Scheduled Traffic State Machines to Support 802.1Qbu Frame Preemption

(Supplement for P802.1Q-rev/D2.0 comment #i-24, #i-27~i-32)

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Overview

- **Current Status**
  - **The IEEE 802.1Qbv-2015 provides enhancements to the forwarding process that supports scheduled traffic**
    - Define a gate operation to change transmission gate state; **SetGateStates**
    - Specify scheduled traffic state machines to execute the gate operation; **List Config, Cycle Timer, List Execute state machine**

  - **The IEEE 802.1Qbu-2016 provides enhancements to the forwarding process that supports frame preemption**
    - Define new gate operations; **Set-And-Hold-MAC, Set-And-Release-MAC**
    - **But, no update of scheduled traffic state machines to execute new gate operations**

- **Proposed Change**
  - **It is intended to reflect the Set-And-Hold-MAC, Set-And-Release-MAC gate operation in the corresponding state machines.**
    - **Modify the List Execute state machine; Define new variables and procedures to support frame preemption**

Gate Operations

Table 8-6 identifies the gate operation types, their parameters, and the actions that result from their execution. The state machines that control the execution of the gate control list, along with their variables and procedures, are specified in clause 8.6.9.

Table 8-6—Gate operations

Operation name	Parameter(s)	Action
SetGateStates	GateState, TimeInterval	The *GateState* parameter indicates a value, *open* or *closed*, for each of the Port's queues. The gates are immediately set to the states indicated in the GateState parameter. This causes gate-close events (3.97) and/or gate-open events (3.98) to occur for any queue where the new GateState represents a change of state relative to the current state of the gate. After *TimeInterval* ticks (8.6.9.4.16) have elapsed since the completion of the previous gate operation in the gate control list, control passes to the next gate operation.
Set-And-Hold-MAC	GateState, TimeInterval	Performs all of the actions defined for the SetGateStates operation; in addition, the start of this operation marks the point in the sequence of gate operations at which the MAC associated with the port is to have stopped transmitting preemptable frames. This is achieved by setting the holdRequest managed object to the value *hold (1)*, at holdAdvance (Table 12-28) nanoseconds in advance of this point for the hold to have taken effect at this point. If frame preemption is not supported or not enabled (preemptionActive is FALSE), this operation behaves the same as SetGateStates.
Set-And-Release-MAC	GateState, TimeInterval	Performs all of the actions defined for the SetGateStates operation; in addition, the start of this operation marks the point in the sequence of gate operations at which the MAC associated with the port is permitted to resume transmitting preemptable frames; if an express frame is currently being transmitted by the MAC, the release takes effect at the end of that transmission. This is achieved by setting the holdRequest managed object to the value *release (2)*, at releaseAdvance (Table 12-28) nanoseconds in advance of this point for the release to have taken effect at this point.[a] If frame preemption is not supported or not enabled (preemptionActive is FALSE), this operation behaves the same as SetGateStates.

[a]The releaseAdvance parameter allows the timing of when the release command is issued to vary depending upon the constraints of a particular implementation. Its value should be less than the minimum frame size so that release does not occur too early and interfere with transmission of the last express frame.

Defined by 802.1Qbv :
The scheduled traffic state machines(specified in 8.6.9) specify procedure to execute only SetGateStates.

Defined by 802.1Qbu :
The scheduled traffic state machines do not specify procedures to execute Set-And-Hold-MAC and Set-And-Release-MAC.

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Note: The blue and green letters are the proposed modifications (additions) to support frame preemption.
The green ones are modified after TSN TG conference call (Oct. 16).
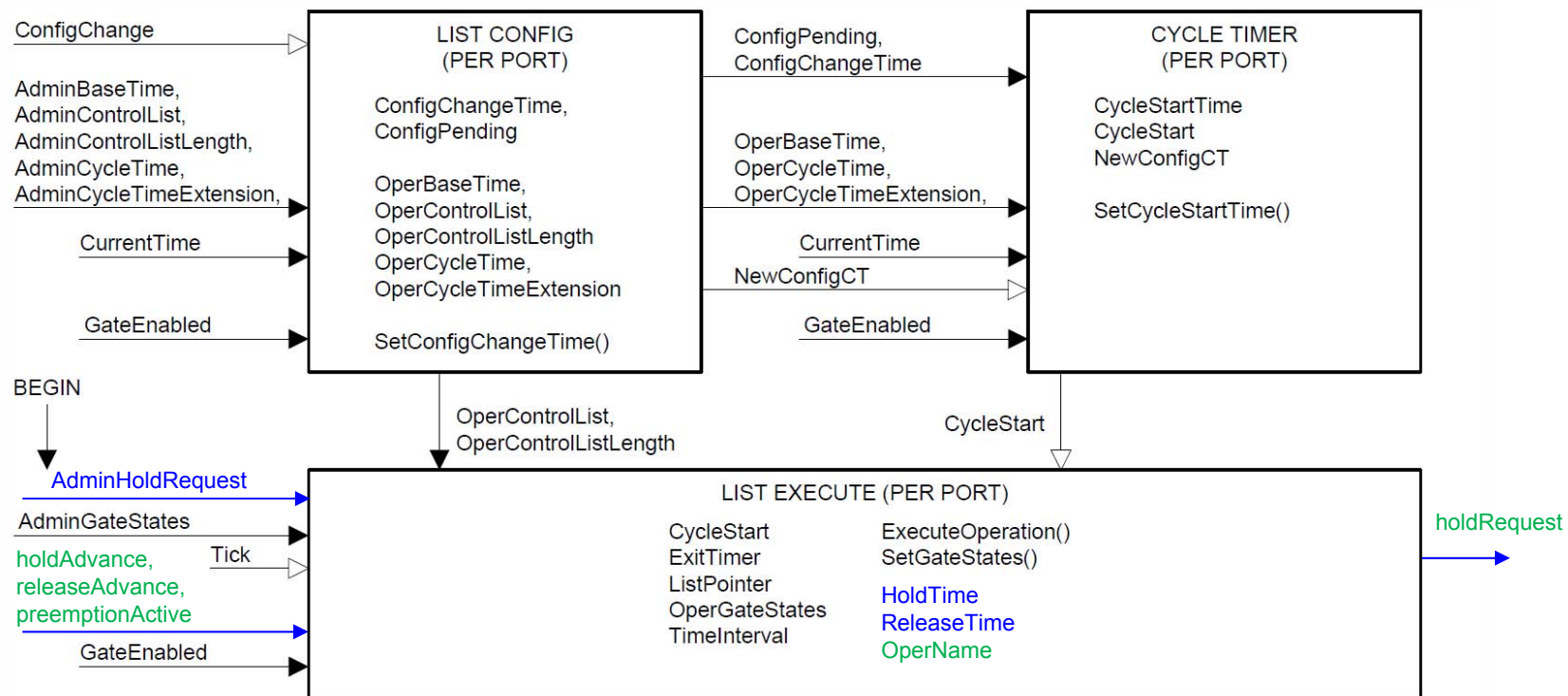

NOTATION:
Variables are shown both within the machine where they are initialized and between machines where they are used to communicate information. In the latter case the arrow styles, running from one machine to another, provide an overview of how the variables are used:

Not changed by the target machine, this variable communicates between state machines for the same port.

Set (or cleared) by the originating machine, cleared (or set) by the target machine, communicates between machines for the same port.

Figure 8-13—Scheduled traffic state machines—overview and relationships

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Proposed modifications in List Execute state machine

Note: The blue and green letters are the proposed additions to the existing figure.
The red ones replaces what are in the existing figure. The green ones are modified after TSN TG conference call (Oct. 16).
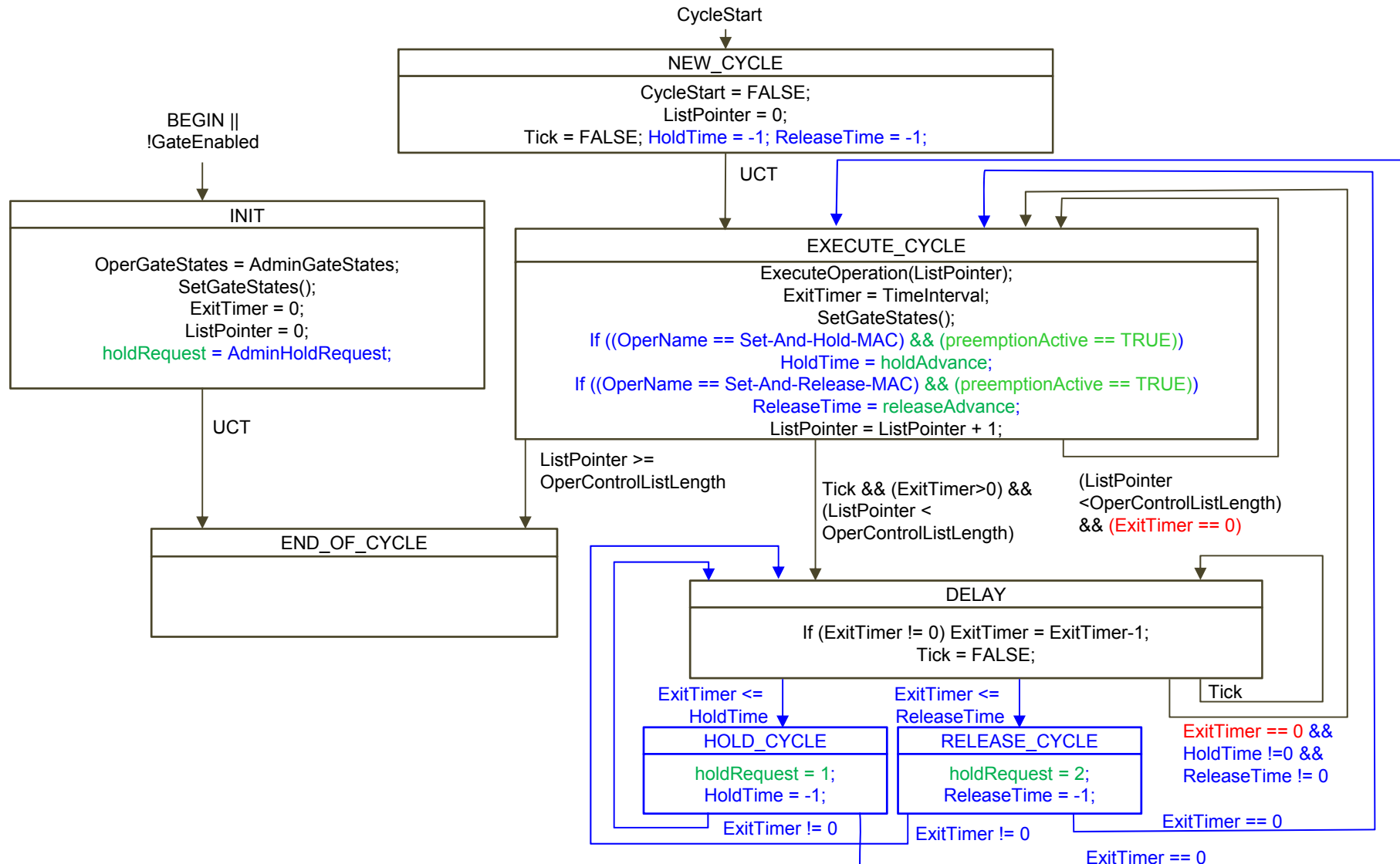

Figure 8-15—List Execute state machine

8.6.9.2.1 ExecuteOperation()

The ExecuteOperation() procedure is responsible for fetching the next gate operation from the OperControlList, along with any parameters associated with it, and performing actions based upon the gate operation that has been fetched. The value of the ListPointer variable (8.6.9.4.15) is used as an index into OperControlList. The procedure processes the operation according to its operation name (Table 8-6) as follows:

Set-And-Hold-MAC, or Set-And-Release-MAC,

a) If the operation name is SetGateStates, ᵛthen the GateState parameter value associated with the operation is assigned to the OperGateStates variable (8.6.9.4.22), and the TimeInterval parameter value associated with the operation is assigned to the TimeInterval variable (8.6.9.4.24). If the TimeInterval parameter value associated with the operation was 0, the TimeInterval variable is assigned the value 1.

b) If the operation name is unrecognized, then the ListPointer variable (8.6.9.4.15) is assigned the value of the OperControlListLength variable (8.6.9.4.23) and the TimeInterval variable (8.6.9.4.24) is assigned the value 0.

c) If there is no TimeInterval parameter associated with the operation, then the TimeInterval variable is assigned the value 0.

Proposed text addition to State Machine Variables

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P802.1Q-Rev D2.0, p.143

Add the following text to clause 8.6.9.4 State machine variables:

8.6.9.4.25 AdminHoldRequest

An integer variable that sets holdRequest to administrative value in List Execute state machine (8.6.2). The value of 1 indicates *hold* and the value of 2 indicates *release*. The value of AdminHoldRequest can be changed by management.

[Commenter's Note]: This variable needs to be defined as a managed object in clause 12 and a MIB in clause 17.

8.6.9.4.26 holdRequest

An integer variable that is used to request the MAC associated with the port to start *hold* or *release* procedure. The value of 1 indicates *hold* and the value of 2 indicates *release*. The value is set by the List Execute state machine (8.6.2) and it's initial value is determined by the value of AdminHoldReqeust variable.

8.6.9.4.27 holdAdvance

An integer number of nanoseconds that can elapse between issuing a HOLD to the MAC and the MAC ceasing to transmit any preemptable frames. This value is used in List Execute state machine (8.6.2). The value of HoldTime is set by this variable if the gate operation is Set-And-Hold-MAC and the value of preemptionActive is TRUE.

8.6.9.4.28 releaseAdvance

An integer number of nanoseconds that can elapse between issuing a RELEASE to the MAC and the MAC being ready to resume transmission of preemptable frames. This value is used in List Execute state machine (8.6.2). The value of ReleaseTime is set by this variable if the gate operation is Set-And-Release-MAC and the value of preemptionActive is TRUE.

(Cont.)

8.6.9.4.29 preemptionActive

A Boolean variable that indicates whether frame preemption is supported and enabled by the MAC. This value is TRUE when frame preemption is operationally active, and FALSE otherwise. This variable is used in List Execute state machine (8.6.2).

8.6.9.4.30 HoldTime

An integer variable set to the value of the holdAdvance parameter (8.6.9.4.27) when the gate operation is Set-And-Hold-MAC and preemptionActive is TRUE. This variable is used in the List Execute state machine (8.6.2) to set the value of the holdRequest to hold(1) at holdAdvance nanoseconds prior to the end of current gate operation. The initial value of this variable is -1.

8.6.9.4.31 ReleaseTime

An integer variable set to the value of the releaseAdvance parameter (8.6.9.4.28) when the gate operation is Set-And-Release-MAC and preemptionActive is TRUE. This variable is used in the List Execute state machine (8.6.2) to set the value of the holdRequest to release(2) at releaseAdvance nanoseconds prior to the end of current gate operation. The initial value of this variable is -1.

8.6.9.4.32 OperName

An integer value that indicates the operation name of gate operation which has been fetched from the OperControlList by the List Execute state machine (8.6.2). The value of 0 indicates SetGateStates, the value of 1 indicates Set-And-Hold-MAC, and the value of 2 indicates Set-And-Release-MAC.