

A NETWORK BASED DISTRIBUTED REAL TIME COMPUTER TELEMETRY SYSTEM

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ABSTRACT

A real time distributed computer telemetry system based on network is described. It is a new generation of open telemetry system in China, which can parallel acquire and process up to 8 data streams of 100bps~3.5Mbps and optimize automatically distribution of processing tasks by using load-balance technique. PCM PSK QPSK PACM may be suitable to the system and the format switched within less than 1 second. The system has been successfully used in the field of aerospace. There are models of automobile, shipboard, airborne as well as ground station for the system. This paper discusses mainly system architecture, performance, principle, and system features.

KEY WORDS

Telemetry Computer System, Open System, Network, Real Time

INTRODUCTION

The System being an open architecture is a distributed real time telemetry data processing system based on network. It can connect multi-telemetry acquisition & processing subsystems and telemetry application workstations to construct a telemetry data real time distributed network computing environment. The system is consisted of high speed real time record equipment, standard network interface, data communication interface and many analog/digital data output channel, which provides convenient, high speed, flexible, telemetry data service for user in real time. Telemetry data acquisition and processing subsystem which has a data driven architecture, can parallel input, process and output multi-stream telemetry data. The system is compatible of multiple telemetry transmission systems, and can be widely used in telemetry applications area. The following table lists the key specifications in the largest scale of system.

Main items	Specification
The number of input stream	Up to 8
PCM bit rate (per stream)	100bps~ 3.5Mbps
Programmable telemetry format	IRIG106-86
CCSDS packet telemetry	Expandable
Telemetry format switch time	< 1 sec.
Data decryption in real time	Yes
HDBus word wide	Data 32bit, Tag 16bit
The number of data processor	Up to 4
HDBus throughput rate	10MW/S
Real time processing parameters	>1500
System real time processing rate	800KW/S
Real time data storage rate	5Mbps
Curve recorder output parameters	128
Mutil-processor load allocation	Automatically optimized
System network environment	Ethernet, TCP/IP, NFS
Application workstation	UNIX, X-Windows, GUI, Multi-Windows graphic workstation

SYSTEM ARCHITECTURE

The system based on distributed parallel processing architecture implements the telemetry data demodulation, processing, and display in real time. The system (see Fig. 1) is consisted of the telemetry acquisition & processing subsystem (telemetry front end) which is a specific telemetry real time computer system based on data driven principle, and the telemetry application workstations. Telemetry front end completes multi-stream synchronous, demodulation, decoding, processing, storage, recording, output and distribution. Telemetry application workstation connecting with telemetry front end by a standard local area network, implements telemetry parameters display, handling & communication, and data analysis offline. The number of telemetry front end and telemetry application workstation can be configured flexibly

according to the system scale. The dual-node network system is constructed with one single-stream telemetry front end and one telemetry workstation, The multi-node distributed network system is constructed with multiple telemetry front ends and multiple workstations. The telemetry front end and the workstation are connected by a standard Ethernet network. TCP/IP network transmission protocol is used to support the heterogeneous computers network interconnect.

Telemetry front end subsystem, which is a dual-buses data driven architecture (see Fig. 2), acquires, demodulates, processes multi-stream in real time, and output data through multi-ports. The high speed telemetry data bus (HDBus) supports data driven principle. The data/tag transmits among the input processors, data processors and output adapters with broadcasting mode. The input processor accomplishes data serial/parallel conversion and sends data to bus with a tag, and the data processors and output adapters are activated by data/tag, that is data driven mode. The ability of system parallel processing and parallel output are highly improved, since system central management and scheduling are not needed, There are integrated and family products, system functions and modules can be configured, cut out and expanded.

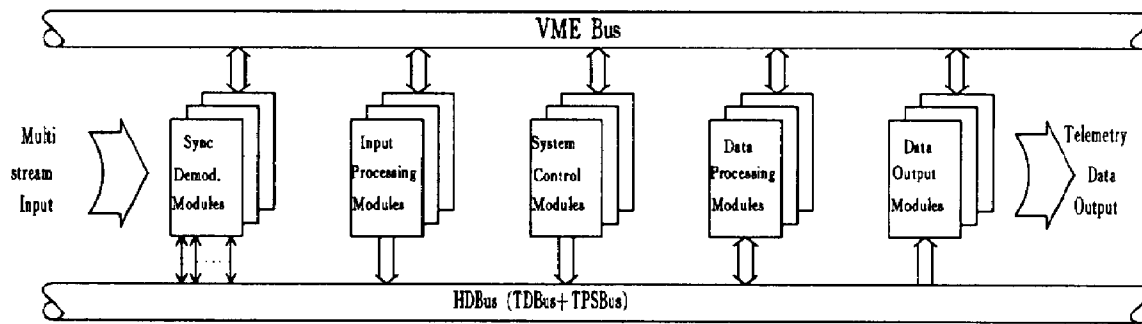


Fig. 2 Acquisition & Processing Subsystem Basic Architecture

Telemetry application workstation is consisted of several graphic workstations. Multi-users, multi-windows and many types of data quick-look and part data processing can be implemented, and system supervision and offline telemetry data processing is accomplished at the same time. In real time, the telemetry front end selects data from data stream and forms data packet to send to network at regular time intervals. Each telemetry application workstation receives data packet to process and display the data needed. The operating system of graphic workstation is UNIX, the GUI technique is used in telemetry system software development based on X-Windows. User graphic interface is convenient, audio-visual. There is a set of offline data processing software including backup storage, data search, data quality check, data processing, data table output, curve output and etc. The hardware platform of a telemetry application workstation can selected microcomputer, workstation or server from different vendors.

TELEMETRY ACQUISITION & PROCESSING SUBSYSTEM

There are two system buses, one is an open industrial standard VME bus, the other is a special data connection bus (HDBus), see Fig. 3. The system administrative bus (VME Bus) have three functions: the first is setup modules, real time control and diagnosis, the second is to support real time data storage, processing and network transmission, the third is to expand system by using OEM function module. The high speed telemetry data interconnect bus (HDBus) is consisted of two subbuses: TDS bus and TPS bus. TDS connects the multi-stream demodulation function modules. TPS bus is a high-speed parallel data bus supporting the data driven operation mode, which includes 32bits data and 16bits tag. The data/tag is sent to bus in broadcast transfer mode. Up to 16 master modules can simultaneously operate on the bus. The bus throughput rate can reach 10MW/s.

The demodulation functional modules includes PCM bit synchronizer, PACM demodulator, data decryptor, format demodulator and simulator. The system can demodulate multi-stream with multiple modules. It is compatible with other transmission system, such as PACM, FSK and PSK/QPSK by expanding corresponding modules. The decoder/decrypter is optional module, can complete Viterbi decoding, RS decoding and data decryption. Frame synchronization and subframe synchronization can be accomplished by format demodulator and telemetry format switching function is optional.

The input processing modules implement data interface from telemetry stream to two system buses. The demodulated data are parallel sent to HDBus with a tag, and telemetry data is stored, processed and output in real time by system controller and VME bus output modules, There are different data input processing modules for different telemetry standard, for example, IRIG106-86 input processor,CCSDS packet processor and 1553B input processor. The bus server receives IRIG-B time code translated by time code generator and sends it to HDBus accompanying a special tag.

The system control modules include system controller and bus server. The bus server is responsible for the TDS integrated parallel arbitrating. The system controller being the master controller of VME bus is responsible for system operation control and management and telemetry data processing in real time. The system can supports external storage medium, such as magnetic disk, optical disk, tape recorder using standard SCSI interface. Multi-stream data can be stored in real time by multi-disk parallel real time storage technique.

The data processing modules include data processor and bus bridge. Data processor is responsible for parallel data processing in real time, being provided with

4 data processors mostly. The data processed is allocated to new tag and sent to TPS. Bidirectional data exchange is processed by bus bridge, which is responsible for data selection and format reformation and data buffer.

The system provides for standard network interface, high speed communication interface, storage interface, many analog and digital output channel. The number of and kind of output module is optional by user according to the system scale and requirement, such as multi-channels curve recorder interface, D/A interface supporting analog display, recording and processing, network interface controller supporting network data communication, high speed DMA output channel, and other types of expandable output interfaces, etc.

The system software real time environment is VMEexec V2. 0, The software operation reliability is improved by embedded software technique. The system software includes the system management software and the parallel processing support software by using multi-processor. The public menu interface is used in the system management software, so it can be accomplished to maintain the telemetry system operation parameter, module setup and operating information and system automatic fault diagnostics. In real time, telemetry data storage, network data transmission and system operation supervisory are accomplished at the same time. The parallel processing support software is composed of parameter data base, task distribution, switch and load tools, and data processing algorithm library. Processing requirement can be defined by user, subsequent task is completed automatically and the system goes into real time state. Task distribution, switch and load tools distribute tasks to every processor with optimum load balance rule.

SYSTEM FEATURES

(1) Distributed processing architecture. The system provides two levels of distributed data processing platform, one is distributed network operating environment consisting of telemetry front end and multiplex telemetry application workstations based on standard LAN, the other is multi-operation components based on two system buses, which parallel process data via multi-processor and output data via multi-ports in real time.

(2) Supporting multi-stream telemetry. Due to the advanced data driven architecture, the system supports multiplex streams to share the processing and output equipments, so that get a higher performance-cost ratio.

(3) Open system architecture. The international standards to be used include, VMEbus, Ethernet, UNIX operating system, TCP/IP protocol, IRIG telemetry

standard, CCSDS packet telemetry recommendation, SCSI-2 Bus, X-Windows, NFS and etc.

(4) Good flexibility and expansion. System configuration is flexible and expandable, because of two levels of system integration environment. The application system can be expanded in system level based on bus and in module level based on network, so that can be used in widely telemetry fields.

(5) General purpose and compatibility. It is compatible with different telemetry systems, and provides with many data demodulation and processing functions, such as channel decoding, data decryption and automatic telemetry format switching in real time.

CONCLUSION

This paper describes a new generation of distributed network telemetry computer system based on an open system architecture, this system that has been provided for vehicle station, shipboard station and ground station has been widely used in aircraft, rocket, satellite, industrial measurement and control fields in China.

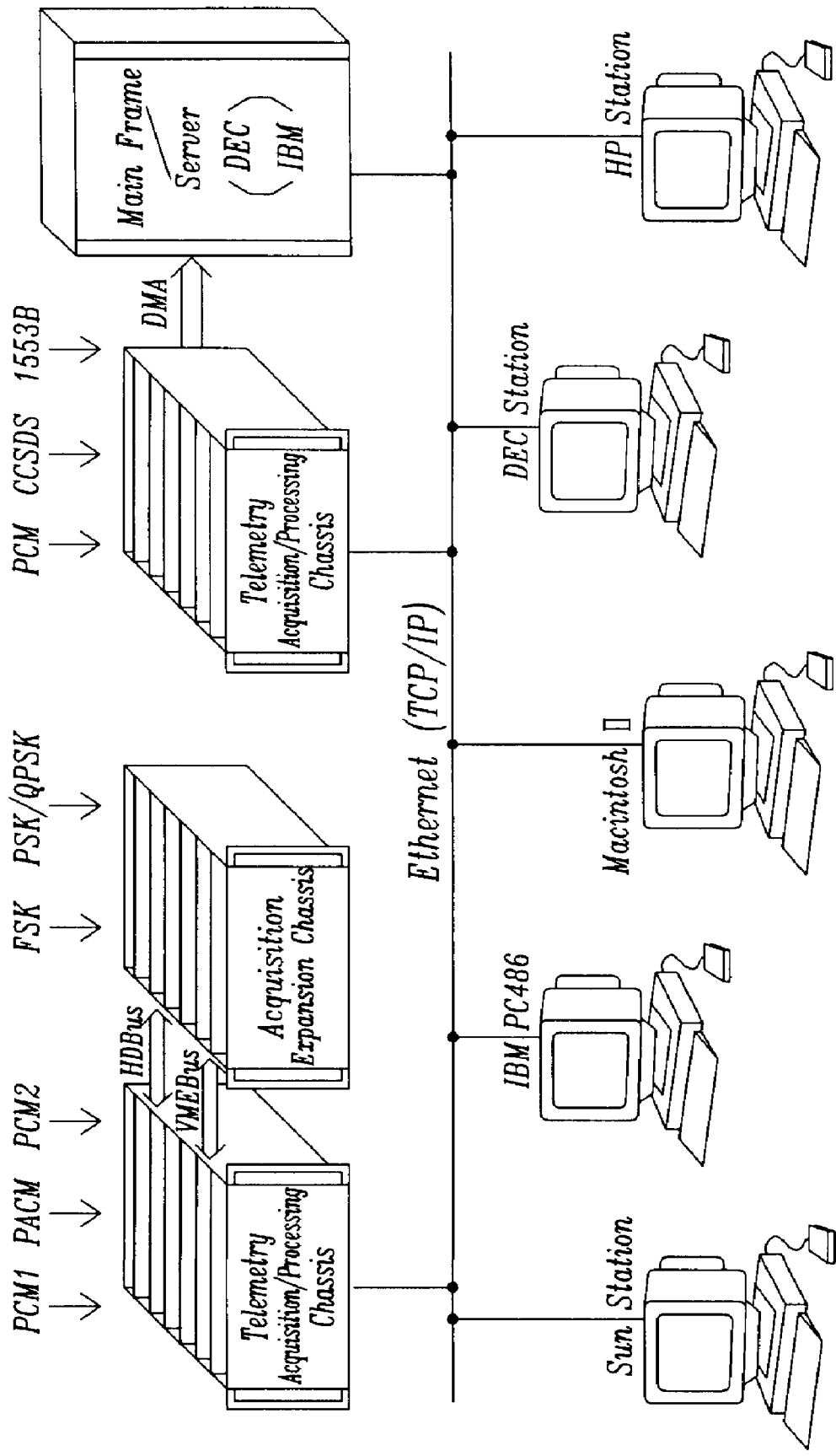


Fig.1 Distributed Real-time Computer Telemetry System Architecture

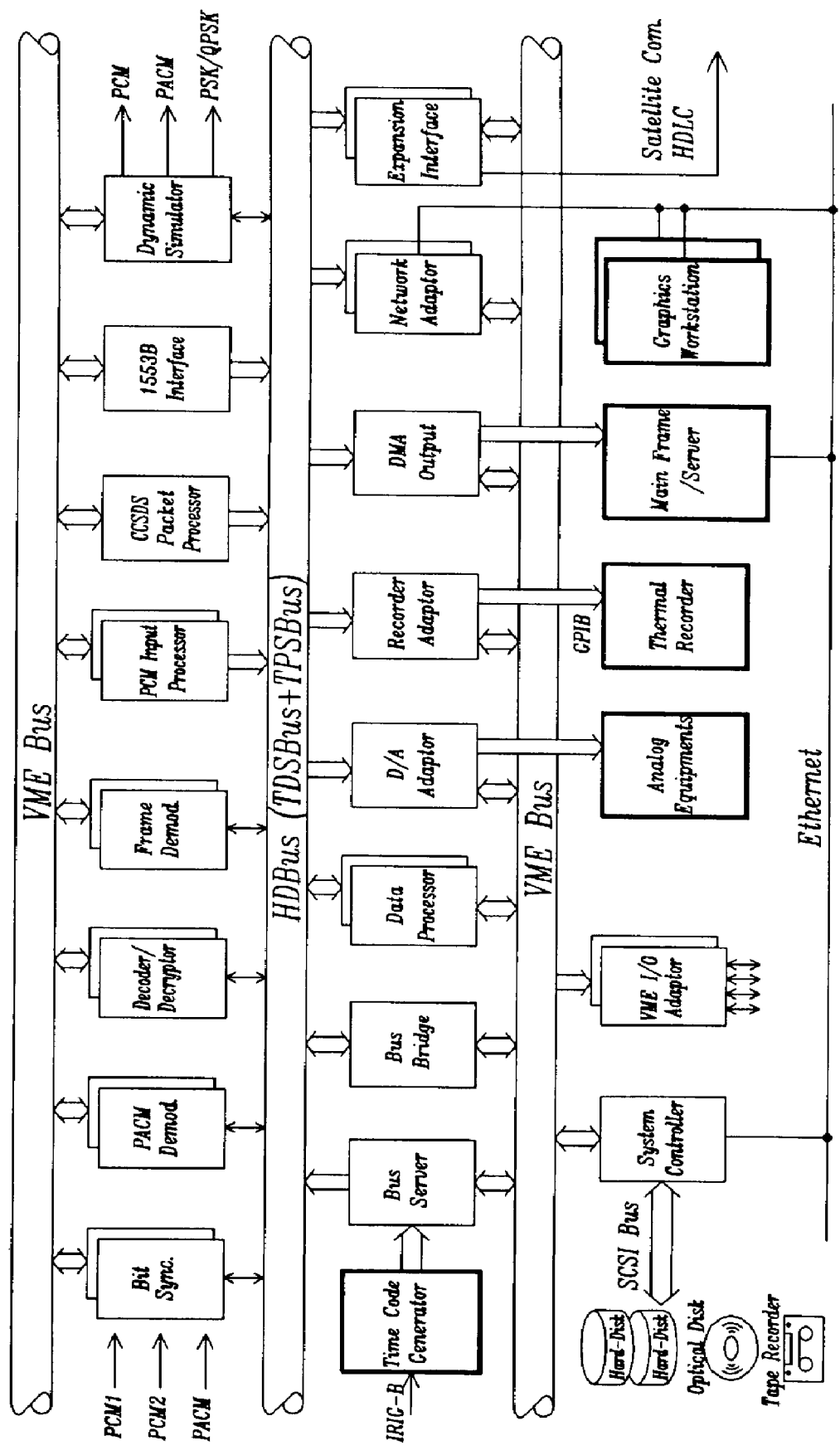


Fig.3 Telemetry Acquisition & Processing Subsystem Function Principle