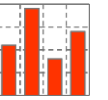


Introduction to Server (SRV) Performance Tests with Oracle

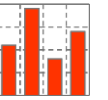
Technical Presentation

September 2014



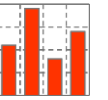
- 1 Why measure SRV performance?
- 2 What is measured?
- 3 Overview of SRV performance tests
- 4 Monitoring SRV performance tests
- 5 Example
- 6 Summary

Why measure Server Performance?



- Applications tend to operate in memory as much as possible to avoid slow I/O operations
 - Delivers best possible Oracle transaction performance
 - Increases CPU utilization
 - Reduces Oracle license costs by reducing the number of necessary cores (Enterprise Edition) or sockets (Standard Edition)

Why measure Server Performance?

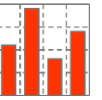


Server memory capacities and costs

- Server support large memory capacities
 - IBM POWER 16 TByte RAM
 - Intel x86 12 TByte RAM
 - Intel Itanium 8 TByte RAM
 - Oracle SPARC 32 TByte RAM

- Memory has become cheap, list price for 1 TByte RAM
 - x86 server: ~ 25'000 USD using 16 GByte DIMM
 - x86 server: ~ 40'000 USD using 32 GByte DIMM
 - RISC server: ~ 50'000 USD using 16 GByte DIMM
 - RISC server: ~ 70'000 USD using 32 GByte DIMM

Why measure Server Performance?

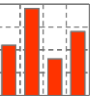


- Oracle recognized the in-memory trend since Version 7 ^[1] and provides specific features for in-memory processing
 - Different buffer cache types for object pinning
 - Parallel SQL for large in-memory objects
 - New 12c In-Memory Option with column store in addition to row store
- Benchware performance tests are useful to determine performance capabilities of 2 and 4 socket server (Oracle SE versus Oracle EE) ^[2]
 - EE is based on core licensing
 - SE is based on socket licensing, but limited to 4 sockets
 - SE1 is based on socket licensing, but limited to 2 sockets

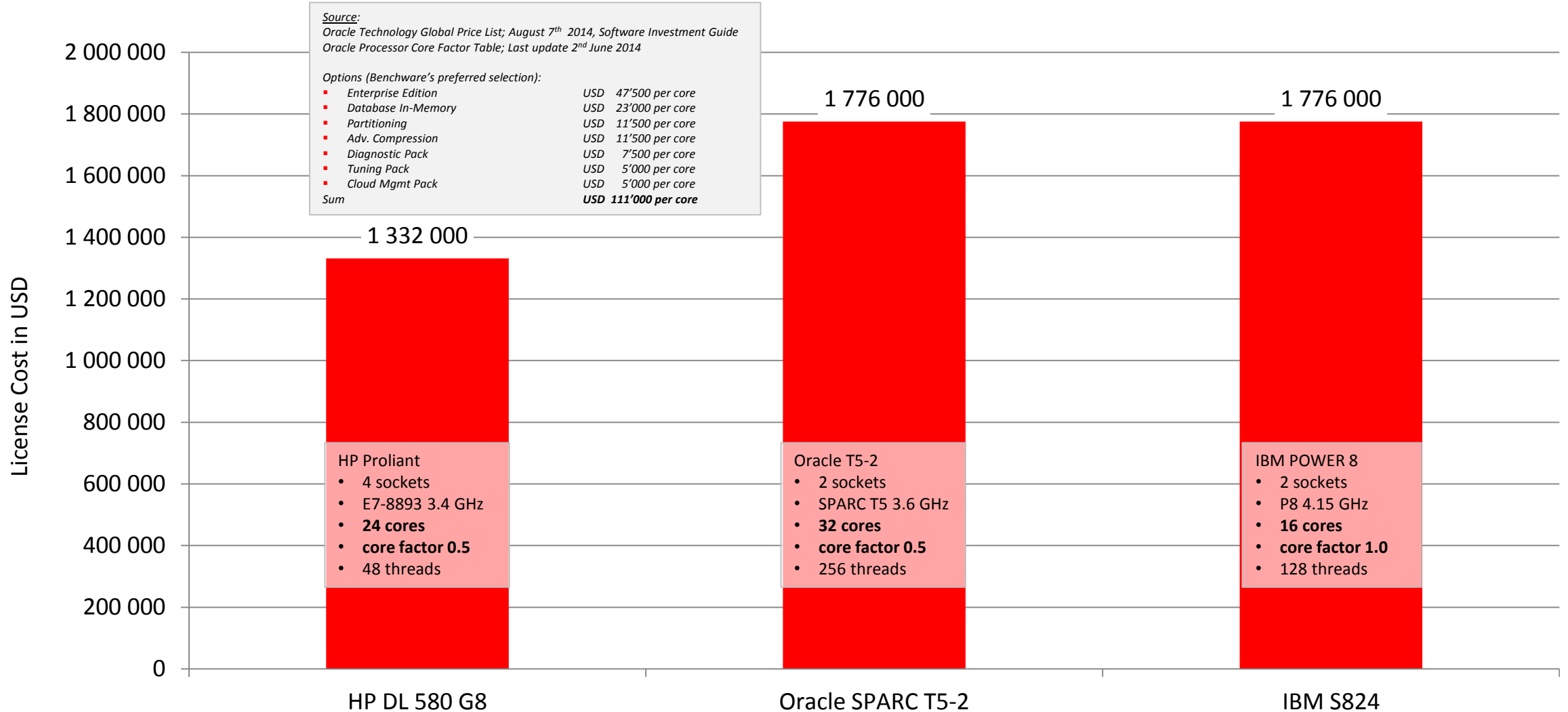
[1] Oracle Version 7.1 introduced the support of 64bit computer systems with the very large memory option

[2] Feinberg, Disbrow: Consider Oracle Standard Edition to Reduce Database Management Systems Costs, Gartner RAC Core Research Note G00174599, 3 March 2010

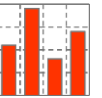
Oracle Enterprise Edition (EE)



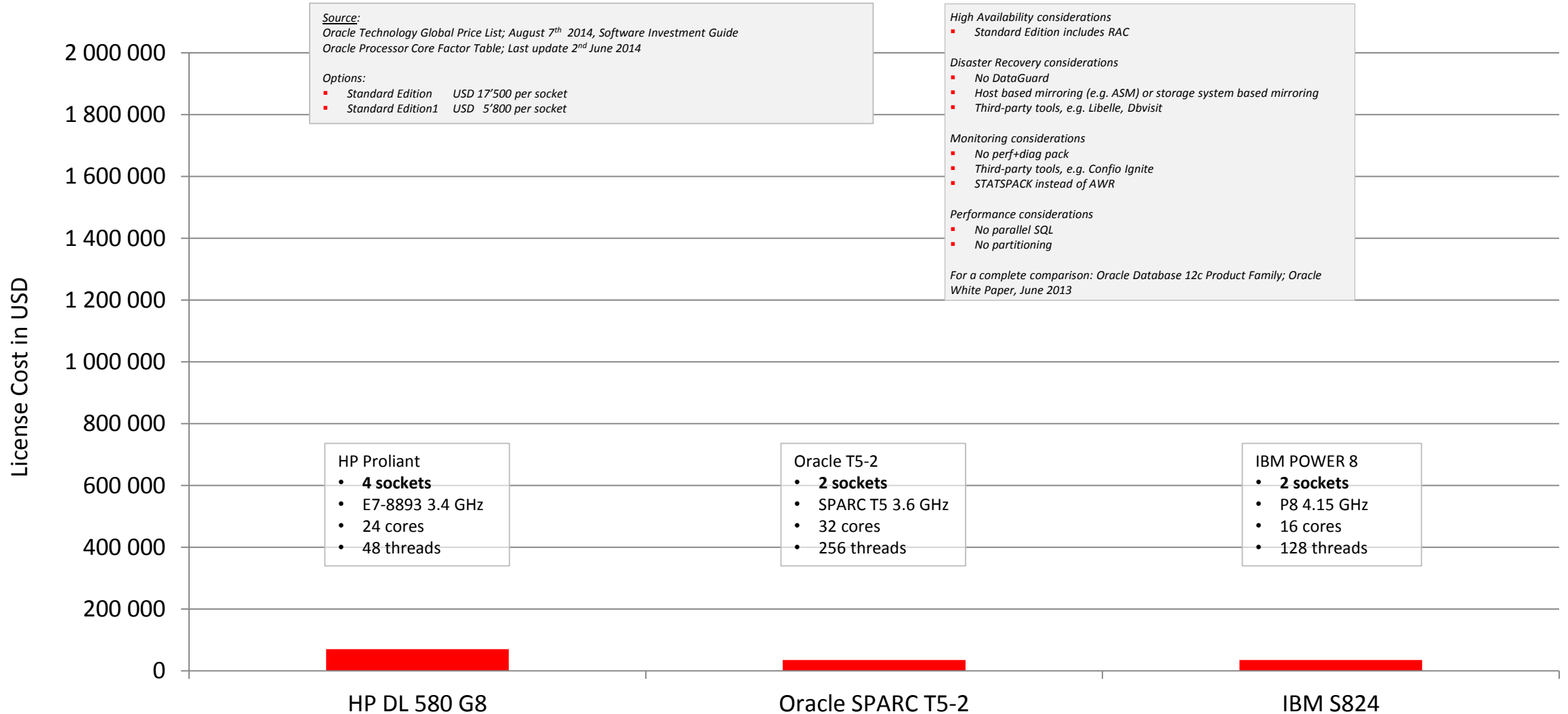
Core based licensing



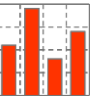
Oracle Standard Edition (SE)



Socket based licensing

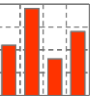


What is measured?



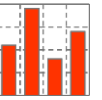
- Speed of single thread
 - Rows per second [rps]
 - Transactions per second [tps]
 - SQL service time in [s]
- System throughput
 - Rows per second [rps]
 - Transactions per second [tps]
 - SQL service time in [s]
 - Oracle database block gets per second (logical I/O) in [dbps]
- Scalability
 - Throughput per process for $n = \{1, 2, 4, 8, \dots, n\}$
- Efficiency of
 - Huge pages
 - NUMA architectures
 - Virtualization

What is measured?



- Server performance from the Oracle point of view
 - Tables pinned in KEEP cache (24 columns, 300 byte avg row length)
 - No I/O operations
 - Oracle SQL in-memory transactions on objects pinned in KEEP cache
- One typical analytic transaction
 - Selection of all rows via full table scan e.g. searching for specific pattern
- Two typical OLTP transactions
 - Selection of one random row via primary key (1 row per SQL), e.g. searching for bank account, product number, order number
 - Selection of a set of random rows via secondary key (Ø 25 rows per SQL), e.g. part list of order, last 25 transactions of bank account

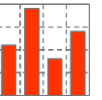
Overview of SRV performance tests with Benchware test codes



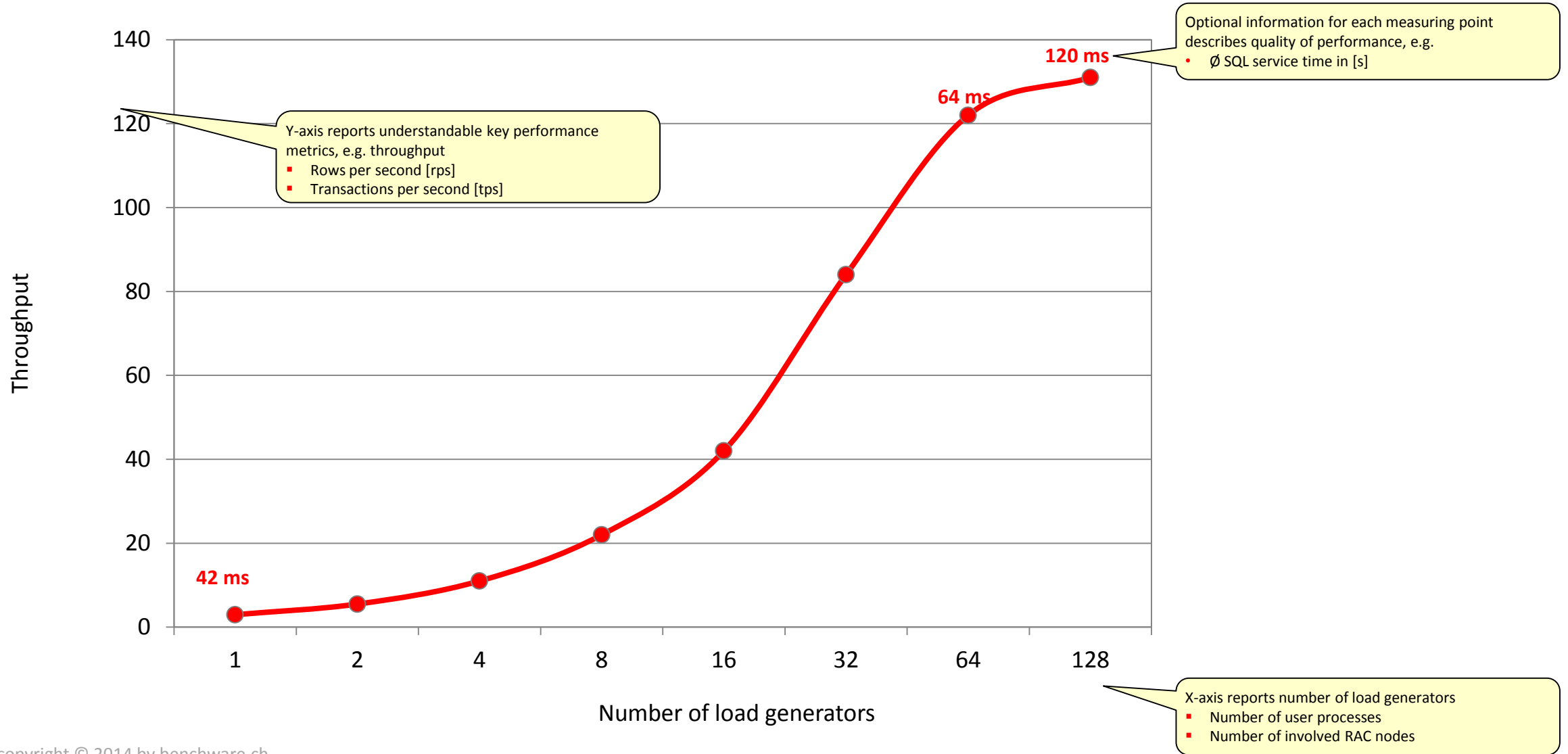
Oracle Server Performance	Test Code for SELECT
Server-bound SQL database transactions on in-memory data objects - no I/O operations	
<ul style="list-style-type: none">All rows, full table scan	SRV-11
<ul style="list-style-type: none">Single row, primary key Returns 1 row per SQL statement	SRV-21
<ul style="list-style-type: none">Multi row, secondary key Returns Ø 25 rows per SQL statement	SRV-31

- All operations use RAM and cause nearly no I/O operations. Therefore all operations are server bound.
- In some cases cost effective 2 socket servers with Oracle Standard Edition are able to deliver the required performance. These tests are useful to determine the performance border between 2 socket and 2+ socket server. Take a look at Gartner Research Note: Consider Oracle Standard Edition to Reduce Database Management System Costs, 3. March 2010
- In-memory performance numbers may be important when evaluating Oracle Times Ten versus Oracle RDBMS

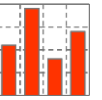
Monitoring SRV performance tests



All load profiles from single process to saturation



Monitoring SRV performance tests



Key performance metrics

- CPU utilization
- Speed in [tps] or [rps]
- Throughput in [tps] or [rps]

Speed:

- Only 1 process
- No conflicts
- No contention

Column 'SQL service time' describes SQL response time at application level

Column 'buffer lread' describes the number of logical I/O in the buffer cache KEEP

Column 'buffer pread' describes the number of physical I/O to the buffer cache KEEP – should be zero for best performance

Run	Tst Code	#N	#J	#T	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Throughput rows/sec [rps]	Throughput txn/sec [tps]	SQL service time [s]	Buffer lread [dbps]	Buffer pread [dbps]	Elap time [s]
6	28 SRV-31	1	1	1	1	1	0	99	2.413E+05	9.652E+03	1.034E-04	2.608E+05	1.000E+00	302
	29 SRV-31	1	2	1	1	1	0	99	4.690E+05	1.876E+04	1.057E-04	5.066E+05	1.000E+00	302
	30 SRV-31	1	4	1	2	1	0	98	8.941E+05	3.576E+04	1.112E-04	9.654E+05	2.000E+00	303
	31 SRV-31	1	8	1	3	2	1	97	1.706E+06	6.825E+04	1.158E-04	1.842E+06	4.000E+00	303
...
	39 SRV-31	8	256	1	67	61	6	33	4.600E+07	1.840E+06	1.371E-04	4.952E+07	6.000E+01	304
	40 SRV-31	8	512	1	98	90	8	2	5.346E+07	2.138E+06	2.330E-04	5.749E+07	5.900E+01	307

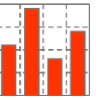
Legend:

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

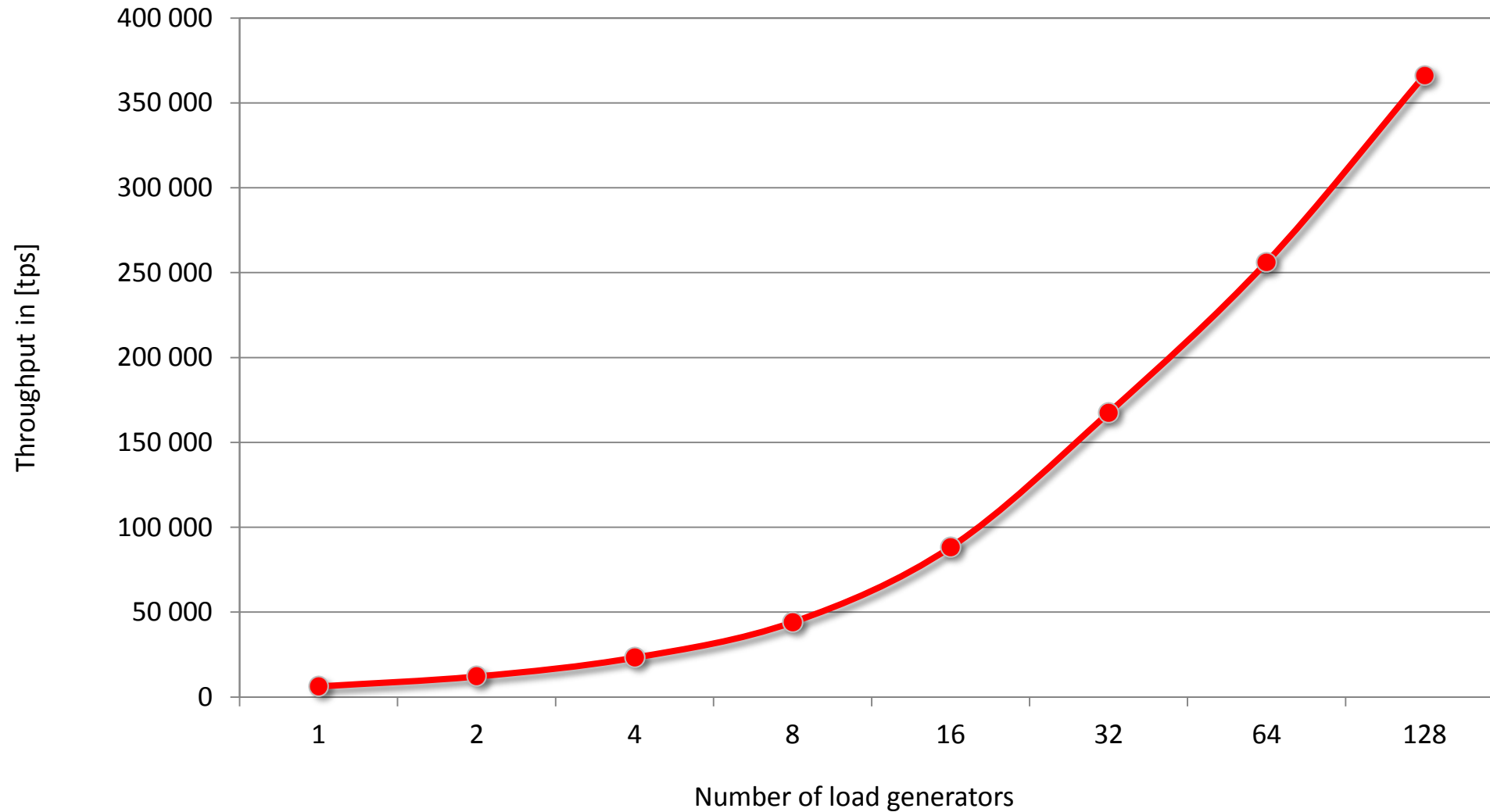
Max throughput:

- All cpu resources are utilized
- Shows efficiency of multithreading

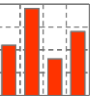
Example of SRV performance results



Oracle in-memory SQL: heavy OLTP transaction, \emptyset 25 rows per transaction



Example of SRV performance results

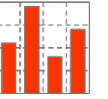


Oracle in-memory SQL: heavy OLTP transaction, Ø 25 rows per transaction

Run	Tst	Code	#N	#J	#T	CPU busy [%]	CPU user [%]	CPU sys [%]	CPU idle [%]	Throughput rows/sec [rps]	Throughput txn/sec [tps]	SQL service time [s]	Buffer lread [bps]	Buffer pread [bps]	Elap time [s]
2	110	SRV-31	1	1	1	0	0	0	100	1.571E+05	6.283E+03	1.590E-04	1.696E+05	0.000E+00	113
	111	SRV-31	1	2	1	1	1	0	99	3.035E+05	1.214E+04	1.646E-04	3.277E+05	0.000E+00	117
	112	SRV-31	1	4	1	2	2	0	98	5.805E+05	2.322E+04	1.698E-04	6.266E+05	0.000E+00	121
	113	SRV-31	1	8	1	3	3	0	97	1.103E+06	4.410E+04	1.790E-04	1.190E+06	0.000E+00	122
	114	SRV-31	1	16	1	6	6	0	94	2.207E+06	8.828E+04	1.798E-04	2.380E+06	0.000E+00	122
	115	SRV-31	1	32	1	12	12	0	88	4.185E+06	1.674E+05	1.898E-04	4.506E+06	0.000E+00	122
	116	SRV-31	1	64	1	25	24	0	75	6.403E+06	2.561E+05	2.461E-04	6.889E+06	0.000E+00	123
	117	SRV-31	1	128	1	49	48	1	51	9.157E+06	3.662E+05	3.392E-04	9.827E+06	0.000E+00	125

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

Summary



Reviewing Server Performance

- Benchware proves real world Server performance with in-memory Oracle SQL transactions
- These representative performance tests for OLTP and analytic database applications deliver fundamental key performance metrics for server systems

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