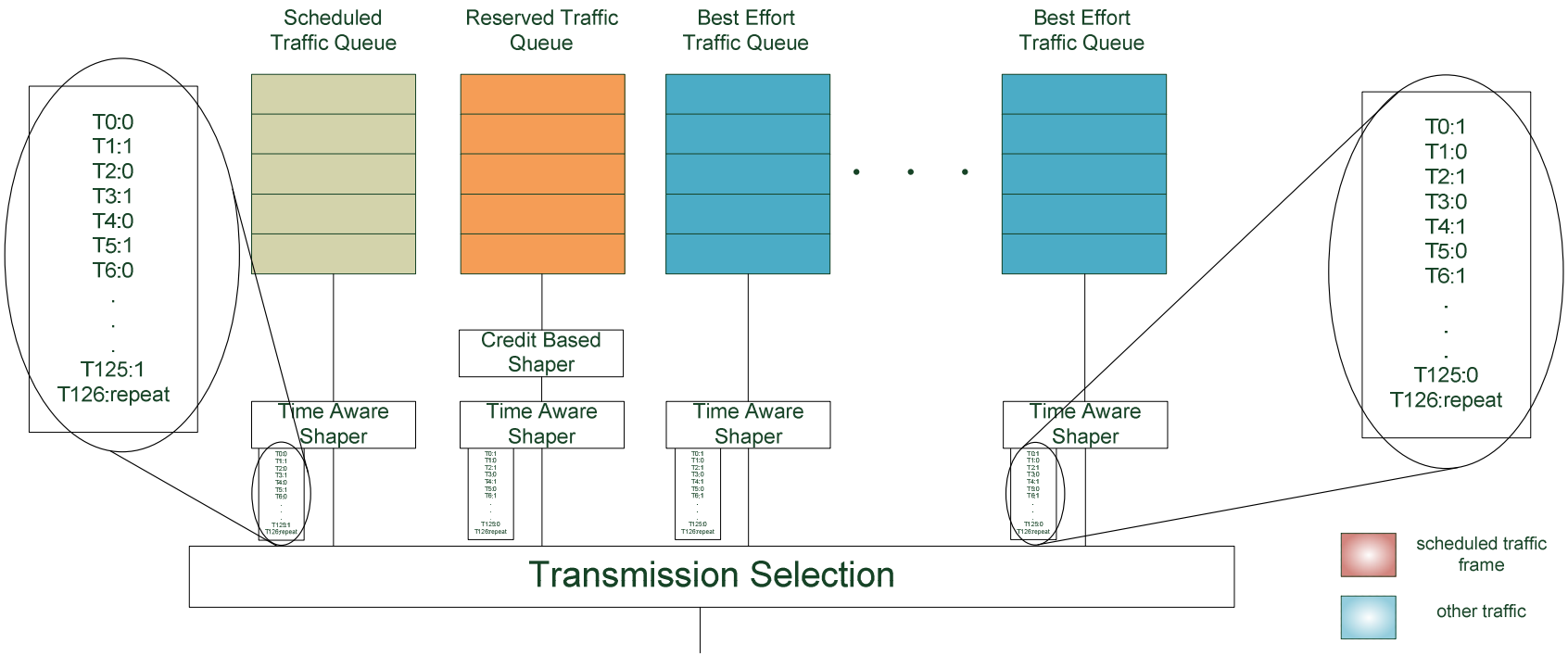



$t_R$ = reference time

$$t_x = t_R + (n \cdot \sum_{i=0}^{126} T_i) + \sum_{i=0}^{x} T_i$$



# Time Aware Shaper – Window Model

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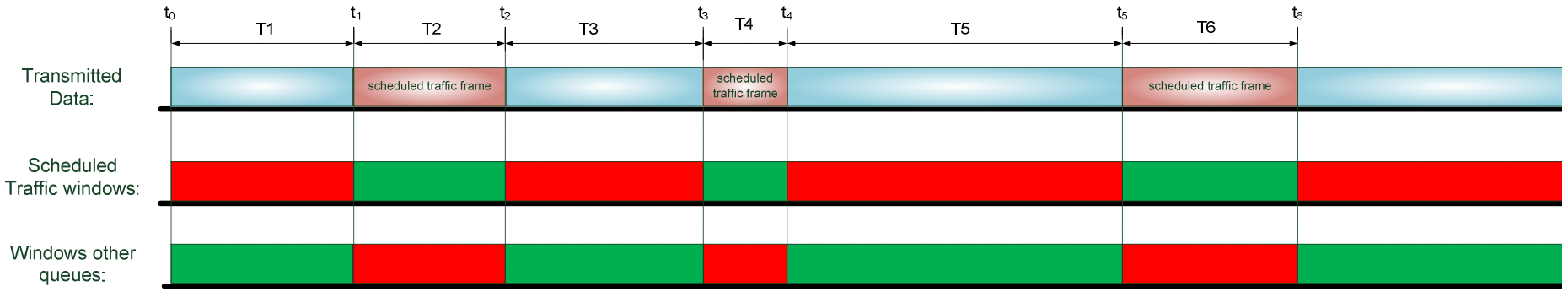


# Event List

- One list per queue
- Events:

  Gate events:

  – Window close event = 0

  – Window open event = 1

  Other events:

  – Repeat

T0:0
T1:1
T2:0
T3:1
T4:0
T5:1
T6:0
.
.
.
T125:1
T126:repeat

- Gate event time interval (T0, T1, …, Tx)
  - Relative to last gate event
  - Granularity: 1ns
  - 32 bit unsigned integer in units of 1 ns (max ≈ 4.2s)
  - In order to have a defined start condition at $t_R$, T0 must be 0
  - $t_R$ = PTP epoch

# Important Device Specific Parameters

- Device specific latency t_Device

  → Necessary to calculate the schedule
- Device specific Time Aware Shaper granularity

  → Necessary to define the minimum window size
- Maximum event list length

# End Station – Talker

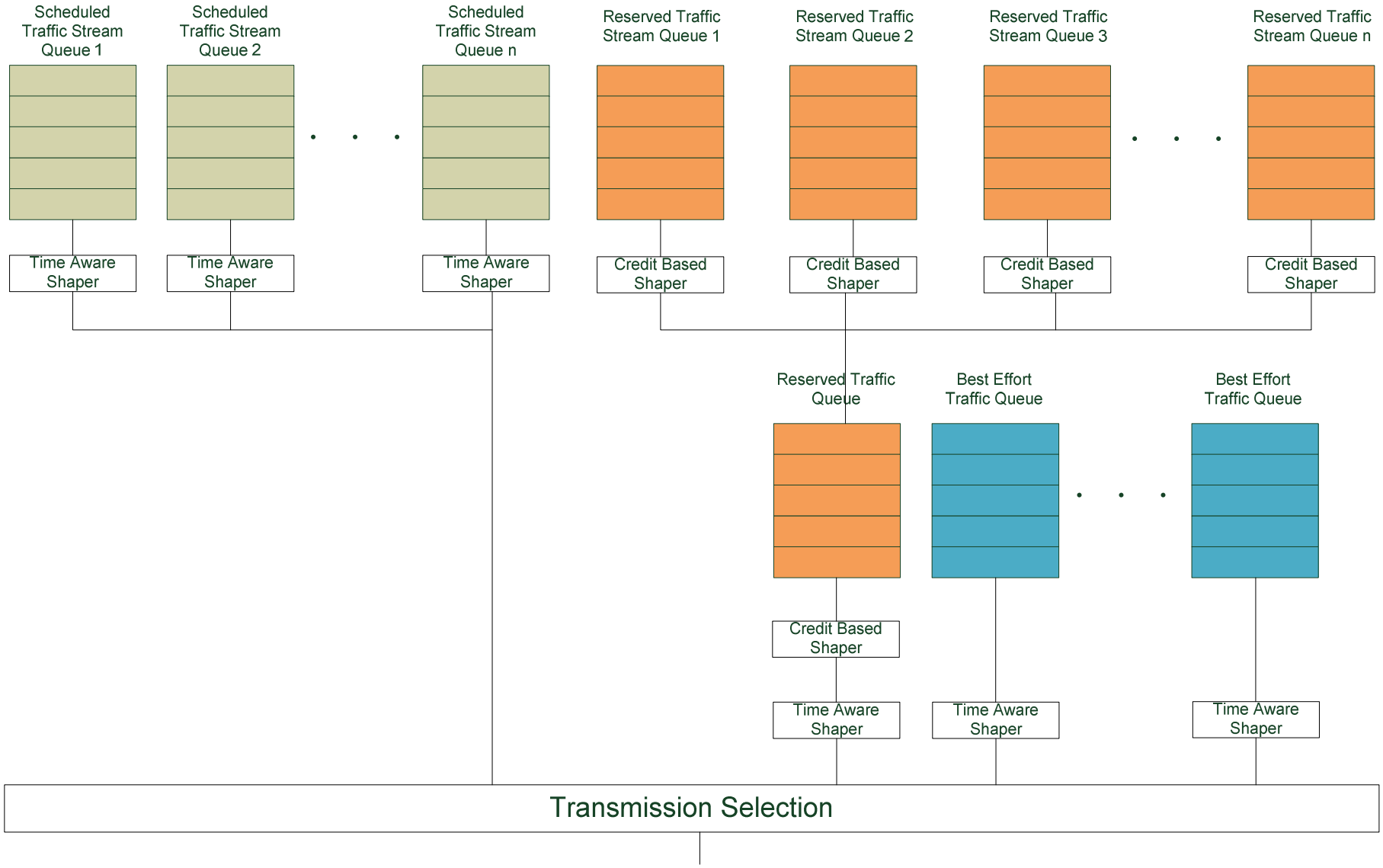
Shaping in the end stations

➔ Per stream shaping in the end stations

➔ Less complicated than CBS

➔ Ensures that a frame from the scheduled stream is transmitted

# End Station – Talker



# Traffic Class and PCP

# Time Aware Domain and Class

- Time Aware (TA) domain

- Time Aware (TA) class

  time aware (TA) class:

  A traffic class whose frames are scheduled in order to achieve minimum latency. A priority value is associated with each TA class. TA classes are denoted by consecutive letters of the alphabet, starting with A and continuing for up to seven classes.

- New PCP for Scheduled Traffic: 4 (default for TA class A)

- Scheduled Traffic has the highest priority (above AVB Gen1 SR class A)

# Thank You