CLAIMS

1. A computer program product for performing an input/output (I/O) operation initiated by an I/O operation instruction at a host computer system configured for communication with a control unit, the computer program product comprising:

a tangible storage medium readable by a processing circuit and storing instructions for execution by the processing circuit for performing a method comprising:

sending, by a channel subsystem in the host computer system, a process login (PRLI) request message to the control unit to initialize a link between the channel subsystem and the control unit, the PRLI request message including a field having a value that indicates whether the channel subsystem supports bi-directional data transfer;

receiving a PRLI response message from the control unit, the PRLI response message including a field having a value that indicates whether the control unit supports bi-directional data transfer;

providing an indication to a host operating system that bi-directional data transfer is supported; and

responsive to executing the I/O operation instruction received from the host computer system, performing a method comprising:

gathering a plurality of commands associated with the I/O operation instruction received from the host computer system, at least one of the plurality of commands specifying an input data transfer and at least one of the plurality of commands specifying an output data transfer;

transferring the plurality of commands to the control unit;

sending at least one output data message to the control unit including output data to be transferred to the control unit, the output data message associated with the at least one of the plurality of commands specifying an output data transfer; and

receiving at least one input message from the control unit including input data to be stored in a main storage of the host computer system, the input data message associated with the at least one of the plurality of commands specifying an input data transfer.

2. The computer program product of claim 1, wherein the plurality of commands are a plurality of device command words (DCW) that each is associated with an I/O command;

and gathering includes obtaining a transport command word (TCW) at the channel subsystem in the host computer system for the I/O operation, the TCW including a transport command control block (TCCB) address field including an address of a TCCB in the main storage of the host computer system, the TCCB including the plurality of DCWs, at least one of the DCWs specifying an input data transfer and at least one of the DCWs specifying an output data transfer.

3. The computer program product of claim 2, wherein transferring the plurality of commands includes transferring the TCCB including the plurality of DCWs to the control unit.

4. The computer program product of claim 3, wherein the indication is configured to specify whether a first-transfer-ready disabled condition is in effect, and the method further comprises:

responsive to the first-transfer-ready disabled condition being in effect, sending the at least one output data message to the control unit following transfer of the TCCB and prior to receiving at least one message from the control unit; and

responsive to the first-transfer-ready disabled condition not being in effect, receiving the at least one message from the control unit prior to sending the at least one output data message.

5. The computer program product of claim 4 wherein the message from the control unit includes one of a transfer-ready message requesting that the channel subsystem send output data and the input data message.

6. The computer program product of claim 2, wherein the TCCB is included in a transport command information unit (IU) sent to the control unit, the transport command IU including a transport command header (TCH), the TCH including a field that indicates whether the channel subsystem is requesting bi-directional data transfer.

7. The computer program product of claim 6, wherein the TCCB includes a write data length (DL) field specifying an amount of output data to be transferred and a bi-directional read data length (BRDL) field specifying an amount of input data to be transferred.

8. The computer program product of claim 7, wherein the method further comprises, responsive to the control unit not supporting bi-directional data operations, receiving a transport response message from the control unit indicating that the I/O operation has ended, the transport response message including a TCH content error indication in response to at least one of:

the control unit detecting that a read (R) bit and a write (W) bit in the TCH are both set to one and that the TCCB does not include the BRDL; and

the control unit detecting that the R bit and the W bit are both set to one and the control unit not supporting bi-directional data transfer.

9. The computer program product of claim 7, wherein the method further comprises receiving a transport response message from the control unit indicating that the I/O operation has ended, and the transport response message includes:

a Data Length Residual Count (DLRC) field that specifies a difference between a DL field value in the TCCB and an amount of output data received by the control unit; and

a BRDL-residual count that specifies a difference between a BRDL field value in the TCCB and an amount of input data sent by the control unit.

10. The computer program product of claim 9, wherein the channel subsystem detects an error in response to at least one of:

a DLRC value not matching a difference between the DL field value in the TCCB and an amount of output data sent to the control unit; and

a BRDL-residual count value not matching a difference between the BRDL field value and an amount of input data received from the control unit.

11. The computer program product of claim 2, wherein the PRLI request message indicates a request to the control unit to indicate whether the control unit supports a transport mode protocol, the transport mode protocol supporting the use of the TCW and the TCCB;

and the PRLI response message includes a field that indicates whether the control unit supports the transport mode protocol.

12. An apparatus for performing an input/output (I/O) operation initiated by an I/O operation instruction at a host computer system configured for communication with a control unit, the host computer system configured to perform:

sending, by a channel subsystem in the host computer system, a process login (PRLI) request message to the control unit to initialize a link between the channel subsystem and the control unit, the PRLI request message including a field having a value that indicates whether the channel subsystem supports bi-directional data transfer;

receiving a PRLI response message from the control unit, the PRLI response message including a field having a value that indicates whether the control unit supports bi-directional data transfer;

providing an indication to a host operating system that bi-directional data transfer is supported; and

responsive to executing the I/O operation instruction received from the host computer system, performing a method comprising:

gathering a plurality of commands associated with the I/O operation instruction received from the host computer system, at least one of the plurality of commands specifying an input data transfer and at least one of the plurality of commands specifying an output data transfer;

transferring the plurality of commands to the control unit;

sending at least one output data message to the control unit including output data to be transferred to the control unit, the output data message associated with the at least one of the plurality of commands specifying an output data transfer; and

receiving at least one input message from the control unit including input data to be stored in a main storage of the host computer system, the input data message associated with the at least one of the plurality of commands specifying an input data transfer.

13. The apparatus of claim 12, wherein the plurality of commands are a plurality of device command words (DCW) that each is associated with an I/O command, and gathering includes obtaining a transport command word (TCW) at the channel subsystem in the host

computer system for the I/O operation, the TCW including a transport command control block (TCCB) address field including an address of a TCCB in the main storage of the host computer system, the TCCB including the plurality of DCWs, at least one of the DCWs specifying an input data transfer and at least one of the DCWs specifying an output data transfer.

14. The apparatus of claim 13, wherein the indication is configured to specify whether a first-transfer-ready disabled condition is in effect, and the host computer system is configured to further perform:

responsive to the first-transfer-ready disabled condition being in effect, sending the at least one output data message to the control unit following transfer of the TCCB and prior to receiving at least one message from the control unit; and

responsive to the first-transfer-ready disabled condition not being in effect, receiving the at least one message from the control unit prior to sending the at least one output data message.

15. The apparatus of claim 13, wherein the TCCB is included in a transport command information unit (IU) sent to the control unit, the transport command IU including a transport command header (TCH), the TCH including a field that indicates whether the channel subsystem is requesting bi-directional data transfer.

16. The apparatus of claim 15, wherein the TCCB includes a write data length (DL) field specifying an amount of output data to be transferred and a bi-directional read data length (BRDL) field specifying an amount of input data to be transferred.

17. The apparatus of claim 16, wherein the host computer system is configured to further perform, responsive to the control unit not supporting bi-directional data operations, receiving a transport response message from the control unit indicating that the I/O operation has ended, the transport response message including a TCH content error indication in response to at least one of:

the control unit detecting that a read (R) bit and a write (W) bit in the TCH are both set to one and that the TCCB does not include the BRDL; and

the control unit detecting that the R bit and the W bit are both set to one and the control unit not supporting bi-directional data transfer.

18. The apparatus of claim 16, wherein the method further comprises receiving a transport response message from the control unit indicating that the I/O operation has ended, the transport response message includes a Data Length Residual Count (DLRC) field that specifies a difference between a DL field value in the TCCB and an amount of output data received by the control unit, and a BRDL-residual count that specifies a difference between a BRDL field value in the TCCB and an amount of input data sent by the control unit, and the channel subsystem recognizes an error in response to at least one of:

a DLRC value not matching a difference between the DL field value in the TCCB and an amount of output data sent to the control unit; and

a BRDL-residual count value not matching a difference between the BRDL field value and an amount of input data received from the control unit.

19. A method of performing an input/output (I/O) operation initiated by an I/O operation instruction at a host computer system configured for communication with a control unit, the method comprising:

sending, by a channel subsystem in the host computer system, a process login (PRLI) request message to the control unit to initialize a link between the channel subsystem and the control unit, the PRLI request message including a field having a value that indicates whether the channel subsystem supports bi-directional data transfer;

receiving a PRLI response message from the control unit, the PRLI response message including a field having a value that indicates whether the control unit supports bi-directional data transfer;

providing an indication to a host operating system that bi-directional data transfer is supported; and

responsive to executing the I/O operation instruction received from the host computer system, performing a method comprising:

gathering a plurality of commands associated with the I/O operation instruction received from the host computer system, at least one of the plurality of commands specifying

an input data transfer and at least one of the plurality of commands specifying an output data transfer;

transferring the plurality of commands to the control unit;

sending at least one output data message to the control unit including output data to be transferred to the control unit, the output data message associated with the at least one of the plurality of commands specifying an output data transfer; and

receiving at least one input message from the control unit including input data to be stored in a main storage of the host computer system, the input data message associated with the at least one of the plurality of commands specifying an input data transfer.

20. The method of claim 19, wherein the plurality of commands are a plurality of device command words (DCW) that each is associated with an I/O command, and gathering includes obtaining a transport command word (TCW) at the channel subsystem in the host computer system for the I/O operation, the TCW including a transport command control block (TCCB) address field including an address of a TCCB in the main storage of the host computer system, the TCCB including the plurality of DCWs, at least one of the DCWs specifying an input data transfer and at least one of the DCWs specifying an output data transfer.

21. The method of claim 20, wherein the indication is configured to specify whether a first-transfer-ready disabled condition is in effect, and the method further comprises:

responsive to the first-transfer-ready disabled condition being in effect, sending the at least one output data message to the control unit following transfer of the TCCB and prior to receiving at least one message from the control unit; and

responsive to the first-transfer-ready disabled condition not being in effect, receiving the at least one message from the control unit prior to sending the at least one output data message.

22. The method of claim 20, wherein the TCCB is included in a transport command information unit (IU) sent to the control unit, the transport command IU including a transport command header (TCH), the TCH including a field that indicates whether the channel subsystem is requesting bi-directional data transfer.

23. The method of claim 22, wherein the TCCB includes a write data length (DL) field specifying an amount of output data to be transferred and a bi-directional read data length (BRDL) field specifying an amount of input data to be transferred.

24. The method of claim 23, further comprising, responsive to the control unit not supporting bi-directional data operations, receiving a transport response message from the control unit indicating that the I/O operation has ended, the transport response message including a TCH content error indication in response to at least one of:

the control unit detecting that a read (R) bit and a write (W) bit in the TCH are both set to one and that the TCCB does not include the BRDL; and

the control unit detecting that the R bit and the W bit are both set to one and the control unit not supporting bi-directional data transfer.

25. The method of claim 22, further comprising receiving a transport response message from the control unit indicating that the I/O operation has ended, and wherein the transport response message includes a Data Length Residual Count (DLRC) field that specifies a difference between a DL field value in the TCCB and an amount of output data received by the control unit, and a BRDL-residual count that specifies a difference between a BRDL field value in the TCCB and an amount of input data sent by the control unit, and the channel subsystem recognizes an error in response to at least one of:

a DLRC value not matching a difference between the DL field value in the TCCB and an amount of output data sent to the control unit; and

a BRDL-residual count value not matching a difference between the BRDL field value and an amount of input data received from the control unit.

CLAIMS

1. A non-transitory computer readable medium comprising executable instructions for performing an input/output (I/O) operation initiated by an I/O operation instruction at a host computer system configured for communication with a control unit, the computer readable medium readable by a processing circuit for performing a method comprising:

sending, by a channel subsystem in the host computer system, a process login (PRLI) request message to the control unit to initialize a link between the channel subsystem and the control unit, the PRLI request message including a field having a value that indicates whether the channel subsystem supports bi-directional data transfer;

receiving a PRLI response message from the control unit, the PRLI response message including a field having a value that indicates whether the control unit supports bi-directional data transfer;

providing an indication to a host operating system that bi-directional data transfer is supported; and

based on executing the I/O operation instruction received from the host computer system, performing a method comprising:

gathering a plurality of commands specified via the I/O operation instruction received from the host computer system, at least one of the plurality of commands specifying an input data transfer and at least one of the plurality of commands specifying an output data transfer;

transferring the plurality of commands to the control unit;

sending at least one output data message to the control unit including output data to be transferred to the control unit, the output data message sent based on the at least one of the plurality of commands specifying an output data transfer; and

receiving at least one input message from the control unit including input data to be stored in a main storage of the host computer system, the input data message sent based on the at least one of the plurality of commands specifying an input data transfer.

2. The computer readable medium of claim 1, wherein the plurality of commands are a plurality of device command words (DCW) that each specifies an I/O command, and gathering includes obtaining a transport command word (TCW) at the channel subsystem in the host computer system for the I/O operation, the TCW including a transport command control block (TCCB) address field including an address of a TCCB in the main storage of the host computer system,

the TCCB including the plurality of DCWs, at least one of the DCWs specifying an input data transfer and at least one of the DCWs specifying an output data transfer.

3. The computer readable medium of claim 2, wherein transferring the plurality of commands includes transferring the TCCB including the plurality of DCWs to the control unit.

4. The computer readable medium of claim 3, wherein the indication is configured to specify whether a first-transfer-ready disabled condition is in effect, and the method further comprises:

based on the first-transfer-ready disabled condition being in effect, sending the at least one output data message to the control unit following transfer of the TCCB and prior to receiving at least one message from the control unit; and

based on the first-transfer-ready disabled condition not being in effect, receiving the at least one message from the control unit prior to sending the at least one output data message.

5. The computer readable medium of claim 4, wherein the message from the control unit includes one of a transfer-ready message requesting that the channel subsystem send output data and the input data message.

6. The computer readable medium of claim 2, wherein the TCCB is included in a transport command information unit (IU) sent to the control unit, the transport command IU including a transport command header (TCH), the TCH including a field that indicates whether the channel subsystem is requesting bi-directional data transfer.

7. The computer readable medium of claim 6, wherein the TCCB includes a write data length (DL) field specifying an amount of output data to be transferred and a bi-directional read data length (BRDL) field specifying an amount of input data to be transferred.

8. The computer readable medium of claim 7, wherein the method further comprises, based on the control unit not supporting bi-directional data operations, receiving a transport response message from the control unit indicating that the I/O operation has ended, the transport response message including a TCH content error indication based on at least one of:

the control unit detecting that a read (R) bit and a write (W) bit in the TCH are both set to one and that the TCCB does not include the BRDL; and

the control unit detecting that the R bit and the W bit are both set to one and the control unit not supporting bi-directional data transfer.

9. The computer readable medium of claim 7, wherein the method further comprises receiving a transport response message from the control unit indicating that the I/O operation has ended, and the transport response message includes:

a Data Length Residual Count (DLRC) field that specifies a difference between a DL field value in the TCCB and an amount of output data received by the control unit; and

a BRDL-residual count that specifies a difference between a BRDL field value in the TCCB and an amount of input data sent by the control unit.

10. The computer program product of claim 9, wherein the channel subsystem detects an error based on at least one of:

a DLRC value not matching a difference between the DL field value in the TCCB and an amount of output data sent to the control unit; and

a BRDL-residual count value not matching a difference between the BRDL field value and an amount of input data received from the control unit.

11. The computer readable medium of claim 2, wherein the PRLI request message indicates a request to the control unit to indicate whether the control unit supports a transport mode protocol, the transport mode protocol supporting the use of the TCW and the TCCB, and the PRLI response message includes a field that indicates whether the control unit supports the transport mode protocol.

12. An apparatus comprising a channel subsystem for performing an input/output (I/O) operation initiated by an I/O operation instruction at a host computer system, the channel subsystem configured for communication with a control unit and including an interface for communication between the host computer system and the control unit, the channel subsystem configured to perform:

sending, by a channel subsystem in the host computer system, a process login (PRLI) request message to the control unit to initialize a link between the channel subsystem and the control unit, the PRLI request message including a field having a value that indicates whether the channel subsystem supports bi-directional data transfer;

receiving a PRLI response message from the control unit, the PRLI response message including a field having a value that indicates whether the control unit supports bi-directional data transfer;

providing an indication to a host operating system that bi-directional data transfer is supported; and

based on executing the I/O operation instruction received from the host computer system, performing a method comprising:

gathering a plurality of commands specified via the I/O operation instruction received from the host computer system, at least one of the plurality of commands specifying an input data transfer and at least one of the plurality of commands specifying an output data transfer;

transferring the plurality of commands to the control unit;

sending at least one output data message to the control unit including output data to be transferred to the control unit, the output data sent based on the at least one of the plurality of commands specifying an output data transfer; and

receiving at least one input message from the control unit including input data to be stored in a main storage of the host computer system, the input data message sent based on the at least one of the plurality of commands specifying an input data transfer.

13. The apparatus of claim 12, wherein the plurality of commands are a plurality of device command words (DCW) that each specifies an I/O command, and gathering includes obtaining a transport command word (TCW) at the channel subsystem in the host computer system for the I/O operation, the TCW including a transport command control block (TCCB) address field including an address of a TCCB in the main storage of the host computer system, the TCCB including the plurality of DCWs, at least one of the DCWs specifying an input data transfer and at least one of the DCWs specifying an output data transfer.

14. The apparatus of claim 13, wherein the indication is configured to specify whether a first-transfer-ready disabled condition is in effect, and the host computer system is configured to further perform:

based on the first-transfer-ready disabled condition being in effect, sending the at least one output data message to the control unit following transfer of the TCCB and prior to receiving at least one message from the control unit; and

based on the first-transfer-ready disabled condition not being in effect, receiving the at least one message from the control unit prior to sending the at least one output data message.

15. The apparatus of claim 13, wherein the TCCB is included in a transport command information unit (IU) sent to the control unit, the transport command IU including a transport command header (TCH), the TCH including a field that indicates whether the channel subsystem is requesting bi-directional data transfer.

16. The apparatus of claim 15, wherein the TCCB includes a write data length (DL) field specifying an amount of output data to be transferred and a bi-directional read data length (BRDL) field specifying an amount of input data to be transferred.

17. The apparatus of claim 16, wherein the channel subsystem is configured to further perform, based on the control unit not supporting bi-directional data operations, receiving a transport response message from the control unit indicating that the I/O operation has ended, the transport response message including a TCH content error indication based on at least one of:

the control unit detecting that a read (R) bit and a write (W) bit in the TCH are both set to one and that the TCCB does not include the BRDL; and

the control unit detecting that the R bit and the W bit are both set to one and the control unit not supporting bi-directional data transfer.

18. The apparatus of claim 16, wherein the method further comprises receiving a transport response message from the control unit indicating that the I/O operation has ended, the transport response message includes a Data Length Residual Count (DLRC) field that specifies a difference between a DL field value in the TCCB and an amount of output data received by the control unit, and a BRDL-residual count that specifies a difference between a BRDL field value in the TCCB and an amount of input data sent by the control unit, and the channel subsystem recognizes an based on at least one of

a DLRC value not matching a difference between the DL field value in the TCCB and an amount of output data sent to the control unit; and

a BRDL-residual count value not matching a difference between the BRDL field value and an amount of input data received from the control unit.

19. A method of performing an input/output (I/O) operation initiated by an I/O operation instruction at a host computer system configured for communication with a control unit, the method comprising:

sending, by a channel subsystem in the host computer system, a process login (PRLI) request message to the control unit to initialize a link between the channel subsystem and the control unit, the PRLI request message including a field having a value that indicates whether the channel subsystem supports bi-directional data transfer;

receiving a PRLI response message from the control unit, the PRLI response message including a field having a value that indicates whether the control unit supports bi-directional data transfer;

providing an indication to a host operating system that bi-directional data transfer is supported; and

based on executing the I/O operation instruction received from the host computer system, performing a method comprising:

gathering a plurality of commands specified via the I/O operation instruction received from the host computer system, at least one of the plurality of commands specifying an input data transfer and at least one of the plurality of commands specifying an output data transfer;

transferring the plurality of commands to the control unit;

sending at least one output data message to the control unit including output data to be transferred to the control unit, the output data message sent based on the at least one of the plurality of commands specifying an output data transfer; and

receiving at least one input message from the control unit including input data to be stored in a main storage of the host computer system, the input data message sent based on the at least one of the plurality of commands specifying an input data transfer.

20. The method of claim 19, wherein the plurality of commands are a plurality of device command words (DCW) that each specifies an I/O command, and gathering includes obtaining a transport command word (TCW) at the channel subsystem in the host computer system for the I/O operation, the TCW including a transport command control block (TCCB) address field including an address of a TCCB in the main storage of the host computer system, the TCCB including the plurality of DCWs, at least one of the DCWs specifying an input data transfer and at least one of the DCWs specifying an output data transfer.

21. The method of claim 20, wherein the indication is configured to specify whether a first-transfer-ready disabled condition is in effect, and the method further comprises:

based on the first-transfer-ready disabled condition being in effect, sending the at least one output data message to the control unit following transfer of the TCCB and prior to receiving at least one message from the control unit; and

based on the first-transfer-ready disabled condition not being in effect, receiving the at least one message from the control unit prior to sending the at least one output data message.

22. The method of claim 20, wherein the TCCB is included in a transport command information unit (IU) sent to the control unit, the transport command IU including a transport command header (TCH), the TCH including a field that indicates whether the channel subsystem is requesting bi-directional data transfer.

23. The method of claim 22, wherein the TCCB includes a write data length (DL) field specifying an amount of output data to be transferred and a bi-directional read data length (BRDL) field specifying an amount of input data to be transferred.

24. The method of claim 23, further comprising, based on the control unit not supporting bi-directional data operations, receiving a transport response message from the control unit indicating that the I/O operation has ended, the transport response message including a TCH content error indication based on at least one of:

the control unit detecting that a read (R) bit and a write (W) bit in the TCH are both set to one and that the TCCB does not include the BRDL; and

the control unit detecting that the R bit and the W bit are both set to one and the control unit not supporting bi-directional data transfer.

25. The method of claim 22, further comprising receiving a transport response message from the control unit indicating that the I/O operation has ended, and wherein the transport response message includes a Data Length Residual Count (DLRC) field that specifies a difference between a DL field value in the TCCB and an amount of output data received by the control unit, and a BRDL-residual count that specifies a difference between a BRDL field value in the TCCB and an amount of input data sent by the control unit, and the channel subsystem recognizes an error based on at least one of:

a DLRC value not matching a difference between the DL field value in the TCCB and an amount of output data sent to the control unit; and

a BRDL-residual count value not matching a difference between the BRDL field value and an amount of input data received from the control unit.