Summary of Aerospace Use Cases

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Background

Detailed Use Case Document

https://www.ieee802.org/1/files/public/docs2021/dp-Jabbar-et-al-Aerospace-Use-Cases-0321-v06.pdf

This presentation gives a summary of the above document

Aerospace Use Cases Collected by the group

1. Small Business Aircraft - ACD
2. Large Passenger Aircraft - ACD
3. Large Passenger Aircraft - Cabin
4. Small and Combat Military Mission Network
5. Large Military Aircraft Mission Network
6. Small, Combat, and Large Military Flight Network (VMS)
7. Unmanned Military Aircraft Network
8. Rotary Wing Mission Network
9. Rotary Wing Flight Network
10. Satellite Network
11. Fibre Channel over TSN backbone (AS6509)

Use Case Documentation

Characteristic	Description
Number of Nodes	Denotes the total number of networking nodes in an instantiation of the use case. Includes both end stations and bridges. May be specified as a range or a maximum value
Physical Topology	Denotes the type of physical topology in use, where in “physical topology” represent the hardware level connectivity between devices. Examples include star, ring, mesh, and point-to-point.. One or more topologies may be specified
Number of Switched hops	Denotes the number of hops between source and destination. May be specified as a range or a maximum value
Number of Streams Per Switch	Denotes the number of unique data streams traversing a bridge in the network. Aerospace requires bridge to maintain isolation between unique data streams. May be specified as a range or a maximum value.
Network Redundancy	Describes the network redundancy architecture in the current instantiations of the use case. One of more redundancy architectures may be specified
Redundancy Mode	Denotes the mode of redundancy. Options include standby, active, hot-active, active-active with voting. One or more modes may be specified.
Data Rate	Denotes the data rate(s) of the physical media. May be specified as one or more rates
Media Type	Denotes the type of media, which may include the physical medium as well as MAC protocol. Examples include 100Base-Tx, Shielded Twisted Pair, May be specified as one or more media types
Worst Case Link Utilization	Denotes the link utilization of the most congested link in the network. Both the “as configured” and “as realized on wire” variants of the link utilization may be specified. May be specified as a range or maximum value.
Dissimilarity, Integrity, Maintainance, Monitoring, Security [DIMMS]	When applicable, denotes the use of dissimilarity, integrity, maintenance, monitoring, or security features. May specify one or more features in use.
Certification Requirements	Specify if any certification requirements apply to this use case. Specify if it is Mandatory, Desired, Do Not Care.
Supported Traffic Types	Listing of Traffic Types from section 4 that exist in this use case

Summary of Use Cases

Characteristic	Current Use		Known/Desired Future Use	Use Case driving the bounds
	Left Bound	***Right Bound***	***Bound***	
Number of Nodes	5	100	500	Large Passenger Aircraft
Physical Topology	Master/Slave Bus, Point-to-point, Ring (daisy chained), switched star or combination		Hybrid – Ring and Star	N/A
Number of switched hops	0	5	15-30	Large passenger cabin. Otherwise <= 4
Number of Streams Per Switch	50	2000	4096	Large Passenger aircraft
Network Redundancy	Two independent networks (A,B). End systems are dual homed to redundant LANs(ARINC664); Fault tolerant Ring; None on point-to-point links Subsystem or full system level redundancy (dual, tri, or quad);		Seamless network redundancy to reduce need for redundant subsystems	DAL A/B systems
Redundancy Mode	Bus Failover (Hot Standby), Frame Failover (Hot Active); Hot Active with voting;			DAL A/B systems
Data Rate	10 Kbps	1 Gbps	100 Gbps	1553, Satellite platform on low end Military mission network on high end
Media Type	Copper: 1394,1553, RS-485/422, ARINC 429, Ethernet (10,100Base-Tx) Multimode Fiber: Fiber Channel, 10Base-Sx or 100Base-Sx			
Worst Case Link Utilization	95% (worst case-configured) 80% (realized on the wire); higher for deterministic buses			Large passenger aircraft for configured Military Flight Networks for realized
Dissimilarity, Integrity, Maintainance, Monitoring, Security [DIMMS]	Monitoring/Maintenance with SNMP or other means	Dissimilarity in design/implementation. High integrity additions, monitoring, security for isolation between assurance levels and cross-domain traffic	Mandatory MIBS for TSN Network	Flight critical systems in large passenger aircraft
Certification Requirements	None, self certified	HW/SW design and development assurance; IMA; and Safety		Passenger Aircraft
Supported Traffic Types	All traffic types			

Takeaway

- Moderate number of nodes (500 max)
- Very few hops (<5). Mostly switched star topology
  - Exception of cabin (up to 30) with Ring topology
- Large number of unique streams that need to be isolated (stream identification, filtering and policing)
- Data rates of 100 Gbps or more desired
- Certifiability is a major requirement (and cost driver)
- While the system design is primarily responsible for achieving the target reliability and availability values, a highly reliable and highly available network helps
- TSN is expected to not only meet the requirements of ARINC664 (profiled Ethernet), but also of segregated subsystems that support highly deterministic and low latency communications.

Thank You!