~~Traffic-Type-Class~~4.6.1 Introduction

Industrial automation applications make use of different traffic schemes/patterns for different functionalities (for example, parameterization, control, alarming). The various traffic patterns have different characteristics and thus, impose different requirements on a TSN network. ~~When~~ To specify~~ing~~ these traffic types, a two-step approach ~~seems to be needed~~is used:

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

~~2.)~~

~~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~~ Ethernet interface" point of view and "application" point of view. Traffic-type-~~classes~~ categories ~~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~~ categories 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~~The characteristics of this traffic are shown in Table X.

Characteristics	
~~Periodicity~~Cyclic	~~Periodic/cyclic traffic~~Yes
Data delivery requirement	Deadline or latency
~~Configuration~~	~~traffic engineered transmission path~~
~~Frame loss and retransmission~~	~~This traffic has zero congestion los~~
Time-triggered transmit	~~Optional~~ Yes
~~Expected behavior of the application receive interface~~	~~Buffered communication interface~~

IA stream

The characteristics of this traffic are shown in Table X.~~IA stream traffic are used for periodic traffic with latency requirements.~~

Characteristics	
Cyclic~~*Periodicity*~~	~~Periodic/cyclic traffic~~Yes
Data delivery requirement~~*Data delivery requirement*~~	Latency
Time-triggered transmit~~*Configuration*~~	~~Learned path~~
Cyclic~~*Frame loss and retransmission*~~	~~This traffic has zero congestion los~~
Time-triggered transmit~~*Time-triggered transmit*~~	~~No~~Optional
~~*Expected behavior of the application receive interface*~~	~~Buffered or Queued communication interface~~

IA traffic engineered non-stream

The characteristics of this traffic are shown in Table X.~~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	
Cyclic~~*Periodicity*~~	~~Aperiodic / sporadic~~No
Data delivery requirement~~*Data delivery requirement*~~	Latency ~~or bandwidth~~
Time-triggered transmitCyclicTime-triggered transmit~~*Configuration*~~	~~Learned path~~
Cyclic~~*Frame loss and retransmission*~~	~~Multiple Senders use the same reserved bandwidth. Frame losses are possible.~~
Time-triggered transmit~~*Time-triggered transmit*~~	No
~~*Expected behavior of the application receive interface*~~	~~Queued communication interface~~

IA non-stream

The characteristics of this traffic are shown in Table X.~~IA non-stream is used for the bulk traffic with no specific data delivery requirements.~~

Characteristics		**Note**
Cyclic~~*Periodicity*~~	~~Aperiodic / sporadic~~No	
Data delivery requirement~~*Data delivery requirement*~~	None	Bulk traffic, best-effort.
Time-triggered transmitCyclicTime-triggered transmitCyclicTime-triggered transmit~~*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.~~
Cyclic~~*Frame loss and retransmission*~~	~~Frame losses are possible.~~	~~Retransmission in case of frame loss~~
Time-triggered transmit~~*Time-triggered transmit*~~	No	
~~*Expected behavior of the application receive interface*~~	~~Queued communication interface~~	~~All received frame are of interest.~~

Table 3 summarizes relevant industrial automation traffic types and their associated characteristics. In an industrial automation system, applications such as audio or video would utilize one of these traffic types. Traffic types are further described in 4.6.3.

Table 1 – Industrial automation traffic types summary

Traffic type name	Cyclic	Data delivery requirements	Time-triggered transmit	Traffic-type-category
Isochronous	Yes	Deadline	Yes	IA time-aware-stream
Cyclic-Synchronous	Yes	Latency	Yes	IA time-aware-stream
Cyclic-Asynchronous	Yes	Latency	No	IA stream
Alarms and Events	No	Latency	No	IA traffic engineered non-stream
Configuration & Diagnostics	No	Latency	No	IA traffic engineered non-stream
Network Control	Optional	Latency	No	IA traffic engineered non-stream
Best Effort	No	N/A	No	IA non-stream

~~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.