Use of Fast Digital Interfaces on Satellites and Their Relationship with EMC Aspects

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The current and the next future scenario of the scientific satellites is characterized by an increasing design complexity in term of amount of mass memory, data throughput and on-board processing capabilities. Central Processing Units running at hundred of Megahertz are used as central core of Payload Computers and their high performance is able to acquire data coming from large detectors, process and transmit huge amount of data towards Flight Mass Memory Units for a temporary storage and finally to Earth. Fast digital interfaces are needed to implement this data flow and low voltage logic components (3.3 V logic level) are mandatory in order to reach speed of tenths or hundreds of Mbit/sec. Among the various possibilities the SpaceWire solution is the leading one, several reasons are behind this fact:

- SpaceWire is a leading data-handling network for use onboard spacecraft. It has already been used or selected to be used on many space missions (Herschel, GAIA, JWST, BEPI COLOMBO,…) and by many nations and international organizations (ESA, NASA, JAXA) and many European industries (and among them also CGS). SpaceWire development was initiated by ESA,
- SpaceWire is a digital I/F developed to connect sensors, mass-memories, processing units, downlink telemetry sub-systems of a generic spacecraft and possibly in the future mission it could be the unique digital I/F present on a spacecraft. Point to point connections but also arbitrary topology network based on SpaceWire routers are feasible,
- SpaceWire falls into an ESA standardization,
- The SpaceWire Interface can be easily accommodated into an ASIC or FPGA (IP cores are available) and space qualified components produced by an European Foundry are available, consequently an extended usage of this I/F also by small medium companies involved in the space market is easy to be conceivable,
- The use of the SpaceWire standard can ensure that equipment is compatible at both the component and sub-system levels. Processing units, mass-memory units and down-link telemetry systems using SpaceWire interfaces developed for one mission can be readily used for other missions or just with little modification (architectures based on building blocks) This means a reduction of the cost of project development, a reduction of the development schedule and an improvement of the design reliability and project confidence,
- ESA is also accompanying the deployment of SpaceWire networks by defining, in coordination with other organizations like NASA, JAXA and Roscosmos, higher level protocols aimed at further extending the capability of SpaceWire to build modular and easy to assemble on-board data systems.

The major SpaceWire electrical characteristics are: serial, low voltage differential signalling, high-speed (2 Mbits/sec to 200 Mbits/sec), bi-directional, full-duplex I/F. Currently no galvanic isolation (through means of signal transformer as in MIL-STD-1553B or Ethernet or optocoupler) is foreseen by the SpaceWire physical layer and consequently a theoretical lower immunity to EMC interferences w.r.t. for example a MIL-STD-1553B Interface is conceivable.
This seminar focuses on fast digital interfaces for Satellite applications and aims at providing an overview of the state of the art and the challenge related to SpaceWire solution. In particular, since high speed could be the source of EMC issues in a satellite, design considerations, preliminary analysis and future trends are presented for the mitigation of potential EMC problems.