February 2018 Edition

Top 10 Public Cloud IaaS Providers

2018 North American Price-Performance Benchmark Report

CLOUD SPECTATOR

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EXECUTIVE SUMMARY

This report examines the results of a study measuring and comparing the performance and price-performance value of 10 CSPs within the North American region. While the CSPs included in the study did not have to be headquartered in North America, they must have at least one data center located within the North American continent (see Methodology page 11).

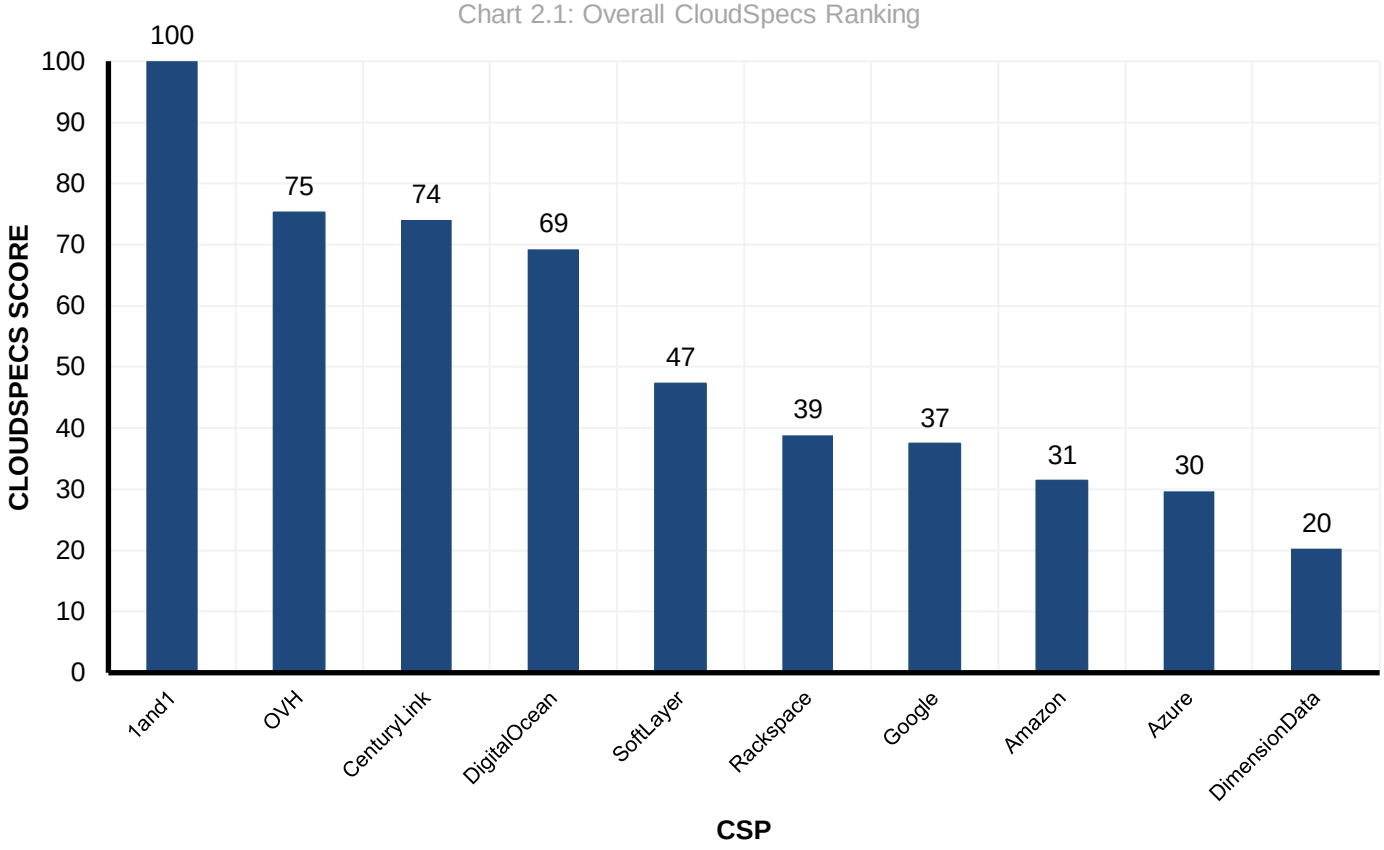
The list of 10 CSPs included major providers like Amazon AWS, Google Compute Engine, Microsoft Azure, and IBM SoftLayer. Smaller CSPs, some of which specialize in high performance and aggressive pricing, were also included.

The performance results are separated into two categories: VM Performance and Block Storage Performance. VM Performance tests the CPU and memory of the virtual machine. This performance data is aggregated into one score that includes both CPU and memory. Block storage is evaluated using two different tests as detailed in the methodology section (page 11).

PRICE-PERFORMANCE KEY FINDINGS

The chart below displays the overall price-performance scores of the providers included in this report. Price and performance of the VM and storage are incorporated into the values.

Chart 2.1: Overall CloudSpecs Ranking

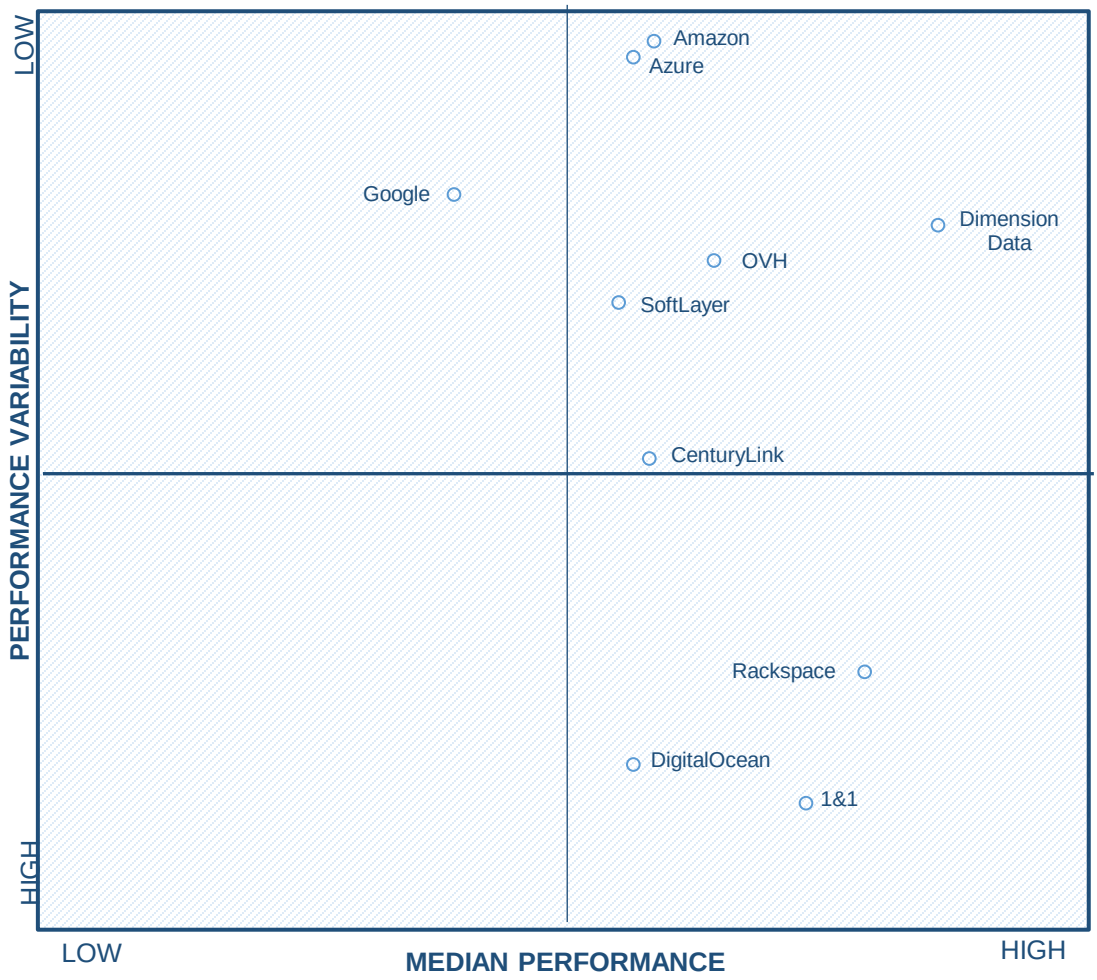


- Value, defined as the ratio of price and performance (see Methodology page 16) varies by 4.9x across the compared IaaS providers.
- 1&1 achieves the highest CloudSpecs Score™ in the Top 10 cloud IaaS providers ranking. This is due to strong VM performance and the most inexpensive packaged pricing found in the study.
- While certain providers, such as Rackspace, may have achieved above-average performance for VM environments, the price-performance value achieved by these types of providers were lower due to higher costs. This study does not account for additional features such as managed services, which are included in Rackspace's pricing.

VM PERFORMANCE KEY FINDINGS

The chart below displays the median performance and performance variability captured across the VM testing on the providers included in the study.

Chart 2.2: VM Performance and Variability Over 24 Hours

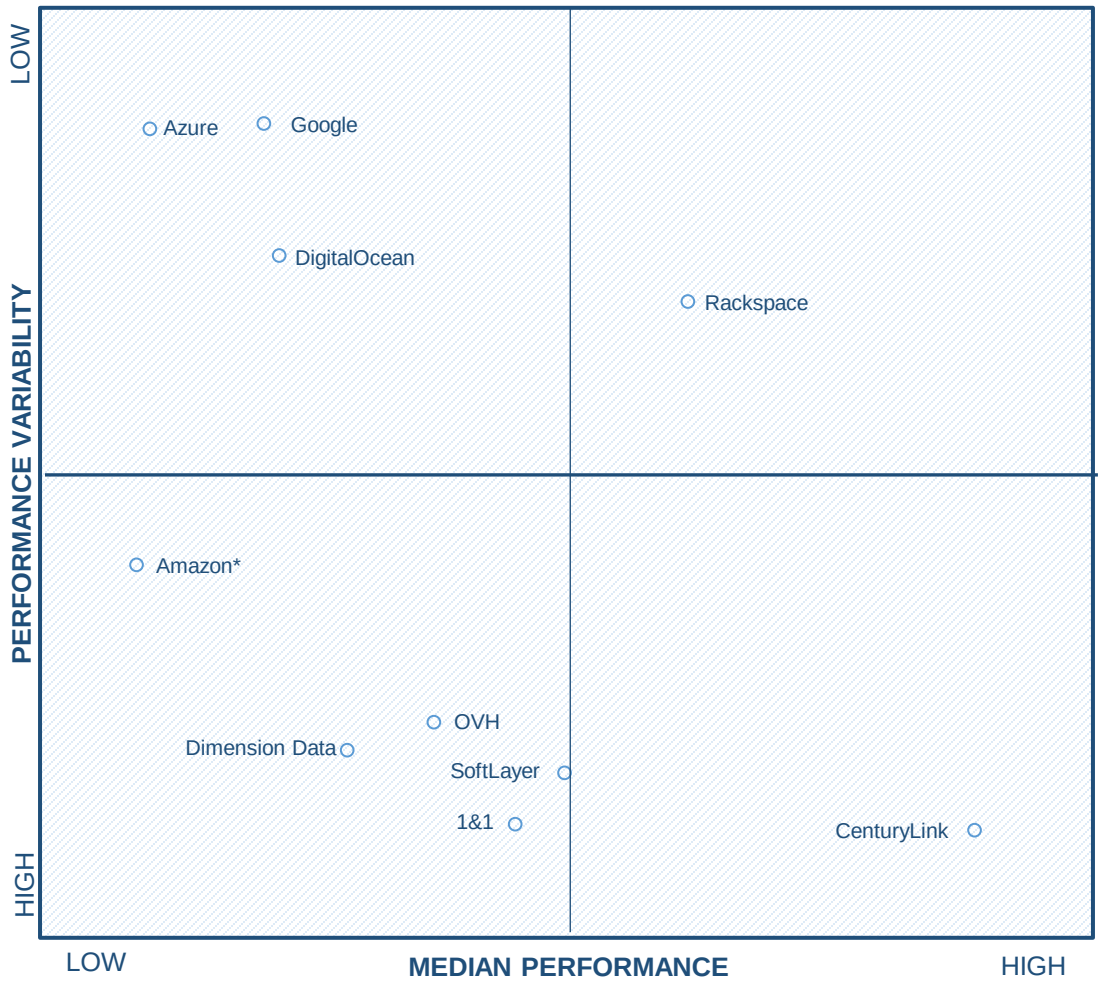


- Providers exhibited a difference of approximately 1.5x in VM (CPU & memory) performance, emphasizing the need for performance testing to understand value.
- While the ten providers displayed relatively similar performance within the right-most grids, the variability is shown to be largely scattered between the various providers.
- Amazon AWS, Microsoft Azure, and Google Compute Engine showed the least performance variability in the 24-hour testing period.

BLOCK STORAGE PERFORMANCE KEY FINDINGS

The chart below displays the median performance and performance variability captured across the Type 1 & 2 storage testing on the providers included in the study.

Chart 2.3: Block Storage Performance and Variability Over 24 Hours



*Amazon's disk variability is artificially high due to an initial burst period that lasted until the volume ran out of I/O credits.

- Relative performance of all VM sizes on Type 1 and Type 2 varied by over 9x between the providers, while the relative perfomance variability varied over 5x
- CenturyLink tested highest in median disk performance, while performance variability exceeded 80% in certain scenarios
- Google Compute showed the lowest performance variability over the testing period. Amazon AWS demonstrated controlled performance throttling on disk IOPS as well. The level of throttling on

AWS EBS disks is determined by the size of the disk. The high amount of variability on AWS is due to a burst function that is built in to EBS and is not representative of an unstable environment.

Table 2.1 below lists the indexed performance scores and variability percentages by CSP. These numbers are used in generating Charts 2.2 and 2.3.

Table 2.1: Performance and Variability of CSPs Over 24 Hours

	VM		Block Disk	
	Performance Index	Variability	Performance Index	Variability
1&1	91	12%	41	60%
Amazon*	81	0%	8	38%
Azure	80	1%	9	0%
CenturyLink	81	7%	80	61%
DigitalOcean	80	11%	20	11%
Dimension Data	100	3%	26	54%
Google	68	3%	19	0%
OVH	85	4%	34	52%
Rackspace	95	10%	55	15%
SoftLayer	79	4%	45	56%

*Amazon's disk variability is artificially high due to an initial burst period that lasted until the volume ran out of I/O credits.

The Performance Index is calculated by indexing the individual performance scores achieved by each VM category (categorized as Small, Medium, Large and Extra Large; see Methodology for more information) on a scale of 0-100 with 100 as the highest possible score. An average across all VM categories is calculated to represent the Performance Index for each provider.

Variability is calculated as the average coefficient of variation (CV), which is the standard deviation expressed as a percentage of the mean performance for the VM categories of each CSP. Higher CV correlates to more fluctuation in performance (i.e., higher performance variability) over the test period.

INTRODUCTION

Public cloud service providers (CSP) purport to offer instantaneous, scalable virtual infrastructure with utility-style pay as you go billing. In reality there is wide variance in CSP cloud performance. While the public cloud IaaS industry streamlines IT through these advantages, a lack of standardization in performance can lead to businesses overspending in order to obtain the necessary performance requirements for their applications.

Cloud Spectator tested 10 of the largest, most well-known public cloud providers with data centers in North America. This report measures and ranks CSPs using a comprehensive performance and price-performance methodology designed by Cloud Spectator specifically for the purpose of measuring cloud services. This report examines the performance of vCPU, memory and block storage, as well as the overall value (the CloudSpecs™ Score) as defined by the relationship between price and performance.

In conjunction with an appropriate cloud vendor selection process, this report will assist purchasing decisions by assessing performance and price-performance from a holistic, industry perspective. The report is specifically designed to educate IT leadership on the variation in performance and price-performance value across public cloud providers. Performance is a critical and often overlooked component when making a cloud purchasing decision, and can have substantial impact on annual operating costs.

WHY IS THIS INFORMATION NECESSARY?

A lack of transparency in the public cloud IaaS marketplace for cloud services performance often leads to misinformation or false assumptions. Users and potential users may be led to view cloud computing as a commodity, differentiated mostly by variety of services. In reality, cloud performance is impacted by a variety of factors from provider to provider, involving everything from the physical hardware (e.g., Intel or AMD, SSD or spinning disk), to the cost of the virtualized resources. By evaluating cloud services based on performance rather than solely price or VM configurations, users are able to maximize value in the cloud.

MISCONCEPTIONS ABOUT PERFORMANCE IN CLOUD

A number of common misconceptions about performance of cloud based servers continue to exist. A few of the top misconceptions revolve around similarity of performance between CSPs, price tied to performance, and resource contention.

1. VM performance is the same from CSP to CSP.

While CSPs often use the same terms to label cloud resources (i.e., vCPUs, RAM or memory, and block storage), differences in the underlying hardware, architecture, and performance tuning lead to entirely different results from the same terms such as vCPUs. For example, on VM performance alone (the virtual processor and memory), the 10 IaaS providers in this report exhibited differences of up to 1.6x. With block storage performance, differences exceeded 39x.

2. There is no correlation between price and performance.

When it comes to additional services such as support, security, geographical location, and managed services on CSPs, you get what you pay for. However, with respect to performance, this study found no correlation between price and performance. The study demonstrated the best-value CSPs in this report (defined as the ratio of price and performance as ranked by the CloudSpecs

Score™) offer virtualized resources at the lowest prices. Similarly sized VMs within the 10 IaaS providers tested displayed a spectrum of prices with up to a 5.8x difference between the least and most expensive CSPs.

3. Resource contention, known colloquially as the Noisy Neighbor Effect, is not a concern with most providers.

A public cloud environment offers multi-tenant physical hosts, which means a business may share the same physical resources with different users on the same hardware. This means that another user with resource-greedy applications could potentially effect the performance of other VMs on the host machine. While resource contention has been addressed by many of the largest providers in an attempt to stabilize VM performance, the block storage offerings still exhibit high levels of performance fluctuations, which may be related to other activity on the same physical host as Cloud Spectator's test VMs. The fluctuation in performance evidenced in some CSPs can significantly affect hosted applications within those environments.

3a. If Noisy Neighbor is a concern, then performance is too unpredictable.

In public cloud environments, some providers, especially major ones such as Microsoft Azure and Amazon Web Services, use performance throttling to deliver a consistent user experience regardless of the actual user load on the physical machine. This means that, while performance may be lower for the VM, the user will not see much change over time. See ***Performance by VM Size*** to view the performance variation of different CSPs over the 24-hour period of the study (on disk performance, Google Compute Engine, Microsoft Azure, and DigitalOcean demonstrated stable performance).

METHODOLOGY

The Cloud Spectator team designed this methodology to measure the performance of various public cloud infrastructure services. These results will provide a general insight into the public cloud industry. However, businesses have varying needs when defining performance requirements, so they should apply testing methodologies relevant to their business and technical use cases to yield more relevant results.

THE CRITERIA

In order to be considered and tested as one of the IaaS providers in this report, a CSP must meet the following criteria as part of its IaaS offering:

1. North American Data Center: The CSP must have at least one data center located within the North American continent. The CSP does not need to be headquartered in North America.
2. Self-Sign-up: A user must be able to sign up for a CSP's services online, rather than reaching out to a sales representative. Contact forms that request users to message the CSP for signup are not considered self sign-up.
3. Self-Service: A user must be able to log into a portal that allows the user to provision, manage, and terminate virtual machines and other cloud-related services.
4. Hourly Billing Intervals: the CSP must provide billing by the hour or less. Some CSPs offer billing by the minute.
5. Block Storage Offerings: Only providers with persistent block storage offerings are included in this study. Cloud Spectator measured disk performance by running performance tests on block storage.

THE SETUP

The team set up anonymous accounts on all cloud service providers. No CSPs provided the team an account to provision virtual machines. For all VMs, Ubuntu 16.04 images were operating systems of choice. In cases when Ubuntu 16.04 was not available, version 14.04 was used, If no Ubuntu images were available, Debian was used. Virtual machines were tested according to four separate categories: Small, Medium, Large and Extra-Large. Each category contained a prerequisite allocation of VM resources, as shown in the table below:

Table 4A: VM Sizing

SIZE	vCPU COUNT	RAM COUNT (GB)	DISK SIZE (GB)
Small	2	4	100
Medium	4	8	150
Large	8	16	200
Extra Large	16	32	500

CSPs were segmented into two categories: (1) Packaged Offering CSPs and (2) Customizable Offering CSPs. Packaged Offering CSPs include providers such as Amazon AWS and Microsoft Azure, which deliver VMs based on pre-packaged sizes. For example, a customer can purchase an instance size of c4.xlarge on AWS. Customizable Offering CSPs allow users to define custom VM sizes by setting resources such as vCPUs, RAM, and disk space. Only block storage was tested for disk because of its durability and persistence. This meant that CSPs that only offer local storage were not included in the report. A single block storage size was paired and tested with each VM size. For other CSPs such as Amazon AWS, which offers local and persistent block storage, the local storage was not measured and did not affect the performance or price-performance ranking of the CSP beyond the potential effect on pricing if local storage is included in packaged VM prices. **Please see the Appendix for a specific list showing what was tested on which providers.**

For Packaged Offering CSPs, the team selected VMs that most closely corresponded to the four categories of sizes. For Customizable Offering CSPs, the team provisioned servers designed to the exact requirements of the four categories of sizes when possible.

For each CSP, the team provisioned three copies of VMs for each size; i.e., three Small, three Medium, three Large, and three Extra-Large VMs. All VMs were provisioned and tested simultaneously for 24 hours. This means that, for each CSP, twelve various-sized VMs were running from the account on the corresponding provider for 24 hours.

Please note that some CSPs do not offer any VMs with resource allocations that would qualify for the Extra Large size.

SIMULTANEOUS TESTING OVER TIME

Three resources were examined to compare performance: vCPU, memory, and storage. Performance tests were run in a continuous, iterative sequence according to the following order: vCPU tests and memory tests followed by block storage tests. Each complete sequence of testing comprised a single cycle, and cycles were repeated without pause for the duration of 24 hours. Different providers completed varying numbers of cycles within the 24-hour time limit, with the number of cycles completed being impacted by the performance levels of the resources tested (higher performance allows each test to be completed faster), which allows the performance data to be compared.

Testing over several iterations impacted the ranking of performance for CSPs. In an uncontrollable multi-tenant environment, VM performance can be affected by issues that arise with neighboring VMs. While these issues may be mitigated with resource planning as a responsibility of the CSP, sometimes performance levels cannot be guaranteed or sustained in the public cloud. Therefore, measuring to examine sustainable performance is just as important on a public cloud as measuring to

examine achieved performance. This is why the Cloud Spectator team chose to test over a period of 24 hours.

Three VMs of each category size were tested in parallel. Single-VM performance may not necessarily be reflective of the potential performance a CSP's VMs can achieve if the provisioned VM is faulty for any number of reasons. Measuring more than a singular VM of each size mitigates the possibility that the performance may be an unusual outlier due to a VM provisioning issue, so results are a more accurate reflection of a VM type's potential performance.

At other times, the physical host itself may experience issues, affecting all VMs residing on it. By provisioning all VMs simultaneously, Cloud Spectator may increase the possibility of measuring on multiple physical hosts with different users and resource contention issues, which would be more representative of a VM size's performance. While all of these processes are implemented to increase the accuracy of the measurements, it should be noted that these practices cannot guarantee 100% accuracy. Even by provisioning three of the same VMs of each category, the VMs still have the possibility of residing on the same physical host, depending on the provider's capacity.

DATA COLLECTION

Testing was conducted throughout Q4 2017 and early Q1 2018. The rankings were produced based on the CloudSpecs Score™, which is a price-performance ratio of the cost and median performance output of the VM. Each VM size category received a VM CloudSpecs Score™ and a block storage CloudSpecs Score™, which were averaged to calculate a CloudSpecs Score™ for the VM. The CSPs with the highest average CloudSpecs Scores™ across all VMs were then ranked. All 10 tested CSPs were ranked according to price-performance.

TESTING USED

The following sections lists the tools and parameters used for the evaluation of the providers in this study.

Table 4B: Testing Tools

TEST	TOOL	TASKS
vCPU Testing	Geekbench 3	Integer and Floating Point
Memory	Geekbench 3 (using STREAM)	Reads and writes
Block Disk	Fio	Reads and writes

vCPU and Memory

vCPU performance was measured with integer and floating point tasks from the Geekbench 3 benchmark suite. The Geekbench 3 benchmark suite was also used in collecting memory bandwidth data, which was used to measure the performance of the system memory (RAM).

Storage

Table 4C: Testing Specifics

CATEGORY	TYPE 1	TYPE 2
Block Size	4KB	128KB
File Size	5GB	128MB

Table 4D: Total Files Used in Block Storage Testing

SIZE	TYPE 1	TYPE 2
Small	1	2
Medium	2	4
Large	4	8
Extra Large	8	16

Storage performance was measured using fio. Two storage scenarios were run to capture performance data: Type 1 and Type 2. In both scenarios, random read & write IOPS were recorded as the indicator of performance over a test period of 60 seconds. Type 1 used a large file size with a small block size, while Type 2 used a small file size with a large block size. The total number of files used in testing varied with the category of VM.

In both testing scenarios, the number of parallel jobs run were set equal to the number of virtual processors in the VM. Each test scenario was run for 12 hours, for a total of 24 hours.

Table 4E: Type 1 Scenario

SCENARIO	BLOCK SIZE	FILE SIZE
Type 1	4KB	5GB
Type 2	128KB	128MB

RANKING CALCULATION

The rankings of the 10 CSPs were determined by calculating the median performance of both vCPU-memory and storage with the monthly cost corresponding to each VM size for two price-performance scores per VM size (one for vCPU-memory and one for storage). The resulting ratios were normalized in relation to the highest-value provider for each resource, which receives a score of 100. Then the two price-performance scores for each VM size were averaged together to get one score per VM size. The providers were then ordered based on their value across all each VM size, and then their scores were averaged for all VM sizes to come up with a final score. The providers that sustained higher ratios across all VM categories ranked highly.

PRICE-PERFORMANCE VALUE (THE CLOUDSPECS SCORE)

Cloud Spectator's price-performance calculation, the CloudSpecs Score™, provides information on how much performance the user receives for each unit of cost. The CloudSpecs Score™ is an indexed, comparable score ranging from 0-100 indicative of value based on a combination of cost and performance.

The calculation of the CloudSpecs Score™ is:

price-performance_value = [VM performance score] / [VM cost]

best_VM_value = max{price-performance_values}

*CloudSpecs Score™ = 100*price-performance_value / best_VM_value*

CPU and Memory

Cloud Spectator used the median Geekbench 3 performance scores as the [VM performance score] to calculate each machine's CPU and memory CloudSpecs Score™.

Block Storage

For both storage scenarios, median random r/w IOPS are used as the [VM performance score] to calculate each machine's Type 1 and Type 2 storage CloudSpecs Score™. Type 1 and Type 2 scores were averaged to calculate a single block storage CloudSpecs Score™.

Overall

Overall storage CloudSpecs Score™ was calculated by averaging block storage and vCPU-memory price-performance scores together so that they have equal weight for each VM size. Then, all resulting VM size scores were averaged together.

1. For block storage performance, the normalized sequential and random CloudSpecs Scores™ were averaged together.
2. The Type 1 and Type 2 CloudSpecs Scores™ were averaged together to create a single storage CloudSpecs™ score per VM size.
3. The overall CPU, memory and storage CloudSpecs Scores™ were calculated by averaging the CPU and memory CloudSpecs Score™ and overall storage CloudSpecs Score™ for each VM size.
4. All VM size scores were then averaged for each provider and normalized to get the final scores on the scale from 1 to 100.

VARIABILITY

Variability is calculated by taking the coefficient of variation (CV) of each VM size's individual performance data points. The CVs are averaged for all VM sizes per CSP. The coefficient of variation is the standard deviation expressed as a percentage of the mean.

CONSIDERATIONS

There are a few consideration to take into account when evaluating the providers under the methodology used in this study. The limitations of the methodology and shifting nature of the pricing and services offered by the providers introduce a number of variables that have to be taken into account.

Limitations within the Methodology

The IaaS industry lacks a standard methodology for evaluating CSPs. While the most effective methodology for measuring value of a CSP varies among use cases, the methodology developed by Cloud Spectator for this study was designed to capture performance statistics based on synthetic performance uniquely adopted for cloud infrastructure, which requires steps including extended testing over a period of time and running multiple VMs in parallel.

Furthermore, the synthetic testing conducted in this study is for measurement of maximum sustainable performance over a period of 24 hours, and is not representative of any specific workload. Therefore, the results are used for comparison purposes only, and cannot be applied to predict application performance. For example, on AWS, the gp2 block volumes demonstrated periods of burst that were limited due to the continuous bursting over the 24-hour period, but the gp2 would not be a recommended option for applications that demand the continuously high IOPS performance.

VM Sizes

The performance data in this report only applies to the tested VM and block sizes. Larger VMs may yield better results with both VM scores and block storage scores. Larger block sizes may also yield better block storage performance scores. Not all CSPs offered the Extra Large size (see Methodology page 11) for testing. In those cases, the CloudSpecs Score was calculated by averaging the three available sizes.

Pricing Calculations and Discounts

In this report, Cloud Spectator used monthly pricing to calculate the cost of VMs on providers. Some providers offer sustained-use discounts based on a monthly interval, while others discount for monthly commitments. Certain providers offer similar discounts on an annual basis or longer. These longer-term discounts were not factored into the analysis. Where available, monthly discounting was factored into the pricing calculations; therefore, for longer or shorter time commitments, the rankings may change.

The Ranking System

The 10 providers included in this report were ranked based on a calculation that considers both performance and cost of the environments. The performance results of vCPU, memory, and block storage are all included in the calculation. While some providers may exhibit high performance on vCPU, memory, and/or block storage, those CSPs may not necessarily rank highly depending on the cost of their environments as compared to their competitors.

Additional Features and Costs

Only the VM, block storage, and costs of those two components were examined in this study. Additional features, such as support costs (where applicable), public and private networks, traffic, and other services that may increase the overall cost of a CSP's offering, were not examined in the report. Depending on the types of use cases, the features not examined may impact the overall rankings.

However, if a user can select between different base infrastructure options that have a difference in performance (e.g. SSD vs. magnetic storage), the options yielding higher performance outputs were chosen with exception to the pay-to-scale IOPS option, such as Provisioned IOPS. The amount and cost of the pay-to-scale IOPS option can affect a provider's ranking.

DATA CENTER LOCATIONS

All VMs were provisioned in the North American data centers of each CSP. Specific locations, as described by each CSP, are listed in Table 4E.

Table 4F: Data Center Locations

Provider	Data Center Location
1&1	US
Amazon	US East (N. Virginia)
Azure	US East
CenturyLink	US East (Sterling)
DigitalOcean	New York
Dimension Data	Ashburn
Google	Northern Virginia
OVH	BHS
Rackspace	Northern Virginia
SoftLayer	Washington DC

PRICE-PERFORMANCE VALUE

This section examines the price-performance value (i.e., the CloudSpecs Score™) of the 10 IaaS providers, which is used in determining each CSP's ranking in this report. The CloudSpecs Score™ is calculated as the ratio between the price, defined as the monthly cost of the VM and block storage, and median performance of the VM and block storage. For more information on the calculation of the CloudSpecs Score™, please see the Methodology.

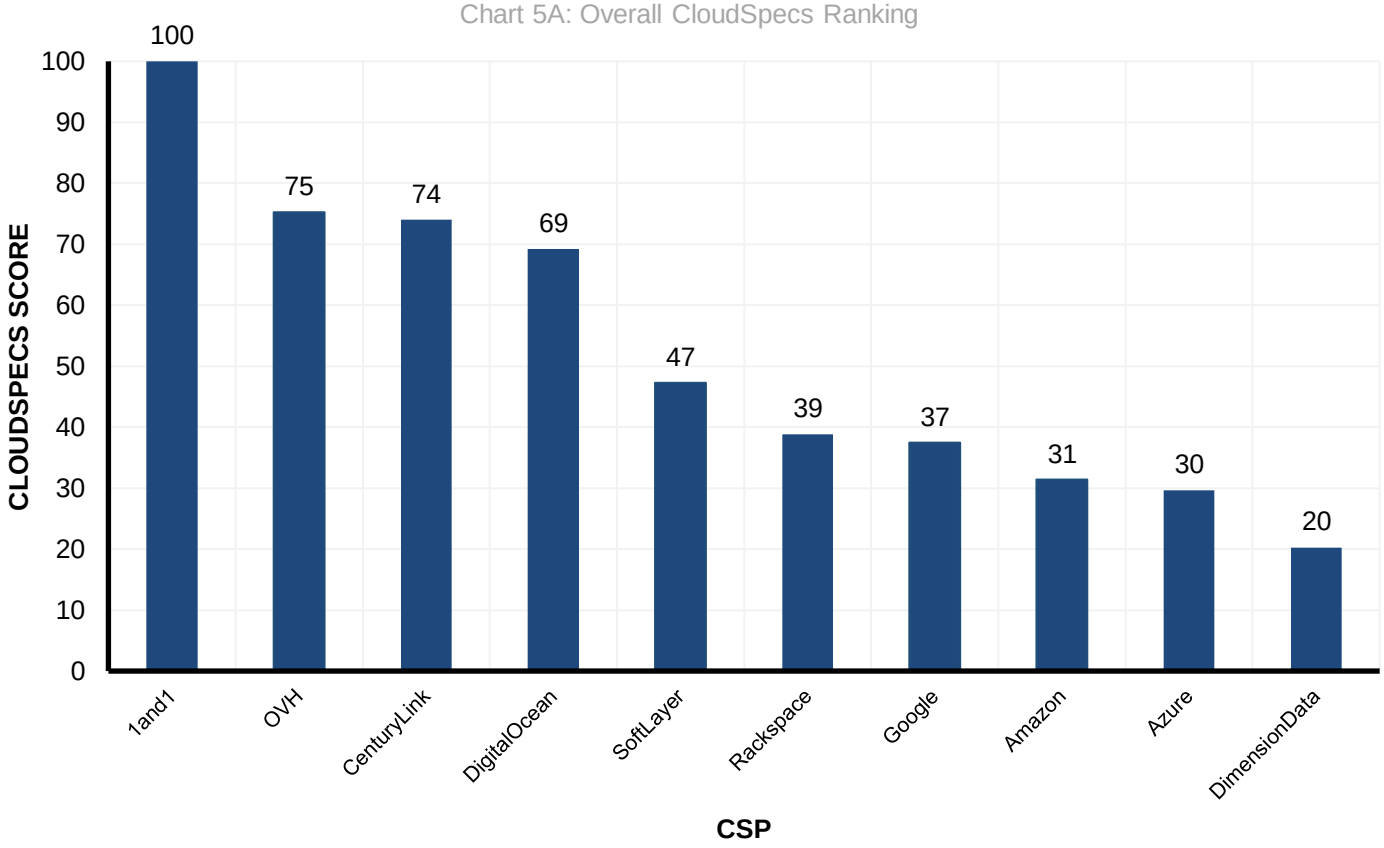
1&1's Cloud Server achieves the highest CloudSpecs Score™ in this study (a CloudSpecs Score of 100). CSPs such as Dimension Data, which achieved high performance scores in the previous section, ranked lower overall due to higher costs of infrastructure.

OVERALL CLOUDSPECS RANKING

The ranking of the Top 10 CSPs based on CloudSpecs Score™ is displayed in Chart 6A.

Value based on price-performance in this study is ranked in relation to the highest-value CSP, 1&1. A difference in value of 4.9x exists between 1&1, the highest-ranked CSP, and Dimension Data, the lowest-ranked CSP in the Top 10.

Chart 5A: Overall CloudSpecs Ranking

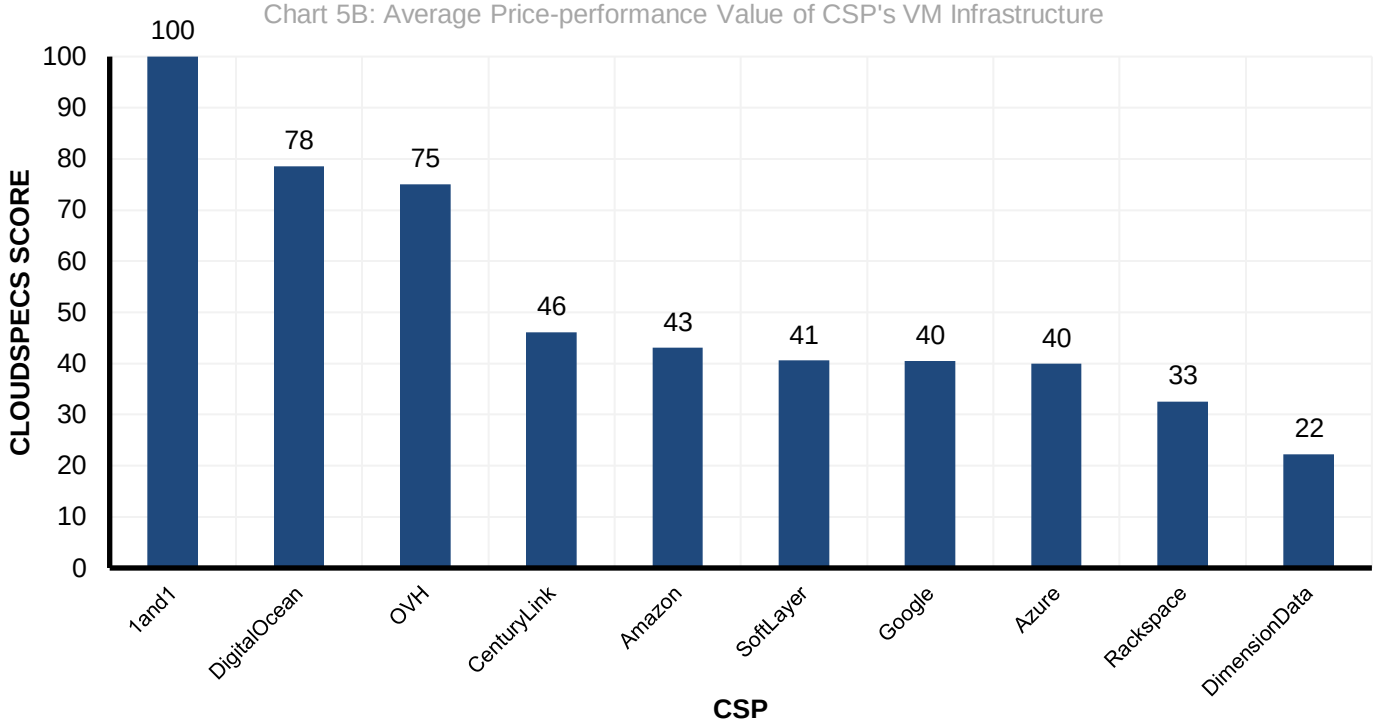


The following sections (vCPU and Memory Value and Block Storage Value) illustrate the individual Value scores segregated by section, which are the scores used to calculate the overall CloudSpecs ranking. 1&1 achieves the highest CloudSpecs ranking in the vCPU and Memory Value category and second in the Block Storage Value category.

VCPU AND MEMORY VALUE

The chart below displays the overall price-performance values of the providers' VMs

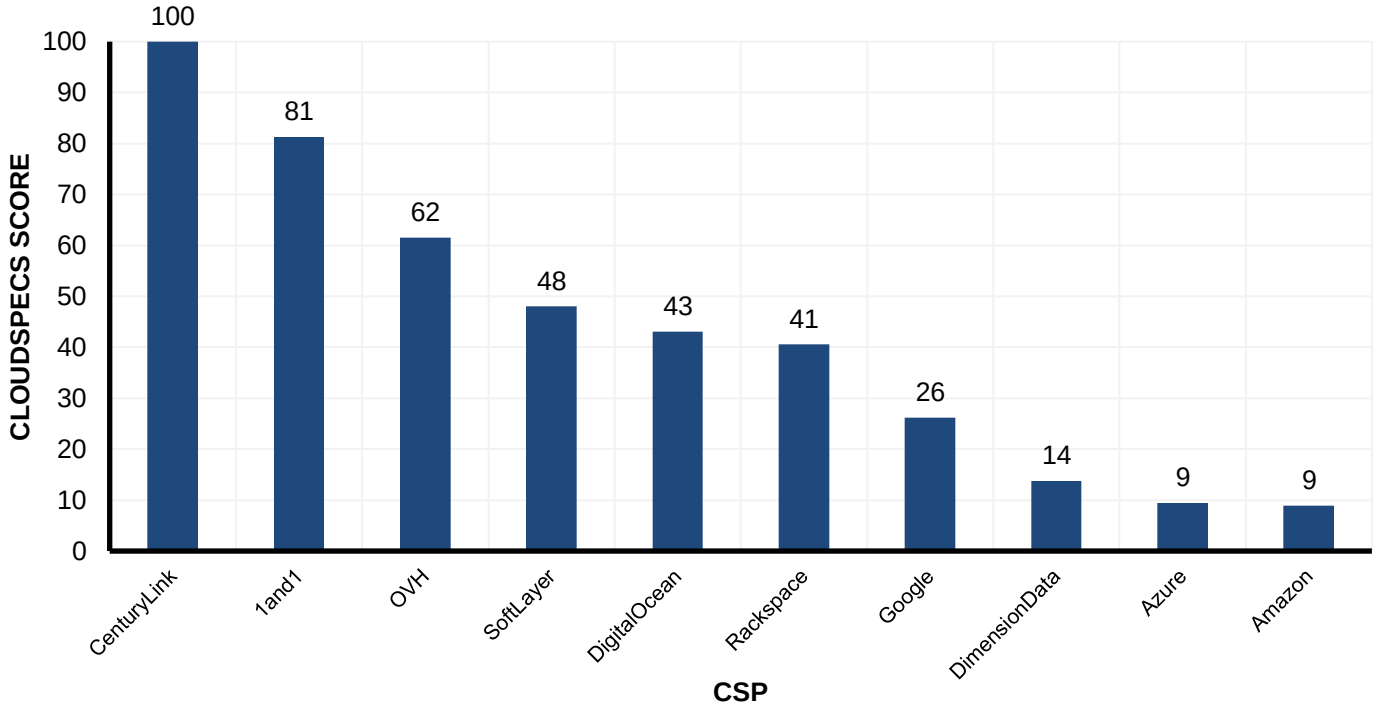
Chart 5B: Average Price-performance Value of CSP's VM Infrastructure



BLOCK STORAGE VALUE

The chart below displays the overall price-performance values of the providers' storage system

Chart 5C: Average Price-performance Value of CSP's Block Disk



PERFORMANCE

This section examines the performance of the 10 IaaS providers ranked in this report. This section does not use the CloudSpecs Score™, which is used to rank providers and can be found in the Price-Performance section of the report.

The period of 24-hour testing across three parallel machines for each category of VMs demonstrated much higher overall stability of performance in the vCPU and memory components for all providers, as compared to block storage performance over the same period. Performance differences are more noticeable as VMs scale up in size (e.g., the XL size), although a noticeable difference exists in the small VM category as well.

For detailed information on performance scores by VM size, see Performance by VM Size on page 32.

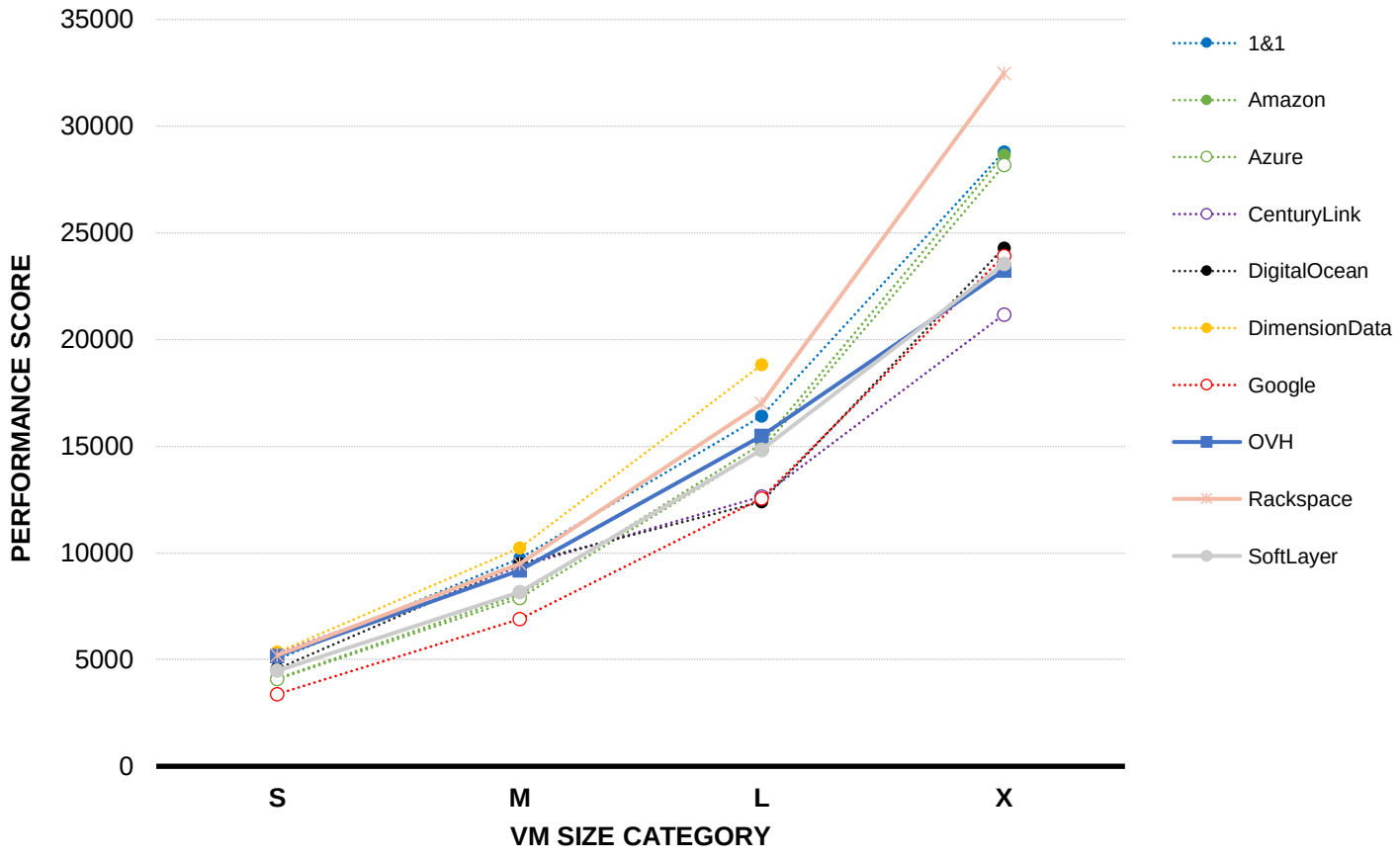
VCPU AND MEMORY PERFORMANCE

Performance differences between CSPs on vCPU and memory remained relatively consistent across the VM sizes:

- The Small VM category exhibits a difference of 1.6x between the highest and lowest-performing CSP VMs.
- The Extra Large VM category exhibits a difference of 1.5x between the highest and lowest-performing CSP VMs.

The chart below displays the median performance scores exhibited by the VMs in this study.

Chart 6A: vCPU and Memory Performance (Median Scores Displayed)



BLOCK STORAGE PERFORMANCE

The performance of read and write in both Type 1 and Type 2 disk scenarios are shown on the following page. Detailed results can be found in the Performance by VM Size on page 32. Each varying disk size corresponded with a VM category (see Methodology page 11). More information on the two scenarios can be found in the Methodology (page 11).

- Block storage is not created equally across CSPs in regards to hardware, architecture, or performance. A difference of more than 180x can exist between highest and lowest-performing block storage offerings across CSPs.
- Reads and writes were targeted to the storage disks themselves and made to avoid hitting the cache. 1&1 and CenturyLink exhibited high storage performance relative to the other providers, but tended to decrease in write performance as the VM sizes increased. In testing the storage, the number of threads matched the number of vCPU's available in the VM. It is possible that as the disks became oversaturated as the thread count increased, which resulted in the lower performance as the VM size and disk size increased.
- While Amazon AWS's Small, Medium, and Large VMs show performance fluctuation, the variance is controlled. On AWS, block storage is allocated a limit of burst-performance time; the limit is dependent on the size of the block storage volume—the larger the volume, the longer the limit for burst performance. After the burst time limit expires, performance is throttled also based on the size of the volume

The charts on the following page display the median performance scores achieved by each of the providers for Type1 and Type2 Read/Write operations.

Chart 6B: Scenario Type 1 - Read (4K) Performance (Median Scores Displayed)

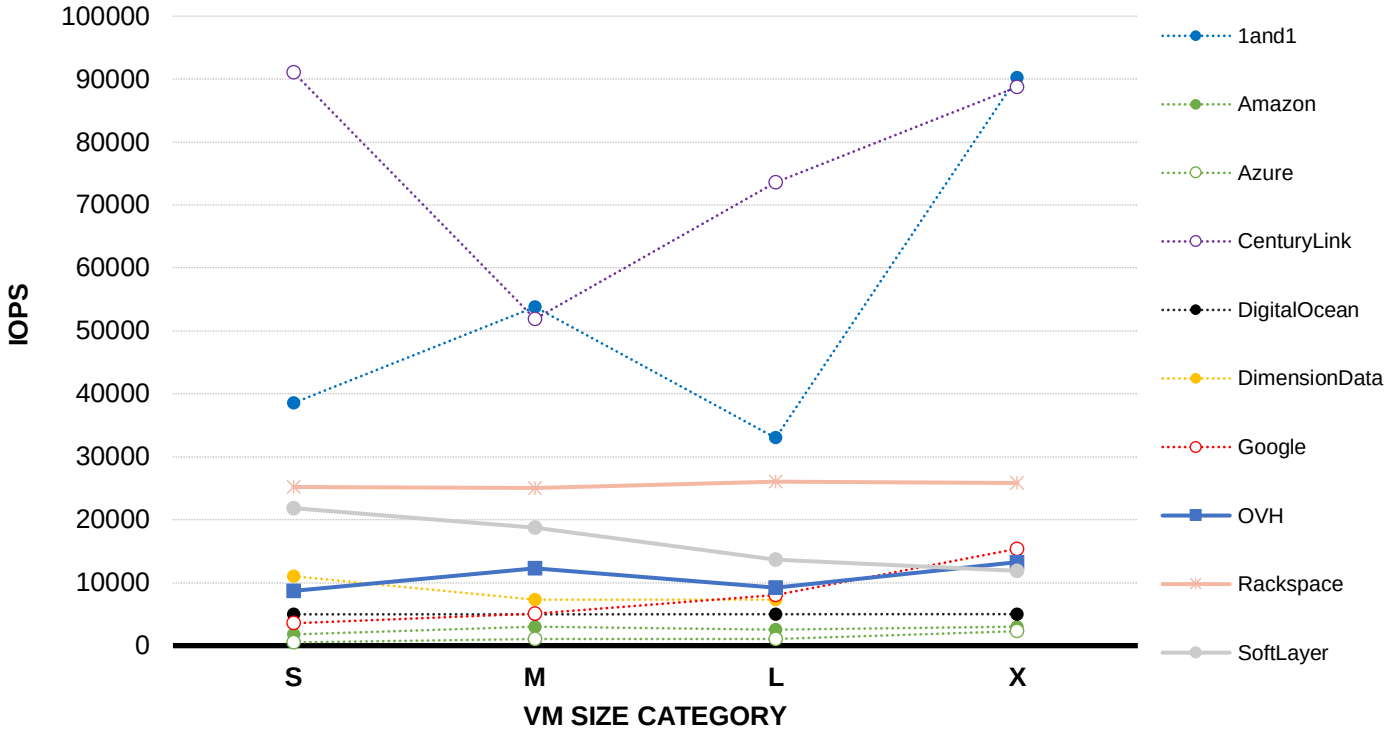


Chart 6C: Scenario Type 1 - Write (4K) Performance (Median Scores Displayed)

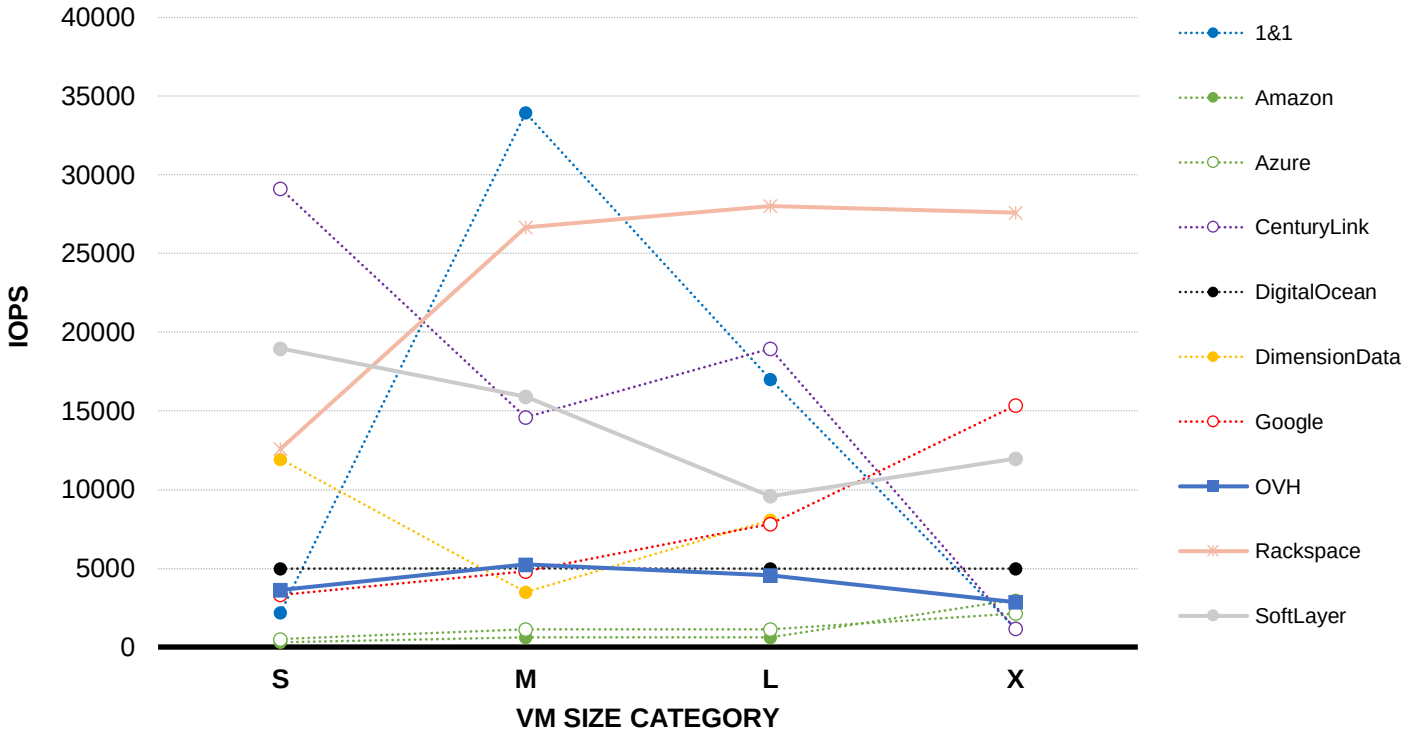


Chart 6D: Scenario Type 2 - Read (128K) Performance (Median Scores Displayed)

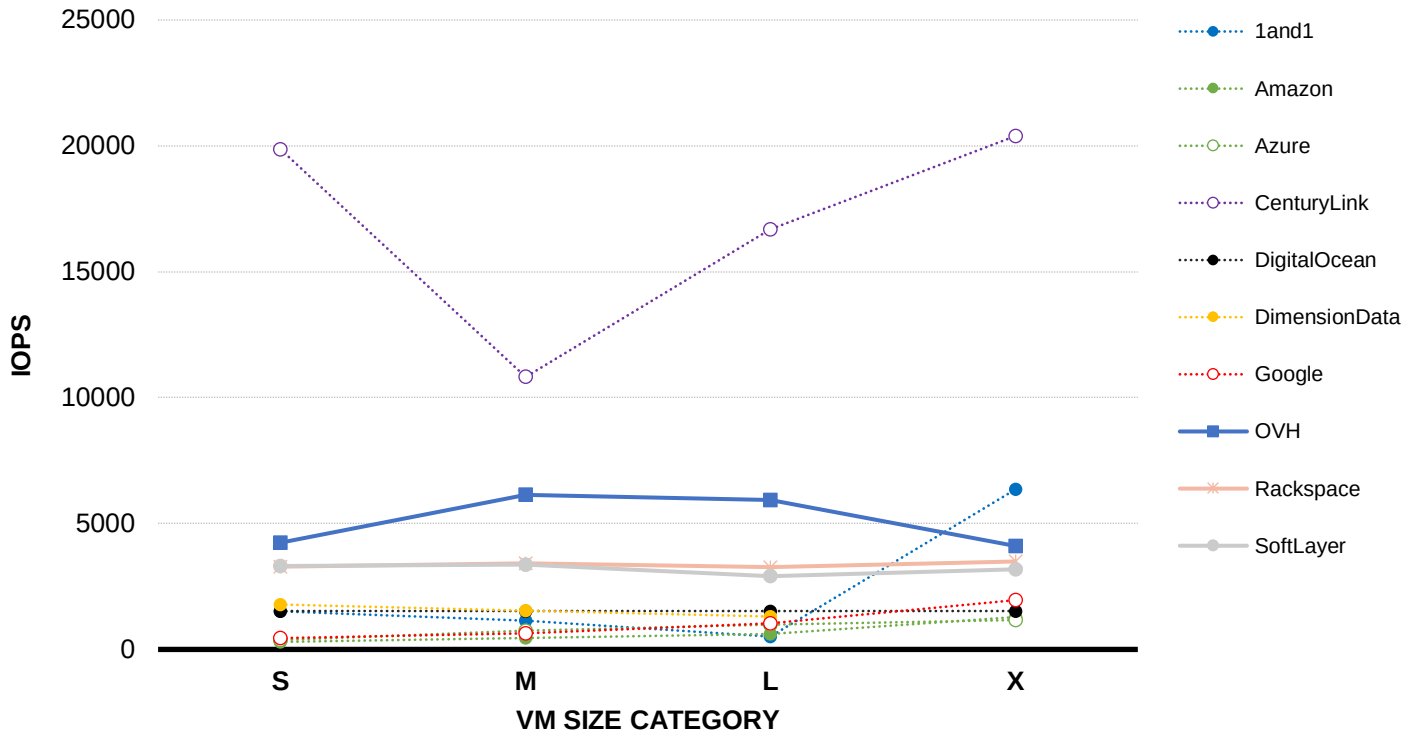
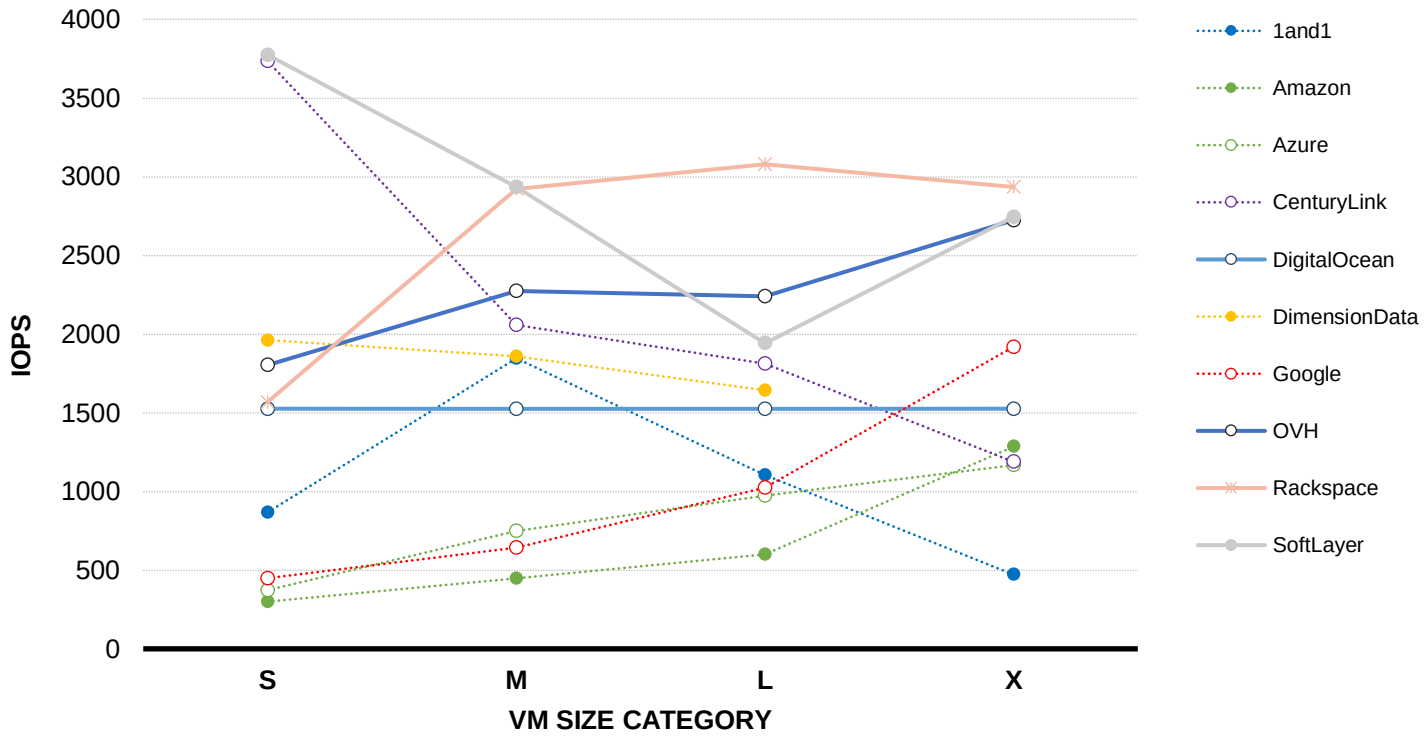


Chart 6E: Scenario Type 2 - Write (128K) Performance (Median Scores Displayed)



PRICING

This section outlines the cost of the VMs and block storage for each size examined in the study across all CSPs. Additional services, unless required (such as Rackspace Managed Services), are not included in the final cost of the VMs. Only the cost of the VM and tested block storage were factored into the final cost. Please keep in mind that some providers may charge for add-on services such as support, while other providers include it into the cost of the VMs.

OVERALL PRICING

The final monthly cost of each VM category for each CSP is calculated as the cost of the VM and the cost of the attached block storage. 1&1 and OVH maintained top ranks as the least-expensive providers in the price ranking.

The chart below displays the monthly costs of the providers' VMs and storage of the resources examined in the study.

Chart 7A: Monthly Cost of VMs Across CSPs

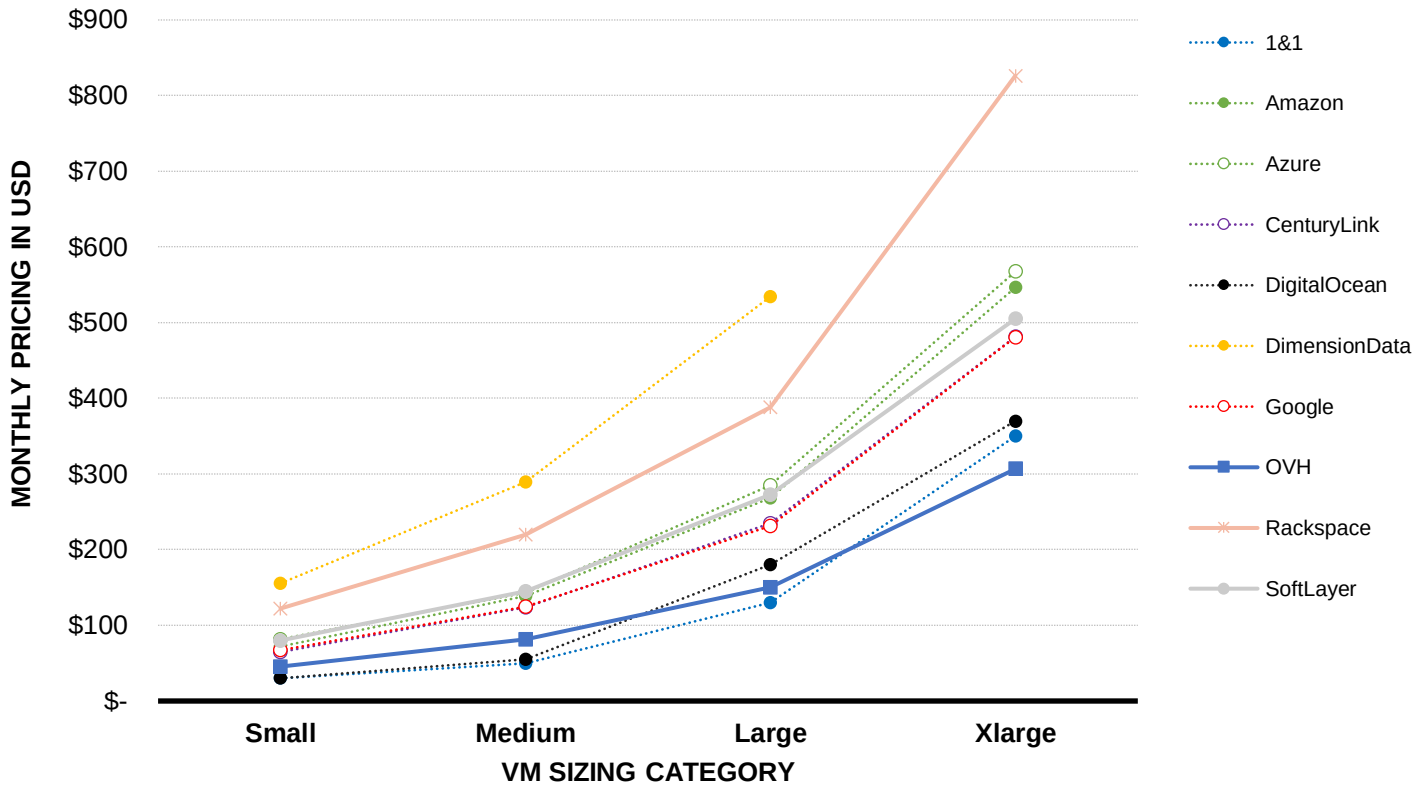


Table 7A: Monthly Cost of VMs Across CSPs

	Small	Medium	Large	Extra Large
1&1	$29.99	$49.99	$129.99	$349.99
Amazon	$72.05	$139.10	$268.20	$546.40
Azure	$81.76	$143.08	$284.76	$567.43
CenturyLink	$64.73	$123.37	$234.57	$481.31
DigitalOcean	$30.00	$55.00	$180.00	$370.00
DimensionData	$155.49	$289.08	$534.36	
Google	$67.12	$124.89	$231.08	$480.86
OVH	$45.49	$81.19	$150.00	$306.60
Rackspace	$122.20	$219.44	$388.21	$826.36
SoftLayer	$79.97	$144.82	$272.72	$505.06

PRICING BY VM CATEGORY

From small to large-sized VMs, the provider rankings remained the same from the least to most expensive provider. On the extra-large VMs, sizing allocation is less standardized, with differences in the amount of memory and local disk (if available) on the VM. The lack of standardization results in ranking changes on the extra-large VMs: OVH offers the least-expensive VM, and Google Compute Engine and CenturyLink Cloud swap rankings. Dimension Data does not have a VM that fits in the extra-large VM category.

Chart 7B: Monthly Cost of Small VMs

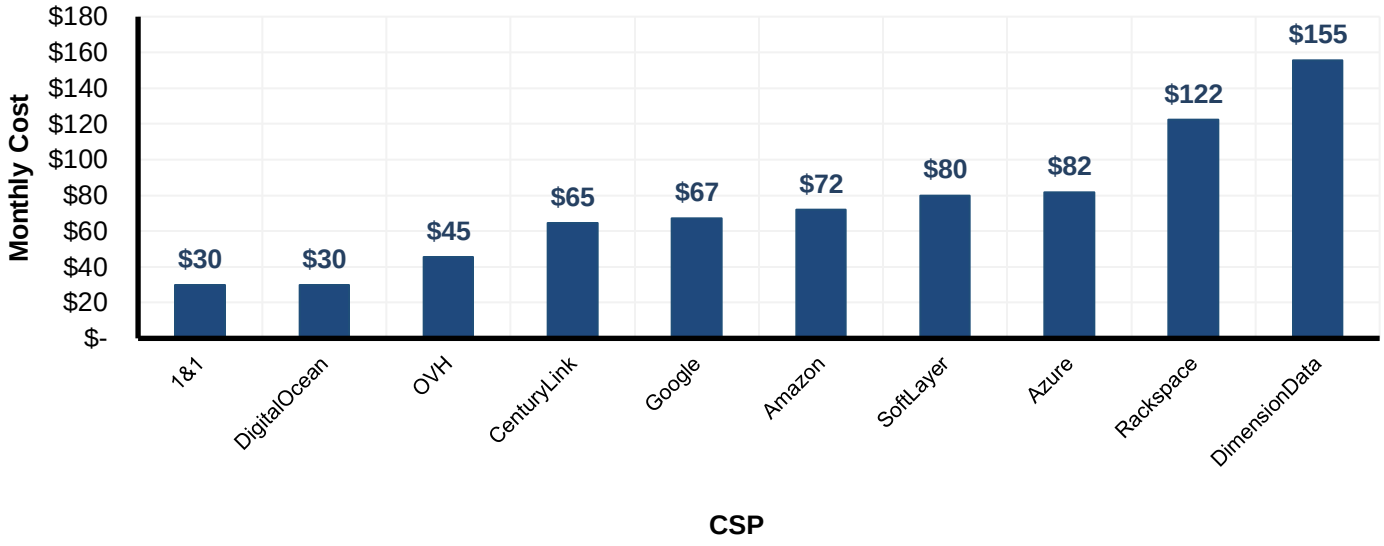


Chart 7C: Monthly Cost of Medium VMs

Chart 7D: Monthly Cost of Large VMs

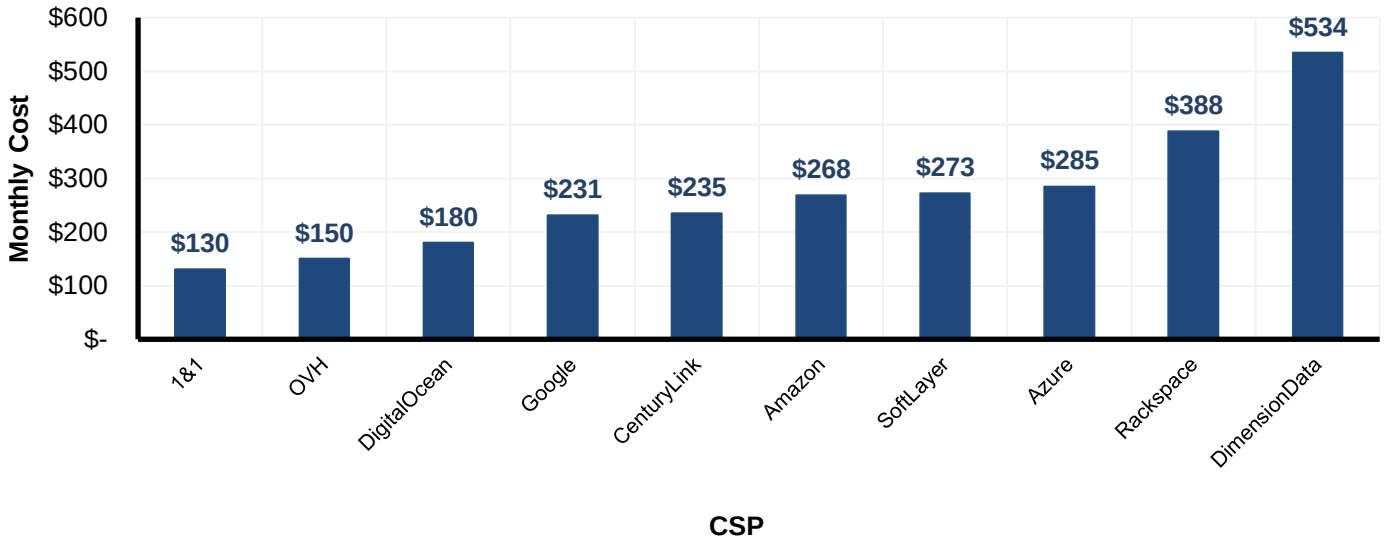
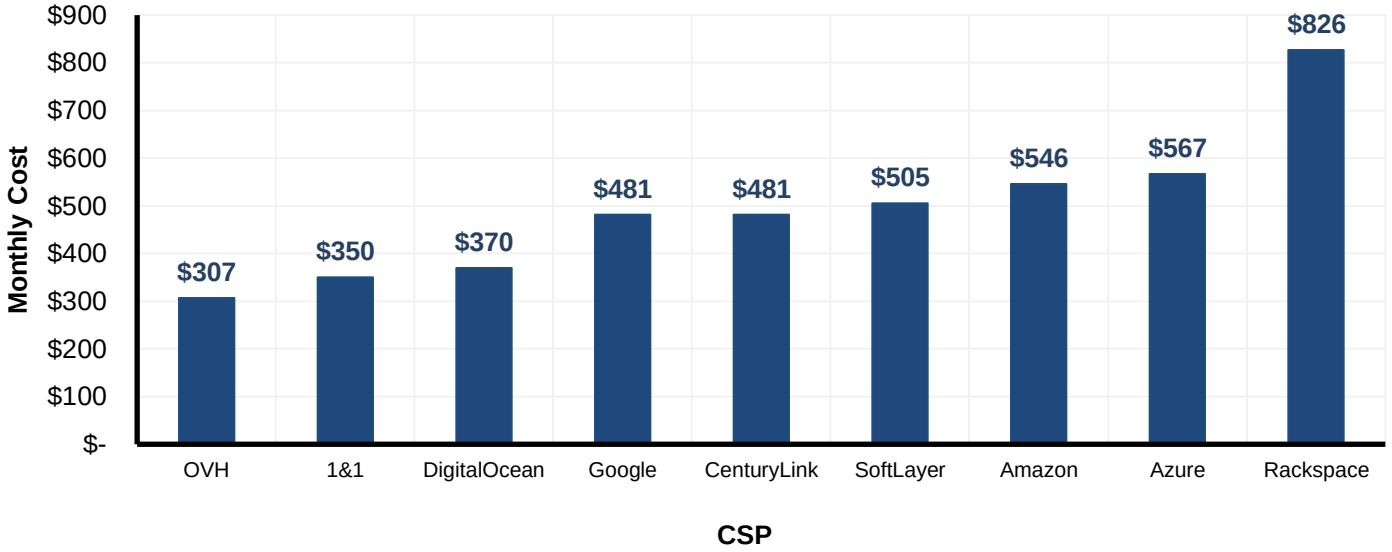


Chart 7E: Monthly Cost of Extra Large VMs

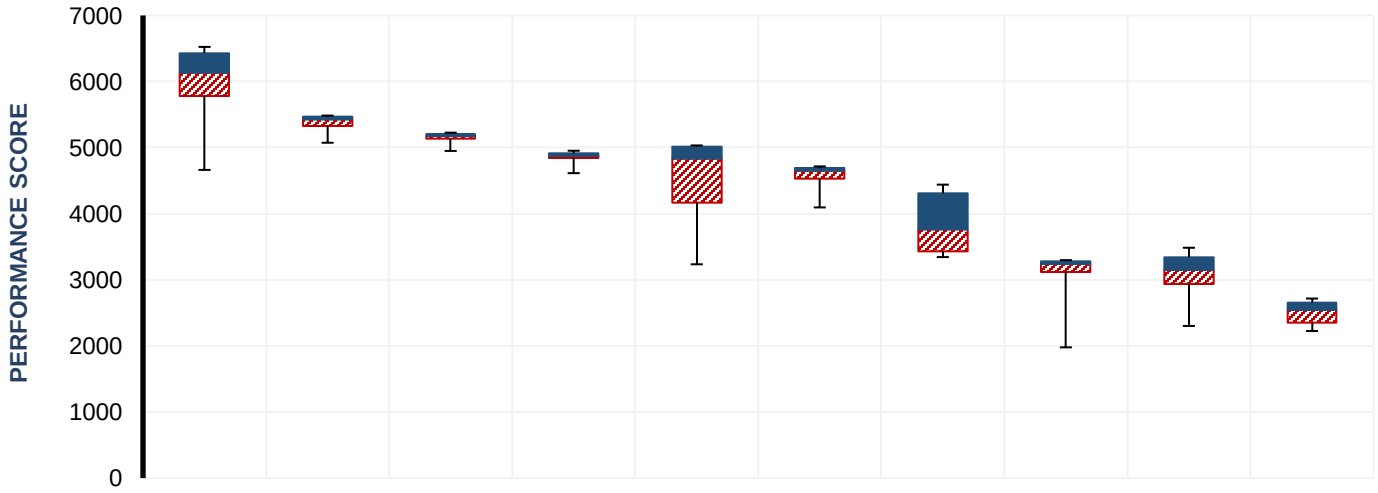


PERFORMANCE BY VM SIZE

UNDERSTANDING THE CHARTS

VM performance is illustrated using percentile scores retrieved from all data points collected. 5th percentile and 95th percentile scores are often used instead of minimum and maximum scores in order to exclude potential outliers. Median scores are used instead of mean to avoid values being skewed by outliers. The information has been integrated into percentile graphs and value tables designed to visualize performance variation captured while testing over time. An example of the performance percentile graph along with a corresponding value table is displayed in Chart 8:

Chart 8: Sample Chart Guide



- **Maximum (MAX)**: The highest performance score(s) achieved on the VM over the course of the study.
- **95TH Percentile (95TH)**: 95% of all scores on the VM achieved this performance score or lower.
- **Median (MED)**: The number separating the higher and lower half of scores. If the median is closer to the 95TH percentile, then more high performance scores were observed than low performance scores (and vice versa).
- **5TH Percentile (5TH)**: 5% of all scores on the VM achieved this performance score or lower.
- **Minimum (MIN)**: The lowest performance score(s) achieved on the VM over the course of the study.

SMALL VMs

Chart 8A.1: VM Performance (Small VMs)

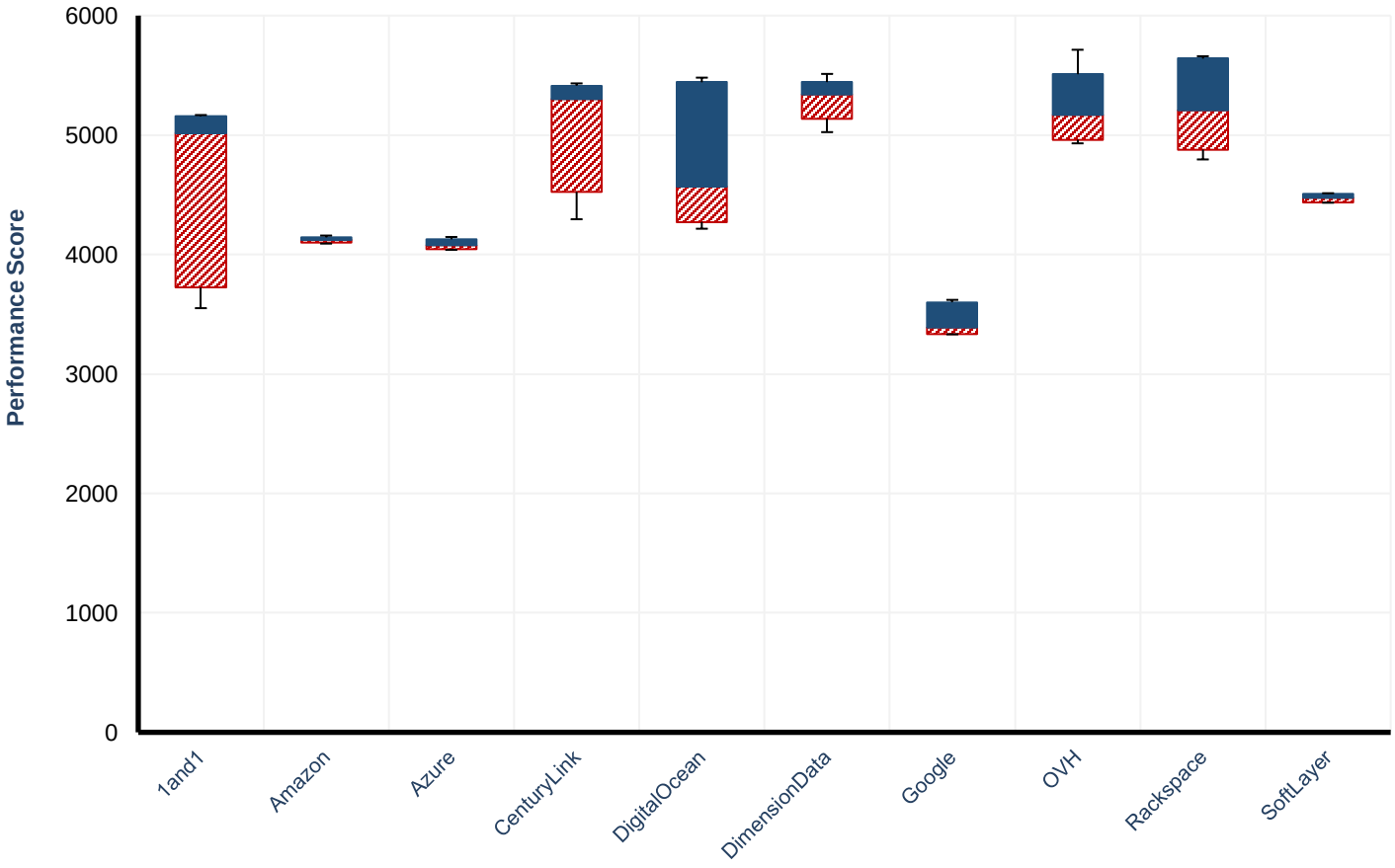


Table 8A.1: VM Performance (Small VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1&1	3,551	3,724	5,013	5,159	5,168	586	13%
Amazon	4,091	4,099	4,120	4,143	4,159	13	0%
Azure	4,039	4,045	4,080	4,128	4,147	28	1%
CenturyLink	4,295	4,524	5,302	5,413	5,433	352	7%
DigitalOcean	4,216	4,273	4,566	5,442	5,481	492	10%
Dimension Data	5,025	5,136	5,342	5,444	5,512	100	2%
Google	3,332	3,336	3,387	3,601	3,620	108	3%
OVH	4,931	4,961	5,167	5,510	5,714	166	3%
Rackspace	4,796	4,878	5,205	5,640	5,660	280	5%
SoftLayer	4,433	4,437	4,475	4,510	4,513	25	1%

Chart 8A.2: Read (4K) Block Disk Performance Type 1 (Small VM)

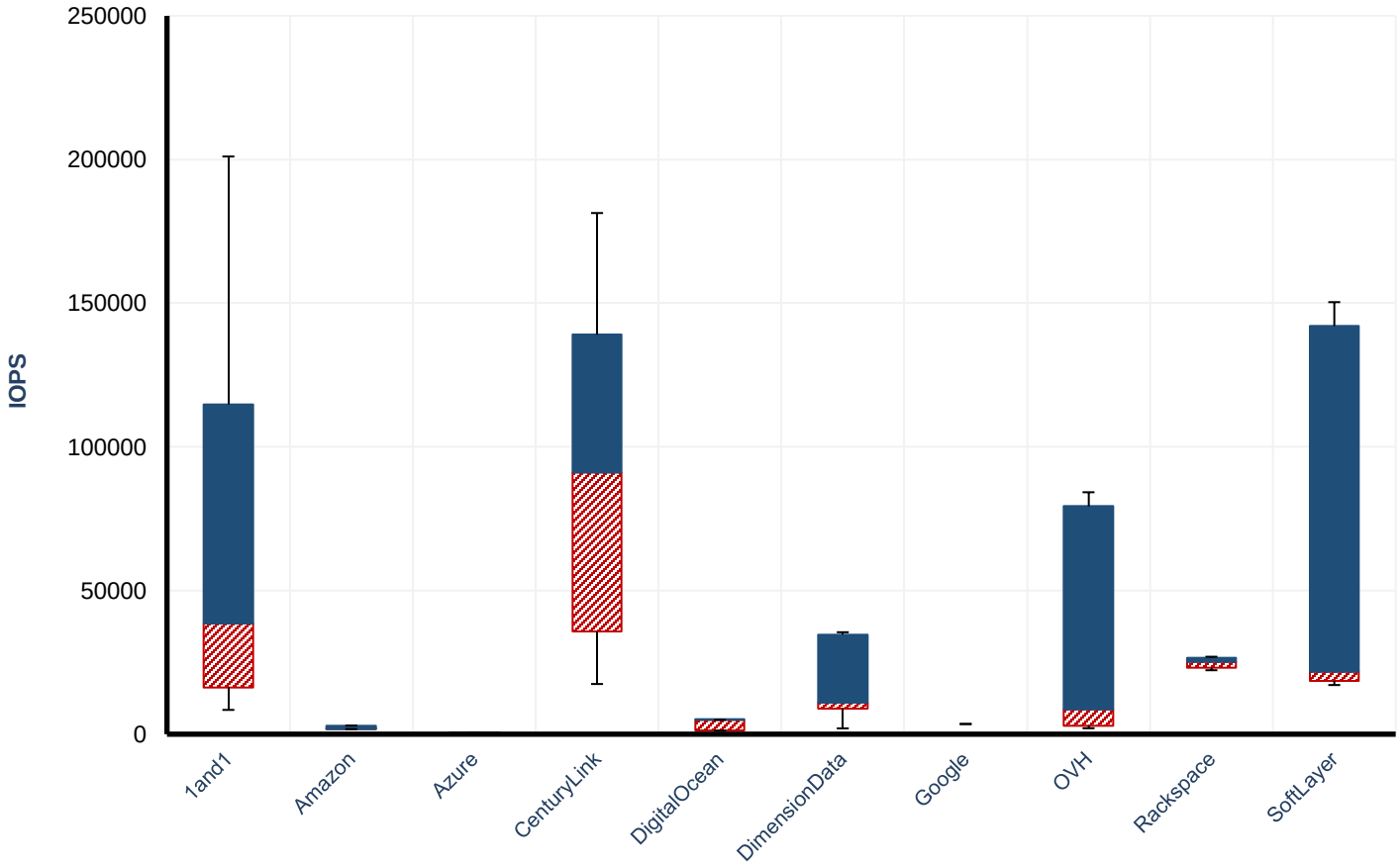


Table 8A.2: Read Block Disk Performance Type 1 (Small VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1&1	8,451	16,251	38,542	114,781	201,046	37,965	79%
Amazon	1,773	1,773	1,777	3,009	3,009	411	21%
Azure	503	505	506	507	507	1	0%
CenturyLink	17,467	35,749	91,073	139,022	181,373	32,513	39%
DigitalOcean	1,208	1,354	4,995	5,001	5,001	1,227	27%
Dimension Data	2,028	8,841	11,021	34,716	35,483	10,975	62%
Google	3,548	3,548	3,548	3,548	3,548	0	0%
OVH	2,074	2,930	8,695	79,282	84,200	20,701	142%
Rackspace	22,256	23,112	25,182	26,529	26,955	1,071	4%
SoftLayer	17,107	18,460	21,840	142,044	150,361	33,260	105%

Chart 8A.3: Write (4K) Block Disk Performance Type 1 (Small VM)

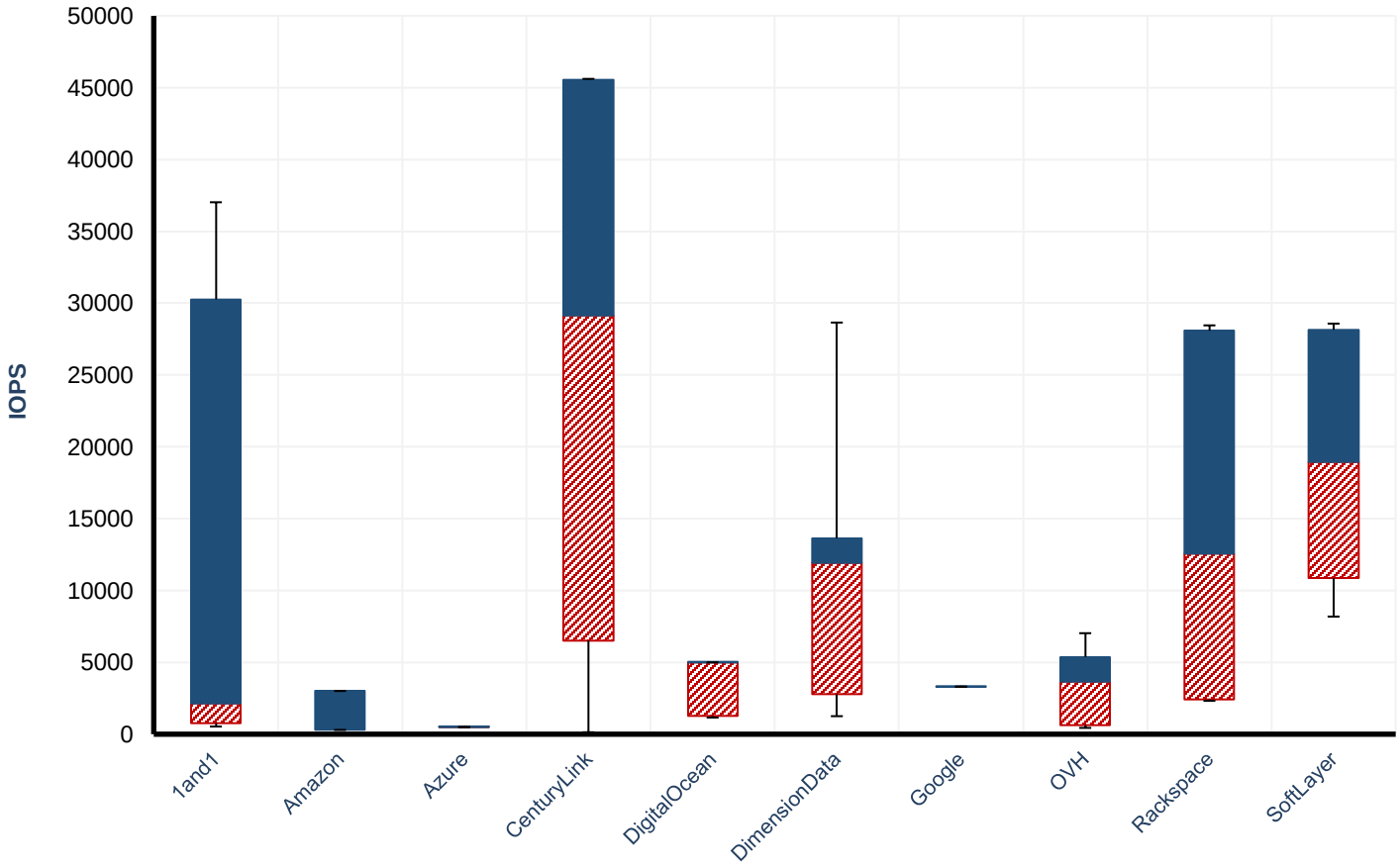


Table 8A.3: Write Block Disk Performance Type 1 (Small VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	535	757	2,167	30,271	37,026	12,199	98%
Amazon	300	300	300	3,007	3,007	902	141%
Azure	481	505	506	507	508	4	1%
CenturyLink	137	6,526	29,133	45,563	45,613	14,352	53%
DigitalOcean	1,158	1,273	4,995	5,001	5,001	1,264	29%
Dimension Data	1,256	2,773	11,944	13,644	28,651	3,880	37%
Google	3,307	3,308	3,308	3,309	3,309	0	0%
OVH	440	625	3,642	5,380	7,030	1,431	40%
Rackspace	2,323	2,424	12,591	28,084	28,456	11,968	83%
SoftLayer	8,186	10,872	18,977	28,147	28,577	4,838	24%

Chart 8A.4: Read (128K) Block Disk Performance Type 2 (Small VM)

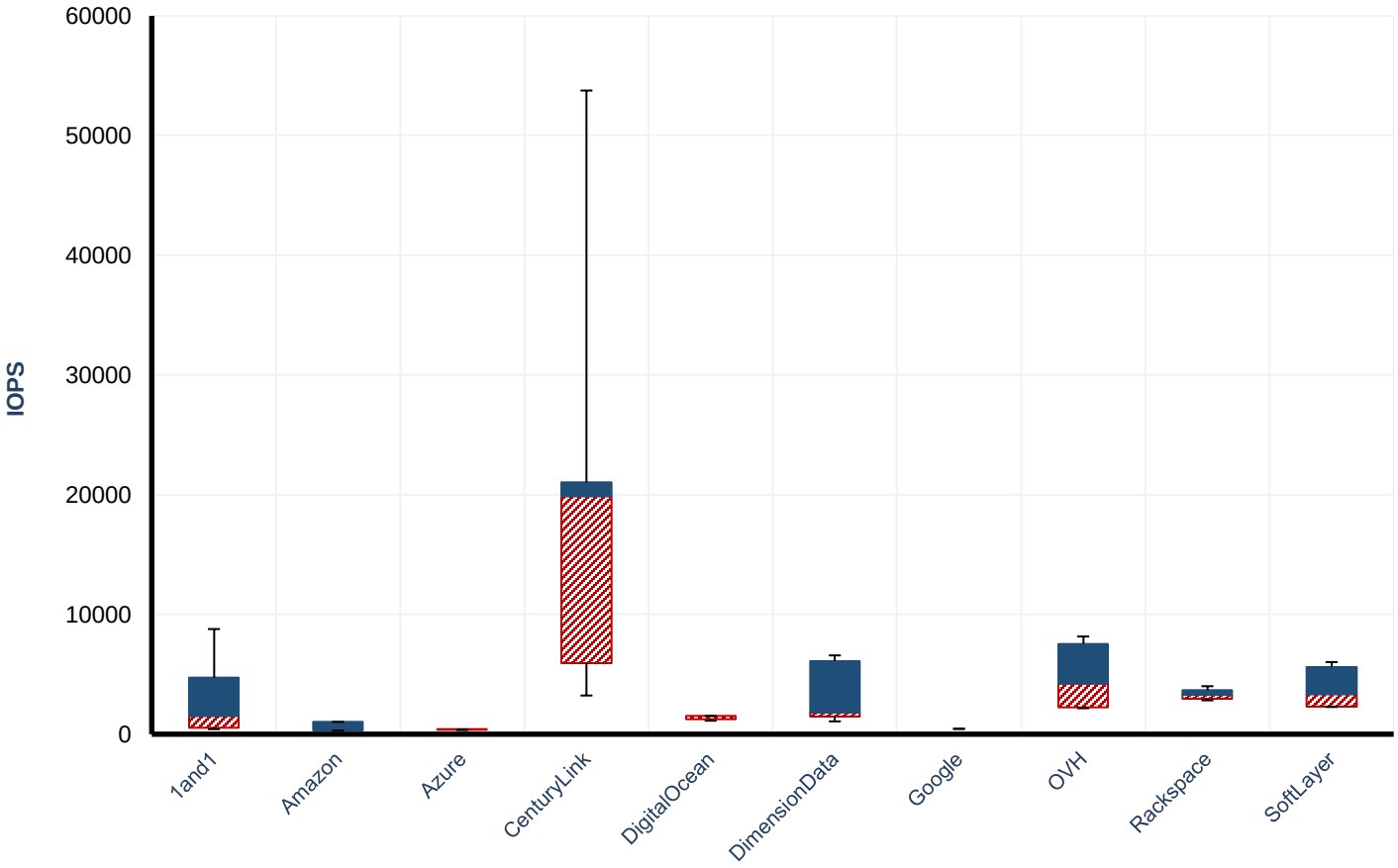


Table 8A.4: Read Block Disk Performance Type 2 (Small VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	424	538	1,527	4,714	8,782	1,417	76%
Amazon	300	300	300	1,027	1,027	242	62%
Azure	369	372	373	373	373	1	0%
CenturyLink	3,233	5,943	19,873	21,027	53,758	8,883	48%
DigitalOcean	1,127	1,265	1,526	1,526	1,526	93	6%
Dimension Data	1,071	1,474	1,783	6,106	6,583	1,852	63%
Google	449	449	449	449	449	0	0%
OVH	2,171	2,221	4,229	7,550	8,162	1,758	42%
Rackspace	2,829	2,978	3,300	3,677	4,010	245	7%
SoftLayer	2,273	2,319	3,324	5,607	6,026	915	27%

Chart 8A.5: Write (128K) Block Disk Performance Type 2 (Small VM)

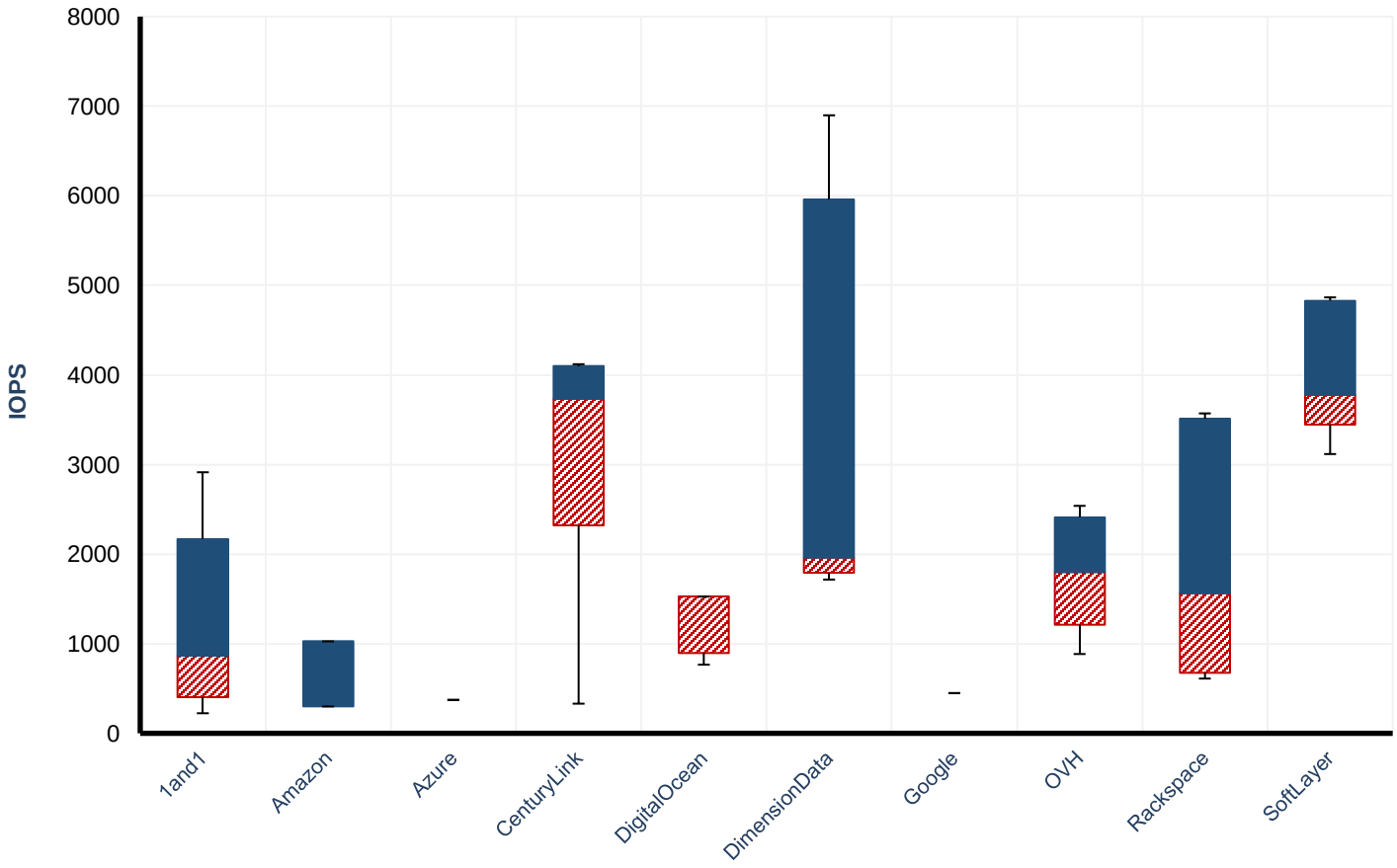


Table 8A.5: Write Block Disk Performance Type 2 (Small VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	224	404	868	2,170	2,914	598	58%
Amazon	300	300	300	1,026	1,026	242	62%
Azure	373	373	373	373	373	0	0%
CenturyLink	331	2,321	3,735	4,096	4,120	803	23%
DigitalOcean	766	897	1,526	1,526	1,526	219	15%
DimensionData	1,716	1,792	1,962	5,961	6,898	1,832	57%
Google	449	449	449	449	449	0	0%
OVH	885	1,213	1,803	2,413	2,539	397	21%
Rackspace	611	678	1,568	3,511	3,571	1,217	64%
SoftLayer	3,117	3,445	3,775	4,829	4,866	512	13%

MEDIUM VMs

Chart 8B.1: VM Performance (Medium VMs)

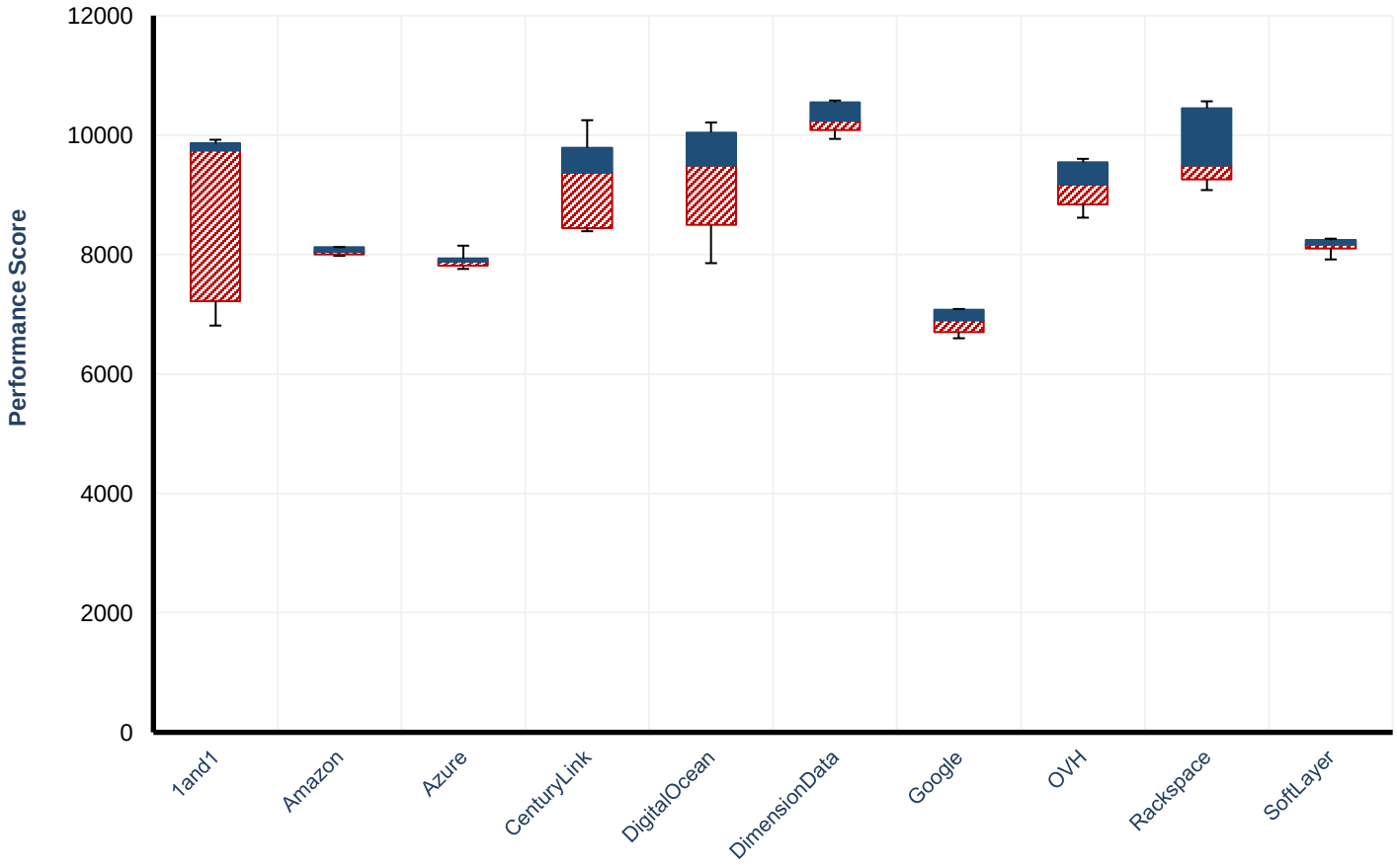


Table 8B.1: VM Performance (Medium VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	6,810	7,219	9,747	9,858	9,921	861	9%
Amazon	7,978	7,998	8,049	8,121	8,124	42	1%
Azure	7,759	7,809	7,878	7,931	8,148	67	1%
CenturyLink	8,390	8,443	9,371	9,788	10,249	389	4%
DigitalOcean	7,855	8,492	9,490	10,045	10,210	432	5%
DimensionData	9,936	10,084	10,243	10,544	10,578	159	2%
Google	6,598	6,699	6,895	7,073	7,088	114	2%
OVH	8,617	8,844	9,171	9,545	9,602	242	3%
Rackspace	9,079	9,259	9,493	10,449	10,565	394	4%
SoftLayer	7,918	8,098	8,167	8,240	8,265	63	1%

Chart 8B.2: Read (4K) Block Disk Performance Type 1 (Medium VM)

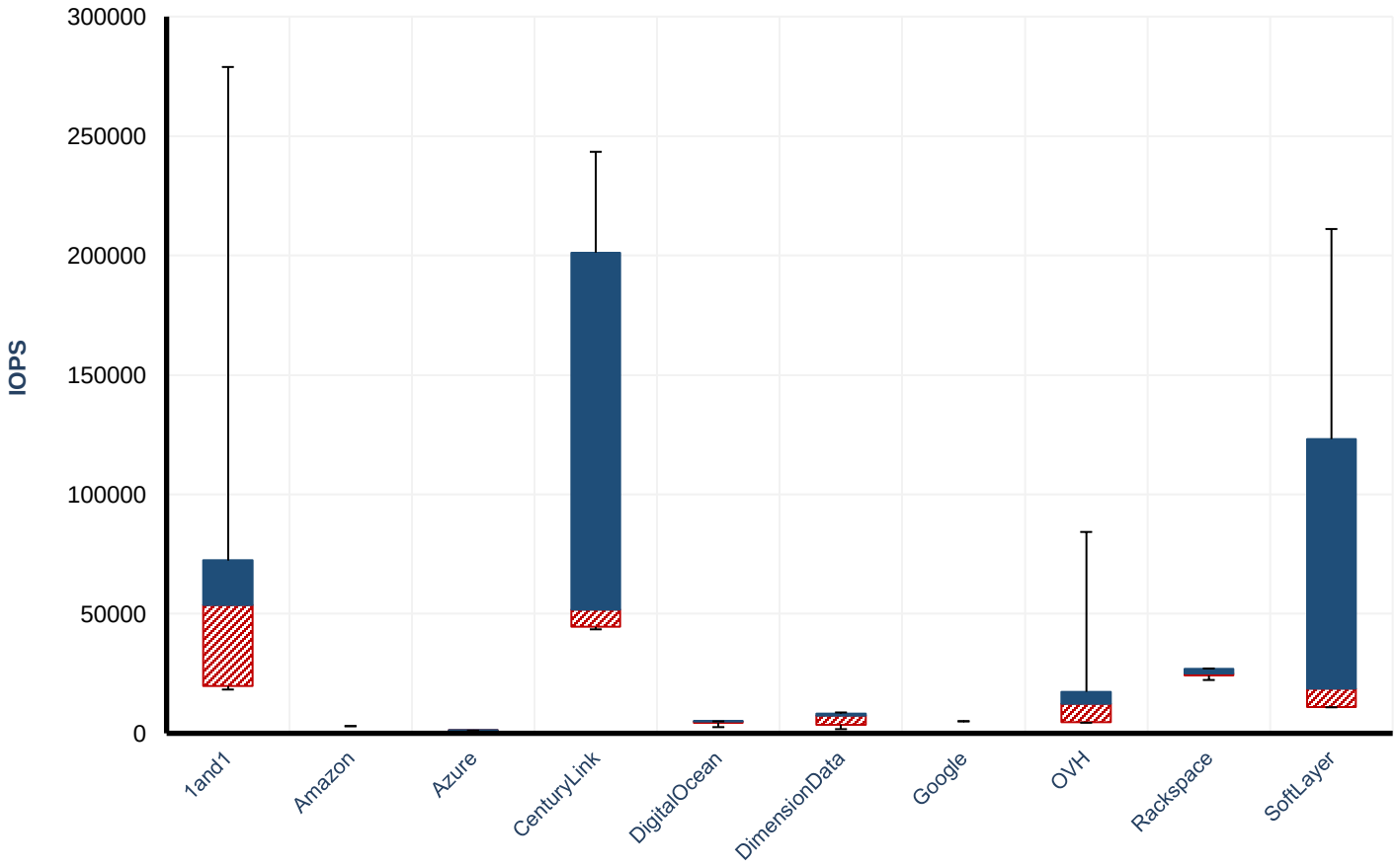


Table 8B.2: Read Block Disk Performance Type 1 (Medium VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	18,333	19,776	53,756	72,324	278,904	48,437	93%
Amazon	3,009	3,009	3,009	3,009	3,009	0	0%
Azure	1,078	1,099	1,103	1,105	1,108	5	0%
CenturyLink	43,529	44,498	51,912	201,196	243,395	46,482	65%
DigitalOcean	2,589	4,317	4,998	5,001	5,001	422	9%
DimensionData	1,746	3,638	7,293	8,367	8,728	1,357	19%
Google	5,047	5,048	5,048	5,048	5,048	0	0%
OVH	4,435	4,577	12,274	17,414	84,292	15,159	112%
Rackspace	22,321	24,137	25,042	27,103	27,129	1,321	5%
SoftLayer	10,888	11,022	18,709	12,3197	211,080	46,092	159%

Chart 8B.3: Write (4K) Block Disk Performance Type 1 (Medium VM)

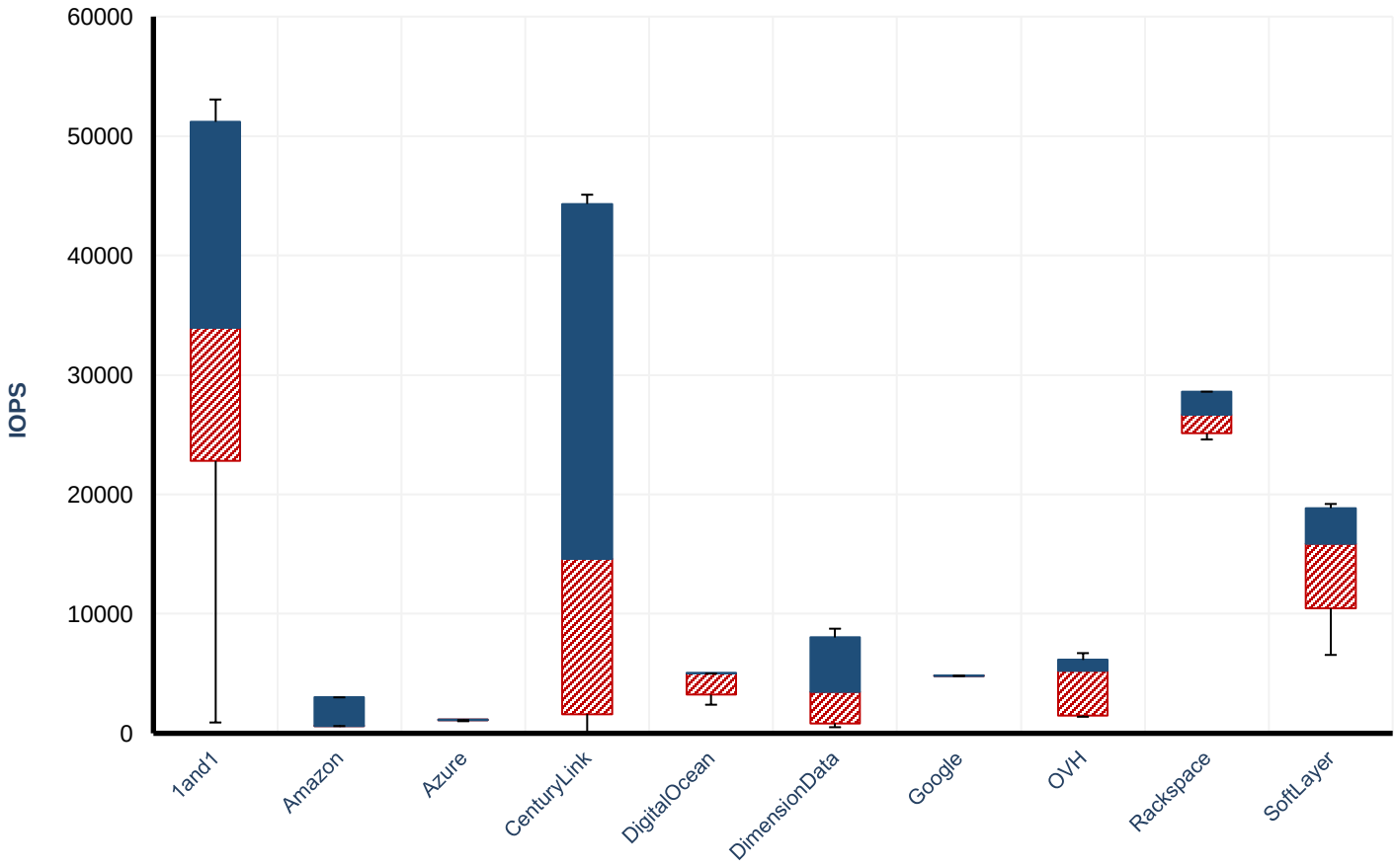


Table 8B.3: Write Block Disk Performance Type 1 (Medium VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	907	22,798	33,944	51,196	53,057	11,543	32%
Amazon	611	612	616	3,006	3,009	903	85%
Azure	1,015	1,100	1,105	1,109	1,109	17	2%
CenturyLink	126	1,612	14,583	44,317	45,089	14,414	66%
DigitalOcean	2,395	3,225	4,999	5,001	5,001	591	12%
DimensionData	512	838	3,489	8,022	8,758	2,457	63%
Google	4,811	4,812	4,813	4,814	4,814	1	0%
OVH	1,386	1,497	5,253	6,145	6,713	1,857	43%
Rackspace	24,599	25,102	26,661	28,587	28,599	1,189	4%
SoftLayer	6,564	10,450	15,890	18,854	19,201	2,908	19%

Chart 8B.4: Read (128K) Block Disk Performance Type 2 (Medium VM)

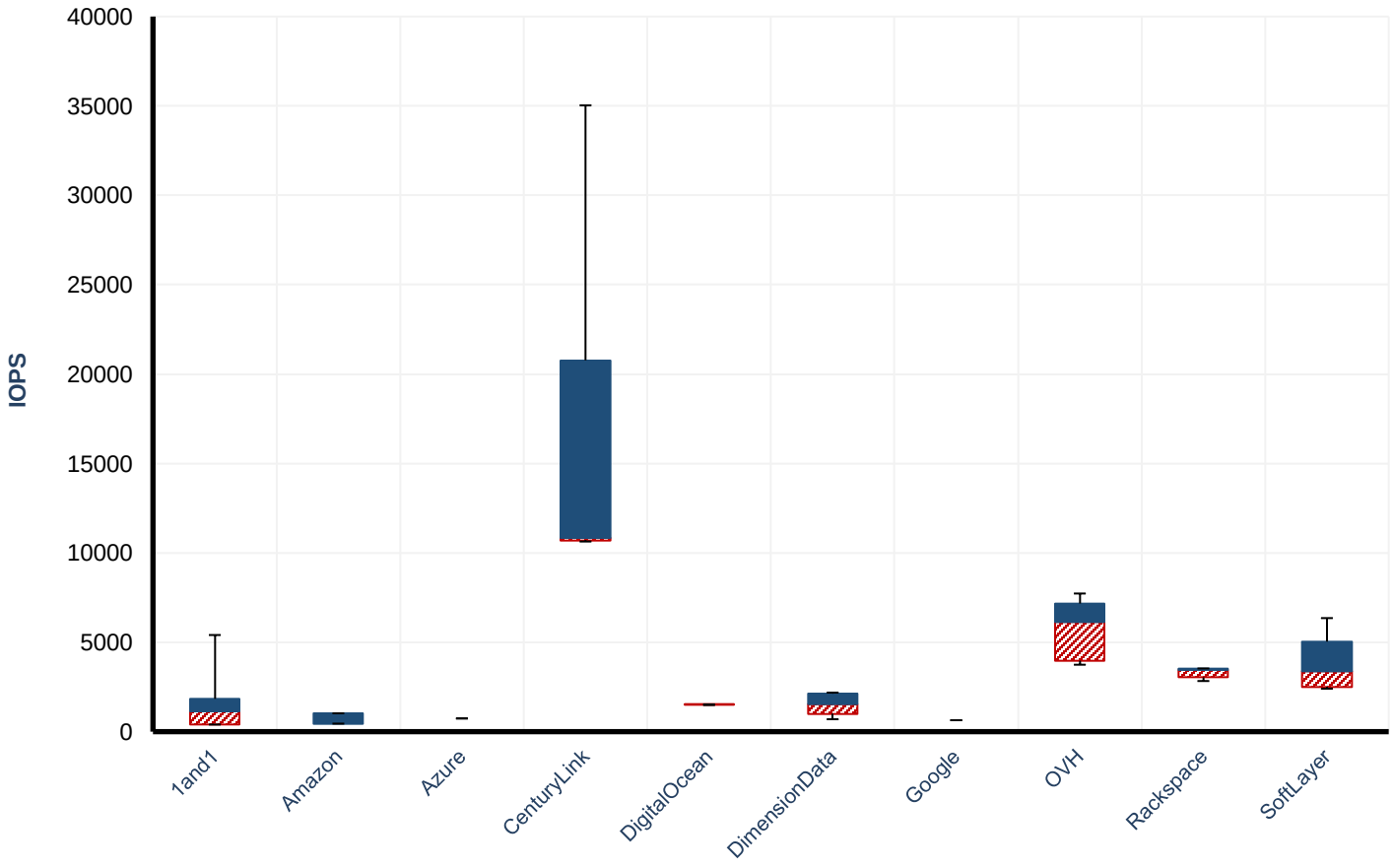


Table 8B.4: Read Block Disk Performance Type 2 (Medium VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	397	411	1,141	1,840	5,406	982	85%
Amazon	450	450	450	1,028	1,028	217	40%
Azure	734	747	747	747	747	2	0%
CenturyLink	10,636	10,704	10,822	20,773	35,035	5,623	39%
DigitalOcean	1,488	1,501	1,526	1,526	1,526	8	1%
DimensionData	696	1,006	1,546	2,126	2,184	403	26%
Google	641	641	641	641	641	0	0%
OVH	3,745	3,967	6,139	7,171	7,728	1,136	19%
Rackspace	2,832	3,036	3,433	3,527	3,534	199	6%
SoftLayer	2,403	2,510	3,370	5,042	6,352	821	24%

Chart 8B.5: Write (128K) Block Disk Performance Type 2 (Medium VM)

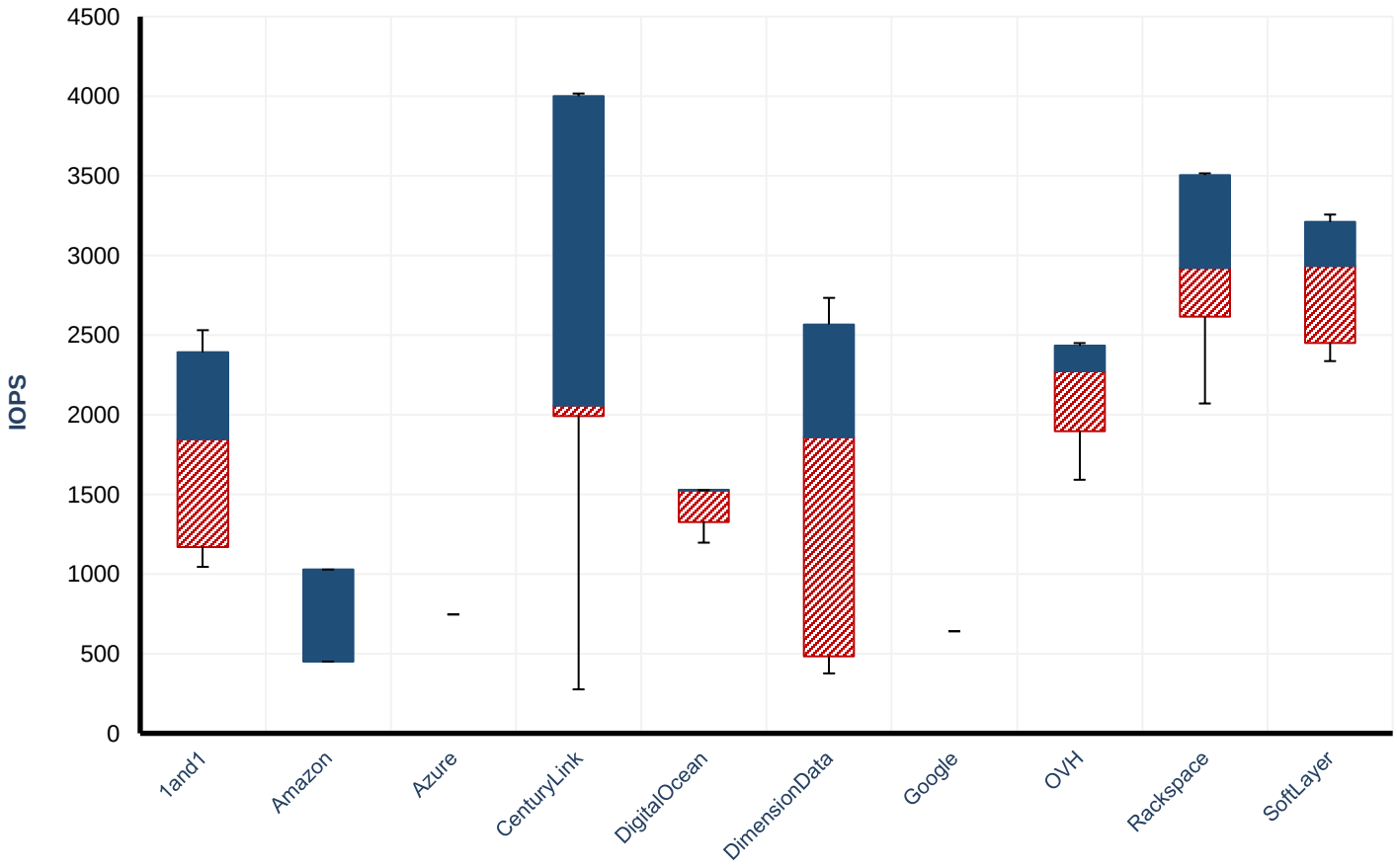


Table 8B.5: Write Block Disk Performance Type 2 (Medium VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	1,045	1,171	1,846	2,391	2,531	421	23%
Amazon	450	450	450	1,027	1,028	216	40%
Azure	746	747	747	747	747	0	0%
CenturyLink	276	1,991	2,059	3,999	4,017	963	38%
DigitalOcean	1,197	1,328	1,525	1,526	1,526	72	5%
DimensionData	376	482	1,860	2,568	2,734	714	44%
Google	641	641	641	641	641	0	0%
OVH	1,592	1,898	2,275	2,433	2,450	178	8%
Rackspace	2,071	2,615	2,922	3,505	3,516	363	12%
SoftLayer	2,337	2,449	2,935	3,210	3,257	260	9%

LARGE VMs

Chart 8C.1: VM Performance (Large VMs)

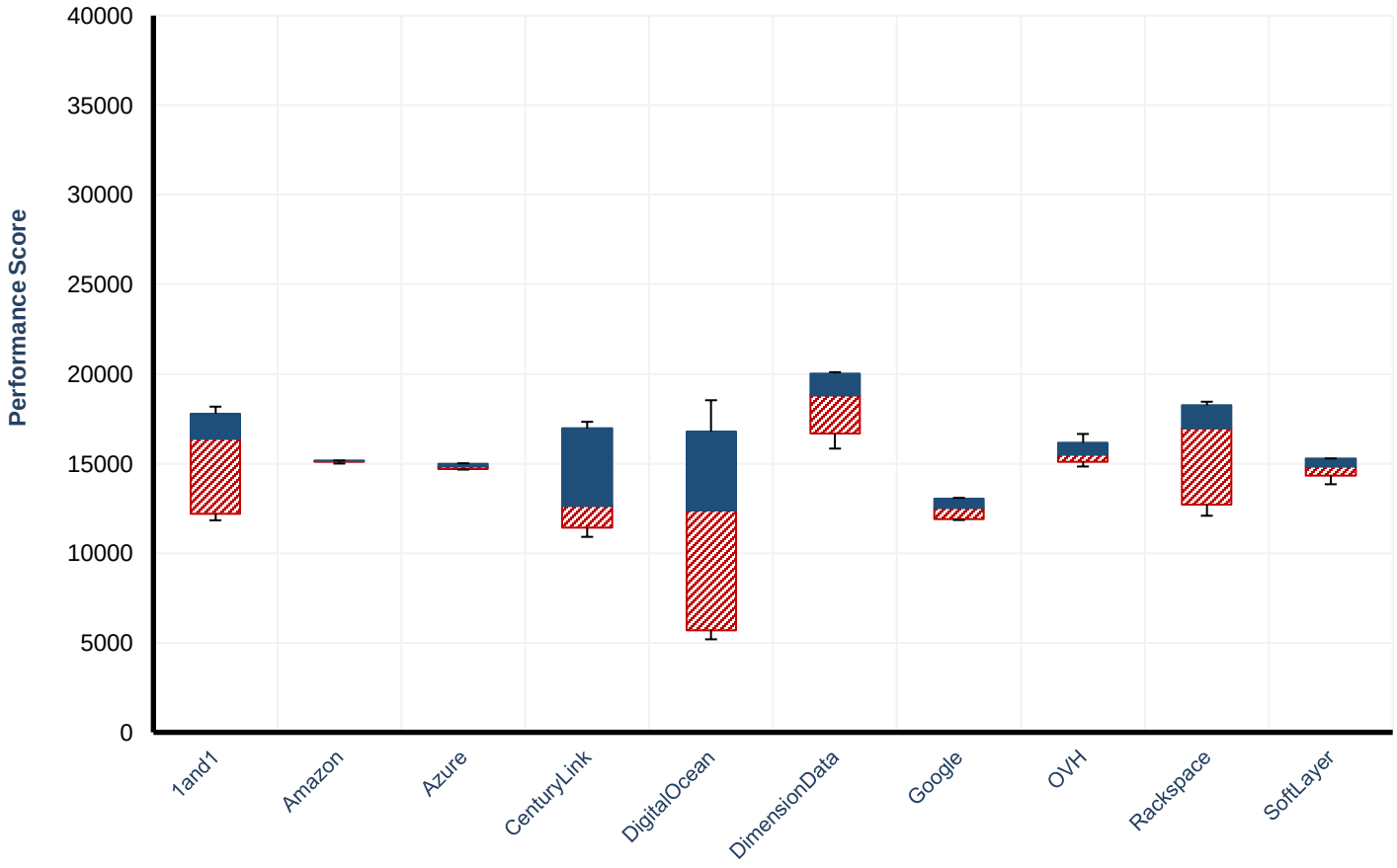


Table 8C.1: VM Performance (Large VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	11,833	12,211	16,397	17,774	18,176	2,059	13%
Amazon	15,000	15,083	15,119	15,150	15,167	24	0%
Azure	14,662	14,699	14,831	14,991	15,013	99	1%
CenturyLink	10,909	11,416	12,637	16,959	17,329	2,017	15%
DigitalOcean	5,190	5,686	12,391	16,789	18,535	3,322	27%
DimensionData	15,836	16,684	18,817	20,021	20,099	1,193	6%
Google	11,850	11,886	12,536	13,053	13,085	436	3%
OVH	14,834	15,101	15,495	16,152	16,654	370	2%
Rackspace	12,088	12,724	16,989	18,247	18,452	2,108	13%
SoftLayer	13,846	14,326	14,844	15,272	15,283	326	2%

Chart 8C.2: Read (4K) Block Disk Performance Type 1 (Large VM)

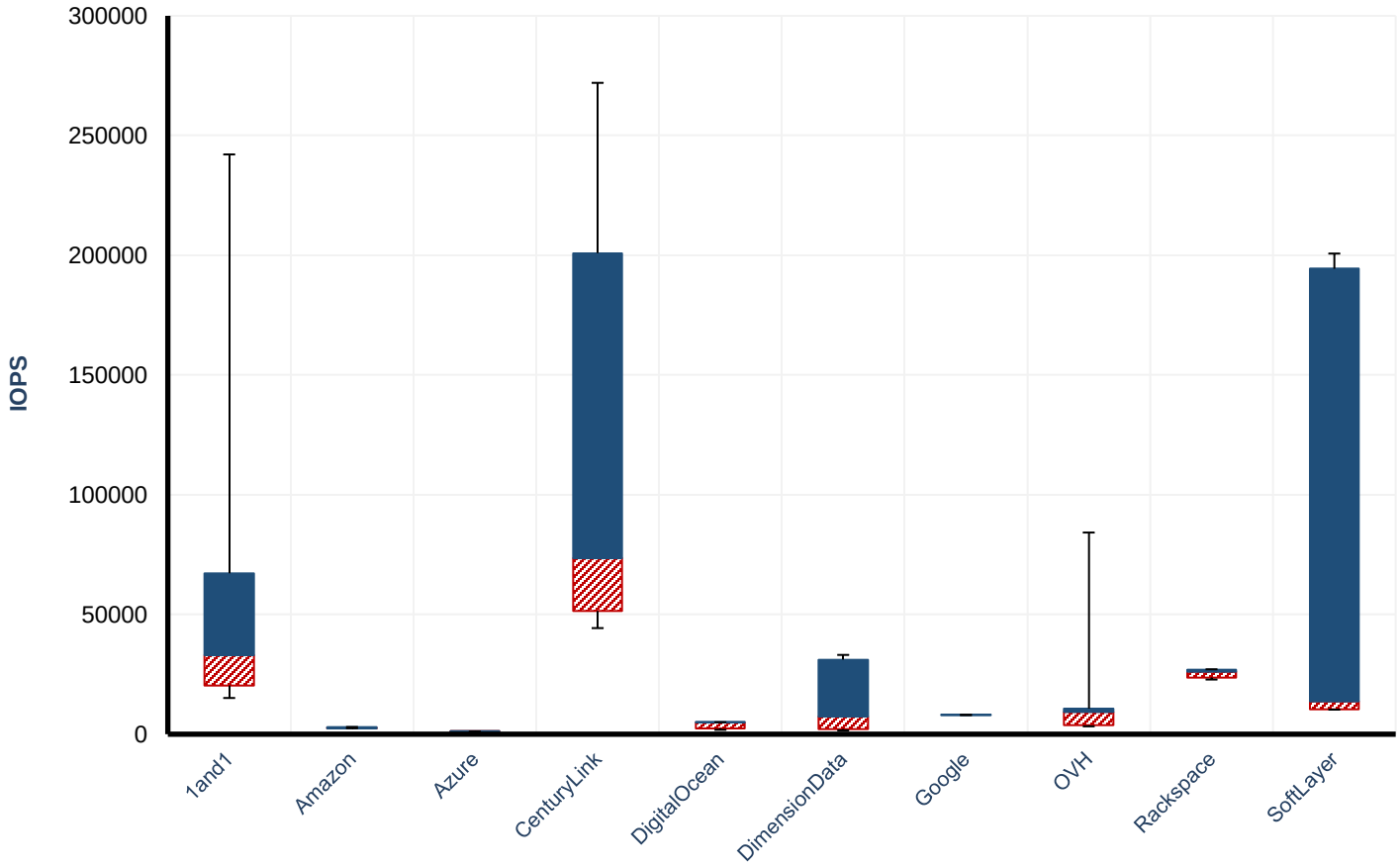


Table 8C.2: Read Block Disk Performance Type 1 (Large VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	15,123	20,334	32,994	67,229	242,127	39,466	97%
Amazon	2,505	2,508	2,511	3,009	3,009	168	7%
Azure	1,019	1,098	1,102	1,106	1,109	12	1%
CenturyLink	44,315	51,439	73,580	200,935	272,013	47,602	55%
DigitalOcean	1,849	2,460	4,990	5,001	5,001	847	18%
DimensionData	1,587	2,185	7,319	31,194	33,109	10,814	86%
Google	8,046	8,046	8,046	8,047	8,047	0	0%
OVH	3,290	3,735	9,159	10,705	84,219	15,106	145%
Rackspace	22,831	23,694	26,050	26,830	27,103	983	4%
SoftLayer	10,262	10,385	13,659	194,382	200,727	49,366	184%

Chart 8C.3: Write (4K) Block Disk Performance Type 1 (Large VM)

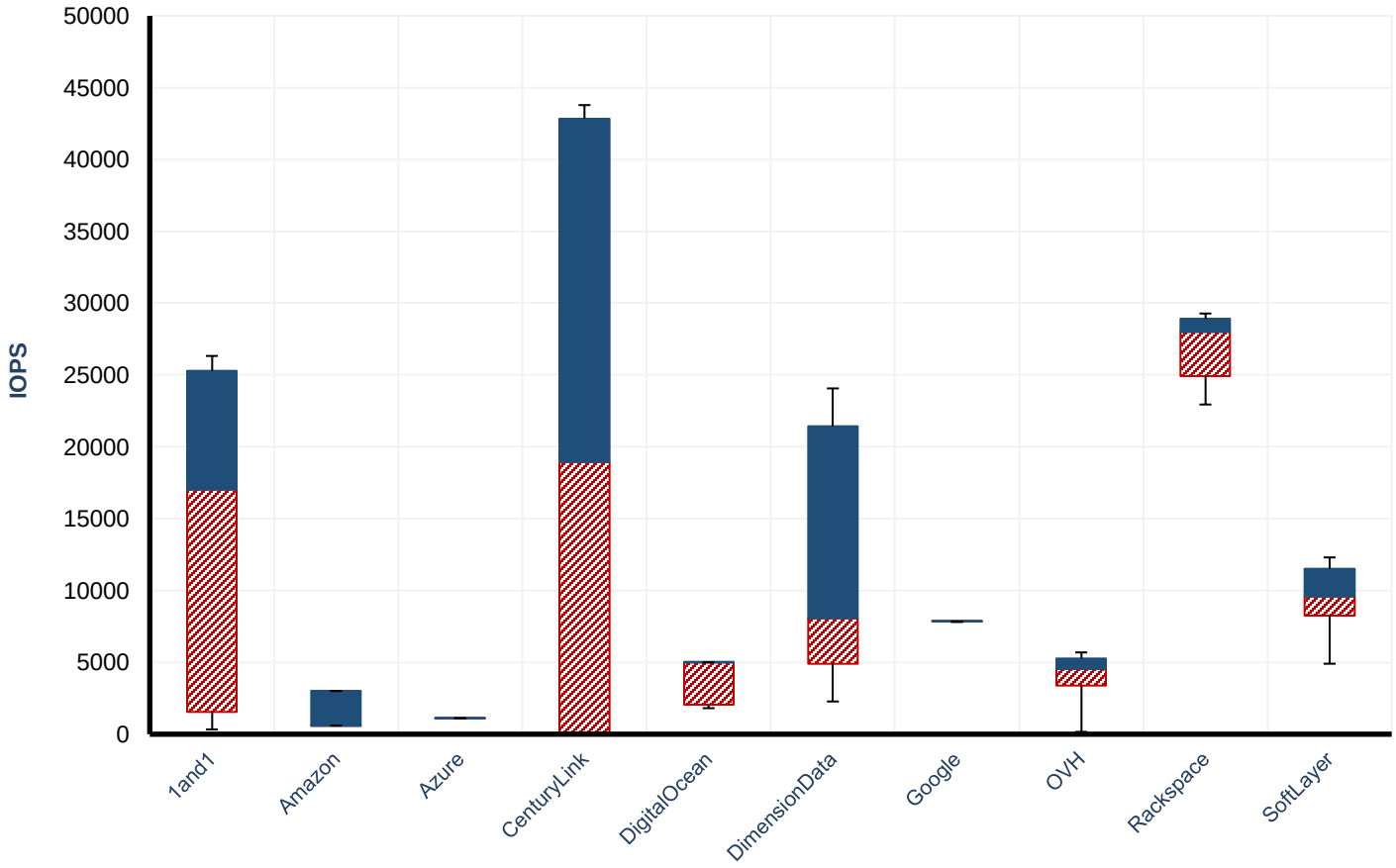


Table 8C.3: Write Block Disk Performance Type 1 (Large VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	329	1,557	17,022	25,271	26,329	6,169	37%
Amazon	600	600	601	3,006	3,006	811	89%
Azure	1,102	1,103	1,106	1,109	1,109	2	0%
CenturyLink	58	147	18,958	42,850	43,788	16,506	90%
DigitalOcean	1,811	2,049	4,998	5,001	5,001	1,041	23%
Dimension Data	2,278	4,887	8,078	21,425	24,068	6,008	55%
Google	7,820	7,820	7,821	7,823	7,824	1	0%
OVH	164	3,372	4,555	5,284	5,694	807	18%
Rackspace	22,946	24,924	28,024	28,902	29,282	1,360	5%
SoftLayer	4,906	8,244	9,585	11,531	12,305	1,427	15%

Chart 8C.4: Read (128K) Block Disk Performance Type 2 (Large VM)

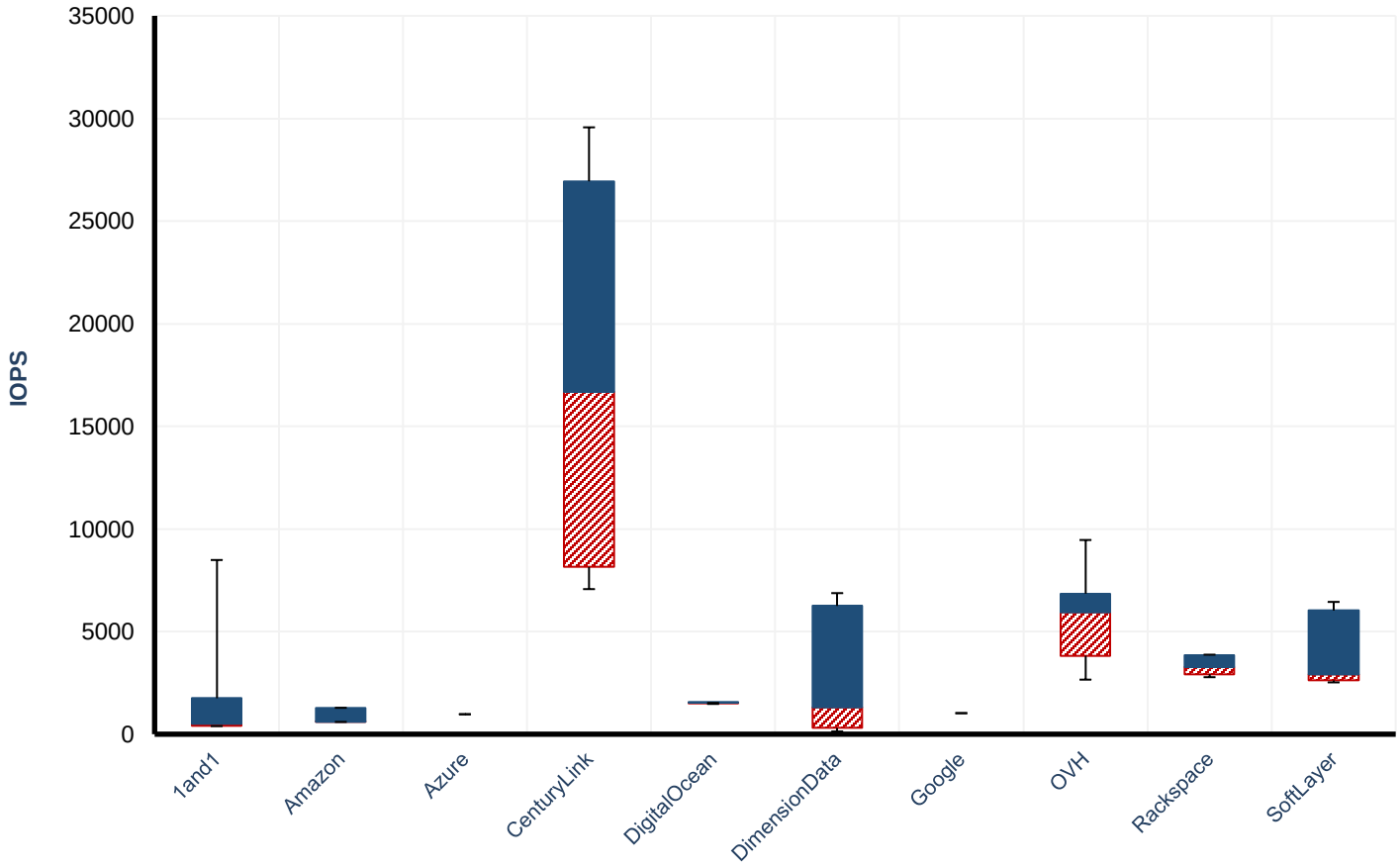


Table 8C.4: Read Block Disk Performance Type 2 (Large VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	395	409	511	1,753	8,487	1,395	155%
Amazon	600	600	601	1,284	1,286	210	31%
Azure	971	972	972	972	973	0	0%
CenturyLink	7,069	8,141	16,673	26,941	29,567	6,457	40%
DigitalOcean	1,476	1,502	1,525	1,526	1,526	10	1%
Dimension Data	134	302	1,307	6,251	6,873	2,013	82%
Google	1,025	1,025	1,025	1,025	1,025	0	0%
OVH	2,658	3,821	5,935	6,848	9,462	1,126	20%
Rackspace	2,778	2,921	3,269	3,849	3,875	348	10%
SoftLayer	2,525	2,618	2,908	6,026	6,445	933	30%

Chart 8C.5: Write (128K) Block Disk Performance Type 2 (Large VM)

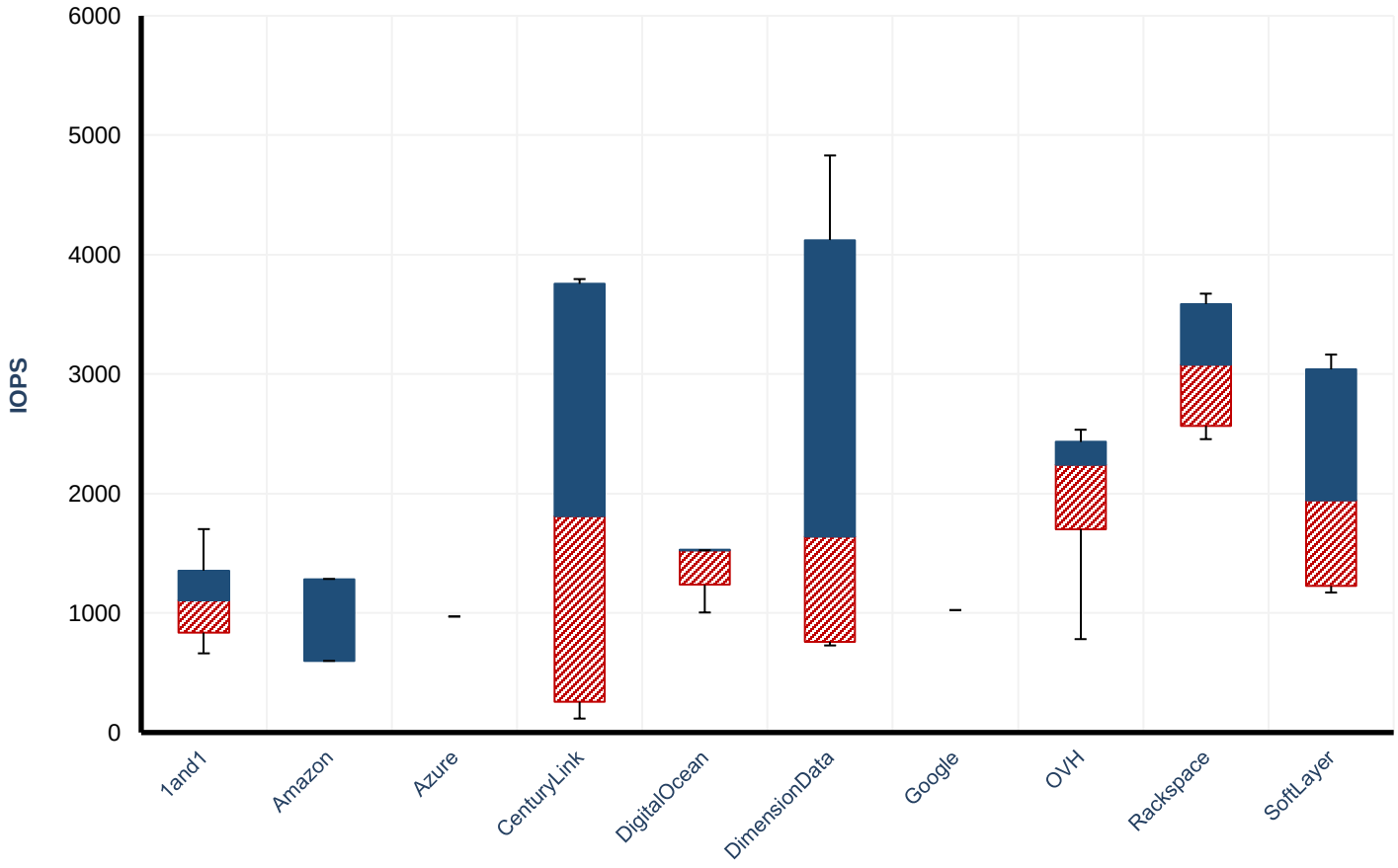


Table 8C.5: Write Block Disk Performance Type 2 (Large VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	663	836	1,104	1,356	1,703	176	16%
Amazon	600	601	601	1,282	1,286	203	30%
Azure	971	972	972	972	972	0	0%
CenturyLink	117	256	1,812	3,757	3,796	1,217	62%
DigitalOcean	1,005	1,236	1,525	1,526	1,526	110	7%
Dimension Data	729	760	1,643	4,123	4,831	1,104	52%
Google	1,025	1,025	1,025	1,025	1,025	0	0%
OVH	782	1,703	2,240	2,432	2,535	261	12%
Rackspace	2,456	2,567	3,080	3,588	3,674	331	11%
SoftLayer	1,172	1,225	1,942	3,041	3,164	620	30%

EXTRA LARGE VMs

Chart 8D.1: VM Performance (Extra Large VMs)

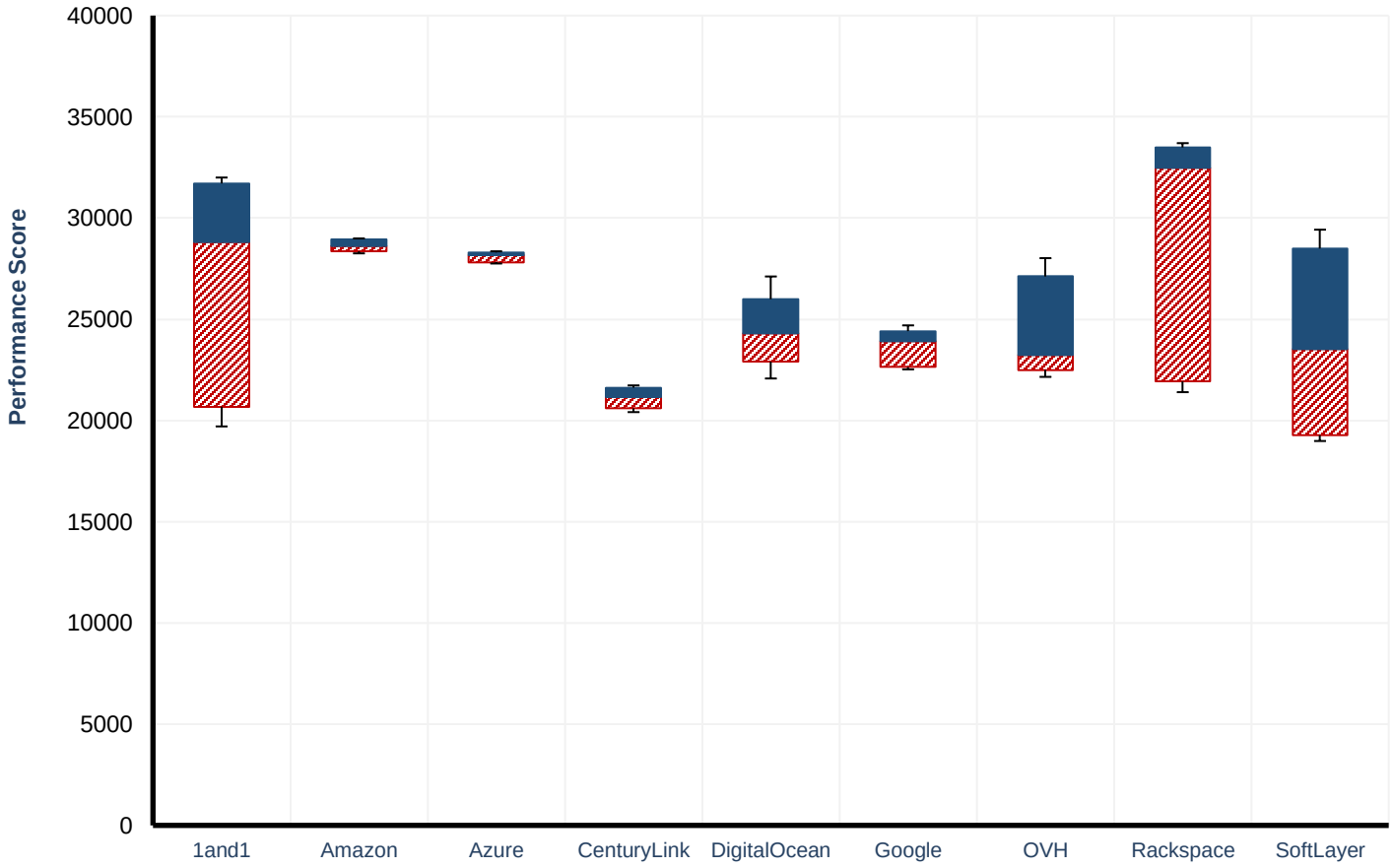


Table 8D.1: VM Performance (Extra Large VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	19,706	20,680	28,798	31,711	32,000	3,629	13%
Amazon	28,254	28,356	28,631	28,954	28,992	239	1%
Azure	27,753	27,808	28,163	28,301	28,357	176	1%
CenturyLink	20,414	20,597	21,173	21,625	21,732	299	1%
DigitalOcean	22,074	22,905	24,295	25,992	27,113	1,056	4%
Google	22,525	22,636	23,926	24,417	24,697	697	3%
OVH	22,154	22,496	23,238	27,113	28,018	1,697	7%
Rackspace	21,398	21,927	32,479	33,488	33,698	5,181	18%
SoftLayer	18,986	19,274	23,537	28,496	29,425	3,333	14%

Chart 8D.2: Read (4K) Block Disk Performance Type 1 (Extra Large VM)

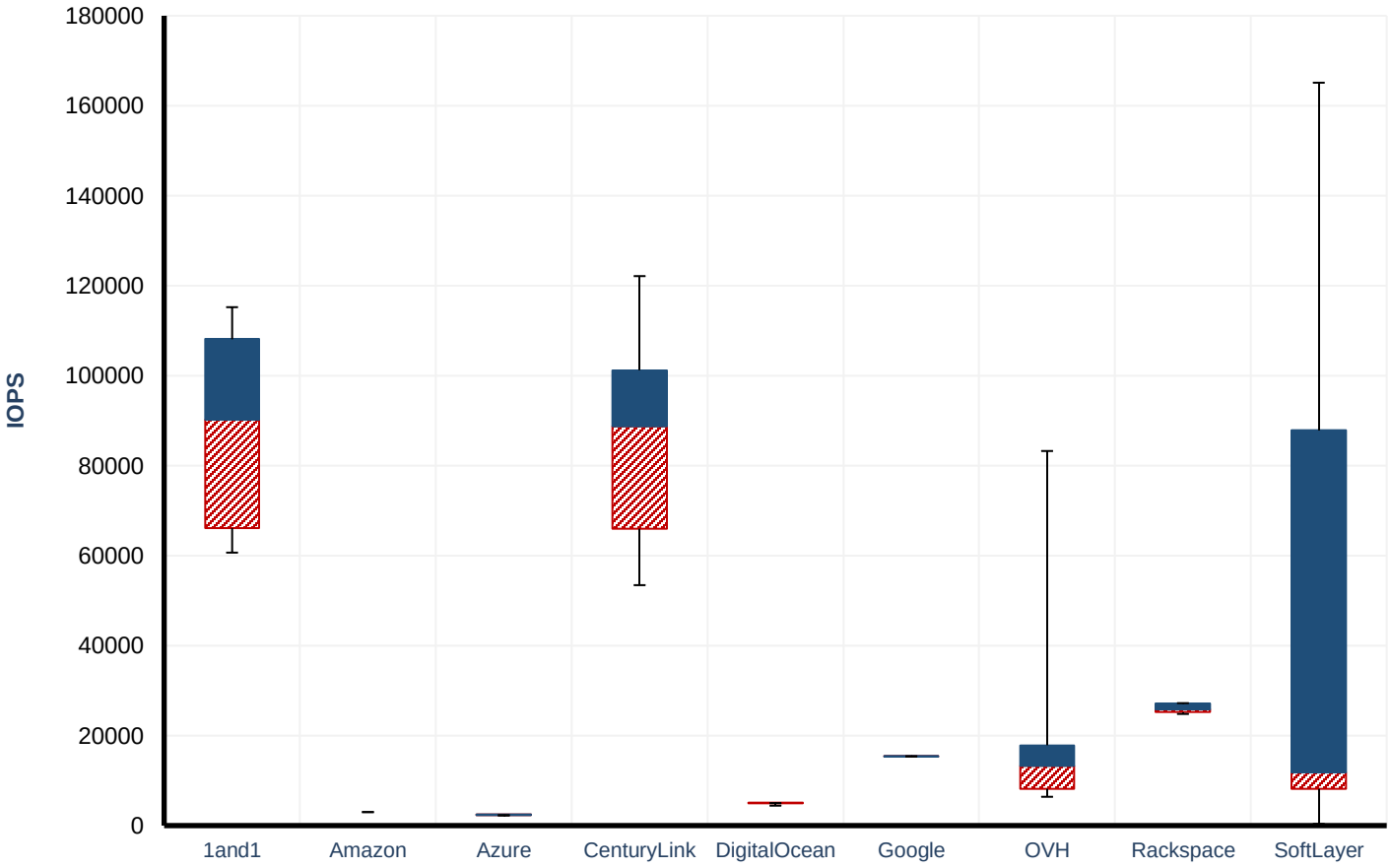


Table 8D.2: Read Block Disk Performance Type 1 (Extra Large VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	60,672	66,130	90,274	108,100	115,225	13,565	15%
Amazon	3,009	3,009	3,009	3,009	3,009	0	0%
Azure	2,257	2,260	2,291	2,307	2,318	16	1%
CenturyLink	53,444	65,967	88,798	101,224	122,133	11,436	13%
DigitalOcean	4,432	4,906	5,001	5,001	5,002	79	2%
Google	15,380	15,381	15,382	15,383	15,383	1	0%
OVH	6,407	8,157	13,267	17,870	83,261	13,811	88%
Rackspace	24,818	25,188	25,852	27,117	27,219	652	3%
SoftLayer	381	8,150	11,880	87,823	165,120	35,068	173%

Chart 8D.3: Write (4K) Block Disk Performance Type 1 (Extra Large VM)

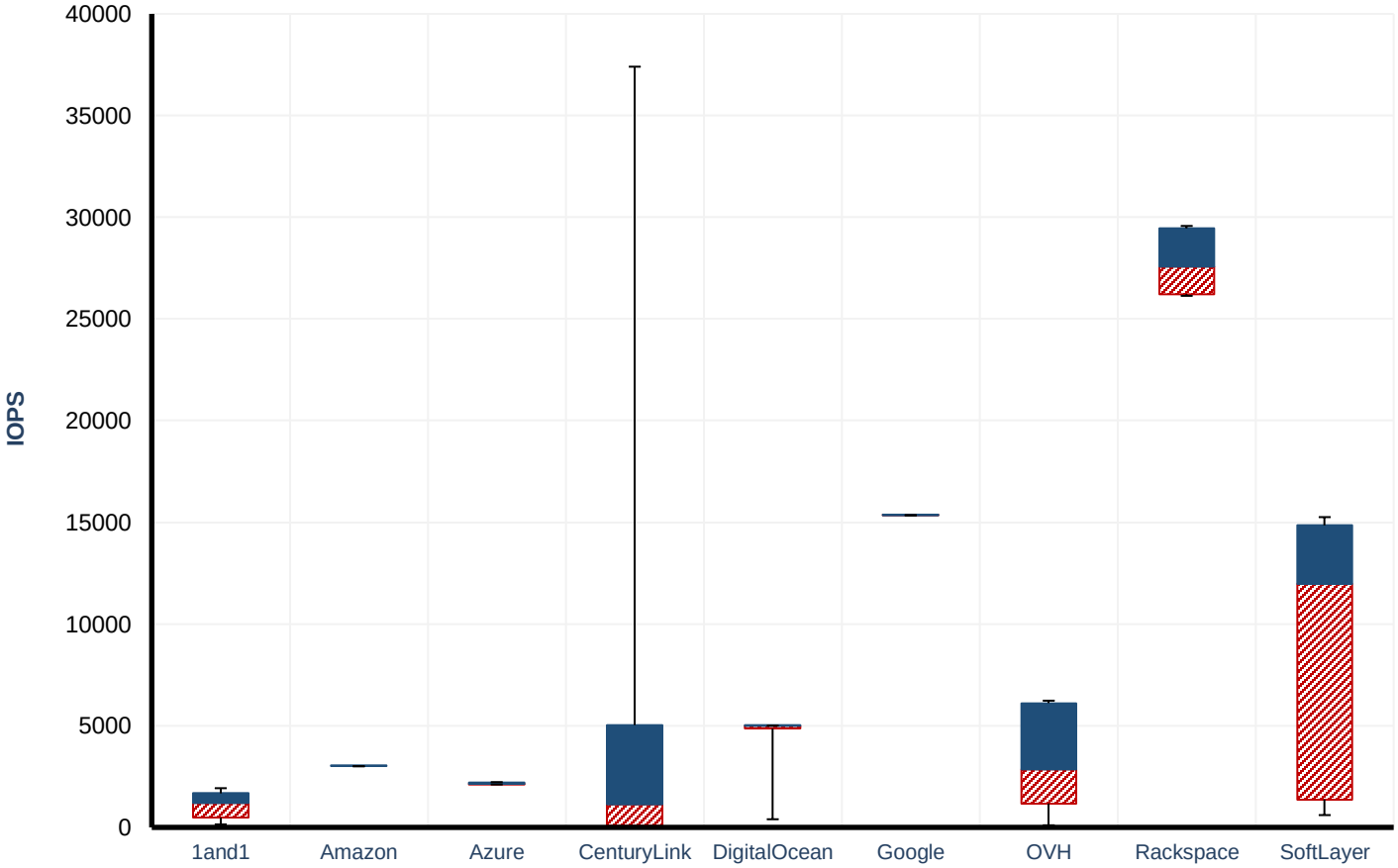


Table 8D.3: Write Block Disk Performance Type 1 (Extra Large VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	146	472	1,184	1,673	1,927	397	34%
Amazon	3,005	3,006	3,006	3,007	3,009	1	0%
Azure	2,108	2,113	2,130	2,189	2,224	26	1%
CenturyLink	56	102	1,149	5,033	37,402	6,011	244%
DigitalOcean	400	4,856	4,980	5,001	5,002	961	20%
Google	15,337	15,343	15,345	15,349	15,352	2	0%
OVH	104	1,171	2,849	6,113	6,230	1,725	45%
Rackspace	26,136	26,217	27,585	29,451	29,572	1,103	4%
SoftLayer	604	1,374	11,959	14,847	15,256	3,810	35%

Chart 8D.4: Read (128K) Block Disk Performance Type 2 (Extra Large VM)

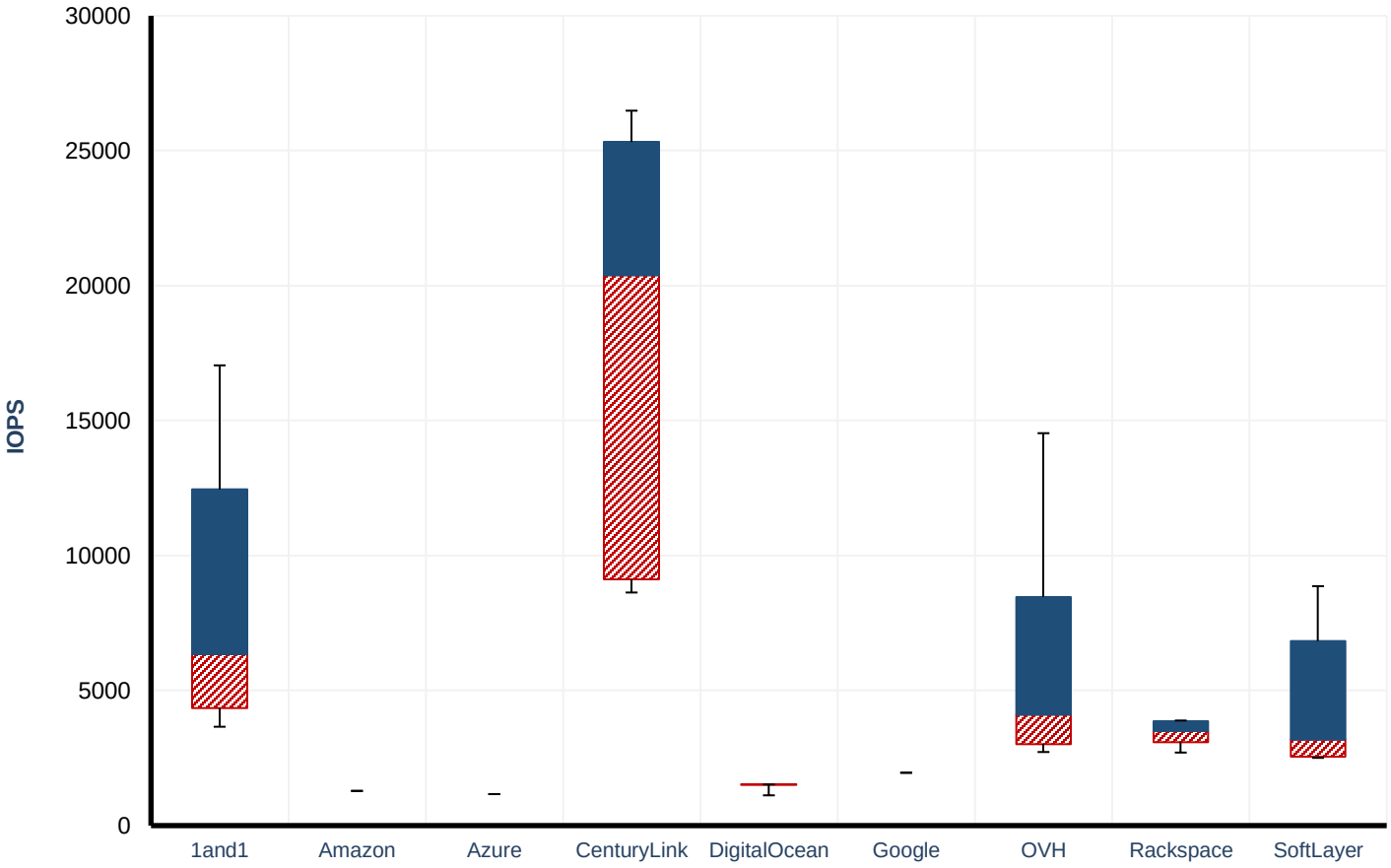


Table 8D.4: Read Block Disk Performance Type 2 (Extra Large VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	3,662	4,353	6,353	12,454	17,049	2,741	39%
Amazon	1,286	1,286	1,286	1,286	1,286	0	0%
Azure	1,166	1,167	1,167	1,167	1,167	0	0%
CenturyLink	8,635	9,120	20,390	25,322	26,484	5,559	30%
DigitalOcean	1,121	1,514	1,526	1,526	1,526	50	3%
Google	1,958	1,958	1,958	1,958	1,958	0	0%
OVH	2,726	3,028	4,110	8,478	14,537	2,420	47%
Rackspace	2,706	3,085	3,493	3,872	3,893	302	9%
SoftLayer	2,510	2,542	3,188	6,836	8,869	1,379	39%

Chart 8D.5: Write (128K) Block Disk Performance Type 2 (Extra Large VM)

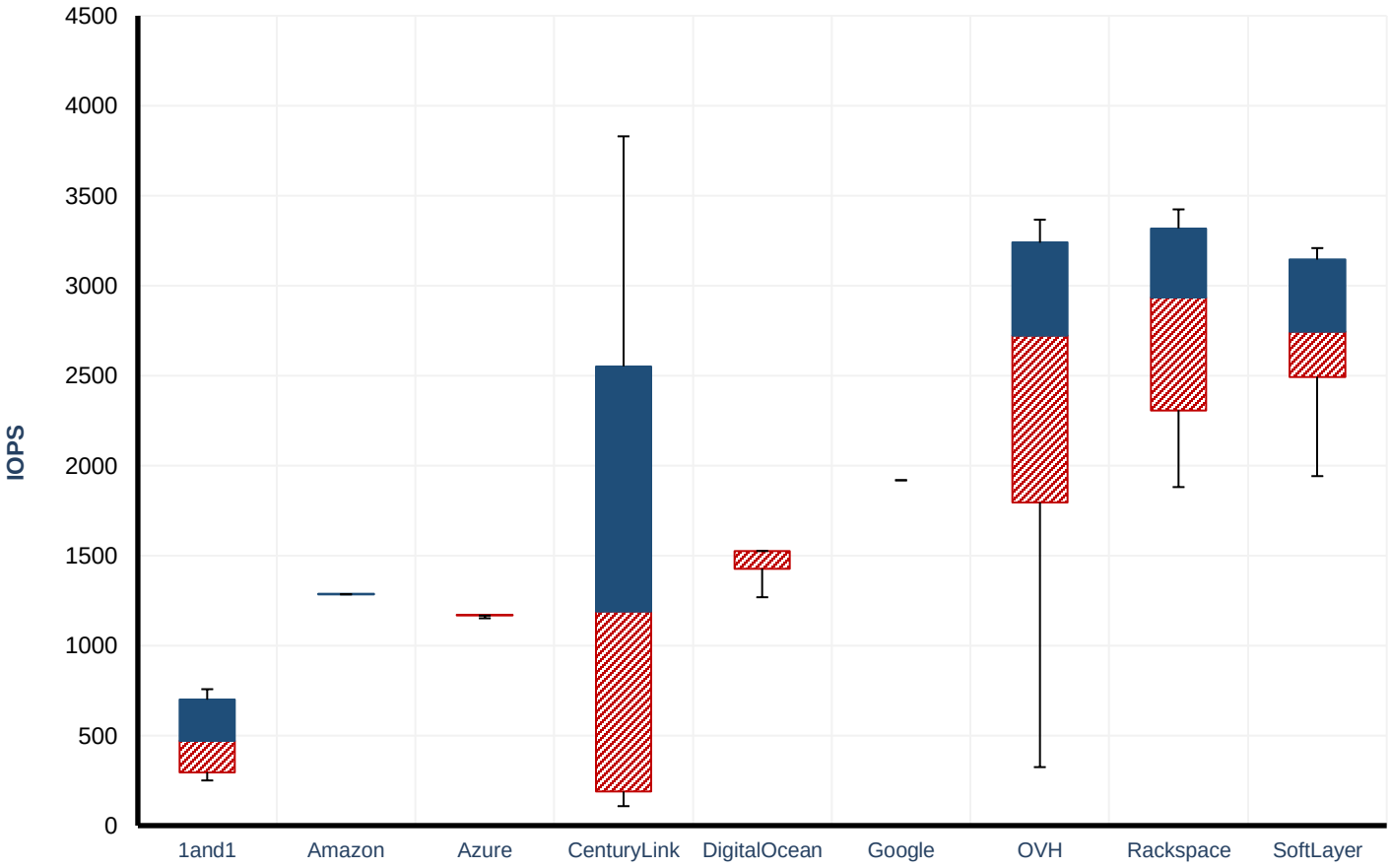


Table 8D.5: Write Block Disk Performance Type 2 (Extra Large VMs)

PROVIDER	MIN	5TH	MEDIAN	95TH	MAX	STDEV	CV
1and1	251	297	472	700	758	133	27%
Amazon	1,285	1,285	1,285	1,286	1,286	0	0%
Azure	1,152	1,167	1,167	1,167	1,167	2	0%
CenturyLink	108	189	1,188	2,551	3,830	867	67%
DigitalOcean	1,269	1,429	1,526	1,526	1,526	47	3%
Google	1,919	1,919	1,919	1,919	1,919	0	0%
OVH	325	1,795	2,724	3,239	3,367	568	21%
Rackspace	1,881	2,308	2,935	3,319	3,424	377	13%
SoftLayer	1,942	2,494	2,745	3,145	3,209	232	8%

ABOUT CLOUD SPECTATOR

Cloud Spectator is a data-driven cloud consultancy specializing in cloud price-performance analysis and cloud consulting.

Cloud Spectator actively monitors many of the largest cloud Infrastructure as a Service (IaaS) providers in the world to evaluate and compare Cloud service performance (i.e., CPU, RAM, disk, internal network, external network and workloads) and pricing to achieve transparency in the cloud market.

Cloud Spectator provides full spectrum cloud consulting services including strategy and planning, architecture and technology selection, deployment and implementation, as well as cloud migration services. In addition, Cloud Spectator also helps cloud providers understand their market position within a competitive landscape.

The firm was founded in early 2011 and is located in Boston, MA.

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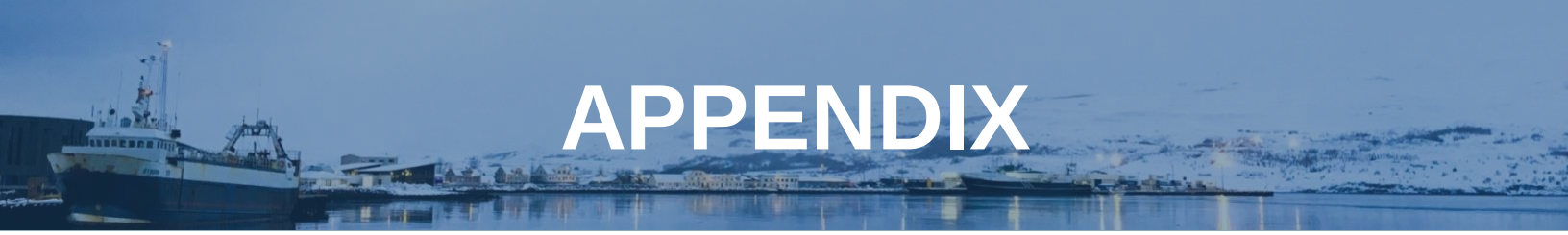

APPENDIX

Tested VM & Storage Configurations

VM Size	Provider	Instance	Storage Type	vCPU	RAM	Storage	Data Center
Small	1and1	Cloud Server XL	SSD Storage	2	4	120	US
	Amazon	c5.large	SSD EBS	2	3.75	100	US East (N. Virginia)
	Azure	F2s v2	Premium Storage P10 (128GB)	2	4	128	US East
	CenturyLink	Customized	Block Storage	2	4	100	Virginia
	DigitalOcean	4GB	SSD Block Storage	2	4	100	US East (New York)
	Dimension Data	Customized	High Performance Storage	2	4	100	Ashburn
	Google	Customized	SSD Persistent Disk	2	4	100	US East
	OVH	B2-7	High Speed Volume	2	7	200	BHS
	Rackspace	Compute1-4	SSD Block Storage	2	3.75	100	N. Virginia
	SoftLayer	Customized	Portable Storage	2	4	100	Washington DC
Medium	1and1	Cloud Server XXL	SSD Storage	4	8	160	US
	Amazon	c5.xlarge	SSD EBS	4	7.5	150	US East (N. Virginia)
	Azure	F4s v2	Premium Storage P10 (128GB)	4	8	128	US East
	CenturyLink	Customized	Block Storage	4	8	150	Virginia
	DigitalOcean	8GB	SSD Block Storage	4	8	150	US East (New York)
	Dimension Data	Customized	High Performance Storage	4	8	150	Ashburn
	Google	Customized	SSD Persistent Disk	4	8	150	US East
	OVH	B2-15	High Speed Volume	4	15	400	BHS
	Rackspace	Compute1-8	SSD Block Storage	4	7.5	150	N. Virginia
	SoftLayer	Customized	Portable Storage	4	8	150	Washington DC
Large	1and1	Cloud Server 3XL	SSD Storage	8	16	240	US
	Amazon	c5.2xlarge	SSD EBS	8	15	200	US East (N. Virginia)
	Azure	F8s v2	Premium Storage P15 (256GB)	8	16	128	US East
	CenturyLink	Customized	Block Storage	8	16	200	Virginia
	DigitalOcean	16GB	SSD Block Storage	8	16	200	US East (New York)
	Dimension Data	Customized	High Performance Storage	8	16	200	Ashburn
	Google	Customized	SSD Persistent Disk	8	16	200	US East
	OVH	B2-30	High Speed Volume	8	30	800	BHS
	Rackspace	Compute1-15	SSD Block Storage	8	15	200	N. Virginia
	SoftLayer	Customized	Portable Storage	8	16	200	Washington DC

Extra Large	1and1	Cloud Server 5XL	SSD Storage	16	48	500	US
	Amazon	c5.4xlarge	SSD EBS	16	30	500	US East (N. Virginia)
	Azure	F16s v2	Premium Storage P20 (512GB)	16	32	512	US East
	CenturyLink	Customized	Block Storage	16	32	500	Virginia
	DigitalOcean	48GB	SSD Block Storage	16	48	500	US East (New York)
	Dimension Data	N/A	N/A	N/A	N/A	N/A	N/A
	Google	Customized	SSD Persistent Disk	16	32	500	US East
	OVH	B2-60	High Speed Volume	16	60	1600	BHS
	Rackspace	Compute1-30	SSD Block Storage	16	30	500	N. Virginia
	SoftLayer	Customized	Portable Storage	16	32	500	Washington DC