On Demand IOPS Calculation in Cloud Environment to Ease Linux-Based Application Delivery

Rajesh Bose, Sandip Roy and Debabrata Sarddar

Abstract Today's era of cloud computing and everlasting demands for real-time analysis of the storage data on cloud, it is essential for IT industries to have cognizance about the storage performance. Cloud is elastic computing model where users can hire computing and on demand storage resources from a remote infrastructure and its popularity depends on low cost and on demand availability. Simultaneous execution of huge number of data-intensive applications on the public cloud call for a huge amount of storage in order to access the persistent data leads to degradation of overall system performance. IT personnel have to be assisted with storage performance measurement for prediction of best storage need. Input/Output Operations Per Second (IOPS) calculation helps to determine the amount of I/O's storage to run. This IOPS calculation is incorporated in cloud environment to alleviate Linux based application delivery.

Keywords Big data · Cloud computing · Input/output operations per second (IOPS) · Cloud storage

1 Introduction

The huge amount of data is being produced by the IT industry due to the execution of massive applications on cloud. When an application underperforms IT analysts are looking towards the standard performance benchmark for hard drives. Even though IOPS calculation is a performance measures by which system administrator can clinch about the storage requirement of the current application's bottleneck [1].

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Due to this aforementioned requirement today's researchers have concerned about the system performance and develop a software tool for making alert to the administrator for upgradation of underlying system [2].

In this paper the calculation of IOPS on Cloud System for measuring maximum IOPS of running application within a particular refresh period is discussed, which helps the IT personnel or Organizations to take decision for changing the storage architecture. Here slow application delivery time is inspected to develop an enhanced environment. Our proposed tool can calculate IOPS of applications executing on Linux based system and also alert the system administrator to upgrade the disk system when the storage as the potential bottleneck.

2 Background Study

2.1 Basic Definition of IOPS

The number of input/output operations a storage device can complete within one second is called Input/Output Operations Per Second (IOPS) [3]. The performance characteristics are measured by randomly or sequentially. Depending upon the file size the random and sequential operations are done. When we are concerning large file then sequential operations are done to access of stored operation in contiguous manner otherwise random operations are done to access locations in the storage device in a non-contiguous way.

There are different characteristics for IOPS measures:

- **Sequential Write IOPS**: The average number of sequential write I/O operations that occur per second
- **Sequential Read IOPS**: The average number of sequential read I/O operations that occur per second
- **Random Write IOPS**: The average number of random write I/O operations that occur per second
- **Random Read IOPS**: The average number of random read I/O operations that occur per second
- **Total IOPS**: The total IOPS when performing mixed read and write operations

2.2 Frontend IOPS

Fronted IOPS is the total number of read and write operations per second generated by an application or applications.

2.3 Backend IOPS

Backend IOPS is the total number of read and write operations per second which a storage controller sends to the physical disks. This phenomenon is also known as storage IOPS.

The backend IOPS or storage IOPS is calculated by the formula below:

$$\begin{aligned} \textit{Storage IOPS} = \text{Number of RAID Groups} \times (((\text{Read Ratio} \times \text{Disk Operations/Sec}) \\ + ((\text{Write Ratio} \times \text{Disk Operations/Sec})/\text{Write Penalty})) \times \text{Quantity of Disk in RAID Group}) \end{aligned} \quad (1)$$

70 % versus 30 % read/write ratio for 15 K SAS in a single RAID 10, the backend IOPS or storage IOPS is:

$$2 \times (((70\% \times 180) + (30\% \times 180)/2)) \times 8 = 2,448 \text{ IOPS}$$

2.4 RAID Penalty

Write operation can't be completed until both the data and parity info have been written to the disk. If the any of the write operations are failed, waiting for extra time to write the parity info on to disk. This phenomenon is called RAID penalty [3] (Table 1).

2.5 IOPS Calculation

The number of input/output operations is done per second. The formula of IOPS calculation is given below [4] (Table 2):

$$\begin{aligned} \text{IOPS per disk} = 1/(((\text{average read seek time} + \text{average write seek time})/2)/1000) \\ + (\text{average rotational latency}/1000)) \end{aligned} \quad (2)$$

The total IOPS of the application is calculated by the following formula [5]:

$$\text{Total IOPS} = \text{Read IOPS} + (\text{RAID level based write penalty} \times \text{Write IOPS}) \quad (3)$$

Table 1 Different RAID level penalties

RAID level	Read	Write
RAID 0	1	1
RAID 1 (and 10)	1	2
RAID 5	1	4
RAID 6	1	6

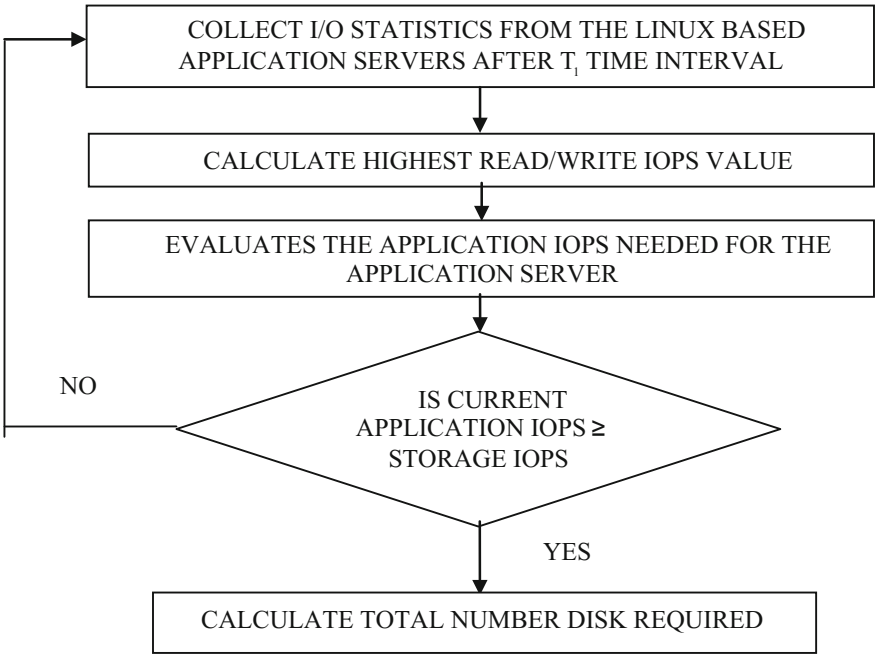
Table 2 Range of IOPS

Disk type	RPM	IOPS range
SATA	5,400	50–75
SATA	7,200	75–100
SAS/FC	10,000	100–125
SSD	N/A	5,000–10,000
SAS/FC	10,000	100–125

To calculate the number of disks is required for frontend IOPS using the following equation [6]:

$$\text{Total number of Disks required} = ((\text{Total Read IOPS} + (\text{Total Write IOPS} \times \text{RAID Penalty}))/\text{Disk Speed IOPS}) \quad (4)$$

2.6 Flow Chart of Our Proposed Model



2.7 Discussion of Our Proposed Work

In this manuscript we have proposed a tool which is incorporated in cloud environment that can collect the input output statistics record from the Linux based application servers in different time interval [7]. Thereafter the tool calculates the highest read/write IOPS value. Then tool evaluates the total application IOPS or IOPS needed for these application servers using Eq. (2).

When first time configured the tool, the storage IOPS or backend IOPS value is also provided or calculated by the Eq. (1) and also is compared the application IOPS with backend IOPS. If application IOPS is higher than backend IOPS then the system understand the reason for slow application delivery. To solve the problem our proposed tool now calculates the total number of disks required using Eq. (4).

After that our proposed tool informs the storage administrator the following details: Application IOPS, Backend IOPS and number of disks required to run the application smoothly. From this report an administrator can easily add the required number of disks to improve the performance [7–9].

2.8 Statistical Data Analysis

We have taken these statistical data for our proposed tool which is given below (Table 3).

We have sorted the r/s and w/s values of various device connected with our proposed tool for any certain running application.

device,	r/s,	w/s,	kr/s,	kw/s,	wait,	actv,	svc_t,	%w,	%b
sda5,	1855.8,	685.6,	3623.79,	244.87,	0.1,	0.7	43.1,	6,	5
sda6,	1855.8,	685.6,	2383.79,	236.89,	8.1,	0.9,	31.1,	1,	5
sda7	505.6,	5.8,	288.6,	46.1,	6.2,	1.1,	25.2,	3,	5
sda3	17.8,	43.68,	754.3,	97.9,	1.9,	0.2,	5.1,	0,	2
sda4	17.8,	42.68,	758.8,	94.9,	1.7,	0.5,	7.3,	0,	3
sda1	0.0,	0.0,	0.4,	0.0,	0.1,	0.0,	0.2,	0,	0
sda2	0.0,	0.0,	0.2,	0.0,	0.4,	0.0,	0.1	0,	0

The maximum r/s, w/s and the value of storage IOPS data are stored in file. Application IOPS is computed using r/s and w/s is 3227.199 which is greater than storage IOPS, i.e. 2448. The number of disk(s) required is 2 in this context.

Table 3 Sample outputs

Linux 2.6.18-238.el5 (TestServer)			15/01/2015								
avg-cpu:			%user		%nice	%system		%iowait	%steal		%idle
			8.57		0.00	1.18		7.66	0.00		82.60
Device	rrqm/s	wrqm/s	r/s	w/s	rsec/s	wsec/s	avgrq-sz	avgqu-sz	await	svctm	%util
sda1	0.00	0.00	0.00	0.00	0.01	0.00	16.01	0.00	1.08	1.07	0.00
sda2	0.00	0.00	0.00	0.00	0.00	0.00	10.47	0.00	1.23	1.22	0.00
sda3	7.14	184.21	17.86	43.68	3818.87	4297.91	131.91	0.07	1.11	0.37	2.30
sda4	7.13	184.21	17.86	43.68	3818.87	4297.91	131.91	0.07	1.11	0.37	2.30
sda5	48.34	3.10	1855.86	685.67	36383.79	236.89	288.11	0.91	7.19	1.23	15.61
sda6	48.34	3.10	1855.86	685.67	36383.79	236.89	288.11	0.91	7.19	1.23	15.61
sda7	58.55	2.48	505.67	5.87	50268.61	146.16	98.57	1.15	2.25	0.48	24.36

3 Conclusion and Future Work

In this context the designed Java package is capable of calculating the application IOPS and number of disk(s) required for any application in Linux environment which helps to improve the overall system performance. As Bigdata application majorly depends on fast disk access, designing such a package for those kind of application in near future is one of the challenging task [3, 10].

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