DATAC BUS MONITOR

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INTRODUCTION

The Digital Autonomous Terminal Access Communications (DATAC) bus is a multiple transmitter data bus developed by the Boeing Company to interconnect various aircraft systems. Figure 1 shows a typical DATAC bus installation for the NASA B-737 aircraft. Essentially a local-area network for use aboard airliners, it uses Carrier-Sense, Multiple Access with Collision Detection (CSMA/CD) protocol. This means that operation of the bus relies on each system that uses a certain set of rules when it "broadcasts" a message via the bus. In the simplest mode of operation, each system listens to determine if the bus is currently in use. If no bus activity is detected, each system enables a counter with a unique value. The first counter to reach its terminal value assumes the right to broadcast over the bus and transmits its data. When the other terminals detect this bus activity, even if their respective timers are active, their timers are reset and are disabled until bus inactivity is again detected. When the current broadcasting system has concluded its transmission, its timer is disabled until all other systems have broadcast. This ensures that one system will not monopolize the bus. The system with the next shortest terminal count will expire next, and it will access the bus. The process is repeated until all systems have had the opportunity to transmit. After all stations have transmitted their messages, the process repeats itself.

A liability of this autonomous protocol is that it is not possible to interrogate a specific subsystem to determine its current operating condition. This would be particularly useful during bus development and testing. Should problems arise with a DATAC system, it would be useful to have a system which would enable an operator to identify which systems are using the bus and the data that they are transmitting. Having an independent means to monitor bus transactions would help in locating problem areas on the bus.

BUS MONITOR UNIT DEVELOPMENT

A bus monitor unit has been developed for the DATAC data bus. The bus monitor unit consists of two systems: a Zilog Z8002-based S100 bus microcomputer system that connects to a DATAC terminal and receives data appearing on the bus, and an IBM PC-compatible computer used to display and interpret that data. The bus monitor unit configuration is shown in figure 2. The Z8002 system receives data from the DATAC terminal by way of a ZBUS-to-S100 interface. The DATAC terminal presents data using the Zilog ZBUS component interconnect specification. The interface circuit translates the ZBUS data transfer signals to their S100 counterparts, allowing the bus terminal to deposit data into the Z8002 systems Random Access Memory (RAM) using a Direct Memory Access (DMA) type operation. Once the data has been received and identified by the Z8002 system, it is transmitted to via a 9600 bits-per-second RS-232C serial data link to the MS-DOS system, which can analyze, display, and store the data.

This bus monitor unit is able to process a maximum of 24 words of data during the 50 milliseconds data repetition rate of the Mode A operation and a maximum of four words during the 10 milliseconds repetition rate of Mode C. The total number of words possible during either the 50 or 10 milliseconds repetition rates is contingent upon the number of systems that are using the bus, but it is possible to estimate the maximum number of words appearing on the system by dividing the frame repetition rate by 20 microseconds to transmit a word across the bus. For example, 50 milliseconds per frame divided by 20 microseconds per word would yield 2,500 words per 50 milliseconds frame. This is a high estimate, since the label words used by each bus system take 24 microseconds themselves to transmit and be processed.

The limiting factor in processing the data is the relative slowness of the serial data link between the Z8002 and MS-DOS systems. The serial link was chosen because a CP/M computer with a closed architecture was originally chosen to serve as the console device for the S100 system. Because of its closed architecture, RS-232 was the only way to transmit data between the two systems. The CP/M system failed and was replaced by the MS-DOS system. Rather than redesign major parts of the system to accommodate a faster link between the two systems, the bus monitor unit was completed using RS-232 and then evaluated.

CONCLUSIONS AND RECOMMENDATIONS

Because of the general nature of the bus monitor unit, it is desirable to process large amounts of data in real time. Test results of the existing bus monitor have indicated areas for improvement. The most obvious improvement is to increase the speed of the data transfers between the S100 and MS-DOS systems. This could be achieved by using a bidirectional 16-bit port between the two computers. Such a port would improve the data transfer rate by nearly an order of magnitude. An expensive but more flexible approach would be to revise the design of the system to incorporate the Z8002 system into the MS-DOS system enclosure. The SS-62 bus used by most IBM PC-compatible computers provides several DMA channels which would be used for even higher-speed data transfers between the S100 and MS-DOS systems. This approach simplifies the overall system design by consolidating the entire unit into a single chassis with a single power supply and one set of support peripherals. The high throughput available with a DMA-type transfer could make real-time analysis and reconstitution of large amounts of data possible, a highly desirable feature for the bus monitor unit.

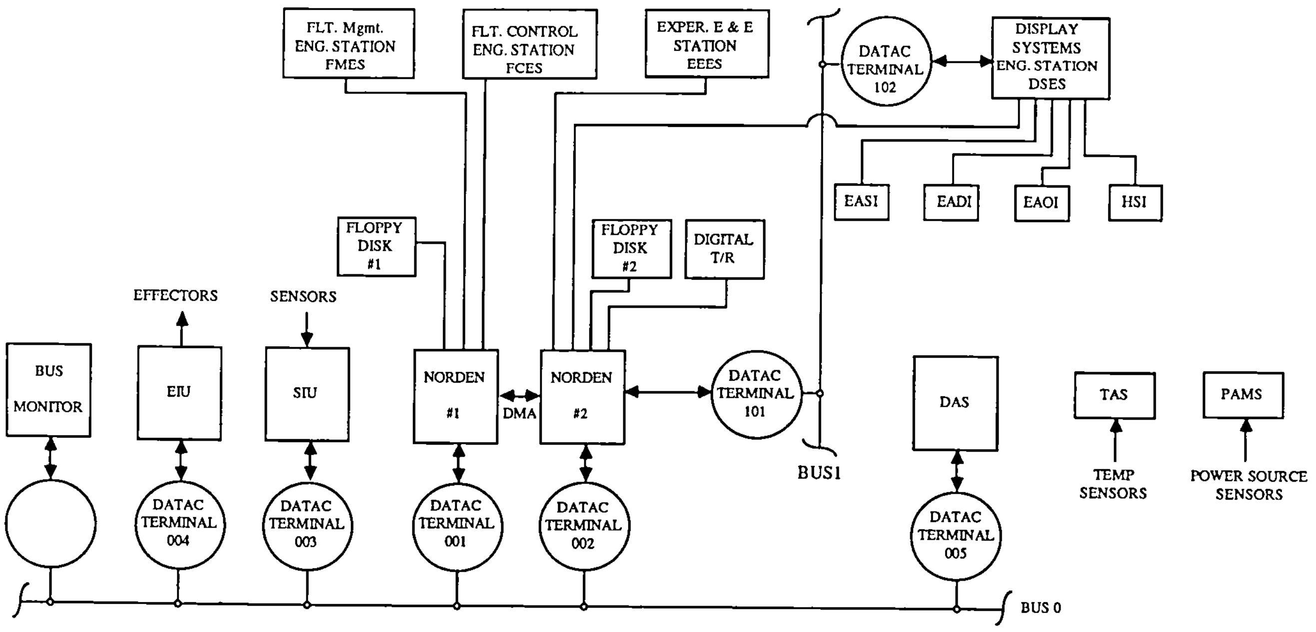

Figure 1. Typical DATAC bus installation for the NASA B-737 aircraft.

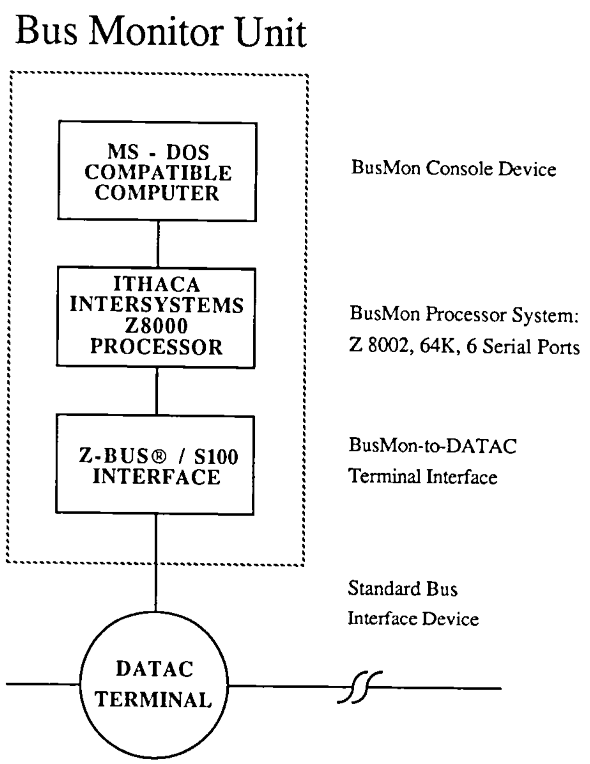

Figure 2. DATAC bus monitor unit configuration.