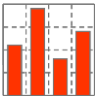


Performance Baseline of Hitachi Data Systems UCP for Oracle

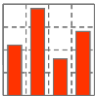
Part IV: Database Performance

Benchmark Performance Suite Release 8.4 (Build 130830)

August 2013



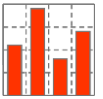
- 1 Introduction to Database Performance Tests**
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Why measure Database performance?

- Projects need understandable key performance metrics for capacity planning
 - Data load
 - Data scan
 - Data aggregation
 - OLTP transactions
 - Time windows for certain operations

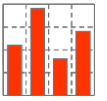
Database Performance



What is measured?

- Speed of single thread
 - Rows per second [rps]
 - Transactions per second [tps]
 - SQL service time [s]
- Maximum throughput of system
 - Rows per second [rps]
 - Transactions per second [tps]
 - SQL service time [s]
 - REDO rate [MBps]
 - REDO service time [s]
- Scalability
 - Throughput per process for $n = \{1, 2, 4, 8, \dots, n\}$
- Efficiency of
 - All platform layers

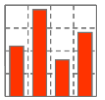
Database Performance



How is Database Performance measured?

- Benchware developed a specific Oracle scenario for each test case

Database Performance

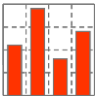


Overview of Database load performance tests with Test Codes

Database Performance Data Load Un-compressed	Test Code for Data Load via buffer cache	Test Code for Data Load direct	
▪ Conventional data load (LGWR stress test)	DBL-11	-	-
▪ Bulk load	-	DBL-21	-

Database Performance Data Load Compressed			Test Code for Data Load direct compressed
▪ Bulk load, compress BASIC			DBL-31
▪ Bulk load, compress OLTP			DBL-32
▪ Bulk load, compress HCC query low			DBL-33
▪ Bulk load, compress HCC archive low			DBL-34

Database Performance

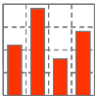


Overview of Database aggregation performance tests with Test Codes

Database Performance Data Aggregation	Test Code for Data on default Storage		
<ul style="list-style-type: none">▪ Create unique b-tree index▪ Create non-unique b-tree index	DBA-11 DBA-12		

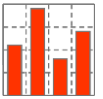
Database Performance Data Scan	Test Code for Data on default Storage	Test Code for Data in Flash Cache	Test Code for Data in Cell Flash Cache
<ul style="list-style-type: none">▪ Full table scan	DBS-12	DBS-13	DBS-14

Database Performance



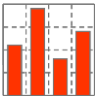
Overview of Database OLTP performance tests with Test Codes

Database Performance OLTP Transactions 1 hit per transaction	Test Code for Data on default Storage	Test Code for Data in Flash Cache	Test Code for Data in Cell Flash Cache
▪ Select transaction	DBX-12	DBX-13	DBX-14
▪ Update transaction	DBX-22	DBX-23	DBX-24



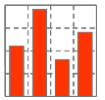
Remarks on other benchmark tools . . .

- SAP, TPC, Swingbench, Hammerora, ...
 - No specific database performance metrics for data scan
 - data load
 - data aggregation
 - No support for Oracle flash cache or Oracle cell flash cache
 - No support for Oracle compression techniques



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Database Performance

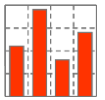


Database Configuration

Database	HDS UCP
<ul style="list-style-type: none">▪ Oracle Release	11.2.0.3
<ul style="list-style-type: none">▪ Partition Option	Yes
<ul style="list-style-type: none">▪ Real Application Cluster	No
<ul style="list-style-type: none">▪ Data Guard	No

Basic Configuration	HDS UCP
<ul style="list-style-type: none">▪ Block size [kByte]	8
<ul style="list-style-type: none">▪ Archiving	Yes
<ul style="list-style-type: none">▪ Force Logging	Yes
<ul style="list-style-type: none">▪ Flashback	No

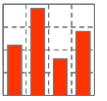
Database Performance



Database Configuration

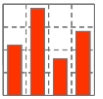
Memory Configuration	HDS UCP
<ul style="list-style-type: none">SGA target [GByte]	48
<ul style="list-style-type: none">PGA target [GByte]	16
<ul style="list-style-type: none">Keep pool [GByte]	16
<ul style="list-style-type: none">Recycle pool [GByte]	4
<ul style="list-style-type: none">Default pool [GByte]	16

REDO Configuration	HDS UCP
<ul style="list-style-type: none">REDO log file size [GByte]	8
<ul style="list-style-type: none">#REDO log files groups	4
<ul style="list-style-type: none">#REDO log file members	1

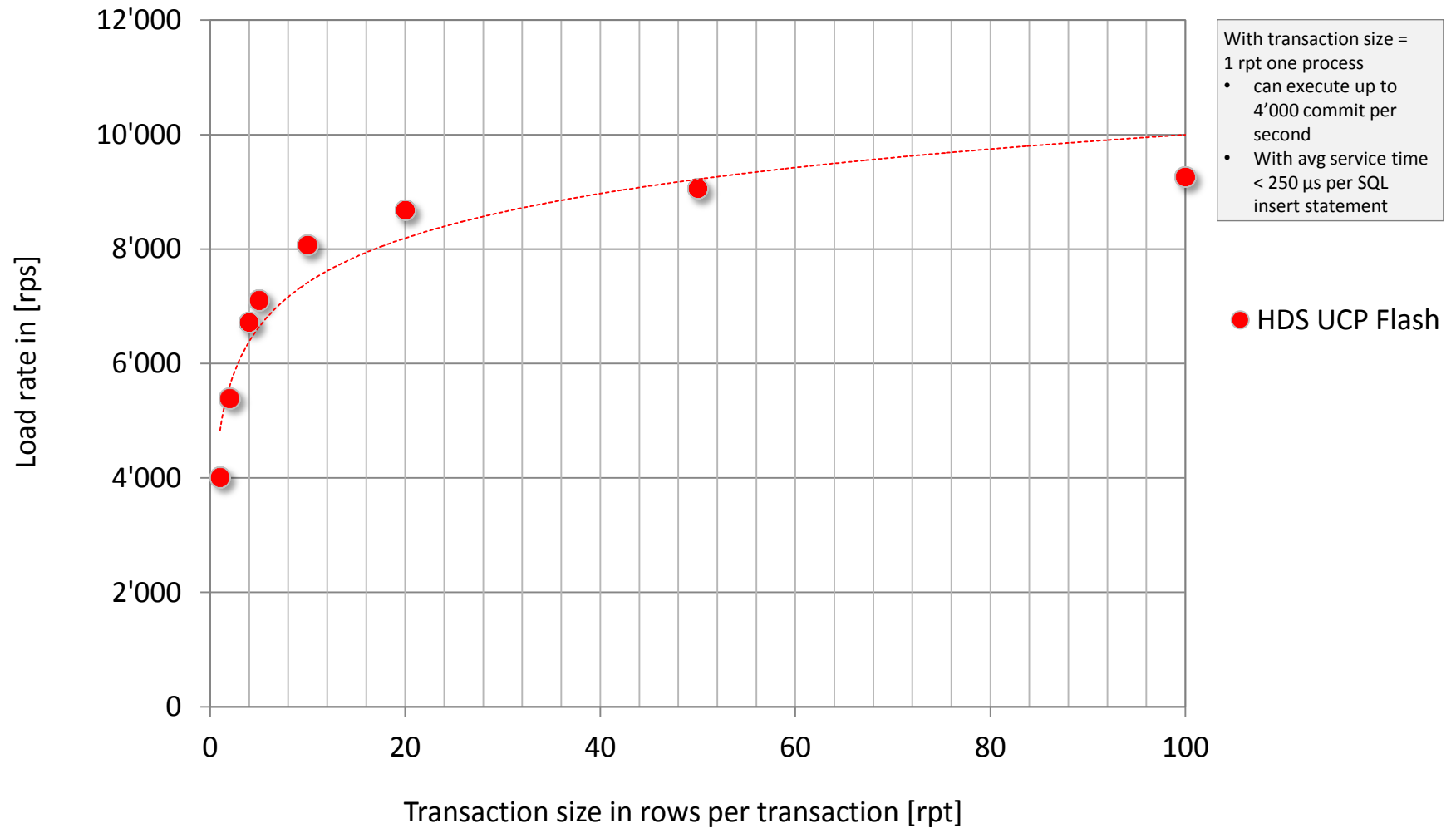


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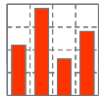
Database Performance



Database transactional load, single process, different transaction size



Database Performance



Database transactional load, single process, different transaction size

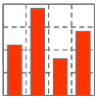
HDS UCP with
Flash

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 [bps]	Physical write [MBps]	REDO size [MBps]	REDO writes [iops]	REDO svt [ms]	REDO sync writes	REDO sync svt [us]	Elap time [s]
22	1 DBL-11	1	1	1	1	5	4.006E+03	4.006E+03	2.493E-04	4112	670	14	7	4008	15	7	14	312
	2 DBL-11	1	1	1	2	5	5.388E+03	2.694E+03	3.704E-04	2831	747	14	7	2694	13	1	87	232
	3 DBL-11	1	1	1	4	4	6.720E+03	1.680E+03	5.928E-04	1882	842	15	8	1683	11	1	75	186
	4 DBL-11	1	1	1	5	4	7.102E+03	1.420E+03	7.018E-04	1700	878	16	8	1424	14	1	187	176
	5 DBL-11	1	1	1	10	4	8.065E+03	8.060E+02	1.239E-03	1185	963	17	9	810	17	1	137	155
	6 DBL-11	1	1	1	20	4	8.681E+03	4.340E+02	2.292E-03	879	986	17	9	439	24	2	86	144
	7 DBL-11	1	1	1	50	4	9.058E+03	1.810E+02	5.476E-03	679	1022	17	9	184	23	1	178	138
	8 DBL-11	1	1	1	100	4	9.259E+03	9.300E+01	1.073E-02	638	1028	17	9	95	29	1	190	135

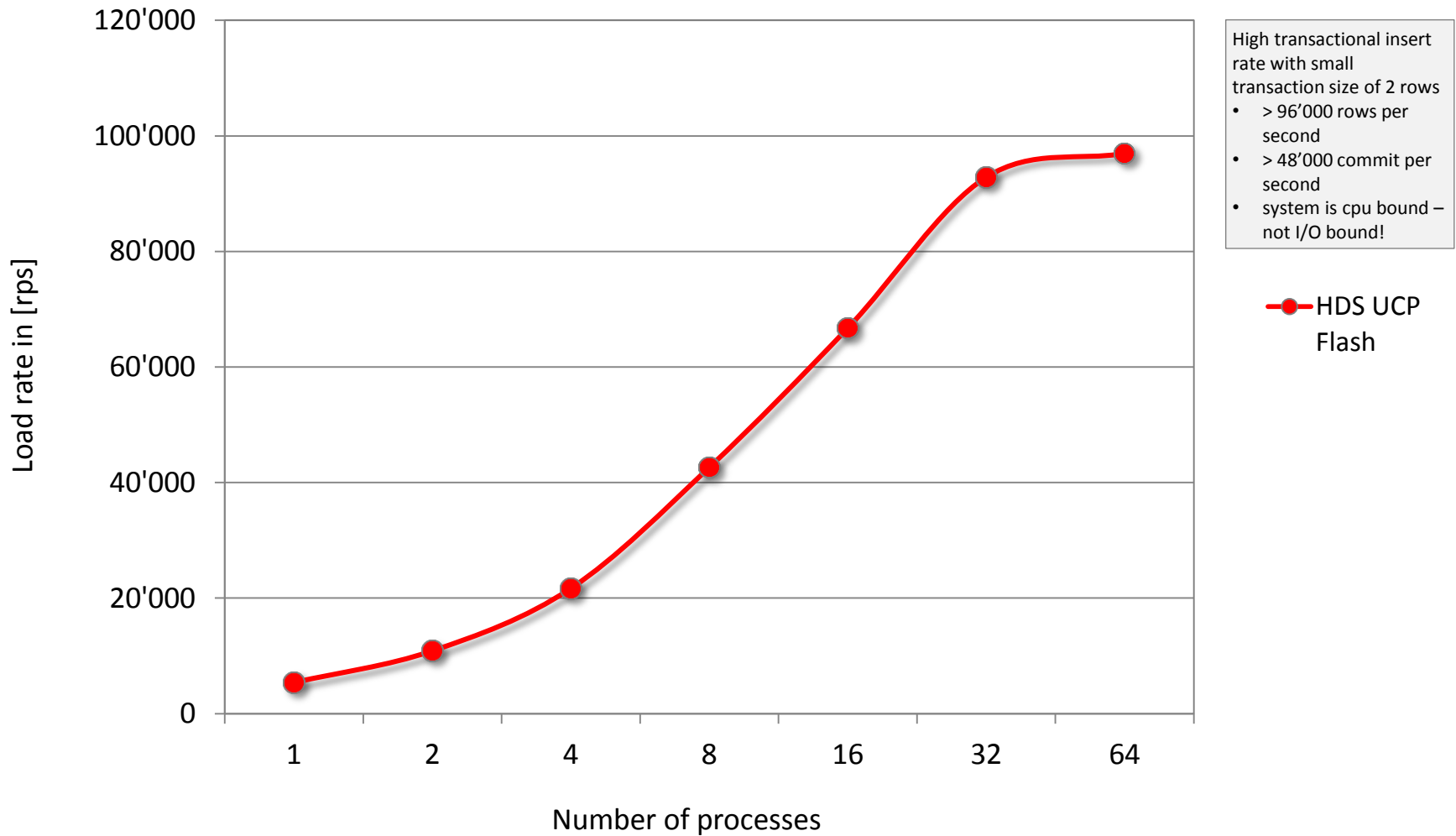
Legend:

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- #T number of threads (PX)
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- [tps] transactions per second
- [iops] i/o operations per second
- [s] time in seconds
- [ms] time in milli seconds
- [μs] time in micro seconds

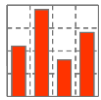
Database Performance



Database transactional load, 2 rows per transaction



Database Performance



Database transactional load, 2 rows per transaction

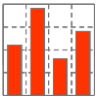
HDS UCP with
Flash

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 [bps]	Physical write [MBps]	REDO size [MBps]	REDO writes [iops]	REDO svt [ms]	REDO sync writes	REDO sync svt [us]	Elap time [s]
23	1 DBL-11	1	1	1	2	4	5.381E+03	2.690E+03	3.700E-04	2843	711	14	7	2691	17	2	56	302
	2 DBL-11	1	2	1	2	8	1.087E+04	5.435E+03	3.674E-04	6499	1537	28	15	5035	15	3	26	299
	3 DBL-11	1	4	1	2	15	2.167E+04	1.083E+04	3.673E-04	13562	3617	85	29	8225	15	4	38	300
	4 DBL-11	1	8	1	2	30	4.262E+04	2.131E+04	3.705E-04	25377	13647	218	57	9224	19	8	33	305
	5 DBL-11	1	16	1	2	65	6.672E+04	3.336E+04	4.624E-04	57007	55552	621	89	5755	34	17	339	326
	6 DBL-11	1	32	1	2	97	9.283E+04	4.641E+04	6.551E-04	40643	42409	573	123	1769	66	34	1884	338
	7 DBL-11	1	64	1	2	98	9.697E+04	4.849E+04	1.290E-03	29586	31928	497	128	200	353	70	12153	330

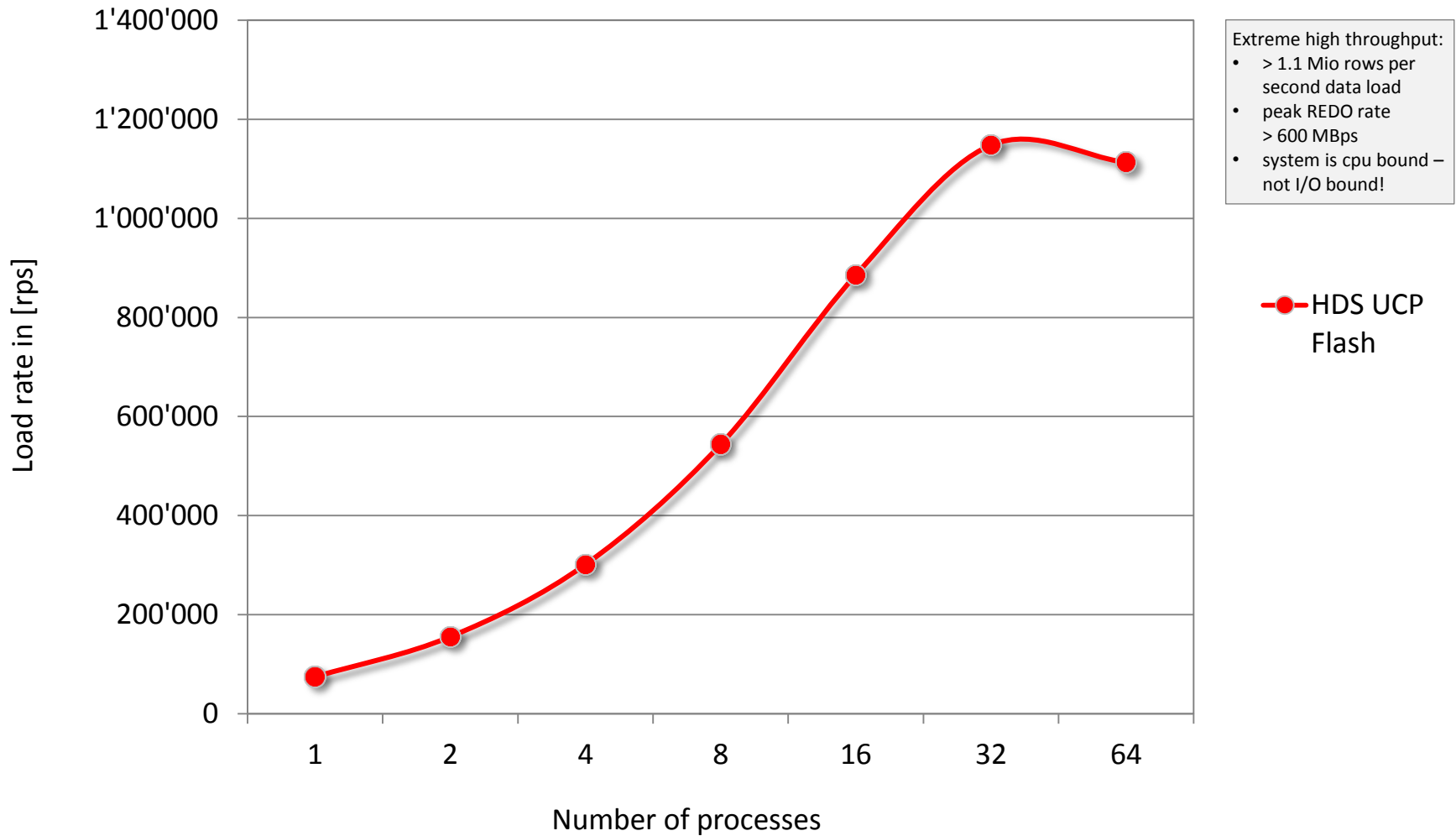
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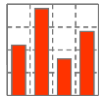
Database Performance



Database bulk load



Database Performance



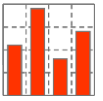
Database bulk load

HDS UCP with
Flash

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 [bps]	Physical write [MBps]	REDO size [MBps]	REDO writes [iops]	REDO svt [ms]	REDO sync writes	REDO sync svt [us]	Elap time [s]
24	1 DBL-21	1	1	1	0	4	7.442E+04	0.000E+00	1.071E+02	712	6688	126	39	43	572	1	144	430
	2 DBL-21	1	2	1	0	8	1.553E+05	0.000E+00	1.023E+02	2660	14725	272	81	73	642	4	249	412
	3 DBL-21	1	4	1	0	14	3.012E+05	0.000E+00	1.051E+02	6160	29061	550	158	137	698	5	555	425
	4 DBL-21	1	8	1	0	28	5.435E+05	0.000E+00	1.148E+02	13872	53055	987	284	224	927	9	1051	471
	5 DBL-21	1	16	1	0	53	8.959E+05	0.000E+00	1.418E+02	21884	85338	1616	464	262	1733	18	2608	578
	6 DBL-21	1	32	1	0	90	1.148E+06	0.000E+00	2.202E+02	29693	105642	2063	601	120	5973	39	6669	892
	7 DBL-21	1	64	1	0	93	1.113E+06	0.000E+00	4.350E+02	28990	104699	2043	595	53	21436	99	27738	1783

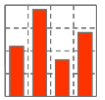
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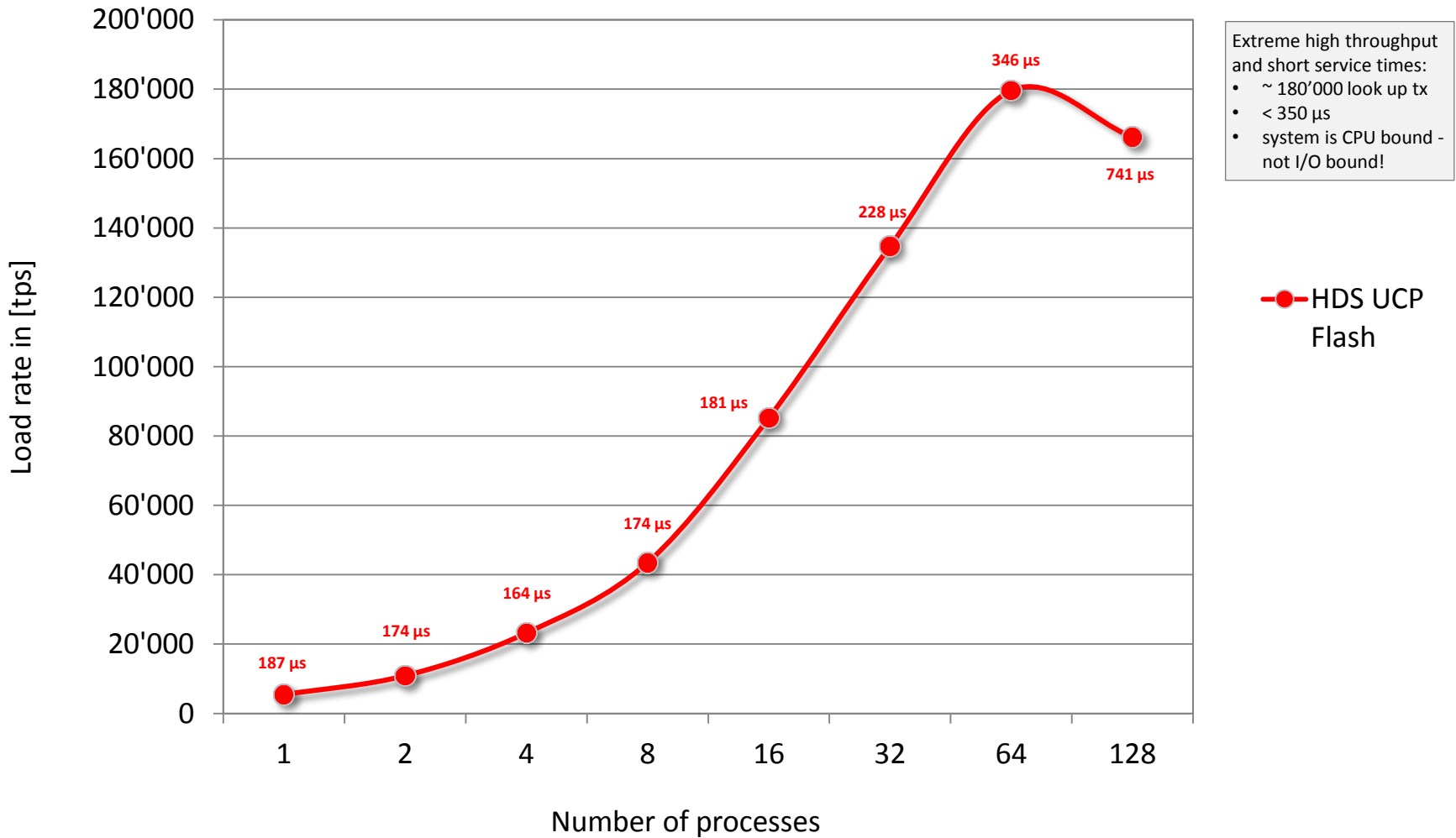


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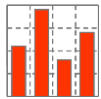
Database Performance



Oracle OLTP select performance, 1 row per transaction



Database Performance



Oracle OLTP select performance, 1 row per transaction

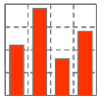
HDS UCP with
Flash

Run	Tst Code	#N	#J	#T	CPU busy [%]	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]
18	1 DBX-12	1	1	1	3	5.320E+03	5.320E+03	1.871E-04	4033	26	6	0	0	32	0	50
	2 DBX-12	1	2	1	5	1.132E+04	1.132E+04	1.737E-04	8608	36	12	0	0	67	0	47
	3 DBX-12	1	4	1	9	2.364E+04	2.364E+04	1.637E-04	18854	50	25	0	0	147	0	45
	4 DBX-12	1	8	1	17	4.433E+04	4.433E+04	1.741E-04	39954	70	46	0	0	312	0	48
	5 DBX-12	1	16	1	33	8.512E+04	8.512E+04	1.811E-04	82951	116	89	0	0	648	1	50
	6 DBX-12	1	32	1	62	1.351E+05	1.351E+05	2.278E-04	137238	164	140	0	0	1072	1	63
	7 DBX-12	1	64	1	92	1.811E+05	1.811E+05	3.456E-04	187886	205	187	0	0	1468	1	94
	8 DBX-12	1	128	1	99	1.677E+05	1.677E+05	7.412E-04	197388	190	175	0	0	1542	0	203

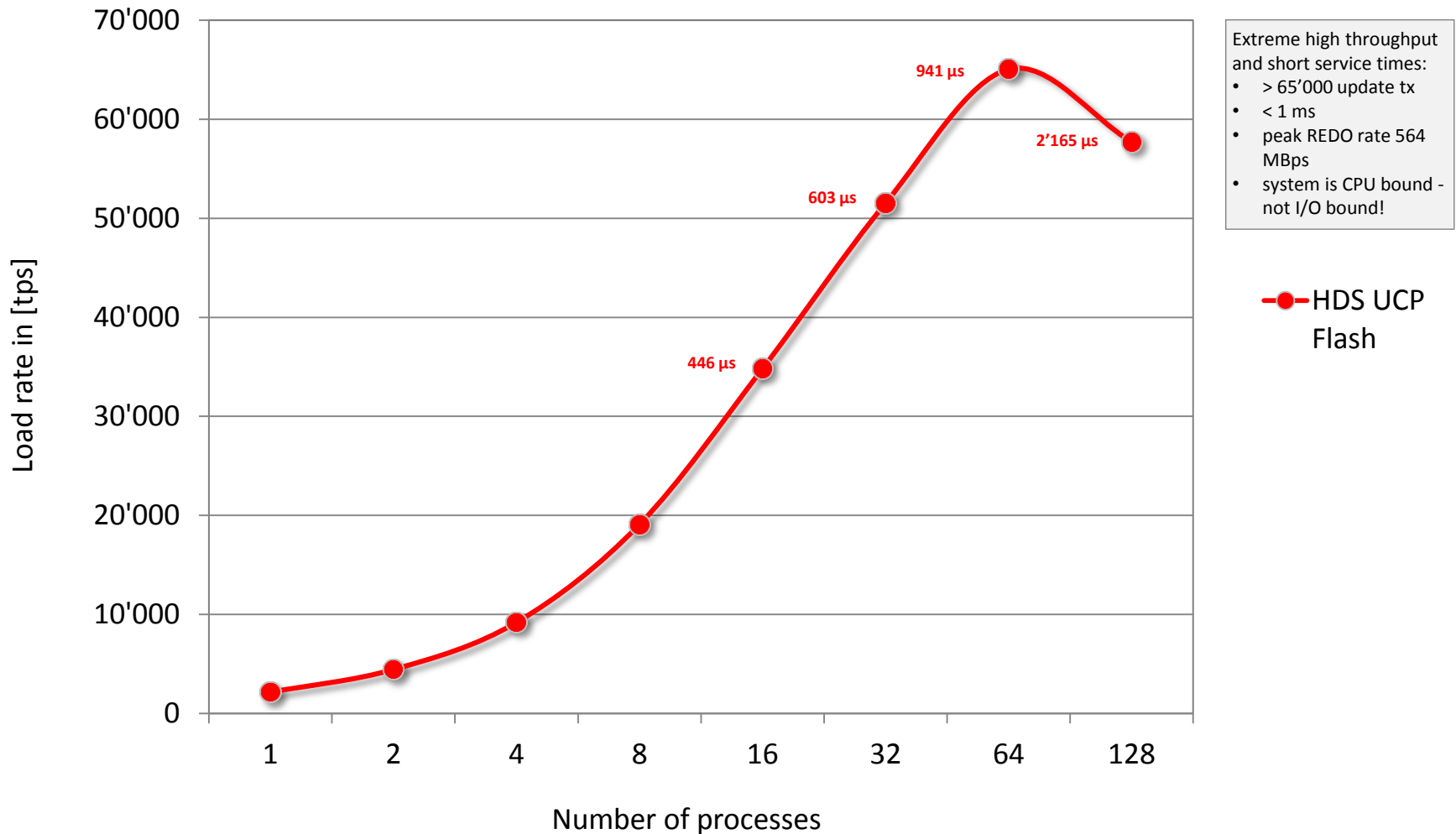
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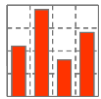
Database Performance



Oracle OLTP update performance, 1 row per transaction



Database Performance



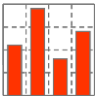
Oracle OLTP update performance, 1 row per transaction

HDS UCP with
Flash

Run	Tst Code	#N	#J	#T	CPU busy [%]	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]
26	9 DBX-22	1	1	1	4	2.138E+03	2.138E+03	4.646E-04	4368	4437	2143	0	0	34	21	58
	10 DBX-22	1	2	1	7	4.414E+03	4.429E+03	4.467E-04	8885	8799	3957	0	0	69	42	56
	11 DBX-22	1	4	1	12	9.133E+03	9.185E+03	4.194E-04	18140	17274	7120	0	0	142	86	54
	12 DBX-22	1	8	1	22	1.904E+04	1.908E+04	4.044E-04	36965	32984	11809	0	0	289	178	52
	13 DBX-22	1	16	1	40	3.467E+04	3.481E+04	4.465E-04	65306	53268	12839	0	0	510	322	57
	14 DBX-22	1	32	1	65	5.133E+04	5.153E+04	6.038E-04	94047	70609	8748	0	0	735	482	77
	15 DBX-22	1	64	1	86	6.483E+04	6.505E+04	9.411E-04	117187	71905	3685	0	0	916	564	122
	16 DBX-22	1	128	1	80	5.750E+04	5.772E+04	2.165E-03	103195	63913	3814	0	0	833	526	275

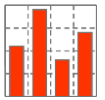
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Benchmark Results

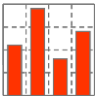


Summary Database Performance

Database Performance Data Load	Metric		HDS UCP With Server internal Flash
Un-Compressed			
▪ Conventional OLTP insert [rps]	[rps]		96'970
▪ Bulk load [rps]	[rps]		1'148'000

Database Performance OLTP Transactions 1 hit per transaction	Metric		HDS UCP With Server internal Flash
Select transaction			
▪ Throughput	[tps]		181'100
▪ Service time	[ms]		0.346
Update transaction			
▪ Throughput	[tps]		65'050
▪ Service Time	[ms]		0.941

Benchmark Results



Reviewing Database Performance

- This is new: all database load benchmark tests are cpu-bound instead of I/O-bound
- Database load and OLTP transactions
 - Extreme high throughput
 - Extreme low service times
- HDS UCP with Flash is excellent platform for all kind of OLTP and DWH operations

BENCHWARE

swiss precision in performance measurement

www.benchmarkware.ch

info@benchmarkware.ch