ASR 9900系列交换矩阵说明和故障排除示例

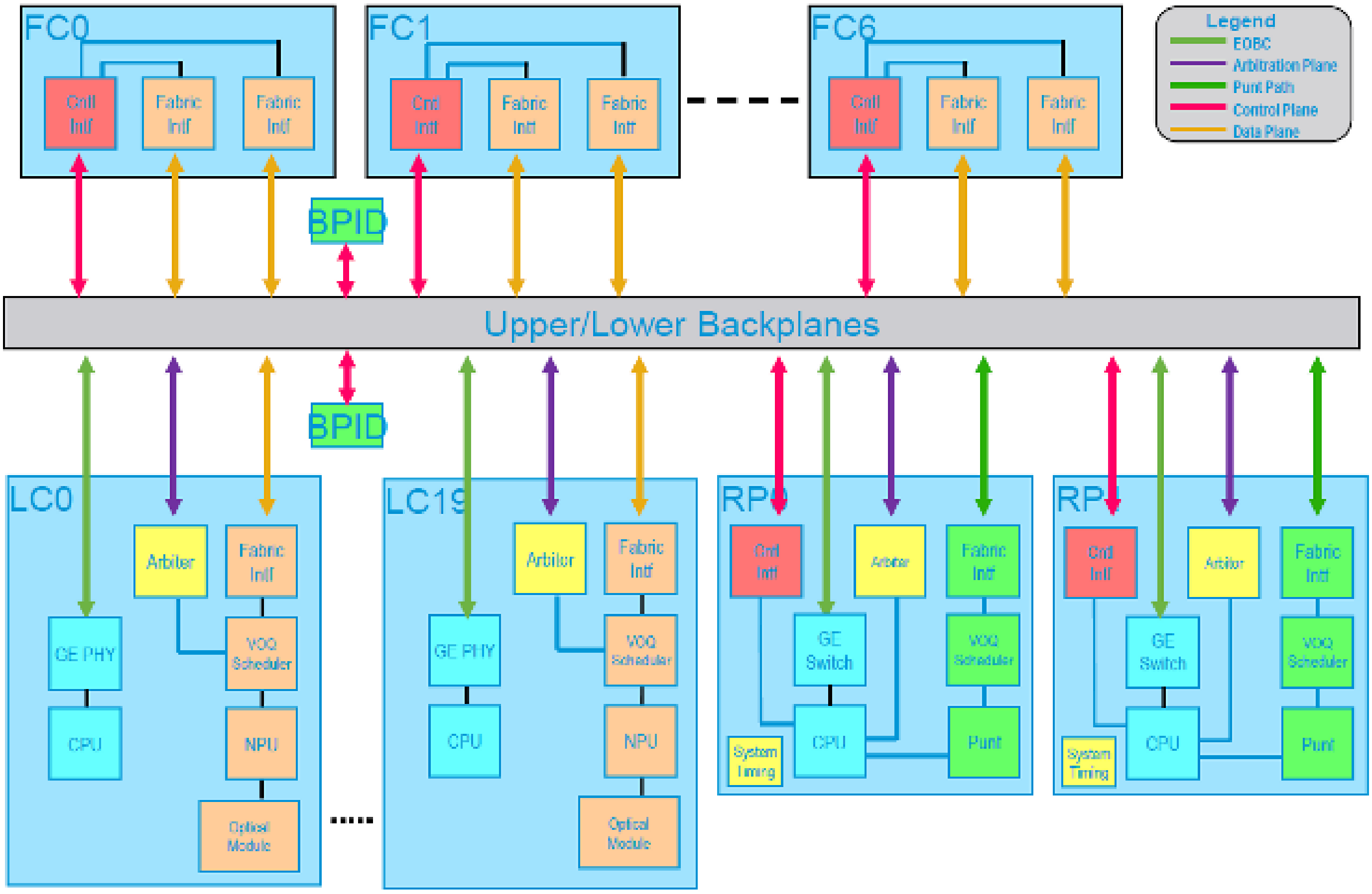
目录

简介

本文档介绍如何在ASR 9922和ASR 9912中使用单独的交换矩阵卡，类似于思科运营商级路由系统(CRS)实施的交换矩阵架构。

思科的ASR 9000(ASR9K)采用三阶段交换矩阵系统。在其他机箱类型（例如，9006和9010）中，三阶段交换矩阵在线卡(LC)上分为第一阶段和第三阶段，在路由交换机处理器(RSP)上分为第二阶段。随着9922和9912的出现，交换矩阵的第二阶段已从RSP移至专用交换矩阵卡，并且使用路由处理器(RP)卡代替RSP。

每个交换矩阵卡(FC)都有自己的主干。这些术语可以互换使用，也可用于CRS术语中使用的术语“平面”。下面是系统的高级视图，交叉开关标记为“交换矩阵接口”。



交换矩阵概述

每个FC具有两个交换矩阵ASIC（通常称为交叉开关ASIC），它们映射为实例0和1，而每个LC和RP具有一个交叉开关接口（实例0）。

在每个LC上，有两个串行器/反序列器(SerDes)接口连接到每个FC，每个FC交叉开关一个SerDes接口（0和1）。这些FC交叉开关用作三级交换矩阵中的第二级，而第一级和第三级则作为LC的交叉开关存在。此外，每个RP的每个FC都有一个SerDes接口，此连接始终位于FC交叉开关实例0上。

交换矩阵详细信息

网络处理器(NP)和交换矩阵接口ASIC(FIA)与交叉开关链路上的调度无关，流量在组成SerDes接口的所有八个链路上实现负载均衡。如果SerDes接口内的单个链路出现问题，则整个接口将关闭。检测到此故障时，交换矩阵驱动程序会发出重新训练以尝试修复链路。

台风

在当前台风架构下，支持五个FC。这些卡提供每个SerDes接口8x7.5 G链路，这等于在编码计算后可用带宽为55 G。对于所有五个FC，每个LC将有2x55x5 = 550 Gbps的可用带宽。当计算出4+1交换矩阵冗余时，每个LC提供440 Gbps的可用带宽。

> **注意**：在带RSP-440和Typhoon LC的9000系列机箱中，每个RSP有4x8x7.5 G链路，另外还有两条链路。来自每个RSP的四个链路提供每个LC可用的全部440 Gbps。

战斧

下一代卡支持115 Gbps SerDes连接。由于增加了对7个交换矩阵卡的支持，因此每个插槽可提供2x115x7 = 1.61 Tbps的带宽。为6+1交换矩阵冗余计算，这为每个插槽提供1.38 Tbps。

交换矩阵卡要求

由于交叉开关上的带宽由所有FIA和NP共享，因此需要进行一些计算才能确定真正的带宽和交换矩阵冗余。

要计算特定LC所需的最小FC数量，请使用以下公式：

(num_ports_used*port_bandwidth)/(FC_bandwidth)

对于具有30个端口的36x10 GigE卡，此值是(30*10)/(110)=2.72 FC，或四舍五入三个FC。

要计算n+1冗余，请使用以下公式：

(num_ports_used*port_bandwidth)/(FC_bandwidth)+ 1

对于36x10 GigE卡，如果使用全部36个端口，则为5。

此表概述了全线速率所需的FC数量。

LC类型	最小值.机箱中所需的FC	n+1冗余所需的光纤通道数量
A9K-MOD80	1	2
A9K-MOD160	2	3
A9K-2x100GE	2	3
A9K-24x10GE	3	4
A9K-36x10GE	4	5

检查交换矩阵卡

交叉开关链路状态

首先要检查的是所有平面(FC)上的所有SerDes链路是否都已启用。要检查这一点，请输入**show controller fabric plane [all | [0-6]]**命令。在本示例中，由于有两个RP和三个LC，因此有(1x2)+(2x3)= 8条链路，并且所有链路都连接到所有平面。

> **注意**：在4.3.0及更高版本中，可以同时检查所有平面的状态。以前，必须逐一指定每个选项。

```
RP/0/RP1/CPU0:ASR9922-B#show platform
Tue Apr 15 14:24:00.935 UTC
Node              Type                      State            Config State
-----------------------------------------------------------------------------
```

```
0/RP0/CPU0       ASR-9922-RP-SE(Standby)   IOS XR RUN        PWR,NSHUT,MON
0/RP1/CPU0       ASR-9922-RP-SE(Active)    IOS XR RUN        PWR,NSHUT,MON
0/0/CPU0         A9K-2x100GE-SE            IOS XR RUN        PWR,NSHUT,MON
0/2/CPU0         A9K-36x10GE-SE            IOS XR RUN        PWR,NSHUT,MON
0/3/CPU0         A9K-MOD160-TR             IOS XR RUN        PWR,NSHUT,MON
0/3/1            A9K-MPA-4X10GE            OK                PWR,NSHUT,MON
```

```
RP/0/RP1/CPU0:ASR9922-B#show controller fabric plane all
Mon Apr 14 14:37:00.116 UTC
Flags: Admin State: 1-Up 2-Down 12-UnPowered 16-Shutdown
      Oper  State: 1-Up 2-Down 3-Admin Down
Summary for All Fabric Planes:
Plane Id Admin State Oper State  Links Up Links Down In Pkt Count  Out Pkt count
====================================================================================
0             01            01      08          00         346770           431250
1             01            01      08          00         44397             44397
2             01            01      08          00         44459             44459
3             01            01      08          00         94005             94005
4             01            01      08          00         73814             73814
```

如果链路显示为关闭状态，可以使用命令**show controller fabric crossbar link-status instance <0-1> spine <FC_num>**准确识别哪个链路。在本示例中，有五个交叉开关链路通向FC4实例0，三个链路通向FC4实例1(5+3=8 from before)。由于RP的原因，实例0上还有两个实例。

> **注意**：有关逻辑到物理插槽映射的详细信息，请参阅附录。

```
RP/0/RP1/CPU0:ASR9922-B#show controllers fabric crossbar link-status instance 0 spine 4
Fri Apr 18 18:08:31.953 UTC
PORT     Remote Slot  Remote Inst    Logical ID  Status
======================================================
01         05               00              0          Up
04         04               00              0          Up
05         02               00              0          Up
08         00               00              0          Up
09         01               00              0          Up
```

```
RP/0/RP1/CPU0:ASR9922-B#show controllers fabric crossbar link-status instance 1 spine 4
Fri Apr 18 18:09:13.637 UTC
PORT     Remote Slot  Remote Inst    Logical ID  Status
======================================================
00         05               00              0          Up
04         04               00              0          Up
05         02               00              0          Up
```

交叉开关统计信息

使用在先前输出中收集的链路状态作为映射和这些统计信息，可以轻松缩小存在流量问题的任何组件的范围。对于每个交叉开关端口（SerDes接口），都会有入口（来自LC）和出口（指向LC）统计信息。按FC交叉开关实例收集这些数据。

```
RP/0/RP1/CPU0:ASR9922-B#show controller fabric crossbar statistics instance 0 spine 4
Tue Apr 22 16:52:23.162 UTC
Port statistics for xbar:0 port:0
==============================
Hi priority stats (unicast)
```

```
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:1
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 14016
   Egress Packet Count Since Last Read        : 24971

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:2
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:4
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 21056
   Egress Packet Count Since Last Read        : 32195

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:5
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 7024
   Egress Packet Count Since Last Read        : 10477

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:6
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:7
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:8
==============================
Hi priority stats (unicast)
===========================
```

```
Low priority stats (multicast)
===========================
   Ingress Packet Count Since Last Read       : 37388
   Egress Packet Count Since Last Read        : 37388

Port statistics for xbar:0 port:9
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 72882
   Egress Packet Count Since Last Read        : 47335

Low priority stats (multicast)
===========================
   Ingress Packet Count Since Last Read       : 37386
   Egress Packet Count Since Last Read        : 37386

Port statistics for xbar:0 port:10
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:11
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:12
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:13
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:14
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:15
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================
```

```
Port statistics for xbar:0 port:16
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:17
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:18
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:19
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:20
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:22
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:24
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================


Total Unicast In:    114978
Total Unicast Out:   114978
Total Multicast In:  74774
Total Multicast Out: 74774
```

检查线路卡

在LC本身上，交叉开关和每个FIA之间有2x8x6.25链路，每个FIA提供100 G的原始带宽。每个NP和FIA之间有一个8x6.25链路，每个NP提供50 G的原始带宽。

> **注**：参考的带宽是原始带宽。考虑开销后，实际带宽略低。

交叉开关链路状态

LC的纵横式链路状态的集合与FC的类似，但在本例中，可以看到从FC纵横式到LC纵横式链路的链路，以及从LC纵横式到FIA链路的链路。如前所述，每个FIA通过两条链路连接到交叉开关。在本示例中，端口00和24都连接到FIA 2。与前面的示例一样，远程插槽22-26是FC，0/2/CPU0与插槽4本身对应。

```
RP/0/RP1/CPU0:ASR9922-B#show controller fabric crossbar link-status inst 0 loc 0/2/CPU0
Wed Apr 23 14:22:42.250 UTC
PORT    Remote Slot  Remote Inst    Logical ID  Status
======================================================
00        04               02              1        Up
01        04               01              1        Up
02        04               01              0        Up
03        04               00              0        Up
04        04               00              1        Up
05        04               03              1        Up
06        04               05              1        Up
07        25               01              0        Up
08        04               03              0        Up
09        25               00              0        Up
10        04               05              0        Up
11        26               01              0        Up
12        26               00              0        Up
14        24               00              0        Up
15        24               01              0        Up
16        23               00              0        Up
17        23               01              0        Up
20        22               00              0        Up
22        22               01              0        Up
23        04               04              1        Up
24        04               02              0        Up
25        04               04              0        Up
```

交叉开关统计信息

使用在先前输出中收集的链路状态作为参考映射，可以使用以下统计信息输出作为缩小存在流量丢失的所有组件的范围的简单方法。

```
RP/0/RP1/CPU0:ASR9922-B#show controller fabric crossbar statistics instance 0 loc 0/2/CPU0
Wed Apr 23 15:53:41.955 UTC
Port statistics for xbar:0 port:0
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15578
```

```
   Egress Packet Count Since Last Read        : 11957

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:1
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15775
   Egress Packet Count Since Last Read        : 11647

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:2
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15646
   Egress Packet Count Since Last Read        : 19774

Low priority stats (multicast)
===========================
   Ingress Packet Count Since Last Read       : 31424
   Egress Packet Count Since Last Read        : 188544

Port statistics for xbar:0 port:3
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15663
   Egress Packet Count Since Last Read        : 15613

Low priority stats (multicast)
===========================
   Ingress Packet Count Since Last Read       : 31424
   Egress Packet Count Since Last Read        : 188547

Port statistics for xbar:0 port:4
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15758
   Egress Packet Count Since Last Read        : 15813

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:5
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15742
   Egress Packet Count Since Last Read        : 15628

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:6
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15773
```

```
   Egress Packet Count Since Last Read        : 13687

Low priority stats (multicast)
===========================
   Ingress Packet Count Since Last Read       : 78666

Port statistics for xbar:0 port:7
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:8
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15679
   Egress Packet Count Since Last Read        : 15793

Low priority stats (multicast)
===========================
   Ingress Packet Count Since Last Read       : 31424
   Egress Packet Count Since Last Read        : 188544

Port statistics for xbar:0 port:9
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 72826
   Egress Packet Count Since Last Read        : 58810

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:10
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15653
   Egress Packet Count Since Last Read        : 23041

Low priority stats (multicast)
===========================
   Egress Packet Count Since Last Read        : 188544

Port statistics for xbar:0 port:11
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:12
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 54172
   Egress Packet Count Since Last Read        : 35440

Low priority stats (multicast)
===========================
```

```
Port statistics for xbar:0 port:14
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15161
   Egress Packet Count Since Last Read        : 17790

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:15
==============================
Hi priority stats (unicast)
===========================

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:16
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15220
   Egress Packet Count Since Last Read        : 17790

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:17
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 1
   Egress Packet Count Since Last Read        : 1

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:20
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 36457
   Egress Packet Count Since Last Read        : 58699

Low priority stats (multicast)
===========================
   Ingress Packet Count Since Last Read       : 188549
   NULL FPOE Drop Count                       : 2
   Egress Packet Count Since Last Read        : 235786

Port statistics for xbar:0 port:22
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 1
   Egress Packet Count Since Last Read        : 1

Low priority stats (multicast)
===========================

Port statistics for xbar:0 port:23
==============================
```

```
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15775
   Egress Packet Count Since Last Read        : 15835

Low priority stats (multicast)
===========================
   Ingress Packet Count Since Last Read       : 31424

Port statistics for xbar:0 port:24
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15843
   Egress Packet Count Since Last Read        : 19464

Low priority stats (multicast)
===========================
   Ingress Packet Count Since Last Read       : 31424
   Egress Packet Count Since Last Read        : 188544

Port statistics for xbar:0 port:25
==============================
Hi priority stats (unicast)
===========================
   Ingress Packet Count Since Last Read       : 15646
   Egress Packet Count Since Last Read        : 15586

Low priority stats (multicast)
===========================
   Egress Packet Count Since Last Read        : 188544


Total Unicast In:    382369
Total Unicast Out:   382369
Total Multicast In:  424335
Total Multicast Out: 1367053
```

故障排除

Crossbar端口关闭

第一个输出表示有两个RP和两个LC。第二个输出表明从FC4到远程插槽0(RP0)的链路已关闭。

```
RP/0/RP0/CPU0:ASR9k-1#show controllers fabric plane all

Plane Id Admin State  Oper State    Links Up  Links Down  In Pkt Count   Out Pkt count
==============================================================================================
0           01           01            06         00        62266063301    62266209776
1           01           01            06         00         18730254608    18730254616
2           01           01            06         00         18730354183    18730354187
3           01           01            06         00         62257126982    62257127007
4           01           01            05         01         37448788006    37448788023

RP/0/RP0/CPU0:ASR9k-1#show controllers fabric crossbar link-status instance 0 spine 4
PORT    Remote Slot  Remote Inst    Logical ID  Status
======================================================
```

```
04          04                00              0           Up
08          00                00              0           Down
09          01                00              0           Up
10          03                00              0           Up
```

由于当交叉开关链路断开时，来自FC的带宽在LC上的所有FIA和NP之间共享，因此在Typhoon系统中，LC的净带宽将减少55 G。系统可以在链路中断的情况下运行，但应立即进行调查。

当交叉开关链路断开时，可能会出现短暂的流量下降，交换矩阵驱动程序会重新训练链路以尝试自动恢复。如果此操作失败，则联机插入和删除(OIR)也可能会恢复此问题。有关任何其他问题，请联系技术支持中心(TAC)。

主干不可用的系统日志

这些消息表明系统运行在建议的五个FC之下。虽然建议始终运行五个FC，但这并不一定意味着系统中LC的任何带宽损失。有关详细信息，请参阅交换矩阵卡要求部分。

```
RP/0/RP1/CPU0:May 13 14:42:22.810 : pfm_node_rp[353]:
%PLATFORM-FABMGR-1-SPINE_UNAVAILABLE : Set|fabmgr[303204]|Fabric Manager(0x1032000)|
Number of active spines has dropped below the recommended number 5

RP/0/RP1/CPU0:May 13 14:53:18.897 : pfm_node_rp[353]:
%PLATFORM-FABMGR-1-SPINE_UNAVAILABLE : Clear|fabmgr[303204]|Fabric Manager(0x1032000)|
Number of active spines has dropped below the recommended number 5
```

FC非活动系统日志

执行FC的OIR时，必须按下两个机械按钮，然后卡才会部分掉位，这需要OIR才能恢复。这些按钮是为了允许FC正常关闭。

在9922路由器上，顶部按钮完全是机械式的，而下部按钮向系统发送信号以正常关闭卡。可以看到此格式的系统日志。如果未按下按钮，并且OIR未解决问题，请联系TAC。

```
RP/0/RP0/CPU0:Dec 24 10:45:27.108 MST: fab_xbar_sp3[220]: FC3 Inactive due to
Front Panel Switch Press. Please OIR to recover.
```

相关信息

- **ASR9000/XR了解A9K中的交换矩阵问题并对其进行故障排除**
- **技术支持和文档 - Cisco Systems**

Appendix

逻辑到物理插槽的映射

这些输出是9922和9912路由器的逻辑插槽到物理插槽的映射。查看fabric show命令时需要此信息。

9922

```
slot 00 -> 0/RP0/CPU0 (0x1)
slot 01 -> 0/RP1/CPU0 (0x11)
slot 02 -> 0/0/CPU0 (0x821)
slot 03 -> 0/1/CPU0 (0x831)
slot 04 -> 0/2/CPU0 (0x841)
slot 05 -> 0/3/CPU0 (0x851)
slot 06 -> 0/4/CPU0 (0x861)
slot 07 -> 0/5/CPU0 (0x871)
slot 08 -> 0/6/CPU0 (0x881)
slot 09 -> 0/7/CPU0 (0x891)
slot 10 -> 0/8/CPU0 (0x8a1)
slot 11 -> 0/9/CPU0 (0x8b1)
slot 12 -> 0/10/CPU0 (0x8c1)
slot 13 -> 0/11/CPU0 (0x8d1)
slot 14 -> 0/12/CPU0 (0x8e1)
slot 15 -> 0/13/CPU0 (0x8f1)
slot 16 -> 0/14/CPU0 (0x901)
slot 17 -> 0/15/CPU0 (0x911)
slot 18 -> 0/16/CPU0 (0x921)
slot 19 -> 0/17/CPU0 (0x931)
slot 20 -> 0/18/CPU0 (0x941)
slot 21 -> 0/19/CPU0 (0x951)
slot 22 -> 0/FC0/SP (0x1960)
slot 23 -> 0/FC1/SP (0x1970)
slot 24 -> 0/FC2/SP (0x1980)
slot 25 -> 0/FC3/SP (0x1990)
slot 26 -> 0/FC4/SP (0x19a0)
slot 27 -> 0/FC5/SP (0x19b0)
slot 28 -> 0/FC6/SP (0x19c0)
slot 34 -> 0/BPID0/SP (0x1220)
slot 35 -> 0/BPID1/SP (0x1230)
slot 36 -> 0/FT0/SP (0x640)
slot 37 -> 0/FT1/SP (0x650)
slot 38 -> 0/FT2/SP (0x660)
slot 39 -> 0/FT3/SP (0x670)
slot 40 -> 0/PM0/SP (0xe80)
slot 41 -> 0/PM1/SP (0xe90)
slot 42 -> 0/PM2/SP (0xea0)
slot 43 -> 0/PM3/SP (0xeb0)
slot 44 -> 0/PM4/SP (0xec0)
slot 45 -> 0/PM5/SP (0xed0)
slot 46 -> 0/PM6/SP (0xee0)
slot 47 -> 0/PM7/SP (0xef0)
slot 48 -> 0/PM8/SP (0xf00)
slot 49 -> 0/PM9/SP (0xf10)
slot 50 -> 0/PM10/SP (0xf20)
slot 51 -> 0/PM11/SP (0xf30)
slot 52 -> 0/PM12/SP (0xf40)
slot 53 -> 0/PM13/SP (0xf50)
slot 54 -> 0/PM14/SP (0xf60)
slot 55 -> 0/PM15/SP (0xf70)
```

9912

```
slot 00 -> 0/RP0/CPU0 (0x1)
slot 01 -> 0/RP1/CPU0 (0x11)
slot 02 -> 0/0/CPU0 (0x821)
slot 03 -> 0/1/CPU0 (0x831)
slot 04 -> 0/2/CPU0 (0x841)
slot 05 -> 0/3/CPU0 (0x851)
```

```
slot 06 -> 0/4/CPU0 (0x861)
slot 07 -> 0/5/CPU0 (0x871)
slot 08 -> 0/6/CPU0 (0x881)
slot 09 -> 0/7/CPU0 (0x891)
slot 10 -> 0/8/CPU0 (0x8a1)
slot 11 -> 0/9/CPU0 (0x8b1)
slot 12 -> 0/FC0/SP (0x18c0)
slot 13 -> 0/FC1/SP (0x18d0)
slot 14 -> 0/FC2/SP (0x18e0)
slot 15 -> 0/FC3/SP (0x18f0)
slot 16 -> 0/FC4/SP (0x1900)
slot 17 -> 0/FC5/SP (0x1910)
slot 18 -> 0/FC6/SP (0x1920)
slot 25 -> 0/BPID0/SP (0x1190)
slot 26 -> 0/FT0/SP (0x5a0)
slot 27 -> 0/FT1/SP (0x5b0)
slot 40 -> 0/PM0/SP (0xe80)
slot 41 -> 0/PM1/SP (0xe90)
slot 42 -> 0/PM2/SP (0xea0)
slot 43 -> 0/PM3/SP (0xeb0)
slot 44 -> 0/PM4/SP (0xec0)
slot 45 -> 0/PM5/SP (0xed0)
slot 46 -> 0/PM6/SP (0xee0)
slot 47 -> 0/PM7/SP (0xef0)
slot 48 -> 0/PM8/SP (0xf00)
slot 49 -> 0/PM9/SP (0xf10)
slot 50 -> 0/PM10/SP (0xf20)
slot 51 -> 0/PM11/SP (0xf30)
```

组播

LC根据通过组播流的源和组(S、G)计算的散列值在交换矩阵上使用固定路径。因此，为了在LC上获得更高的组播吞吐量，必须拥有更多源和组发生变化的流，以便在所有活动交换矩阵平面上均匀分布流量。如果删除或禁用所选的FC，链路选择算法将在可用的活动交换矩阵平面中选择不同的链路。

组播转发使用称为交换矩阵组ID(FGID)的12位交换矩阵报头字段。位0和1保留给RP0/1。剩余的10位（从2到11）用于为20个LC分配地址。由于1位可用于地址2个LC，因此成对LC [(LC0、LC10),(LC1、LC11),(LC2、LC12)等]之间具有冗余组播数据包复制（超播）。如果成对LC上没有接口加入该组播组，则成对LC上的本地交叉开关会丢弃冗余组播流量。

FGID位	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
插槽	RP0	RP1	LC0	LC1	LC2	LC3	LC4	LC5	LC6	LC7	LC8	LC
成对插槽	X	X	LC10	LC1	LC12	LC13	LC14	LC15	LC16	LC17	LC18	LC