



CHAPTER 4

Planning for Card Redundancy, Line Redundancy, and Bulk Distribution

This chapter describes how to plan for card redundancy, line redundancy, and bulk distribution on MGX switches. The card redundancy feature uses a secondary card of the same or similar type (MPSM-8-T1E1 cards support other card types) to serve as a standby card and to take over if the active card fails. The line redundancy feature extends this same type of fault tolerance to individual lines connected to the switch. (In this chapter, *switch* refers to the MGX switches and the MGX 8880 gateway.)

Bulk distribution is a feature that uses an SRM card to aggregate T1 or E1 traffic from selected service modules and transmit that traffic over higher speed back cards connected to the SRM. Aggregated traffic received at the SRM cards is distributed to the individual service modules. The primary feature of bulk distribution is that it enables a switch to use fewer T3 or OC-3 lines instead of many T1 or E1 lines. A secondary benefit is that SRME cards can provide line redundancy to cards that otherwise could not use that feature.

Because a configuration change for any of these services has the potential to interrupt service and can require substantial configuration teardown, it is important to develop a plan for these services early. This plan determines how controller cards and service modules must be installed in the chassis, and how lines must connect to the cards before configuration starts. Once the hardware is installed, the software configuration team uses this plan to configure the switch. For the switch to operate properly, the hardware installation must match the planned software configuration.

The features described in this chapter are not supported on all cards. [Table 4-1](#) lists all the card types and the features they support.

Table 4-1 *Card Redundancy, Line Redundancy, and Bulk Distribution Features per Card*

Card Type	Card Redundancy Options	Line Redundancy Supported	Bulk Distribution Supported
AUSM8T1/B ¹ AUSM8E1/B ¹	Standalone	None ²	Yes
	1:N		
AXSM-1-2488 AXSM-1-2488/B AXSM-1-9953-XG	Standalone	None	No
	1:1	Intercard APS	
AXSM-2-622-E	Standalone	None	No
	1:1	Intercard and intracard APS	

Table 4-1 Card Redundancy, Line Redundancy, and Bulk Distribution Features per Card (continued)

Card Type	Card Redundancy Options	Line Redundancy Supported	Bulk Distribution Supported
AXSM-4-622	Standalone	Intracard APS	No
AXSM-4-622/B	1:1	Inter-card and intracard APS	
AXSM-4-2488-XG			
AXSM-8-155-E	Standalone	Intracard APS	No
	1:1	Inter-card and intracard APS	
AXSM-16-155	Standalone	Intracard APS	No
AXSM-16-155/B	1:1	Inter-card and intracard APS	
AXSM-16-155-XG			
AXSM-16-T3E3	Standalone	None	No
AXSM-16-T3E3/B	1:1		
AXSM-16-T3E3-E			
AXSM-32-T1E1-E			
CESM-8E1 ¹	Standalone	None ²	Yes
CESM-8T1 ¹	1:N		
CESM-8T1/B			
FRSM-2CT3	Standalone	None	No
FRSM-2T3E3	1:1		
FRSM-8E1 ¹	Standalone	None ²	Yes
FRSM-8E1-C ¹	1:N		
FRSM-8T1 ¹			
FRSM-8T1-C ¹			
FRSM-12-T3E3	Standalone	None	No
	1:1		
FRSM-HS2/B	Standalone	None	No
	1:1 ³		
MPSM-8-T1E1	Standalone	None ²	Yes
	1:N		
MPSM-16T1E1	1:1	None	No
	1:N		
MPSM-T3E3-155	Standalone	Intracard APS	No
	1:1	Inter-card and intracard APS	
PXM1E-4-155	Standalone	Intracard APS	No
PXM1E-8-155	Preconfigured 1:1	Inter-card and intracard APS	
PXM1E-8-T3/E3	Standalone 1:1	None	No
PXM1E-16-T1/E1	Preconfigured 1:1		
PXM1E COMBO	Standalone	Intracard APS	No
	Preconfigured 1:1	Inter-card and intracard APS	

Table 4-1 *Card Redundancy, Line Redundancy, and Bulk Distribution Features per Card (continued)*

Card Type	Card Redundancy Options	Line Redundancy Supported	Bulk Distribution Supported
PXM45 PXM45/B PXM45/C	Standalone	None	No
	Preconfigured 1:1		
RPM-PR-256 RPM-PR-512 RPM-XF-512	Standalone	None	No
	1:N without SRM		
SRM-3T3	Standalone	None	Yes
	Preconfigured 1:1		
SRME	Standalone	None	Yes
	Preconfigured 1:1	Intercard APS	
SRME/B	Standalone	None	Yes
	Preconfigured 1:1	Intercard APS ⁴	
VISM-PR-8E1 VISM-PR-8T1	Standalone	None	Yes
	1:N		
VXSM-4-155	Standalone	Intracard APS	No
	1:1	Intercard and intracard ⁵ APS	
VXSM-48-T1E1	Standalone	None	No
	1:1		
VXSM-T3	Standalone	None	No
	1:1		

1. MPSM-8-T1E1 can replace or serve as a standby card for this card type.
2. When bulk distribution is used with redundant PXM1Es and SRMEs or SRME/Bs, intercard APS line redundancy (through the SRME) is supported.
3. 1:1 redundancy supported only with the SCSI2-2HSSI/B back card and a FRSM-HS1/B HSSI Y-cable. 1:1 redundancy is not supported in slots that use the 12IN1-8S back card.
4. SRME/B supports T3, SONET, and SDH interfaces. Intercard APS is available only on SONET and SDH interfaces.
5. VXSM intracard APS is supported only on 1:1 redundant card installations in MGX 8880 slots 3 and 4.

Planning Standalone and Redundant Card Configurations

A PXM card or service module operates in either standalone mode or redundant mode, depending on the card type, the other cards in the switch, and the configuration applied to that card. The following subsections provide planning guidelines for installing cards that will operated in standalone and redundant configurations.

Standalone Card Configuration Guidelines

When a card is inserted in a switch without a standby or redundant card, it operates in standalone mode. If a standalone card goes down, all the connections on that card will fail and traffic will be lost. All cards that can be installed in an MGX switch can operate in standalone mode. However, Cisco recommends configuring redundancy to ensure that you will not lose traffic and connectivity in the event of a card or line failure.

All Cisco MGX 8850 switch cards operate in the standalone configuration without additional configuration. Standalone configurations are often used in lab environments or other non-critical applications.

In the standalone configuration, the appropriate back cards must be installed according to the following guidelines:

- For all PXM cards, both back cards must be installed.
- For AXSM, FRSM12, and VXSM cards that support two back cards, at least one back card must be installed.
- For RPM cards, install back cards according to the requirements for your installation.
- For MGX 8880 installations, redundancy back cards must be installed in slots 4 and 20, and this makes front card slot 4 impractical for standalone use. (Technically, a standalone card in slot 4 can connect to back cards in slot 3, but it is more practical and intuitive to have all standalone front and back cards in slot 3.)
- For all other service modules, one back card must be installed or bulk distribution must be configured.

SRM cards are optional and add 1:N card redundancy, bulk distribution, and bit error rate testing (BERT) services to a Cisco MGX 8850 switch. These services apply to select service modules, so in a MGX 8850 (PXM45) switch, for example, you can install a standalone PXM and still support 1:N card redundancy for select service modules.

When you install SRM cards, it is important to note the relationship between the SRM cards and the PXM cards, which is shown in [Table 4-2](#). For example, in a MGX 8850 (PXM1E) switch, the PXM in slot 7 is preconfigured to work with SRMs in slots 15 and 31. The SRM in slot 15 provides SRM services to the upper bay, and the SRM in slot 31 provides SRM services in the lower bay.

Table 4-2 Preconfigured Relationship Between PXM and SRM Cards

Switch	PXM Slot	Upper Bay SRM Slot	Lower Bay SRM Slot
MGX 8830 and MGX8830/B	1	7	—
	2	14	—
MGX 8850 (PXM1E/PXM45), MGX 8850/B, and MGX 8880	7	15	31
	8	16	32

Because the relationship between PXM and SRM cards is preconfigured and cannot be changed during configuration, it is important to install these cards using the configuration options listed in [Table 4-2](#). Use the following guidelines when installing PXM and SRM cards:

- When using a standalone PXM configuration, the switch supports a single standalone SRM per bay.
- For the MGX 8830, a standalone SRM provides services to all cards in the switch and must be installed in the slot that supports the standalone PXM. For example, if the standalone PXM is installed in slot 1, the standalone SRM must be installed in slot 7.
- For the MGX 8850 (PXM1E/PXM45) switches and the MGX 8880 Media Gateway, up to two standalone SRMs can be installed to provide SRM services to the upper and lower bays. For example, when a standalone PXM is installed in slot 8, a standalone SRM in slot 16 can provide SRM services to the upper bay, and a standalone SRM in slot 32 can provide SRM services to the lower bay.
- When installing two standalone SRMs in MGX 8850 (PXM1E/PXM45) switches, you can install different SRM card types in different bays. For example, you can install an SRM-3T3/C card in one bay and an SRME/B card in the other bay.
- SRME/B is the only SRM supported on the MGX 8880 Media Gateway.
- SRM cards are not supported on MGX 8950 switches.

1:1 Redundant Card Configuration Guidelines

The 1:1 redundant card configurations provide the optimum protection against failure of a single card. In the 1:1 redundant card configuration, one card operates in the active mode and a second card operates in hot standby mode, ready to provide services in the event of an active card failure. To minimize switchover time and prevent service interruption, standby cards are dedicated to a single active card and cannot support additional cards. Standby cards do not support services until they transition to the active state.



Note

To prevent total switch service interruption in the event of a PXM card failure, Cisco recommends using redundant PXM cards.

There are two types of 1:1 redundant card configurations on Cisco MGX 8850 switches, preconfigured redundancy and configured redundancy. The following sections describe these redundancy types and provide guidelines for installing cards to support these configurations.



Note

The 1:1 card redundancy configuration is sometimes referred to by the older term, *Y-cable redundancy*. This is because older card sets always used Y cables to connect both 1:1 redundant cards to the same communications line. However, with the addition of APS line redundancy, it is very common to have 1:1 redundant cards that do not use Y cables, so this guide uses the term *1:1 card redundancy*.

Preconfigured Redundancy (PXM and SRM)

Cisco MGX 8850 switches are preconfigured to support redundant PXM and SRM cards. If you want to use redundant PXM and SRM cards, simply install cards in the appropriate slot as described in [Table 4-3](#).

Table 4-3 Preconfigured Redundancy for Cisco MGX 8850 Switches

Switches	Redundancy Role	PXM Slot	Upper Bay SRM Slot	Lower Bay SRM Slot
MGX 8830 and MGX 8830/B	Primary	1	7	—
	Secondary	2	14	—
MGX 8850 (PXM1E/PXM45), MGX 8850/B and MGX 8880	Primary	7	15	31
	Secondary	8	16	32
MGX 8950	Primary	7	—	—
	Secondary	8	—	—

SRM cards are optional and add 1:N card redundancy, bulk distribution, and bit error rate testing (BERT) services to a Cisco MGX 8850 switch. These services apply to select service modules, so in a MGX 8850 (PXM45) or MGX 8850/B switch, for example, you might use 1:1 card redundancy for some cards and 1:N redundancy for others.

When you install SRM cards, it is important to note the relationship between the SRM cards and the PXM cards, which is shown in [Table 4-3](#). For example, in a MGX 8850 (PXM1E) switch, the primary preconfigured card set is a PXM in slot 7, an SRM covering the upper bay in slot 15, and an SRM covering the lower bay in slot 31. The secondary configuration is a PXM in slot 8, an SRM covering the upper bay in slot 16, and an SRM covering the lower bay in slot 32. If the primary card set fails, a switchover to the secondary card set is initiated. [Figure 4-1](#) and [Figure 4-2](#) show the card positions for PXM and SRM cards in the switches that support SRM cards.

Figure 4-1 MGX 8850 Switch or MGX 8880 Media Gateway with Redundant PXMs and SRMs

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						P X M 1 E	P X M 1 E							S R M	S R M
17	18	19	20	21	22	or	or	25	26	27	28	29	30	31	32
						P X M 4 5	P X M 4 5							S R M	S R M

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Figure 4-2 MGX 8830 Switch with Redundant PXMs and SRMs

SRM	14	SRM	7
	13		6
	12		5
	11		4
	10		3
	PXM		2
	PXM		1

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Because the relationship between PXM and SRM cards is preconfigured and cannot be changed, it is important to install these cards in the proper slots to support the intended configuration. Use the following guidelines when installing PXM and SRM cards:

- For redundant PXM1E installations, the card sets must be identical.
- If redundant PXMs are used and SRM services are required, redundant SRMs must be installed for each bay that uses SRM services.
- For the MGX 8830 or MGX 8830/B, a redundant pair of SRMs provides services to all service module slots in the switch.
- For the MGX 8850 (PXM1E/PXM45), MGX 8850/B switches and the MGX 8880 Media Gateway, a redundant pair of SRMs provides services to only one bay. For example, to support redundant SRM services in the lower bay, SRM cards must be installed in slots 31 and 32.
- When installing redundant SRMs for a MGX 8830 or MGX 8830/B switch or a single bay in a MGX 8850 (PXM1E/PXM45) or MGX 8850/B switch, the redundant SRMs must use compatible configurations. The switch cannot support two different SRM configurations in the same bay. The following are valid SRM redundant configurations:
 - Two SRM-3T3/C
 - One SRM-3T3/C and one SRME/B with a BNC-3T3-M back card.
 - Two SRME
 - Two SRME/B
 - One SRME and one SRME/B
- The MGX 8880 Media Gateway supports only the SRME/B.
- When redundant SRMs are installed, both SRMs must use the same back card type.
- When installing redundant SRMs in a MGX 8850 (PXM1E/PXM45) or MGX 8850/B switch or a MGX 8880 Media Gateway, you can install one SRM configuration in one bay and another type of SRM configuration in the other bay. For example, the top bay might use SRME/B services and BNC-3T3-M back cards, and the bottom bay might use SRME/B services and MGX-SMFIR-1-155 back cards.
- SRM cards are not supported on MGX 8950 switches.

Configured 1:1 Card Redundancy

Configured 1:1 card redundancy operates much like 1:1 PXM redundancy. The difference is that the redundancy is not preconfigured. To use configured 1:1 card redundancy with cards such as AXSM, FRSM12, and VXSM cards, the cards must be installed in the appropriate slots, and the cards must be configured to operate as a redundant pair. After configuration, one card operates in active mode, and the other card operates in hot standby mode. If the active card fails, the standby card takes over, and no calls are lost.



Note

This configuration provides fault tolerance for the service modules only. Some cards, such as selected AXSM, PXM1E, and VXSM cards, support line redundancy. For more information on planning for line redundancy, see “[Redundant Line Configuration Guidelines](#),” which appears later in this chapter.

When planning a configured 1:1 card redundancy configuration, consider the following:

- Configured 1:1 card redundancy is supported by many service module families. Refer to [Table 4-1](#) to see which service modules support 1:1 card redundancy.
- When redundant cards are connected to a standalone line, the cards can be placed in any available slots; they do not have to be installed in adjacent slots, although doing so makes the cabling easier.
- When redundant cards are connected to redundant lines using intercard APS, the cards must be placed in adjacent slots. For more information, see “[Redundant Line Configuration Guidelines](#),” which appears later in this chapter.
- When redundant cards are connected to redundant lines using intercard APS in a MGX 8950 switch, you must install redundant AXSM-XG cards in adjacent slots where the odd numbered slot is the lower number. For example, you can install redundant AXSM-XG cards in slots 3 and 4. However, if you install redundant AXSM-XG cards in slots 4 and 5, intercard APS cannot be configured for these cards.
- The front cards must be identical. If you install non-matching cards, such as an AXSM OC-48 card and a AXSM OC-3 card, these cards cannot be configured as a redundant pair.
- The back card sets must be compatible. For T1, E1, T3, and E3 interfaces, this means that the back cards must be identical. For optical and STM-1 interfaces, the back cards must use the appropriate speed based on the front card, but you can use different interface types. For example, if a service module supports single mode and multimode fiber interfaces, you can use both interface types in the same redundant card set.
- The cards must be cabled and configured for standalone lines (Y-cables) or redundant lines (APS). Although cards can be configured before the cabling is installed, the redundant card set will not operate properly until the correct cabling is installed between the redundant card pair. For more information, see “[Planning for Standalone and Redundant Line Configurations](#),” which appears later in this chapter.

1:N Redundant Card Configuration Guidelines (Except RPM)

1:N card configurations use one standby card to back up multiple active cards. If an active card fails, the standby card loads the proper configuration and takes over operation for the active card. Once the standby card transitions to the active mode, it is no longer available to back up other active cards.

With the exception of 1:N redundant configurations on RPM cards, 1:N redundant card configurations always require the services of one or more SRM cards.

SRM cards support 1:N redundancy in the following modes:

- 1:N redundancy without bulk distribution
- 1:N redundancy with bulk distribution

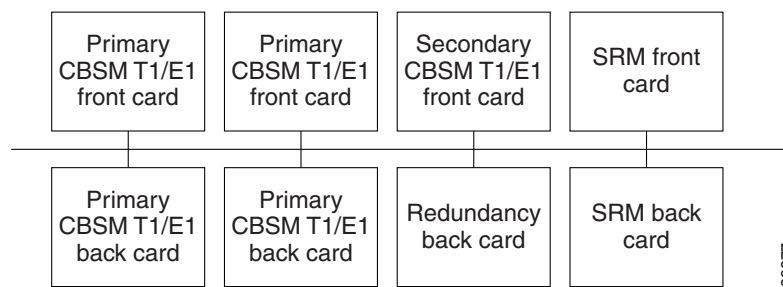
The following subsections describe how 1:N redundancy operates in these two configurations and provide guidelines for installing cards to support 1:N redundant configurations.

1:N Redundancy without Bulk Distribution

When 1:N redundancy is used without bulk distribution, you must install a special redundancy back card for each 1:N redundant card set as shown in [Figure 4-3](#). This redundancy back card has no connectors on it and is installed behind the standby card.

If an active card in the 1:N redundant card set fails, the standby card takes over, and the SRM routes communications from the standby back card through the special redundancy back card, and over to the back card behind the failed card. This configuration allows the standby card to use the lines connected to the back card behind the failed primary card.

Figure 4-3 Example 1:N Redundant Configuration without Bulk Distribution



The rerouting of the line communications takes place over a single redundancy bus, one of which is installed in each bay of a Cisco MGX 8850 switch. A MGX 8830 or MGX 8830/B switch has one redundancy bus, and MGX 8850 (PXM1E/PXM45), MGX 8850/B, and MGX 8880 switches have two, one for each bay. The redundancy bus is available to only one 1:N redundant card set at a time, so if any 1:N protected card fails in a bay, the redundancy bus is unavailable to all other 1:N redundant card sets.

To support 1:N redundancy without bulk distribution, cards must be installed according to the following guidelines:

- The SRM-3T3/C, SRME, and SRME/B cards provide 1:N card redundancy for 8-port AUSM, FRSM, CESM, MPSM, and VISM-PR cards that use T1 and E1 lines. Refer to [Table 4-1](#) to see if a specific service module supports 1:N card redundancy.
- All cards in a 1:N redundant card set (without bulk distribution) must have back cards. Each primary card must have an appropriate back card with line connections, and the secondary card must have the appropriate redundancy back card.
- The primary back cards in a 1:N redundancy set must all be of the same interface type. For example, all of the cards should be either T1 or E1 back cards. Do not mix interface types in the same redundancy set.
- When the secondary card is an AUSM, CESM, FRSM, or VISM, all cards in a 1:N redundant card set must be of the same type. For example, a FRSM-8T1 can act as a standby card for other FRSM-8T1 cards; it cannot serve as a standby card for an AUSM-8T1/B.

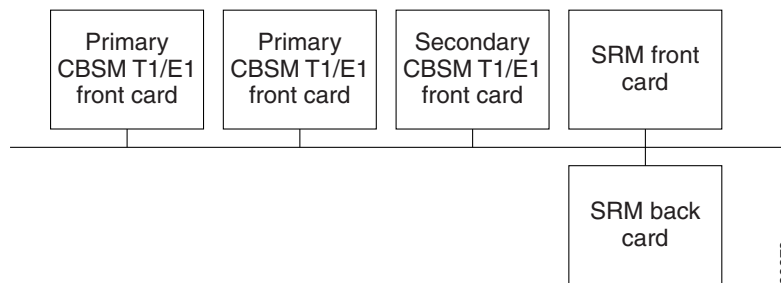
- When the secondary card is an MPSM-8-T1E1, the MPSM-8-T1E1 can back up the following card types: AUSM, FRSM, CESH and MPSM-8-T1E1. For example, the same MPSM-8-T1E1 could simultaneously serve as a secondary card for AUSM, FRSM, CESH and MPSM-8-T1E1 cards.
- All cards in a 1:N redundant card set must be installed in the same bay. For example, in a MGX 8850 (PXM1E/PXM45) or MGX 8850/B switch, all cards in a specific 1:N redundant card set must be installed in the upper bay or in the lower bay. The 1:N redundant card set cannot be split between the upper and lower bays.
- SRMs must be installed in each bay that supports 1:N redundancy, and the number of SRMs in that bay must match the number of installed PXMs and be placed as described in “[Standalone Card Configuration Guidelines](#)” or “[1:1 Redundant Card Configuration Guidelines](#).”

1:N Redundancy with Bulk Distribution

Bulk distribution is an SRM card feature that combines communications paths from multiple T1 or E1 lines on individual service modules and forwards those communications over T3 or OC-3 lines connected to SRM back cards. Communications received over the SRM T3 or OC-3 lines are separated into individual T1 or E1 data streams and forwarded to the appropriate service module. Bulk distribution enables you to use one T3 or OC-3 line for service module communications instead of multiple T1 or E1 lines.

When 1:N redundancy is used with bulk distribution, no back cards are installed behind service modules in a 1:N redundant card set. All communications lines for the protected cards are rerouted through the backplane to the SRM back card as shown in [Figure 4-4](#).

Figure 4-4 Example 1:N Redundant Configuration with Bulk Distribution Enabled



If an active card in the 1:N redundant card set fails, the standby card takes over, and the SRM routes communications from the standby back card to the appropriate logical lines within the SRM T3 or OC-3 line. When bulk distribution is used, the 1:N redundant card set does not use the redundancy bus on the backplane, so the SRM can support failures in multiple 1:N redundant card sets.

To support a 1:N redundancy configuration with bulk distribution, use the following guidelines:

- SRM T3 configurations (SRM-3T3/C and SRME/B with the BNC-3T3-M back card) support bulk distribution on 8-port AUSM, FRSM, CESH, MPSM-8-T1E1, and VISM-PR cards that use T1 lines only. Refer to [Table 4-1](#) to see if a specific service module supports bulk distribution.
- SONET and SDH configurations (SRME and SRME/B with the MGX-SMFIR-1-155 or MGX-STM1-EL-1 back cards) support bulk distribution on 8-port AUSM, FRSM, CESH, MPSM-8-T1E1, and VISM-PR cards that use T1 or E1 lines. Refer to [Table 4-1](#) to see if a specific service module supports bulk distribution.
- All cards in a 1:N redundant card set that uses bulk distribution should not have back cards. When bulk distribution is enabled, all lines on a card are routed through the SRM.

- When the secondary card is an AUSM, FRSM, or CESM, all cards in a 1:N redundant card set must be of the same type. For example, a FRSM-8T1 can act as a standby card for other FRSM-8T1 cards; it cannot serve as a standby card for an MPSM-8-T1E1.
- When the secondary card is an MPSM-8-T1E1, the MPSM-8-T1E1 can back up the following card types simultaneously: AUSM, FRSM, CESM, and MPSM-8-T1E1.
- All cards in a 1:N redundant card set must be installed in the same bay. For example, in a MGX 8850 (PXM1E/PXM45) or MGX 8850/B switch, all cards in a specific 1:N redundant card set must be installed in the upper bay or in the lower bay. The 1:N redundant card set cannot be split between the upper and lower bays.
- SRMs must be installed in each bay that supports 1:N redundancy, and the number of SRMs in that bay must match the number of installed PXMs and be placed as described in “[Standalone Card Configuration Guidelines](#)” or “[1:1 Redundant Card Configuration Guidelines](#).”
- Enabling bulk distribution does not prevent you from using 1:N redundancy without bulk distribution. For example, in the same bay you can set up a 1:N redundancy card set with bulk distribution and a 1:N redundancy card set without bulk distribution.

1:N Redundant Card Configuration Guidelines (RPM Only)

RPM-PR and RPM-XF cards can operate in 1:N redundant card configurations without the services of SRM cards. In this configuration type, one standby RPM card takes over if any active RPM in the redundant card set fails. For more information, refer to the *Cisco MGX Route Processor Module (RPM-PR) Installation and Configuration Guide*.



Note

If RPMs are installed with backcards, then the active and standby RPM backcards need to have ethernet or POS connectivity established such that the active cards and the standby card have the same IP reachability. Otherwise, IP connectivity can be disrupted by an RPM switchover.

Planning for Standalone and Redundant Line Configurations

Most cards support only standalone line configurations. Some cards, such as PXM1E, AXSM, VXSM, and SRME/B also support redundant lines. [Table 4-1](#) lists all the card types and indicates which cards support redundant line configurations. The following subsections provide information you need to know when planning for standalone and redundant line configurations.

Standalone Line Configuration Guidelines

Standalone line configurations can be used to support standalone or redundant card configurations. However, the standalone line configuration you use will be dependent on one of the following card configurations:

- Standalone card
- 1:1 redundant card
- 1:N redundant card (except RPM)
- 1:N redundant RPM

Standalone Card Configurations

When planning for a standalone line on a standalone card, consider the following guidelines:

- A single line (transmit and receive) should be attached to the connectors for each line. Y-cables, which are introduced later for 1:1 redundant card installations, should not be installed.
- If the standalone line is for a standalone PXM1E or SRM card, no card should be installed in the reserved redundant slot for that card.
- Slot 4 on the MGX 8880 switch is preconfigured to use redundant back cards, which physically connect the front card in slot 4 to any back cards installed in slot 3. Slot 4 cannot support a standalone configurations on its own. Therefore, it is recommended that you use slot 4 only for 1:1 redundant card configurations.

1:1 Redundant Card Configurations

When planning for a standalone line and a 1:1 redundant card configuration, consider the following guidelines:

- For most installations, a pair of Y-cables must be installed between matching line numbers on the redundant back cards, one for the transmit connector and one for the receive connector. Each Y-cable links a pair of transmit or receive connectors to the standalone line. Typically, a pair of Y-cables is required for each line that uses BNC, SMB, MCC or optical connectors. Some cards, such as the AXSM-32-T1E1-E, use special back card connectors and Y-cables that route both transmit and receive paths through a single cable.
- The redundant cards must be configured for 1:1 or “Y-cable” redundancy.
- Y-cabling of MMF backcards is possible, but must be subject to careful evaluation of the optical power budget. You must consider the following information when Y-cabling MMF interfaces:
 - The losses introduced by the Y-cable assemblies themselves, fiber connectors, patch panels, and so forth, can affect the optical power budget.
 - Single ended Y-cable deployments are typically within the acceptable optical power budget. Double ended Y-cable deployments are likely to have too much attenuation to work correctly.
 - Cisco optical Y-cables incorporate an optical splitter, which effectively divides the optical power in half to each leg of the Y-cable. This split results in an effective 3db attenuation, and this does not include the additional attenuation introduced by the Y-cable fiber connectors themselves.
- Slot 4 in the MGX 8880 uses redundancy back cards that connect the front card in slot 4 to any back cards in slot 3. Because there is only one back card set, no Y-cables are required for standalone line installations with 1:1 card redundancy in slots 3 and 4.

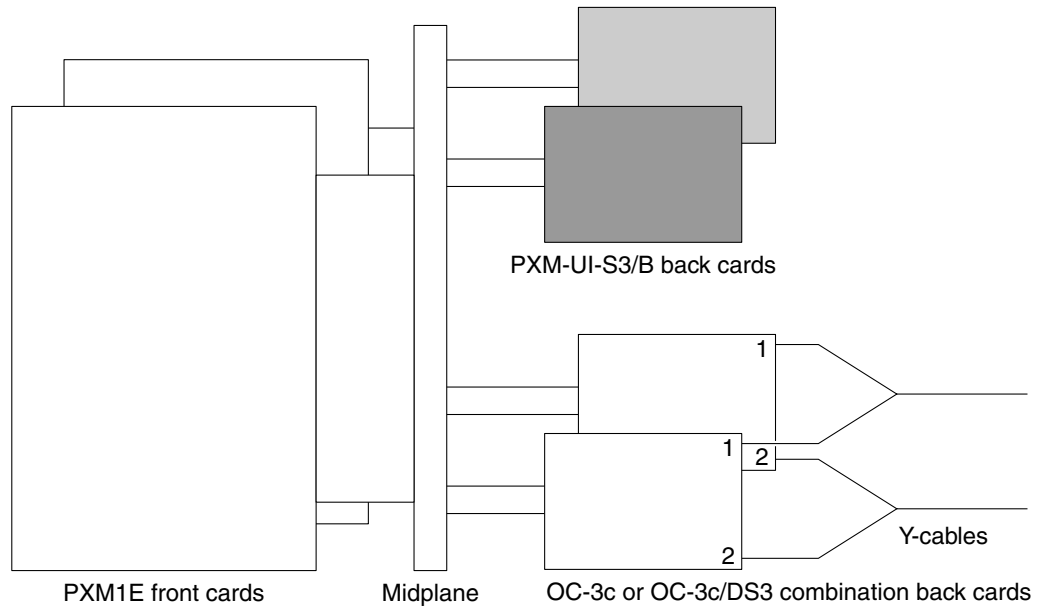


Note

The 1:1 card redundancy configuration is sometimes referred to by the older term, *Y-cable redundancy*. This is because older card sets always used Y cables to connect both 1:1 redundant cards to the same communications line. However, with the addition of the APS line redundancy, it is very common to have 1:1 redundant cards that do not use Y cables, so this guide uses the term *1:1 card redundancy*.

Figure 4-5 shows how redundant PXM1E cards use a Y-cable to connect to standalone lines.

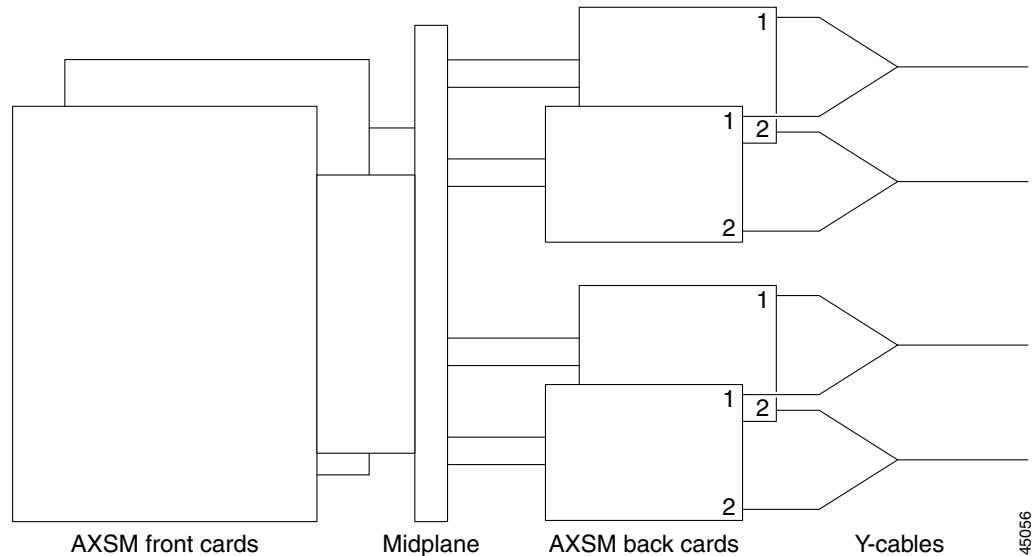
Figure 4-5 Redundant PXM1E Configuration with Standalone Lines



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Figure 4-6 shows how redundant AXSM cards connect to standalone lines. Other service modules that support 1:1 card redundancy, such as FRSM12 and FRSM-HS2/B, use Y-cables in a similar manner.

Figure 4-6 Redundant AXSM Configuration with Standalone Lines



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Note

This configuration provides fault tolerance for the front cards only. This configuration does not provide fault tolerance for back cards or lines. If you need fault tolerance for back cards and lines, refer to “Redundant Line Configuration Guidelines” section on page 4-14.

1:N Redundant Card Configurations (Except RPM)

When planning for a standalone line in a 1:N redundant card configuration, consider the following guidelines:

- A single line (transmit and receive) should be attached to the connectors for each line. Y-cables, which are introduced earlier for 1:1 redundant card installations, should not be installed.
- For 1:N redundant card configuration without bulk distribution, the redundant card set must be established according to the guidelines in “[1:N Redundancy without Bulk Distribution](#),” which appears earlier in this chapter.
- For 1:N redundant card configuration with bulk distribution, the redundant card set must be established according to the guidelines in “[1:N Redundancy with Bulk Distribution](#),” which appears earlier in this chapter.
- When bulk distribution is used on the card hosting the standalone line, the line is standalone from the service module to the SRM card. This is a single physical connection over the switch backplane. However, when the standalone line reaches the SRM, the SRME and SRME/B can be configured for redundant lines, if redundant SRMs are used with SONET, SDH, or STM-1 interfaces. When the SRME or SRME/B is configured for redundant lines, all cards that use bulk distribution through that card pair have redundant line protection. For more information, see “[Redundant Line Configuration Guidelines](#),” which appears later in this chapter.

1:N Redundant RPM Configurations

The method you use for connecting multiple RPMs to a single network will depend on the back card type. For example, if you are configuring two RPM-PRs for 1:N redundant operation over a connection to a single Ethernet 10/100 network, you would directly connect the corresponding ports or lines to a hub on that network. You would not use a Y-cable.

For more information on preparing RPM cards for 1:N redundancy, refer to *Cisco MGX Route Processor Module (RPM-PR) Installation and Configuration Guide*.

Redundant Line Configuration Guidelines

Redundant line configurations extend fault tolerance to individual lines. As with redundant cards, redundant lines operate as a pair. If one line fails, the other line in the redundant pair takes over.

Cisco MGX 8850 switches use Automatic Protection Switching (APS) to provide line fault tolerance. APS is a component of SONET and is therefore available only on optical interfaces and STM-1 interfaces (which are the electrical equivalent of SONET OC-3). [Table 4-1](#) lists all the card types and shows which cards support APS.



Note

Redundant lines (APS) are not supported on T1 and E1 cards. However, SRME and SRME/B can indirectly provide redundant line protection to T1 and to E1 lines when the hosting service modules are configured for bulk distribution through a redundant SRM card set. For more information, see “[Inter-card APS Configurations](#),” which appears later in this chapter.

The switch installation determines whether the switch can support APS, but APS does not operate until it is enabled and configured. When planning for APS, the hardware preparation includes:

- Placing front cards in the appropriate slots to support the planned APS configuration.
- Installing an APS connector if required.

- Cabling working and protection lines so that the role of each line is the same at both ends of the line.

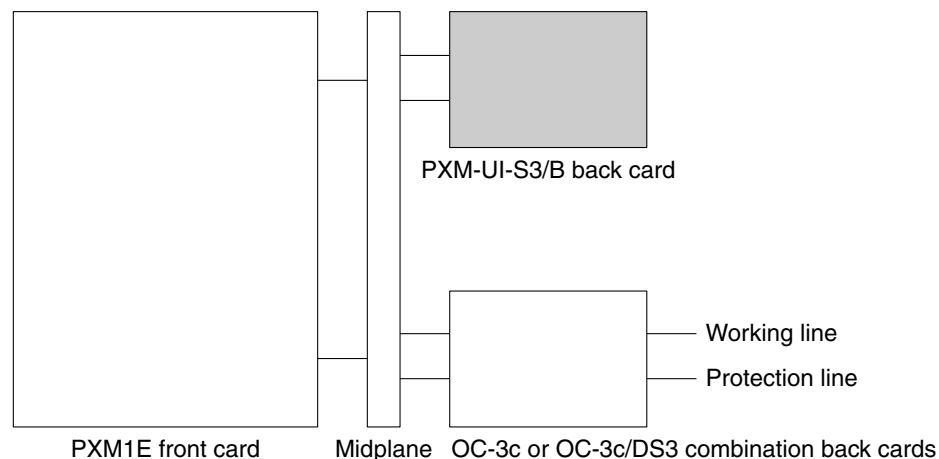
When APS is enabled and configured, the configuration must define a *working line* and a *protection line* for each redundant line pair. The working line is the primary or preferred line, and communications take place over that line as long as the line remains operative. If a failure occurs on the working line, APS initiates a switchover to the protection line. For proper APS operation between two switches a working line on one switch must also be the working line on the other switch, and the same applies to the protection line. Most service modules have specific requirements for which lines can host working lines and which can host protection lines, so proper hardware installation is required before the switch can be configured to support APS.

Cisco MGX 8850 switches support two types of APS: intracard APS and intercard APS. The following subsections describe these two APS options and provide guidelines for preparing for APS configurations.

Intracard APS Configurations

Intracard APS configurations are created with the working and protection lines on the same back card or in the same back card set. As shown in [Figure 4-7](#), intracard APS makes it possible to have redundant line protection for a standalone card configuration.

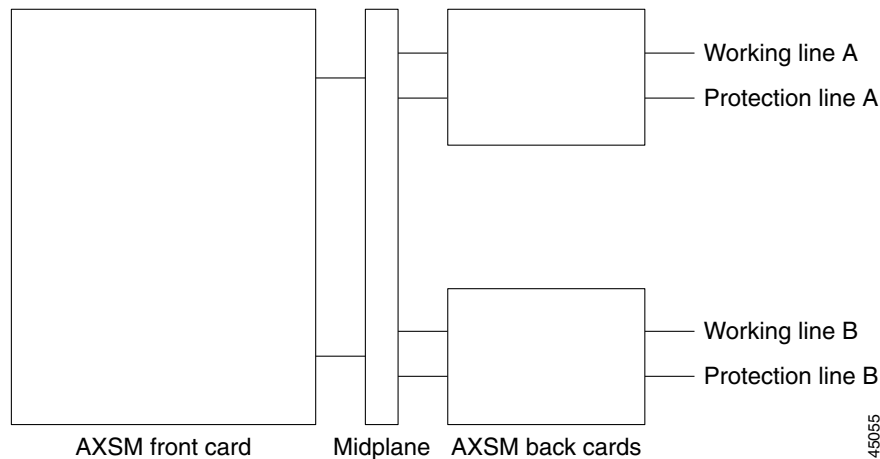
Figure 4-7 Standalone PXM1E with Intracard APS



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Figure 4-8 shows how a standalone AXSM connects to redundant lines.

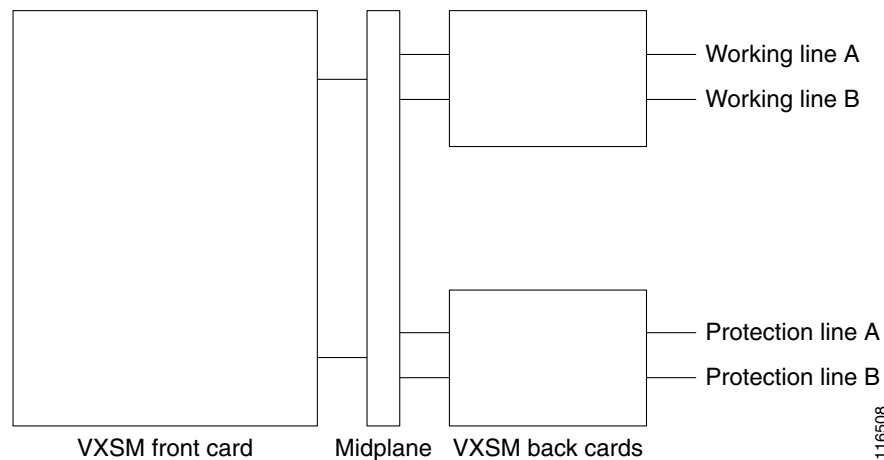
Figure 4-8 Standalone AXSM with Intracard APS



Because the front cards are far more complex and expensive than the back cards, intracard APS is not practical for most 1:1 redundant card installations. The use of intracard APS for most service modules cuts the available port count in half.

The exception to the above rule is the VXSM-4-155, which uses two 4-port back cards to double its port count. When intracard APS is used with VXSM-4-155, all four ports can be configured for intracard APS without cutting the port count. Figure 4-9 shows how a standalone VXSM connects to redundant lines.

Figure 4-9 Standalone VXSM with Intracard APS



When planning an intracard APS configuration, consider the following requirements:

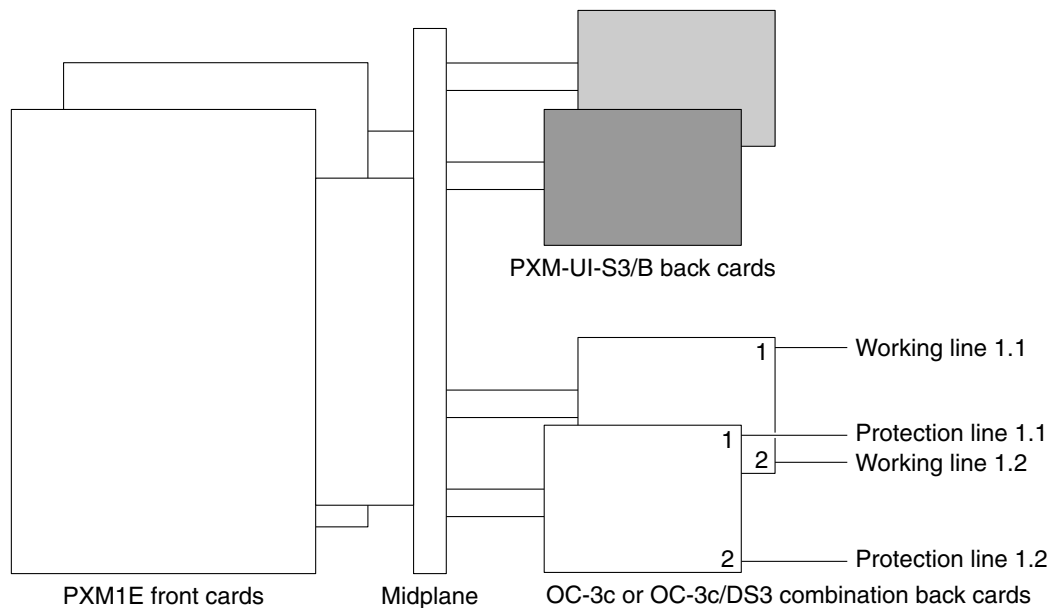
- Not all cards support intracard APS. Table 4-1 lists all the card types and specifies which cards support intracard APS.
- For all cards except VXSM-4-155, the working line and the protection line must connect to adjacent ports on the same back card.

- For VXSM-4-155 cards, the working line connects to a port on the upper bay back card and the protection line connects to the corresponding port on the lower bay back card. For example, if port 2 is configured for intracard APS, the working line is connected to port 2 in the upper bay and the protection line is connected to port 2 in the lower bay.
- For all cards except VXSM-4-155, the working line must be assigned to an odd-numbered port. For example, the working line could be line 1 and the protection line could be line 2.
- For all cards except VXSM-4-155, the working line must be assigned to a lower numbered port than the protection line. For example, the working line could be on port 3 and the protection line on port 4. If the protection line is on port 2, do not assign the working line to port 3.
- The switches at both ends of the APS lines must be configured for APS, and the role of each line (working or protection) must be the same at both ends of the line.
- Slot 4 in the MGX 8880 uses redundancy back cards that connect the front card in slot 4 to any back cards in slot 3. Because slot 4 cannot support intracard APS on its own, it is recommended that you use slot 3 and not slot 4 for standalone card operation with intracard APS, or, that you use 1:1 card redundancy in slots 3 and 4 with intracard APS as described in the next section.
- Because the AXSM-1-2488, AXSM-1-9953-XG, and SRME cards have only one port on their back cards, they cannot be configured for intracard APS operation. They can be configured for intercard APS, which is described later in this chapter. This also applies to SRME/B cards that use SONET or SDH interfaces.

Intercard APS Configurations

Intercard APS configurations are created with the working and protection lines on different back cards. As shown in [Figure 4-10](#), intercard APS makes it possible to extend the fault tolerance provided by redundant front cards to back cards and lines.

Figure 4-10 Redundant PXM1E Configuration with Intercard APS



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Back card and line fault tolerance is provided by intercard APS. If the working line or the back card to which it is connected fails, communications traffic is rerouted through the protection line and the back card to which it is connected.

Figure 4-11 shows how a redundant AXSM card set uses intercard APS.

Figure 4-11 Redundant AXSM Configuration with Intercard APS

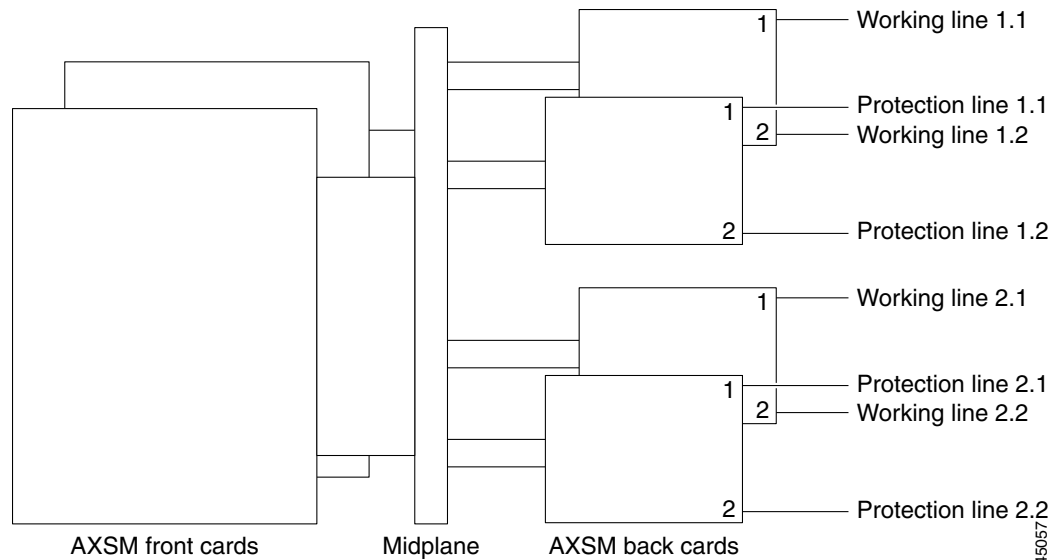
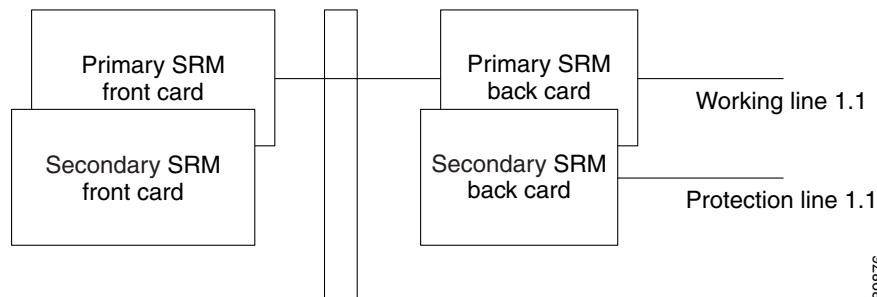


Figure 4-12 shows redundant SRMEs using intercard APS.

Figure 4-12 Redundant SRMEs with Intercard APS



When planning a redundant line configuration that uses intercard APS, consider the following requirements:

- Not all cards support intercard APS. [Table 4-1](#) lists all the card types and specifies which cards support intercard APS.
- Card redundancy must be configured or verified as described in “[1:1 Redundant Card Configuration Guidelines](#),” which appears earlier in this chapter.
- Some PXM1E back card types require an APS mini-backplane to support intercard APS. The PXM1E APS mini-backplane requirements are listed in [Table 4-4](#).
- Redundant AXSM, MPSM, and VXSM cards must be installed in adjacent slots to support intercard APS.

- Some service module back card types require an APS mini-backplane to support intercard APS. The APS mini-backplane requirements are listed in [Table 4-4](#).
- On an MGX 8880 Media Gateway, slots 3 and 4 do not support intercard APS.
- When used with SONET or SDH interfaces, the SRME/B provides the same APS support as the SRME.
- Redundant SRME and SRME/B back cards must be joined together with the APS mini-backplane. The SRME APS mini-backplane requirements are listed in [Table 4-4](#).
- The working line must be defined on the primary card, and the protection line must be defined on the secondary card. The primary and secondary cards are predefined for PXM1E and SRM, and are defined during configuration for AXSM, MPSM, and VXSM.
- The working line and protection line numbers must be identical for intercard APS configurations. For example, you can assign the working line to line 9 on a primary PXM1E-COMBO card and the protection line to line 9 on a secondary card. You cannot assign the working line to line 9 on one card and the protection line to line 10 on the other.
- The switches at both ends of the APS lines must be configured for APS, and the role of each line (working or protection) must be the same at both ends of the line.

[Table 4-4](#) describes the APS connector requirements for intercard APS.

Table 4-4 APS Connector Options and Requirements

Front Card Type	MGX 8830 APS Options ¹	MGX 8850 APS Options ¹	MGX 8880 APS Options	MGX 8950 APS Options
AXSM/A Cards (labeled AXSM)				
AXSM-1-2488	—	Slots 1–6, 9–14: MGX-8850-APS-CON MGX-APS-CON ²	—	—
AXSM-4-622				
AXSM-16-155				
AXSM/B Cards				
AXSM-1-2488/B	—	Slots 1–6, 9–14: MGX-8850-APS-CON MGX-APS-CON ²	Slots 1, 2, 5, and 6: APS connector built in.	Slots 1-6, 11-16: MGX-APS-CON-8950
AXSM-4-622/B			Slots 3 and 4: No intercard APS.	
AXSM-16-155/B			Slots 9–14: MGX-8850-APS-CON MGX-APS-CON	
AXSM-E Cards				
AXSM-2-622-E	—	Slots 1–6, 9–14: MGX-8850-APS-CON MGX-APS-CON ²	Slots 1, 2, 5, and 6: APS connector built in.	—
AXSM-8-155-E			Slots 3 and 4: No intercard APS.	

Table 4-4 APS Connector Options and Requirements (continued)

Front Card Type	MGX 8830 APS Options ¹	MGX 8850 APS Options ¹	MGX 8880 APS Options	MGX 8950 APS Options
AXSM-XG Cards				
AXSM-1-9953-XG	—	—	—	Slots 1-6, 11-16: APS connector built in.
AXSM-4-2488-XG	—	—	—	Slots 1-6, 11-16: APS connector built in.
AXSM-8-622-XG	Slots 3-6, 10-13: MGX-8830-APS-CON	Slots 1-6, 9-14: MGX-8850-APS-CON MGX-APS-CON ²	—	Slots 1-6, 11-16: MGX-APS-CON-8950
AXSM-16-155-XG				
MPSM-T3E3-155	Slots 3-6, 10-13: MGX-8830-APS-CON	Slots 1-6, 9-14, 17-22, 25-30: MGX-8850-APS-CON	—	—
PXM1E-4-155	Slots 1 and 2: MGX-8830-APS-CON	Slots 7 and 8 ³ : MGX-8850-APS-CON MGX-APS-CON ⁴	—	—
PXM1E-8-155	Slots 1 and 2: MGX-8830-APS-CON	Slots 7 and 8: MGX-8850-APS-CON MGX-APS-CON ⁴	—	—
PXM1E-COMBO	Slots 1 and 2: APS connector built in.	Slots 7 and 8: APS connector built in.	—	—
SRME	Slots 7 and 14: MGX-8850-APS-CON	Slots 15,16, 31, 32: MGX-8850-APS-CON	Slots 15,16, 31, 32: MGX-8850-APS-CON	—
SRME/B ⁵	Slots 7 and 14: MGX-8850-APS-CON	Slots 15,16, 31, 32: MGX-8850-APS-CON	Slots 15,16, 31, 32: MGX-8850-APS-CON	—
VXSM-4-155	—	Slots 1-6, 9-14: MGX-8850-APS-CON MGX-APS-CON ²	Slots 1, 2, 5, and 6: APS connector built in. Slots 3 and 4: No intercard APS. Slots 9-14: MGX-8850-APS-CON MGX-APS-CON	—

1. MGX 8850/B and 8830/B slots can use an APS-CON only if no RCON is installed.
2. MGX-APS-CON is not supported in the MGX 8850/B chassis. Use the MGX-8850-APS-CON connector instead.
3. MGX 8850 (PXM1E) switches do not require an APS mini-backplane to support intercard APS for PXM1E-4-155. However, Cisco recommends that you install an APS connectors on PXM1E-4-155 cards to facilitate future upgrades to the PXM1E-8-155.
4. The MGX-APS-CON connector is not supported for use with PXM1E. Use the MGX-8850-APS-CON connector instead.
5. APS connector supported only for the MGX-SMFIR-1-155 and MGX-STM1-EL-1 back cards.

Planning for Bulk Distribution

Bulk distribution is a feature that uses an SRM card to multiplex T1 or E1 traffic from selected service modules and transmit that traffic over higher speed back cards connected to the SRM. Multiplexed traffic received at the SRM cards is distributed to the individual service modules. The primary feature of bulk

distribution is that it enables a switch to use fewer T3 or OC-3 lines instead of many T1 or E1 lines. A secondary benefit is that SRME and SRME/B cards can provide line redundancy to cards that otherwise could not use that feature.

When planning for bulk distribution, consider the following guidelines:

- Bulk distribution works with T1 and E1 service modules. Refer to [Table 4-1](#) to see which service modules support bulk distribution.
- When a service module is configured to use bulk distribution, this service is applied to all lines on the service module and no back cards are required.
- A standalone SRM installation should be installed according to the guidelines in “[Standalone Card Configuration Guidelines](#),” which appears earlier in this chapter.
- A redundant SRM installation should be installed according to the guidelines in “[1:1 Redundant Card Configuration Guidelines](#),” which appears earlier in this chapter.
- A standalone service module installation that uses bulk distribution should be installed according to the guidelines in “[Standalone Card Configuration Guidelines](#),” which appears earlier in this chapter.
- A redundant service module installation that uses bulk distribution should be installed according to the guidelines in “[1:N Redundant Card Configuration Guidelines \(Except RPM\)](#),” which appears earlier in this chapter.
- A standalone or redundant SRM-3T3/C configuration can support up to 80 T1 channels, each of which supports a service module T1 port. These channels can be divided between up to 10 card slots per bay.
- A standalone or redundant SRME/B with a BNC-3T3-M back card can support up to 84 T1 channels, each of which supports a service module T1 port. These channels can be divided between up to 11 card slots per bay.
- The maximum number of E1 channels is 63, each of which supports a service module E1 port. These channels can be divided between up to 8 card slots per bay.
- A standalone or redundant SRME or SRME/B SONET/SDH configuration can support up to 84 T1 channels or 63 E1 channels per bay, and these channels can be divided between all 12 card slots in the bay.

Planning for Advanced Software Features

Inverse Multiplexing over ATM (IMA) Configurations—MGX 8830, MGX 8850 (PXM45), and MGX 8850 (PXM1E)

The PXM1E-16-T1E1 and AXSM-32-T1E1-E cards support *inverse multiplexing over ATM* (IMA) into a single, higher-speed logical ATM port. The IMA feature enables multiple T1 or E1 lines to be grouped into a single high-speed ATM port.

**Note**

The PXM1E-16-T1E1 card is used in MGX 8830 and MGX 8850 (PXM45) switches; the AXSM-32-T1E1-E card is used in MGX 8850 (PXM45) switches.

This feature does not apply to MGX 8950.

The advantage of the IMA feature is that you do not need T3/E3 circuits to support high bandwidth on your switch. T1 IMA supports up to 16 1.544-Mbps links, and E1 IMA supports up to 16 2.048-Mbps links.

Here are some IMA characteristics:

- Is ATM Forum 1.0- and 1.1-compliant.
- Supports differential delays of up to 200 milliseconds (ms) across T1s and up to 250 ms across E1s in an IMA group.
- Configures each T1 or E1 interface as a single port running at full line rate when IMA is disabled.
- Any group of n x T1s or n x E1s can support an n x T1 or n x E1 port when IMA is enabled.
- When enabled, can have multiple IMA ports of any configuration supported per card. (A specific T1 or E1 line can be in only one T1/E1 or IMA port at a time.)

When a T1/E1 circuit fails, an IMA port automatically adjusts to continue operation over the remaining circuits. You can also configure the minimum number of T1/E1 links, which allows the IMA group to continue operating when individual T1/E1 link failures occur.

**Note**

To configure switches for IMA, the only hardware requirement is that all lines in a group must be set up between the same two cards on a pair of switches. Beyond that, all IMA configuration is done in the software.

To configure the software for IMA or other configurations in this section, refer to the *Cisco MGX 8800/8900 Series Configuration Guide, Release 5.2* for details.