The primary purpose of the 1553 data bus is to provide a common medium for the exchange of data between systems and sub-systems on the 1553 data bus in the form of message transmissions. The 1553 standard defines different types of message transmission formats based on three word types: command words, data words, and status words. The 1553 standard also defines the criteria for the validation of message transmissions, such as valid sync, Manchester encoding, number of bits, odd parity, *etc.* The 1553 standard, however, does not validate the data being transmitted, which is the responsibility of each of the sub-systems connected to the 1553 data bus.

This responsibility may be provided by data guards that lie directly between an endpoint of a 1553 data bus system and the other sub-systems on the 1553 data bus system. However, if a data guard is always active for a remote terminal, this will create latency concerns in the 1553 data bus system (because of the additional response time required for a remote terminal to transmit its status word in response to a command word from a BC) and may be too restrictive for normal operations and only considered acceptable in the presence of known or suspected threats. Accordingly, there is a need for a data guard compatible with a 1553 data bus system that can be initialized and activated at any point in its operational lifecycle and that may be deactivated and reactivated at will by an operator of the 1553 data bus system.

SUMMARY

An aspect of the disclosure provides a data guard system for use with a MIL-STD-1553 data bus. The data guard system includes a first coupler, a second coupler, a third coupler, a first switch communicatively coupled to the third coupler, a second switch communicatively coupled to the first switch via the first coupler, a guarded bus, and a data guard communicatively coupled to the second coupler. The guarded bus is in signal communication with the second coupler and the second switch. The data guard includes a first 1553

controller, a filter, a plurality of memory blocks, a microprocessor, a second 1553 controller, and a third 1553 controller. The first 1553 controller is in signal communication with the second coupler. The filter includes a plurality of pre-defined data rule sets configured to be applied to data traffic messages received from the MIL-STD-1553 data bus. The plurality of memory blocks are directly accessible to the first 1553 controller. The microprocessor is in signal communication with the first switch, the second switch, the first 1553 controller, and the filter. A plurality of data traffic messages from a remote terminal (RT) connected to the second switch is, responsive to the data guard system being in an active mode, directed by the second switch onto the guarded bus and then to the second coupler. A data traffic message of the plurality of data traffic messages is compared against the plurality of pre-defined data rule sets to determine whether the data traffic message matches at least one data rule of the pre-defined data rule sets. The second 1553 controller is in signal communication with the second coupler. The third 1553 controller is in signal communication with the second coupler. The second 1553 controller and the third 1553 controller are configured to send data messages from the guarded bus directly into memory blocks of the plurality of memory blocks of the data guard and receive data messages directly from memory blocks of the plurality of memory blocks as directed by the microprocessor.

Another aspect of the disclosure provides a method of validating data traffic on an MIL-STD-1553 data bus with a data guard toggleable into an active mode and a passive mode. The method includes receiving data traffic from the MIL-STD-1553 data bus in signal communication with the data guard, and directing the data traffic onto a transparent bus or a guarded bus of the data guard using a first switch and a second switch. Responsive to the received data traffic being directed onto the guarded bus, the method includes accessing a data rule set from a computer file stored on a computer-

readable medium stored on a data guard, wherein the data rule set includes a plurality of pre-defined sub-rules, comparing the data traffic from the MIL-STD-1553 data bus against each of the pre-defined sub-rules of the data rule set, and determining whether the data traffic matches any one of the plurality of pre-defined sub-rules of the data rule set. The method further includes configuring the data guard using a graphical user interface tool that allows a system administrator to pre-generate the data rule sets of a filter of the data guard and to associate one or more remote terminals with the data guard.

Another aspect of the present disclosure provides a data guard configured to evaluate and authenticate data traffic on an MIL-STD-1553 data bus. The data guard includes a first coupler, a second coupler, a third coupler, a first switch, a second switch, a guarded bus, a first 1553 controller, a filter a plurality of memory blocks, a microprocessor, a second 1553 controller, and a third 1553 controller. The guarded bus is in signal communication with the second coupler and the second switch. The first 1553 controller is in signal communication with the second coupler. The filter includes a plurality of pre-defined data rule sets configured to be applied to data traffic messages received from the MIL-STD-1553 data bus. The plurality of memory blocks are directly accessible to the first 1553 controller. The microprocessor is in signal communication with first switch, the second switch, the first 1553 controller, and the filter. A plurality of data traffic messages from a remote terminal in signal communication with the second switch is, responsive to the data guard being in an active mode, directed by the second switch onto the guarded bus and then to the second coupler. A data traffic message of the plurality of data traffic messages is compared against the plurality of pre-defined data rule sets to determine if the data traffic message matches at least one of the pre-defined data rule sets. The second 1553 controller is in signal communication with the second coupler. The third 1553 controller is in signal

communication with the second coupler. The second 1553 controller and the third 1553 controller are configured to send data messages from the guarded bus directly into memory blocks of the plurality of memory blocks of the data guard and receive data messages directly from memory blocks of the plurality of memory blocks as directed by the microprocessor.

A data guard system for use with an MIL-STD-1553 data bus ("1553 data bus") is disclosed. The data guard system includes two switches, three couplers, a transparent bus, a guarded bus, and a data guard device, wherein the data guard device may be connected to the main bus of the 1553 data bus through the transparent bus and the guarded bus using the couplers. Using the two switches, the data guard system may be toggled between a passive mode and an active mode.

CLAIMS

1. A data guard system for use with a MIL-STD-1553 data bus, the data guard system comprising:

a first coupler;

a second coupler;

a third coupler;

a first switch communicatively coupled to the third coupler;

a second switch communicatively coupled to the first switch via the first coupler;

a guarded bus in signal communication with the second coupler and the second switch; and

a data guard communicatively coupled to the second coupler, the data guard comprising:

a first 1553 controller in signal communication with the second coupler;

a filter that includes a plurality of pre-defined data rule sets configured to be applied to data traffic messages received from the MIL-STD-1553 data bus;

a plurality of memory blocks directly accessible to the first 1553 controller;

a microprocessor in signal communication with the first switch, the second switch, the first 1553 controller, and the filter, wherein a plurality of data traffic messages from a remote terminal (RT) connected to the second switch is, responsive to the data guard system being in an active mode, directed by the second switch onto the guarded bus and then to the second coupler, and wherein a data traffic message of the plurality of data traffic messages is compared against the plurality of pre-defined data rule sets to determine whether the data traffic message matches at least one data rule of the pre-defined data rule sets; and

a second 1553 controller in signal communication with the second coupler; and

a third 1553 controller in signal communication with the second coupler, wherein the second 1553 controller and the third 1553 controller are configured to send data messages from the guarded bus directly into memory blocks of the plurality of memory blocks of the data guard and receive data messages directly from memory blocks of the plurality of memory blocks as directed by the microprocessor.

2. The data guard system of claim 1, further comprising:

a transparent bus in signal communication with the first switch, the second switch, the first coupler, and the third coupler, wherein the plurality of data traffic messages from the remote terminal, using the second switch, are directed onto the transparent bus responsive to the data guard system being in a passive mode, the plurality of data traffic messages sent to the transparent bus via the third coupler using the first switch, wherein data traffic from the remote terminal is sent by way of the first coupler to the MIL-STD-1553 data bus.

3. The data guard system of claim 2, wherein

the data guard system is toggled between the active mode and the passive mode by signals received from a bus controller of the data guard system.

4. The data guard system of claim 3, further comprising:

a first stub cable connecting the bus repeater with a fourth coupler; and

a second stub cable connecting the fourth coupler with a monitor terminal, wherein the monitor terminal is configured to act as a bus monitor for the data guard system and extract selected information from the data guard.

5. The data guard system of any one of claims 3-4, further comprising:

a triaxial connector in signal communication with the second switch;

a stub cable in signal communication with the triaxial connector; and

an RT connected to the stub cable.

6. The data guard system of any one of claims 3-5, further comprising a graphical user interface (GUI) tool that allows a system administrator to configure data guards of the data guard system and the data rule sets of the filter of the data guards.

7. The data guard system of any one of claims 1-2, wherein the first coupler comprises a first transformer coupler, wherein the second coupler comprises a second transformer coupler, and wherein the third coupler comprises a third transformer coupler.

8. The data guard system of claim 1, wherein the data guard is configured to transmit the data traffic message to the first coupler responsive to the data traffic message matching the at least one data rule of the pre-defined data rule sets.

9. The data guard system of claim 1, wherein the data guard further comprises:

a fourth 1553 controller in signal communication with the third coupler;

wherein the fourth 1553 controller is configured to send data messages directly from the MIL-STD-1553 data bus by way of the third coupler to memory blocks of the plurality of memory blocks of the data guard and to send data messages directly from the memory blocks of the plurality of memory blocks of the data guard to the MIL-STD-1553 data bus by way of the third coupler as directed by the microprocessor.

10. The data guard system of any one of claims 1, 2, or 7, further comprising a bus repeater in signal communication with the first coupler, wherein the bus repeater is inserted into the MIL-STD-1553 data bus.

11. The data guard system of claim 10, wherein a protected payload RT is connected to the data guard by way of a triaxial connector connected to the second switch.

12. The data guard system of claim 11, wherein the protected payload RT includes one or more associated RTs that are protected by the data guard.

13. A method of validating data traffic on an MIL-STD-1553 data bus with a data guard toggleable into an active mode and a passive mode, the method comprising:

receiving data traffic from the MIL-STD-1553 data bus in signal communication with the data guard;

directing the data traffic onto a transparent bus or a guarded bus of the data guard using a first switch and a second switch;

responsive to the data traffic being directed onto the guarded bus:

accessing a data rule set from a computer file stored on a computer-readable medium stored on a data guard, wherein the data rule set includes a plurality of pre-defined sub-rules;

comparing the data traffic from the MIL-STD-1553 data bus against each of the pre-defined sub-rules of the data rule set; and

determining whether the data traffic matches any one of the plurality of pre-defined sub-rules of the data rule set; and

configuring the data guard using a graphical user interface tool that allows a system administrator to pre-generate the data rule sets of a filter of the data guard and to associate one or more remote terminals with the data guard.

14. The method of claim 13, further comprising, responsive to the data traffic being directed onto the transparent bus, directing the data traffic back onto the MIL-STD-1553 data bus.

15. The method of claim 14, further comprising:

responsive to a determination that the data traffic matches any one of the plurality of pre-defined sub-rules of the data rule set, directing the data traffic to an original destination.

16. The method of claim 15, further comprising:

responsive to a determination that the data traffic does not match any one of the plurality of pre-defined sub-rules of the data rule set,

analyzing the data traffic that has been determined to be a mismatch in relation to the data rule set,

blocking the data traffic from passing through the data guard, and

notifying a user of a violation of a pre-defined sub-rule of the data rule set.

17. The method of claim 16, further including comprising toggling the data guard between an active mode wherein the data traffic is compared against each of the pre-defined sub-rules of the data rule set and a passive mode wherein the data traffic bypasses the data guard.

18. The method of claim 13, wherein the data guard comprises a first transformer coupler, a second transformer coupler, and a third transformer coupler.

19. A data guard configured to evaluate and authenticate data traffic on an MIL-STD-1553 data bus, the data guard comprising:

a first coupler;

a second coupler;

a third coupler;

a first switch;

a second switch;

a guarded bus in signal communication with the second coupler and the second switch;

a first 1553 controller in signal communication with the second coupler;

a filter that includes a plurality of pre-defined data rule sets configured to be applied to data traffic messages received from the MIL-STD-1553 data bus;

a plurality of memory blocks directly accessible to the first 1553 controller; and

a microprocessor in signal communication with first switch, the second switch, the first 1553 controller, and the filter wherein a plurality of data traffic messages from a remote terminal in signal communication with the second switch is, responsive to the data guard being in an active mode, directed by the second switch onto the guarded bus and then to the second coupler, and wherein a data traffic message of the plurality of data traffic messages is compared against the plurality of pre-defined data rule sets to determine whether the data traffic message matches at least one of the pre-defined data rule sets;

a second 1553 controller in signal communication with the second coupler; and

a third 1553 controller in signal communication with the second coupler, wherein the second 1553 controller and the third 1553 controller are configured to send data messages from

the guarded bus directly into memory blocks of the plurality of memory blocks of the data guard and receive data messages directly from memory blocks of the plurality of memory blocks as directed by the microprocessor.

20. The data guard of claim 19, wherein the data guard is toggled to a passive mode by signals sent to the first switch and the second switch by a bus controller on the MIL-STD-1553 data bus.