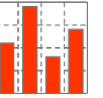


Oracle Platform Performance Baseline

Oracle 12c on Hitachi VSP G1000

Benchmark Report

December 2014



1 System Configuration

2 Introduction into Oracle Platform Performance Tests

3 Storage Benchmark Results – Sequential I/O

4 Storage Benchmark Results – Random I/O

5 Database Load Benchmark Results – Buffer Insert

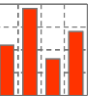
6 Database Load Benchmark Results – Bulk Load

7 Database OLTP Performance – Select Transactions

8 Database OLTP Performance – Update Transactions

9 Summary

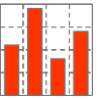
System Configuration



Server System Configuration

CPU and Server	Hitachi Compute Blade X55R3
CPU type	Intel Xeon E5-2690
Clock rate in [GHz], overclocking configured	2.90
#sockets	2
#cores	16
#threads	32
RAM capacity in [GByte]	64
Cluster	
#server within cluster	16
Software	
Operating System	Oracle Linux 6.5
Oracle Database System	12.1.0.1
Benchware Performance Suite	8.6 Build 140801

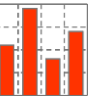
System Configuration



Storage System Configuration

FC attached Storage System	Hitachi VSP G1000
Host connectivity	64 x 8 Gbps
Cache in [GByte]	1'024
Flash storage	
▪ #modules	64
▪ #spare modules	-
▪ #usable modules	64
▪ RAID level	10 (2D + 2D)
▪ Capacity raw in [TByte]	64 x 1.6 = 102.4
▪ Capacity usable in [TByte]	51.2
Number of attached database server	16
▪ #hba's single db server	2
▪ #ports single db server	4

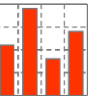
System Configuration



Volume Management

Volume Manager	Linux I/O Management and ASM
#LUN's for ASM disk group REDO	16
#LUN's for ASM disk group DATA	256
Concatenated or Striped	striped
Linux I/O Scheduler	NOOP
Queue depth <ul style="list-style-type: none">▪ Emulex HBA▪ I/O scheduler	128 ?
Special parameters <ul style="list-style-type: none">▪ asm_au_size▪ Fdisk for single partition per LUN with 4 MByte offset	4 MByte yes

System Configuration



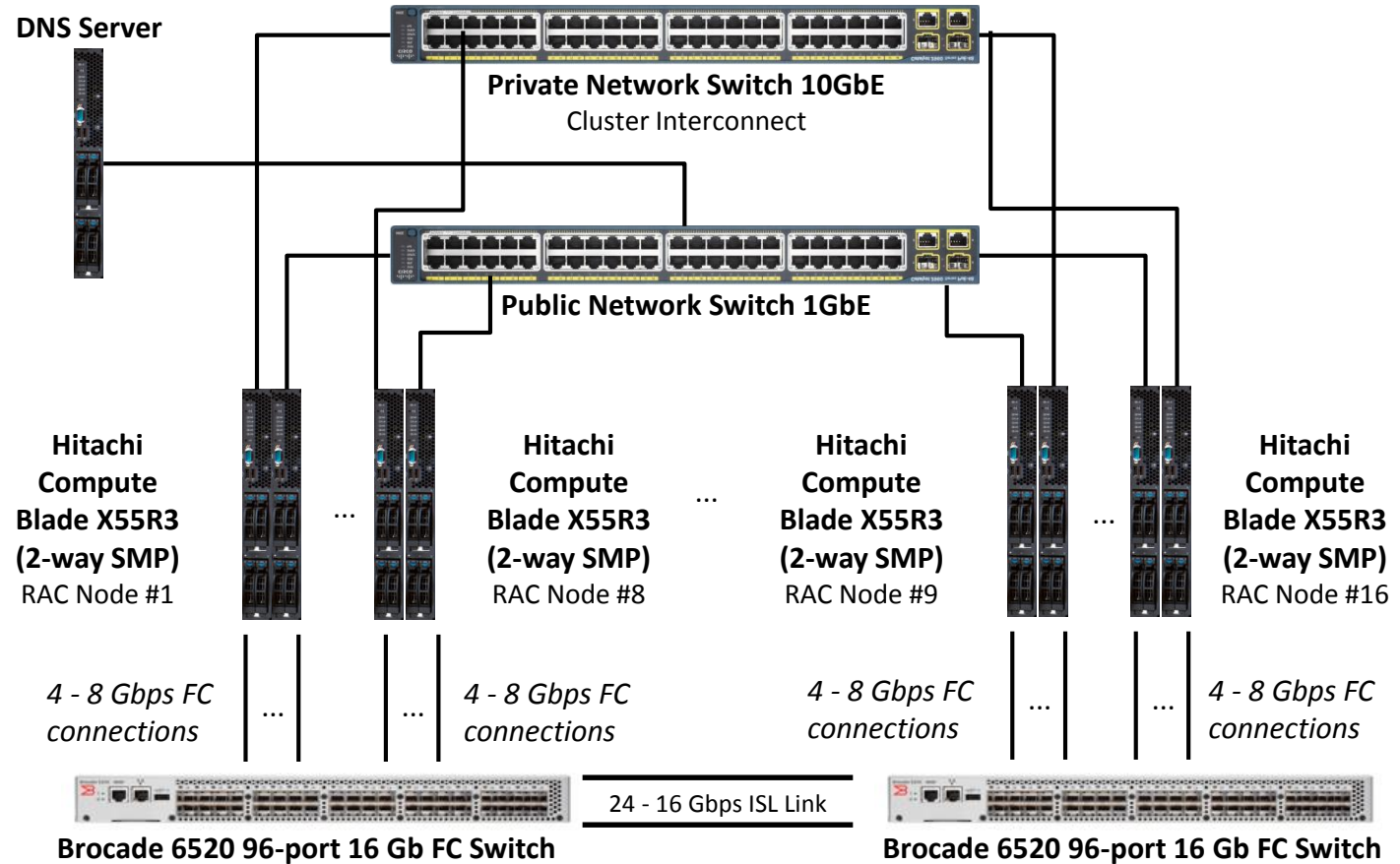
Database Management

Database	Oracle 12.1.0.1
Database block size in [KByte]	8
Database size in [GByte]	8'192
SGA size per cluster node in [GByte]	32
Archiving	no
Force logging	no
Flashback	no
REDO configuration	
▪ #log file groups	32
▪ #log file group member	2
▪ log file size in [GByte]	8

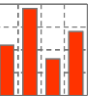
System Configuration



Server Configuration: 16 node Oracle RAC Cluster



System Configuration



Storage Configuration



Brocade 6520 96-port 16 Gb FC Switch

24-16 Gbps ISL Link



Brocade 6520 96-port 16 Gb FC Switch

32- 8 Gbps FC connections

32- 8 Gbps FC connections



Hitachi Virtual Storage Platform G1000 All Flash Array

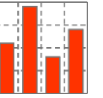
8 Virtual Storage Directors (VSD) pairs
(16 VSDs, 8 VSDs per chassis)

1024GB cache

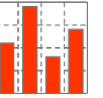
4 FC Front End Director (FED) pairs
(8 FEDs, 4 FEDs per chassis)
(8x8Gb connections per FED, 64 connections)

4 SAS Back End Director (BED) pairs
(8 BED, 4BEDs per chassis)

64 x 1.6TB Hitachi Accelerated Flash module drives
(32 FMDs per chassis)

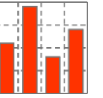


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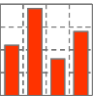
- Have a look at www.benchmarkware.ch/methodology for more information about how to benchmark Oracle platforms
 - Unpredictable performance of complex Oracle platforms
 - Key Performance Metrics to validate performance capabilities of an Oracle platform
 - Why industry benchmarks and PoCs fail to indicate Oracle platform performance
 - Requirements to an Oracle platform benchmark tool

 - How to benchmark Storage System (STO) performance of Oracle platforms?
 - How to benchmark Data Load (DBL) performance of Oracle platforms?
 - How to benchmark OLTP Transaction (DBX) performance of Oracle platforms?

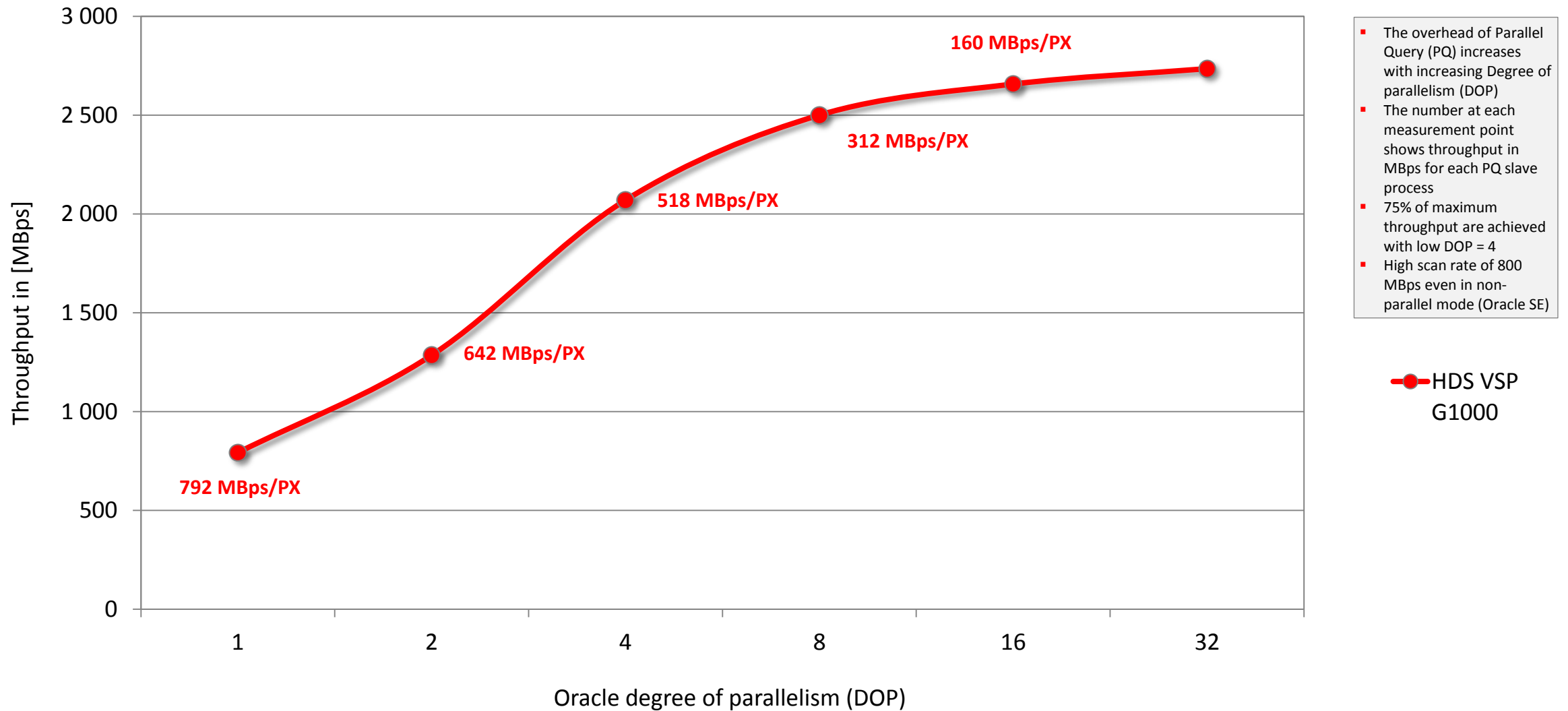


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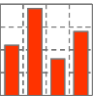
Storage Benchmark Results



Oracle storage performance: sequential read, 1 process, different Oracle DOP



Storage Benchmark Results



Oracle sequential read: single process with different DOP

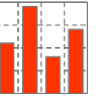
HDS VSP G1000

Run	Tst	Code	#N	#J	#T	CPU busy [%]	CPU sys [%]	Physical read [iops]	Physical read [dbps]	Physical read [MBps]	Physical write [iops]	Physical write [dbps]	Physical write [MBps]	REDO write [iops]	Hitrate db flash [%]	Hitrate exa flash [%]	Elap time [s]
81	1	STO-12	1	1	1	2	1	805	101366	792	5	2	0	1	0	0	296
	2	STO-12	1	1	2	3	1	1303	164451	1285	5	4	0	0	0	0	298
	3	STO-12	1	1	4	3	1	2091	264916	2070	8	5	0	1	0	0	302
	4	STO-12	1	1	8	3	1	2525	320023	2500	8	5	0	1	0	0	300
	5	STO-12	1	1	16	4	1	2680	340029	2657	7	5	0	1	0	0	300
	6	STO-12	1	1	32	4	1	2875	350020	2735	7	4	0	1	0	0	300
	7	STO-12	1	1	64	4	1	3006	352191	2752	8	7	0	1	0	0	301

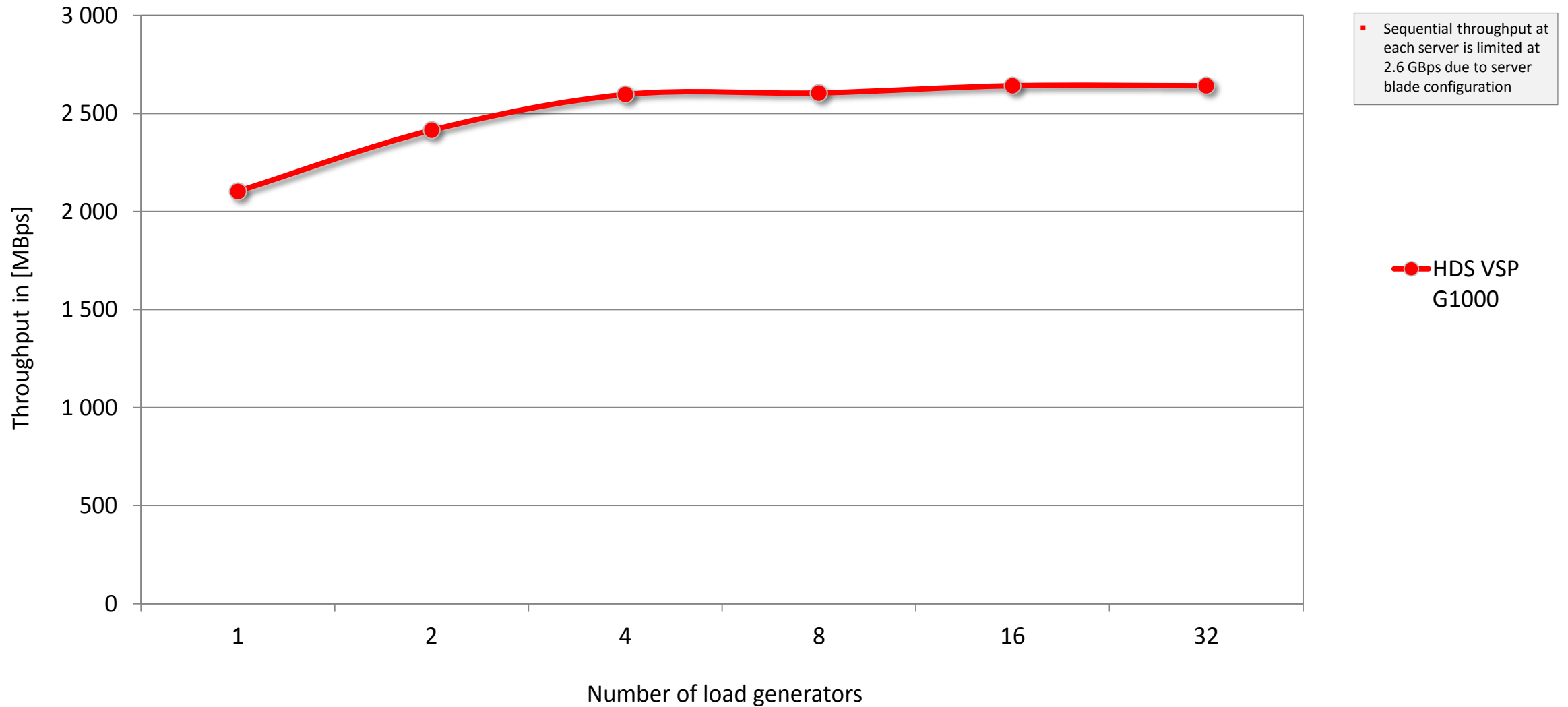
Legend:

Run	benchmark run id	#N	number of RAC nodes	[rps]	rows per second	[iops]	i/o operations per second	[s]	time in seconds
Tst	benchmark test id	#J	number of load generators (jobs)	[tps]	transactions per second	[dbps]	database blocks per second	[ms]	time in milli seconds
Code	benchmark test code	#T	number of threads (PX)	[ops]	operations per second	[MBps]	mega byte per second	[μs]	time in micro seconds

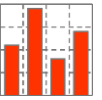
Storage Benchmark Results



Oracle sequential read: single database server, each process uses DOP = 4



Storage Benchmark Results



Oracle sequential read: single database server, each process uses DOP = 4

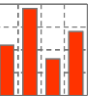
HDS VSP G1000

Run	Tst	Code	#N	#J	#T	CPU busy [%]	CPU sys [%]	Physical read [iops]	Physical read [dbps]	Physical read [MBps]	Physical write [iops]	Physical write [dbps]	Physical write [MBps]	REDO write [iops]	Hitrate db flash [%]	Hitrate exa flash [%]	Elap time [s]
83	1	STO-12	1	1	4	3	1	2116	269115	2103	6	3	0	2	0	0	301
	2	STO-12	1	2	4	4	1	2434	308990	2414	6	5	0	0	0	0	301
	3	STO-12	1	4	4	4	1	2618	332242	2596	8	4	0	1	0	0	301
	4	STO-12	1	8	4	4	1	2628	333359	2604	7	5	0	1	0	0	306
	5	STO-12	1	16	4	4	1	2664	338008	2641	8	7	0	1	0	0	287
	6	STO-12	1	32	4	4	1	2668	338057	2641	7	7	0	1	0	0	284

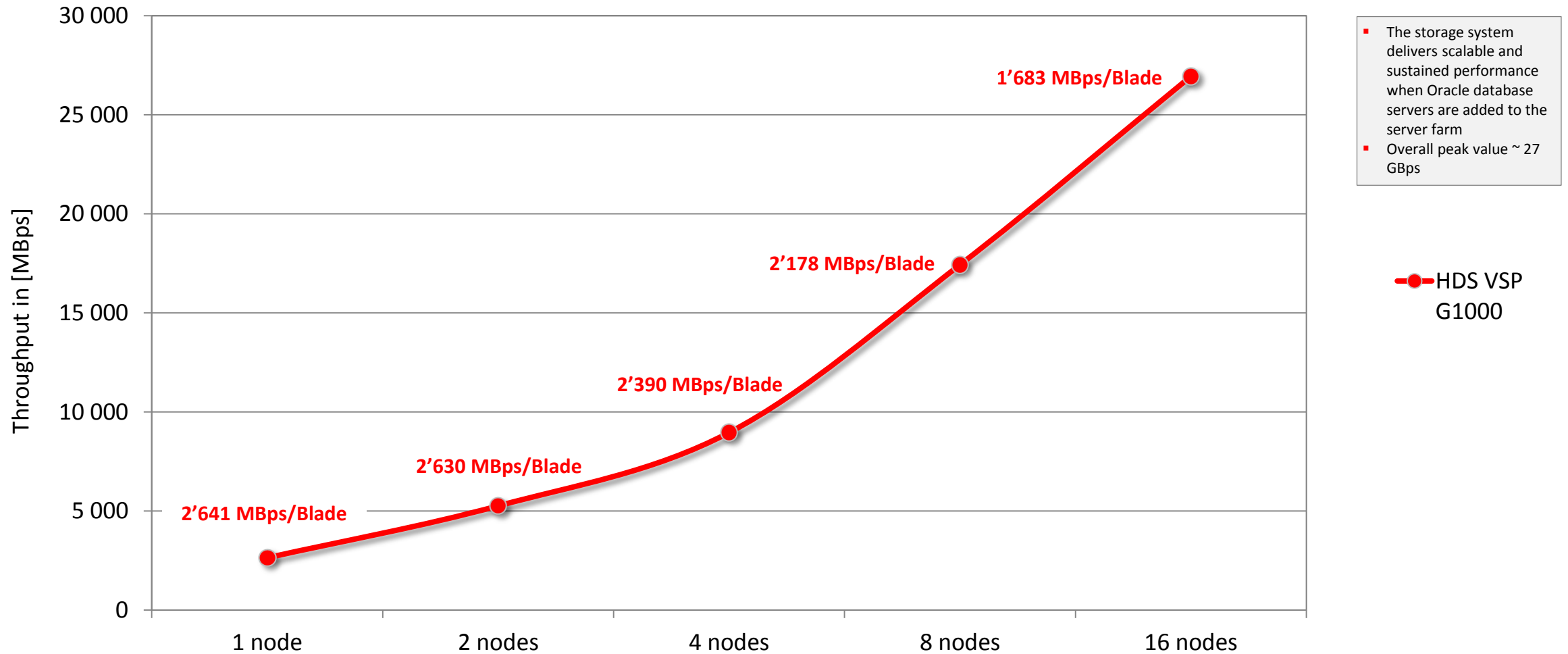
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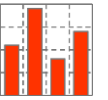
Storage Benchmark Results



Oracle sequential read: database cluster



Storage Benchmark Results



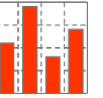
Oracle sequential read: database cluster

HDS VSP G1000

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87	1	STO-12	2	8	2	4	1	5061	644746	5037	12	6	0	3	0	0	304
	2	STO-12	2	16	2	4	1	5286	673215	5260	12	8	0	1	0	0	306
	3	STO-12	2	32	2	4	1	4911	624621	4880	11	8	0	2	0	0	309
90	2	STO-12	4	8	2	3	1	7534	960274	7502	16	9	0	3	0	0	302
	3	STO-12	4	16	2	4	1	9599	1223695	9560	15	10	0	2	0	0	304
	4	STO-12	4	32	2	4	1	8999	1146599	8958	21	13	0	4	0	0	307
91	2	STO-12	8	16	2	3	1	12840	1636079	12782	24	17	0	3	0	0	305
	3	STO-12	8	32	2	3	1	17494	2230285	17425	27	19	1	3	0	0	304
	4	STO-12	8	64	2	4	1	16440	2094493	16364	35	24	0	7	0	0	307
92	2	STO-12	16	32	2	2	1	19267	2453968	19172	40	34	0	4	0	0	304
	3	STO-12	16	64	2	3	1	26321	3354126	26205	48	35	0	7	0	0	305
	4	STO-12	16	128	2	3	1	27056	3447407	26934	54	40	1	10	0	0	304

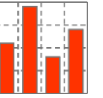
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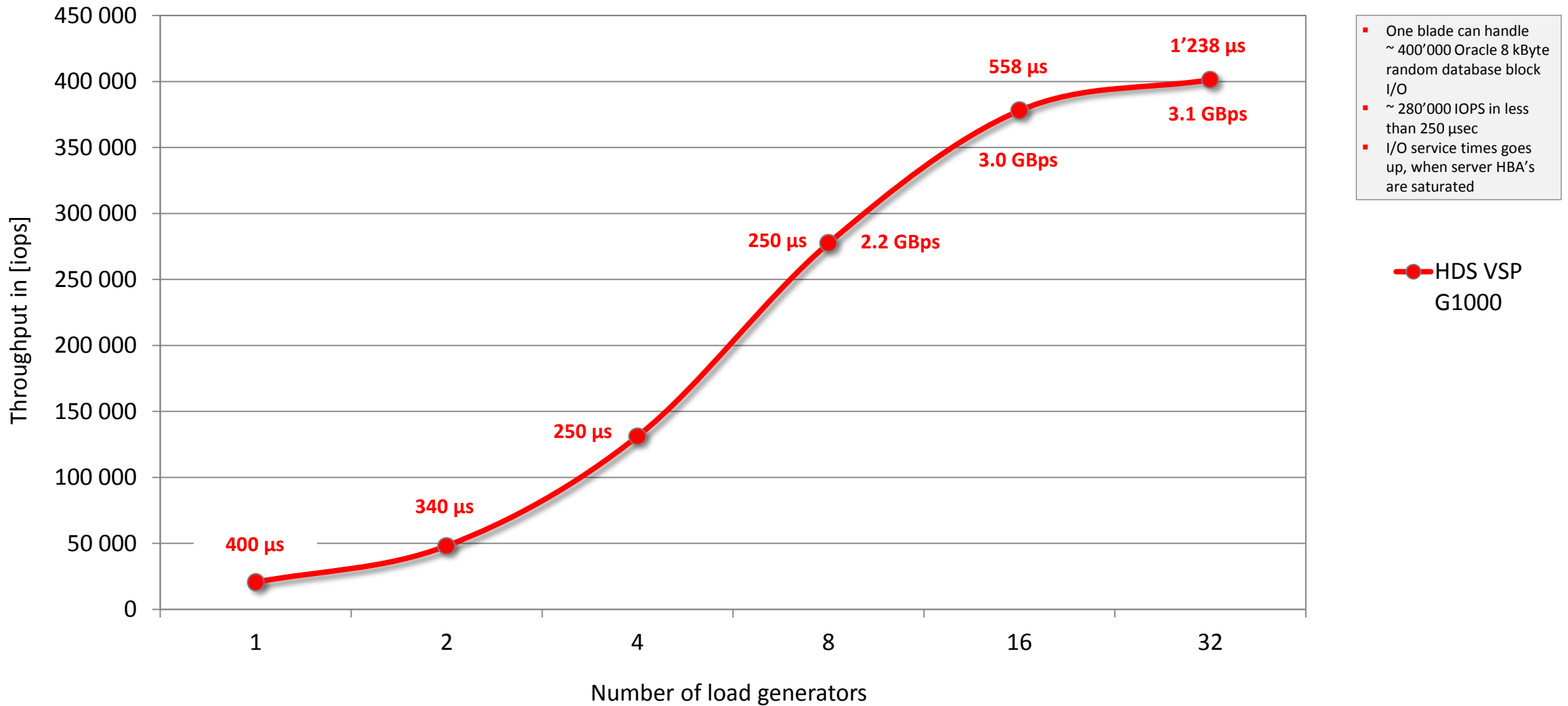


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Storage Benchmark Results



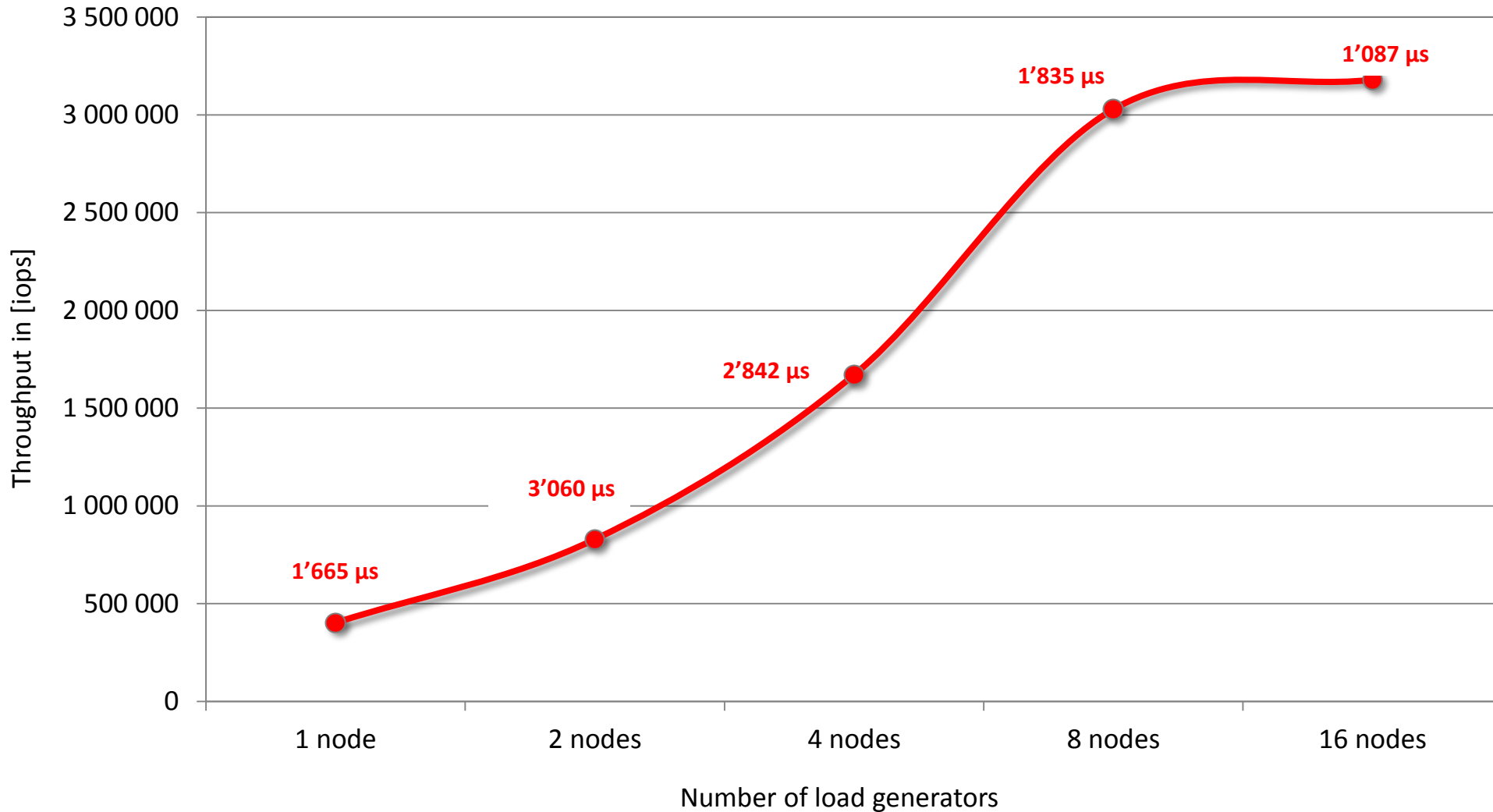
Oracle storage performance: random read, Oracle block size 8 kByte, 1 DB server



Storage Benchmark Results



Oracle storage performance: random read, Oracle block size 8 kByte, large cluster

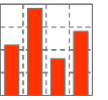


This test is throughput oriented, not service-time oriented

- I/O throughput scales nearly linear up to 8 servers, each ~ 375'000 IOPS
- I/O service time reflect not the storage system service time, but the Oracle I/O service time
- I/O service time may be limited by queuing effects somewhere in the blade configuration

● HDS VSP G1000

Storage Benchmark Results



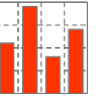
Oracle storage performance: random read, Oracle block size 8 kByte, large cluster

HDS VSP G1000

Run	Tst	Code	#N	#J	#T	CPU busy [%]	CPU sys [%]	Physical read [iops]	Physical read [dbps]	Physical read [MBps]	Physical write [iops]	Physical write [dbps]	Physical write [MBps]	REDO write [iops]	Hitrate db flash [%]	Hitrate exa flash [%]	Elap time [s]
165	6	STO-62	1	32	1	8	3	401386	401380	3136	33	32	0	2	0	0	301
	7	STO-62	1	48	1	8	3	402713	402709	3146	31	31	0	2	0	0	301
166	2	STO-62	2	64	1	16	5	826603	826603	6458	54	49	0	3	0	0	300
	3	STO-62	2	128	1	18	6	829231	829221	6478	54	46	0	5	0	0	301
	5	STO-62	4	128	1	32	11	1599283	1599291	12495	87	77	1	6	0	0	301
	6	STO-62	4	256	1	35	12	1670669	1670661	13052	96	81	1	9	0	0	302
167	2	STO-62	8	256	1	39	12	2451486	2453312	19167	139	117	1	12	0	0	322
	3	STO-62	8	512	1	38	12	3028016	3028938	23664	178	141	1	19	0	0	301
170	1	STO-62	16	128	1	13	4	2861630	2862276	22362	172	147	1	12	0	0	303
	2	STO-62	16	256	1	14	5	3174230	3174239	24800	208	164	2	22	0	0	302
	3	STO-62	16	512	1	14	4	3179157	3179134	24838	212	168	2	23	0	0	302

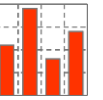
Legend:

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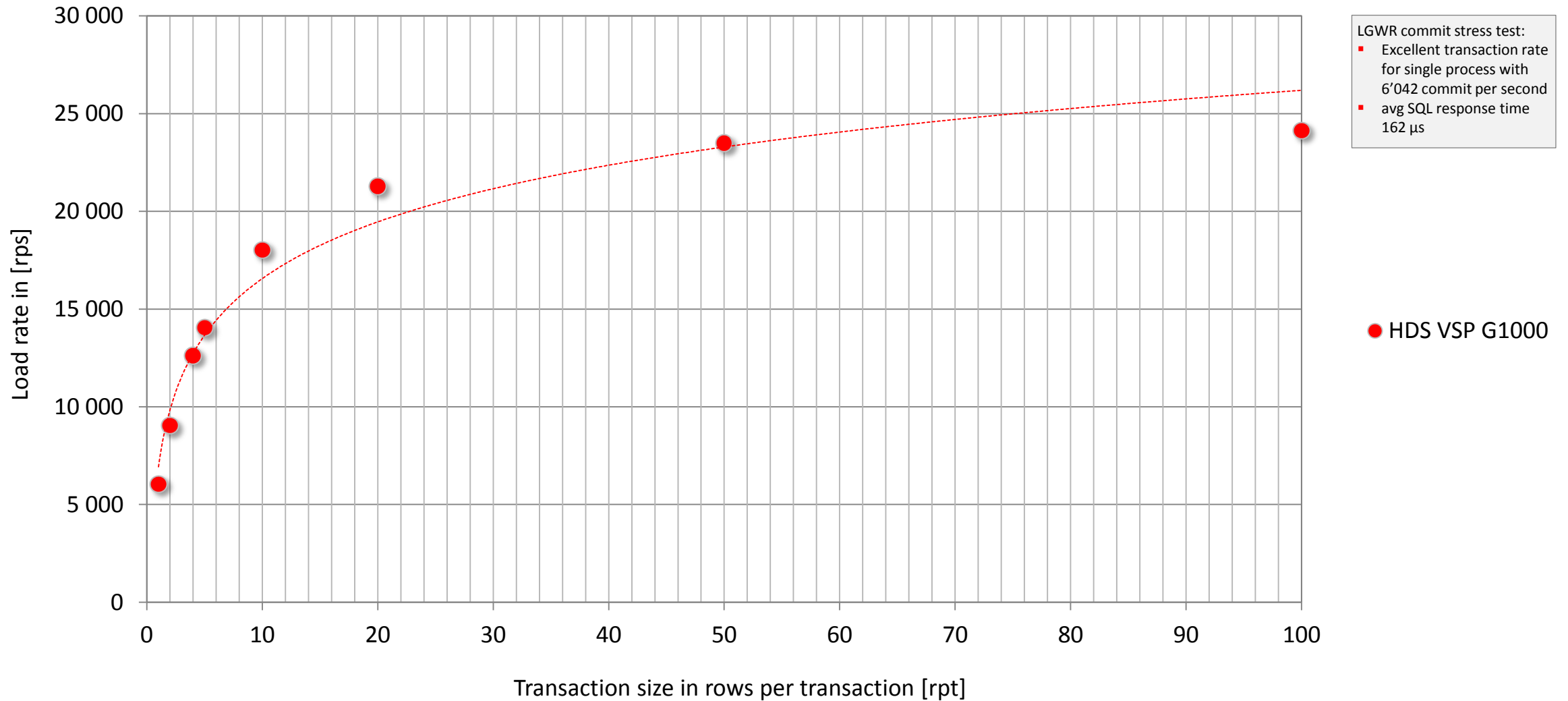


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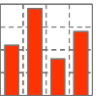
Data Load Benchmark Results



Oracle buffer cache insert: single process, different transaction size



Data Load Benchmark Results



Oracle buffer cache insert: single process, different transaction size

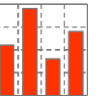
HDS VSP G1000

Run	Tst	Code	#N	#J	#T	TX size [rpt]	CPU busy [%]	Throughput rows/sec [rps]	Throughput txn/sec [tps]	SQL service time [s]	Physical write [iops]	Physical write [dbps]	Physical write [MBps]	REDO size [MBps]	REDO writes [iops]	REDO svt [ms]	REDO sync writes	REDO sync [us]	Elap time [s]
224	1	DBL-11	1	1	1	1	3	6.042E+03	6.042E+03	1.622E-04	8497	944	33	11	4182	92	10	137	331
	2	DBL-11	1	1	1	2	3	9.036E+03	4.518E+03	2.168E-04	8226	1179	38	13	4036	67	2	2984	332
	3	DBL-11	1	1	1	4	2	1.262E+04	3.155E+03	3.090E-04	6271	1590	47	16	3040	516	2	1630	317
	4	DBL-11	1	1	1	5	2	1.404E+04	2.807E+03	3.463E-04	5388	1862	51	17	2568	146	10	608	285
	5	DBL-11	1	1	1	10	3	1.802E+04	1.802E+03	5.338E-04	3789	2216	60	20	1746	209	2	3736	333
	6	DBL-11	1	1	1	20	2	2.128E+04	1.064E+03	9.057E-04	2462	2531	68	23	1070	193	8	1065	282
	7	DBL-11	1	1	1	50	2	2.349E+04	4.700E+02	2.038E-03	1266	2453	71	25	478	324	11	113	298
	8	DBL-11	1	1	1	100	1	2.414E+04	2.410E+02	3.941E-03	798	2622	73	25	249	334	3	2905	290

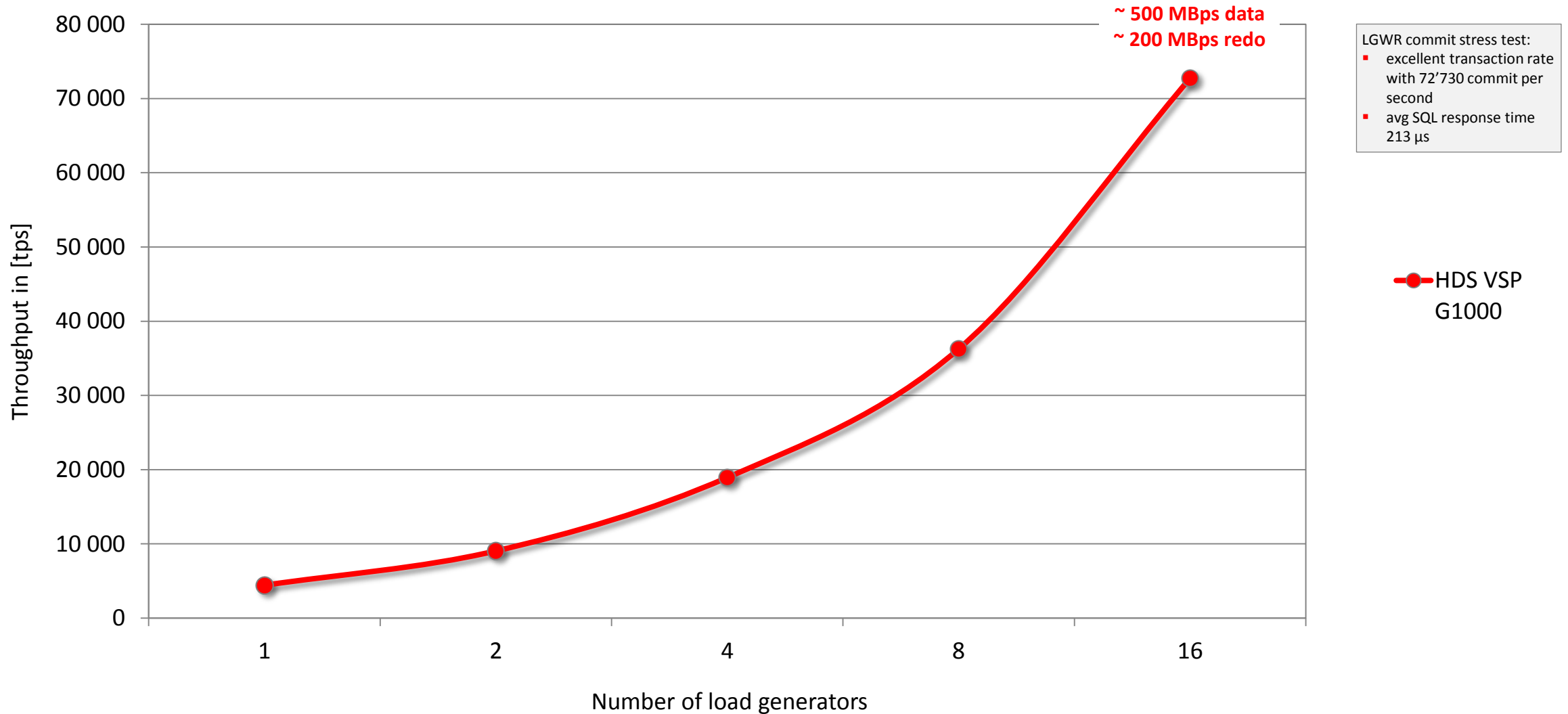
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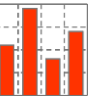
Data Load Benchmark Results



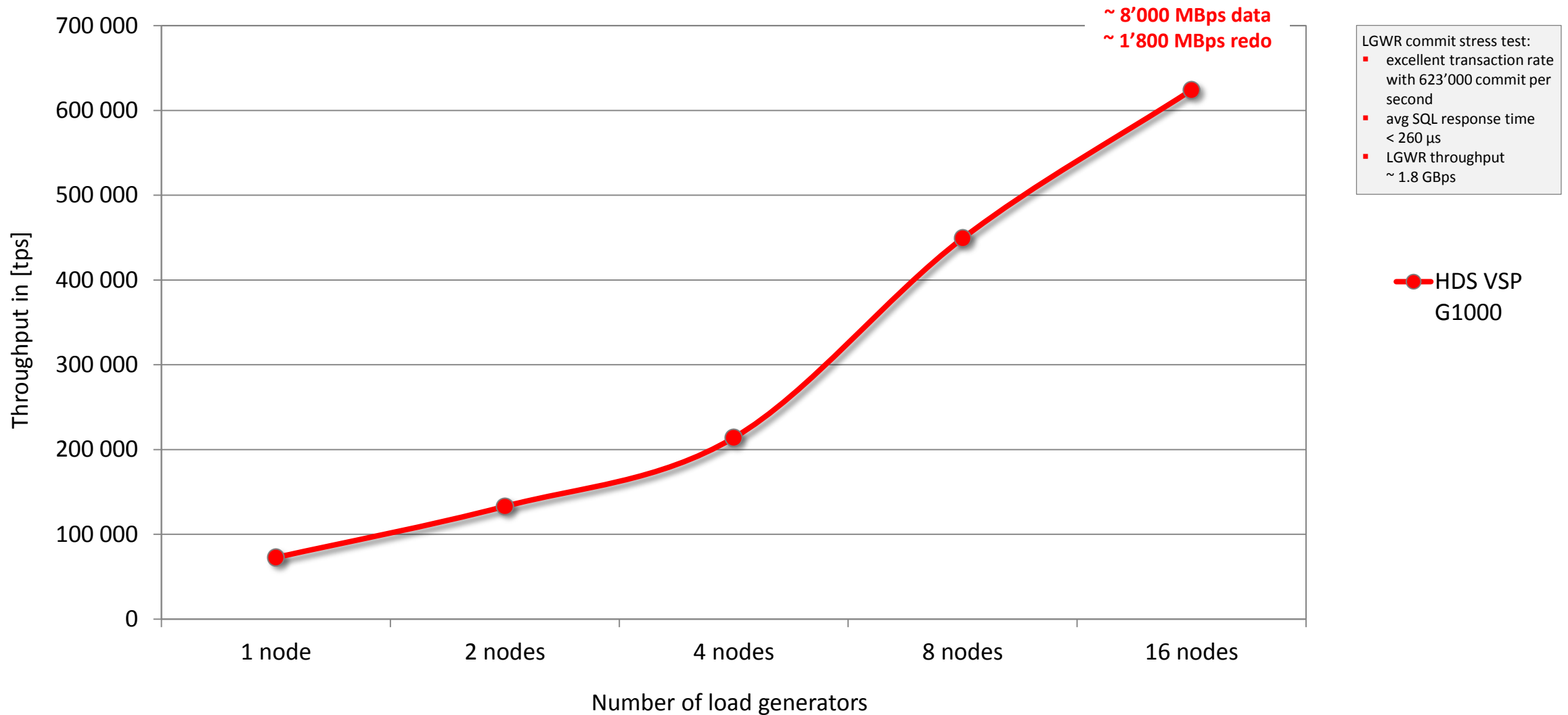
Oracle buffer cache insert: 2 rows per transaction, 1 database server



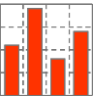
Data Load Benchmark Results



Oracle buffer cache insert: 2 rows per transaction, cluster



Data Load Benchmark Results



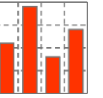
Oracle buffer cache insert: 2 rows per transaction

HDS VSP G1000

Run	Tst	Code	#N	#J	#T	TX size [rpt]	CPU busy [%]	Throughput rows/sec [rps]	Throughput txn/sec [tps]	SQL service time [s]	Physical write [iops]	Physical write [dbps]	Physical write [MBps]	REDO size [MBps]	REDO writes [iops]	REDO svt [ms]	REDO sync writes	REDO sync [us]	Elap time [s]	
224	9	DBL-11	1	1	1	2	3	8.824E+03	4.412E+03	2.206E-04	7722	1028	36	13	3758	99	9	1116	340	
	10	DBL-11	1	2	1	2	3	1.807E+04	9.036E+03	2.113E-04	11574	2106	73	26	3675	121	4	157	332	
	11	DBL-11	1	4	1	2	4	3.786E+04	1.893E+04	2.039E-04	14298	16334	243	55	2990	195	11	192	317	
	12	DBL-11	1	8	1	2	6	7.251E+04	3.625E+04	2.136E-04	23130	48818	600	105	2564	548	15	205	331	
	13	DBL-11	1	16	1	2	9	1.455E+05	7.273E+04	2.126E-04	18898	35471	709	208	2109	535	19	501	330	
	14	DBL-11	2	4	1	2	5	3.704E+04	1.852E+04	2.082E-04	22985	5324	157	53	7022	162	14	194	324	
	15	DBL-11	2	8	1	2	6	7.595E+04	3.798E+04	2.036E-04	28698	22130	405	109	6354	94	9	315	316	
	16	DBL-11	2	16	1	2	9	1.514E+05	7.571E+04	1.978E-04	29795	38015	751	217	5165	272	30	334	317	
	17	DBL-11	2	32	1	2	16	2.659E+05	1.330E+05	2.230E-04	54874	129499	1805	382	3555	615	44	899	361	
	18	DBL-11	4	16	1	2	11	1.459E+05	7.295E+04	2.082E-04	52677	32183	696	210	12231	145	20	364	329	
	19	DBL-11	4	32	1	2	18	2.767E+05	1.383E+05	2.183E-04	62598	93001	1557	397	10193	366	44	467	347	
	20	DBL-11	4	64	1	2	26	4.174E+05	2.087E+05	2.361E-04	97909	242245	3139	600	5623	339	87	2079	345	
	21	DBL-11	4	128	1	2	34	4.278E+05	2.139E+05	3.838E-04	166612	370471	4170	616	1973	2745	171	2241	374	
	22	DBL-11	8	64	1	2	30	5.167E+05	2.583E+05	2.209E-04	118425	189006	3029	741	20148	234	71	377	360	
	23	DBL-11	8	128	1	2	56	8.982E+05	4.491E+05	2.495E-04	223518	581841	7226	1292	11310	227	165	2078	285	
	225	1	DBL-11	16	128	1	2	27	7.985E+05	3.992E+05	2.229E-04	155183	267346	4482	1145	26732	251	196	629	387
		2	DBL-11	16	256	1	2	42	1.248E+06	6.239E+05	2.542E-04	271703	775045	9772	1793	12479	1291	420	10780	327

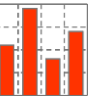
Legend:

Run	benchmark run id	#N	number of RAC nodes	[rps]	rows per second	[iops]	i/o operations per second	[s]	time in seconds
Tst	benchmark test id	#J	number of load generators (jobs)	[tps]	transactions per second	[dbps]	database blocks per second	[ms]	time in milli seconds
Code	benchmark test code	#T	number of threads (PX)	[ops]	operations per second	[MBps]	mega byte per second	[us]	time in micro seconds

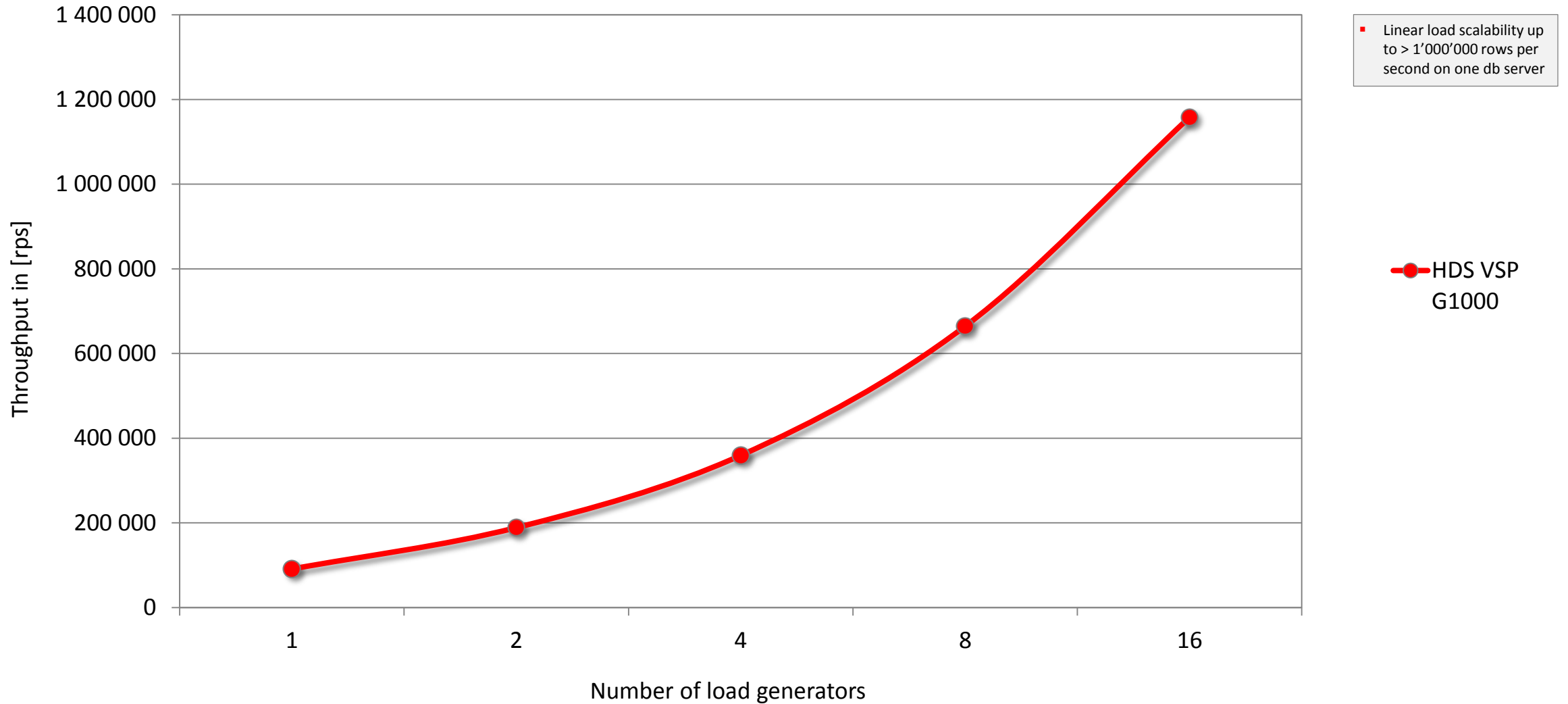


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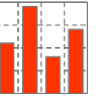
Data Load Benchmark Results



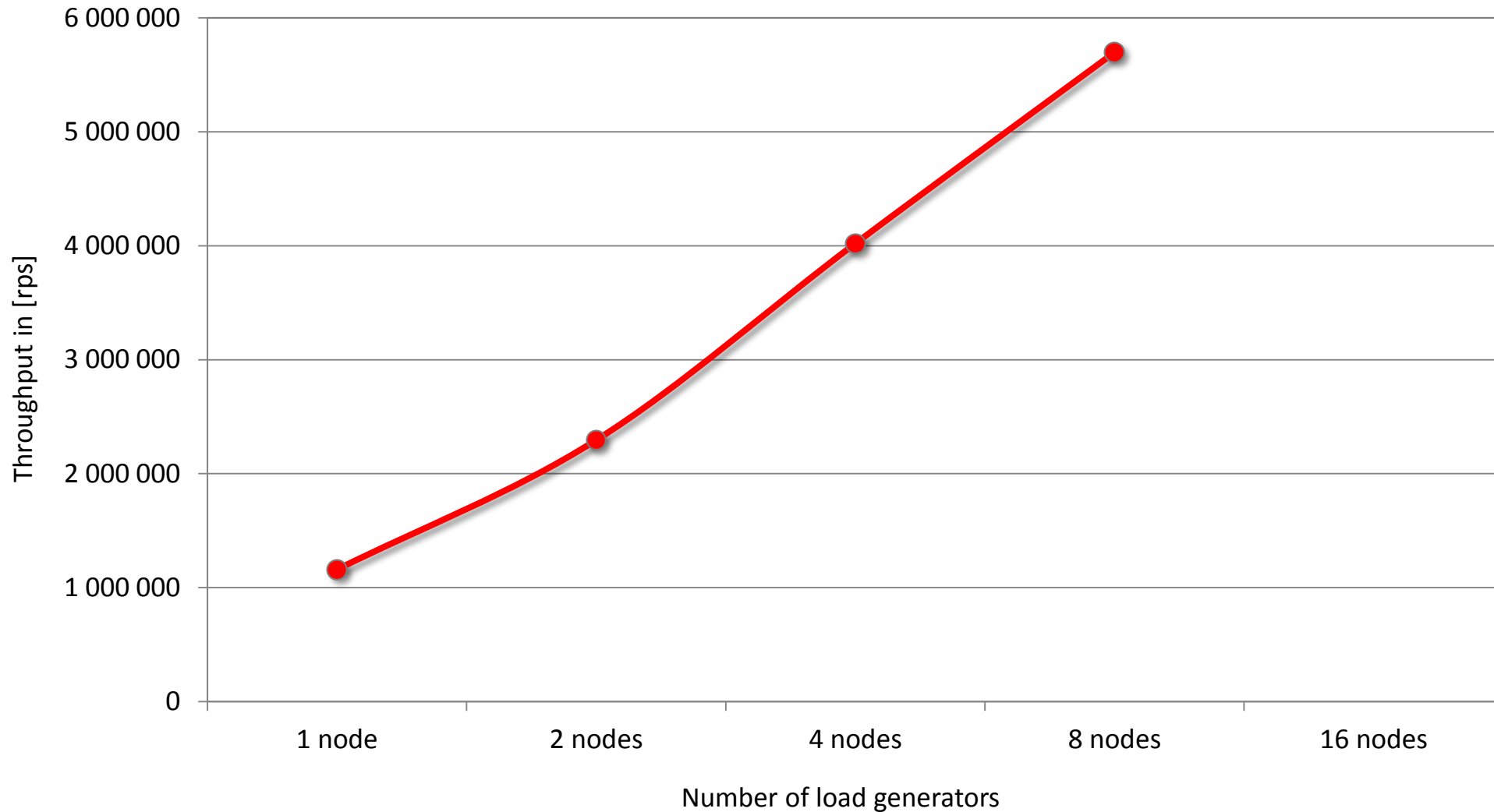
Oracle bulk insert: 1 node



Data Load Benchmark Results



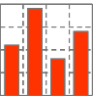
Oracle bulk insert: cluster



- Linear load scalability up to > 4'000'000 rows per second on a cluster with 4 database server
- Further scalability is limited by Oracle cache fusion synchronization – even when data is loaded in non-shared segments

● HDS VSP
G1000

Data Load Benchmark Results



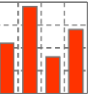
Oracle bulk insert

HDS VSP G1000

Run	Tst	Code	#N	#J	#T	TX size [rpt]	CPU busy [%]	Throughput rows/sec [rps]	Throughput txn/sec [tps]	SQL service time [s]	Physical write [iops]	Physical write [dbps]	Physical write [MBps]	REDO size [MBps]	REDO writes [iops]	REDO svt [ms]	REDO sync writes	REDO sync svt [us]	Elap time [s]
228	1	DBL-21	1	1	1	0	4	9.122E+04	0.000E+00	1.032E+01	1123	6110	82	16	47	547	8	122	296
	2	DBL-21	1	2	1	0	7	1.889E+05	0.000E+00	1.000E+01	2675	12643	169	34	80	733	7	931	307
	3	DBL-21	1	4	1	0	13	3.595E+05	0.000E+00	1.048E+01	5167	24050	322	65	134	711	11	394	306
	4	DBL-21	1	8	1	0	26	6.645E+05	1.000E+00	1.126E+01	9057	44550	595	119	187	883	14	690	304
	5	DBL-21	1	16	1	0	50	1.158E+06	1.000E+00	1.318E+01	17824	80152	1056	208	136	597	25	21594	304
229	3	DBL-21	2	32	1	0	50	2.068E+06	2.000E+00	1.406E+01	25436	152815	1962	372	319	1048	109	35967	308
	4	DBL-21	2	64	1	0	81	2.494E+06	2.000E+00	2.214E+01	42463	189894	2409	448	196	4531	1358	74399	308
230	3	DBL-21	4	128	1	0	37	4.028E+06	4.000E+00	2.159E+01	54507	302216	3857	724	461	2997	2049	73868	317
248	1	DBL-21	8	256	1	0	48	5.684E+06	6.000E+00	2.185E+01	51634	418812	5382	1021	738	1935	14299	107925	323
	2	DBL-21	8	512	1	0	50	5.697E+06	6.000E+00	3.901E+01	48122	479770	5863	1024	819	2326	8129	86678	337

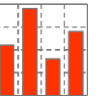
Legend:

Run	benchmark run id	#N	number of RAC nodes	[rps]	rows per second	[iops]	i/o operations per second	[s]	time in seconds
Tst	benchmark test id	#J	number of load generators (jobs)	[tps]	transactions per second	[dbps]	database blocks per second	[ms]	time in milli seconds
Code	benchmark test code	#T	number of threads (PX)	[ops]	operations per second	[MBps]	mega byte per second	[μs]	time in micro seconds

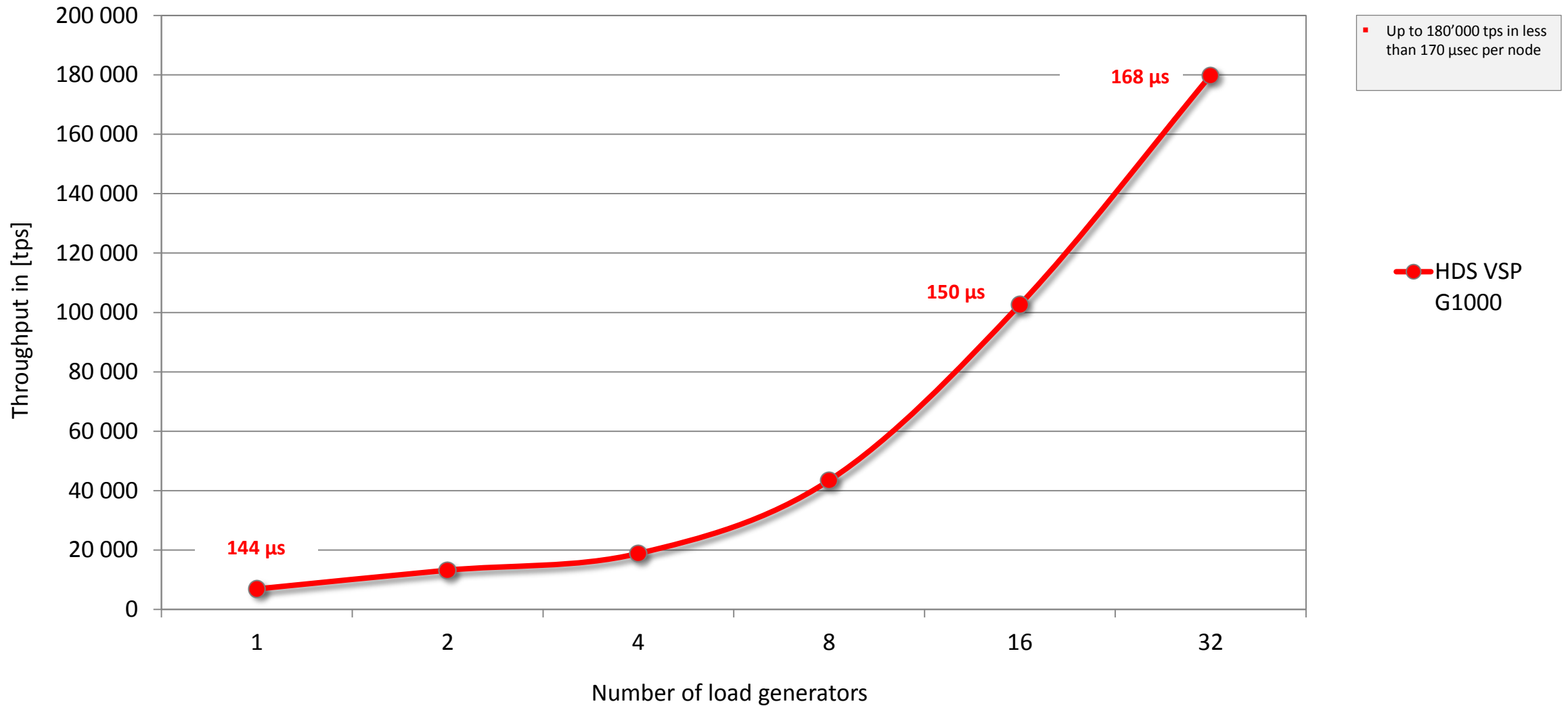


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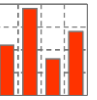
OLTP Select Benchmark Results



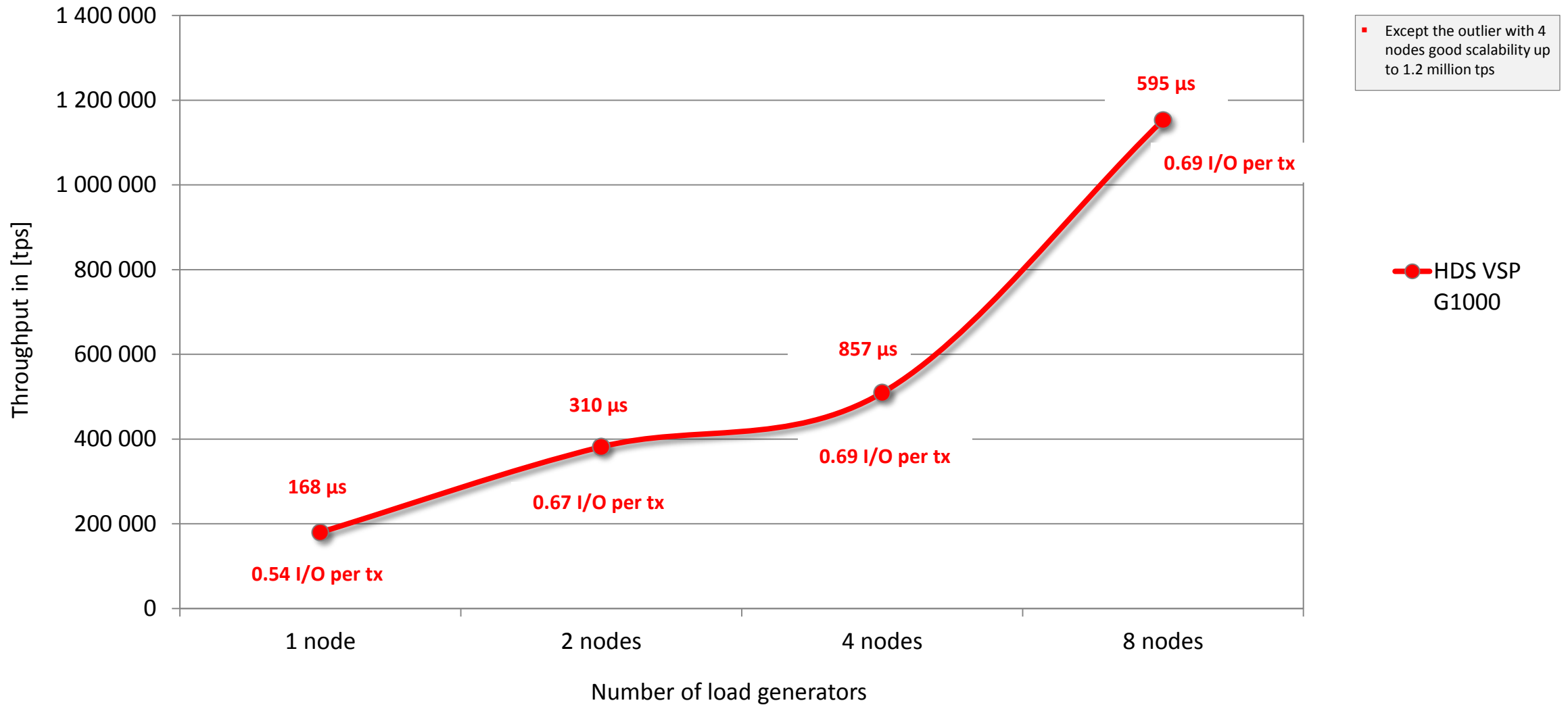
Oracle OLTP select transaction: 1 row hit per transaction, 1 node



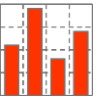
OLTP Select Benchmark Results



Oracle OLTP select transaction: 1 row hit per transaction, cluster



OLTP Select Benchmark Results



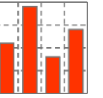
Oracle OLTP select transaction: 1 row hit per transaction

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Run	Tst Code	#N	#J	#T	CPU busy [%]	CPU sys [%]	Throughput rows/sec [rps]	Throughput txn/sec [tps]	SQL service time [s]	Physical read [iops]	Physical write [iops]	REDO write [iops]	Hitrate db flash [%]	Hitrate exa flash [%]	Physical read [MBps]	Physical write [MBps]	Elap time [s]
218	1 DBX-12	1	1	1	2	0	6.861E+03	6.861E+03	1.444E-04	751	14	0	0	0	33	0	302
	2 DBX-12	1	2	1	4	1	1.317E+04	1.317E+04	1.484E-04	2896	17	2	0	0	57	0	309
	3 DBX-12	1	4	1	6	1	1.880E+04	1.880E+04	2.045E-04	9075	13	0	0	0	71	0	311
	4 DBX-12	1	8	1	13	1	4.339E+04	4.339E+04	1.791E-04	20157	13	0	0	0	158	0	307
	5 DBX-12	1	16	1	25	3	1.026E+05	1.026E+05	1.501E-04	47788	20	3	0	0	373	0	311
	6 DBX-12	1	32	1	55	6	1.798E+05	1.798E+05	1.684E-04	97893	16	1	0	0	765	0	316
255	3 DBX-12	2	64	1	57	8	2.703E+05	2.703E+05	2.238E-04	144922	29	2	0	0	1133	0	317
	4 DBX-12	2	128	1	85	12	3.815E+05	3.815E+05	3.099E-04	255301	27	3	0	0	1995	0	323
256	3 DBX-12	4	256	1	56	9	4.194E+05	4.194E+05	5.563E-04	258186	55	10	0	0	2018	0	334
	4 DBX-12	4	512	1	67	10	5.090E+05	5.090E+05	8.567E-04	353088	61	14	0	0	2759	0	346
257	2 DBX-12	8	512	1	61	10	9.537E+05	9.537E+05	4.797E-04	594946	85	18	0	0	4649	1	337
	3 DBX-12	8	786	1	72	11	1.153E+06	1.153E+06	5.947E-04	797178	106	23	0	0	6228	1	335

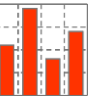
Legend:

Run	benchmark run id	#N	number of RAC nodes	[rps]	rows per second	[iops]	i/o operations per second	[s]	time in seconds
Tst	benchmark test id	#J	number of load generators (jobs)	[tps]	transactions per second	[dbps]	database blocks per second	[ms]	time in milli seconds
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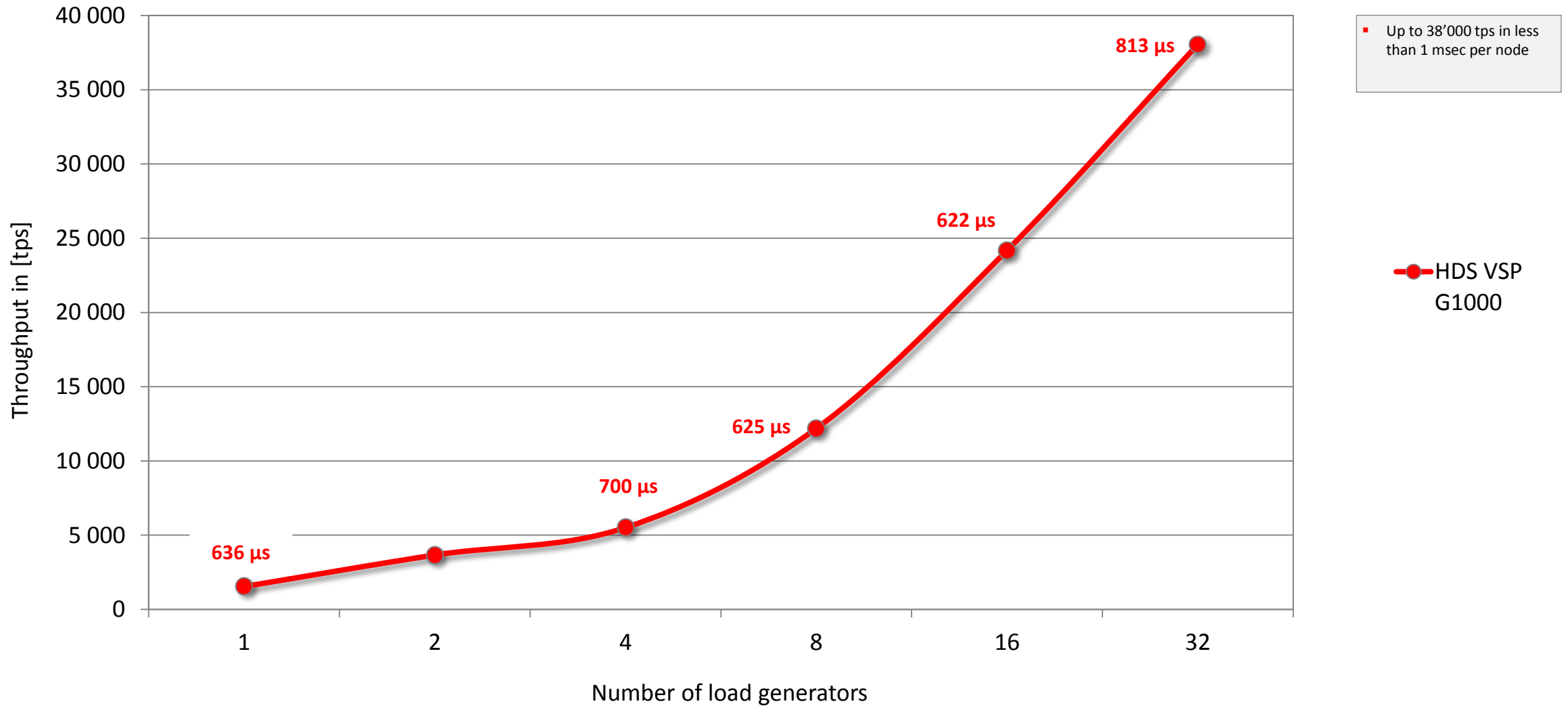


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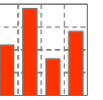
OLTP Update Benchmark Results



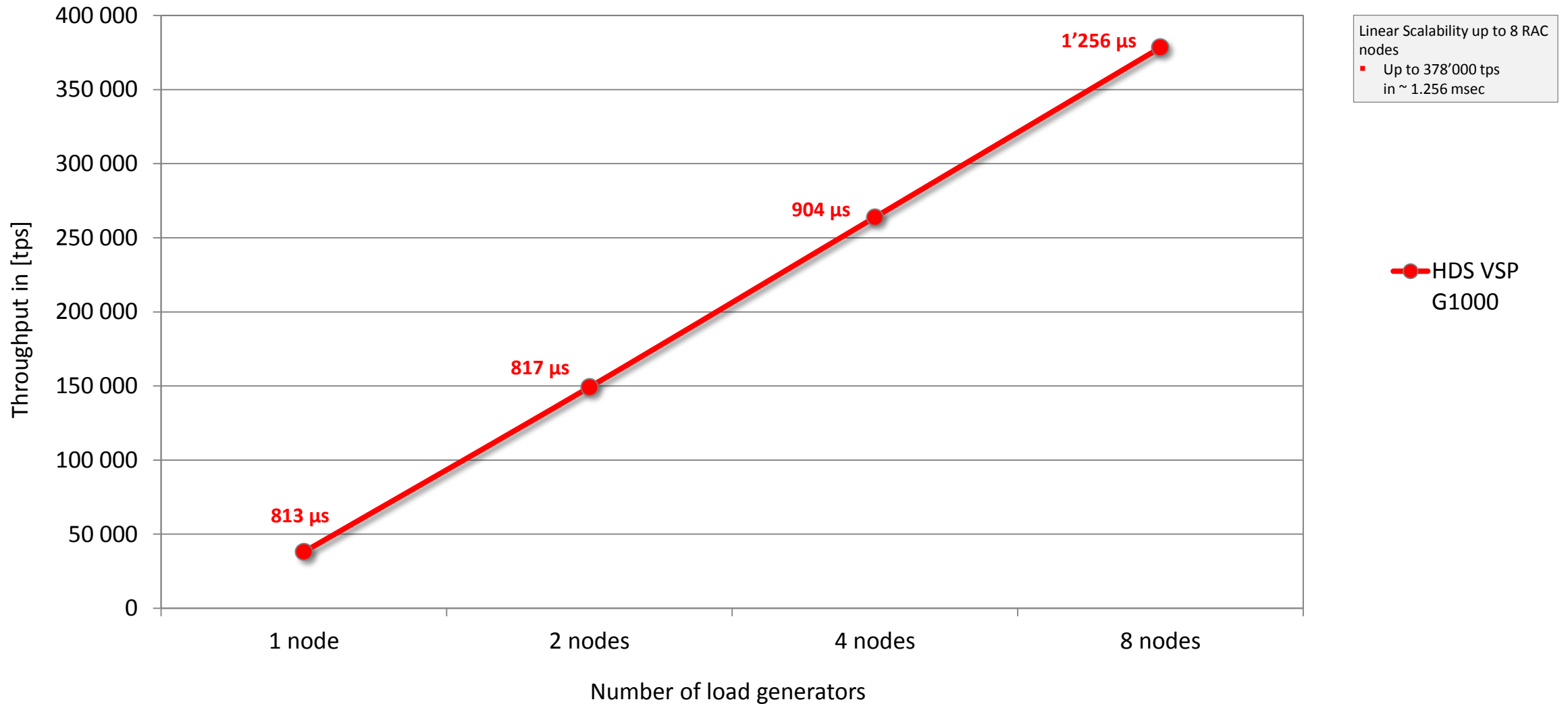
Oracle OLTP update transaction: 1 row hit per transaction, 1 node



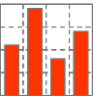
OLTP Update Benchmark Results



Oracle OLTP update transaction: 1 row hit per transaction, cluster



OLTP Update Benchmark Results



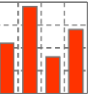
Oracle OLTP update transaction: 1 row hit per transaction

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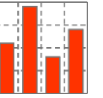
Run	Tst Code	#N	#J	#T	CPU busy [%]	CPU sys [%]	Throughput rows/sec [rps]	Throughput txn/sec [tps]	SQL service time [s]	Physical read [iops]	Physical write [iops]	REDO write [iops]	Hitrate db flash [%]	Hitrate exa flash [%]	Physical read [MBps]	Physical write [MBps]	Elap time [s]	
252	1 DBX-22	1	1	1	2	1	1.544E+03	1.544E+03	6.357E-04	508	3710	1349	0	0	26	14	298	
	2 DBX-22	1	2	1	3	1	3.667E+03	3.667E+03	5.370E-04	1477	7126	2437	0	0	57	32	300	
	3 DBX-22	1	4	1	4	1	5.513E+03	5.513E+03	7.006E-04	5318	10750	3629	0	0	42	49	312	
	4 DBX-22	1	8	1	6	1	1.219E+04	1.219E+04	6.251E-04	10877	16751	3697	0	0	85	103	315	
	5 DBX-22	1	16	1	10	2	2.418E+04	2.418E+04	6.222E-04	18596	33158	3153	0	0	191	225	316	
	6 DBX-22	1	32	1	15	3	3.805E+04	3.805E+04	8.129E-04	32643	37699	2531	0	0	255	326	307	
	9 DBX-22	2	64	1	28	5	9.438E+04	9.438E+04	6.408E-04	78239	101043	5797	0	0	611	841	313	
	10 DBX-22	2	128	1	39	6	1.492E+05	1.492E+05	8.174E-04	125965	143453	3923	0	0	984	1340	312	
	260	2 DBX-22	4	128	1	47	7	1.672E+05	1.672E+05	7.219E-04	139590	189160	11329	0	0	1091	1512	317
		3 DBX-22	4	256	1	65	9	2.639E+05	2.639E+05	9.042E-04	220874	273953	8468	0	0	1726	2421	320
261	2 DBX-22	8	256	1	38	6	2.475E+05	2.475E+05	9.649E-04	210669	289410	20905	0	0	1648	2229	319	
	3 DBX-22	8	512	1	52	8	3.784E+05	3.784E+05	1.256E-03	318813	403674	16345	0	0	2491	3446	322	

Legend:

Run	benchmark run id	#N	number of RAC nodes	[rps]	rows per second	[iops]	i/o operations per second	[s]	time in seconds
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- The HDS VSP G1000 Storage System is a well suited storage platform for large Oracle server farms
- Oracle does not scale beyond 8 RAC nodes in all storage performance tests
 - scalability of random I/O is limited by exchanging messages, not by cache fusion block synchronization

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