



## **AWS R5b delivers better performance and cost than Azure E64\_32s\_v4 for a SQL Server workload**

2X the new orders per minute (NOPM) performance and as much as 62% cost savings in price/performance with an Elastic Cloud Computing (EC2) R5b instance

## **Deliver better performance for transactional database workloads at a lower cost by choosing an Amazon EC2 R5b instance**

**An Amazon EC2 r5b.8xlarge instance cost less and processed more NOPM for an online transaction processing (OLTP) workload than a Microsoft Azure E64\_32s\_v4 VM**

Choosing a cloud service provider (CSP) for your Microsoft SQL Server database workloads is a bit like piloting a quadcopter drone for the first time. Figuring out how to balance throttle (performance) and trim (cost) can get you where you need to go. For many organizations, performance is likely a priority, but for high-performance databases, that could come at a hefty price. R5b instances from Amazon EC2 could offer a balance of performance and cost that helps your organization.

We ran an OLTP workload for SQL Server 2019 Enterprise edition on an Amazon EC2 r5b.8xlarge instance and a Microsoft Azure E64\_32s\_v4 VM because they have similar specifications for input/output operations per second (IOPS) performance. Intel® Xeon® Scalable processors using Cascade Lake microarchitecture powered both instances, and both instances ran Microsoft Windows Server 2019. The EC2 instance processed more database transactions than the Azure VM. More transactions could mean more revenue from ecommerce applications, more users for an enterprise resource planning (ERP) application, or reduced costs due to consolidated workloads.

We also found that the on-demand, license-included Amazon EC2 R5b instance and its Elastic Block Storage (EBS) General Purpose SSD (gp2) volumes could cost less than the on-demand, license-included Azure VM delivering the same level of performance as the EC2 instance. That means a lower expense for your organization. Paying less to get better transactional database performance is an excellent reason to consider Amazon EC2 R5b instances for your large SQL Server databases.

## Get better performance with an Amazon EC2 R5b instance

To demonstrate the performance differences between the Amazon EC2 r5b.8xlarge and Azure E64\_32s\_v4 VM, we ran a TPC-C-like OLTP workload from HammerDB v3.3. We chose those two instances because they used Intel Xeon processors from the same generation (Cascade Lake), offered the same number of cores (32), and because they could deliver similar max IOPS (86,667 for the EC2 instance according to Amazon and 80,000 for the Azure VM according to Microsoft). Meeting those two criteria meant that we had to test an Azure VM with a higher nominal vCPU count and hourly cost than the EC2 instance.

To match the vCPU count and maximum IOPs limit of the EC2 r5b.8xlarge instance, we chose the Azure E64\_32s v4 VM. Looking at the Esv4-series VMs, the E32s v4 is capable of a maximum of 51,200 IOPs, and the E64s v4 is capable of a maximum of 80,000 IOPs, much closer to the 86,667 maximum IOPs reported by Amazon Web Services (AWS) for the r5b.8xlarge instance.

The I/O capability and memory of the Azure Es series VMs scale with the number of cores allotted to the VM, so we chose Azure's Constrained vCPU capable VMs to match the vCPU count and maximum disk I/O of the EC2 instance. The E64\_32s v4 has the memory and disk specs of the E64 v4, but uses only 32 cores. The higher cost Azure VM also included more memory than the EC2 instance.

We believe these facts support our decision to compare the SQL Server NOPM performance in HammerDB of the 32-core EC2 r5b.8xlarge instance and the Azure E64\_32s v4 VM. In addition, choosing the Azure E64\_32s v4 VM rather than the E64 v4 VM reduced per-core SQL licensing costs.

For compute resources, an Intel Xeon Platinum 8259CL processor with a base core frequency of 2.50 GHz powered the EC2 instance, and an Intel Xeon Platinum 8272CL processor with a base core frequency of 2.60 GHz powered the Azure VM. The EC2 instance had 253 GB of memory and more than 31 TB of Amazon EBS from six EBS 5,334GB gp2 drives in a single-striped volume. The Azure VM had 504 GB of memory and more than 48 TB of storage from six 8,192GB P60 drives in a single-striped volume. For both solutions, we chose the number and type of drives that would allow us to max out the IOPS specs on each instance while also matching each other as closely as possible. Both storage configurations had six drives, with each drive configured to deliver 16,000 IOPS.

Table 1 presents a side-by-side comparison of the two instances' configurations.

Table 1: Configuration details for the instances and storage we tested.

Test parameter	Amazon Elastic Compute Cloud (EC2)	Microsoft Azure
SQL Server Version	Microsoft SQL Server 2019 (KB4577194)	Microsoft SQL Server 2019 (KB4577194)
Region	us-east-1b	East US (Zone 1)
Operating System	Microsoft Windows Server 2019 Datacenter 10.0.17763 / Build 17763	Microsoft Windows Server 2019 Datacenter 10.0.17763 / Build 17763
Instance Type	r5b.8xlarge	E64_32s v4
CPU vCores	32	32
RAM (GB)	253	504
Storage Type	gp2	P60
Disk Configuration for Data / Logs	6x 5334GB, single stripe	6x 8192GB, single stripe

## NOPM on an OLTP workload

AWS r5b.8xlarge

1,468,743

Azure E64\_32s\_v4

720,157

2x  
performance

Figure 1 shows the median NOPM for the two instances we tested. The EC2 instance delivered better OLTP performance than the Azure VM—more than double the NOPM. Doing more work with the same number of instances, or the same amount of work with fewer instances, could translate to savings for your organization.

Figure 1: The NOPM each instance delivered while running an OLTP workload. Larger is better. Source: Principled Technologies.

### Why NOPM?

NOPM is a metric for OLTP workloads that shows only the number of new-order transactions completed in one minute as part of a serialized business workload. HammerDB claims that because NOPM is “independent of any particular database implementation [it] is the recommended primary metric to use.”<sup>2</sup> NOPM comes from the database schema itself, which means IT staff and IT decision makers can use the data to compare performance of different databases that run different transaction types. For example, a database administrator could compare the NOPM of their ecommerce database workload to the NOPM of their inventory database workload because both run new-order transactions but differ in other transaction types.



## Spend less each month to run OLTP workloads on an Amazon EC2 R5b instance

Table 2 presents two price per performance scenarios for the on-demand, license-included EC2 instance and Azure VM we tested. The instances ran in eastern US region data centers on December 23, 2020.<sup>3,4</sup> We compiled the on-demand costs of both solutions for a full 730-hour month to provide a worst-case cost comparison.<sup>5,6,7</sup> Expenses vary depending on the plan an organization chooses, which would include using the cloud for short-term performance bursts or needing longer-term options (e.g., one year, three years). Using the performance numbers from our testing, the price for 1,000 NOPM from the EC2 instance was \$17 USD lower than the price for 1,000 NOPM from the Azure VM in the 730-hour scenario. With that cost difference, an organization could pay as much as 62 percent less for the EC2 R5b instance we tested than the Azure VM achieving comparable NOPM performance.

Table 2: Pricing for the EC2 and Azure instances and their respective storage. Source: Principled Technologies.

Test Scenario	Parameter	Amazon Elastic Compute Cloud (EC2)	Microsoft Azure
730-hr usage scenario	Monthly On-Demand Price (USD)	\$14,785.28 (Instance cost \$11,574.88 + storage cost \$3,210.40)	\$19,528.96 (Instance cost \$13,852.48 + storage cost \$5,676.48)
	Performance (NOPM)	1,468,743	720,157
	Price/Performance (\$/1,000 NOPM)	\$10.07	\$27.12
240-hr usage scenario	Monthly On-Demand Price (USD)	\$4,859.53 (Instance cost \$3,805.44 + storage cost \$1,054.09)	\$6,420.48 (Instance cost \$4,554.24 + storage cost \$1,866.24)
	Performance (NOPM)	1,468,743	720,157
	Price/Performance (\$/1,000 NOPM)	\$3.31	\$8.92

Table 2 also shows a second cost comparison scenario with lower cloud utilization (240-hour costs). This second scenario is based on 8-hours per day usage. In the scenario, we assumed an administrator would spin up an instance and restore respective snapshots to the storage volume to use for eight hours per day, then spin down the instance, save a new daily snapshot, and delete the storage at the end of the 8-hour day. Based on the price per 1,000 NOPM difference in this scenario, an organization could again pay as much as 62 percent less with the EC2 R5b instance we tested with EBS storage than the Azure VM achieving comparable NOPM performance.

Figure 2 shows the price per 1,000 NOPM for the two instances we tested in the 730-hour scenario.

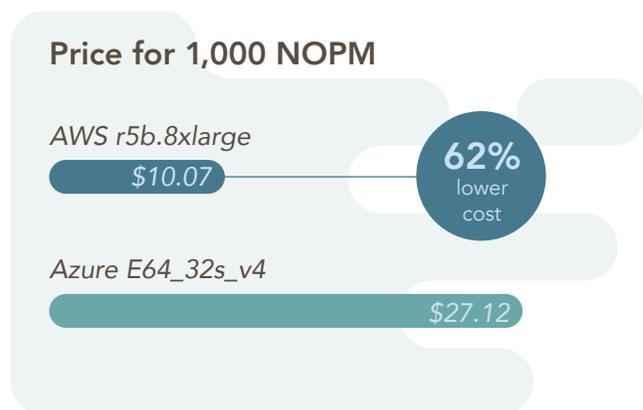


Figure 2: The price per 1,000 NOPM each instance could provide in a 730-hour scenario. Smaller is better. Source: Principled Technologies.



## Conclusion

Running large transactional database workloads on a CSP platform could introduce challenges in meeting performance goals and cost requirements. Choosing EC2 R5b instances for your organization could allow you to spend less each month on a cloud solution that offers higher performance, thus potentially helping deliver stronger revenue streams and support a larger user base. We found that an EC2 r5b.8xlarge instance powered by an Intel Xeon Scalable processor delivered better SQL Server NOPM performance on the HammerDB benchmark and a lower price per 1,000 NOPM than an Azure E64\_32s\_v4 VM powered by similar Intel Xeon Scalable processors.

- 1 Amazon, "About AWS," accessed February 4, 2021, <https://aws.amazon.com/about-aws/>.
- 2 HammerDB, "Comparing HammerDB results," accessed February 4, 2021, <https://www.hammerdb.com/docs/ch03s04.html>.
- 3 Amazon, "Amazon EC2 On-Demand Pricing," accessed February 2, 2021 <https://aws.amazon.com/ec2/pricing/on-demand/>.
- 4 Microsoft, "Windows Virtual Machines Pricing," accessed February 2, 2021, <https://azure.microsoft.com/en-us/pricing/details/virtual-machines/windows/>.
- 5 Instance pricing from both CSPs did not include operating system or SQL Server costs. To include those, we used each CSP's pricing calculator.
- 6 Amazon, "AWS Pricing Calculator," accessed February 2, 2021, <https://calculator.aws/#/>.
- 7 Microsoft, "Pricing calculator," accessed February 2, 2021, <https://azure.microsoft.com/en-us/pricing/calculator/>.

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