Conformance Class IEC/IEEE 60802

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Abstract

This document describes an example Conformance Class based on “60802-Steindl-ExampleSelections-0119-v02.pdf” as a starting point for feature alignment.
The parameters and values given in this document are presenting the ongoing discussions. Currently there is no agreement which attributes, parameters and values are mandatory within the profile.

Log

V0.1	Initial version
V0.5	Update with Example Selections “Y” and “Z”
V0.6	Update after discussion in IEC/IEEE 60802
V0.7	Update after discussion in IEC/IEEE 60802
V1.0	Initial public version for IEC/IEEE 60802
V1.2	Version created during Edinburgh meeting
V1.3	Version created in preparation for Hawaii meeting

Content

Contributor group 1
Abstract 1
Log 2
Content 3
Figures 4
Tables 5
1 References 6
2 Terms and Definitions 7
2.1 Definitions 7
2.2 IEEE802 terms 7
3 TSN in Industrial Automation 8
3.1 General 8
3.2 Conformance Class 8
3.2.1 Standard selection 8
3.2.1.1 General 8
3.2.1.2 Terms 8
3.2.1.3 IEEE 802.3 9
3.2.1.4 IEEE 802.1Q 10
3.2.1.5 IEEE 802.1AB 18
3.2.1.6 IEEE 802.1AS 19
3.2.1.7 IEEE 802.1CB 20
3.2.1.8 IEC standards 22
3.2.2 End-station 23
3.2.2.1 General 23
Literature and related Contributions 27

Figures

Es konnten keine Einträge für ein Abbildungsverzeichnis gefunden werden.

Tables

Table 1: IEEE 802.3 selection 9
Table 2: IEEE 802.1Q selection 10
Table 3: IEEE 802.1 configuration - centralized 15
Table 4: IEEE 802.1 configuration - distributed 16
Table 5: IEC/IEEE 60802 definitions selection 17
Table 6: IEEE 802.1AB selection 18
Table 7: IEEE 802.1AS selection 19
Table 8: IEEE 802.1CB selection 20
Table 9: IEC standards selection 22
Table 10: End-station selection 23

1 References

60802-industrial-use-cases-0918-v13.pdf

60802-Steindl-ExampleSelections-0119-v02.pdf

60802-Steindl-QuantityFigures-0519-v01.pdf

60802-Steindl-TimelinessUseCases-0718-v01.pdf

2 Terms and Definitions

2.1 Definitions

Conformance Class	A selection of IEC and IEEE features and quantities which allows to solve the required use cases.

2.2 IEEE802 terms

Priority regeneration	See IEEE 802.1Q-2018 clause 6.9.4 Regenerating priority
Ingress rate limiting	See IEEE 802.1Q-2018 clause 8.6.5 Flow classification and metering

3 TSN in Industrial Automation

3.1 General

Supporting a Conformance Classes shall allow interoperability for Bridges and End-Station as defined in the scope of IEC/IEEE 60802.

3.2 Conformance Class

3.2.1 Standard selection

3.2.1.1 General

A Conformance Class selects out of the following standards

IEEE802.3-2018 - IEEE Standard for Ethernet

IEEE802.1Q-2018 - Bridges and Bridged Networks

IEEE802.1AB-2016 - Station and Media Access Control Connectivity Discovery

IEEE802.1AS-2020[1] - Timing and Synchronization for Time-Sensitive Applications

IEEE802.1CB-2017 - Frame Replication and Elimination for Reliability

3.2.1.2 Terms

Supported:
This feature is used in any class of device

Support, but optional:
This feature is intended to be used in some class of device.
For silicon vendors, these topics may be “supported”, too.

Not used:
The used and thus the support of this feature is not intended.

Ω / TBD:
Not provided until agreed release date for this version.

—:
No quantities, because the assigned feature is not supported.

???:
The responsible editor is not able to fill this cell without a discussion with the other contributors.

[1] Assumes that IEEE802.1AS will be updated in 2020

3.2.1.3 IEEE 802.3

Table 1 shows the selection.

Table 1: IEEE 802.3 selection

Attribute	Classification	Example Selection "SI"	Example Selection "TT"	Example Selection "RA"	Example Selection "AB"	Example Selection "MI"	Example Selection "YO"	Example Selection "BR"
MAU Types[2]								
Data rate								
10Mbps	Feature	Supported	Supported	Supported	Supported	Not used	Supported	Supported but optional
100Mbps	Feature	Supported	Supported	Supported	Supported	Supported	Supported	Supported
1Gbps	Feature	Supported	Supported	Supported	Supported	Supported	Supported	Supported but optional
2,5Gbps	Feature	Supported	Ω	Supported	Supported	Not used	Supported	Supported but optional
5Gbps	Feature	Supported	Ω	Supported	Supported	Not used	Supported	Supported but optional
10Gbps	Feature	Supported	Ω	Supported	Supported	Not used	Supported	Supported but optional
Maximum frame size[3] [4] 802.3 79.3.4.1	Quantity	1522	1522	1522	1522	2000	1522	1522
Link length[1]	Information	At least 100m	Depends on media	Depends on media	Depends on media	Depends on media	Depends on media	Depends on media
Preemption	Feature							
10Mbps[5]	Feature	Supported	Supported but optional	Supported but optional	Supported but optional	Not used	Not used	Supported but optional
100Mbps	Feature	Supported	Supported but optional	Supported but optional	Supported but optional	Not used	Not used	Supported but optional
1Gbps	Feature	Supported	Supported but optional	Supported but optional	Supported but optional	Not used	Not used	Supported but optional
2,5Gbps	Feature	Supported but optional	Supported but optional	Supported but optional	Supported but optional	Not used	Not used	Supported but optional
5Gbps	Feature	Not used	Supported but optional	Not used	Supported but optional	Not used	Not used	Supported but optional
10Gbps	Feature	Not used	Supported but optional	Not used	Supported but optional	Not used	Not used	Supported but optional

[2] Attributes like full duplex, IEEE 802.1AS support, IEEE 802.1AB support, auto polarity, auto negotiation, synchronization error budget, to be supported link length are selection criteria for the MAU Types.
[3] Use of PRP leads to the support of longer frames – e.g. support of Jumbo frames
[4] Use of double VLAN tagging increase the to be supported size to 1526
[5] Need to convince IEEE 802.3 to allow preemption for 10 Mbps also.

3.2.1.4 IEEE 802.1Q

Table 2, Table 3, Table 4 and Table 5 show the selection.

Table 2: IEEE 802.1Q selection

Attribute	Classification	Example Selection "SI"	Example Selection "TT"	Example Selection "RA"	Example Selection "AB"	Example Selection "MI"	Example Selection "YO"	Example Selection "BR"
Queues 802.1Q 8.6.6	Quantity	Eight	Eight	Four	Eight	Five	Four[6]	Eight
Preassigned PCPs	Quantity	Example: PCP:7 for network mgmt., PCP:6 for High streams, PCP:5 for Low stream, PCP:4-2 for in domain, and PCP:1-0 for inter domain	Example: PCP:7-2 for Isochronous streams, and PCP:1-0 for inter domain	Example: PCP:7 for isochronous/network management (PTP, DLR, STP), PCP: 6 for cyclic/network management (LLDP, YANG, SNMP) PCP: 5:0 for application dependent	Example (intra TSN domain): PCP:7 for network control PCP:6 for High/Isochronous streams, PCP:5 for Low/cyclic stream PCP:4 for Operator commands	Example: PCP:7 for Isochronous PCP:6 for cyclic PCP:2 for network control PCP:1 for config., diagnostics PCP:0 for other application	Example: PCP:7 network management, PCP:6 C2D, PCP:5 C2C / C2Comp, PCP:4 alarm / event, PCP:3-0 for application dependent	Ω
VLAN Identification	Quantity	Up to 8 VIDs Four for streams, rest for non-stream	Up to 8 VIDs	Up to 8 VIDs	Up to 8 VIDs Seven for streams, rest for non-stream	Up to 8 VIDs	Up to 8 VIDs	At least 16 VIDs
VLANs used for streams (in FDB configuration) "Static trees"								
Learning disable	Feature	Supported	Supported	Supported	Supported, but optional	Supported	Supported	Supported
Individual VLAN learning (IVL)	Feature	Supported	Supported	Supported	Supported, but optional	Not used	Supported	Supported but optional
Default forwarding rule	Feature	Drop	Drop	Drop	Drop	Flooding	Drop	Drop
VLANs used for non-stream (in FDB configuration)								
Learning enabled	Feature	Supported	Ω	Supported	Supported, but optional	Not used	Supported	Supported
Shared VLAN learning (SVL)	Feature	Supported	Ω	Supported	Supported, but optional	Not used	Supported	Supported, but optional
Default forwarding rule	Feature	Flooding	Ω	Flooding	Flooding	Flooding	Flooding	Flooding
FDB size 802.1Q 8.8	Quantity							
Streams	Quantity	8192[7]	512	4096	8192	16		8192

[6] Four for Line/Ring and Eight for Star topologies
[7] A minimum 2048 per VLAN

Attribute	Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
static MC entries used for streams							16384 entries – useable for streams and default VLAN(s)	
Non-stream static/dynamic entries for remaining VLAN(s)	Quantity	2048	128	1024	Ω	16		Ω
Spanning tree 802.1Q 13								
For stream VLANs	Feature							
RSTP	Feature	Not used	Ω	Not used	Not used	Not used	Supported but optional	Not used
MSTP	Feature	Not used	Ω	Not used	Not used	Not used	Supported but optional	Not used
For non-stream VLANs	Feature							
RSTP	Feature	Supported but optional	Ω	Supported but optional	Supported	Not used	Supported but optional	Supported
MSTP	Feature	Supported but optional	Ω	Supported but optional	Supported but optional	Not used	Supported but optional	Supported but optional
Transmission selection control 802.1Q 8.6.8								
Strict priority	Feature	Supported	Supported	Supported	Supported	Supported	Supported	Supported
Credit based shaper	Feature	Not used	Supported	Supported, but Optional	Supported, but Optional	Not used	Supported, but Optional	Supported
Scheduled traffic 802.1Q 8.6.9, 8.6.8.4								
Time aware shaper	Feature							
10Mbps	Feature	Supported	Supported	Supported	Supported	Not used	Supported but optional	Supported
100Mbps	Feature	Supported	Supported	Supported	Supported	Supported	Supported	Supported
1Gbps	Feature	Supported but optional	Supported	Supported	Supported	Supported	Supported	Supported
2,5Gbps	Feature	Not used	Ω	Supported	Supported	Not used	Supported but optional	Supported
5Gbps	Feature	Not used	Ω	Supported	Supported	Not used	Supported but optional	Supported
10Gbps	Feature	Not used	Ω	Supported	Supported	Not used	Supported but optional	Supported
Cyclic queuing and forwarding	Feature	Not used	Not used	Not used	Supported, but Optional	Not used	Not used	Supported, but Optional
Gate Control List entries 802.1Q 8.6.8.4	Quantity	At least 3	At least 256	At least 3	At least 256	At least 5	At least 3	At least 256
Tick granularity 802.1Q 8.6.8.4	Quantity	=< 10ns	100ns	10ns	10ns	16ns	=< 100ns	10ns

Attribute	Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
Admin Cycle Time range 802.1Q 8.6.8.4								
100Mbps	Quantity	250 µs to 1 ms	62,5 µs to 10 ms	250 µs to 1 ms	250 µs to 20 ms	250 µs to 1 s	1 ms	100 µs to 20 ms
>=1Gbps	Quantity	31,25 µs to 1 ms	62,5 µs to 10 ms	31,25 µs to 1 ms	20 µs to 20 ms	31,25 µs to 1 s	100 µs to 1 ms	20 µs to 10 ms
Timing points for scheduled traffic 802.1Q 12.29.2[8]	Quantity	=< 10ns	10ns	10ns	10ns	16ns	=< 100ns	10ns
Maximum gap for transmission of consecutive frames[9]	Quantity	IPG	IPG	IPG	IPG	96 bit times	IPG	IPG
Ingress rate limiter / Flow classification and metering 802.1Q 8.6.5 (MEF 10.3)								
Unicast	Feature	Supported	Not used	Supported but optional	Supported but optional	Not used	Supported but optional	Supported but optional
Multicast / Broadcast	Feature	Supported	Not used	Supported but optional	Supported but optional	Not used	Supported but optional	Supported but optional
Ingress filtering and policing (Qci) 802.1Q 8.6.5.1								
Number of streams	Quantity	—	Ω	4096	8192	—	8000	8192
Stream Gates 802.1Q 8.6.5.1.2	Feature	Not used	Supported but optional	Supported but optional	Supported but optional	Not used	Not used	Supported
Number of stream gates	Quantity	—	Ω	8	8	—	—	Ω
Flow Meters 802.1Q 8.6.5.1.3	Feature	Not used	Supported but optional	Supported but optional	Supported but optional	Not used	Supported but optional	Supported
Number of flow meters	Quantity	2 × number of ports[10]	Ω	8	8	—	Ω	Ω
Stream Filter 802.1Q 8.6.5.1.1	Feature	Not used	Supported but optional	Supported but optional	Supported but optional	Not used	Supported but optional	Ω
Ingress and egress frame modification								
Priority regeneration (PCP) 802.1Q 6.9.4	Feature	Supported	Supported	Supported	Supported	Not used	Supported	Supported
VLAN stripping and adding	Feature	Supported	Supported	Supported	Supported	Not used	Supported	Supported

[8] Minimum and maximum for the delay before the first frame is transmitted after gate open
[9] Getting the value for calculating window sizes
[10] If useable for ingress rate limiting fitting to the domain boundary requirements

Attribute	Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
802.1Q 6.9 and 8.8.2								
Preemption 802.1Q 6.7.2	Feature	Supported	Supported but optional	Supported but optional	Supported but optional	Not used	Not used	Supported
First fragment size	Quantity	64	64	64	64	—	—	64
Number of Hold & Release events 802.1Q 12.30.1	Quantity	2	256	At least 1	2^{11}	—	—	Ω
10Mbps	Feature	Supported	Supported	Supported but optional	Supported but optional	Not used	Not used	Supported but optional
100Mbps	Feature	Supported	Supported	Supported but optional	Supported but optional	Not used	Not used	Supported but optional
1Gbps	Feature	Supported	Supported	Supported but optional	Supported but optional	Not used	Not used	Supported but optional
2,5Gbps	Feature	Supported but optional	Ω	Supported but optional	Supported but optional	Not used	Not used	Supported but optional
5Gbps	Feature	Not used	Ω	Not used	Supported but optional	Not used	Not used	Supported but optional
10Gbps	Feature	Not used	Ω	Not used	Supported but optional	Not used	Not used	Supported but optional
Synchronized network access								
Start of cycle trigger[12]	Feature	Supported	Supported	Supported but optional	Supported but optional	Supported	Supported	Supported
Per stream trigger 802.1Qcc 46.6.2.5.3.5	Feature	Not used	Supported	Not used	Supported but optional	Not used	Not used	Supported
Maximum gap for transmission of consecutive frames[13]	Quantity	IPG	IPG	IPG	IPG	96 bit times	IPG	IPG
Bridge / Forwarding resources[14]	Specify attributes for the resource management. Ensure buffering of stream and non-stream traffic during stream transmission							
Real-Time traffic[15]								
Stream High in-class interference								
>= 1Gbps	Quantity	Up to 200µs for an egress port	Ω	Up to 500µs for an egress port	Up to 2 ms for an egress port	Up to 300µs for an egress port	Up to 500µs for an egress port	Ω

[11] maxframesize/minframesize of a TSN domain. Is this value seen for the whole queue or just one frame? Given that there are holdAdvance and releaseAdvance events, then 2 x maxframesize/minframesize.
[12] Specified as a special case of the per stream trigger by using “time aware offset = 0” for all streams
[13] Getting the value for network calculus and calculating window sizes
[14] Model for resource calculation needed due to implementation dependency. What needs to be achieved? What is the goal?
[15] Both stream classes share the time limit; if only stream high is used, then 200µs are available for high. If only low is used, then 200µs are available for low. If both are used, then they need to share the 200µs.

Attribute	Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
<= 100Mbps	Quantity	Up to 500µs for an egress port	Ω	Up to 500µs for an egress port	Up to 2 ms for an egress port	Up to 300µs for an egress port	Up to 500µs for an egress port	Ω
Stream Low intra- and in-class interference								
>= 1Gbps	Quantity	Up to 200µs for an egress port	Ω	Up to 500µs for an egress port	Up to 2 ms for an egress port	Up to 300µs for an egress port	Up to 500µs for an egress port	Ω
<= 100Mbps	Quantity	Up to 500µs for an egress port	Ω	Up to 500µs for an egress port	Up to 2 ms for an egress port	Up to 300µs for an egress port	Up to 500µs for an egress port	Ω
Non-real-Time traffic[16]								
Non real-time traffic[17]								
>= 1Gbps[18]	Quantity	Up to 200µs for an egress port	Minimum of 16k per port	Up to 500µs for an egress port	Up to 2 ms for an egress port	Up to 300µs for an egress port	Up to 500µs for an egress port	Ω
<= 100Mbps[19]	Quantity	Up to 500µs for an egress port	Minimum of 16k per port	Up to 500µs for an egress port	Up to 2 ms for an egress port	Up to 300µs for an egress port	Up to 500µs for an egress port	Ω

[16] Stream and non-stream forwarding resources needs to be guaranteed.
[17] Having a time triggered network usage model requires to buffer non-stream traffic during the stream time period to avoid the deletion of the packet being synchronized with the application period.
[18] Length of the period of stream transmission at egress ports need to be protected against congestion lost. „Minimum of 25 Kbytes per port” is an equivalent of 200µs transmission period for 1Gbps.
[19] Length of the period of stream transmission at egress ports need to be protected against congestion lost. „Minimum of 6,25 Kbytes per port” is an equivalent of 500µs transmission period for 100Mbps.

Table 3: IEEE 802.1 configuration - centralized

Attribute	Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
Configuration-Centralized								
Class based scheduling	Feature	Supported	Not used	Supported	Supported	Supported	Supported	Not used
Stream based scheduling	Feature	Not used	Supported	Not used	Supported	Not used	Not used	Supported
path computation	Feature	Supported	Supported	Supported	Supported but optional	???	Supported	Supported
network calculus	Feature	Supported	Supported	Supported	Supported but optional	???	Supported	Supported
topology discovery	Feature	Supported	Supported	Supported	Supported	???	Supported	Supported
device network feature discovery	Feature	Supported	Supported	Supported	Supported	???	Supported	Supported
management protocol	Feature							
SNMP (if YANG Models are still missing)	Feature	Supported	Supported	Not used	Supported	Supported	Not used	Not used
MIBs	Quantity	Ω	Ω	—	Ω	???	—	—
NETCONF	Feature	Supported	Supported	Supported	Supported	Supported	Supported	Supported
SSH	Feature	Supported but optional	Supported	Supported but optional	Supported but optional	Not used	Ω	Supported but optional
TLS	Feature	Supported but optional	Supported but optional	Supported but optional	Supported but optional	Supported	Ω	Supported
YANGs	Quantity	Ω	Ω	Supported	Ω	???	Ω	Ω
CNC Election (making sure there is only one active CNC per domain)	Feature	Supported	Supported	Supported	Supported	???	Supported	Supported
Dynamic configuration	Feature	Supported	Supported	Supported	Supported	???	Supported	Supported
Standardized stream reservation request from end-stations	Feature	Supported	Supported	Supported	Supported	???	Supported	Supported
Number of supported streams	Quantity	8192	512	4096	8192	4096	8000	8192
Number of devices (bridges and end-stations) per TSN domain	Quantity	1000	200	1000	3000	256	2000	5000

Table 4: IEEE 802.1 configuration - distributed

Attribute		Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
Configuration-Distributed (M2M communication) LRP/RAP									
	path computation	Feature	Supported	Not used	Supported	Supported but optional	???	Supported	Supported but optional
	Standardized stream reservation request from end-stations	Feature	Supported	Not used	Supported	Supported but optional	???	Supported	Supported but optional
	Number of supported streams	Quantity	256	—	256	Ω	Ω	256	—
	Number of devices (bridges and end-stations) per TSN domain	Quantity	Ω	—	Ω	Ω	Ω	128	—

Table 5: IEC/IEEE 60802 definitions selection

Attribute		Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
Cut through forwarding		Forwarding latency optimization							
	Delayed Cut-through[20]	Feature	Supported	Not used	Supported	Supported but optional	Supported	Not used	Supported but optional
	Direct Cut-through	Feature	Supported	Supported	Supported	Supported but optional	Not used	Not used	Supported
	Number of queues supporting it	Quantity	8	1 (Isochronous queue only)	With preemption: 1 (Isochronous queue only) Without preemption: up to 8	2: isochronous and cyclic	5	—	1

[20] Not limited to port being free on receive. Packet is forward to the DST port as soon as the port is free. No need to wait for the complete packet reception

3.2.1.5 IEEE 802.1AB

Table 6 shows the selection.

Table 6: IEEE 802.1AB selection

Attribute		Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
TSN Domain TLV (IEEE802.1Q TLV or IEC/IEEE60802 TLV)		Feature	Supported	Supported	Supported	Supported	Supported	Supported	Supported
802.3 extension		Feature							
	MAC/PHY Configuration/Status	Feature	Supported	Ω	Not used	Supported	???	Supported but optional	Ω
	Power Via Medium Dependent Interface (MDI)	Feature	Supported but optional	Ω	Not used	Supported but optional	???	Not used	Ω
	Maximum Frame Size	Feature	Supported	Ω	Not used	Supported but optional	Supported	Supported but optional	Ω
	Additional Ethernet Capabilities (Preemption)	Feature	Supported	Supported	Supported but optional	Supported but optional	Not used	Not used	Supported
802.1 extension		Feature							
	Port VLAN ID	Feature	Supported but optional	Ω	—	Supported but optional	Supported	Supported but optional	Ω
	Port And Protocol VLAN ID	Feature	Supported but optional	Ω	—	Supported	Supported	Supported but optional	Ω
	VLAN Name	Feature	Supported but optional	Ω	—	Supported	Supported	Supported but optional	Ω
	VLAN Name	Feature	Supported but optional	Ω	—	Supported	Supported	Supported but optional	Ω
	Protocol Identity	Feature	Supported but optional	Ω	—	Supported	Supported	Supported but optional	Ω
	VID Usage Digest	Feature	Supported but optional	Ω	—	Supported but optional	Supported	Supported but optional	Ω
	Management VID	Feature	Supported but optional	Ω	—	Supported but optional	Supported	Supported but optional	Ω
802.1AB “Transmit on data change” (9.2.5.20 defined variable txNow := TRUE)		Feature	Supported	Supported	Supported but optional	Supported[21]	Supported	Supported	Ω
802.1AB “Topology Discovery”		Feature	Supported	Supported	Supported	Supported	Supported	Supported	Supported

[21] we should also write something about txCredit>0. Anyway, why this sudden concentration on txNow? If LLDP is supported, the standard says: "An LLDP agent shall conform to the specifications of each of the state machines indicated in Table 9-1 for the operating mode that it supports." (just before chapter 9.1.1. from 802.1AB-2016).

3.2.1.6 IEEE 802.1AS

Table 7 shows the selection.

Table 7: IEEE 802.1AS selection

Attribute	Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
Grandmaster PTP Instance	Feature	Supported but optional	Supported but optional	Supported but optional	Supported	Supported but optional	Supported but optional	Supported
PTP End Instance	Feature	Supported	Supported	Supported	Supported	Supported	Supported	Supported
Sync send interval								
Working Clock send interval	Quantity	31,25 ms	31,25 ms	1 s	Ω	31,25 ms	1 s	Ω
Global Time send interval	Quantity	125 ms	125 ms	1 s	Ω	125 ms	1 s	Ω
gPTP Domains								
Working Clock	Quantity	1	1	1	1	1	1	1
Global Time	Quantity	1	1	1	1	1	1	1
Seamless redundancy – Hot Standby	Feature	Supported but optional	Supported but optional	Not used	Supported but optional	Not used	Supported but optional	Supported but optional
Working Clock	Quantity	1	1	—	1	—	1	1
Global Time	Quantity	1	1	—	1	—	1	1
BMCA Redundancy – Cold Standby	Feature	Not used	Supported	Supported but optional	Supported but optional	Supported but optional	Supported	Supported
Externally Managed Sync Trees (YANG/MIB)	Feature	Supported	Supported but optional	Not used	Not used	Not used	Supported but optional	Supported
802.1AS “Announce”	Feature	Not used	Supported	Supported	Supported	Supported	Supported	Supported
Working Clock	Feature	Ω	Ω	Supported	Supported	Supported	Supported	Ω
Global Time	Feature	Ω	Ω	Supported	Supported	Supported	Supported	Ω
802.1AS “Signal”	Feature	Not used	Supported but optional	Supported	Supported	Not used	Supported	Supported
gPTP capable	Feature	Ω	Ω	Supported	Supported	—	Supported	Ω

3.2.1.7 IEEE 802.1CB

Table 8 shows the selection.

Table 8: IEEE 802.1CB selection

Attribute	Classification	Example Selection "SI"	Example Selection "TT"	Example Selection "RA"	Example Selection "AB"	Example Selection "MI"	Example Selection "YO"	Example Selection "BR"
Stream identification	Selection out of a list within 802.1CB							
Null Stream (DMAC + TCI.VID based) 802.1CB 6.4	Feature	Supported	Supported	Supported	Supported	Supported	Supported	Supported
IP stream 802.1CB 6.7	Feature	Not used	Not used	Supported	Supported but optional	Not used	Supported	Supported but optional
1CB (Frame replication and elimination for reliability)	Feature							
1CB TAG supported	Feature	Not used	Supported	Supported but optional	Supported but optional	Not used	Supported but optional	Supported
HSR TAG supported	Feature	Not used	Supported but optional	Not used	Supported but optional	Not used	Not used	Not used
PRP Trailer supported	Feature	Not used	Supported but optional	Supported but optional	Supported but optional	Not used	Not used	Not used
FRER in end-stations supported	Feature							
FRER in end-stations only	Feature							
1CB TAG supported	Feature	Not used	Supported	Supported but optional	Supported but optional	Not used	Supported	Supported
HSR TAG supported	Feature	Not used	Supported but optional	Not used	Supported but optional	Not used	Not used	Not used
PRP Trailer supported	Feature	Not used	Supported but optional	Supported but optional	Supported but optional	Not used	Not used	Not used
Vendor specific trailer supported	Feature	Supported	Not used	Not used	Not used	Not used	Not used	Not used
Number of streams	Feature	4096[22]	128	4096	8192	—	8000	8000
FRER in bridges	Feature							
1CB TAG supported	Feature	Supported but optional[23]	Supported	Supported but optional	Supported but optional	Not used	Supported but optional	Supported
HSR TAG supported	Feature	Supported but optional[24]	Supported but optional	Not used	Supported but optional	Not used	Not used	Not used
PRP Trailer supported	Feature	Supported but optional[25]	Supported but optional	Supported but optional	Supported but optional	Not used	Not used	Not used

[22] 8192 stream supported in a TSN Domain may be used for seamless redundancy which leads to 4096 redundant handled streams
[23] Only for network infrastructure components
[24] Only for network infrastructure components
[25] Only for network infrastructure components

Attribute	Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
Vendor specific trailer supported	Feature	Not used	Ω	Ω	Not used	Not used	Not used	Not used
Number of streams	Feature	—	128	4096	8192	—	8000	8000
Stream translation	Selection out of a list within 802.1CB							
Active DMAC and VLAN identification 802.1CB 6.6								
Ingress Port	Feature	Supported	Supported	Supported	Not used	Not used	Supported	Ω
Number of streams	Quantity	64 streams	—	64 streams	—	—	64 streams	—
Egress Port	Feature	Not used	Ω	Not used	Supported	Not used	Not used	Ω
Number of streams	Quantity	—	—	—	8192	—	—	—

153 ### *3.2.1.8 IEC standards*

154 Table 9 shows the selection.

155 **Table 9: IEC standards selection**

Attribute		Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
IEC 62439-2 “MRP”									
	MRP manager	Feature	Supported but optional	Not used	Not used	Ω	Not used	Not used	Not used
	MRP client	Feature	Supported but optional	Not used	Not used	Ω	Not used	Not used	Not used
IEC 62439-3 “PRP” and “HSR”									
	PRP	Feature	Ω	Not used	Supported but optional	Ω	Not used	Not used	Not used
	HSR	Feature	Ω	Not used	Not used	Ω	Not used	Not used	Not used
IEC 61158-x-2 IEC 61784-2 “DLR”									
	DLR	Feature	Not used	Ω	Supported	Ω	Not used	Not used	Not used

156

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158 ### 3.2.2 End-station

159 #### *3.2.2.1 General*

160 Table 10 shows the selection.

161 **Table 10: End-station selection**

Attribute	Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
Queues 802.1Q 8.6.6	Quantity	Eight	Ω	Ω	Eight	Five	Four and eight[26]	Ω
Preassigned PCPs	Quantity	Example: PCP:7 for network mgmt., PCP:6 for High streams, PCP:5 for Low stream, PCP:4-2 for in domain, and PCP:1-0 for inter domain	Ω	Ω	Example (intra TSN domain): PCP:7 for network control PCP:6 for High/Isochronous streams, PCP:5 for Low/cyclic stream PCP:4 for Operator commands (PC NICs)	Example: PCP:7 for Isochronous PCP:6 for cyclic PCP:2 for network control PCP:1 for config., diagnostics PCP:0 for other application	Example: PCP:7 network management, PCP:6 C2D, PCP:5 C2C / C2Comp, PCP:4 alarm / event, PCP:3-0 for application dependent	Ω
VLAN Identification	Quantity	Up to 5 VIDs Four for streams, one for non-stream	Ω	Ω	At least 4 VIDs	Up to 8 VIDs	Up to 8 VIDs	Ω
VLANs used for streams	Quantity	2 + 2	Ω	Ω	At least 3	Ω	4	Ω
VLANs used for non-stream	Quantity	1	Ω	Ω	At least 1	Ω	4	Ω
Streams								
Number of streams transmitted	Quantity	512	Ω	Ω	At least 128	Ω	???	Ω
Number of streams received	Quantity	512	Ω	Ω	At least 128	Ω	???	Ω
Non-stream connections	Quantity	512 + 256	Ω	Ω	At least 128	Ω	???	Ω
Transmission selection control 802.1Q 8.6.8								
Strict priority	Feature	Supported	Ω	Ω	Supported, but optional	Supported	Supported	Ω
Credit based shaper	Feature	Not used	Ω	Ω	Supported, but optional	Not used	Supported, but optional	Ω
Scheduled traffic								

[26] Four for Line/Ring and Eight for Star topologies

Attribute	Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
802.1Q 8.6.9, 8.6.8.4								
Time aware shaper	Feature							
10Mbps	Feature	Supported	Ω	Ω	Supported, but optional	Not used	Supported, but optional	Ω
100Mbps	Feature	Supported	Ω	Ω	Supported, but optional	Supported	Ω	Ω
1Gbps	Feature	Supported but optional	Ω	Ω	Supported, but optional	Supported	Ω	Ω
2,5Gbps	Feature	Not used	Ω	Ω	Supported, but optional	Not used	Supported, but optional	Ω
5Gbps	Feature	Not used	Ω	Ω	Supported, but optional	Not used	Supported, but optional	Ω
10Gbps	Feature	Not used	Ω	Ω	Supported, but optional	Not used	Supported, but optional	Ω
Cyclic queuing and forwarding	Feature	Not used	Ω	Ω	Supported, but optional	Not used	Not used	Ω
Gate Control List entries 802.1Q 8.6.8.4	Quantity	At least 3	Ω	Ω	At least 8	At least 5	At least 3	Ω
Tick granularity 802.1Q 8.6.8.4	Quantity	<= 10ns	Ω	Ω	<= 10ns	16ns	<= 100ns	Ω
Admin Cycle Time range 802.1Q 8.6.8.4	Quantity							
100Mbps	Quantity	250 µs to 1 ms	Ω	Ω	250 µs to 20 ms	250 µs to 1 s	1 ms	Ω
>=1Gbps	Quantity	31,25 µs to 1 ms	Ω	Ω	250 µs to 20 ms	31,25 µs to 1 s	31,25 µs to 1 ms	Ω
Timing points for scheduled traffic 802.1Q 12.29.2[27]	Quantity	<= 10ns	Ω	Ω	<= 10ns	16ns	<= 100ns	Ω
Maximum gap for transmission of consecutive frames[28]	Quantity	IPG	Ω	Ω	IPG	96 bit times	IPG	Ω
Preemption 802.1Q 6.7.2	Feature	Supported	Ω	Ω	Not used	Not used	Not used	Ω
First fragment size	Quantity	128	Ω	Ω	—	—	—	Ω
Number of Hold & Release events 802.1Q 12.30.1	Quantity	2	Ω	Ω	—	—	—	Ω
10Mbps	Feature	Supported	Ω	Ω	Not used	Not used	Not used	Ω
100Mbps	Feature	Supported	Ω	Ω	Not used	Not used	Not used	Ω
1Gbps	Feature	Supported	Ω	Ω	Not used	Not used	Not used	Ω
2,5Gbps	Feature	Supported but optional	Ω	Ω	Not used	Not used	Not used	Ω
5Gbps	Feature	Not used	Ω	Ω	Not used	Not used	Not used	Ω

[27] Minimum and maximum for the delay before the first frame is transmitted after gate open
[28] Getting the value for calculating window sizes

Attribute	Classification	Example Selection “SI”	Example Selection “TT”	Example Selection “RA”	Example Selection “AB”	Example Selection “MI”	Example Selection “YO”	Example Selection “BR”
10Gbps	Feature	Not used	Ω	Ω	Not used	Not used	Not used	Ω
Synchronized network access								
Start of cycle trigger[29]	Feature	Supported	Ω	Ω	Supported but optional	Supported	Supported	Ω
Per stream trigger 802.1Qcc 46.6.2.5.3.5	Feature	Not used	Ω	Ω	Supported but optional	Not used	Not used	Ω
Maximum gap for transmission of consecutive frames[30]	Quantity	IPG	Ω	Ω	IPG	96 bit times	IPG	Ω
Transmission into the network								
Real-Time traffic Stream High in-class interference								
>= 1Gbps	Quantity	Up to 200µs for a 1ms Admin Cycle time	Ω	Ω	Up to 2 ms	Up to 300 µs	Up to 100 µs for an egress port	Ω
<= 100Mbps	Quantity	Up to 500µs for a 1ms Admin Cycle time	Ω	Ω	Up to 2 ms	Up to 300 µs	Up to 200 µs for an egress port	Ω
Real-Time traffic Stream Low intra- and in-class interference								
>= 1Gbps	Quantity	Up to 200µs for a 1ms Admin Cycle time	Ω	Ω	Up to 2 ms	Up to 300 µs	Up to 100 µs for an egress port	Ω
<= 100Mbps	Quantity	Up to 500µs for a 1ms Admin Cycle time	Ω	Ω	Up to 2 ms	Up to 300 µs	Up to 200 µs for an egress port	Ω
Non real-time traffic								
>= 1Gbps	Quantity	Up to 25 Kbytes per port	Ω	Ω	Up to 2 ms	Up to 300 µs	Up to 100 µs for an egress port	Ω
<= 100Mbps	Quantity	Up to 3,25 Kbytes per port	Ω	Ω	Up to 2 ms	Up to 300 µs	Up to 200 µs for an egress port	Ω

[29] Specified as a special case of the per stream trigger by using “time aware offset = 0” for all streams
[30] Getting the value for network calculus and calculating window sizes

162

163

Literature and related Contributions

Literature:

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