CLAIMS

1. A storage system for processing an operation request, wherein the storage system comprises a controller and a disk enclosure, and the controller communicates with the disk enclosure by using an Ethernet network; the controller comprises a central processing unit and a back-end adapter; the disk enclosure and the back-end adapter each have a media access control, MAC, address; multiple disks are connected in the disk enclosure, and each disk in the disk enclosure is connected to the disk enclosure by using the Serial Attached Small Computer System Interface, SAS, protocol; the back-end adapter stores a correspondence between the MAC address of the disk enclosure and a SAS protocol address of each disk in the disk enclosure;

the back-end adapter is configured to: receive a Small Computer System Interface, SCSI, protocol operation request sent by the central processing unit, wherein the SCSI protocol operation request carries a SCSI protocol transaction identifier of the controller and a SAS protocol address of a target disk; query a correspondence between the MAC address of the disk enclosure and the SAS protocol address of the target disk according to the SAS protocol address of the target disk, to obtain the MAC address of the disk enclosure; encapsulate the SCSI protocol operation request into an Ethernet operation request packet; and send the Ethernet operation request packet to the disk enclosure according to the MAC address of the disk enclosure, wherein the Ethernet operation request packet carries the MAC address of the back-end adapter and the MAC address of the disk enclosure; and

the disk enclosure is configured to: receive and decapsulate the Ethernet operation request packet, to obtain the SCSI protocol operation request; and send the SCSI protocol operation request to the target disk according to the SAS protocol address of the target disk.

~~2. The system according to claim 1,~~;

wherein the disk enclosure is further configured to establish a correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller;

the disk enclosure is further configured to: receive a SCSI protocol operation request

response that is sent by the target disk according to the SCSI protocol operation request, wherein the SCSI protocol operation request response carries the SCSI protocol transaction identifier of the controller; query the correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller according to the SCSI protocol transaction identifier of the controller, to obtain the MAC address of the back-end adapter; encapsulate the SCSI protocol operation request response into an Ethernet operation request response packet; and send the Ethernet operation request response packet to the controller according to the MAC address of the back-end adapter, wherein the Ethernet operation request response packet carries the MAC address of the back-end adapter; and

the back-end adapter is further configured to: receive and decapsulate the Ethernet operation request response packet, to obtain the SCSI protocol operation request response; and send the SCSI protocol operation request response to the central processing unit.

~~3~~2. The system according to claim ~~2~~1, wherein the back-end adapter is further configured to: encapsulate the SCSI protocol transaction identifier of the controller in the SCSI protocol operation request into a first field of the Ethernet operation request packet; and encapsulate the SAS protocol address of the target disk in the SCSI protocol operation request into a second field of the Ethernet operation request packet, wherein the first field, the second field, and a field carrying the SCSI protocol operation request are three different fields;

that the disk enclosure establishes a correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller specifically comprises: the disk enclosure decapsulates the first field of the Ethernet operation request packet, to obtain the SCSI protocol transaction identifier of the controller, and establishes the correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller; and

that the disk enclosure sends the SCSI protocol operation request to the target disk according to the SAS protocol address of the target disk specifically comprises: the disk enclosure decapsulates the second field of the Ethernet operation request packet, to obtain the SAS protocol address of the target disk, and sends the SCSI protocol operation request to the target disk according to the SAS protocol address of the target disk.

4~~3~~. The system according to claim ~~3~~2, wherein the back-end adapter is further configured

to record a transaction execution state of the SCSI protocol operation request; specifically, when sending the Ethernet operation request packet to the disk enclosure, the back-end adapter records the transaction execution state of the SCSI protocol operation request as establishing a link with a SCSI protocol transaction of the target disk and executing the SCSI protocol transaction.

~~5~~4. The system according to claim 4~~3~~, wherein the back-end adapter is further configured to update, according to the SCSI protocol operation request response, the transaction execution state of the SCSI protocol operation request to be that the execution of the SCSI protocol transaction is complete and the link with the SCSI protocol transaction of the target disk is released.

~~6~~5. The system according to claim 4~~3~~, wherein when the Ethernet operation request response packet does not carry the SCSI protocol transaction identifier of the controller, the back-end adapter is further configured to discard the SCSI protocol operation request response.

~~7~~6. The system according to claim 1, wherein the correspondence between the MAC address of the disk enclosure and the SAS protocol address of the target disk is established by the back-end adapter according to resource information sent by the disk enclosure, and the resource information comprises the MAC address of the disk enclosure and the SAS protocol address of the target disk.

~~8. A method for processing an operation request, wherein the method is applied to a controller, and the controller communicates with a disk enclosure by using an Ethernet network; the controller comprises a central processing unit and a back-end adapter; the disk enclosure and the back-end adapter each have a media access control, MAC, address; multiple disks are connected in the disk enclosure, and each disk in the disk enclosure is connected to the disk enclosure by using the Serial Attached Small Computer System Interface, SAS, protocol; the back-end adapter stores a correspondence between the MAC address of the disk enclosure and a SAS protocol address of each disk in the disk enclosure; and~~

~~the method comprises:~~

~~sending, by the central processing unit, a Small Computer System Interface, SCSI, protocol operation request, wherein the SCSI protocol operation request carries a SAS~~

protocol address of a target disk; and

receiving, by the back-end adapter, the SCSI protocol operation request sent by the central processing unit; querying a correspondence between the MAC address of the disk enclosure and the SAS protocol address of the target disk according to the SAS protocol address of the target disk, to obtain the MAC address of the disk enclosure; encapsulating the SCSI protocol operation request into an Ethernet operation request packet carrying the MAC address of the back-end adapter and the MAC address of the disk enclosure; and sending the Ethernet operation request packet to the disk enclosure according to the MAC address of the disk enclosure.

9. The method according to claim 8, wherein the SCSI protocol operation request further carries a SCSI protocol transaction identifier of the controller, and the method further comprises: encapsulating the SCSI protocol transaction identifier of the controller into a first field of the Ethernet operation request packet, and encapsulating the SAS protocol address of the target disk into a second field of the Ethernet operation request packet, wherein the first field, the second field, and a field that is in the Ethernet operation request packet and carries the SCSI protocol operation request are three different fields.

10. The method according to claim 9, wherein the method further comprises:

receiving and decapsulating, by the back-end adapter, an Ethernet response packet for the Ethernet operation request packet that is sent by the disk enclosure, to obtain a SCSI protocol operation request response; and sending the SCSI protocol operation request response to the central processing unit, wherein the Ethernet response packet for the Ethernet operation request packet carries the MAC address of the back-end adapter; and

receiving, by the central processing unit, the SCSI protocol operation request response.

11. The method according to claim 10, wherein the back-end adapter further records a transaction execution state of the SCSI protocol operation request; specifically, when sending the Ethernet operation request packet to the disk enclosure, the back-end adapter records the transaction execution state of the SCSI protocol operation request as establishing a link with a SCSI protocol transaction of the target disk and executing the SCSI protocol transaction.

12. The method according to claim 11, wherein the method further comprises: updating, by the back-end adapter according to the SCSI protocol operation request response, the

~~transaction execution state of the SCSI protocol operation request to be that the execution of the SCSI protocol transaction is complete and the link with the SCSI protocol transaction of the target disk is released.~~

~~13. The method according to claim 11, wherein when the Ethernet response packet for the Ethernet operation request packet does not carry the SCSI protocol transaction identifier of the controller, the SCSI protocol operation request response is discarded.~~

~~14. The method according to claim 8, wherein the correspondence between the MAC address of the disk enclosure and the SAS protocol address of the target disk is established by the back-end adapter according to resource information sent by the disk enclosure, and the resource information comprises the MAC address of the disk enclosure and the SAS protocol address of the target disk.~~

~~15~~7. A method for processing an operation request, wherein the method is applied to a disk enclosure, and a controller communicates with the disk enclosure by using an Ethernet network; the controller comprises a central processing unit and a back-end adapter; the disk enclosure and the back-end adapter each have a media access control, MAC, address; multiple disks are connected in the disk enclosure, and each disk in the disk enclosure is connected to the disk enclosure by using the Serial Attached Small Computer System Interface, SAS, protocol; and

the method comprises:

receiving and decapsulating, by the disk enclosure, an Ethernet operation request packet sent by the controller, to obtain a Small Computer System Interface, SCSI, protocol operation request, wherein the Ethernet operation request packet carries the MAC address of the back-end adapter and the MAC address of the disk enclosure, and the SCSI protocol operation request carries a SCSI protocol transaction identifier of the controller and a SAS protocol address of a target disk; and

sending, by the disk enclosure, the SCSI protocol operation request to the target disk according to the SAS protocol address of the target disk~~.~~;

~~16. The method according to claim 15,~~ wherein the method further comprises: establishing, by the disk enclosure, a correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller;

receiving, by the disk enclosure, a SCSI protocol operation request response that is sent by the target disk according to the SCSI protocol operation request, wherein the SCSI protocol operation request response carries the SCSI protocol transaction identifier of the controller;

querying, by the disk enclosure, the correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller according to the SCSI protocol transaction identifier of the controller, to obtain the MAC address of the back-end adapter;

encapsulating, by the disk enclosure, the SCSI protocol operation request response into an Ethernet operation request response packet, wherein the Ethernet operation request response packet carries the MAC address of the back-end adapter; and

sending, by the disk enclosure, the Ethernet operation request response packet to the controller according to the MAC address of the back-end adapter.

~~17~~8. The method according to claim ~~16~~7, wherein a first field of the Ethernet operation request packet carries the SCSI protocol transaction identifier of the controller, and a second field of the Ethernet operation request packet carries the SAS protocol address of the target disk, wherein the first field, the second field, and a field that is in the Ethernet operation request packet and carries the SCSI protocol operation request are three different fields;

the establishing, by the disk enclosure, a correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller specifically comprises: decapsulating, by the disk enclosure, the first field of the Ethernet operation request packet, to obtain the SCSI protocol transaction identifier of the controller, and establishing the correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller; and

the sending, by the disk enclosure, the SCSI protocol operation request to the target disk according to the SAS protocol address of the target disk specifically comprises: decapsulating, by the disk enclosure, the second field of the Ethernet operation request packet, to obtain the SAS protocol address of the target disk, and sending the SCSI protocol operation request to the target disk according to the SAS protocol address of the target disk.

~~18. A controller, wherein the controller is applied to a storage system, and the storage~~

system comprises the controller and a disk enclosure; the controller communicates with the disk enclosure by using an Ethernet network; the controller comprises a central processing unit and a back-end adapter; the disk enclosure and the back-end adapter each have a media access control, MAC, address; multiple disks are connected in the disk enclosure, and each disk in the disk enclosure is connected to the disk enclosure by using the Serial Attached Small Computer System Interface, SAS, protocol; the back-end adapter stores a correspondence between the MAC address of the disk enclosure and a SAS protocol address of each disk in the disk enclosure;

the central processing unit is configured to send a Small Computer System Interface, SCSI, protocol operation request, wherein the SCSI protocol operation request carries a SAS protocol address of a target disk; and

the back-end adapter is configured to: receive the SCSI protocol operation request; query a correspondence between the MAC address of the disk enclosure and the SAS protocol address of the target disk according to the SAS protocol address of the target disk, to obtain the MAC address of the disk enclosure; encapsulate the SCSI protocol operation request into an Ethernet operation request packet; and send the Ethernet operation request packet to the disk enclosure according to the MAC address of the disk enclosure, wherein the Ethernet operation request packet carries the MAC address of the back-end adapter and the MAC address of the disk enclosure.

19. The controller according to claim 18, wherein the SCSI protocol operation request further carries a SCSI protocol transaction identifier of the controller; and the back-end adapter is further configured to: encapsulate the SCSI protocol transaction identifier of the controller into a first field of the Ethernet operation request packet, and encapsulate the SAS protocol address of the target disk into a second field of the Ethernet operation request packet, wherein the first field, the second field, and a field that is in the Ethernet operation request packet and carries the SCSI protocol operation request are three different fields.

20. The controller according to claim 19, wherein the back-end adapter is further configured to: receive and decapsulate an Ethernet response packet for the Ethernet operation request packet that is sent by the disk enclosure, to obtain a SCSI protocol operation request response; and send the SCSI protocol operation request response to the central processing

~~unit, wherein the Ethernet response packet for the Ethernet operation request packet carries the MAC address of the back-end adapter; and~~

~~the central processing unit is further configured to receive the SCSI protocol operation request response.~~

~~21. The controller according to claim 20, wherein the back-end adapter is further configured to record a transaction execution state of the SCSI protocol operation request; specifically, when sending the Ethernet operation request packet to the disk enclosure, the back-end adapter records the transaction execution state of the SCSI protocol operation request as establishing a link with a SCSI protocol transaction of the target disk and executing the SCSI protocol transaction.~~

~~22. The controller according to claim 21, wherein the back-end adapter is further configured to update, according to the SCSI protocol operation request response, the transaction execution state of the SCSI protocol operation request to be that the execution of the SCSI protocol transaction is complete and the link with the SCSI protocol transaction of the target disk is released.~~

~~23. The controller according to claim 21, wherein the back-end adapter is further configured to discard the SCSI protocol operation request response when the Ethernet response packet for the Ethernet operation request packet does not carry the SCSI protocol transaction identifier of the controller.~~

~~24. The controller according to claim 18, wherein the correspondence between the MAC address of the disk enclosure and the SAS protocol address of the target disk is established by the back-end adapter according to resource information sent by the disk enclosure, and the resource information comprises the MAC address of the disk enclosure and the SAS protocol address of the target disk.~~

~~25~~9. A disk enclosure, wherein the disk enclosure is applied to a storage system, and the storage system comprises a controller and the disk enclosure; the controller comprises a central processing unit and a back-end adapter; the disk enclosure and the back-end adapter each have a media access control, MAC, address; multiple disks are connected in the disk enclosure, and each disk in the disk enclosure is connected to the disk enclosure by using the Serial Attached Small Computer System Interface, SAS, protocol; the controller

communicates with the disk enclosure by using an Ethernet network; and

the disk enclosure comprises:

a first transceiver unit, configured to receive an Ethernet operation request packet sent by the controller, wherein the Ethernet operation request packet carries the MAC address of the back-end adapter and the MAC address of the disk enclosure;

an encapsulating and decapsulating unit, configured to decapsulate the Ethernet operation request packet received by the first transceiver unit, to obtain a Small Computer System Interface, SCSI, protocol operation request, wherein the SCSI protocol operation request carries a SCSI protocol transaction identifier of the controller and a SAS protocol address of a target disk; and

a second transceiver unit, configured to send the SCSI protocol operation request to the target disk according to the SAS protocol address of the target disk~~.~~;

~~26. T~~the disk enclosure ~~according to claim 25,~~ further comprising an establishing unit and a querying unit, wherein:

the establishing unit is configured to establish a correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller;

the second transceiver unit is further configured to receive a SCSI protocol operation request response that is sent by the target disk according to the SCSI protocol operation request, wherein the SCSI protocol operation request response carries the SCSI protocol transaction identifier of the controller;

the querying unit is configured to query, according to the SCSI protocol transaction identifier of the controller, the correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller that is established by the establishing unit, to obtain the MAC address of the back-end adapter;

the encapsulating and decapsulating unit is further configured to encapsulate the SCSI protocol operation request response into an Ethernet operation request response packet, wherein the Ethernet operation request response packet carries the MAC address of the back-end adapter; and

the first transceiver unit is further configured to send the Ethernet operation request response packet to the controller according to the MAC address of the back-end adapter.

~~27~~10. The disk enclosure according to claim ~~26~~9, wherein a first field of the Ethernet operation request packet carries the SCSI protocol transaction identifier of the controller, and a second field of the Ethernet operation request packet carries the SAS protocol address of the target disk, wherein the first field, the second field, and a field that is in the Ethernet operation request packet and carries the SCSI protocol operation request are three different fields;

that the establishing unit establishes a correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller specifically comprises: the encapsulating and decapsulating unit decapsulates the first field of the Ethernet operation request packet, to obtain the SCSI protocol transaction identifier of the controller, and the establishing unit establishes the correspondence between the MAC address of the back-end adapter and the SCSI protocol transaction identifier of the controller; and

that the second transceiver unit sends the SCSI protocol operation request to the target disk according to the SAS protocol address of the target disk specifically comprises: the encapsulating and decapsulating unit decapsulates the second field of the Ethernet operation request packet, to obtain the SAS protocol address of the target disk, and the second transceiver unit sends the SCSI protocol operation request to the target disk according to the SAS protocol address of the target disk.

~~28. A back-end adapter, wherein the back-end adapter is applied to a controller of a storage system, the storage system comprises the controller and a disk enclosure, and the controller communicates with the disk enclosure by using an Ethernet network; the controller comprises a central processing unit and the back-end adapter; the disk enclosure and the back-end adapter each have a media access control, MAC, address; multiple disks are connected in the disk enclosure, and each disk in the disk enclosure is connected to the disk enclosure by using the Serial Attached Small Computer System Interface, SAS, protocol; the back-end adapter stores a correspondence between the MAC address of the disk enclosure and a SAS protocol address of each disk in the disk enclosure; and~~

~~the back-end adapter comprises:~~

~~a first transceiver unit, configured to send a Small Computer System Interface, SCSI, protocol operation request, wherein the SCSI protocol operation request carries a SAS protocol address of a target disk;~~

a querying unit, configured to query a correspondence between the MAC address of the disk enclosure and the SAS protocol address of the target disk, to obtain the MAC address of the disk enclosure;

an encapsulating and decapsulating unit, configured to encapsulate the SCSI protocol operation request into an Ethernet operation request packet, wherein the Ethernet operation request packet carries the MAC address of the back-end adapter and the MAC address of the disk enclosure; and

a second transceiver unit, configured to send the Ethernet operation request packet to the disk enclosure according to the MAC address of the disk enclosure.

29. The back-end adapter according to claim 28, wherein the SCSI protocol operation request further carries a SCSI protocol transaction identifier of the controller; and the encapsulating and decapsulating unit is further configured to encapsulate the SCSI protocol transaction identifier of the controller into a first field of the Ethernet operation request packet, and encapsulate the SAS protocol address of the target disk into a second field, wherein the first field, the second field, and a field that is in the Ethernet operation request packet and carries the SCSI protocol operation request are three different fields.

30. The back-end adapter according to claim 29, wherein the second transceiver unit is further configured to receive an Ethernet response packet for the Ethernet operation request packet that is sent by the disk enclosure, wherein the Ethernet response packet for the Ethernet operation request packet carries the MAC address of the back-end adapter;

the encapsulating and decapsulating unit is further configured to decapsulate the Ethernet response packet for the Ethernet operation request packet, to obtain a SCSI protocol operation request response; and

the first transceiver unit is further configured to send the SCSI protocol operation request response to the central processing unit.

31. The back-end adapter according to claim 30, wherein the back-end adapter further comprises a recording unit, configured to record a transaction execution state of the SCSI protocol operation request; specifically, when the Ethernet operation request packet is sent to the disk enclosure, the recording unit records the transaction execution state of the SCSI protocol operation request as establishing a link with a SCSI protocol transaction of the target

~~disk and executing the SCSI protocol transaction.~~

~~32. The back-end adapter according to claim 31, wherein the recording unit is further configured to update, according to the SCSI protocol operation request response, the transaction execution state of the SCSI protocol operation request to be that the execution of the SCSI protocol transaction is complete and the link with the SCSI protocol transaction of the target disk is released.~~

~~33. The back-end adapter according to claim 31, wherein the first transceiver unit is further configured to discard the SCSI protocol operation request response when the Ethernet operation response packet for the Ethernet operation request packet does not carry the SCSI protocol transaction identifier of the controller.~~

~~34. The back-end adapter according to claim 29, wherein the correspondence between the MAC address of the disk enclosure and the SAS protocol address of the target disk is established by the back-end adapter according to resource information sent by the disk enclosure, and the resource information comprises the MAC address of the disk enclosure and the SAS protocol address of the target disk.~~