Whitepaper

ENGINEERING SIMULATION
MAKE THE **SMART CHOICE** WITH **2CRSi WORKSTATIONS**

Getting the Most out of Ansys® Fluent® and Ansys® Mechanical® with 2CRSi Workstations Powered by Intel® Xeon® W-3300 Processors

Executive Summary

It's easy to lose the perspective and to keep an overview, so here are the key takeaways of the comparative benchmarks for the Intel Xeon W-3365 vs the AMD Threadripper PRO 3975WX.

• The Intel Xeon W-3365 system performs better than the AMD Threadripper PRO 3975WX system:
  • On average, 5.54% better in Ansys Fluent (Linux, default BIOS, default launch mode)
  • On average, 14.18% better in Ansys Mechanical (Linux, default BIOS, default launch mode)

• The trend we observed is that the performance advantage for the Intel-based solution becomes bigger as the datasets become larger, such as the F1 race car (140m cells – with a 12% advantage in Fluent). So since customers' datasets are far bigger today than the size used in the standard models of the Ansys benchmarks (eg F1 customers today use over 1 bn cells for simulations), it is reasonable to assume that the advantage of the Intel solution will be even bigger for most customers' real-life simulation jobs.

• The Intel-based workstation, in quite a few cases, gets the job done in the same (wall-clock) time as the AMD-based solution, but with less processes (for example with 16 or 24 processes on the Xeon vs 32 processes for the Threadripper PRO). This means that customers would have CPU cores available in the Intel-based system to run other jobs simultaneously, in some cases up to 16 CPU cores. That's a very significant productivity and ROI factor to take into account: to get more simulations done in a given time-frame, and maximize the ROI of your Ansys licenses.

• In terms of OS choice, we have seen that Linux provides better performance than a Windowsbased solution out-of-the box for the Intel-based platform across the board (16 to 32 cores). This allows for more performance optimization, which increases the gap even more with the Threadripper PRO; for the AMD-based solution, Windows provides better performance up until 24 processes, for 28 cores and above Linux scales better.

• With optimized BIOS and optimized launch scripts (Linux only), 2CRSi/MV Concept can provide you with 18% to 21% better performance for the Intel Xeon W-3365 workstation compared to the default BIOS/default launch settings.

• Not all Gigahertz frequencies are created equal: don't be misled by advertised Turbo frequencies. As we have seen, the Intel Xeon W-3365 provides much better performance at lower average CPU frequencies (17.5% less) and lower max Turbo frequencies than the Threadripper PRO 3975WX. What matters more is the IPC (Instructions per clock/cycle) of a processor: that will determine performance for a given workload, and is a function of the underlying processor architecture, supported instruction sets and software optimization.

Introduction

Ansys is the global leader in engineering simulation, helping innovative companies deliver radically better products and solve their most complex design challenges with its broad portfolio of engineering simulation software. These simulations have the potential to reduce design costs, accelerate product development and time-to-market, thus helping businesses establish competitive advantage in their industry.

Selecting the right hardware for your Ansys applications is not an easy task: given the rapid pace of CPU innovation in the last few years, and the number of processor families and processor options available today from Intel and AMD, you can easily get this feeling of no longer seeing the forest for the trees. That's why it's important to have relevant and objective data points about the performance of latest-gen platforms with recent releases of Ansys software.

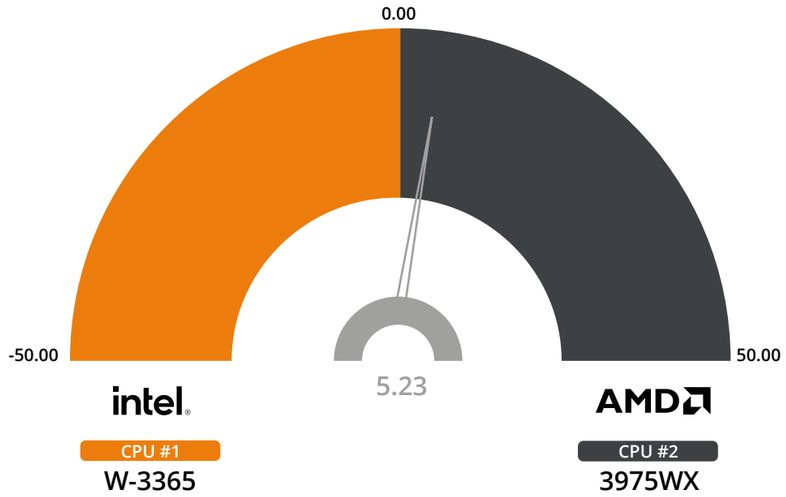
The primary intent of this white paper is to provide customers exactly with these useful, objective and verifiable data points for Ansys 2021 R2 software, and for this purpose 2CRSi partnered with Ansys and MVConcept, an engineering lab and a reputed Ansys HPC Partner. We ran Ansys standard benchmarks for Fluent and Mechanical on the latest generation of Intel and AMD workstation processors, each featuring 32 physical CPU cores. The only difference between the 2 systems are the processors and their respective motherboards: every other component such as memory, storage options, cooling, chassis and power supplies are the same.

The second objective of this paper is to provide meaningful insights on how to optimize your platforms: with the solid expertise of MVConcept in Ansys simulation software and processor architecture, we explore and compare options such as the choice of OS, standard vs optimized BIOS, and out-of-the box vs optimized launch commands for Ansys software. You'll be (pleasantly) surprised how much more mileage you can get by going down this path of optimization. It can make a big difference, in terms of more iterations you could do with a given configuration, or you will discover that by choosing the right processor, you can do a job in the same time but with up to 16 cores less compared to "the other" CPU brand! That's a lot of cores you could use to do other simulation tasks at the same time, thus maximizing the ROI of your Ansys licences.

There's a tonne of benchmark data we crunched through: over a 1000 tests, across the 2 workstations, with 14 standard models for Fluent and 13 standard models for Mechanical, and across 16, 20, 24, 28 and 32 CPU cores. Our paper intends to provide a synopsis with the most relevant highlights and conclusions, but we can provide online access to the full details of our benchmarks, and give you the possibility to run the benchmark on your hardware to compare your results with ours. You could also do a run with your dataset on our setup (provided your request is validated by our team and covered by mutual legal agreements).

1.1 Ansys Fluent Results

1.1.1 Ansys Fluent: CPU Performance Analysis – Wall-clock time



Graph 1: score for 32 processes, default BIOS, default launch mode, Linux 8

On average, the Intel Xeon W-3365 workstation performs 5.54% better than the system equipped with the Threadripper Pro 3975WX.

However, there's a lot more relevant details that underpin this single number.

Below you will see an overview of the different Ansys Fluent models and the respective score of the 2 CPUs for each.

Total Wall-Clock Time

Test Name	Total wall-clock time - CPU #1	% Diff - Total wall-clock time	Total wall-clock time - CPU #2	Difference - Total wall-clock time
f1_racecar_140m	2 426	-12,11	2 760	-334,14
aircraft_wing_14m	148	-11,81	168	-19,80
combustor_71m	4 846	-10,99	5 444	-598,50
sedan_4m	22	-10,89	24	-2,64
landing_gear_15m	384	-9,43	424	-39,94
pump_2m	31	-9,08	34	-3,09
exhaust_system_33m	391	-8,81	429	-37,82
rotor_3m	24	-5,86	25	-1,49
oil_rig_7m	114	-3,65	118	-4,30
lm6000_16m	272	-1,69	276	-4,68
fluidized_bed_2m	30	-1,31	30	-0,40
aircraft_wing_2m	16	0,19	16	0,03
combustor_12m	519	0,97	514	5,01
ice_2m	252	6,86	236	16,21

Out of the 14 standard Fluent model benchmarks, the Intel Xeon W-3365 workstation wins in 11 out of 14 tests, nearly 80% of the benchmarks.

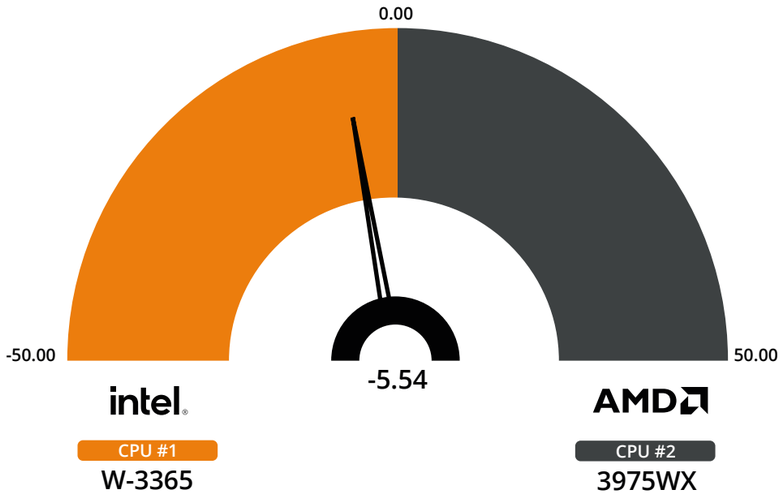
What is more, it wins with a margin of 12% compared to the competitive processor in the F1 racecar benchmark, the one with the highest number of cells.

One trend that we observe is that the Intel processors offer better performance for bigger datasets, i.e. the models with a higher number of cells. And it needs to be noted that the standard model for the F1 race car has “only” 140M cells, whereas customers in this industry today are using models exceeding 1Bn cells! So the performance advantage of the Intel platform is likely to be even a lot more in what customers are testing in their daily jobs.

Just a side note: for the F1 race car simulation @140M cells, you need 300GB of RAM memory! There is a F1 race car simulation @ 280M cells, but then you’d need 600GB of RAM.
So technically these are perfectly possible, but they come at a price.

1.1.2 Ansys Fluent: CPU Performance Analysis – Core Solver Rating

The Ansys Core Solver rating indicates the number of benchmarks that can be run on a given machine in a 24-hour period. A higher value represents better expected performance on actual real-life workloads.



Graph2: score for 32 processes, default BIOS, default launch mode, Linux 8

The Intel system performs, on average, 5.54% better on this metric than the competition.
Below you see the details with the Core Solver rating for each Fluent model. You can see that for the Sedan
model, for example, with the Intel system you’d be able to do 435 iterations more in 24 hours.

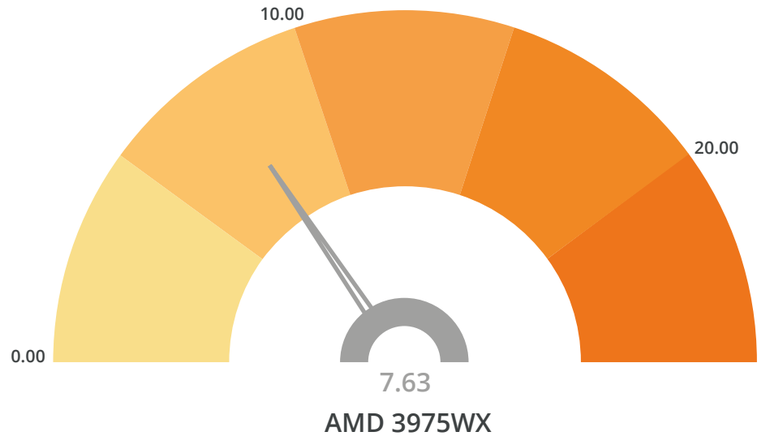
Test Name	Core Solver Rating - CPU #1	% Diff - Core Solver Rating	Core Solver Rating - CPU #2	Difference - Core Solver Rating
ice_2m	342	6,86	366	-23.49
combustor_12m	167	0,97	168	-1.62
aircraft_wing_2m	5,261	0,19	5,271	-9.95
fluidized_bed_2m	2,883	-1,31	2,845	37.88
lm6000_16m	318	-1,69	313	5.38
oil_rig_7m	761	-3,65	733	27.75
rotor_3m	3,617	-5,86	3,405	211.82
exhaust_system_33m	221	-8,81	201	19.46
pump_2m	2,796	-9,08	2,542	253.98
landing_gear_15m	225	-9,43	204	21.22
sedan_4m	4,001	-10,89	3,565	435.91
combustor_71m	18	-10,99	16	1.96
aircraft_wing_14m	584	-11,81	515	69.02
f1_racecar_140m	36	-12,11	31	4.31

Core Solver Rating

Test Name	Core Solver Rating - CPU #1	% Diff - Core Solver Rating	Core Solver Rating - CPU #2	Difference - Core Solver Rating
aircraft_wing_14m	584	11,81	515	69,02
aircraft_wing_2m	5 261	-0,19	5 271	-9,95
combustor_12m	167	-0,97	168	-1,62
combustor_71m	18	10,99	16	1,96
exhaust_system_33m	221	8,81	201	19,46
f1_racecar_140m	36	12,11	31	4,31
fluidized_bed_2m	2 883	1,31	2 845	37,88
ice_2m	342	-6.86	366	-23,49
landing_gear_15m	225	9,43	204	21,22
lm6000_16m	318	1,69	313	5,38
oil_rig_7m	761	3,65	733	27,75
pump_2m	2 796	9,08	2 542	253,98
rotor_3m	3 617	5,86	3 405	211,82
sedan_4m	4 001	10,89	3 565	435,91

1.2 Ansys Fluent: default BIOS vs Optimized BIOS

1.2.1 AMD Threadripper PRO 3975WX: default BIOS vs Optimized BIOS



Graph3: score for 32 processes, default BIOS vs Optimized BIOS, Windows 10

With the workstation equipped with the AMD Threadripper PRO 3975WX, we see that it pays off to put some efforts in optimizing the BIOS: 7.63% performance gain. So it would be good to have that kind of engineering expertise in-house.

See below the table what that means in terms of wall-clock time gains:

BIOS #1 Default | **BIOS #2** Opti

Total Wall-Clock Time

Test Name	Total Wall-Clock Time - BIOS #1	% Diff - Total Wall-Clock Time	Total Wall-Clock Time - BIOS #2	Difference - Total Wall-Clock Time
aircraft_wing_14m	173.44	8.43	159.96	-13.48
aircraft_wing_2m	16.77	4.41	16.06	-0.71
combustor_12m	537.31	5.69	508.38	-28.94
combustor_71m	5,982.11	15.77	5,167.10	-815.01
exhaust_system_33m	452.08	7.68	419.82	-32.26
f1_racecar_140m	2,813.41	9.14	2,577.88	-235.53
fluidized_bed_2m	34.63	4.29	33.21	-1.42
ice_2m	292.75	6.34	275.29	-17.46
landing_gear_15m	444.57	9.68	405.33	-39.24
lm6000_16m	316.25	4.41	302.89	-13.36
oil_rig_7m	128.03	6.40	120.32	-7.70
pump_2m	36.76	10.58	33.24	-3.52
rotor_3m	27.59	5.54	26.14	-1.45
sedan_4m	24.70	8.42	22.78	-1.92

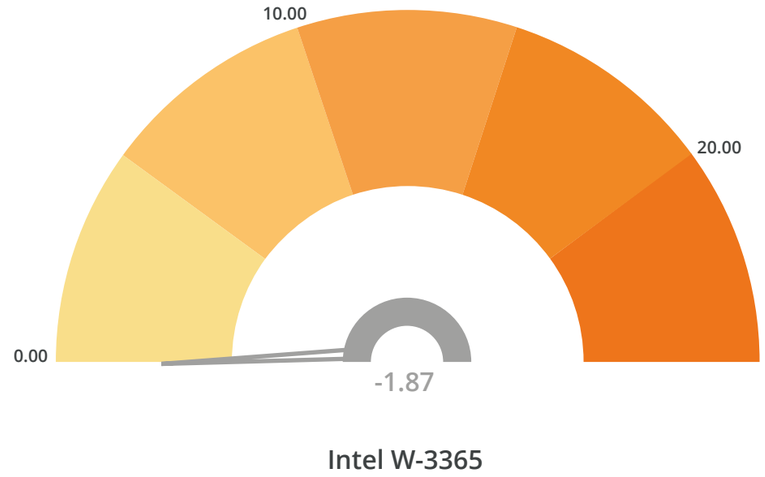
Or the gains in terms of Core Solver rating:

BIOS #1 Default | **BIOS #2** Opti

Core Solver Rating

Test Name	Core Solver Rating - BIOS #1	% Diff - Core Solver Rating	Core Solver Rating - BIOS #2	Difference - Core Solver Rating
aircraft_wing_14m	498.16	8.43	540.14	41.97
aircraft_wing_2m	5,151.44	4.41	5,378.82	227.38
combustor_12m	160.80	5.69	169.95	9.15
combustor_71m	14.44	15.77	16.72	2.28
exhaust_system_33m	191.12	7.68	205.80	14.68
f1_racecar_140m	30.71	9.14	33.52	2.81
fluidized_bed_2m	2,495.02	4.29	2,602.02	107.00
ice_2m	295.14	6.34	313.85	18.72
landing_gear_15m	194.34	9.68	213.16	18.82
lm6000_16m	273.20	4.41	285.25	12.05
oil_rig_7m	674.86	6.40	718.06	43.20
pump_2m	2,350.32	10.58	2,599.04	248.73
rotor_3m	3,132.02	5.54	3,305.41	173.38
sedan_4m	3,497.69	8.42	3,792.30	294.61

1.2.2 Intel Xeon W-3365: default BIOS vs Optimized BIOS



Graph5: score for 32 processes, default BIOS vs Optimized BIOS, Windows 10

With the Intel-based workstation, we notice that there's actually performance loss from "optimized" settings. At least at 32 processes. With 16 processes, we see a gain of 5.58%, but the trend is that as the number of processes increases, there's less and less gain from optimized BIOS settings on the Intel-based system (remember: all these results can be made available to you online, upon request).

So in conclusion: with workstations based on Xeon W-3300 processors, you have no need for engineering tuning skills. You can go with the out-of-box experience.

Below you have the table with the detailed results for the different Fluent models – wall-clock time:

BIOS #1 Default | **BIOS #2** Opti

Total Wall-Clock Time

Test Name	Total wall-clock time - BIOS #1	% Diff - Total Wall-Clock Time	Total wall-clock time - BIOS #2	Difference - Total Wall-Clock Time
aircraft_wing_14m	160.43	2.31	156.81	-3.63
aircraft_wing_2m	18.72	-5.59	19.83	1.11
combustor_12m	575.56	0.75	571.26	-4.29
combustor_71m	5,169.41	2.58	5,039.19	-130.22
exhaust_system_33m	433.86	2.89	421.66	-12.20
f1_racecar_140m	2,578.46	3.57	2,489.68	-88.78
fluidized_bed_2m	35.52	-5.58	37.62	2.10
ice_2m	341.35	-19.54	424.25	82.90
landing_gear_15m	421.47	2.17	412.51	-8.96
lm6000_16m	314.94	1.77	309.47	-5.47
oil_rig_7m	128.81	-2.17	131.66	2.85
pump_2m	35.48	-0.18	35.54	0.06
rotor_3m	30.05	-10.31	33.51	3.46
sedan_4m	24.16	1.16	23.88	-0.28

When looking at the detailed results for the different Fluent models, we can observe that the poor score is mainly due to the negative impact of 2 or 3 small-scale models, ranging from 2M to 3M cells.
For larger models, with a high number of cells, such as the F1 race car, there are some gains (3.57%) to be realized.

And the detailed results for the Core Solver Rating:

BIOS #1 Default

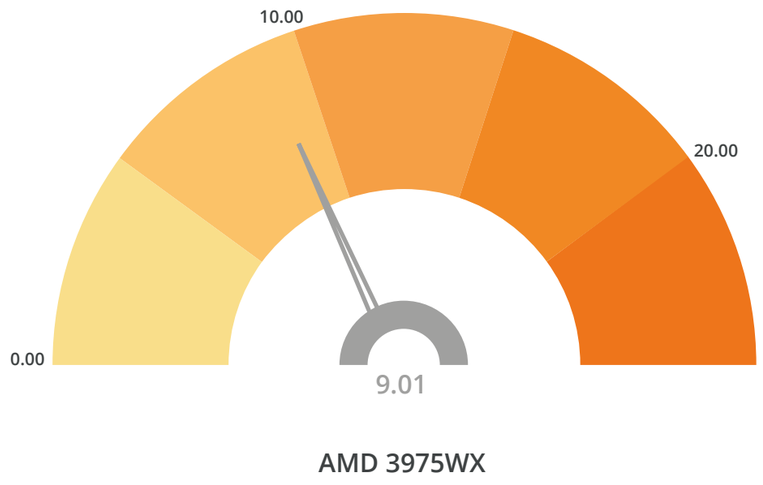
BIOS #2 Opti

Core Solver Rating

Test Name	Core Solver Rating - BIOS #1	% Diff - Core Solver Rating	Core Solver Rating - BIOS #2	Difference - Core Solver Rating
aircraft_wing_14m	538.54	2.31	550.99	12.45
aircraft_wing_2m	4,614.89	-5.59	4,357.03	-257.86
combustor_12m	150.12	0.75	151.24	1.13
combustor_71m	16.71	2.58	17.15	0.43
exhaust_system_33m	199.14	2.89	204.90	5.76
f1_racecar_140m	33.51	3.57	34.70	1.19
fluidized_bed_2m	2,432.64	-5.58	2,296.83	-135.80
ice_2m	253.12	-19.54	203.65	-49.46
landing_gear_15m	205.00	2.17	209.45	4.45
lm6000_16m	274.34	1.77	279.19	4.85
oil_rig_7m	670.78	-2.17	656.25	-14.54
pump_2m	2,435.45	-0.18	2,431.06	-4.39
rotor_3m	2,875.11	-10.31	2,578.64	-296.47
sedan_4m	3,576.46	1.16	3,618.09	41.64

1.3 Optimized BIOS plus optimized Ansys launch script:

1.3.1 AMD Threadripper PRO 3975WX: Optimized BIOS plus optimized Ansys launch script



Graph6: score for 32 processes, Optimized BIOS + Optimized Launch script,Linux CentOS 8

When combining both optimizations, BIOS plus the optimized launch script, we see an overall gain of 9.01% with the AMD system, i.e. only a gain of 1.38% compared to the gains with the optimized BIOS only, so really not that much gain from the script.

Below you have the table with the detailed results for the different Fluent models – wall-clock time:

MODE #1_BIOS #1 Default_Default

MODE #2_BIOS #2 MVC_Opti_Opti

Total Wall-Clock Time

Test Name	Total Wall-Clock Time - MODE #1_BIOS #1	% Diff - Total Wall-Clock Time	Total Wall-Clock Time - MODE #2_BIOS #2	Difference - Total Wall-Clock Time
aircraft_wing_14m	167.67	10.66	151.52	-16.15
aircraft_wing_2m	16.39	9.54	14.97	-1.43
combustor_12m	513.58	7.43	478.04	-35.54
combustor_71m	5,444.41	7.66	5,056.89	-387.52
exhaust_system_33m	429.08	8.66	394.88	-34.20
f1_racecar_140m	2,760.36	8.25	2,550.02	-210.34
fluidized_bed_2m	30.37	6.64	28.48	-1.89
ice_2m	236.18	2.62	230.14	-6.04
landing_gear_15m	423.75	10.24	384.40	-39.35
lm6000_16m	276.30	8.66	254.27	-22.03
oil_rig_7m	117.86	11.76	105.45	-12.40
pump_2m	33.99	12.07	30.33	-3.66
rotor_3m	25.37	10.17	23.03	-2.34
sedan_4m	24.23	11.84	21.67	-2.57

And the detailed results for the Core Solver Rating:

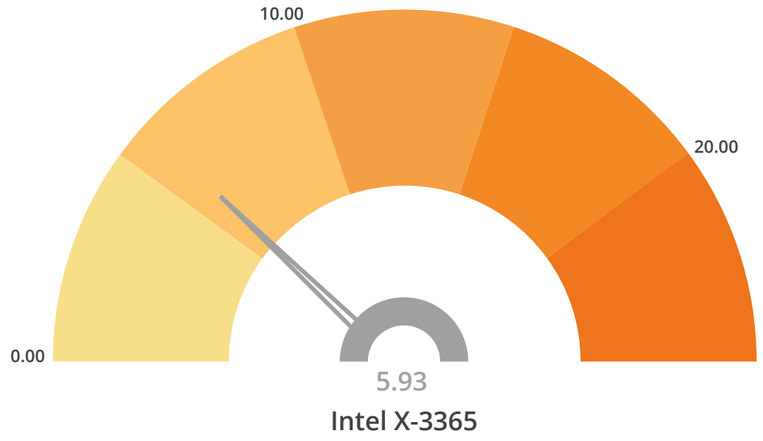
BIOS #1 Default

BIOS #2 Opti

Core Solver Rating

Test Name	Core Solver Rating - BIOS #1	% Diff - Core Solver Rating	Core Solver Rating - BIOS #2	Difference - Core Solver Rating
aircraft_wing_14m	538.54	2.31	550.99	12.45
aircraft_wing_2m	4,614.89	-5.59	4,357.03	-257.86
combustor_12m	150.12	0.75	151.24	1.13
combustor_71m	16.71	2.58	17.15	0.43
exhaust_system_33m	199.14	2.89	204.90	5.76
f1_racecar_140m	33.51	3.57	34.70	1.19
fluidized_bed_2m	2,432.64	-5.58	2,296.83	-135.80
ice_2m	253.12	-19.54	203.65	-49.46
landing_gear_15m	205.00	2.17	209.45	4.45
lm6000_16m	274.34	1.77	279.19	4.85
oil_rig_7m	670.78	-2.17	656.25	-14.54
pump_2m	2,435.45	-0.18	2,431.06	-4.39
rotor_3m	2,875.11	-10.31	2,578.64	-296.47
sedan_4m	3,576.46	1.16	3,618.09	41.64

1.3.2 Intel Xeon W-3365: Optimized BIOS plus optimized Ansys launch script



Graph7: score for 32 processes, Optimized BIOS + Optimized Launch script, Linux CentOS 8

With the workstation based on the Intel Xeon W-3365 processor, we see an overall performance gain of 7.8%: when taking into account the negative (average) impact of the optimized BIOS of -1,87%, we have a significant gain overall from the combination of optimized BIOS and the optimized launch script. But this gain will (unfortunately) be limited to Linux-based installations.

Below you have the table with the detailed results for the different Fluent models – wall-clock time:

MODE #1_BIOS #1 Default_Default

MODE #2_BIOS #2 MVC_Opti_Opti

Total Wall-Clock Time

Test Name	Total Wall-Clock Time - MODE #1_BIOS #1	% Diff - Total Wall-Clock Time	Total Wall-Clock Time - MODE #2_BIOS #2	Difference - Total Wall-Clock Time
aircraft_wing_14m	147.86	6.88	138.34	-9.52
aircraft_wing_2m	16.42	1.05	16.25	-0.17
combustor_12m	518.58	17.41	441.68	-76.91
combustor_71m	4,845.91	16.24	4,168.98	-676.93
exhaust_system_33m	391.26	11.25	351.70	-39.56
f1_racecar_140m	2,426.22	22.08	1,987.36	-438.85
fluidized_bed_2m	29.97	-35.10	46.17	16.21
ice_2m	252.38	-0.24	252.99	0.61
landing_gear_15m	383.81	6.92	358.98	-24.83
lm6000_16m	271.63	3.06	263.55	-8.08
oil_rig_7m	113.56	1.69	111.67	-1.89
pump_2m	30.90	17.41	26.32	-4.58
rotor_3m	23.89	6.71	22.39	-1.50
sedan_4m	21.59	7.70	20.05	-1.54

Note: There appears to be one negative result, for the fluidized bed, but in reality this is a bug in the test tool : the tool has increased the number of iterations from 50 to 75, i.e. a 50% increase. So a “decrease” of 35.10% in wall-clock time for 50% higher number of iterations, is not really the correct number.

We also notice that the gains for the large F1 race car model (140m cells) are impressive : 22% better performance! And 16% for the Combustor 2 model (71m cells).

MODE #1_BIOS #1 Default_Default

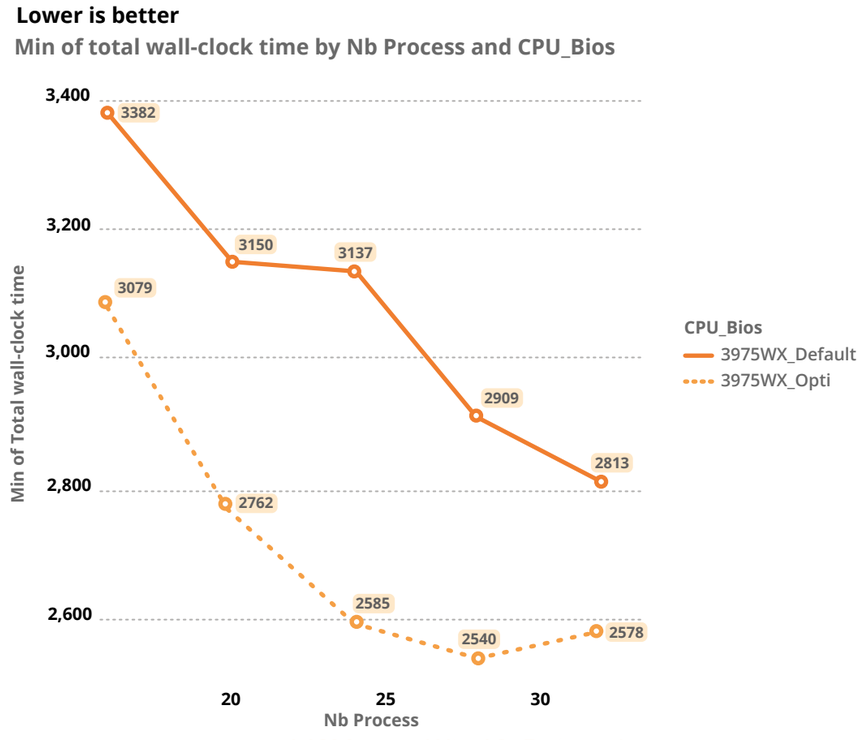
MODE #2_BIOS #2 MVC_Opti_Opti

Core Solver Rating

Test Name	Core Solver Rating - MODE #1_BIOS #1	% Diff - Core Solver Rating	Core Solver Rating - MODE #2_BIOS #2	Difference - Core Solver Rating
aircraft_wing_14m	584.32	6.88	624.55	40.22
aircraft_wing_2m	5,260.91	1.05	5,316.27	55.35
combustor_12m	166.61	17.41	195.62	29.01
combustor_71m	17.83	16.24	20.72	2.90
exhaust_system_33m	220.82	11.25	245.66	24.84
f1_racecar_140m	35.61	22.08	43.47	7.86
fluidized_bed_2m	2,883.17	-35.10	1,871.26	-1,011.91
ice_2m	342.34	-0.24	341.51	-0.82
landing_gear_15m	225.11	6.92	240.68	15.57
lm6000_16m	318.09	3.06	327.83	9.75
oil_rig_7m	760.86	1.69	773.71	12.85
pump_2m	2,796.21	17.41	3,282.92	486.72
rotor_3m	3,616.88	6.71	3,859.73	242.85
sedan_4m	4,001.30	7.70	4,309.23	307.93

1.4 Ansys Fluent Core Solver Analysis by number of cores: Default BIOS vs Optimized BIOS

1.4.1 AMD Threadripper PRO 3975WX: Core Solver Analysis Default vs Opti BIOS



Graph8: F1 race car model shown, 140M cells, Win 10, Default Launch mode

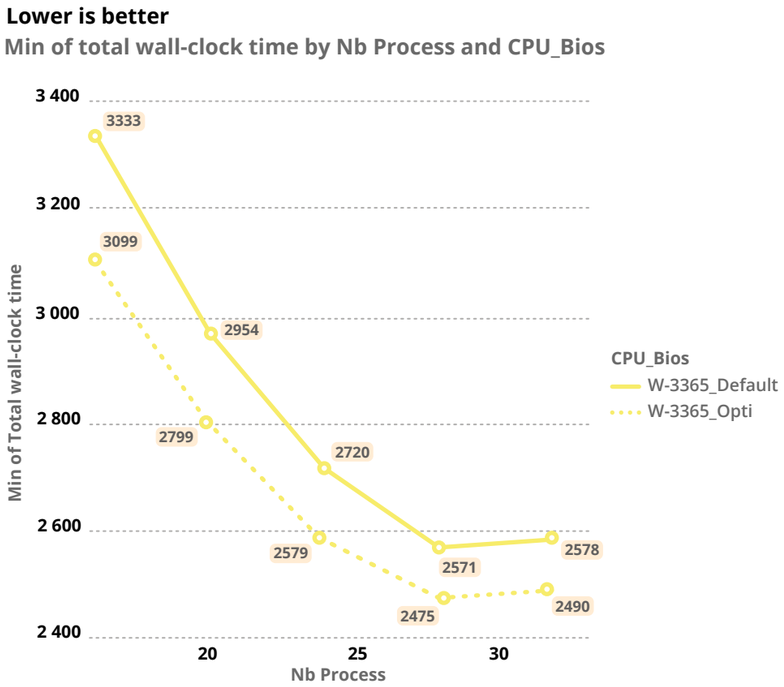
With the AMD Threadripper PRO 3975WX, we see significant performance gains with optimized BIOS, as mentioned before: wall-clock time for 32 processes goes down from 2813 seconds to 2578, a gain of 8.3%.

In the below table you can see multiple parameters for these results: max Core Solver Rating, max. Core Solver speedup, and max Core Solver Efficiency.

Test Name	f1_racecar_140m			
CPU_Bios	Min of Total Wall-Clock Time	Max of Core Solver Rating	Max of Core Solver Speedup	Max of Core Solver Efficiency
3975WX_Default	**2 813**	**30,71**	**19,23**	**100%**
16	3 382	25,55	16,00	100%
20	3 150	27,43	17,18	86%
24	3 137	27,54	17,25	72%
28	2 909	29,70	18,60	66%
32	2 813	30,71	19,23	60%
3975WX_Opti	**2 540**	**34,02**	**19,40**	**100%**
16	3 079	28,06	16,00	100%
20	2 762	31,28	17,84	89%
24	2 585	33,42	19,05	79%
28	2 540	34,02	19,40	69%
32	2 578	33,52	19,11	60%
Best	**2 540**	**34,02**	**19,40**	**100%**

We see that the best max Core Solver results go up from 30,71 (32 processes) to 34,02 (28 processes).

1.4.2. Intel Xeon W-3365: Core Solver Analysis Default vs Opti BIOS



Graph9: F1 race car model shown, 140M cells, Win 10, Default Launch mode

For the Intel Xeon W-3365, the optimized BIOS produces a performance gain of approx. 3.5% (32 processes), less spectacular but still good to take.

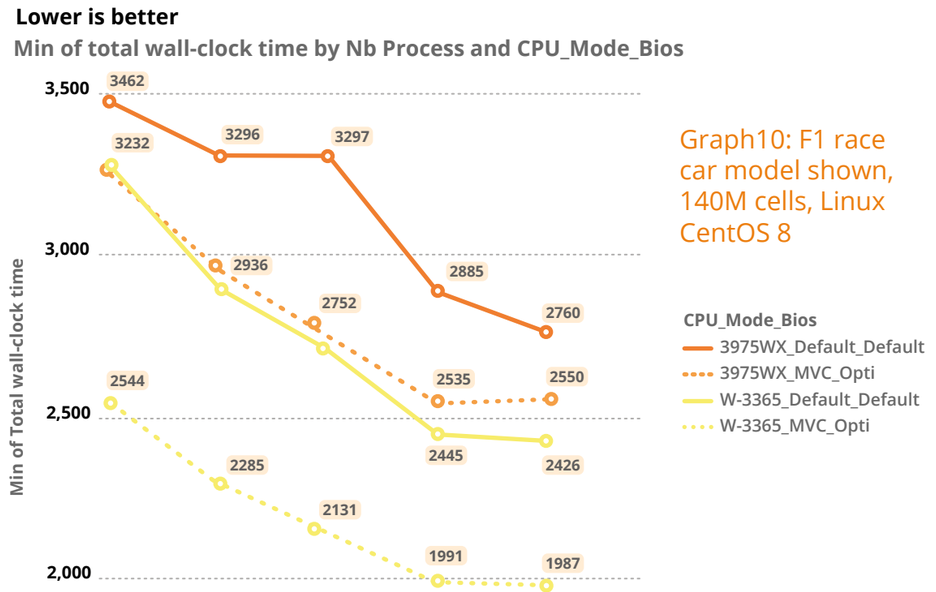
We also note that with non-optimized BIOS, the Intel system wall-clock time is 8.3% less than for the AMD solution, but that advantage is reduced to 3.5% with optimized BIOS on both sides (32 processes).

In the below table you can see multiple parameters for these results: max Core Solver Rating, max. Core Solver speedup, and max Core Solver Efficiency.

Test Name	f1_racecar_140m			
CPU_Bios	Min of Total Wall-Clock Time	Max of Core Solver Rating	Max of Core Solver Speedup	Max of Core Solver Efficiency
W-3365_Default	**2,571**	**33.61**	**20.74**	**100%**
16	3,333	25.93	16.00	100%
20	2,954	29.25	18.05	90%
24	2,720	31.77	19.61	82%
28	2,571	33.61	20.74	74%
32	2,578	33.51	20.68	65%
W-3365_Opti	**2,475**	**34.91**	**20.04**	**100%**
16	3,099	27.88	16.00	100%
20	2,799	30.87	17.72	89%
24	2,579	33.50	19.23	80%
28	2,475	34.91	20.04	72%
32	2,490	34.70	19.92	62%
Best	**2,475**	**34.91**	**20.74**	**100%**

One thing to note is that the best wall-clock time (with optimized BIOS) achieved by the AMD Threadripper PRO configuration is 2578 seconds (using 32 processes), something the optimized Intel-based solution achieves with only 24 processes (2579 seconds), so again with the Xeon W-based system you can have 8 CPU cores available to run another job simultaneously and optimize your Ansys production runs.

1.5 Ansys Fluent Core Solver Analysis by number of cores: Default BIOS/ Default Launch settings vs Optimized BIOS/Optimized Launch Script



Graph10: F1 race car model shown, 140M cells, Linux CentOS 8

One thing that jumps out here is that the best optimized wall-clock time result from the AMD solution (2550 seconds – 32 processes), is achieved by the Intel-based system using only 16 processes (2544 seconds), so you can save up to 16 cores to do other production runs with the Xeon W-3365.

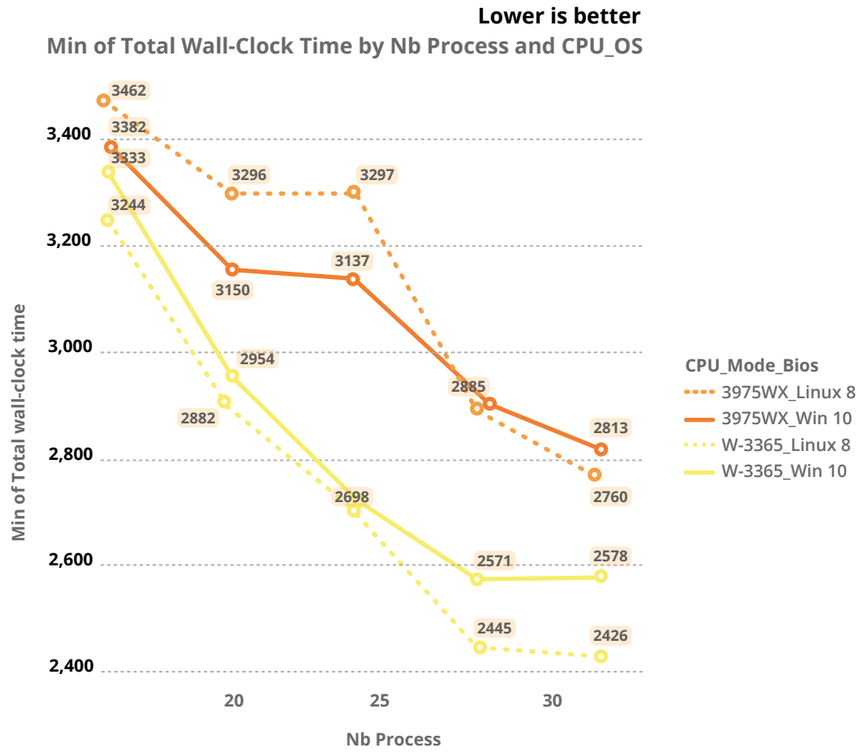
We can also observe that with 32 processes, the Xeon solution has 22% faster wall-clock time compared to the Threadripper PRO system (1987 seconds vs 2550 seconds).

Note that Optimized launch scripts are only available under Linux.

Test Name	f1_racecar_140m			
CPU_Mode_Bios	Min of Total Wall-Clock Time	Max of Core Solver Rating	Max of Core Solver Speedup	Max of Core Solver Efficiency
3975WX_Default_Default	**2,760**	**31.30**	**20.06**	**100%**
16	3,462	24.96	16.00	100%
20	3,296	26.22	16.80	84%
24	3,297	26.21	16.80	70%
28	2,885	29.94	19.19	69%
32	2,760	31.30	20.06	63%
3975WX_MVC_Opti_Opti	**2,535**	**34.09**	**20.40**	**100%**
16	3,232	26.73	16.00	100%
20	2,936	29.43	17.62	88%
24	2,752	31.39	18.79	78%
28	2,535	34.09	20.40	73%
32	2,550	33.88	20.28	63%
W-3365_Default_Default	**2,426**	**35.61**	**21.39**	**100%**
16	3,244	26.63	16.00	100%
20	2,882	29.98	18.01	90%
24	2,698	32.02	19.24	80%
28	2,445	35.34	21.23	76%
32	2,426	35.61	21.39	67%
W-3365_MVC_Opti_Opti	**1,987**	**43.47**	**20.48**	**100%**
16	2,544	33.96	16.00	100%
20	2,285	37.82	17.82	89%
24	2,131	40.54	19.10	80%
28	1,991	43.40	20.45	73%
32	1,987	43.47	20.48	64%
Best	**1,987**	**43.47**	**21.39**	**100%**

We can see that the highest Core Solver rating is achieved with the Xeon W-3365 with a score of 43.47 (32 processes) vs 34.09 for the Threadripper PRO 3975WX (28 processes), while being 21% faster (wall-clock time)!

1.6 Ansys Fluent Core Solver Analysis by number of cores – OS comparison



Graph11: results for F1 race car model shown, 140M cell)

For the comparison of Ansys Fluent Core Solver performance with Linux CentOS 8 and Windows 10, we can see that in the case of the AMD Threadripper PRO, Windows is providing better performance up until 24 processes, and then Linux takes the upper hand for 28 processes and above, although by a small margin (1.8%).

For the Intel Xeon W-3300 platform, Linux is consistently outperforming the Windows version, not by much but the difference becomes more significant at 28 processes and above (5.8% @ 32 processes).

We also observe that as a result, the delta (looking at wall-clock time) between the 2 platforms and the 2 operating systems is much bigger for Linux than for Windows: with Windows, the Intel performance advantage is 8.4%, but the gap for Linux is 12.1%.

Test Name	f1_racecar_140m			
CPU_OS	Min of Total Wall-Clock Time	Max of Core Solver Rating	Max of Core Solver Speedup	Max of Core Solver Efficiency
3975WX_Linux 8	**2,760**	**31.30**	**20.06**	**100%**
16	3,462	24.96	16.00	100%
20	3,296	26.22	16.80	84%
24	3,297	26.21	16.80	70%
28	2,885	29.94	19.19	69%
32	2,760	31.30	20.06	63%
3975WX_Win 10	**2,813**	**30.71**	**19.23**	**100%**
16	3,382	25.55	16.00	100%
20	3,150	27.43	17.18	86%
24	3,137	27.54	17.25	72%
28	2,909	29.70	18.60	66%
32	2,813	30.71	19.23	60%
W-3365_Linux 8	**2,426**	**35.61**	**21.39**	**100%**
16	3,244	26.63	16.00	100%
20	2,882	29.98	18.01	90%
24	2,698	32.02	19.24	80%
28	2,445	35.34	21.23	76%
32	2,426	35.61	21.39	67%
W-3365_Win 10	**2,571**	**33.61**	**20.74**	**100%**
16	3,333	25.93	16.00	100%
20	2,954	29.25	18.05	90%
24	2,720	31.77	19.61	82%
28	2,571	33.61	20.74	74%
32	5,578	33.51	20.68	65%
Best	**2,426**	**35.61**	**21.39**	**100%**

We see that the Xeon W-3365 shows a higher Core Solver Rating score than the Threadripper PRO, both for Windows 10 and Linux CentOS 8: 33.51 vs 30.71 (9.1% better – Windows 10), and 35.61 vs 31.30 (13.8% - Linux), @32 processes.

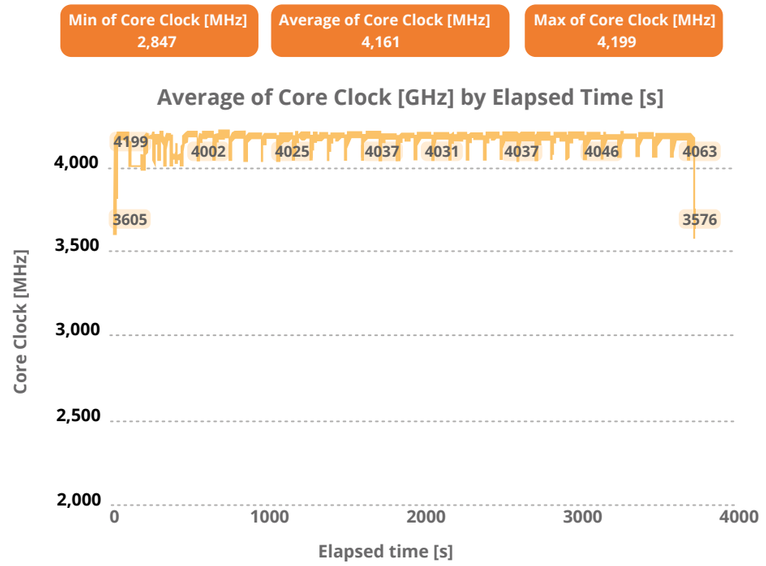
1.7 Ansys Fluent: Monitoring System Behaviour and Analysis

Building workstations optimized for Ansys applications requires in-depth system and application analysis to make sure you are turning the knobs in the right direction, and also to question conventional wisdom: it's not always the system with the highest CPU frequency which will finish the job first.

So let's take a closer look at the key components affecting performance.

CPU Frequency

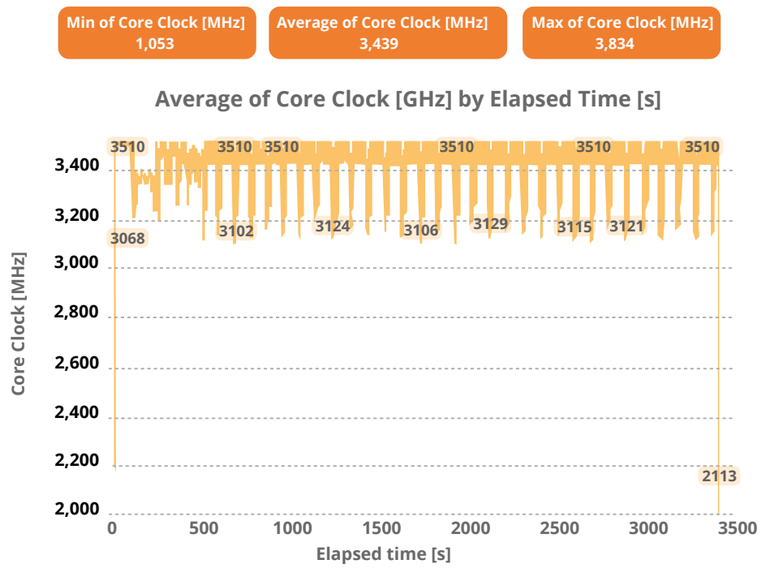
1.7.1 CPU Frequency: AMD Threadripper PRO 3975WX



Graph12: results for F1 race car model shown, 140M cells, default BIOS, default launch, 32 processes.

For the F1 race car model, with 32 processes, the AMD Threadripper PRO ran at an average core clock frequency of 4.16GHz, i.e. way above the Base Frequency of 3.50GHz, and shows Max Core Clock frequency of 4.199GHz, so it actually ran a lot of the time close to its maximum Turbo Frequency of 4.20GHz, since the delta between average and max core frequencies is so small. This also shows that the system was properly cooled, if it was able to run so close to max Turbo frequency: it was not held back by thermal limitations.

1.7.2 CPU Frequency: Xeon W-3365



Graph13: results for F1 race car model shown, 140M cells, default BIOS, default launch process, 32 processes

The Xeon W-3365 shows average CPU frequency of 3.43GHz and max core frequency of 3.84GHz, so well below the frequencies of the Threadripper PRO 3975WX: average CPU frequency for the Intel processor is 17.5% lower than the CPU from the competition, and max core frequency is 8.3% lower.

While running at far lower frequencies, the Intel-based workstation turns around the simulation job (32 processes) much faster when looking back at the wall-clock time: 12% faster under Linux, and 8.30% faster under Windows! We recap the data points in the table below.

Ansys Fluent test F1 race car, 140M cells, 32 processes (wall-clock time, seconds)				
Operating System	**Xeon W-3365**	**Threadripper PRO 3975WX**	**DELTA**	**DELTA %**
Win 10	2578	2813	-235	-8.35%
CentOS 8	2426	2760	-334	-12.10
(Win 10 vs CentOS 8)	106.27%	101.92%		

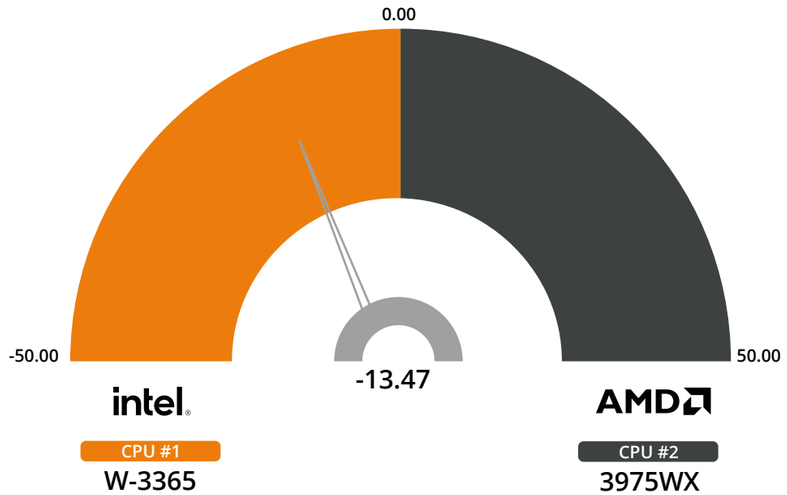
So frequency is not the most indicative parameter to watch out for: it's not about frequency, it's all about IPC (Instructions per clock cyle)! The IPC reveals the capability of the underlying CPU architecture to process a certain workload in a given time frame. That will be a better indicator of the capability of a system to sustain a certain "throughput" (performance) level to process a certain workload in a given time frame. Performance will obviously be influenced by the supported instruction sets in the software (such as SSE2, AVX 2.0) and the level of optimization: it's a combination of optimized software and hardware.

Testbed set-up:

Hardware & Software Set-up		
	Intel Xeon W-3300	**AMD Threadripper PRO**
Motherboard Workstation	Workstation motherboard LGA4189/C621A	Workstation motherboard SWRX8
CPU	Intel Xeon W-3365	AMD Threadripper PRO 3975WX
# CPU cores	32	32
# Threads per core	1	1
CPU Base frequency	2.70GHz	3.50GHz
Max Turbo frequency single-core	4.00GHz	Up to 4.20GHz
CPU L3 cache	48MB	128MB
CPU TDP	270W	280W
CPU socket	LGA4189	sWRX8
RAM	8 x 64GB DDR4-3200 RDIMM Dual Rank (Samsung M393A8G40xxx)	8 x 64GB DDR4-3200 RDIMM Dual Rank (Samsung M393A8G40xxx)
SSD	Corsair MP600 XT 1TB M.2 PCIe 4.0 x4	Corsair MP600 XT 1TB M.2 PCIe 4.0 x4
Chassis	Corsair Obsidian 1000D	Corsair Obsidian 1000D
Cooling	Liquid cooling	Liquid cooling
Power supply	HX1200 - 1200W Platinum PSU	HX1200 - 1200W Platinum PSU
Operating System 1	Microsoft Windows 10 Pro	Microsoft Windows 10 Enterprise LTSC
Operating System 2	Linux CentOS 8.4.2105	Linux CentOS 8.4.2105
Ansys software (Fluent/ Mechanical)	2021 R2	2021 R2

2. Ansys Mechanical results

2.1.1 Ansys Mechanical: CPU Performance Analysis – Wall-clock time



Graph14

On average the Intel Xeon W-3365 Workstation performs 13.47% better that the system equipped with the Threadripper Pro 3975WX.

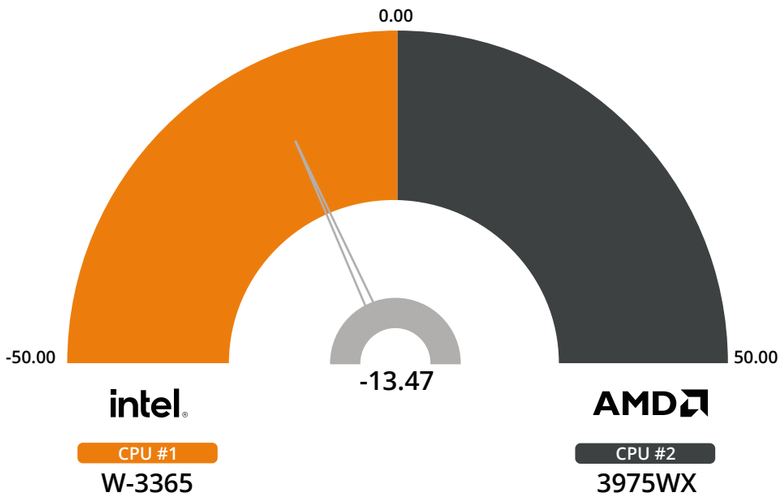
Below you will see an overview of the different Ansys Mechanical models and the respective score for each of the CPUs. Out of the 13 standard Mechanical tests, the Intel Xeon W-3365 workstation wins in all of them. It wins with a comfortable margin, ranging from approximately 8% to 28% across all tests complexities. Although daily use workloads might be more complex, the Intel platform consistently offers an advantage over the AMD platform.

It can be observed that the benchmarks with iterative solver (cg/ln) benefit the most from memory bandwidth while those with direct (sparse) solver (sp) benefit the most from flop speed.

Total Wall-Clock Time				
Test Name	Core Solver - CPU #1	% Diff - Core Solver	Core Solver - CPU #1	Difference - Core Solver
V21cg-1	232	-0,77	234	-2
V21cg-2	180	-2,59	185	-5
V21cg-100mdof	572	-8,36	624	-52
V21ln-2	327	-9,08	360	-33
V21ln-1	207	-10,87	232	-25
V21cg-3	141	-12,18	160	-20
V21sp-8mdof	1 148	-12,76	1 316	-168
V21sp-2	273	-12,87	313	-40
V21sp-4	161	-14,35	188	-27
V21sp-5	155	-18,13	189	-34
V21sp-25mdof	357	-21,69	456	-99
V21sp-3	146	-22,93	189	-43
V21sp-1	272	-28,48	380	-108

2.1.2 Ansys Mechanical: CPU Performance Analysis – Core Solver Rating

The Ansys Core Solver rating indicates the number of benchmarks that can be run on a given machine in a 24-hour period. A higher value represents better expected performance on actual real-life workloads.



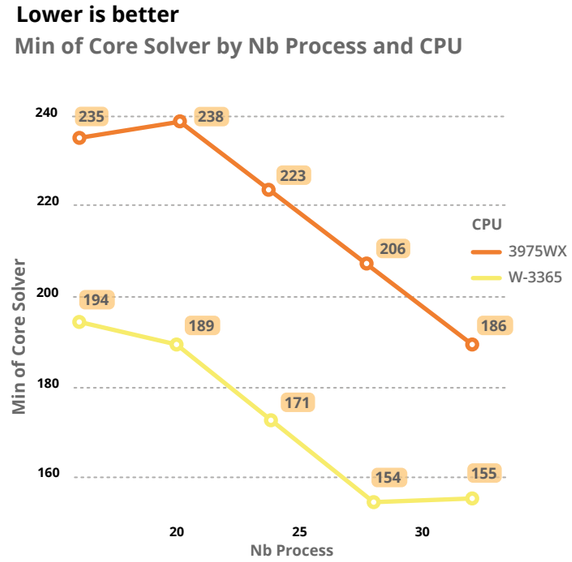
Graph15

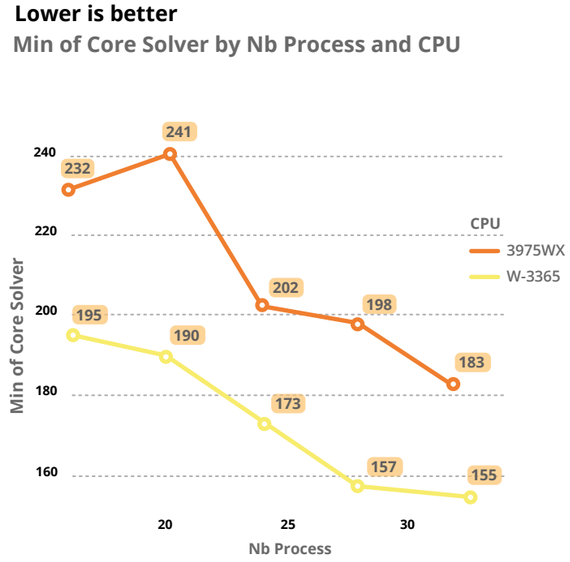
The Intel system performs on average 13.47% better on this metric than the competition. Below is the deial with the Core Solver rating for each Mechanical model. In the V21-sp1 at , for example, with the Intel system, you would be able to perform 318 iterations in 24 hours, 90 more than with the AMD System. With the v21-sp5 one would perform more than a 100 more iterations.

Core Solver Rating

Test Name	Core Solver - CPU #1	% Diff - Core Solver	Core Solver - CPU #1	Difference - Core Solver
V21cg-1	372,74	-0,77	369,86	2,87
V21cg-100mdof	151,00	-8,36	138,37	12,62
V21cg-2	479,20	-2,59	466,77	12,43
V21cg-3	614,51	-12,18	539,66	74,85
V21ln-1	418,20	-10,87	372,74	45,46
V21ln-2	263,90	-9,08	239,93	23,96
V21sp-1	318,23	-28,48	227,61	90,62
V21sp-2	316,60	-12,87	275,86	40,74
V21sp-25mdof	242,22	-21,69	189,68	52,54
V21sp-3	592,19	-22,93	456,42	135,77
V21sp-4	536,31	-14,35	459,33	76,98
V21sp-5	557,78	-18,13	456,66	101,12
V21sp-8mdof	75,24	-12,76	65,64	9,60

2.2 Ansys Mechanical: default Mode vs optimized Mode

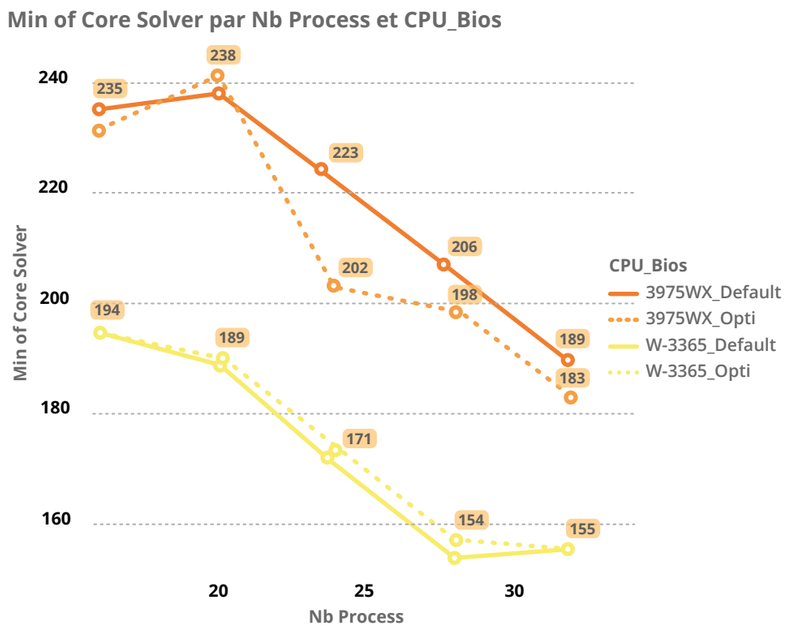




Graph16 (left): Default Mode, Graph17 (right): Optimized Mode

While we showed previously that optimizing the system's BIOS settings the tests show that this is again true for the Mechanical benchmarks. One can see with the v21-sp5 test that even with a nonoptimized BIOS, the minimum number of Core Solver, the Intel W-3365 workstation performs better than the AMD system. The Intel system requires 12 less cores to reach the same minimum Core Solver and when using 32 cores, requires 18% less Core Solvers to complete the simulation.

2.3 Ansys Mechanical Core Solver Analysis by number of cores – BIOS comparison

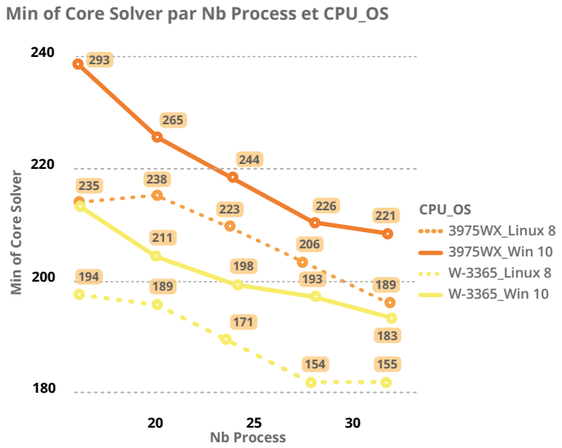


When switching from a default BIOS to an optimized one, the improvements are marginal for the Intel W-3365 Workstation. The performance is consistent across the number of cores used, with Min Core Solver scores varying less than 2%. One could argue that there is no extra juice to squeeze out of the Intel machine, however, this means the CPU's maximum performance is already available to the user, easing up the setup process. On the contrary, when performing the switch for the Threadripper Pro 3975WX, there is slightly more performance to extract, sometimes up to 10% which is not negligeable.
On the other hand, the performance does not scale well across the number of CPU cores being used: when using 20 cores of the Threadripper Pro 3975WX, the performance is better, although marginally, when the BIOS is not optimized.

Test Name	V21sp-5			
CPU_Bios	Min of Core Solver	Max of Core Solver Rating	Max of Core Solver Speedup	Max of Core Solver Efficiency
3975WX_Default	**189,20**	**456,66**	**19,85**	**100%**
16	234,70	368,13	16,00	100%
20	237,90	363,18	15,78	79%
24	222,50	388,31	16,88	70%
28	205,90	419,62	18,24	65%
32	189,20	456,66	19,85	62%
3975WX_Opti	**182,50**	**473,42**	**20,30**	**100%**
16	231,60	373,06	16,00	100%
20	240,70	358,95	15,40	77%
24	202,20	427,30	18,33	76%
28	198,00	436,36	18,72	67%
32	182,50	473,42	20,30	63%
W-3365_Default	**154,10**	**560,67**	**20,15**	**100%**
16	194,10	445,13	16,00	100%
20	188,90	457,38	16,44	82%
24	170,90	505,56	18,17	76%
28	154,10	560,67	20,15	72%
32	154,90	557,78	20,05	63%
W-3365_Opti	**154,50**	**559,22**	**20,15**	**100%**
16	194,60	443,99	16,00	100%
20	190,30	454,02	16,36	82%
24	173,00	499,42	18,00	75%
28	156,80	551,02	19,86	71%
32	154,50	559,22	20,15	63%
Best	**154,10**	**560,67**	**20,30**	**100%**

We can see that the highest Core Solver rating is achieved with the Xeon W-3365 with a score of 559.22 (32 processes) vs 473.42 for the Threadripper PRO 3975WX (32 processes), while being 27% faster (Min Core Solver).

2.4 Ansys Mechanical Core Solver Analysis by number of cores – OS comparison



The Operating System choice can be as important as the hardware and its underlying software optimization. The graph above shows that both the AMD and Intel machines perform better under the Linux operating system.

For the Intel Xeon W-3365 machine, switching from Windows10 to the Linux OS translates in a performance boost between 11.6% and 17.44%.

Test Name	V21sp-5			
CPU_OS	Min of Core Solver	Max of Core Solver Rating	Max of Core Solver Speedup	Max of Core Solver Efficiency
3975WX_Linux 8	**189,20**	**456,66**	**19,85**	**100%**
16	234,70	368,13	16,00	100%
20	237,90	363,18	15,78	79%
24	222,50	388,31	16,88	70%
28	205,90	419,62	18,24	65%
32	189,20	456,66	19,85	62%
3975WX_Win 10	**221,40**	**390,24**	**21,19**	**100%**
16	293,20	294,68	16,00	100%
20	264,70	326,41	17,72	89%
24	243,70	354,53	19,25	80%
28	225,50	383,15	20,80	74%
32	221,40	390,24	21,19	66%
W-3365_Linux 8	**154,10**	**560,67**	**20,15**	**100%**
16	194,10	445,13	16,00	100%
20	188,90	457,38	16,44	82%
24	170,90	505,56	18,17	76%
28	154,10	560,67	20,15	72%
32	154,90	557,78	20,05	63%
W-3365_Win 10	**183,10**	**471,87**	**20,38**	**100%**
16	233,20	370,50	16,00	100%
20	210,50	410,45	17,73	89%
24	197,70	437,03	18,87	79%
28	192,80	448,13	19,35	69%
32	183,10	471,87	20,38	64%
Best	**154,10**	**560,67**	**21,19**	**100%**

Switching to the Linux OS can translate in a 18.8% performance boost in Core Solver rating, meaning that the end user will be able to run a much bigger amount of simulations than when using Windows10.

Achieving Maximum Ansys performance with 2CRSi Workstations

2CRSi proposes 2 families of workstations: Fanless and Extreme workstations. The workstations tested here for Ansys applications are definitely part of the Extreme product line-up. Customers have the choice between 2 models: Kraken and Storm workstations.

The Kraken workstations feature 2 motherboards: one for the Xeon W-3300 processors, and a second one for Intel Core i9-12900K processors. The Xeon W-3365 configuration is meant for the heavy compute jobs, such as Ansys Fluent or Ansys Mechanical simulations, with 32 cores (you can go up to 38 cores with the Xeon W-3375). The Core i9-12900K unit is added to have an independent and extremely fast platform for pre- and post-processing jobs, with 8 Performance-cores offering max Turbo frequencies of up to 5.20GHz (base frequency of P-cores is 3.20GHz), and 8 Efficient-cores offering max Turbo frequencies of up to 3.90Ghz (base frequency for these E-cores is 2.40GHz). Since you have 2 motherboards, customers can decide to adopt a multi-OS strategy: use Windows for the Core i9-12900K configuration, and Linux for the motherboard equipped with the Xeon W-3365 (since we have seen that the best performance for Ansys Fluent and Ansys Mechanical was achieved using Linux).

The 2CRSi Storm workstations come with a single motherboard, in this case featuring the Xeon W-3365 processor, and are targeted at those compute-intensive simulation jobs Ansys customers typically do using Fluent or Mechanical.

The Kraken solution provides an all-in-one, end-to-end solution for all your challenging engineering tasks: pre- and post-processing jobs are performed blazingly fast by the Intel Core i9-12900K processors, while the heavy-duty Ansys simulations are crunched most efficiently by the Xeon W-3365. Whichever model is best suited for your current needs, both these 2CRSi Extreme workstation models are equipped with advanced cooling technology: that is how we ensure not only the best performance, but also an extended lifespan, reducing cost of ownership further still.

The Intel Xeon W-3365 revealed itself as the better choice for the more compute-intensive Ansys Fluent and Ansys Mechanical tasks: with the optimizations we realized through the partnership with MVConcept (BIOS optimizations, optimized launch scripts for Linux), we can offer significantly better performance compared to what you can expect to get from alternative, out-of-the box solutions.
So Ansys customers can be assured our offerings bring maximum return on investment: with 2CRSi optimized workstations for Ansys, every licensed core will be fully utilized to deliver the fastest engineering simulation results.

See for yourself, take the test!

The 2CRSi Kraken and Storm workstations powered by the Intel Xeon W-3365 processor will provide customers with cutting-edge Ansys modelling performance. We want to provide customers and prospects an opportunity to access our portal with the detailed benchmark results, and to run the benchmark test on their system, or alternatively to run their dataset on our workstation remotely. That way, you can assess how your current workstations compare – and just how much your business would gain from an upgrade. If you are interested, click here to register and to access the terms and conditions of this offer.