Traffic Patterns for Converged Industrial Communication

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Traffic Patterns for Converged Industrial Communication

LNI4.0 LABS NETWORK INDUSTRIE 4.0

Rationale

- Different applications have different requirements regarding data transfer (=traffic pattern)
- Applications and hence associated traffic patterns have different priorities
  - Hard real-time traffic has highest priority
  - Best effort traffic has lowest priority
- Various traffic patterns shall coexist on one network
  - Properties of higher priority traffic will be guaranteed, independent of behavior of lower priority traffic
  - Unused bandwidth of higher priority traffic can be used by lower priorities

List of Traffic Patterns

Application view

* unused bandwidth can be consumed by lower priorities

ID	Working Name	Guarantee	App synchronized to Nw	Phase aligned actions	Periodic / Sporadic	Bandwidth reservation	Data size	Redundancy mechanism	Comment
Class I	isochronous	bounded latency/deadline	✓	✓	P	✓	bounded	seamless	Future use (LNI)
Class II	cyclic	bounded latency	optional		P	✓	bounded	seamless	LNI first use case
Class III	network control	priority	-	-	S	✓*		not required	
Class IV	audio/video	bounded latency/bandwidth	-	-	P	✓*	bounded	regular	
Class V	alarms/ events	bounded latency/bandwidth	-	-	S	✓*		regular	
Class VI	config/ diagnosis	bandwidth	-	-	S	✓*		regular	
Class VII	best effort	-	-	-	S			regular	

Description of Traffic Patterns

Class 1 – Isochronous

- → Application entirely synchronised with network
- cyclic operation, very small jitter
- all participants and applications synchronized over/through the network
- amount of data per node per cycle constant (at least bounded)
- optional seamless redundancy
- talker guarantees fixed sending time (option 1) or synchronised sending per StreamClass (option 2)
- network guarantees bandwidth and latency
- guaranteed reception time at listener
- applications :
  - highly synchronous, fast control applications, e.g. synchronised axis (high-end motion control) , IOs
  - highly synchronous applications like line integration, connection to robotics
- comparable today‘s solutions : SERCOS, POWERLINK, EtherCAT, Profinet IRT, …

Description of Traffic Patterns

Class 2 – Cyclic

- → Application NOT entirely synchronised with network
- cyclic operation with jitter (compared to class 1)
- participants can be synchronized, don‘t have to be
- amount of data per node per cycle constant (at least bounded)
- optional seamless redundancy
- talkers send, when data is ready
- network guarantees bandwidth and maximum latency
- applications:
  - fast control applications with tolerable jitter, e.g. position control (standard Motion Control), IOs
  - applications with tolerable jitter like Scada, HMI
- comparable today‘s solutions: Profinet RT, CC-Link IE, Ethernet/IP, …

- LNI 4.0 1st Use Case: („phase“)synchronous application on robots (2 pcs.), transportation, cameras: current cycle time 12ms. The first LNI Use Case requires clock sync; Controllers of this Use Cases (robot, camera,…) are fully phase-aligned to each other, however, probably not with the network

Description of Traffic Patterns

Class 3 – Network Control

- All protocols, which are required for maintaining the normal operation of the network (time sync, etc)
- sporadic occurances of messages
- Restrictions in terms of number or size of messages (slow protocols)
- no requirements regarding redundancy, priorized service, however, less priority than stream classes

Description of Traffic Patterns

Class 4 – Video

- cyclic operation
- participants usually synchronized
- amount of data per node per cycle constant (at least bounded)
- optional seamless redundancy
- network guarantees bandwidth and maximum latency
- applications:
  - quality control and video surveillance

Description of Traffic Patterns

Class 5 – Alarms/Events

- sporadic occurances of messages
- typically common format (=size) of messages
- regular: switchover redundancy , optional: seamless redundancy
- a maximum number of alarms per time that have to be guaranteed by the network can be given
- network guarantees bandwidth. no latency guarantee required since in the 100ms range
- unused bandwidth can be „ceded“
- applications:
  - guaranteed bandwidth for transmission of error and alarm messages
- comparable today‘s solutions: various field busses, various redundancy solutions

Description of Traffic Patterns

Class 6 – Config/Diagnosis

- sporadic occurances of messages
- no restriction in terms of number or size of messages
- typically using a transport layer (hence, no network redundancy required)
- no latency requirements
- requirements for bandwidth, to allow for „normal“ operation (bandwidth allocation per class)
- network guarantees bandwidth
- unused bandwidth can be „ceded“

Description of Traffic Patterns

Class 7 – Best effort

- the rest
- no requirements regarding redundancy, bandwidth, latency, …
- uses remaining bandwidth