Summary of Aerospace Traffic Types

Abdul Jabbar
GE Research

Background

Complete list of data flows by function and their characteristics

https://www.ieee802.org/1/files/public/docs2021/dp-Jabbar-et-all-Aerospace-Traffic-Characterization-0421-v02.pdf

This presentation gives a summary of the above document:

Traffic Types Documentation

Characteristic	Description
Periodicity	Traffic types comprise data streams that can either be **Periodic:** transmitted in a cyclic/periodic (e.g. signal transmission) or **Aperiodic:** transmitted in a acyclic/sporadic (e.g. event-driven) manner
Typical Period	Period denotes the planned data transmission interval (often also called "cycle") at the application layer. **#:** Specify period for cyclic traffic **N/A:** for aperiod/acyclic traffic
Application Synchronized to Network	Is the application producing traffic type synchronized to the network time at the application layer? YES or NO
Data Delivery Guarantee Mode	Packet(s) are delivered to all receivers: **Deadline:** before a specified time, relative to cycle time. (applies to periodic data) **Latency**: within a predictable timespan from the start of the transmission **Bandwidth**: if bandwidth utilization is within in the resources reserved by the sender **None**: no special delivery requirements
Delivery Guarantee Value	**#:** Typical quantification of the data delivery guarantee for 80% of the use cases If "deadline" mode is used, specify if the data will be delivered in the same period or not
Application Tolerant to Jitter	application's tolerance of a certain amount of latency variation of the packet's transmission (a.k.a Jitter) **yes**: application can tolerate jitter as specified (always yes for "Bandwidth" and "none" delivery modes) **no**: highly sensitive application requires negligible jitter
Tolerable Jitter Value	**#:** Value of acceptable jitter for periodic applications **NEG**: Jitter must be negligible **N/A:** if data delivery guarantee mode is "bandwidth" or "none"
Applications Tolerant to packet loss	Application's tolerance to a certain amount of consecutive packet loss **Yes**: app can tolerate loss due to recovery mechanism in upper layer protocols or basic redundancy **No**: app cannot tolerate a single packet loss
Tolerable packet loss Value	**#:** Num of consecutive packet loss tolerable to app. **0:** if application is not tolerant to packet loss
Application payload size variability	**fixed**: application payload size remain fixed **variable**: app payload varies from one packet to packet
Payload Value (Bytes)	**#:** size/range of application data (payload) to be transmitted in the Ethernet frames.
Data Criticality	Criticality of this data for operation of the critical parts of the system **high**: highly critical for the operation. (DAL A, B) **medium**: relevant but not continuously needed for the operation (Dal C, D) **low:** not relevant for operation (DAL E)

Representative Aerospace Data Flows based on Function

1. File Transfers - Mission Loading, Video Transfer, Image Transfer, Nav/Map data
2. Asynchronous Parametric Data – sensors, displays,
3. Synchronous Parametric Data – closed loop control and Inertial
4. Command and Control – Weapons release authorization, commands
5. Audio Streaming – Cockpit audio, cabin PA,
6. Video Streaming – Uncompressed real-time video (ARINC818) , compressed video streams
7. Maintenance and Health Monitoring – fault reporting, testing
8. Fiber Channel over TSN (FCoT) – HS1760 (weapons systems), and other FC based applications
9. Extremely High BW Source - raw Radar data
10. Raw IQ data and Raw Plot data

Summary of Traffic Types

Traffic Characteristic	Current Use		Known/Desired future use	Use case driving the Bound
	Left Bound	*Right Bound*	*Bound*	
Synchronicity	Synchronous	Asynchronous		
Periodicity/Cycle Time	5 msec	Aperiodic	1 msec	Flight critical controls
Delivery Guarantee Mode	Deadline, Latency, Bandwidth			
Latency Mode Reqs	1 msec	150 msec	100 usec	Weapons Control Legacy buses over TSN
Tolerance to interference (delay variation/jitter)	< 1 usec	Up to latency limit		Fly-by-wire, synchronous sensors
Tolerance to Loss*	none	10 consecutive frames		Flight controls, weapons release
Payload size (Bytes)	8	2112		Fiber Channel over TSN

**All aerospace systems are robust to losses and failures. Indicates desirable behavior*

Takeaway

- Two categories of traffic – Ethernet (ARINC664, COTS) based and Non-Ethernet (ARINC 429, FC, 1553, FireWire) based
- Current Ethernet (ARINC664) based systems:
  - Asynchronous with 50 msec or higher cycle time
  - Latency bounded with acceptable delay variation (jitter) up to latency bound
- Current non-Ethernet based systems:
  - Partitioned/Segmented subsystems
  - Synchronous and Asynchronous with 1 msec or higher cycle time
  - Sensitive to both Latency/deadline and delay variation (jitter) – require determinism
- Future TSN-based systems:
  - Need to address requirements of both Ethernet and non-Ethernet systems
  - Potential evolving use cases with sub-millisecond latency bounds (100 usec or lower)
- Systems are designed to be inherently tolerant to network frame loss. But eliminating congestion loss remains an objective.

Thank You!