

# PRICE-PERFORMANCE ANALYSIS

Comparison of Amazon AWS, IBM SoftLayer, NxtGen ECS, and Microsoft Azure

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## Table of Contents

1. Introduction	2
2. Executive Summary	3
3. Methodology	4
4. Pricing Details	6
5. Performance Details	9
6. Value Details	10
7. Conclusion	11
8. Appendix	12

## INTRODUCTION

The ability for a user to provision and access virtualized server resources on demand highlights one of the key benefits of cloud computing. Applications can dynamically scale to accommodate load, and users only pay for the resources used. While the concept has catalyzed the adoption of cloud, one overlooked criteria for cloud selection directly impacts what users spend: performance.

Cloud resources are not standardized; therefore, the underlying hardware and architecture heavily impacts the performance of a virtual machine found on the public cloud. Often, the topic of performance is not considered until the newly migrated infrastructure causes problems, and the business must operate reactively rather than proactively.

Cloud Spectator is an analyst firm focused on the areas of performance and cost analytics of the cloud IaaS marketplace. We conduct studies and publish reports such as this document, commissioned by NxtGen, to provide a level of unique transparency for the industry. While many organizations focus on price when selecting a vendor, understanding the price-performance value of that vendor can guide the organization to a better purchase decision.

This report compares the cost and performance of four different public cloud offerings: Amazon Web Services, IBM SoftLayer, Microsoft Azure, and NxtGen ECS. Cost is examined, and performance is later applied to illustrate the noticeable difference between price and price-performance value.

## EXECUTIVE SUMMARY

Four different public IaaS offerings were compared in this report: Amazon Web Services, IBM SoftLayer, Microsoft Azure, and NxtGen ECS. This study contains three major areas of focus:

1. pricing (i.e., the cost of the tested infrastructure),
2. performance,
3. and value (i.e., the relationship between the cost and performance of the infrastructure).

### Summary of Findings



### Key Findings:

1. **NxtGen ECS demonstrated the lowest overall cost of infrastructure.** The cost of infrastructure was calculated by taking monthly prices on all VMs assuming full utilization (730 hours) and applying all qualified discounts.
2. **NxtGen ECS also demonstrated the highest performance.** Performance is defined by component performance (vCPU, memory, disk, and internal network) grouped into categories of Web Server and Database.
3. **NxtGen ECS ranked top in price-performance value due to the combination of lowest overall cost and high performance.**

## METHODOLOGY

Four different public IaaS offerings were compared in this report: Amazon Web Services, IBM SoftLayer, Microsoft Azure, and NxtGen ECS. The tests spanned throughout April 2016.

- Two total iterations (24 hours each) of continuous testing were performed on each VM set measured per provider.
- Tests measuring performance of vCPU, memory, disk, and internal network cycled sequentially and continuously until the end of the 24-hour period.
- A VM set is defined as two VMs of the same size (i.e., two clone environments). A set was necessary to run internal network testing.
  - Data collected on components include:
    - vCPU(s): integer and floating point processing
    - Memory: memory bandwidth
    - Disk: Read and Write IOPS
    - Internal Network: network throughput

Test	Measurements	Description
Geekbench 3	Processor & Memory	Geekbench 3 is a licensable product designed by Primate Labs. It is a collection of tests designed to simulate real-world scenarios, providing an indication of processor and memory performance.
Fio	Block Storage	Fio is an open source tool designed to stress IO. Cloud Spectator configured Fio to run sequential read, sequential write, random read, and random write tests to gather performance data on block storage IOPS.
Iperf	Network Throughput	Iperf is an open source tool used to measure network throughput between client and server. By default, Iperf connects between the machines and measures throughput performance using a TCP protocol. Cloud Spectator used the default TCP protocol and transferred data bi-directionally.

For performance, each VM received performance results based on

- 1) CPU performance,
- 2) disk IOPS,
- 3) memory bandwidth,
- 4) and internal network throughput.

The median scores of each category from each test cycle were normalized based on the highest score of each VM category, and averaged to give each VM an indexed score out of 100. For performance, the vCPU, disk, and internal network performance scores were averaged, while for the database, memory performance was included in the average as well, resulting in a VM score. The VM scores of each provider were averaged and normalized to produce a Provider Performance Score. The Provider Performance Score is the performance measurement used to represent performance of each provider in this report.

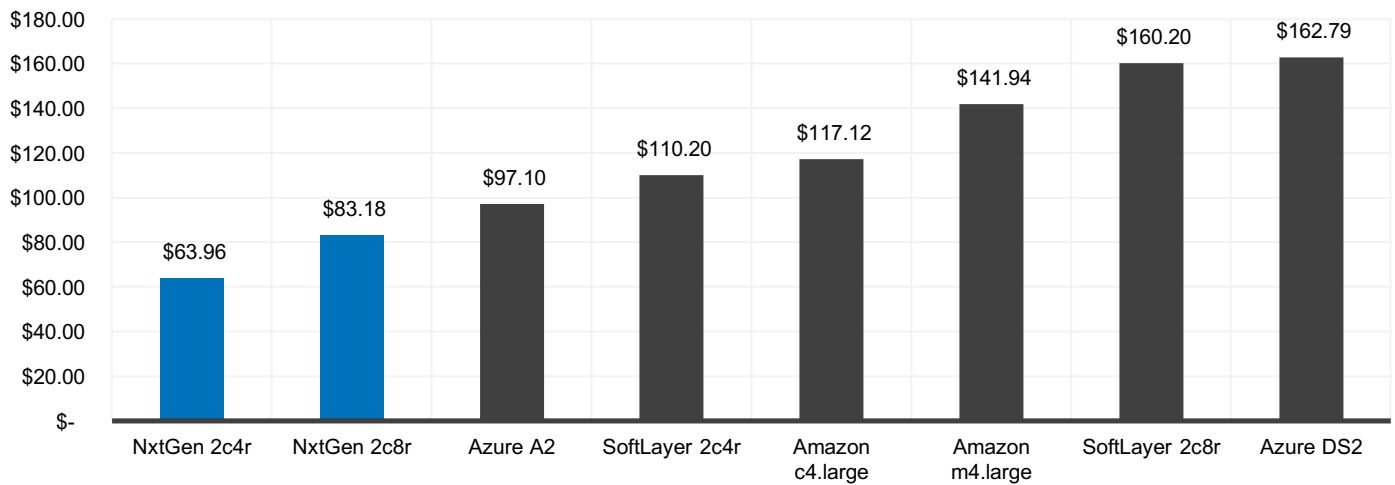
Value is measured through an indexed price-performance number, derived from a calculation and labeled as the CloudSpecs Score. The score is calculated as such:

1.  $\text{provider\_value} = \{\text{provider performance score}\} / \{\text{provider cost}\}$
2.  $\text{best\_provider\_value} = \max\{\text{provider\_values}\}$
3.  $\text{Provider's CloudSpecs Score} = 100 * \text{provider\_value} / \text{best\_provider\_value}$

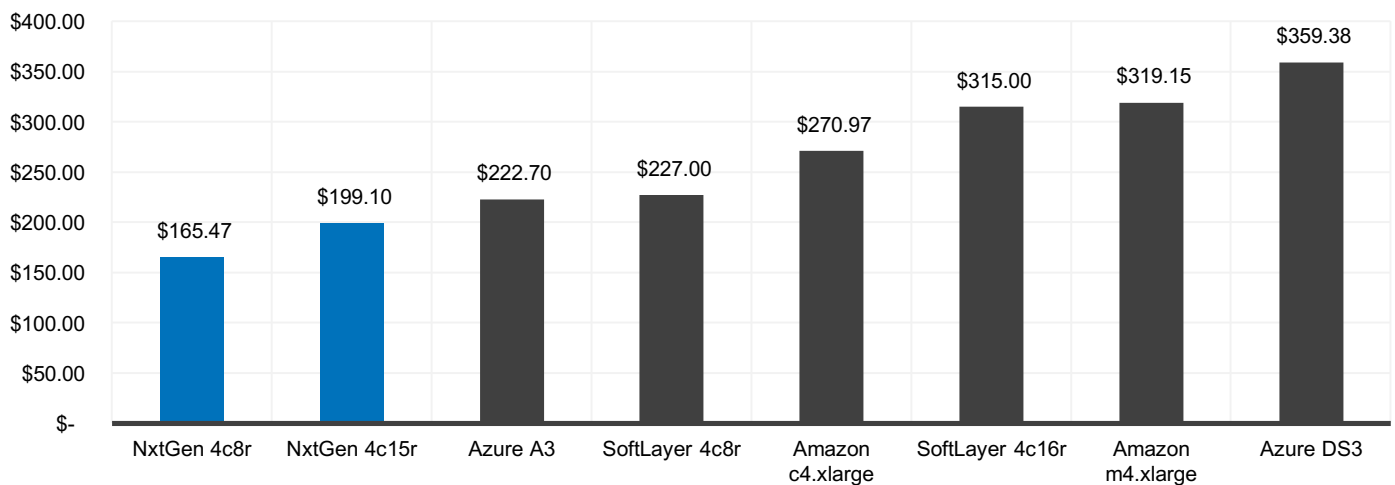
## PRICING EVALUATION

The monthly cost of each tested virtual machine was recorded for the purpose of a pricing analysis among the studied providers. The total monthly cost of each provider's VM is based on the cost of the virtual machine and any added block storage. NxtGen ECS ranked highest in affordability due to the low cost of each VM.

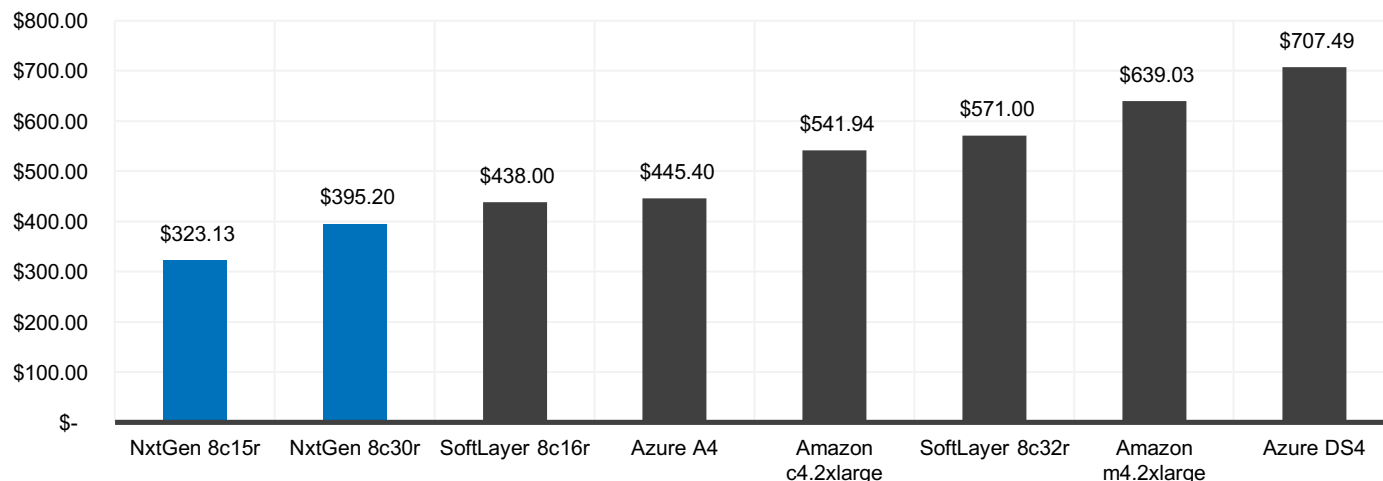
### 2 vCPU Machines



### 4 vCPU Machines



### 8 vCPU Machines



Provider	Type	VM Price	Storage Type	Storage Price	Total Price
Amazon	c4.large	\$105.12	100GB EBS SSD	\$12.00	\$117.12
Amazon	c4.xlarge	\$210.97	500GB EBS SSD	\$60.00	\$270.97
Amazon	c4.2xlarge	\$421.94	1000GB EBS SSD	\$120.00	\$541.94
Amazon	m4.large	\$129.94	100GB EBS SSD	\$12.00	\$141.94
Amazon	m4.xlarge	\$259.15	500GB EBS SSD	\$60.00	\$319.15
Amazon	m4.2xlarge	\$519.03	1000GB EBS SSD	\$120.00	\$639.03
Azure	A2	\$87.60	100GB Page Blob	\$9.50	\$97.10
Azure	A3	\$175.20	500GB Page Blob	\$47.50	\$222.70
Azure	A4	\$350.40	1000GB Page Blob	\$95.00	\$445.40
Azure	DS2	\$143.08	128GB Premium Storage	\$19.71	\$162.79
Azure	DS3	\$286.16	512GB Premium Storage	\$73.22	\$359.38
Azure	DS4	\$572.32	1024GB Premium Storage	\$135.17	\$707.49
SoftLayer	2c4r	\$96.00	100GB SAN	\$14.20	\$110.20
SoftLayer	2c8r	\$146.00	100GB SAN	\$14.20	\$160.20
SoftLayer	4c8r	\$188.00	500GB SAN	\$39.00	\$227.00
SoftLayer	4c16r	\$276.00	500GB SAN	\$39.00	\$315.00



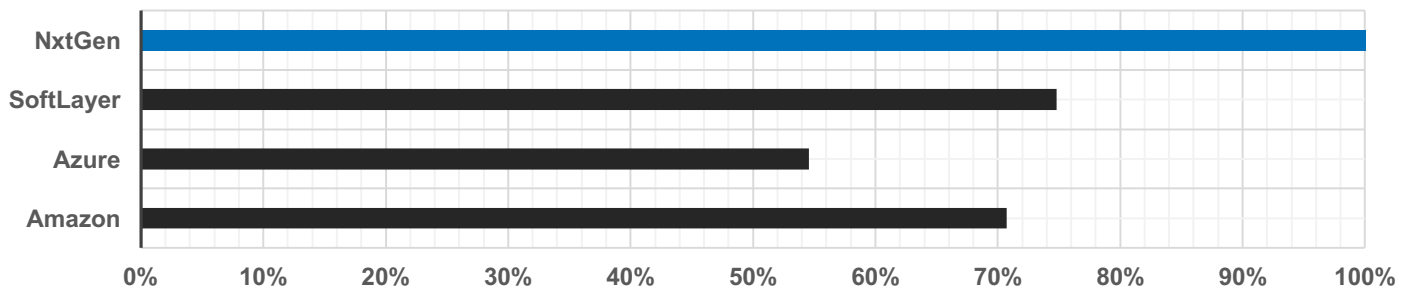
<b>SoftLayer</b>	8c16r	\$359.00	1000GB SAN	\$79.00	\$438.00
<b>SoftLayer</b>	8c32r	\$492.00	1000GB SAN	\$79.00	\$571.00
<b>NxtGen</b>	2c4r	\$50.45	100GB vSAN	\$13.51	\$63.96
<b>NxtGen</b>	2c8r	\$69.67	100GB vSAN	\$13.51	\$83.18
<b>NxtGen</b>	4c8r	\$97.90	500GB vSAN	\$67.57	\$165.47
<b>NxtGen</b>	4c15r	\$131.53	500GB vSAN	\$67.57	\$199.10
<b>NxtGen</b>	8c15r	\$187.99	1000GB vSAN	\$135.14	\$323.13
<b>NxtGen</b>	8c30r	\$260.06	1000GB vSAN	\$135.14	\$395.20

## PERFORMANCE DETAILS

vCPU, memory, disk, and internal network performance were measured to derive database and web server performance comparisons. Web server performance is a combination of vCPU, disk, and internal network, while database performance includes memory as well. The performance charts represent an overall score calculated from individual performance of each VM tested. In both the database and the web server scenario, NxtGen ECS's performance ranks highest compared to other offerings.

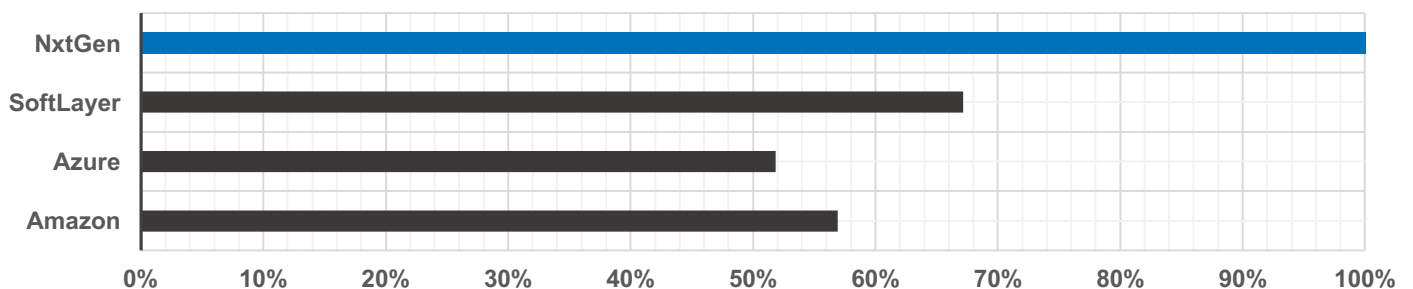
A clustered database environment combines single-node databases into a system acting as a single entity, or cluster. Clustered databases can improve performance and boost resiliency to avoid a single point-of-failure. While the resources that affect single-node database performance translate over to a clustered database environment, another factor, internal network, plays a major role in affecting the cluster's performance as well.

Database Performance



High-traffic web servers cluster web server environments behind load balancers to leverage horizontal scalability and serve requests to large amounts of incoming users. Examples include large news outlets, travel websites, and e-commerce shops.

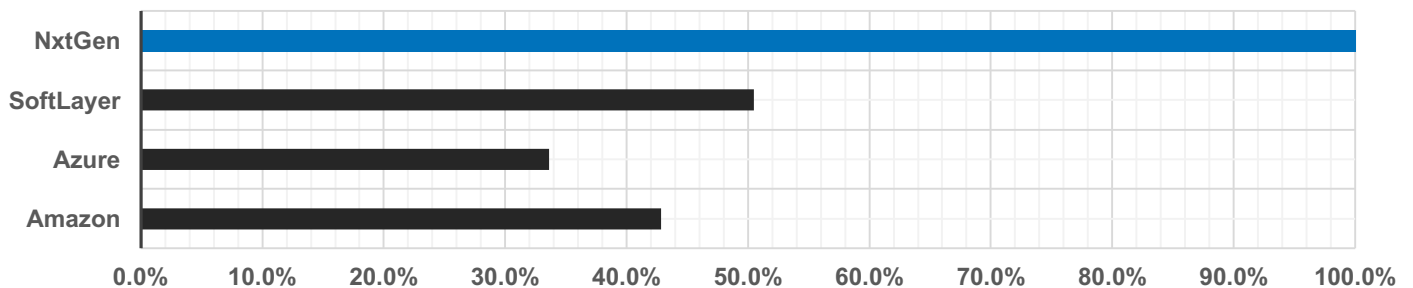
Web Server Performance



## VALUE DETAILS

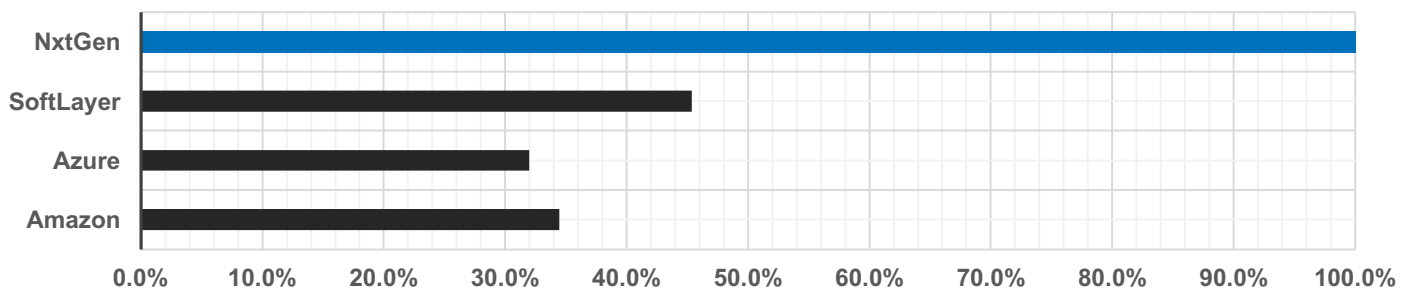
The value of each provider is calculated and ranked by the ratio between price and performance, as illustrated in the previous sections. The calculation can be found in the Methodology. The value ranking addresses the question: how much performance can a user receive for the amount of money a user spends?

Value Comparison: Database Performance



Due to the combination of low cost and high performance, NxtGen ECS achieves the highest value scores. NxtGen scores more than 3x higher in value than Microsoft Azure, more than 2.5x higher than Amazon AWS, and more than 2x higher than IBM SoftLayer.

Value Comparison: Web Server Performance



## CONCLUSION

The results of the cloud servers and providers tested in this study highlight a critical component to understanding the value of cloud computing: performance. The misconception of the industry as a commodity may mislead users to disregard the importance of performance in cloud computing, but examples highlighted in this report demonstrate the differences in performance and value among vendors.

NxtGen delivers more than 3x price-performance value against Microsoft Azure, based on the virtual machines environments measured in this study. The resulting value can lead to larger cost savings and improved user experience.

## ABOUT CLOUD SPECTATOR

Cloud Spectator is a cloud benchmarking and consulting agency focused on cloud Infrastructure-as-a-Service (IaaS) performance. The company actively monitors several of the largest IaaS providers in the world, comparing VM performance (i.e., CPU, RAM, disk, internal network, and workloads) and pricing to achieve transparency in the cloud market. The company helps cloud providers understand their market position and helps business make intelligent decisions in selecting cloud providers and lowering total cost of ownership. The firm was founded in early 2011 and is located in Boston, MA.

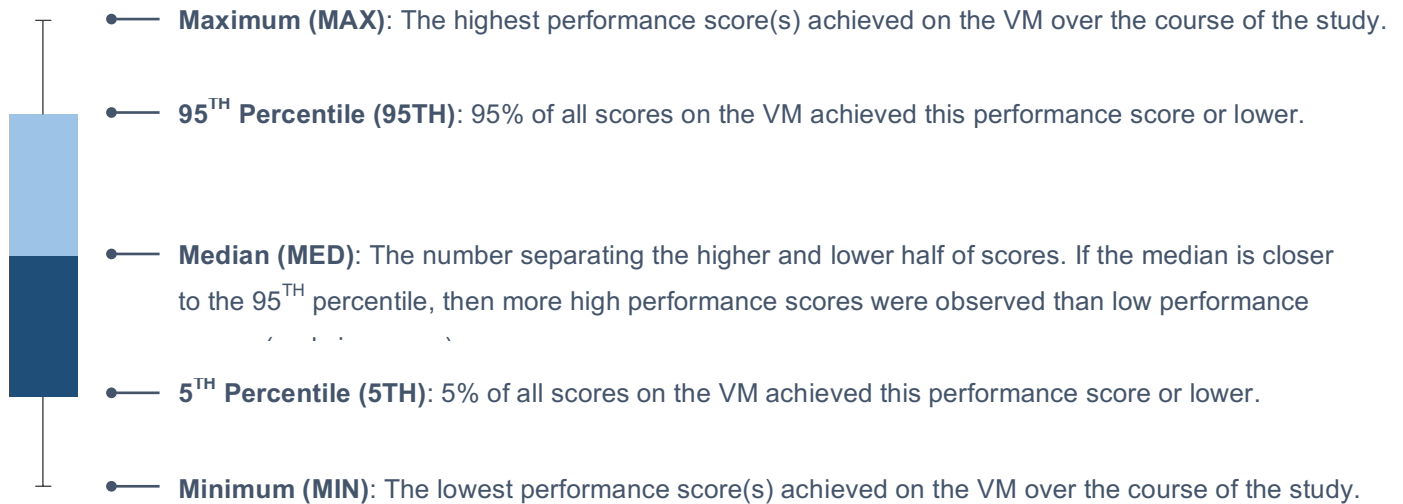
For questions about this report, to request a custom report, or if you have general inquiries about our products and services, please contact Cloud Spectator ([www.cloudspectator.com](http://www.cloudspectator.com)) at +1 (617) 300-0711 or [contact@cloudspectator.com](mailto:contact@cloudspectator.com).



## APPENDIX

Details of each test are collected within the appendix. All performance charts are displayed as box-and-whisker plots to highlight performance and performance variance tracked by Cloud Spectator measurement tools during the study.

How to interpret the graphs:



## vCPU Performance

Chart 3.1A: CPU PERFORMANCE (2vCPU VMs)

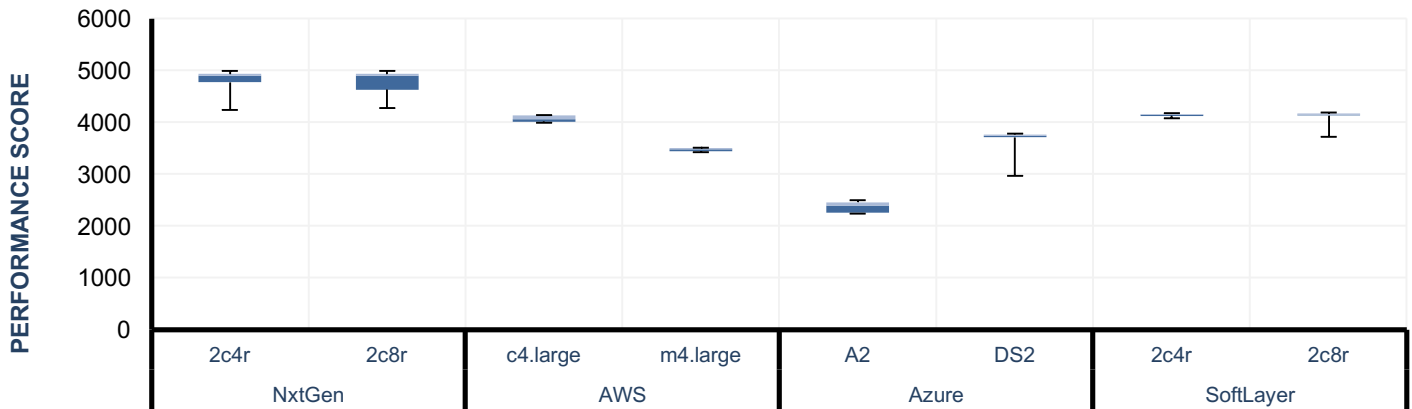


Chart 3.1B: CPU PERFORMANCE (4vCPU VMs)

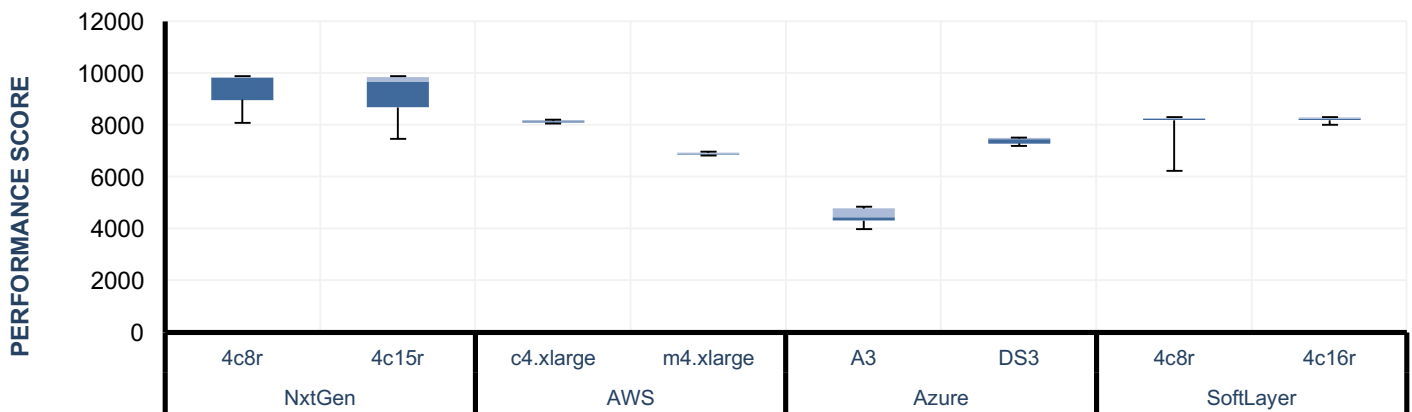
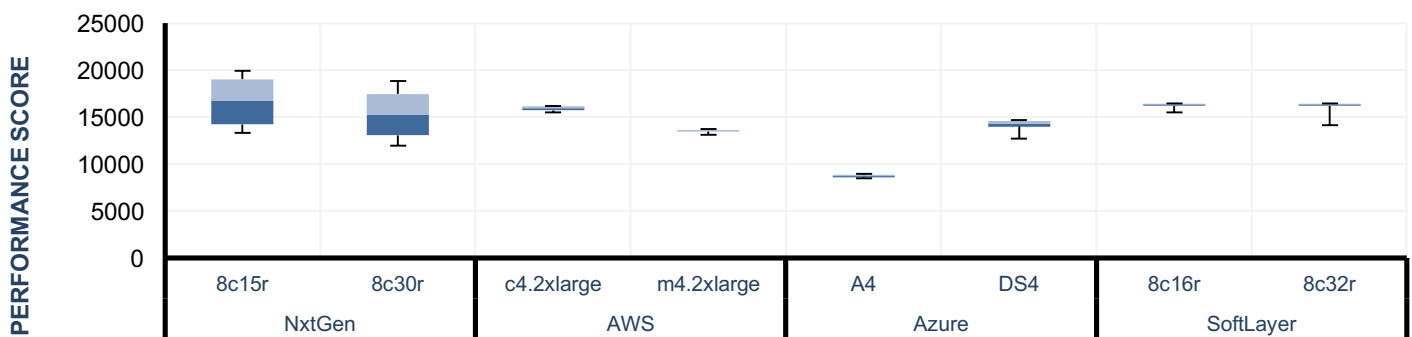


Chart 3.1C: CPU PERFORMANCE (8vCPU VMs)



# Memory Bandwidth Performance

Chart 4A: MEMORY PERFORMANCE (2vCPU VMs)



Chart 4B: MEMORY PERFORMANCE (4vCPU VMs)

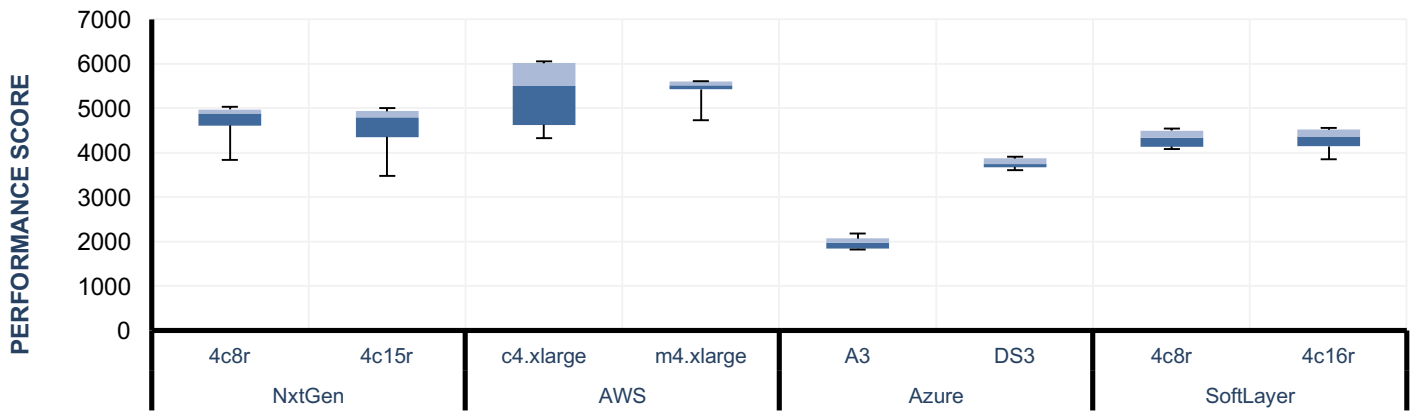
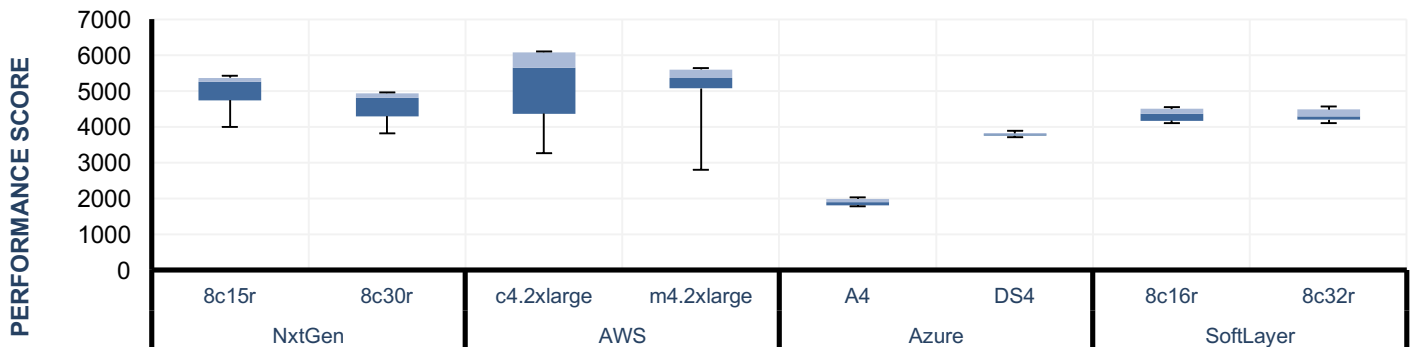


Chart 4C: MEMORY PERFORMANCE (8vCPU VMs)



## Storage IOPS Performance

Chart 6A: STORAGE PERFORMANCE - RANDOM R/W (100GB)

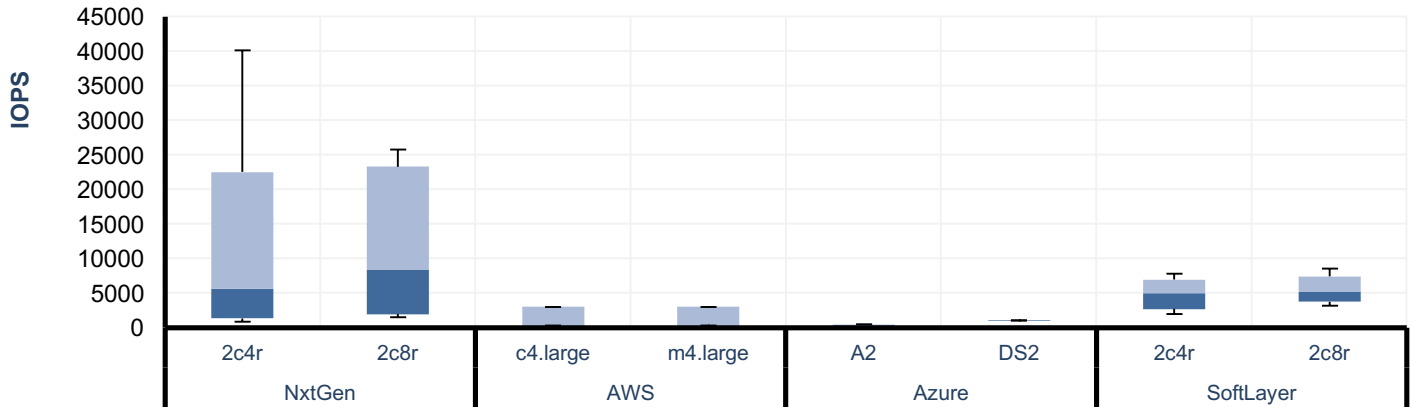


Chart 6B: STORAGE PERFORMANCE - RANDOM R/W (260GB)

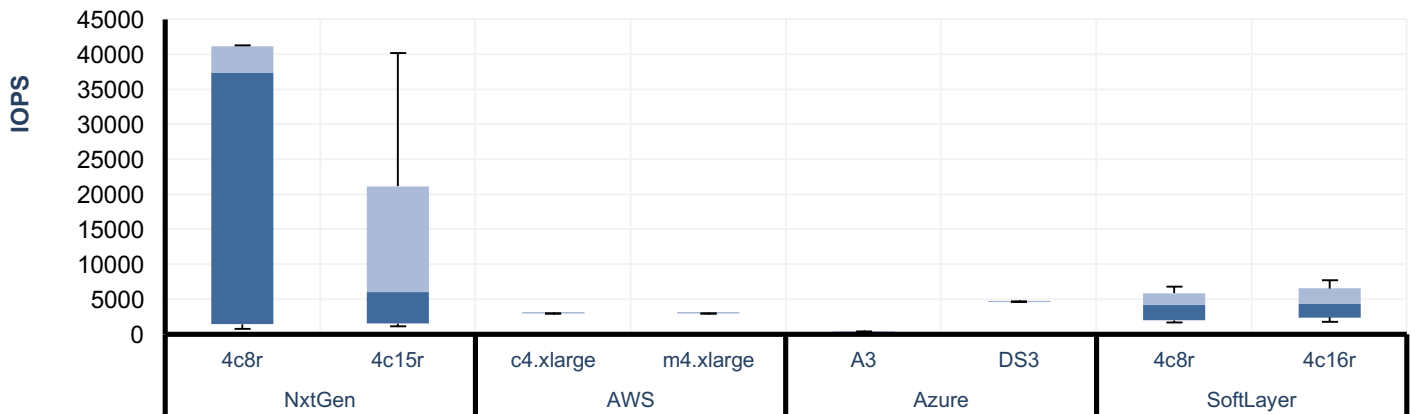
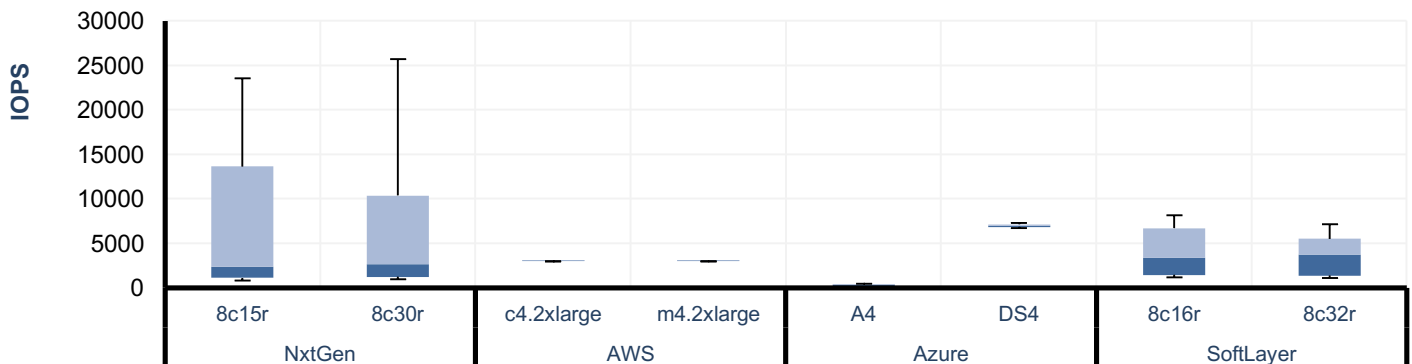


Chart 6C: STORAGE PERFORMANCE - RANDOM R/W (500GB)





## Internal Network Performance

Chart 1A: INTERNAL NETWORK PERFORMANCE  
(2vCPU VMs)

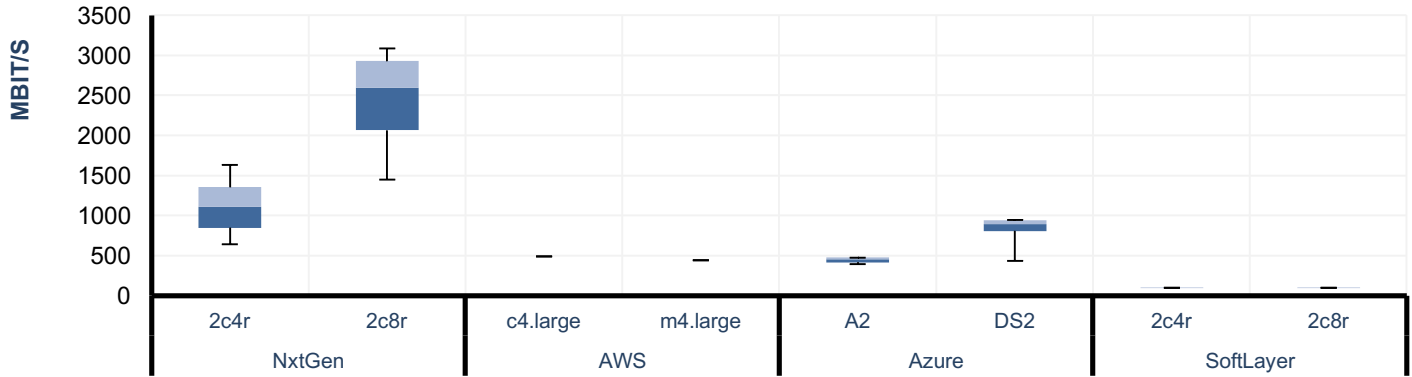


Chart 1A: INTERNAL NETWORK PERFORMANCE  
(4vCPU VMs)

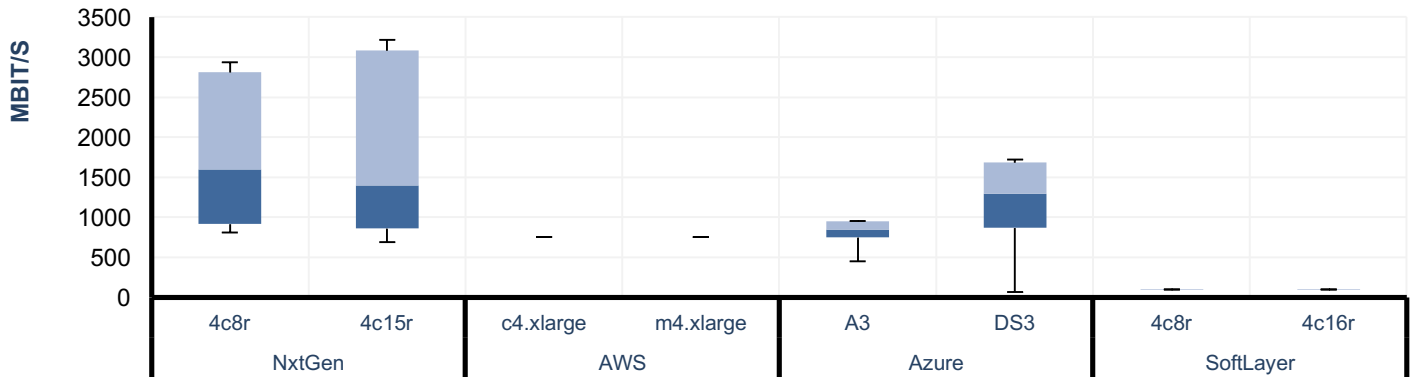


Chart 1A: INTERNAL NETWORK PERFORMANCE  
(8vCPU VMs)

