# **Troubleshoot Memory Errors on UCS Servers**

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# Introduction

This document describes the troubleshooting steps to handle memory errors on UCS Servers.

# Prerequisites

### Requirements

Cisco recommends that you have knowledge of these topics.

- Basic understanding of UCS.
- Basic understanding of Memory Architecture.

## **Components Used**

The information in this document is based on these software and hardware versions:

• UCS Family Servers M5, M6, M7 and higher.

- UCS Manager
- Cisco Integrated Management Controller (CIMC)
- Cisco Intersight Managed Mode (IMM)

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.

# **Background Information**

## **Memory Errors**

Memory errors are encountered when an attempt is made to read a memory location. The value read from the memory does not match the value that is supposed to be there. These errors are classified into two types:

1. Soft errors

Soft errors are transient and do not continue to be repeated. These are temporary and can often be corrected by retrying the read or rewriting the memory location.

2. Hard Errors

Permanent physical defects cause these. Rewriting the memory location and retrying the read access does not eliminate a hard error. As a result, this memory error is uncorrectable, and the memory needs to be replaced as the error continues to repeat.

#### **Correctable Errors**

If errors are detected and corrected, they are considered correctable. This can be accomplished by retrying the read or by calculating the correct memory contents using Error Correction Code (ECC) data and writing the proper data back into memory. After an error is detected and corrected, the Cisco Integrated Management Controller (IMC) logs the event in the System Event Log.

Typically, correctable errors are the result of soft errors. If correctable errors persist within the same memory location over an extended period, it could indicate a potential hard error.

### Adaptive Double Device Data Correction (ADDDC)

ADDDC Sparing can correct two successive DRAM failures if they reside in the same region. ADDDC dynamically moves data from failing bits to spare memory, preventing correctable errors from becoming uncorrectable. A threshold of correctable ECC errors is required to trigger the mechanism.

ADDDC helps in some scenarios where correctable ECC errors precede Uncorrectable ECC errors.

### Post Package Repair (PPR)

Post Package Repair (PPR) can permanently repair failing memory regions within a DIMM by leveraging redundant DRAM rows. This permanent in-field repair allows for rapid recovery from hard errors without

needing to replace the DIMM. To perform a repair, the system must experience an ADDDC event and go through at least one reboot cycle. This repair activity does not affect performance or the total memory available to the OS.

PPR and ADDDC are enabled by default, however, can be configurable. PPR requires ADDDC Sparing RAS mode to also be enabled. If the RAS setting is other than ADDDC Sparing or Platform Default, PPR is not operational. The only supported PPR mode is Hard PPR, which means repairs are permanent.

### Partial Cache Line Sparing (PCLS)

There is an error-prevention mechanism in the memory controller. It works by identifying faulty small portions of data in memory. These faulty locations are recorded in a special directory, along with backup data that can replace them. When the memory is accessed, if there is an error in those faulty spots, the controller uses the backup data from the directory to ensure everything runs smoothly.

**Note**: The features are available depending on the CPU architecture and the firmware version running on the server. Ensure you are in the last recommended version to handle the memory errors better.

## **Troubleshoot RAS Faults**

### **UCS Manager**

Generally, you see these faults in UCS Manager as an RAS event.

Summary	Properties			
Severity : 👽 Major/None	Affected object	sys/rack-unit-18/mgmt/h	nealth	
	Description	RAS Event (24) : Please c	heck the Health tab for mor	e details
Last Transition : 2024-03-17T00:13:24Z	ID	15220583	Туре	management
ctions	Cause	health-major	Created at	2024-03-17T00:13:24Z
Acknowledge Fault	Code	F1706	Number of Occurren	nces: 1
	Original severity	Major		
	Previous severity	Major	Highest severity	: Major
			ок	Cancel H

In the health summary, you can find more information about the error, whether PCLS or PPR was triggered.

#### PCLS example

On M6 servers and newer, you have the option to enable Patrial cache line sparing (PCLS) as a BIOS option, which is an error-prevention mechanism. The server must be rebooted as soon as possible, so PPR can kick in and repair the DIMM. Once the server is rebooted, monitor for additional UCS Manager faults for the same DIMM.

As the alert mentions, it is recommended to reboot the server at the earliest convenience, since there is an associated risk of experiencing an Uncorrectable Error, and consequently an unexpected server downtime.

ipment / Cl	nassis / Cha	assis 2 / Servers /	Server 7					
ieneral I	nventory	Virtual Machines	Installed Firmware	CIMC Sessions	SEL Logs	VIF Paths	Health	Diagnost
Aanagement	Services							
ealth Summ	ary							
Health Qualifi Health Severi	er: RAS Eve ty: Major	ent (2C)						
Y Advanced	i I Filter 🔺 E	xport 🚔 Print						
Severity		Name	Description	ι			Value	•
V Majo	r	RAS Event	(2C) PCLS (Par	tial Cache Line Spari	ng) is activated	on DIMM DDR	4, PPR I	Required
Details								
bloose	RAS Eve	nt (2C)		<u></u>				
Name				DIMAN				
Descriptio	n : PCLS (P DDR4_P experier Repair w system	artial Cache Line Sp 2_D1_ECC. This DIM noing an Uncorrecta vill be performed on reboot.	M is at an increased on M is at an increased of ble Error. Post Packag this DIMM during the	risk of ge next				
Descriptio	n : PCLS (P DDR4_P experier Repair w system i : Major	artial Cache Line S 2_D1_ECC. This DIN toing an Uncorrecta vill be performed on reboot.	aring) is activated on IM is at an increased i ible Error. Post Packag this DIMM during the	prisk of ge next				

#### PPR example

The server has ADDDC and PPR enabled, and a RAS event occurred. The fault suggests rebooting for PPR to repair the DIMM. The server needs to be rebooted as soon as possible for PPR to kick in and repair the DIMM.

Once the server is rebooted, monitor for additional UCS Manager faults for the same DIMM.

As the alert mentions, it is recommended to reboot the server at the earliest convenience, since there is an associated risk of experiencing an Uncorrectable Error, and consequently an unexpected server downtime.

Hybrid Display	Installed Firmware	SEL Logs	CIMC Sessions	VIF Paths	Power Control Monitor	Health	
Management Serv	ices						
ealth Summary							
Health Qualifier :	RAS Event (14)		26				
Health Severity :	Major						
ealth Details							
T. Advanced Filte	r 🔺 Evport 🛋 Drine						
Severity	Name	Des	cription		Value		
V Major	RAS Event (1	4) ADD	ADDDC Rank-level adaptive virtual lockstep is activa		step is activa PPR Requi	PPR Required	
Details			1				
Name :	RAS Event (14)		_				
Description :	ADDDC Rank-level adapti lockstep is activated on D (DDR4_P1_F1_ECC). This I increased risk of experier Uncorrectable Error. Post	ve virtual IMM 0x14 DIMM is at an ncing an Package Repa	sir				

### **Intersight Managed Mode**

The Server has ADDDC enabled, and a BANK VLS event occurred, creating the fault you see. In this scenario, the next step is to perform a server reboot as soon as possible to allow PPR to be executed.

A	Memoryl InitBankError
-	Sep 7, 2024 6:32 AM
	Memory unit SW-COS1-ND2-FI-3/chassis-2/server-8/board/memory- array/memory-unit-DIMM_P2_D1 has encountered a Bank VLS error

### **Cisco Integrated Management Controller (CIMC)**

The fault appears as shown when using the Cisco Integrated Management Controller. If the server has ADDDC and a VLS event occurred, then this is working as designed to prevent uncorrectable errors.

<b>€ uludu</b> Cis	sco Integrate	d Manageme	nt Controller	-	
/ / Faults a	nd Logs / Fa	ult Summary	*		
Fault Summary	Fault History	System Event	Log Cisco IMC Log	Logging Contr	ols
Fault Entries					
					Show Quick Filter
Time	Severit	y Code	Domain Name		Description
2024-02-19T03 16.3	39 🔻 Majo	r F1706	sys/rack-unit-1/board/men	narray-1/mem-5	ADDDC Bank-level adaptive virtual lockstep is activated on DIMM 0x08 (DDR4_P1_C1_ECC). This DIMM is at an increased risk of

#### **Troubleshooting Steps**

- Verify no other DIMM faults are present for instance and Uncorrectable Error.
- Schedule a maintenance window.
- Place a host in maintenance mode, and reboot the server to attempt permanent repair of the DIMM using Post Package Repair (PPR).

#### **UCSM Reboot Steps**

**Note**: You can reboot the server from the OS as well. This example uses the reboot option from the server UI.

Navigate to your UCS Manager web Interface.

Blade Server

Navigate to **Equipment > Chassis > Server X**.

**Integrated Server** 

Navigate to **Equipment > Rack-Mounts > Server X**.

Click KVM console.

Equipment

Chassis

Rack-Mounts

Enclosures

- FEX
- Servers
  - Server 1 ①
  - Server 2 (1)
  - Server 3 (1)
- Fabric Interconnects
  - Fabric Interconnect A (primary) ()
  - Fabric Interconnect B (subordinate) ()
- Policies

Port Auto-Discovery Policy

	ventory v	nirtual Machines	Hybrid Display	Inst
It Summary				
8	V		0	
0	0	0	1	
tus				
erall Status :	ок			-
) Status Deta	ails			
ions				
ate Service Prof	file			
ociate Service P	Profile			
Desired Power	State			
t Server				
tdown Server				
et				
over Server				
ver Maintenance	Э			
A Console >> -	-	_		
to CIMC for So	>> L			
on Locator LE	D			
k FP Buttons				
w POST Results				
t Fault Suppres	sion			
p Fault Suppres				
pression Task P	Properties			

on the KVM windows, click server actions, select Reset, and click OK.

Boot Server Shutdown Server Reset

Monitor in the KVM the reboot process, and ensure the OS boots up correctly.

### **IMM Reboot Steps**

Navigate to the Servers Tab, identify the server, and click the Action (three dots) menu.

();	Overview	Servers				
0	Operate ^	* All Servers  +  Q Search		Health = Health	y × <b>⊽ Filters</b> 6 results <b>Re</b>	set A
IL	Servers	Health	Power (1) On 6	HCL Status	Bundle Version • 4.2(3e) 1 • 4.3(4.24)	×××
	Fabric Interconnects	6 Healthy 6			6 = 4.3(3.24 5.2(0.23) Other 2	÷
	HyperFlex Clusters					
	Virtualization	0 C220-API	: Hea	eith :	Model : UCSC-C220-M7S	\$
	Integrated Systems	C220-API ⊕ ↔		O Healthy	UCSC-C220-M7S	
		🗍 🙂 FI-6536-1		O Healthy	UCSC-C220-M5SX	
2	Analyze ^	U FI-6536-1-3		O Healthy	UCSX-210C-M7	E
	Explorer New	🕐 FI-6536-1-6		O Healthy	UCSX-410C-M7	
		UCSC-C240-M550	0	O Healthy	UCSC-C240-M5SD	
9	Configure ^			Rows p	er page 18 🗸 🤇 1	) >

Next, select the **Power** menu and then **Power Cycle** option.

ervers		Power Off		Dower	
* All Servers 🐵 +		Power Cycle	System	>	
··· Ø		<ul> <li>Hard Reset</li> <li>Shut Down Operating System</li> </ul>		Profile	>
Health 6 • Healthy 6	Power (¹) On 6	HCL Status	E	Install Operating System Upgrade Firmware Launch vKVM	1
Name	: н	lealth	Mode	Start Alarm Suppression	l.
U C220-API		Healthy	ucso	Open TAC Case	
C220-API 3 00-		C Healthy	ucsc	C Set License Tier	
U FI-6536-1					
🗍 🕐 FI-6536-1		Healthy	ucsc	Collect Tech Support Bu	Indle
<ul> <li>U FI-6536-1</li> <li>U FI-6536-1-3</li> </ul>		<ul><li>Healthy</li><li>Healthy</li></ul>	ucsc ucsx-	Collect Tech Support Bu -210C-M7	indle
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Click the **Power Cycle** button to confirm the action.

# **Power Cycle Server**

Server 'FI-6536-1-3' will be Power Cycled.



Set One Time Boot Device (1)



Validate the progress under the **Requests** menu.

		Q Search	C 00	oi 41 16 🗘 🚾	18 🔺 23 🧿	A
Requests						×
* All Requests 🛞 +						
Q Search	<b>₹ Filters</b> 476 results				ڻ E	xport
Status	Execution Type					XX
) In Progress 1 ( Action Required 1	Execute 476					
Failed 72 Success 400						
Name Status	: Initiator	Target Type	Target Name	Start Time	: Duration	\$
Power Cycle	ogress 0%	Blade Server	FI-6536-1-3	a few seconds ago	6 s	

#### **CIMC Reboot Steps**

Navigate to the Host Power option and select Power Cycle.

		÷ 🗹 0	
		Refresh Host Power Launch	vk
Cisco Integrated N	lanagement Controller (Cisco I	Host: Powered On	
		Power Off	
Hostname:	C240	Power On	
IP Address:	10.31.123.252	Power Cycle	
MAC Address:	10:F9:20:80:E9:28	Hard Reset	
Firmware Version:	4.2(1a)	Shut Down	
Current Time (UTC):	Wed Oct 16 19:36:16 2024		
Local Time:	Wed Oct 16 19:36:16 2024 UTC +0000 (Local)		
Timezone:	UTC	Select Timezone	

Launch the KVM to monitor the reboot process, and ensure the OS boots up correctly.

#### **Monitor for New Faults**

If no errors occur after reboot meaning that there is no other RAS event or fault related to the DIMM, PPR was successful and the server can be put back into use.

If new ADDDC events occur, repeat the reboot process outlined in the previous steps to perform additional permanent repairs with PPR.

If an Uncorrectable Error, or inoperable fault occurs after reboot, the fault indicates that a memory needs to be replaced.

**Note**: Please open a case with Cisco TAC to replace the DIMM if you encounter any of these faults.

### UCS Manager Uncorrectable Memory Error

ili.ili. cisco	UCS Manager				1 3 0 0						
<b>.</b>	All		Equipment / Chassis / Chassis	1 (primary)							-
	Equipment		< lans PSUs Hybrid Disp	olay Slots In	stalled Firmware SEL	Logs Power Control Monitor	Connectivity Policy	Evonts FSM St	tatistics Pow	er Temperatures	Faults
	<ul> <li>Chassis</li> </ul>		Filters 🛞	ψ Filter τ <sub>γ</sub> Advan	Ψ Filter Ψ <sub>2</sub> Advanced Filter ♠ Export ♠ Print Hide Fault Details						¢
쁆	Chassis 1 (prima	ay) 🛞	Severity 3	Severity	Code	D	Affected object Ca	ause	Last Transition	a Description	
=	<ul> <li>FI-IO Modules</li> </ul>		Show All	0	F1236	956383	sys/chassis-1/bladehe	ealth-led-amber-bl	2022-06-1870	1:46:51; sys/chass	is-1/blado
	<ul> <li>Fans</li> </ul>		V Major								
	<ul> <li>Servers</li> </ul>		Minor								
_	· Rack-Mounts		Warning								
-	Enclosures		O info								
	<ul> <li>Servers</li> </ul>		Condition								
		ts	O Soaking	Details							
<b>4</b> 0	<ul> <li>Fabric Interconne</li> </ul>	ect A (primary)	Suppressed	Summary		Properties					1
	Fabric Interconnect B (subordinate)     Policies			Last Transition : 2022-06-18T01:46:51Z		Affected object Description	sys/chassis-1/blade-1/he sys/chassis-1/blade-1/he Threshold Crossed;	2-1/health-led e-1/health-led shows error. Reason DDR4_P1_D2_ECC:Sensor			
	Port Auto-Disco	very Policy		Actions		(D	956383	Туре	; eq	equipment	
				Acknowledge Fa	ult	Cause	health-led-amber-blinkin	g Created at	: 20	022-06-18T01:46:51	z
							F1236	Number of 0	Occurrences : 1		
						Original severity	Critical	Mindowst was a	<b>C</b>	dala at	
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#### IMM Memory Uncorrectable Error

Uncorrectable error fault. The fault indicates the DIMM has an uncorrectable error and needs to be replaced.

# MemoryUnitUncorrectableError

a few seconds ago

# Memory unit /chassis-2/server-5/board/memory-array/memory-unit-DIMM\_P1\_G2 has encountered an uncorrectable ECC error

#### **CIMC Uncorrectable Memory Error**

<b>h</b> /.	1 / / Faults and Logs / Fault Summary 🖈						Refresh   Host Power   Launch vKVM	Ping	CIMC Re	boot
Fau	It Summary	Fault History	System	Event Log	Cisco IMC Log Logging Controls					
	Fault Entries	S								
								Show	Quick Filte	er 👘
	Time	Severit	y	Code	Domain Name	Probable Cause	Description			
	2022-05-26T14:04	1:53 🔻 Majo	r	F0185	sys/rack-unit-1/board/memarray-1/mem-14	equipment-inoperable	DDR4_P2_G2_ECC: DIMM 14 is inoperable : Check or replace DIMM			
	2022-04-26T10:14	:02 Inform	nat	F0460	sys/rack-unit-1/mgmt/log-SEL-0	log-capacity	CSCO_SEL_FULNESS: System Event log capacity is low			
	2022-04-26T10:13	:32 O Inform	nat	F0462	sys/rack-unit-1/mgmt/log-SEL-0	log-capacity	SEL_FULLNESS: System Event log is Full: Clear the log			

## **Related Information**

<u>Memory Technical Overview - Memory RAS Features</u>