IEEE802.1Qcc UNI and Traffic Specifications

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Background

- At the July, 2018 Plenary, Günter Steindl presented Network Configuration & Stream Configuration http://www.ieee802.org/1/files/public/docs2018/60802-Steindl-Configuration-0718-v02.pdf
- This led to a discussion on the availability of managed objects, management protocols, and address assignment protocols.
- Also discussed was how to specify traffic requirements (i.e. cycle time, jitter, etc.)
- It was felt that a contribution on the current capabilities of IEEE802.1Qcc would help facilitate further discussion.

Qcc Management Models

- IEEE802.1Qcc supports 3 management models:
  - Fully distributed model -
    - End stations that contain users of Streams (i.e. Talkers and Listeners) Communicate the user requirements directly over the TSN user/network protocol. The network is configured in a fully distributed manner, without a CNC
  - Centralized network / distributed user model (hybrid model)
    - End stations communicate their requirements directly over the TSN UNI.
    - All configuration of Bridges for TSN Streams is performed by this CNC using a remote network management protocol.
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Fully distributed model

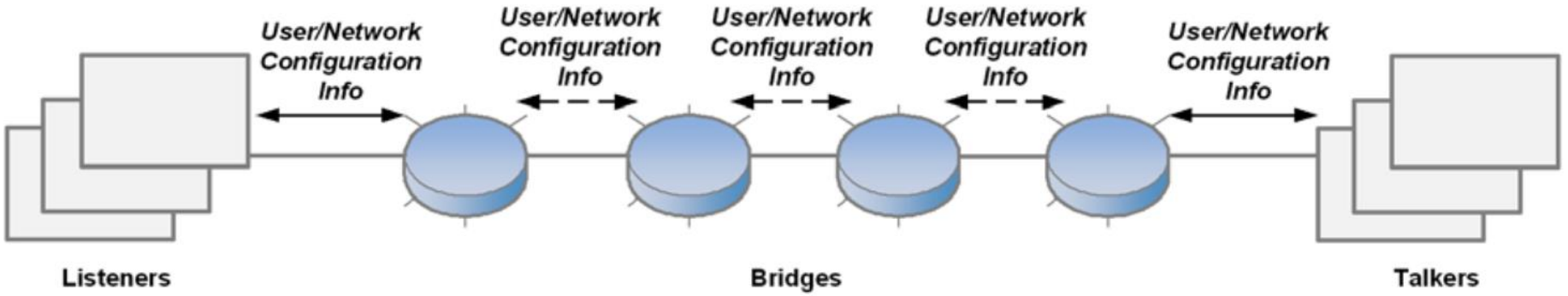


Figure 46-1 — Fully Distributed Model

- The following TSN features can be configured by Bridges using this model:
  - Credit-based shaper algorithm
- Presumably, work on P802.1Qdd will expand these options

Centralized network / distributed user model (hybrid model)

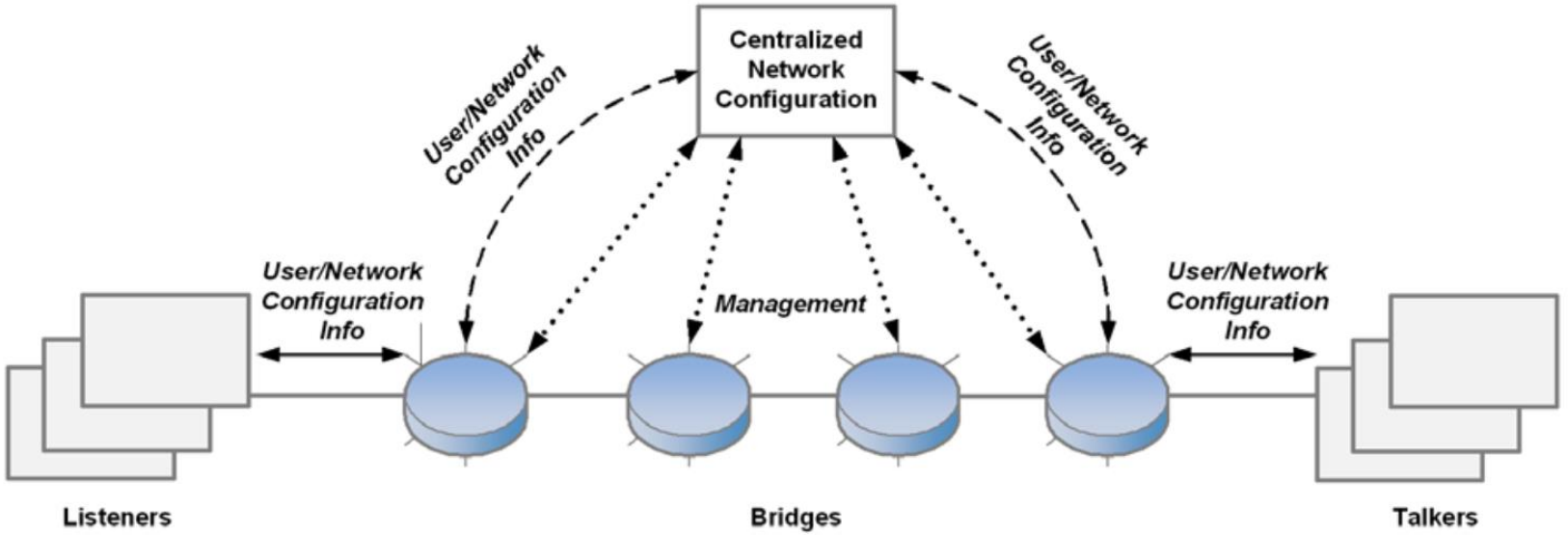


Figure 46-2 — Centralized Network / Distributed User Model

- The following TSN features can be configured by Bridges using this model:
  - Credit-based shaper algorithm
  - Frame preemption
  - Scheduled traffic
  - Frame Replication and Elimination for Reliability (IEEE Std 802.1CB)
  - Per-stream filtering and policing
  - Cyclic queuing and forwarding

Centralized network / distributed user model (hybrid model)

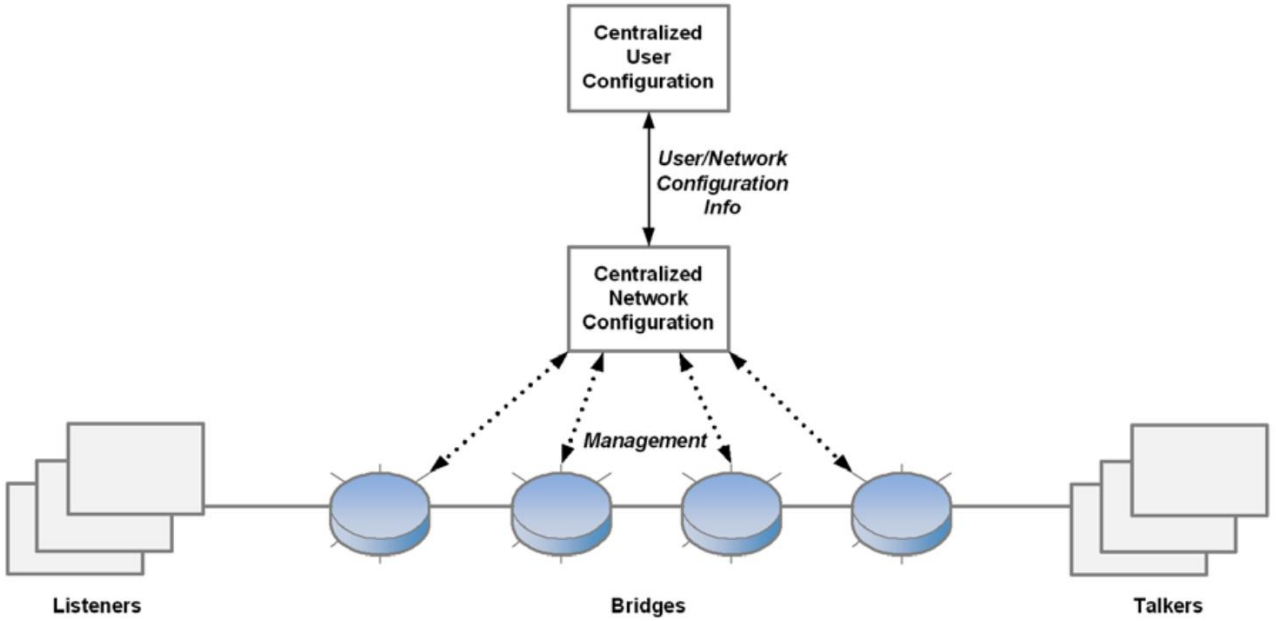


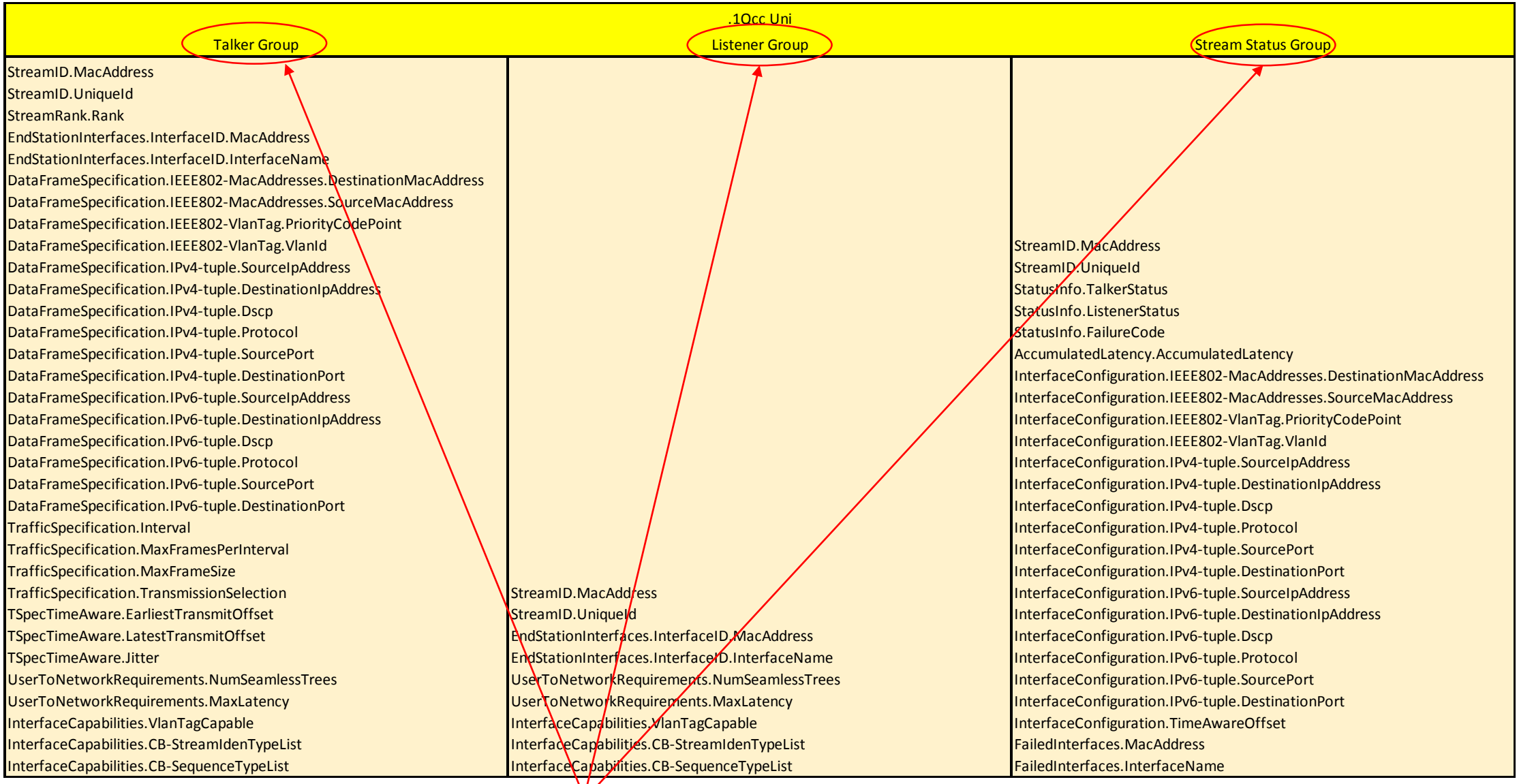
Figure 46-3 — Fully Centralized Model

- The following TSN features can be configured by Bridges using this model:
  - Credit-based shaper algorithm
  - Frame preemption
  - Scheduled traffic
  - Frame Replication and Elimination for Reliability (IEEE Std 802.1CB)
  - Per-stream filtering and policing
  - Cyclic queuing and forwarding

Qcc UNI

.1Qcc Uni		
Talker Group	Listener Group	Stream Status Group
StreamID.MacAddress		
StreamID.UniqueId		
StreamRank.Rank		
EndStationInterfaces.InterfaceID.MacAddress		
EndStationInterfaces.InterfaceID.InterfaceName		
DataFrameSpecification.IEEE802-MacAddresses.DestinationMacAddress		
DataFrameSpecification.IEEE802-MacAddresses.SourceMacAddress		
DataFrameSpecification.IEEE802-VlanTag.PriorityCodePoint		
DataFrameSpecification.IEEE802-VlanTag.VlanId		StreamID.MacAddress
DataFrameSpecification.IPv4-tuple.SourceIpAddress		StreamID.UniqueId
DataFrameSpecification.IPv4-tuple.DestinationIpAddress		StatusInfo.TalkerStatus
DataFrameSpecification.IPv4-tuple.Dscp		StatusInfo.ListenerStatus
DataFrameSpecification.IPv4-tuple.Protocol		StatusInfo.FailureCode
DataFrameSpecification.IPv4-tuple.SourcePort		AccumulatedLatency.AccumulatedLatency
DataFrameSpecification.IPv4-tuple.DestinationPort		InterfaceConfiguration.IEEE802-MacAddresses.DestinationMacAddress
DataFrameSpecification.IPv6-tuple.SourceIpAddress		InterfaceConfiguration.IEEE802-MacAddresses.SourceMacAddress
DataFrameSpecification.IPv6-tuple.DestinationIpAddress		InterfaceConfiguration.IEEE802-VlanTag.PriorityCodePoint
DataFrameSpecification.IPv6-tuple.Dscp		InterfaceConfiguration.IEEE802-VlanTag.VlanId
DataFrameSpecification.IPv6-tuple.Protocol		InterfaceConfiguration.IPv4-tuple.SourceIpAddress
DataFrameSpecification.IPv6-tuple.SourcePort		InterfaceConfiguration.IPv4-tuple.DestinationIpAddress
DataFrameSpecification.IPv6-tuple.DestinationPort		InterfaceConfiguration.IPv4-tuple.Dscp
TrafficSpecification.Interval		InterfaceConfiguration.IPv4-tuple.Protocol
TrafficSpecification.MaxFramesPerInterval		InterfaceConfiguration.IPv4-tuple.SourcePort
TrafficSpecification.MaxFrameSize		InterfaceConfiguration.IPv4-tuple.DestinationPort
TrafficSpecification.TransmissionSelection	StreamID.MacAddress	InterfaceConfiguration.IPv6-tuple.SourceIpAddress
TSpecTimeAware.EarliestTransmitOffset	StreamID.UniqueId	InterfaceConfiguration.IPv6-tuple.DestinationIpAddress
TSpecTimeAware.LatestTransmitOffset	EndStationInterfaces.InterfaceID.MacAddress	InterfaceConfiguration.IPv6-tuple.Dscp
TSpecTimeAware.Jitter	EndStationInterfaces.InterfaceID.InterfaceName	InterfaceConfiguration.IPv6-tuple.Protocol
UserToNetworkRequirements.NumSeamlessTrees	UserToNetworkRequirements.NumSeamlessTrees	InterfaceConfiguration.IPv6-tuple.SourcePort
UserToNetworkRequirements.MaxLatency	UserToNetworkRequirements.MaxLatency	InterfaceConfiguration.IPv6-tuple.DestinationPort
InterfaceCapabilities.VlanTagCapable	InterfaceCapabilities.VlanTagCapable	InterfaceConfiguration.TimeAwareOffset
InterfaceCapabilities.CB-StreamIdenTypeList	InterfaceCapabilities.CB-StreamIdenTypeList	FailedInterfaces.MacAddress
InterfaceCapabilities.CB-SequenceTypeList	InterfaceCapabilities.CB-SequenceTypeList	FailedInterfaces.InterfaceName

Qcc UNI



Three major requirement groupings.

Qcc UNI

.1Qcc Uni		
Talker Group	Listener Group	Stream Status Group
StreamID.MacAddress	Identifies/translates individual streams	
StreamID.UniqueId		
StreamRank.Rank		
EndStationInterfaces.InterfaceID.MacAddress		
EndStationInterfaces.InterfaceID.InterfaceName		
DataFrameSpecification.IEEE802-MacAddresses.DestinationMacAddress		
DataFrameSpecification.IEEE802-MacAddresses.SourceMacAddress		
DataFrameSpecification.IEEE802-VlanTag.PriorityCodePoint		
DataFrameSpecification.IEEE802-VlanTag.VlanId		StreamID.MacAddress
DataFrameSpecification.IPv4-tuple.SourceIpAddress		StreamID.UniqueId
DataFrameSpecification.IPv4-tuple.DestinationIpAddress		StatusInfo.TalkerStatus
DataFrameSpecification.IPv4-tuple.Dscp		StatusInfo.ListenerStatus
DataFrameSpecification.IPv4-tuple.Protocol		StatusInfo.FailureCode
DataFrameSpecification.IPv4-tuple.SourcePort		AccumulatedLatency.AccumulatedLatency
DataFrameSpecification.IPv4-tuple.DestinationPort		InterfaceConfiguration.IEEE802-MacAddresses.DestinationMacAddress
DataFrameSpecification.IPv6-tuple.SourceIpAddress		InterfaceConfiguration.IEEE802-MacAddresses.SourceMacAddress
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DataFrameSpecification.IPv6-tuple.Protocol		InterfaceConfiguration.IPv4-tuple.SourceIpAddress
DataFrameSpecification.IPv6-tuple.SourcePort		InterfaceConfiguration.IPv4-tuple.DestinationIpAddress
DataFrameSpecification.IPv6-tuple.DestinationPort		InterfaceConfiguration.IPv4-tuple.Dscp
TrafficSpecification.Interval		InterfaceConfiguration.IPv4-tuple.Protocol
TrafficSpecification.MaxFramesPerInterval		InterfaceConfiguration.IPv4-tuple.SourcePort
TrafficSpecification.MaxFrameSize		InterfaceConfiguration.IPv4-tuple.DestinationPort
TrafficSpecification.TransmissionSelection	StreamID.MacAddress	InterfaceConfiguration.IPv6-tuple.SourceIpAddress
TSpecTimeAware.EarliestTransmitOffset	StreamID.UniqueId	InterfaceConfiguration.IPv6-tuple.DestinationIpAddress
TSpecTimeAware.LatestTransmitOffset	EndStationInterfaces.InterfaceID.MacAddress	InterfaceConfiguration.IPv6-tuple.Dscp
TSpecTimeAware.Jitter	EndStationInterfaces.InterfaceID.InterfaceName	InterfaceConfiguration.IPv6-tuple.Protocol
UserToNetworkRequirements.NumSeamlessTrees	UserToNetworkRequirements.NumSeamlessTrees	InterfaceConfiguration.IPv6-tuple.SourcePort
UserToNetworkRequirements.MaxLatency	UserToNetworkRequirements.MaxLatency	InterfaceConfiguration.IPv6-tuple.DestinationPort
InterfaceCapabilities.VlanTagCapable	InterfaceCapabilities.VlanTagCapable	InterfaceConfiguration.TimeAwareOffset
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DataFrameSpecification.IPv4-tuple.SourceIpAddress		StreamID.UniqueId
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UserToNetworkRequirements.MaxLatency	UserToNetworkRequirements.MaxLatency	InterfaceConfiguration.IPv6-tuple.DestinationPort
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InterfaceCapabilities.CB-SequenceTypeList	InterfaceCapabilities.CB-SequenceTypeList	FailedInterfaces.InterfaceName

Specifies the requirements of the Talker's traffic

TSpecTimeAware container

- *The presence of TSpecTimeAware specifies that the Talker's traffic is synchronized to a known time on the network (e.g. using IEEE Std 802.1AS). The TSpecTimeAware group provides elements to specify the Talker's time-aware transmit to the network. The Talker and Listeners of a Stream are assumed to coordinate using user (application) mechanisms, such that each Listener is aware that its Talker transmits in a timeaware manner. If MaxFramesPerInterval is greater than one, the time-aware Talker shall transmit multiple frames as a burst within the Interval, with the minimum inter-frame gap allowed by the media.*

  NOTE — Although scheduled traffic (8.6.8.4) specifies a valid implementation of a time-aware Talker, the TSpecTimeAware group is intended to support alternate implementations of scheduling.

Traffic Requirements in Qcc

- Interval –
  - Interval specifies the period of time in which the traffic specification cannot be exceeded. The traffic specification is specified by MaxFramesPerInterval and MaxFrameSize.
  - If the TSpecTimeAware group is not present, the Interval specifies a sliding window of time. The Talker's transmission is not synchronized to a time on the network, and therefore the traffic specification cannot be exceeded during any Interval in time (i.e. a bandwidth specification)
  - If the TSpecTimeAware group is present, the Interval specifies a window of time that is aligned with thetime epoch that is synchronized on the network. This is equivalent to a cycle time in control/industrial applications
- EarliestTransmitOffset- The earliest offset within the Interval at which the Talker is capable of starting transmit of its frames
- LatestTransmitOffset – The latest offset within the Interval at which the Talker is capable of starting transmit of its frames
- Jitter - The maximum difference in time between the Talker's transmit offsets, and the ideal synchronized network time

User To Network Requirements in Qcc

- NumSeamlessTrees - The number of trees that the network will configure to deliver seamless redundancy for the Stream
- MaxLatency – Maximum latency from Talker to Listener(s) for a single frame of the Stream
- Jitter - The maximum difference in time between the Talker's transmit offsets, and the ideal synchronized network time

- ***Note: All traffic specifications and User to Network specification are per stream***

Conclusions

- The Qcc UNI provides all traffic specifications needed to specify industrial traffic types
  - This does not imply that protocol or means by which the CUC becomes aware of these specifications is defined or specified
  - Likewise, it does not imply that the data models (i.e. MIB, YANG) for TSN managed objects are available. There is on-going work in the TSN TG to address this deficiency.
- The IEC/IEEE 60802 Joint Project should examine the UNI for completeness. The spectrum of industrial expertise is much broader than was available during the drafting of the standard.
- The Qcc UNI should be examined as part of the .1Qdd development.

Thank you