Exploring ARINC with SLDV

What is ARINC 429?

- Data transfer standard for aircraft avionics
- ARINC 429 has the following parameters: data, SSM, freshness, and timing associated with it. The data comes at a specific rate say every 0.1 second.
- SSM can be any one of the 4 values:
  - NCD (No Computed Data - data may not be accurate)
  - NO – (Normal Operation - data is correct)
  - FW (Failure Warning – system failure, data may not be accurate)
  - FT (Functional Test – the system is doing a self test and data should not be used).
- There are other parameters like label which are not considered for this study.
- In this work we focus on protocol behavior for data validity and fault check.

Design

- Input SSM = 1 (NO), 2 (FW), 3 (FT), 4(NCD)
- Input Fresh (Boolean) True => data is updated every 0.1 sec
- Input Data (integer) this is the time varying data that is transmitted, assume range -100 to 100
- Output Fault (Boolean) True => faulted
- Output Fault_Reason (Integer) 1= communication fault (due to not fresh) 2 = producer fault (due to SSM = FW)
- Output Valid (Boolean) True => data is valid
- Output Data_out (Integer) range -100 to 100. If invalid this will be held constant.

Requirements

- “Data is fresh” implies that the data is coming through every 0.1 second. “Data is not fresh” implies that data is not coming every 0.1 second. It could be intermittent data coming over a broken line or data is not coming at all for long durations and then again it starts coming over the line. This could be a problem with the producing system.
- “Data is valid” implies that the data updates are happening at 0.1 second and the SSM is indicating NORM. “Data is invalid” implies that Data is not valid.
- “Faulty” implies that the data is not valid perhaps due to the Data is not fresh or Data is fresh but SSM is FW. “Not Faulty” implies that the Data (bus) is not Faulted.

Requirements – Data Validity

- Initially data is invalid
- Validity shall toggle after a persistence check. Shall not toggle every frame.
- If it is indicated Data is not fresh for at least two continuous samples, the ARINC processing system shall set Data is invalid after two samples.
- If it is indicated Data is fresh AND SSM is not NORM for at least two continuous samples, the ARINC processing system shall set Data is invalid after two samples.
- When it is indicated Data is fresh AND SSM is NORM for at least three continuous samples, the ARINC processing system shall set Data is valid after three samples.

Requirements – Data Fault

- Initially data is not faulted
- If in previous sample Data is invalid AND conditions for invalidity exist currently (SSM is not NORM but Fresh OR Data is not fresh) the ARINC processing system shall continue Data is invalid.
- “Fault condition is set” implies Data is invalid AND
  - (Data is fresh AND SSM is FW) OR
  - Data is not fresh
- If Fault condition is set for at least six continuous samples, the ARINC processing system shall set Data is Faulted after six samples.
- If in previous sample Data is Faulted AND Fault condition is set, the ARINC processing system shall continue Data is Faulted

Requirements – Data Fault

- When it is indicated Data is valid, the ARINC processing system shall set Data is not faulted.
- When Fault condition is NOT set for at least six continuous samples, the ARINC processing system shall set Data is not faulted.