

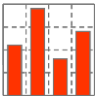
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# Performance Baseline of HP Proliant Oracle Platform

Part I: CPU Performance

Technical Presentation

February 2014



## **1 Introduction to CPU Performance Tests**

2 CPU and Server Configuration

3 CPU Benchmark Results – Basic Arithmetic Operations

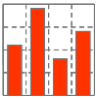
4 CPU Benchmark Results – Mixed Operations with SQL built-in functions

5 CPU Benchmark Results – Algorithms

6 Reviewing CPU Benchmark Results

# CPU Performance

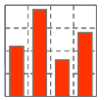
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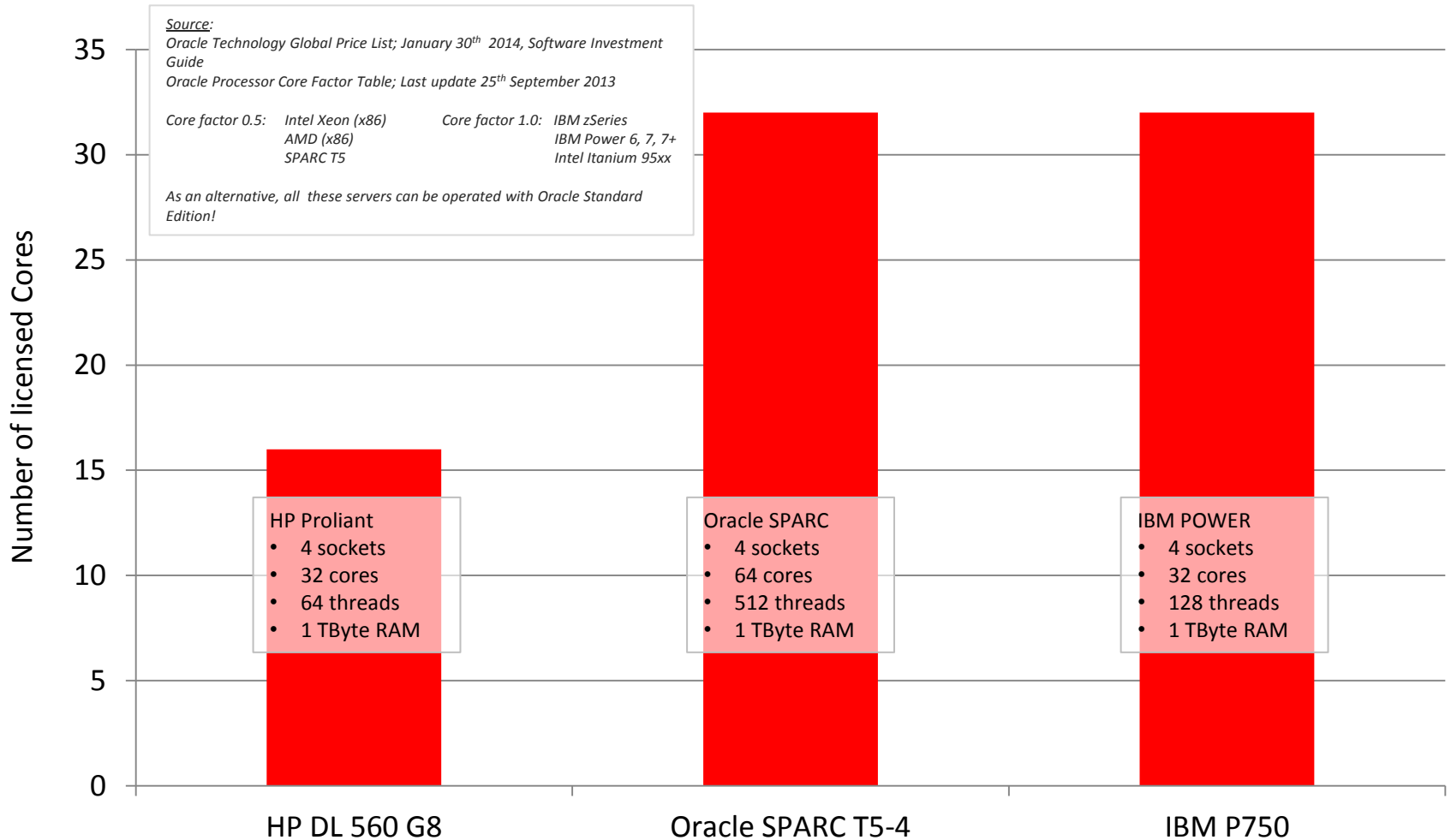
Why measure CPU performance?

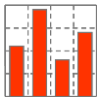
- CPU performance has a huge impact on
  - Oracle license (*core factor*) and maintenance cost - even with Unlimited License Agreement (ULA)
  - Performance of most database operations
  - Performance of compute intensive operations

# CPU Performance



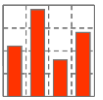
## Oracle EE Core Licensing – Price Performance Ratio?





## What is measured?

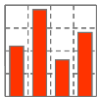
- CPU performance from the Oracle point of view
  - Pure processor performance
  - Including level 1, 2, 3 cache
  - No memory access
  - No I/O operations
  - Using Oracle data types and Oracle SQL built-in functions
- Speed of single thread
  - Elapsed time [s] for algorithms
  - Operations per second [ops]
- Maximum throughput of system
  - Operations per second [ops]
- Scalability
  - Throughput per process for  $n = \{1, 2, 4, 8, \dots, n\}$
- Efficiency of
  - Multi threading
  - Virtualization
  - Encryption



How is CPU performance measured?

- Following data types are most important for Oracle applications
  - PLS\_INTEGER
  - NUMBER
  - VARCHAR2
  - DATE
  
- Benchware uses Oracle data types in PL/SQL to measure the performance characteristics of a CPU

# CPU Performance

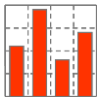


## Overview of CPU performance tests with Benchware test codes

Oracle CPU Performance	Test Code for	Test Code for	Test Code for	Test Code for	Test Code for
speed and throughput of arithmetic operations with typical Oracle data types and SQL built in functions; native compiled PL/SQL	SIMPLE_INTEGER	SIMPLE_FLOAT	PLS_INTEGER	NUMBER	VARCHAR2
▪ Basic arithmetic operation	CPU-11	CPU-12	CPU-13	CPU-14	-
▪ Mixed operations and SQL built in functions	-	CPU-22	CPU-23	CPU-24	CPU-25

Oracle CPU Performance	Test Code for	Test Code for	Test Code for	Test Code for	Test Code for
speed of recursive algorithms; native compiled PL/SQL	SIMPLE_INTEGER	SIMPLE_FLOAT	PLS_INTEGER	NUMBER	VARCHAR2
▪ Fibonacci numbers n = {39, 40, 41, 42}	CPU-31	-	-	CPU-34	-
▪ Prime numbers [2'000'000, 2'001'000]	CPU-41	-	-	CPU-44	-

# CPU Performance



## Monitoring

### ■ CPU utilization, speed and throughput

Speed:

- Only 1 process
- No conflicts
- No contention

Run	Tst	Code	#N	#J	#T	CPU busy [%]	CPU sys [%]	CPU user [%]	CPU idle [%]	Throughput ops/sec [ops]	lap time [s]
15	19	CPU-14	1	1	1	4	0	3	96	3.682E+07	121
	20	CPU-14	1	2	1	7	1	6	93	7.364E+07	121
	21	CPU-14	1	4	1	13	1	12	87	1.461E+08	122
	22	CPU-14	1	8	1	25	0	25	75	2.901E+08	120
	23	CPU-14	1	16	1	50	1	49	50	5.570E+08	125
	24	CPU-14	1	32	1	94	0	94	6	5.794E+08	127

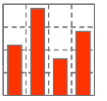
Max throughput:

- All cpu resources are utilized

**Legend:**

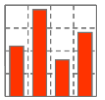
- Run benchmark run id
- Tst benchmark test id
- Code benchmark test code
- #N number of RAC nodes
- #J number of jobs, round robin distributed to all nodes
- #T number of threads (PX)
- [ops] operations per second
- [s] elapsed time in seconds





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# CPU Performance



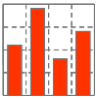
## CPU architecture

CPU	E5-2690 Sandy Bridge	E5-4650 Sandy Bridge	E7-4870 Westmere
Launch date	2012	2012	2012
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

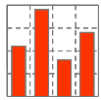
# CPU Performance



## 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
Benchmark Performance Suite			

# CPU Performance

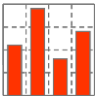


## Oracle Licensing

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

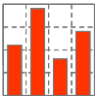
  

Oracle Standard Edition	DL 380 G8	DL 560 G8	DL 980 G7
#sockets	2	4	8 *)
Oracle Standard Edition license cost (17'500 per socket)	35'000	70'000	-
Oracle Standard Edition One license cost (5'800 per socket)	11'600	23'200	-

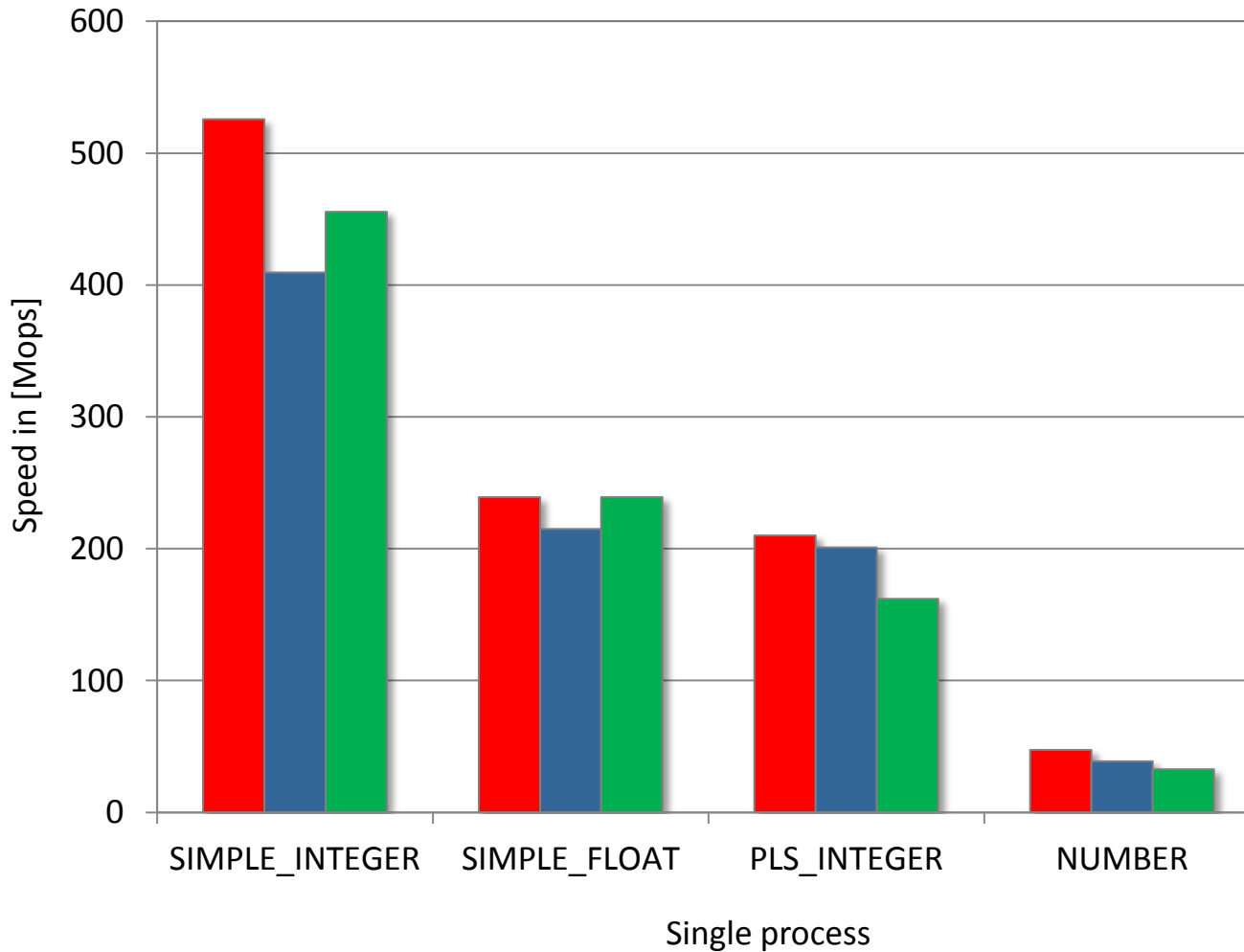


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# CPU Performance



Speed of single core / single process, arithmetic ADD operation

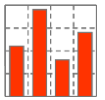


Speed:

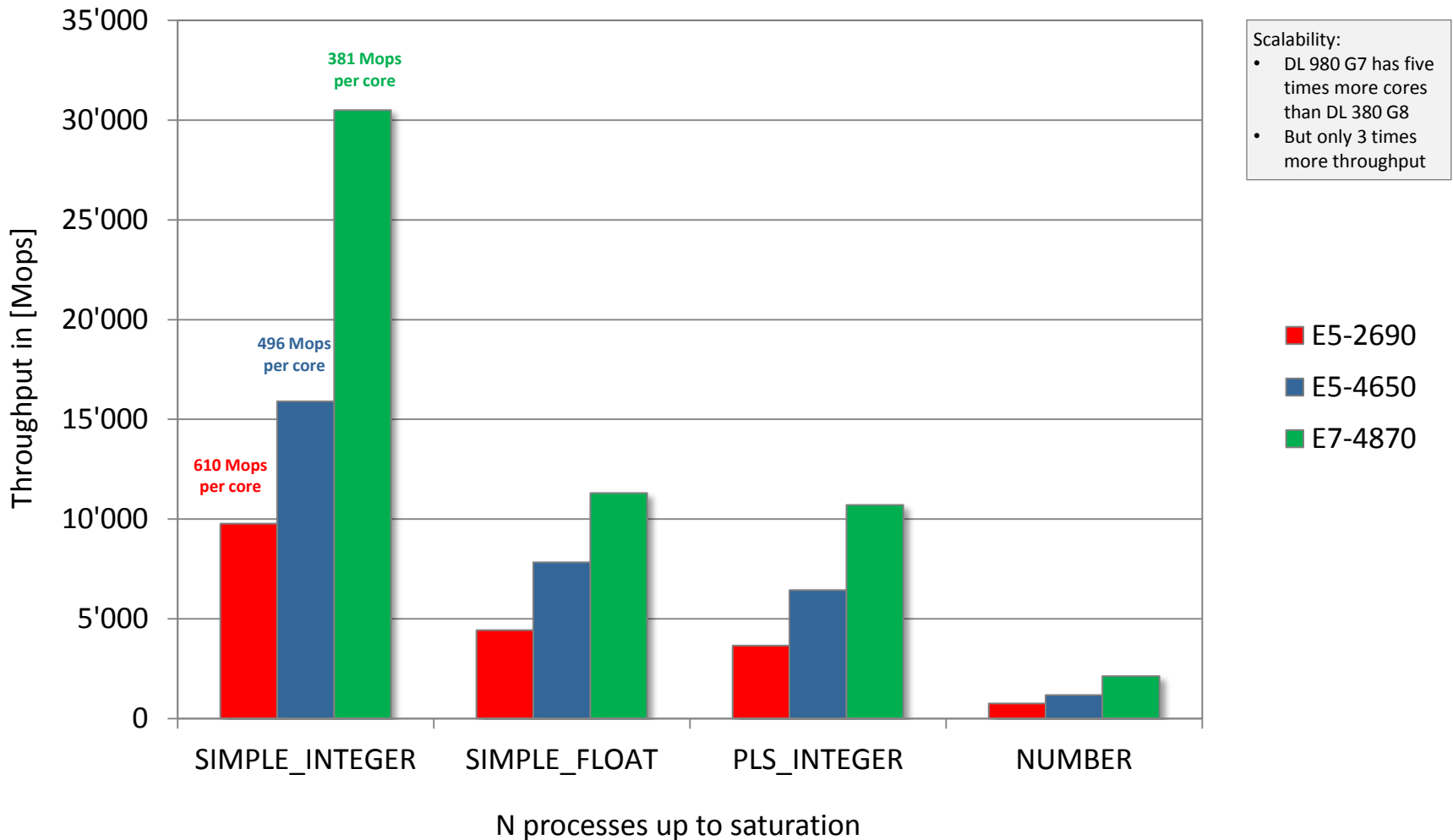
- differences between slowest and fastest processor
- ~ 30% SIMPLE\_INTEGER
- ~ 45% NUMBER

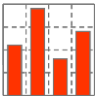
■ E5-2690  
■ E5-4650  
■ E7-4870

# CPU Performance



Throughput of all cores, arithmetic ADD operation

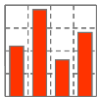




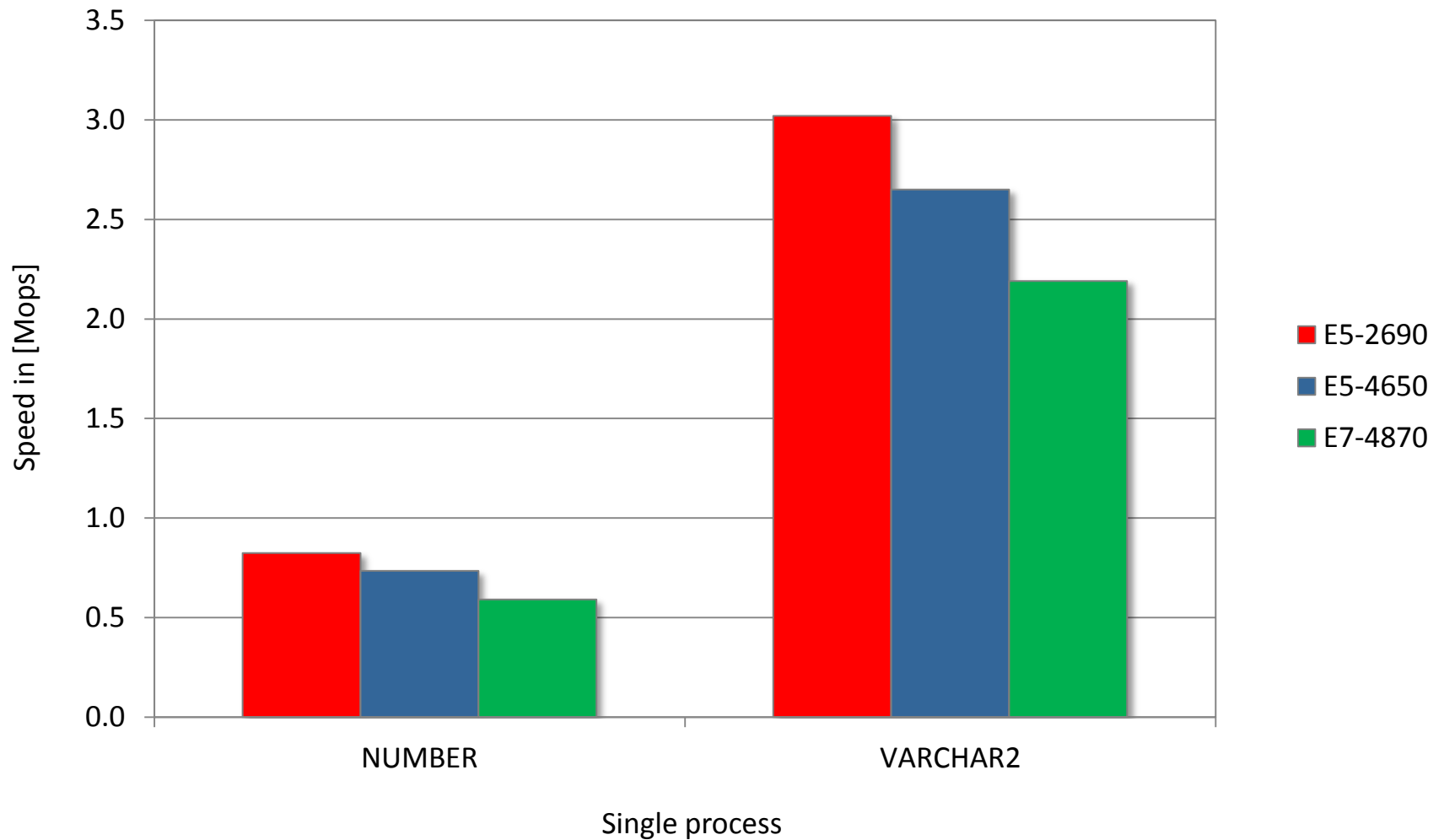
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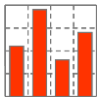
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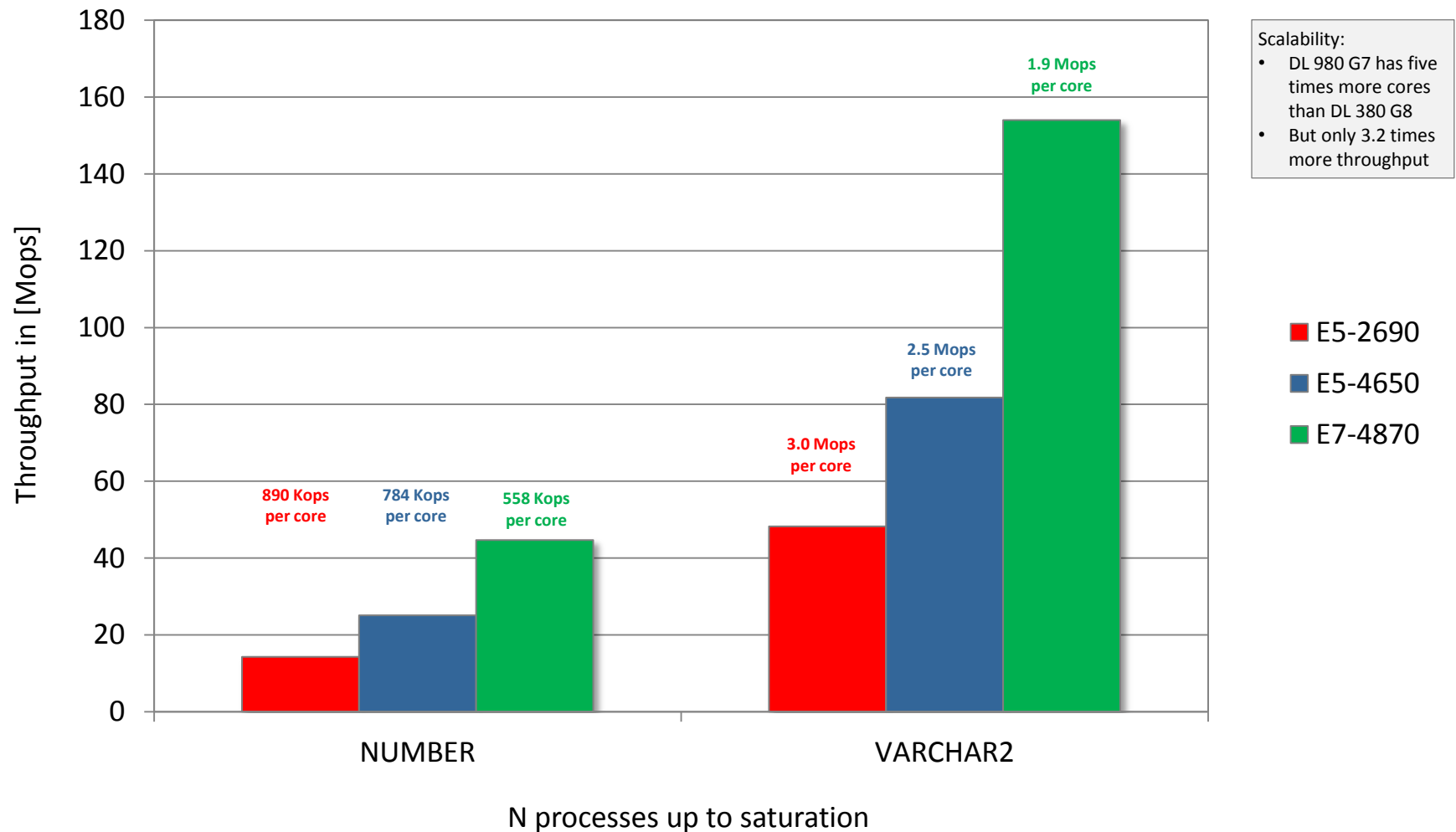
Speed of single core / single process, mixed SQL operations

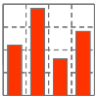


# CPU Performance

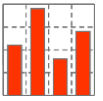


Throughput of all cores, mixed SQL operations



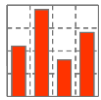


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# Benchmark Results



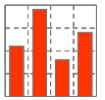
## Reviewing CPU Performance

	Metric	E5-2690 Sandy Bridge	E5-4650 Sandy Bridge	E7-4870
#cores		16	32	80
#threads		32	64	160
Basic arithmetic ADD operation				
Metric				
Single thread speed				
▪ SIMPLE_INTEGER	[Mops]	526	409	455
▪ SIMPLE_FLOAT	[Mops]	239	215	162
▪ PLS_INTEGER	[Mops]	210	201	162
▪ <b>NUMBER</b>	[Mops]	47	39	33
Throughput				
▪ SIMPLE_INTEGER	[Mops]	9'770	15'900	30'500
▪ SIMPLE_FLOAT	[Mops]	4'430	7'830	11'300
▪ PLS_INTEGER	[Mops]	3'650	6'430	10'700
▪ <b>NUMBER</b>	[Mops]	756	1'180	2'130

Legend:

[Mops] million operations per second

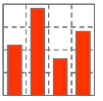
# Benchmark Results



## Reviewing CPU Performance

	Metric	E5-2690 Sandy Bridge	E5-4650 Sandy Bridge	E7-4870
#cores		16	32	80
#threads		32	64	160
Mixed arithmetic operations	Metric			
Speed				
▪ SIMPLE_FLOAT	[Mops]	10.9	9.4	9.0
▪ PLS_INTEGER	[Mops]	0.8	0.7	0.6
▪ NUMBER	[Mops]	0.8	0.7	0.6
Throughput				
▪ SIMPLE_FLOAT	[Mops]	190	338	622
▪ PLS_INTEGER	[Mops]	14	25	45
▪ NUMBER	[Mops]	14	25	45
Mixed string operation	Metric			
Speed				
▪ VARCHAR2	[Mops]	3.0	2.7	2.2
Throughput				
▪ VARCHAR2	[Mops]	48.2	81.8	154.0

# Benchmark Results



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## Reviewing CPU Performance

- If speed is required, choose 2 socket server
  - Standard Edition and Standard Edition One may be an option
- If speed and scalability is required, choose 4 socket server
  - Oracle Standard Edition may be an option
- Only if single applications need large monolithic SMP servers, choose 8 socket server

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