5 IEEE P802.1DC/contrib.

Suggested text for Draft Standard for Local and metropolitan area networks —

Quality of Service Provision by
 Network Systems

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1 Contents

3 1.1 Scope 4 4 1.2 Purpose 4 5 1.3 State diagram conventions 4 6 1.4 Specification model 6 7 1.5 Specification precedence 5 8 1.6 Introduction 5 92 Normative references 6 103 Definitions 5 114 Abbreviations 5 125 Conformance 5 126 Conformance 5 127 End system required behaviors 5 128 End system required behaviors 6 129 5.1 Requirements terminology 5 120 End system required behaviors 6 121 5.1 Requirements terminology 5 127 S Relay system optional behaviors 6 128 6.2 End system required behaviors 10 129 5.7 Common optional behaviors 10 120 6.1 Introduction 11 121<	<mark>2</mark> 1.	Overv	view	
4 1.2 Purpose	3	1.1	Scope	4
5 1.3 State diagram conventions	4	1.2	Purpose	
6 1.4 Specification model 4 7 1.5 Specification precedence 5 8 1.6 Introduction 5 92. Normative references 6 103. Definitions 7 114. Abbreviations 6 125. Conformance 6 13 5.1 Requirements terminology 6 14 5.2 End system required behaviors 6 15 5.3 End system required behaviors 6 16 5.4 Relay system optional behaviors 10 17 5.5 Relay system optional behaviors 10 18 5.6 Common equired behaviors 10 19 5.7 Common optional behaviors 10 206. IEEEE Std 802.1Q Quality of Service provision 11 12 6.1 Introduction 11 21 6.2 Bridge and end station model 11 22 6.3.4 Class of service assignment 11 23 6.3.2 Flow identification, filtering, and me	5	1.3	State diagram conventions	
7 1.5 Specification precedence 5 8 1.6 Introduction 5 92. Normative references 6 103. Definitions 7 114. Abbreviations 7 125. Conformance 6 13 5.1 Requirements terminology 6 14 Abbreviations 6 6 15 5.3 End system required behaviors 6 15 5.3 End system optional behaviors 6 16 5.4 Relay system optional behaviors 6 16 5.4 Relay system optional behaviors 10 17 5.5 Relay system optional behaviors 10 18 5.6 Common required behaviors 10 20.6 IEEE Std 802.1Q Quality of Service provision 11 21 6.1 Introduction 11 22 6.3 Tridge and end station model 11 23 6.2.1 Bridge and end station model 11 24 6.2.2 End station model 12 <td>6</td> <td>14</td> <td>Specification model</td> <td>4</td>	6	14	Specification model	4
1.5 Operations precedence 12 92. Normative references 0 103. Definitions 11 114. Abbreviations 12 115. Requirements terminology 12 115. Relay system optional behaviors 12 115. Relay system orequired behaviors 11 116. 6. Common optional behaviors 11 117. 5.7 Relay system orequired behaviors 11 118. 5.6 Common optional behaviors 11 119. 5.7 Common optional behaviors 11 120.6. IEEE Std 802.1Q Quality of Service provision 11 121. Bridge model 11 12 122. End station model 11 123. C3.2 Flow identification, filteri	7	1.5	Specification precedence	5
92. Normative references 0 103. Definitions 7 114. Abbreviations 7 115. End system required behaviors 7 115. Relay system required behaviors 7 115. Relay system optional behaviors 10 116. 5.4 Relay system optional behaviors 10 118. 5.6 Common optional behaviors 10 119. 5.7 Common optional behaviors 10 120.6. IEEE Std 802.1Q Quality of Service provision 11 121. 6.1 Introduction 11 122. 6.2 End system optional behaviors 11 123. 6.2.1 Bridge model 11 124. 6.2.2 End system optional station model 11 125. Gala Class of service asogament 11 12 </td <td>2 2</td> <td>1.5</td> <td>Introduction</td> <td></td>	2 2	1.5	Introduction	
92. Normative references 0 103. Definitions 7 114. Abbreviations 7 114. Abbreviations 7 114. Abbreviations 8 125. Conformance 9 13 5.1 Requirements terminology 9 14 5.2 End system optional behaviors 9 15 5.3 End system optional behaviors 9 16 5.4 Relay system optional behaviors 10 17 5.5 Relay system optional behaviors 10 18 5.6 Common optional behaviors 10 19 5.7 Common optional behaviors 11 20 6.1 Introduction 11 21 6.1 Introduction 11 22 6.3 Quality of service model 11 23 6.3.1 The forwarding process 11 24 6.3.2 Flow identification, filtering, and metering 11 25.3 Quality of service model 11 6.3.3 Forwarding proc	0	1.0		
10 3. Definitions 114. Abbreviations 114. Abbreviations 114. 11 4. Abbreviations 114. 11 4. Abbreviations 114. 11 4. Abbreviations 114. 11 4. Abbreviations 114. 12 5. Conformance 114. 12 5. Conformance 114. 13 5.1 Requirements terminology 114. 14 5.2 End system optional behaviors 115. 15 5.3 End system optional behaviors 116. 16 5.4 Relay system required behaviors 116. 17 5.5 Relay system optional behaviors 116. 18 5.6 Common required behaviors 116. 19 5.7 Common optional behaviors 116. 10 6.1 Introduction 117. 11 6.1 Introduction 117. 12 6.1 Bridge model 116. 13 6.2.1 Bridge model 116. 14 6.2.2 End station model 116. 12 6.3 Quality of service model 116.	<mark>9</mark> 2.	Norm	native references	6
114. Abbreviations 5 125. Conformance 5 13 5.1 Requirements terminology 5 14 5.2 End system required behaviors 5 15 5.3 End system optional behaviors 5 16 5.4 Relay system required behaviors 5 17 5.5 Relay system optional behaviors 10 18 5.6 Common required behaviors 10 19 5.7 Common required behaviors 10 206. IEEE Std 802.1Q Quality of Service provision 11 21 6.1 Introduction 11 23 6.2.1 Bridge model 11 24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding processes relevant to QoS provision 12 37 6.3.4 Quality of service assignment 11	10 3.	Defin	nitions	7
12 5. Conformance 9 13 5.1 Requirements terminology 9 14 5.2 End system required behaviors 9 15 5.3 End system required behaviors 9 16 5.4 Relay system optional behaviors 9 17 5.5 Relay system optional behaviors 10 18 5.6 Common required behaviors 10 19 5.7 Common optional behaviors 10 20.6 IEEE Std 802.1Q Quality of Service provision 11 21 6.1 Introduction 11 22 6.2 Bridge and end station model 11 23 6.2.1 Bridge model 11 24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 26 6.3.3 Forwarding 11 26 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 12 31 </td <td>11 4.</td> <td>Abbro</td> <td>eviations</td> <td></td>	11 4.	Abbro	eviations	
13 5.1 Requirements terminology 5.2 14 5.2 End system required behaviors 5.3 15 5.3 End system required behaviors 5.3 16 5.4 Relay system optional behaviors 5.3 17 5.5 Relay system optional behaviors 10 18 5.6 Common required behaviors 10 19 5.7 Common optional behaviors 10 20.6 IEEE Std 802.1Q Quality of Service provision 11 21 6.1 Introduction 11 22 6.2 Bridge model 11 23 6.2.1 Bridge model 11 24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 12 30 6.3.6 Transmission selection 11 31 6.4 Other bridge processes relevant to Q	12 <i>5</i> .	Confe	ormance	9
14 5.2 End system required behaviors 5 15 5.3 End system required behaviors 5 16 5.4 Relay system pedional behaviors 5 17 5.5 Relay system optional behaviors 10 18 5.6 Common required behaviors 10 19 5.7 Common optional behaviors 10 20.6 IEEE Std 802.1Q Quality of Service provision 11 21 6.1 Introduction 11 22 6.2 Bridge and end station model 11 23 6.2.1 Bridge model 11 24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 31 6.3.5 Deterministic or probabilistic discard 12 31 6.3.6 Tran	13	5.1	Requirements terminology	9
15 5.3 End system optional behaviors 5 16 5.4 Relay system required behaviors 10 17 5.5 Relay system optional behaviors 10 18 5.6 Common required behaviors 10 19 5.7 Common required behaviors 10 20.6. IEEEE Std 802.1Q Quality of Service provision 11 21 6.1 Introduction 11 23 6.2.1 Bridge and end station model 11 24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 11 31 6.3.6 Transmission selection 12 32 6.3.6 Transmission selection 12 33 6.4 Other bridge port transmit and receive Y 12 34 6.4.1 <td>14</td> <td>5.2</td> <td>End system required behaviors</td> <td>9</td>	14	5.2	End system required behaviors	9
16 5.4 Relay system required behaviors	15	5.3	End system optional behaviors	9
17 5.5 Relay system optional behaviors 10 18 5.6 Common required behaviors 10 19 5.7 Common optional behaviors 10 20 6. IEEE Std 802.1Q Quality of Service provision 11 21 6.1 Introduction 11 22 6.2 Bridge and end station model 11 23 6.2.1 Bridge model 11 24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 11 31 6.3.6 Transmission selection 11 33 6.4 Other bridge processes relevant to QoS provision 12 34 6.4.1 Bridge port transmit and receive Y 12 35 6.4.2 <td>16</td> <td>5.4</td> <td>Relay system required behaviors</td> <td>9</td>	16	5.4	Relay system required behaviors	9
18 5.6 Common required behaviors 10 19 5.7 Common optional behaviors 10 20 6. IEEE Std 802.1Q Quality of Service provision 11 21 6.1 Introduction 11 22 6.2 Bridge and end station model 11 23 6.2.1 Bridge model 11 24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 11 31 6.3.6 Transmission selection 11 33 6.4 Other bridge processes relevant to QoS provision 12 34 6.4.1 Bridge port transmit and receive Y 12 35 6.4.2 Link Aggregation 13 36 4.4.1 Bridge port tran	17	5.5	Relay system optional behaviors	
19 5.7 Common optional behaviors 10 20 6. IEEE Std 802.1Q Quality of Service provision 11 21 6.1 Introduction 11 22 6.2 Bridge and end station model 11 23 6.2.1 Bridge model 11 23 6.2.1 Bridge model 11 24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 11 31 6.3.6 Transmission selection 11 33 6.4 Other bridge porcesses relevant to QoS provision 12 34 6.4.1 Bridge port transmit and receive Y 12 35 6.4.2 Link Aggregation 12 36 6.4.3 Security Y 1	18	5.6	Common required behaviors	
20 6. IEEE Std 802.1Q Quality of Service provision 11 21 6.1 Introduction 11 22 6.2 Bridge and end station model 11 23 6.2.1 Bridge model 11 24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 11 31 6.3.5.1 Deterministic or probabilistic discard 11 32 6.3.6 Transmission selection 11 33 6.4 Other bridge processes relevant to QoS provision 12 34 6.4.1 Bridge port transmit and receive Y 12 35 6.4.2 Link Aggregation 13 36 6.4.3 Security Y 12 37.7 Quality of Service Provision by	19	5.7	Common optional behaviors	
21 6.1 Introduction 11 22 6.2 Bridge and end station model 11 23 6.2.1 Bridge model 11 24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 11 31 6.3.6.1 Transmission selection 11 32 6.3.6 Transmission selection 11 33 6.4 Other bridge processes relevant to QoS provision 12 34 6.4.1 Bridge port transmit and receive Y 12 35 6.4.2 Link Aggregation 12 36 6.4.3 Security Y 12 37.7 Quality of Service Provision by Network Systems 13 39 7.1.1 End systems <td< td=""><td><mark>20</mark> 6.</td><td>IEEE</td><td>E Std 802.1Q Quality of Service provision</td><td></td></td<>	<mark>20</mark> 6.	IEEE	E Std 802.1Q Quality of Service provision	
21 6.1 Introduction 1 22 6.2 Bridge and end station model 1 23 6.2.1 Bridge model 1 24 6.2.2 End station model 1 25 6.3 Quality of service model 1 26 6.3.1 The forwarding process 1 27 6.3.2 Flow identification, filtering, and metering 1 28 6.3.3 Forwarding 1 29 6.3.4 Class of service assignment 1 30 6.3.5 Queue management 1 31 6.3.6.1 Transmission selection 1 32 6.3.6 Transmission selection 1 33 6.4 Other bridge processes relevant to QoS provision 1 34 6.4.1 Bridge qost transmit and receive Y 1 35 6.4.2 Link Aggregation 1 36 6.4.3 Security Y 1 37 Quality of Service Provision by Network Systems 1 39 7.1.1 End systems 1	04	<i>c</i> 1		11
22 6.2 Bridge and end station model 11 23 6.2.1 Bridge model 11 24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 30 6.3.5 Queue maagement 11 31 6.3.6 Transmission selection 11 32 6.3.6 Transmission selection 11 33 6.4 Other bridge processes relevant to QoS provision 12 34 6.4.1 Bridge gradion 12 35 6.4.2 Link Aggregation 12 36 6.4.3 Security Y 12 37.7 Quality of Service Provision by Network Systems 12 38 7.1 Adapting the bridge QoS architecture to non-bridge systems 12 39 7.1.1 End	21	6.1	Introduction	
23 6.2.1 Bridge model 1 24 6.2.2 End station model 1 25 6.3 Quality of service model 1 26 6.3.1 The forwarding process 1 27 6.3.2 Flow identification, filtering, and metering 1 28 6.3.3 Forwarding 1 29 6.3.4 Class of service assignment 1 30 6.3.5 Queue management 1 31 6.3.5.1 Deterministic or probabilistic discard 1 32 6.3.6 Transmission selection 1 33 6.4 Other bridge processes relevant to QoS provision 1 34 6.4.1 Bridge port transmit and receive Y 1 35 6.4.2 Link Aggregation 1 36 6.4.3 Security Y 1 37 7. Quality of Service Provision by Network Systems 1 38 7.1 Adapting the bridge QoS architecture to non-bridge systems 1 39 7.1.1 End systems 1 41 7.1.3	22	6.2	Bridge and end station model	
24 6.2.2 End station model 11 25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 11 31 6.3.6 Transmission selection 11 32 6.3.6 Transmission selection 11 33 6.4 Other bridge port transmit and receive Y 12 34 6.4.1 Bridge port transmit and receive Y 12 35 6.4.2 Link Aggregation 12 36 6.4.3 Security Y 12 37 7. Quality of Service Provision by Network Systems 12 38 7.1 Adapting the bridge QoS architecture to non-bridge systems 12 39 7.1.1 End systems 12 40 7.1.2 Non-bridge relay systems 12 41 7.1.3	23		6.2.1 Bridge model	
25 6.3 Quality of service model 11 26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 11 31 6.3.6 Transmission selection 11 32 6.3.6 Transmission selection 11 33 6.4 Other bridge processes relevant to QoS provision 12 34 6.4.1 Bridge port transmit and receive Y 12 35 6.4.2 Link Aggregation 12 36 6.4.3 Security Y 12 37 7. Quality of Service Provision by Network Systems 13 38 7.1 Adapting the bridge QoS architecture to non-bridge systems 13 39 7.1.1 End systems 13 40 7.1.2 Non-bridge relay systems 14 7.1.2 Non-bridge relay systems 14 7.1.2 Non-bridge re	24	6.0	6.2.2 End station model	
26 6.3.1 The forwarding process 11 27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 11 31 6.3.6 Transmission selection 11 32 6.3.6 Transmission selection 11 33 6.4 Other bridge processes relevant to QoS provision 12 34 6.4.1 Bridge port transmit and receive Y 12 35 6.4.2 Link Aggregation 12 36 6.4.3 Security Y 12 37 Quality of Service Provision by Network Systems 12 38 7.1 Adapting the bridge QoS architecture to non-bridge systems 12 39 7.1.1 End systems 12 41 7.1.2 Non-bridge relay systems 12 42 7.2 Quality of service specification 12 43 7.2.1 Flow identification 12 44 <t< td=""><td>25</td><td>6.3</td><td>Quality of service model</td><td></td></t<>	25	6.3	Quality of service model	
27 6.3.2 Flow identification, filtering, and metering 11 28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 11 31 6.3.5.1 Deterministic or probabilistic discard 11 32 6.3.6 Transmission selection 11 33 6.4 Other bridge processes relevant to QoS provision 12 34 6.4.1 Bridge port transmit and receive Y 12 35 6.4.2 Link Aggregation 12 36 6.4.3 Security Y 12 37 Quality of Service Provision by Network Systems 12 38 7.1 Adapting the bridge QoS architecture to non-bridge systems 12 39 7.1.2 Non-bridge relay systems 12 41 7.1.3 Interpreting IEEE Std 802.1Q for non-bridges 12 42 7.2 Quality of service specification 12 43 7.2.1 Flow identification 12 44 7.2.2 Flow metering 12	26		6.3.1 The forwarding process	
28 6.3.3 Forwarding 11 29 6.3.4 Class of service assignment 11 30 6.3.5 Queue management 11 31 6.3.5.1 Deterministic or probabilistic discard 11 32 6.3.6 Transmission selection 11 33 6.4 Other bridge processes relevant to QoS provision 12 34 6.4.1 Bridge port transmit and receive Y 12 35 6.4.2 Link Aggregation 12 36 6.4.3 Security Y 12 37 Quality of Service Provision by Network Systems 13 38 7.1 Adapting the bridge QoS architecture to non-bridge systems 14 39 7.1.1 End systems 14 40 7.1.2 Non-bridge relay systems 14 41 7.1.3 Interpreting IEEE Std 802.1Q for non-bridges 14 42 7.2 Quality of service specification 14 43 7.2.1 Flow identification 14 44 7.2.2 Flow filtering 15 45 <td>27</td> <td></td> <td>6.3.2 Flow identification, filtering, and metering</td> <td></td>	27		6.3.2 Flow identification, filtering, and metering	
296.3.4Class of service assignment11306.3.5Queue management11316.3.5.1Deterministic or probabilistic discard11326.3.6Transmission selection11336.4Other bridge processes relevant to QoS provision12346.4.1Bridge port transmit and receive Y12356.4.2Link Aggregation12366.4.3Security Y12377.Quality of Service Provision by Network Systems12387.1Adapting the bridge QoS architecture to non-bridge systems13397.1.1End systems13407.1.2Non-bridge relay systems13417.1.3Interpreting IEEE Std 802.1Q for non-bridges14427.2Quality of service specification14447.2.2Flow identification14457.2.3Flow metering14467.2.4Strict priority15	28		6.3.3 Forwarding	11
30 6.3.5 Queue management 11 31 6.3.5.1 Deterministic or probabilistic discard 11 32 6.3.6 Transmission selection 11 33 6.4 Other bridge processes relevant to QoS provision 12 34 6.4.1 Bridge port transmit and receive Y 12 35 6.4.2 Link Aggregation 12 36 6.4.3 Security Y 12 37 Quality of Service Provision by Network Systems 12 38 7.1 Adapting the bridge QoS architecture to non-bridge systems 12 39 7.1.1 End systems 13 40 7.1.2 Non-bridge relay systems 13 41 7.1.3 Interpreting IEEE Std 802.1Q for non-bridges 13 42 7.2 Quality of service specification 14 43 7.2.1 Flow identification 14 44 7.2.2 Flow filtering 14 45 7.2.3 Flow metering 14 46 7.2.4 Strict priority 15	29		6.3.4 Class of service assignment	
316.3.5.1Deterministic or probabilistic discard326.3.6Transmission selection336.4Other bridge processes relevant to QoS provision346.4.1Bridge port transmit and receive Y356.4.2Link Aggregation366.4.3Security Y377.Quality of Service Provision by Network Systems387.1Adapting the bridge QoS architecture to non-bridge systems397.1.1End systems407.1.2Non-bridge relay systems417.1.3Interpreting IEEE Std 802.1Q for non-bridges427.2Quality of service specification437.2.1Flow identification447.2.2Flow metering457.2.3Flow metering467.2.4Strict priority	30		6.3.5 Queue management	
326.3.6Transmission selection11336.4Other bridge processes relevant to QoS provision12346.4.1Bridge port transmit and receive Y12356.4.2Link Aggregation12366.4.3Security Y12377.Quality of Service Provision by Network Systems13387.1Adapting the bridge QoS architecture to non-bridge systems13397.1.1End systems13407.1.2Non-bridge relay systems13417.1.3Interpreting IEEE Std 802.1Q for non-bridges13427.2Quality of service specification13447.2.2Flow identification13457.2.3Flow metering14467.2.4Strict priority14	31		6.3.5.1 Deterministic or probabilistic discard	
336.4Other bridge processes relevant to QoS provision12346.4.1Bridge port transmit and receive Y12356.4.2Link Aggregation12366.4.3Security Y1237 7.Quality of Service Provision by Network Systems13387.1Adapting the bridge QoS architecture to non-bridge systems13397.1.1End systems13407.1.2Non-bridge relay systems13417.1.3Interpreting IEEE Std 802.1Q for non-bridges13427.2Quality of service specification13447.2.2Flow identification13457.2.3Flow metering13467.2.4Strict priority13	32		6.3.6 Transmission selection	
346.4.1Bridge port transmit and receive Y12356.4.2Link Aggregation12366.4.3Security Y1237 7.Quality of Service Provision by Network Systems13387.1Adapting the bridge QoS architecture to non-bridge systems13397.1.1End systems13407.1.2Non-bridge relay systems13417.1.3Interpreting IEEE Std 802.1Q for non-bridges13427.2Quality of service specification13437.2.1Flow identification13447.2.2Flow filtering13457.2.3Flow metering13467.2.4Strict priority13	33	6.4	Other bridge processes relevant to QoS provision	
356.4.2Link Aggregation12366.4.3Security Y1237 7.Quality of Service Provision by Network Systems13387.1Adapting the bridge QoS architecture to non-bridge systems13397.1.1End systems13407.1.2Non-bridge relay systems13417.1.3Interpreting IEEE Std 802.1Q for non-bridges13427.2Quality of service specification13437.2.1Flow identification13447.2.2Flow filtering13457.2.3Flow metering13467.2.4Strict priority13	34		6.4.1 Bridge port transmit and receive Y	
300.4.3Security 137 7.Quality of Service Provision by Network Systems13387.1Adapting the bridge QoS architecture to non-bridge systems13397.1.1End systems13407.1.2Non-bridge relay systems13417.1.3Interpreting IEEE Std 802.1Q for non-bridges13427.2Quality of service specification13437.2.1Flow identification13447.2.2Flow filtering13457.2.3Flow metering13467.2.4Strict priority13	35		6.4.2 Link Aggregation	
37 7.Quality of Service Provision by Network Systems12387.1Adapting the bridge QoS architecture to non-bridge systems13397.1.1End systems13407.1.2Non-bridge relay systems13417.1.3Interpreting IEEE Std 802.1Q for non-bridges13427.2Quality of service specification13437.2.1Flow identification13447.2.2Flow filtering14457.2.3Flow metering13467.2.4Strict priority13	07.7			12
387.1Adapting the bridge QoS architecture to non-bridge systems13397.1.1End systems13407.1.2Non-bridge relay systems13417.1.3Interpreting IEEE Std 802.1Q for non-bridges13427.2Quality of service specification13437.2.1Flow identification13447.2.2Flow filtering13457.2.3Flow metering13467.2.4Strict priority13	377.	Quali	ity of Service Provision by Network Systems	
39 7.1.1 End systems 13 40 7.1.2 Non-bridge relay systems 13 41 7.1.3 Interpreting IEEE Std 802.1Q for non-bridges 13 42 7.2 Quality of service specification 13 43 7.2.1 Flow identification 13 44 7.2.2 Flow filtering 13 45 7.2.3 Flow metering 13 46 7.2.4 Strict priority 13	38	7.1	Adapting the bridge QoS architecture to non-bridge systems	
407.1.2Non-bridge relay systems13417.1.3Interpreting IEEE Std 802.1Q for non-bridges13427.2Quality of service specification13437.2.1Flow identification13447.2.2Flow filtering13457.2.3Flow metering13467.2.4Strict priority13	39		7.1.1 End systems	
417.1.3Interpreting IEEE Std 802.1Q for non-bridges13427.2Quality of service specification13437.2.1Flow identification13447.2.2Flow filtering13457.2.3Flow metering13467.2.4Strict priority13	40		7.1.2 Non-bridge relay systems	
42 7.2 Quality of service specification 13 43 7.2.1 Flow identification 12 44 7.2.2 Flow filtering 13 45 7.2.3 Flow metering 13 46 7.2.4 Strict priority 13	41		7.1.3 Interpreting IEEE Std 802.1Q for non-bridges	
43 7.2.1 Flow identification 13 44 7.2.2 Flow filtering 13 45 7.2.3 Flow metering 13 46 7.2.4 Strict priority 13	42	7.2	Quality of service specification	
44 7.2.2 Flow filtering	43		7.2.1 Flow identification	
45 7.2.3 Flow metering	44		7.2.2 Flow filtering	13
46 7.2.4 Strict priority	45		7.2.3 Flow metering	13
	46		7.2.4 Strict priority	

1		7.2.5	Priority flow control	13
2		7.2.6	Enhanced transmission selection	13
3		7.2.7	Credit-based shaper	13
4		7.2.8	Time-scheduled transmission	13
5		7.2.9	Cyclic queuing and forwarding	13
6		7.2.10	Asynchronous traffic shaper	13
7 8.	Manag	ed Object	S	14
<mark>8</mark> 9.	YANG	models .		15
<mark>9</mark> 10.	MIB n	nodules		16
10 Annex	A (nor	mative)	Protocol Implementation Conformance Statement (PICS) proforma	17
11	A.1	Introduct	ion	17
11 12	A.1	Introduct A.1.1	ion Abbreviations and special symbols	17 17
11 12 13	A.1	Introduct A.1.1 A.1.2	ion Abbreviations and special symbols Instructions for completing the PICS proforma	17 17 18
11 12 13 14	A.1	Introduct A.1.1 A.1.2 A.1.3	ion Abbreviations and special symbols Instructions for completing the PICS proforma Additional information	17 17 18 18
11 12 13 14 15	A.1	Introduct A.1.1 A.1.2 A.1.3 A.1.4	ion Abbreviations and special symbols Instructions for completing the PICS proforma Additional information Exceptional information	17 17 18 18 18
11 12 13 14 15 16	A.1	Introduct A.1.1 A.1.2 A.1.3 A.1.4 A.1.5	ion Abbreviations and special symbols Instructions for completing the PICS proforma Additional information Exceptional information Conditional items	17 17 18 18 18 19
11 12 13 14 15 16 17	A.1	Introduct A.1.1 A.1.2 A.1.3 A.1.4 A.1.5 A.1.6	ion Abbreviations and special symbols Instructions for completing the PICS proforma Additional information Exceptional information Conditional items Identification	17 18 18 18 19 19
11 12 13 14 15 16 17 18	A.1 A.2	Introduct A.1.1 A.1.2 A.1.3 A.1.4 A.1.5 A.1.6 PICS pro	ion	17 18 18 18 19 19 19 20
11 12 13 14 15 16 17 18 19	A.1 A.2	Introduct A.1.1 A.1.2 A.1.3 A.1.4 A.1.5 A.1.6 PICS pro A.2.1	ion	17 18 18 18 19 19 20 20
11 12 13 14 15 16 17 18 19 20 Annex	A.1 A.2 B (info	Introduct A.1.1 A.1.2 A.1.3 A.1.4 A.1.5 A.1.6 PICS pro A.2.1 rmative)	ion Abbreviations and special symbols Instructions for completing the PICS proforma Additional information Exceptional information Conditional items Identification forma for Quality of Service Provision by Network Systems Major capabilities/options Bibliography	17 17 18 18 19 20 20 21

IEEE P802.1DC[™]/contrib.

2 for: Draft Standard for

3 Local and metropolitan area networks—

4

⁵ Quality of Service Provision by Network⁶ Systems

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161. Overview

17 1.1 Scope

18 This standard specifies procedures and managed objects for Quality of Service (QoS) features specified in 19 IEEE Std 802.1Q, such as per-stream filtering and policing, queuing, transmission selection, stream control 20 and preemption, in a network system which is not a bridge.

21 1.2 Purpose

22 1.3 State diagram conventions

23 This document uses the state diagram conventions defined in Annex E of IEEE Std 802.1Q-2018.

24 1.4 Specification model

25 The model of operation documented by this standard is simply a basis for describing the functionality of a 26 compliant equipment. Implementations can adopt any internal model of operation compatible with the 27 externally visible behavior that this standard specifies. Conformance of equipment to this standard is purely 28 in respect of observable protocol.

11.5 Specification precedence

2 If any conflict among parts of this standard become apparent, C functions (see 1.3) take precedence over 3 other parts of the standard, followed by information in normative Tables, followed by that in normative text, 4 followed by that in normative Figures. Non-normative Tables, Figures, and text are in Annexes and are 5 clearly marked as such.

61.6 Introduction

7 IEEE Std 802.1Q[™] specifies the operation of Bridges and Bridged Networks. Certain parts of that 8 specification can be classified as describing Quality of Service processes (QoS). QoS processes are those 9 that affect the following parameters:

- a) Latency: The time required to forward a frame¹ from source to destination through a bridged network.
- b) Frame loss: The likelihood of discarding a frame, rather than forwarding it, due to various events occurring between the source and destination.
- 14 c) Variations in the above parameters.

15 These parameters can be applied to individual frames, or to collections of frames, such as a single flow of 16 frames from one source application instance to another, all frames sharing the same priority value, or all 17 frames bound for a particular destination. Minimums, maximums, averages, or any other mathematical 18 function can be applied to the collection.

19 Processes that are *not* a part of QoS for the purposes of the present standard include:

- 20 d) Forwarding: the choice of output port(s), to which a given frame is forwarded by a Bridge.
- e) Transformations that frames may undergo as they are forwarded due to forwarding decisions, e.g
 adding VLAN tags or updating fields in an IPv4 header.

23 Clauses 2, 3, and 4 contain the normative references, definitions, and abbreviations used in this standard, 24 respectively. Clause 5 is the starting point for the requirements for various types of systems to claim 25 compliance to this standard. Clause 6 helps the reader understand the specifications for QoS processes in 26 IEEE Std 802.1Q. Clause 7 contains the specifications for non-Bridge systems to implement those QoS 27 processes. Clauses 8, 9, and 10 define the managed objects to control these processes, and their YANG and 28 MIB representations.

^{1.} Bridges, by definition, receive, transmit, and forward frames, as defined in IEEE Std 802. Other standards from IEEE and other organizations use the term "packet" for a unit if transmitted data. The casual reader can equate "frames" with "packets".

12. Normative references

2 The following referenced documents are indispensable for the application of this document (i.e., they must 3 be understood and used, so each referenced document is cited in text and its relationship to this document is 4 explained). For dated references, only the edition cited applies. For undated references, the latest edition of 5 the referenced document (including any amendments or corrigenda) applies. Non-normative references (i.e., 6 that provide additional information not required for the application of this document) are given in Annex B.

7 NOTE—The inclusion of a document in this list of normative references indicates that information in that document is 8 necessary to implement the present standard. It does not imply the that any other part of that referenced document is 9 required to be implemented by a system conformant to the present standard.

10 IEEE Std 802TM, IEEE Standards for Local and Metropolitan Area Networks: Overview and Architecture.^{1, 2}

11 <u>IEEE Std 802.1QTM</u>, IEEE Standard for Local and metropolitan area networks—Bridges and Bridged 12 Networks.

13 IEEE Std 802.1AX[™], IEEE Standard for Local and metropolitan area networks—Link Aggregation.

^{1.} IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ, 08854, USA (http://standards.ieee.org/).

^{2.} The IEEE standards or products referred to in this clause are trademarks of the Institute of Electrical and Electronics Engineers, Inc.

13. Definitions

2 The following terms are specific to this standard:

3 Company Identifier (CID): A 24-bit value, obtained from the IEEE Registration Authority Committee, 4 that can be used for protocol identification.

5 Bridge: (From IEEE Std 802.1Q-2018) A system that includes Media Access Control (MAC) Bridge or 6 Virtual Local Area Network (VLAN) Bridge component functionality and that supports a claim of 7 conformance to Clause 5 of IEEE Std 802.1Q-2018 for system behavior.

8 end station: (From IEEE Std 802) A device attached to a LAN or MAN, which acts as a source of and/or 9 destination for data traffic carried on the LAN or MAN.

10 end system: A system attached to a network that is an initial source or a final destination of data transmitted 11 across that network.

12 NOTE—The term "end system" is often used in this document in places where the reader of IEEE 802 standards would 13 expect the term, "end station," in order to avoid confusion caused by standards relating to routers. For example, a router, 14 as defined by IETF, is an IEEE 802 "end station," but not an "end system." Where this standard specifically refers to the 15 use of IEEE 802 services, the term "end station" is used. Where it refers to more generalized instances of associationless 16 services, the term "end system" is used.

17 **frame:** (From IEEE Std 802) The format of aggregated bits from a medium access control (MAC) sublayer 18 entity that are transmitted together in time.

19 **Organizationally Unique Identifier (OUI):** A 24-bit value, obtained from the IEEE Registration Authority 20 Committee, that can be used for protocol identification.

21 relay system: A router or a bridge.

22 NOTE—The term "relay system" is often used in this document in places where the reader of IEEE 802 standards would 23 expect the term, "bridge." A relay system can, in theory, be a router, a bridge, or some other kind of forwarding device. 24 Where this standard specifically refers to one or the other, the terms "router" or "bridge" are used. Where it refers to 25 more generalized instances of associationless services, the term "relay system" is used.

26 system: An end system or a relay system.

14. Abbreviations

2 This standard contains the following abbreviations:

- 3 CID Company Identifier
- 5 OUI Organizationally Unique Identifier
- 7 QoS Quality of Service

15. Conformance

2 This clause specifies the mandatory and optional capabilities provided by conformant implementations of 3 this standard.

45.1 Requirements terminology

5 For consistency with existing IEEE and IEEE 802.1 standards, requirements placed upon conformant 6 implementations of this standard are expressed using the following terminology:

- 7 a) Shall is used for mandatory requirements;
- 8 b) May is used to describe implementation or administrative choices. "May" means "is permitted to,"
 9 and hence, "may" and "may not" mean precisely the same thing;
- c) Should is used for recommended choices. The behaviors described by "should" and "should not" are
 both permissible but not equally desirable choices.

12 The Protocol Implementation Conformance Statement (PICS) proformas (see Annex A) reflect the 13 occurrences of the words "shall," "may," and "should" within the standard.

14 The standard avoids needless repetition and apparent duplication of its formal requirements by using is, is 15 not, are, and are not for definitions and the logical consequences of conformant behavior. Behavior that is 16 permitted but is neither always required nor directly controlled by an implementor or administrator, or 17 whose conformance requirement is detailed elsewhere, is described by can. Behavior that never occurs in a 18 conformant implementation or system of conformant implementations is described by cannot. The word 19 allow is used as a replacement for the phrase "Support the ability for," and the word capability means "can 20 be configured to."

21 5.2 End system required behaviors

22 An end system conformant to this standard shall, on one or more ports:

- a) Conform to the end system architecture (7.1.1, 7.1.3).
- 24 b) Support all of the items listed in 5.6.

25 5.3 End system optional behaviors

26 An end system conformant to this standard may:

- a) Support flow identification (7.2.1).
- 28 b) Support flow filtering (7.2.2).
- 29 c) Support flow metering (7.2.3).
- 30 d) Support any of the items listed in 5.7 on at least one port.

31 5.4 Relay system required behaviors

32 A relay system conformant to this standard shall, on more than one port:

- a) Conform to the relay system architecture (7.1.2, 7.1.3).
- 34 b) Support all of the items listed in 5.6.

1 5.5 Relay system optional behaviors

- 2 A relay system conformant to this standard may:
- 3 a) Support any of the items listed in 5.7 on more than one port.

45.6 Common required behaviors

- 5 Any system conformant to this standard shall:
- 6 a) Support transmission selection by strict priority (7.2.4).

7 5.7 Common optional behaviors

8 Any system conformant to this standard may:

- 9 a) Support transmission selection by priority flow control (7.2.5).
- 10 b) Support transmission selection by enhanced transmission selection (7.2.6).
- 11 c) Support transmission selection by the credit-based shaper (7.2.7).
- 12 d) Support transmission selection by time-scheduled transmissions (7.2.8).
- 13 e) Support cyclic queuing and forwarding (7.2.9).
- 14 f) Support transmission selection by the asynchronous traffic shaper (7.2.10).

16. IEEE Std 802.1Q Quality of Service provision

26.1 Introduction

3 This purpose of this Clause 6 is to serve as a guide to the reader to understand the model for Quality of 4 Service (QoS) provision in IEEE Std 802.1Q-2018. This clause contains no normative specifications. It lists 5 the processes, gives some clue to their relationships, and provides references to the clauses in IEEE Std 802.1Q-2018 that specify the operation of these processes.

7 6.2 Bridge and end station model

8 6.2.1 Bridge model

9 6.2.2 End station model

10 6.3 Quality of service model

11 6.3.1 The forwarding process

12 The overall forwarding process is described succinctly in clause 8.6 of IEEE Std 802.1Q-2018. This clause 13 describes "a day in the life of a frame"; it is a linear description of the processes through which a forwarded 14 frame progresses. Some of these processes are not relevant to QoS, in that they are concerned with 15 addressing, forwarding, VLAN classifications, and other matters that are tied to whether, or to which port, a 16 Bridge forwards a frame, rather than how fast or how reliably the frame is forwarded. The following clauses 17 call out the process that are relevant to QoS.

18 6.3.2 Flow identification, filtering, and metering

19 6.3.3 Forwarding

20 6.3.4 Class of service assignment

21 6.3.5 Queue management

- 22 a) Residence time exceeded
- 23 b) Drop precedence

24 6.3.5.1 Deterministic or probabilistic discard

25 6.3.6 Transmission selection

- 26 a) Strict priority
- 27 b) Priority flow control
- 28 c) Enhanced transmission selection
- 29 d) Credit-based shaper
- 30 e) Time-scheduled transmission
- 31 f) Cyclic queuing and forwarding
- 32 g) Asynchronous traffic shaper

1 6.4 Other bridge processes relevant to QoS provision

2 6.4.1 Bridge port transmit and receive Y

- 3 6.4.2 Link Aggregation
- 4 6.4.3 Security Y

17. Quality of Service Provision by Network Systems

27.1 Adapting the bridge QoS architecture to non-bridge systems

3 << Contributor's note: These sections give a model for an end system (upper layers and one or more ports) 4 and a relay system (ports and a relay function). The relay function is not specified, of course. The only 5 functions of the ports that are discussed are QoS functions. The QoS functions in7.2 are ordered, insofar as 6 they must be ordered for the model and managed object to make sense, and shown in the diagram. This 7 section will also have text explaining that this clause is not an implementation guide, but is a model for 8 matching the managed objects to externally-visible behaviors. >>

97.1.1 End systems

10 7.1.2 Non-bridge relay systems

11 7.1.3 Interpreting IEEE Std 802.1Q for non-bridges

12 << Contributor's note: Basically for "Bridge", read, "relay system". For "bridge port", read "interface". However, 13 no "shall" or "should" in IEEE Std 802.1Q-2018 is a requirement on a relay system conformant to the present 14 standard except as called out in this Clause 7. >>

157.2 Quality of service specification

16 << The following elements are mostly independent. The relationships among them are discussed in 7.1. Each 17 section, belows, tells you what, in IEEE 802.1Q, you must do in order to claim this feature for your non-Bridge

18 relay system. >>

197.2.1 Flow identification

20 << Contributor's note: Flow identification, filtering, and metering are lumped together as "Per-Stream Filtering 21 and Policing". They will be broken out as more-or-less separate features, all referencing the same areas of 22 the text. >>

23 7.2.2 Flow filtering

24 7.2.3 Flow metering

25 7.2.4 Strict priority

- 26 7.2.5 Priority flow control
- 27 7.2.6 Enhanced transmission selection
- 28 7.2.7 Credit-based shaper
- 29 7.2.8 Time-scheduled transmission
- 30 7.2.9 Cyclic queuing and forwarding
- 31 7.2.10 Asynchronous traffic shaper

18. Managed Objects

2 << Contributor's note: At present, it is unclear whether this will be a reference to clause 12 of IEEE 3 802.1Q-2018, or whether new managed objects will be needed. >>

19. YANG models

2 << Contributor's note: At this time, it is not known to the contributor whether the brand-new IEEE 802.1Q 3 YANG models are sufficiently separated from the rest of the Bridge YANG models to be usable by reference, 4 so that a new YANG model for QoS is not needed in this document. If so, this clause will be deleted. If not, we 5 have issues to deal with. See Clause 10 for similar issues with the MIB. >>

110. MIB modules

2 << Contributor's note: The MIB modules that control queuing in IEEE Std 802.1Q are not usable by 3 P802.1DC, because they are part of the Bridge MIB, and are indexed by Bridge Component and Bridge Port.
4 A new MIB, tied to the interface stack, instead of the Bridge MIB, is required for P802.1DC. It is To Be 5 Determined whether that new MIB is:

- 6 a) A new MIB in P802.1DC that parallels the Bridge MIB.
- 7 b) A new MIB in P802.1DC that is intended to replace part of the Bridge MIB.
- 8 c) A new MIB in the next revision of 802.1Q that is referenced by P802.1DC.
- 9 d) Some combination of the above.

10 >>

1 Annex A

2 (normative)

3 Protocol Implementation Conformance Statement (PICS) pro-

4 forma

⁵ A.1 Introduction¹

6 The supplier of an implementation that is claimed to conform to this standard shall complete the following 7 protocol implementation conformance statement (PICS) proforma.

8 A completed PICS proforma is the PICS for the implementation in question. The PICS is a statement of 9 which capabilities and options of the protocol have been implemented. A PICS is included at the end of each 10 clause as appropriate. The PICS can be used for a variety of purposes by various parties, including the 11 following:

12 13	a)	As a checklist by the protocol implementor, to reduce the risk of failure to conform to the standard through oversight;
14 15 16	b)	As a detailed indication of the capabilities of the implementation, stated relative to the common basis for understanding provided by the standard PICS proforma, by the supplier and acquirer, or potential acquirer, of the implementation;
17 18 19	c)	As a basis for initially checking the possibility of interworking with another implementation by the user, or potential user, of the implementation (note that, while interworking can never be guaranteed, failure to interwork can often be predicted from incompatible PICS);
20 21	d)	As the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation, by a protocol tester.

22 A.1.1 Abbreviations and special symbols

23 The following symbols are used in the PICS proforma:

24	М	mandatory field/function
25	!	negation
26	0	optional field/function
27	0. <n></n>	optional field/function, but at least one of the group of options labeled by
28		the same numeral <n> is required</n>
29	O/ <n></n>	optional field/function, but one and only one of the group of options
30		labeled by the same numeral <n> is required</n>
31	Х	prohibited field/function
32	<item>:</item>	simple-predicate condition, dependent on the support marked for <item></item>
33	<item1>*<item2>:</item2></item1>	AND-predicate condition, the requirement must be met if both optional
34		items are implemented
35	<item1>+<item2>:</item2></item1>	OR-predicate condition, the requirement must be met if either of the
36		optional items are implemented

1. *Copyright release for PICS proformas:* Users of this standard may freely reproduce the PICS proforma in this subclause so that it can be used for its intended purpose and may further publish the completed PICS.

1 A.1.2 Instructions for completing the PICS proforma

2 The first part of the PICS proforma, Implementation Identification and Protocol Summary, is to be 3 completed as indicated with the information necessary to identify fully both the supplier and the 4 implementation.

5 The main part of the PICS proforma is a fixed-format questionnaire divided into subclauses, each containing 6 a group of items. Answers to the questionnaire items are to be provided in the right-most column, either by 7 simply marking an answer to indicate a restricted choice (usually Yes, No, or Not Applicable), or by entering 8 a value or a set or range of values. (Note that there are some items where two or more choices from a set of 9 possible answers can apply; all relevant choices are to be marked.)

10 Each item is identified by an item reference in the first column; the second column contains the question to 11 be answered; the third column contains the reference or references to the material that specifies the item in 12 the main body of the standard; the sixth column contains values and/or comments pertaining to the question 13 to be answered. The remaining columns record the status of the items—whether the support is mandatory, 14 optional or conditional—and provide the space for the answers.

15 The supplier may also provide, or be required to provide, further information, categorized as either 16 Additional Information or Exception Information. When present, each kind of further information is to be 17 provided in a further subclause of items labeled A < i > or X < i >, respectively, for cross-referencing purposes, 18 where < i > is any unambiguous identification for the item (e.g., simply a numeral); there are no other 19 restrictions on its format or presentation.

20 A completed PICS proforma, including any Additional Information and Exception Information, is the 21 protocol implementation conformance statement for the implementation in question.

22 Note that where an implementation is capable of being configured in more than one way, according to the 23 items listed under Major Capabilities/Options, a single PICS may be able to describe all such configurations. 24 However, the supplier has the choice of providing more than one PICS, each covering some subset of the 25 implementation's configuration capabilities, if that would make presentation of the information easier and 26 clearer.

27 A.1.3 Additional information

28 Items of Additional Information allow a supplier to provide further information intended to assist the 29 interpretation of the PICS. It is not intended or expected that a large quantity will be supplied, and the PICS 30 can be considered complete without any such information. Examples might be an outline of the ways in 31 which a (single) implementation can be set up to operate in a variety of environments and configurations; or 32 a brief rationale, based perhaps upon specific application needs, for the exclusion of features that, although 33 optional, are nonetheless commonly present in implementations.

34 References to items of Additional Information may be entered next to any answer in the questionnaire, and 35 may be included in items of Exception Information.

36 A.1.4 Exceptional information

37 It may occasionally happen that a supplier will wish to answer an item with mandatory or prohibited status 38 (after any conditions have been applied) in a way that conflicts with the indicated requirement. No 39 preprinted answer will be found in the Support column for this; instead, the supplier is required to write into 40 the Support column an X<i> reference to an item of Exception Information, and to provide the appropriate 41 rationale in the Exception item itself. 1 An implementation for which an Exception item is required in this way does not conform to this standard.

2 Note that a possible reason for the situation described above is that a defect in the standard has been 3 reported, a correction for which is expected to change the requirement not met by the implementation.

4 A.1.5 Conditional items

5 The PICS proforma contains a number of conditional items. These are items for which both the applicability 6 of the item itself, and its status if it does apply—mandatory, optional, or prohibited—are dependent upon 7 whether or not certain other items are supported.

8 Individual conditional items are indicated by a conditional symbol of the form "<item>:<s>" in the Status 9 column, where "<item>" is an item reference that appears in the first column of the table for some other 10 item, and "<s>" is a status symbol, M (Mandatory), O (Optional), or X (Not Applicable).

11 If the item referred to by the conditional symbol is marked as supported, then 1) the conditional item is 12 applicable, 2) its status is given by "<s>", and 3) the support column is to be completed in the usual way. 13 Otherwise, the conditional item is not relevant and the Not Applicable (N/A) answer is to be marked.

14 Each item whose reference is used in a conditional symbol is indicated by an asterisk in the Item column.

A.1.6 Identification

A.1.6.1 Implementation identification

Supplier (Note 1)			
Contact point for queries about the PICS (Note 1)			
Implementation Name(s) and Version(s) (Notes 1 and 3)			
Other information necessary for full identification—e.g., name(s) and version(s) of machines and/or operating system names (Note 2)			
NOTE 1—Required for all implementations. NOTE 2—May be completed as appropriate in meeting the requirements for the identification. NOTE 3—The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g., Type, Series, Model).			

A.1.6.2 Protocol summary

Identification of protocol specification	IEEE P802.1DC, Quality of Service Provision by Network Systems.
Identification of amendments and corrigenda to the PICS proforma that have been completed as part of the PICS	Amd : Cor: Amd :
	Col
Have any exceptions been noted? (See A.1.4. The answer, "Yes" means that the implementation does not conform to IEEE P802.1DC.	Yes [] No []

1 A.2 PICS proforma for Quality of Service Provision by Network Systems

2 A.2.1 Major capabilities/options

Item	Feature	Subclause	Value/Comment	Status	Support
				0	Yes [] No []

1 Annex B

2 (informative)

3 Bibliography

4 [B1] IEEE Std 802.3TM, IEEE Standard for Ethernet.

1 Annex Z

2 (informative)

3 Commentary

4 << Contributor's Note: This is a temporary Annex intended to record issues and their resolutions as the 5 project proceeds. It will be removed prior to Sponsor ballot. >>

6