SPACEWIRE NETWORK TOPOLOGIES IN DISTRIBUTED DATA ACQUISITION AND CONTROL SYSTEMS

Session: SpaceWire Networks and Protocols

Short Paper

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ABSTRACT

The SpaceWire allows networks with arbitrary topology, ensures scalability to support various requirements in number of nodes, throughput and fault-tolerance. The article considers methodology for development of efficient SpaceWire interconnection topologies for distributed onboard data acquisition and control systems.

In data acquisition from many sources or for data distribution to multiple actuators and data sinks tree or fat tree network topologies look obvious. We consider other regular or near regular topologies – grids, torus, hypercube, cube connection cycle. SpaceWire network tolerance to faults of interconnection lines and routing switches, conditions for efficient using of different topologies to support reliability and throughput/latency characteristics improvement are considered.

Another problem for SpaceWire interconnections is efficient support of data flows from multiple low intensive sources. Data packet flows from primary sources, as well as flow of packets to nodes (e.g. application level or system management commands) may have low density. The SpaceWire links utilization could be very low, cabling and numerous routing switches to support many terminal nodes in interconnection could be excessive in implementation cost. To deal with this cost-efficiency problem for low throughput segments of SpaceWire networks daisy-chain topologies could be used efficiently.

Multiport SpaceWire terminal nodes application for daisy-chains implementation is considered. Summary data packet flow from such a chain could provide reasonable load for a routing switch port. In the article we estimate hardware costs and data packet delivery latency for hierarchical network structures with and without daisy-chains. Research results are corroborated by SpaceWire networks simulation.