Video Management Unit (VMU)

Rugged Video and Data Processor

Overview

The VMU is a generic COTS-based rugged video and data processor, originally developed as an upgrade for ESA's Fluid Science Lab (FSL) on ISS Columbus and designed to manage state-of-the-art scientific cameras and sensors.

The system contains a radiation tolerant space-grade commercial computer unit for system monitoring and management, and for interfacing to the payload host (Columbus / FSL in the case of FSL VMU MkII). These data interfaces are implemented via MIL-STD-1553B, optical TAXI and discrete lines. Gigabit Ethernet can be used instead.

Towards the scientific instruments, a multitude of standard and custom interfaces are provided: GigE, USB 2.0, LVDS, RS422 UART, RS232 UART, and bi-directional LVTTL/RS422 trigger lines.

A powerful Intel Core i7 based ruggedized industrial grade CompactPCI Serial computer is provided for interfacing the scientific instruments and performing data storage, compression, routing, on-line processing and offline processing. The system also provides TCL-based scripting facilities for effective scientific experiment run execution.

APPLICATIONS

High-performance scientific video and data acquisition with advanced synchronisation and time-tagging functionality, and custom data processing, storage and routing.

SERVICES AVAILABLE

Custom data acquisition and processing
Unit support
Unit customization

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2 TB of on-board storage is provided through an array of harddisks. Data downlink to ground is provided through an optical TAXI interface or via Gigabit Ethernet. The boards of the CompactPCI can easily be replaced by crew in case of failure. This mitigates the reliability concerns related to the use of industrial grade COTS boards.

The FSL VMU MkII system developed for FSL was customized at the level of power, data, thermal, and mechanical interfaces. Different configurations are possible. Changing the type of data interfaces is made easy though the use of the industry-standard CompactPCI Serial platform. Customization of the data handling and processing is made easy through the use of a Linux platform, with packetized software management.

In its initial configuration, power consumption is around 100W, weight around 23kg, and volume around 90,000cm^3. Options for a mass of 18kg and volume of 45,000cm^3 are available.

High performance Military-grade circular connectors are used throughout (except on the COTS boards), while integrated EMI/power filtering is designed to meet power input voltage, spikes, surges, transients, and EMI/EMC compatibility requirements of typical space deployments.

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The VMU allows for video and data management across operating temperature ranges, shock/vibration and radiation conditions representative of a deployment on ISS, and has been fully tested against launch conditions on Cygnus/SpaceX/HTV and operations conditions aboard ISS/Columbus. TRL of the system is 8. Launch of FSL VMU MkII is manifested on SpaceX-15 in June 2018.

Product Roadmap

Beyond the current configuration of the VMU, known as FSL VMU MkII, derived designs are expected to be developed for other ISS payloads. While the FSL VMU MkII follows the standard TC/TM paradigm, the use of direct TCP/IP connectivity to the VMU can be easily implemented for a more powerful and flexible operation of the VMU.

Applications

The VMU is specifically designed for the data and video management of scientific payloads needing high data rates and complex processing. Its modular design and use of industry-grade COTS frontends allows for customization at the level of interfaces and functionality at minimal cost.

Features

- MIL-STD-1553B interface for TC/TM, time distribution, file transfer, and RT/RT transfer.
- Optical 32 Mbps TAXI interface for High Rate Data transfer.
- Tailoring of the capabilities and functions needs by the targeted mission and spacecraft
- Possibility of Gigabit Ethernet interface for TC/TM, time distribution, file transfer, and high rate science data transfer.
- External monitoring and control via 5V bi-level status/command and thermistors.
- 3 Gigabit Ethernet interfaces for scientific instruments, 1 for connection to on-board Laptop.

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- Control and acquisition of up to 3 GigE Vision 1.1/2.0 cameras.
- 2 USB 2.0 interfaces.
- 1 Mbps RS422 UART interface for TC/TM and data transfer with experiment.
- Bi-directional RS422 and LVTTL triggering with software-configurable behaviour.
- Proprietary LVDS/RS232 interface for Thermoteknix 640FF thermal camera.
- Legacy LVDS/RS422 interface for Kodak ES1.0 digital cameras.
- Legacy interface for NTSC analogue cameras.
- 2 TB of harddisk-based storage (size and RAID configuration van be customized).
- Data handling: complex operations scenarios involving storage, replay, downlink, Crew visualisation, compression, online processing, offline processing.
- Compression: JPEG, PNG, H.264, frame dropping, region-of-interest, scaling, custom data processing via customer-provided software.
- Designed to meet ISS internal environmental conditions (shock, vibration, radiation, temperature).
- Designed to meet MIL-STD-461F EMI/EMC (conducted & radiated emissions & susceptibility) and to survive to typical power input and transients.
- Multi-threaded software architecture on 64bit Linux operating system with packaged software management.
- High-performance Military grade circular connectors.

Reliability:

- MTBF of core system (excluding Crew-replaceable industrial grade boards): 243000h (Calculated per MIL-HDBK-217F).

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