802.1AS Slave Clock Interface Proposal (revised)

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Slave Clock behaviors

- “Capture” timing behaviors
  - Event timestamp
  - Cross timestamp to another timescale
- “Generate” timing behaviors
  - Clock gen (e.g. 1PPS, 44.1kHz, 24.576MHz)
  - Single trigger out at specified time
- “Status” behavior
  - Warn client of timescale discontinuity

Clock timing behavior abstract logic

- *Fundamental capabilities:* application independent
  - Event capture
  - Trigger generation
  - Both require only two very simple primitives:
    - Event (in or out): zero parameters
    - Global time (out or in): one parameter
- *Derived capabilities:* more application specific, perhaps more directly useful
  - Cross timestamp
  - Clock gen
  - Both require more complex primitives

Proposal: Five Easy Pieces

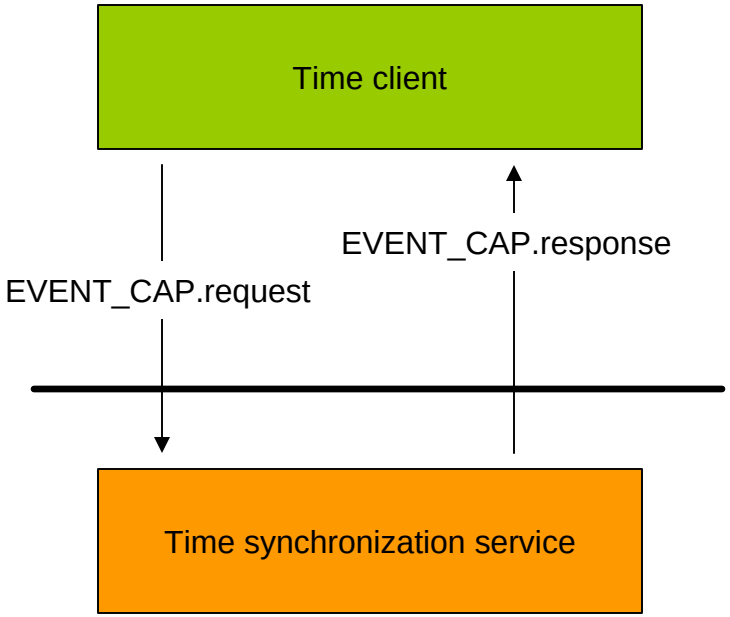
- Define 5 interfaces in 802.1AS for slave clocks:
  - Event Capture
  - Trigger Generate
  - Cross Timestamp
  - Clock Generate
  - Discontinuity
- Cross Timestamp is defined as state machine relying on the Event Capture interface
- All five interfaces are Optional in PICS
  - *If implemented*, each has mandatory & optional prims.

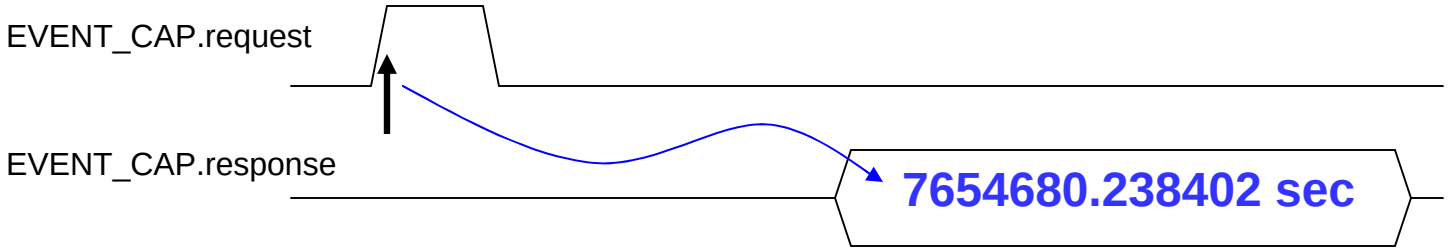
Fundamental Interfaces

```
EVENT_CAP.request {  // mandatory
     // No parameters
   }
EVENT_CAP.response {  // mandatory
     grandTime  // Time when request received
   }
```

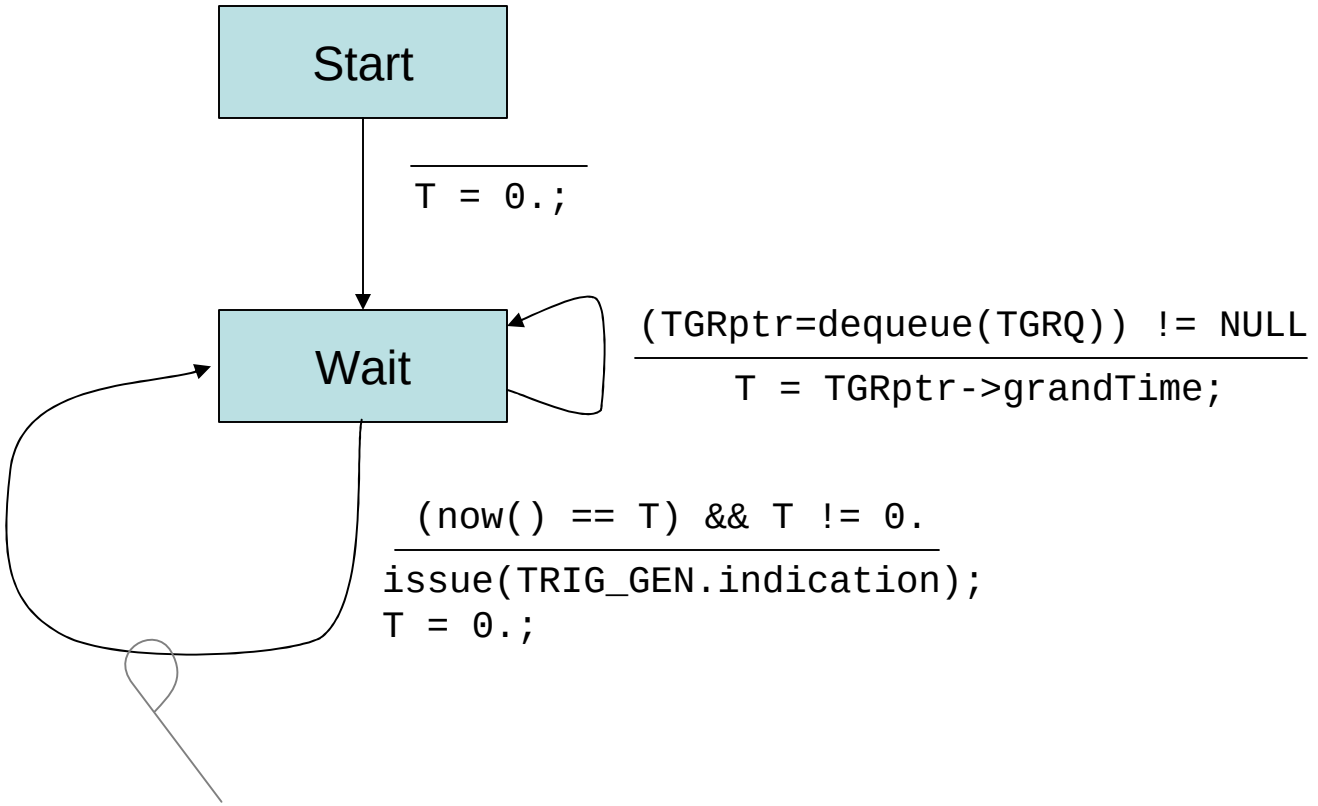
```
TRIG_GEN.request {  // mandatory
     grandTime  // Time when trig to be generated
   }
TRIG_GEN.indication {  // mandatory
     // No parameters
   }
```

Event Capture service interface





TRIG_GEN state machine



Note: the conditional for this transition is TRUE only instantaneously.
This is considered acceptable for an abstract Mealy state machine.

Clock Generator Interface

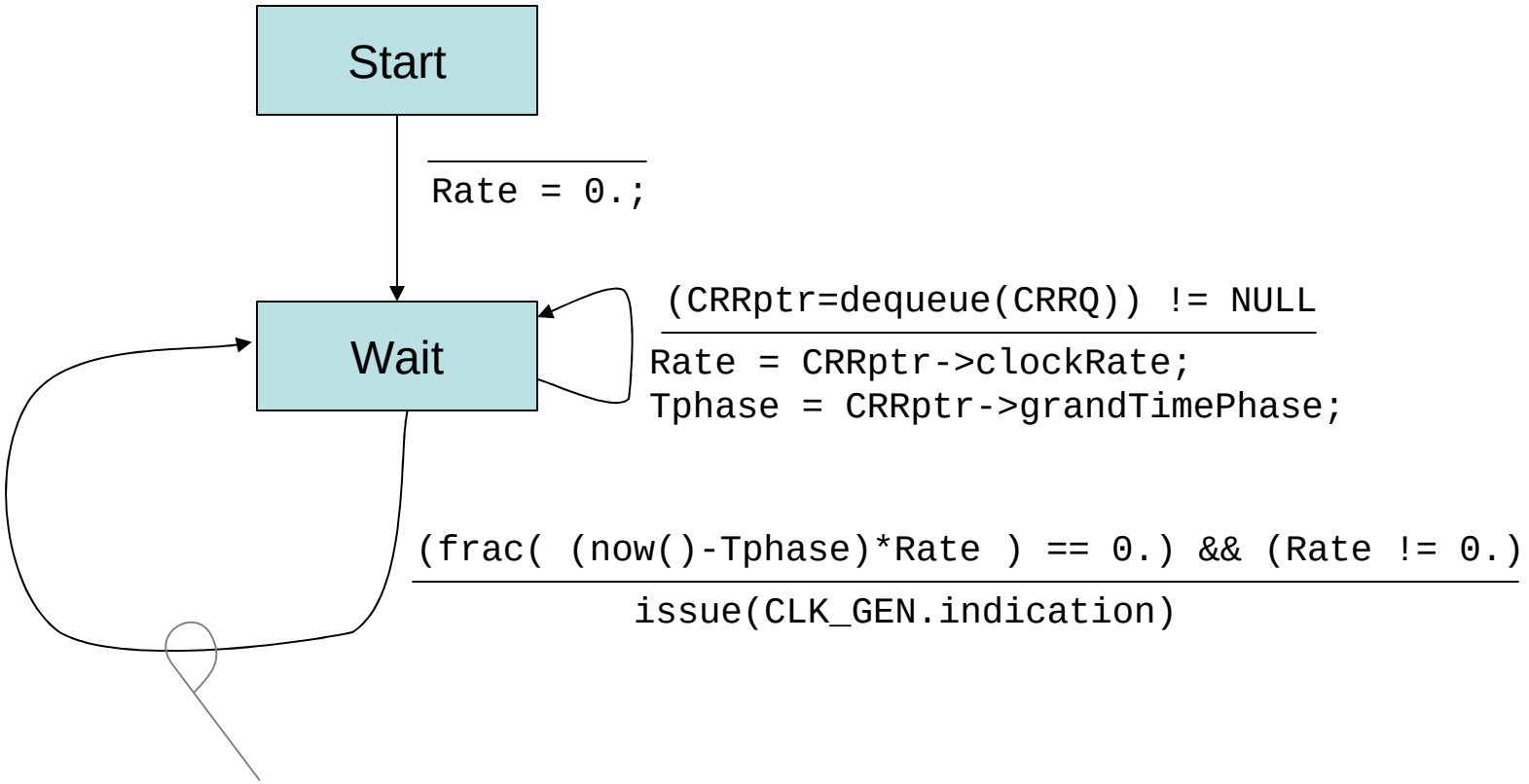
```
CLK_RATE.request {  // mandatory
      clockRate,  // cycles per second (0 = never)
      grandTimePhase  // CLK_GEN phase specification
   }
CLK_GEN.indication {  // mandatory
      grandTime // Time of this event (optionally
                // NULL)
   }
```

Behavior of this interface:

A `CLK_GEN.indication` is generated for every time *t* at which

(*t* – `grandTimePhase`) = *n* * 1/`clockRate` for some integer *n*

CLK_GEN state machine



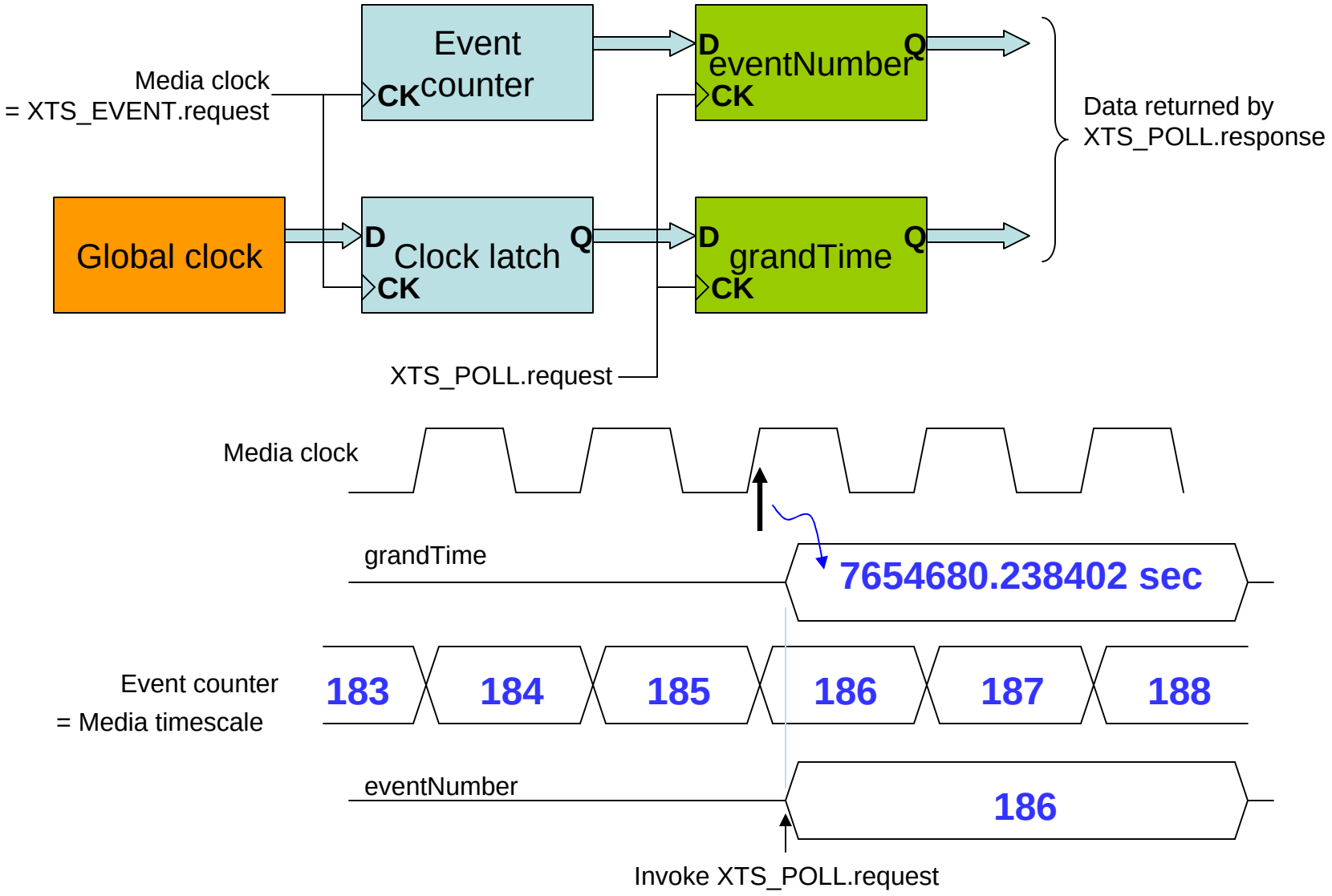
Note: the conditional for this transition is TRUE only instantaneously.
This is considered acceptable for an abstract Mealy state machine.

Cross Timestamp Interface

```
XTS_EVENT.request {  // optional
     // No parameters }
XTS_JAM.request {  // optional
     newCount  // Value to jam into event counter
   }
XTS_POLL.request {  // mandatory
     // No parameters }
XTS_POLL.response {  // mandatory
     grandTime,    // Timestamp of eventNumber'th
                   //   XTS_EVENT.request
     eventNumber  // value of event counter at time of
                   //   XTS_POLL.request
   }
```

Behavior of this interface is defined by an adaptation layer state machine which passes each `XTS_EVENT.request` primitive to the underlying layer as an `EVENT_CAP.request` while also counting the requests.

Example: Media clock cross-stamp



Cross Timestamp Interface II

- If `XTS_EVENT.request` is driven by a media clock, *eventNumber* : *grandTime* is the cross-timestamp required for many synchronization algorithms (e.g. RTP).
  - `XTS_EVENT` and `XTS_JAM` are optional, as the interface remains very useful even when the underlying media clock is maintained by another application interface.
- The so-called “underlying media clock” may be a precision low-jitter (i.e. PLL filtered) time-of-day clock
- The “underlying media clock” may also be the *stationTime* of dvj presos, or 61883 SYT clock
- If `XTS_EVENT.request` is driven by individual arbitrary events, this interface provides the integrity check offerred in earlier dvj and ch proposals by the *frameCount* field.

Discontinuity Interface

```
TIME_DISC.indication {  // mandatory
     disruption // boolean
   }
```

This primitive is generated whenever there is a change in the value of the *disruption* parameter.

The *disruption* parameter is set to TRUE if

- an event (e.g. change of GrandMaster ID) occurs which constitutes a potential timescale discontinuity, or
- the 802.1AS layer detects a nonuniformity in the progression of time greater than a <TBD> threshold (e.g. the currently active GrandMaster is manually set or newly acquires lock to an external reference)

The *disruption* parameter is set to FALSE otherwise.

Optional/Mandatory recap

- All five interfaces are optional
  - Example: a device may expose time only as programmatic availability of a *stationTime : grandTime* cross-stamp.
  - Example: a device may expose time only as the availability of a 1 kHz squarewave.
  - Standardizing the fundamental interfaces (Event Capture and Trigger Generate) is useful for defining the behavior of the derived interfaces even if the fundamental interfaces are not exposed.
- Within each interface specification there are primitives which are mandatory *if* claiming PICS compliance with that interface spec.
- All five interfaces are abstract.
- Why define interfaces if they are all optional & abstract?
  - Reduce the probability of “stupid” implementations by newbies = increase the chance of successful early deployment of AVB.

Task Status: Slave Clock Interface

- Event Capture interface
  - Well understood, has consensus, editorial only
- Cross Timestamp interface
  - New, needs socialization
  - Needs adaptation State Machine and text
- Trigger Generation interface
  - New, needs socialization
  - Needs behavioral text
- Clock Generation interface
  - Consensus in principle, verify details of primitives
  - Needs behavioral text
- Discontinuity interface
  - Consensus in principle, verify details of semantics
  - Nonuniformity detection needs review
  - Needs State Machine and text