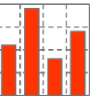


Introduction to Processor (CPU) Performance Tests with Oracle

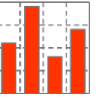
Technical Presentation

September 2014



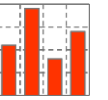
- 1 Why measure CPU performance?
- 2 What is measured?
- 3 Overview of CPU performance tests
- 4 Monitoring CPU performance tests
- 5 Example
- 6 Summary

Why measure CPU performance?



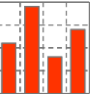
- CPU performance has a huge impact on
 - Performance of most database operations
 - Oracle license and maintenance cost
 - » Enterprise Edition (EE) with core based licensing
 - » Standard Edition (SE) with socket based licensing
 - Performance of compute intensive tasks
 - » E.g. calculation of interests, value at risks, . . .

What is measured?



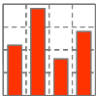
- Speed of single thread
 - Elapsed time for algorithms in [s]
 - Operations per second [ops]
- System throughput
 - Operations per second [ops]
- Scalability
 - Throughput per process for $n = \{1, 2, 4, 8, \dots, n\}$
- Efficiency of
 - Multithreading
 - Virtualization
 - Encryption

What is measured?



- CPU performance from the Oracle point of view
 - Using Oracle's procedural language PL/SQL
 - Almost no memory access
 - No I/O operations
 - Pure processor performance
 - Including level 1, 2, 3 cache

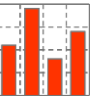
Overview of CPU performance tests with Benchware test codes



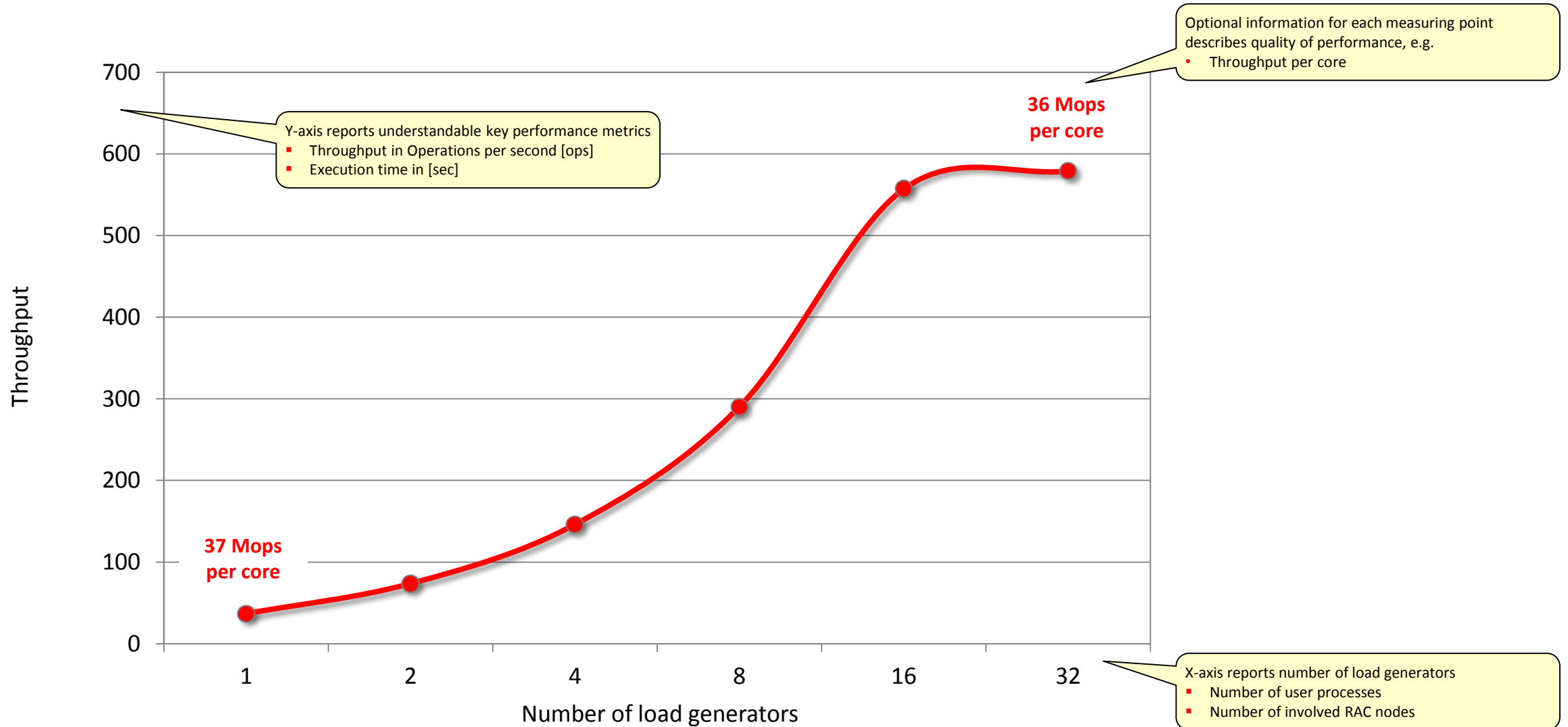
Oracle CPU Performance	Test Code for	Test Code for	Test Code for	Test Code for	Test Code for
speed and throughput of arithmetic operations with typical Oracle data types and SQL built in functions; native compiled PL/SQL	SIMPLE_INTEGER	SIMPLE_FLOAT	PLS_INTEGER	NUMBER	VARCHAR2
<ul style="list-style-type: none"> Basic arithmetic operation 	CPU-11	CPU-12	CPU-13	CPU-14	-
<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> Fibonacci numbers $n = \{39, 40, 41, 42\}$ 	CPU-31	-	-	CPU-34	-
<ul style="list-style-type: none"> Prime numbers within interval [2'000'000, 2'001'000] 	CPU-41	-	-	CPU-44	-

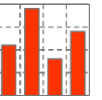
Monitoring CPU performance tests



All load profiles from single process to system saturation



Monitoring CPU performance tests



■ Key performance metrics

- CPU utilization
- Speed in [ops]
- Throughput in [ops]

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]	Elap 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

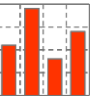
Legend:

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

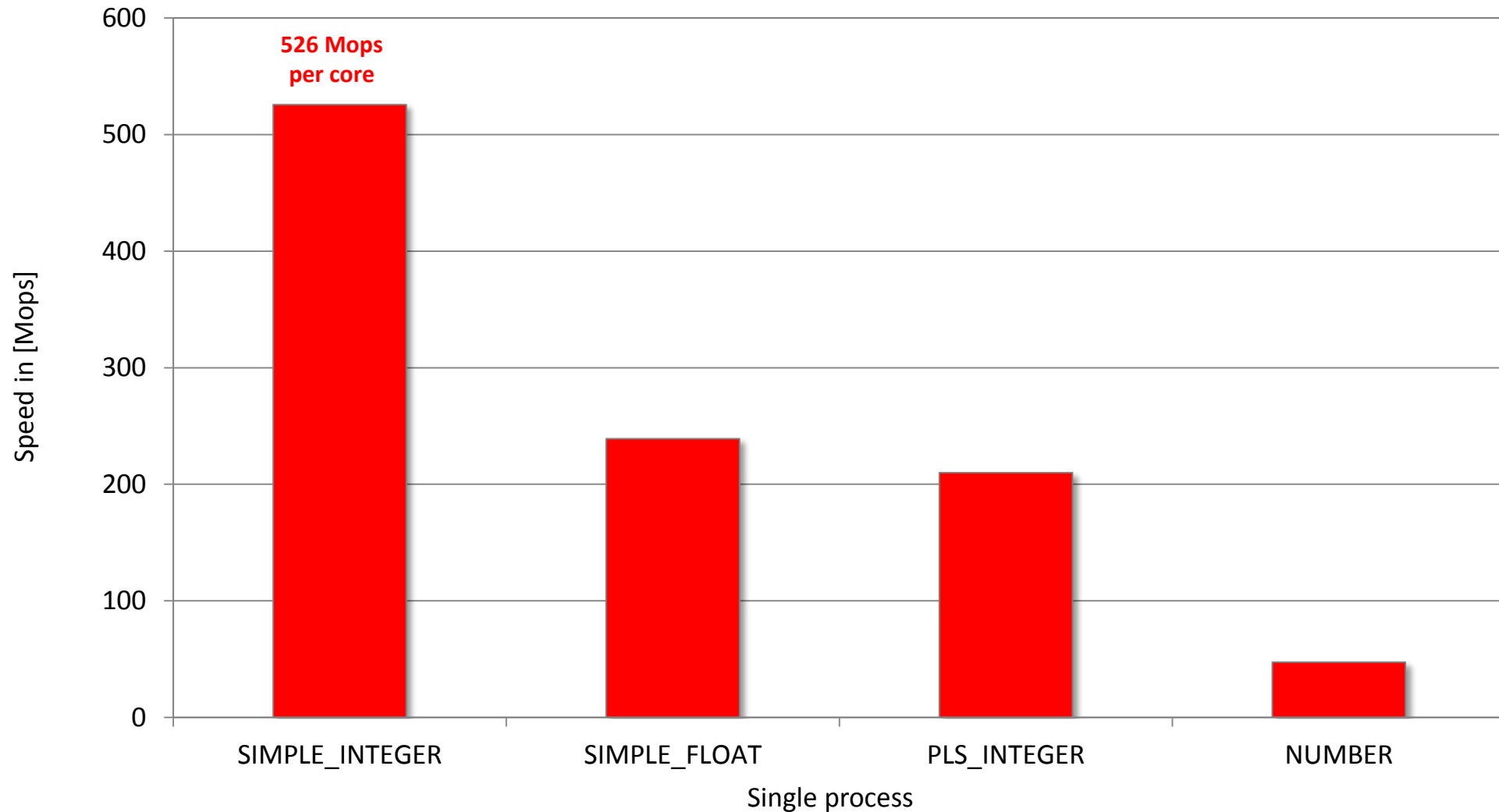
Max throughput:

- All cpu resources are utilized
- Shows efficiency of multithreading

Example of CPU performance results



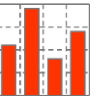
Oracle CPU speed: arithmetic ADD operation, single process / single thread / single core



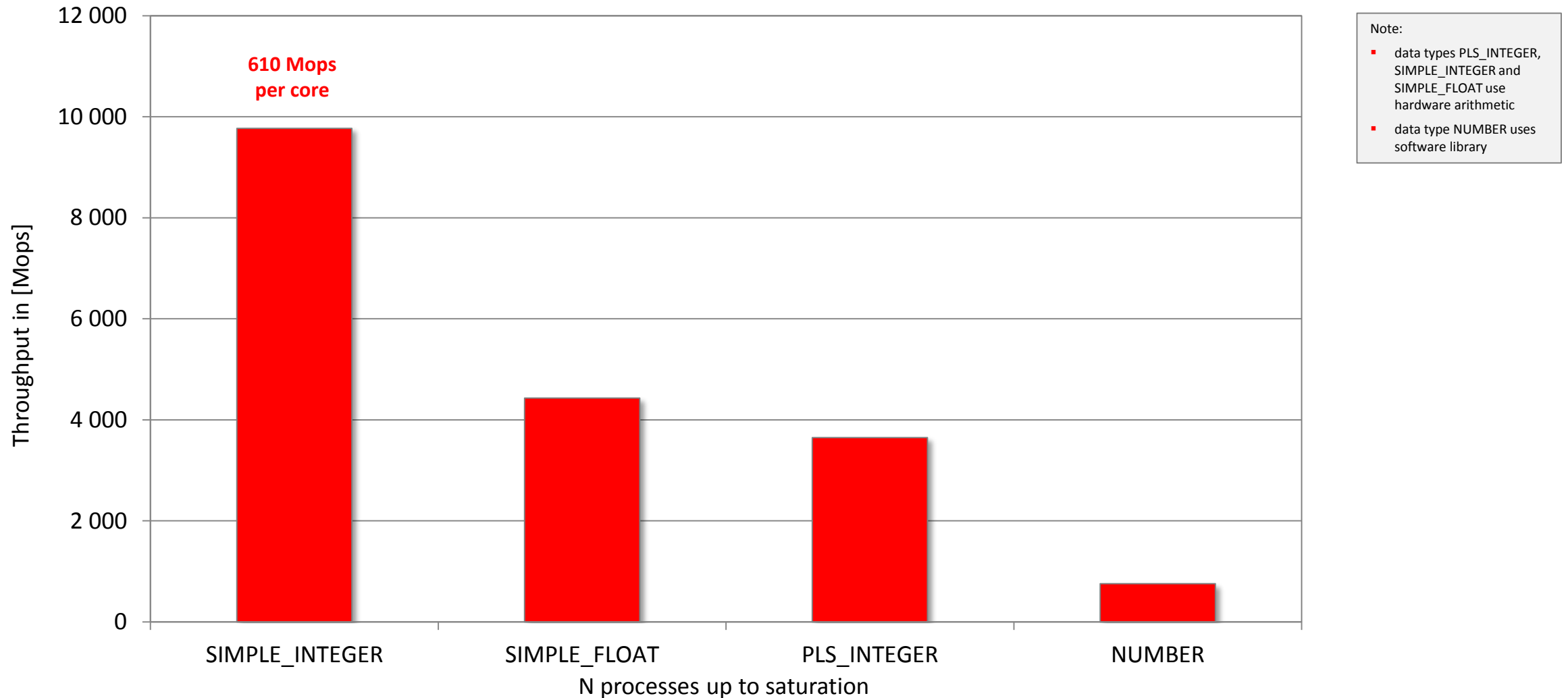
Note:

- data types PLS_INTEGER, SIMPLE_INTEGER and SIMPLE_FLOAT use hardware arithmetic
- data type NUMBER uses software library

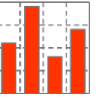
Example of CPU performance results



Oracle CPU throughput: arithmetic ADD operation, max processes up to system saturation



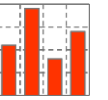
Summary



Reviewing CPU Performance

- SPEC uses programming languages
 - C
 - C++
 - Fortran
- Benchware uses Oracle's procedural language PL/SQL
 - SQL and PL/SQL data types
 - SQL built in functions

Summary



Reviewing CPU Performance

- These performance tests are a first indicator for processors performance capabilities for numeric operations
- These performance tests do not necessarily show the maximum performance capabilities in a mixed workload environment when all pipelines and execution units are used
- Benchware Version 9 introduces the possibility to run different performance tests in parallel to increase maximum throughput of processors

BENCHWARE

swiss precision in performance measurement

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