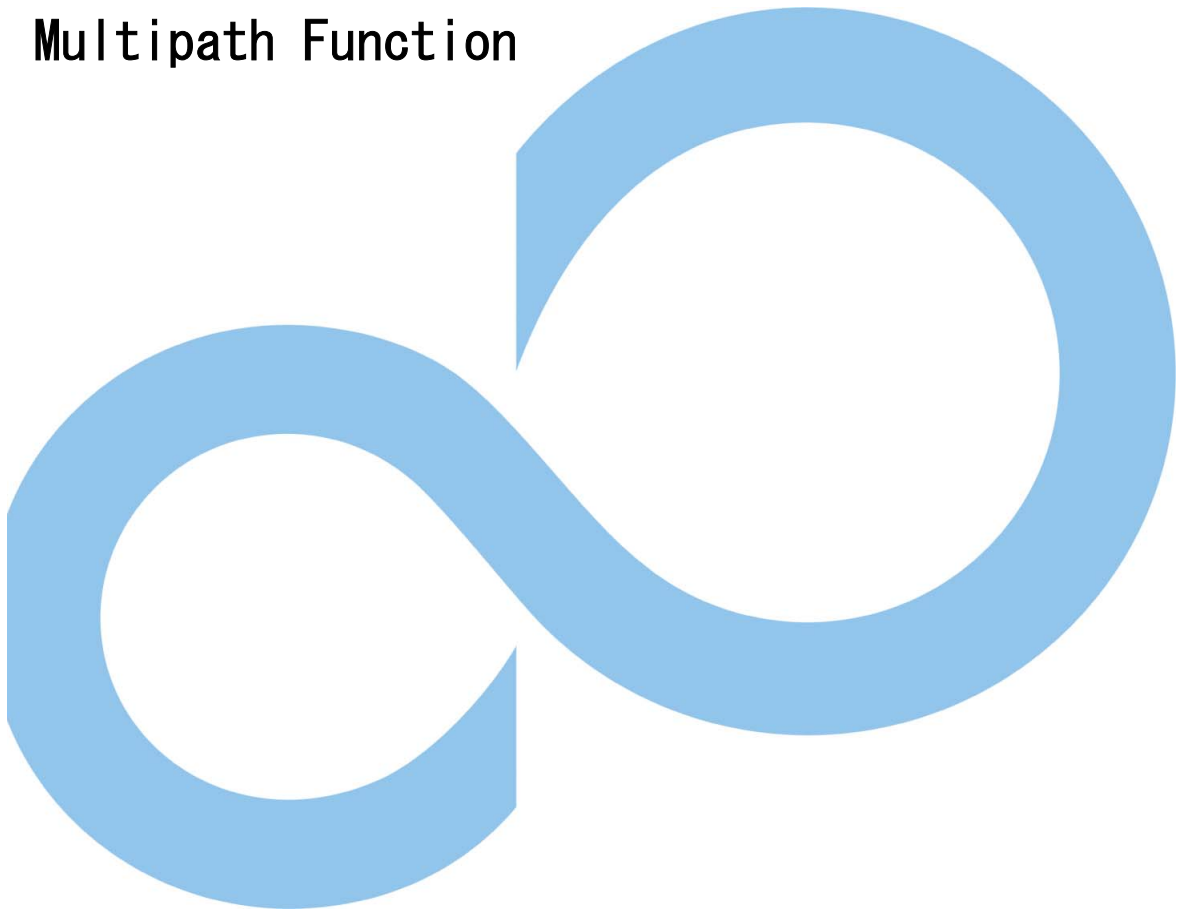# PRIMECLUSTER Global Link Services Configuration and Administration Guide:

Multipath Function

FUJITSU

Preface

This manual describes the capabilities, and installation, operation of the Multipath function in the PRIMECLUSTER Global Link Services (GLS). "GLS" is the abbreviated name for "Global Link Services."

Who Should Use This Manual

This manual is intended for system administrators responsible for the installation administration of PRIMECLUSTER Global Link Services (GLS). In this manual, the description of some terms may be omitted to avoid lengthy expression.

How This Manual Is Organized

This section describes the chapters in this manual.

Chapter 1 Product Outline
Chapter 1 describes the distinctive features of the PRIMECLUSTER Global Link Services (GLS) Multipath function.

Chapter 2 Capabilities
Chapter 2 describes the provided capabilities of the PRIMECLUSTER Global Link Services (GLS) Multipath function and notes for the administrator.

Chapter 3 Configuration
Chapter 3 describes the environmental configuration of the PRIMECLUSTER Global Link Services (GLS) Multipath function.

Chapter 4 Operation
Chapter 4 describes the administrative procedure for the PRIMECLUSTER Global Link Services (GLS) Multipath function.

Chapter 5 Maintenance
Chapter 5 describes the future reference necessary for troubleshooting of the PRIMECLUSTER Global Link Services (GLS) Multipath function.

Chapter 6 Command Reference
Chapter 6 describes how to work with the provided command of the PRIMECLUSTER Global Link Services (GLS) Multipath function.

Chapter 7 Administration on a Cluster System
Chapter 7 describes administration of the PRIMECLUSTER Global Link Services (GLS) Multipath function to use on the clustering system.

Chapter 8 Dynamic Reconfiguration (DR) Function
Chapter 8 The Dynamic Reconfiguration (DR) function which GP7000F M1000/2000 and PRIMEPOWER 800/900/1000/1500/2000/2500 offer is described about the idea of environmental construction which uses the PRIMECLUSTER Global Link Services (GLS) Multipath function. And, the Multipath function when DR is executed is described.

Appendix A Messages
Appendix A shows the informational and error messages from the PRIMECLUSTER Global Link Services (GLS) Multipath function.

Abbreviated Name

· The Solaris(TM) Operating Environment is abbreviated as Solaris OE.

Trademark Acknowledgments

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Revision History

Edition	Date	Revised section (*1) (Added/Deleted/Altered)	Details
01	2003-03	-	-

*1 Section(s) with asterisk (*) refer to the previous edition when those were deleted.

Attention

First edition in March, 2003

Chapter 1 Product Outline

1.1 Multipath Function

The Multipath function communicates with two or more network interface cards (NICs) by making redundant transmission paths between the NIC and the switch. If an unexpected failure is detected in the transmission path or on the NIC, the communication path is automatically switched to continue communication and to achieve the high-reliability of the communication.

The methods of the Multipath function can be classified into two types:

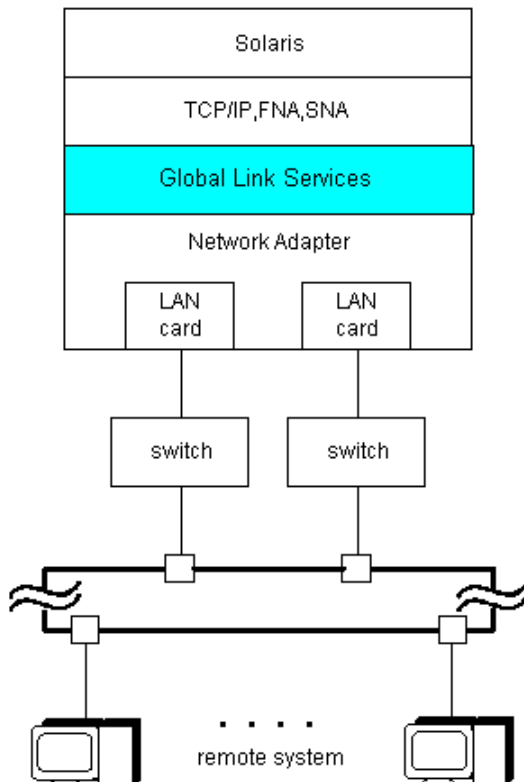- Multipath method
- Multilink Ethernet method

Function outlines of the methods are given in Section "1.1.1 Multipath method," and Section "1.1.2 Multilink Ethernet method."

The Multipath function corresponds to the Dynamic Reconfiguration (DR) function provided by the GP7000F model 1000/2000 or PRIMEPOWER 800/900/1000/1500/2000/2500.
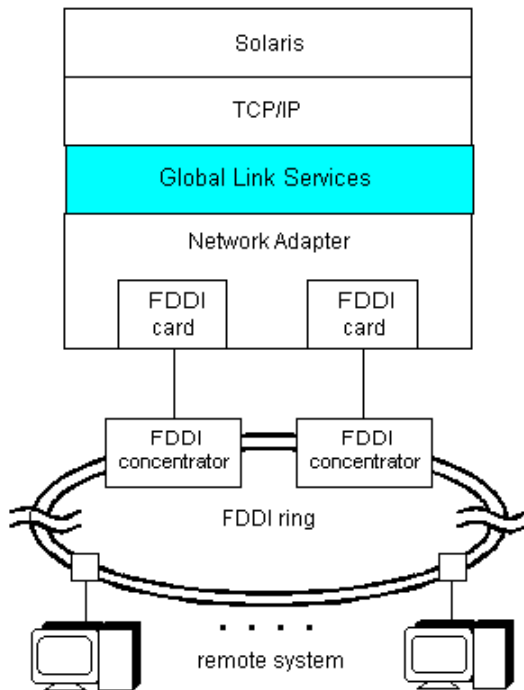
1.1.1 Multipath method

The Multipath method communicates with two or more network interface cards (NIC) by making the transmission path between the NIC and the switch redundant, and by an exclusive access of the NIC (one adapter is put into "active" state during normal operation). When unexpected failures are detected in transmission path or on NIC, the online NIC is switched to the standby NIC to achieve the high-reliability of the communication.

The Multipath function is also able to implement FNA and SNA protocol as high-layer protocol used like TCP/IP. And, not only the Ethernet LAN card but also the FDDI card and the ATM card can be used as a NIC.

[Figure 1.1 Ethernet connection in Multipath method]

[Figure 1.2 FDDI connection in Multipath method]
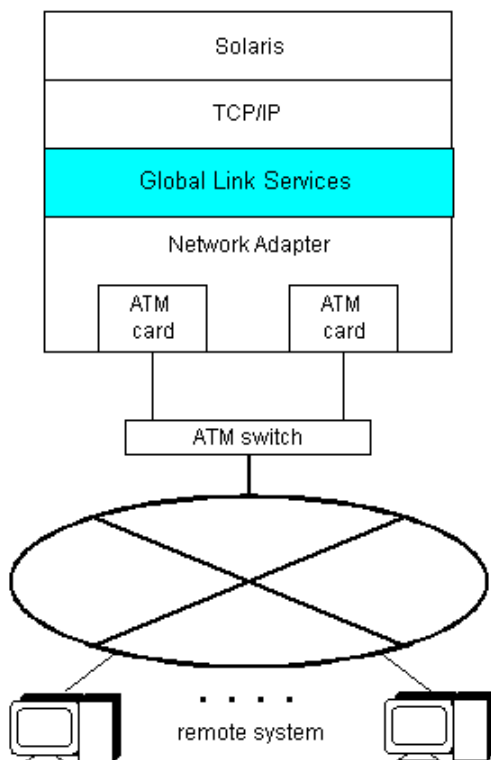
[Figure 1.3 ATM connection in Multipath method]

The provided functions are listed in "Table 1.1 Multipath functions," and supported LAN driver whom the Multipath function can use is listed in "Table 1.2 Support Media List."

Please refer to "2.2 Notes" when you use FDDI, ATM, and Gigabit Ethernet.

[Table 1.1 Multipath functions]

Usable upper protocol		TCP/IP, FNA, and SNA
Fault monitoring system	Fault monitoring	If an abnormal transmission path or abnormal packet is detected by the transmission path monitoring daemon, the online NIC is switched to the standby NIC.
	Switching time	About 10 seconds For ATM connection, switching might take longer, depending on the specifications of the ATM protocol being used and the ATM switch.
	Detectable failure	NIC, cable, and switch failures
	Fault monitoring system start/stop	The fault monitoring system is started at system initiation and stopped with system termination.
Switching function	Behavior at switching	The communication path of the online NIC is stopped("fail" status), and the communication path of standby NIC is put into communication("active" status).
	Switching back operation	It can fail back by executing a command to the standby path.
NIC-sharing capability		NICs which composes of the Multipath function cannot be shared by other methods or high-layer protocols.
Reachable (ready to communicate) remote device		Selectable
DR function (*1)		The DR function is implemented by providing DR scripts.

*1 The Dynamic Reconfiguration (DR) function is provided by the GP7000F model 1000/2000 or PRIMEPOWER 800/900/1000/1500/2000/2500.

[Table 1.2 Multipath media support]

Media type	Driver name	Supported
Ethernet	le driver	Not supported
FastEthernet	hme driver	Supported
	qfe driver	Supported
	fjqe driver	Supported
	eri driver	Not supported
Gigabit Ethernet	vge driver	Not supported
	ge driver	Supported
	ce driver	Not supported
	fjge driver	Supported
	fjgi driver	Supported
FDDI	pf driver	Not supported
	snd driver	Supported
ATM	ba driver	Not supported
	li driver	Supported

1.1.2 Multilink Ethernet method

The Multilink Ethernet function uses multiple FastEthernet or Gigabit Ethernet cards and connects to a switch with built-in Multilink Ethernet method. This makes the transmission path between the LAN card (NIC) and the switch redundant, and enables simultaneous use of the NICs (all communication paths are put into "active" state in normal operation). This results in distribution of the data transfer load to multiple components and in a wider band for communication, thereby enhancing transfer efficiency for remote systems.
If an unexpected failure is detected in a transmission path or on the NIC, the transmission data path is switched to another online NIC to continue communication.

On the Multilink Ethernet method, only TCP/IP can be used as a high-layer protocol.

Also, only Ethernet LAN cards are used as NICs; FDDI and ATM cards cannot be used.

Caution

- Use of Multilink Ethernet method requires a switch supporting Multilink Ethernet method.
  The name of the Multilink Ethernet method can differs for each switch. For example, the name "Multilink Ethernet function" or "Trunking function" might be used.
- The communication bandwidth of the Multilink Ethernet method can be calculated as "number of NICs used x transfer rate x instances of full-duplex communication". In other words, the obtained communication bandwidth is higher, but transfer performance (throughput) does not necessarily increase.
- Multilink Ethernet method and the Trunking function do not establish a data transfer protocol.
  They are simply functions for distributing transmission data and depend on the distribution method of the switch that receives the data.
- The Multilink Ethernet method is a function intended to distribute loads and to enhance transfer efficiency by simultaneously using two or more NICs.
  If the number of used NICs increases, however, the CPU load rate of the local system might increase as well, affecting transfer performance (throughput) of the entire system.
  The transfer performance (throughput) might also be affected by the distribution method adopted by the switch connected to the local system and the network configuration.
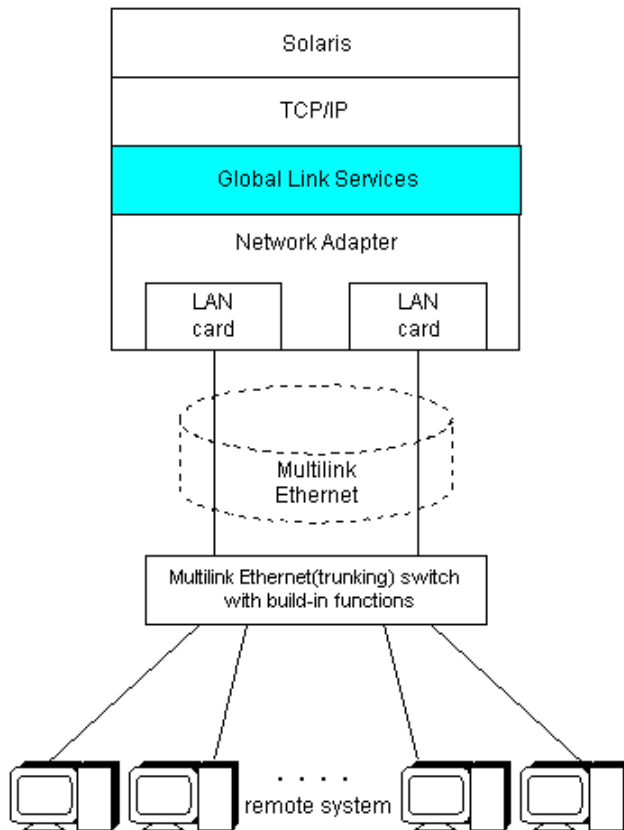
[Figure 1.4 Multilink Ethernet method]

The provided functions are listed in "Table 1.3 Multilink Ethernet functions." "Table 1.4 Multilink Ethernet support media," lists the media that can be used in Multilink Ethernet method.
Also, be sure to read "2.2 Notes."

[Table 1.3 Multilink Ethernet functions]

Usable upper protocol		TCP/IP
Data distribution system	Remote MAC address distribution	Before data is transmitted, the transmission destination NIC is determined based on the remote MAC address.
	Round-robin distribution	Data is transmitted by distributing it evenly to component NICs.

	Destination IP address distribution	Before data is transmitted, the transmission destination NIC is determined based on the remote IP address.
	Destination/Source IP address distribution	Before data is transmitted, the transmission destination NIC is determined based on the remote IP address and the local IP address
Fault monitoring system	Fault monitoring	If an abnormal transmission path or abnormal packet is detected by the transmission path monitoring daemon, another online NIC is selected.
	Switching time	About 10 seconds
	Detectable failure	NIC, cable, and switch failures
	Fault monitoring start/stop	The fault monitoring system is started at system initiation and stopped with system termination.
Switching function	Behavior at switching	Communication path of the online NIC is stopped("fail" status), and the communication path of standby NIC is put into communication("active" status).
	Switching back operation	The failed NIC is in "fail" state, not in "active" state.
NIC sharing capability		NICs configured for Multipath functions cannot be shared by operations of other types or by the high-layer protocols.
Reachable (ready to communicate) remote device		Selectable
DR function (*1)		The DR function is implemented by providing DR scripts.

*1 The Dynamic Reconfiguration (DR) function is provided by the GP7000F model 1000/2000 or PRIMEPOWER 800/900/1000/1500/2000/2500.

[Table 1.4 Multilink Ethernet media support]

Media type	Driver name	Supported
Ethernet	le driver	Not supported
FastEthernet	hme driver	Supported
	qfe driver	Supported
	fjqe driver	Supported
	eri driver	Not supported
Gigabit Ethernet	vge driver	Not supported
	ge driver	Supported
	ce driver	Not supported
	fjge driver	Supported
	fjgi driver	Supported
FDDI	pf driver	Not supported
	snd driver	Not supported
ATM	ba driver	Not supported
	li driver	Not supported

1.1.2.1 MAC address distribution method

This section explains the Multilink Ethernet MAC address distribution method.

In the MAC address distribution method, the Multipath function independently determines the transmission destination NIC from the remote MAC (transmission destination MAC) address added to the transmission data, and transmits the data.
This method lowers the likelihood of the transmission path being occupied by one remote system if there are many remote systems to be connected and enhances the transmission efficiency of the other remote systems.

"Figure 1.5 Transmission data flow in MAC address distribution method," diagrams the transmission

data flow in MAC address distribution method.
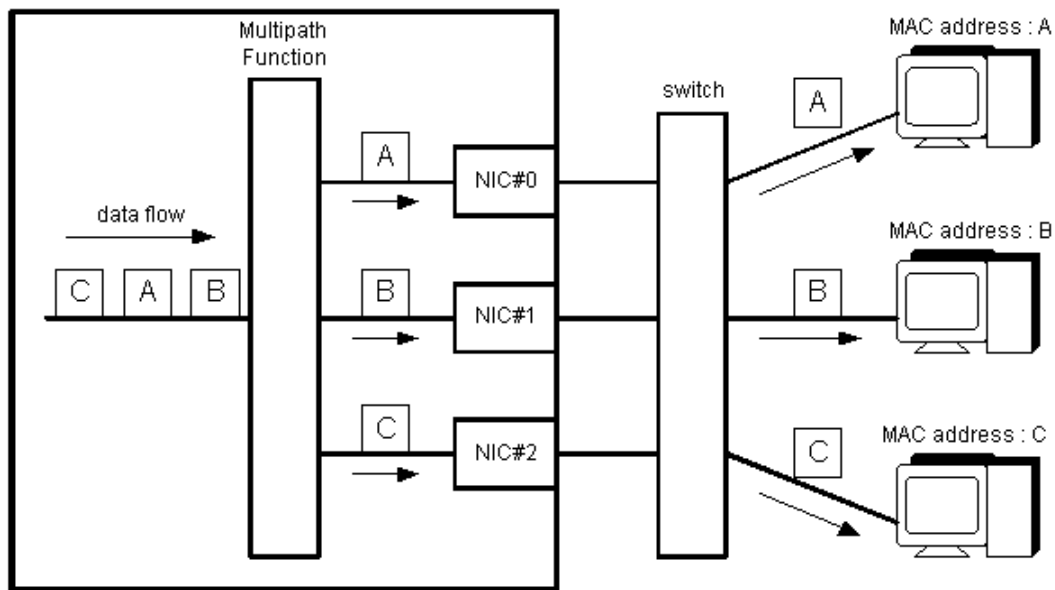
[Figure 1.5 Transmission data flow in MAC address distribution method]

Caution

· The CPU load rate increases in proportion to the number of used NICs.
Therefore, response to the remote system can be expected to improve, but the transfer performance does not necessarily increase.
· The transmission path through which the local system receives data depends on the distribution method of the switch.
When the switching method distributes the data to remote MAC (transmission destination MAC) addresses, the data is received on one transmission path because the local system has only one MAC address.
When the switching method distributes the data from local MAC (transmission source MAC) addresses, the data is received via distributed transmission paths, where the Multipath function efficiently uses the component NICs. This leads to more efficient communication.
· Since a remote MAC (destination MAC) address turns into a MAC address of a router, when the router is installed between the local system and the remote system, the transmission path becomes one.
When the router is installed between the local system and the remote system, Multilink Ethernet destination IP address distribution method is effective.
Multilink Ethernet destination IP address distribution method is shown in subsection "1.1.2.3 Destination IP address distribution method."

1.1.2.2 Round-robin distribution method

This section explains the Multilink Ethernet round-robin distribution method.

In round-robin distribution method, the Multipath function transmits data by distributing it evenly to the component NICs.
This method is effective for normal use because it does not exclusively use the redundant components or NICs whereas the Multipath and MAC address distribution method do.
However, as noted below, this might not lead to improved transfer performance.

"Figure 1.6 Transmission data flow in round-robin distribution method," diagrams the transmission data flow in round-robin distribution method.
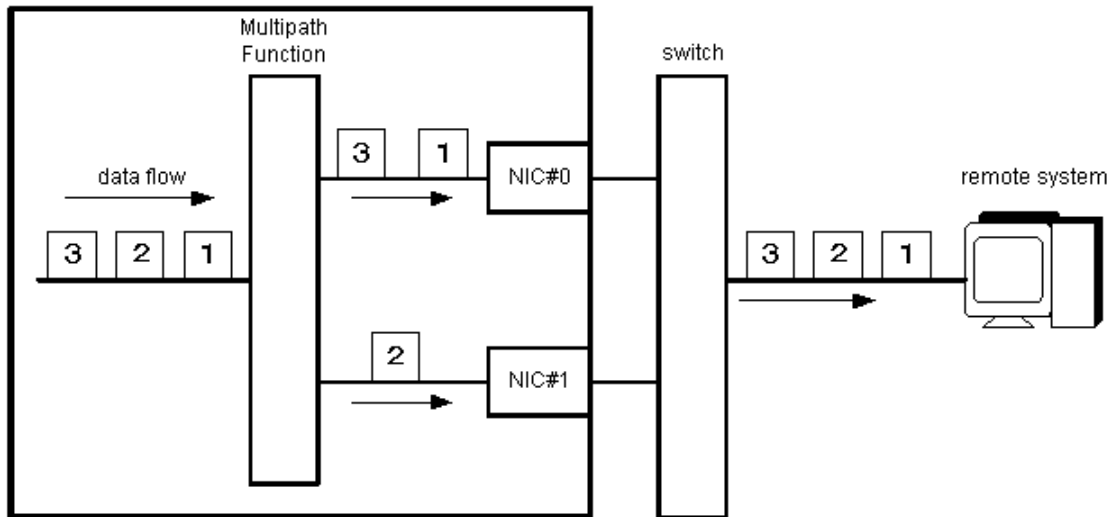
[Figure 1.6 Transmission data flow in round-robin distribution method]

Caution

- The CPU load rate increases in proportion to the number of NICs used.
- In round-robin data distribution method, the sequence of transmitting and receiving data cannot be guaranteed because it is affected by data delays and deletions caused by the processing sequence and transmission path noise on the local system and the switches for connection.
  Therefore, it might be necessary to re-transmit data on the high-layer, which adversely affects transfer performance.

1.1.2.3 Destination IP address distribution method

This section explains Multilink Ethernet destination IP address distribution method.

In the destination IP address distribution method, the Multipath function independently determines the transmission destination NIC from the remote IP (transmission destination IP) address added to the transmission data, and transmits the data.
This method lowers the likelihood of the transmission path being occupied by one remote system, if there are many remote systems to be connected, and enhances the transmission efficiency of the other remote systems. In the destination IP address distribution method, the transmission data is distributed even when a router is installed between the local system and the remote system.

"Figure 1.7 Transmission data flow in destination IP address distribution method," diagrams the transmission data flow in destination IP address distribution method.

⚠️ **Caution**

· The CPU load rate increases in proportion to the number of used NICs.
· The transmission path through which the local system receives data depends on the distribution method of the switch.
When the switching method distributes the data to a remote IP (transmission destination IP) address, the data is received on one transmission path because the local system has only one MAC address.
When the switching method distributes the data from a local IP (transmission source IP) address, the data is received via distributed transmission paths, where the Multipath function efficiently uses the component NICs. This leads to more efficient communication.
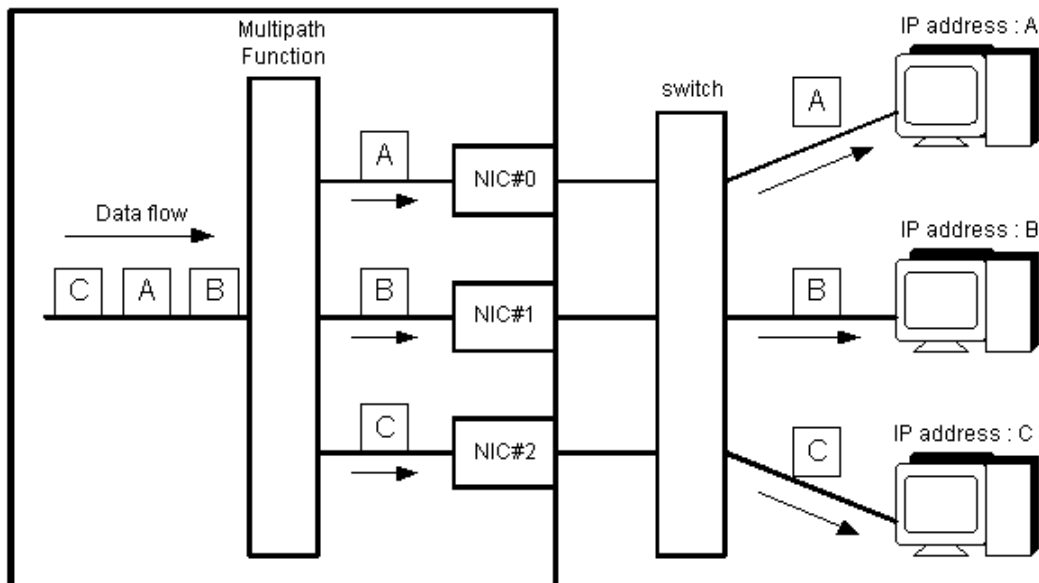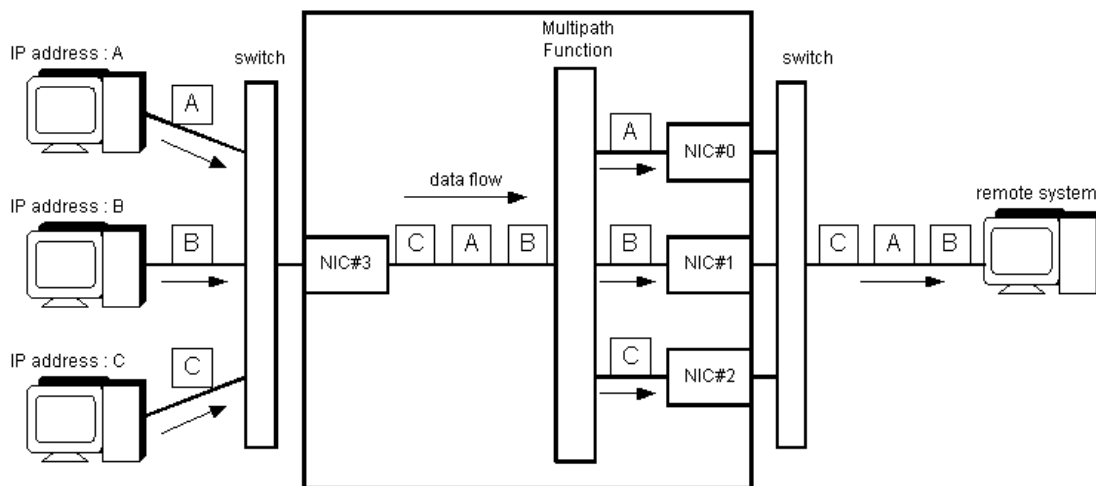
1.1.2.4 Destination/Source IP address distribution method

This section explains the Multilink Ethernet destination/source IP address distribution method.

In the destination/source IP address distribution method, the Multipath function independently determines the transmission destination NIC from the remote IP (transmission destination IP) and local IP (transmission source IP) address added to the transmission data, and transmits the data.
This method lowers the likelihood of the transmission path being occupied by one remote system, if there are many remote systems to be connected, and enhances the transmission efficiency of the other remote systems. Moreover, when transmitting data to the same remote system from two or more local systems, e.g. when local system uses it as a router, this method enhances the transmission efficiency of the other transmission source systems.

"Figure 1.8 Transmission data flow in destination/source IP address distribution method," diagrams the transmission data flow in destination/source IP address distribution method.

[Figure 1.8 Transmission data flow in destination/source IP address distribution method]

⚠️ **Caution**

· The CPU load rate increases in proportion to the number of used NICs.
· The transmission path through which the local system receives data depends on the distribution method of the switch.
When the switching method distributes the data to a remote IP (transmission destination IP) address, the data is received on one transmission path because the local system has only one MAC address.
When the switching method distributes the data from a local IP (transmission source IP) address, the data is received via distributed transmission paths, where the Multipath function efficiently uses the component NICs. This leads to more efficient communication.

1.2 Benefits

Installing the Multipath function enables you to build a reliable network system where the desirable capabilities such as fault tolerance and high availability are available.

The Multipath method implements redundant communication in both the FNA and SNA protocols without putting any restrictions on the selection of the high-layer protocol.
The Multilink Ethernet method provides enhancements in data transfer efficiency and high communication bandwidth.

In addition, to correspond to the Dynamic Reconfiguration(DR) function of GP7000F model 1000/2000 or PRIMEPOWER 800/900/1000/1500/2000/2500, a DR script is offered in the Multipath function.

The iompadm command (I/O Multipath control command) can be used for status display and restoration.

10

Chapter 2 Capabilities

2.1 Outline of Functions

Using the Multipath function allows you to connect two or more network interface cards (NICs) onto the same network (LAN), and makes the transmission path between the NIC and the switch redundant.
One logical interface is used to communicate with the NIC using exclusive access (one adapter is put into "active" state during normal operation).

The transmission path is switched when some abnormalities are detected between the transmission path or NIC and the switch.
When a NIC is switched, the MAC address that is set in the environment file is taken over as the default configuration. Therefore, the remote system can continue communicating without sensing the changeover to the standby NIC.

The Multipath function may occasionally be expressed as MPNET.
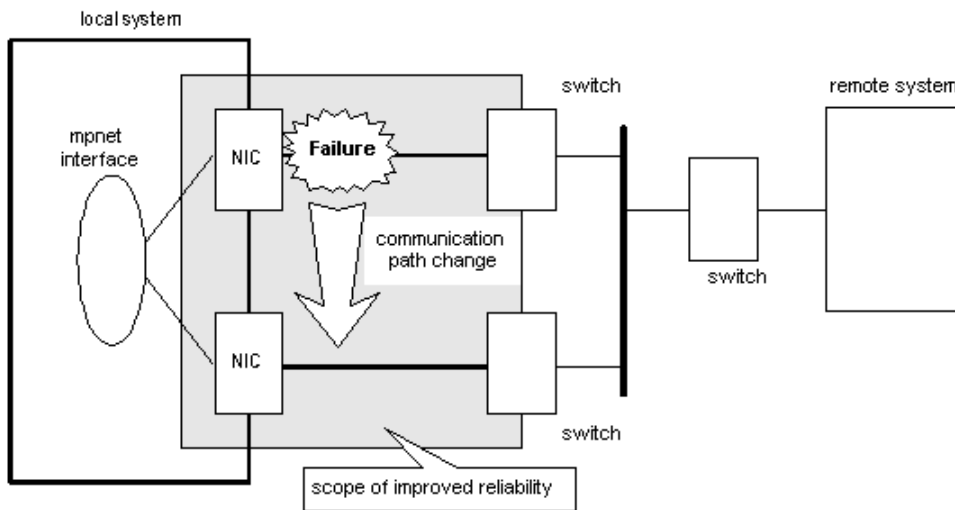
[Figure 2.1 Operation of Multipath Function Example]

- · Connection configuration
    - ‐ The duplicated NICs are connected onto the same network. Connection with the remote system is established either on the same network or on the network over the router.
- · Feature
    - ‐ The iompadm command (I/O Multipath control command) can be used for status display and restoration.
- · Scope
    - ‐ Multipath function is achieved not only with TCP/IP protocol but also FNA and SNA to make a duplex LAN system.

The system configuration of the Multipath function is shown in "Figure 2.2 System Configuration of Multipath Function."
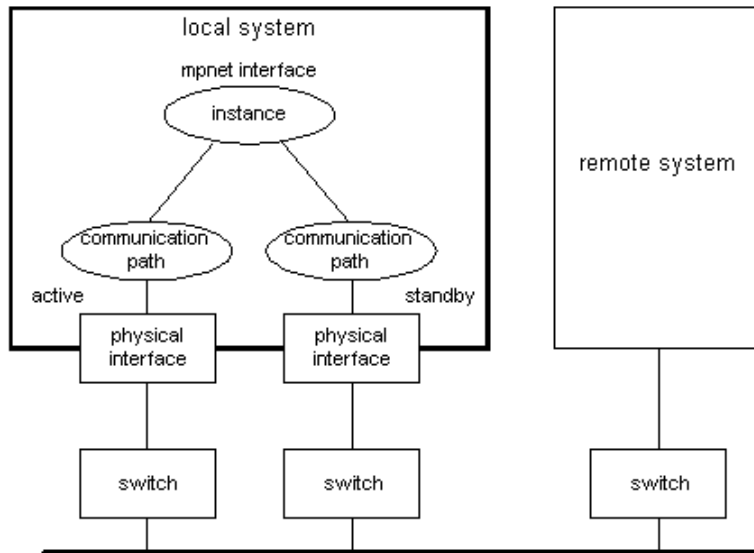
[Figure 2.2 System Configuration of Multipath Function]

Each component and the meaning are as follows.

- Instance
  - The logical interface name that the higher level or the user accesses is called the instance. In the Multipath function, the instance is expressed as the MPNET interface name.
- Communication path
  - The physical device name of NIC used is expressed as the communication path.

2.1.1 Fault monitoring system

2.1.1.1 Fault monitoring

The connected state (Link up/down) of the transmission path between the online NIC and switch is monitored by the transmission path monitoring daemon to check the error rate of communication (I/O). Moreover, the connected state (Link up/down) of the transmission path between the standby NIC and switch is monitored by the transmission path monitoring daemon.

When some abnormalities are detected in the transmission path between the online NIC and switch, the online NIC is switched to the standby NIC then the monitoring target must be changed into the standby NIC. Moreover, when some abnormalities are detected in the transmission path between standby NIC and switch, the standby NIC will be in the unusable state.

If the communication path that changed into the unusable state by link down detection is recognized to be normal by the transmission path monitoring demon, it will be restored automatically. It restores in about 5 seconds after the connection state of a transmission path is detected to be normal (Link up).
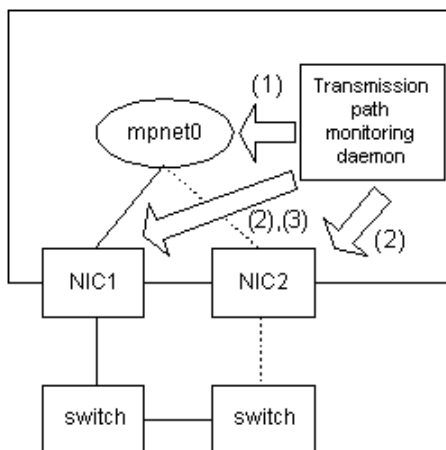
(1): Determine the multipath status
  The "active" and "standby" path
  is found.
(2): Monitor the Link Up/Down status
  Check for failty cable connection.
(3): Monitor the number of packet errors
  The input-output packet error rate is
  monitored.
  ("active" path only)

[Figure 2.3 Fault Monitoring of Multipath Function]

⚠️ **Caution**

· When the FDDI card is used, the connection state (Link up/down) monitoring of the transmission path from the standby NIC to switch is not supported. Moreover, automatic restoration is not supported.

2.1.1.2 Switching time

The switching time (error detection time) is about 10 seconds.
However, the switching time is occasionally affected by the ATM switch.

The online NIC is monitored in 5 seconds intervals by the transmission path monitoring daemon, and the standby NIC is monitored in 300 seconds intervals. The connection state monitoring of the transmission path will judge that the transmission path is abnormal, if Link down is detected twice consecutively. If abnormalities are detected by the online NIC, the standby NIC will change to online, and to be in the state where it cannot be used if abnormalities are detected by the standby NIC. As for the error rate monitoring of the communication packet, the switching is done upon the error rate of the input and output packet reaching 50%.

2.1.1.3 Detectable failures

Multipath function can detect the following failures.

(1): NIC failure
(2): Cable failure
    (including missing cable)
(3): Switch failure
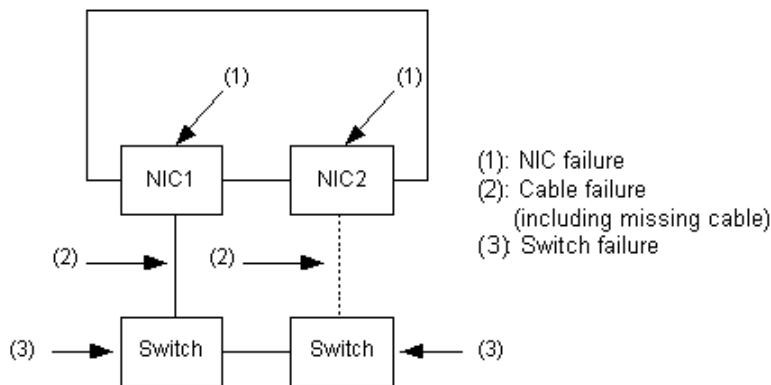
[Figure 2.4 Range of Fault Detection by Multipath Function]

2.1.1.4 Monitoring start/stop timing

The transmission path monitoring daemon starts automatically when the system is initiated, and stops automatically at system stop.

The transmission path monitoring daemons are executed on the number of processes of which the logical interfaces are activated. This means that one process of the transmission path monitoring daemon is started for one logical interface.

The process name of the transmission path monitoring daemon is "mpnetd."

2.1.2 Switching function

State transition of communication paths

Each used communication path has the state (status) for the switching operation. The state transition of the communication path is explained in "Figure 2.5 State Transition of Communication Path." The meaning of those states is shown in "Table 2.1 Description of the state of communication path."

It is possible to refer to the state of the communication path only when it was able to activate normally. Refer to Subsection "6.3.2.1 info subcommand" or "6.3.2.2 status subcommand" of "6.3 Multipath control command" for the method of monitoring the state of the communication path.
Moreover, refer to "6.3 Multipath control command" for the subcommand used for the state transition.

Refer to "Chapter 8 Dynamic Reconfiguration (DR) Function" for the Dynamic Reconfiguration (DR) function.
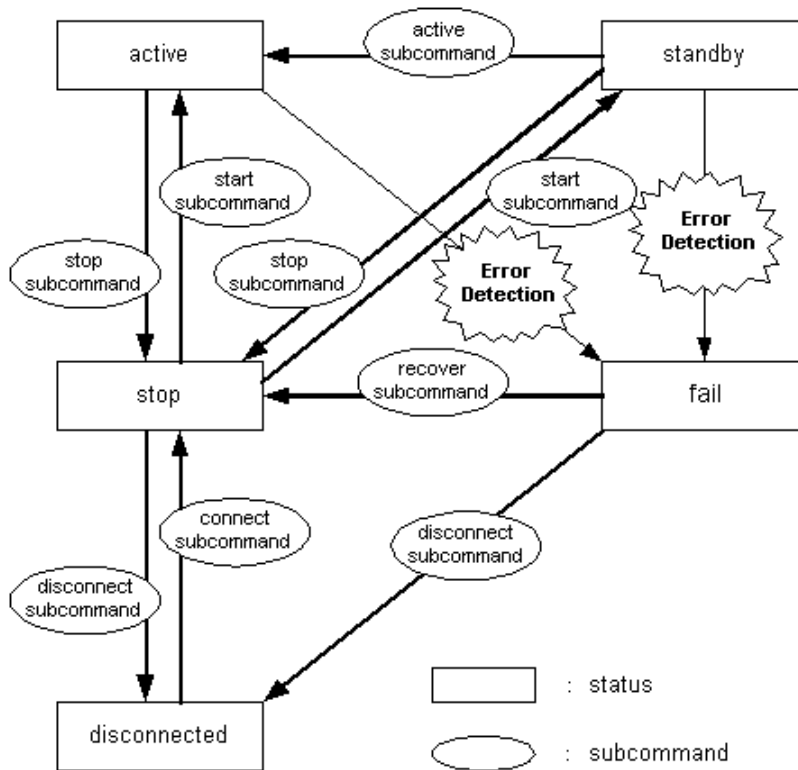
[Figure 2.5 State Transition of a Communication Path]

[Table 2.1 Descriptions of the states of communication paths]

State	Description
active	Communicating/Ready to communicate
standby	Ready to communicate but the standby state
stop	Stopped
fail	Disabled due to error detection
disconnected	Disconnected state
busy	Processing

Switching operation

When status of the communication path is displayed, the online NIC shows "active" state. When switching the online NIC, the driver software searches the standby NIC, and the MAC address configured by the environmental setting is taken over to the standby NIC.
Upon detection of an error, console messages are output from the driver software and the transmission path monitoring daemon.

The online NIC changes from "active" state to "fail" state to switch to the standby NIC. The standby NIC changes from "standby" state to "active" state to continue communicating with the remote system.

Operation of switching back

The "standby NIC" is changed from "standby" state into "active" state by executing "active subcommand", and communication is continued.
At this time, the online NIC in "active" state changes to "standby" state.
And, "standby" state changes from "fail" state in executing "recover subcommand" and "start subcommand", and can be reused as the standby NIC.

2.1.3 Reachable remote device

The devices that communicates with TCP/IP, FNA, or SNA protocols can be targeted.

2.2 Notes

2.2.1 Notes on installation

2.2.1.1 General notes

· When Solaris OE is installed, a configuration file with the name "hostname.interface_name (e.g. hostname.hme0)"for a TCP/IP interface is created in the /etc area when making the network settings, such as the configuration for the basic interface (e.g. hme0).
When using the Multipath function, a file named "/etc/hostname.interface_name," and "/etc/hostname6.interface_name" for configuring the logical interface of the Multipath function must not be included. For example, if the hme0 interface is used in the Multipath function, the file /etc/hostname.hme0 must be deleted.
When using the Multipath function, skip the network setup of the interface during installation of Solaris OE. If this is not possible, restart the system in single user mode after configuring the network and delete the "/etc/hostname.interface_name" and "/etc/hostname6.interface_name" file.
· The maximum number of devices (the number of communication paths) that one logical interface can use is eight. Because the main system has mounting restrictions on the number of adapters to be used, the number of devices to be installed must be checked.
When the ATM card is used, the number of maximum devices (the number of communication paths) that one logical interface can use is two.
· The number of MPNET interfaces which can be configured is up to 16 interfaces.
· When Gigabit Ethernet is used, the "vge" driver (X1044A adapter) can not be used.
· When using the Jumbo Frame feature of Gigabit Ethernet, PP028GE1 and PW008GE1 and PW008GE4, PW008GE5 are supported. Other Gigabit Ethernet cards are not supported. In addition, when using Jumbo Frame, the driver version of "FUJITSU PCI Gigabit Ethernet 1.4" or later is needed. Therefore, check the driver version before installation.
· When using the Jumbo Frame feature of Gigabit Ethernet, the MTU length configuration file "/etc/fjmtu.fjgeX" or "/etc/fjmtu.fjgiX" needs to setup to physical interfaces used by the Multipath function. All the "/etc/fjmtu.fjgeX" or "/etc/fjmtu.fjgiX" of the physical interface of Gigabit Ethernet which use the Multipath function must set up the same value. When a different value is set up, the MTU length of the TCP/IP interface of the Multipath function is set as 1500.
Please refer to "FUJITSU PCI Gigabit Ethernet 1.4 User's Guide" about the Jumbo Frame feature.
· FastEthernet cannot be used together with Gigabit Ethernet in one logical interface.
· When FDDI is used, only GP7B8FD2 and GP7B8FD2-F are supported with the Multipath function. Other FDDI cards are not supported.
· When ATM is used, only GP7B8AT1 and GP7B8AT1-F are supported with the Multipath function. Other ATM cards are not supported. Note that in GP7B8AT1 and GP7B8AT1-F, adapter 002AA or later can be used. Therefore, check the adapter version before installation.
· When the TCP/IP interface is used, the Multipath function will not support IPv4 tunnel and IPv6 tunnel. IPv6 is not supported, when using ATM.
· The communications that use SNMP (Simple Network Management Protocol) are not supported.
· The Multipath function does not support PRIMECLUSTER Scalable Internet Services (SIS).
· If the Multipath function is installed, the driver version of any of the media listed in the table below must be checked. The table lists the driver versions that can be used for the specific Multipath function.

Media (adapter name)	Driver name and version
FDDI card (GP7B8FD2)	FUJITSU PCI FDDI 1.2 or later
ATM card (GP7B8AT1)	FUJITSU PCI ATM 1.2 or later
Gigabit Ethernet card (PP028GE1/PW008GE1)	FUJITSU PCI Gigabit Ethernet 1.2 or later (Jumbo Frame corresponds with driver version of 1.4 or later.)
Gigabit Ethernet card (PW008GE4/PW008GE5)	FUJITSU PCI Gigabit Ethernet 2.0 or later
Quad Fast Ethernet card (PW008QE1)	FUJITSU PCI Quad 10/100 Ethernet 1.0 or later

2.2.1.2 Notes on Multipath method

· A maximum of eight devices (communication paths) can be used by one logical interface.
Because of restrictions with respect to the number of adapters that can be installed on the main system, the number of devices to be installed must be checked.
If ATM cards are used, a maximum of two devices (communication paths) can be used by one logical interface because one system can only contain two cards.

2.2.1.3 Notes on Multilink Ethernet method

· The switches used for interconnection must have the Multilink Ethernet or Trunking function.
· A maximum of eight devices (communication paths) can be used by one logical interface.
  Because the main system has restrictions on the number of adapters to be used, the number of devices to be mounted must be checked.
· Only TCP/IP can be used as the high-layer protocol.

2.2.2 Notes on defining the high-layer protocol environment

· Netcompo OSI-BASE is not supported.
· Netcompo FNA-LAN is supported in version 1.4 or later.
· When the environmental configuration of upper products (e.g. Netcompo FNA-LAN) is configured from the menu, the MPNET interface name is not displayed. Configure the environmental configuration by using the editor.
· Regulation of intervals of data resending and retry frequency depends on the high-layer protocols used. You must set the retry time longer than 10 seconds because it takes about ten seconds for switching the Multipath function.
· Process might come to remain stopped waiting for receipt of data, if the transmission path is switched by a high-layer protocol or the application software. The monitoring function must be set to the non-communication state for the high-layer protocol.

2.2.3 Notes on operation

· The Multipath function detects abnormality after about ten seconds and does the path switch. However, the communication might not be restarted at once by re-study of the switch or the retry time of high-layer protocol.
· When the ATM connection, if the path switch the communication might not be restarted at once by the specification of the ATM switch connected, and the specification of the ATM protocol.
· When using ATM, the MPNET interface is not able to be activated by the "MPNET activation and deactivation" command (*mpnetinit* command or *mpnetconfig* command) which the Multipath function offers. The communication of ATM might not be able to be restarted even if activated. Please execute reboot if you activate ATM.

Chapter 3 Configuration

3.1 Environmental Configuration

This chapter explains the environmental configuration of Multipath function.
In the configuration of the Multipath function, the environmental configuration file is provided beforehand. Use text editor to configure the following files.

- · 3.2 /etc/opt/FJSVmpnet/conf/config
- · 3.3 /etc/opt/FJSVmpnet/conf/parameters
- · 3.4 /etc/opt/FJSVmpnet/conf/hosts
- · 3.5 /etc/opt/FJSVmpnet/conf/hosts6
- · 3.6 /etc/opt/FJSVmpnet/conf/hostname
- · 3.7 /etc/opt/FJSVmpnet/conf/hostname6

3.2 /etc/opt/FJSVmpnet/conf/config

The logical device name of LAN used for the communication path that is composed by MPNET (that is, the interface to be activated) is defined in this file. The configuration of this file cannot be omitted.

The following configuration samples are provided in this file. Copy the line to be used from the sample to configure the configuration.

The form of the entry is shown below.

```
#ident "@(#)config  Rel 2.2 02/06/06  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/config file
#
#
# Set the starting interface name on the this machine.
#
# format:
# interface-name  media-type   lan-interface:lan-interface:....
#
# example:
# mpnet0       ether      hme0:hme1
# mpnet1       ether      ge0:ge1
#
```

interface-name

This indicates the interface name of MPNET.

The interface name is composed of the driver name "mpnet" in lower-case and the instance number (decimal number).
Unique values must be specified in the same configuration.

media-type

This indicates the type of the logical device of LAN used.

- · ether : When you uses FastEthernet card or Gigabit Ethernet card.
- · fddi : When you uses FDDI card.
- · atm : When you uses ATM, and you use IPoA(RFC1157 SVC connection).
- · lane : When you uses ATM, and you use LAN emulation.

lan-interface

This indicates the logical device name of LAN used.

⚠ **Caution**

- · The FastEthernet driver (hme and qfe) cannot be used together with the Gigabit Ethernet driver in one logical interface.
- · Make sure there is no double specification of the same logical device name of LAN.

· For an ATM connection, the number of logical devices (communication path) for which one logical interface can be specified is up to two.
· When using the ATM cards, the Permanent Virtual Circuit (PVC) feature is not supported.
· In the Multipath function, the "/etc/hostname.interface-name" file which corresponds to the logical interface which the Multipath function composes must not exist. Please delete the corresponding "/etc/hostname.interface-name" file, if it exists.

The configuration example is shown in the following:

· Example of Ethernet connection and environmental configuration

```
#ident "@(#)config  Rel 2.2 02/06/06  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/config file
#
#
# Set the starting interface name on the this machine.
#
# format:
# interface-name  media-type   lan-interface:lan-interface:....
#
# example:
# mpnet0      ether      hme0:hme1
# mpnet1      ether      ge0:ge1
#

mpnet0       ether      hme0:hme1
mpnet1       ether      ge0:ge1
mpnet2       ether      qfe0:qfe4
```

· Example of FDDI connection and environmental configuration

```
#ident "@(#)config  Rel 2.2 02/06/06  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/config file
#
#
# Set the starting interface name on the this machine.
#
# format:
# interface-name  media-type   lan-interface:lan-interface:....
#
# example:
# mpnet0      ether      hme0:hme1
# mpnet1      ether      ge0:ge1
#

mpnet0       fddi       snd0:snd1
mpnet1       fddi       snd2:snd3
```

· Example of ATM connection and environmental configuration

```
#ident "@(#)config  Rel 2.2 02/06/06  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/config file
#
#
# Set the starting interface name on the this machine.
#
# format:
# interface-name  media-type   lan-interface:lan-interface:....
#
# example:
# mpnet0      ether      hme0:hme1
# mpnet1      ether      ge0:ge1
#

mpnet0      lane      li0:li32
mpnet1      lane      li1:li33
mpnet2      atm       li16:li48
```

3.3 /etc/opt/FJSVmpnet/conf/parameters

Operation information for MPNET on each interface is defined. This configuration cannot be omitted.

The following configuration samples are provided in this file. Copy the line to be used from the sample to configure the configuration for the communication type.

The form of the entry is shown below.

```
#ident "@(#)config  Rel 2.2 02/06/07  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/parameters file
#
#
# Set the interface parameters on the this machine.
#
# format:
# interface-name  MAC-address:func-mode:trunk-mode   cluster
#
# example:
# mpnet0      -:0:0                 none
# mpnet1      020000000000:0:0           none
#
```

Each parameter is explained as follows.

interface-name

This indicates the interface name of the MPNET.

See the section "3.2 /etc/opt/FJSVmpnet/conf/config" to specify the interface name.
Unique values must be specified in the same configuration.

MAC-address

This indicates MAC address.

The specified MAC address is used to take over in the communication path that are composed of one interface.
To have the MAC address taken over in the communication path, specify "-" in the global MAC address.
To replace the MAC address with other values for takeover, specify your MAC address with the 12 digit number.

⚠️ **Caution**

· When the ATM card is used, "-" (global MAC address) cannot be specified for the MAC address.

Please specify a local MAC address, and apply the following regulations.
The MAC address of the first logical device (li0 and li32, etc.) becomes base point, and the MAC address of the next logical device becomes the MAC address plus 1 (hexadecimal number).
For instance, when the MAC address of li0 is "020000000000", the MAC address of li1 is "020000000001", and the MAC address of li16 becomes "020000000010".
The Multipath function should set the MAC address according to these regulations. Refer to "Example of ATM connection and environment configuration."
· In the cluster system, "-" (global MAC address) cannot be used when SNA or FNA protocol is used for the high-layer protocol. The MAC address value must be specified.

func-mode

Function mode

The following values can be specified.

· 0 : Use Multipath method.
· 1 : Use Multilink Ethernet method.

If any other value is specified, the mode cannot be activated.

trunk-mode

Multilink Ethernet data distribution method

This parameter is valid if 1 (Multilink Ethernet method) is specified in the func-mode parameter. If 0 (Multipath method) is specified, specify 0 for this parameter.
The following values can be specified.

· 0 : Use the remote MAC address distribution method.
· 1 : Use the round-robin distribution method.
· 2 : Use the destination IP address distribution method
· 3 : Use the destination/source IP address distribution method

If any other value is specified, the Multilink Ethernet data distribution method cannot be activated.

cluster

This indicates the cluster configuration.
Choose one of the following for the target interface:
Specify "none" for no cluster target.
Specify space (blank) for the cluster target.
When using ATM, the MPNET interface which takes over by the cluster, and the MPNET interface which is not so cannot be intermingled.

Refer to "Chapter 7 Administration on a Cluster System" for the environmental configuration method of cluster system.

The configuration example is shown in the following:
· Environmental configuration example of Ethernet connection or FDDI connection

```
#ident "@(#)config Rel 2.2 02/06/07 FUJITSU"
#
#    /etc/opt/FJSVmpnet/conf/parameters file
#
#
# Set the interface parameters on the this machine.
#
# format:
# interface-name  MAC-address:func-mode:trunk-mode   cluster
#
# example:
# mpnet0      -:0:0              none
# mpnet1      020000000000:0:0         none
#

mpnet0      -:0:0              none
mpnet1      020000000001:0:0        none
mpnet2      020000000010:0:0        none
```

· Example of ATM connection and environment configuration

The example of setting the MAC address is described based on the interface of "Example of ATM connection and environmental configuration" described to the /etc/opt/FJSVmpnet/conf/config file.

- Interface mpnet0 (Logical device name:li0/li32)
- Interface mpnet1 (Logical device name:li1/li33)
- Interface mpnet2 (Logical device name:li16/li48)

When the MAC address which mpnet0 uses is set as "020000000000", the MAC address of mpnet1 adds 1 (hexadecimal number) from the MAC address of mpnet0, and becomes "020000000001". Similarly, the MAC address of mpnet2 adds 0x10 from The MAC address of mpnet0, and becomes "020000000010".
The configuration example is shown in the following:

```
#ident "@(#)config  Rel 2.2 02/06/07  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/parameters file
#
#
# Set the interface parameters on the this machine.
#
# format:
# interface-name  MAC-address:func-mode:trunk-mode   cluster
#
# example:
# mpnet0      -:0:0                 none
# mpnet1      020000000000:0:0          none
#

mpnet0      020000000000:0:0        none
mpnet1      020000000001:0:0        none
mpnet2      020000000010:0:0        none
```

3.4 /etc/opt/FJSVmpnet/conf/hosts

The IPv4 interface that uses TCP/IP is specified. This configuration can be omitted if the interface that specified in the "config" and "parameters" file is used only by an FNA or SNA connection.

Caution

- This configuration allows you to activate and deactivate the TCP/IP interface using with the *mpnet_ifinit* or *mpnet_ifconfig* command.
- Please do not specify the hostname.mpnetX in the /etc directory when you do this configuration. In the Multipath function, the interface set in /etc/opt/FJSVmpnet/conf/hosts file corresponds to "hostname.interface".
- To specify the hostname, define the IP address in the /etc/inet/hosts file, and define the net mask value in /etc/inet/netmasks, if necessary. Refer to the Solaris OE manual for setting IP address and the netmask value.
- When using a TCP/IP interface for the cluster system, it is necessary to set up this configuration for the online node and the standby node. Moreover, when using IP address takeover, it is necessary to set up the IP address taken over in the /etc/inet/hosts file of each node.
- IPv4 tunnel and IPv6 tunnel are not supported by this product.
- The trailer protocol is not supported by this product.

The following configuration samples are provided in this file. Copy the line to be used from the sample to define the configuration for the communication type.

The form of the entry is shown below.

```
#ident "@(#)config  Rel 2.2 02/06/07  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/hosts file
#
#
# Set the IP host name on the this machine.
#
# format:
# interface-name  hostname
#
# example:
# mpnet0      server1
# mpnet1      server2
#
```

Each parameter is explained as follows.

interface-name

This indicates the interface name of the MPNET.

See the section "3.2 /etc/opt/FJSVmpnet/conf/config" to specify the interface name.
Unique value must be specified in the same configuration.

hostname

This indicates the IPv4 address or the host name that is specified in the /etc/inet/hosts file.

The configuration example is shown in the following:

```
#ident "@(#)config  Rel 2.2 02/06/07  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/hosts file
#
#
# Set the IP host name on the this machine.
#
# format:
# interface-name  hostname
#
# example:
# mpnet0      server1
# mpnet1      server2
#

mpnet0      srv_host0
mpnet1      srv_host1
mpnet2      srv_host2
```

3.5 /etc/opt/FJSVmpnet/conf/hosts6

The IPv6 interface that uses TCP/IP is defined. This configuration can be omitted if the interface that is specified in the "config" and "parameters" file is used only by an FNA or SNA connection.

Caution

· This configuration enables activating and deactivating the TCP/IP interface using the *mpnet_ifinit6* or *mpnet_ifconfig6* command.
· Please do not specify the hostname6.mpnetX file in the /etc directory when you do this configuration. In the Multipath function, the interface set in /etc/opt/FJSVmpnet/conf/hosts6 file corresponds to "hostname6.interface".
· The host name cannot be specified. It is necessary to specify the IPv6 address directly. When specification of the IPv6 address is omitted, arbitrary IPv6 addresses are assigned by Solaris OE system.
· When using a TCP/IP interface for the cluster system, it is necessary to set up this

configuration for the online node and the standby node.
· The trailer protocol is not supported by this product.

The following configuration samples are provided in this file. Copy the line to be used from the sample to define the configuration for the communication type.

The form of the entry is shown below.

```
#ident "@(#)config  Rel 2.2 02/06/07  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/hosts6 file
#
#
# Set the IPv6 host name on the this machine.
#
# format:
# interface-name  IPv6-address
#
# example:
# mpnet0      fe80::1000:0001/112
# mpnet1
#
```

Each parameter is explained as follows.

interface-name

This indicates the interface name of the MPNET.

See the section "3.2 /etc/opt/FJSVmpnet/conf/config" to specify the interface name.
Unique values must be specified in the same configuration.

hostname

This indicates IPv6 address.
The IPv6 address can be omitted. When the IPv6 address is omitted, the IPv6 address is arbitrarily assigned by the Solaris OE system at activation.

The configuration example is shown in the following:

```
#ident "@(#)config  Rel 2.2 02/06/07  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/hosts6 file
#
#
# Set the IPv6 host name on the this machine.
#
# format:
# interface-name  IPv6-address
#
# example:
# mpnet0      fe80::1000:0001/112
# mpnet1
#

mpnet0      fe80::abcd:ef01:2345:0101/112
mpnet1      fe80::fedc:ba98:7654:3210/96
mpnet2
```

3.6 /etc/opt/FJSVmpnet/conf/hostname

The IPv4 virtual interfaces to be associated with the MPNET interface configured in "/etc/opt/FJSVmpnet/conf/hosts" file are defined. This specification can be omitted. This configuration is effective, when two or more logical IPv4 addresses are required (e.g. when using destination/source IP address distribution method of Multilink Ethernet method etc.).

The following configuration samples are provided in this file. Copy the line to be used from sample to specify the configuration.

The form of the entry is shown below.

```
#ident "@(#)config  Rel 2.2 02/06/07  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/hostname file
#
#
# Set the virtual IP host name on the this machine.
#
# format:
# interface-name(VIF) hostname
#
# example:
# mpnet0:1       server1
# mpnet1:1       server2
#
```

Each parameter is explained as follows.

interface-name(VIF)

The virtual interface name over the MPNET interface of MPNET is specified.

The virtual interface name is expressed by adding ":" and instance number (number of 1-255) to the logical interface name that is specified in the "/etc/opt/FJSVmpnet/conf/config" file.

hostname

This indicates the IPv4 address or the host name that is specified in the /etc/inet/hosts file.

The configuration example is shown in the following.

```
#ident "@(#)config  Rel 2.2 02/06/07  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/hostname file
#
#
# Set the virtual IP host name on the this machine.
#
# format:
# interface-name(VIF) hostname
#
# example:
# mpnet0:1       server1
# mpnet1:1       server2
#

mpnet0:1       srv_host0_1
mpnet1:1       srv_host1_1
mpnet2:1       srv_host2_1
```

Caution

- This configuration enables activating and deactivating the TCP/IP interface using with the *mpnet_ifinit* or the *mpnet_ifconfig* command.
- To specify the hostname, define the IP address in the /etc/inet/hosts file, and define the net mask value in /etc/inet/netmasks file if necessary. Refer to the Solaris OE manual for setting the IP address and the net mask value.
- When using cluster system, IP address takeover by the logical IP address is not supported. When using IP address takeover, it is necessary to use the takeover that used the IPv4 address of the MPNET interface.

3.7 /etc/opt/FJSVmpnet/conf/hostname6

The IPv6 virtual interfaces to be associated with the MPNET interface configured in "/etc/opt/FJSVmpnet/conf/hosts6" file are defined. This specification can be omitted. This configuration

is effective, when two or more logical IPv6 addresses are required (e.g. when using destination/source IP address distribution method of Multilink Ethernet method etc.).

The following configuration samples are provided in this file. Copy the line to be used from the sample to specify the configuration.

The form of the entry is shown below.

```
#ident "@(#)config  Rel 2.2 02/06/07  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/hostname6 file
#
#
# Set the virtual IPv6 host name on the this machine.
#
# format:
# interface-name(VIF) IPv6-address
#
# example:
# mpnet0:1        fe80::0101:0001/112
# mpnet1:1        fe80::0201:0001/112
#
```

Each parameter is explained as follows.

interface-name(VIF)

The logical interface name over the logical interface of MPNET is specified.

The logical interface name is expressed by adding ":" and instance number (number of 1-255) to the MPNET interface name that specified in the "/etc/opt/FJSVmpnet/conf/config" file.

hostname

This indicates an IPv6 address. In this setup, the IPv6 address is required.

The configuration example is shown in the following.

```
#ident "@(#)config  Rel 2.2 02/06/07  FUJITSU"
#
#     /etc/opt/FJSVmpnet/conf/hostname6 file
#
#
# Set the virtual IPv6 host name on the this machine.
#
# format:
# interface-name(VIF) IPv6-address
#
# example:
# mpnet0:1        fe80::0101:0001/112
# mpnet1:1        fe80::0201:0001/112
#

mpnet0:1     fe80::0102:0304:0506/112
mpnet1:1     fe80::0123:4567:0001/112
mpnet2:1     fe80::0800:20bd:fe92/112
```

Caution

· This configuration enables activating and deactivating the TCP/IP interface using with the *mpnet_ifinit6* or the *mpnet_ifconfig6* command.
· The host name cannot be specified. Moreover, specification of an IPv6 address is required.
· When using a cluster system, the IP address takeover by the logical IP address is not supported. When using IP address takeover, it is necessary to use the takeover that used the IPv6 address of the MPNET interface.

Chapter 4 Operation

This chapter explains the ways to operate the Multipath function.

The following commands can be used to administer the Multipath function.

Available commands are listed in "Table 4.1 Multipath function commands."

See "Chapter 6 Command Reference" for further instruction of each command.

[Table 4.1 Multipath function commands]

Type	Command	Description	Permission
Starting/Stopping of Multipath function	/opt/FJSVmpnet/bin/mpnetinit	The MPNET interfaces that have been configured are activated/deactivated.	Super-user
	/opt/FJSVmpnet/bin/mpnetconfig	The specified interface that has been configured is activated/deactivated.	Super-user
Display of MAC address	/opt/FJSVmpnet/bin/mpnet_getmac	The MAC address of the specified interface is displayed.	Super-user
Multipath control	/usr/opt/FJSViomp/bin/iompadm	The configuration information of MPNET, status displays, and the communication paths are restored.	Super-user
Starting/Stopping of TCP/IP interface	/opt/FJSVmpnet/bin/mpnet_ifinit	The IPv4 interfaces that use the MPNET are activated/deactivated.	Super-user
	/opt/FJSVmpnet/bin/mpnet_ifconfig	The specified IPv4 interfaces that use the MPNET are activated/deactivated.	Super-user
	/opt/FJSVmpnet/bin/mpnet_ifinit6	The IPv6 interfaces that use the MPNET are activated/deactivated.	Super-user
	/opt/FJSVmpnet/bin/mpnet_ifconfig6	The specified IPv6 interfaces that use the MPNET are activated/deactivated.	Super-user
Display of the amount of the transmission data	/opt/FJSVmpnet/bin/mpnetstat	The amount of the transmission data of the specified interface is displayed.	Super-user
Display of the connection state of transmission path.	/opt/FJSVmpnet/bin/mpnetlinkwatch	The connection state of the transmission path of the specified interface and the specified path is displayed.	Super-user

4.1 Start and Stop of Multipath Function

This section explains how to activate and terminate the Multipath function.

4.1.1 Starting Multipath function

When the system is activated, all interfaces are automatically activated by the Multipath function.

To start all the configured interfaces, use the *mpnetinit* command. To start a specific interface, that is already configured, use the *mpnetconfig* command. For details, please refer to "6.1.1 mpnetinit command" and "6.1.2 mpnetconfig command."

4.1.2 Stopping Multipath function

The Multipath function is automatically terminated at system termination.

To stop all the configured interfaces, use the *mpnetinit* command. To stop a specific interface, use the *mpnetconfig* command. For details, please refer to "6.1.1 mpnetinit command" and "6.1.2 mpnetconfig command."

Caution

· To terminate all interfaces, stop the high-layer protocols that use the interfaces first, before executing the command.
  To terminate specific interfaces, stop the high-layer protocols that use the target interface before executing the command. Whether the high-layer protocol for each interface can be terminated or all interfaces are terminated depends on the command specification of the high-layer protocol.
  For TCP/IP interface, The *mpnet_ifinit* command or the *mpnet_ifconfig* command can be used.
· When using a system as the NFS server, the Multipath function cannot be stopped using these commands.

4.2 To Display MAC Address Used

To display the MAC address of the interface defined in environmental configuration file of the Multipath function, use the *mpnet_getmac* command.

To set the environment of the FNA protocol and SNA protocol that needs the configuration of MAC address, this command is used. For details, please refer to "6.2.1 mpnet_getmac command."

4.3 Multipath Control

To show the configuration information of the online interface and the status display of each communication path, the *iompadm* command is issued.

The *iompadm* command is also used to restore communication path failure. For details, please refer to "6.3.1 iompadm command" and "6.3.2 iompadm subcommands."

4.4 Start and Stop of TCP/IP Interface

This section explains how to start and stop the TCP/IP interface that has the environmental configuration.

4.4.1 Starting IPv4 interface

When the system is activated, the TCP/IP interface is automatically started.

To start all the IPv4 interfaces that have been configured, the *mpnet_ifinit* command is used. To start a specific IPv4 interface that has been configured, the *mpnet_ifconfig* command is used. For details, please refer to "6.4.1 mpnet_ifinit command" and "6.4.2 mpnet_ifconfig command."

4.4.2 Stopping IPv4 interface

The TCP/IP interface is automatically terminated at system termination.

To stop all the IPv4 interfaces that have been configured, the *mpnet_ifinit* command is used. To stop a specific IPv4 interface, the *mpnet_ifconfig* command is used. For details, please refer to "6.4.1 mpnet_ifinit command" and "6.4.2 mpnet_ifconfig command."

4.4.3 Starting IPv6 interface

When the system is activated, the TCP/IP interface is automatically started.

To start all the IPv6 interfaces that have been configured, the *mpnet_ifinit6* command is used. To start a specific IPv6 interface that has been configured, the *mpnet_ifconfig6* command is used. For details, please refer to "6.4.3 mpnet_ifinit6 command" and "6.4.4 mpnet_ifconfig6 command."

4.4.4 Stopping IPv6 interface

The TCP/IP interface is automatically terminated at system termination.

To stop all the IPv6 interfaces that have been configured, the *mpnet_ifinit6* command is used. To stop a specific IPv6 interface that has been configured, the *mpnet_ifconfig6* command is used. For details, please refer to "6.4.3 mpnet_ifinit6 command" and "6.4.4 mpnet_ifconfig6 command."

4.5 To Display the Amount of the Transmission Data

By using the *mpnetstat* command, the amount of the transmission data of the interface defined in the environmental configuration file of Multipath function is displayed.

The display of the amount of transmission data is used when displaying the amount of data distributed

by the Multilink Ethernet method. For details, please refer to "6.6.1 mpnetstat command."

4.6 To Display the Connection State of Transmission Path

By using the *mpnetlinkwatch* command, the connection state (Link up/down) of the transmission path of the communication path which constitutes the interface defined as the environmental configuration file of a Multipath function can be displayed. For details, please refer to "6.7.1 mpnetlinkwatch command."

After exchanging a NIC by the DR function, in order to confirm whether there is any connection mistake of a cable, the connection state of a transmission path is displayed. Please refer to "Chapter 8 Dynamic Reconfiguration (DR) Function" for information about the DR Function.

Chapter 5 Maintenance

Chapter 5 explains the commands as the future reference necessary for troubleshooting the Multipath function.

5.1 Gathering Information at Fault Occurrence

Gather the following information for further investigation when an abnormality occurs in the Multipath function.

- · Content of operation and error messages
- · Console log (/var/adm/messages)
- · Environmental configuration file
- · Output of iompadm info
- · Output of ifconfig -a when TCP/IP interface is used
- · Output of process list (ps -ef)
- · Output of communication path (logical device) statistical information (netstat -k device-name)

5.2 Online Trace

This section explains how to gather the information from the online trace.

Caution

- · Do not execute the trace process during normal operation because CPU load rises and performance decreases.
- · The trace command can only be issued by the super-user.

5.2.1 Starting of trace

[Synopsis]

/opt/FSUNnet/bin/strotr -k mpnet.XXXX [-m msize][-a]

[Description]

The trace data collection logging begins.

[Options]

The following options can be specified.

-k mpnet.all_line: This option is specified to gather the trace of all interfaces.

-k mpnet.*interface-name*: This option is specified to gather the trace of specified interface only. This parameter can be specified only after MPNET is activated. If this parameter is specified before MPNET is activated, an error occurs and the trace does not start.

-m msize: The trace buffer in the main storage region is specified in kilobyte units within the range of 8-256. Default value is eight kilobyte.

-a : This option is specified to gather all data. Only 32 bytes of data are gathered when this option is omitted.

[Examples]

- · Example of mpnet.all_line

```
# /opt/FSUNnet/bin/strotr -k mpnet.all_line -m 256 -a
strotr : Normal End.
```

- · Example of mpnet.*Interface_name*

```
# /opt/FSUNnet/bin/strotr -k mpnet.mpnet0 -m 256 -a
strotr : Normal End.
```

⚠ Caution

· The all_line and the interface name cannot be specified at the same time.

5.2.2 Stopping of trace

[Synopsis]

/opt/FSUNnet/bin/stpotr -k mpnet.XXXX

[Description]

The trace data collection logging is stopped.

[Options]

Specify the parameter that was activated by the strotr.

The following options can be specified.

-k mpnet.all_line: This option is specified to terminate the trace of all interfaces.

-k mpnet.*interface_name*: This option is specified to terminate only the trace of specified interface.

[Examples]

· Example of mpnet.all_line

```
# /opt/FSUNnet/bin/stpotr -k mpnet.all_line
stpotr : "mpnet.all_line" is stopped.
```

· Example of mpnet.*Interface_name*

```
# /opt/FSUNnet/bin/stpotr -k mpnet.mpnet0
stpotr : "mpnet.mpnet0" is stopped.
```

5.2.3 Output of driver trace

[Synopsis]

/opt/FSUNnet/bin/prtotr -k mpnet.XXXX

[Description]

The trace logging data collection is output.

[Options]

Specify the parameter that was activated by the strotr.

The following options can be specified.

-k mpnet.all_line: The trace information which was gathered by specifying the all_line is output.

-k mpnet.*interface_name* : The specific interface trace information which is gathered by specifying the interface name is output. The specific interface information gathered from the trace of the all_line cannot be output by specifying the interface name.

[Examples]

· Example of mpnet.all_line

```
# /opt/FSUNnet/bin/prtotr -k mpnet.all_line > /tmp/mpnet.trc
```

· Example of mpnet.*Interface_name*

```
# /opt/FSUNnet/bin/prtotr -k mpnet.mpnet0 > /tmp/mpnet0.trc
```

Chapter 6 Command Reference

This chapter explains the commands of the Multipath function.

6.1 MPNET Activation and Deactivation Commands

6.1.1 mpnetinit command

Name

mpnetinit - The activation and deactivation command of all Multipath network

Synopsis

/opt/FJSVmpnet/bin/mpnetinit [start|stop]

Description

This command activates and deactivates all interfaces that have been configured.
When activating, all information that has been configured is set to the driver, and the interface becomes ready state. When deactivating, all activated interfaces are deactivated.

Notes

This command can only be issued by the super-user.

Contents

When activating, the following messages shown below, are output.
When deactivating, nothing is displayed at the normal termination.

```
# /opt/FJSVmpnet/bin/mpnetinit start
MPNET: mpnet0: now up
MPNET: mpnet0: MPNET daemon started
MPNET: mpnet1: now up
MPNET: mpnet1: MPNET daemon started
```

Caution

· When ATM is used, it is not possible to activate by using this command. Please reboot the system.
· When using a system as an NFS server, the MPNET interface cannot be deactivated using this command.

6.1.2 mpnetconfig command

Name

mpnetconfig - The activation and deactivation command of a specific Multipath network interface

Synopsis

/opt/FJSVmpnet/bin/mpnetconfig interface_name [start|stop]

Description

This command activates and deactivates the specified interface.
When activating, the configuration of the specified interface is set to the driver, and the interface becomes a ready. When deactivating, the specified interface is deactivated.

Notes

This command can only be issued by the super-user. This command can be used when a specific interface is started or is terminated.

Contents

When activating, the following messages shown below are output.
When deactivating, nothing is displayed at normal termination.

```
# /opt/FJSVmpnet/bin/mpnetconfig mpnet0 start
MPNET: mpnet0: now up
MPNET: mpnet0: MPNET daemon started
```

Caution

· When ATM is used, it is not possible to activate by using this command. Please reboot the system.
· When using a system as an NFS server, the MPNET interface cannot be deactivated using this command.

6.2 MAC Address Display Command

6.2.1 mpnet_getmac command

Name

mpnet_getmac - The MAC address display command

Synopsis

/opt/FJSVmpnet/bin/mpnet_getmac interface_name

Description

The *mpnet_getmac* command displays the MAC address defined in the environmental configuration. This command can be used to output the MAC address that may be used for the configuration of the upper products.

Notes

This command can only be issued by the super-user.

Contents

The following messages (examples) are output.

```
# /opt/FJSVmpnet/bin/mpnet_getmac mpnet0
MPNET: mpnet0: 080012345678
```

6.3 Multipath Control Command

6.3.1 iompadm command

Name

iompadm - The Multipath control command

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet [-p] subcommand [parameter]

Description

The iompadm command is used to display the status of the communication paths that compose the interface or to restore the communication path where a fault occured.

This command shows the status and restoration of the communication path by combining specified subcommand and parameter.
The following can be specified for the option.

-c mpnet : Class name is specified. The "mpnet" must be specified.

-p : When this parameter is specified to display the status, the physical device name in addition to the logical device name is displayed in the displayed communication path. When this parameter is omitted, only the logical device name is displayed in the displayed communication path.

subcommand : The subcommand and the outline of functions are listed in "Table 6.1 Subcommand List." See the section "6.3.2 iompadm subcommands" for details.

parameter : The parameter is specified in combination with the subcommand. Details of parameters that can be used by combining are explained in section "6.3.2 iompadm subcommands."

[Table 6.1 Subcommand List]

Subcommand	Description
info	Configuration information in the specified interface or in all interfaces, and the status of the communication path are displayed.
status	The status of the specified communication path is displayed.
ident	The class list of the specified communication path is displayed.
probe	The interface to which the specified communication path belongs is displayed.
recover	The specified communication path is restored.
start	The specified communication path is changed to the path that can be communicable after the recover command is issued.
stop	The communication path in the "active" state or the "standby" state is switched to the "stop" state.
active	The communication path in the "standby" state is switched to the "active" state.
add	Adds the specified communication path to the specified interface. The communication path after an addition will be in the "stop" state.
del	Delete the communication path in the "stop" state from the specified interface.
disconnect	The communication path in the "stop" state or the "fail" state is switched to the "disconnected" state.
connect	The communication path of the specified "disconnected" state is switched to "stop" state.
version	Version information of this product is displayed.
help	Help information of specified command is displayed.

Notes

This command can only be issued by the super-user.

Contents

Refer to the description of each subcommand explanation in section "6.3.2 iompadm subcommands."

6.3.2 iompadm subcommands

This section explains subcommands of the iompadm command.
The subcommand and the outline of functions are listed in "Table 6.2 Subcommand List."

[Table 6.2 Subcommand List]

Subcommand	Description
info	Configuration information in the specified interface or in all interfaces, and the status of the communication path are displayed.
status	The status of the specified communication path is displayed.
ident	The class list of the specified communication path is displayed.
probe	The interface to which the specified communication path belongs is displayed.

recover	The specified communication path is restored.
start	The specified communication path is changed to the path that can be communicable after the recover command is issued.
stop	The communication path in the "active" state or the "standby" state is switched to the "stop" state.
active	The communication path in the "standby" state is switched to the "active" state.
add	Adds to the specified interface the specified communication path. The communication path after an addition will be in the "stop" state.
del	Delete the communication path in the "stop" state from the specified interface.
disconnect	The communication path in the "stop" state or the "fail" state is switched to the "disconnected" state.
connect	The communication path of the specified "disconnected" state is switched to "stop" state.
version	Version information of this product is displayed.
help	Help information of specified command is displayed.

6.3.2.1 info subcommand

Capabilities

Configuration information for the specified interface or for all interface, and the status of the communication path are displayed.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet [-p] info [interface_name]

Example

The following messages (examples) are output.

· Example of no "-p" option

```
# /usr/opt/FJSViomp/bin/iompadm -c mpnet info
IOMP: mpnet0
Element:
     hme0   online  active  unblock ""
     hme1   online  standby unblock ""
Node:
     mpnet0
Function:
     MPmode=false
     AutoPath=true
     Block=false
     NeedSync=false

IOMP: mpnet1
Element:
     qfe0   online  active  unblock "No bind"
     qfe4   online  standby unblock ""
Node:
     mpnet1
Function:
     MPmode=false
     AutoPath=true
     Block=false
     NeedSync=false
```

· Example of "-p" option

```
# /usr/opt/FJSViomp/bin/iompadm -p -c mpnet info
IOMP: mpnet0
Element:
     hme0   online  active  unblock ""
-> /pci@1f,4000/network@1,1
     hme1   online  standby unblock ""
-> /pci@4,4000/SUNW,hme@2,1
Node:
     mpnet0
Function:
     MPmode=false
     AutoPath=true
     Block=false
     NeedSync=false

IOMP: mpnet1
Element:
     qfe0   online  active  unblock "No bind"
-> /pci@4,2000/pci@1/SUNW,qfe@0,1
     qfe4   online  standby unblock ""
-> /pci@4,2000/pci@2/SUNW,qfe@4,1
Node:
     mpnet1
Function:
     MPmode=false
     AutoPath=true
     Block=false
     NeedSync=false
```

Contents

Information output from the above examples is explained in "Table 6.3 Communication path status."

[Table 6.3 Communication path status]

Information	Description
online / offline	Brief status of the communication path is displayed. - online : enabled to communicate - offline : disabled to communicate
active / standby / stop / fail / disconnected	Detailed status of the communication path is displayed. - active : enabled for communication or under operation - standby : ready for communication but in an idle state - stop : stopped state - fail : disabled for communication caused by a failure - busy : The communication path is being processed. - disconnected : The communication path has been disconnected by the DR function.
block / unblock	The authorized status of direct access to the communication path from the outside is displayed. - block : prohibited - unblock : permitted
Message	Supplemental information of the current system status or the error cause is displayed. If no supplemental information is displayed, quotation marks ("") are displayed. Refer to "Table 6.4 Message List" for details of the message displayed.
-> XXXX XXXX	When "-p" option is specified, the physical device name is displayed.

Refer to "Table 6.4 Message List" for details of the message displayed.

For the terms "capabilities of restoration" described in the table, see the section "6.3.2.5 recover subcommand" in "6.3 Multipath Control Command."

[Table 6.4 Message List]

Status	Message	Description	Restorable
active	None	Communication is being established by the upper BIND.	-
	No bind	Communication is ready because the upper BIND is not issued.	-

standby	None	Enabled to communicate but in an idle status.	-
stop	None	Stopped state	-
fail	Line error	An abnormality occurred in the transmission path.	A
	Attach error	The communication path (device) does not exist.	C
	Configuration error	The error occurred while activating the communication path (device).	C
	Bus error	The hardware error occurred in the communication path.	C
	Device not respond	No response to the issued command was returned from the communication path.	B
disconnected	None	The command does not get a response from the communication path.	-
busy	Line up process	The communication path is being activated.	-
	Line down process	The communication path is being deactivated.	-

Legend: A : Possible B : Might be possible C : Impossible - : Not affect

6.3.2.2 status subcommand

Capabilities

This command displays the status of all the communication paths of the specified interface or the status of the specified path.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet [-p] status interface_name [communication_path_name]

Example

The following messages (examples) are output.

· Example of no communication path name

```
# /usr/opt/FJSViomp/bin/iompadm -c mpnet status mpnet0
hme0   online  active  unblock ""

hme1   online  standby unblock ""
```

· Example of specification of communication path name

```
# /usr/opt/FJSViomp/bin/iompadm -c mpnet status mpnet0 hme0
hme0   online  active  unblock ""
```

Contents

Information output from above examples is the same as the status of the communication path of Section "6.3.2.1 info subcommand."

Refer to Table "Table 6.3 Communication path status" for details of the communication path status.

6.3.2.3 ident subcommand

Capabilities

The class list of the communication path used is displayed.
In this product, "mpnet" is displayed.

Synopsis

/usr/opt/FJSViomp/bin/iompadm ident communication_path_name

Example

The following messages (examples) are output. The following messages (examples) are output.

```
# /usr/opt/FJSViomp/bin/iompadm ident hme0
mpnet
```

6.3.2.4 probe subcommand

Capabilities

The interface to which specified communication path belongs is displayed.

Synopsis

/usr/opt/FJSViomp/bin/iompadm probe communication_path_name

Example

The following messages (examples) are output.

```
# /usr/opt/FJSViomp/bin/iompadm probe hme0
mpnet   mpnet0
```

6.3.2.5 recover subcommand

Capabilities

Restoration is executed for the failed communication path.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet recover interface_name [communication_path_name]

Description

This command is used to restore the communication path that failed in the transmission path.
This subcommand can be executed only when the message "Line error" is displayed using the info subcommand or the status subcommand.

The state of the communication path changes to "stop" state after this subcommand is processed successfully.
This command can be executed for the specified communication path if a communication path name is specified.

Notes

This subcommand may not restore successfully if NIC failure or LAN driver error occur in the fail state.

6.3.2.6 start subcommand

Capabilities

The communication path in "stop" status is changed to ready status.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet start interface_name [communication_path_name]

Description

This command changes the state of the communication path in "stop" status to "active" status.

The state of the communication path changes into "standby" or "active" status when this subcommand is processed successfully.
This command can be executed for the specified communication path if a communication path name is specified.

Caution

When you use the multiple interfaces of the ATM, and the communication path name is specified and this subcommand is executed, the "active" state path must not exist together in the ATM card.

6.3.2.7 stop subcommand

Capabilities

The communication path in the "active" state or the "standby" state of the specified interface is switched to the "stop" state.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet stop interface_name [communication_path_name]

Description

This subcommand is used when changing the communication path in "active" state or "standby" state into "stop" state.

When this subcommand is processed successfully, the communication path is put into "stop" state.

When the communication path name is specified, this subcommand is processed for the specified communication path.

When this subcommand is processed for a communication path, the communication path in "active" state is put into "stop" state, and the communication path in "standby" state is put into "active" state.

Caution

When stopping the communication path of "active" state and the communication path of "standby" state does not exist, or when omitting the communication path name and stopping all communication paths, communication stops.

6.3.2.8 active subcommand

Capabilities

The communication path is switched, and it changes from the "standby" state to the "active" state.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet active interface_name communication_path_name

Description

When "standby" state's communication path is specified, the path switch is done from the "active" state's communication path. In addition, the communication path that was the "active" state is changed to the "standby" state.

This subcommand is available for the communication path in "standby" state, and can be used also for the switching back of the communication path.

When this subcommand is processed successfully, the specified communication path is put into "active" status, and the "active" communication path is put into "standby" status.

Caution

When you use the multiple interfaces of the ATM, and the communication path is switched by this subcommand. The communication path in other interfaces should switch the communication path by this subcommand.

6.3.2.9 add subcommand

Capabilities

This subcommand adds the communication path to the specified interface.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet add interface_name communication_path_name

Description

This subcommand is used when adding the communication path to the specified interface.

When it is executed successfully, the specified communication path will be in "stop" state.

Caution

- When the ATM card is used, this subcommand is not supported.
- A different device from the kind of device that constitutes the specified interface cannot be added.
  For example, when the specified interface consists of Fast Ethernet devices, only a Fast Ethernet device can be added.
- When adding the communication path, this subcommand updates the environmental configuration file "/etc/opt/FJSVmpnet/conf/config" file.
  If multiple instances of this subcommand are executed at the same time, the environmental configuration file "/etc/opt/FJSVmpnet/conf/config" may be damaged.
  Therefore, please do not execute except at console terminal (e.g. telnet command).

6.3.2.10 del subcommand

Capabilities

This subcommand deletes the communication path from the specified interface.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet del interface_name communication_path_name

Description

This subcommand is used when deleting from the specified interface the communication path in the "stop" state, "fail" state, or "disconnected" state.

The communication path of "active" state, "standby" state cannot be deleted with this subcommand.
Please change to "stop" state by the stop subcommand before executing this subcommand.

When this subcommand is executed successfully, the specified communication path will be deleted from the specified interface.

Caution

- When the ATM card is used, this subcommand is not supported.
- When adding the communication path, this subcommand updates the environmental configuration file "/etc/opt/FJSVmpnet/conf/config."
  If multiple instances of this subcommand are executed at the same time, the environmental configuration file "/etc/opt/FJSVmpnet/conf/config" file may be damaged.
  Therefore, please do not execute except at console terminal (e.g. telnet command).

6.3.2.11 disconnect subcommand

Capabilities

The communication path in the "stop" state or the "fail" state is switched to the "disconnected" state.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet disconnect interface_name communication_path_name

Description

This subcommand will switch the specified communication path to the "disconnected" state, if the specified communication path is in the "stop" state or the "fail" state. If the communication path is in any other state, this subcommand will be ended in an error.

6.3.2.12 connect subcommand

Capabilities

The communication path in the "disconnected" state is switched to the "stop" state.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet connect interface_name communication_path_name

Description

This subcommand will switch the specified communication path to the "stop" state, if the specified communication path is in the "disconnected" state. If the communication path is not "disconnected" state, the iompadm command will be ended without changing anything.

6.3.2.13 version subcommand

Capabilities

The version information of this product is displayed.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet version

Example

The following messages (examples) are output.

```
# /usr/opt/FJSViomp/bin/iompadm -c mpnet version
iompadm Version: 1.0.0 (1999/12/04)
FJIOMP-API-Level: 2.1
mpnet: 2.2
mpnet-API-level: 1.0
```

6.3.2.14 help subcommand

Capabilities

This menu shows how to use a subcommand.

Synopsis

/usr/opt/FJSViomp/bin/iompadm -c mpnet help

Example

The following messages (examples) are output.

```
# /usr/opt/FJSViomp/bin/iompadm -c mpnet help
subcommand :
  help              Shows this help message.
  ident             Returns the class name for IOMP device.
  info              Returns information about an instance.
  probe             Returns class and instance name for IOMP device.
  recover           Recovers the path after an error.
  start             Restarts the use of a path.
  stop              Stops the use of a path.
  active            Activates the path.
  add               Adds the path.
  del               Deletes the path.
  disconnect        Disconnects the path.
  connect           Connects the path.
  status            Returns the path status.
  version           Shows versions.
usage :
  iompadm [-p] [-c mpnet] help
  iompadm [-p] [-c mpnet] ident device-name
  iompadm [-p] [-c mpnet] info [interface-name]
  iompadm [-p] [-c mpnet] probe device-name
  iompadm [-p] [-c mpnet] recover interface-name [device-name]
  iompadm [-p] [-c mpnet] start interface-name [device-name]
  iompadm [-p] [-c mpnet] stop interface-name [device-name]
  iompadm [-p] [-c mpnet] active interface-name device-name
  iompadm [-p] [-c mpnet] add interface-name device-name
  iompadm [-p] [-c mpnet] del interface-name device-name
  iompadm [-p] [-c mpnet] disconnect interface-name device-name
  iompadm [-p] [-c mpnet] connect interface-name device-name
  iompadm [-p] [-c mpnet] status interface-name [device-name]
  iompadm [-p] [-c mpnet] version
```

6.4 TCP/IP Interface Activation and Deactivation Commands

6.4.1 mpnet_ifinit command

Name

mpnet_ifinit - Activation and deactivation command for all IPv4 interfaces

Synopsis

/opt/FJSVmpnet/bin/mpnet_ifinit [start|stop]

Description

This command activates and deactivates all IPv4 interfaces that have been configured.
The state of all IPv4 interfaces that have been configured is changed to the "active" or "standby" status.
In deactivation, this command deactivates all activated IPv4 interfaces that are being used in the multipath network.

Notes

This command can only be issued by the super-user.

Contents

The following messages (examples) are output in activation status.
Nothing is displayed when terminating successfully.

```
# /opt/FJSVmpnet/bin/mpnet_ifinit start
Setting netmask of mpnet0 to 255.255.255.128
mpnet_ifinit: mpnet0: INET now up
Setting netmask of mpnet1 to 255.255.255.0
mpnet_ifinit: mpnet1: INET now up
```

6.4.2 mpnet_ifconfig command

Name

mpnet_ifconfig - The activation and deactivation command for a specified IPv4 interface

Synopsis

/opt/FJSVmpnet/bin/mpnet_ifconfig interface_name [start|stop]

Description

This command activates and deactivates the IPv4 interface specified by an interface name.
The state of the specified IPv4 interface is changed to the "active" or "standby" status.
In deactivation, this command deactivates the specified IPv4 interface that is used in the multipath network.

Notes

This command can only be issued by the super-user.

This command can be used to start or stop of the specific IPv4 interface.

Contents

The following messages (examples) are output.
In deactivation, nothing is displayed when terminating successfully.

```
# /opt/FJSVmpnet/bin/mpnet_ifconfig mpnet1 start
Setting netmask of mpnet1 to 255.255.255.0
mpnet_ifinit: mpnet1: INET now up
```

6.4.3 mpnet_ifinit6 command

Name

mpnet_ifinit6 - The activation and deactivation command for all IPv6 interfaces

Synopsis

/opt/FJSVmpnet/bin/mpnet_ifinit6 [start|stop]

Description

This command activates and deactivates all IPv6 interfaces that have been configured.
The state of all IPv6 interfaces that have been configured is changed to the "active" or "standby" status.
In deactivation, this command deactivates all activated IPv6 interfaces that are being used in the multipath network.

Notes

This command can only be issued by the super-user.

Contents

The following messages (examples) are output for activation status.
Nothing is displayed when terminating successfully.

```
# /opt/FJSVmpnet/bin/mpnet_ifinit6 start
mpnet_ifinit6: mpnet0: INET6 now up
mpnet_ifinit6: mpnet1: INET6 now up
mpnet_ifinit6: mpnet0:1: INET6 now up
mpnet_ifinit6: mpnet1:1: INET6 now up
```

6.4.4 mpnet_ifconfig6 command

Name

mpnet_ifconfig6 - The activation and deactivation command of a specified IPv6 interface

Synopsis

/opt/FJSVmpnet/bin/mpnet_ifconfig6 interface_name [start|stop]

Description

This command activates and deactivates the IPv6 interface specified by an interface name.
The state of the specified IPv6 interface is changed to the "active" or "standby" status.
In deactivation, this command deactivates the specified IPv6 interface that is used in multipath network.

Notes

This command can only be issued by the super-user.

This command can be used to start or stop of the specific IPv6 interface.

Contents

The following messages (examples) are output standard.
In deactivation, nothing is displayed when terminating successfully.

```
# /opt/FJSVmpnet/bin/mpnet_ifconfig6 mpnet1 start
mpnet_ifconfig6: mpnet1 : INET6 now up
mpnet_ifconfig6: mpnet1 :1 : INET6 now up
```

6.5 Cluster Administration Commands

6.5.1 mpnet_addrid

Name

mpnet_addrid - The resource registration command

Synopsis

/opt/FJSVmpnet/cluster/bin/mpnet_addrid -a | -d interface

Description

This command registers the resource of the interface for the cluster which is configured as the target node.

This command registers the resource of target node only. Therefore, when registering the resource of other nodes, it is necessary to execute this command on that node.

-a : The resource of all the interfaces for the cluster which are configured is registered.

-d interface : The resource of the interface for the cluster specified by "interface" is registered. It is used when registering the resource of the specific interfaces at the time of adding the interface for the cluster etc.

Notes

This command can only be issued by the super-user.

When the command processed successfully, resource information is automatically stored in "cluster" parameter in /etc/opt/FJSVmpnet/conf/parameters file.

6.5.2 mpnet_delrid

Name

mpnet_delrid - The resource remove command

Synopsis

/opt/FJSVmpnet/cluster/bin/mpnet_delrid -a | -d interface

Description

This command deletes the resource of the interface for the cluster which is configured as the target node.

This command deletes the resource of target node only. Therefore, when deleting the resource of other nodes, it is necessary to execute this command on that node.

-a : The resource of all the interfaces for the cluster which are configured is deleted.

-d interface : The resource of the interface for the cluster specified by "interface" is deleted. This command can be used when the resource of a specific interface is deleted.

Notes

This command can only be issued by the super-user.

When the command processed successfully, resource information is automatically deleted from the "cluster" parameter in /etc/opt/FJSVmpnet/conf/parameters file.

6.5.3 mpnet_rid

Name

mpnet_rid - The batch registration/deletion command of resources

Synopsis

/opt/FJSVmpnet/cluster/bin/mpnet_rid -a [-A|-n node] | -d [-A|-n node]

Description

This command can register or delete a resource to the node specified by the parameter.

This command is recommended on the target nodes of which the hardware configuration and LAN device configuration are the same.
The batch registration of resources performs resource registration of all interfaces based on the environmental configuration in the /etc/opt/FJSVmpnet/conf/parameters file of the node that executes this command, and it copies to the node specified with the parameter.

Moreover, when registering resources collectively, it is necessary to use an environmental configuration copy (*mpnet_copyfile*) command beforehand, and to copy the environmental configuration.
The batch deletion of resources performs resource deletion of all the interfaces of the node that specified with the parameter. The /etc/opt/FJSVmpnet/conf/parameters file before resource registration of the node which executed this command is copied.

When all nodes are specified to be parameters, it is registered or deleted to all the constituted nodes including the node that carries out command execution.

-a : Adds the resource of the node on which this command executed.

-a -A : Adds the resource of all nodes.

-a -n node : Adds the resource of the node specified in the "node." Be sure to specify the node name in the "node."

-d : Deletes only the resource of the node that executes this command.

-d -A : Deletes the resource of all nodes.

-d -n node : Deletes the resource of the node specified in the "node." Be sure to specify the node name in the "node."

Notes

This command can only be issued by the super-user.

This command adds an interface to the environmental configuration file. When registering a resource, use the *mpnet_addrid* command instead of this command.
If an userApplication has already been registered, the resource ID stored in the file may be deleted. If the command is executed, check the resource ID of the interface by using the clgettree command, and set it again.

6.5.4 mpnet_copyfile

Name

mpnet_copyfile - Command to copy the environmental configuration file between nodes

Synopsis

/opt/FJSVmpnet/cluster/bin/mpnet_copyfile [-a | -n node]

Description

This command can copy all environmental configuration files for the node specified in the parameter.
This command is best processed on the target nodes of which the hardware configuration and LAN device configuration are the same.

-a : Copies the environmental configuration files in the nodes to the all nodes.

-n node : Environmental configuration file is copied between nodes for the node specified in "node." Be sure to specify the cluster node name in "node."

Notes

This command can only be issued by the super-user.

6.6 Display Command of the Amount of the Transmission Data

6.6.1 mpnetstat command

Name

mpnetstat - display network statistics

Synopsis

/opt/FJSVmpnet/bin/mpnetstat interface_name [-i time] [-n|-a]

Description

This command displays the amount of the transmission data of each device of the interface specified by the interface_name, and the specified interface status.

-i time : The amount of transmission data is displayed for every second interval specified by "time". When 0 is specified to be "time", it displays once.

-n : The number of error packets is not displayed.

-a : The amount of transmission data of each device of the specified interface and an interface is displayed. But the time and the state are not displayed.

Example

· Example of no option

```
# /opt/FJSVmpnet/bin/mpnetstat mpnet0

Jul 25 09:12:27 2001 Instance: mpnet0 Mode: RR  Status: online

Name  Status    Ipkts    Ierrs  Opkts     Oerrs Collis %Ipkt %Opkt

hme1  active    3743847   0    2105262    0    0     49.4 49.3
hme2  active    3829556   0    2163297    0    0     50.6 50.7
```

· Example of "-n" option

```
# /opt/FJSVmpnet/bin/mpnetstat mpnet0 -n

Jul 25 09:19:09 2001 Instance: mpnet0 Mode: IOMP  Status: online

Name  Status    Ipkts     Opkts     Collis %Ipkt %Opkt

hme1  standby   6760766   3725882   0    79.5 79.5
hme2  active    1746139   962170    0    20.5 20.5
```

· Example of "-a" option

```
# /opt/FJSVmpnet/bin/mpnetstat mpnet0 -a

Name   Ipkts     Ierrs Opkts     Oerrs Collis %Ipkt %Opkt

mpnet0 7556064    0    4257790    0    0     100.0 100.0

hme1   3743847    0    2105262    0    0     49.4 49.3
hme2   3829556    0    2163297    0    0     50.6 50.7
```

Contents

Information output from the above examples is explained in "Table 6.5 Output information of the mpnetstat command."

[Table 6.5 Output information of the mpnetstat command]

Information	Description
Instance: mpnetX	The specified interface is displayed.
Mode: IOMP / MH / RR / DA / DSA	The distribution method of the specified interface is displayed. - IOMP : Multipath method - MH : Remote MAC Address distribution method - RR : Round Robin distribution method - DA : Destination IP Address distribution method - DSA : Destination/Source IP Address distribution method
Status: Online / Offline / Unconfigured	The state of the specified interface is displayed. - online : enable to communicate - offline : disable to communicate - unconfigured : All communication paths have been disconnected by the DR function.
Name	The device name of the interface is displayed.
Status	The state of the device is displayed. - active : enable to communicate or under operation - standby : ready for communication but in an idle state - stop : stopped state - fail : disabled for communication caused by a failure - busy : The communication path is being processed. - disconnected : The communication path has been disconnected by the DR function.

Ipkts	The number of the input packets for each device is displayed.
Ierrs	The number of the input error packets for each device is displayed.
Opkts	The number of the output packets for each device is displayed.
Oerrs	The number of the output error packets for each device is displayed.
Collis	The number of collisions is displayed.
%Ipkts	The rate of the number of input packets of the device to the total number of input packets is displayed.
%Opkts	The rate of the number of output packets of the device to the total number of output packets is displayed.

Notes

This command can only be issued by the super-user.

In the Multipath method, the amount of the packet data of a standby device may not be 0, because of transmissions, such as broadcasting data.

6.7 Display Command of the State of Transmission Path

6.7.1 mpnetlinkwatch command

Name

mpnetlinkwatch - display the state of transmission path

Synopsis

/opt/FJSVmpnet/bin/mpnetlinkwatch interface_name [communication_path_name]

Description

This command displays the connection state (Link Up/Down) of the transmission path of the communication path of the specified interface or the specified communication path.

Please execute this command and be sure to check whether there is any cable omission, when the device is exchanged by the DR function.

Example

The following examples are output.

```
# /opt/FJSVmpnet/bin/mpnetlinkwatch mpnet0

Link watch Instance: mpnet0

Name  Status     Link Status

hme1  standby    up
hme2  active     up
```

Contents

Information output from the above examples is explained in "Table 6.6 Output information of the mpnetlinkwatch command."

[Table 6.6 Output information of the mpnetlinkwatch command]

Information	Description
Link watch instance: mpnetX	The specified interface is displayed.
Name	The device name of the interface is displayed.
Status	The state of the device is displayed. - active : enabled to communicate or under operation - standby : ready for communication but in an idle state

	- stop : stopped state - fail : disabled for communication caused by a failure - busy : The communication path is being processed. - disconnected : The communication path has been disconnected by the DR function.
Link Status	The cable connection state of the device is displayed. - up : Link up state - down : Link down state

Notes

This command can only be issued by the super-user.

When the FDDI card is used, this command is not supported.

Chapter 7 Administration on a Cluster System

This chapter explains the ways to configure the environmental configuration and to use the Multipath function on the SynfinityCluster system and PRIMECLUSTER system

The Multipath function does not support cluster failover when using PRIMECLUSTER 4.0.

7.1 The Correspondence Outline in a Cluster System

The Multipath function supports the following connection types in the cluster system.

- · Standby mode (1:1 / N:1)
- · Mutual standby mode

The resource of the Multipath function is set as each interface.
A cluster node is changed, not only when an online node panics, but when the abnormalities in transmission paths are detected by the communication path of the MPNET interface and it becomes impossible to use all communication paths.

Moreover, mode of operation, a MAC address, etc. can be taken over by configuring the environmental configuration of an online node and a standby node identically.

"Figure 7.1 Example of Switching Node in All Communication Paths Failure" shows how to switch the node when all the communication paths in the interface used by the online node are out of application.

The "userApplication" on PRIMECLUSTER is equivalent to "cluster service" on SafeCLUSTER. For details, please refer to the glossary of the SafeCLUSTER and PRIMECLUSTER manuals.
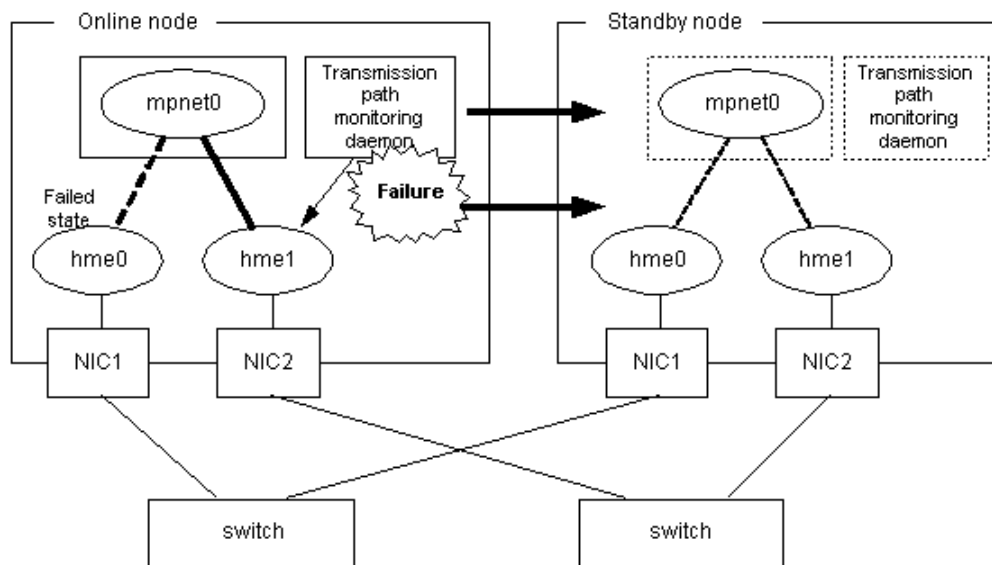
[Figure 7.1 Example of Switching Node in All Communication Paths Failure]

7.1.1 Standby mode

In normal operation, a local system communicates with the remote system using the Multipath function of the online node.

When abnormalities (panics, hangs, and transmission path failure) occur in the online node, the Multipath function switches the resource onto the standby node to take over the communication of the online node by reconnecting the path.

The Standby mode configuration is shown in "Figure 7.2 Standby mode Configuration."
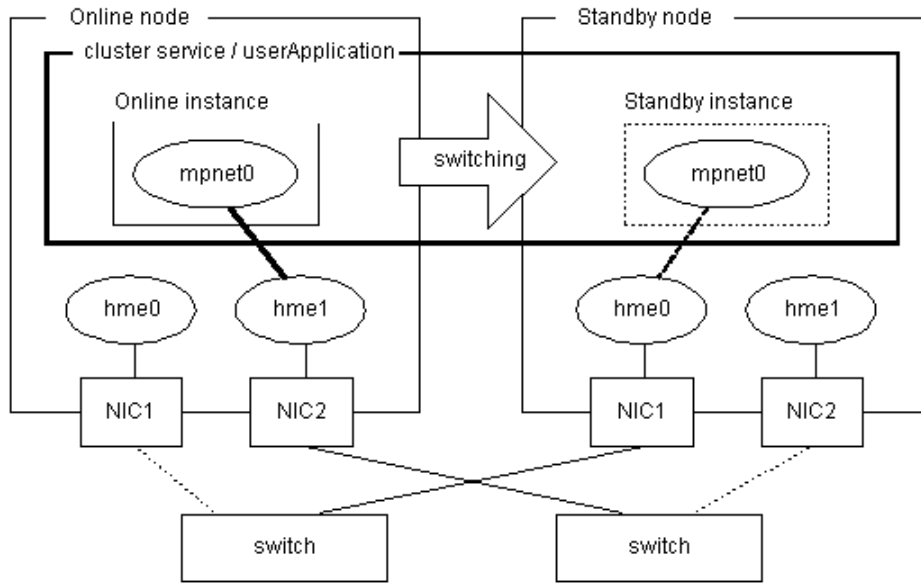
[Figure 7.2 Standby mode Configuration]

7.1.2 Mutual standby mode

Mutual standby mode can be created by defining two or more interfaces with the Multipath function and by configuring each resource as another application.

In normal operation, a local system communicates with the remote system using communication path on the online instance of each cluster service or each userApplication.
When abnormalities (panics, hangs, and transmission path failure) occur in the online node, the Multipath function switches the resource onto the standby node to take over the communication of the online node by reconnecting the path.

The Mutual standby configuration is shown in "Figure 7.3 Mutual standby mode Configuration."
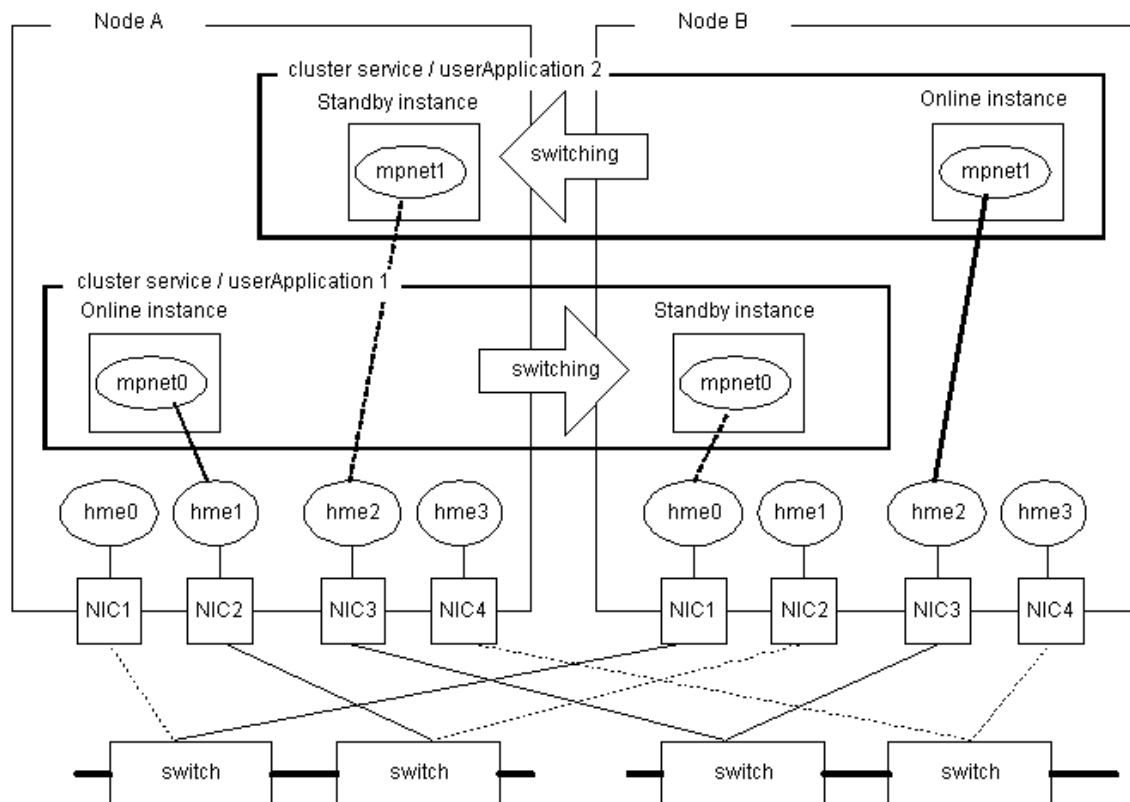
[Figure 7.3 Mutual standby mode Configuration]

7.1.3 Notes

- The Multipath function can only be used for the enterprise LAN system. The Multipath function cannot be used for the operating control LAN system that is used in a private LAN (a private path) between nodes or under the operating management view.
- When the environmental configuration of the Multipath function is set, it is necessary to set the same interface name in each node. That is, when "mpnet0" is set as the interface name, the interface name set as a standby node also needs to set up "mpnet0." Registration of a resource can be performed when an interface name that is different by each node is set up. However, the registered resource may not be displayed in case cluster service and userApplication are registered after it using the operating management view.
- When "-" (global MAC address) is specified in the "MAC-address" parameter in the /etc/opt/FJSVmpnet/conf/parameters file, the global MAC address of each node is used.
  This means that the MAC address used by the online node is not succeeded to the standby node.
  MAC address value must be set if you use the MAC address of the online node for the MAC address of the standby node.
- The MAC address value must be set if you use FNA or SNA protocol as the high-layer protocol. In this case, "-" (global MAC address) is not specified in the "MAC-address" parameter in /etc/opt/FJSVmpnet/conf/parameters file.
- The TCP/IP interface is automatically activated at the cluster change by the environmental configuration in /etc/opt/FJSVmpnet/conf/hosts file of each node. Refer to "Chapter 3 Configuration" for detailed information about configuration.
- When the ATM is used, it becomes only "1:1 standby mode".
- Please register all the resources concerning ATM in one cluster service or one userApplication. When the cluster is switched when registering in different cluster service or userApplication, the communication might not be restarted.
- In Multipath function, if it becomes "fail" state by the abnormalities in the transmission path of the communication path to use all communication paths, a cluster will be changed.

7.2 The environmental configuration on SynfinityCluster

7.2.1 Adding the Cluster Environmental Configuration

In the Multipath function, the resource registration is required as well as the usual environmental configuration.

"Figure 7.4 Flow of an Additional Procedure of Cluster Environmental Configuration" shows how to perform the additional procedure of the configuration.
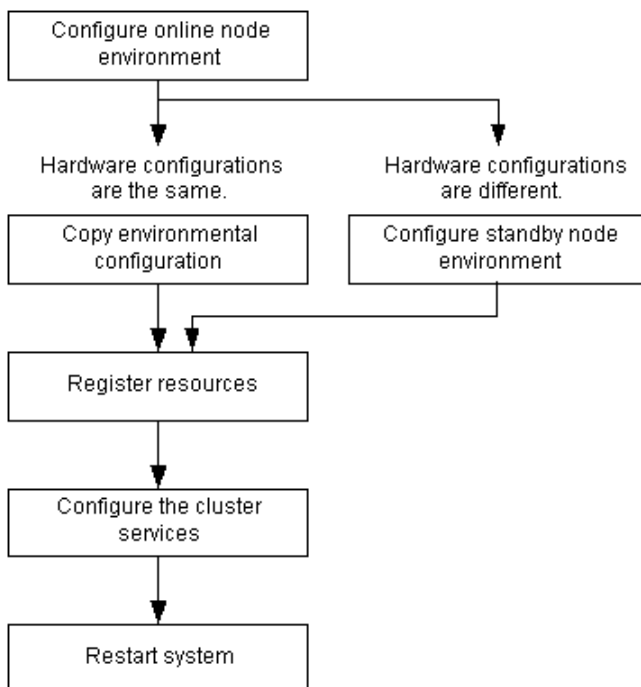
[Figure 7.4 Flow of an Additional Procedure of Cluster Environmental Configuration]

The command shown in "Table 7.1 Cluster Configuration Operation Command" can be used to perform the cluster environmental configuration.
This command can only be executed in the cluster system environment.

[Table 7.1 Cluster Configuration Operation Command]

Type	Command	Description	Permission
Adding/ Removing resource	/opt/FJSVmpnet/cluster/bin/mpnet_addrid	Resource is added.	Super-user
	/opt/FJSVmpnet/cluster/bin/mpnet_delrid	Resource is removed.	Super-user
	/opt/FJSVmpnet/cluster/bin/mpnet_rid	The resources of all nodes or specified nodes are added or removed.	Super-user
Copy of Environmental Configuration	/opt/FJSVmpnet/cluster/bin/mpnet_copyfile	Environmental configuration information is copied into all nodes or specified nodes.	Super-user

7.2.1.1 Environmental Configuration

For the Multipath function to work properly, common environmental configuration must be performed.
Refer to "Chapter 3 Configuration" for detailed information about configuration.

Be sure to perform the environmental configuration in each node.
There are two configuration methods: Set the environmental configuration in each node, or using "copy" (*mpnet_copyfile*) command to perform the environmental configuration.
When the environmental configuration is performed for each node without the "copy" (*mpnet_copyfile*) command, the configuration in the interface should have same information between nodes.
The "copy" (*mpnet_copyfile*) command is best processed on the target nodes of which the hardware configuration and LAN device configuration are the same.

For details about the "copy" (*mpnet_copyfile*) command, see "Chapter 6 Command Reference."

7.2.1.2 Adding the resource

A resource is added for each interface after the environmental configuration completed.

A resource is added only for the clustering interface for which " " (blank) is specified in the "cluster" parameter in the "/etc/opt/FJSVmpnet/conf/parameters" file. When "none" is specified in the parameter, the resource is not added in the non-clustering interface.

A resource should be added in all nodes with the Multipath function deactivated.

The following commands are used to add the resource.
Refer to "Chapter 6 Command Reference" for details.

"Example of Confirming the Resource Registration" and "Example of the Content of /etc/opt/FJSVmpnet/conf/parameters/file" are shown as examples after the command execution.

[Command]

Command	Action
/opt/FJSVmpnet/cluster/bin/mpnet_addrid	This command adds the resource in the node used. The resources in all interfaces or specified interfaces that are defined in the environmental configuration of the node can be added.
/opt/FJSVmpnet/cluster/bin/mpnet_rid	This command is used to add the resources of all nodes or specified nodes. Use this command after executing the environmental configuration copy command. The Resources are added based on configuration information in the target node, and the /etc/opt/FJSVmpnet/conf/parameters file.

[Example of Confirming the Resource Registration]

```
# /etc/opt/FJSVcluster/bin/clgettree

      Cluster 1 cluster

             Domain 2 Domain0
```

```
                     Shared 7 SHD_Domain0

                           Psd 8 planpath0 ON

                           Psd 9 planpath1 ON

                           SHD_MPDisk 44 SHD_D2048 UNKNOWN

                                 MPDisk 42 mphd2048 ON fin121

                                 MPDisk 43 mphd2048 ON fin120

                           SHD_MPDisk 47 SHD_D2049 UNKNOWN

                                 MPDisk 45 mphd2049 OFF-STOP fin120

                                 MPDisk 46 mphd2049 OFF-STOP fin121

                     Node 3 fin120 ON

                           SystemState2 14 FJSVclprt_spool UNKNOWN

                           Ethernet 25 hme0 ON

                           MPDisk 43 mphd2048 ON

                           MPDisk 45 mphd2049 OFF-STOP

                           SymfoWARE_RDB 52 st1 ON

                           Application 57 rdbtest ON

                           MPNET 66 MPNET_mpnet0 UNKNOWN (*1)

                     Node 5 fin121 ON

                           SystemState2 15 FJSVclprt_spool UNKNOWN

                           Ethernet 26 hme0 ON

                           MPDisk 42 mphd2048 ON

                           MPDisk 46 mphd2049 OFF-STOP

                           SymfoWARE_RDB 53 st1 ON

                           Application 58 rdbtest ON

                           MPNET 67 MPNET_mpnet0 UNKNOWN (*1)

 #
```

*1: Resource ID in interface (Resource ID in the example indicates "66" and "67")

[Example of the Content of /etc/opt/FJSVmpnet/conf/parameters/file]

```
#ident "@(#)config Rel 2.2 02/06/07 FUJITSU"
#
#    /etc/opt/FJSVmpnet/conf/parameters file
#
#
# Set the interface parameters on the this machine.
#
# format:
# interface-name  MAC-address:func-mode:trunk-mode   cluster
#
# example:
# mpnet0      -:0:0             none
# mpnet1      020000000000:0:0          none
#

mpnet0      020000000001:0:0          66
```

7.2.1.3 Adding the resource to a cluster service

The added resource is registered to a cluster service.

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The resource registration to the cluster service allows you to switch the cluster interface.

When the ATM is used, register all the resources concerning ATM in one cluster service.

Caution

· When two or more resources are registered in one service, each resource of the Multipath function should change priority. It is possible to change on the "Setting application launch/stop priority" screen of the cluster operation management view. The priority in each resource of Multipath function should be set to become unique in the service. Multipath function's resource name is "MPNET_mpmetX", and the class is "System state 2".

7.2.1.4 Notes

· Do not delete or change the resource information that is set in the "/etc/opt/FJSVmpnet/conf/parameters" file after the resource is added.
If you delete the resource manually, the provided command cannot delete the specified resource.

7.2.2 Deleting the Cluster Environmental Configuration

This section explains how to delete the cluster environmental configuration of the Multipath function, and explains the ways to delete the configuration.

Be sure to stop the service using with the cluster operation management view before the following procedures are performed.
"Figure 7.5 Flow of Deleting the Cluster Environmental Configuration" shows the work flow of deleting the cluster environmental configuration.
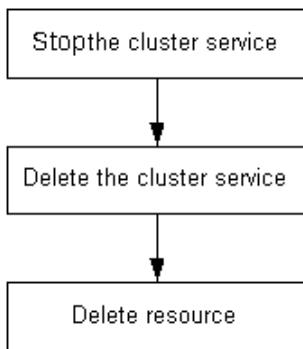
[Figure 7.5 Flow of Deleting the Cluster Environmental Configuration]

7.2.2.1 Deleting the resource from cluster service

The resource in the cluster service tree of the cluster control is deleted.

7.2.2.2 Deleting the resource

The resource is deleted.

The resource should be deleted with the Multipath function deactivated.

The following commands are used to delete the resource.
Refer to "Chapter 6 Command Reference" for details.

[Command]

Command	Action
/opt/FJSVmpnet/cluster/bin/mpnet_delrid	This command deletes the resource in the target node. The resources in all interfaces or specified interfaces that are defined in the environmental configuration of the node can be deleted.
/opt/FJSVmpnet/cluster/bin/mpnet_rid	This command deletes the resource in all nodes or the specified nodes. This command deletes the resource in the all nodes, and then copies the previous file (/etc/opt/FJSVmpnet/conf/parameters) that existed in the nodes to the target nodes.

[Example of Confirming the Resource Deletion]

```
# /etc/opt/FJSVcluster/bin/clgettree
     Cluster 1 cluster
          Domain 2 Domain0
               Shared 7 SHD_Domain0
                    Psd 8 planpath0 ON
                    Psd 9 planpath1 ON
                    SHD_MPDisk 44 SHD_D2048 UNKNOWN
                         MPDisk 42 mphd2048 ON fin121
                         MPDisk 43 mphd2048 ON fin120
                    SHD_MPDisk 47 SHD_D2049 UNKNOWN
                         MPDisk 45 mphd2049 OFF-STOP fin120
                         MPDisk 46 mphd2049 OFF-STOP fin121
               Node 3 fin120 ON
                    SystemState2 14 FJSVclprt_spool UNKNOWN
                    Ethernet 25 hme0 ON
                    MPDisk 43 mphd2048 ON
                    MPDisk 45 mphd2049 OFF-STOP
                    SymfoWARE_RDB 52 st1 ON
                    Application 57 rdbtest ON
               Node 5 fin121 ON
                    SystemState2 15 FJSVclprt_spool UNKNOWN
                    Ethernet 26 hme0 ON
                    MPDisk 42 mphd2048 ON
                    MPDisk 46 mphd2049 OFF-STOP
                    SymfoWARE_RDB 53 st1 ON
                    Application 58 rdbtest ON
#
```

7.2.2.3 Notes

· Do not delete or change the resource information that is set in the "/etc/opt/FJSVmpnet/conf/parameters file" after the resource is added.
If you delete the resource manually, the provided command cannot delete the specified resource.

7.3 The environmental configuration on PRIMECLUSTER

7.3.1 Adding the Cluster Environmental Configuration

In the Multipath function, resource registration is required as well as the usual environmental configuration.

"Figure 7.6 Flow of an Additional Procedure of Cluster Environmental Configuration" shows how to perform the additional procedure of the configuration by using the "userApplication Configuration wizard." The registration of a resource is the same procedure even when using "RMS wizards." Please refer to "Configuration using the RMS Wizards" of the "PRIMECLUSTER Relient Monitor Services (RMS) Configuration and Administration Guide" manual about the details of the configuration method of the userApplication using "RMS Wizards."
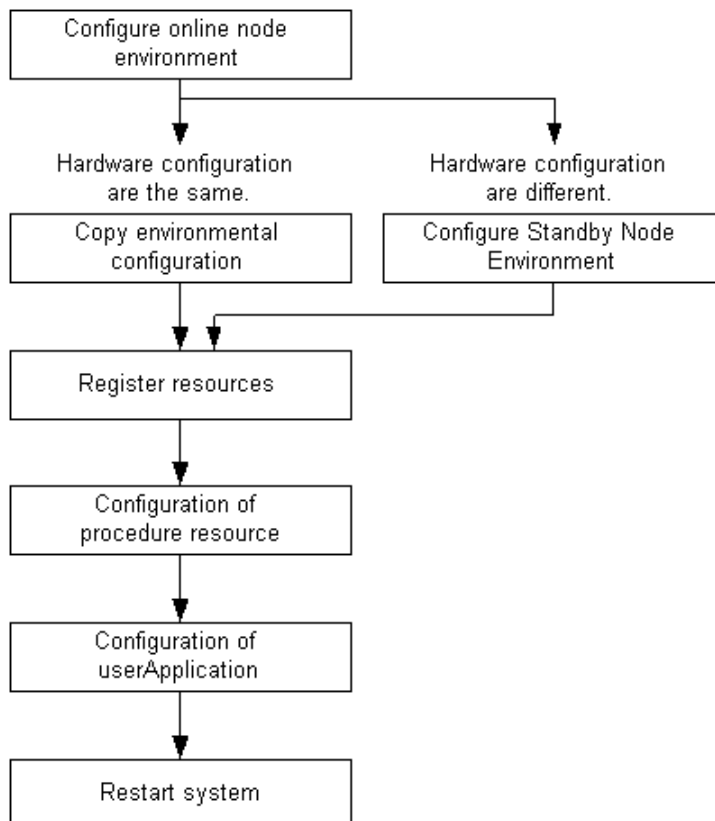
[Figure 7.6 Flow of an Additional Procedure of Cluster Environmental Configuration]

The command shown in "Table 7.2 Cluster Configuration Operation Command" can be used to perform the cluster environmental configuration.
This command can only be execute in the clustering system environment.

[Table 7.2 Cluster Configuration Operation Command]

Type	Command	Description	Permission
resource registration / deletion	/opt/FJSVmpnet/cluster/bin/mpnet_addrid	resources are registered	Super-user
	/opt/FJSVmpnet/cluster/bin/mpnet_delrid	resources are deleted.	Super-user
	/opt/FJSVmpnet/cluster/bin/mpnet_rid	The resources of all nodes or specified nodes are registered or deleted.	Super-user
copy of environmental configuration	/opt/FJSVmpnet/cluster/bin/mpnet_copyfile	Environmental configuration is copied into all nodes or the specified node.	Super-user

7.3.1.1 Environmental Configuration

For the Multipath function to work properly, common environmental configuration must be performed.
Refer to "Chapter 3 Configuration" for detailed information about configuration.

Be sure to perform the environmental configuration in each node.
There are two configuration methods: Set the environmental configuration in each node, or using "copy" (*mpnet_copyfile*) command to perform the environmental configuration.
When the environmental configuration is performed for each node without the "copy" (*mpnet_copyfile*) command, the configuration in the interface should have same information between nodes.
The "copy" (*mpnet_copyfile*) command is recommended on the target node of which the hardware configuration and LAN device configuration are the same.

For details about the "copy" (*mpnet_copyfile*) command, see "Chapter 6 Command Reference."

7.3.1.2 Resource Registration

The resource is registered for each interface after the environmental configuration is completed.

A resource is registered only for the MPNET interface by which the " " (blank) is specified to be the cluster" parameter of the "/etc/opt/FJSVmpnet/conf/parameters" file. A resource is not registered about the other MPNET interface.

The resource should be registered in all nodes with the Multipath function deactivated.

The following commands are used to register the resource.
Refer to "Chapter 6 Command Reference" for details.

"Example of Confirming the Resource Registration" and "Example of the Content of /etc/opt/FJSVmpnet/conf/parameters/file" are shown as examples of "*clgettree*" output after the command execution.

[Command]

Command	Action
/opt/FJSVmpnet/cluster/bin/mpnet_addrid	This command adds the resource in the node used. The resources in all interfaces or specified interfaces that are defined in the environmental configuration of the node can be registered.
/opt/FJSVmpnet/cluster/bin/mpnet_rid	This command is used to add the resources of all nodes or specified nodes. Use this command after executing the environmental configuration copy command. The resources are registered based on configuration information in the target node, and "/etc/opt/FJSVmpnet/conf/parameters" file in which the resource was registered in all nodes or the specified nodes is copied.

[Example of Confirming the Resource Registration]

```
# /etc/opt/FJSVcluster/bin/clgettree
     Cluster 1 cluster
          Domain 2 Domain0
                Shared 7 SHD_Domain0
                      Psd 8 planpath0 ON
                      Psd 9 planpath1 ON
                      SHD_MPDisk 44 SHD_D2048 UNKNOWN
                            MPDisk 42 mphd2048 ON fin121
                            MPDisk 43 mphd2048 ON fin120
                      SHD_MPDisk 47 SHD_D2049 UNKNOWN
                            MPDisk 45 mphd2049 OFF-STOP fin120
                            MPDisk 46 mphd2049 OFF-STOP fin121
                Node 3 fin120 ON
                      SystemState2 14 FJSVclprt_spool UNKNOWN
                      Ethernet 25 hme0 ON
                      MPDisk 43 mphd2048 ON
                      MPDisk 45 mphd2049 OFF-STOP
                      SymfoWARE_RDB 52 st1 ON
                      Application 57 rdbtest ON
                      MPNET 66 MPNET_mpnet0 UNKNOWN (*1)
                Node 5 fin121 ON
                      SystemState2 15 FJSVclprt_spool UNKNOWN
                      Ethernet 26 hme0 ON
                      MPDisk 42 mphd2048 ON
                      MPDisk 46 mphd2049 OFF-STOP
```

```
                    SymfoWARE_RDB 53 st1 ON

                    Application 58 rdbtest ON

                    MPNET 67 MPNET_mpnet0 UNKNOWN (*1)

 #
```

*1: Resource ID in interface (Resource ID in the example indicates "66" and "67")

[Example of the Content of /etc/opt/FJSVmpnet/conf/parameters/file]

```
#ident "@(#)config  Rel 2.2 02/06/07  FUJITSU"
#
#    /etc/opt/FJSVmpnet/conf/parameters file
#
#
# Set the interface parameters on the this machine.
#
# format:
# interface-name  MAC-address:func-mode:trunk-mode   cluster
#
# example:
# mpnet0       -:0:0                 none
# mpnet1       020000000000:0:0           none
#

mpnet0       020000000001:0:0           66
```

7.3.1.3 Configuration of procedure resource

The procedure resource is created using the "userApplication Configuration wizard." In the Multipath function, since the interface for the cluster will be switched using a procedure, please choose "Procedure" as the resource type. Here, "X" expresses the instance number of the Multipath function.

Please refer to a "Configuration using the RMS Wizards" for the details of wizards.

7.3.1.4 Configuration of userApplication

The registered resource is added to userApplication.

If the resource is added to userApplication, taking over of the interface for the cluster will be attained.

When the ATM is used, register all the resources concerning ATM in one userApplication.

Please refer to a " Configuration using the RMS Wizards" for the details of wizards.

7.3.1.5 Notes

· Do not delete or change the resource information that is set in the /etc/opt/FJSVmpnet/conf/parameters file after the resource is registered.
If you delete the resource manually, the provided command cannot delete the specified resource.

7.3.2 Deleting the Cluster Environmental Configuration

This section explains how to delete the cluster environmental configuration of the Multipath function, and explains the ways to delete the configuration.

Be sure to stop the RMS, using with the cluster operation management view, before the following procedures are performed.
"Figure 7.7 Flow of Deleting the Cluster Environmental Configuration" shows the work flow of deleting the cluster environmental configuration.
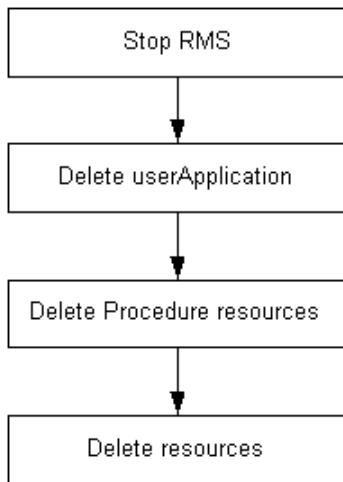
[Figure 7.7 Flow of Deleting the Cluster Environmental Configuration]

7.3.2.1 Deleting resource from userApplication

The userApplication of the Multipath function is deleted using "userApplication Configuration wizard." Please refer to a "Configuration using the RMS Wizards" for the details of wizards.

7.3.2.2 Deleting procedure resource

The procedure resource of the Multipath function is deleted using "userApplication Configuration wizard." Please refer to a "Configuration using the RMS Wizards" for the details of wizards.

7.3.2.3 Deleting resource

The registered resource is deleted.

The resource should be deleted with the Multipath function with deactivated.

The following commands are used to delete the registered resource.
Refer to "Chapter 6 Command Reference" for details.

[Command]

Command	Action
/opt/FJSVmpnet/cluster/bin/mpnet_delrid	This command deletes the resource in the target node. The resources in all interfaces or specified interfaces that are defined in the environmental configuration of the node can be deleted.
/opt/FJSVmpnet/cluster/bin/mpnet_rid	This command deletes the resource in all nodes or the specified nodes. This command deletes the resource in the all nodes, and then copies the previous file (/etc/opt/FJSVmpnet/conf/parameters) that existed in the nodes to the target nodes.

[Example of Confirming the Resource Deletion]

```
# /etc/opt/FJSVcluster/bin/clgettree
      Cluster 1 cluster
            Domain 2 Domain0
                  Shared 7 SHD_Domain0
                        Psd 8 planpath0 ON
                        Psd 9 planpath1 ON
                        SHD_MPDisk 44 SHD_D2048 UNKNOWN
                              MPDisk 42 mphd2048 ON fin121
                              MPDisk 43 mphd2048 ON fin120
                        SHD_MPDisk 47 SHD_D2049 UNKNOWN
```

```
                              MPDisk 45 mphd2049 OFF-STOP fin120
                              MPDisk 46 mphd2049 OFF-STOP fin121
                Node 3 fin120 ON
                        SystemState2 14 FJSVclprt_spool UNKNOWN
                        Ethernet 25 hme0 ON
                        MPDisk 43 mphd2048 ON
                        MPDisk 45 mphd2049 OFF-STOP
                        SymfoWARE_RDB 52 st1 ON
                        Application 57 rdbtest ON
                Node 5 fin121 ON
                        SystemState2 15 FJSVclprt_spool UNKNOWN
                        Ethernet 26 hme0 ON
                        MPDisk 42 mphd2048 ON
                        MPDisk 46 mphd2049 OFF-STOP
                        SymfoWARE_RDB 53 st1 ON
                        Application 58 rdbtest ON
 #
```

7.3.2.4 Notes

· Do not delete or change the resource information that is set in the "/etc/opt/FJSVmpnet/conf/parameters" file after the resource is registered.
If you delete the resource manually, the provided command cannot delete the specified resource.

Chapter 8 Dynamic Reconfiguration (DR) Function

This chapter explains the idea of environmental construction which uses the Multipath function and the operation when Dynamic Reconfiguration (DR) is executed for the DR function which the GP7000F M1000/2000 and PRIMEPOWER 800/900/1000/1500/2000/2500 offer.

In the use of the DR function, refer to the undermentioned manual.
· Dynamic Reconfiguration User's Guide

8.1 Multipath function for DR

The Multipath function provides a DR script to achieve DR functionality.
By executing the DR command, the DR script of the Multipath function is called, and the corresponding communication path (logical device) of the Multipath function is disconnected or connected.
As a result, the user can execute DR for a LAN configuration with the Multipath function without considering the DR script.

Refer to "8.3 Operation when DR command is executed" for the operation of the Multipath function.

After connecting by the DR function, Please execute the *mpnetlinkwatch* command, in order to check that the cable has not fallen out. Refer to "6.7 Display Command of the State of Transmission Path" for information about the *mpnetlinkwatch* command.

8.2 Environmental Construction

When a LAN configuration that uses the Multipath function is constructed on a GP7000F M1000/2000 or PRIMEPOWER 800/900/1000/1500/2000/2500, a configuration like "Figure 8.1 recommendation LAN configuration" is recommended.
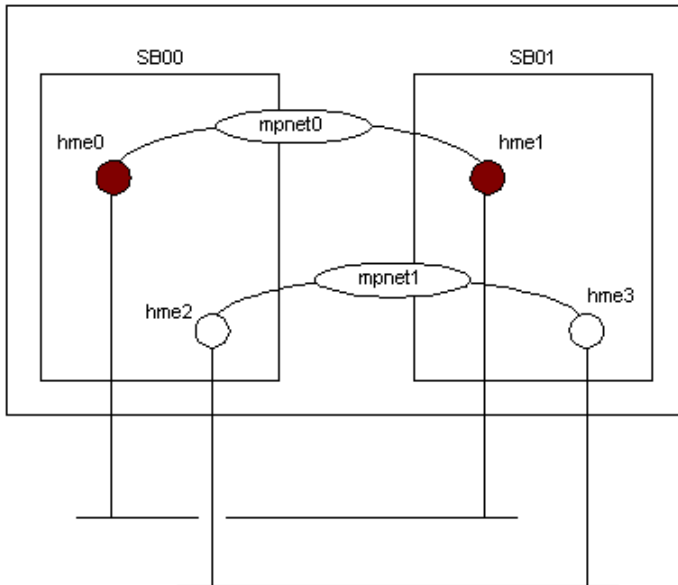
[Figure 8.1 recommendation LAN configuration]

The DR function is done to the unit of System Board (SB) of the GP7000F M1000/2000 and PRIMEPOWER 800/900/1000/1500/2000/2500.
When disconnecting by the DR command, it is possible to make communication continue by having a redundant communication path between System Boards, like recommended configuration.

8.3 Operation when DR command is executed

8.3.1 Operation when disconnecting
· For the Multipath method
If the communication path to disconnect is in the "active" state when disconnecting (drc -disconnect),

after changing the communication path in the "standby" state to the "active" state, disconnecting processing of the applicable communication path will be performed in DR script of a Multipath function.

If the communication path to disconnect is not the "active" state, disconnecting processing is performed as it is.

If the communication path to disconnect is the active path, and the standby path does not exist, a warning message is displayed and an inquiry regarding processing continuation is done.

Disconnect processing is done to all communication paths which correspond to the disconnected NIC when the connection is ATM.

Caution

With an ATM connection, do not specify -reset parameter and "-next" parameter, when disconnecting with the DR command.

· For the Multilink Ethernet method

When disconnecting (drc -disconnect), the DR script of the Multipath function disconnects the communication path. If the communication path is the "active" state, the transmission path is switched to another communicating (active) path.

If the communication path is not the "active" state, it is disconnected as is.

If the communication path is the "active" state, and no other communicating (active) path exists, a warning message is output asking the user whether to continue or stop communication.

8.3.2 Operation when connecting

· For a Multipath method

When connecting with the DR command (drc -connect), the DR script of the Multipath function connects the corresponding path and changes it to the "standby" state.

Connect processing is done to all communication paths which correspond to the connected NIC when the connection is ATM.

Caution

With an ATM connection, do not specify the -reset parameter when connecting with the DR command.

· For a Multilink Ethernet method

When connecting with the DR command (drc -connect), the DR script of the Multipath function connects the communication path. The communication path is then put into "active" state to restart communication.

8.3.3 Operation when canceling

During disconnect processing with the DR command, when the processing stops by inquiry or a situation which must stop the disconnect process according to certain factors occurs, cancellation processing of disconnecting is done.
Similarly, when connecting by a DR command, and a situation by which should case connect processing to be discontinued occurs, cancellation processing of the connection is done.

In the DR script of the Multipath function, reconnect processing is executed as the cancellation processing of disconnecting, and the path is returned to the state before the disconnecting.

· For a Multipath method

When the state before the disconnect is the "active" state or the "standby" state, it changes to the "standby" state. And, when the state before the disconnect is "fail" state or "stop" state, it changes to the "stop" state.
Occasionally, it does not return to the state before disconnecting, if there is hardware breakdown etc.

In the cancellation processing of a connection, processing of the re-disconnection is done, and the state is returned to "disconnected" state.

In the case of ATM, all communication paths that correspond to NIC which is reconnecting or re-disconnecting are processed.

· For a Multilink Ethernet method

When the state before the disconnect is "active" state, it changes to the "active" state. And, when the state before the disconnect is "fail" state or "stop" state, it changes to the "stop" state.

Occasionally, it does not return to the state before disconnecting, if there is a hardware breakdown etc.

In the cancellation processing of a connection, processing of the re-disconnection is done, and the state is returned to "disconnected" state.

8.4 Display messages

The DR script of the Multipath function outputs messages when the communication path is disconnected and communication cannot be continued because the switching destination path is inactive or invalid. This also occurs if connection or disconnection fails because an abnormality is detected while the DR script is running.

In "Table 8.1 Display Message List," the message of the DR script of the Multipath function and presence of the inquiry for the user is described.

[Table 8.1 Display Message List]

Code	Message	Meaning	Inquiry
0001	When the DR processing is executed for this path, the communication is disconnected. interface=XX path=YY	If the DR processing is executed for communication path YY in interface XX, the communication will be disconnected.	none
0002	Is the DR processing continued ?	Do you want DR to be continued?	exist
0003	iompadm command abnormal end. action=ZZ interface=XX path=YY	When subcommand ZZ of the iompadm command for communication path YY in interface XX was executed, it was terminated abnormally.	none

8.5 Reply file

In the DR script of the Multipath function, when communication cannot be continued after disconnecting the communication path, or the disconnecting or connecting fails by abnormality detection during the DR script's operation, a message is output, the user is asked whether to continue the DR processing.

When the adrc command is executed, in the Multipath function the undermentioned reply file is prepared as a means to respond to these inquiries to respond automatically.

· /etc/opt/FJSVdr/reply/C/FJSVmpnet

The format of the reply file is as follows.

Please refer to "Dynamic Reconfiguration User's Guide" for details.

<MESSAGE ID>:<REPLY CODE>:<COMMENT>

The default value is set in the reply file of the Multipath function as follows.

```
0002:1:"query if DR process is removed"
```

Each parameter is explained.

message-ID

Message ID(0002) which responds automatic response is set.

Please do not change.

reply-code

To set the value which responds automatically. Please set "0" or "1".

· 0 : yes: Processing is continued.
· 1 : no : Processing is not continued.(Default)

comment

Comment for MESSAGE ID.

Please do not change.

Appendix A Messages

This chapter describes the list of console message that the MPNET driver and commands output.

A.1 MPNET Driver Messages

Description of messages which the MPNET driver outputs and the workaround are explained.

[List of the Messages]

Message	Meaning	Workaround
NOTICE: MPNET: Online: mpnetX: yyy	Communication path xxx of mpnetX is in the Online state.	Normal operation. No action required.
NOTICE: MPNET:Path Change succeed. mpnetX: yyy -> zzz	Communication path of mpnetX switched from yyy to zzz.	Normal operation. No action required.
WARNING: MPNET: Path Change failed. mpnetX: yyy -> zzz	Communication path switch of mpnetX from yyy to zzz failed.	Confirm the network status such as the adapters used by communication path zzz. Contact your technical support if problem persists.
WARNING: MPNET:0001: Can't allocate streams resources	Allocating the system memory failed.	Increase the system memory.
WARNING: MPNET:2001: _init mod_install failed 0xXX	Error occurred in driver initialization (_init).	Contact your technical support.
WARNING: MPNET:2003: _info mod_info failed 0xXX	Error occurred in driver initialization (_info).	Contact your technical support.
WARNING: MPNET:2006: attach ddi_create_minor_node failed 0xXX	Error occurred in the driver attaching process (creating the special file).	Contact your technical support.
WARNING: MPNET:2006: attach ddi_detach_cmd_t failed 0xXX	Error occurred in the driver attaching process (unsupported command).	Contact your technical support.
WARNING: MPNET:2007: detach ddi_attach_cmd_t failed 0xXX	Error occurred in the driver attaching process	Contact your technical support.
WARNING: MPNET:2008: Device not respond.mpnetX:YYY (0xZZ)	No response to command 0xZZ from communication path yyy of mpnetX.	Restoration may be attempted by the "iompadm recover" command. When it is not restored, contact your technical support.
WARNING: MPNET:2009: Data type intermingled	Abnormalities were detected in the data type of the device.	Contact your technical support.
NOTICE: MPNET:0101: Recovered. streams resource allocate is succeeded	Restored from the allocation failure of system memory.	Normal operation. No action required.

A.2 MPNET Monitoring Daemon Messages

Description of messages output at the *mpnetinit* command or *mpnetconfig* command and the workaround are explained.

[List of Error Messages]

Message	Description	
WARNING: MPNET: mpnetd: mpnetd.conf not found	Meaning	The mpnetd.conf file is not found.
	Workaround	Confirm whether MPNET is installed correctly. If the problem persists, contact your technical support.

Message	Description	
WARNING: MPNET: mpnetd: mpnetX yyy line error(link down)	Meaning	In device yyy, an abnormal transmission path (cable missing (Link Down), etc.) was detected.
	Workaround	Confirm whether the communication path is connected correctly. Restore the MPNET by using the iompadm recover command after the cause is solved.
WARNING: MPNET: mpnetd: mpnetX yyy line error(ipackets error)	Meaning	In device yyy, a transmission path failure (frequent occurrence of abnormal input packets) was detected.
	Workaround	Check the network equipment (adapter, cables, and switches). Restore MPNET by using the iompadm recover command after the cause is solved.
WARNING: MPNET: mpnetd: mpnetX yyy line error(opackets error)	Meaning	In device yyy, a transmission path failure (frequent occurrence of an abnormal output packet) was detected.
	Workaround	Check the network equipment (adapter, cables, and switches). Restore MPNET by using the iompadm recover command after the cause is solved.

A.3 Activation Command Messages

A.3.1 mpnetinit Command Messages

Description of messages output at the *mpnetinit* command and the workaround are explained.

[List of error messages]

Message	Description	
mpnetinit: already up mpnetX	Meaning	The mpnetX has already been activated.
	Workaround	Normal operation. No action required.
MPNET: mpnetX: now up	Meaning	The mpnetX was activated.
	Workaround	Normal operation. No action required.
MPNET: mpnetX: daemon started	Meaning	The MPNET monitoring daemon of mpnetX was started.
	Workaround	Normal operation. No action required.
MPNET: mpnetX: daemon start failed	Meaning	Activation of the MPNET monitoring daemon of mpnetX failed.
	Workaround	Contact your technical support.
mpnetinit: /opt/FJSVmpnet/sbin/mpnetlink not found	Meaning	/opt/FJSVmpnet/sbin/mpnetlink is missing.
	Workaround	Verify whether the file is installed correctly. Contact your technical support if problem persists.
mpnetinit: /opt/FJSVmpnet/sbin/mpnetconf not found	Meaning	/opt/FJSVmpnet/sbin/mpnetconf is missing.
	Workaround	Verify whether the file is installed correctly. Contact your technical support if problem persists.
mpnetinit: /etc/opt/FJSVmpnet/conf/config not found	Meaning	/etc/opt/FJSVmpnet/conf/config is missing.
	Workaround	Verify whether the file is installed correctly. Contact your technical support if problem persists.
mpnetinit: /etc/opt/FJSVmpnet/conf/parameters not found	Meaning	/etc/opt/FJSVmpnet/conf/parameters is missing.
	Workaround	Verify whether the file is installed correctly. Contact your technical support if problem persists.
mpnetinit: /opt/FJSVmpnet/daemon/mpnetd not found	Meaning	/opt/FJSVmpnet/daemon/mpnetd is missing.
	Workaround	Verify whether the file is installed correctly. Contact your technical support if problem persists.

Message	Description	
mpnetinit: /etc/opt/FJSVmpnet/conf/parameters configration error	Meaning	The environmental configuration is not defined in the /etc/opt/FJSVmpnet/conf/parameters file.
	Workaround	Verify the environmental configuration is correctly defined in /etc/opt/FJSVmpnet/conf/parameters file
mpnetinit: /opt/FJSVmpnet/sbin/mpnetlink failed	Meaning	/opt/FJSVmpnet/sbin/mpnetlink abnormally ended.
	Workaround	Check the error message about /opt/FJSVmpnet/sbin/mpnetlink to see if the environment is correctly defined.
mpnetinit: /opt/FJSVmpnet/sbin/mpnetconf failed	Meaning	/opt/FJSVmpnet/sbin/mpnetconf abnormally ended.
	Workaround	Check the error message about /opt/FJSVmpnet/sbin/mpnetconf to see if the environment is correctly defined.
can't unload the module: Device busy	Meaning	The MPNET driver cannot be unloaded.
	Workaround	Deactivate all the upper protocols that use the MPNET driver, and deactivate MPNET again
mpnetcntl: ERROR: /dev/xxx: NNNN NNNN	Meaning	Abnormality occurred in /dev/xxx.
	Workaround	Verify the environmental configuration and installation of the driver. Contact your technical support if problem persists.
mpnetcntl: ERROR: /var/opt/FJSVmpnet/conf/mpnettab: No such file or directory	Meaning	/var/opt/FJSVmpnet/conf/mpnettab is missing.
	Workaround	Verify the installation of the driver. Contact your technical support if problem persists.
mpnetcntl: ERROR: /var/opt/FJSVmpnet/conf/mpnettab: Link index not found	Meaning	LINK index is not found in /var/opt/FJSVmpnet/conf/mpnettab.
	Workaround	Verify the interface name is specified correctly.
mpnetcntl: ERROR: /etc/opt/FJSVmpnet/conf/config: NNNN	Meaning	An abnormality is found in /etc/opt/FJSVmpnet/conf/config.
	Workaround	Verify the installation of the driver. Contact your technical support if problem persists.
mpnetcntl: ERROR: /etc/opt/FJSVmpnet/conf/config: Device configration error	Meaning	The wrong device name is specified in /etc/opt/FJSVmpnet/conf/config.
	Workaround	Correct the device name specified in /etc/opt/FJSVmpnet/conf/config.
mpnetcntl: ERROR: /etc/opt/FJSVmpnet/conf/config: Device type error	Meaning	The specified device name and device type specified in /etc/opt/FJSVmpnet/conf/config are mismatched.
	Workaround	Verify the device name and device type specified in /etc/opt/FJSVmpnet/conf/config are entered correctly.
mpnetcntl: ERROR: mpnetX: Select device error: yyy	Meaning	An error was found in device name yyy specified in mpnetX.
	Workaround	Verify the specified device name yyy.
mpnetcntl: ERROR: configration device count error: mpnetX	Meaning	The number of specified devices exceeds the maximum number allowed.
	Workaround	Verify the number of devices defined in /etc/opt/FJSVmpnet/conf/config does not exceed the maximum number allowed.
mpnetcntl: mpnetX: configration parameter error: /etc/opt/FJSVmpnet/conf/config	Meaning	The specified interface name is not found in /etc/opt/FJSVmpnet/conf/config.

Message		Description
	Workaround	Verify the specified interface name is defined in /etc/opt/FJSVmpnet/conf/config correctly.
mpnetcntl: mpnetX: configuration parameter error: /etc/opt/FJSVmpnet/conf/parameters	Meaning	The specified interface name is not found in /etc/opt/FJSVmpnet/conf/parameters.
	Workaround	Confirm the specified interface name is defined in /etc/opt/FJSVmpnet/conf/parameters correctly.
mpnetcntl: XXX: unknown name	Meaning	An error was found in interface name XXX.
	Workaround	Specify a correct interface name.
mpnetcntl: mpnetX: not enough memory	Meaning	Memory cannot be allocated due to insufficient memory.
	Workaround	Increase memory to solve the problem and retry this command again.
mpnetcntl: mpnetX: /dev/mpnet: NNNN	Meaning	The /dev/mpnet file "OPEN" and the activation failed. (NNNN indicates the error information)
	Workaround	Contact your technical support.
mpnetcntl: mpnetX: /etc/opt/FJSVmpnet/conf/config: NNNN	Meaning	The /etc/opt/FJSVmpnet/conf/config file "OPEN" failed. (NNNN indicates the error information)
	Workaround	Contact your technical support.
mpnetcntl: mpnetX: /etc/opt/FJSVmpnet/conf/parameters: NNNN	Meaning	The /etc/opt/FJSVmpnet/conf/parameters file "OPEN" failed. (NNNN indicates the error information)
	Workaround	Contact your technical support.
mpnetcntl: mpnetX: file definition error: /etc/opt/FJSVmpnet/conf/parameters	Meaning	Wrong information was found in the environmental configuration of /etc/opt/FJSVmpnet/conf/parameters.
	Workaround	Check the environmental configuration of /etc/opt/FJSVmpnet/conf/parameters to see if there is error in the file.
mpnetcntl: mpnetX: file definition error: /etc/opt/FJSVmpnet/conf/parameters	Meaning	Wrong information was found in the environmental configuration of /etc/opt/FJSVmpnet/conf/parameters.
	Workaround	Check the environmental configuration of /etc/opt/FJSVmpnet/conf/parameters to see if there is error in the file.
mpnetcntl: mpnetX: configuration device error: /etc/opt/FJSVmpnet/conf/config	Meaning	Wrong information was found in the environmental configuration of /etc/opt/FJSVmpnet/conf/config.
	Workaround	Check the environmental configuration of /etc/opt/FJSVmpnet/conf/config to see if there is error in the file.
mpnetcntl: mpnetX: can't get Global MAC address: /etc/opt/FJSVmpnet/conf/parameters	Meaning	Obtaining the global MAC address failed.
	Workaround	Contact your technical support.
mpnetcntl: mpnetX: configration device count error: mpnetX	Meaning	The number of specified devices exceeds the maximum number allowed.
	Workaround	Verify the number of devices defined in /etc/opt/FJSVmpnet/conf/config does not exceed the maximum number allowed.

A.3.2 mpnetconfig Command Messages

Refer to Section "A.3.1 mpnetinit Command Message" for the message output by the *mpnetconfig* command.

A.4 iompadm Command Messages

Description of messages output at the iompadm command and the workaround are explained.

[List of messages]

Message	Description	
iompadm: cannot initialize library: Permission Denied	Meaning	The initialization failed because an authority other than super user tried to process the command.
	Workaround	Execute the command as super user.
iompadm: cannot initialize library: No Memory	Meaning	The initialization failed due to insufficient memory.
	Workaround	Increase memory to solve the problem and retry this command again.
iompadm: Too many classes specified: Invalid Arguments	Meaning	The class was specified two times or more.
	Workaround	Confirm the synopsis of this command.
iompadm: invalid command: Invalid Arguments	Meaning	An error is found in the subcommand name.
	Workaround	Confirm the synopsis of this command.
iompadm: cannot initialize library: Invalid Path	Meaning	There is no valid Plug-In or initialization is failed for all the Plug-Ins.
	Workaround	Verify the driver is installed correctly. Contact your technical support if problem persists.
iompadm: XXX: Invalid Arguments	Meaning	An error was found in the specified option, subcommand or parameter.
	Workaround	Confirm the synopsis of this command.
iompadm: XXX: No Memory	Meaning	An insufficient memory condition occurred while processing this command.
	Workaround	Increase memory to solve the problem and retry the command again.
iompadm: XXX: Invalid Path Number	Meaning	The path was added/deleted to the same class by another process while processing this command.
	Workaround	Execute the command again after the other process completes.
iompadm: XXX: Invalid Path	Meaning	An error was found in the communication path name specified in the parameter.
	Workaround	Specify a valid communication path name.
iompadm: XXX: Too Many Path	Meaning	The communication paths specified in the parameter exceeded the maximum number allowed.
	Workaround	Confirm the number of target that devices specified in the environmental configuration does not exceed the maximum number allowed.
iompadm: XXX: Not Implemented	Meaning	The specified subcommand is not supported in this product.
	Workaround	Use an available subcommand.
iompadm: XXX: Class not Found	Meaning	The class that corresponds to the specified communication path name is not found.
	Workaround	Verify the specified communication path name.
iompadm: XXX: Not Supported	Meaning	It was going to change to an unsupported.
	Workaround	Use an available subcommand.
iompadm: XXX: IO Error	Meaning	The command abnormally ended.
	Workaround	Check the network equipment (adapter, cables, and switches). Contact your technical support if problem persists.

Message	Description	
iompadm: XXX: Internal Error	Meaning	The specified interface name does not exist. Or, the command is not accepted.
	Workaround	Verify the specified interface name or subcommand.
iompadm: XXX: Invalid Instance	Meaning	An error was found in the specified interface name.
	Workaround	Verify the specified interface name.
iompadm: XXX: Class not Found	Meaning	The class name specified by XXX does not exist.
	Workaround	Specify the correct class name.

A.5 mpnetstat Command Messages

Description of messages output at the *mpnetstat* command and the workaround are explained.

[List of messages]

Message	Description	
MPNET: mpnetstat: Not super-user	Meaning	The command failed because an authority other than the super-user tried to execute.
	Workaround	Execute the command as super-user.
MPNET: mpnetstat: malloc error NNNN	Meaning	An insufficient memory condition occurred while executing this command (NNNN indicates the error information)
	Workaround	Increase memory to solve the problem and retry the command again.
MPNET: mpnetstat: /dev/mpnet open error NNNN	Meaning	The /dev/mpnet file open and the activation failed. (NNNN indicates the error information)
	Workaround	Contact your technical support.
MPNET: mpnetstat: /usr/sbin/netstat -k error (NNNN)	Meaning	Failed to execute the /usr/bin/netstat command. (NNNN indicates the error information)
	Workaround	Contact your technical support.
MPNET: mpnetstat: ioctl(FIOMPGETPROP) error NNNN	Meaning	Failed to execute the command for the MPNET driver. (NNNN indicates the error information)
	Workaround	Contact your technical support.
MPNET: mpnetstat: ioctl(FIOMPALLINSTNUM) error NNNN	Meaning	Failed to execute the command for the MPNET driver. (NNNN indicates the error information)
	Workaround	Contact your technical support.

A.6 mpnetlinkwatch Command Messages

Description of messages output at the *mpnetlinkwatch* command and the workaround are explained.

[List of messages]

Message	Description	
MPNET: mpnetlinkwatch: Not super-user	Meaning	The command failed because an authority other than the super-user tried to execute.
	Workaround	Execute the command as super-user.
MPNET: mpnetlinkwatch: /etc/opt/FJSVmpnet/conf/config not found	Meaning	/etc/opt/FJSVmpnet/conf/config file is missing.
	Workaround	Verify the file is installed correctly. Contact your technical support if problem persists.
MPNET: mpnetlinkwatch: /etc/opt/FJSVmpnet/conf/config XXX not	Meaning	The specified interface name (XXX) is not found in the /etc/opt/FJSVmpnet/conf/config file.

Message		Description
found	Workaround	Confirm whether the specified interface name is correct or it is defined as /etc/opt/FJSVmpnet/conf/config.
MPNET: mpnetlinkwatch: /etc/opt/FJSVmpnet/conf/config mpnetX illegal media type yyy	Meaning	There is an error in the media type defined in the /etc/opt/FJSVmpnet/conf/config file for the specified interface name (mpnetX).
	Workaround	Verify the media type (yyy) of the interface name (mpnetX) defined in the /etc/opt/FJSVmpnet/conf/config file.
MPNET: mpnetlinkwatch: malloc error NNNN	Meaning	An insufficient memory condition occurred while executing this command (NNNN indicates the error information)
	Workaround	Increase memory to solve the problem and retry the command again.
MPNET: mpnetlinkwatch: /dev/mpnet open error NNNN	Meaning	The /dev/mpnet file open and the activation failed. (NNNN indicates the error information)
	Workaround	Contact your technical support.
MPNET: mpnetlinkwatch: mpnetX yyy illegal	Meaning	There is an error in the device name yyy specified by mpnetX.
	Workaround	Verify the specified device name.
MPNET: mpnetlinkwatch: mpnetX yyy line error (link down)	Meaning	For device yyy, a transmission path failure (cable missing (Link Down), etc.) was detected.
	Workaround	Check whether the communication path is connected correctly. Restore the MPNET by using the iompadm recover command after the cause is solved.
MPNET: mpnetlinkwatch: ioctl(FIOMPMAXPATHNUM) error NNNN	Meaning	Failed to execute the command for the MPNET driver. (NNNN indicates the error information)
	Workaround	Contact your technical support.
MPNET: mpnetlinkwatch: ioctl(FIOMPGETPROP) error NNNN	Meaning	Failed to execute the command for the MPNET driver. (NNNN indicates the error information)
	Workaround	Contact your technical support.
MPNET: mpnetlinkwatch: ioctl(MPNIOCLINKDOWN) error NNNN	Meaning	Failed to execute the command for the MPNET driver. (NNNN indicates the error information)
	Workaround	Contact your technical support.