AX Series
Fault-Tolerant Network
Configuration Guide

for the Guaranteed Network

Edition 3

Preface

This document describes the operational overview, construction methods, and the operational management of fault-tolerant networks (hereafter *FT networks*) to help assist in the introduction of an FT network system consisting of the AX6000S family.

Related documents

- AX series product manuals (http://www.alaxala.com/en/techinfo/manual/index.html)
- White Paper: *ALAXALA Network Corporation's Fault-Tolerant Networks That Ensure Uninterrupted System Operation*
- *AX Series SML Usage Guide - Application on a Large-Scale Fault-Tolerant Network*

Notes on using this document

The information in this document is based on basic operations verified under the environment specified by ALAXALA Networks Corporation, and does not guarantee the operations in functionality, performance, and reliability under all environment requirements. Please understand that this document is intended to help with system configuration for our products.

Unless otherwise stated, the OS software version as of the creation of this document is as shown below. Note that the AX6600S series supports Ver. 11.1 or later versions.

AX6700S, AX6600S, AX6300S: Ver. 11.1
AX3600S, AX2400S : Ver. 11.1.B

Information in this document is subject to change without notice.

Export restrictions

If you export this guide, you must check and comply with all applicable laws, rules and restrictions of Japan and any other countries, such as Japan's Foreign Exchange and Foreign Trade Law and U.S. export control laws and regulations.

Conventions: The terms "Switch" and "switch"

The term Switch (upper-case "S") is an abbreviation for any or all of the following models:

- AX6700S series switch
- AX6600S series switch
- AX6300S series switch
- AX3600S series switch
- AX2400S series switch

The term switch (lower-case "s") might refer to a Switch, another type of switch from the current vendor, or a switch from another vendor. The context decides the meaning.

Trademarks

- The ALAXALA name and logo mark are trademarks or registered trademarks of ALAXALA Networks Corporation.
- Ethernet is a trade name of Xerox Corporation in the United States.
- Other company and product names in this document are trademarks or registered trademarks of their respective owners.

Revision history

Edition	Rev.	Date	Description	Applicable sections
Edition 1	--	November 21, 2008	First edition	--
Edition 2	--	July 24, 2009	A lineup chart for FT switches belonging to the AX6000S family was added.	2.1
			The section titled *AX6600S configuration* was added.	2.3
			The section titled *AX6300S configuration* was added.	2.4
			A description of the behaviors that take place in case of failure and during recovery in AX6600S and AX6300S series switches was added.	2.5
			Examples of how to apply an FT network system using AX6608S and AX6308S series switches were added.	3.1
			Important points on constructing a system using AX6600S and AX6300S series switches were added.	3.2
			Configuration examples of AX6600S and AX6300S series switches were added.	3.3
			In an example of how to utilize an FT network, an AX6600S series switch was used as the server farm switch.	3.4
			- A figure illustrating the LED status and a list of respective operating status when an AX6700S series switch is running in redundant mode were added. - Descriptions of AX6600S and AX6300S series switches running in redundant mode were added. - A description of mismatch of system information between the active and standby modules in a redundant configuration was added.	4.1
			Chapter 5 was newly added. A description of differences across AX6700S, AX6600S, and AX6300S series switches was added.	5
			Chapter 6 was newly added. Some notes were added.	6
			AX6600S and AX6300S series switch configuration files were added.	Appendix
Edition 3	--	March 11, 2011	In an example of how to utilize an FT network, an NIF installed on AX6300S series switches has been changed.	3.4
			A note on the execution interval for active-standby switchover operations has been added.	6.1
			A note regarding AX6300S series switches has been added.	6.3

Contents

1. What Is an FT Network?

1.1 Overview of an FT network

In contrast to a conventional network that is controlled by dynamic routing, an FT network is configured by adding the following two elements: ***Graceful Restart*** for stabilizing the entire system and a ***fault-tolerant switch*** (hereafter an ***FT switch***) that provides improved failure tolerance of the device (switch) itself.

- Graceful Restart (localization of faults)
  When a fault occurs, this functionality ensures that the subsequent recalculation of route information is only performed in the faulty device (localization of the recalculation processing). The stabilization of the system is achieved by preventing a fault from affecting other devices.
- FT switches (high-speed switchover of the location where the fault has occurred)
  An FT switch enables greater availability of each device by incorporating the functionality of two devices into a single device. It enforces high-speed, reliable switchovers within the device, ensuring immediate recovery from a fault without affecting communication. Your system can be simplified by eliminating the need for STP, VRRP, or other protocols to configure devices and lines in a redundant configuration.

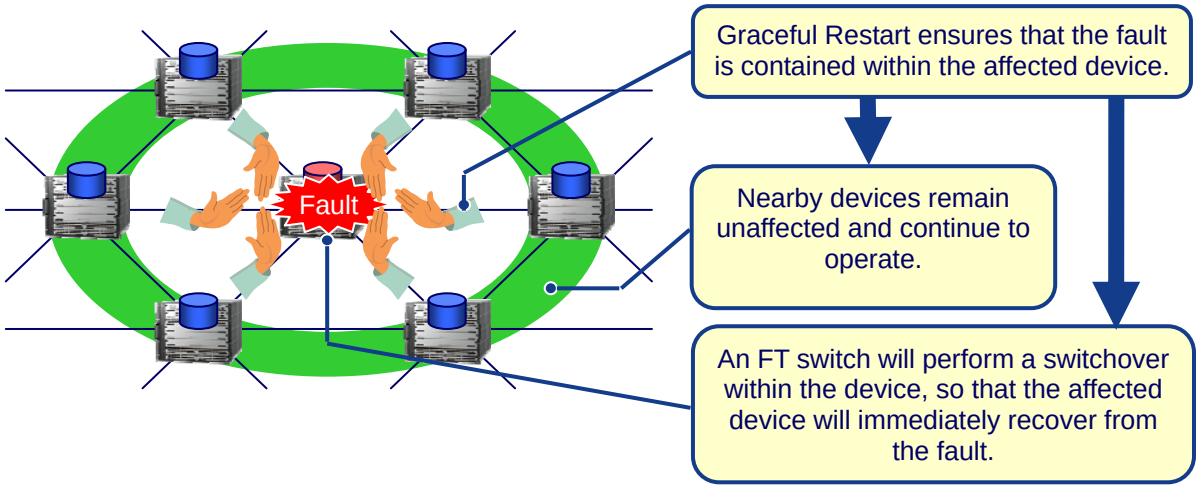


Figure 1.1-1 Overview of a fault-tolerant network

1.2 Features of an FT network

As suggested by the name "fault tolerant", this Switch allows for continued operation even in the event of faults, and offers the following advantages:

- Graceful Restart allows for stabilization of the entire network while utilizing the advantages of dynamic routing.
- The functionality of two devices is incorporated into a single device, thus allowing you to reduce the number of devices required. High-speed, reliable switchovers are guaranteed while eliminating the need to go through cumbersome setup and tuning that are required to configure redundancy.
- Redundant lines are configured via a link aggregation instead of STP, thus eliminating loop failures.
- There will be no need for gateway redundancy protocols (VRRP, etc.), which means that the device will be free from flapping.
- You need fewer devices and use fewer protocols, which contributes to a simpler network and reduced operation and management costs.
- "No-stop" software updates can be performed.
- Communication will remain uninterrupted even when a module is being replaced. ("No-stop" maintenance can be performed.)

Thus, the simplicity and greater availability of an FT network is a suitable solution for a mission-critical system.

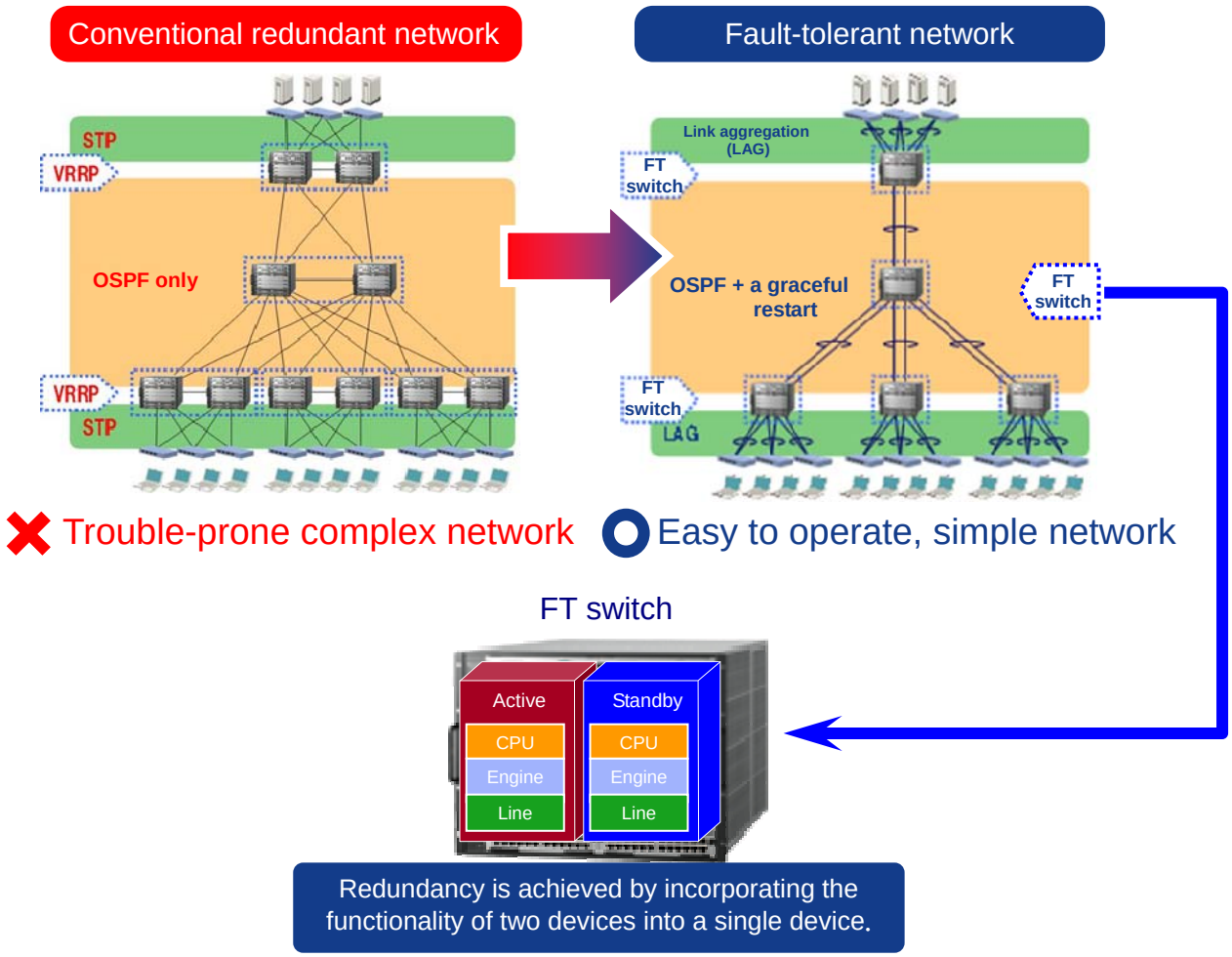


Figure 1.2-1 Conventional redundant network vs. fault-tolerant network

2. Overview of an FT Switch

2.1 FT switches: AX6000S family

A lineup consisting of the AX6700S, AX6600S, and AX6300S series switches comprises the AX6000S family FT switches, which constitute the core of FT networks proposed by ALAXALA Networks Corporation.

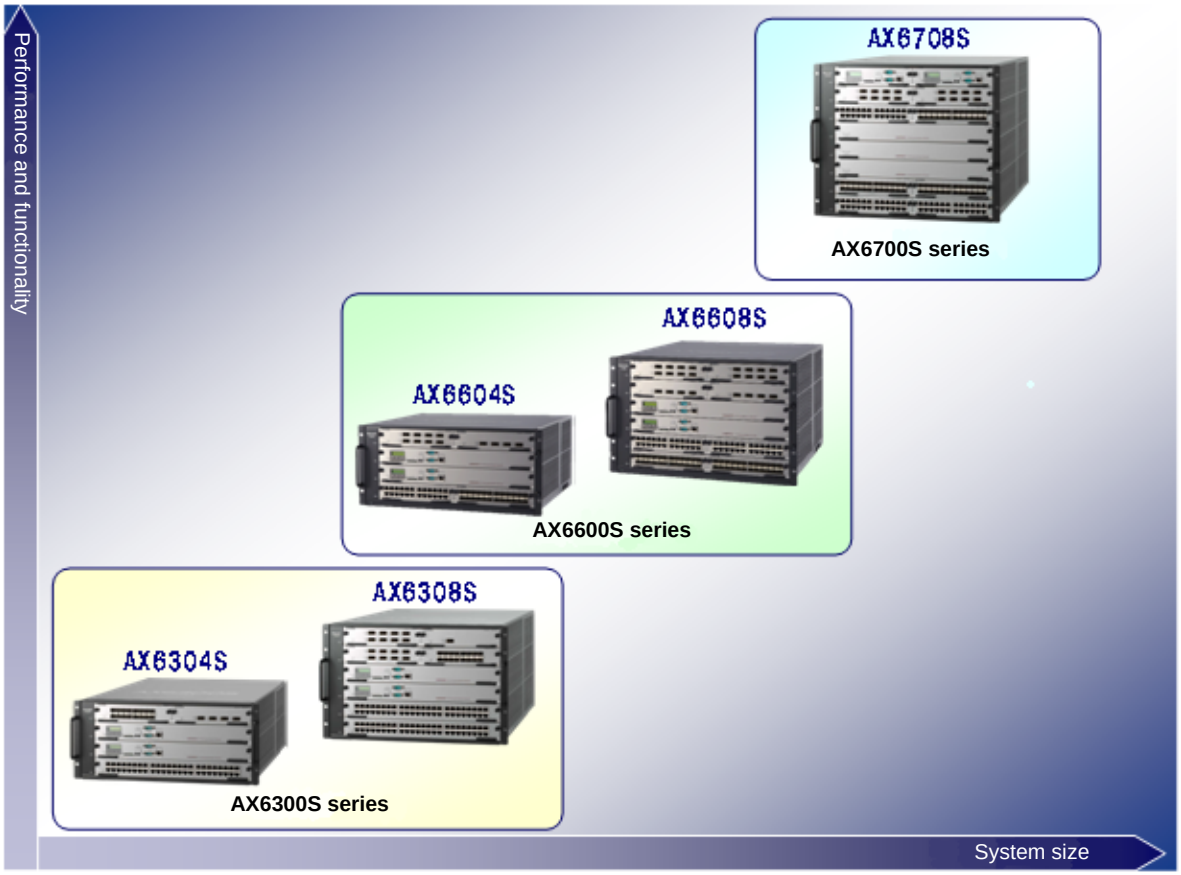


Figure 2.1-1 FT switches - AX6000S family

2.2 AX6700S series switch configurations

This section describes AX6700S series switch hardware configurations as well as provides an overview of a redundant configuration. The following modules are incorporated into AX6700S series switches, all of which can be configured for redundancy.

Table 2.2-1 List of AX6700S modules

No.	Module type	Overview	Maximum number of modules that can be installed
1	BCU (Basic control unit)	BCUs are equipped with components such as CPUs and have software running on them.	2
2	BSU (Basic switching unit)	BSUs perform packet transfer processing.	3
3	NIF (Network interface unit)	NIFs handle lines (interfaces).	8
4	PS (Power supply unit)	PSs supply power.	8 (AC) 4 (DC)
5	FAN (Fan unit)	Three fans are inserted per module.	4

As shown in *Figure 2.2-1*, BCUs, BSUs, and NIFs are inserted into the front panel of the device, whereas PSs and FANs are inserted into the rear panel.

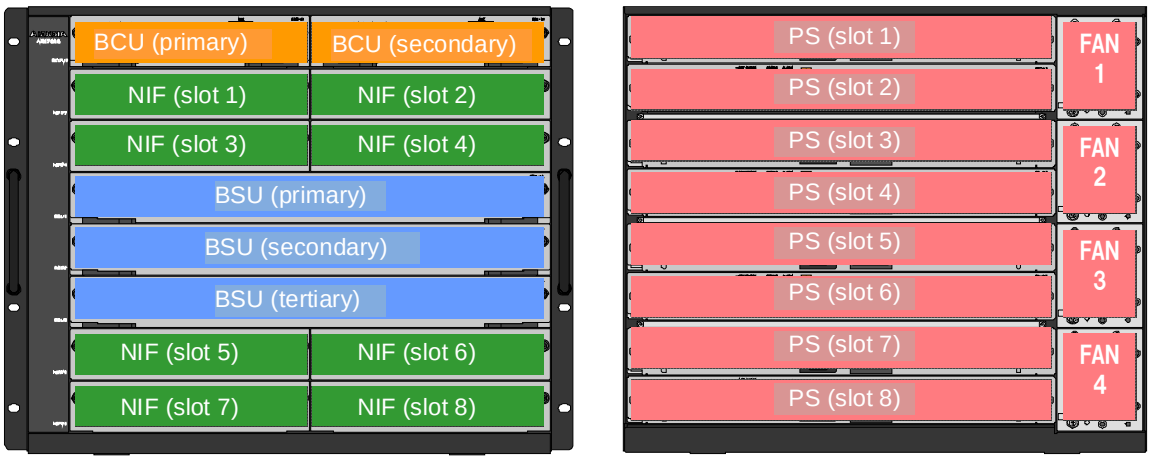


Figure 2.2-1 Where to insert AX6700S modules

Figure 2.2-2 shows an example of an AX6700S hardware configuration. If the AC power supply is used, four power supply units (PSs) are used in the standard configuration. To configure PSs for redundancy, use four additional PSs for standby. Four fan units (FANs) are inserted into the chassis, so that the device can continue to operate even if one of them fails.

Basic control units (BCUs) are configured in a 1+1 redundant configuration. The single-act, double-act, and triple-act operation of basic switching units (BSUs) allows for scalable expansion of the switching capacity. You can also designate one BSU as active (ACT) and one or more BSUs as standby (SBY). A standby BSU, if present, will become the active one when a failure occurs in the original BSU. Even in the absence of a standby BSU, the BSU in which a failure has occurred will keep running in degenerate mode.

Unlike BCUs and BSUs, there is no active/standby concept for a network interface unit (NIF). However, redundancy can still be achieved by inserting two identical NIFs into the device and then setting up link aggregation between them.

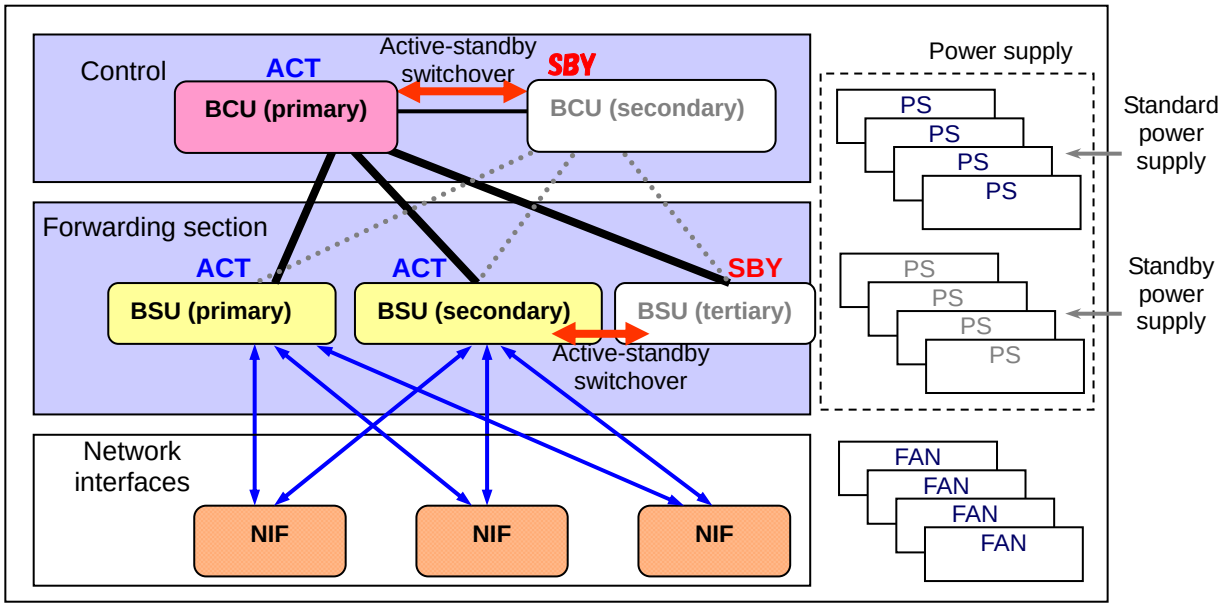


Figure 2.2-2 Example of an AX6700S hardware configuration (BSUs configured for double-act operation with a 2+1 redundant configuration)

In the AX6700S series, the control section (BCUs) and the forwarding section (BSUs) are configured such that they are completely independent of each other both physically and logically. This configuration enables high-speed, reliable switchovers in case of any failures. The AX6700S series contains the flagship models of our FT switches, featuring fault tolerant capability that allows both BCUs and BSUs to be configured for redundancy, high maintainability and operability achieved by allowing each module to be replaced with ease, flexible scalability that enables users to select an appropriate BSU configuration that can deliver the required performance, and dynamic power saving functionality that enables energy efficient operation that meets day-to-day performance requirements.

The operation modes for BSUs are shown below. As a guide, single-act operation with a 1+1 redundant configuration is recommended for a system that is configured to use mainly 1 GbE connections, whereas double-act operation with a 2+1 redundant configuration and triple-act operation are recommended for a system that is configured to use mainly 10 GbE connections or a system that is configured for optimal performance.

Table 2.2-2 BSU operation modes

Operation mode	Overview	Maximum switching capacity	Recommended redundant configuration
Single-act	One active BSU	384 Gbps	1+1 redundancy: One standby BSU
Double-act	Two active BSUs	768 Gbps	2+1 redundancy: One standby BSU
Triple-act	Three active BSUs	1.15 Tbps	Three active BSUs

2.3 AX6600S series switch configurations

This section describes AX6600S series switch hardware configurations as well as provides an overview of a redundant configuration. The following modules are incorporated into AX6600S series switches, all of which can be configured for redundancy.

Table 2.3-1 List of AX6600S modules

No.	Module type	Overview	Maximum number of modules that can be installed	
			AX6608S	AX6604S
1	CSU (Control and switching unit)	CSUs are equipped with CPUs and PSPs#1, have software running on them, and perform packet transfer processing.	2	
2	NIF (Network interface unit)	NIFs handle lines (interfaces). These are the same NIFs as the ones used in AX6700S switches.	8	4
3	PS (Power supply unit)	PSs supply power.	4 (AC)/2 (DC)	
4	FAN (Fan unit)	Three fans are inserted per module.	3	2

#1: PSP (packet switching processor) is part of a CSU that performs packet transfer processing.

As shown in *Figure 2.3-1*, CSUs and NIFs are inserted into the front panel of the device, whereas PSs and FANs are inserted into the rear panel.

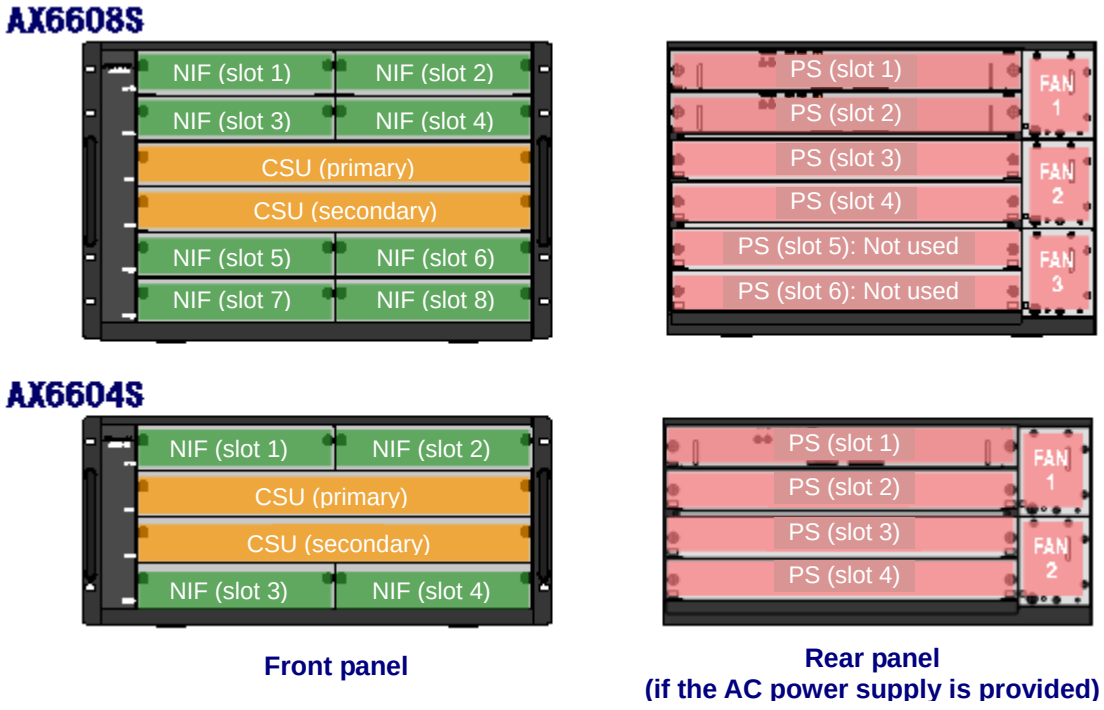


Figure 2.3-1 Where to insert AX6600S modules

Figure 2.3-2 shows an example of an AX6600S hardware configuration. If the AC power supply is used, two power supply units (PSs) are used in the standard configuration (applicable to both AX6608S and AX6604S series switches). To configure PSs for redundancy, use two additional PSs for standby (applicable to both AX6608S and AX6604S series switches). Either three (AX6608S) or two (AX6604S) fan units (FANs) are inserted into the chassis, so that the device can continue to operate even if one of them fails.

Control and switching units (CSUs) consist of two parts: a control section (CPUs) and a forwarding section (PSPs). CPUs are configured in a 1+1 redundant configuration. On the other hand, the single-act and double-act operation of PSPs allow for scalable expansion of the switching capacity. You can also designate one PSP as active (ACT) and one or more PSPs as standby (SBY). A standby PSP, if present, will become the active one

when a failure occurs in the original PSP. Even in the absence of a standby PSP, the PSP in which a failure has occurred will keep running in degenerate mode.

Unlike CSUs, there is no active/standby concept for a network interface unit (NIF). However, it can be configured for redundancy by inserting two identical NIFs into the device and then setting up link aggregation between them.

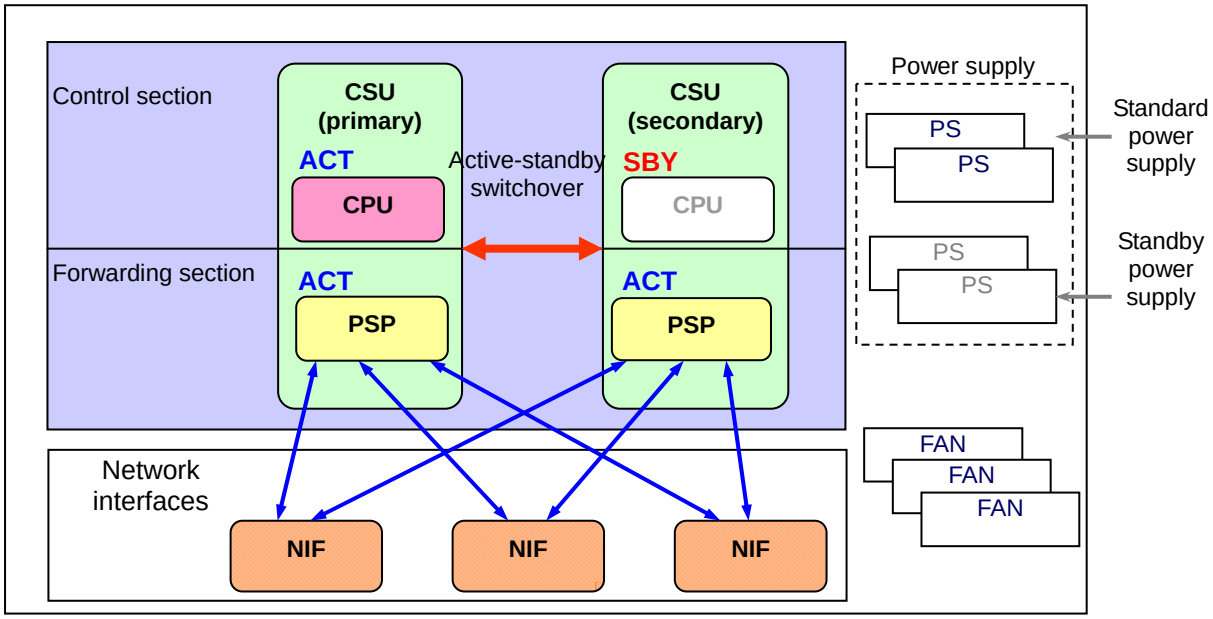


Figure 2.3-2 Example of an AX6608S hardware configuration (CSUs configured for double-act operation)

As shown above, in the AX6600S series, the control section (CPUs) and the forwarding section (PSPs) of the CSU are configured such that they are physically integrated, although they can be operated and controlled independently. This configuration makes the AX6600S series a balanced model, inheriting the high transfer performance of the AX6700S series and at the same time promising good performance despite reduced space and cost achieved by reducing the number of modules used. The AX6600S series also features a dynamic power saving functionality.

The operation modes for CSUs are shown below. As a guide, single-act operation is recommended for a system that is configured to use mainly 1 GbE connections, whereas double-act operation is recommended for a system that is configured to use mainly 10 GbE connections or a system that is configured for optimal performance.

Table 2.3-2 CSU operation modes

Operation mode	Overview	Maximum switching capacity	Redundancy
Single-act	One active PSP	192 Gbps	1+1 redundancy: One standby PSP (The CPU section is configured for 1+1 redundancy.)
Double-act	Two active PSPs	384 Gbps	Two PSPs are active at a time. If one of them becomes faulty, communication will be continued in degenerate mode. (The CPU section is configured for 1+1 redundancy.)

* The maximum switching capacity for AX6608S is shown.

2.4 AX6300S series switch configurations

This section describes AX6300S series switch hardware configurations and provides an overview of a redundant configuration. The following modules are incorporated into AX6300S series switches, all of which can be configured for redundancy.

Table 2.4-1 List of AX6300S modules

No.	Module type	Overview	Maximum number of modules that can be installed	
			AX6308S	AX6304S
1	MSU (Management and switching unit)	MSUs are equipped with CPUs and PSPs#1, have software running on them, and perform packet transfer processing.	2	
2	NIF (Network interface unit)	NIFs handle lines (interfaces).	8	4
3	PS (Power supply unit)	PSs supply power.	4 (AC)/2 (DC)	
4	FAN (Fan unit)	Three fans are inserted per module.	3	2

#1: PSP (packet switching processor) is part of an MSU that performs packet transfer processing.

As shown in Figure 2.4-1, MSUs and NIFs are inserted into the front panel of the device, whereas PSs and FANs are inserted into the rear panel.

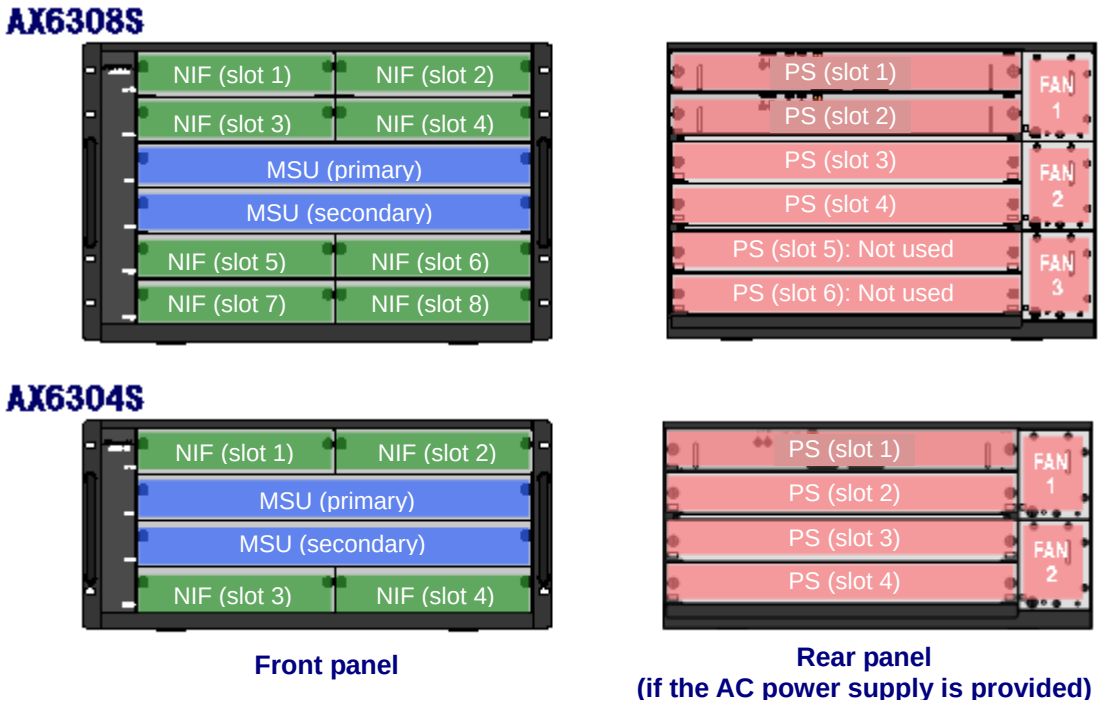


Figure 2.4-1 Where to insert AX6300S modules

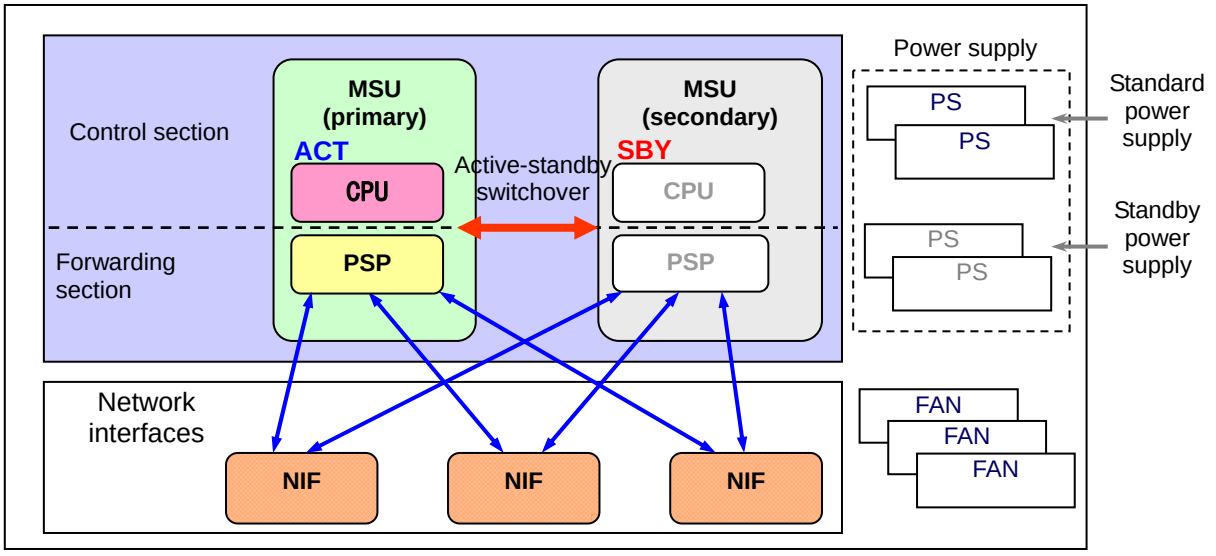


Figure 2.4-2 Example of an AX6308S hardware configuration

In the AX6300S series, the control section (CPUs) and the forwarding section (PSPs) of MSUs are configured such that they are integrated both physically and logically. This configuration resembles the hardware configuration of the AX6600S series. Allowing for a reduction in the number of MSUs used, this model prioritizes cost performance, featuring a simple redundancy functionality where if only one MSU is inserted, the MSU is operated in a single configuration, and if two MSUs are inserted, the MSUs are operated in a redundant configuration, with either one of them acting as a standby MSU.

ALAXALA Networks Corporation recommends that the AX6300S series be operated with two MSUs inserted to ensure greater availability. Furthermore, as a guide, this series is recommended for a system that is configured to use mainly 1 GbE connections.

Table 2.4-2 MSU operation modes

Operation mode	Overview	Maximum switching capacity	Redundancy
MSU redundancy	One active PSP	192 Gbps	1+1 redundancy: One standby MSU

* The maximum switching capacity for AX6308S is shown.

2.5 Behaviors that take place in the event of a failure and during recovery of the FT switch

This section summarizes the possible locations of failure, behavior that takes place when a failure occurs and during recovery, and the impact on communication. The information provided below assumes that the control section, the forwarding section, and the power supply units are configured for redundancy, and that NIFs are configured for link aggregation.

Table 2.5-1 Behaviors that take place in the event of a failure and during recovery

Error location		Behavior that takes place in case of failure	Behavior that takes place during recovery	Impact on communication
Control section	AX6700S BCU	A standby BCU takes over for an active BCU.	The target BCU will be re-initialized, automatically restored, and then placed in standby mode.#1 (Six auto-recovery attempts are allowed per hour.)	No frame loss
	AX6600S CSU (CPU)	A standby CSU takes over for an active CSU.	The target CSU will be re-initialized, automatically restored, and then placed in standby mode.#1 (Six auto-recovery attempts are allowed per hour.)	No frame loss
	AX6300S MSU (CPU)	A standby MSU takes over for an active MSU.	The target MSU will be re-initialized, automatically restored, and then placed in standby mode.#1 (Six auto-recovery attempts are allowed per hour.)	The switchover will take 50 milliseconds or less.
Forwarding section	AX6700S BSU	A standby BSU takes over for an active BSU. If triple-act operation is used, the BSUs will be operated in degenerate mode.	The target BSU will be re-initialized, automatically restored, and then placed in standby mode.#1 (Three auto-recovery attempts are allowed per hour.)	The switchover will take 50 milliseconds or less.
	AX6600S CSU (PSP)	A standby CSU takes over for an active CSU. If double-act operation is used, the CSUs will be operated in degenerate mode.	The target CSU will be re-initialized, automatically restored, and then placed in standby mode.#1 (Six auto-recovery attempts are allowed per hour.)	The switchover will take 50 milliseconds or less.
	AX6300S MSU (PSP)	A standby MSU takes over for an active MSU.	The target MSU will be re-initialized, automatically restored, and then placed in standby mode.#1 (Six auto-recovery attempts are allowed per hour.)	The switchover will take 1 second or less.
Network Interface (NIF)		Degraded operation of link aggregation is performed.	The target NIF will be re-initialized and automatically restored, followed by the restoration of the link aggregation operation.#1 (Three auto-recovery attempts are allowed per hour.)	The switchover will take 1 second or less. Note that the switchover time varies by the type of NIFs used.

Error location	Behavior that takes place in case of failure	Behavior that takes place during recovery	Impact on communication
Port	Degraded operation of link aggregation is performed.	The target port will be re-initialized and automatically restored, followed by the restoration of the link aggregation operation.[#1, #2]	The switchover will take 1 second or less. Note that the switchover time varies by the type of NIFs used.
Line	Degraded operation of link aggregation is performed.	Lines will not be restored automatically.	The switchover will take 1 second or less. Note that the switchover time varies by the type of lines used.
PS (Power supply)	(1) The device will be operated without interruption using the power supplied from other power source. (2) The device will be stopped when the power required to run the device ceases to be supplied.	(1) The target power supply unit will not be restored automatically. (2) The target power supply unit will not be restored because the device stops.	(1) No impact on communication (2) All communication is lost because the device stops.
FAN (Fan unit)	(1) If one of the fan units fails, the remaining fans will be placed in high-speed mode. (2) If two or more of the fan units fail and remain that way for five minutes or more, the device stops.	(1) The target fan unit will not be restored automatically. (2) The target fan units will not be restored because the device stops.	(1) No impact on communication (2) All communication is lost because the device stops.

#1: If the `no system recovery` configuration command is set, automatic restoration will not be performed. Once a failure occurs seven times within an hour in BCUs, CSUs, or MSUs, or once a hardware failure occurs four times within an hour in BSUs, NIFs, or ports, automatic restoration will not be performed.

#2: There are two types of port failures: link failure and hardware failure. Automatic restoration for link failures can be performed an infinite number of times, whereas automatic restoration for hardware failures can only be performed up to three times per hour.

3. Examples of How To Apply an FT network system

This chapter provides important points on constructing a system.

3.1 Example of how to build an FT network system

The figure below shows an example of a basic FT network configuration. The core/distribution switch is configured using an FT switch (AX6700S, AX6600S, and AX6300S) that incorporates in-device redundancy technology by which two devices are integrated into one. Both OSPF and Graceful Restart are applied to the path between the core/distribution switch and the server switch to enhance system-level reliability. The link aggregation is used to incorporate redundancy into the line section.

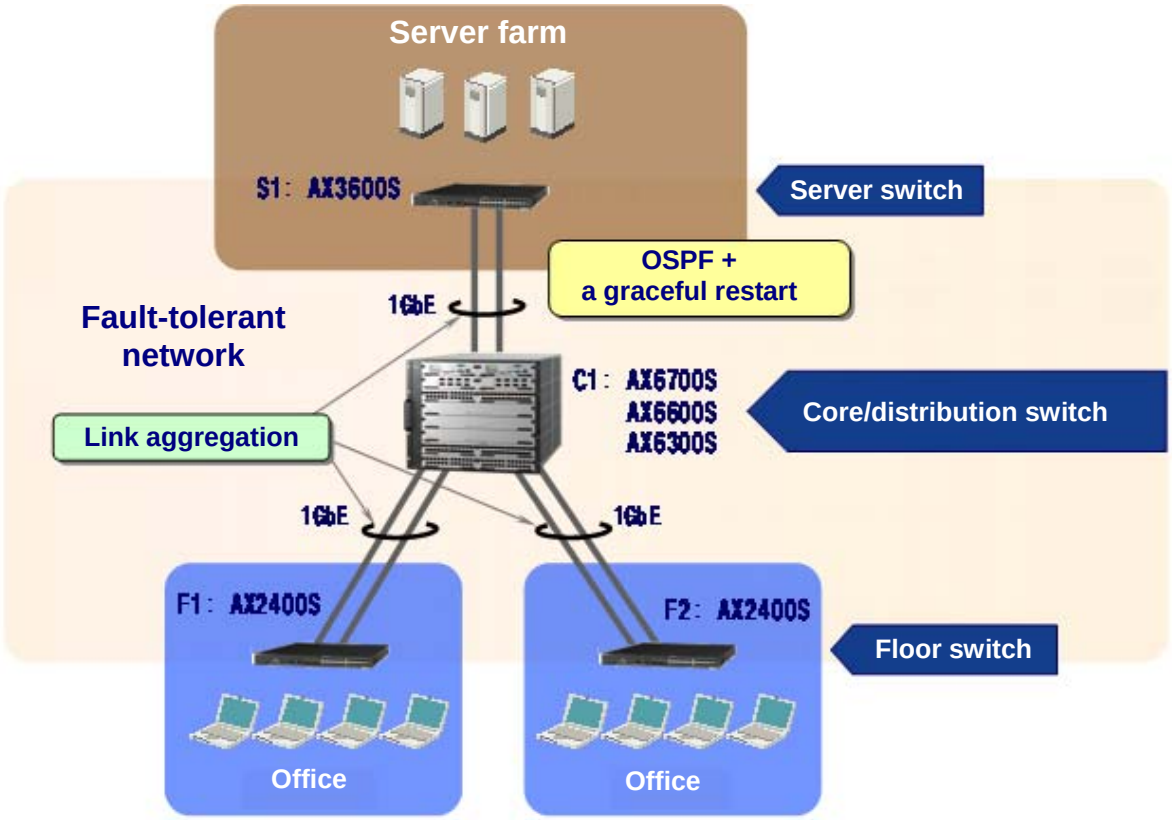


Figure 3.1-1 Example of an FT network configuration

The subsections will describe how to configure an FT network using an AX6700S, AX6600S, and AX6300S series switch as the C1 device that constitutes a core/distribution switch.

(1) Example of an FT network configuration that uses an AX6700S series switch

Figure 3.1-2 shows a physical connection diagram with an AX6708S switch used as device C1.

To ensure in-device redundancy, BCUs, BSUs, NIFs, and PSs (power supply units) are configured for redundancy, and two BSUs are inserted for single-act operation in 1+1 redundancy mode.

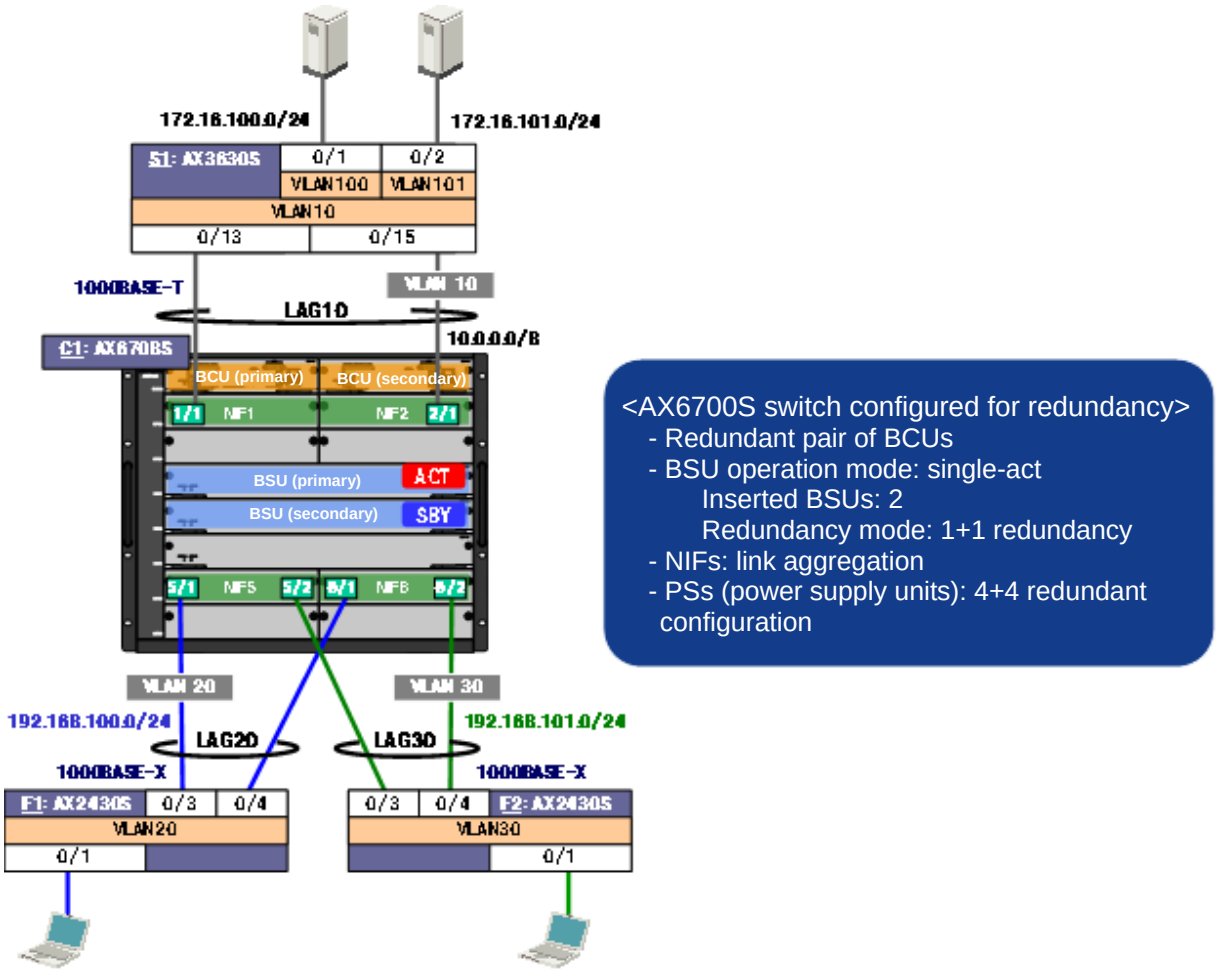


Figure 3.1-2 Physical configuration of a network in which an AX6708S switch is used as device C1

Modules used when AX6708S is configured for redundancy

Product name (abbreviation)	Model name	Product description	Quantity
AX6708S	AX-6700-S08	Chassis & fans	1
PS-A11	AX-F6300-1A11	Power supply	8
BCU-S1	AX-F6700-2S1	Control section	2
BSU-LA	AX-F6700-3LA	Forwarding section	2
NK1G-24T	AX-F6700-713T	1 GbE UTP NIF	2
NK1G-24S	AX-F6700-713S	1 GbE optic NIF	2
SFP-SX	AX-F6244-3S1S	1000BASE-SX SFP	4

(2) Example of an FT network configuration that uses an AX6600S series switch

Figure 3.1-3 shows a physical connection diagram with an AX6608S switch used as device C1.

To ensure in-device redundancy, CSUs, NIFs, and PSs (power supply units) are configured for redundancy, and two CSUs are inserted for single-act operation in 1+1 redundancy mode.

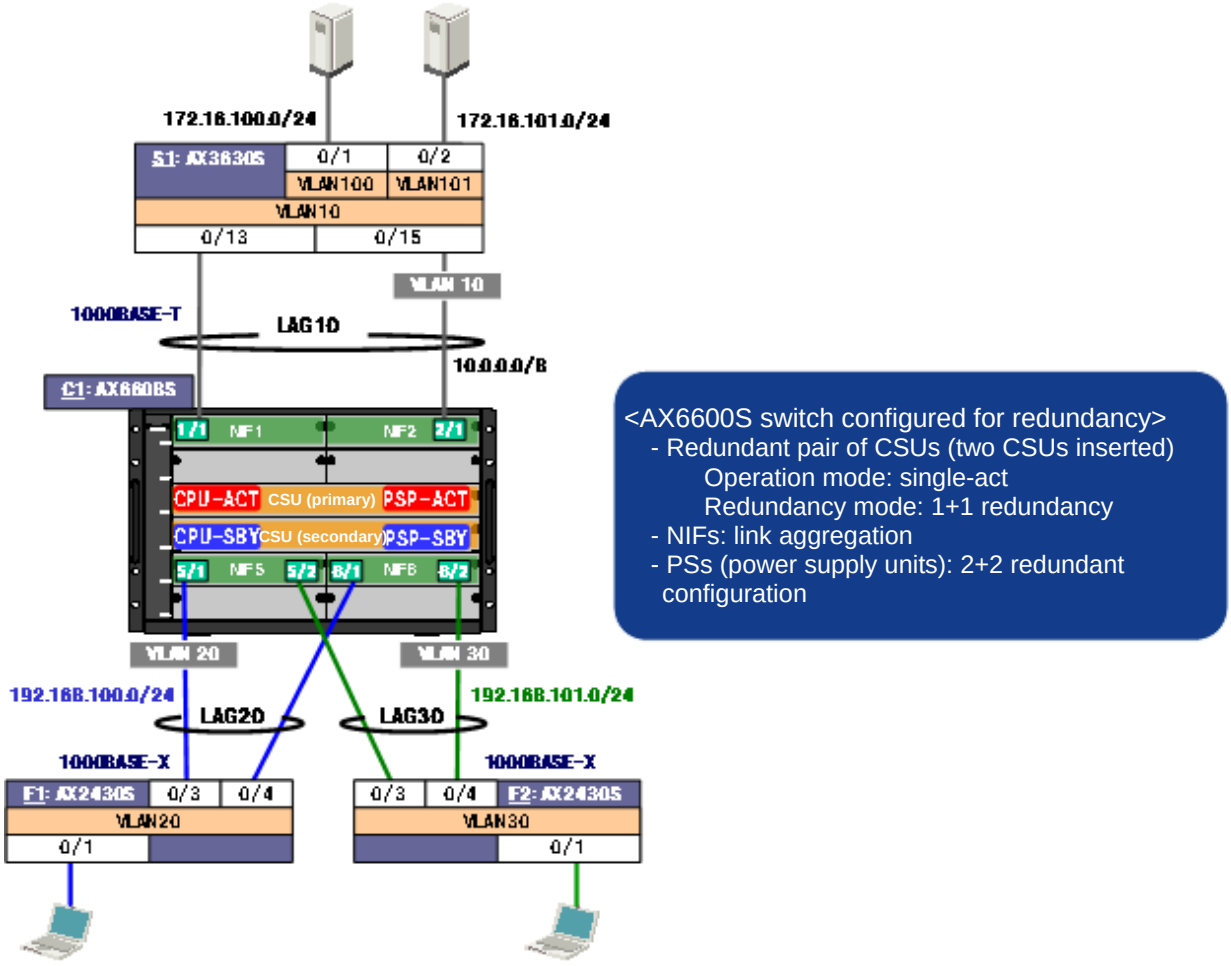


Figure 3.1-3 Physical configuration of a network in which an AX6608S switch is used as device C1

Modules used when AX6608S is configured for redundancy

Product name (abbreviation)	Model name	Product description	Quantity
AX6608S	AX-6600-S08	Chassis & fans	1
PS-A11	AX-F6300-1A11	Power supply	4
CSU-1A	AX-F6600-41A	Control section & forwarding section	2
NK1G-24T	AX-F6700-713T	1 GbE UTP NIF	2
NK1G-24S	AX-F6700-713S	1 GbE optic NIF	2
SFP-SX	AX-F6244-3S1S	1000BASE-SX SFP	4

(3) Example of an FT network configuration that uses an AX6300S series switch

Figure 3.1-4 shows a physical connection diagram with an AX6308S switch used as device C1.

To ensure in-device redundancy, MSUs, NIFs, and PSs (power supply units) are configured for redundancy, and two MSUs are inserted for operation in 1+1 redundancy mode.

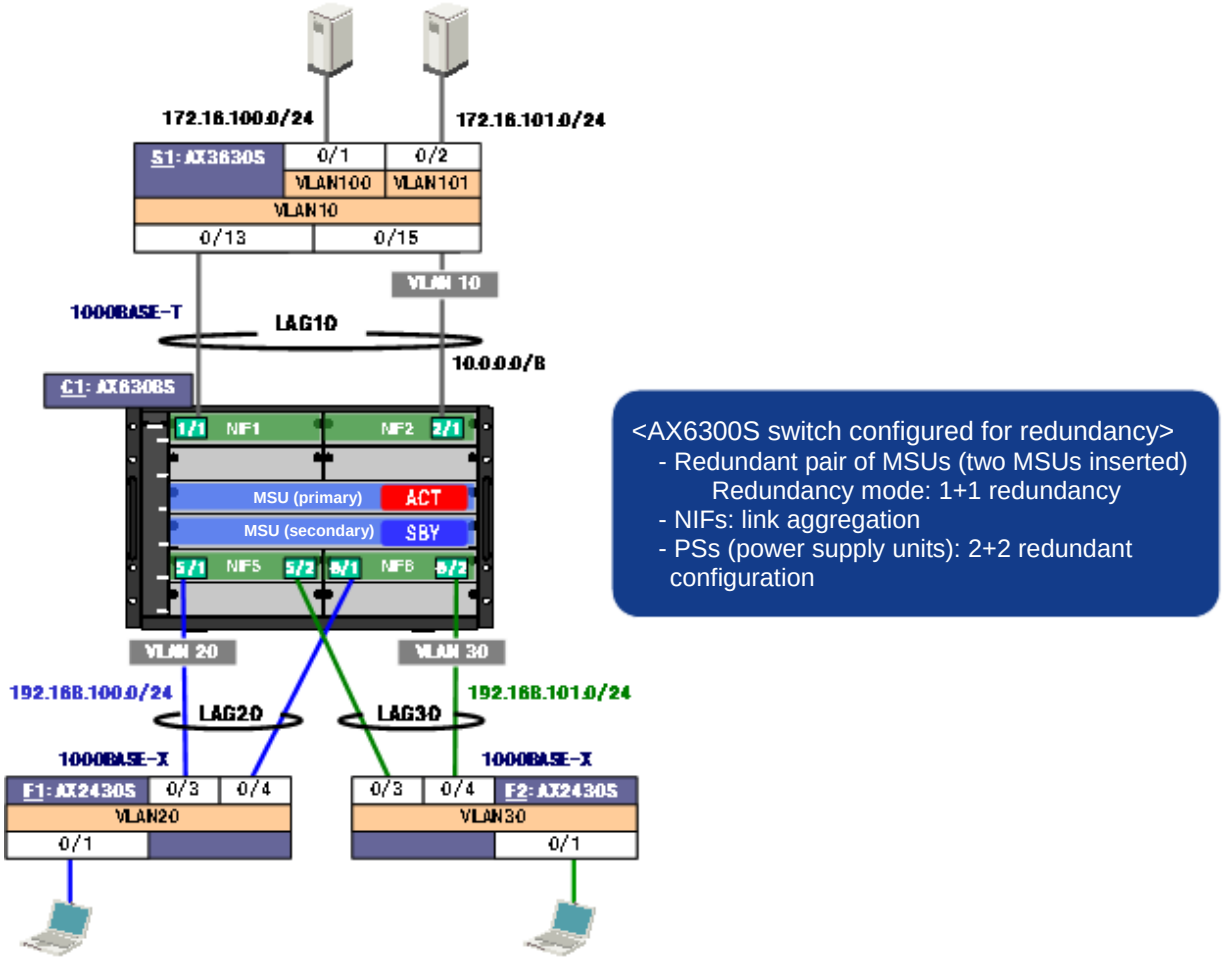


Figure 3.1-4 Physical configuration of a network in which an AX6308S switch is used as device C1

Modules used when an AX6308S series switch is configured for redundancy

Product name (abbreviation)	Model name	Product description	Quantity
AX6308S	AX-6300-S08	Chassis & fans	1
PS-A11	AX-F6300-1A11	Power supply	4
MSU-1A	AX-F6300-51A	Control section & forwarding section	2
NH1G-24T	AX-F6300-713T	1 GbE UTP NIF	2
NH1G-24S	AX-F6300-713S	1 GbE optic NIF	2
SFP-SX	AX-F6244-3S1S	1000BASE-SX SFP	4

3.2 Important points on constructing a system

Important points on constructing a system can be summarized as follows:

(1) Configure modules for redundancy.
(2) Provide redundancy for NIFs by configuring link aggregation between multiple NIFs.
(3) Use static mode for link aggregation.
(4) Optimize the link-down detection time.
(5) Disable spanning trees (STP).
(6) Graceful Restart is very useful.

Details are given below.

(1) Configure modules for redundancy.

(a) Configuring redundancy for BCUs and BSUs on an AX6700S series switch

- Configuring BCUs for redundancy

  You can configure redundancy just by inserting a pair of BCUs. There is no need for use of commands as there are no configuration/operation commands that define redundancy. However, you need to ensure that the software version and configuration are consistent between the active and standby BCUs.

- Configuring BSUs for redundancy

  To configure BSUs for redundancy, set the number of active BSUs.

  In this configuration example, 1+1 redundancy mode is used, in which one BSU acts as an active unit and another as a standby unit. This means that the number of active BSUs is 1. In this case, a single-act operation will take effect.

(b) Configuring redundancy for CSUs on an AX6600S series switch

You can configure redundancy just by inserting two CSU modules. There is no need for use of commands as there are no configuration/operation commands that define redundancy. However, you need to ensure that the software version and configuration are consistent between the active and standby modules.

You can set the number of active PSPs for the forwarding section independently from the setting of the control section. If two CPU modules are inserted, the PSPs for both CSU modules will act as active units by default.

In this configuration example, 1+1 redundancy mode is used, in which one PSP acts as an active unit and another as a standby unit. This means that the number of active PSPs is 1. In this case, a single-act operation will take effect, with the other PSP acting as a standby.

(c) Configuring redundancy for MSUs on an AX6300S series switch

You can configure redundancy just by inserting a pair of MSUs. In this case, the 1+1 redundant mode takes effect, with one MSU acting as an active unit and the other one as a standby. There is no need for use of commands as there are no configuration/operation commands that define redundancy. However, you need to ensure that the software version and configuration are consistent between the active and standby MSUs.

(d) NIF redundancy

You can configure NIFs for redundancy by means of link aggregation. For details, see *(2)* below. The same configuration applies to all devices belonging to the AX6000S family.

(e) PS (AC power supply) redundancy

In AX6700S series switches, four PSs are used as a set. To configure PSs for redundancy, use two sets of PSs (eight PSs).

In the AX6600S and AX6300S series, two PSs are used as a set. To configure PSs for redundancy, use two sets of PSs (four PSs). The same number of PSs is available for eight-NIF-slot models (AX6608S and AX6308S) and four-NIF-slot models (AX6604S and AX6304S).

If you configure PSs for redundancy, ALAXALA Networks Corporation recommends that you set the functionality for outputting a warning message in case PS redundancy is no longer available.

(2) Provide redundancy for NIFs by configuring link aggregation between multiple NIFs.

To provide redundancy against NIF failures, NIFs must be configured for redundancy by configuring link aggregation between different NIF ports. In this way, even if a failure occurs in one NIF, the link aggregation functionality ensures the operation is performed in degenerate mode using the other NIF.

* Note that there is a limit to the number of channels that can be handled by link aggregation.
The maximum number of channels that can be handled by each device model is as follows:
AX6708S, AX6608S, AX6308S: 63 channels
AX6604S, AX6304S: 48 channels

(3) Use static mode for link aggregation.

When an active-standby switchover occurs in the control section (BSU, CSU, or MSU) of an FT switch, communication will sometimes be interrupted for a prolonged period of time because LACP does not support active-standby switchovers without communication interruption.

However, in static mode, active-standby switchovers can be performed without interrupting communication. For this reason, use static mode for link aggregation.

(4) Optimize the link-down detection time.

When static mode is used for link aggregation, the line status is determined by the link status of ports. Thus, make sure that you set as small a link-down detection time (`link-debounce time`) as possible without risking the link becoming unstable.

(5) Disable spanning trees (STP).

In an FT network, line redundancy is provided by using link aggregation, instead of spanning trees. For this reason, disable all spanning tree settings specified for the device.

STP does not support the functionality to perform active-standby switchovers without communication interruptions. Thus, if STP is enabled, active-standby switchovers will lead to communication being interrupted for a prolonged period of time. To avoid such situations, disable STP on the FT switch.

(6) Graceful Restart is very useful.

If a switchover takes place due to a BCU failure or other reasons, the OSPF control will restart at that moment, but with Graceful Restart functionality, communication will remain uninterrupted.

In this configuration example, an AX6000S family FT switch is specified as a restart device, whereas an AX3630S L3 switch that is connected to the restart device is specified as a helper device.

3.3 Configuration example

(1) Setting up an AX6700S, AX6600S, or AX6300S series switch as device C1

Setting the core switch C1	
Configuring modules for redundancy	
Setting BSUs for AX6700S	
`(config)# redundancy max-bsu 1`	Set BSUs for redundancy. BSU1 acts as an active unit, and BSU2 as a standby unit. In this case, the standby BSU is in a hot standby state. **(Important points for constructing a system (1))**
Setting CSUs for AX6600S	
`(config)# redundancy max-psp 1`	Set PSPs for redundancy. A PSP for CSU1 acts as an active unit, and a PSP for CSU2 acts as a standby unit. In this case, the standby PSP is in a hot standby state. **(Important points for constructing a system (1))**
Setting MSUs for AX6300S	
`(Settings unnecessary)`	In the case of AX6300S series switches, you can configure redundancy by inserting a redundant pair of MSUs. There is no need to set the MSUs for redundancy. In this case, the standby PSP is in a hot standby state. **(Important points for constructing a system (1))**
Setting PSs for redundancy	
`(config)# power redundancy-mode redundancy-check`	Set the functionality for outputting a warning message in case PS redundancy is no longer available. **(Important points for constructing a system (1))**
Setting VLANs for data transfer	
`(config)# vlan 10,20,30`	Set the VLANs to be used. VLANs for data transfer: 10, 20, 30
Setting ports	

`(config)# interface range gigabitethernet 1/1, gigabitethernet 2/1`
`(config-if-range)# link debounce time 0`
`(config-if-range)# channel-group 10 mode on`
 	
`(config)# interface range gigabitethernet 5/1, gigabitethernet 6/1`
`(config-if-range)# link debounce time 0`
`(config-if-range)# channel-group 20 mode on`
 	
`(config)# interface range gigabitethernet 5/2, gigabitethernet 6/2`
`(config-if-range)# link debounce time 0`
`(config-if-range)# channel-group 30 mode on`
	Set each port.
	Configure the channel group 10 to ports 1/1 and 2/1 for the device S1 connection.
	Configure the channel group 20 to ports 5/1 and 6/1 for the device F1 connection.
	Configure the channel group 30 to ports 5/2 and 6/2 for the device F2 connection.
	
	(Important points for constructing a system (2)(3)(4))

Setting port channels	

`(config)# interface port-channel 10`
`(config-if)# switchport mode access`
`(config-if)# switchport access vlan 10`
 	
`(config)# interface port-channel 20`
`(config-if)# switchport mode access`
`(config-if)# switchport access vlan 20`
 	
`(config)# interface port-channel 30`
`(config-if)# switchport mode access`
`(config-if)# switchport access vlan 30`
	Set each port channel.
	Set VLAN 10 for port channel 10.
	Set VLAN 20 for port channel 20.
	Set VLAN 30 for port channel 30.

Assigning an IP address	

`(config)# interface vlan 10`
`(config-if)# ip address 10.0.0.1 255.0.0.0`
 	
`(config)# interface vlan 20`
`(config-if)# ip address 192.168.100.1 255.255.255.0`
 	
`(config)# interface vlan 30`
`(config-if)# ip address 192.168.101.1 255.255.255.0`
	Assign an IP address to each VLAN.
	IP address for VLAN 10: 10.0.0.1/8
	IP address for VLAN 20: 192.168.100.1/24
	IP address for VLAN 30: 192.168.101.1/24

Setting the core switch C1	
Disabling spanning trees	
`(config)# spanning-tree disable`	Disable STP. **(Important points for constructing a system (5))**
Setting a routing protocol	

`(config)# router ospf 1`
`(config-router)# router-id 100.1.1.1`
`(config-router)# graceful-restart mode restart`
`(config-router)# network 10.0.0.0 0.255.255.255 area 0`
`(config-router)# network 192.168.100.0 0.0.0.255 area 0`
`(config-router)# network 192.168.101.0 0.0.0.255 area 0`
	Specify OSPF as a routing protocol.
	Specify the router ID.
	Specify the router as a restart router for Graceful Restart. **(Important points for constructing a system (6))**
	Specify a network to be controlled using OSPF.

(2) Setting up an AX3630S series switch (device S1)

Setting the server farm switch S1	
Setting VLANs for data transfer	
`(config)# vlan 10,100-101`	Set the VLANs to be used. VLANs for data transfer: 10, 100, 101
Setting ports	

`(config)# interface range gigabitethernet 0/13, gigabitethernet 0/15`
`(config-if-range)# link debounce time 0`
`(config-if-range)# channel-group 10 mode on`
 	
`(config)# interface gigabitethernet 0/1`
`(config-if-range)# media-type rj45`
`(config-if)# switchport mode access`
`(config-if)# switchport access vlan 100`
 	
`(config)# interface gigabitethernet 0/3`
`(config-if-range)# media-type rj45`
`(config-if)# switchport mode access`
`(config-if)# switchport access vlan 101`
	Set each port.
	Configure the channel group 10 to ports 0/13 and 0/15 for the device C1 connection.
	For port 0/1, set VLAN 100 as an access port for the server 1 connection.
	For port 0/3, set VLAN 101 as an access port for the server 2 connection.
	(Important points for constructing a system (2)(3)(4))

Setting port channels	

`(config)# interface port-channel 10`
`(config-if)# switchport mode access`
`(config-if)# switchport access vlan 10`
	Set the port channel.
	Set VLAN 10 for port channel 10.

Assigning an IP address	

`(config)# interface vlan 10`
`(config-if)# ip address 10.0.0.2 255.0.0.0`
 	
`(config)# interface vlan 100`
`(config-if)# ip address 172.16.100.1 255.255.255.0`
 	
`(config)# interface vlan 101`
`(config-if)# ip address 172.16.101.1 255.255.255.0`
	Assign an IP address to each VLAN.
	IP address for VLAN 10: 10.0.0.2/8
	IP address for VLAN 20: 172.16.100.1/24
	IP address for VLAN 30: 172.16.101.1/24

Disabling spanning trees	
`(config)# spanning-tree disable`	Disable STP. **(Important points for constructing a system (5))**
Setting a routing protocol	

`(config)# router ospf 1`
`(config-router)# router-id 100.1.1.2`
`(config-router)# graceful-restart mode helper`
`(config-router)# network 10.0.0.0 0.255.255.255 area 0`
`(config-router)# network 172.16.100.0 0.0.0.255 area 0`
`(config-router)# network 172.16.101.0 0.0.0.255 area 0`
	Specify OSPF as a routing protocol.
	Specify the router ID.
	Specify the router as a helper router for Graceful Restart. **(Important points for constructing a system (6))**
	Specify a network to be controlled using OSPF.

(3) Setting up an AX2430S series switch (device F1)

Setting the access switch F1	
Setting VLANs for data transfer	
`(config)# vlan 20`	Set the VLAN to be used. VLAN for data transfer: 20
Setting ports	

`(config)# interface range gigabitethernet 0/3, gigabitethernet 0/4`
`(config-if-range)# link debounce time 0`
`(config-if-range)# channel-group 20 mode on`
 	
`(config)# interface gigabitethernet 0/1`
`(config-if-range)# media-type rj45`
`(config-if)# switchport mode access`
`(config-if)# switchport access vlan 20`
	Set each port.
	Configure the channel group 20 to ports 0/3 and 0/4 for the device C1 connection.
	
	For port 0/1, set VLAN 20 as an access port for the terminal 1 connection.
	(Important points for constructing a system (2)(3)(4))

Setting port channels	

`(config)# interface port-channel 20`
`(config-if)# switchport mode access`
`(config-if)# switchport access vlan 20`
	Set the port channel.
	Set VLAN 20 for port channel 20.

Disabling spanning trees	
`(config)# spanning-tree disable`	Disable STP. **(Important points for constructing a system (5))**

(4) Setting up an AX2430S series switch (device F2)

Setting the access switch F2	
Setting VLANs for data transfer	
`(config)# vlan 30`	Set the VLAN to be used. VLAN for data transfer: 30
Setting ports	

`(config)# interface range gigabitethernet 0/3, gigabitethernet 0/4`
`(config-if-range)# link debounce time 0`
`(config-if-range)# channel-group 30 mode on`
 	
`(config)# interface gigabitethernet 0/1`
`(config-if-range)# media-type rj45`
`(config-if)# switchport mode access`
`(config-if)# switchport access vlan 30`
	Set each port.
	Configure the channel group 30 to ports 0/3 and 0/4 for the device C1 connection.
	
	For port 0/1, set VLAN 30 as an access port for the terminal 2 connection.
	(Important points for constructing a system (2)(3)(4))

Setting port channels	

`(config)# interface port-channel 30`
`(config-if)# switchport mode access`
`(config-if)# switchport access vlan 30`
	Set the port channel.
	Set VLAN 30 for port channel 30.

Disabling spanning trees	
`(config)# spanning-tree disable`	Disable STP. **(Important points for constructing a system (5))**

3.4 An example of how to utilize an FT network

The figure below shows an example of an FT network configuration for creating a large network. Important points on constructing a system and configuration examples are also given.

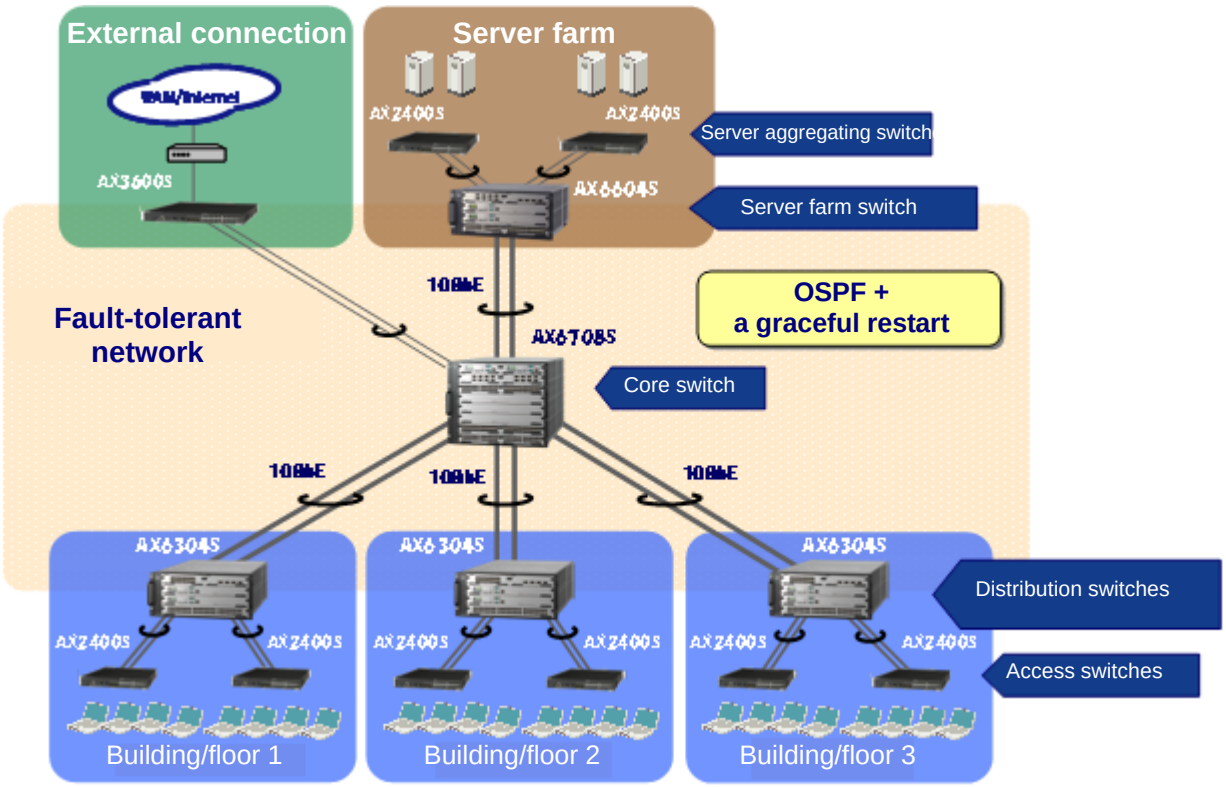


Figure 3.4-1 Example of a large network configuration

(1) Important points on constructing a system

Tip 1	
Higher bandwidth	Use a 10-GbE connection for connecting with the core switch to provide higher bandwidth. Furthermore, because traffic is expected to converge on the core switch and the server farm switch, assign high-performance FT switches, namely AX6700S and AX6600S series switches, to the core switch and server farm switch, respectively.
Tip 2	
Higher availability	Assign FT switches to the locations where reliability is critical. FT switches enhance reliability at the device level by means of in-device redundancy technology. Furthermore, you can prevent loops by aggregating lines to provide redundancy (link aggregation). The core switch provides independent NIFs for the server farm side and the building/floor side to enhance redundancy.
Tip 3	
System stabilization	Use OSPF as the Layer 3 routing protocol with Graceful Restart to enhance system-level reliability and stability.
Tip 4	
Cost reduction	Assign a standard FT switch, an AX6300S series switch, as a distribution switch to reduce costs.

If you are configuring distribution switches and a server farm switch using L2 switches, the SML functionality of the AX series is useful. For details about SML functionality, see the separate system configuration guide *AX Series SML Usage Guide - Application of a Large-Scale Fault-Tolerant Network.*

(2) Example of system configuration

◆ Core switch x 1

Hardware configuration per unit

Product name (abbreviation)	Model name	Product description	Quantity
AX6708S	AX-6700-S08	AX6708S chassis (including FAN units)	1
PS-A11	AX-F6300-1A11	AC power supply unit (redundant configuration)	8
BCU-S1	AX-F6700-2S1	Basic control unit (redundant configuration)	2
BSU-LA	AX-F6700-3LA	Switching unit (standard table size) (redundant configuration)	3
NK10G-4RX	AX-F6700-722F	Network interface unit (10 GbE)	4
XFP-SR	AX-F6244-3X1S	10GBASE-SR XFP	8
NK1G-24S	AX-F6700-713S	Network interface unit (1 GbE)	2
SFP-SX	AX-F6244-3S1S	1000BASE-SX SFP	2

◆ Distribution switch x 3

Hardware configuration per unit

Product name (abbreviation)	Model name	Product description	Quantity
AX6304S	AX-6300-S04	AX6304S chassis (including FAN units)	1
PS-A11	AX-F6300-1A11	AC power supply unit (redundant configuration)	4
MSU-1A	AX-F6300-51A	Management and switching unit (standard table size) (redundant configuration)	2
NH10G-4RX	AX-F6300-722F	Network interface unit (10 GbE)	2
XFP-SR	AX-F6244-3X1S	10GBASE-SR XFP	2
NH1G-24T	AX-F6300-713T	Network interface unit (1 GbE)	2

◆ Access switch x 6

Hardware configuration per unit

Product name (abbreviation)	Model name	Product description	Quantity
AX2430S-24T	AX-2430-24TE-B	AX2430S-24T basic model	1

◆ Server farm switch x 1

Hardware configuration per unit

Product name (abbreviation)	Model name	Product description	Quantity
AX6604S	AX-6600-S04	AX6604S chassis (including FAN units)	1
PS-A11	AX-F6300-1A11	AC power supply unit (redundant configuration)	4
CSU-1A	AX-F6600-41A	Control and switching unit (standard table size) (redundant configuration)	2
NK10G-4RX	AX-F6700-722F	Network interface unit (10 GbE)	2
XFP-SR	AX-F6244-3X1S	10GBASE-SR XFP	2
NK1G-24T	AX-F6700-713T	Network interface unit (1 GbE)	2

◆ Server handling switch x 2

Hardware configuration per unit

Product name (abbreviation)	Model name	Product description	Quantity
AX2430S-24T	AX-2430-24TE-B	AX2430S-24T basic model	1

◆ Switch for external connections x 1

Hardware configuration per unit

Product name (abbreviation)	Model name	Product description	Quantity
AX3630S-24T	AX-3630-24TE-A	AX3630S-24T advanced model	1

4. Operation Management

4.1 Operation commands for redundant configurations

This section describes the basic operations related to redundant configurations of FT switches.

(1) Checking the redundant status

You can use the following commands to check the in-device redundancy configuration status, link aggregation status, and Graceful Restart status.

- **Checking the status of AX6700S modules (PSs (power supply units), FANs, BCUs, and BSUs): `show system` command**

Example of the `show system` command output (excerpt)

```
C1# show system
Date 2009/07/03 15:31:18 UTC
System: AX6708S, OS-SE Ver. 11.1
Node : Name=C1
   Device redundancy cpu status : duplex
   Power control : normal
   Power redundancy-mode : check is executed
   PS1 = active
   PS2 = active
   PS3 = active
   PS4 = active
   PS5 = active
   PS6 = active
   PS7 = active
   PS8 = active
   Fan : active No = FAN1(1), FAN1(2), FAN1(3),
                     FAN2(4), FAN2(5), FAN2(6),
                     FAN3(7), FAN3(8), FAN3(9),
                     FAN4(10), FAN4(11), FAN4(12)
                     Speed=normal
   BCU1 : active
      CPU : AX-F6700-2S1 [BCU_S1 , 80200020]
      Boot : 2009/07/03 11:23:02 , power on , 0 times restart
      Lamp : STATUS LED=green , ACTIVE LED=green , SYSTEM1 LED=green
      System operation panel : No error
      Board : CPU=PowerPC 833MHz , Memory=2,097,152kB(2048MB)

   BCU2 : standby
      CPU : AX-F6700-2S1 [BCU_S1 , 80200020]
      Boot : 2009/07/03 11:23:12 , power on , 0 times restart
      Lamp : STATUS LED=green , ACTIVE LED=light off , SYSTEM1 LED=green
      System operation panel : No error
      Board : CPU=PowerPC 833MHz , Memory=2,097,152kB(2048MB)
   Redundancy bsu-mode : fail-safe
   BSU1 : active AX-F6700-3LA [BSU-LA] , 0 times restart
      Lamp : STATUS LED=green , ACTIVE LED=green
   BSU2 : standby hot AX-F6700-3LA [BSU-LA] , 0 times restart
      Lamp : STATUS LED=green , ACTIVE LED=light off
   BSU3 : notconnect
```

... Basic control units (BCUs) are configured for redundancy.

... Normal power mode

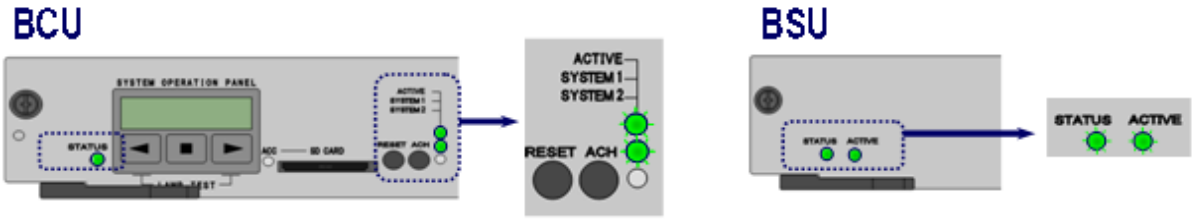
... Mode that issues a warning message in case PS redundancy is lost. This can be specified in the configuration.

... [PS status]
Eight power supply units are inserted for redundancy. Default number of power supply units would be four.

... [FAN status]
Four modules are configured, with three fans inserted in each.

... [BCU status]
BCU1 is an active unit, and BCU2 is a standby unit.

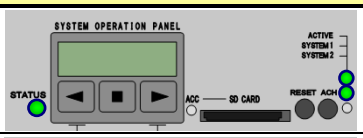
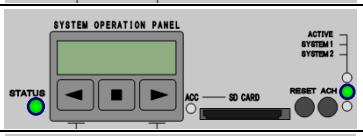
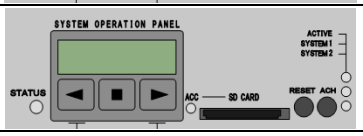
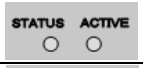
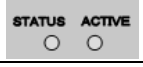
... [BSU status]
BSU1 is an active unit, and BSU2 is a standby unit.
1+1 redundancy configuration for single-act operation



Module type	LED		Status
BCU (control sections)	STATUS	Green: Power on Off: Power off	Indicates the BCU operating status.
	ACTIVE	Green: Active Off: Standby	Indicates the active or standby status of the BCU.
	SYSTEM1	Green: Operational	Indicates that an active or standby unit is operational.
	SYSTEM2	Green: Power saving mode Off: Normal power mode	Indicates the power mode status.
BSU (forwarding section)	STATUS	Green: Power on Off: Power off	If the LED is off, the BSU is in one of the following two statuses: A standby BSU is not operational, or in a cold standby state (`cold2`).
	ACTIVE	Green: Active Off: Standby	Indicates the active or standby status of the BSU.

The following table describes the operating status of AX6700S BCUs and BSUs and their indicated status.

Table 4.1-1 List of operating statuses of AX6700S BCUs and BSUs

Module	Status	Status inside the module		Panel LED	Output of the show system command
		Control section	Forwarding section		
BCU	ACT	ACT	None		`BCUm :active`
	SBY	SBY	None		`BCUm :standby`
	Stop	Power off	None		`BCUm :inactive`
	Not implemented	--	--	--	`BCUm :notconnect`
BSU	ACT	None	ACT		`BSUn :active`
	SBY	None	SBY(hot)		`BSUn :standby hot`
			SBY(cold)		`BSUn :standby cold`
			SBY(cold2)	 #2	`BSUn :standby cold2`
	Stop	None	Power off	 #2	`BSUn :inactive`
	Not implemented	--	--	--	`BSUn :notconnect`

#1: *m* (*m* = 1, 2) in the `show system` command output denotes the location where a BCU is inserted, whereas *n* (*n* = 1, 2, 3) denotes the location where a BSU is inserted.

#2: If two LEDs are off for the BSU, it means that the BSU is either in a cold standby state (`cold2`) or not operational. In either case, the LED indication is the same. Check the BSU status using the `show system` command when you replace the module.

- **Checking the status of AX6600S modules (PSs (power supply units), FANs, and CSUs): `show system` command**

Example of the `show system` command output (excerpt)

```
C1# show system
Date 2009/07/02 18:06:18 UTC
System: AX6604S, OS-SE Ver. 11.1
Node : Name=C1
   Device redundancy cpu status : duplex
   Power control : normal
   Power redundancy-mode : check is executed
   PS1 = active
   PS2 = active
   PS3 = active
   PS4 = active
   Fan : active No = FAN1(1), FAN1(2), FAN1(3),
                     FAN2(4), FAN2(5), FAN2(6)
                     Speed=normal
   CSU1 : active
      CPU : AX-F6600-41A [CSU-1A , 80200020]
      Boot : 2009/07/02 18:00:40 , power on , 0 times restart
      PSP : active
      Lamp : STATUS LED=green , ACTIVE LED=green
             SYSTEM1 LED=green , SYSTEM2 LED=light off
      System operation panel : No error
      Board : CPU=PowerPC 667MHz , Memory=1,048,576kB(1024MB)

   CSU2 : standby
      CPU : AX-F6600-41A [CSU-1A , 80200020]
      Boot : 2009/07/02 18:01:48 , power on , 0 times restart
      PSP : standby hot
      Lamp : STATUS LED=green , ACTIVE LED=light off
             SYSTEM1 LED=green , SYSTEM2 LED=light off
      System operation panel : No error
      Board : CPU=PowerPC 667MHz , Memory=1,048,576kB(1024MB)
```

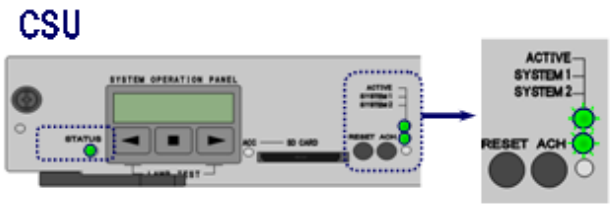
... Control and switching units (CSUs) are configured for
... Normal power mode
... Mode that issues a warning message in case PS redundancy is lost. This can be specified in the

... [PS status]
Four power supply units are inserted for redundancy. Default number of power supply units would be two.

... [FAN status]
Two modules are configured for AX6604S, with three fans inserted in each.

... [CSU status]
(1) Control section (CPUs)
CSU1 is an active unit, and CSU2 is a standby unit.

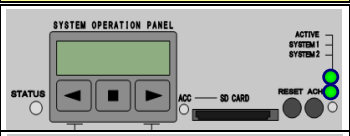
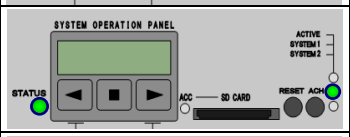
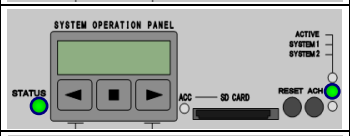
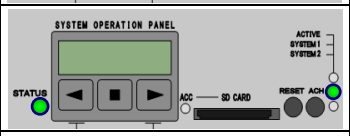
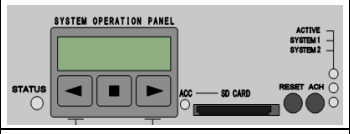
(2) Forwarding section (PSPs)
CSU1 is an active unit, and CSU2 is a standby unit. (1+1 redundancy configuration for single-act operation, with the standby PSP placed in a hot standby state)



	LED		
CSU (control section & forwarding section)	STATUS	Green: Power on Off: Power off	Indicates the CSU operating status.
	ACTIVE	Green: Active Off: Standby	Indicates the active or standby status of the CSU (control section).
	SYSTEM1	Green: Operational	Indicates that an active or standby unit is operational. For a standby CSU, the corresponding PSP would be in one of the following three statuses: Active status, hot standby status (`hot`), or cold standby status (`cold2`).
	SYSTEM2	Green: Power saving mode Off: Normal power mode	Indicates the power mode status.

The following table describes the operating status of AX6600S CSUs and their status indication.

Table 4.1-2 List of operating status of AX6600S CSUs

Module	Status	Status inside the module		LED indication on the panel	Output of the show system command
		Control section	Forwarding section		
CSU	ACT	ACT	ACT		`CSUn :active (PSP :active)`
	SBY	SBY	ACT		`CSUn :standby (PSP :active)`
		SBY	SBY(hot)		`CSUn :standby (PSP :standby hot)`
		SBY	SBY(cold2)		`CSUn :standby (PSP :standby cold2)`
	Stop	Power off			`CSUn :Inactive`
	Not implemented	--		--	`CSUn :notconnect`

#1: *n* (*n* = 1, 2) in the `show system` command output denotes the location where a CSU is inserted.

#2: You can confirm CSU operating status by checking if the STATUS LED and ACTIVE LED are on or off. However, when the CSU is in a standby state (ACTIVE LED is off), you cannot determine the PSP status from the LED indicator. To check the operating status of all parts including PSPs, use the `show system` command.

- **Checking the status of AX6300S modules (PSs (power supply units), FANs, and MSUs): `show system` command**

Example of the `show system` command output (excerpt)

```
C1# show system
Date 2009/07/03 11:57:43 UTC
System: AX6304S, OS-SE Ver. 11.1
Node : Name=C1
   Device redundancy cpu status : duplex
   Power control : normal
   Power redundancy-mode : check is executed
  PS1 = active
  PS2 = active
  PS3 = active
  PS4 = active
  Fan : active No = FAN1(1), FAN1(2), FAN1(3),
                    FAN2(4), FAN2(5), FAN2(6)
                    Speed=normal
  MSU1 : active
     CPU : AX-F6300-51A [MSU-1A , 80200020]
     Boot : 2009/07/03 11:53:35 , operation reboot , 0 times restart
     PSP : active
     Lamp : STATUS LED=green , ACTIVE LED=green , SYSTEM1 LED=green
     System operation panel : No error
     Board : CPU=PowerPC 667MHz , Memory=1,048,576kB(1024MB)

  MSU2 : standby
     CPU : AX-F6300-51A [MSU-1A , 80200020]
     Boot : 2009/07/03 11:54:51 , power on , 0 times restart
     PSP : standby
     Lamp : STATUS LED=green , ACTIVE LED=light off , SYSTEM1 LED=green
     System operation panel : No error
     Board : CPU=PowerPC 667MHz , Memory=1,048,576kB(1024MB)
```

... Management and switching units (MSUs) are configured for redundancy.

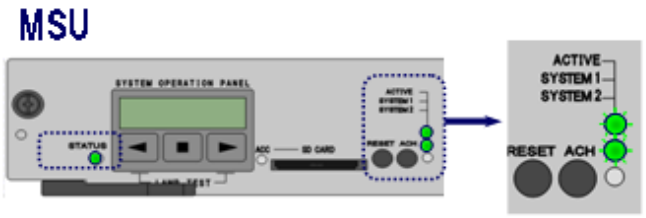
... Normal power mode

... Mode that issues a warning message in case PS redundancy is lost. This can be specified in the configuration.

... [PS status]
Four power supply units are inserted for redundancy. Default number of power supply units would be two.

... [FAN status]
Two modules are configured for AX6304S, with three fans inserted in each.

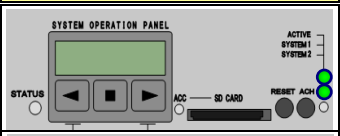
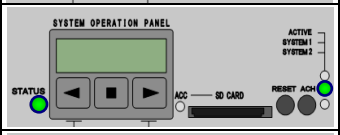
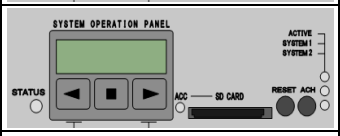
... [MSU status}
MSU1 is an active unit, and MSU2 is a standby unit. In AX6300S, the PSP status corresponds to



Module type	LED		Status
MSU (control section & forwarding section)	STATUS	Green: Power on Off: Power off	Indicates the MSU operating status.
	ACTIVE	Green: Active Off: Standby	Indicates the active or standby status of the MSU (control section & forwarding section).
	SYSTEM1	Green: Operational	Indicates that an active or standby unit is operational.
	SYSTEM2	Always off	The LED is always off because this is not supported yet.

The following table describes the operating status of AX6300S MSUs and their status indication.

Table 4.1-3 List of operating status of AX6300S MSUs

Module	Status	Status inside the module		LED indication on the panel	Output of the `show system` command
		Control section	Forwarding section		
MSU	ACT	ACT	ACT		`MSUn :active` `(PSP :active)`
	SBY	SBY	SBY		`MSUn :standby` `(PSP :standby)`
	Stop	Power off			`MSUn :inactive`
	Not implemented	--		--	`MSUn :notconnect`

#1: *n* (*n* = 1, 2) in the `show system` command output denotes the location where an MSU is inserted.

- **Checking the status of link aggregation**

The output of the `show port` command shows the status of ports and the summary information on link aggregation.

Example of the `show port` command output (excerpt)

```
C1# show port
Date 2008/10/15 14:15:41 UTC
Port Counts: 96
Port  Name          Status   Speed          Duplex     FCtl FrLen ChGr/Status
 1/ 1 geth1/1        up      1000BASE-T      full(auto) off   1518  10/up
 2/ 1 geth2/1        up      1000BASE-T      full(auto) off   1518  10/up
 5/ 1 geth5/1        up      1000BASE-SX     full(auto) off   1518  20/up
 5/ 3 geth5/3        up      1000BASE-SX     full(auto) off   1518  30/up
 6/ 1 geth6/1        up      1000BASE-SX     full(auto) off   1518  20/up
 6/ 3 geth6/3        up      1000BASE-SX     full(auto) off   1518  30/up
```

... The group IDs and status of link aggregation are shown.

Port No. | Port Name | Port Status | Line type (Speed) | Connection Mode | Flow Control | LAG Status

The output of the `show channel-group` command shows the mode of link aggregation and the status of ports by group ID, allowing you to confirm NIF redundancy.

Example of the `show channel-group` command output

```
C1# show channel-group
Date 2008/10/15 14:14:08 UTC
channel-group Counts:3
ChGr:10   Mode:Static
  CH Status    :Up        Elapsed Time:00:18:02
  Multi Speed  :Off       Load Balance:MAC-IP-PORT
  Max Active Port:16
  Max Detach Port:15
  MAC address: 0012.e2e0.da99     VLAN ID:10
  Port(2)        :1/1
                 2/1
  Up Port(2)     :1/1,2/1
  Down Port(0)   :
ChGr:20   Mode:Static
  CH Status    :Up        Elapsed Time:00:18:03
  Multi Speed  :Off       Load Balance:MAC-IP-PORT
  Max Active Port:16
  Max Detach Port:15
  MAC address: 0012.e2e0.daa3     VLAN ID:20
  Port(2)        :5/1
                 6/1
  Up Port(2)     :5/1,6/1
  Down Port(0)   :
ChGr:30   Mode:Static
  CH Status    :Up        Elapsed Time:00:18:03
  Multi Speed  :Off       Load Balance:MAC-IP-PORT
  Max Active Port:16
  Max Detach Port:15
  MAC address: 0012.e2e0.daad     VLAN ID:30
  Port(2)        :5/3
                 6/3
  Up Port(2)     :5/3,6/3
  Down Port(0)   :
```

... Link aggregation mode

... LAG10 port status

... LAG20 port status

... LAG30 port status

- **Checking the status of Graceful Restart**

You can check the status of Graceful Restart by executing the `show ip ospf` command.

Example of the `show ip ospf` command output

```
------ <<Restart router>> ----------------------------------------------------------
C1# show ip ospf
Date 2008/10/15 15:42:11 UTC
OSPF protocol: ON
:
Graceful Restart: Restart   ... Acts as a restart router.
  Restart Time  : 60s
  Restart Status: Finished    2008/10/15 15:41:53

------ <<Helper router>> -----------------------------------------------------------
S1# show ip ospf
Date 2008/10/15 15:42:19 UTC
OSPF protocol: ON
:
Graceful Restart: Helper   ... Acts as a helper router.
  Helper Status : Finished    2008/10/15 15:41:04
```

Displays the time at which graceful restart was activated last.

If Graceful Restart is activated on a restart router due to active-system switchover resulting from a BCU failure or the restart of the unicast routing program, a message log will be output in both the restart and helper routers.

Log output upon the activation of Graceful Restart

```
------ <<Restart router>> ----------------------------------------------------------

10/15 15:41:53 OSPF: Graceful restart finished successfully (in domain 1).

------ <<Helper router>> -----------------------------------------------------------

10/15 15:41:04 OSPF: Adjacency 100.1.1.1 address 10.0.0.1 (VLAN0010) is established.
```

(2) Standby-active switchover operation

To manually switch between the active and standby modules (BCUs, CSUs, MSUs, BSUs, NIFs), use the commands shown in the table below. For BCUs, CSUs, and MSUs, execute the command on the active module. For BSUs and NIFs, execute the command on the target module.

Table 4.1-4 Active-standby module switchover operation

Module	Switchover command	Switchback command
BCU (AX6700S) CSU (AX6600S) MSU (AX6300S)	`redundancy force-switchover`	`redundancy force-switchover`
BSU (AX6700S)	`inactivate bsu` *<bsu no.>*	`activate bsu` *<bsu no.>*#1
NIF	`Inactivate nif` *<nif no.>*	`activate nif` *<nif no.>*

#1: The status (active or standby) of the target module after the switchback command is executed depends on the redundant configuration.

(3) Mismatch of system information between the active and standby modules in a redundant

configuration

Modules that incorporate the control section of each series, that is, BCUs in the AX6700S series, CSUs in the AX6600S series, and MSUs in the AX6300S series, are subject to a mismatch of software versions, configurations, and/or license keys between the active and standby modules, which can arise when modules are added or replaced.

This subsection describes how to detect and resolve these three types of mismatches.

Table 4.1-5 Indication of mismatch in system information and restricted operations

Mismatch in system information	Indication of mismatch	Restricted operations
Software version	• Warning by means of log output	• Configuration change • Synchronization (`synchronize`)
Configuration	• Warning by means of log output • LED (SYSTEM1): Orange	• Active-standby switchover (`redundancy force-switchover`)
License key	• Warning by means of log output • LED (SYSTEM1): Orange	• Active-standby switchover (`redundancy force-switchover`)

#1: More than one of the above mismatches can sometimes occur simultaneously. If a mismatch in software versions coexists with other mismatches, you will not be able to perform active-standby switchover.

You can detect a mismatch of information between the active and standby modules by means of the message log output and LED indication. Examples of the individual message log output are shown below. In this state, the operations described in Table 4.1-5 are restricted.

Log output when a mismatch arises between the information of the active and standby modules

```
------ <<Log indicating a software version mismatch>> ----------------------------------------

07/13 04:31:56 E3 SOFTWARE 01300462 1001:1e0700000000 There is mismatch between active
and standby software version.   ... Software version mismatch between the active and
                                    standby modules

------ <<Log indicating a configuration mismatch>> ----------------------------------------

07/09 07:09:50 E5 CONFIG 00010007 0100:1e2700000000 There is mismatch between active
and standby configuration.      ... Configuration mismatch between the active and
                                    standby modules

------ <<Log indicating a license key mismatch>> ----------------------------------------

07/14 04:38:29 E5 SOFTWARE 01300479 1001:1e4700000000 There is mismatch between active
and standby license key.        ... License key mismatch between the active and
                                    standby modules
```

If an information mismatch arises between the active and standby modules, take the steps shown below. The logs shown below are examples of the message logs output to indicate that information matches between the active and standby modules.

- Software version mismatch
  Upgrade the standby software to the same version as the active software.

- Configuration mismatch[#2]
  Synchronize the configuration by executing the `synchronize` command.

- License key mismatch[#2]
  Synchronize the license key by executing the `synchronize` command. To enable the synchronized license key, restart the standby module.

#2: If this mismatch occurs at the same time as the software version mismatch, upgrade the standby software to the same version as the active software first.

Log output indicating a match of system information between the active and standby modules

```
------ <<Log indicating a match of software versions>> ----------------------------------------

07/22 00:54:24 E3 SOFTWARE 01300463 1001:1d2d00000000 Active and standby software version
is identical.
                    ... Indicates a match of software versions between the active and standby modules.

------ <<Log indicating a match of configurations>> ----------------------------------------

07/22 00:55:32 E3 CONFIG 00010006 0100:1d0d00000000 Active and standby configuration is
identical.
                    ... Indicates a match of configurations between the active and standby modules.

------ <<Log indicating a match of license keys>> ----------------------------------------

07/22 00:56:37 R5 SOFTWARE 01300479 1001:26db00000000 Active and standby license key is
identical.
                    ... Indicates a match of license keys between the active and standby modules.
```

4.2 Updating the software without stopping the Switch

(1) Procedure for updating the software without stopping the Switch

This section describes how to update the software while the device is being operated. The FT switch offers "no-stop" software update functionality by which software can be updated without interrupting communication.

For details about the software update procedure, see the *AX6700S/AX6600S/AX6300S Software Update Guide*.

[1] Execute the `show system` command to confirm if the following condition is met:

Free space on the internal flash memory is greater than the storage space required by the update file.

↓

[2] Prepare the update file.

Rename the update file to `k.img` and transfer it to a location under `/usr/var/update/` in the active module. Then, move to `/usr/var/update/`.

↓

[3] Update the standby software.

Execute the `ppupdate k.img standby` command to initiate a software update for the standby module. When the update is complete, the standby module will restart automatically.#1 Wait until the restart is complete. Execute the `show system` command to check the update result.

#1: At this moment, a message log notifying a version mismatch between the active and standby systems will be output.

↓

[4] Update the active software.

Execute the `ppupdate k.img active` command to initiate a software update for the active module. When the update is complete, the active module will restart automatically. At this moment, an active-standby switchover will take place. Wait until the restart is complete.#2

Execute the `show system` command to check the update result.

#2: At this moment, a message log notifying a version match between the active and standby systems will be output.

Note: If you remotely update the software, sessions will be terminated during an active-standby switchover. Log in to the device again.

↓

[5] Execute the `show system` command to confirm a version match between the active and standby modules.

Figure 4.2-1 Software update procedure

(2) Conditions for and notes on software update

Conditions for "no-stop" software updates are summarized in the following table.

Table 4.2-1 Conditions for "no-stop" software updates

Item	Conditions	
Device configuration	AX6700S	• BCUs are configured for redundancy. • At least two BSUs are inserted.
	AX6600S	• CSUs are configured for redundancy.
	AX6300S	• MSUs are configured for redundancy.
Supported functions	You must use any functionality that supports active-standby switchovers without communication interruptions. For details, see *17.1.5 Functionality that enables non-stop communication at system switchover* in the *Configuration Guide Vol. 2*.	
Software version	Before update, the same software version must be running on both the active and standby units.	
Configuration	• There must be no difference between the running configuration and startup configuration. • There must be no startup configuration differences between the active system and the standby system.	
License key	There must be no license key differences between the active and standby modules. The license does not take effect by simply entering a license key. After the device restarts, the license is applied.	

During a software update, BSU or NIF control software (HDC: Hardware Dependent Code) might be updated. The software update will be followed by a restart of the BSU, CSU, or NIF. Therefore, note the following points:

- For the AX6700S series, insert more than one BSU and place them in either active mode or hot-standby mode.
- For the AX6600S series, insert two CSUs, and place one PSP in active mode and the other in hot-standby mode.
- Specify manual updates for NIF HDCs. For details, see *12.2.3 Updating the HDC* in the *Configuration Guide Vol. 1*.

4.3 Troubleshooting

FT switches are capable of continuing operation even in the event of failure. This section addresses the failures that can occur in each one of the redundant modules in the AX6700S series, describes the steps leading to the detection of faulty parts, and provides some examples of failures. The procedures for replacing the faulty parts and checking the replaced parts will also be given.

Similar procedures apply to the AX6600S and AX6300S series.

(1) Troubleshooting flow

You can detect a failure that occurred in the device by using the LEDs, message log entries output from the device, or SNMP traps. The flow chart below shows hot to isolate the failure. If you find any abnormality in the device, execute the `show system` command to check the device status. With this command, you can identify roughly where the fault might be. Then, execute the `show logging` command to check previous events. By doing so, you can check the history of past failures as well as the date and time of failure occurrence.

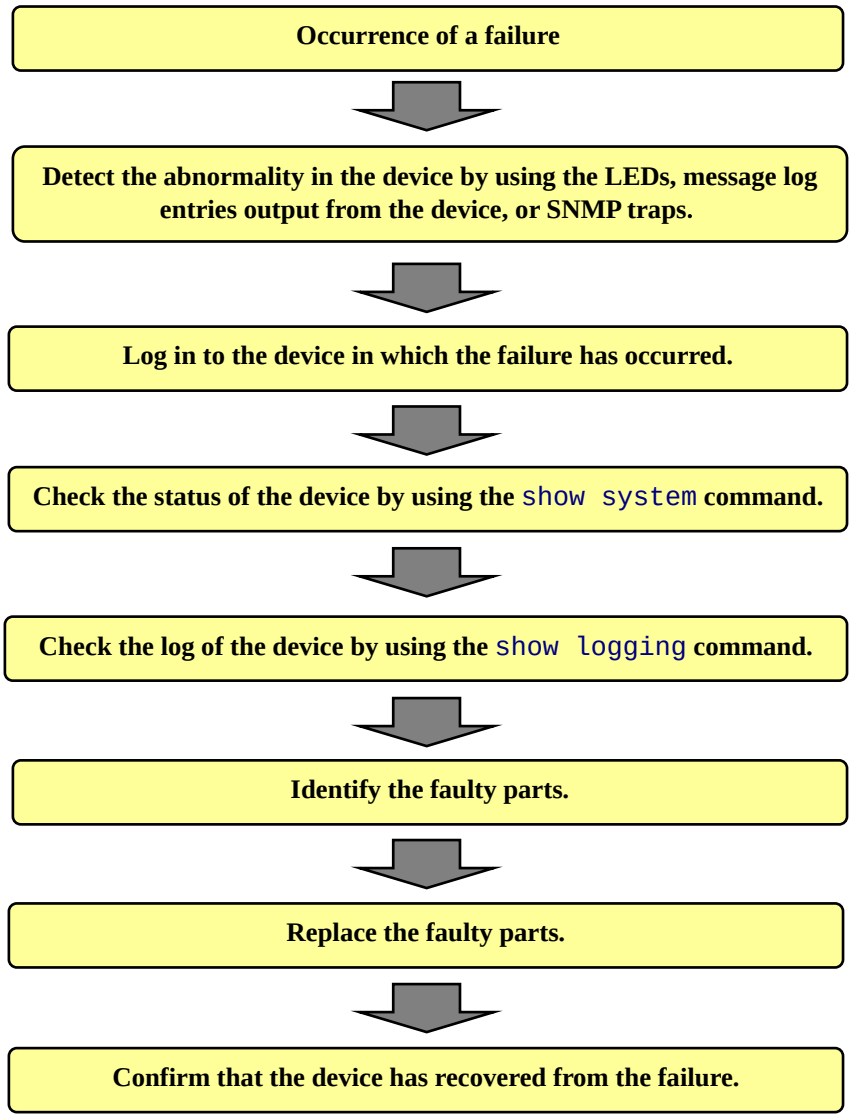


Figure 4.3-1 Troubleshooting flow

Shown below are the examples of failure logs output in cases of actual failures in individual modules (BCUs, BSUs, NIFs, PSs (power supply units), and FANs), followed by a summary of how to identify and deal with them.

- **Example of BCU failures**

```
C1# show logging
-----------------
EVT 11/04 16:37:43 E3 BCU 01300412 2314:259200000000 System status changed from duplex to
simplex.  ... System is now running in a single configuration, instead of a redundant configuration.

ERR 11/04 16:37:43 E5 BCU 01300440 2314:0eb600000000 Fatal error detected on other system.
This system (BCU2) is active.
          ... A fatal error has occurred in the standby BCU. BCU2 is acting as an active module in this system.
********************************************************************************
*********                                  [Cause] A hardware failure has occurred in BCU1 and automatic
                                                 restoration cannot be performed.
C1# show system                           [Solution] Replace BCU1.
----------------
    BCU1 : fault ... Operation has stopped due to a hardware failure.
    BCU2 : active
       CPU : AX-F6700-2S1 [BCU_S1 , 80200020]
       Boot : 2008/11/04 14:05:54 , power on , 0 times restart
       Lamp : STATUS LED=green , ACTIVE LED=green , SYSTEM1 LED=green
       System operation panel : No error
```

A fatal error has occurred in BCU1, causing the BCU to change from a redundant configuration to a single configuration. Furthermore, BCU1 is no longer operational. To resolve this failure, you have to replace BCU1.

- **Example of BSU failures**

```
C1# show logging
-----------------
ERR 11/04 15:00:11 E6 BSU-LA BSU:1 25080400 3281:000000000000 BSU restarted, but not recovered
from hardware failure.   ... Restarting BSU1 did not enable the device to recover from a hardware failure.
EVT 11/04 14:55:42 E3 BSU BSU:2 25070900 1681:000000000000 This BSU changed to active.
EVT 11/04 14:55:42 E3 BSU BSU:1 25070901 1681:000000000000 This BSU changed from active.
ERR 11/04 14:55:42 E5 BSU BSU:1 25070204 1681:000000000000 Fatal error detected on active BSU.
ERR 11/04 14:55:41 E6 BSU-LA BSU:1 25080200 3280:400100001000 BSU restarted because of its
hardware failure.
            ... A hardware failure in BSU1 caused the device to restart. Subsequently, BSU2 took over the active role.
********************************************************************************
********                                   [Cause] A hardware failure has occurred in BSU1 and automatic
                                                 restoration cannot be performed.
C1# show system                           [Solution] Replace BSU1.
----------------
       System operation panel :
          Event level : E6
          Location of event occurrence : BSU-LA
          Message identifier : 25080200
          Event occurrence interface identifier : BSU:1
   ------------------------------------------------
   BSU1 : fault AX-F6700-3LA [BSU-LA] , 3 times restart  ... Operation has stopped due to a
      Lamp : STATUS LED=-------- , ACTIVE LED=green           hardware failure.
   BSU2 : active AX-F6700-3LA [BSU-LA] , 0 times restart
      Lamp : STATUS LED=green , ACTIVE LED=green
   BSU3 : notconnect
```

A hardware failure occurred in BSU1, causing BSU2 to take over the active role. Furthermore, BSU1 has already gone through three restarts and therefore an automatic restoration cannot be performed. To resolve this failure, you have to replace BSU1.

- **Example of an NIF failure**

```
C1# show logging
-----------------
ERR 11/04 14:21:22 E6 NK1G-24T NIF:1 25020400 5540:000000000000 NIF restarted, but not recovered
from hardware failure.   ... Restarting NIF1 did not enable the device to recover from a hardware failure.
EVT 11/04 14:20:50 E3 MAC 20120010 0800:000000000000 Port(1/1) detached from Channel Group(10)
- Port down. ... The line (1/1) went down due to an NIF1 failure, which subsequently became detached from channel group
ERR 11/04 14:20:47 E6 NK1G-24T NIF:1 25020200 5540:840100010000 NIF restarted because of its
hardware failure.  ... A hardware failure in NIF1 caused the device to restart.

********************************************************************************************
********

                                        [Cause] A hardware failure has occurred in NIF1 and automatic
C1# show system                                 restoration cannot be performed.
----------------                        [Solution] Replace NIF1.
       System operation panel :
          Event level : E6
          Location of event occurrence : NK1G-24T
          Message identifier : 25020200
          Event occurrence interface identifier : NIF:1

********************************************************************************************
********

C1# show nif
----------------
NIF1: fault  24-port 10BASE-T/100BASE-TX/1000BASE-T    retry:3  ... Operation has stopped due
      Average:0Mbps/48Gbps  Peak:0Mbps at 00:00:00                 to a hardware failure.
```

A hardware failure occurred in NIF1, causing link aggregation to enter degraded mode. Furthermore, NIF1 has already gone through three restarts and therefore automatic restoration cannot be performed. To resolve this failure, you have to replace NIF1.

- **Example of a PS (power supply unit) failure**

```
C1# show logging
-----------------
ERR 11/04 16:59:38 E8 PS 00000102 2200:000000000000 Power unit isn't redundantly mounted.
                  ... The redundancy of the power supply unit has been lost.
ERR 11/04 16:59:38 E8 PS 00000001 2200:000000000000 PS8 is notconnect.
                  ... PS8 has not been inserted.

********************************************************************************************
*********
                                        [Cause] PS8 has not been inserted.
                                        [Solution] Check if PS8 is inserted.
C1# show system
----------------
       System operation panel :
          Event level : E8
          Location of event occurrence : PS
          Message identifier : 00000102
          Event occurrence interface identifier : none
```

PS8 has not been inserted. Also, the following warning message[#1] will be output: `The power supply is not in a redundant configuration.` To resolve this situation, check if PS8 is inserted. If it is, then it needs to be replaced.

#1: Set `power redundancy-mode` in the configuration. If this is not set, the warning message will not be output.

- **Example of a FAN failure**

```
C1# show logging
-----------------
ERR 11/04 16:54:17 E8 FAN 00000001 1800:000000000000 Error detected on FAN1(1), Replace FAN1.
                    ... A failure has occurred in FAN1 (1).
********************************************************************************
***********

C1# show system
----------------
       System operation panel :
          Event level : E8
          Location of event occurrence : FAN
          Message identifier : 00000001
          Event occurrence interface identifier : none1
```

[Cause] A failure has occurred in FAN (1).
[Solution] Replace FAN1.

Of the FAN1 unit, the fault occurred in the fan on the front side. This causes the remaining fans to increase their speed. To resolve this failure, you have to replace FAN1. For details about the location of each FAN, see Table *9-4 FAN number and operation log and their relation to the chassis* in the manual *Operation Command Reference Vol. 1*.

(2) How to replace each module

The table below summarizes how to replace modules when necessary, and describes commands to be executed upon replacement. Use the `inactivate` command to remove BCUs, BSUs, or NIFs, and use the `activate` command to replace BCUs.

Table 4.3-1 How to replace modules

Module to be replaced	Replacement procedure	Command to be executed	Impact on communication
BCU	Turn the power off by executing the `inactive` command.	`inactivate standby`	None
	Replace the target BCU.	(No need for commands)	
	Turn the power on by executing the `active` command.	`activate standby`	
BSU	Turn the power off by executing the `inactive` command.	`inactivate bsu` *<bsu no.>*	None
	Replace the target BSU. (After the BSU is replaced, the power will automatically turn back on.)	(No need for commands)	
NIF	Turn the power off by executing the `inactive` command.	`inactivate nif` *<nif no.>*	Possibility of instantaneous interruption due to the restoration of link aggregation
	Replace the target NIF. (After the NIF is replaced, the power will automatically turn back on.)	(No need for commands)	
PS (Power supply)	Turn off the power switch corresponding to the target PS.	(No need for commands)	None
	Replace the target PS.		
	Turn the power switch on.		
FAN (Fan unit)	Replace the target FAN.	(No need for commands)	None

(3) How to confirm restoration

After completing the replacement procedure, confirm that the redundant configuration is restored to the state before the failure occurred. Of the replaced modules, the BCU will resume operation as a standby unit. In the case of BSUs, if single-act or double-act operation is used in a redundant configuration, the replaced BSU will resume operation as a standby unit. In the case of NIFs, link aggregation will recover and immediately resume operation. PSs and FANs will resume operation the moment they are replaced.

To confirm the restoration status of each module, use the `show system` command to check if they are in a redundant configuration. For the NIF, use the `show channel-group` command to check the restoration status. For details about examples of how to execute commands, see *4-1 Operation commands for redundant configuration*.

5. Differences in the AX6700S, AX6600S, and AX6300S series

5.1 Comparison of the main specifications

As mentioned in Chapter 2, the main differences in the different series of FT switches (AX6700S, AX6600S, and AX6300S) are related to the differences in the physical configuration and logical operations of the control section and forwarding section that constitute the core of the device. The different features of these series offer users different options to select from based on their network size, purpose, and budget.

Table 5.1-1 compares the specifications of the individual series belonging to the AX6000S family.

Table 5.1-1 Comparison of the specifications of the AX6000S family series

No.		AX6700S	AX6600S	AX6300S
1	Control section: Maximum number of modules that can be installed	(BCU) 2	(CSU) 2	(MSU) 2
2	Forwarding section: Maximum number of modules that can be installed	(BSU) 3		
3	Switching capacity[#1]	x1: 384 Gbps x2: 768 Gbps x3: 1.15 Tbps	x1: 192 Gbps x2: 384 Gbps	192 Gbps
4	Packet processing performance[#1]	x1: 240 Mpps x2: 480 Mpps x3: 720 Mpps	x1: 120 Mpps x2: 240 Mpps	120 Mpps
5	Support for the dynamic power saving functionality	Yes	Yes	No
6	Number of lines that can be handled (10GBASE-R)	64	AX6608S: 64 AX6604S: 32	AX6308S: 64 AX6304S: 32
7	Number of lines that can be handled (1000BASE-X)	192	AX6608S: 192 AX6604S: 96	AX6308S: 192 AX6304S: 96
8	Control section: Active-standby switchover time in case of failure	No frame loss	No frame loss	50 msec or less
9	Forwarding section: Active-standby switchover time in the case of a failure	50 msec or less[#2] (Within two minutes)	50 msec or less[#2] (Within two minutes)	1 second or less

#1: These values vary depending on the operating status of the forwarding section. x*n* (*n* = 1, 2, 3) in the table denotes the number of operational modules. In an AX6300S series switch, only one module operates in the forwarding section.

#2: The value shown in the upper line is applicable to hot standby mode whereas the value shown within the parentheses in the lower line is applicable to cold standby mode.

5.2 Redundant operation of each series

The mode of operation differs across the individual series of the AX6000S family because the configuration of the control and forwarding sections differs by model.

In all models, the control section is always operated in hot standby mode by default when two BCUs, CSUs, or MSUs are inserted. In this case, there is no need to specify operations in the configuration. Note that in the AX6600S and AX6300S series, the controls section is physically integrated with the forwarding section. This means that when active-standby switchover occurs in the control section, the same also occurs simultaneously in the forwarding section.

As shown in Table 5.2-1, with the AX6700S and AX6600S series, users are allowed to select the operating mode of the forwarding section by using the configuration settings. For the AX6300S series, the forwarding section is always operated in hot standby mode.

Table 5.2-1 Operating mode of the forwarding section of the AX6000S family

Redundancy mode for the forwarding section	Features	AX6700S BSU	AX6600S CSU (PSP)	AX6300S MSU (PSP)
Double-act (Concurrent operation)	High-speed active-standby switchovers and increased switching capacity	Y max-bsu 2 (or 3)	Y max-psp 2	N
Hot standby (Energized and standing by)	High-speed active-standby switchovers	Y max-bsu 1 (or 2) standby-bsu hot	Y max-psp 1 standby-psp hot	Y (No need to set the configuration)
Cold standby (De-energized and standing by)	Low power consumption	Y max-bsu 1 (or 2) standby-bsu cold2	Y max-psp 1 standby-psp cold2	N

Y: Configurable. The lower line shows how to set the corresponding mode using a `redundancy` command.
N: Not configurable

The following figure shows the redundant operation status of the forwarding section of each series of the AX6000S family.

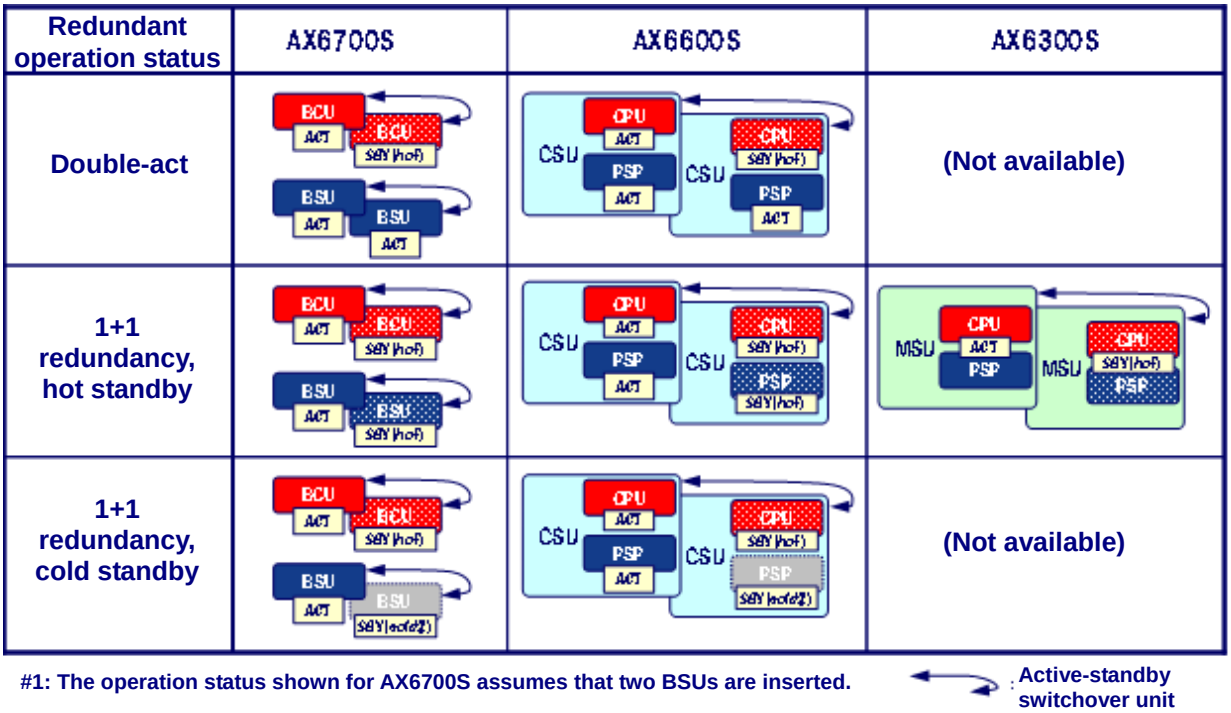


Figure 5.2-1 Operating mode of the AX6000S family

6. Notes

6.1 Notes applicable to all AX6000S family series

(1) inactivate standby operation command

If you execute the `inactivate standby` operation command with two BCUs, CSUs, or MSUs inserted, the standby module will be stopped. Note that, in this case, the device will not be in a cold standby state and will only have the active module running.

(2) Maximum number of channels that can be handled with link aggregation

Note that there is a limit to the number of channels that can be handled by link aggregation. The following table describes the maximum number of channels that can be handled by each device model.

Table 6.1-1 Number of channels that can be handled by link aggregation

Device model		Maximum number of channels that can be handled per device
AX6700S series	AX6708S	63
AX6600S series	AX6608S	63
	AX6604S	48
AX6300S series	AX6308S	63
	AX6304S	48

(3) Software version mismatch

Software version mismatches can occur when you add or replace modules. However, the LEDs or the panel remain the same as during normal state, with no error indication of any kind displayed. Therefore, when you replace modules or perform similar operations, check the software version using the operation log message or the `show system` command.

* For details about mismatch of information in redundant configuration, see *(3) Mismatch of system information between the active and standby modules in a redundant configuration* in *4.1 Operation commands for redundant configuration*.

(4) Conditions for enabling "no-stop" software updates

- The device must be configured for redundancy. Furthermore, in cases of the AX6700S and AX6600S series, the forwarding section must be in the hot standby state.
- You must use functionality that supports active-standby switchovers without communication interruptions.
- The same software version must be running on both the active and standby modules.
- There must be no configuration difference between the active and standby modules.
- There must be no license key difference between the active and standby modules.

* For details about conditions for enabling "no-stop" software updates, see *(2) Conditions for and notes on software update* in *4.2 "No-stop" software update*.

(5) Execution interval for active-standby switchover operations

If you perform active-standby switchover using the switchover command `redundancy force-switchover` or the ACH switch, wait for approximately three minutes before performing a switchover again.

If you perform switchovers repeatedly without any time in between, you might lose connectivity temporarily.

6.2 Notes for AX6700S series switches

(1) Configuring redundancy for BSUs (redundancy max-bsu)

If you do not specify any value for `redundancy max-bsu`, the default value of `3` is assumed, regardless of the actual number of BSUs inserted. Thus, in cases where two BSUs are inserted with the setting for `redundancy max-bsu` omitted, the device assumes that BSUs have entered degenerate mode in which two instead of three BSUs are operational, compromising performance.

For this reason, make sure that you set the actual number of inserted BSUs in the configuration.

(2) Configuring redundancy for BSUs (redundancy standby-bsu)

In the AX6700S series, the setting specified using the configuration command `redundancy standby-bsu` is enabled in a configuration in which a standby module exists. Without a standby module, this setting will not be enabled.

6.3 Notes for AX6600S series switches

(1) Configuring redundancy for PSPs (redundancy standby-psp)

In the AX6600S series, the setting specified using the configuration command `redundancy standby-psp` is enabled in a configuration in which a standby module exists. Without a standby module, this setting will not be enabled.

6.4 Notes for AX6300S series switches

(1) Restrictions on some NIF modules

If an active-standby switchover occurs due to a failure in some of the NIF modules inserted into an AX6300S series switch that affects all the modules, such as a failure in the power supply section within the module, communication will sometimes be interrupted for a prolonged period of time. Such NIF modules include the following:

Product name (abbreviation)	Model name	Product description
NH10G-1RX	AX-F6300-721F	Ethernet LAN with one port for 10GBASE-R for the AX6300S series

Appendix. Configuration Files

The files below provide examples of the configurations described in this guide. The text files of all configurations available for each device, base on the examples of FT network configurations described in Chapter 3, are attached to this file. (You need Adobe Reader version 6.0 or later to extract the attached files.) To view a specific configuration, open the attached file that has the same name as the file name shown below for each device.

3.1 Example of how to build an FT network system

	Device name and applicable device	Applicable file
FT network configuration that uses FT switches (AX6700S, AX6600S, AX6300S)	C1 (AX6708S) (AX6608S) (AX6308S)	3-1_FTN_C1_AX67S.txt 3-1_FTN_C1_AX66S.txt 3-1_FTN_C1_AX63S.txt
	S1 (AX3630S)	3-1_FTN_S1.txt
	F1 (AX2430S)	3-1_FTN_F1.txt
	F2 (AX2430S)	3-1_FTN_F2.txt

Edition 3 – March 18, 2011

Network Technical Support
ALAXALA Networks Corporation

Shin-Kawasaki Mitsui Bldg West Tower, 890
Kashimada, Saiwai-ku, Kawasaki-shi,
Kanagawa 212-0058, JAPAN
http://www.alaxala.com/en/index.html