Dell PowerEdge VRTX Acoustics and Thermals

This Dell technical white paper guides users to optimal use of thermal and acoustical features of PowerEdge VRTX.

Chris E. Peterson

Rob Curtis

Tony Nava

Contents

July 2013 | Rev 1.0

Executive summary

Thermals and acoustics are key design areas of the Dell™ PowerEdge™ VRTX. Although delivery to the acoustical sensitivity of an open office layout is the primary focus of this white paper, several other thermal and acoustical design features are also discussed. These features include configuration-based acoustics, an Enhanced Acoustics option that enables users to maintain a quiet environment even with high-power processors, an Enhanced Cooling Mode (ECM) that provides for greater cooling capacity when desired, and fan speed offsets. Understanding these features can help users optimize the system for specific use cases in their particular environments.

Acoustical choices

Introduction

PowerEdge VRTX has been designed for open office acoustics. The host chassis has been mechanically designed to damp the baseline acoustical signature with respect to the wide range of supported power loads and hard disk drives (HDDs). Dell's patent-pending blower module delivers a smooth sound that is absent of tones (buzzes, hums, whistles, etc.) and yields a low acoustic intensity per delivered airflow. The resulting sound is generally masked by that of normal office air conditioning or conference room conversations.

The lowest acoustical values that PowerEdge VRTX will reach are represented in Table 1 below. Dell focuses on sound quality in addition to sound power level and sound pressure level. At LpA=36 dBA and no prominent tones (see descriptions of these metrics in Table 1), the sound is generally appropriate for an open office layout (see Table 2,

Sound quality describes how disturbing or pleasing a sound is interpreted, and Dell references a number of psychacoustical metrics and thresholds in delivering to it. Tone prominence is one such metric. Sound power and sound pressure levels increase with greater populations or higher utilization, while sound quality remains good even as the frequency content changes. Acoustical changes with components or utilization are described in the following section. More extensive description of Dell Enterprise acoustical design and metrics is available in the white paper "Dell Enterprise Acoustics."

Table 1. Lowest acoustical output that PowerEdge VRTX attains (for example, a low-feature configuration in idle mode), metrics used to describe it, and corresponding configuration and utilization.

Sound power level	Sound pressure level	Sound quality
LwA-UL, bels, re: 1 pW	LpA, dBA, re: 20 µPa	Prominent Tones
5.4	36	None present
LwA–UL is the upper limit sound power levels (LwA) calculated per section 4.4.1 of ISO 9296 (1988) and measured in accordance to ISO 7779 (2010).	LpA is the front bystander position A-weighted sound pressure level calculated per section 4.3 of ISO9296 (1988) and measured in accordance with ISO7779 (2010).	Prominent tone: Criteria of D.6, D.10, and D.11 of ECMA-74 12th ed. (2012) are followed to determine if discrete tones are prominent. The system is floor-standing and acoustic transducer is at front bystander position, ref ISO7779.

[1] "Dell Enterprise Acoustics," Chris E. Peterson, Dell, Inc., 2011.

Table 2. Acoustical reference points and output comparisons

	Value measured at your ears		Equivalent familiar noise experience
	LpA, dBA, re 20 µPa	Loudness, sones	
	90	80	Loud concert
	75	39	Data center, vacuum cleaner, voice must be elevated to be heard
	60	10	Conversation levels
PowerEdge VRTX with Standard M620	45	4	Whispering, open office layout, normal living room
PowerEdge VRTX with "Enhanced Acoustics" M620 and/or all M520s	35	2	Quiet office
	30	1	Quiet library
PowerEdge T620	20	0	Recording studio

Configuration and utilization guidance

Certain configurations and utilizations are quieter than others. If your environment is acoustically sensitive, Dell can help you choose the right configuration.

- **Cooling needs**: Airflow is the chief driver of noise for the PowerEdge VRTX, and the chassis has been designed to reduce impedance to airflow. Airflow reflects the heat power dissipation needs such that components meet their thermal specifications. Because some components' power may be relatively low compared to others but also have more stringent thermal requirements, you may not find the connection between airflow, acoustics and components to be intuitive. Table 3 is intended to help provide guidance. A few general statements can be made for minimization of acoustical output, for example, using all M520 server nodes or lowest power (or no) PCI cards.
- **Utilization distribution**: As workloads increase, component utilization and heat output increase. These require airflow, which, as mentioned in the earlier paragraph, result in greater acoustical output. The acoustical difference between idle and operating modes for a variety of configurations is shown in Table 3, Because utilization impacts acoustics, the distribution of the utilization can help in noise management. For example, if it is feasible in an application to distribute the work load over time, then the work load at any given time is lower and hence the airmover noise is lower. Another approach might be to plan the timing of greater work loads when fewer personnel are present; for example, overnight.

- **TurboBoost mode**: Acoustical levels can be kept low during operating modes when TurboBoost mode is turned off (in BIOS) for the processor. Operating modes can increase ~5 dBA (~50% louder) when TurboBoost mode is turned on.
- **HDDs**: Are a distant second in noise generation. However, the following will further reduce the acoustical signature after the above has been pursued. Spindle speed of HDDs is most closely tied with noise. As 10k are significantly quieter, they are recommended over 15k HDDs for reduction of acoustical output.
- **Power supplies**: When power draw or preheat to a power supply increases, the internal fans of power supply units (PSUs) rotate at higher RPM. A way to reduce the power draw on any one PSU is to increase the installed quantity. PowerEdge VRTX will meet open office acoustics with just two PSUs, but it will meet open office acoustics over a wider range of high load applications when four PSUs are used.

Table 3. Acoustical output of PowerEdge VRTX, metrics used to describe it, and corresponding configuration and utilization.

		Sound Power Level [1]	Sound Pressure Level [2]	Sound Quality [3]
Configuration [4]	Operating mode	LwA-UL, bels, re: 1 pW	LpA, dBA, re: 20 µPa	Prominent tones
4x M520 server nodes with Intel® E5-2420 CPUs, 6x 8GB DIMMs, 16x 10k 2.5" HDDs, and 4x 1100W PSUs.	Idle	5.4	36	None present
	Operating, 50% TDP	5.4	36	None present
	Operating, 70% TDP	5.4	36	None present
	Operating, 100% TDP	5.4	36	None present
3x M620 server nodes with Intel® E5-2660 CPUs, 6x 8GB DIMMs, 16x 10k 2.5" HDDs, and 4x 1100W PSUs.	Idle	5.5	37	None present
	Operating, 50% TDP	6.2	41	None present
	Operating, 70% TDP	6.2	41	None present
	Operating, 100% TDP	7.3	53	None present
3x M620 server nodes with Intel® E5-2660 CPUs, Enhanced Acoustic Option, 6x 8GB DIMMs, 16x 10k 2.5" HDDs, and 4x 1100W PSUs.	Idle	5.5	37	None present
	Operating, 50% TDP	5.8	39	None present
	Operating, 70% TDP	5.8	39	None present
	Operating, 100% TDP	6.8	48	None present
3x M620 server nodes with Intel® E5-2650 CPUs, Enhanced Acoustic Option, 6x 8GB DIMMs, 16x 10k 2.5" HDDs, and 4x 1100W PSUs.	Idle	5.5	37	None present
	Operating, 50% TDP	5.6	37	None present
	Operating, 70% TDP	5.8	39	None present
	Operating, 100% TDP	6.8	48	None present
3x M620 server nodes with Intel® E5-2640 CPUs, Enhanced Acoustic Option, 6x 8GB	Idle	5.4	36	None present
	Operating, 50% TDP	5.6	37	None present
	Operating, 70% TDP	5.7	37	None present

		Sound Power Level [1]	Sound Pressure Level [2]	Sound Quality [3]
DIMMs, 16x 10k 2.5" HDDs, and 4x 1100W PSUs.	Operating, 100% TDP	6.8	48	None present
3x M620 server nodes with Intel® E5-2630L CPUs, 6x 8GB DIMMs, 16x 10k 2.5" HDDs, and 4x 1100W PSUs.	Idle	5.4	36	None present
	Operating, 50% TDP	6.2	42	None present
	Operating, 70% TDP	6.5	45	None present
	Operating, 100% TDP	7.3	53	None present

[1]LwA – UL is the upper limit sound power levels (LwA) calculated per section 4.4.1 of ISO 9296 (1988) and measured in accordance to ISO 7779 (2010).

[2]LpA is the front bystander position A-weighted sound pressure level calculated per section 4.3 of ISO9296 (1988) and measured in accordance with ISO7779 (2010).

[3]Prominent tone: Criteria of D.6, D.10, and D.11 of ECMA-74 12th ed. (2012) are followed to determine if discrete tones are prominent. The system is floor-standing and acoustic transducer is at front bystander position, ref ISO7779

[4]Configuration Variations: Server node types and processor types are the key variables in acoustical variation. Acoustical variation with Hard Disk Drive (HDD) quantity, type, or speed is not presented, because the variation is generally masked by blower module acoustics and apparent only at the lowest acoustical levels. For example, ≤ 5.7 bels. Acoustical variation with PSU quantity is not presented, because its role is limited to high workloads at which the variation may be masked by blower module acoustics when the blower module also increases in speed to provide airflow to cool the involved components.

Enhanced Acoustics option

Dell offers an Enhanced Acoustics option for M620 server nodes when they are configured with processors at 95W. It incorporates a processor heat sink larger than that in the standard 95W M620 server node. Because the heat sink is larger, the tradeoff of its use is reduced, yet still balanced, DIMM (memory) count. Specifically, 16 balanced DIMMs fit with the Enhanced Acoustics option vs. 24 balanced DIMMs with the standard 95W M620 server node. The benefit is suppression of acoustical output (see Table 2 and Table 3) for moderate to high workload utilization. For example, while operating at 50% TDP, the PowerEdge VRTX with the Enhanced Acoustics option is about 30% louder than idle, whereas the standard option is about 50% louder than idle. Note that the acoustical suppression is only attained when all M620 server nodes installed in the PowerEdge VRTX are equipped with the Enhanced Acoustics option. That is, a standard 95W M620 server node will dominate acoustical output when mixed with a M620 server node with the Enhanced Acoustics option.

Cooling choices

Enhanced Cooling Mode (ECM)

ECM is a PowerEdge VRTX feature that allows for increased cooling capacity for the server modules installed in the chassis. Example uses of ECM are server modules with high power (≥95W) processors installed in an environment above 30C or for any server module configuration operating in a fresh-air environment.

The increased cooling capacity is achieved by allowing the four chassis blower modules to rotate at a higher RPM. As a result, the system power consumption and sound power levels may be increased when ECM is enabled. By default, ECM is disabled. When ECM is disabled the maximum airflow delivery per server module is equivalent to that of the Dell PowerEdge M1000e chassis. When ECM is enabled, the blower modules have the capability to deliver approximately 20% more airflow per server module.

The ECM feature only affects the speed of the system blower modules and does not affect the six cooling fans dedicated to storage and I/O components. Thus, enabling ECM will only increase the cooling capacity for the server modules. It is also important to note that ECM is not designed to provide increased cooling to the servers at all times. Even with ECM enabled, the higher blower speeds will only be seen when the increased

cooling is needed. Examples of this situation include high levels of server utilization or stress and high ambient temperatures.

Fan offset options

The PowerEdge VRTX system supports six hot-swappable cooling fans that provide cooling to the storage and I/O components within the enclosure. The fan offset option allows the user to increase airflow delivery to those components when required. This option may be needed for users with custom hardware installed who are seeking additional cooling beyond the baseline system fan setting.

When the fan offset option is set to **off**, the default, the system will maintain the fans at the minimum speed required to cool the hardware in the chassis. Blower speeds (that is, cooling of the server modules) are not changed when the fan offset option is enabled.

It is important to understand that with any of the fan offset options enabled, power consumption will be increased. The system will be comparitively louder with the low offset, noticeably louder with the medium offset, and significantly louder with the high offset.

The user can enable the fan offset option in the CMC web interface by selecting one of the following options on the **System Overview** > **Fans** > **Setup** page.

- Off (Default) — System default fan speeds are maintained on the basis of hardware inventory installed.
- Low — Increases the fan speed by 20% of the maximum fan speed. Minimum speed is 35%.
- Medium — Increases the fan speed by 50% of the maximum fan speed. Minimum speed is 65%.
- High — Fan speed is are set to 100% of the maximum speed.

Other system and fan attributes

Familiarity with the following can help you understand cooling and acoustical responses.

- **Event triggers and responses**: In order to maintain system cooling, the speed of the six cooling fans in the storage and I/O section of the chassis will be increased when the following events are detected: Chassis Intrusion and Fan Fail.
- **Blower module**: The blower modules are critical for server module cooling and should only be removed in the event of a blower module failure. During replacement of a failed blower module, the replacement blower module should be installed in the chassis as quickly as possible to avoid any cooling-related impacts to the server modules (such as, throttling).

Note:

- You can use the acoustics- and thermal-related features discussed in this white paper using the **Fans** and **Advanced Fan Configuration** pages of the Dell Chassis Management Controller (CMC) for PowerEdge VRTX. For information about the fields that appear on these pages, read through the online Help page by clicking **Help** ( ) in the upper-right corner of these two pages.
- You can perform similar operations by using the RACADM commands that you run at a command line interface (CLI). For more information about using these features on a Web interface and RACADM CLI, refer to the *Chassis Management Controller for Dell PowerEdge VRTX Version 1.0 User's Guide* and *Chassis Management Controller for PowerEdge VRTX RACADM Command Line Reference Guide* available at Dell.com/Support/Manuals.

Conclusion

Dell PowerEdge VRTX is designed for open-office layout acoustics. Several design features, however, allow its acoustics and cooling to be modulated for specific use cases and particular environments. Options provided to users include an Enhanced Acoustics option, configurations, Enhanced Cooling Mode, and fan offsets. Their use and resultant values are described in this white paper.