

# **Server Memory and Persistent Memory population rules for HPE Gen10 Plus servers with 3rd Gen Intel Xeon Scalable processors**

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## Introduction

This paper describes how to populate HPE DDR4 SmartMemory DIMMs and HPE Persistent Memory in HPE ProLiant Gen10 Plus servers, HPE Synergy Gen10 Plus compute modules, and HPE Apollo Gen10 Plus compute modules using 3rd Gen Intel® Xeon® Scalable processors. HPE Server Memory for Gen10 Plus servers support faster data rates, lower latencies, and greater power efficiency than the DIMMs used in previous generations of [HPE servers](#). HPE SmartMemory also provides superior performance over third-party memory when used in HPE servers.

HPE Gen10 Plus servers with Intel® Gen3 Scalable processors offer increased memory channels and sockets than the Gen10 family of servers.

- **HPE Gen10 Plus:** Eight memory channels per CPU with up to two DIMM slots per channel (16 DIMM slots per CPU).
- **HPE Gen10:** Six memory channels per CPU with up to two DIMM slots per channel (12 DIMM slots per CPU).

The increase in channel count improves nominal bandwidth by 46% if all channels are used. At the same time, the memory speed increases from 2933 MT/s to 3200 MT/s and channels increase from 6 to 8 per processor.

In addition to describing these improvements, this white paper reviews the rules, best practices, and optimization strategies that should be used when installing HPE DDR4 DIMMs in HPE Gen10 Plus servers.

## Populating HPE DDR4 DIMMs in HPE Gen10 Plus servers

HPE Gen10 Plus systems support a variety of flexible memory configurations, enabling the system to be configured and run in any valid memory controller configuration. For optimal performance and functionality, you should follow these rules when populating HPE Gen10 Plus servers with HPE DDR4 DIMMs. Violating these rules may result in reduced memory capacity, performance, or error messages during boot. Table 1 summarizes the overall population rules for HPE Gen10 Plus servers.

**Table 1.** DIMM population rules for HPE Gen10 Plus servers

Category	Population guidelines
<b>Processors and DIMM slots</b>	<p>Install DIMMs only if the corresponding processor is installed. If only one processor is installed in a two-processor system, only half of the DIMM slots are available to populate.</p> <p>If a memory channel consists of more than one DIMM slot, the white DIMM slot is located furthest from the CPU. White DIMM slots denote the first slot to be populated in a channel. For one DIMM per channel (DPC), populate white DIMM slots only.</p> <p>When mixing HPE SmartMemory DIMMs of different ranks in the same channel, place the HPE SmartMemory DIMM with the higher number of ranks in the white DIMM slot and the HPE SmartMemory DIMM with the lower number of ranks in the black DIMM slot.</p> <p>If multiple CPUs are populated, split the HPE SmartMemory DIMMs evenly across the CPUs and follow the corresponding CPU rules when populating DIMMs.</p>
<b>Performance</b>	<p>To maximize performance, it is recommended to balance the total memory capacity across all installed processors and load the channels similarly whenever possible (see <a href="#">Appendix B</a>).</p> <p>If the number of DIMMs does not spread evenly across the CPUs, populate as close to evenly as possible.</p> <p>Avoid creating an unbalanced configuration for any CPU.</p>
<b>DIMM types and capacities</b>	<p>The maximum memory capacity is a function of the number of DIMM slots on the platform, the largest DIMM capacity qualified on the platform and the number and model of qualified processors installed on the platform.</p> <p>Do not mix HPE SmartMemory RDIMMs and HPE SmartMemory LRDIMMs in the same system.</p> <p>The 256 GB 8R 3DS LRDIMM cannot be mixed with any other DIMMs. The 128 GB 4R LRDIMM cannot be mixed with any other DIMMs.</p> <p>HPE servers based on 3rd Gen Intel Xeon Scalable processors do not support unbuffered DIMMs (UDIMMs).</p> <p>HPE SmartMemory DIMMs with x4 and x8 DRAMs can be mixed in the same channel. RAS features affected when mixing x4 and x8 DIMMs are online spare, mirrored memory, and HPE Fast Fault Tolerance.</p> <p>When Intel® Optane™ Persistent Memory 200 series are installed, only Advanced ECC supported.</p>
<b>DIMM speed</b>	<p>The maximum memory speed is a function of the memory type, memory configuration, and processor model.</p> <p>DIMMs of different speeds may be mixed in any order; however, the server will select the lowest common speed among all of the DIMMs on all of the CPUs.</p> <p>HPE SmartMemory DIMMs and HPE NVDIMM-Ns from previous generation servers are not compatible with the current generation. Certain HPE SmartMemory features such as Memory Authentication and Enhanced Performance may not be supported.</p>
<b>Heterogeneous mix</b>	<p>There are no performance implications for mixing sets of different capacity DIMMs at the same operating speed. For example, latency and throughput will not be negatively impacted by installing an equal number of 16 GB dual-rank DDR4-3200 DIMMs (one per channel) and 32 GB dual-rank DDR4-3200 DIMMs (one per channel).</p> <p>Take each DIMM type and create a configuration as if it were a homogeneous configuration.</p>



### Introduction to DIMM slot locations

In general, DIMM population order follows the same logic for all HPE Gen10 Plus servers—although physical arrangement may vary from server to server. To populate DIMMs in the correct order and location, refer to illustrations found in [Appendix B](#) for HPE SmartMemory DIMMs, and [Appendix C](#) for HPE Persistent Memory, available in 128, 256, and 512 GB modules, featuring Intel Optane Persistent Memory 200 series. Each illustration reflects the DIMM slots to use for a given number of DIMMs around a single processor, assuming a common DIMM type.

If multiple processors are installed, split the DIMMs evenly across the processors and follow the corresponding rule when populating DIMMs for each processor (see Figure 1 for an example). For optimal throughput and reduced latency, populate all eight channels of each installed CPU identically.

The first DIMM slots for each channel have white connectors, and the second DIMM slots, if any, have black connectors.

Figure 1 shows a sample DIMM slot configuration for the HPE ProLiant DL380 and DL360 Gen10 Plus servers, which have two sockets and 32 DIMM slots. Diagrams for all servers are included in [Appendix A](#).

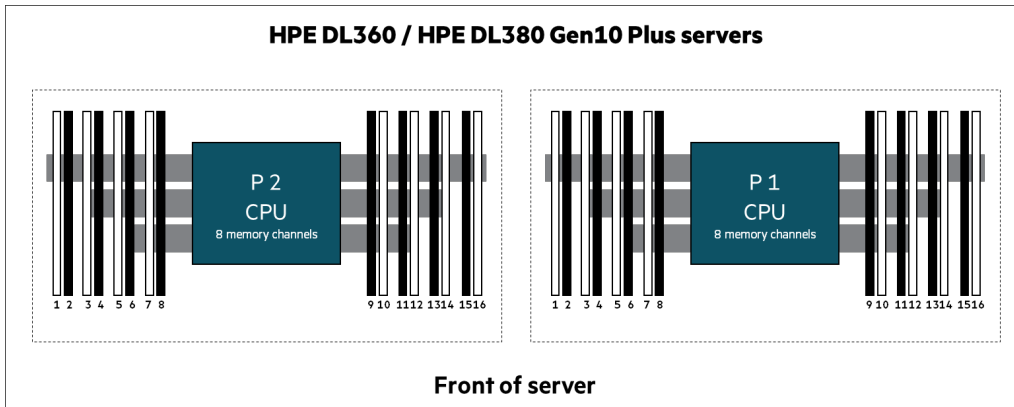


Figure 1. 32 DIMM slot locations in HPE ProLiant DL360 / DL380 Gen10 Plus servers

### Population guidelines for HPE SmartMemory DIMMs

This section provides generic guidelines for populating HPE SmartMemory DIMMs in HPE Gen10 Plus servers. See [Appendix B](#) for population guidelines for specific HPE Gen10 Plus servers.

HPE SmartMemory DIMMs may be populated in many permutations that are allowed but may not provide optimal performance. The system ROM reports a message during the power on self-test if the population is not supported or is not balanced.

Table 2 shows a sample of the population guidelines for HPE SmartMemory DIMMs in HPE Gen10 Plus servers with sixteen DIMM slots per CPU (e.g., HPE ProLiant DL360 and DL380, Gen10 Plus servers). For a given number of HPE SmartMemory DIMMs per CPU, populate those DIMMs in the corresponding numbered DIMM slot(s) on the corresponding row. Corresponding tables for all servers are included in [Appendix B](#).

Table 2. HPE SmartMemory DIMM population guidelines for HPE Gen10 Plus servers with sixteen DIMM slots per CPU

HPE ProLiant Gen10 Plus 16 slots per CPU DIMM population order																
1 DIMM															14	
2 DIMMs <sup>1</sup>			3												14	
4 DIMMs <sup>1</sup>			3				7			10					14	
6 DIMMs	1		3				7			10					14	16
8 DIMMs <sup>1,2</sup>	1		3		5		7			10		12			14	16
12 DIMMs*	1	2	3	4			7	8	9	10			13	14	15	16
12 DIMMs <sup>1,2**</sup>	1		3	4	5		7	8	9	10		12	13	14		16
16 DIMMs <sup>1,2</sup>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

<sup>1</sup> Support Hemi (hemisphere mode).

<sup>2</sup> Support Software Guard Extensions (SGX).

\* Supported for 6-way interleave.

\*\* Unbalanced: Supported for SNC 2, 4/8 way interleave.

Configurations not listed are not supported and if populated, the server may result in non-optimal memory performance or other unexpected behavior.



As shown in Table 2, memory should be installed as indicated based upon the total number of DIMMs being installed per CPU. For example:

- If two HPE SmartMemory DIMMs are being installed per CPU, they should be installed in DIMM slots 3 and 14.
- If six HPE SmartMemory DIMMs are being installed per CPU, they should be installed in DIMM slots 1, 3, 7, 10, 14, and 16.

Unbalanced configurations not listed and may not provide optimal performance. This is because memory performance may be inconsistent and reduced compared to balanced configurations. Applications that rely heavily on throughput will be most impacted by an unbalanced configuration. Other applications that rely more on memory capacity and less on throughput will be far less impacted by such a configuration.

### Population guidelines for HPE Persistent Memory

This section provides generic guidelines for populating HPE Persistent Memory in HPE Gen10 Plus servers. See [Appendix C](#) population guidelines for specific HPE Gen10 Plus servers.

HPE SmartMemory DIMMs and HPE Persistent Memory may be populated in some permutations that are allowed but may not provide optimal performance. The system ROM reports a message during the power on self-test if the population is not supported or is suboptimal.

Populate HPE SmartMemory DIMMs first, then add HPE Persistent Memory modules in the remaining DIMM slots. Population rules specific to HPE Persistent Memory modules include:

- The HPE Persistent Memory population may be different on every processor (this is not optimal for HPE SmartMemory DIMMs).
- If a channel has both an HPE SmartMemory DIMM and an HPE Persistent Memory module, the HPE SmartMemory DIMM must be in the white slot and the HPE Persistent Memory module must be in the black slot.
- HPE Persistent Memory can be paired with either HPE SmartMemory RDIMM or HPE SmartMemory LRDIMM but mixing RDIMMs and LRDIMMs is not allowed.
- The use of HPE Persistent Memory disables RAS features like Online Spare, Mirrored Memory, and HPE Fast Fault Tolerance.

### Memory interleaving

Memory interleaving is a technique used to maximize memory performance by spreading memory addresses evenly across memory devices. Interleaved memory results in a contiguous memory region across multiple devices with sequential accesses using each memory device in turn, instead of using the same one repeatedly. The result is higher memory throughput due to the reduced wait times for memory banks to become available for desired operations between reads and writes.

Memory interleaving techniques include:

#### Rank interleaving

This technique interleaves across ranks within a memory channel. When configured correctly, sequential reads within the channel will be interleaved across ranks. This enhances channel throughput by increasing utilization on the channel. Rank interleaving is a lower priority than channel interleaving when creating an interleave region and a 1-DPC region across three channels will be higher priority than a two-DIMM region within a channel.

#### Channel interleaving

This technique interleaves across memory channels. When configured correctly, sequential reads will be interleaved across memory channels. Channel bandwidth will be accumulated across the interleaved channels. The Unified Extensible Firmware Interface System utilities user guide for HPE ProLiant Gen10 Plus servers and HPE Synergy servers goes into detail regarding setting up memory for interleaving.

#### Memory controller interleaving

3rd Gen Intel Xeon Scalable processors have four memory controllers per CPU, each one supporting two channels. The channels selected for channel interleaving are based on matching channels in the memory controllers and across memory controllers.

#### Node interleaving

This technique interleaves across sockets and is not optimal for modern software and operating systems that understand non-uniform memory access (NUMA) system architectures. Node interleaving is not supported while HPE NVDIMM-Ns are present. Non-NUMA operating environments, however, may see improved performance by enabling node interleaving.



## Understanding balanced DIMM configurations

Optimal memory performance is achieved when the system is configured with a fully homogeneous and balanced DIMM configuration. Unbalanced DIMM configurations are those in which the installed memory is not distributed evenly across the memory channels or the CPUs. Hewlett Packard Enterprise discourages unbalanced configurations because they will always have lower performance than similar balanced configurations. There are two types of unbalanced configurations, each with its own performance implications.

### Memory configurations that are unbalanced across channels

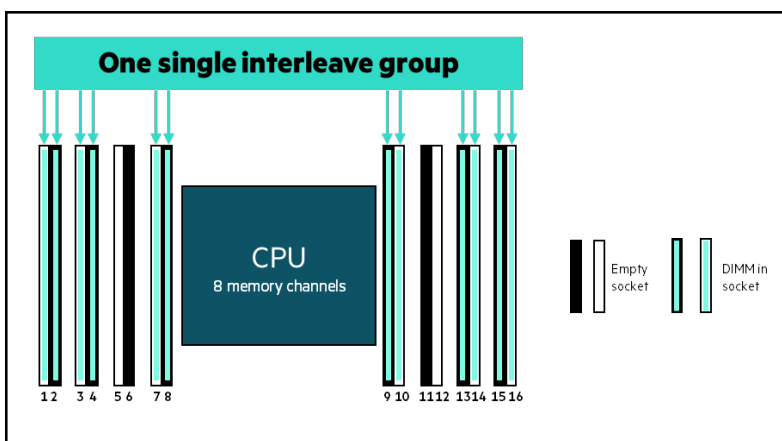
The primary effect of memory configurations that are unbalanced across channels is a reduction in the number of channels that can be interleaved. Interleaving fewer channels results in a decrease in memory throughput in those regions that span fewer memory channels. Peak performance is achieved when the interleave region can span all 8 channels per CPU. If you look at Table 3, there is only one unbalanced configuration listed. There are two interleave regions in this configuration. One can interleave across all channels on the processor, thus achieving peak performance in the region. The second region, however, can only interleave reads across four channels as a second DIMM is not installed in the other channels. Depending on where memory is allocated, the application will experience different memory performance from run to run. Best case would be peak performance and worst case would be 50% of peak performance.

**Table 3.** Impact of unbalanced configurations on memory throughput

DIMMs	Number of interleaved channels per processor		Throughput compared to peak	
	Largest group	Smallest group	Largest group	Smallest group
1	1	1	12.50%	12.50%
2	2	2	25.00%	25.00%
4	4	4	50.00%	50.00%
6	6	6	75%	75%
8	8	8	100.00%	100.00%
12	6	6	75%	75%
12*	8	4	100.00%	50%
16	8	8	100.00%	100.00%

\* Unbalanced

Unbalanced configurations are tagged with an asterisk. In these cases, there will be multiple interleave regions of different sizes. Each region will exhibit different performance characteristics. When running a benchmark sensitive to throughput (such as STREAM), the benchmark program may measure the throughput of any of the different interleave groups and report confusing results.



**Figure 2.** Example of memory that has balanced population



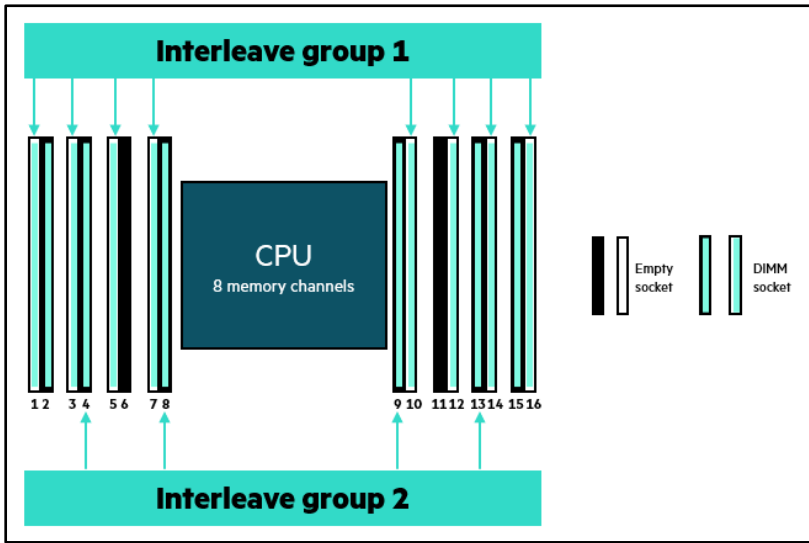


Figure 3. Example of memory that has unbalanced population

Figure 2 and Figure 3 show an example of balance and unbalanced population memory configurations. Figure 2 shows a balanced configuration with 12 DIMMs and all 12 DIMMs are in the same interleave region. Figure 3 shows unbalanced configuration with 12 DIMMs. In this case, there are two interleave regions each with different performance characteristics.

**Memory configurations that are unbalanced across processors**

Figure 3 shows a memory configuration that is unbalanced across processors. The CPU 1 threads operating on the larger memory capacity of CPU 1 may have adequate local memory with relatively low latencies and high throughput. The CPU 2 threads operating on the smaller memory capacity of CPU 2 may consume all available memory on CPU 2 and request remote memory from CPU 1. The longer latencies and limited throughput of cross-CPU communications associated with the remote memory will result in reduced performance of those threads. In practice, this may result in non-uniform performance characteristics for software program threads, depending on which processor executes them.

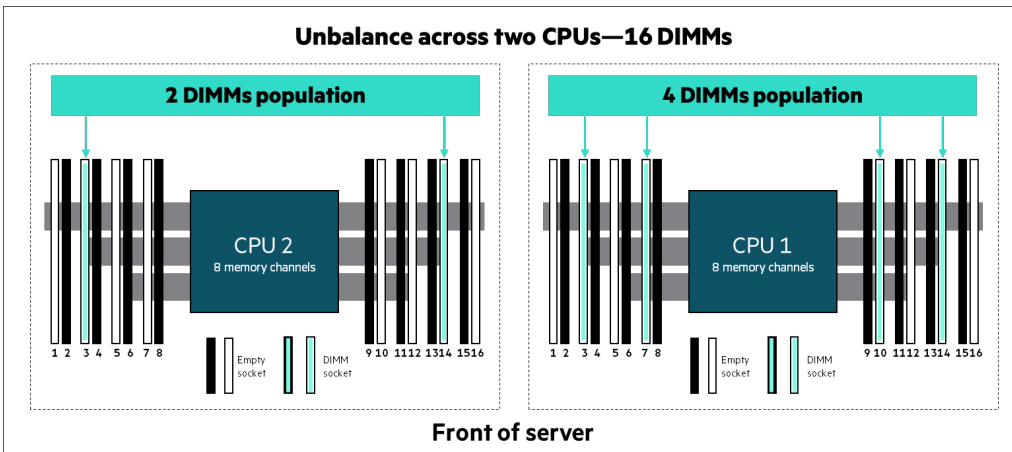
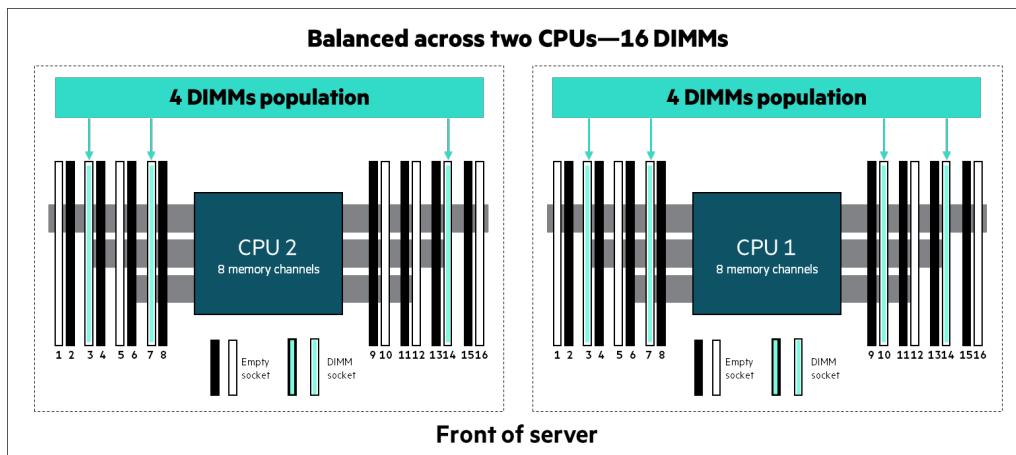


Figure 4. Example of memory that is unbalanced across processors

Figure 4 shows an example of unbalanced memory configurations across processors. In this example, the first processor has four DIMMs while the second CPU only has two DIMMs installed. Both CPU configurations are balanced, but the imbalance is from CPU to CPU.





**Figure 5.** Example of a memory configuration that is balanced across processors

Figure 5 shows an example of a configuration that is balanced across processors. In this example, both processors have four DIMMs installed.

## Unsupported configurations

### For system configuration:

If the system is in a validated configuration there is no error log.

If the system is in an unsupported (not validated) configuration, there will be an informational warning log as below:

- The DIMM population on one or more processors results in a memory configuration that is not validated. This may result in non-optimal memory performance or other unexpected behavior.

If a DIMM failure results in a DIMM being mapped out and the resulting configuration is unsupported (not validated), there will be an error log as below:

- A memory error has resulted in one or more DIMMs being mapped out resulting in a memory configuration that is not validated. This may result in non-optimal memory performance or other unexpected behavior.

If an unsupported mix of DIMMs is installed (such as RDIMM+LRDIMM), there will be an error log as below:

- Unsupported DIMM configuration detected: Mixed DIMM configuration are not supported in this system. The system can only have one DIMM type (such as RDIMM or LRDIMM) installed at a time—system halted! (Major Code:%3, Minor Code:%4).

### For DIMM record:

If any DIMM/PMem violates the population, there will be an error log record as below to warn user:

- Unsupported DIMM configuration detected: Processor %1 DIMM %2 violates DIMM population rules. (Major Code: 00000017, Minor Code: 00000013).

This is a configuration issue, not a DIMM failure. Do not replace indicated DIMM. Please refer the population rules for DIMM configuration installation. Once the configuration issue is resolved, the error will no longer be reported.

If a DIMM/PMem failure results the DIMM/PMem violates the population, there will be an error log record as below to warn user:

- Unsupported DIMM configuration detected: Processor %1 DIMM %2 has population violation due to an event that has led to an unsupported configuration. (Major Code:%3, Minor Code:%4).





## Memory population and system settings

HPE Gen10 Plus servers using 3rd Gen Intel Xeon Scalable processors support various system settings that influence a wide range of system capabilities. In a couple of cases, these settings introduce a stricter set of population requirements than would otherwise exist for the default system settings. These settings are sub-NUMA clustering in the performance menu and mirrored mode in the memory reliability, accessibility, and serviceability (RAS) menu.

In the case of memory mirroring, only the 8-DIMM and 16-DIMM configurations are supported. See the [Memory RAS technologies for HPE ProLiant/Synergy/Blade Gen10 servers with Intel Xeon Scalable processors](#) for more details.

In the case of sub-NUMA clustering, all memory controllers must have the same amount of memory installed. Due to this, the 6-DIMM configuration and the balanced 12-DIMM configuration are not able to support sub-NUMA clustering. This is the one case where a balanced configuration is not the primary recommended configuration.

When Intel Optane Persistent Memory 200 series are installed, Advanced ECC is supported in MM mode, HPE Fast Fault Tolerance (also called ADDDC) is supported in AD mode after BIOS 1.50 (Advanced ECC is supported in AD before BIOS 1.50). Please check RAS feature for Intel Optane Persistent Memory 200 series for in [Appendix D](#).

## Conclusion

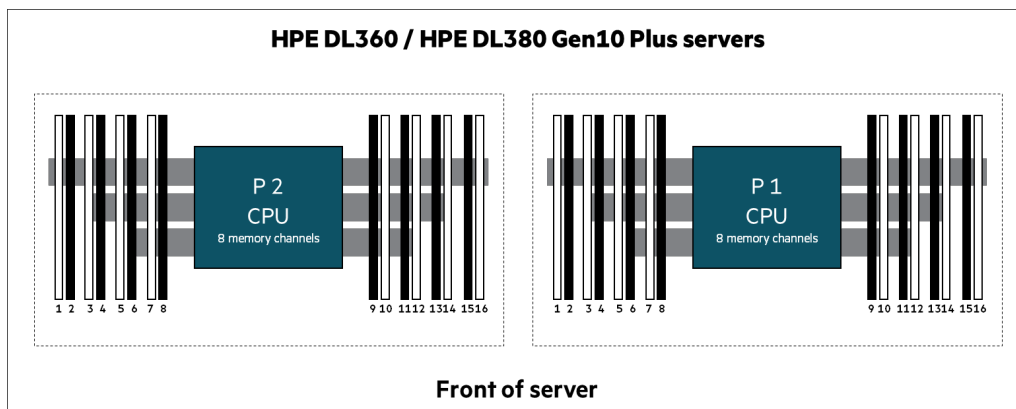
Following the population guidelines maximizes memory performance of HPE SmartMemory DIMMs and HPE PMem in HPE Gen10 Plus servers with 3rd Gen Intel Xeon Scalable processors.

## Appendix A—HPE Gen10 Plus DIMM slot locations

This section illustrates the physical location of the DIMM slots for HPE Gen10 Plus servers using 3rd Gen Intel Xeon Scalable processors. HPE servers support 16, 12, or 8 DIMM slots per CPU.

### DIMM slot locations in HPE ProLiant DL360 / DL380 Gen10 Plus servers

HPE ProLiant DL360 and DL380 Gen10 Plus servers have 16 DIMM slots per CPU.



**Figure 6.** DIMM slot locations in HPE ProLiant DL360 / DL380 Gen10 Plus servers



### DIMM slot locations in HPE Synergy 480 Gen10 Plus compute modules

HPE Synergy 480 Gen10 Plus compute modules have 16 DIMM slots per CPU.

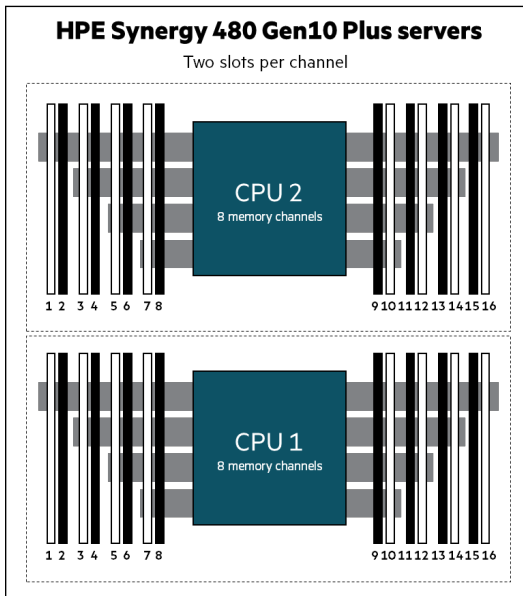


Figure 7. DIMM slot locations for HPE Synergy 480 Gen10 Plus compute modules (P1 and P2 are rotated)

### DIMM slot locations in HPE Apollo 4200 Gen10 Plus servers (HPE ProLiant XL420 Gen10 Plus)

HPE Apollo 4200 Gen10 Plus servers have 12 DIMM slots per CPU. Four channels have single dedicated DIMM slots, and four channels have two shared DIMM slots.

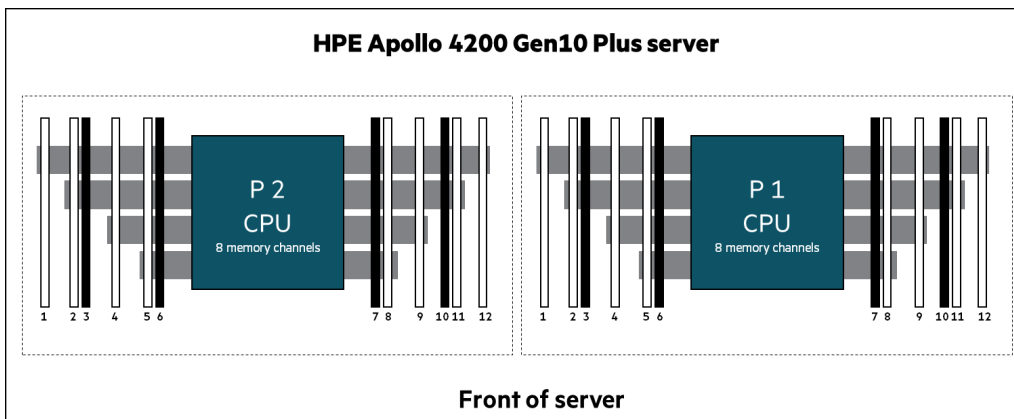


Figure 8. DIMM slot locations in HPE Apollo 4200 Gen10 Plus servers



### DIMM slot locations in HPE ProLiant XL220n / HPE ProLiant XL290n Gen10 Plus servers

HPE ProLiant XL220n / HPE ProLiant XL290n Gen10 Plus servers have eight DIMM slots per CPU.

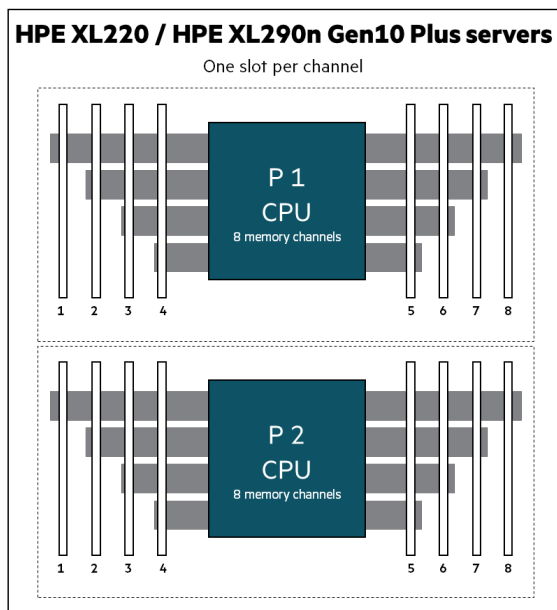


Figure 9. DIMM slot locations in HPE ProLiant XL220n / HPE ProLiant XL290n Gen10 Plus servers (P1 and P2 are rotated)

### DIMM slot locations in HPE ProLiant DL110 Gen10 Plus servers

HPE ProLiant DL110 Gen10 Plus servers have eight DIMM slots per CPU.

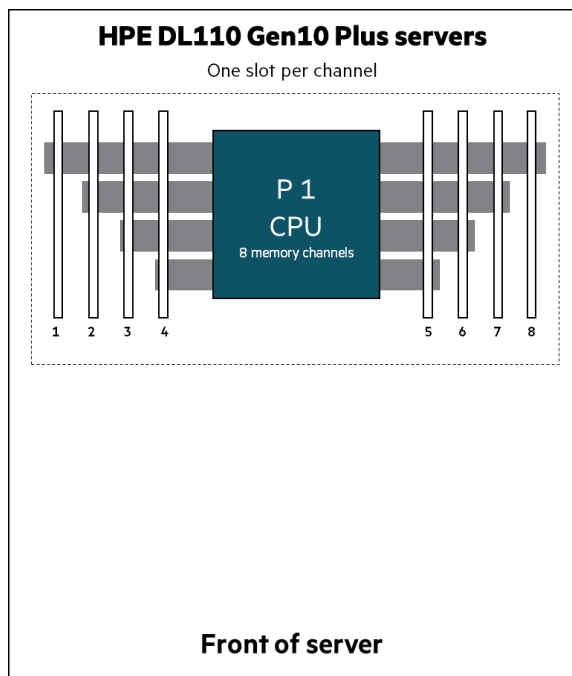


Figure 10. DIMM slot locations in HPE ProLiant DL110 Gen10 Plus servers (MLB is rotated comparing to HPE ProLiant DL360/DL380)



## Appendix B—Population guidelines for HPE SmartMemory DIMMs

This section illustrates which DIMM slots to use when populating memory in HPE Gen10 Plus servers using 3rd Gen Intel Xeon Scalable processors. Each illustration reflects the DIMM slots to use for a given number of DIMMs around a single processor, given a common DIMM type. If multiple processors are installed, split the DIMMs evenly across the processors and follow the corresponding rule when populating DIMMs for each processor. Table 4 represents the bootstrap processor and the population shown will ensure that the first DIMM populated is in the right place. Unbalanced configurations are noted with an asterisk. In these configurations, memory performance may be inconsistent or reduced compared to a balanced configuration.

In cases of a heterogeneous mix, take each DIMM type and create a configuration as if it were a homogeneous configuration. Depending on the per-channel rules, populate the DIMMs with highest rank count in white DIMM slots in each channel, and then populate the other DIMMs in the black DIMM slots in each channel. See the last illustration for an example of a popular mix.

### Population guidelines for HPE SmartMemory DIMMs in HPE ProLiant DL360 / DL380 Gen10 Plus servers

HPE ProLiant DL360 / DL380 Gen10 Plus servers have 16 DIMM slots per CPU.

**Table 4.** Population guidelines for HPE SmartMemory DIMMs in HPE ProLiant DL360 / DL380 Gen10 Plus servers

HPE ProLiant DL360 / DL380 Gen10 Plus servers per CPU DIMM population order															
1 DIMM															14
2 DIMMs <sup>1</sup>			3												14
4 DIMMs <sup>1</sup>			3				7			10					14
6 DIMMs	1		3				7			10					14
8 DIMMs <sup>1,2</sup>	1		3		5		7			10		12			14
12 DIMMs*	1	2	3	4			7	8	9	10			13	14	15
12 DIMMs <sup>1,2**</sup>	1		3	4	5		7	8	9	10		12	13	14	16
16 DIMMs <sup>1,2</sup>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

<sup>1</sup> Support Hemi (hemisphere mode).

<sup>2</sup> Support Software Guard Extensions (SGX).

\*Supported for 6-way interleave.

\*\*Unbalanced: Supported for SNC 2, 2-/4-/8-way interleave.

Configurations not listed are not supported and if populated, the server may result in non-optimal memory performance or other unexpected behavior.



## Population guidelines for HPE SmartMemory DIMMs in HPE Synergy 480 Gen10 Plus compute modules

HPE Synergy 480 Gen10 Plus compute modules have 16 DIMM slots per CPU.

**Table 5.** Population guidelines for HPE SmartMemory DIMMs in HPE Synergy 480 Gen10 Plus compute modules

**HPE Synergy 480 Gen10 Plus servers per CPU DIMM population order**

**CPU 1**

1 DIMM																14	
2 DIMMs <sup>1</sup>		3														14	
4 DIMMs <sup>1</sup>		3				7			10							14	
6 DIMMs	1	3				7			10							14	16
8 DIMMs <sup>1,2</sup>	1	3		5		7			10		12					14	16
12 DIMMs*	1	2	3	4		7	8	9	10				13		14	15	16
12 DIMMs <sup>1,2**</sup>	1		3	4	5	7	8	9	10		12		13		14		16
16 DIMMs <sup>1,2</sup>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	

**CPU 2**

1 DIMM			3														
2 DIMMs <sup>1</sup>			3													14	
4 DIMMs <sup>1</sup>			3				7			10						14	
6 DIMMs	1		3				7			10						14	16
8 DIMMs <sup>1,2</sup>	1		3		5		7			10		12				14	16
12 DIMMs*	1	2	3	4			7	8	9	10				13		14	15
12 DIMMs <sup>1,2**</sup>	1		3	4	5		7	8	9	10		12		13		14	16
16 DIMMs <sup>1,2</sup>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	

<sup>1</sup> Support Hemi (hemisphere mode).

<sup>2</sup> Support Software Guard Extensions (SGX).

\* Supported for 6-way interleave.

\*\* Unbalanced: Supported for SNC 2, 2-/4-/8-way interleave.

Configurations not listed are not supported and if populated, the server may result in non-optimal memory performance or other unexpected behavior.

## Population guidelines for HPE SmartMemory DIMMs in HPE Apollo 4200 Gen10 Plus compute modules

**Table 6.** Population guidelines for HPE SmartMemory DIMMs in HPE Apollo 4200 Gen10 Plus servers

**HPE Apollo 4200 Gen10 Plus servers per CPU DIMM population order**

1 DIMM																	11
2 DIMMs <sup>1</sup>		2															11
4 DIMMs <sup>1</sup>		2				5				8							11
6 DIMMs	1	2				5				8							11
8 DIMMs <sup>1,2</sup>	1	2			4	5				8	9						11
12 DIMMs <sup>1,2*</sup>	1	2	3	4	5	6	7	8	9	10							11

<sup>1</sup> Support Hemi (hemisphere mode).

<sup>2</sup> Support Software Guard Extensions (SGX).

\* Supported for SNC 2, 2-/4-/8 way interleave.

Configurations not listed are not supported and if populated, the server may result in non-optimal memory performance or other unexpected behavior.



## Population guidelines for HPE SmartMemory DIMMs in HPE ProLiant XL220n / HPE ProLiant XL290n Gen10 Plus compute modules

**Table 7.** Population guidelines for HPE SmartMemory DIMMs in HPE ProLiant XL220n / HPE ProLiant XL290n Gen10 Plus servers

**HPE ProLiant XL220n / HPE ProLiant XL290n Gen10 Plus servers per CPU DIMM population order**

CPU 1								
1 DIMM		2						
2 DIMMs <sup>1</sup>		2					7	
4 DIMMs <sup>1</sup>		2		4	5		7	
6 DIMMs	1	2		4	5		7	8
8 DIMMs <sup>1,2</sup>	1	2	3	4	5	6	7	8

CPU 2								
1 DIMM							7	
2 DIMMs <sup>1</sup>		2					7	
4 DIMMs <sup>1</sup>		2		4	5		7	
6 DIMMs	1	2		4	5		7	8
8 DIMMs <sup>1,2</sup>	1	2	3	4	5	6	7	8

<sup>1</sup> Support Hemi (hemisphere mode).

<sup>2</sup> Support Software Guard Extensions (SGX).

Configurations not listed are not supported and if populated, the server may result in non-optimal memory performance or other unexpected behavior.

## Population guidelines for HPE SmartMemory DIMMs in HPE ProLiant DL110 Gen10 Plus compute modules

**Table 8.** Population guidelines for HPE SmartMemory DIMMs in HPE ProLiant DL110 Gen10 Plus servers

**HPE ProLiant DL110 Gen10 Plus server CPU DIMM population order**

1 DIMM		2						
2 DIMMs <sup>1</sup>		2					7	
4 DIMMs <sup>1</sup>		2		4	5		7	
6 DIMMs	1	2		4	5		7	8
8 DIMMs <sup>1,2</sup>	1	2	3	4	5	6	7	8

<sup>1</sup> Support Hemi (hemisphere mode).

<sup>2</sup> Support Software Guard Extensions (SGX).

Configurations not listed are not supported and if populated, the server may result in non-optimal memory performance or other unexpected behavior.



### Mixed HPE SmartMemory DIMM configurations

In cases of a heterogeneous mix, take each DIMM type and create a configuration as though it were a homogeneous configuration. Here are rules to mix HPE SmartMemory DIMM configurations.

1. Do not mix HPE SmartMemory RDIMMs and HPE SmartMemory LRDIMMs in the same system.
2. The 256 GB 8R 3DS LRDIMM cannot be mixed with any other DIMMs. The 128 GB 4R LRDIMM cannot be mixed with any other DIMMs.
3. HPE servers based on 3rd Gen Intel Xeon Scalable processors do not support UDIMMs.
4. HPE SmartMemory DIMMs with x4 and x8 DRAMs can be mixed in the same channel. RAS features affected when mixing x4 and x8.
5. Populate highest rank count in white DIMM slots in each channel, then populate the other DIMMs in the black DIMM slots in each channel.

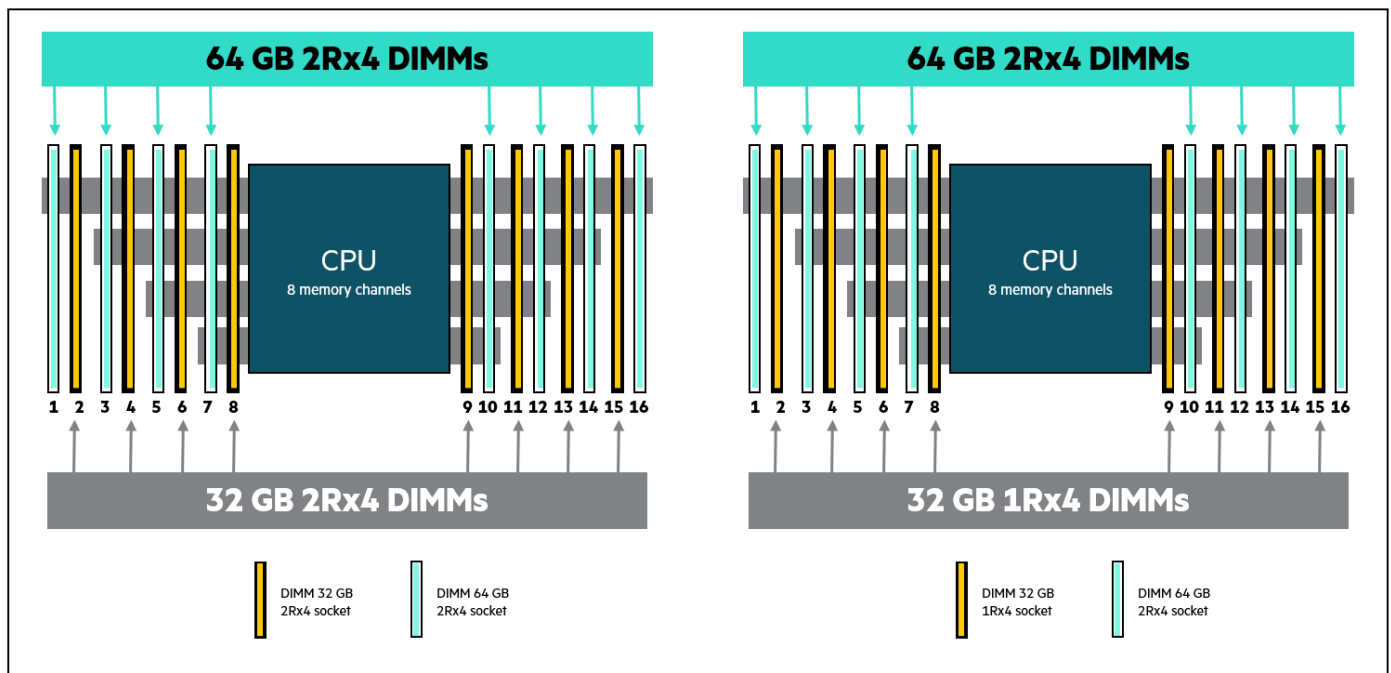
Table 9 shows heterogeneous mix configuration based on rules.

**Table 9.** Mixed population guidelines for HPE SmartMemory DIMMs

P/N	Description	P07525-B21	P06029-B21	P06031-B21	P06033-B21	P11038-B21	P40007-B21	P06035-B21	P06037-B21	P06039-B21
		8GB 1Rx8 3200 MT/s RDIMM	16GB 1Rx4 3200 MT/s RDIMM	16GB 2Rx8 3200 MT/s RDIMM	32GB 2Rx4 3200 MT/s RDIMM	32GB 2Rx8 3200 MT/s RDIMM	32GB 1Rx8 3200 MT/s RDIMM	64GB 2Rx4 3200 MT/s RDIMM	128GB 4Rx4 3200 MT/s LRDIMM	256GB 8Rx4 3DS 3200 MT/s LRDIMM
P07525-B21	HPE 8GB 1Rx8 PC4-3200AA-R Smart Kit	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
P06029-B21	HPE 16GB 1Rx4 PC4-3200AA-R Smart Kit	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
P06031-B21	HPE 16GB 2Rx8 PC4-3200AA-R Smart Kit	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
P06033-B21	HPE 32GB 2Rx4 PC4-3200AA-R Smart Kit	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
P40007-B21	HPE 32GB 1Rx4 PC4-3200AA-R Memory Kit	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
P11038-B21	HPE 32GB 2Rx8 PC4-3200AA-R Smart Kit	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
P06035-B21	HPE 64GB 2Rx4 PC4-3200AA-R Smart Kit	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
P06037-B21	HPE 128GB 4Rx4 PC4-3200AA-L Smart								Yes	
P06039-B21	HPE 256GB 8Rx4 PC4-3200AA-L 3DS Smart									Yes

In cases of a heterogeneous mix, take each DIMM type and create a configuration as though it were a homogeneous configuration. Depending on the per-channel rules, populate the DIMMs with highest rank count in white DIMM slots in each channel, then populate the other DIMMs in the black DIMM slots in each channel. The following illustration shows homogeneous configuration and different rank DIMM mixed configuration.





**Figure 11.** Mixing HPE SmartMemory 64 GB 2Rx4 and 32 GB 2Rx4 DIMMs homogeneous configuration and 64 GB 2Rx4 and 32 GB 1Rx4 mixed configuration

### Appendix C—Population guidelines for Intel Optane Persistent Memory 200 series for HPE

For data-intensive workloads where latency and capacity are key considerations, HPE Apollo, HPE ProLiant, and HPE Synergy servers deliver faster data access at a reasonable price point when equipped with 128, 256, or 512 GB modules of Intel Optane Persistent Memory 200 series for HPE. This new Persistent Memory offering, based on phase-change memory technology, must be included alongside HPE SmartMemory DIMMs.

DIMMs and Intel Optane Persistent Memory 200 series for HPE modules are installed in specific configurations based on the workload requirements of the server. Supported configurations are optimized for Persistent Memory capacity, volatile memory capacity, and performance. Verify all DIMMs and Intel Optane Persistent Memory 200 series for HPE capacity size and types across all sockets on the platform are the same. When Intel Optane Persistent Memory 200 series are installed, Advanced ECC is supported in MM mode, HPE Fast Fault Tolerance (also called ADDDC) is supported in AD mode after BIOS 1.50 (Advanced ECC is supported in AD before BIOS 1.50).

Please check RAS feature for Intel Optane Persistent Memory 200 series in [Appendix D](#).

- Persistent Memory capacity—the available capacity is equal to the HPE Persistent Memory capacity.
- Volatile memory capacity
  - App Direct (1 LM) mode—the volatile capacity is equal to the DIMM capacity.
  - Memory (2 LM) mode—the volatile capacity is the HPE Persistent Memory capacity.
- Performance
  - Uses all channels to efficiently utilize processor resources.
  - Memory (2 LM) mode—The DIMM:PMem ratio is between 1:4 and 1:16. More regular DIMMs provide a better cache ratio.





**Table 10.** DIMMs and Intel Optane PMem 200 series for HPE modules installed in the server in the following configurations

**Note:** The following population rule only applies to HPE ProLiant DL360 and HPE ProLiant DL380.

**HPE ProLiant DL360, HPE ProLiant DL380 Gen10 Plus servers per CPU DIMM population order**

Mode	DDR4+ PMem	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8	Slot 9	Slot 10	Slot 11	Slot 12	Slot 13	Slot 14	Slot 15	Slot 16
AD, MM	4+4	D		P		D		P			P		D		P		D
AD	6+1	D		D				D			D		P		D		D
AD	8+1	D		D		D		D			D		D	P	D		D
AD, MM	8+4	D		D	P	D		D	P	P	D		D	P	D		D
AD, MM	8+8	D	P	D	P	D	P	D	P	P	D	P	D	P	D	P	D
AD	12+2	P		D	D	D	D	D	D	D	D	D	D	D	D		P

Persistent Memory (P)  
 DIMMs (D)  
 App Direct mode (AD)  
 Memory mode (MM)

**Table 11.** DIMMs and Intel Optane PMem 200 series for HPE modules installed in the server in the following configurations

**Note:** The following population rule only applies to HPE SY480.

**HPE SY480 Gen10 Plus server per CPU DIMM population order**

**CPU 1**

Mode	DDR4+ PMem	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8	Slot 9	Slot 10	Slot 11	Slot 12	Slot 13	Slot 14	Slot 15	Slot 16
AD, MM	4+4	D		P		D		P			P		D		P		D
AD	6+1	D		D				D			D		P		D		D
AD	8+1	D		D		D		D			D		D	P	D		D
AD, MM	8+4	D		D	P	D		D	P	P	D		D	P	D		D
AD, MM	8+8	D	P	D	P	D	P	D	P	P	D	P	D	P	D	P	D
AD	12+2	P		D	D	D	D	D	D	D	D	D	D	D	D		P

**CPU 2**

Mode	DDR4+ PMem	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8	Slot 9	Slot 10	Slot 11	Slot 12	Slot 13	Slot 14	Slot 15	Slot 16
AD, MM	4+4	D		P		D		P			P		D		P		D
AD	6+1	D		D		P		D			D				D		D
AD	8+1	D		D	P	D		D			D		D		D		D
AD, MM	8+4	D		D	P	D		D	P	P	D		D	P	D		D
AD, MM	8+8	D	P	D	P	D	P	D	P	P	D	P	D	P	D	P	D
AD	12+2	P		D	D	D	D	D	D	D	D	D	D	D	D		P

Persistent Memory (P)  
 DIMMs (D)  
 App Direct mode (AD)  
 Memory mode (MM)

**Note**

P07525-B21—HPE 8GB 1Rx8 3200 RDIMM does not support pairing with Intel Optane PMem 200 series for HPE.



**Table 12.** DIMMs and Intel Optane PMem 200 series for HPE modules installed in the server in the following configurations

**Note:** The following population rule **only** applies to HPE Apollo 4200.

**HPE Apollo 4200 Gen10 Plus per CPU DIMM population order**

Mode	DDR4+PMem	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8	Slot 9	Slot 10	Slot 11	Slot 12
AD, MM	4+4	D	P		D	P			P	D		P	D
AD	6+1	D	D			D			D	P		D	D
AD	8+1	D	D		D	D			D	D	P	D	D
AD, MM	8+4	D	D	P	D	D	P	P	D	D	P	D	D

Persistent Memory (P)  
 DIMMs (D)  
 App Direct mode (AD)  
 Memory mode (MM)

**Table 13.** DIMMs and Intel Optane PMem 200 series for HPE modules installed in the server in the following configurations

**Note:** The following population rule **only** applies to HPE Apollo 2000.

**HPE Apollo 2000 Gen10 Plus server per CPU DIMM population order**

**CPU 1**

Mode	DDR4+PMem	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8
AD, MM	4+4	D	P	D	P	P	D	P	D
AD	6+1	D	D	P	D	D		D	D

**CPU 2**

Mode	DDR4+PMem	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8
AD, MM	4+4	D	P	D	P	P	D	P	D
AD	6+1	D	D		D	D	P	D	D

Persistent Memory (P)  
 DIMMs (D)  
 App Direct mode (AD)  
 Memory mode (MM)

## Appendix D—RAS feature for Intel Optane Persistent Memory 200 series

- Static Virtual Lockstep for SDDC (+1)
- Demand Scrubbing
- Patrol Scrubbing
- App Direct Address Scrub (ARS)
- Data Poisoning
- Address Verification
- Error Reporting
- Fault Isolation
- Error Injection



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