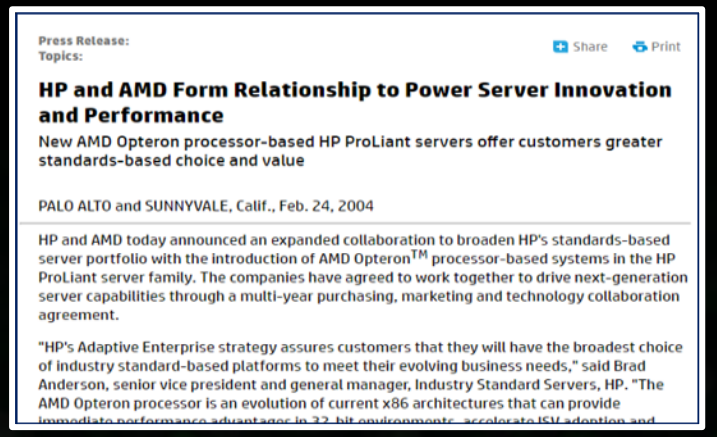
Hewlett Packard Enterprise | AMD

ОБНОВЛЕННЫЕ И НОВЫЕ СЕРВЕРЫ HPE PROLIANT НА ОСНОВЕ ПРОЦЕССОРОВ AMD

Александр Трошин

15 Апреля 2021

HPE И AMD – ПАРТНЁРСТВО ДЛИНОЮ В 17 ЛЕТ



Press Release:
Topics:

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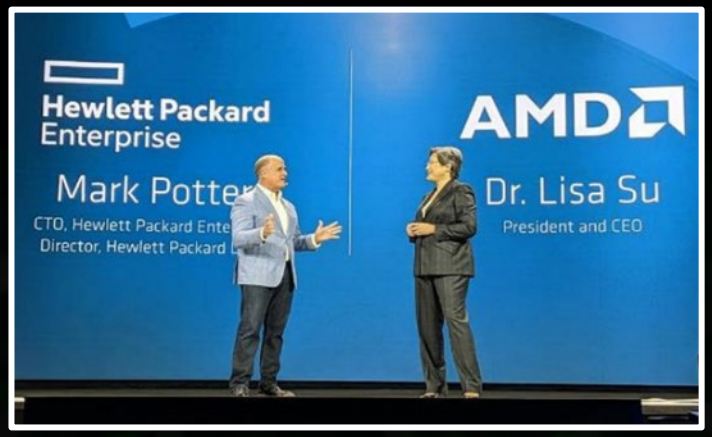
HP and AMD Form Relationship to Power Server Innovation and Performance

New AMD Opteron processor-based HP ProLiant servers offer customers greater standards-based choice and value

PALO ALTO and SUNNYVALE, Calif., Feb. 24, 2004

HP and AMD today announced an expanded collaboration to broaden HP's standards-based server portfolio with the introduction of AMD Opteron™ processor-based systems in the HP ProLiant server family. The companies have agreed to work together to drive next-generation server capabilities through a multi-year purchasing, marketing and technology collaboration agreement.

"HP's Adaptive Enterprise strategy assures customers that they will have the broadest choice of industry standard-based platforms to meet their evolving business needs," said Brad Anderson, senior vice president and general manager, Industry Standard Servers, HP. "The AMD Opteron processor is an evolution of current x86 architectures that can provide



2004	2005	2006	2007	2008	2009	2010	2011	2012	2014	2016	2017	2019	2020	2021
DL145 DL585	BL25p DL35p BL45p DL385	BL465c BL685c DL365	ML115	BL495c DL165 DL185 DL785	SL165z	MicroServer	SL165s SL335s	SL4545	m700	m700p	DL325/DL385 Gen10, CL3150, Apollo 35	DL325/DL385 Gen10 Plus, SVT 325	Apollo 2000 Gen10 Plus, Apollo 6500 Gen10 Plus, dHCI, DX 385	DL325/DL385 Gen10 Plus v2, DL345/DL365 Gen10 Plus

AMD Opteron Era

G1 … Gen8

AMD EPYC Era

Gen10, Gen10 Plus …

AMD VS INTEL ТЕХНИЧЕСКОЕ СРАВНЕНИЕ[1]

Характеристики	AMD® EPYC™ Rome	Intel® Xeon® Cascade Lake	Преимущество AMD
Ядер на процессор	Up to **64**	Up to 28	**2.3X**
Скорость оперативной памяти	**3200 MT/s**	2133, 2400, 2666, 2933 MT/s	**up to 1.5X**
Каналы оперативной памяти	**8**	6	**1.33X**
Максимальная пропускная способность оперативной памяти	**204.8 GB/s**	102.4–140.8 GB/s	**1.45X to 2X**
Максимальный объём оперативной памяти на процессор	**4 TB**	1 TB (2 TB, 4.5 TB – большая цена)	**up to 4X**
Тип и скорость шины ввода-вывода (PCIe)	**Gen4, 16 GT/s (~2 GB/s)**	Gen3, 8 GT/s (~1 GB/s)	**2X**
Кол-во линий ввода-вывода (PCIe) на процессор	Up to **128**	Up to 48	**2.7X**

[1] 2nd Generation AMD EPYC processor family compared to 2nd Generation Intel Xeon Scalable processor family. Not including Xeon 9000 series processors which have very specific environment requirements.

AMD VS INTEL ТЕХНИЧЕСКОЕ СРАВНЕНИЕ [1]

Характеристики	AMD® EPYC™ Milan	Intel® Xeon® Ice Lake	Преимущество AMD
Ядер на процессор	Up to **64**	Up to 40	**1.6X**
Скорость оперативной памяти	3200 MT/s	3200 MT/s	=
Каналы оперативной памяти	8	8	=
Максимальная пропускная способность оперативной памяти	204.8 GB/s	204.8 GB/s	=
Максимальный объём оперативной памяти на процессор	4 TB	4 TB	=
Тип и скорость шины ввода-вывода (PCIe)	Gen4, 16 GT/s (~2 GB/s)	Gen3, 8 GT/s (~1 GB/s)	=
Кол-во линий ввода-вывода (PCIe) на процессор	Up to **128**	Up to 64	**2X**
Максимальный объём кэша процессора 3-его уровня	**Up to 256 MB**	Up to 60 MB	**~4.27X**
Максимальный объём кэша процессора 3-его уровня на ядро	**Up to 32 MB**	Up to 2.25 MB	**~14.2X**

[1] 3rd Generation AMD EPYC processor family compared to 3rd Generation Intel Xeon Scalable processor family.
Not including Xeon 9000 series processors which have very specific environment requirements.

ПОРТФОЛИО **HPE** ПРОДУКТОВ НА БАЗЕ ПРОЦЕССОРОВ **AMD**

Rome: 2-ое поколение AMD EPYC процессоров

ProLiant Gen10 Plus

DL325 Gen10 Plus

DL385 Gen10 Plus

ProLiant Gen10

DL325 Gen10

DL385 Gen10

Гиперконвергентные решения

SimpliVity 325 Gen10

dHCI: Nimble + DL325 Gen10/Gen10 Plus

dHCI: Nimble + DL385 Gen10/Gen10 Plus

Milan: 3-ее поколение AMD EPYC процессоров

Gen10 Plus v2/Gen10 Plus

DL325 Gen10 Plus v2

DL385 Gen10 Plus v2

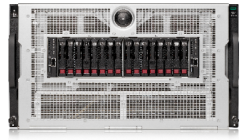
DL345 Gen10 Plus*

DL365 Gen10 Plus*

*с поддержкой 5-ти процессоров 2-ого поколения

Системы для высокопроизводительных вычислений (доступны со 2-ым и 3-им поколением процессоров)

Apollo 2000 Gen10 Plus



Apollo 6500 Gen10 Plus

HPE Cray EX425
HPE Cray EX235n

РЕШЕНИЯ HPE НА БАЗЕ 3-ЕГО ПОКОЛЕНИЯ ПРОЦЕССОРОВ AMD EPYC

Идеальное решение для МСП и повседневных задач

HPE ProLiant DL325 Gen10 Plus v2

Оптимизированное для хранения и обработки данных решение

HPE ProLiant DL345 Gen10 Plus

Оптимизированное по плотности размещения стоечное решение

HPE ProLiant DL365 Gen10 Plus

Оптимизированное решение для требовательных задач

HPE ProLiant DL385 Gen10 Plus v2

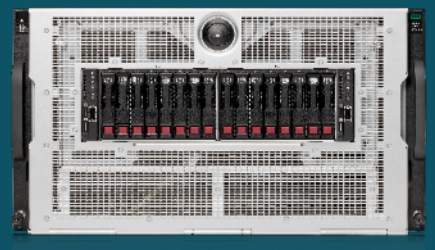
Специализированные Суперкомпьютеры

HPE Cray Supercomputers

HPE Cray EX425 – 4-ёх узловое лезвие
HPE Cray EX235n – AMD EPYC с графическими ускорителями

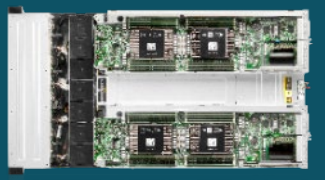
Решение для высокопроизводительных вычислений и ИИ с графическим ускорением

HPE Apollo 6500 Gen10 Plus



Масштабируемое решение с оптимизированной плотностью размещения

HPE Apollo 2000 Gen10 Plus



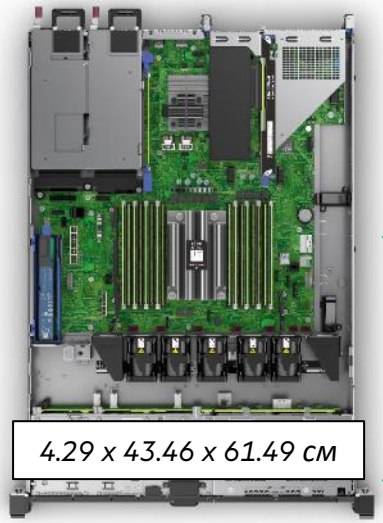
Масштабируемые вычисления с оптимизацией плотности для рабочих нагрузок высокопроизводительных вычислений и искусственного интеллекта

СТОЕЧНЫЕ СЕРВЕРА НА БАЗЕ ПРОЦЕССОРОВ **AMD EPYC MILAN**

Идеальное решение для МСП и повседневных задач	Оптимизированное для хранения и обработки данных решение	Оптимизированное по плотности размещения стоечное решение	Оптимизированное решение для требовательных задач
1U, 1P	**2U, 1P**	**1U, 2P**	**2U, 2P**
HPE ProLiant DL325 Gen10 Plus v2	HPE ProLiant DL345 Gen10 Plus	HPE ProLiant DL365 Gen10 Plus	HPE ProLiant DL385 Gen10 Plus v2
			
VDI **SMB/МСП, удалённые офисы** **Edge/граничные вычисления**	**Базы данных** **Гиперконвергентные решения** **Хранение данных**	**VDI** **CAE – моделлирование, симуляции и другие инженерные задачи**	**Искусственный интелект** **Машинное обучение** **Big Data аналитика**

ВНЕШНИЙ ВИД ШАССИ **DL325** И ИЗМЕНЕНИЯ

DL325 Gen10
61 см
(24inch)



4.29 x 43.46 x 61.49 см

4 LFF or 10 SFF

DL325 Gen10 Plus
83 см
(33inch)

Короткое шасси
(2 ряда дисков)
4.28 X 43.46 X 82.62 см

8 LFF or 16 SFF

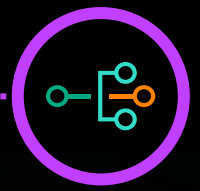
DL325 Gen10 Plus Long
101 см
(40inch)

Длинное шасси
(3 ряда дисков)
4.28 X 43.46 X 100.88 см

12 LFF or 24 SFF

КЛЮЧЕВЫЕ РАБОЧИЕ НАГРУЗКИ ДЛЯ **HPE-AMD** СЕРВЕРОВ

AMD и **HPE** работают вместе, чтобы предоставить решения, оптимизированные для рабочих нагрузок, которые помогут быстро реагировать на запросы бизнеса



Виртуализация

Увеличенное количество ядер и объем памяти обеспечивают отличную плотность виртуальных машин, контейнеров и приложений, одновременно увеличивая загрузку процессора

HPE ProLiant DL325 Gen10 Plus v2 Server

HPE ProLiant DL365 Gen10 Plus Server

Управление базами данных

Больше разъёмов входа-выхода и больше ёмкость хранилища для решения задач в сфере баз данных

HPE ProLiant DL345 Gen10 Plus Server

Big Data аналитика

Большое количество ядер, увеличенный объем памяти, большая емкость ввода-вывода и большое количество линий **PCIe 4.0** уменьшают задержку и увеличивают пропускную способность для лучших результатов при работе большим объемом данных

HPE ProLiant DL385 Gen10 Plus v2 Server

Искусственный интеллект и машинное обучение

Поддержка нескольких процессоров с большим количеством ядер с увеличенным объемом памяти и ускорителями графического процессора обеспечивают повышение производительности для ускорения обработки.

Транскодинг видео - HPE ProLiant DL385 Gen10 Plus v2 Server

Вычисления с графическим ускорением - HPE Apollo 6500 Gen10 Plus

Высокопроизводительные вычисления

Большое количество ядер, увеличенный объем памяти и емкость ввода-вывода, а также поддержка графических ускорителей графического процессора ускоряют приложения с интенсивными вычислениями

HPE Apollo Systems и HPE Cray EX Системы

РЕКОРД: DL385 GEN10 PLUS V2 – ЛУЧШИЙ СЕРВЕР ДЛЯ ВИРТУАЛИЗАЦИИ!

Ключевые выводы:

- #1 AMD результат
- #1 4-ёх узловый результат
- Больше производительность и больше хост-серверов, в сравнении с другими 2-ух процессорными системами на базе 4-ёх узлов
- На 12.53% больше производительность и на 20% больше хост-серверов, чем предыдущей 4-ёх узловый рекорд
- Новый рекорд по сравнению с Fujitsu PRIMERGY с вдвое меньшим количеством процессоров

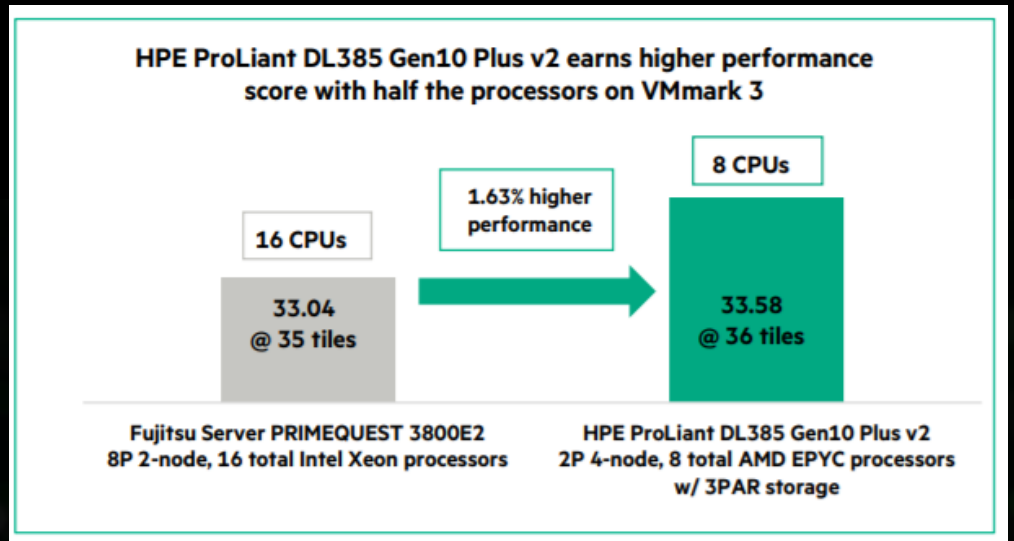


FIGURE 1. HPE ProLiant DL385 Gen10 Plus v2 8P and competitor 16P results on the VMmark 3.1.1 benchmark

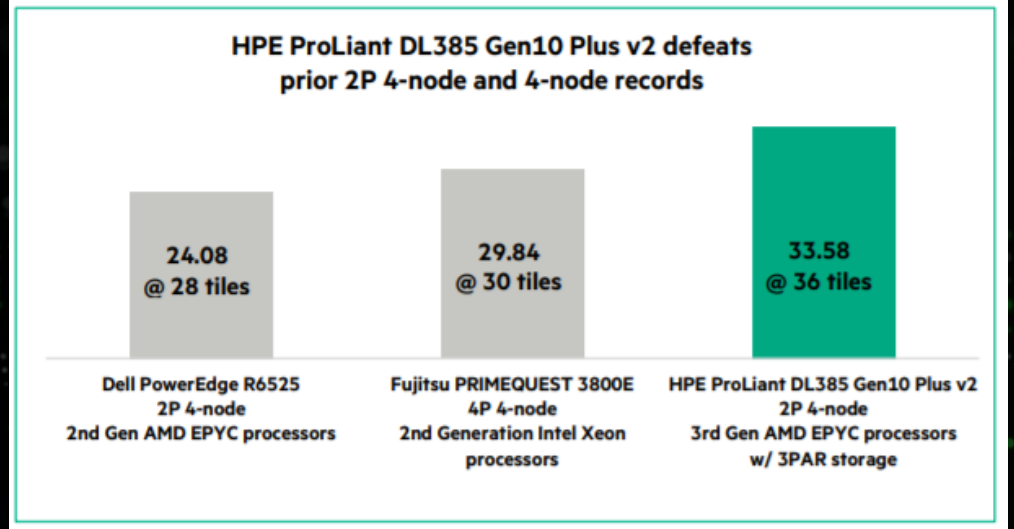


FIGURE 2. HPE ProLiant DL385 Gen10 Plus v2 versus prior top 2P 4-node and 4-node results

Performance Brief

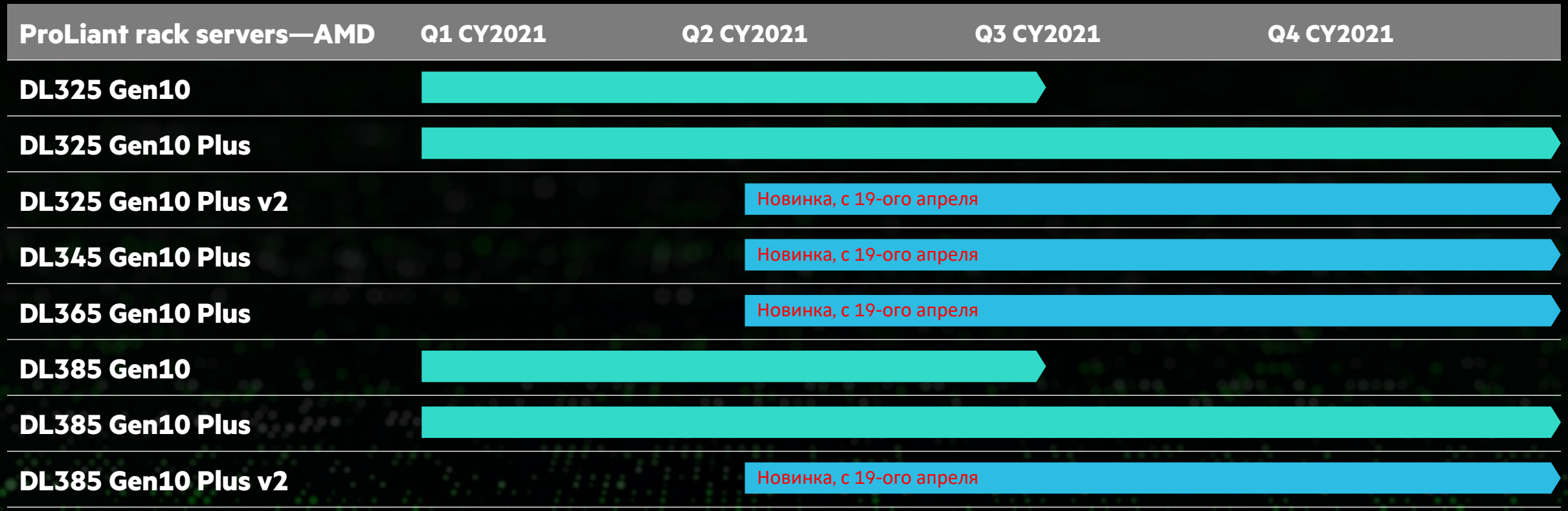
Discover More

ПОРТФОЛИО HPE-AMD DL3X5 ПРОДУКТОВ




	DL325 1U 1P	DL345 2U 1P	DL365 1U 2P	DL385 2U 2P	Особенности поколений и платформ
AMD Zen3 (Milan) Новинка	**Gen10 Plus v2** Доступно с 19 апреля	**Gen10 Plus** Доступно с 19 апреля	**Gen10 Plus** Доступно с 19 апреля	**Gen10 Plus v2** Доступно с 19 апреля	• Tri-mode контроллеры с поддержкой NVMe и SAS/SATA дисков • DL325: длина меньше 1м • DL345 и DL365 поддерживают 5 Rome-процессоров • Процессоры до 280Вт • Графические ускорители AMD (MI100 - DL385 Gen10 Plus v2)
AMD Zen2 (Rome)	**Gen10 Plus** Доступно сейчас	-	-	**Gen10 Plus** Доступно сейчас	• PCIe 4-ого поколения • Процессоры до 240Вт • Open Firmware и OCP сетевые адаптеры • Новые NVMe диски с PCIe 4-ого поколения • 3200 МГц – скорость оперативной памяти
	Gen10 Ограниченная доступность	-	-	**Gen10** Ограниченная доступность	• До 64 ядер на процессор • Процессоры до 200Вт • 2933 МГц – скорость оперативной памяти

СТОЕЧНЫЕ СЕРВЕРЫ **HPE** С ПРОЦЕССОРАМИ **AMD**, ДОРОЖНАЯ КАРТА



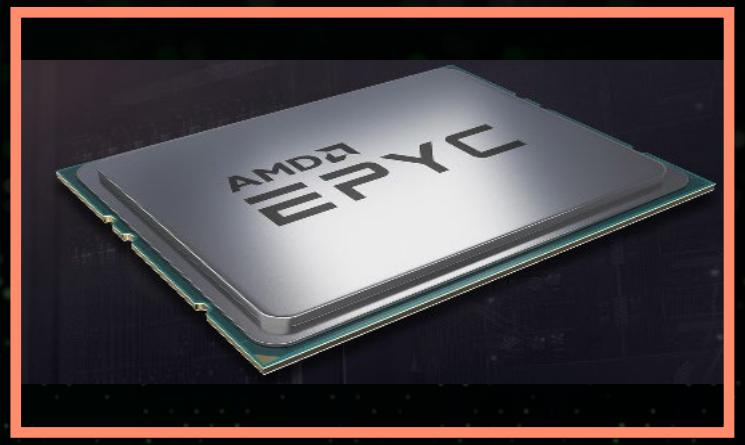
■ Доступно ■ План

HPE PROLIANT С ПРОЦЕССОРАМИ MILAN

	DL325 Gen10 Plus V2	DL345 Gen10 Plus	DL365 Gen10 Plus	DL385 Gen10 Plus V2
Compute	Up to (1) AMD® EPYC® 7003 series processors, 64 cores, 280W, PCIe 4.0, up to three available slot(s)	Up to (1) AMD® EPYC® 7003 series processors, 64 cores, 280W, PCIe 4.0, up to four available slot(s)	Up to (2) AMD® Milan Processor family, up to 64 Cores, 240W, PCIe Gen 4.0, up to three (3) available slot(s)	Up to (2) AMD® Milan Processor family, up to 64 Cores, 280W,, PCIe Gen 4.0, up to eight (8) available slot(s)
Memory	HPE Smart Memory (16) DDR4, up to 3200 MHz (4 TB max)	HPE Smart Memory (16) DDR4, up to 3200 MHz (4 TB max)	HPE Smart Memory (32) DDR4 8 channels per CPU, up to 3200MHz (1DPC) (8.0 TB* max)	HPE Smart Memory (32) DDR4 8 channels per CPU, up to 3200MHz (1DPC) (8.0 TB* max)
Persistent Memory	No Support	No Support	No Support	No Support
Storage	Standard HPE Smart Array SR100i, Software RAID (8 drives + 2 NVMe) Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features, Tri-Mode Controllers for h/w RAID on NVMe drives.	Standard HPE Smart Array SR100i, Software RAID (8 drives + 2 NVMe) Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features, Tri-Mode Controllers for h/w RAID on NVMe drives.	Standard HPE Smart Array SR100i* Software RAID (support post launch) Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features. Tri-Mode Controllers* for h/w RAID on NVMe drives.	Standard HPE Smart Array SR100i* Software RAID (Only for 2NVMe) Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features. Tri-Mode Controllers* for h/w RAID on NVMe drives.
Drives	4 LFF/ 8 + 2 SFF HDD/SSD, 10 SFF NVMe Basic carriers	12 LFF + 2 SFF/ 24 SFF + 2 SFF HDD/SSD, 24 SFF NVMe + 2 SFF Basic carriers	10 SFF HDD/SSD, 10 NVMe (x4) PCIe SSD	36 SFF / 16 LFF+2SFF max, HDD/SSD, 32 NVMe (x4) PCIe SSD
Networking	Choice of OCP + Standup	Choice of OCP + Standup	Choice of OCP + Standup	Choice of OCP + Standup
VGA/Serial/USB/SD Ports	Front Display Port Opt, Rear VGA & Optional Serial, 4 USB 3.0, Front Management port and dedicated rear iLO port	Front Display Port Opt, Rear VGA & Optional Serial, 4 USB 3.0, Front Management port and dedicated rear iLO port	Front Display Port Opt, Rear VGA & Optional Serial, 5 USB 3.0, + 1 USB 2.0 optional. Front Management port and dedicated rear iLO port	Front Display Port Opt, Rear VGA & Optional Serial, 5 USB 3.0, + 2 USB 2.0 optional, Dual Micro-SD. Front Management port and dedicated rear iLO port
GPU Support	Up to 2 Single Wide only	Up to 3 Single Wide	(2) Single Wide	(8) Single/ (3) Double- Wide & Active/Passive up to 10.5” (3)
Management - Converged	HPE OneView and HPE iLO Advanced	HPE OneView and HPE iLO Advanced	HPE OneView, HPE iLO Advanced and HPE InfoSight	HPE OneView, HPE iLO Advanced and HPE InfoSight
Management - Support	HPE Insight Online with enhanced mobile appl	HPE Insight Online with enhanced mobile appl	HPE Insight Online with enhanced mobile appl	HPE Insight Online with enhanced mobile appl
Management - Embedded	HPE iLO 5, SUM, RESTful Interface Tool, UEFI	HPE iLO 5, SUM, RESTful Interface Tool, UEFI	HPE iLO 5, SUM, RESTful Interface Tool, UEFI	HPE iLO 5, SUM, RESTful Interface Tool, UEFI
Power & Cooling	up to 96% eff. To 1600W	up to 96% eff. To 1600W	up to 96% eff. To 1600W	up to 96% eff. To 1600W
Industry Compliance	ASHRAE A3 & A4, lower idle power, Energy Star	ASHRAE A3 & A4, lower idle power, Energy Star	ASHRAE A3 & A4, lower idle power, Energy Star	ASHRAE A3 & A4, lower idle power, Energy Star
Chassis Depth	1U, 25.34”	28” (SFF), 29.5” (LFF)	1U, 29.65” (SFF)	28” (SFF), 29.5” (LFF)
Serviceability Easy Install Rails	Standard	Standard	Standard	Standard
Warranty	3/3/3	3/3/3	3/3/3	3/3/3

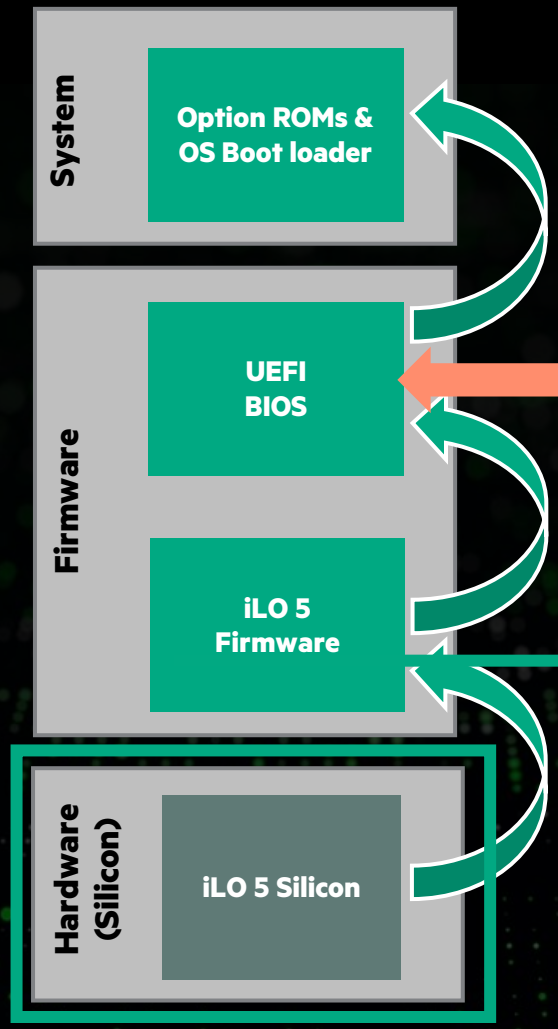
БЕЗОПАСНОСТЬ ИНФРАСТРУКТУРЫ С **HPE** И **AMD**

+



SEV is supported for RedHat, SUSE and VMware vSphere 7 update 1 from Sep-15

HPE Silicon Root of Trust



Secure Memory Encryption (SME)
Secure RAM encryption
Protects data from hacker attacks on the main memory

Secure Encrypted Virtualization (SEV[1])
Secure encrypted virtualization encrypts and isolates Virtual Machines

AMD Secure Processor
Additional security through HPE iLO and AMD Secure Processor (embedded in EPYC)

HPE Servers powered by AMD EPYC Processors are not susceptible to:

Meltdown Variant 3, Rogue Data Cache
Foreshadow-NG (OS Kernal/SMM Attack)
Foreshadow-NG (VMM Attack)
Foreshadow- (SGX Attack)
Zombie Load
Spoiler
and others..

Read more

КРАТКОЕ ОПИСАНИЕ ПРОДУКТОВ И ПАРТНЕРСТВА **HPE-AMD**

HPE и AMD – 17 лет партнёрства

HPE ProLiant Серверы с AMD EPYC процессорами – больше производительности за меньшие деньги:

- **Лидер в области безопасности ИТ-инфраструктуры** на рынке
- **Лучшая производительность, подтвержденная мировыми рекордами**
- **Технологическое лидерство** с 7-нм технологией → Поддержка **большего числа виртуальных машин на сервер → снижение затрат на лицензии, обслуживание, энергию и т.д.**

AMD EPYC – лидерство архитектуры и сильная дорожная карта

Мировые рекорды производительности, обеспечивающие лучшие бизнес-результаты

Широкое и постоянно растущее портфолио HPE-AMD продуктов:
DL325 & DL385 Gen10 & Gen10 Plus, SimpliVity 325, dHCI, Apollo 2000 Gen10 Plus, Apollo 6500 Gen10 Plus, DX385 и т.д.
+Новое – платформы на базе AMD EPYC 3-его поколения:
Обновлённые: DL325 & DL385 Gen10 Plus v2
Новинки: DL345 & DL365 Gen10 Plus

Есть вопросы? – Свяжитесь со мной
Менеджер по развитию HPE-AMD бизнеса в центральной и восточной Европе

HPE and AMD home page: https://www.hpe.com/us/en/solutions/amd.html
HPE-AMD World Records: Leadership workload optimized performance product availability matrix
AMD's security messages: https://www.amd.com/en/corporate/security-updates
HPE security messages: https://www.hpe.com/uk/en/services/security-vulnerability.html

СПАСИБО!

ENDNOTES (1)

EPYC-18: MAX BOOST FOR AMD EPYC PROCESSORS IS THE MAXIMUM FREQUENCY ACHIEVABLE BY ANY SINGLE CORE ON THE PROCESSOR UNDER NORMAL OPERATING CONDITIONS FOR SERVER SYSTEMS.

GD-83: USE OF THIRD PARTY MARKS / LOGOS/ PRODUCTS IS FOR INFORMATIONAL PURPOSES ONLY AND NO ENDORSEMENT OF OR BY AMD IS INTENDED OR IMPLIED. GD-177: AMD INFINITY GUARD SECURITY FEATURES ON EPYC™ PROCESSORS MUST BE ENABLED BY SERVER OEMS AND/OR CLOUD SERVICE PROVIDERS TO OPERATE. CHECK WITH YOUR OEM OR PROVIDER TO CONFIRM SUPPORT OF THESE FEATURES. LEARN MORE ABOUT INFINITY GUARD AT HTTPS://WWW.AMD.COM/EN/TECHNOLOGIES/INFINITY-GUARD.

GD-177: AMD INFINITY GUARD SECURITY FEATURES ON EPYC™ PROCESSORS MUST BE ENABLED BY SERVER OEMS AND/OR CLOUD SERVICE PROVIDERS TO OPERATE. CHECK WITH YOUR OEM OR PROVIDER TO CONFIRM SUPPORT OF THESE FEATURES. LEARN MORE ABOUT INFINITY GUARD AT HTTPS://WWW.AMD.COM/EN/TECHNOLOGIES/INFINITY-GUARD.

MLN-001: AMD EPYC™ 7003 SERIES PROCESSORS REQUIRE A BIOS UPDATE FROM YOUR SERVER OR MOTHERBOARD MANUFACTURER IF USED WITH A MOTHERBOARD DESIGNED FOR THE AMD EPYC™ 7002 SERIES PROCESSORS. A MOTHERBOARD DESIGNED AT MINIMUM FOR EPYC 7002 PROCESSORS IS REQUIRED FOR EPYC 7003 SERIES PROCESSORS.

MLN-003: BASED ON AMD INTERNAL TESTING AS OF 02/1/2021, AVERAGE PERFORMANCE IMPROVEMENT AT ISO-FREQUENCY ON AN AMD EPYC™ 72F3 (8C/8T, 3.7GHZ) COMPARED TO AN AMD EPYC™ 7F32 (8C/8T, 3.7GHZ), PER-CORE, SINGLE THREAD, USING A SELECT SET OF WORKLOADS INCLUDING ESTIMATED SPECRATE®2017_INT_BASE,SPECRATE®2017_FP_BASE, AND REPRESENTATIVE SERVER WORKLOADS.

MLN-004: LOGIN VSI™ PRO V4.1.40.1 COMPARISON BASED ON AMD INTERNAL TESTING AS OF 02/01/2021 MEASURING THE MAXIMUM "KNOWLEDGE WORKER" DESKTOP SESSIONS WITHIN VSI BASELINE +1000MS RESPONSE TIME USING VMWARE ESXI 7.0U1 AND VMWARE HORIZON 8 ON A SERVER USING 2X AMD EPYC 7763 VERSUS A SERVER WITH 2X INTEL XEON GOLD 6258R FOR ~112% MORE MAX [~2.1X THE] PERFORMANCE. RESULTS MAY VARY.

MLN-006: HAMMERDB 4.0 OLTP COMPARISON BASED ON AMD INTERNAL TESTING ON ORACLE® 19C RDBMS AS OF 02/01/2021 ON A SERVER USING 2X AMD EPYC 75F3 VERSUS A SERVER USING 2X AMD EPYC 7542 FOR ~19% MORE [~1.2X THE] PERFORMANCE. TPROC-C: OLTP WORKLOAD PROFILE IN HAMMERDB DERIVED, FROM THE TPC-C SPECIFICATION USING 2000 WAREHOUSES. RESULTS MAY VARY.

MLN-007: RESULTS AS OF 01/28/2021 USING SPECRATE®2017_INT_BASE. THE 2P AMD EPYC 7763 A MEASURED ESTIMATED SCORE OF 798, VERSUS THE CURRENT HIGHEST SCORE INTEL CASCADE LAKE REFRESH SERVER WITH A SCORE OF 397 USING 2P INTEL GOLD 6258R, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q3/CPU2017-20200915-23981.PDF. OEM PUBLISHED SCORE(S) FOR EPYC MAY VARY. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION.

MLN-008: RESULTS AS OF 01/28/2021 USING SPECRATE®2017_FP_BASE. THE 2P AMD EPYC 7763 HAS AN A MEASURED ESTIMATED SCORE OF 614.7 VERSUS THE CURRENT HIGHEST SCORE INTEL CASCADE LAKE REFRESH SERVER WITH A SCORE OF 309 AND 2P INTEL GOLD 6258R, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q3/CPU2017-20200915-23979.PDF. OEM PUBLISHED SCORE(S) FOR EPYC MAY VARY. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION.

MLN-016: RESULTS AS OF 01/28/2021 USING SPECRATE®2017_INT_BASE. THE AMD EPYC 7763 ESTIMATED SCORE OF 798 IS HIGHER THAN THE CURRENT HIGHEST 2P SERVER WITH AN AMD EPYC 7H12 AND A SCORE OF 717, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q2/CPU2017-20200525-22554.PDF. OEM PUBLISHED SCORE(S) FOR EPYC MAY VARY.

MLN-017: RESULTS AS OF 01/28/2021 USING SPECRATE®2017_INT_BASE. THE AMD EPYC 75F3 A MEASURED ESTIMATED SCORE OF 546 HAS UP TO 23% HIGHER THAN A COMPARABLE 2P EPYC 7002 CPU POWERED SERVER, THE 7532 WITH A SCORE OF 444, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q3/CPU2017-20200622-23002.PDF . OEM PUBLISHED SCORE(S) FOR 3RD GEN EPYC MAY VARY. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION. "

MLN-018: RESULTS AS OF 02/20/2021 USING SPECRATE®2017_INT_BASE. THE AMD EPYC 7763 A MEASURED ESTIMATED SCORE OF 804 WHICH IS HIGHER THAN THE CURRENT HIGHEST 2P SERVER WITH AN AMD EPYC 7H12 AND A SCORE OF 717, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q2/CPU2017-20200525-22554.PDF. OEM PUBLISHED SCORE(S) FOR EPYC MAY VARY. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION.

MLN-040: RESULTS AS OF 02/20/2021 USING SPECRATE®2017_INT_BASE. THE 2P AMD EPYC 7763 HAS A MEASURED ESTIMATED SCORE OF 804, VERSUS THE CURRENT HIGHEST SCORE INTEL CASCADE LAKE REFRESH SERVER WITH A SCORE OF 397 USING 2P INTEL GOLD 6258R, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q3/CPU2017-20200915-23981.PDF. OEM PUBLISHED SCORE(S) FOR EPYC MAY VARY. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION.

ENDNOTES (2)

MLN-041: RESULTS AS OF 02/20/2021 USING SPECRATE®2017_FP_BASE. THE 2P AMD EPYC 7763 HAS A MEASURED ESTIMATED SCORE OF 625 VERSUS THE CURRENT HIGHEST SCORE INTEL CASCADE LAKE REFRESH SERVER WITH A SCORE OF 309 WITH A 2P INTEL GOLD 6258R BASED SERVER, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q3/CPU2017-20200915-23979.PDF. OEM PUBLISHED SCORE(S) FOR EPYC MAY VARY. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION.

MLN-043: WRF VERSION 4.1.5 COMPARISON BASED ON AMD INTERNAL TESTING COMPLETED ON 2/17/2021 ON A REFERENCE PLATFORM WITH 2X EPYC™ 75F3 (32C) COMPARED TO AN INTEL SERVER ON A PRODUCTION SYSTEM WITH 2X INTEL® XEON® GOLD 6258R (28C) PROCESSORS. RESULTS MAY VARY.

MLN-044: SPECJBB®2015-MULTIJVM CRITICAL-JOPS COMPARISON BASED ON SUPERMICRO COMPLIANT RUN AND BEST SPEC.ORG PUBLISHED 2X INTEL XEON PLATINUM 8280 RESULT AS OF 02/22/2021. THE 2X AMD EPYC 7763 HAS A SCORE OF 295,335 SPECJBB®2015-MULTIJVM CRITICAL-JOPS (351,175 SPECJBB®2015-MULTIJVM MAX-JOPS) USING THE FOLLOWING CONFIGURATION: SUPERMICRO A+ AS-1124US-TNRP SERVER (MODEL H12DSU-IN), 2X AMD EPYC 7763, 16X 64 GB QUAD-RANK LR-DIMM DDR4-3200 MEMORY, SUSE ENTERPRISE LINUX 15 SP2, OPENJDK 15.0.2. VERSUS THE HIGHEST PUBLISHED SPECJBB®2015-MULTIJVM CRITICAL-JOPS SCORE OF A 2X INTEL XEON PLATINUM 8280 SERVER OF 138,942 SPECJBB®2015-MULTIJVM CRITICAL-JOPS (165,958 SPECJBB®2015-MULTIJVM MAX-JOPS), HTTP://WWW.SPEC.ORG/JBB2015/RESULTS/RES2019Q2/JBB2015-20190314-00428.HTML FOR ~112% MORE [~2.12X THE] PERFORMANCE. SPEC® AND SPECJBB® ARE TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE MORE AT WWW.SPEC.ORG.

MLN-046: STREAM TRIAD GB/S COMPARISON BASED ON AMD INTERNAL TESTING AS OF 02/01/2021 ON A SERVER WITH 2X AMD EPYC 7763 VERSUS THE 2X AMD EPYC 7742 PROCESSORS SCORE. RESULTS MAY VARY.

MLN-047: STREAM TRIAD GB/S COMPARISON BASED ON AMD INTERNAL TESTING AND A PUBLISHED COMPETITIVE INTEL RESULT AS OF 02/01/2021 CONFIGURATIONS: ON A SERVER WITH 2X AMD EPYC 75F3 (371.5 GB/S) VERSUS THE 2X INTEL XEON GOLD 6258R PROCESSORS SCORE AT (224 GB/S, HTTPS://NEWSROOM.INTEL.COM/NEWS/PRODUCT-FACT-SHEET-ACCELERATING-5G-NETWORK-INFRASTRUCTURE-CORE-EDGE) FOR ~66% MORE [~1.7X THE] PERFORMANCE. RESULTS MAY VARY.

MLN-048: ANSYS® CFX® 2021.1 COMPARISON BASED ON AMD INTERNAL TESTING AS OF 02/05/2021 MEASURING THE TIME TO RUN THE RELEASE 14.0 TEST CASE SIMULATIONS (CONVERTED TO JOBS/DAY - HIGHER IS BETTER) USING A SERVER WITH 2X AMD EPYC 75F3 VERSUS 2X INTEL XEON GOLD 6258R. THE EXTERNAL FLOW OVER A LEMANS CAR TEST CASE INDIVIDUALLY WAS 112% [2.1X THE] PER NODE OR 85% PER CORE PERFORMANCE. RESULTS MAY VARY.

MLN-049: ANSYS® LS-DYNA® VERSION 2021.1 COMPARISON BASED ON AMD INTERNAL TESTING AS OF 02/05/2021 MEASURING THE TIME TO RUN NEON, 3CARS, PPT-SHORT, ODB10M-SHORT, AND CAR2CAR TEST CASE SIMULATIONS (CONVERTED TO JOBS/DAY - HIGHER IS BETTER) CONFIGURATIONS USING A SERVER WITH 2X AMD EPYC 75F3 (17555 TOTAL SECONDS) VERSUS A SERVER WITH 2X INTEL XEON GOLD 6258R. (28774 TOTAL SECONDS) FOR ~81.0% MORE [~1.8X THE] PER NODE OR ~59% [~1.6X THE] PER CORE AVERAGE PERFORMANCE. THE 3CARS TEST CASE GAIN INDIVIDUALLY WAS 126% [~2.26X THE] PER NODE OR ~98% PER CORE JOBS/DAY PERFORMANCE. RESULTS MAY VARY.

MLN-050: ESI VIRTUAL PERFORMANCE SOLUTION (VPS BETTER KNOWN AS PAM-CRASH®) VERSION 2020.0 COMPARISON BASED ON AMD INTERNAL TESTING AS OF 02/05/2021 MEASURING THE NEON TEST CASE SIMULATION (CONVERTED TO JOBS/DAY - HIGHER IS BETTER) USING A SERVER WITH 2X AMD EPYC 75F3 VERSUS A SERVER WITH 2X INTEL XEON GOLD 6258R FOR ~43% MORE [~1.4X THE] PER NODE OR ~25% PER CORE JOBS/DAY PERFORMANCE. RESULTS MAY VARY.

MLN-053: STAR-CCM+ 2020.3 COMPARISON BASED ON AMD INTERNAL TESTING AS OF 02/05/2021 MEASURING THE AVERAGE SECONDS TO COMPLETE 11 TEST CASES AND CONVERTED TO JOBS/DAY (HIGHER IS BETTER) USING A SERVER WITH 2X AMD EPYC 75F3 VERSUS A SERVER WITH 2X INTEL XEON GOLD 6258R. THE KCS MARINE HULL WITH NO RUDDER IN FINE WAVES TEST CASE INDIVIDUALLY WAS ~79% MORE [~1.7X THE] PER NODE OR ~57% BETTER PER CORE PERFORMANCE. RESULTS MAY VARY.

MLN-055: AMD EPYC 7003 CPUS WITH PCIE4 LANES HAVE 2X THE I/O THROUGHPUT CAPACITY PER LANE THAN ANY INTEL XEON SCALABLE CPU WHICH USE PCIE3. PCIE4 PROVIDES 16GB/S OF LINK BANDWIDTH VERSUS PCIE3 WITH 8GB/S, HTTPS://PCISIG.COM/PCI-EXPRESS-DELIVERING-NEEDED-BANDWIDTH-OPEN-COMPUTE-PROJECT.

MLN-056: EACH AMD EPYC 7003 PROCESSOR HAS 8 MEMORY CHANNELS. EACH INTEL XEON SCALABLE PROCESSOR HAS 6 MEMORY CHANNELS. 8 – 6 = 2 ÷ 6 = 0.33 AMD EPYC HAS 33% MORE MEMORY BANDWIDTH. CLASS BASED ON INDUSTRY-STANDARD PIN-BASED (LGA) X86 PROCESSORS.

MLN-057: A 2P AMD EPYC 72F3 8 CORE CPU POWERED SERVER HAS A MEASURED ESTIMATED SPECRATE®2017_INT_BASE SCORE OF 176 WITH A PER CORE SCORE OF 11.00. THE POSTED SCORE ON SPEC.ORG AS OF 02/20/2021 YIELDING THE HIGHEST PER CORE PERFORMANCE IS A SERVER WITH TWO INTEL GOLD 6250 8 CORE CPUS WITH A PER CORE SCORE OF 9.875, FROM A PUBLISHED SCORE OF 158, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q3/CPU2017-20200915-23977.PDF. SCORES ARE AS OF 02/20/2021. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION.

ENDNOTES (3)

MLN-058: A 2P AMD EPYC 72F3 8 CORE CPU POWERED SERVER HAS A MEASURED ESTIMATED SPECRATE®2017_INT_BASE SCORE OF 220 YIELDING A PER CORE SCORE OF 13.75. THE POSTED SCORE ON SPEC.ORG AS OF 02/20/2021 YIELDING THE HIGHEST PER CORE PERFORMANCE IS A SERVER WITH ONE AMD EPYC 7F32 8 CORE CPU WITH A PER CORE SCORE OF 12.875, FROM A PUBLISHED SCORE OF 103, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q2/CPU2017-20200316-21228.PDF. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION.

MLN-059: EPYC 7313 AND 7343 CPU POWERED 2P SERVERS HAVE MEASURED ESTIMATED SPECRATE®2017_INT_BASE SCORES OF 287 AND 295 RESPECTIVELY (287+295= 582, 582/2=291), IS UP TO 25% HIGHER THAN THAN HIGHEST POSTED SCORE 2P EPYC 7282 AND 7302 POWERED SERVERS WITH SPECRATE®2017_INT_BASE SCORES OF 215 AND 246 RESPECTIVELY (215+246= 461, 461/2=230.5). 291/230.5= 1.26. 16 CORE EPYC 7003 CPUS HAVE 126% THE PERF OR 26% MORE PERFORMANCE OF 16C 7002 CPUS. OEM PUBLISHED SCORE(S) FOR 3RD GEN EPYC MAY VARY. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION.

MLN-060: EPYC 7643 AND 7763 CPU POWERED 2P SERVERS HAVE MEASURED ESTIMATED SPECRATE®2017_FP_BASE SCORES OF 510 AND 614.7 RESPECTIVELY (AVERAGE SCORE 562.35), IS UP TO 15% HIGHER THAN THAN 2P EPYC 7552 AND 7662 POWERED SERVERS WITH SPECRATE®2017_FP_BASE SCORES OF 435 AND 546 RESPECTIVELY (AVERAGE SCORE 490.5). OEM PUBLISHED SCORE(S) FOR 3RD GEN EPYC MAY VARY. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION.

MLN-061: AS OF FEB. 20, 2021, THE INTEL LOG TRENDLINE FROM TOP SPECRATE®2017_INT_BASE PUBLISHED SCORES TO DATE FOR 2P INTEL BASED XEON SP (LGA SOCKETED) SERVERS FOR EACH OF 2017, 2018, 2019, 2020, AND 2021. THE AMD LOG TRENDLINE FROM TOP SPECRATE®2017_INT_BASE PUBLISHED SCORE TO DATE, FOR 2P INTEL BASED AMD EPYC SERVERS FOR EACH OF 2017, 2018, 2019, AND 2020, AND FOR 2021 THE MEASURED ESTIMATE SCORE FOR THE EPYC 7763 FOR SPECRATE®2017_INT_BASE.THE LINES BELOW ARE ORGANIZED AS: YEAR, CPU MODEL, SPEC SCORE, URL.2017, INTEL 8180, 302, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2017Q4/CPU2017-20170928-00070.PDF2018, INTEL 8180, 304, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2018Q3/CPU2017-20180709-07701.PDF2019, INTEL 8280L, 364, SHOULD BE 8280L HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2019Q2/CPU2017-20190429-12779.PDF2020, INTEL 6258R, 397, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q3/CPU2017-20200915-23981.PDF2021, INTEL 6258R, 397, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q3/CPU2017-20200915-23981.PDF.2017, AMD EPYC 7601, 275, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2017Q4/CPU2017-20171211-01594.PDF2018, EPYC 7601, 282, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2018Q3/CPU2017-20180827-08666.PDF2019, EPYC 7742, 701, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2019Q4/CPU2017-20191125-20001.PDF2020, EPYC 7H12, 717, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q2/CPU2017-20200525-22554.PDF2021, EPYC 7763, 802 MEASURED ESTIMATE, NO LINK AVAILABLE.OEM PUBLISHED SCORE(S) FOR 3RD GEN EPYC MAY VARY. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION.

MLNTCO-001 THE BARE METAL TCO (TOTAL COST OF OWNERSHIP) ESTIMATOR SOLUTION COMPARES THE SELECTED AMD EPYC™ AND INTEL® XEON® CPU BASED SERVER SOLUTIONS REQUIRED TO DELIVER A TOTAL_PERFORMANCE OF 25000 UNIT OF INTEGER PERFORMANCE BASED ON PUBLISHED THE SPECRATE®2017_INT_BASE SCORES FOR INTEL AND AMD MEASURED ESTIMATED SCORES FOR AMD EPYC 7003. THIS ANALYSIS IS BASED ON TOOL VERSION: 02/20/2021 V0.9982. THIS ESTIMATION REFLECTS A 4 YEAR TIME FRAME. THIS ANALYSIS COMPARES A 2 CPU AMD EPYC EPYC_7763 POWERED SERVER WITH A MEASURED ESTIMATED SPECRATE®2017_INT_BASE SCORE OF 802; COMPARED TO A 2 CPU INTEL XEON GOLD_6258R BASED SERVER WITH A SPECRATE®2017_INT_BASE SCORE OF 397, HTTPS://SPEC.ORG/CPU2017/RESULTS/RES2020Q3/CPU2017-20200915-23981.PDF. BOTH AMD EPYC AND INTEL BASED SERVERS USE THE SAME ESTIMATED COST FOR THE FOLLOWING ELEMENTS OF THE ANALYSIS: SERVER CHASSIS SIZE OF 2RU AT A COST OF $2500 PER CHASSIS; INTERNAL STORAGE $380; PHYSICAL SERVERS MANAGED PER ADMIN: 30; FULLY BURDENED COST PER ADMIN $110500; SERVER RACK SIZE OF 42; SPACE ALLOWANCE PER RACK OF 27 SQ FEET; MONTHLY COST OF DATA CENTER SPACE $20 PER SQ FOOT; COST PER KW FOR POWER $0.12; POWER DROP PER RACK OF 12KW; AND A PUE (POWER USAGE EFFECTIVENESS OF 2).THE EPYC POWERED SOLUTION ESTIMATES ARE: 32 2P EPYC 7763 POWERED TOTAL SERVERS AT A HARDWARE ONLY ACQUISITION COST OF $19232 PER SERVER, WHICH INCLUDES TOTAL SYSTEM MEMORY OF 768GB, WHICH IS 6GB OF MEMORY / CORE AND A TOTAL SYSTEM MEMORY COST OF $3072; INTERNAL STORAGE COST OF $380. THE TOTAL AMD EPYC HARDWARE ACQUISITION COST FOR THIS SOLUTION IS $615424. EACH SERVER DRAWS ~611KWHR PER MONTH. FOR THE 4 YEARS OF THIS EPYC POWERED SOLUTION ANALYSIS THE: TOTAL SOLUTION POWER COST IS ~$225240 WHICH INCLUDES THE PUE FACTOR; THE TOTAL ADMIN COST IS ~$471468, AND THE TOTAL REAL ESTATE COST IS ~$77760. THE TOTAL 4 YEAR TCO ESTIMATE FOR THE AMD SOLUTION IS $1389892.THE INTEL BASED SOLUTION ESTIMATES ARE: 63 2P XEON GOLD 6258R BASED TOTAL SERVERS AT A HARDWARE ONLY ACQUISITION COST OF $12316 PER SERVER, WHICH INCLUDES TOTAL SYSTEM MEMORY OF 384GB, WHICH IS 6.9GB OF MEMORY / CORE AND A TOTAL SYSTEM MEMORY COST OF $1536; INTERNAL STORAGE COST OF $380. THE TOTAL INTEL HARDWARE ACQUISITION COST FOR THIS SOLUTION IS $775908. EACH SERVER DRAWS ~476KWHR PER MONTH. FOR THE 4 YEARS OF THIS INTEL BASED SOLUTION ANALYSIS THE: TOTAL SOLUTION POWER COST IS $345460 WHICH INCLUDES THE PUE FACTOR; THE TOTAL ADMIN COST IS ~$928200, AND THE TOTAL REAL ESTATE COST IS ~$103680. THE TOTAL 4 YEAR TCO ESTIMATE FOR THE INTEL SOLUTION IS $2153248.DELIVERING 25000 OF ESTIMATED SPECRATE®2017_INT_BASE PERFORMANCE, PRODUCES THE FOLLOWING ESTIMATED RESULTS: THE AMD EPYC SOLUTION REQUIRES 49% FEWER SERVERS [1-(AMD SERVER COUNT / INTEL SERVER COUNT)]; 25% LESS SPACE [1-(AMD RACK COUNT / INTEL RACK COUNT)]; 35% LESS POWER [1-(AMD POWER COST / INTEL POWER COST)]; PROVIDING A 35% LOWER 4 YEAR TCO [1-(AMD TCO / INTEL TCO)].AMD PROCESSOR PRICING BASED ON 1KU PRICE AS OF FEBRUARY 2021. INTEL® XEON® SCALABLE PROCESSOR DATA AND PRICING FROM HTTPS://ARK.INTEL.COM AS OF SEPTEMBER 2020. ALL PRICING IS IN USD. RESULTS SHOWN HERE ARE ESTIMATES AND ACTUAL RESULTS MAY VARY. PRODUCT AND COMPANY NAMES ARE FOR INFORMATIONAL PURPOSES ONLY AND MAY BE TRADEMARKS OF THEIR RESPECTIVE OWNERS. SPECRATE® SCORES AS OF 02/20/2021. AMD EPYC PERFORMANCE NUMBERS BASED ON AMD INTERNAL ESTIMATES AND ARE SUBJECT TO CHANGE BASED ON ACTUAL RESULTS. SPEC®, SPECRATE® AND SPEC CPU® ARE REGISTERED TRADEMARKS OF THE STANDARD PERFORMANCE EVALUATION CORPORATION. SEE WWW.SPEC.ORG FOR MORE INFORMATION. AMD EPYC PERFORMANCE NUMBERS BASED ON AMD MEASURED INTERNAL ESTIMATES AND ARE SUBJECT TO CHANGE BASED ON ACTUAL RESULTS.RESULTS GENERATED BY THE AMD EPYC™ BARE METAL SERVER TCO ESTIMATION TOOL, VERSION: 02/20/2021 V0.9982.

ENDNOTES (4)

NEW HPE PROLIANT DL385 GEN10 PLUS V2 IS THE BEST AMD-BASED SERVER FOR VIRTUALIZATION!

Key takeaways:

- #1 AMD result
- #1 4-node result
- 39.45% more performance and 28.57% more tiles compared to 2P 4-node results with previous generation processors
- 12.53% more performance and 20% more tiles than previous 4-node record
- With only half the total CPUs, defeats Fujitsu PRIMERGY by 1.63% higher performance score

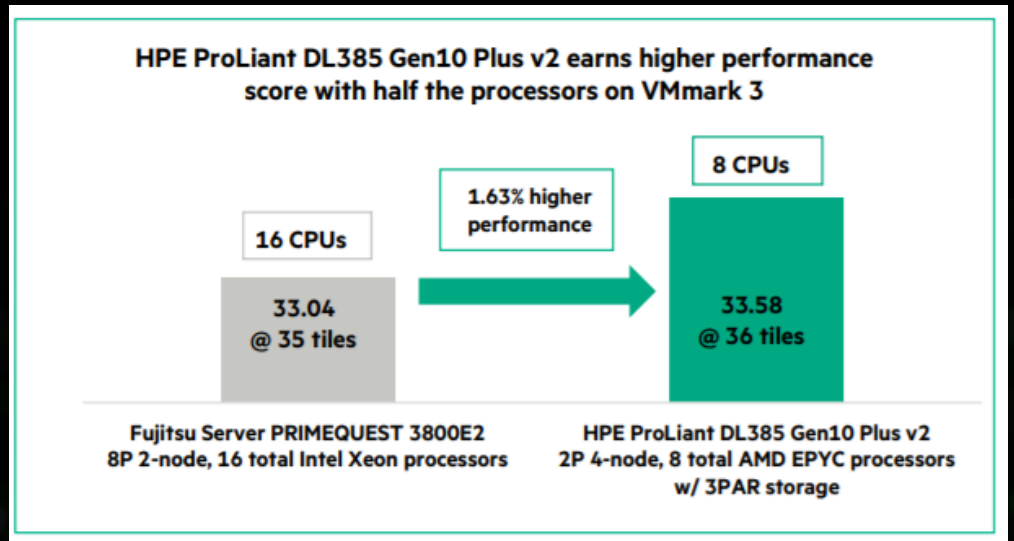


FIGURE 1. HPE ProLiant DL385 Gen10 Plus v2 8P and competitor 16P results on the VMmark 3.1.1 benchmark

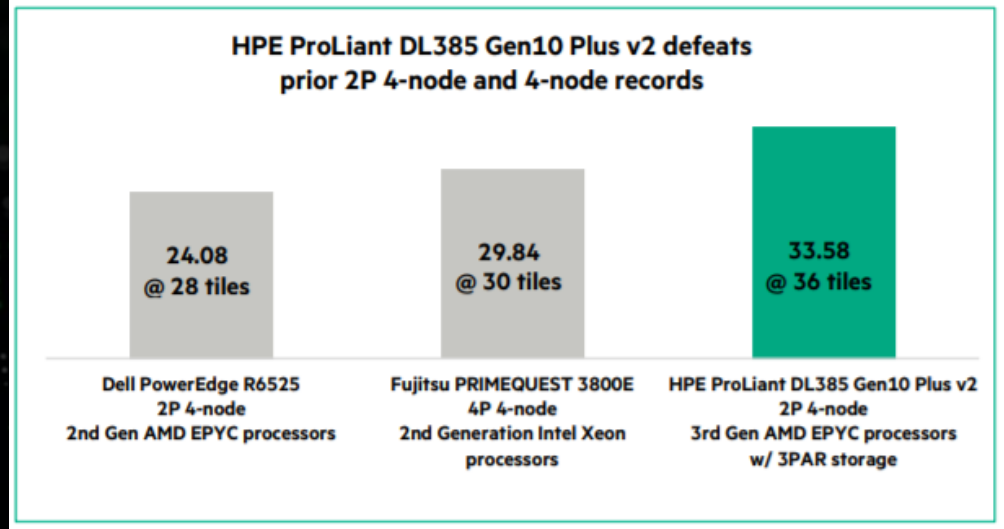


FIGURE 2. HPE ProLiant DL385 Gen10 Plus v2 versus prior top 2P 4-node and 4-node results

Performance Brief

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HPE PROLIANT SERVERS WITH AMD EPYC – EXCELLENT CHOICE

Key takeaways

HPE ProLiant AMD EPYC™ Gen10 Plus Servers offer an excellent combination of energy efficiency proof points and leadership design across form factors

- HPE ProLiant AMD EPYC rack servers with the latest AMD EPYC processors offer the right form factor for the right workload with increased sustainability compared to previous generation processors

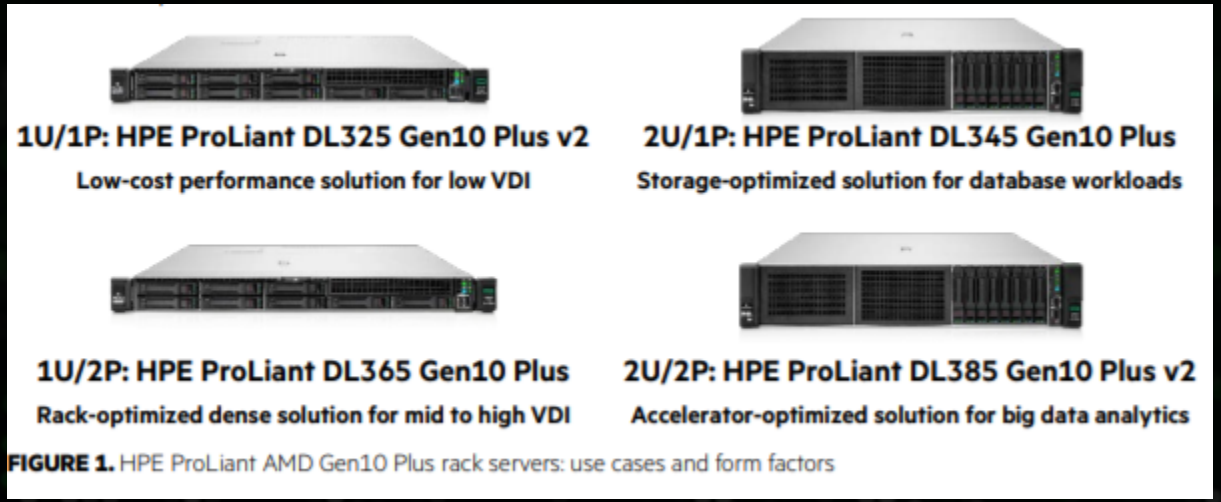

FIGURE 1. HPE ProLiant AMD Gen10 Plus rack servers: use cases and form factors

Performance Brief

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HPE PROLIANT AMD EPYC™ GEN10 PLUS 1P AND 2P SERVERS ACHIEVE FIVE WORLD RECORDS ON JAVA WORKLOAD

Key takeaways

HPE ProLiant DL345 Gen10 Plus

- #1 1P on 3 SPECjbb2015 metrics
  - MultiJVM max-jOPS
  - MultiJVM critical-jOPS
  - Distributed max-jOPS

HPE ProLiant DL385 Gen10 Plus v2

- #1 2P on 2 SPECjbb2015 metrics:
  - MultiJVM max-jOPS
  - Distributed max-jOPS

HPE ProLiant DL345 Gen10 Plus and DL385 Gen10 Plus achieved 16.8% and 17.1% gains respectively compared to closest 1P and 2P competitors

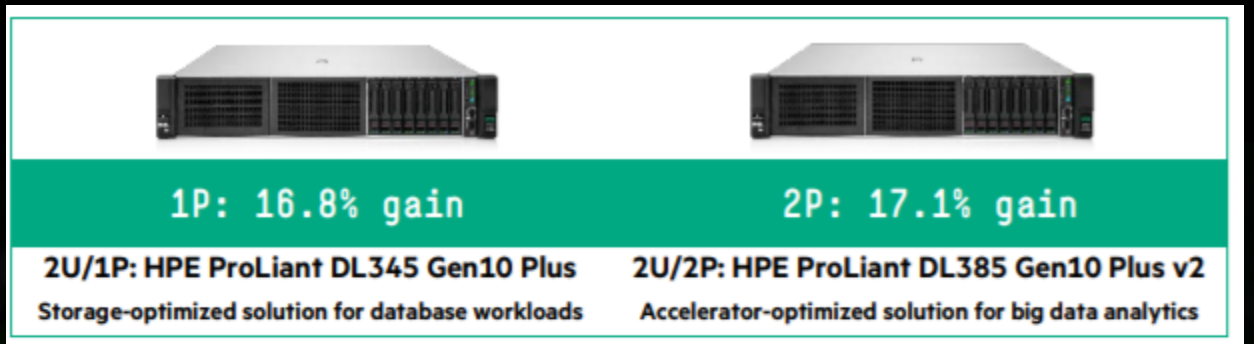

FIGURE 1. HPE ProLiant DL345 Gen10 Plus and HPE ProLiant DL385 Gen10 Plus v2 gains versus closest competitors

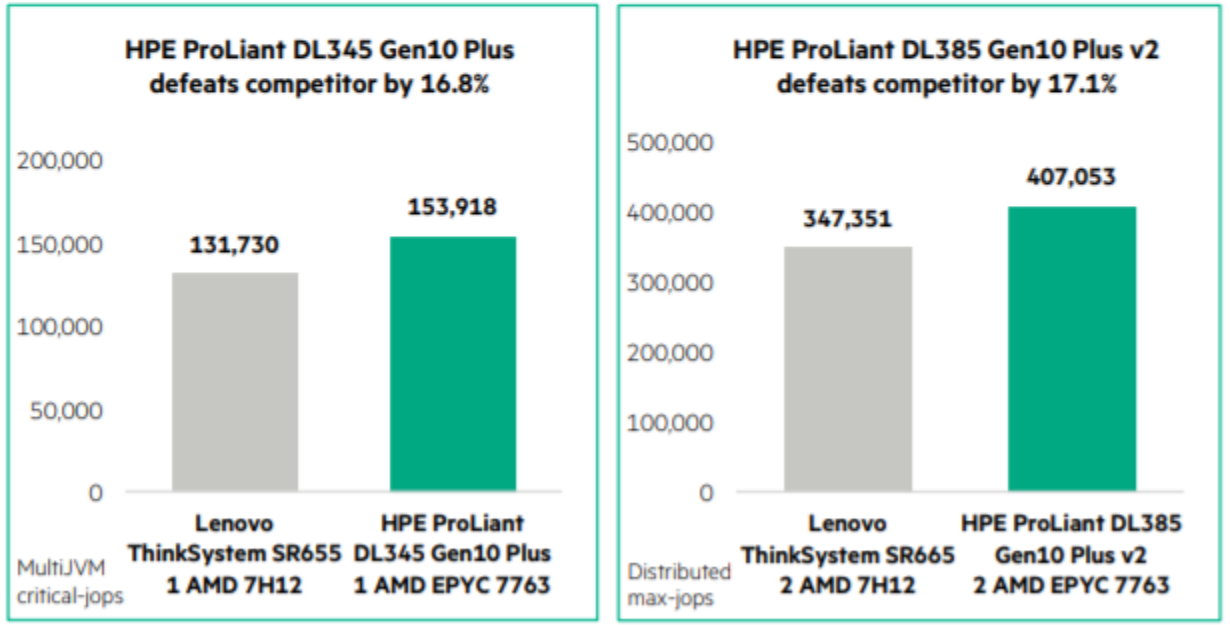

FIGURE 2. HPE AMD EPYC and competitor results comparison for 1P and 2P on the SPECjbb2015 benchmark

Performance Brief

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NEW HPE PROLIANT AMD SERVERS GAIN 7 WORLD PERFORMANCE RECORDS FOR DECISION SUPPORT DATABASE WORKLOADS

Key takeaways:

DL385 Gen10 Plus v2:

- #1 overall world record performance
- #1 overall world record price/performance
- 1st 2P result for TPC-H @10000GB scale factor
- Best 2P Performance
- 2P DL385 Gen10 Plus v2 beats the 4P Cisco UCS C480 M5 Server
- 14% more performance than 4P Cisco and 16.42% less cost than previous best, the 4P Dell EMC PowerEdge R940xa, on TPC-H @10000GB scale factor

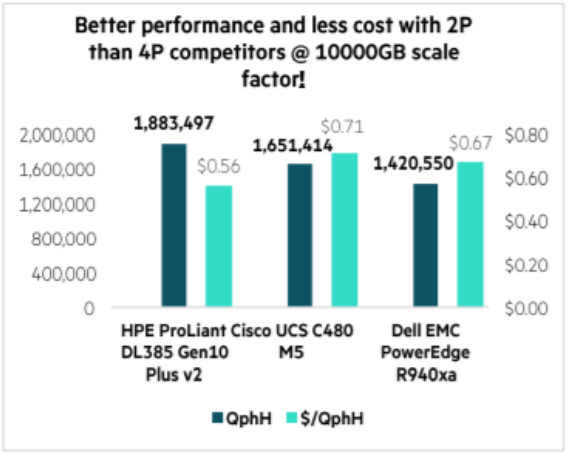
DL345 Gen10 Plus:

- #1 overall performance
- Best 1P performance
- #3 overall price/performance
- 8.2% better performance than previous best on TPC-H @3000GB scale factor
- 27.4% more performance and 16.7% less cost in comparison to 2nd Gen AMD EPYC Processors

2U/2P: HPE ProLiant DL385 Gen10 Plus v2

Ideal choice as an accelerator-optimized solution for big data analytics

FIGURE 1 The HPE ProLiant DL385 Gen10 Plus v2 offers 14% more performance than the 4P Cisco UCS C480 M5 server and is 16.42% more affordable than the previous best on the Dell EMC PowerEdge R940xa Server

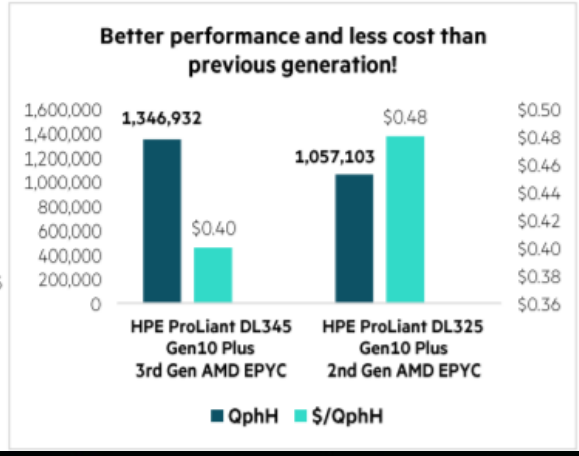


In addition, the HPE ProLiant DL345 Gen10 Plus server achieved the #1 result for non-clustered decision support database workloads, and a gain in pure performance of 27.4% with a reduction in cost of 16.7%[2] compared to the previous generation.

2U/1P: HPE ProLiant DL345 Gen10 Plus

Ideal choice as a storage-optimized solution for database workloads

FIGURE 2 The HPE ProLiant DL345 Gen10 Plus server provides 27.4% performance and costs 16.7% less than the previous generation, the HPE ProLiant DL325 Gen10 Plus



Performance Brief

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HPE APOLLO 2000 GEN10 PLUS SYSTEM WITH HPE PROLIANT XL225N GEN10 PLUS SERVERS ACHIEVES 18 WORLD RECORDS IN ENERGY EFFICIENCY

Key Takeaways

- #1 overall 2-node, 3-node, and 4-node results
- #1 2P 2-node, 3-node, and 4-node results
- #1 Linux 2-node, 3-node, and 4-node results
- #1 Linux 2P 2-node, 3-node, and 4-node results
- #1 Windows 2-node, 3-node, and 4-node results
- #1 Windows 2P 2-node, 3-node, and 4-node results
- The first multi-node system that beat the 17000 overall ssj/ops/watt barrier

#1 overall

#1 Linux

#1 Windows

Up to 54% higher energy efficiency

Table 1. The HPE ProLiant XL225n Gen10 Plus swept all 2-node, 3-node, and 4-mode categories for overall, Linux, and Windows leadership.

Processors / nodes	HPE ProLiant XL225n Gen10 Plus overall ssj_ops/watt
2P 2-node	**16,320**
2P 3-node	**17,336**
2P 4-node	**17,696**
2P 2-node	**16,320**
2P 3-node	**17,336**
2P 4-node	**17,696**
2P 2-node	**15,574**
2P 3-node	**16,205**
2P 4-node*	**17,530***

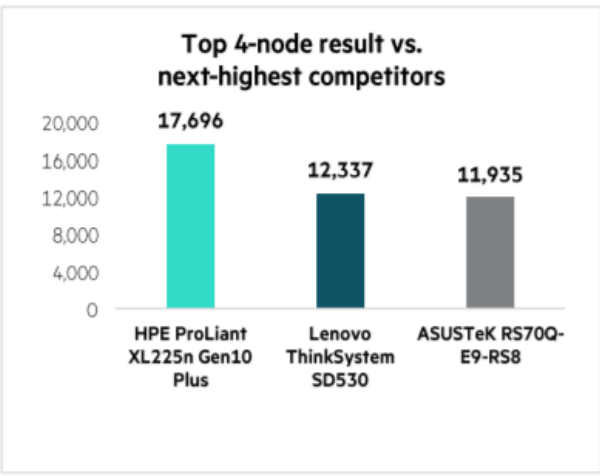

Figure 1 HPE Apollo 2000 Gen10 Plus System with HPE ProLiant XL225n Gen10 Plus servers compared to 4-node top competitors

Performance Brief

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AMD

HPE PLATFORMS BACK UP SLIDES

HPE PROLIANT DL325 GEN10 PLUS V2 WITH MILAN

Low-cost performance solution

1U, 1P

HPE ProLiant DL325
Brushfire

VDI (low)

Cost optimized
Shorter depth chassis (<25.5")

Primary workload: VDI (low)

Feature	Specs
Processors	AMD® Milan processors up to 280W
Drive carrier	Basic carrier
Front drive count	4 LFF SAS/SATA 8 +2 SFF SAS/SATA 8 +2 SFF NVMe x4 PCIe Gen4 (U.3 or U.2)
Rear drive count	No rear drive
Boot options	M.2 SATA SSD support using enablement kit (uses a PCIe slot) NS204i-p boot controller (Tinker) (uses a PCIe slot) 32GB microSD RAID 1 USB boot drive
GPU support	2 single wide (under consideration)
I/O	Up to 3 x16 PCIe Gen4 x8 PCIe Gen4 OCP3 slot (Expandable to x16 using cable) x8 AROC
Storage controller	Support for SAS/SATA controllers and tri-mode controllers
Chassis depth	25.34"
Targeted workloads	VDI

HPE PROLIANT DL325 GEN TO GEN COMPARISONS

	Gen10 Rome	Gen10 Plus Rome	Gen10 Plus v2 Milan
Compute	Up to (1) AMD® EPYC™ 7002 series processors, **64 cores, 200W** , PCIe 3.0, up to three available slot(s)	Up to (1) AMD EPYC 7002 series processors, **64 cores, 225W**, **PCIe 4.0**, up to three available slot(s)	Up to (1) **AMD EPYC 7003 series processors**, 64 cores, **280W**, PCIe 4.0, up to three available slot(s)
Memory	HPE Smart Memory (16) DDR4, up to 2933 MHz (2 TB max)	HPE Smart Memory (16) DDR4, up to **3200 MHz (4 TB max)**	HPE Smart Memory (16) DDR4, up to 3200 MHz (4 TB max)
Persistent memory	No support	No support	No support
Storage	Standard HPE Smart Array S100i, Software RAID Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features	Standard **HPE Smart Array SR100i*,** Software RAID (8 drives + 2 NVMe) Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features.	Standard HPE Smart Array SR100i, Software RAID (8 drives + 2 NVMe) Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features, **Tri-Mode Controllers for h/w RAID on NVMe drives.**
Drives	4 LFF/8 + 2 SFF SAS/SATA, 10 SFF NVMe	Up to 12LFF/24SFF/24 NVMe Smart Carrier	**4 LFF/ 8 + 2 SFF SAS/SATA, 10 SFF NVMe Basic carriers**
Networking	**4x1GbE embedded** + choice of FlexibleLOM + standup	**4x1GbE embedded + choice of OCP** + standup	Choice of OCP + standup
VGA/serial/USB/SD ports	Front display port opt, rear VGA and optional serial, 4 USB 3.0, dual Micro-SD. Front management port and dedicated rear iLO port	Front display port opt, rear VGA and optional serial, 4 USB 3.0 Front management port and dedicated rear iLO port	Front display port opt, rear VGA and optional serial, 4 USB 3.0 Front management port and dedicated rear iLO port
GPU support	Up to 1 single wide	Up to **2 single wide**	Up to 2 single wide
Management—converged	HPE OneView and HPE iLO Advanced	HPE OneView. HPE iLO Advanced, and HPE InfoSight	HPE OneView. HPE iLO Advanced, and HPE InfoSight
Management—support	HPE Insight Online with enhanced mobile appl	HPE Insight Online with enhanced mobile appl	HPE Insight Online with enhanced mobile appl
Management—embedded	HPE iLO 5, SUM, RESTful Interface Tool, UEFI	HPE iLO 5, SUM, RESTful Interface Tool, UEFI	HPE iLO 5, SUM, RESTful Interface Tool, UEFI
Power and cooling	Up to 96% eff. to 1600W	Up to 96% eff. to 1600W	Up to 96% eff. to 1600W
Industry compliance	ASHRAE A3 and A4, lower idle power, Energy Star	ASHRAE A3 and A4, lower idle power, Energy Star	ASHRAE A3 and A4, lower idle power, Energy Star
Chassis depth	1U, 24.2”	1U, **31.8” (Up to 8LFF/20 SFF) or 39.3”(12LFF/24SFF)**	1U, **25.34”**
Serviceability easy install rails	Standard	Standard	Standard
Warranty	3/3/3	3/3/3	3/3/3

HPE PROLIANT DL345 GEN10 PLUS WITH MILAN

Single-socket scalable solution

2U, 1P

HPE ProLiant DL345 Gen10 Plus

Crossroads

Shared board from DL325 Gen10 Plus
Leveraged chassis DL385 Gen10 Plus

Primary workload: database

Feature	Specs
Processors	AMD® Milan processors up to 280W; select Rome CPUs (5)
Drive carrier	Basic carrier
Front drive count	12 LFF HDD/SSD; SAS/SATA 24 SFF HDD/SSD; SAS/SATA 24 SFF NVMe x4 PCIe Gen4 (U.3 or U.2) 24 SFF NVMe x1 PCIe Gen4 (U.3)
Rear drive count	2 SFF SAS/SATA/x4 NVMe (only U.3)
Boot options	M.2 SATA SSD support using enablement kit (Uses a PCIe slot) NS204i-p boot controller (Tinker) (Uses a PCIe slot) 32GB microSD RAID 1 USB Boot Drive
GPU support	Up to 3 single wide (active/passive)
I/O	Up to 4 PCIe Gen4 slots 2 x16 PCIe Gen4 on Primary; x16 PCIe Gen4 or 2 x8 PCIe Gen4 on Secondary x8 PCIe Gen4 OCP3 slot (Expandable to x16 using cable) X8 AROC
NVMe support	Total 24 x4 PCIe Gen4 (U.3 or U.2) Up to 16 NVMe drives off motherboard (Uses the AROC slot)
Storage controller	Support for SAS/SATA controllers and tri-mode controllers
Chassis depth	28” (SFF), 29.5” (LFF)
Targeted workloads	Database; SDS

HPE PROLIANT DL345 GEN10 PLUS WITH MILAN

	Gen10 Plus Milan
Compute	Up to (1) AMD® EPYC™ 7003 series processors, 64 cores, 280W, PCIe 4.0, up to four available slots
Memory	HPE Smart Memory (16) DDR4, up to 3200 MHz (4 TB max)
Persistent memory	No Support
Storage	Standard HPE Smart Array SR100i, Software RAID (8 drives + 2 NVMe) Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features, Tri-Mode Controllers for h/w RAID on NVMe drives.
Drives	12 LFF + 2 SFF/ 24 SFF + 2 SFF SAS/SATA, 24 SFF NVMe + 2 SFF Basic carriers
Networking	Choice of OCP + Standup
VGA/serial/USB/SD ports	Front Display Port Opt, Rear VGA and Optional Serial, 4 USB 3.0, Front Management port and dedicated rear iLO port
GPU support	Up to 3 Single Wide
Management—converged	HPE OneView, HPE iLO Advanced, and HPE InfoSight
Management—support	HPE Insight Online with enhanced mobile appl
Management—embedded	HPE iLO 5, SUM, RESTful Interface Tool, UEFI
Power and cooling	up to 96% eff. To 1600W
Industry compliance	ASHRAE A3 and A4, lower idle power, Energy Star
Chassis depth	28” (SFF), 29.5” (LFF)
Serviceability easy install rails	Standard
Warranty	3/3/3

HPE PROLIANT DL365 GEN10 PLUS WITH MILAN

Rack optimized dense solution

1U, 2P

Shared board from DL385 Gen10 Plus
Leveraged chassis from DL360 Gen10 Plus

With only 1 processor populated

NVMe drives	PCIe options	AROC/OCP
10 x4 NVMe drives	2 slots: 1 x16 1 x8	Both Config limitation: When 10 NVME install, No AROC support and only support with 1 x8 OCP. With 8 NVMe install, can support 1x AROC with 1x8 OCP.

Primary workload: VDI

Feature	Specs
Processors	AMD Milan Processors up to 240W (280W Post launch); selected Rome processors (5)
Drive carrier	Basic Carrier
Front drive count	8 +2 SFF SAS/SATA 8 +2 SFF NVMe x4 PCIe Gen4 (U.3 or U.2)
Rear drive count	No rear drive
Boot options	M.2 SATA SSD Support using enablement kit (Uses a PCIe slot) Riser option includes Tinker Support NS204i-p Boot controller (Tinker) (Uses a PCIe slot) 32GB microSD RAID 1 USB Boot Drive
GPU support	2 single wide (active/passive)
I/o	Up to 3 x16 PCIe Gen4 Riser option with tinker support—2 x16 and 1 x8 x8 PCIe Gen4 OCP3 slot (Expandable to x16 using cable) x8 AROC
Storage controller	Support for SAS/SATA controllers and Tri-mode controllers
Chassis depth	29.65” (SFF)
Targeted workloads	VDI, EDA/CAD, Database

HPE PROLIANT DL365 GEN10 PLUS WITH MILAN

	Gen10 Plus Milan
Compute	Up to (2) AMD® Milan Processor family, up to 64 Cores, 240W, PCIe Gen 4.0, up to three (3) available slot(s)
Memory	HPE Smart Memory (32) DDR4 8 channels per CPU, up to 3200MHz (1DPC) (8.0 TB* max)
Persistent memory	No Support
Storage	Standard HPE Smart Array SR100i* Software RAID (Only for 2NVMe) Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features. Tri-Mode Controllers* for h/w RAID on NVMe drives.
Drives	10 SFF SAS/SATA, 10 NVMe (x4) PCIe SSD
Networking	Choice of OCP + Standup
VGA/serial/USB/SD ports	Front Display Port Opt, Rear VGA and Optional Serial, 5 USB 3.0, + 1 USB 2.0 optional. Front Management port and dedicated rear iLO port
GPU support	(2) Single Wide
Management—converged	HPE OneView, HPE iLO Advanced and HPE InfoSight
Management—support	HPE Insight Online with enhanced mobile appl
Management—embedded	HPE iLO 5, SUM, RESTful Interface Tool, UEFI
Power and cooling	up to 96% eff. To 1600W
Industry compliance	ASHRAE A3 and A4, lower idle power, Energy Star
Chassis depth	29.65” (SFF)
Serviceability easy install rails	Standard
Warranty	3/3/3

HPE PROLIANT DL385 GEN10 PLUS V2 WITH MILAN

Accelerator optimized solution

2U, 2P

HPE ProLiant DL385 Gen10 Plus v2

Shared board with DL365 Gen10 Plus Existing Chassis

With only 1 processor populated

NVMe drives	PCIe options	AROC/OCP
8 x4 NVMe drives	3 slots: 1 x16 1 x8	Both

Primary workload: ML/Big Data Analytics

Feature	Specs
Processors	AMD Milan processors up to 280W
Drive carrier	Basic Carrier
Front drive count	12 LFF SAS/SATA 24 SFF SAS/SATA 24 SFF NVMe x4 PCIe Gen4 (U.3 or U.2) 24 SFF NVMe x1 PCIe Gen4 (U.3)
Mid tray count	8 SFF SAS/SATA/NVMe x4 PCIe Gen4 (U.3) 4LFF SAS/SATA
Rear drive count	4 SFF SAS/SATA (and proposed NVMe U.3 TBC) / 4 LFF
Boot options	M.2 SATA SSD Support using enablement kit (Uses a PCIe slot) NS204i-p Boot controller (Tinker) (Uses a PCIe slot) 32GB microSD RAID 1 USB Boot Drive
GPU support	8 single wide or 3 double wide (active/passive)
I/o	Total 8 PCIe Gen4 Slots x8 PCIe Gen4 OCP3 slot (Expandable to x16 using cable) x8 AROC Up to 6 x16 PCIe Gen4
Nvme support	Total 32 x4 PCIe Gen4 U.3 (24 x4 PCIe Gen4 U.2) Up to 16 NVMe drives off mother board (Uses the AROC slot) X8 and x16 retimer cards to connect additional NVMe drives using PCIe slots
Storage controller	Support for SAS/SATA controllers and Tri-mode controllers
Chassis depth	28” (SFF), 29.5” (LFF)
Targeted workloads	AI/ML, Structured Data Analytics, NFV

HPE PROLIANT DL385 GEN TO GEN COMPARISONS

	Gen10 Rome	Gen10 Plus Rome	Gen10 Plus v2 Milan
Compute	Up to (2) AMD® EPYC® 7002 Series Processor family, up to **64 Cores, 200W** PCIe 3.0, up to eight (8) available slot(s)	Up to (2) AMD® **Rome Processor family, up to 64 Cores, 225W, PCIe Gen 4.0,** up to eight (8) available slot(s)	Up to (2) AMD® **Milan** Processor family, up to 64 Cores**, 280W,** PCIe Gen 4.0, up to eight (8) available slot(s)
Memory	HPE Smart Memory (32) DDR4 8 channels per CPU, up to **2933MHz** (4.0 TB+ max)	HPE Smart Memory (32) DDR4 8 channels per CPU, **up to 3200MHz (1DPC) (8.0 TB* max)**	HPE Smart Memory (32) DDR4 8 channels per CPU, **up to 3200MHz (1DPC) (8.0 TB* max)**
Persistent memory	No support	No support	No support
Storage	Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features	Standard **HPE Smart Array SR100i*** Software RAID (Only for 2NVMe) Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features.	Standard **HPE Smart Array SR100i*** Software RAID (Only for 2NVMe) Choice of HPE Smart Array Essential or Performance Controllers for performance or additional features. **Tri-Mode Controllers* for h/w RAID on NVMe drives.**
Drives	12+4+3 LFF+2SFF max/ 24+6 SFF SAS/SATA, 24 NVMe PCIe SSD and M.2 enablement	**20 LFF+2SFF max/ 38 SFF SAS/SATA, 32 NVMe (x4) PCIe SSD**	20 LFF+2SFF max/ 36 SFF SAS/SATA, 32 NVMe (x4) PCIe SSD
Networking	**4x1GbE embedded** + Choice of FlexibleLOM + Standup	**4x1GbE embedded** + **Choice of OCP** + Standup	**Choice of OCP** + Standup
VGA/serial/USB/SD ports	Front Display Port Opt, Rear VGA and Optional Serial, 5 USB 3.0, + 2 USB 2.0 optional, Dual Micro-SD. Front Management port and dedicated rear iLO port	Front Display Port Opt, Rear VGA and Optional Serial, 5 USB 3.0, + 2 USB 2.0 optional, Dual Micro-SD. Front Management port and dedicated rear iLO port	Front Display Port Opt, Rear VGA and Optional Serial, 5 USB 3.0, + 2 USB 2.0 optional, Dual Micro-SD. Front Management port and dedicated rear iLO port
GPU support	Single(6)/Double-Wide (3) and Active/Passive up to 10.5”	**(8) Single/ (3) Double-Wide** and Active/Passive up to 10.5” (3)	**(8) Single/ (3) Double-Wide** and Active/Passive up to 10.5” (3)
Management—converged	HPE OneView and HPE iLO Advanced	HPE OneView, HPE iLO Advanced and HPE InfoSight	HPE OneView, HPE iLO Advanced and HPE InfoSight
Management—support	HPE Insight Online with enhanced mobile appl	HPE Insight Online with enhanced mobile appl	HPE Insight Online with enhanced mobile appl
Management—embedded	HPE iLO 5, SUM, RESTful Interface Tool, UEFI	HPE iLO 5, SUM, RESTful Interface Tool, UEFI	HPE iLO 5, SUM, RESTful Interface Tool, UEFI
Power and cooling	Up to 96% eff. to 1600W	Up to 96% eff. to 1600W	Up to 96% eff. to 1600W
Industry compliance	ASHRAE A3 and A4, lower idle power, Energy Star	ASHRAE A3 and A4, lower idle power, Energy Star	ASHRAE A3 and A4, lower idle power, Energy Star
Chassis depth	26.75” (SFF), 28.75” (LFF)	28” (SFF), 29.5” (LFF)	28” (SFF), 29.5” (LFF)
Serviceability easy install rails	Standard	Standard	Standard
Warranty	3/3/3	3/3/3	3/3/3