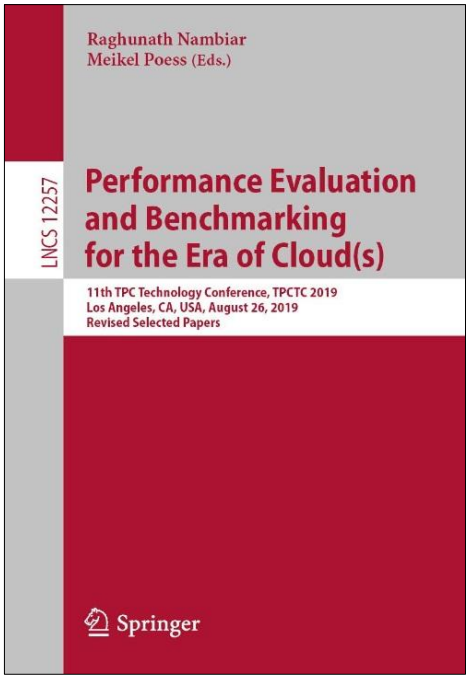
peakmarks

peakmarks® Key Performance Metrics

A complete performance review of the peakmarks® reference system, using two Exadata X7 database servers and three Exadata X8 storage servers, covering all peakmarks workloads and key performance metrics.

February 2025



peakmarks® presented its software at the 11th Technology Conference of the Transaction Processing Performance Council (TPC) 2019 in Los Angeles.

Copyright Information

Safe Harbor Statement

All performance data in this presentation were determined with the peakmarks® Software under certain conditions and do not necessarily correspond to the manufacturer's specifications. All information in this presentation is current as of January 2025.

Abbreviations and Metrics

Nodes	number of cluster nodes
Jobs	number of workload processes
[GBps]	gigabyte per second
[MBps]	megabyte per second
[kBps]	kilobyte per second
[kBpt]	kilobyte per transaction
[IOPS]	I/O operations per second
[dbps]	database blocks per second
[rbps]	redo blocks per second
[s]	seconds
[ms]	milliseconds
[µs]	microseconds
BuCache	Database Buffer Cache
FlCache	Database or Exadata Flash Cache
[qps]	queries per second
[rps]	rows per second
[tps]	transactions per second
[sps]	SQL executions per second
[ops]	operations per second

Agenda

1 Introduction to peakmarks® Software

2 Platform Description of peakmarks® Reference System

3 Server Systems Performance

4 Storage Systems Performance

5 Log Writer Processes Performance

6 Database Writer Processes Performance

7 Data Load Performance

8 Data Analytics Performance

9 Online Transaction Processing Performance

10 PL/SQL Application Program Performance

11 Summary of peakmarks® Key Performance Reporting Scripts

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Performance is not everything.
But without performance, everything is worth nothing.

Introduction to peakmarks® Software

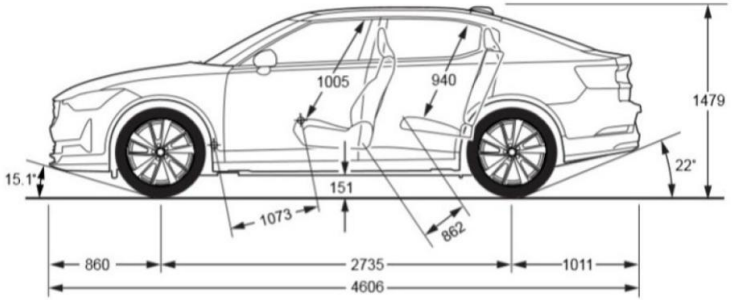
Transparency on Performance

Simple and understandable Performance Metrics

No clear and transparent performance metrics are currently available for Oracle database platforms, whether hosted on cloud services or installed on-premises.

However, Peakmarks has taken inspiration from the automotive industry, which uses easily understandable and comparable performance indicators.

Access to reliable performance metrics is crucial for a better understanding of Oracle database infrastructure performance. These metrics allow for cross-vendor comparability and support the evaluation, quality assurance, and capacity planning of Oracle database infrastructures, resulting in higher cost efficiency.



Long range Single motor	Long range Dual motor	Long range Dual motor with Performance pack
Driveline Rear-wheel drive	Driveline All-wheel drive	Driveline All-wheel drive
Power[1] 220 kW / 299 hp	Power[1] 310 kW / 421 hp	Power[1] 335 kW / 455 hp
Torque[1] 361 lb-ft	Torque[1] 546 lb-ft	Torque[1] 546 lb-ft
0-60 mph[1] 5.9 seconds	0-60 mph[1] 4.3 seconds	0-60 mph[1] 4.1 seconds
Top speed[1] 127 mph	Top speed[1] 127 mph	Top speed[1] 127 mph
Range up to[2] 320 mi (EPA)	Range up to[2] 276 mi (EPA)	Range up to[2] 247 mi (EPA)*
Towing power Up to 2000 lbs	Towing power Up to 2000 lbs	Towing power Up to 2000 lbs
Battery 400 V Lithium-ion battery 82 kWh capacity, 27 modules	Battery 400 V Lithium-ion battery 78 kWh capacity, 27 modules	Battery 400 V Lithium-ion battery 78 kWh capacity, 27 modules

Source: www.polestar.com

Simple and understandable Performance Metrics

Scope	Key Performance Metric	Measurement Unit	Workloads
Server Performance	▪ Query throughput ▪ Query response time ▪ Buffer cache scan rate	[qps] [ms] [MBps]	Look-up queries, complex queries, reports, scans, mixed queries on data in the buffer cache (no I/O operations).
Storage Performance	▪ SQL sequential read throughput ▪ SQL random I/O throughput ▪ SQL random I/O service time	[MBps] [IOPS] [µs]	Conventional storage and intelligent storage with offload technology.
LGWR Performance	▪ Log writer throughput ▪ Log writer latency	[tps], [MBps] [ms]	Transactions generating varying REDO sizes.
DBWR Performance	▪ Database writer throughput	[dbps]	Massive block changes in the database buffer cache.
Data Load Performance	▪ Data load rate	[MBps], [rps]	Buffered data load (transactional systems), direct data load (data warehouse and analytic systems), and streamed data load (IOT applications).
Data Analytics Performance	▪ Data scan rate	[MBps], [rps]	Conventional storage, intelligent storage with offload technology, row store, column store.
Online Transaction Processing Performance	▪ Transaction throughput ▪ Transaction response time	[ops] [ms]	OLTP operations of different complexity; read-intensive operation mix with reporting and data load; write-intensive operation mix with heavy updates and data load.
PL/SQL application program Performance	▪ PL/SQL operation throughput ▪ PL/SQL algorithm processing time	[Mops] [s]	Arithmetic operations on different numeric data types, mixed built-in operations on different data types, recursive Fibonacci number algorithm, prime number algorithm.

Transparency on Performance

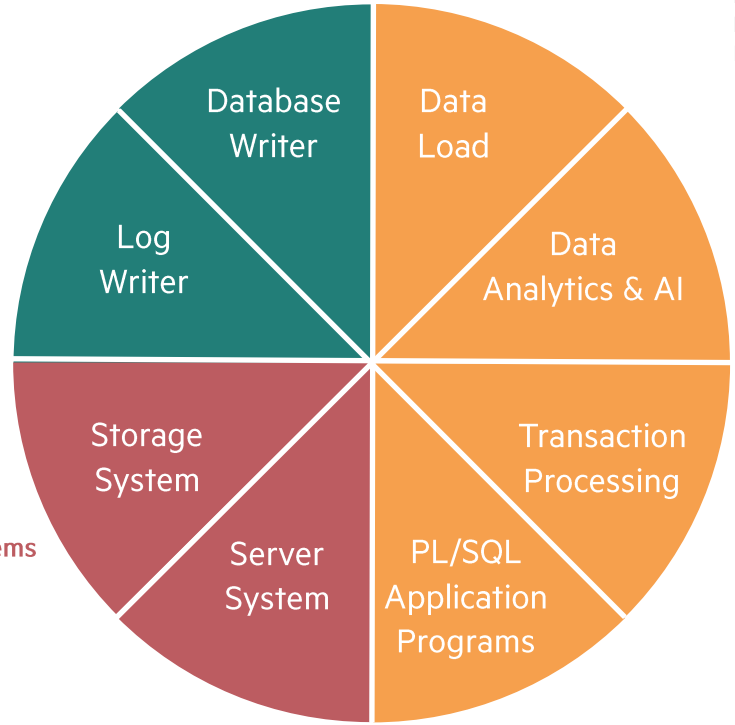
Over 30 workloads across 8 core database disciplines

Workload for Database Writer
- DBWR-THR

Workloads for Log Writer
- LGWR-LAT
- LGWR-THR

Workloads for Storage Systems
- STO-READ
- STO-OFFLOAD
- STO-RANDOM
- STO-SCATTER

Workloads for Server Systems
- SRV-MIXED2
- SRV-QUERY1
- SRV-QUERY25
- SRV-REPORT
- SRV-SCAN



Workloads for Data Load
- DL-BUFFER
- DL-DIRECT
- DL-STREAM

Workloads for Data Analytics & AI
- DA-STORAGE
- DA-OFFLOAD
- DA-ROWSTORE
- DA-COLSTORE

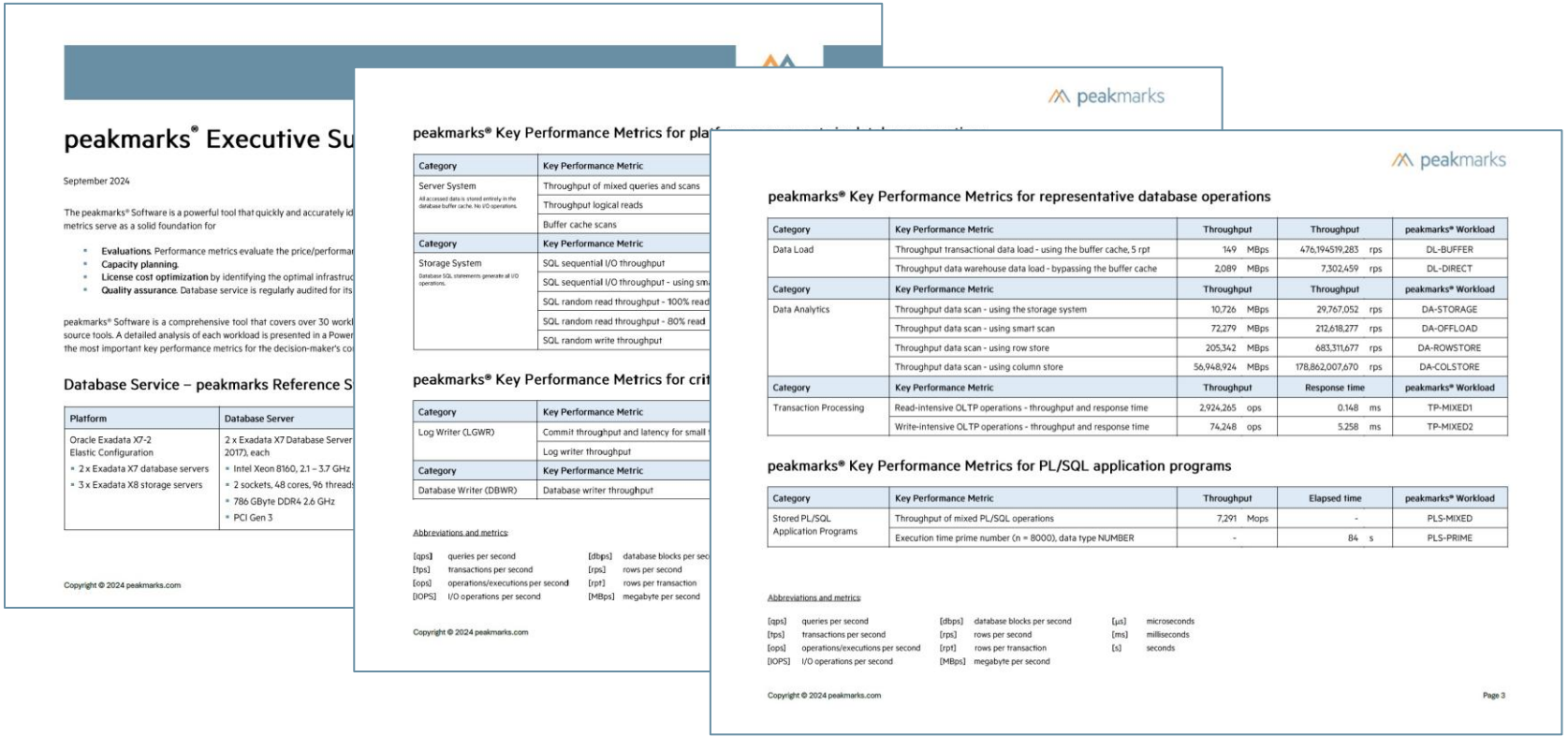
Note: AI workloads are currently being evaluated.

Workloads for Transaction Processing
- TP-MIXED1
- TP-MIXED2
- TP-REPORT
- TP-LOOKUP
- TP-LIGHT
- TP-MEDIUM
- TP-HEAVY

Workloads for PL/SQL Application Programs
- PLS-MIXED2
- PLS-ADD
- PLS-BUILTIN
- PLS-FIBO
- PLS-PRIME

Transparency on Performance

peakmarks® Executive Summary - Simple and understandable Performance Metrics – within 48 hours



peakmarks® Executive Su

September 2024

The peakmarks® Software is a powerful tool that quickly and accurately id
metrics serve as a solid foundation for

- **Evaluations**. Performance metrics evaluate the price/performa
- **Capacity planning**.
- **License cost optimization** by identifying the optimal infrastruc
- **Quality assurance**. Database service is regularly audited for its

peakmarks® Software is a comprehensive tool that covers over 30 workl
source tools. A detailed analysis of each workload is presented in a Power
the most important key performance metrics for the decision-maker's co

Database Service – peakmarks Reference S

Platform	Database Server
Oracle Exadata X7-2 Elastic Configuration ▪ 2 x Exadata X7 database servers ▪ 3 x Exadata X8 storage servers	2 x Exadata X7 Database Server 2017), each ▪ Intel Xeon 8160, 2.1 – 3.7 GHz ▪ 2 sockets, 48 cores, 96 thread ▪ 786 GByte DDR4 2.6 GHz ▪ PCI Gen 3

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peakmarks® Key Performance Metrics for pla

Category	Key Performance Metric
Server System All accessed data is stored entirely in the database buffer cache. No I/O operations.	Throughput of mixed queries and scans
	Throughput logical reads
	Buffer cache scans
Category	**Key Performance Metric**
Storage System Database SQL statements generate all I/O operations.	SQL sequential I/O throughput
	SQL sequential I/O throughput - using sm
	SQL random read throughput - 100% read
	SQL random read throughput - 80% read
	SQL random write throughput

peakmarks® Key Performance Metrics for crit

Category	Key Performance Metric
Log Writer (LGWR)	Commit throughput and latency for small
	Log writer throughput
Category	**Key Performance Metric**
Database Writer (DBWR)	Database writer throughput

Abbreviations and metrics:

[qps]	queries per second	[dbps]	database blocks per sec
[tps]	transactions per second	[rps]	rows per second
[ops]	operations/executions per second	[rpt]	rows per transaction
[IOPS]	I/O operations per second	[MBps]	megabyte per second

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peakmarks® Key Performance Metrics for representative database operations

Category	Key Performance Metric	Throughput	Throughput	peakmarks® Workload
Data Load	Throughput transactional data load - using the buffer cache, 5 rpt	149 MBps	476,194519,283 rps	DL-BUFFER
	Throughput data warehouse data load - bypassing the buffer cache	2,089 MBps	7,302,459 rps	DL-DIRECT
Category	**Key Performance Metric**	**Throughput**	**Throughput**	**peakmarks® Workload**
Data Analytics	Throughput data scan - using the storage system	10,726 MBps	29,767,052 rps	DA-STORAGE
	Throughput data scan - using smart scan	72,279 MBps	212,618,277 rps	DA-OFFLOAD
	Throughput data scan - using row store	205,342 MBps	683,311,677 rps	DA-ROWSTORE
	Throughput data scan - using column store	56,948,924 MBps	178,862,007,670 rps	DA-COLSTORE
Category	**Key Performance Metric**	**Throughput**	**Response time**	**peakmarks® Workload**
Transaction Processing	Read-intensive OLTP operations - throughput and response time	2,924,265 ops	0.148 ms	TP-MIXED1
	Write-intensive OLTP operations - throughput and response time	74,248 ops	5.258 ms	TP-MIXED2

peakmarks® Key Performance Metrics for PL/SQL application programs

Category	Key Performance Metric	Throughput	Elapsed time	peakmarks® Workload
Stored PL/SQL Application Programs	Throughput of mixed PL/SQL operations	7,291 Mops	-	PLS-MIXED
	Execution time prime number (n = 8000), data type NUMBER	-	84 s	PLS-PRIME

Abbreviations and metrics:

[qps]	queries per second	[dbps]	database blocks per second	[µs]	microseconds
[tps]	transactions per second	[rps]	rows per second	[ms]	milliseconds
[ops]	operations/executions per second	[rpt]	rows per transaction	[s]	seconds
[IOPS]	I/O operations per second	[MBps]	megabyte per second		

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Simple. Representative. Fast.

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Platform description of peakmarks® Reference System

Database Server

	Oracle Exadata X7-2 Single Instance	Oracle Exadata X7-2 2-Node RAC Cluster
Launch date	2017	2017
Processor	Intel Xeon 8160, 2.1 – 3.7 GHz	Intel Xeon 8160, 2.1 – 3.7 GHz
#sockets, total	2	4
#cores, total	48	96
#threads, total	96	192
DRAM capacity, total	768 GByte, DDR4, 2.6 GHz	1,536 GByte, DDR4, 2.6 GHz
DRAM capacity per core	8 GByte	8 GByte
Operating System	Bare metal, OEL	Bare metal, OEL
Connectivity	InfiniBand, 2 x 40 Gbps	InfiniBand, 2 x 40 Gbps per server system

Storage Server

	Oracle Exadata X8-2 Scale-Out Storage Server High Capacity
Launch date	2018
#storage server, total	3
DRAM capacity, total	192 GByte
PMEM capacity, total	-
XRMEM capacity, total	-
Flash capacity, total raw	76.8 TByte
Disk capacity, total raw	504 TByte
Connectivity	InfiniBand, 2 x 40 Gbps per storage system
File system	ASM normal redundancy, ASM allocation unit 4 MByte
Compression	No
Deduplication	No

Platform Description

Database Software

	Oracle 19.25 Enterprise Edition
Database block size	8 kByte
Log Modus	NOARCHIVELOG
DataGuard	No
REDO Log Files	per instance 4 x 4 GByte with multiplexing
SGA size	per instance 384 GByte

peakmarks® Software

	Single Instance	2-Node RAC Cluster
Version	10.3	10.3
Build	250201	250201
Database size	8 TByte	2 x 4 TByte

Notes:

- To ensure full transparency, the peakmarks® Software generates individual Oracle AWR reports for each single performance test. In Oracle AWR reports, the idle wait event "enq: UL - contention" indicates process synchronization by the peakmarks® control process and does not cause wait states of workload execution processes.
- peakmarks® shows slightly better performance results than AWR because peakmarks® is the inner snapshot around tests while AWR is the outer snapshot for performance statistics.

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Stop guessing. Start measuring.

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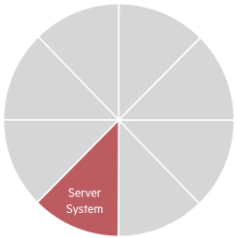
Workloads to determine the Server Performance in Oracle Database Operations



Motivation

The server's performance significantly impacts the performance of all database operations and the license and maintenance costs.

The goals of System Architects and Capacity Planners are to

- Validate the performance capabilities (speed, throughput, scalability) of server components in database operation: processors, main memory, and internal memory channels.
- Determine the impact of server virtualization, multithreading, NUMA effects, and encryption on server performance.
- Optimize database license and maintenance costs for server system (per-core performance).

Notes

- Some cloud service providers do not publish their server components and configurations, which are subject to change without prior notice.
- Customers need to know the per-thread performance, which significantly impacts application process performance.
- Customers need to know the per-core performance, which significantly impacts Oracle license costs. In some cases, Oracle licensing costs exceed infrastructure costs.

Server System Workloads

Key Performance Metrics

- SQL query throughput on cached data in queries per second [qps]
- SQL query response time on cached data in milliseconds [ms]
- Logical reads on cached data in database blocks per second [dbps]
- SQL buffer cache scan rate on cached data in megabytes per second [MBps]

peakmarks® KPM Reports

- kpm_query.sql
- kpm_scan.sql

Description

Workload	Measurement Unit	Action
SRV-QUERY1	[qps] [ms]	Latency-oriented look-up query – select 1 row via index, e.g., select customer, account, product, order, invoice. This workload shows maximum query throughput and minimum response time for simple queries.
SRV-QUERY25	[qps] [ms]	Data volume-oriented look-up query – select Ø 25 rows via index, e.g., select last month's bank account bookings; select item list of order. This workload shows maximum query throughput and minimum response time for more complex queries.
SRV-REPORT	[dbps]	Online Report – select Ø 125 rows via index, e.g., select last month's cell phone call records. This workload shows maximum logical read throughput.
SRV-SCAN	[MBps]	Search on non-indexed data (full table scan). This workload shows a maximum database buffer cache scan rate.

Notes

- All accessed tables are stored in the database buffer cache and operated under optimal conditions.
- There are almost no I/O operations, and all SRV workloads are CPU-bound.
- These queries occur in all applications in all industries and demonstrate performance in real-world operations.

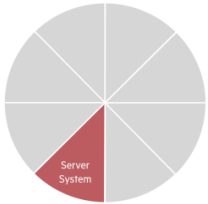
Description

Workload	Measurement Unit	Action
SRV-MIXED2	[qps] [ms]	Mixed queries and full table scans on cached data. This workload includes the functionality of the workloads SRV-QUERY1, SRV-QUERY25, SRV-REPORT, and SRV-SCAN. It is important to note that SPEC numbers may not always be available or may not accurately represent Oracle database operations. To determine the performance of the server system in Oracle database operations, we rely on the peakmarks workload SRV-MIXED2 to compare CPU architectures such as ARM, Intel Xeon, AMD EPYC, IBM POWER, and IBM Z.

Notes

- All accessed tables are stored in the database buffer cache and operated under optimal conditions.
- There are almost no I/O operations, and all SRV workloads are CPU-bound.
- These queries occur in all applications in all industries and demonstrate performance in real-world operations.

Server System Performance



Workload SRV-QUERY1 – Simple look-up query, highest throughput, lowest response time

kpm_query.sql

Reference System
Single Instance

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Queries total [qps]	Queries per cpu [qps]	Response time [ms]	Log reads total [dbps]	Log reads per cpu [dbps]	BuCache read [%]	Elapsed time [s]
2	8	SRV-QUERY1	1	1	2	1	0	98	87,801	87,801	0.011	351,296	351,296	99.96	182
	9	SRV-QUERY1	1	24	25	25	0	75	1,582,456	65,936	0.015	6,316,792	263,200	100.00	183
	10	SRV-QUERY1	1	48	50	49	1	50	2,289,912	47,707	0.021	9,117,211	189,942	100.00	183
	11	SRV-QUERY1	1	72	75	73	1	25	2,445,720	33,968	0.029	9,707,025	134,820	100.00	185
	12	SRV-QUERY1	1	96	99	97	1	1	2,624,808	27,342	0.036	10,390,106	108,230	100.00	184
	13	SRV-QUERY1	1	120	98	97	1	2	2,629,405	27,390	0.045	10,404,025	108,375	100.00	184

Reference System
2-node Cluster

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Queries total [qps]	Queries per cpu [qps]	Response time [ms]	Log reads total [dbps]	Log reads per cpu [dbps]	BuCache read [%]	Elapsed time [s]
3	8	SRV-QUERY1	2	2	3	2	0	97	168,110	84,055	0.012	700,573	350,287	99.96	182
	9	SRV-QUERY1	2	48	25	25	0	75	3,165,325	65,944	0.015	12,662,437	263,801	100.00	183
	10	SRV-QUERY1	2	96	51	50	1	49	4,535,667	47,247	0.021	18,089,298	188,430	100.00	184
	11	SRV-QUERY1	2	144	75	74	1	25	4,884,597	33,921	0.029	19,424,636	134,893	100.00	184
	12	SRV-QUERY1	2	192	97	96	1	3	5,217,195	27,173	0.036	20,682,321	107,720	100.00	184
	13	SRV-QUERY1	2	240	97	95	1	3	5,238,571	27,284	0.045	20,758,793	108,119	100.00	184

Workload SRV-QUERY25 – More complex query

kpm_query.sql

Reference System
Single Instance

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Queries total [qps]	Queries per cpu [qps]	Response time [ms]	Log reads total [dbps]	Log reads per cpu [dbps]	BuCache read [%]	Elapsed time [s]
2	14	SRV-QUERY25	1	1	2	1	0	98	23,815	23,815	0.042	667,574	667,574	99.98	181
	15	SRV-QUERY25	1	24	25	25	0	75	424,103	17,671	0.056	11,862,656	494,277	100.00	184
	16	SRV-QUERY25	1	48	50	49	0	50	710,387	14,800	0.067	19,815,970	412,833	100.00	184
	17	SRV-QUERY25	1	72	74	73	1	26	808,971	11,236	0.087	22,530,341	312,921	100.00	185
	18	SRV-QUERY25	1	96	98	97	1	2	892,029	9,292	0.106	24,807,939	258,416	100.00	184
	19	SRV-QUERY25	1	120	99	97	1	1	895,553	9,329	0.132	24,905,165	259,429	100.00	185

Reference System
2-node Cluster

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Queries total [qps]	Queries per cpu [qps]	Response time [ms]	Log reads total [dbps]	Log reads per cpu [dbps]	BuCache read [%]	Elapsed time [s]
3	14	SRV-QUERY25	2	2	2	1	0	98	45,831	22,916	0.043	1,312,419	656,210	99.98	182
	15	SRV-QUERY25	2	48	25	25	0	75	804,045	16,751	0.059	22,513,981	469,041	100.00	184
	16	SRV-QUERY25	2	96	50	49	1	50	1,392,238	14,502	0.068	38,856,551	404,756	100.00	184
	17	SRV-QUERY25	2	144	75	73	1	25	1,580,172	10,973	0.090	44,030,010	305,764	100.00	186
	18	SRV-QUERY25	2	192	98	96	1	2	1,748,929	9,109	0.108	48,660,768	253,442	100.00	184
	19	SRV-QUERY25	2	240	96	95	1	4	1,751,218	9,121	0.135	48,722,321	253,762	100.00	185

Workload SRV-REPORT – Online Report, max throughput of Logical Reads

kpm_query.sql

Reference System
Single Instance

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Queries total [qps]	Queries per cpu [qps]	Response time [ms]	Log reads total [dbps]	Log reads per cpu [dbps]	BuCache read [%]	Elapsed time [s]
2	2	SRV-REPORT	1	1	2	1	0	98	6,724	6,724	0.149	858,058	858,058	100.00	182
	3	SRV-REPORT	1	24	25	25	0	75	110,689	4,612	0.214	14,111,219	587,967	100.00	185
	4	SRV-REPORT	1	48	50	49	0	50	190,147	3,961	0.249	24,160,811	503,350	100.00	184
	5	SRV-REPORT	1	72	74	73	1	26	222,966	3,097	0.317	28,264,196	392,558	100.00	186
	6	SRV-REPORT	1	96	99	97	1	1	249,365	2,598	0.380	31,545,847	328,603	100.00	185
	7	SRV-REPORT	1	120	99	97	1	1	249,917	2,603	0.474	31,614,268	329,315	100.00	185

Reference System
2-node Cluster

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Queries total [qps]	Queries per cpu [qps]	Response time [ms]	Log reads total [dbps]	Log reads per cpu [dbps]	BuCache read [%]	Elapsed time [s]
3	2	SRV-REPORT	2	2	2	2	0	98	12,885	6,443	0.155	1,664,597	832,299	100.00	182
	3	SRV-REPORT	2	48	25	25	0	75	210,605	4,388	0.225	26,871,984	559,833	100.00	184
	4	SRV-REPORT	2	96	50	49	1	50	371,041	3,865	0.256	47,163,974	491,291	100.00	185
	5	SRV-REPORT	2	144	75	73	1	25	433,130	3,008	0.326	54,929,209	381,453	100.00	186
	6	SRV-REPORT	2	192	97	95	1	3	486,424	2,533	0.391	61,566,778	320,660	100.00	185
	7	SRV-REPORT	2	240	98	96	1	2	482,599	2,514	0.490	61,077,171	318,110	100.00	185

Workload SRV-SCAN – Scan-Rate in Oracle Buffer Cache

kpm_scan.sql

Reference System
Single Instance

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Scan rate total [MBps]	Scan rate per cpu [MBps]	Log reads total [dbps]	Log reads per cpu [dbps]	BuCache read [%]	Elapsed time [s]
2	20	SRV-SCAN	1	1	2	1	0	98	2,889	2,889	370,231	370,231	100.00	181
	21	SRV-SCAN	1	24	25	25	0	75	61,406	2,559	7,844,411	326,850	100.00	185
	22	SRV-SCAN	1	48	50	49	0	50	101,734	2,119	12,740,662	265,430	100.00	185
	23	SRV-SCAN	1	72	75	74	0	25	125,221	1,739	15,302,052	212,529	100.00	185
	24	SRV-SCAN	1	96	99	97	0	1	137,537	1,433	16,690,783	173,862	100.00	185
	25	SRV-SCAN	1	120	98	97	0	2	129,183	1,346	16,258,624	169,361	100.00	184

Reference System
2-node Cluster

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Scan rate total [MBps]	Scan rate per cpu [MBps]	Log reads total [dbps]	Log reads per cpu [dbps]	BuCache read [%]	Elapsed time [s]
3	20	SRV-SCAN	2	2	2	1	0	98	6,077	3,038	778,815	389,408	100.00	183
	21	SRV-SCAN	2	48	25	25	0	75	118,717	2,473	15,175,934	316,165	100.00	185
	22	SRV-SCAN	2	96	50	50	0	50	201,129	2,095	24,978,200	260,190	100.00	184
	23	SRV-SCAN	2	144	75	74	1	25	249,635	1,734	30,445,982	211,430	100.00	185
	24	SRV-SCAN	2	192	97	95	1	3	267,332	1,392	32,399,623	168,748	100.00	184
	25	SRV-SCAN	2	240	97	96	0	3	254,165	1,324	31,932,750	166,316	100.00	184

Workload SRV-MIXED2 – Mixed queries and full table scans

kpm_query.sql

Reference System
Single Instance

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Queries total [qps]	Queries per cpu [qps]	Response time [ms]	Log reads total [dbps]	Log reads per cpu [dbps]	BuCache read [%]	Elapsed time [s]
3	2	SRV-MIXED2	1	1	2	1	0	98	4,403	4,403	0.227	372,475	372,475	100.00	184
	3	SRV-MIXED2	1	24	25	25	0	75	91,813	3,826	0.257	7,361,353	306,723	100.00	185
	4	SRV-MIXED2	1	48	51	50	0	49	158,833	3,309	0.298	12,592,731	262,349	100.00	185
	5	SRV-MIXED2	1	72	74	73	0	26	189,900	2,638	0.372	15,083,281	209,490	100.00	186
	6	SRV-MIXED2	1	96	98	97	0	2	217,982	2,271	0.435	17,250,276	179,690	100.00	184
	7	SRV-MIXED2	1	120	98	97	1	2	206,998	2,156	0.574	16,919,829	176,248	100.00	184

Reference System
2-node Cluster

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Queries total [qps]	Queries per cpu [qps]	Response time [ms]	Log reads total [dbps]	Log reads per cpu [dbps]	BuCache read [%]	Elapsed time [s]
4	2	SRV-MIXED2	2	2	2	1	0	98	8,757	4,379	0.227	767,049	383,525	100.00	184
	3	SRV-MIXED2	2	48	25	25	0	75	177,894	3,706	0.266	14,283,137	297,565	100.00	185
	4	SRV-MIXED2	2	96	50	49	0	50	309,195	3,221	0.308	24,484,968	255,052	100.00	185
	5	SRV-MIXED2	2	144	75	74	1	25	372,314	2,586	0.382	29,405,143	204,202	100.00	185
	6	SRV-MIXED2	2	192	97	95	1	3	416,230	2,168	0.456	32,859,162	171,141	100.00	185
	7	SRV-MIXED2	2	240	96	95	1	4	398,383	2,075	0.596	32,593,067	169,756	100.00	184

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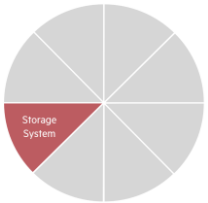
Workloads to determine the Storage Performance in Oracle Database Operations



Motivation

Storage performance significantly impacts the performance of all database operations and, in some cases, storage license and maintenance costs.

The goals of System Architects and Capacity Planners are to

- Validate the performance capabilities of the storage system in database operations.
- Validate the impact of storage technologies like deduplication, compression, encryption, replication, off-loading, tiering, etc., on database performance and storage space utilization.
- Optimize storage system license and maintenance costs.

Notes

- Some cloud service providers do not publish their storage components and configurations.
- Components and configurations of cloud services are subject to change without notice.

Storage System Workloads

Key Performance Metrics

- SQL sequential read throughput in megabytes per second [MBps]
- SQL random read throughput in I/O operations per second [IOPS]
- SQL I/O read service time in milliseconds [ms]
- SQL random write throughput in database blocks per second [dbps]

peakmarks® KPM Reports

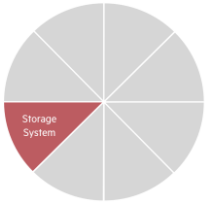
- kpm_ioread.sql
- kpm_iowrite.sql

Description

Workload	Measurement Unit	Action
STO-READ	[MBps]	SQL statements performing a sequential table scan using conventional storage devices. This workload delivers maximum sequential throughput using conventional storage.
STO-OFFLOAD	[MBps]	SQL statements performing a sequential table scan using smart-scan offload technology. This workload delivers maximum sequential throughput using smart-scan technology on Oracle Engineered Systems.
STO-RANDOM	[IOPS] [ms]	SQL statements reading/updating blocks via index access for different read/write ratios. The workload parameter specifies the write ratio in %. The following values are supported {0, 1, 2, 3, ..., 99, 100}. This workload delivers maximum random I/O operations per database server and/or storage system.
STO-SCATTER	[dbps]	SQL statement performing scattered block writes bypassing the buffer cache. The workload STO-SCATTER writes the blocks by foreground processes; in contrast, the DBWR-THR workload writes the blocks by background processes.

Notes
- In general, all STO workloads are I/O-bound. However, the STO-RANDOM workload also requires corresponding CPU power.
- These kinds of storage workloads are generic to all applications in all industries.

Storage System Performance



Workload STO-READ – Sequential Read

kpm_ioread.sql

Reference System
Single Instance

Run	Test	Workload	Wri [%]	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Phys reads total [IOPS]	IO time read [ms]	Phys reads total [MBps]	Phys reads FlCache [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
4	1	STO-READ	0	1	1	1	1	1	0	99	0	2,198	0.396	2,190	2,190	100.00	0.00	200
	2	STO-READ	0	1	8	1	2	1	1	98	0	4,727	1.087	4,713	4,713	100.00	0.00	305
	3	STO-READ	0	1	16	1	2	1	1	98	0	5,156	2.424	5,142	5,142	100.00	0.00	267
	4	STO-READ	0	1	24	1	3	2	1	97	0	4,993	3.922	4,982	4,982	100.00	0.00	301
	5	STO-READ	0	1	32	1	3	1	1	97	0	5,576	5.356	5,566	5,566	100.00	0.00	359

Reference System
2-node Cluster

Run	Test	Workload	Wri [%]	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Phys reads total [IOPS]	IO time read [ms]	Phys reads total [MBps]	Phys reads FlCache [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
5	1	STO-READ	0	2	2	1	1	1	0	99	0	2,955	0.564	2,932	2,932	100.00	0.00	192
	2	STO-READ	0	2	12	1	3	2	1	97	0	9,861	0.990	9,809	9,809	100.00	0.00	210
	3	STO-READ	0	2	24	1	4	3	1	96	0	9,481	2.195	9,431	9,431	100.00	0.00	242
	4	STO-READ	0	2	36	1	2	1	1	98	0	9,944	3.320	9,915	9,915	100.00	0.00	262
	5	STO-READ	0	2	48	1	3	2	1	97	0	8,787	4.284	8,753	8,753	100.00	0.00	339

Workload STO-OFFLOAD – Sequential Read using offload technology

kpm_ioread.sql

Reference System
Single Instance

Run	Test	Workload	Wri [%]	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Phys reads total [IOPS]	IO time read [ms]	Phys reads total [MBps]	Phys reads FlCache [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
4	33	STO-OFFLOAD	0	1	1	1	1	1	0	99	0	66,296	0.310	66,196	66,196	100.00	0.00	180
	34	STO-OFFLOAD	0	1	8	1	2	1	1	98	0	72,542	0.492	72,454	72,454	100.00	0.00	183
	35	STO-OFFLOAD	0	1	16	1	2	1	1	98	0	73,748	0.875	73,657	73,657	100.00	0.00	191
	36	STO-OFFLOAD	0	1	24	1	2	1	1	98	0	72,219	1.559	72,132	72,132	100.00	0.00	187
	37	STO-OFFLOAD	0	1	32	1	2	1	1	98	0	72,925	2.278	72,836	72,836	100.00	0.00	192
	38	STO-OFFLOAD	0	1	40	1	2	1	1	98	0	73,560	3.008	73,470	73,470	100.00	0.00	204

Reference System
2-node Cluster

Run	Test	Workload	Wri [%]	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Phys reads total [IOPS]	IO time read [ms]	Phys reads total [MBps]	Phys reads FlCache [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
5	33	STO-OFFLOAD	0	2	2	1	1	1	0	99	0	70,137	0.476	69,982	69,982	100.00	0.00	180
	34	STO-OFFLOAD	0	2	16	1	2	1	1	98	0	74,500	0.852	74,380	74,380	100.00	0.00	183
	35	STO-OFFLOAD	0	2	32	1	1	1	1	99	0	74,170	2.184	74,050	74,050	100.00	0.00	189
	36	STO-OFFLOAD	0	2	48	1	2	1	1	98	0	74,112	3.689	73,993	73,993	100.00	0.00	184
	37	STO-OFFLOAD	0	2	64	1	1	1	1	99	0	73,812	5.154	73,693	73,693	100.00	0.00	190

Workload STO-RANDOM – Random I/O, 100% read

kpm_ioread.sql

Reference System
Single Instance

Run	Test	Workload	Wri [%]	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Phys reads total [IOPS]	IO time read [ms]	Phys reads total [MBps]	Phys reads FlCache [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
4	65	STO-RANDOM	0	1	1	1	2	1	1	98	0	42,922	0.223	335	335	100.00	1.78	180
	67	STO-RANDOM	0	1	16	1	18	8	7	82	0	513,375	0.313	4,011	4,011	100.00	1.37	184
	69	STO-RANDOM	0	1	32	1	28	13	10	72	0	697,447	0.768	5,449	5,449	100.00	1.58	184
	71	STO-RANDOM	0	1	48	1	33	15	12	67	0	717,470	1.517	5,605	5,605	100.00	1.92	183
	73	STO-RANDOM	0	1	64	1	36	18	13	64	0	721,963	2.162	5,640	5,640	100.00	2.29	183
	75	STO-RANDOM	0	1	80	1	38	19	13	62	0	723,673	2.927	5,654	5,654	100.00	2.35	183
	77	STO-RANDOM	0	1	96	1	39	20	13	61	0	725,225	4.080	5,667	5,667	100.00	3.07	182

Reference System
2-node Cluster

Run	Test	Workload	Wri [%]	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Phys reads total [IOPS]	IO time read [ms]	Phys reads total [MBps]	Phys reads FlCache [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
5	65	STO-RANDOM	0	2	2	1	2	1	1	98	0	68,363	0.235	537	537	100.00	33.76	184
	66	STO-RANDOM	0	2	16	1	10	5	3	90	0	519,731	0.271	4,079	4,079	100.00	7.22	184
	67	STO-RANDOM	0	2	32	1	17	8	6	83	0	886,881	0.399	6,965	6,965	100.00	4.99	184
	68	STO-RANDOM	0	2	48	1	22	11	7	78	0	1,078,610	0.592	8,478	8,478	100.00	4.43	184
	69	STO-RANDOM	0	2	64	1	26	13	9	74	0	1,194,654	0.856	9,391	9,391	100.00	4.35	183
	70	STO-RANDOM	0	2	80	1	29	15	10	71	0	1,256,642	1.177	9,881	9,881	100.00	4.41	183
	71	STO-RANDOM	0	2	96	1	31	16	10	69	0	1,300,794	1.520	10,228	10,228	100.00	4.40	184
	72	STO-RANDOM	0	2	112	1	33	17	11	67	0	1,325,752	1.906	10,426	10,426	100.00	4.41	184

Workload STO-RANDOM – Random I/O, 80% read, 20% write

kpm_ioread.sql

Reference System
Single Instance

Run	Test	Workload	Wri [%]	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Phys reads total [IOPS]	IO time read [ms]	Phys reads total [MBps]	Phys reads FlCache [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
4	97	STO-RANDOM	20	1	1	1	2	1	1	98	0	39,845	0.227	311	311	100.00	16.44	181
	98	STO-RANDOM	20	1	8	1	10	5	3	90	0	244,568	0.269	1,911	1,911	100.00	16.56	183
	99	STO-RANDOM	20	1	16	1	17	9	5	83	0	384,163	0.367	3,001	3,001	100.00	16.67	184
	100	STO-RANDOM	20	1	24	1	23	12	7	77	0	470,636	0.540	3,677	3,677	100.00	16.92	183
	101	STO-RANDOM	20	1	32	1	27	15	8	73	0	527,693	0.742	4,123	4,123	100.00	17.15	184
	102	STO-RANDOM	20	1	40	1	29	16	9	71	0	548,172	1.088	4,283	4,283	100.00	17.36	183
	103	STO-RANDOM	20	1	48	1	31	18	9	69	0	557,951	1.448	4,359	4,359	100.00	17.85	183

Reference System
2-node Cluster

Run	Test	Workload	Wri [%]	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Phys reads total [IOPS]	IO time read [ms]	Phys reads total [MBps]	Phys reads FlCache [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
5	97	STO-RANDOM	20	2	2	1	2	1	1	98	0	68,267	0.237	537	537	100.00	40.93	184
	98	STO-RANDOM	20	2	16	1	10	6	3	90	0	410,706	0.298	3,225	3,225	100.00	21.57	182
	99	STO-RANDOM	20	2	32	1	15	9	4	85	0	587,410	0.384	4,617	4,617	100.00	20.39	184
	100	STO-RANDOM	20	2	48	1	16	9	4	84	0	611,665	0.410	4,806	4,806	100.00	20.76	184
	101	STO-RANDOM	20	2	64	1	16	9	5	84	0	611,516	0.421	4,810	4,810	100.00	21.23	184

Workload STO-SCATTER – Random Write foreground processes

kpm_iowrite.sql

Reference System
Single Instance

Run	Test	Workload	Wri [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Phys writes total [dbps]	Phys writes total [IOPS]	Phys writes total [MBps]	Phys writes FlCache [MBps]	FlCache write [%]	Elapsed time [s]
4	129	STO-SCATTER	100	1	1	2	1	1	98	0	52,340	13,099	411	411	100.00	182
	130	STO-SCATTER	100	1	8	10	5	4	90	0	294,928	73,742	2,315	2,314	99.99	183
	131	STO-SCATTER	100	1	16	15	7	5	85	0	306,507	76,640	2,406	2,384	99.09	183
	132	STO-SCATTER	100	1	24	24	13	9	76	0	341,693	85,454	2,682	1,826	68.07	184
	133	STO-SCATTER	100	1	32	31	17	12	69	0	331,120	82,850	2,599	1,704	65.54	184

Reference System
2-node Cluster

Run	Test	Workload	Wri [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Phys writes total [dbps]	Phys writes total [IOPS]	Phys writes total [MBps]	Phys writes FlCache [MBps]	FlCache write [%]	Elapsed time [s]
5	129	STO-SCATTER	100	2	2	2	1	1	98	0	112,457	28,161	882	882	100.00	182
	130	STO-SCATTER	100	2	12	7	3	3	93	0	391,895	98,016	3,075	3,075	100.00	183
	131	STO-SCATTER	100	2	24	9	4	3	91	0	438,272	109,642	3,440	3,440	100.00	184
	132	STO-SCATTER	100	2	36	10	5	4	90	0	457,030	114,398	3,587	3,587	100.00	183
	133	STO-SCATTER	100	2	48	12	6	4	88	0	465,436	116,583	3,654	3,654	100.00	184

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Workloads to determine the Log Writer Performance

Motivation

Log Writer processes are primarily responsible for transaction management and database consistency in case of failures.

These processes are critical to overall Oracle performance, especially with a high transaction load.

The goals of System Architects and Capacity Planners are to

- Optimize throughput and latency of REDO log writers.
- Validate the impact of Oracle Data Guard on local transaction performance.
- Validate the impact of several other factors on log writer performance, such as data deduplication, data compression, usage of ASM redundancy level, etc.

Log Writer Workloads

Key Performance Metrics

- SQL commit throughput in transactions per second [tps]
- SQL commit latency in milliseconds [ms]
- Log writer throughput in megabyte per second [MBps]

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- kpm_lgwr.sql

Log Writer Workloads

Description

Workload	Measurement Unit	Action
LGWR-LAT	[tps] [ms]	Log-Writer latency test; workload uses COMMIT WRITE WAIT IMMEDIATE. This workload shows the commit rate and the commit latency; the REDO size per transaction is configurable between 1 and 256 Kbyte.
LGWR-THR	[MBps]	Log-Writer throughput test; workload uses COMMIT WRITE NOWAIT BATCH. This workload shows the maximum amount of redo data written by log writer processes.

Notes

- These log writer operations are generic to all applications in all industries.
- The actual REDO data volume per transaction can vary depending on the database size and the usage of RAC technology.

Log Writer Performance

Log Writer Performance

Workload LGWR-LAT – Small transactions, max commit throughput, low commit latency

kpm_lgwr.sql

Reference System
Single Instance

Run	Test	Workload	REDO size [kBpt]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	#prc LGWR	Commit thrput [tps]	Commit latency [ms]	LogFile sync [ms]	REDO data [rbps]	REDO data [IOPS]	REDO data [MBps]	FlCache write [%]	Elapsed time [s]
7	1	LGWR-LAT	1	1	1	1	1	0	99	0	9	3,432	0.291	0.226	10,421	3,432	4	99.19	182
	4	LGWR-LAT	1	1	36	6	4	1	94	0	9	50,482	0.713	0.632	138,830	50,483	58	100.00	183
	7	LGWR-LAT	1	1	72	11	9	1	89	0	9	82,488	0.872	0.776	216,293	82,491	94	100.00	181
	10	LGWR-LAT	1	1	108	14	12	2	86	0	9	99,829	1.075	0.970	255,180	99,834	114	100.00	182
	13	LGWR-LAT	1	1	144	19	16	2	81	0	9	119,781	1.200	1.087	297,867	119,788	136	100.00	184
	16	LGWR-LAT	1	1	180	20	17	2	80	0	9	130,706	1.374	1.259	321,461	130,715	148	100.00	184
	19	LGWR-LAT	1	1	216	20	17	2	80	0	9	136,700	1.576	1.454	334,175	136,710	155	100.00	183
	22	LGWR-LAT	1	1	252	22	19	3	78	0	9	141,127	1.768	1.639	343,810	141,139	160	100.00	183
	25	LGWR-LAT	1	1	288	23	20	3	77	0	9	143,286	2.002	1.866	348,007	143,300	162	100.00	185

Reference System
2-node Cluster

Run	Test	Workload	REDO size [kBpt]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	#prc LGWR	Commit thrput [tps]	Commit latency [ms]	LogFile sync [ms]	REDO data [rbps]	REDO data [IOPS]	REDO data [MBps]	FlCache write [%]	Elapsed time [s]
6	1	LGWR-LAT	1	2	2	2	1	1	98	0	18	5,786	0.345	0.261	17,535	5,786	7	100.00	183
	3	LGWR-LAT	1	2	48	5	4	1	95	0	18	65,639	0.725	0.628	201,211	65,641	82	100.00	184
	5	LGWR-LAT	1	2	96	9	7	1	91	0	18	112,166	0.854	0.741	326,427	112,171	138	100.00	184
	7	LGWR-LAT	1	2	144	12	10	1	88	0	18	147,103	0.977	0.852	414,272	147,110	180	100.00	184
	9	LGWR-LAT	1	2	192	15	13	2	85	0	18	177,952	1.073	0.933	490,016	177,960	218	100.00	182
	11	LGWR-LAT	1	2	240	18	15	2	82	0	18	201,958	1.183	1.037	547,699	201,969	246	100.00	184
	13	LGWR-LAT	1	2	288	20	17	2	80	0	18	214,453	1.336	1.176	576,546	214,466	261	100.00	184

Workload LGWR-THR – Maximum log writer throughput

kpm_lgwr.sql

Reference System
Single Instance

Run	Test	Workload	REDO size [kBpt]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	#prc LGWR	Commit thrput [tps]	Commit latency [ms]	LogFile sync [ms]	REDO data [rbps]	REDO data [IOPS]	REDO data [MBps]	FlCache write [%]	Elapsed time [s]
7	65	LGWR-THR	N/A	1	1	3	2	1	97	0	9	6	179.896	7.773	464,152	0	219	100.00	180
	66	LGWR-THR	N/A	1	4	9	6	2	91	0	9	17	231.710	102.712	1,436,286	1	679	100.00	183
	67	LGWR-THR	N/A	1	8	12	8	3	88	0	9	19	424.444	222.289	1,532,510	3	725	100.00	182
	68	LGWR-THR	N/A	1	12	12	8	3	88	0	9	19	617.102	329.582	1,540,017	4	728	100.00	182
	69	LGWR-THR	N/A	1	16	12	8	3	88	0	9	20	797.316	400.283	1,559,291	5	737	100.00	183
	70	LGWR-THR	N/A	1	20	13	8	3	87	0	9	20	991.248	439.145	1,534,597	6	726	99.94	183

Reference System
2-node Cluster

Run	Test	Workload	REDO size [kBpt]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	#prc LGWR	Commit thrput [tps]	Commit latency [ms]	LogFile sync [ms]	REDO data [rbps]	REDO data [IOPS]	REDO data [MBps]	FlCache write [%]	Elapsed time [s]
6	65	LGWR-THR	N/A	2	2	3	2	1	97	0	18	6	311.938	5.754	531,475	1	251	100.00	182
	66	LGWR-THR	N/A	2	8	8	6	1	92	0	18	26	308.269	11.158	2,159,685	3	1,021	100.00	184
	67	LGWR-THR	N/A	2	16	12	9	2	88	0	18	32	495.237	208.415	2,644,803	5	1,251	100.00	183
	68	LGWR-THR	N/A	2	24	12	9	2	88	0	18	33	717.651	317.827	2,654,800	8	1,255	100.00	183
	69	LGWR-THR	N/A	2	32	12	9	2	88	0	18	35	916.391	400.766	2,698,317	10	1,276	100.00	184

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Swiss precision in performance measurement.

Workloads to determine the Database Writer Performance

Motivation

Database writer performance for buffer management is critical to overall database performance, especially for transaction systems with a high rate of updates and applications that primarily load data via the buffer cache.

The goals of System Architects and Capacity Planners are to

- Optimize the number of database writer processes.
- Validate the impact of several factors on database writer performance, e.g., ASM redundancy level.

Database Writer Workloads

Key Performance Metrics

- Database writer throughput in database blocks per second [dbps]

peakmarks® KPM Reports

- kpm_dbwr.sql

Database Writer Workloads

Description

Workload	Measurement Unit	Action
DBWR-THR	[dbps] [MBps]	Database-Writer throughput test; massive block changes in the buffer cache; workload uses COMMIT WRITE NOWAIT BATCH. This workload shows the maximum number of changed blocks written back to the storage system by database writer processes. The number of database writer processes is a configurable Oracle instance parameter. The workload DBWR-THR writes the blocks by background processes; in contrast, the STO-SCATTER workload writes the blocks by foreground processes.

Database Writer Performance

Workload DBWR-THR – Maximum database writer throughput

kpm_dbwr.sql

Reference System
Single Instance

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	#prc DBWR	Completed check points	Phys writes total [dbps]	Phys writes total [IOPS]	Phys writes total [MBps]	REDO data [MBps]	Phys writes FlCache [MBps]	FlCache write [%]	Elapsed time [s]
8	1	DBWR-THR	1	1	4	3	1	96	0	12	4	60,933	44,735	657	44	568	86.37	183
	2	DBWR-THR	1	8	19	12	5	81	0	12	10	243,067	206,954	2,265	177	2,241	98.95	181
	3	DBWR-THR	1	16	20	12	5	80	0	12	10	251,439	216,247	2,343	183	2,340	99.88	181
	4	DBWR-THR	1	24	20	12	5	80	0	12	10	249,037	215,769	2,320	181	2,313	99.68	189
	5	DBWR-THR	1	32	21	13	5	79	0	12	10	242,731	211,724	2,261	176	2,257	99.80	184

Reference System
2-node Cluster

Run	Test	Workload	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	#prc DBWR	Completed check points	Phys writes total [dbps]	Phys writes total [IOPS]	Phys writes total [MBps]	REDO data [MBps]	Phys writes FlCache [MBps]	FlCache write [%]	Elapsed time [s]
7	1	DBWR-THR	2	2	3	2	1	97	0	24	5	50,907	35,123	480	40	480	100.00	183
	2	DBWR-THR	2	16	16	12	3	84	0	24	17	368,766	88,704	3,466	282	3,466	100.00	186
	3	DBWR-THR	2	32	29	19	6	71	0	24	21	455,321	380,445	4,297	358	4,226	98.34	189
	4	DBWR-THR	2	48	31	21	6	69	0	24	22	467,141	398,699	4,408	367	4,346	98.58	182
	5	DBWR-THR	2	64	34	24	6	66	0	24	21	453,691	398,521	4,281	356	4,239	99.01	184

Notes

- Oracle DBWR processes use asynchronous multiblock write operations. The ratio of [dbps] and [IOPS] show the average number of blocks per I/O.
- Oracle does not provide an accurate service time for random write operations..

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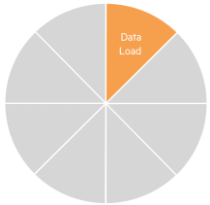
Workloads to determine the Data Load Performance



Motivation

Data load performance capabilities are essential for all kinds of database applications:

- transaction processing systems.
- data warehouse systems and data analytics systems.

The amount of data is increasing, and the time window for loading the data decreases.

The goals of System Architects and Capacity Planners are to

- Optimize data load throughput.
- Validate the impact of several factors on data load performance.

Data Load Workloads

Key Performance Metrics

- SQL data load rate in rows per second [rps] for transactional data load
- SQL data load rate in megabytes per second [MBps] for bulk load

peakmarks® KPM Reports

- kpm_dl.sql

Data Load Workloads

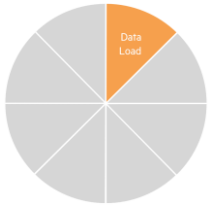
Description

Workload	Measurement Unit	Action
DL-BUFFER	[MBps] [rps]	Insert of program generated data via default buffer cache into Oracle tables, includes maintenance of 1 index, uses COMMIT WRITE WAIT IMMEDIATE. The workload parameter specifies the number of rows per INSERT; the following values are supported {1, 2, 3, 4, 5, … , 99, 100}. This data load workload is mainly used in Transaction Processing systems.
DL-DIRECT	[MBps] [TBph]	Insert data by copying from other tables (CTAS technology with NOLOGGING) bypassing the buffer cache, includes maintenance of 1 index, uses COMMIT WRITE NOWAIT BATCH. This data load workload is mainly used in Data Warehouse systems.
DL-STREAM (planned for future release)	[MBps] [rps]	Insert of program generated data via memory-optimized pool into Oracle tables, includes maintenance of 1 index, does not need COMMIT operations. The workload parameter specifies the number of rows per INSERT; the following values are supported {1, 2, 3, 4, 5, … , 99, 100}. This data load workload is mainly used in Internet-of-Things systems.

Notes

- These data load workloads are generic to all applications in all industries.
- The data load throughput depends mainly on the method (buffered, direct, streamed) and the transaction size (number of rows between commits).

Data Load Performance



Workload DL-BUFFER – Transactional data load via buffer cache

kpm_dl.sql

Reference System
Single Instance

Run	Test	Workload	TXN size [rpt]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Load rate total [rps]	Load rate total [MBps]	Phys writes total [IOPS]	Phys writes total [MBps]	REDO data [MBps]	FlCache write [%]	Elapsed time [s]
9	1	DL-BUFFER	5	1	1	1	1	0	99	0	15,105	4	6,294	35	12	100.00	182
	3	DL-BUFFER	5	1	16	5	4	1	95	0	127,381	36	14,684	294	99	100.00	183
	5	DL-BUFFER	5	1	32	8	6	1	92	0	193,189	55	17,594	443	150	100.00	184
	7	DL-BUFFER	5	1	48	10	8	1	90	0	214,300	61	12,917	517	167	95.42	186
	9	DL-BUFFER	5	1	64	13	10	2	87	0	239,341	68	14,823	560	186	97.37	190
	11	DL-BUFFER	5	1	80	15	13	2	85	0	257,221	74	14,946	594	200	98.29	187
	13	DL-BUFFER	5	1	96	17	14	2	83	0	270,216	77	13,609	623	209	98.52	184

Reference System
2-node Cluster

Run	Test	Workload	TXN size [rpt]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Load rate total [rps]	Load rate total [MBps]	Phys writes total [IOPS]	Phys writes total [MBps]	REDO data [MBps]	FlCache write [%]	Elapsed time [s]
8	1	DL-BUFFER	5	2	2	2	1	1	98	0	25,409	7	10,676	62	22	100.00	183
	3	DL-BUFFER	5	2	32	6	4	1	94	0	207,043	59	16,053	510	177	100.00	184
	5	DL-BUFFER	5	2	64	10	8	1	90	0	320,252	92	18,091	787	274	100.00	184
	7	DL-BUFFER	5	2	96	12	10	1	88	0	404,718	116	20,184	980	346	100.00	185
	9	DL-BUFFER	5	2	128	14	12	1	86	0	455,250	130	19,234	1,094	388	100.00	181
	11	DL-BUFFER	5	2	160	15	13	1	85	0	496,630	142	15,170	1,193	423	100.00	183
	13	DL-BUFFER	5	2	192	17	15	1	83	0	536,110	153	13,778	1,287	456	100.00	185

Data Load Performance

Workload DL-DIRECT – Bulk data load bypassing the buffer cache

kpm_dl.sql

Reference System
Single Instance

Run	Test	Workload	TXN size [rpt]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Load rate total [rps]	Load rate total [MBps]	Phys writes total [IOPS]	Phys writes total [MBps]	REDO data [MBps]	FlCache write [%]	Elapsed time [s]
9	65	DL-DIRECT	N/A	1	1	3	2	1	97	0	345,556	99	15,024	359	36	100.00	182
	66	DL-DIRECT	N/A	1	8	13	9	3	87	0	1,950,143	558	84,132	2,208	199	99.90	185
	67	DL-DIRECT	N/A	1	16	12	10	2	88	0	1,995,392	571	45,345	1,846	186	98.96	181
	68	DL-DIRECT	N/A	1	24	15	11	3	85	0	2,617,305	749	63,142	2,321	239	94.88	185
	69	DL-DIRECT	N/A	1	32	14	11	2	86	0	2,479,785	709	50,537	2,075	226	98.00	183

Reference System
2-node Cluster

Run	Test	Workload	TXN size [rpt]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Load rate total [rps]	Load rate total [MBps]	Phys writes total [IOPS]	Phys writes total [MBps]	REDO data [MBps]	FlCache write [%]	Elapsed time [s]
8	65	DL-DIRECT	N/A	2	2	3	2	1	97	0	695,039	199	21,009	758	79	100.00	182
	66	DL-DIRECT	N/A	2	16	13	9	2	87	0	3,902,779	1,117	143,095	4,108	407	98.03	183
	67	DL-DIRECT	N/A	2	32	17	12	3	83	0	5,173,491	1,480	159,012	4,616	505	85.97	189
	68	DL-DIRECT	N/A	2	48	20	14	4	80	0	6,065,668	1,735	155,110	6,332	569	65.31	184
	69	DL-DIRECT	N/A	2	64	21	15	4	79	0	6,443,264	1,843	166,079	5,025	596	86.39	183
	70	DL-DIRECT	N/A	2	80	21	15	4	79	0	6,428,332	1,839	151,480	6,278	574	68.59	184

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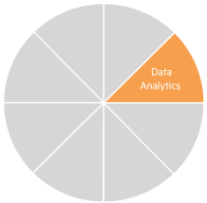
Workloads to determine the Data Analytics Performance



Motivation

In general, data analytics operations cause full table scans. The performance of full table scan operation depends on the location of data in the storage hierarchy (storage, memory) and the technology used to boost scan performance (smart scan for the data location storage system, in-memory column store for the data location memory).

The goals of System Architects and Capacity Planners are to

- Optimize data scan throughput.
- Validate the impact of several factors on data analytics performance
  - Smart scan offload technology
  - In-memory column store technology
- Optimize Oracle license and maintenance costs, because some technologies need separate licenses.

Data Analytics Workloads

Key Performance Metrics

- SQL data scan rate in rows per second [rps] for in-memory column store
- SQL data scan rate in megabytes per second [MBps] for all other data locations

peakmarks® KPM Reports

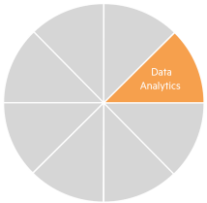
- kpm_da.sql

Description

Workload	Measurement Unit	Action
DA-STORAGE	[MBps] [rps]	Simple aggregate after full table scan and grouping, using conventional storage.
DA-OFFLOAD	[MBps] [rps]	Simple aggregate after full table scan and grouping, using smart-scan offload technology.
DA-ROWSTORE	[MBps] [rps]	Simple aggregate after full table scan and grouping, using row-store.
DA-COLSTORE	[MBps] [rps]	Simple aggregate after full table scan and grouping, using column-store. Starting in Oracle 19.8, the base level of the in-memory option supports up to 16 GByte in-memory column store without license costs.

Note
These kinds of analytic workloads are generic to all applications in all industries.

Data Analytics Performance



Workload DA-STORAGE – Data analytics query using conventional storage technology

kpm_da.sql

Reference System
Single Instance

Run	Test	Workload	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Scan rate total [rps]	Scan rate per cpu [rps]	Scan rate total [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
10	1	DA-STORAGE	1	1	1	1	1	0	99	0	3,991,972	3,991,972	1,357	100.00	0.00	180
	2	DA-STORAGE	1	8	1	3	2	1	97	0	18,049,808	2,256,226	6,137	100.00	0.00	184
	3	DA-STORAGE	1	16	1	5	4	1	95	0	16,918,007	1,057,375	5,707	100.00	0.00	198
	4	DA-STORAGE	1	24	1	4	3	1	96	0	18,424,868	767,703	6,187	100.00	0.00	185
	5	DA-STORAGE	1	32	1	4	3	1	96	0	18,121,132	566,285	6,159	100.00	0.00	190

Reference System
2-node Cluster

Run	Test	Workload	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Scan rate total [rps]	Scan rate per cpu [rps]	Scan rate total [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
9	1	DA-STORAGE	2	2	1	1	1	0	99	0	7,043,878	3,521,939	2,364	100.00	0.00	181
	2	DA-STORAGE	2	16	1	3	2	1	97	0	30,070,135	1,879,383	10,209	100.00	0.00	183
	3	DA-STORAGE	2	32	1	4	3	1	96	0	34,099,023	1,065,594	10,691	100.00	0.00	189
	4	DA-STORAGE	2	48	1	3	2	1	97	0	37,946,718	790,557	11,530	100.00	0.00	183
	5	DA-STORAGE	2	64	1	4	3	1	96	0	38,045,758	594,465	11,505	100.00	0.00	189

Workload DA-OFFLOAD – Data analytics query using offload storage technology

kpm_da.sql

Reference System
Single Instance

Run	Test	Workload	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Scan rate total [rps]	Scan rate per cpu [rps]	Scan rate total [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
10	33	DA-OFFLOAD	1	1	1	1	1	0	99	0	110,679,393	110,679,393	37,623	100.00	0.00	180
	34	DA-OFFLOAD	1	8	1	2	1	1	98	0	214,337,372	26,792,172	72,853	100.00	0.00	180
	35	DA-OFFLOAD	1	16	1	2	1	1	98	0	218,569,233	13,660,577	74,292	100.00	0.00	180
	36	DA-OFFLOAD	1	24	1	2	1	1	98	0	219,338,875	9,139,120	74,553	100.00	0.00	180
	37	DA-OFFLOAD	1	32	1	2	1	1	98	0	219,524,669	6,860,146	74,617	100.00	0.00	181
	38	DA-OFFLOAD	1	40	1	2	1	1	98	0	219,402,371	5,485,059	74,575	100.00	0.00	181

Reference System
2-node Cluster

Run	Test	Workload	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Scan rate total [rps]	Scan rate per cpu [rps]	Scan rate total [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
9	33	DA-OFFLOAD	2	2	1	2	1	1	98	0	120,752,399	60,376,200	41,081	100.00	0.00	180
	34	DA-OFFLOAD	2	16	1	2	1	1	98	0	206,900,759	12,931,297	70,378	100.00	0.00	180
	35	DA-OFFLOAD	2	32	1	2	1	1	98	0	209,241,399	6,538,794	71,174	100.00	0.00	180
	36	DA-OFFLOAD	2	48	1	2	1	1	98	0	209,538,023	4,365,375	71,275	100.00	0.00	181
	37	DA-OFFLOAD	2	64	1	2	1	1	98	0	209,314,436	3,270,538	71,199	100.00	0.00	181

Workload DA-ROWSTORE – Data analytics query using buffer cache row store

kpm_da.sql

Reference System
Single Instance

Run	Test	Workload	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Scan rate total [rps]	Scan rate per cpu [rps]	Scan rate total [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
10	97	DA-ROWSTORE	1	1	1	2	1	0	98	0	11,023,663	11,023,663	3,330	0.00	99.40	180
	98	DA-ROWSTORE	1	24	1	25	25	0	75	0	187,128,256	7,797,011	56,520	0.00	100.00	185
	99	DA-ROWSTORE	1	48	1	50	49	0	50	0	290,082,288	6,043,381	87,617	0.00	100.00	185
	100	DA-ROWSTORE	1	72	1	75	74	0	25	0	366,489,046	5,090,126	110,695	0.00	100.00	184
	101	DA-ROWSTORE	1	96	1	98	97	0	2	0	370,420,123	3,858,543	111,882	0.00	100.00	184
	102	DA-ROWSTORE	1	120	1	97	96	0	3	0	334,211,096	3,481,366	100,945	0.00	100.00	183

Reference System
2-node Cluster

Run	Test	Workload	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Scan rate total [rps]	Scan rate per cpu [rps]	Scan rate total [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
9	97	DA-ROWSTORE	2	2	1	2	1	0	98	0	19,105,580	9,552,790	5,960	0.00	100.00	184
	98	DA-ROWSTORE	2	48	1	25	25	0	75	0	390,243,138	8,130,065	118,061	0.00	100.00	185
	99	DA-ROWSTORE	2	96	1	50	49	0	50	0	663,716,748	6,913,716	200,665	0.00	100.00	185
	100	DA-ROWSTORE	2	144	1	74	73	1	26	0	824,398,193	5,724,987	249,198	0.00	100.00	185
	101	DA-ROWSTORE	2	192	1	96	95	1	4	0	873,665,030	4,550,339	264,083	0.00	100.00	184
	102	DA-ROWSTORE	2	240	1	95	94	1	5	0	839,374,563	4,371,743	253,728	0.00	100.00	184

Workload DA-COLSTORE – Data analytics query using buffer cache column store

kpm_da.sql

Reference System
Single Instance

Run	Test	Workload	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Scan rate total [rps]	Scan rate per cpu [rps]	Scan rate total [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
10	65	DA-COLSTORE	1	1	1	2	1	0	98	0	6,050,459,708	6,050,459,708	2,076,580	0.00	99.99	180
	66	DA-COLSTORE	1	8	1	9	8	0	91	0	30,947,962,375	3,868,495,297	10,621,700	0.00	100.00	185
	67	DA-COLSTORE	1	16	1	17	17	0	83	0	52,989,350,611	3,311,834,413	18,186,598	0.00	100.00	185
	68	DA-COLSTORE	1	24	1	26	25	0	74	0	63,799,594,918	2,658,316,455	21,896,818	0.00	100.00	185
	69	DA-COLSTORE	1	32	1	34	33	0	66	0	70,800,031,014	2,212,500,969	24,299,409	0.00	100.00	185
	70	DA-COLSTORE	1	40	1	43	42	1	57	0	72,746,966,220	1,818,674,156	24,967,621	0.00	100.00	185
	71	DA-COLSTORE	1	48	1	51	50	1	49	0	71,076,678,233	1,480,764,130	24,394,363	0.00	100.00	184

Reference System
2-node Cluster

Run	Test	Workload	Nodes	Jobs	DOP	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	Scan rate total [rps]	Scan rate per cpu [rps]	Scan rate total [MBps]	FlCache read [%]	BuCache read [%]	Elapsed time [s]
9	65	DA-COLSTORE	2	2	1	2	1	0	98	0	10,981,842,046	5,490,921,023	3,764,914	0.00	100.00	183
	66	DA-COLSTORE	2	16	1	9	9	0	91	0	61,119,820,456	3,819,988,779	20,953,771	0.00	100.00	184
	67	DA-COLSTORE	2	32	1	17	17	0	83	0	95,902,617,078	2,996,956,784	32,878,376	0.00	100.00	183
	68	DA-COLSTORE	2	48	1	26	25	0	74	0	109,043,636,733	2,271,742,432	37,383,543	0.00	100.00	184
	69	DA-COLSTORE	2	64	1	34	33	1	66	0	125,326,232,214	1,958,222,378	42,965,703	0.00	100.00	184
	70	DA-COLSTORE	2	80	1	42	41	1	58	0	132,504,790,353	1,656,309,879	45,426,744	0.00	100.00	184
	71	DA-COLSTORE	2	96	1	52	50	1	48	0	138,715,382,349	1,444,951,899	47,555,936	0.00	100.00	184

peakmarks

Swiss precision in performance measurement.

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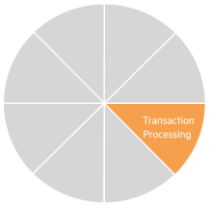
Workloads to determine the Online Transaction Processing Performance



Motivation

For capacity planning reasons, it is necessary to know the performance characteristics of a platform for transactions of varying complexity. Transaction Processing is the most complex database operation.

The goals of System Architects and Capacity Planners are to

- Optimize the transaction throughput and transaction response time.
- Validate the impact of several factors on transaction throughput and response time:
  - Ratio of database size and buffer cache size
  - transaction size
  - I/O random read service time
  - log writer latency
- Identify the limiting resource.

Key Performance Metrics

- SQL transaction throughput per second [tps]
- SQL transaction response time in milliseconds [ms]

peakmarks® KPM Reports

- kpm_tp.sql — key performance metrics
- kpm_tpplus.sql — logical I/O, physical I/O and REDO data per SQL statement
- kpm_tpio.sql — total physical I/O (IOPS, MBps) and flash cache hit rate

Description

Workload	Measurement Unit	Action
TP-REPORT	[sps]	Online report of transaction processing application.
	[ms]	SELECT Ø 25 rows via index.
TP-LOOKUP	[sps]	Fast lookup query.
	[ms]	SELECT single row via index, e.g., SELECT an account, product.
		If configured, this workload uses tables in the memory-optimized row store (access via hash key) introduced in 18c for fast look-up. Otherwise, it uses regular tables with a b-tree index.

Notes:

- These transaction processing workloads are generic to all applications in all industries.
- The technology used for workload TP-LOOKUP (memory-optimized tables) is generally available in Oracle Enterprise Edition starting with 19.12.

Description

Workload	Measurement Unit	Action
TP-LIGHT	[tps] [ms]	Light transaction type. SELECT/UPDATE single row via index, e.g., SELECT/UPDATE an account, product, or order with different SELECT/UPDATE ratios using SELECT FOR UPDATE locking. The workload parameter specifies the update ratio in %; the following values are supported {1, 2, 3, 4, 5, ..., 99, 100}.
TP-MEDIUM	[tps] [ms]	Medium transaction type. SELECT/UPDATE Ø 25 rows via index, e.g., SELECT/UPDATE last month's bank account bookings with different SELECT/UPDATE ratios using SELECT FOR UPDATE locking. The workload parameter specifies the update ratio in %; the following values are supported {1, 2, 3, 4, 5, ... , 99, 100}.
TP-HEAVY	[tps] [ms]	Heavy transaction type. SELECT/UPDATE Ø 125 rows via index, e.g., SELECT/UPDATE last month's cell phone call records with different SELECT/UPDATE ratios using SELECT FOR UPDATE locking. The workload parameter specifies the update ratio in %; the following values are supported {1, 2, 3, 4, 5, ... , 99, 100}.

Note
These transaction processing workloads are generic to all applications in all industries.

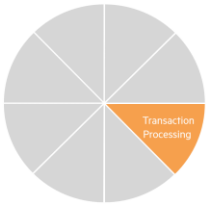
Description

Workload	Measurement Unit	Action
TP-MIXED1	[tps] [ms]	A more read-intensive mix of different transaction types. This workload is composed of the workloads TP-LOOKUP, TP-REPORT, TP-MEDIUM (with 30% UPDATE) and DL-BUFFER (with 3 rpt).
TP-MIXED2	[tps] [ms]	A more write-intensive mix of different transaction types. This workload is composed of the workloads TP-LOOKUP, TP-LIGHT (40% UPDATE), TP-MEDIUM (30% UPDATE), and DL-BUFFER (with 3 rpt).

Notes

- Compared to TP-MIXED2, TP-MIXED1 uses more CPU and 30% less REDO data per transaction. The I/O ratio between read and write is around 3:1.
- Compared to TP-MIXED1, TP-MIXED2 generates 30% more logical writes and 100% more physical writes per SQL. The I/O ratio between read and write is around 1:1.
- TP-MIXED1 and TP-MIXED2 are the most representative peakmarks® workloads for determining Oracle transaction processing performance capabilities on a specific platform.
- These kinds of transaction processing workloads are generic to all industry applications.
- peakmarks provides several performance reports for TP workloads: kpm_tp.sql shows overall transaction performance, kpm_tpplus.sql provides more detailed information, and kpm_tpio.sql provides physical I/O information.

Online Transaction Processing Performance



Workload TP-REPORT – Online Report, Ø 25 rows per query

kpm_tp.sql

Reference System
Single Instance

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
6	2	TP-REPORT	N/A	1	1	1	1	0	99	0	0	0.000	799	1.251	19.46	100.00	96.02	180
	5	TP-REPORT	N/A	1	30	21	11	7	79	0	0	0.000	17,324	1.715	17.93	100.00	99.73	183
	8	TP-REPORT	N/A	1	60	35	18	12	65	0	0	0.000	26,004	2.297	16.35	100.00	99.60	184
	11	TP-REPORT	N/A	1	90	44	24	14	56	0	0	0.000	29,318	3.053	15.52	100.00	98.12	183
	14	TP-REPORT	N/A	1	120	49	27	16	51	0	0	0.000	30,201	3.940	15.13	100.00	95.07	183
	17	TP-REPORT	N/A	1	150	52	28	16	48	0	0	0.000	30,775	4.832	15.76	100.00	93.35	183
	20	TP-REPORT	N/A	1	180	54	30	17	46	0	0	0.000	30,873	5.781	15.62	100.00	98.95	184

Reference System
2-node Cluster

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
10	2	TP-REPORT	N/A	2	2	2	1	1	98	0	0	0.000	1,268	1.577	63.53	100.00	99.99	182
	4	TP-REPORT	N/A	2	40	17	9	5	83	0	0	0.000	21,602	1.825	31.78	100.00	100.00	186
	6	TP-REPORT	N/A	2	80	28	15	8	72	0	0	0.000	32,688	2.423	28.74	100.00	100.00	183
	8	TP-REPORT	N/A	2	120	37	21	11	63	0	0	0.000	39,092	3.041	25.74	100.00	99.99	184
	10	TP-REPORT	N/A	2	160	44	25	13	56	0	0	0.000	43,775	3.616	24.50	100.00	100.00	184
	11	TP-REPORT	N/A	2	180	46	27	13	54	0	0	0.000	45,484	3.914	23.25	100.00	99.99	184
	12	TP-REPORT	N/A	2	200	50	29	14	50	0	0	0.000	46,773	4.221	25.32	100.00	100.00	185

Note:
The workload TP-REPORT uses a simple SELECT statement without locking; therefore, it is not a transaction.

Workload TP-LOOKUP – Look-up query, 1 row per query

kpm_tp.sql

Reference System
Single Instance

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
6	34	TP-LOOKUP	N/A	1	1	1	0	0	99	0	0	0.000	4,860	0.206	81.73	100.00	100.00	185
	36	TP-LOOKUP	N/A	1	20	21	21	0	79	0	0	0.000	1,415,296	0.014	100.00	100.00	100.00	183
	38	TP-LOOKUP	N/A	1	40	42	41	0	58	0	0	0.000	2,104,906	0.019	100.00	100.04	46.79	182
	40	TP-LOOKUP	N/A	1	60	63	61	1	37	0	0	0.000	2,374,680	0.025	100.00	100.00	100.00	184
	42	TP-LOOKUP	N/A	1	80	82	81	1	18	0	0	0.000	2,503,982	0.032	100.00	100.00	97.89	183
	44	TP-LOOKUP	N/A	1	100	97	96	1	3	0	0	0.000	2,609,189	0.038	100.00	100.04	52.34	182
	46	TP-LOOKUP	N/A	1	120	97	95	1	3	0	0	0.000	2,622,073	0.046	100.00	100.00	96.30	182
	48	TP-LOOKUP	N/A	1	140	96	95	1	4	0	0	0.000	2,622,615	0.053	100.00	100.00	100.00	182

Reference System
2-node Cluster

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
10	34	TP-LOOKUP	N/A	2	2	2	1	0	98	0	0	0.000	155,496	0.013	99.92	100.02	100.00	184
	35	TP-LOOKUP	N/A	2	20	11	10	0	89	0	0	0.000	1,463,131	0.014	100.00	100.55	100.00	183
	36	TP-LOOKUP	N/A	2	40	21	21	0	79	0	0	0.000	2,748,215	0.014	100.00	100.26	100.00	183
	37	TP-LOOKUP	N/A	2	60	32	31	0	68	0	0	0.000	3,613,864	0.016	100.00	100.49	100.00	183
	38	TP-LOOKUP	N/A	2	80	42	41	0	58	0	0	0.000	4,174,802	0.019	100.00	100.50	100.00	183
	39	TP-LOOKUP	N/A	2	100	52	51	1	48	0	0	0.000	4,598,891	0.022	100.00	100.52	100.00	183
	40	TP-LOOKUP	N/A	2	120	62	61	1	38	0	0	0.000	4,726,716	0.025	100.00	100.49	100.00	183

Note:
The workload TP-LOOKUP uses a simple SELECT statement without locking; therefore, it is not a transaction.

Workload TP-LIGHT – Light transaction, 1 row per transaction, 20% updates

kpm_tp.sql

Reference System
Single Instance

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
6	66	TP-LIGHT	20	1	1	1	1	0	99	0	1,223	0.818	1,479	0.676	78.60	100.00	98.27	184
	70	TP-LIGHT	20	1	40	21	14	5	79	0	37,668	1.045	45,266	0.870	82.90	100.00	100.00	185
	74	TP-LIGHT	20	1	80	34	24	7	66	0	67,315	1.174	80,897	0.977	86.22	100.00	99.99	185
	78	TP-LIGHT	20	1	120	40	27	8	60	0	92,243	1.290	110,870	1.074	88.21	100.00	100.00	184
	82	TP-LIGHT	20	1	160	45	31	10	55	0	107,660	1.477	129,428	1.228	88.85	100.00	100.00	184
	86	TP-LIGHT	20	1	200	48	33	10	52	0	116,193	1.709	139,717	1.421	88.89	100.00	100.00	184
	90	TP-LIGHT	20	1	240	51	36	11	49	0	121,915	1.957	146,641	1.627	88.55	100.00	100.00	184
	94	TP-LIGHT	20	1	280	56	39	12	44	0	126,085	2.208	151,699	1.835	88.26	100.00	100.00	183

Reference System
2-node Cluster

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
10	66	TP-LIGHT	20	2	2	2	1	1	98	0	1,843	1.082	2,332	0.855	93.45	100.00	100.00	186
	70	TP-LIGHT	20	2	80	23	16	5	77	0	65,151	1.214	78,381	1.009	85.96	100.00	100.00	185
	72	TP-LIGHT	20	2	120	28	19	5	72	0	89,922	1.319	108,136	1.097	87.42	100.00	100.00	184
	74	TP-LIGHT	20	2	160	32	23	6	68	0	115,236	1.373	138,585	1.141	88.89	100.00	100.00	185
	76	TP-LIGHT	20	2	200	35	25	7	65	0	134,659	1.467	161,942	1.220	89.25	100.00	100.00	185
	78	TP-LIGHT	20	2	240	38	27	7	62	0	150,106	1.580	180,551	1.313	89.19	100.00	100.00	185
	80	TP-LIGHT	20	2	280	41	29	8	59	0	161,863	1.708	194,716	1.420	89.27	100.00	100.00	184
	82	TP-LIGHT	20	2	320	42	30	8	58	0	172,997	1.829	208,130	1.520	89.19	100.00	100.00	184

Notes:

- The workload TP-LIGHT uses a SELECT FOR UPDATE statement; therefore, this SELECT statement is always a transaction.
- The update parameter specifies the number of SELECT statements which are followed by an UPDATE statement.

Workload TP-MEDIUM – Medium transaction, Ø 25 row per transaction, 20% updates

kpm_tp.sql

Reference System
Single Instance

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
6	98	TP-MEDIUM	20	1	1	2	1	1	98	0	490	2.040	596	1.677	62.63	100.00	99.79	182
	100	TP-MEDIUM	20	1	16	20	10	6	80	0	5,159	3.062	6,275	2.518	60.50	100.00	100.00	184
	102	TP-MEDIUM	20	1	32	31	17	9	69	0	8,318	3.811	10,040	3.157	62.98	100.00	100.00	184
	104	TP-MEDIUM	20	1	48	32	18	9	68	0	11,018	4.330	13,340	3.577	62.96	100.00	100.00	183
	106	TP-MEDIUM	20	1	64	34	20	10	66	0	13,466	4.706	16,262	3.897	62.55	100.00	100.00	184
	108	TP-MEDIUM	20	1	80	34	20	10	66	0	13,627	5.813	16,468	4.810	62.40	100.00	100.00	183

Reference System
2-node Cluster

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
10	98	TP-MEDIUM	20	2	2	2	1	1	98	0	808	2.471	1,105	1.806	81.34	100.00	100.00	184
	100	TP-MEDIUM	20	2	32	19	11	5	81	0	7,679	4.126	9,384	3.376	64.43	100.00	100.00	184
	102	TP-MEDIUM	20	2	64	25	14	7	75	0	11,459	5.545	14,017	4.533	67.55	100.00	100.00	183
	104	TP-MEDIUM	20	2	96	30	17	8	70	0	13,021	7.318	15,842	6.015	66.21	100.00	100.00	183
	106	TP-MEDIUM	20	2	128	34	20	9	66	0	14,279	8.909	17,445	7.292	68.30	100.00	100.00	183
	107	TP-MEDIUM	20	2	144	35	21	9	65	0	14,141	10.110	17,507	8.167	67.72	100.00	100.00	183

Notes:

- The workload TP-MEDIUM uses a SELECT FOR UPDATE statement; therefore, this SELECT statement is always a transaction.
- The update parameter specifies the number of SELECT statements which are followed by an UPDATE statement.

Workload TP-HEAVY – Heavy transaction, Ø 125 row per transaction, 20% updates

kpm_tp.sql

Reference System
Single Instance

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
6	130	TP-HEAVY	20	1	1	3	1	1	97	0	197	5.086	250	3.993	65.16	100.00	100.00	181
	131	TP-HEAVY	20	1	8	18	9	6	82	0	1,269	6.267	1,655	4.807	63.48	100.00	99.99	183
	132	TP-HEAVY	20	1	16	25	13	8	75	0	1,931	8.192	2,366	6.685	61.30	100.00	100.00	184
	133	TP-HEAVY	20	1	24	26	14	8	74	0	2,619	9.050	3,192	7.426	61.16	100.00	100.00	184
	134	TP-HEAVY	20	1	32	28	15	8	72	0	2,909	10.907	3,545	8.950	61.12	100.00	100.00	184
	135	TP-HEAVY	20	1	40	29	16	8	71	0	2,855	13.827	3,520	11.215	61.25	100.00	100.00	186

Reference System
2-node Cluster

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
10	130	TP-HEAVY	20	2	2	3	2	1	97	0	360	5.547	530	3.767	77.92	100.00	100.00	184
	131	TP-HEAVY	20	2	16	15	8	4	85	0	2,023	7.842	2,553	6.212	69.84	100.00	100.00	184
	132	TP-HEAVY	20	2	32	23	13	7	77	0	2,667	11.834	3,459	9.123	66.11	100.00	100.00	185
	133	TP-HEAVY	20	2	48	27	15	8	73	0	2,992	15.874	3,721	12.765	65.74	100.00	100.00	184
	134	TP-HEAVY	20	2	64	29	17	8	71	0	3,276	19.361	4,097	15.481	69.05	100.00	100.00	184
	135	TP-HEAVY	20	2	80	31	18	8	69	0	3,357	23.628	4,220	18.797	68.43	100.00	100.00	184

Notes:

- The workload TP-HEAVY uses a SELECT FOR UPDATE statement; therefore, this SELECT statement is always a transaction.
- The update parameter specifies the number of SELECT statements which are followed by an UPDATE statement.

Workload TP-MIXED1 – Mixed transactions with SELECT, UPDATE and INSERT statements

kpm_tp.sql

Reference System
Single Instance

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
5	2	TP-MIXED1	N/A	1	1	1	1	0	99	0	175	5.714	2,590	0.386	41.50	100.00	100.00	180
	5	TP-MIXED1	N/A	1	24	23	14	6	77	0	4,214	5.661	60,693	0.393	44.80	100.00	100.00	184
	8	TP-MIXED1	N/A	1	48	40	25	10	60	0	7,015	6.782	101,040	0.471	45.15	100.00	100.00	183
	11	TP-MIXED1	N/A	1	72	54	35	13	46	0	8,827	8.064	127,147	0.560	45.24	100.00	100.00	183
	14	TP-MIXED1	N/A	1	96	65	42	15	35	0	10,046	9.459	144,719	0.657	45.31	100.00	100.00	183
	17	TP-MIXED1	N/A	1	120	70	47	16	30	0	10,647	11.178	153,414	0.776	45.28	100.00	100.00	183
	20	TP-MIXED1	N/A	1	144	73	49	17	27	0	10,858	13.136	156,490	0.911	45.32	100.00	100.00	184

Reference System
2-node Cluster

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
11	2	TP-MIXED1	N/A	2	2	2	1	0	98	0	397	5.021	5,793	0.344	74.69	100.00	100.00	183
	3	TP-MIXED1	N/A	2	16	10	6	2	90	0	3,010	5.273	43,435	0.365	54.81	100.00	100.00	184
	4	TP-MIXED1	N/A	2	32	18	11	4	82	0	5,285	5.987	76,224	0.415	53.20	100.00	100.00	184
	5	TP-MIXED1	N/A	2	48	23	15	6	77	0	7,058	6.737	101,565	0.468	52.27	100.00	100.00	184
	6	TP-MIXED1	N/A	2	64	28	18	7	72	0	8,333	7.614	120,103	0.528	51.61	100.00	100.00	183
	7	TP-MIXED1	N/A	2	80	31	20	8	69	0	9,249	8.571	133,301	0.595	51.19	100.00	100.00	183
	8	TP-MIXED1	N/A	2	96	34	22	8	66	0	9,988	9.536	143,965	0.662	51.63	100.00	100.00	183
	9	TP-MIXED1	N/A	2	112	36	24	8	64	0	10,264	10.812	147,955	0.750	51.17	100.00	100.00	184

Workload TP-MIXED2– Mixed transactions with SELECT, UPDATE and INSERT statements

kpm_tp.sql

Reference System
Single Instance

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
5	34	TP-MIXED2	N/A	1	1	2	1	1	98	0	285	3.512	4,228	0.237	69.83	100.00	100.00	182
	36	TP-MIXED2	N/A	1	16	20	11	6	80	0	3,501	4.543	51,811	0.307	68.56	100.00	100.00	184
	38	TP-MIXED2	N/A	1	32	32	19	9	68	0	5,765	5.506	85,324	0.372	68.40	100.00	99.99	183
	40	TP-MIXED2	N/A	1	48	38	24	10	62	0	6,883	6.844	101,866	0.462	68.38	100.00	100.00	185
	42	TP-MIXED2	N/A	1	64	40	25	10	60	0	7,036	8.968	104,149	0.606	68.43	100.00	100.00	185
	44	TP-MIXED2	N/A	1	80	39	24	10	61	0	7,055	11.010	104,456	0.744	68.42	100.00	99.99	189

Reference System
2-node Cluster

Run	Test	Workload	Upd [%]	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	CPU iow [%]	TXN thrput total [tps]	TXN resp time [ms]	SQL thrput total [sps]	SQL resp time [ms]	BuCache read [%]	FlCache read [%]	FlCache write [%]	Elapsed time [s]
11	34	TP-MIXED2	N/A	2	2	2	1	1	98	0	444	4.496	6,644	0.300	85.65	100.00	100.00	183
	35	TP-MIXED2	N/A	2	16	14	8	3	86	0	3,231	4.901	47,897	0.331	73.92	100.00	100.00	184
	36	TP-MIXED2	N/A	2	32	21	13	5	79	0	5,403	5.868	80,045	0.396	72.80	100.00	100.00	184
	37	TP-MIXED2	N/A	2	48	25	16	6	75	0	6,921	6.872	102,547	0.464	72.77	100.00	100.00	184
	38	TP-MIXED2	N/A	2	64	29	18	7	71	0	8,008	7.931	118,641	0.535	72.51	100.00	100.00	184
	39	TP-MIXED2	N/A	2	80	32	20	8	68	0	8,661	9.177	128,311	0.619	72.41	100.00	100.00	184
	40	TP-MIXED2	N/A	2	96	33	21	8	67	0	8,959	10.662	132,756	0.720	72.39	100.00	100.00	184

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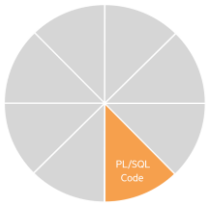
Workloads to determine the PL/SQL Application Program Performance



Motivation

Mission-critical systems use PL/SQL to encapsulate essential functions for efficient execution as close to the data as possible. This aspect is critical in cloud environments with separate databases and application servers to reduce traffic between both environments.

The goals of System Architects and Capacity Planners are to

- Validate processor performance capabilities to execute PL/SQL code

Notes

- Separating applications and data may cause performance problems. For example, each roundtrip between the Microsoft Azure data center (application) and the Oracle Cloud Infrastructure data center (data) takes around 2 ms.
- Starting in 2023, both vendors will provide their infrastructure in a single data center to reduce roundtrip time.
- Starting in 2025, other cloud service provider like AWS and Google will follow this approach.

PL/SQL Application Workloads

Key Performance Metrics

- PL/SQL operation throughput in a million operations per second [Mops]
- PL/SQL computing time to process algorithms in seconds [s]

peakmarks® KPM Reports

- kpm_pls.sql
- Kpm_algorithm.sql

Description

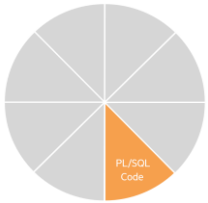
Workload	Measurement Unit	Action
PLS-ADD	[Mops]	Addition of numbers using different numeric data types. The workload parameter specifies the data type; the following values are supported {SI, SF, PI, NU, DA}. This workload shows the impact of the PL/SQL data type on the performance of simple arithmetic operations.
PLS-BUILTIN	[Mops]	Data type-specific operations, including SQL built-in functions, based on core banking and telco billing applications. The workload parameter specifies the data type; the following values are supported {SI, SF, PI, NU, VC}. This workload shows the impact of the PL/SQL data type on the performance of typical operations.

Note
The following abbreviations for PL/SQL data types are used: SI = SIMPLE_INTEGER, SF = SIMPLE_FLOAT, PI = PLS_INTEGER, NU = NUMBER, DA = DATE, VC = VARCHAR2.

Description

Workload	Measurement Unit	Action
PLS-MIXED2	[Mops]	Mixed data type-specific operations, including SQL built-in functions. This mixed workload is composed of workloads PLS-ADD (NUMBER), PLS-ADD (PLS_INTEGER), PLS_BUILTIN (NUMBER), and PLS_BUILTIN (VARCHAR2). PLS-MIXED2 is the most representative peakmarks workload to determine an Oracle database server's PL/SQL performance capabilities.
PLS-FIBO	[s]	Calculation of Fibonacci number N. The workload parameter specifies N; the following values are supported {39, 40, 41, 42, 43, 44}. This workload shows the single-thread performance of a simple recursive algorithm implemented in PL/SQL.
PLS-PRIME	[s]	Calculation of first N prime numbers. The workload parameter specifies N; the following values are supported {1000, 10000}. This workload shows the single-thread performance of a simple algorithm implemented in PL/SQL.

PL/SQL Application Program Performance



Workload PLS-MIXED2 – complex workload with most used PL/SQL operations and data types

kpm_pls.sql

Reference System
Single Instance

Run	Test	Workload	Parameter	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Operations total [Mops]	Operations per cpu [Mops]	Operation time [ns]	Elapsed time [s]
11	1	PLS-MIXED2	N/A	1	1	2	1	0	98	12.06	12.06	0.00	183
	2	PLS-MIXED2	N/A	1	24	25	25	0	75	255.42	10.64	0.00	184
	3	PLS-MIXED2	N/A	1	48	50	49	0	50	403.42	8.40	0.00	183
	4	PLS-MIXED2	N/A	1	72	75	74	0	25	400.15	5.56	0.00	185
	5	PLS-MIXED2	N/A	1	96	97	97	0	3	402.79	4.20	0.00	184
	6	PLS-MIXED2	N/A	1	120	97	96	0	3	401.09	4.18	0.00	184

Reference System
2-node Cluster

Run	Test	Workload	Parameter	Nodes	Jobs	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Operations total [Mops]	Operations per cpu [Mops]	Operation time [ns]	Elapsed time [s]
12	1	PLS-MIXED2	N/A	2	2	2	1	0	98	23.78	11.89	0.00	183
	2	PLS-MIXED2	N/A	2	48	25	25	0	75	507.74	10.58	0.00	184
	3	PLS-MIXED2	N/A	2	96	50	49	0	50	806.77	8.40	0.00	184
	4	PLS-MIXED2	N/A	2	144	73	72	0	27	802.06	5.57	0.00	184
	5	PLS-MIXED2	N/A	2	192	93	92	0	7	798.73	4.16	0.00	184
	6	PLS-MIXED2	N/A	2	240	94	93	0	6	799.29	4.16	0.00	183

Workload PLS-FIBO and PLS-PRIME – single thread computing time of algorithms

Reference System
Single Instance

kpm_algorithm.sql

```
                                                CPU  CPU  CPU  CPU Elapsed
                          Para                busy user  sys idle    time
 Run Test Workload       meter Nodes  Jobs  [%]  [%]  [%]  [%]     [s]
---- ---- ------------ ------ ----- ----- ---- ---- ---- ---- -------
  11    7 PLS-FIBO         42     1     1    2    1    0   98      73


                                                CPU  CPU  CPU  CPU Elapsed
                          Para                busy user  sys idle    time
 Run Test Workload       meter Nodes  Jobs  [%]  [%]  [%]  [%]     [s]
---- ---- ------------ ------ ----- ----- ---- ---- ---- ---- -------
  11    8 PLS-PRIME      8000     1     1    2    1    0   98      82
```

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Summary of peakmarks® Key Performance Metrics Reporting Scripts

Summary of peakmarks® Key Performance Reporting Scripts

SQL> @kpm_all

SQL> @kpm_query
SQL> @kpm_scan
SQL> @kpm_ioread
SQL> @kpm_iowrite
SQL> @kpm_lgwr
SQL> @kpm_dbwr
SQL> @kpm_dl
SQL> @kpm_da
SQL> @kpm_tp
SQL> @kpm_tpplus
SQL> @kpm_tpio
SQL> @kpm_pls
SQL> @kpm_algorithm

peakmarks Mission

Identify Key Performance Metrics for Oracle Database Platforms.

On-Premises and in the Cloud.

For Quality Assurance, Evaluations, and Capacity Planning.