EDR™ MEDESO

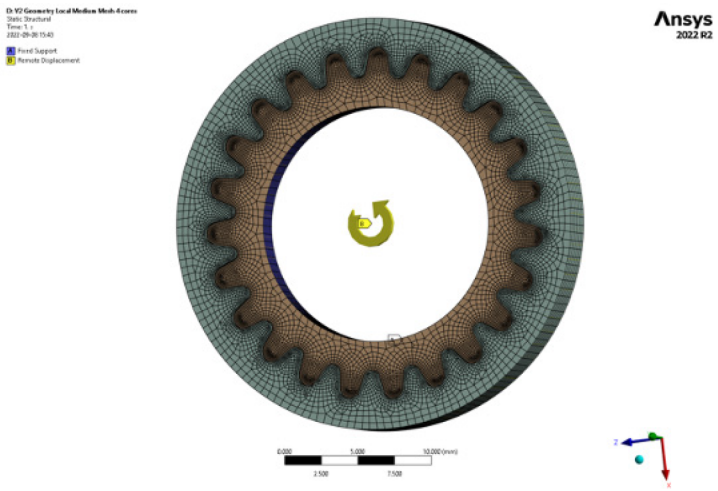
CloudConnect Benchmark

CloudConnect vs On-Premise Hardware

Which one is better?

The Case

- Mechanical Static Structural simulation of a teethed connection with 508 886 nodes and 108 912 elements
- Bilinear isotropic hardening
- Frictional contact between the teeth with a friction co-efficient of 0.2
- Outer teeth are rotated for 1.5 degrees which results in 1.8% maximum plastic strain
- Simulation was run with 10 timesteps and a direct solver



On-Premise hardware we had at hand:

Power Desktop – Fujitsu Celsius R970n – 8000 €

Intel Xeon Gold 6148 @ 2.4GHz, 20 cores, 192GB System memory

CAD laptop – Lenovo P52 – 2500 €

Intel i7-8750H CPU @ 2.2GHz, 6 Cores

CloudConnect – Cloud Hardware Tested

Diamond
- 12 cores
- Intel Xeon Platinum 8151, 3.4 GHz
- 192GB system memory

Diamond
- 24 cores
- Intel Xeon Platinum 8151, 3.4 GHz
- 384GB system memory

Malachite
- 64 cores
- 3rd gen Intel Xeon, 3.5 GHz
- 1024GB system memory

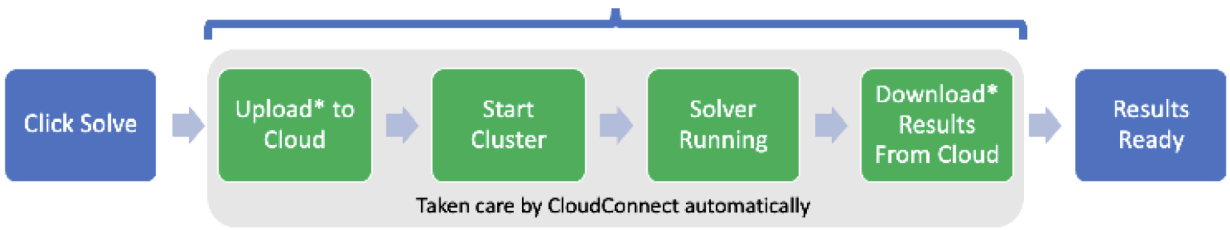
CloudConnect utilizes Rescale cloud for solving

- Diamond and Malachite are Rescale cloud solving core types especially fit for Mechanical simulations
- See more at Coretypes List - Rescale

We Measured – Time to Results

Laptop or Power Desktop

CloudConnect "Time to results"

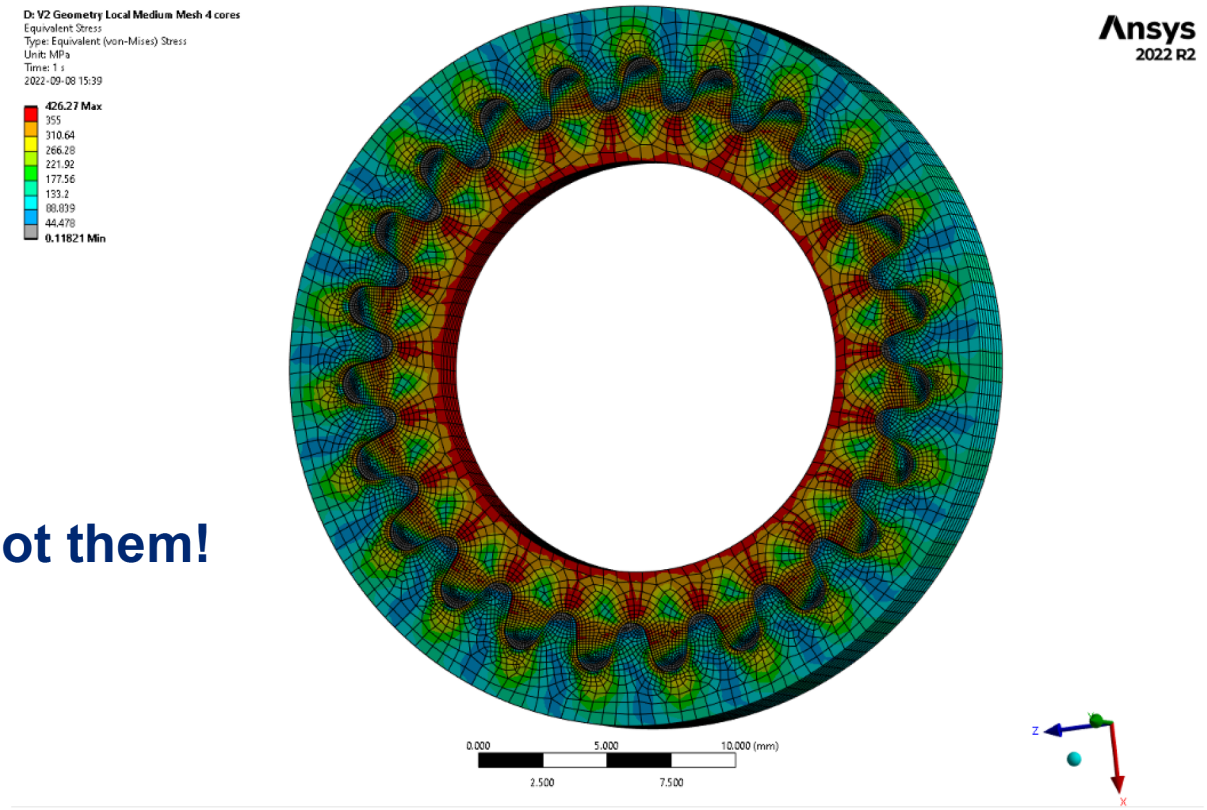


* Conservative network upload/download speed of 2MB/s used, higher if better network available.

Five Tests of Different Hardware

1. CAD laptop 4 cores, on-premise
   - 4 cores is the maximum one can run without any HPC licenses
2. Power desktop 12 cores, on-premise
   - 12 cores is supported with a one HPCPack license
3. Diamond 12 cores, CloudConnect
   - How does CloudConnect compare against the option 2?
4. Diamond 24 cores, CloudConnect
   ~10k nodes/CPU core
   - Does it scale, do we get results faster?
5. Malachite 64 cores, CloudConnect with **double the model size**
   - Practically impossible to solve with the laptop
   - Can CloudConnect increase model accuracy without sacrificing time-to-results?

	Local On-Premise		CloudConnect		
	CAD Laptop	Power Desktop	Diamond-12c	Diamond-24c	Malachite-64c
FEA mesh nodes	508886	508886	508886	508886	**1023025**
Cost of hardware [€]	3000	8000	-	-	-
CPU name	Intel I7-8750H	Intel Xeon Gold 6148	Intel Xeon Platinum 8151	Intel Xeon Platinum 8151	3rd gen. Intel Xeon
CPU clock speed [GHz]	2,2	2,4	3,4	3,4	3,5
CPU cores used to solve	4	12	12	24	64
System memory [GB]	32	192	192	384	1024



The result?

All options got them!

Laptop - What Did We Experience?

- It took 2h 55min to get the results
- As 4 out of 6 CPU cores were 100% utilized, we couldn't do CAD modeling or any slightly more demanding activities during solving
- Disconnecting the power plug and going battery powered wasn't an option either
- The laptop became a slow, hot and loud desktop machine
- Possibility to work from home
- We got the results!

Bad experience, these laptops are not meant for simulation solving

CAD laptop – Lenovo P52 – 2500€
Intel i7-8750H CPU @ 2.2GHz, 6 Cores
32GB System memory

Power Desktop - What Did We Experience?

- It took 1h 10min to get the results – more than 2x faster than with a laptop!
- Computer usable for other productivity activities during solving
- Impossible to carry-on to work-from-home activities
- Not super easy to argue for investment upfront
- Pretty good user experience

Good minimum baseline for anyone doing simulations!

Power Desktop -
Fujitsu Celsius R970n - 8000€
Intel Xeon Gold 6148 @ 2.4GHz, 20 cores, 192GB System memory

CloudConnect - What Did We Experience?

- Significantly faster than the CAD laptop
  - We could do work with the laptop during the CloudConnect solve!
- As fast or faster than the power desktop
- Possibility to double the model size and still get results almost as fast as with the power desktop!

	CloudConnect		
	Diamond-12c	Diamond-24c	Malachite-64c
FEA mesh nodes	508886	508886	1023025
Cost of Hardware [€]	-	-	-
CPU name	Intel Xeon Platinum 8151	Intel Xeon Platinum 8151	3rd gen. Intel Xeon
CPU clock speed [GHz]	3,4	3,4	3,5
CPU cores used to solve	12	24	64
System memory [GB]	192	384	1024
Memory allocated [GB]	66	74	198
Memory used [GB]	49	53	142
Solver time	56min	36min	1h 1min
Upload to cloud time*	1min	1min	1min
Cloud cluster start-up time	5min	5min	5min
Cloud results download time*	7min	7min	13min
Time to results	1h 9min	49min	1h 20min

* Conservative network upload/download speed of 2MB/s used, higher if better network available.

How About the Costs?

	Local On-Premise		CloudConnect		
	CAD Laptop	Power Desktop	Diamond-12c	Diamond-24c	Malachite-64c
FEA mesh nodes	508886	508886	508886	508886	1023025
Cost of hardware [€]	3000	8000	-	-	-
CPU name	Intel i7-8750H	Intel Xeon Gold 6148	Intel Xeon Platinum 8151	Intel Xeon Platinum 8151	3rd gen. Intel Xeon
CPU clock speed [GHz]	2,2	2,4	3,4	3,4	3,5
CPU cores used to solve	4	12	12	24	64
System memory [GB]	32	192	192	384	1024
Memory allocated [GB]	23	48	66	74	198
Memory used [GB]	15	62	49	53	142
Solver time	2h 55min	1h 10min	56min	36min	1h 1min
Upload to cloud time*	-	-	1min	1min	1min
Cloud cluster start-up time	-	-	5min	5min	5min
Cloud results download time*	-	-	7min	7min	13min
Time to results	2h 55min	1h 10min	1h 9min	49min	1h 20min
Unit cost, priority [€/core/hour]	-	-	0.277	0.277	0.1628
Unit cost, on-demand [€/core/hour]	-	-	0.0959	0.0959	0.1191
Minutes run	-	-	56	36	61
Cost of run, priority [€]	-	-	**3.10**	**3.99**	**10.59**
Cost of run, on-demand [€]	-	-	**1.07**	**1.38**	**7.75**

CloudConnect costs for hardware for solving was between 1.07 € and 10.59 €

The 6-Point Summary

1. Using laptops for solving is not efficient even for small models.
2. Using power desktops for solving is a good baseline but they cannot be used when working from home.
3. On-premise performance hardware will always have fixed up-front costs, effort to maintenance and limited scaling capability.
4. At the cost of one desktop, user can run almost one thousand cloud runs without having to worry about hardware getting old, low utilization factor or warranty support ending.
5. CloudConnect is faster than on-premise hardware as soon as the model size is increased.
6. Almost all companies would benefit from complementing on-premise hardware with CloudConnect to have an easy access to cloud HPC.

Want to know more about our solutions related to cloudconnect?

digitallabs.edrmedeso.com/cloudconnect

EDR™ MEDESO