Processor Memory Parity Errors (PMPEs)

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Introduction

This document describes what causes parity errors on Cisco routers, and how to troubleshoot them.

Prerequisites

Requirements

Cisco recommends that you have knowledge of how to troubleshoot router crashes.

Refer to Troubleshooting Router Crashes for more information.

Components Used

This document is not restricted to specific software and hardware versions.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

Identify a Parity Error

Memory parity errors occur in MultiChannel Interface Processor (MIPS)-based processor products such as:

- Cisco 4500/4700 Series Routers
- Cisco 7500 Series Routers (RSP1, RSP2, RSP4, RSP8, VIP2-10, VIP2-15, VIP2-20, VIP2-40, VIP2-50)
- Cisco 7000 Series Routers (RSP 7000)
- Cisco 7200 Series Routers (NPE-100, NPE-150, NPE-175, NPE-200, NPE-225, NPE-300)
- Cisco 12000 Series Internet Router

Here are some messages, which are all related to the detection of bad parity somewhere in the system (the list is not exhaustive, but contains the most common messages):

- In the **show version** command output:

```
System restarted by processor memory parity error at PC 0x6014F7C0,
 address 0x0
```

or

```
System restarted by shared memory parity error at PC 0x60130F40
```

If you have the output of a **show version** command from your Cisco device, you can use Cisco CLI Analyzer to display potential issues and fixes. In order to use Cisco CLI Analyzer, you must be a registered customer, be logged in, and have JavaScript enabled.

- In the console logs, or in the crashinfo files:

```
-  *** Cache Error Exception ***
   Cache Err Reg = 0xa401a65a
   data reference, primary cache, data field error , error on SysAD Bus
   PC = 0xbfc17950, Cause = 0x0, Status Reg = 0x3040d007


-  Error: primary data cache, fields: data,
   virtual addr 0x6058A000, physical addr(21:3) 0x18A000, vAddr(14:12) 0x2000
   virtual address corresponds to main:data, cache word 0

                 Low Data   High Data  Par    Low Data   High Data  Par
   L1 Data  : 0:0xFEFFFEFE 0x65776179 0x13 1:0x20536572 0x76657220 0x89
              2:0x646F6573 0x206E6F74 0x9C 3:0x20737570 0x706F7274 0xF8

                 Low Data   High Data  Par    Low Data   High Data  Par
   Mem Data : 0:0xFEFFFEFE 0x65776179 0x13 1:0x20536572 0x76657220 0x89
              2:0x646F6573 0x206E6F74 0x9C 3:0x20737570 0x706F7274 0xF8
```

```
-  *** Shared Memory Parity Error ***
   shared memory control register= 0xffe3
   error(s) reported for: CPU on byte(s): 0/1

-  %PAR-1-FATAL: Shared memory parity error
   shared memory status register= 0xFFEF
   error(s) reported for: CPU on byte(s): 0/1 2/3


-  %RSP-3-ERROR: MD error 0000008000000200
   %RSP-3-ERROR: QA parity error (bytes 0:3) 02
   %RSP-3-ERROR: MEMD parity error condition
   %RSP-2-QAERROR: reused or zero link error, write at addr 0100 (QA)
       log 22010000, data 00000000 00000000
   %RSP-3-RESTART: cbus complex


-  %RSP-3-ERROR: CyBus error 01
   %RSP-3-ERROR: read data parity
   %RSP-3-ERROR: read parity error (bytes 0:7) 20
   %RSP-3-ERROR: physical address (bits 20:15) 000000

-  %RSP-3-ERROR: MD error 00800080C000C000
   %RSP-3-ERROR: SRAM parity error (bytes 0:7) F0
   %RSP-3-RESTART: cbus complex
```

Soft Versus Hard Parity Errors

There are two kinds of parity errors:

- **Soft parity errors**

  These errors occur when an energy level within the chip (for example, a one or a zero) changes. When referenced by the CPU, such errors cause the system to either crash (if the error is in an area that is not recoverable) or they recover other systems (for example, a CyBus complex restarts if the error was in the packet memory (MEMD)). In case of a soft parity error, there is no need to swap the board or any of the components. See the Related Information section for additional information about soft parity errors.

- **Hard parity errors**

  These errors occur when there is a chip or board failure that corrupts data. In this case, you need to re-seat or replace the affected component, which usually involves a memory chip swap or a board swap. There is a hard parity error when multiple parity errors occur at the same address. There are more complicated cases that are harder to identify. In general, if you see more than one parity error in a particular memory region in a relatively short period, you can consider it to be a hard parity error.

Studies have shown that soft parity errors are 10 to 100 times more frequent than hard parity errors. Therefore, Cisco highly recommends you to wait for a second parity error before you replace anything. This greatly reduces the impact on your network.

Isolate the Problem

A router has memory in different locations. Theoretically, any memory location can be affected by the parity error, but most memory problems occur in dynamic RAM (DRAM) or shared RAM (SRAM). Based on the

platform, here is how you can find out what memory location has been affected, and, if it turns out to be a hard parity error, what part you must replace:

Cisco 4500 and 4700 Platforms

On the Cisco 4500 and 4700 platforms, the crashinfo file is not available in versions earlier than Cisco IOS® Software Release 12.2(10) and 12.2(10)T.

One way to find out where the error occurred is to look at the "restart reason" in the console logs, and in the output of the **show version** command:

- Parity Error in DRAM:

  If you did not manually reload the router after the crash, the **show version** output looks like this:

  ```
  System restarted by processor memory parity error at PC 0x601799C4,
   address 0x0
  System image file is "flash:c4500-inr-mz.111-14.bin", booted via flash
  ```

  If a crashinfo file is available, or if console logs have been captured, you can also see something like this:

  ```
  *** Cache Error Exception ***
   Cache Err Reg = 0xa0255c61
   data reference, primary cache, data field error , error on SysAD Bus
   PC = 0xbfc0edc0, Cause = 0xb800, Status Reg = 0x34408007
  ```

  Repeated occurrence of parity errors in DRAM indicates that either the DRAM or the chassis is defective. If you recently removed the chassis, or if you performed any hardware configuration changes, re-seat the DRAM chips to solve the problem. Otherwise, replace the DRAM as a first step. This must prevent the parity errors. If the router still crashes, replace the chassis.

- Parity Error in SRAM:

  If you did not manually reload the router after the crash, the **show version** command output looks like this:

  ```
  System  restarted by shared memory parity error at PC 0x60130F40
  System image file is "flash:c4500-inr-mz.111-14.bin", booted via flash
  ```

  If a crashinfo file is available, or if console logs have been captured, you can also see something like this:

  ```
  <#root>

  *** Shared Memory Parity Error ***
  ```

```
shared memory control register= 0xffe3
error(s) reported for:

CPU

 on byte(s): 0/1
```

or

```
<#root>

%PAR-1-FATAL: Shared memory parity error
shared memory status register= 0xFFEF
error(s) reported for:

CPU

 on byte(s): 0/1 2/3
```

or

```
<#root>

*** Shared Memory Parity Error ***
shared memory control register= 0xffdf
error(s) reported for:

NIM1

 on byte(s): 0/1  2/3
```

Note:

- If the error is reported for the CPU, replace the SRAM.
- If the error is reported for NIM(x), replace the network module in slot (x). The SRAM allocated to slot (x) can also be affected. In this case, replace the SRAM.

  Repeated parity errors in SRAM indicate either defective SRAM chips, or a defective network module that has written bad parity in the SRAM. If you removed the chassis recently, or if you made any hardware configuration changes, re-seat the network modules and the SRAM chips to solve the problem. Otherwise, check where the error is reported in the console logs (see the output example above).

Route/Switch Processor (RSP), Network Processing Engine (NPE), and Route Processor (RP) Platforms

As with the Cisco 4000 series, the problem can be due to faulty DRAM or SRAM for these platforms. The problem can also be because of a defective processor card (RP, RSP or NPE). The Cisco 7000 and 7500 can also report parity errors generated by a faulty or badly seated Interface Processor (legacy xIP or VIP).

Check the crashinfo file and the console logs for one of these error messages:

Parity Error in DRAM or SRAM (MEMD)

For the RP, RSP and NPE, you usually see something like this:

```
<#root>

Error: primary data cache, fields: data, (

SysAD

)
virtual addr

0x6058A000

, physical addr(21:3) 0x18A000, vAddr(14:12) 0x2000

virtual address corresponds to main:data

, cache word 0
```

or simply:

```
<#root>

Error: primary data cache, fields: data,

SysAD

phy21:3 0x201880, va14:12 0x1000, addr

63E01880
```

This indicates a problem on the RSP itself. If the problem only occurs once, it is most probably a transient issue.

Parity Error Pulled from SRAM

For the RSP, the message can look like this:

```
%RSP-3-ERROR: MD error 0000008000000200
%RSP-3-ERROR: QA parity error (bytes 0:3) 02
%RSP-3-ERROR: MEMD parity error condition
%RSP-2-QAERROR: reused or zero link error, write at addr 0100 (QA)
    log 22010000, data 00000000 00000000
%RSP-3-RESTART: cbus complex
```

or

```
%RSP-3-ERROR: CyBus error 01
```

```
%RSP-3-ERROR: read data parity
%RSP-3-ERROR: read parity error (bytes 0:7) 20
%RSP-3-ERROR: physical address (bits 20:15) 000000
```

If there is no indication of another interface processor that writes bad parity into the SRAM (for example, VIP2-1-MSG error messages), the most likely reason for the parity error is the SRAM itself. In this case, replace the RSP.

If other error messages indicate that an interface processor writes bad parity, it can be a faulty or badly-seated card.

Versatile Interface Processor

If you receive `%VIP2-1-MSG: slot(x)` messages in the logs or in the crashinfo file, refer to Troubleshooting VIP Crashes.

Recommended Actions

At the first occurrence of a parity error, it is not possible to distinguish between a soft or hard parity error. From experience, most parity occurrences are soft parity errors, and you can usually dismiss them. If you have recently changed some hardware or have moved the box, try to re-seat the affected part (DRAM, SRAM, NPE, RP, RSP, or VIP). Frequent multiple parity occurrences signify faulty hardware. Replace the affected part (DRAM, RSP, VIP, or motherboard) with the help of the instructions mentioned in this document.

Information to Collect if You Open a TAC Service Request

If you still need assistance after you follow the troubleshooting steps above and want to open a service request with the Cisco Support Case Manager, be sure to include this information:

- Troubleshooting performed before you opened the service request.
- **show technical-support** command output (in enable mode if possible).
- **show log** command output or console captures if available.
- crashinfo file (if it is present, and not already included in the **show technical-support** command output. If multiple crashinfo files exist, include all of them).
- Number of reloads due to processor memory parity errors that you have seen and when they have occurred.

Once the case has been created, please attach the collected data to your case in non-zipped, plain text format (.txt). In order to attach information to your service request, upload it through the Support Case Manager Tool (registered customers only) . If you cannot access the Support Case Manager Tool, attach the relevant information to your service request, and send it to attach@cisco.com with your service request number in the subject line of your message.

Note: Do not manually reload or power-cycle the router before you collect the above information unless required to troubleshoot a processor memory parity error, because this can cause important information to be lost that is needed to determine the root cause of the problem.

Related Information

- **Cisco 7200 Parity Error Fault Tree**
- **Troubleshooting Router Crashes**
- **Memory Errors, Detection, and Correction**
- **Technical Support & Documentation - Cisco Systems**