Traffic-Type-Class Introduction

When specifying traffic types, a two-step approach seems to be needed:

1.) First define characteristics of generic traffic type (traffic-type-class) and
2.) Second define instances of the generic types, i.e. the traffic types

Such an approach will allow to translate the different use cases into a list of possible traffic types based on this traffic-type-classes.

This two-step approach allows a clear differentiation between characteristics as seen from the "network interface" point of view and "application" point of view. Traffic-type-classes would allow different IEEE 802 feature selections to achieve the specified goals

Definitions

In order to define the traffic-type-classes we need a more precise definition of the stream traffic and the definition of the non-stream traffic.

Stream traffic (or Stream) is a unidirectional flow of data from a Talker to one or more Listeners, which is usually sent periodically. Network resources and/or bandwidth may be reserved in order to meet the application requirements (e.g., latency). From the system design point of view Streams are either:

- dynamic planed configured in a network by means of (ad-hoc) stream reservation mechanisms (e.g., by using the centralized approach using the CNC and CUC or distributed approach)
- statically planed and/or configured by means of traffic engineering tools.

Non-stream traffic is a flow of data from a Sender to a Receiver which is usually send sporadically and uses shared network resources which may be reserved to meet potential application requirements.

Traffic Type Classes

Four traffic-types-classes are identified in Industrial Automation (IA) systems:

1. IA time-aware stream
2. IA stream
3. IA traffic engineered non-stream
4. IA non-stream

IA time-aware stream

IA time-aware stream *are used for periodic* traffic with either deadline or latency requirements.

Characteristics		Note
Periodicity	Periodic/cyclic traffic	
Data delivery requirement	Deadline or latency	Each stream may have its individual deadline or latency value, but also multiple streams with the same period may share the same deadline or latency value
Configuration	traffic engineered transmission path	The network shall be configured such that the Stream configuration is not affected by the spanning tree mechanisms alone, as by selection of an alternative path for a given stream the requested application properties of that stream can be invalidated (e.g., latency requirement is not satisfied).
Frame loss and retransmission	This traffic has zero congestion los	No retransmission in case of frame loss
Time-triggered transmit	Optional	
Expected behavior of the application receive interface	Buffered communication interface	Only the latest received frame is of interest

IA stream

IA stream traffic are used for periodic traffic with latency requirements.

Characteristics		Note
Periodicity	Periodic/cyclic traffic	
Data delivery requirement	Latency	Each stream may have its individual deadline or latency value, but also multiple streams with the same period may share the same deadline or latency value
Configuration	Learned path	The network shall be configured such that the Stream configuration is not affected by the spanning tree mechanisms alone, as by selection of an alternative path for a given stream the requested application properties of that stream can be invalidated (e.g., latency requirement is not satisfied).
Frame loss and retransmission	This traffic has zero congestion los	No retransmission in case of frame loss
Time-triggered transmit	No	
Expected behavior of the application receive interface	Buffered or Queued communication interface	

IA traffic engineered non-stream

This traffic is used for application that send sporadic traffic but have wither latency application requirements or require a certain bandwidth along the path of the traffic.

Characteristics		Note
Periodicity	Aperiodic / sporadic	
Data delivery requirement	Latency or bandwidth	Event traffic usually require some latency guarantee and the configuration traffic might require some bandwidth reservation. Expected bandwidth usage is engineered offline, and Ethernet interfaces are configured accordingly.
Configuration	Learned path	Ethernet interfaces and network are configured at run-time to establish a path between a Sender and a Receiver. Non-stream traffic configuration may be affected by the spanning tree mechanisms.
Frame loss and retransmission	Multiple Senders use the same reserved bandwidth. Frame losses are possible.	Retransmission in case of frame loss
Time-triggered transmit	No	
Expected behavior of the application receive interface	Queued communication interface	All received frame are of interest.

IA non-stream

IA non-stream is used for the bulk traffic with no specific data delivery requirements.

Characteristics		Note
Periodicity	Aperiodic / sporadic	
Data delivery requirement	None	Bulk traffic, best-effort.
Configuration	Learned path	Ethernet interfaces and network are configured at run-time to establish a path between a Sender and a Receiver. Non-stream traffic configuration may be affected by the spanning tree mechanisms.
Frame loss and retransmission	Frame losses are possible.	Retransmission in case of frame loss
Time-triggered transmit	No	
Expected behavior of the application receive interface	Queued communication interface	All received frame are of interest.

Example assignments

Traffic types to traffic-type-classes assignment

This is an example how the traffic types can be assigned to specific traffic-type-class .

Traffic-type-class	Traffic type
IA time-aware-stream	• Isochronous • Cyclic-Synchronous
IA stream	• Cyclic-Asynchronous • Video • Audio/Voice
IA traffic engineered non-stream	• Alarms and Events • Configuration & Diagnostics • Network Control
IA non-stream	• Best Effort

Traffic classes to traffic-type-classes assignment

The following Table defines the usage of the following traffic classes based on the traffic type-classes:

Traffic class	Traffic type class	Traffic Type
7	IA time-aware-stream	Periodic, traffic engineered path, time-sensitive stream, zero congestion loss, defined receive deadline (engineered max latency)
6		Periodic, traffic engineered path, time-sensitive stream, zero congestion loss, engineered max latency
5	IA stream	Periodic, learned path, time-sensitive stream, defined bandwidth, engineered max latency
4	IA traffic engineered non-stream	Event-driven, learned path, defined bandwidth, network management
3		Event-driven, learned path, defined bandwidth
2		Event-driven, learned path, defined bandwidth
1	IA non-stream	Event-driven, learned path, limited bandwidth (per class)
0		Event-driven, learned path, limited bandwidth

Traffic-Type-Classes definition would allow different IEEE 802 feature selections to achieve the specified goals. Moreover it helps in identification of the traffic protection mechansims.