



Signal and Data Processing Rack

Introduction

The Signal and Data Processing (SDP) Rack is one of the sub-systems in the radar network which provides resources for radar signal processing, data capturing and data recording with other radar control functions.

This Case Study highlights Mistral's expertise in the architecture and design of a custom hybrid system that supports two industry standard bus architectures VME and VPX, to meet the requirements of input /output signals, communication links, processing capability and data transfer capability.



“ This case study showcases Mistral's expertise in the architecture and design of a custom hybrid system that supports two industry standard bus architectures VME and VPX. ”

The Customer

A leading Defense Lab selected Mistral to design, build and integrate a system capable of functioning as a Signal and Data Processing (SDP) Rack.

The Requirement

The customer's requirement was to design and integrate a solution that met their overall functional/performance criteria and adhered to longevity, product life cycle management and integration norms.

- ▲ Mechanical design of the SDP Rack with structural and thermal analysis
 - The rack had to be housed in a sheltered space on a wheeled vehicle
 - The rack had to be mounted on shock mounts in an air conditioned shelter and an AC vent had to be provisioned on top of the SDP rack to allow circulation of conditioned air to the rack for cooling purposes
 - The rack had to be designed in compliance with JSS 55555 and MIL - STD 461 E and would be subjected to environmental and EMI/EMC tests, at the customer premises
- ▲ Design and Fabrication of the hybrid backplane (VPX and VME)
- ▲ Generation of Wiring Charts, Inter Connection Document (ICD) and providing cable harnesses as per the ICD
- ▲ The rack had to be equipped with:
 - Quad Power PC and Intel based processing system
 - Quad channel sFPDP module mounted on VPX board capable of communication using sFPDP protocol
 - VPX based Gigabit Ethernet Switch
 - Provision for Redundant Power Supply
 - Power Supplies for the entire rack. Circuit breakers and protection circuitry to be provided to prevent damage to the electronics housed in the rack
 - The rack had to be mounted with LEDs, to indicate the health of the power supplies and the fans.

Solution Provided

Mistral is a professional design services company with extensive experience in embedded hardware and software development for Mil-Aero applications. This capability, in conjunction with partnerships with leading embedded solution providers like Curtiss Wright Controls Defense Solutions and Wind River Systems, enabled Mistral to provide a complete solution to meet the customer expectations.

Mistral developed the SDP Rack, an air-cooled mechanical enclosure system comprising of the following components:

- ▶ Power PC based VPX processing cards
- ▶ Quad Channel sFPDP Module for sFPDP interface
- ▶ VPX based Data Recorder card
- ▶ VPX based Gigabit Ethernet Switch
- ▶ Intel Core 2 Duo based VME processing board
- ▶ Flash PMC module
- ▶ Two port Gigabit Ethernet PMC Module
- ▶ Custom Hybrid Backplane
- ▶ Serial to LAN converter
- ▶ Necessary Power Supplies

Backplane Chassis

The VPX based chassis consists of 6U VPX cards and VME cards. To accommodate this, the chassis was equipped with custom hybrid backplane, designed by Mistral and its solution partner adhering to VPX and VME standards. The backplane has 12 VPX slots and 2 VME slots.

Design Services and System Integration:

Mistral was involved in the design and development of the entire system from the initial phase of system architecting, to component selection, system engineering and validation. The solution offered included:

- ▶ System Design
 - System Study with report generation to ensure all the operational environmental conditions and performance requirements were met. This included the complete 3D computer modeling of the system, system power consumption calculations, system cooling calculations, system structural analysis, system thermal analysis and external/ internal cable harness
- ▶ Hardware Design
 - Design and development of:
 - Rugged Air cooled Rack
 - Hybrid Backplane having 12 VPX slots and 2 VME slots
 - Redundant Power supplies
 - Complete cable harness design
- ▶ Integration
 - Integration of all boards within the system; and establishing functional capabilities of base card, inter and intra-system communication, GigE network establishment, Inter Processor Communication with inter- and intra-system dependencies

- Integration and testing of COTS and custom designed hardware
- Integration of drivers, BSP and DSP libraries
- ▶ Verification and Validation
 - Design and validation of the rack for a high-power application, with thermal management.
 - Rugged systems adherence to ground based application - All boards supplied cater to the requirements of JSS 55555 and MIL - STD 461 E.

The Challenges

- ▶ Design and fabrication of 14-slot hybrid backplane comprising of VPX and VME bus architecture
- ▶ VPX backplane had to incorporate half mesh fabric connection while maintaining high level of signal integrity
- ▶ Conformance to environmental conditions including thermal management, structural rigidity, EMI/EMC conformance.

Key Achievements

- ▶ Complete integration of the COTS that used two industry standard bus architectures VPX and VME. The system was realized with two different operating platforms (Linux and VxWorks)
- ▶ Power ON sequencing, temperature monitoring and control inside the SDP Rack
- ▶ Establishing optical links for sFPDP, Fiber Channel and Gigabit Ethernet for external and internal network
- ▶ The integrated SDP rack was qualified i.e. EMI / EMC tests and environmental tests carried out as an integrated system instead of qualifying the individual sub-systems. System designed adhered to the requirements of JSS 55555 and MIL - STD 461 E Specifications.

Customer Benefits

- ▶ A multi-vendor selection of best-of-breed sub-systems was made available as an integrated system through a single system integrator; who not only provided the solution but would also provide support and maintenance for the coming years
- ▶ Shortened customer's end-to-end product development cycle and ensured on-time deployment schedule
- ▶ A fully integrated deployable solution, compliant with functional and environmental standards was made available.



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