

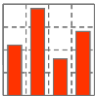
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# Performance Baseline of HP Proliant Oracle Platform

Part II: Server (SRV) Performance

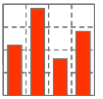
Technical Presentation

February 2014



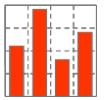
- 1 Introduction to Server (SRV) Performance Tests**
- 2 CPU and Server Configuration
- 3 Benchmark Results – In-Memory SQL Operations
- 4 Reviewing Server Benchmark Results

# Server Performance



## Why measure Server Performance?

- Applications tend to operate in memory as much as possible to avoid slow I/O operations
- Server support large memory capacities
  - Intel x86                      2 TByte RAM
  - Intel Itanium                8 TByte RAM
  - IBM Power                    16 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:                    ~ 60'000 USD using 32 GByte DIMM
  - RISC server:                  ~ 55'000 USD using 16 GByte DIMM

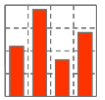


## Why measure Server Performance?

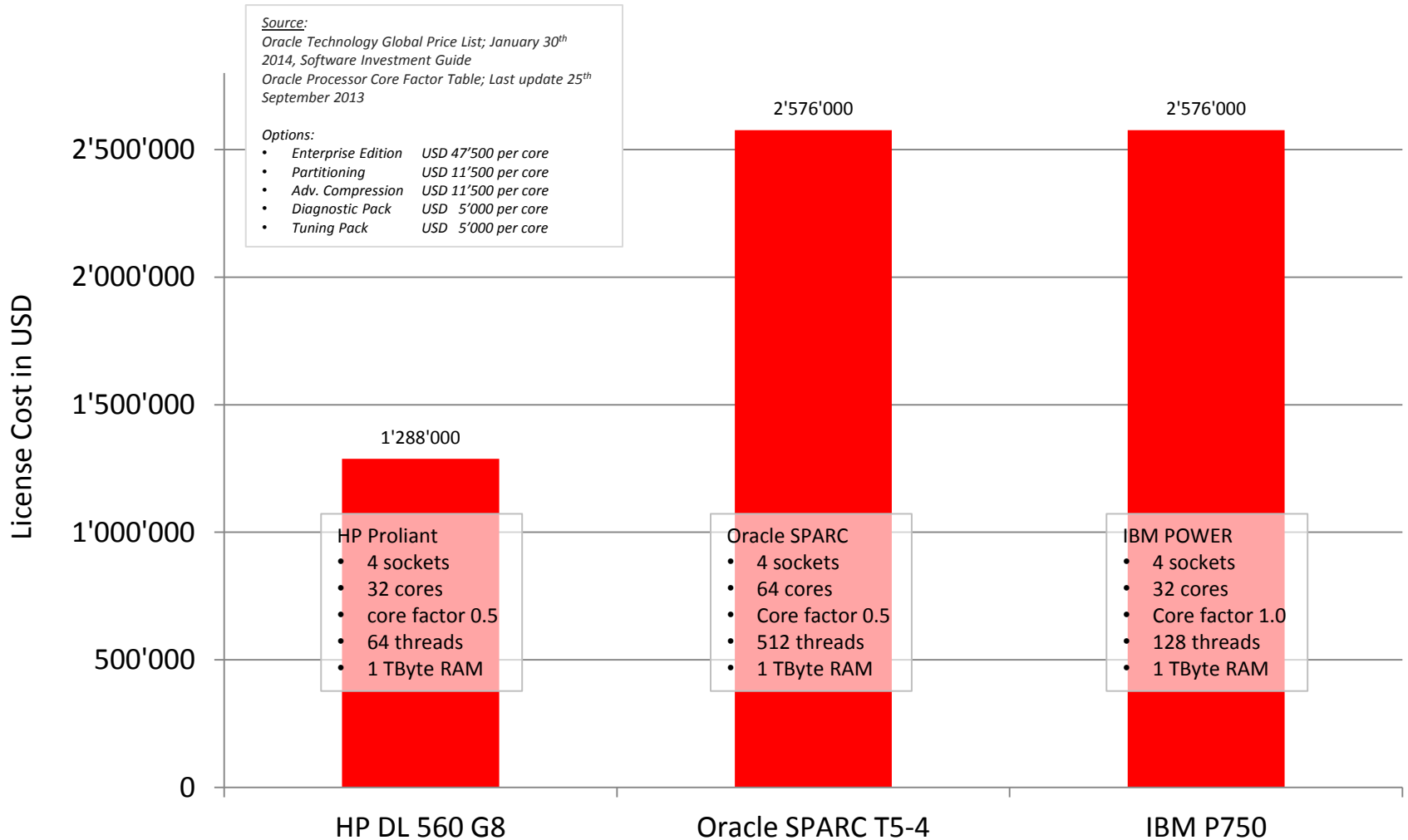
- Oracle recognized this trend and provides specific features for in-memory processing
  - Different Cache types for object pinning
  - Parallel SQL for large in-memory objects
  - New 12c Release 2 In-Memory Option
- These tests are useful to determine performance capabilities of 2 socket server (Oracle SE versus Oracle EE) <sup>1)</sup>
  - 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

<sup>1)</sup> *Feinberg, Disbrow: Consider Oracle Standard Edition to Reduce Database Management Systems Costs, Gartner RAC Core Research Note G00174599, 3 March 2010*

# Server Performance



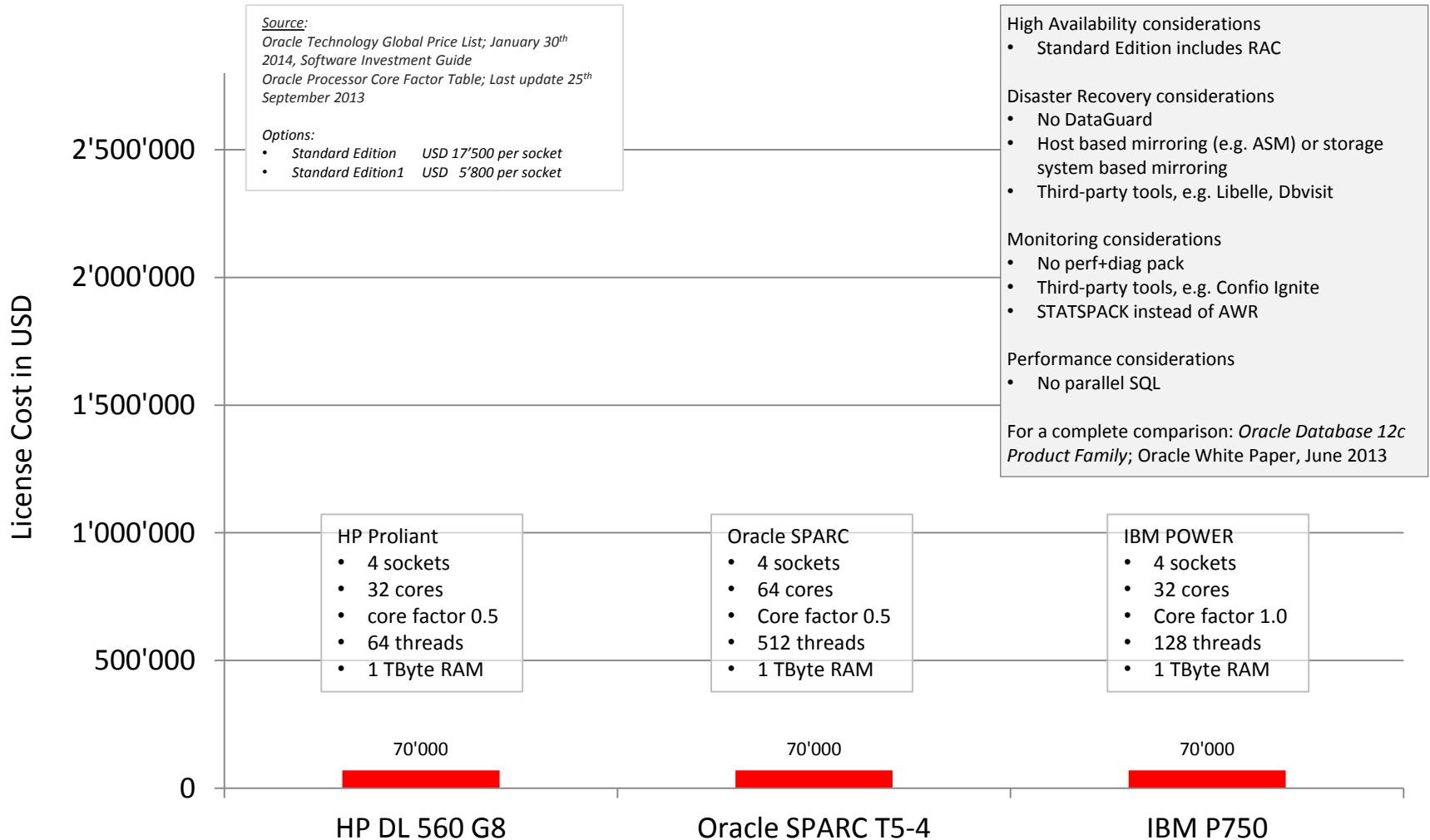
## Oracle EE Core Licensing – Price Performance Ratio?



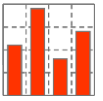
# Server Performance



## Oracle SE Socket Licensing – Price Performance Ratio?

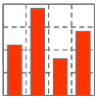


# Server Performance



## What is measured?

- Server performance from the Oracle point of view
  - No I/O operations
  - Oracle SQL transactions on objects pinned in KEEP cache
- Speed of single thread
  - Rows per second [rps]
  - Transactions per second [tps]
  - Service time in [s]
- Maximum throughput of system
  - Rows per second [rps]
  - Transactions per second [tps]
  - 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 and NUMA architectures when using large RAM capacities
  - Virtualization

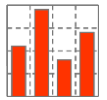


How is Server Performance measured?

- Benchware Loader pins objects in Oracle SGA
- Three typical Oracle transaction profiles
  - Selection of all rows via full table scan (all rows per SQL), e.g. for data analytics
  - Selection of one random row via primary key (1 row per SQL), e.g. searching for bank account, product number, order number
  - Selection of many random rows via secondary key (Ø 25 rows per SQL), e.g. part list of order, last 25 transactions of bank account



# Server Performance



## Overview of Server performance tests with Benchware test codes

Oracle Server Performance	Test Code for	Test Code for	Test Code for	Test Code for
Server-bound SQL database transactions on in-memory data objects - no I/O operations	SELECT	INSERT	UPDATE	DELETE
▪ All rows, full table scan	SRV-11	1)	2)	3)
▪ Single row, primary key 1 hit per SQL statement	SRV-21	1)	2)	3)
▪ Multi row, secondary key 25 hits per SQL statement	SRV-31	1)	2)	3)

<sup>1)</sup> Inserting rows generates massive I/O, we use this scenario for the LGWR stress test (test code DBL-12), but not for server tests.

<sup>2)</sup> Updating rows of in memory tables generates massive I/O, we use this scenario for the DBWR stress test (test code STO-42), but not for server tests.

<sup>3)</sup> SQL delete statements are currently not part of our benchmark suite.

### Remarks:

- 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

# Server Performance



## Monitoring

### ■ CPU utilization, speed and throughput

Speed:

- Only 1 process
- No conflicts
- No contention

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]
22	18	SRV-31	1	1	1	2	1	0	98	2.496E+05	9.983E+03	9.984E-05	2.696E+05	0.000E+00	303
	19	SRV-31	1	2	1	3	2	0	97	4.845E+05	1.938E+04	1.031E-04	5.232E+05	0.000E+00	298
	20	SRV-31	1	4	1	5	4	1	95	9.457E+05	3.782E+04	1.050E-04	1.021E+06	0.000E+00	301
	21	SRV-31	1	8	1	9	8	1	91	1.838E+06	7.352E+04	1.079E-04	1.983E+06	0.000E+00	303
	22	SRV-31	1	16	1	17	16	1	83	2.955E+06	1.182E+05	1.340E-04	3.183E+06	0.000E+00	302
	23	SRV-31	1	32	1	25	23	2	75	3.445E+06	1.378E+05	2.290E-04	3.707E+06	0.000E+00	303
	24	SRV-31	2	64	1	50	46	4	50	6.912E+06	2.765E+05	2.286E-04	7.436E+06	0.000E+00	302
	25	SRV-31	4	128	1	99	91	7	1	1.382E+07	5.529E+05	2.280E-04	1.488E+07	1.000E+00	303

**Legend:**

- Run benchmark run id
- Tst benchmark test id
- Code benchmark test code
- #N number of RAC nodes
- #J number of jobs
- #T number of threads (PX)
- [rps] rows per second
- [tps] transactions per second
- [dbps] database blocks per second
- [s] elapsed time in seconds

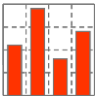
Max throughput:

- All cpu resources are utilized

- Column 'buffer lread' describes the number of logical I/O in the buffer cache KEEP
- Colum 'buffer pread' describes the number of physical I/O to the buffer cache KEEP – should be zero for best performance
- Column 'SQL service time' describes response time at application level

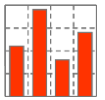
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# Server Performance



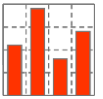
## CPU architecture

CPU	E5-2690 Sandy Bridge	E5-4650 Sandy Bridge	E7-4870 Westmere
Launch date	2012	2012	2011
Clock rate [GHz]	2.9	2.7	2.4
Max number of sockets	2	4	4
#cores per socket	8	8	10
Multithreading	2-fold	2-fold	2-fold
<b>Performance Numbers from other Benchmarks</b>			
SPECint_base2006 (speed)	55.4	50.5	38.1
Oracle CPU speed in sys.aux_stats\$	2605	-	-

Remark:

- Oracle has an internal estimation about CPU speed in sys.aux\_stats\$, but none estimation about CPU throughput.
- This value does not correlate with SPECint\_base2006

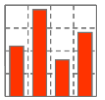
# Server Performance



## Server configuration

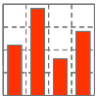
Server	DL 380 G8	DL 560 G8	DL 980 G7 <small>*) With HP PREMA</small>
CPU type	E5-2690	E5-4650	E7-4870
#sockets	2	4	8 *)
#cores	16	32	80
#threads	32	64	160
<b>Performance Numbers from other Benchmarks</b>			
SPECint_base_rate_2006 (throughput)	670	1'200	2'070
<b>Software</b>			
Operating System	Linux	Linux	Linux
Oracle Database System	11.2.0.3	11.2.0.3	11.2.0.3
Benchware Performance Suite			

# Server Performance



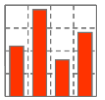
## Oracle Licensing

Oracle Enterprise Edition	DL 380 G8	DL 560 G8	DL 980 G7 <small>*) With HP PREMA</small>
Oracle core license factor	x 0.5	x 0.5	x 0.5
Oracle license cost <small>(list price 30th of January 2014)</small>			
<ul style="list-style-type: none"> <li>▪ Enterprise Edition (47'500)</li> <li>▪ Partition Option (11'500)</li> <li>▪ Diagnostic Pack (5'000)</li> <li>▪ Tuning Pack (5'000)</li> </ul>	<p>380'000</p> <p>92'000</p> <p>40'000</p> <p>40'000</p>	<p>760'000</p> <p>184'000</p> <p>80'000</p> <p>80'000</p>	<p>1'900'000</p> <p>460'000</p> <p>200'000</p> <p>200'000</p>
Total Oracle license cost	552'000	1'104'000	2'760'000
Oracle Standard Edition	DL 380 G8	DL 560 G8	DL 980 G7
#sockets	2	4	8 *)
Oracle Standard Edition license cost (17'500 per socket)	35'000	70'000	-
Oracle Standard Edition One license cost (5'800 per socket)	11'600	23'200	-

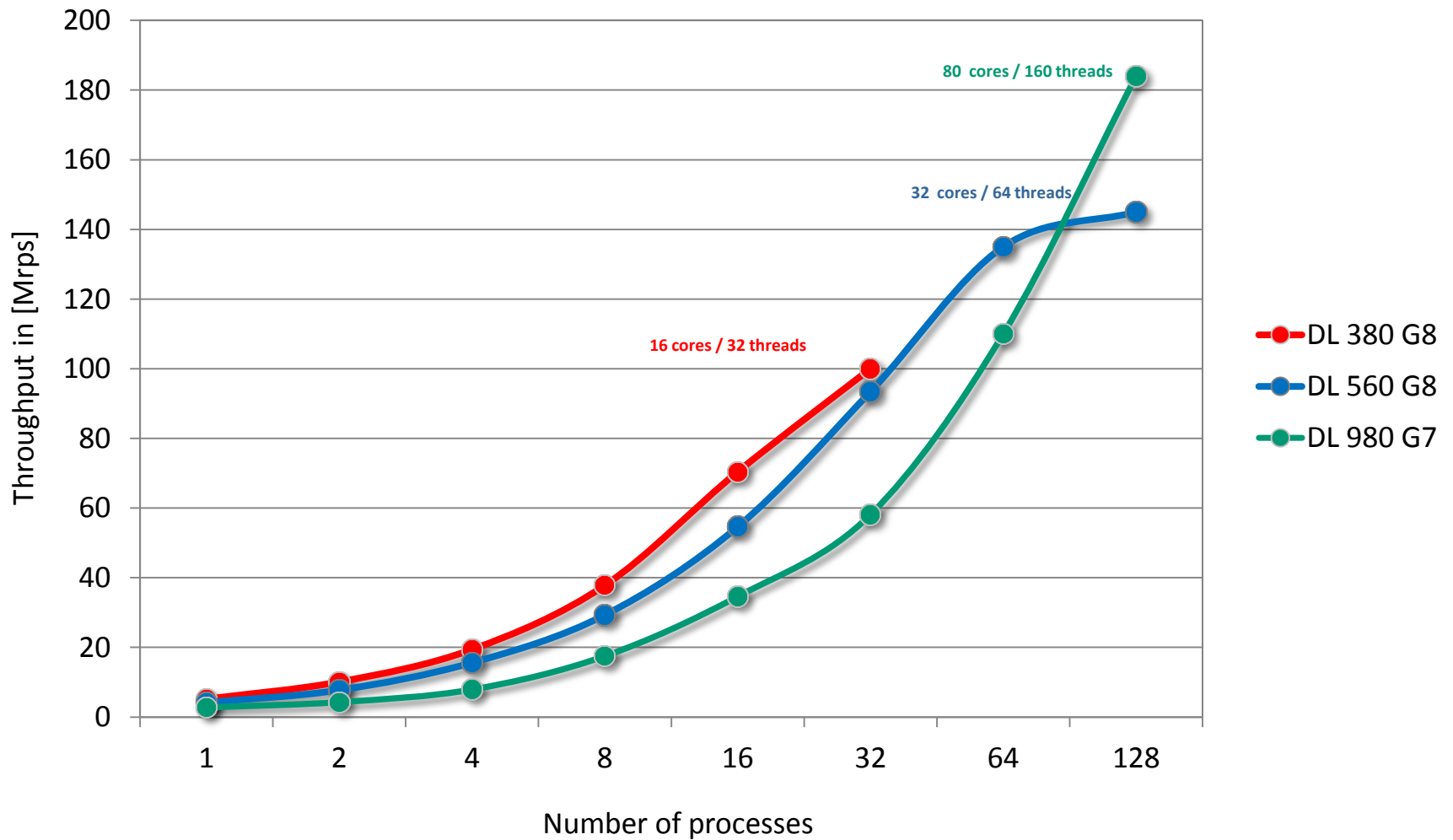


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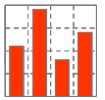


In-memory SQL, full table scan

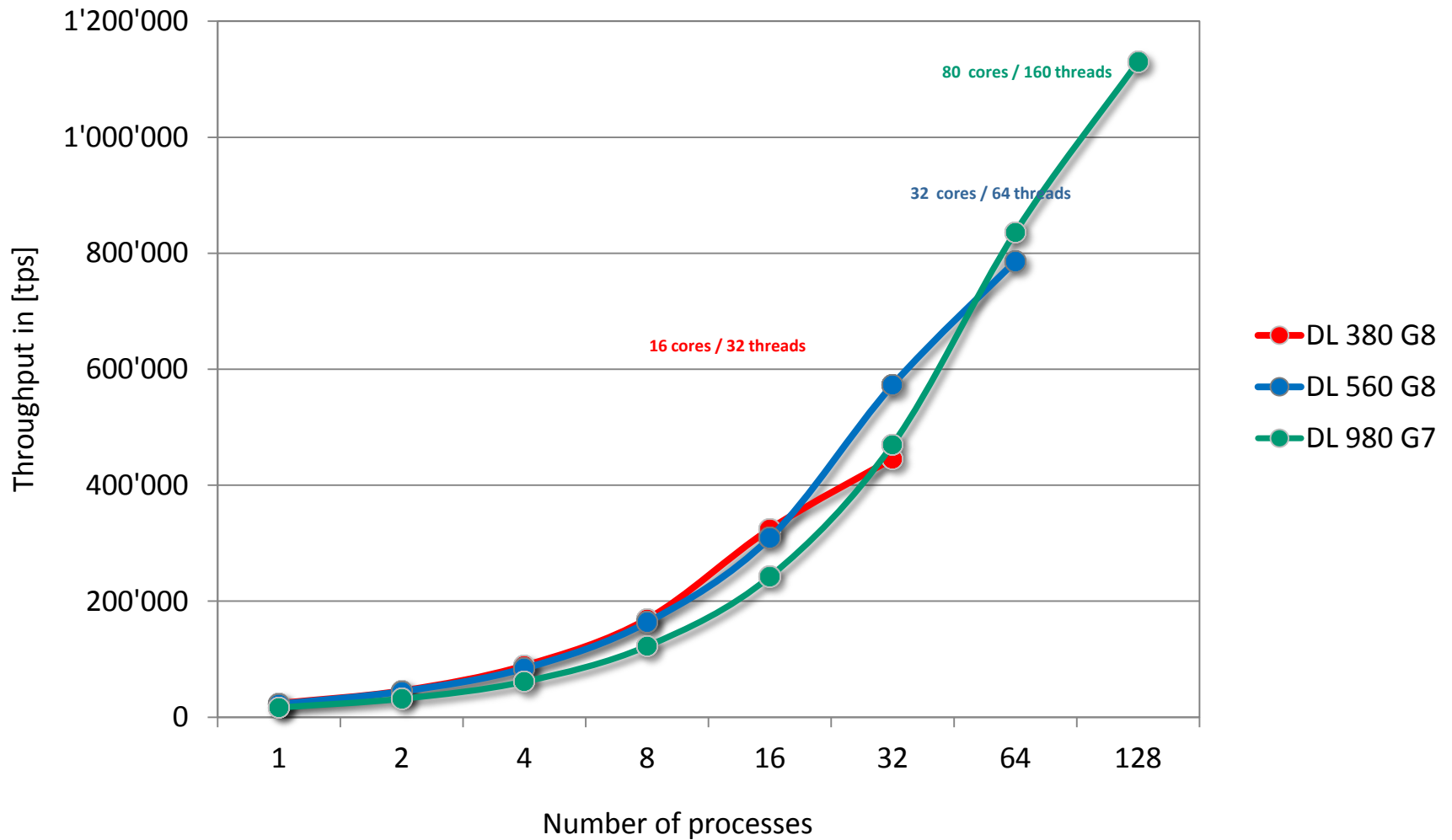




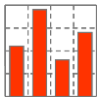
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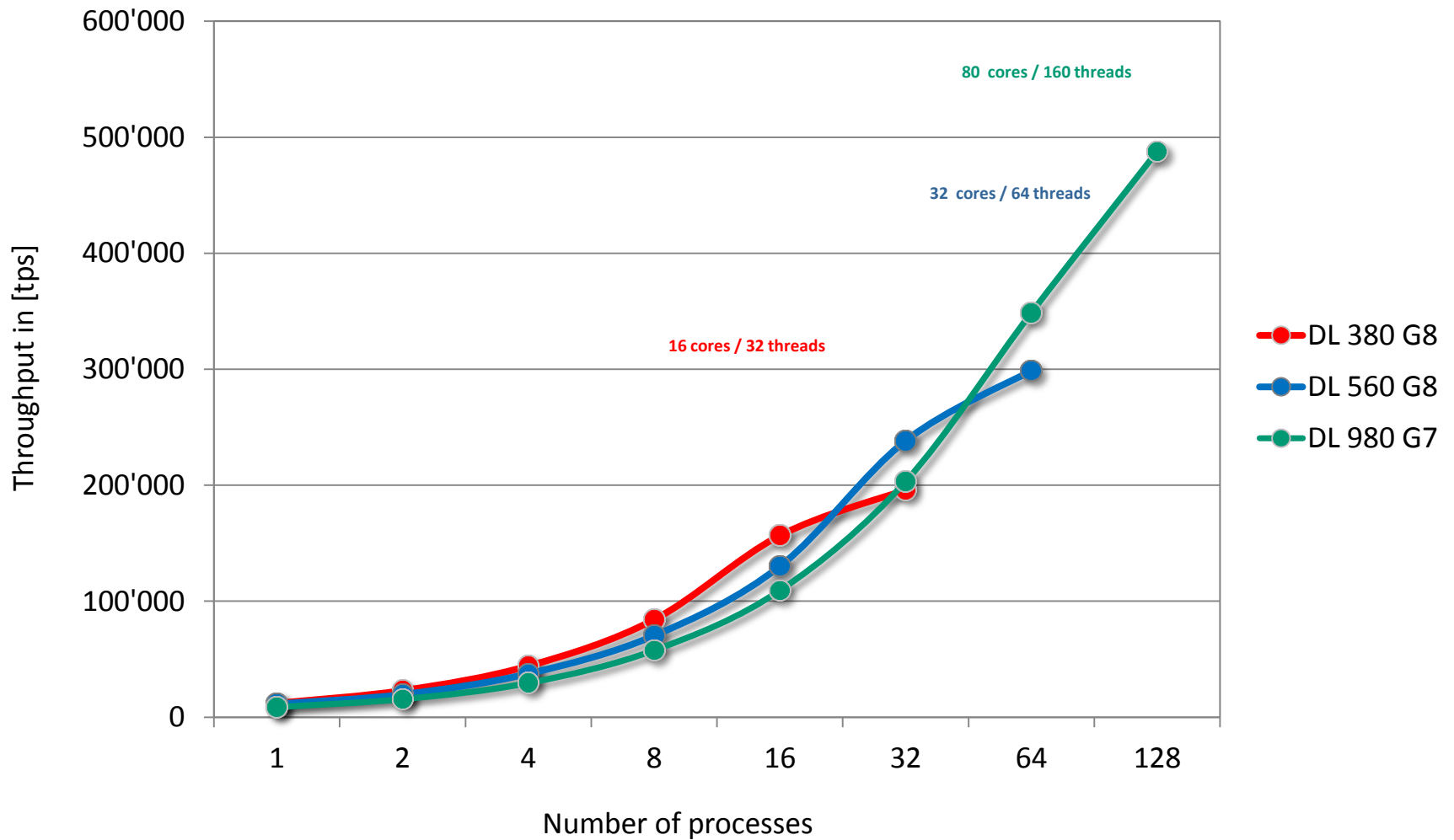
In-memory SQL, primary key access, 1 row hit per transaction

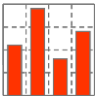


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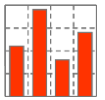
In-memory SQL, secondary key access, 25 row hits per transaction





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# Benchmark Results



## Reviewing Server Performance

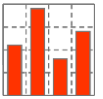
	Metric	DL 380 G8	DL 560 G8	DL 980 G7 <small><sup>1)</sup> With HP PREMA</small>
#cores		16	32	80
#threads		32	64	160
In-memory SQL operations		Metric		
Single thread speed				
▪ Full table scan	[Mrps]	5.16	4.15	2.76
▪ Light transaction (primary key access)	[tps]	23'810	22'480	16'670
	[μs]	-	-	-
▪ Heavy transaction (secondary key access)	[tps]			
Throughput				
▪ Full table scan	[Mrps]	100	145	184
▪ Light transaction (primary key access)	[tps]	442'600	781'800	1'130'000
	[μs]	-	-	-
▪ Heavy transaction (secondary key access)	[tps]	193'000	289'500	487'700

Legend:

[Mrps] million rows per second

[tps] transactions per second

# Benchmark Results



## Reviewing Server Performance

- The 4 socket server delivers 20% less speed than the 2 socket server but provides 50% more throughput
  - Standard Edition and Standard Edition One may be an option
- Only if single applications need large monolithic SMP servers, choose 8 socket server

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