

# Power Efficiency "How To" for the Dell PowerEdge Server Portfolio

How to order and configure Dell PowerEdge servers for optimal power efficiency

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### **Executive summary**

As energy costs rise and the concerns surrounding the environmental impact of energy generation also increase, the focus on power efficiency within data centers is more important than ever. IT departments are becoming increasingly concerned with power efficiency, looking to save every watt possible without sacrificing the system performance required to meet their business needs. At first glance, optimizing servers for power efficiency may seem like a daunting task due to the seemingly overwhelming complexity of power management features, the multitude of configuration options, and the potential side effects of enabling these features. To help customers navigate through their system power options, Dell has focused on simplifying power management on the Dell<sup>™</sup> PowerEdge<sup>™</sup> 13th generation server portfolio by providing easy-to-use system profiles for those customers that want fast and simple deployment. For those customers wishing to fine-tune their systems for the optimal performance/power balance appropriate for their particular workloads, Dell also incorporates flexible and highly granular configuration options with detailed help windows, giving Dell customers the tools to custom tailor their servers on a system-by-system basis.

### Introduction

The Dell PowerEdge 13<sup>th</sup> generation servers are designed with a focus on maximizing performance while minimizing power consumption. To minimize power consumption in the data center, you must select components that emphasize power efficiency, as well as configure settings for efficiency, such as BIOS and iDRAC, before deployment. This white paper serves as a "how to" guide for optimizing a PowerEdge server for power consumption. The majority of this guide applies to both rack and tower servers.

### How to order a server for power efficiency

Dell PowerEdge servers provide many configuration options that you can use to minimize a server's power consumption. Dell offers tools to help you determine the server configurations that best fit your needs and reduce power use.

### Advisor tools

Dell offers online advisor tools to help you navigate through some of the complex component selections. These tools quickly and easily help you assess and determine which PowerEdge configuration options best suit your needs.

### **ESSA**

The Dell Energy Smart Solution Advisor (ESSA)<sup>1</sup> offers a feature called **Help Me Choose** to assist with the selection of a power supply for PowerEdge rack and tower servers. ESSA can be used to estimate the power requirements for a particular server configuration, to estimate available headroom for a desired power supply, and to assess the return-on-investment benefit for right-sizing. With the **Help Me Choose** feature for PSUs, you can choose from PSUs with different capacity points, efficiency ratings, input types, and redundancy configurations to find the best PSU solution to meet your needs.

Figure 1 illustrates how Help Me Choose for PSUs helps guide you when selecting a power supply for a particular configuration. The lowest supported PSU capacity is the default recommendation, but you can also

<sup>&</sup>lt;sup>1</sup> http://essa.us.dell.com/dellstaronline/Launch.aspx/ESSA?c=us&l=en&s=corp

choose to upgrade to a larger capacity PSU for additional headroom or to a PSU with higher efficiency, such as the 1100W Platinum+ or the 750W Titanium power supply.

PowerEdge R730				Cost Per kWh:\$	0.14/kWh
		Estimated Input Power At Workload	Estimated Maximum Potential Power	Estimated Annu C	al Energy Cost(Continua )peration)
PSU Option		(W)	(W)	At Workload (\$USD)	At Maximum Potential Power (\$USD)
O Dual, Hot-plug, Redundant Power Supply (1+1), 495W		820	1035	1005.65	1269.32
Dual, Hot-plug, Redundant Power Supply (1+1), 750W	Dell Recommended	820	1035	1005.65	1269.32
O Dual, Hot-plug, Redundant Power Supply (1+1), 750W, ïtanium, 200-240VAC		820	1035	1005.65	1269.32
O Dual, Hot-plug, Redundant Power Supply (1+1), 1100W		798	1018	978.67	1248.48
O Single, Hot-plug Power Supply (1+0), 495W		820	1035	1005.65	1269.32
◯ Single, Hot-plug Power Supply (1+0), 750W		820	1035	1005.65	1269.32
Varning: Exceeding PSU rated capacity may drive system thr	ottling				

Figure 1 PSU Help Me Choose example recommending the 750W PSU

#### **Processor and Memory Selector**

The <u>Dell PowerEdge Processor and Memory Selector</u><sup>2</sup> is an online tool that provides advice for selecting a memory configuration that is optimized for price, performance, power, and/or RAS based on user input. Since the memory controller is integrated into an Intel<sup>®</sup> Xeon<sup>®</sup> processor, selecting the processor is also a crucial part of building an optimal memory configuration. Dell PowerEdge servers support a rich assortment of memory configurations, and with the PowerEdge Processor and Memory Selector, you can easily select a configuration to meet your workload requirements.

The first page in the Processor and Memory Selector (Figure 2) is the Welcome page that explains how to use the tool. To begin, select a processor type, and then click **Next** to go the Configuration page.

Welcome to the Dell PowerEdge Processor and Memory Selector     Welcome to the Dell PowerEdge Processor and Memory Selector     Welcome to the Dell PowerEdge Processor and Memory Selector     Welcome to reate a new configuration and offers options based on the selected server model, preferred performance bin and reliability     actives. The assumptions made by the tool are as follows:         The values in the yellow box can be changed to better reflect your environment, however         these often include default values that may be calculated from other entries.         green         The values in the green box denotes that they have been changed with user input and         will no longer automatically recalculate.         The values in the white box or any text are calculated and cannot be changed.         The values in the white box or any text are calculated and cannot be changed.         The blue circle icons with an 1° contain descriptions and formulas to help explain how an         served at or a formula was calculated.         The server are to be proved at or a formula was calculated.         The server are descriptions and formulas to help explain how an         server at or a formula was calculated.         The server are descriptions and formulas to help explain how an         server at or a formula was calculated.         The server are descriptions and formulas to help explain how an         server at or a formula was calculated.         The server are descriptions and formulas to help explain how an         server at or a formula was calculated.         The server are descriptions and formulas to help explain how an         server at or a formula was calculated.         The server are descriptions and formulas to help explain how an         server at or a formula was calculated.         The server at or a formula was calculated.         Thes	Welcome	Configuration Results	
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yellow       The values in the yellow box can be changed to better reflect your environment, however these often include default values that may be calculated from other entries.       Before using the tool, it is recommended to know the type of processor necessary to support the operating system and applications for your choice of Dell PowerEdge. (*required field)         green       The values in the green box denotes that they have been changed with user input and will no longer automatically recalculate.       Select the type of processor.*         white       The values in the white box or any text are calculated and cannot be changed.       N Bridge: Intel® Xeon® v2 product family         The blue circle icons with an 1° contain descriptions and formulas to help explain how an assumption was enviral at or a formula was calculated. These can be selected in add       Haswell: Intel® Xeon® v3 product family	II PowerEdge Protection II PowerEdge Protection	ocessor and Memory Selector allows you to create a new configuration and offers options based or nptions made by the tool are as follows:	n the selected server model, preferred performance bin and reliability
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white       The values in the white box or any text are calculated and cannot be changed.         Image: the blue circle icons with an 'i' contain descriptions and formulas to help explain how an assumption was arrived at or a formula was calculated. These can be selected to add	green	The values in the green box denotes that they have been changed with user input and will no longer automatically recalculate.	Select the type of processor.* Sandybridge: Intel® Xeon® product family I'vy Bridge: Intel® Xeon® v2 product family
The blue circle icons with an 'i' contain descriptions and formulas to help explain how an essumption was erived at or a formula was calculated. These can be selected to add	white	The values in the white box or any text are calculated and cannot be changed.	Haswell: Intel® Xeon® v3 product family
customer notes or see and audit log of changes to the fields' value. Click on the "Next" button at the bottom after choosing your processor type to move to the Configuration Tab.	0	The blue circle icons with an 'i' contain descriptions and formulas to help explain how an assumption was arrived at, or a formula was calculated. These can be selected to add customer notes or see and audit log of changes to the fields' value.	Click on the "Next" button at the bottom after choosing your processor type to move to the Configuration Tab.
underlined The text values that are underlined, contain a hyper link to more detail assumptions.	underlined	The text values that are underlined, contain a hyper link to more detail assumptions.	

Figure 2 Dell PowerEdge Processor and Memory Selector - Welcome page

<sup>&</sup>lt;sup>2</sup> http://www.poweredgecpumemory.com/

On the Configuration page (Figure 3), enter information the tool can use to provide configuration guidance. In Step 1, select a server type.

				Tell a Frie
PowerEdge Processor and Memory Selector				
Welcome Configuration Results				
STEP 1: Select server model (*=required)	Select a Server			
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STEP 2: Specify target memory		ACCOUNTED IN THE OWNER OF	ALC: NOT THE OWNER OF THE OWNER OWNER OF THE OWNER OWNER OF THE OWNER OWNE	
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STEP 3: Select performance bin	- The second	The state of the s		-
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different computing needs:				
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STEP 4: Check applicable reliability features		In the second se	And and a second s	T
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Fault Resilient Memory (FRM)			Contraction of the same state	and the second

Figure 3 Dell PowerEdge Processor and Memory Selector - Configuration page

Once you've selected a server, the tool displays basic information about the server to help you decide which server most effectively meets your needs, as shown on the right panel of the Configuration page in Figure 4.

View Options Help	
Il PowerEdge Processor and Memory Selector Welcome Configuration Results STEP 1: Select server model (*=required)	Tell a Fre PowerEdge R730 Intel Xeon E5-2600v3 (x2) 24 DIMMS
necessary to support the operating system and applications for your choice of Dell PowerEdge.           R730 Intel Xeon E5-2600v3 (x2) 24 DIMMS       ●         Processor Information       ●         STEP 2:       Specify target memory         Number of processor(s)       2         Number of DIMMS       24         Installed       Min         Target       Max         memory (GB)       8         STEP 3:       Select performance bin         The Intel Xeon processor product family offers a range of processors that can deliver the right blend of performance, price and features to match different computing needs:       0         Output Dire       0       0	Overview         • The corporate IT standard to adapt to any workload, I/O optimized for VDI, and 2:1 GPU applications, simplify IT, The R730, unprecedented scalability to meet all your needs.         Exercise         • 2U 2S workhorse for a wide range of workloads         • New third generation embedded management automates deployment and routine tasks to provide effortless
Advanced Bin Standard bin Basic bin     Segment Optimized STEP 4: Check applicable reliability features     Memory mirroring     Fault Resilient Memory (FRM)     Submit Data	<ul> <li>system management and serviceability</li> <li>Best for Virtualization with Failsafe Hypervisor, large memory foot print and Dell Fault Resilient Memory technology</li> <li>Internal GPU support for compute intensive workloads and VDI</li> <li>Highly flexible configuration options to precisely fit your needs, including modular TPM</li> </ul>

Figure 4 Dell PowerEdge Processor and Memory Selector - Server selection

Click **Processor Information** for detailed information on the processor family of the chosen server (Figure 5). On the Processor Information page, click the link (Figure 5, circled in red) for details about the processor product family.



Figure 5 Dell PowerEdge Processor and Memory Selector - Processor information

The processor page (Figure 6) provides detailed information about the platform-supported processor product family, including part numbers, core count, cache size, and clock frequency. The processors are divided into descriptive categories with application guidance for each category to help you match your requirements with the appropriate processor model.

Intel® Xeon® processor E3-2600v3 product family The Intel® Xeon® processor E5-2600v3 pro enable IT managers to succeed. Selecting the Processor That Is Right for N	duct family has the performance			
The Intel® Xeon® processor E5-2600v3 pro- enable IT managers to succeed. Selecting the Processor That Is Right for \	duct family has the performanc			_
Selecting the Processor That Is Right for N		xe, the efficiency and is focuse	ed on bring the Service Quality to	(
	You			
The Intel® Xeon® processor E5-2600v3 pro features to match different computing need	duct family offers a range of pr	ocessors that can deliver the r	ight blend of performance, price and	
Advanced	». I: Offers highest functionality a	nd optimal server return on in	vestment (ROI)	
Standard	: Best mix of performance, val	ue and advanced features	vestment (roly	
Basic	: Cost-sensitive customers seek	ing basic features		
Low power	r: Focused on energy efficiency	and designed to deliver lowe	est power and best performance per wa	att
Frequency optimized	l: Ideal for high-performance o processor offering	omputing (HPC) and technica	I computing with the highest frequenc	y
	Processor Number	Cores/Cache	Frequency	
Advanced	E5-2650 v3	10C/ 25M	2.3GHz	
	E5-2660 v3	10C/ 25M	2.8GHz	
	E5-2670 v3	12C/ 30M	2.3GHz	
	E5-2680 v3	12C/ 30M	2.5GHz	
	E5-2690 v3	12C/ 30M	2.6GHz	
Basic	E5-2603 v3	6C/ 15M	1.6GHz	
	E5-2609 v3	6C/ 15M	1.9GHz	
Low Power	E5-2630L v3	8C/ 20M	1.8GHz	
	E5-2650L v3	12C/ 30M	1.8GHz	
Segment Optimized	E5-2667 v3	8C/ 20M	3.2GHz	
	E5-2699 v3	18C/ 45M	2.3GHz	
	E5-2623 v3	4C/ 10M	3.0GHz	
	E5-2637 v3	4C/ 15M	3.5GHz	
	E5-2643 v3	6C/ 20M	3.4GHz	
	E5-2683 v3	14C/ 35M	2.0GHz	
	E5-2685 v3 *	12C/ 30M	2.6GHz	
	E5-2695 v3	14C/ 35M	2.3GHz	
	E5-2697 v3	14C/ 35M	2.6GHz	
	E5-2698 v3	16C/ 40M	2.3GHz	
Standard	E5-2620 v3	6C/ 15M	2.4GHz	
Standard	E5-2630 v3	8C/ 20M	2.4GHz	
	E5-2640 v3	8C/ 20M	2.6GHz	
Workstation	E5-1620 v3	4C/ 10M	3.5GHz	
	E5-1630 v3	4C/ 10M	3.7GHz	
	E5-1650 v3	6C/ 15M	3.5GHz	
	E5-1660 v3	8C/ 20M	3.0GHz	
	E5-1680 v3	8C/ 20M	3.2GHz	
	E5-2887W/v3	10C/ 25M	3.1GHz	
	20200777700	100/20W	0.10112	

Figure 6 Dell PowerEdge Processor and Memory Selector - Processor details

After selecting a processor category, click **Close** to return to the Dell PowerEdge Processor and Memory Selector Configuration page (Figure 4).

Step 2 provides guidance for memory configuration, again based on user input. First, enter the number of processors for the server. Based on the number of processors, the **Installed memory (GB)** fields, comprising the maximum number of DIMMs and the minimum and maximum memory sizes, update automatically (Figure 7).

	Tell a Frie
l PowerEdge Processor and Memory Selector Welcome Configuration Results	RewerEdge R720 Intel Year E5 2600//2 (v2) 24 DIMMS
Steed server model ("=required)           t is recommended to know the minimum processor or memory           recessary to support the operating system and applications for your           choice of Dell PowerEdge.           R730 Intel Xeon E5-2600V3 (x2) 24 DIMMS	
STEP 2:       Specify farget memory         Number of processor(s)       2         Number of DIMMS       24         nemory (GB)       8       2         Target memory is beyond the given limit.       0         Closest available memory size (GB)       0         STEP 3:       Select performance bin         The Intel Xeon processor product family offers a range of processors that can deliver the right blend of performance, price and features to match ifferent computing needs:	Overview           • The corporate IT standard to adapt to any workload, I/O optimized for VDI, and 2:1 GPU applications, Simplify IT, The R730, unprecedented scalability to meet all your needs.           Benefits           • 2U 2S workhorse for a wide range of workloads           • New third generation embedded management automates deployment and routine tasks to provide effortless
Advanced Bin     Standard bin     Segment Optimized     Step 4:     Check applicable reliability features     Memory mirroring     Advanced ECC	system management and serviceability <ul> <li>Best for Virtualization with Failsafe Hypervisor, large memory foot print and Dell Fault Resilient Memory technology</li> <li>Internal GPU support for compute intensive workloads and VDI</li> </ul>
Fnable rank sparing     Fault Resilient Memory (FRM)     Submit Data	<ul> <li>Highly flexible configuration options to precisely fit your needs, including modular TPM</li> </ul>

Figure 7 Dell PowerEdge Processor and Memory Selector – Setting processor count



Next, set the desired target memory size based on the server operating system, application, and workload (Figure 8). The target memory size must be within the range specified by the **Min** and **Max** fields (inclusive). The application automatically finds the closest available memory size matching the target memory value supplied.

	Email a Report Tell a Frie
Velcome Configuration Results	
TEP 1: Select server model (*=required)	PowerEdge R730 Intel Xeon E5-2600v3 (x2) 24 DIMMS
t is recommended to know the minimum processor or memory recessary to support the operating system and applications for your hoice of Dell PowerEdge.	
R730 Intel Xeon E5-2600v3 (x2) 24 DIMMS	
Processor Information	
STEP 2: Specify target memory	
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nstalled Min Target* Max	
(Insest available memory size (GB)	Overview
	<ul> <li>The corporate IT standard to adapt to any workload, I/O optimized for VDI, and 2:1 GPU applications,</li> </ul>
TEP 3: Select performance bin	Simplify IT, The R730, unprecedented scalability to meet all your needs.
The Intel Xeon processor product family offers a range of processors that	Benefits
an deliver the right blend of performance, price and features to match	<ul> <li>2U 2S workhorse for a wide range of workloads</li> </ul>
	<ul> <li>New third generation embedded management automates deployment and routine tasks to provide effortless</li> </ul>
Advanced Bin      Standard bin     Basic bin     Scampet Optimized	system management and serviceability
Segment Optimized	<ul> <li>Best for Virtualization with Failsafe Hypervisor, large memory foot print and Dell Fault Resilient Memory technology</li> </ul>
TEP 4: Check applicable reliability features	Internal CDL support for announce intension undefinede and VDL
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Submit Data	

Figure 8 Dell PowerEdge Processor and Memory Selector – Setting target memory size

In Step 3, select the processor performance bin (Figure 9) based upon the information garnered from the Processor Information page (Figure 6) in Step 1.

Https://roianalyst.alinean.com/dell/AutoLogin.do?d=240	4933 P + 🗎 C × 🥘 alinean.com ×
File • View • Options • Help • Dell PowerEdge Processor and Memory Selector	Email a Report Create a Report Tell a Friend
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Enable rank sparing     Enable rank sparing     Fault Resilient Memory (FRM)	<ul> <li>Highly flexible configuration options to precisely fit your needs, including modular 1 PM</li> </ul>
Submit Data	
Dell	Previous Next Several by

Figure 9 Dell PowerEdge Processor and Memory Selector – Setting processor performance bin



In Step 4, select the memory reliability features (Figure 10). The various choices here affect the final number of required DIMMs, and you may need to adjust the target memory size in Step 2.

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File * View * Options * Help * Dell PowerEdge Processor and Memory Selector	Email a Report Create a Report Tell a Friend
Welcome Configuration Results	
STEP 1:       Select server model (*=required)         It is recommended to know the minimum processor or memory necessary to support the operating system and applications for your choice of Dell PowerEdge.         R730 Intel Xeon E5-260v3 (x2) 24 DIMMS         Processor Information         STEP 2:       Specify target memory         Number of processor(s)       2 • 0         Number of DIMMS       24         Installed       Min         memory (GB)       8         STEP 2:       Select performance bin         Closest available memory size (GB)       16         STEP 3:       Select performance bin         The Intel Xeon processor groduct family offers a range of processors that can deliver the right blend of performance, price and features to match different computing needs:	PowerEdge R730 Intel Xeon E5-2600v3 (x2) 24 DIMMS
Advanced Bin <u>Standard bin</u> Basic bin     Secreant Optimized      STEP 4: Check applicable reliability features     Memory mirroring <u>I</u> Advanced ECC II     Enable rank sparing <u>I</u> Limit to X4 DIMMs II     Fault Resilient Memory (FRM) II	<ul> <li>New third generation embedded management automates deployment and routine tasks to provide effortless system management and serviceability</li> <li>Best for Virtualization with Failsafe Hypervisor, large memory foot print and Dell Fault Resilient Memory technology</li> <li>Internal GPU support for compute intensive workloads and VDI</li> <li>Highly flexible configuration options to precisely fit your needs, including modular TPM</li> </ul>
Suumit Lists	
Dell	Previous Next Previous Alinean

Figure 10 Dell PowerEdge Processor and Memory Selector – Memory reliability features

In the example shown in Figure 11, selecting the memory reliability option **Advanced ECC** causes the minimum limit of the installed memory to increase from 8GB to 16GB, which results in the requested value "Target" to fall outside of the allowed range of values.



Figure 11 Dell PowerEdge Processor and Memory Selector – Target memory size invalid



Adjusting the target memory size to 16GB in the example corrects the error (Figure 12).

	Email a Report Create a Report Tell a Fri
I PowerEdge Processor and Memory Selector Welcome Configuration Results STEP 1: Select server model ("=required)	PowerEdge R730 Intel Xeon E5-2600v3 (x2) 24 DIMMS
It is recommended to know the minimum processor or memory necessary to support the operating system and applications for your choice of Dell PowerEdge.	
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STEP 4:       Check applicable reliability features         Memory mirroring       Image: Advanced ECC         Enable rank sparing       Image: Limit to X4 DIMMs         Fault Resilient Memory (FRM)       Image: Limit to X4 DIMMs	technology Internal GPU support for compute intensive workloads and VDI Highly flexible configuration options to precisely fit your needs, including modular TPM

Figure 12 Dell PowerEdge Processor and Memory Selector – Target memory size correction



Once you are satisfied with the server configuration, click **Submit Data** or click **Next** to see the recommended results (Figure 13).

	Email a Report Oreate a Report Tell a Frie
Il PowerEdge Processor and Memory Selector Welcome Configuration Results	
STEP 1: Select server model ("=required) It is recommended to know the minimum processor or memory necessary to support the operating system and applications for your	PowerEdge R730 Intel Xeon E5-2600v3 (x2) 24 DIMMS
choice of Dell PowerEdge. R730 Intel Xeon E5-2600v3 (x2) 24 DIMMS Processor Information	
STEP 2:     Specify target memory       Number of processor(s)     2       Number of DIMMS     24       Installed     Min       Target*     Max       memory (GB)     16       =     16       =<	
Closest available memory size (GB)	Overview     The corporate IT standard to adapt to any workload, I/O optimized for VDI, and 2:1 GPU applications, Simplify IT, The R730, unprecedented scalability to meet all your needs.
The Intel Xeon processor product family offers a range of processors that can deliver the right blend of performance, price and features to match different computing needs:	Benefits     2U 2S workhorse for a wide range of workloads     New third generation embedded management automates deployment and routine tasks to provide effortless
Advanced Bin     Standard bin     Sagment Optimized  STEP 4:     Check applicable reliability features	system management and serviceability  Best for Virtualization with Failsafe Hypervisor, large memory foot print and Dell Fault Resilient Memory technology
Memory mirroring     Memory mirroring     Advanced ECC     Advanced ECC     Fault Resilient Memory (MM)     Fault Resilient Memory (MM)	<ul> <li>Internal GPU support for compute intensive workloads and VDI</li> <li>Highly flexible configuration options to precisely fit your needs, including modular TPM</li> </ul>

Figure 13 Dell PowerEdge Processor and Memory Selector – Submit data



In the example in Figure 14, the tool notifies the user that the chosen memory configuration does not use all of the available memory channels, creating an unbalanced configuration. To change the memory configuration, return to the Configuration page by clicking the Configuration tab or clicking **Previous**.

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Dell PowerEdge Pro	guration	esults	tor			_					
Mixed configurations selected reliability fea selection. Select one	will limit channel in tures, the closest of the options and	nterleaving, the t available men d click on "Get	ereby limitir nory and po your repor	ng memory performance. I opulation of channels varie t" button to get further def	ncreasing mem es. Following a tails on the cho	nory size to proc re the configura sen option.	luce homo ation option	geneous DIMM type is re s available based on the	commended. De	epending upon the	
			R730	Intel Xeon E5-260	0V3 (x2) 2	4 DIMMS		Get your report			
Option1: Nominal	Configuration			Option2: Maximum	Performance			Option3: Balanced	I Configuration		
The recommended optim	The recommended configuration is based on finding the optimal minimum DIMM size.				The recommended configuration is focused on finding the optimal DIMM size based on performance (speed). The recommended configuration is focused on formation optimal DIMM size based on performance (speed).			ocused on finding the ance (speed) and power.			
	Relative Amount: \$\$\$\$				Relative Amount: \$\$\$\$				Relative	Amount: \$\$\$\$	
	Slot 0 Sl	lot 1 S	lot 2	1	Slot 0 S	ilot 1 SI	ot 2		Slot 0	Slot 1 Slot 2	
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Channel 1	4	0	0	Channel 1	4	0	0	Channel 1	4	0 (	5
Channel 2	0	0	0	Channel 2	0	0	0	Channel 2	0	0 (	2
Channel 3	0	0	0	Channel 3	0	0	0	Channel 3	0	0 0	)
This is an unbalanced configuration. You may consider changing your target memory size to get to balanced solution.       This is an unbalanced configuration. You may consider changing your target memory size to get to balanced solution.       This is an unbalanced configuration. You may consider changing your target memory size to get to balanced solution.         Closest available memory.       1000       Closest available memory.       16GB       Closest available memory.       16GB         Quantity: 4   RDIMM   4GB IR x8/2133   Y8R2G, DDR4       Quantity: 4   RDIMM   4GB IR x8/2133   Y8R2G, DDR4       Quantity: 4   RDIMM   4GB IR x8/2133   Y8R2G, DDR4       Quantity. 4   RDIMM   4GB IR x8/2133   Y8R2G, DDR4											
System memory speed Relative power ranking	d: 0:	213	33@1.2V	System memory speed: Relative power ranking:		213	3@1.2V	System memory speed Relative power ranking		2133@1.2\	
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Dell				Previous	lepo	rt 🚔				Aline	an

Figure 14 Dell PowerEdge Processor and Memory Selector – Results page for unbalanced configuration

The Dell PowerEdge Processor and Memory Selector Results page (Figure 15) displays multiple configurations that balance power consumption with system performance. In this example:

- **Option 1: Nominal Configuration** stresses finding the minimum DIMM size that meets the user requirements.
- **Option 2: Maximum Performance Configuration** finds the optimal DIMM size to maximize performance.
- **Option 3: Balanced Configuration** provides a memory configuration that provides a balance between maximizing performance and minimizing power consumption.

View Options Help  Help	emory Selector Results Interleaving, thereby limiti t available memory and p d click on "Get your repo R730 xased on finding the	ing memory performance. Inc opulation of channels varies rt" button to get further detai D Intel Xeon E5-2600 Option2: Maximum Pe	reasing memory size Following are the cc is on the chosen option IV3 (x2) 24 DIMI enformance	to produce homo infiguration optior in. MS	geneous DIMM type is reco is available based on the Get your report	Email a Report	Create a Report Tell a Frie
ell PowerEdge Processor and Me Welcome Configuration R Mixed configurations will limit channel in selected reliability features, the closest selection. Select one of the options and O Option1: Nominal Configuration The recommended configuration is bu optimal minimum DIMM Relative A	emory Selector Results Interleaving, thereby limiti t available memory and p d click on "Get your repo R730 xased on finding the	ing memory performance. Inc opulation of channels varies rt" button to get further detai D Intel Xeon E5-2600	reasing memory size . Following are the cr is on the chosen opti IV3 (x2) 24 DIM erformance	to produce homo infiguration option on. VIS	geneous DIMM type is reco is available based on the Get your report	mmended. Dep	ending upon the
Mixed configurations will limit channel is selected reliability features, the closest selection. Select one of the options and O Option1: Nominal Configuration The recommended configuration is be optimal minimum DIMM Relative A	Interleaving, thereby limiti t available memory and p d click on "Get your repo R730 pased on finding the	ng memory performance. Inc opulation of channels varies rt" button to get further detai 0 Intel Xeon E5-2600	reasing memory size . Following are the co Is on the chosen opti IV3 (X2) 24 DIMI erformance	to produce homo onfiguration option on. MS	geneous DIMM type is reco is available based on the Get your report	ommended. Dep	ending upon the
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O Option1: Nominal Configuration The recommended configuration is bi optimal minimum DIMM Relative A	ased on finding the	Option2: Maximum Pe	erformance				
The recommended configuration is b optimal minimum DIMN Relative A	ased on finding the				Option3: Balanced 0	Configuration	
Relative A	M size.	The recommended configuration is focused on finding the optimal DIMM size based on performance (speed).			The recommended configuration is focused on finding the optimal DIMM size based on performance (speed) and power.		
	Relative Amount: \$\$\$\$			Relative Amount: \$\$\$			Amount: \$\$\$
Slot 0 Sl	lot 1 Slot 2	Slo	ot 0 Slot 1	Slot 2		Slot 0 Sl	lot 1 Slot 2
Channel 0 4	4 0	Channel 0	8 0	0	Channel 0	8	0 0
Channel 1 4	4 0	Channel 1	8 0	0	Channel 1	8	0 0
Channel 2 4	4 0	Channel 2	8 0	0	Channel 2	8	0 0
Channel 3 4	4 0	Channel 3	8 0	0	Channel 3	8	0 0
Closest available memory: 64GB Quantity: 16   RDIMM   4GB 1R x8	8/2133   Y8R2G, DDR4	Closest available memory: Quantity: 8   RDIMI	64GB M   8GB 2R x8/2133	H8PGN, DDR4	Closest available memor Quantity: 8   RDIN	ry: 64GB VIM   8GB 2R x8	3/2133   H8PGN, DDR4
System memory speed: Relative power ranking:	1866@1.2V	System memory speed: Relative power ranking:		2133@1.2V	System memory speed: Relative power ranking:		2133@1.2V
		III					
		Previous	Report				Powered

Figure 15 Dell PowerEdge Processor and Memory Selector – Results page for final configuration

For a PDF-formatted report for each recommended configuration, click the radio button by the configuration option(s), and then click **Get your report** or click **Report** (Figure 16).

	rocessor and Me	emory Select	tor								
Welcome Cor	nfiguration R	tesults									
Mixed configuration selected reliability f selection. Select on	ns will limit channel in reatures, the closest ne of the options and	nterleaving, the t available mem d click on "Get y	reby limiti ory and p /our repo R730	ng memory performance opulation of channels va rt" button to get further d	<ul> <li>Increasing meaning</li> <li>Following</li> <li>Jetails on the ch</li> <li>600v3 (x2)</li> </ul>	emory size to pro are the configur nosen option. 24 DIMMS	educe homo ration option	geneous DIMM type is re is available based on the Get your report	ecommended. De e	epending upon ti	he
O Option : Nomin	al Configuration			Option2: Maximur	m Performance			Ontion3: Balance	d Configuration		
The ecommende opt	ed configuration is b imal minimum DIMN	ased on finding M size.	the	The recommended of optimal DIMM s	configuration is size based on pe	focused on findin erformance (spee	ng the d).	The recommended optimal DIMM size b	configuration is a ased on performa	ocused on findir ance (speed) and	ng the I power.
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Channel 0	4	4	0	Channel 0	8	0	0	Channel 0	8	0	0
Channel 1	4	4	0	Channel 1	8	0	0	Channel 1	8	0	0
Channel 2	4	4	0	Channel 2	8	0	0	Channel 2	8	0	0
Channel 3	4	4	0	Channel 3	8	0	0	Channel 3	8	0	0
Closest available m Quantity: 16	emory: 64GB RDIMM   4GB 1R x8	3/2133   Y8R2G	, DDR4	Closest available men Quantity: 8   RI	nory: 640 DIMM   8GB 2R	9B x8/2133   H8PG	N, DDR4	Closest available mer Quantity: 8   R	nory: 64G DIMM   8GB 2R	B x8/2133   H8PG!	N, DDR4
System memory spe	eed:	186	3@1.2V	System memory speed	d:	213	33@1.2V	System memory spee	d:	213	33@1.2V
Relative power rank	ing:			Relative power ranking	g:			Relative power rankin	9:		

Figure 16 Dell PowerEdge Processor and Memory Selector – Get report



Select the "Dell PowerEdge Processor and Memory Selector Analysis" template and click **Create Report** (Figure 17).

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Mixed configuratio	ns will limit channel interle	Cuesto a Popout	comme		pon the		
selection. Select o	ne of the options and clid Choose	a template from below and click "Create Report" to prepare a report.					
		Dell PowerEdge Processor and Memory Selector Analysis					
Option1: Nomi	nal Configuration		I Confid				
The recommend	ded configuration is based		ponfigur	ration is focused on	finding the		
op	otimal minimum DIMM size		sed on	performance (speed	d) and power.	=	
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Channel 0	4				0		
Channel 1	4						
Channel 2	4						
Channel 3	4						
Closest available n	nemory: 64GB		lory:				
Quantity: 18	RDIMM   4GB 1R x8/213	🚔 Create Report	DIMM		18PGN, DDR4		
			-				
System memory sp					2133@1.2V		
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Figure 17 Dell PowerEdge Processor and Memory Selector – Report template

#### **Order validator**

Dell ordering tools protect your Dell PowerEdge server orders by validating that the selected server configuration can be supported by the selected power supply(s). If the selected power supply cannot support the hardware configuration, the order validator directs you to upgrade the power supply or downgrade the server configuration, and blocks the order from being submitted. If for some reason you are unsuccessful in ordering a power supply configuration that the **Help Me Choose for PSUs** feature shows as supported, contact Dell Sales for assistance.



### Components

Various component options are available on Dell PowerEdge servers that can reduce power consumption. The overall power savings are compounded when power distribution (voltage regulator and power supply) efficiencies are also considered.

#### Processor

For multiple generations, Dell PowerEdge servers have supported low-voltage versions of Intel Xeon processors that provide equivalent performance with lower power consumption. If one of the low-voltage processor options meets your performance and feature requirements, Dell recommends selecting the low-voltage processor version for additional power reduction.

#### Memory

Many factors impact memory power consumption, including the DIMM type, organization, DRAM technology, DIMM capacity, operating frequency, and operating voltage. In addition to using the Memory Advisor tool, here are some general guidelines for selecting a memory configuration:

- Consider higher capacity DIMMs to reduce the number of total DIMMs and DIMMs per channel (DPC). As a general rule, two DIMMs of the same frequency and technology type will use more power than a single DIMM of twice the capacity. For instance, two 4GB DIMMs will use more power than a single 8GB DIMM. An additional benefit may be seen as reducing the DPC may allow a memory configuration to operate at a higher frequency and improve overall performance.
- Select DIMMs with x8 DRAM. DIMMs with x8 DRAM have half as many DRAM devices accessed at a time compared to DIMMs with x4 DRAM, reducing average power consumption.

#### Storage

When selecting storage, there are many options that impact storage power consumption. Here are some general guidelines for selecting a storage configuration:

- Consider higher capacity hard drives to reduce the number of total hard drives. Workload should be carefully considered, as reducing the number of hard drives may impact the performance workloads sensitive to Input/Output Per Second (IOPS).
- **Consider solid-state drives (SSD).** While SSDs have limited capacity, they typically consume less power than hard disk drives that require a motor to spin the disk. They also have a much lower latency and larger bandwidth.
- **Consider lower RPM hard drives.** Typically, the lower the hard drive RPM, the lower the power consumption. Customer usage models that do not require top-end storage performance can benefit from lower power consumption.
- **Consider 2.5-inch hard drives**. Typically, hard drive power consumption is lower with smaller form factors.
- Consider software RAID for configurations with four drives or less. Software RAID is supported across the new PowerEdge server portfolio for configurations with four drives or less, which significantly reduces power consumption by removing a hardware RAID adapter from the configuration. While hardware RAID provides higher performance, configurations with four drives or less typically do not require top-end storage performance.

#### **Power supply**

Power supply selection can have a significant impact on the power consumption of the system. The new PowerEdge server portfolio supports a broad power supply portfolio to help customers select a power supply appropriate for their hardware configuration. Power supplies are typically more efficient when operating at a larger percentage of the rated output. Selecting a lower rated output power supply (right-sizing) increases the percentage of the load to rated output. This is especially true for redundant PSU configurations that load share. When right-sizing, you should consider future server hardware upgrades to avoid the need for upgrading the power supply.

In addition to right-sizing, the power supply portfolio offers upgrade options for higher efficiency levels. When combined with right-sizing, the highest-efficiency power supply configuration can be selected for your configuration.



Figure 19 PSU power dissipation vs. system load

### **BIOS Settings**

The Dell PowerEdge 13<sup>th</sup> generation servers support system profiles that serve as "easy buttons" for applying default BIOS and firmware values targeted for performance, performance-per-watt, or RAS for dense configurations. You can select System Profiles as part of your order to be programmed in the Dell factory. If you are interested in power efficiency, a performance-per-watt profile is recommended. Dell specifically recommends the Dell Active Power Controller (DAPC) BIOS Setting in the ordering tool.

### How to configure a server for power efficiency

When you purchase a new PowerEdge server, you will receive a server that has been designed with a heavy design focus on power efficiency. However, there are many tweaks you can make to your server to save even more power. These additional adjustments take advantage of your particular usage model.

### No performance impact

Some tweaks may impact performance while others may not. The tweaks in this section do not impact performance.

#### Hardware setup

C-states are low-power processor states that help with IDLE power. USB devices like mice and keyboards can impact processor C-states by preventing the system from entering low-power states. USB devices also require power from the server, increasing the server's total power consumption. Using remote access and removing USB devices that are not required can often reduce the server's power consumption.

#### Unused services and ports

System BIOS provides multiple setup options to disable unused devices and ports. Disabling these devices allows the BIOS to configure them to reduce consumed power. Table 1 lists the BIOS setup options.

Location	Submenu	Setting	Recommendation
System BIOS Settings	SATA settings	Embedded SATA	Disable if not used to reduce power.
System BIOS Settings	Integrated devices	Integrated RAID controller	Disable if not used to reduce power.
System BIOS Settings	Integrated devices	User-accessible USB ports	Disable if not used to reduce power.
System BIOS Settings	Integrated devices	Internal USB port	Disable if not used to reduce power.
System BIOS Settings	Integrated devices	Integrated network card 1	Disable if not used to reduce power.
System BIOS Settings	Integrated devices	Slot disablement	Disable if not used to reduce power.
iDRAC Settings	Network	Enable NIC	Disable if not used to reduce power.

Table 1	Catura		ام م م ، ، م ا	م م ب با م م م	اء مر ما	
Table T	setup a	opuons:	Unused	devices	and	ports

#### **Power supply**

Power supplies are optimized to run with high-line (230V) input voltage. While PowerEdge power supplies support auto-ranging, low-line (115V) operation can reduce overall efficiency by about 2%.

When you order redundant power supply configurations, overall system power efficiency is reduced by power supplies sharing the load and operating at a lower point on their efficiency curves. Rack and tower PowerEdge

servers support Power Supply Hot Spare, which puts the redundant power supply in a "sleep state" to remove the efficiency impact of redundant power supply configurations. Hot Spare is enabled by default, and you can select which of the power supplies will be the hot spare primary. This should be the power supply on the most cost-effective and power-efficient grid, as the primary power supply may see the majority of the load. Rack and tower PowerEdge servers also support the ability to disable power factor correction (PFC) to reduce power consumption when the system is in standby (S5 state).

Table 2 lists the setup options for configuring the power supply.

Table 2	Setup options:	Power	supply
---------	----------------	-------	--------

Location	Submenu	Recommendation
Power Configuration	Power supply redundancy policy	Set to redundant if PSU can support server hardware configuration.
Power Configuration	Enable hot spare	Redundant PSU configuration required.
Power Configuration	Primary power supply unit	Select PSU connected to most efficient or cost-effective power grid.
Power Configuration	Enable power factor correction	Disable to reduce S5 standby power.

#### **Component updates**

Dell periodically releases updates for components such as BIOS, drives, and firmware. These updates may provide improvements to performance and power consumption. Install the latest updates to ensure your servers have access to the latest improvements.

### Potential for minor performance impact

New PowerEdge servers support multiple tweaks that may have a minor impact to performance. The performance impact is often workload-dependent and may not be measurable with typical workloads.

#### System profiles

As first described in "How to order a server", system profiles serve as a quick and easy way to apply default BIOS and firmware values targeted for performance, performance-per-watt, or RAS for dense configurations. If you are interested in power efficiency, a performance-per-watt profile is recommended. Dell specifically recommends the Performance per Watt (DAPC) profile. This is the system's default setting.

#### Performance per Watt (DAPC)

DAPC is a Dell proprietary implementation of dynamic processor power management that provides superior performance-per-watt compared to OS-based dynamic power management. Unlike unique OS implementations, DAPC provides consistent results regardless of the operating system and provides dynamic processor power management even if it is not supported by the OS or hypervisor.

DAPC System profile is configured in the factory when you select "Power Saving Dell Active Power Controller" in the ordering tool. This is the recommended profile for performance-per-watt.

#### Performance per Watt (OS)

This profile uses OS-based dynamic processor power management. The effectiveness will vary based on the operating system implementation.

The Performance per Watt (OS) System profile is configured in the factory when you select the "Power Saving BIOS Setting" option in the ordering tool.

Table 3 provides the setup options for configuring the system profile.

#### Table 3Setup options: System profile

Location	Submenu	Setting	Description
System BIOS Settings	System Profile settings	System Profile	Select Performance per Watt (DAPC) profile.

Table 4 provides the setup option values associated with each system profile.

#### Table 4 System profile definitions

Subsystem	Setting	System Profile					
System		Performance	Performance per Watt (OS)	Performance per Watt (DAPC) (default)	Dense	Custom	
CPU	CPU Power Management	Maximum Performance	OS DBPM	System DBPM (DAPC)	System DBPM (DAPC)	System DBPM (DAPC)	
	Turbo Boost	Enabled	Enabled	Enabled	Disabled	Enabled	
	C1E	Disabled	Enabled	Enabled	Enabled	Enabled	
	C-States	Disabled	Enabled	Enabled	Enabled	Enabled	
	Monitor/MWait	Enabled	Enabled	Enabled	Enabled	Enabled	
Memory	Frequency	Maximum Performance	Maximum Performance	Maximum Performance	Dense Configuration Optimized	Maximum Performance	
	Patrol Scrub	Standard	Standard	Standard	Extended	Standard	
	Refresh Rate	1x	1x	1x	2x	1x	
Thermal	Thermal Algorithm	Maximum Performance	Minimum Power	Minimum Power	Dense Configuration Optimized	Maximum Performance	

#### Power management

This section refers to the dynamic management of a component's performance for a given workload to reduce power consumption.

Processor power management controls the use of processor performance states (P-states), where the processor operating frequency and voltage are dynamically adjusted to match workload performance requirements. For typical workloads, demand-based power management (DBPM) is recommended, particularly System DBPM (DAPC). Latency sensitive and deterministic-performance workloads could be

impacted by the delays required to transition between P-states. To disable P-state transitions and force the processor to always run at the rated frequency, set to Maximum Performance.

Processor C-states are IDLE, non-operational, low-power processor states. While C-states reduce IDLE power consumption, latency sensitive and deterministic-performance workloads could be impacted by the delay to exit a C-state. Deeper C-states provide greater power savings but have longer exit delays.

Memory Clock Enable (CKE) and self-refresh power management features reduce memory power when IDLE. Like processor P- and C-states, latency sensitive and deterministic-performance workloads could be impacted. PowerEdge servers also support power management of the Quick Path Interconnect (QPI) interface on Intel Xeon processors. QPI power management also introduces latency penalties for returning to a performance state. Memory and QPI power management are tied to the C1E and C-state setup options and can be disabled.

Dell PowerEdge RAID controllers (PERC) support Physical Disk Power Management through the Dell OpenManage Storage Management application. Like power management features for processor and memory, Physical Disk Power Management spins down IDLE drives to reduce power consumption. Physical Disk Power Management is disabled by default.

Table 5 provides the setup options for configuring power management.

Table 5	Setup	options:	Power	management
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Location	Submenu	Setting	Description
System BIOS Settings	System Profile Settings	CPU Power Management	Enable System DBPM (DAPC).
System BIOS Settings	System Profile Settings	C1E	Enable C1E. Also enables DIMM CKE power down and QPI power management.
System BIOS Settings	System Profile Settings	C States	Enable C-states. Also enables DIMM self- refresh.
System BIOS Settings	System Profile Settings	Monitor / Mwait	Disable for rogue OS that does not comply with C-states disabled. Can be set to disabled only when the C-state option is set to disabled.
Open Manage Server Administrator	Storage	Power Saving Mode	Maximum Power Saving Mode to reduce IDLE power of all drives.
Open Manage Server Administrator	Storage	Time Interval for Spin Down (in Minutes)	Shorten time for more aggressive power savings.
Open Manage Server Administrator	Storage	Spin Down Unconfigured	Enable to spin down unconfigured drives to reduce power.
Open Manage Server Administrator	Storage	Spin Down Hot Spares	Enable to spin down Hot Spare drives to reduce power.
Open Manage Server Administrator	Storage	Spin Down Configured	Enable to spin down configured drives to reduce IDLE power.

Location	Submenu	Setting	Description
Open Manage Server	Storage Saving (Idle C)	Automatic	Enable Idle C to reduce
Administrator		Disk Power	IDLE power.

#### Reduce top-end power consumption

You can also reduce power by limiting top-end performance. The performance impact of reducing top-end performance is workload dependent, and may be acceptable for many workloads. Turbo Boost is a performance feature in Intel processors that provides temporary operation above the rated processor frequency. The benefit of Turbo Boost is based on power and thermal headroom where there can be performance variations; for example, between processor sockets and servers. Workloads requiring deterministic performance may need to disable Turbo Boost.

Turbo Boost does present some challenges to the system due to the additional power required to support the performance bursts. The additional power allocation that is required to run in Turbo Boost mode can impact power supply right-sizing. If Turbo Boost is disabled, its power allocation can be removed from the platform power budget to support a smaller power supply, or it can be re-allocated to support additional components, such as memory or storage.

Reducing memory frequency is another option to reduce power by reducing top-end performance. Reducing memory frequency will have a direct impact on DIMM power consumption.

Table 6 Reducing top-end power consumption					
Location	Submenu	Setting	Description		
System BIOS Settings	System Profile Settings	Turbo Boost	Disable to reduce peak power. Requires Custom System Power.		
System BIOS Settings	System Profile Settings	Memory Frequency	Set to lower frequency to reduce power. Requires Custom System Power.		
Processor Settings	QPI Speed	QPI Speed	Set to lower speed to reduce power.		
System BIOS Settings	Processor Settings	Number of Cores per Processor	Minimize active physical cores to reduce power.		
Devices	Device Specific	Link Speed	For each adapter, review settings for power options. For example, set to lower speeds to reduce power.		

Table 6 highlights setup options to reduce top-end power consumption.

#### Thermal management

Thermal management options can also impact power consumption. By default, the Thermal Base Algorithm is set to Auto, which maps to the selected system profile. If a Performance per Watt system profile was not selected, the Thermal Base Algorithm can be set to Minimum Power, which will reduce the fan speed response in high ambient environments, which will reduce total system power that may have slight performance impacts. Minimum Power setting provides a balance of performance and power and is the Thermal Base Algorithm setting mapped to the Performance per Watt system profiles.

Table 7 provides the setup options for thermal management.

Location	Submenu	Setting	Description
iDRAC Settings	Thermal	Thermal Base Algorithm	Set to Auto if System Profile is Performance per Watt (DAPC). Otherwise, set to Minimum Power.

#### Table 7 Setup options: Thermal management

#### **Miscellaneous**

Table 8 describes miscellaneous power setup options.

Location	Submenu	Setting	Description
System BIOS	Processor	Adjacent Cached Line	Disable for performance per watt.
Settings	Settings	Prefetcher	
System BIOS Settings	Processor Settings	Hardware Prefetcher	Disable for performance per watt.
System BIOS	Processor	DCU Streamer	Disable for performance per watt.
Settings	Settings	Prefetcher	
System BIOS Settings	Processor Settings	DCU IP Prefetcher	Disable for performance per watt.
System BIOS Settings	System Profile Settings	Memory Refresh Rate	Set to 1x to reduce power.
System BIOS	System	AC Power Recovery	Select random or specify to minimize datacenter power spikes after AC recovery.
Settings	Security	Delay	
System BIOS	Miscellaneous	In-System	Enable for optimal tuning for power. May increase boot time after configuration change.
Settings	Settings	Characterization	

 Table 8
 Miscellaneous power setup options

#### Power capping

Dell PowerEdge 13<sup>th</sup> generation servers support a user-defined power cap through iDRAC8 and OpenManage Power Center. If data center-level efficiency curves are understood, power capping can be used to limit server power consumption to optimize overall data center power efficiency. Power capping can also be used to reduce peak power consumption. Depending on workload, performance impact may be negligible. See Figure 19 for an example of power capping.

Table 9 provides the setup options for configuring power capping.

ere					
Location	Submenu	Setting	Description		
Power Configuration	iDRAC Power Cap Policy	Enable if system power limit is desired.	Set to limit sustained power consumption.		
iDRAC Settings	Power Configuration	Maximum Power Limit (Watts, BTU/hr)	Set to limit sustained power consumption.		
iDRAC Settings	Power Configuration	Maximum % of Recommended System Limit	Set to limit sustained power consumption.		

Table 9Setup options: Power capping



Figure 20 Power capping example

#### **Operating systems**

Operating systems provide various power management configuration options such as USB selective suspend and video timeout. For details, review the operating system documentation on operating system power management features.

### About the authors

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