Ansys Cloud

HPC as easy as it should be

Challenges

Ansys Cloud

Cloud Market & challenges

The US cloud computing industry had total revenues of **$85.4bn in 2018**, representing a compound annual growth rate (CAGR) of **29.5%** between 2014 and 2018. In comparison, the European and Asia-Pacific industries grew with **CAGRs of 32.2%** and **28.8%** respectively, over the same period, to reach respective values of **$36.0bn and $20.6bn** in 2018

Challenges we address :

- Work from home
- Remove the HW barrier
- Less cutting corners
- Time to market
- Evolution of hardware
- Cyber security
- Innovation
- IT Complexity

Example of win with Ansys Cloud

Ansys **Cloud** and Ansys **HFSS has solved** an entire RFIC (5.5 x 5.5mm) at **5GHz.** It was **impossible before** the use of the **Cloud** and we did it in only **couple of hours.**

Ansys Cloud generates over **$40,000** in annual savings for each Marmon engineer using it

Benefits

Ansys Cloud

What is Ansys Cloud ?

Ansys Cloud increases simulation throughput by removing the **hardware** barrier. **Ansys** is the only Simulation Software vendor that has **cloud directly integrated** into our **simulation software**. We have a **secure** , **scalable** and **cost-effective** approach to **HPC in the cloud**.

Key partnership :

Microsoft Azure

Industry : All industries

Products : EBU / MBU / FBU / Ls-Dyna (+2021 release : Discovery, SPEOS.., CFX..) + HPC

Trends: All Trends (5G, AI, Autonomous, Digital Transformation …)

Key Audience : IT Director, R&D Manager, Head of R&D , Cloud IT Architect, Head of Research, Engineering Manager, Head of HPC.

2020 : Ansys Flagships solvers

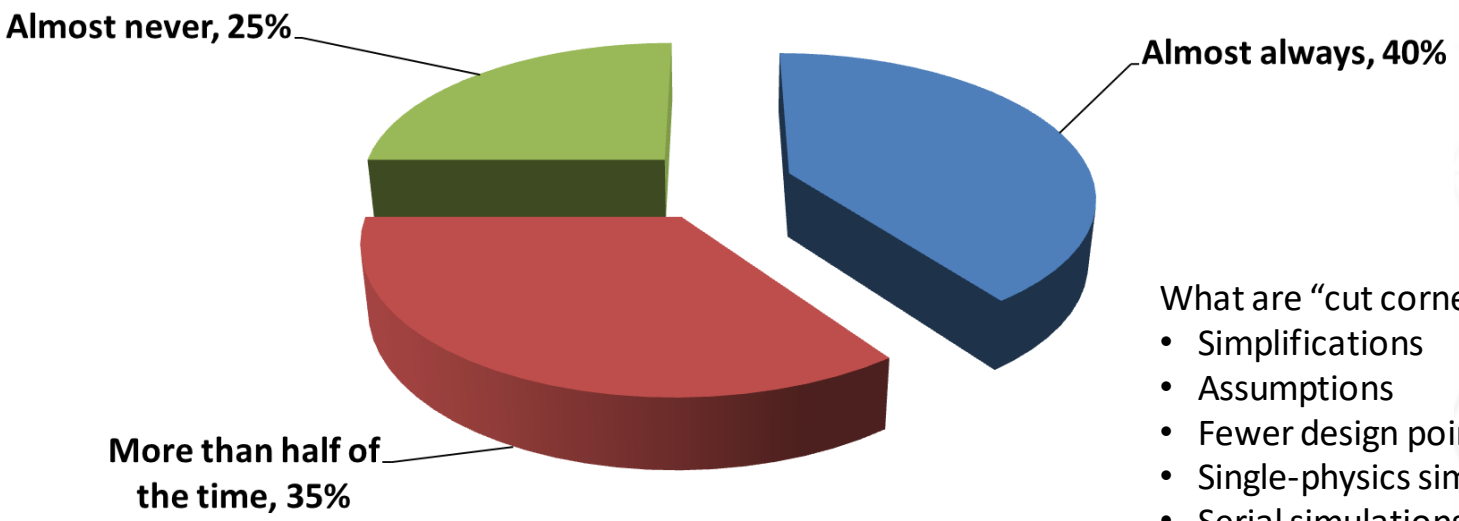
2021 : Extension with others Ansys Products

2022 and beyond:

Ansys Cloud as the backbone for cloud-based simulation solutions

Why Cloud: Costs of being compute bound

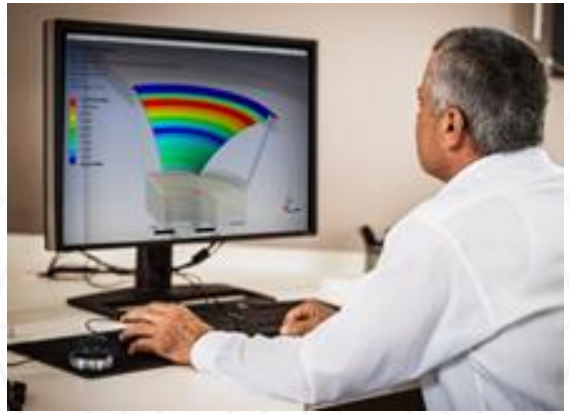
How often do you "cut corners" due to your compute limitation?



2018 Survey of Ansys users

What are "cut corners"
- Simplifications
- Assumptions
- Fewer design points
- Single-physics simulations
- Serial simulations

40% of Ansys user base run simulations exclusively on a laptop/desktop!



>56% less than 36 cores

HW constraints negatively impacted simulation effectiveness for almost 75% of users

Impacting engineering throughput

Yesterday

Using Local Resources

Tomorrow

Using Ansys Cloud + Azure Resources

Use local machine for model setup	→	Use local machine for model setup
Use local machine for solving	→	Use **Ansys Cloud** for solving
8 CPU cores	→	132 CPU cores
32 GB RAM	→	1,056 GB RAM
Running 1 job at a time	→	Running 10 jobs at a time (12 cores per design point)
8 hours per design point	→	6 hours per design point
10 design points = **80 hours**	→	10 design points = **6 hours**

✓ ***User Experience is identical.***

✓ ***Ansys and Microsoft handle all the IT.***

Ansys Cloud, unleash the power!

Tuned to deliver best performance

Local Computing

Ansys Flagship Solvers

Ansys Cloud : no speed limit !

The Benefits of Cloud

Increase simulation throughput

Pay for only what you use

Access the latest hardware (at scale!)

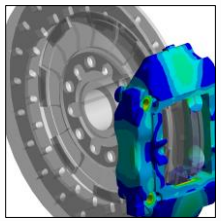
Move fixed expenses to variable (CapEx -> OpEx)

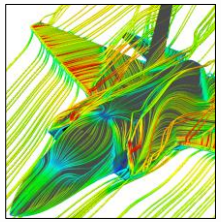
Focus on engineering (not maintaining clusters)

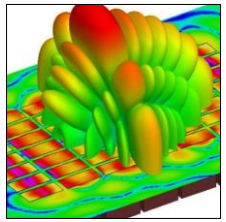
Solution

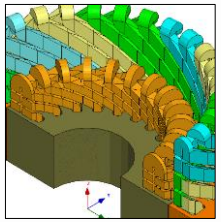
Ansys Cloud

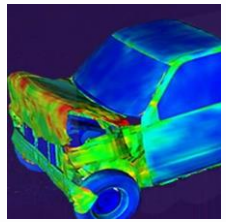
Ansys Cloud - *HPC as Easy as it Should Be*

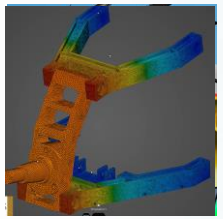

Mechanical

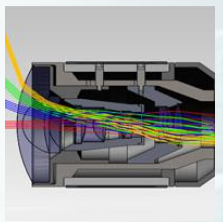

Fluent

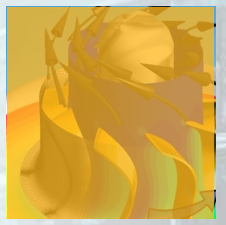

HFSS, SIwave, Icepak**


Maxwell*, Q3D (2D & 3D)*


Ansys LS-DYNA***


Ansys Discovery ****


Ansys Speos *****


CFX 2021 R2

Ansys CLOUD

Microsoft Azure

Supported Versions

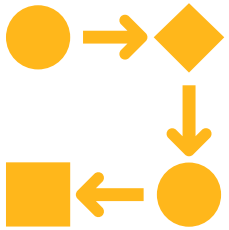
- Ansys 2019 R2
- *Ansys 2019 R3
- **Ansys 2020 R1
- ***Ansys 2020 R2
- ****Ansys 2021 R1

Compute Nodes

- High memory bandwidth
- Large capacity RAM
- High performance interconnect
  - Low latency MPI
  - High BW
- SSD-based working directory

- Solve in the cloud directly from the desktop application
- Highly optimized for Ansys solvers
- Single vendor solution for SW+HW (BYO Azure coming soon)
- Seven data centers worldwide
- Data localized and secured

Ansys Cloud is HPC optimized



Workflow

Cloud access is integrated **directly** from your Ansys software. With **only a few mouse** clicks, you have the **power** of the cloud to use as you wish.

Performance

This complete solution — from solvers to the cloud — was developed by Ansys for **full architecture integration**. Like a Formula 1 race car, Ansys Cloud is **tuned** for Ansys solvers.

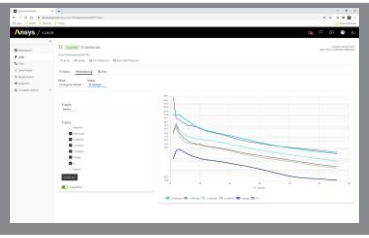
Support

Ansys **supports the entire simulation process** from **hardware to software**, from beginning to end.

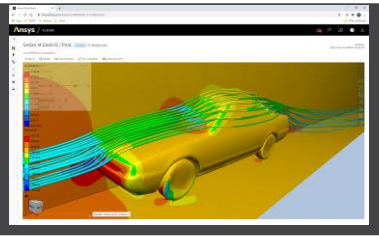
Ansys Cloud workflow

Submit jobs from desktop application

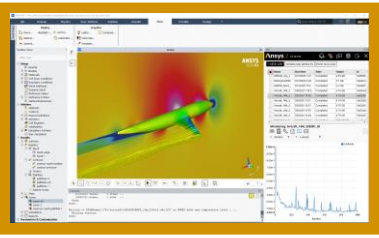
Monitor from app or cloud portal

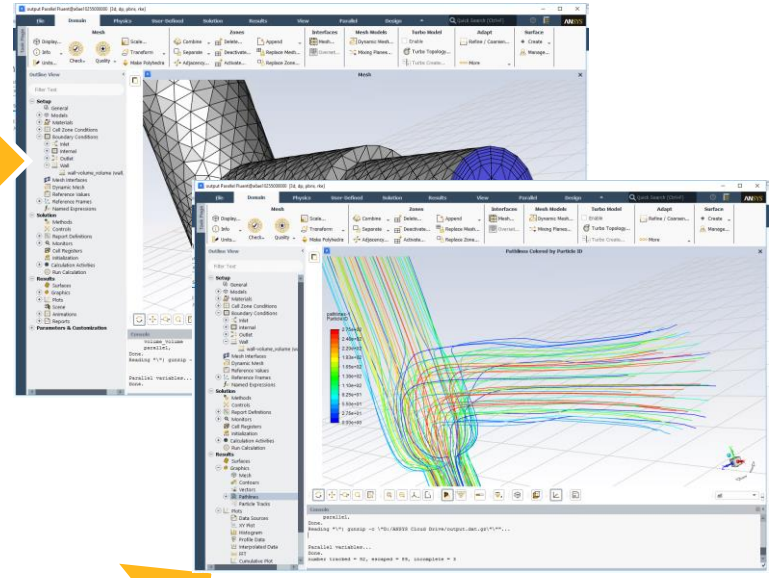


Visualize results in the cloud



Download to workstation





Newly added!
Ansys' In Browser Cloud Offering for interactive cloud-based workflows

Talking about Security

Regions and Geographies

- Geographies are fault-tolerant to withstand complete region failure

Data Residency

- **Data residency persists based on the selected region.**

Data Retention and Deletion Policy

- Each customer is solely responsible for their data retention and deletion policy and procedure.

Availability

- The Ansys Cloud Service application is deployed in multiple regions to achieve **high availability**.

Penetration testing

- Security controls are addressed by **Microsoft through their platform as a service (PaaS)** . with third party penetration test performed regularly.

Cloud Interface – Fluent/Mechanical

Cloud Interface in application

File transfer Agent status
- Green – running, ready
- Red – Stepped
- Yellow - busy

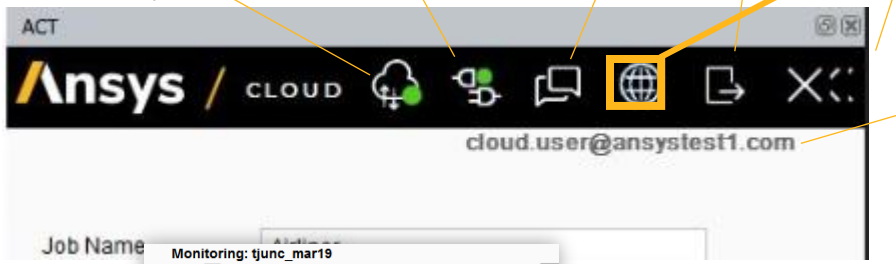
Cloud Connection status
- Green – Connected
- Red – not connected

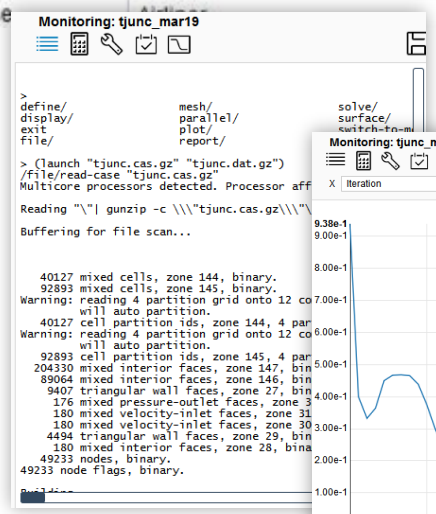
Forum

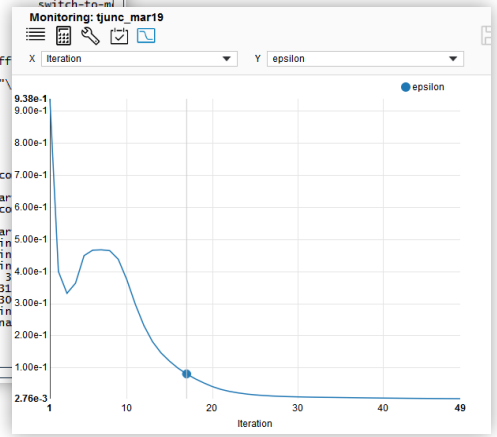
Sign out

Exit app

Account logged in

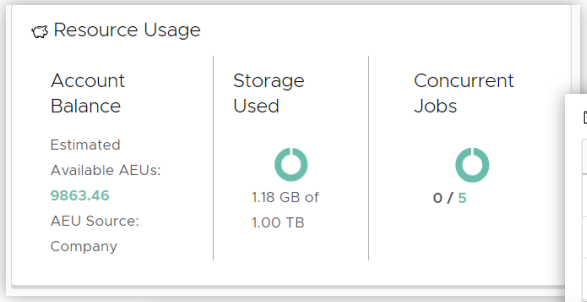


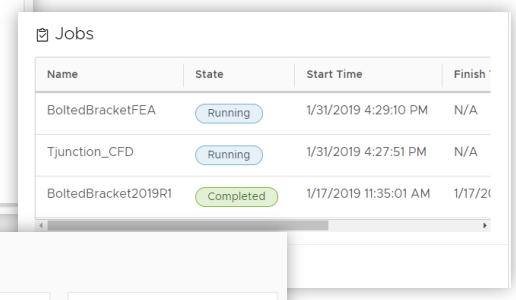


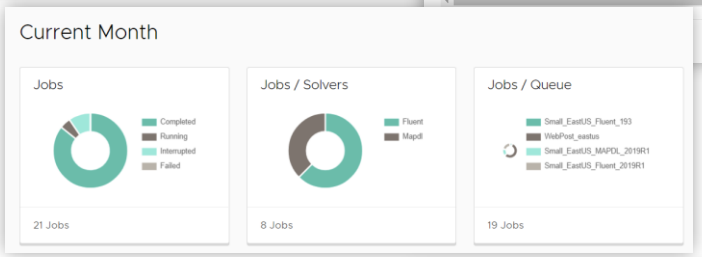


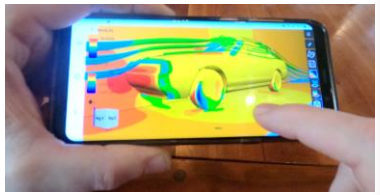
Ansys Cloud Portal:

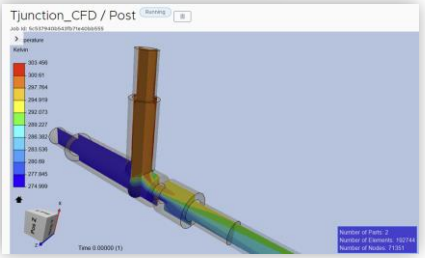
- Job management
- Analytics and dashboards,
- Postprocessing
- App download





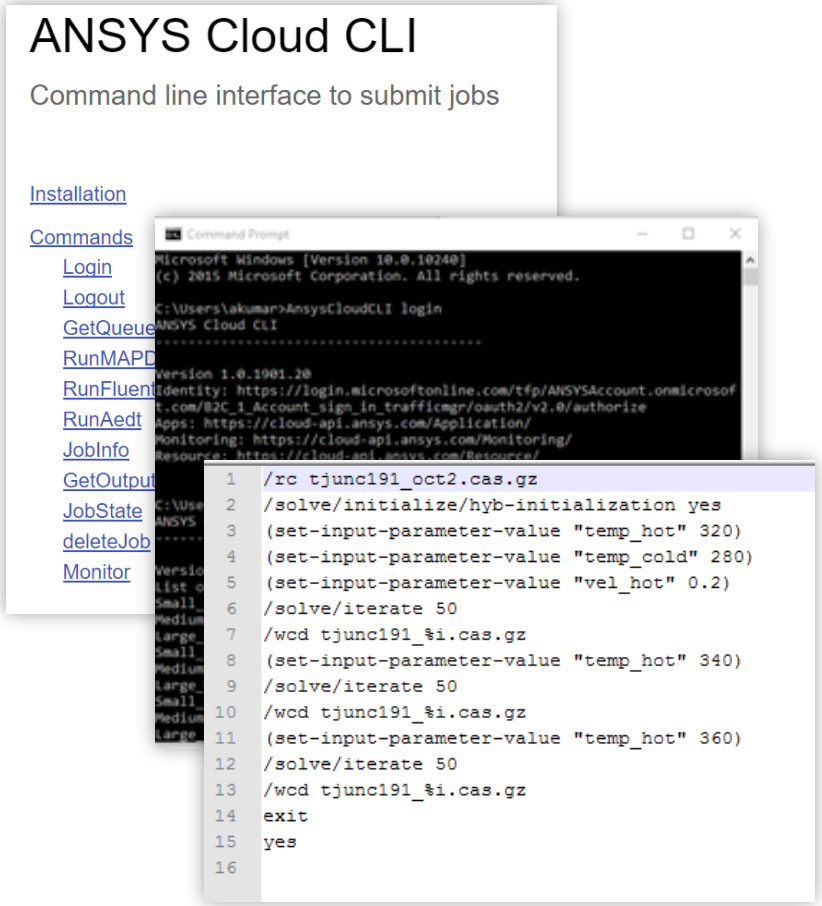




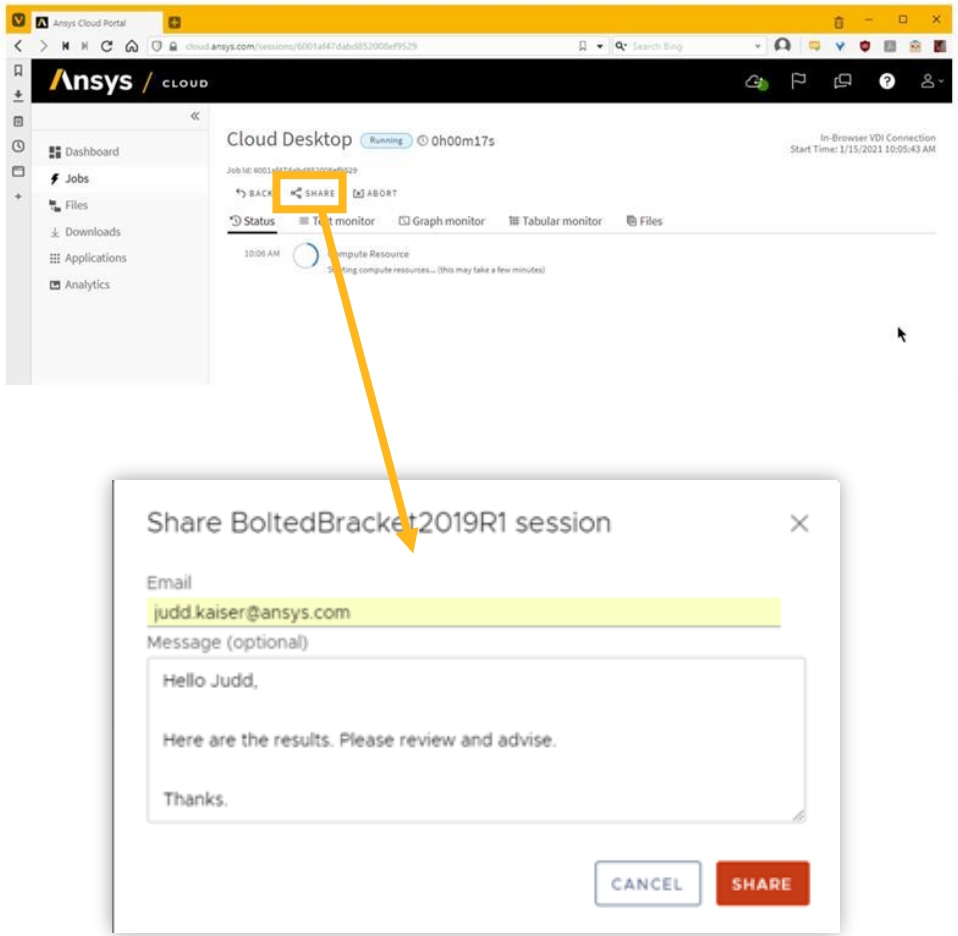


Other Features

Command Line Interface (CLI)



Customers can collaborate or seek help



What's New ?

Ansys CLOUD

Latest update

HPC Optimized

- Better **Price/Performance up to 960 cores**
- Increased **flexibility** for flagship solvers
- New AEDT Configurations

Run Ansys Applications Interactively In-Browser

- Interactive cloud-based workstations: **Now running in-browser**
- New HW configurations supporting Nvidia **GPU**
- New high-core count configurations, **up to 120 cores**
- Broader product **testing/support** coverage for interactive applications in Ansys Cloud

Ansys Elastic Pricing

- New "Ansys Elastic Currency" simplified pricing with a **single rate**
- **AEC – Ansys Elastic Currency** – like AEUs – enables SW usage on Cloud and on prem AND enables HW usage on Cloud
- **AHC – Ansys Managed Hardware Solution** – the same as AEC (pricing, rates) except that it ONLY enables use of cloud hardware

New geos for HW

- WW coverage
- Broader Support/training
- Pricing adapted to your geo
- Better availability
- GDPR

*New regions

Azure H-Series V-Series and Ansys Cloud

New VM Integrated into Ansys Cloud release

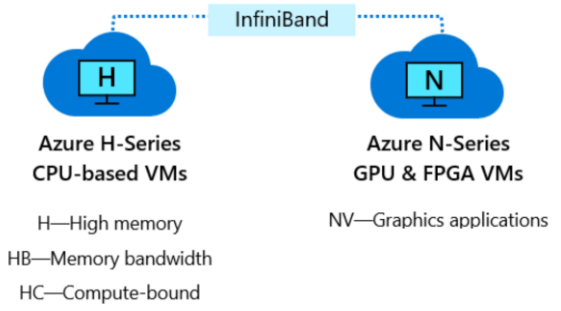
Reconfigured HPC clusters adding **HC, HB and HBv2** instances delivering larger configurations and **better price/performance**

- Updated benchmark data and **New HW recommendations**
- **Increased flexibility** for Solvers (*choose your region, VM type, number of nodes, number of cores*)
- AEDT adopting **new configurations** based on HC

Microsoft Azure

Azure H-Series VM Specifications

	HBv2	HB	HC	H
Workload Optimized	Memory Bandwidth	Memory Bandwidth	Dense Compute	Large-Memory HPC
CPU	AMD EPYC 2nd Gen "Rome"	AMD EPYC 1st Gen "Naples"	Intel Xeon Platinum 1st Gen "Skylake"	Intel Xeon E5 v3 "Haswell"
Cores/VM	120	60	44	16
TeraFLOPS/VM (FP64)	4 TF	0.9 TF	2.6 TF	0.7 TF
Memory Bandwidth	353 GB/s	263 GB/sec	191 GB/sec	82 GB/s
Memory	4 GB/core, 480 total	4 GB/core, 240 total	8 GB/core, 352 GB	14 GB/core, 224 GB
Local Disk	900 GB NVMe	700 GB NVMe		2 TB SATA
InfiniBand	200 Gb HDR	100 Gb EDR		56 Gb FDR
Network	32 GbE	32 GbE		16 GbE



GPUs for visualization, rendering, and remote desktops:

	NV
Cores	6, 12, 24
GPU	K80
Memory	56/112/224 GB
Local Disk	~380/~680/~1.5 TB SSD
Network	Azure Network + InfiniBand (la

New HW Configurations coming with HPC and In-Browser Interactive Client

More choice, more flexibility, more power

HPC

In Browser

Infra	Cores per node	Frequency Peak	RAM per Node	Memory Bandwidth	Interconnect	
H16r	16	3.3 GHz	112 GB	80 GB/s	56 Gb/s	Current Configurations
H16mr	16	3.3 GHz	224 GB	80 GB/s	56 Gb/s	
HBv1	60	2.55 GHz	240 GB	263 GB/s	100 Gb/s	**Released 15 Nov**
HBv2	120	3.1 GHz	480 GB	350 GB/s	200 Gbs	
HC	44	3.4 GHz	352 GB	191 GB/s	100 Gb/s	
Nv6	6 cores, M60 GPU	NA	56 GB	NA	In Browser only	
Nv12sv3	12 cores, M60 GPU	NA	112 GB	NA	In Browser only	

5 new HW configurations

Interconnect is up to **X4**

Memory is up to **X4**

Cores per node is up to **X8**

GPU Support

- ✓ Ansys' in-browser interactive client which avoids the firewall issues of RDP
- ✓ New options for interactive use with HW configurations with an Nvidia GPU (NV6, NV12s_v3)
- ✓ New high-core count interactive virtual machines (up to 120 cores on a single VM with HBv2)
- ✓ Broader product testing/support coverage for interactive use in Ansys Cloud

New In-Browser Interactive Client

New HW configurations with an Nvidia GPU + In-browser client

From **6-core up to 120 cores cloud**-based workstation available in minutes

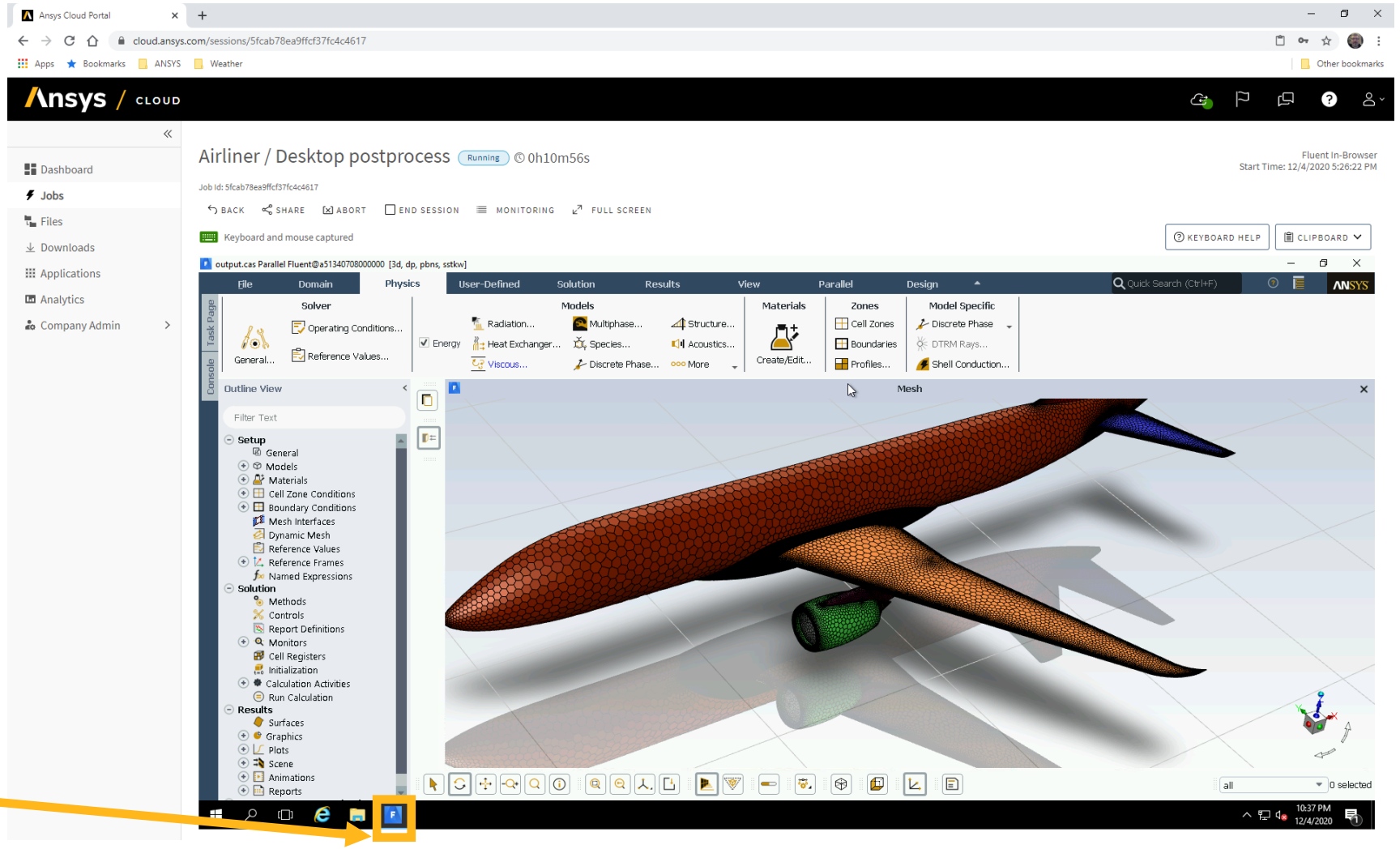
Ansys Solutions installed and ready to use

Can be used with **AEC/AHC's and BYOL**

Performance optimized to ensure **reduced latency**

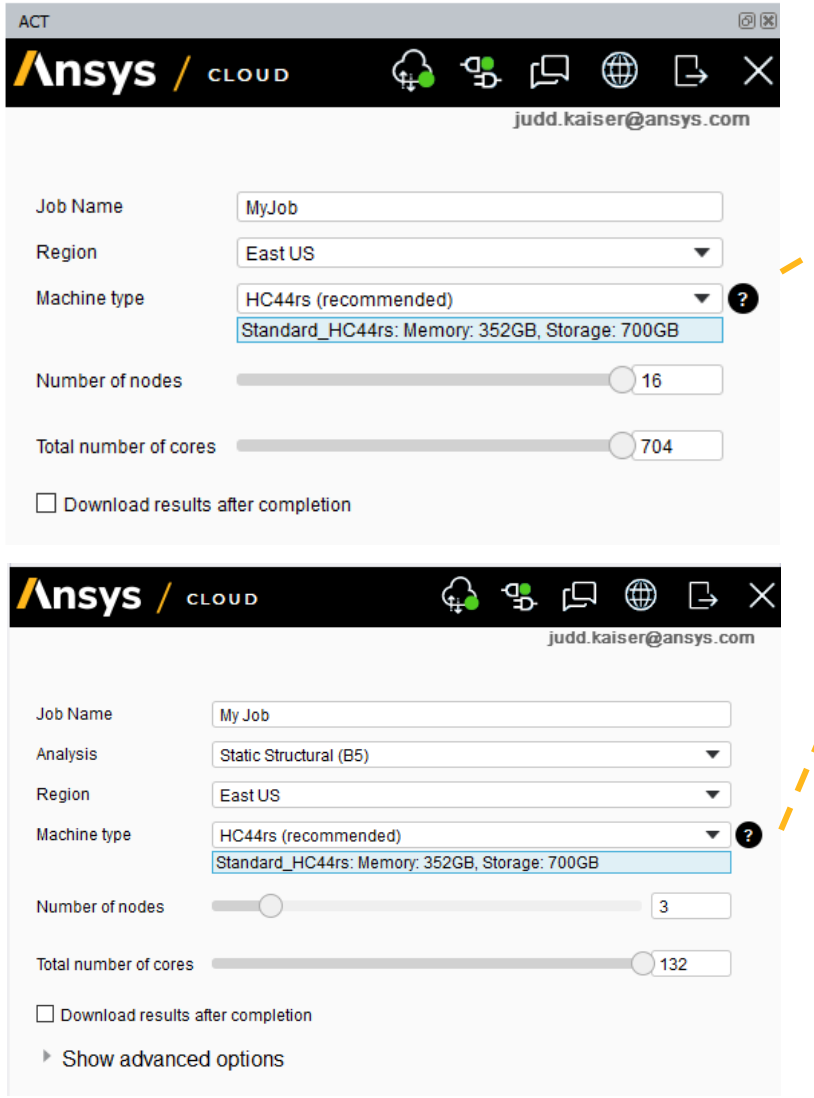
Pre or post process in the **cloud** or complete a full workstation solve

Seamless remote application experience. Feels like you are working on your local machine.



Ansys Cloud forum

Read The Technical WP



- ✓ NEW UI with possibility to change number of nodes, total number of cores
- ✓ Access the recommandation for your solver on Ansys Cloud Forum

Choosing performance-optimized hardware configurations for Fluids jobs

Updated 3 days ago

You now have multiple options for the virtual machine types to be used for Fluids HPC jobs. In this article, we'll share a sampling of benchmarking that Ansys has done with the Fluent application in order to help guide you in making these choices.

Choosing performance-optimized hardware configurations for Mechanical jobs

Updated 3 days ago

You now have multiple options for the virtual machine types to be used for Mechanical HPC jobs. In this article, we'll share a sampling of benchmarking that Ansys has done with the Mechanical application in order to help guide you in making these choices. The data shown in this article corresponds to analyses using the MAPDL solver. For results relevant to Ansys LS-DYNA, refer to this article.

Choosing performance-optimized hardware configurations for Ansys LS-DYNA jobs

Updated 3 days ago

You now have multiple options for the virtual machine types to be used for ANSYS LS-DYNA jobs. In this article, we'll share a sampling of benchmarking that Ansys has done with in order to help guide you in making these choices.

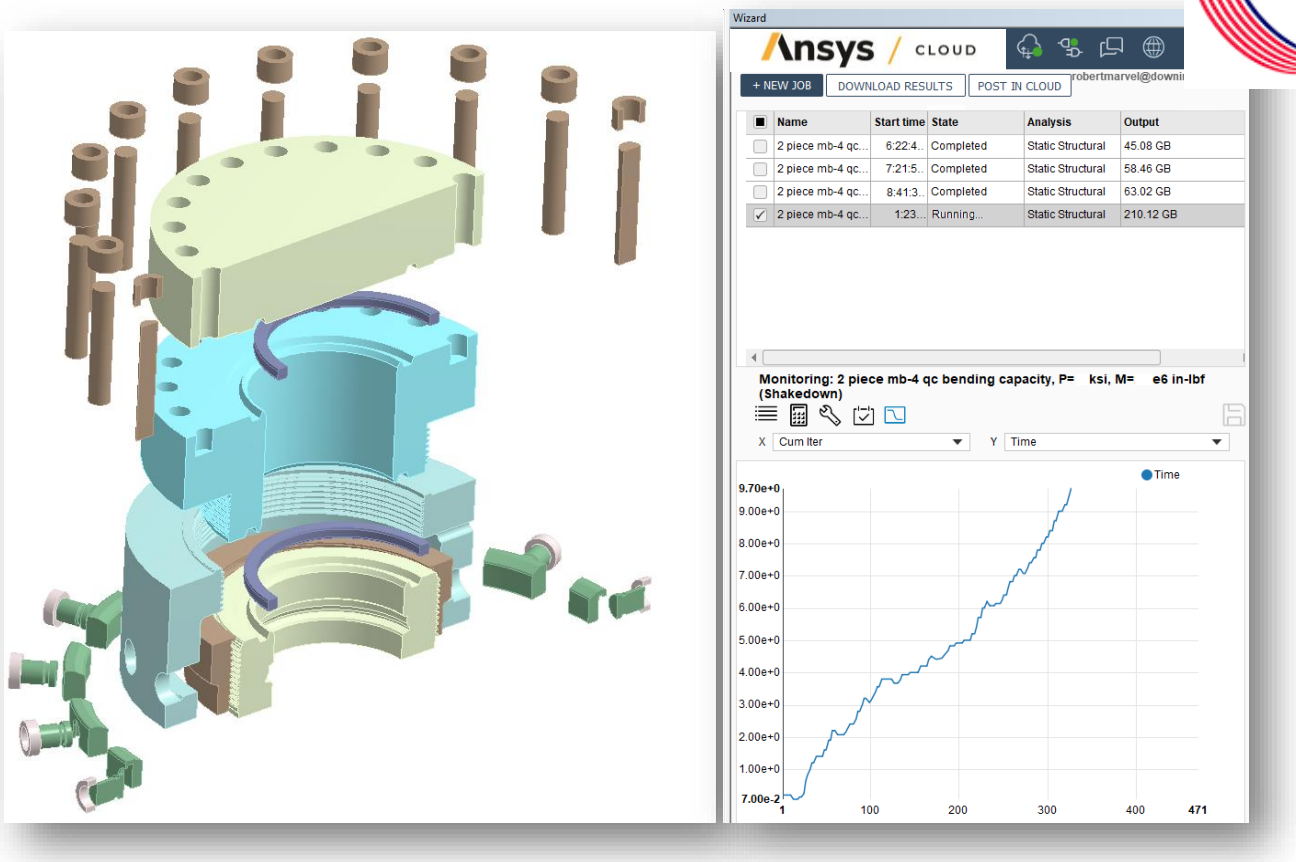
Ansys Cloud for Mechanical

5x

Faster Simulation Turnaround

8 hrs.

Savings in Installation & Well Downtime



"Ansys Cloud has been a game-changer from a productivity standpoint. … Ansys Cloud has reduced the time of each job from 20-25 hours to only 2-4 hours."

Tim Marvel, P.E.
Vice President, Business Development & Technology

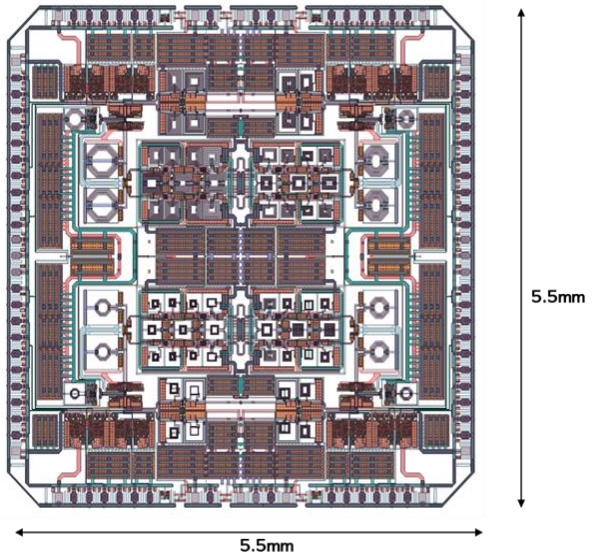
HFSS and Ansys Cloud

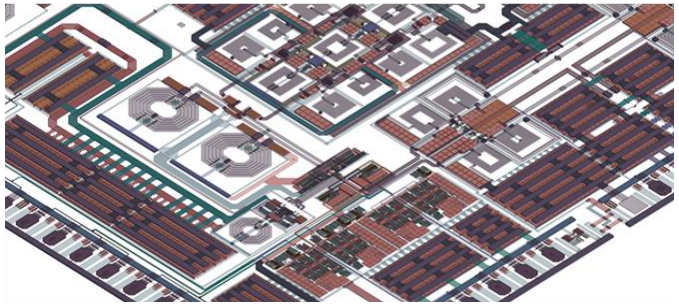
Ansys / ELECTRONICS

Ansys CLOUD

Read the article Here

It was impossible, until now. It's true – a Full Chip Solved in HFSS and Cloud!





Ansys **HFSS has solved** an entire RFIC (5.5 x 5.5mm) at **5GHz**

- ✓ Compute cores used: **704 cores (Intel Xeon Platinum 8168, Azure "HC" machines)**
- ✓ RAM: **2.6TB**
- ✓ Mesh size at adaptive pass 15: **23.5M** Tetrahedron and **93M** unknowns
- ✓ Initial Mesh Time: **1h55m**
- ✓ Adaptive Mesh Time: **29h47m**
- ✓ **16-node HC VM** in Ansys Cloud gives massive RAM to solve a huge problem in HFSS for **companies designing RFIC's.**

HFSS Layout automated IC-specific meshing in Ansys HFSS → Ansys Cloud on **Microsoft Azure**

"It is so rewarding to see a problem of this size and complexity solved on Azure, putting this level of HPC power in the hands of engineers when they need it the most.", says **Merrie Williamson, Microsoft VP Azure Apps and Infrastructure**.

Ansys

What Customer's are Saying

Microsoft

« Our collaboration brings together Azure's compute and IoT capabilities with Ansys' simulation excellence to help businesses across industries transform at scale. During a time when autonomous systems are on the rise, Ansys will enable cloud engineers to increase productivity and accelerate the delivery of innovative solutions."

Scott Guthrie, Executive Vice President, Cloud + AI at Microsoft

Downing Wellhead Equipment

"Ansys Cloud has been a game-changer from a productivity standpoint. ... Ansys Cloud has reduced the time of each job from 20-25 hours to only 2-4 hours."

Tim Marvel, P.E.
Vice President, Business Development & Technology

Rockwell Automation

"As a strategic partner and customer of both Microsoft and Ansys, our engineering teams will accelerate their product development processes with these dynamic new cloud capabilities. Adding Ansys Cloud to our existing technology infrastructure sped up our simulations by 50% and we have solved larger problems with more accuracy. Together, we are boosting engineering productivity and driving top-line impact, even while our engineers work from home."

Scot Tutkovics, vice president, engineering operations, Rockwell Automation

Ansys

What Customer's are Saying

"Marmon Holdings, a global industrial organization comprising 10 diverse business sectors and more than 100 autonomous manufacturing and service businesses, is adopting Ansys Cloud to make Ansys simulation technology readily available to its engineering community. On-demand access to HPC via Ansys Cloud will provide Marmon's engineering teams with simulation capacity exactly when and where it is needed."

Jeff Garascia, Chief Innovation Officer

"Ansys Cloud allowed us to tackle CFD simulations which were not practical for us to tackle before. Thanks to the flexibility and ease to access additional computational resources, we were able to solve more complicated simulations right from the Ansys GUI itself."

-Khaled Saleh, Ph.D., P.E | Engineering Manager- Simulation Group
Goodman Manufacturing, a member of Daikin group

"The Ansys Cloud service built into Ansys Mechanical provides intuitive, easy-to-access to HPC directly from the application. For large, high-fidelity models, Ansys Cloud reduced our solve times by 5-6X and cut the entire simulation workflow by half."

Marcos Blancho, Mechanical Simulation Engineer

What Customer's are Saying

"Ansys Cloud Compute is intuitive to use and integrates seamlessly into our Fluent workflow. Using an internet browser to check job status, view convergence plots, and pause or stop jobs we had more control of our simulations than with other cloud services, and this made our computational work much more efficient."

Adam Kline-Schoder, Flight Data Analyst

"High-efficiency equipment is critical for improving plant performance in the oil and gas industry. Ansys Cloud enables Hytech Ingenieria to calculate large and complicated geometries within hours, instead of days or weeks -- resulting in significant time savings."

Luis Baikauskas, Process Engineer

"Cloud computing is the new standard for engineering analysis. Ansys Cloud provides an easy-to-use option for quick access to cloud HPC directly from within Ansys applications. This is especially useful for businesses with variable simulation workloads."

Bert Blocken, Professor

Microsoft and Ansys Partnership

”We are and always will be partner led”
-Satya Nadella, CEO Microsoft

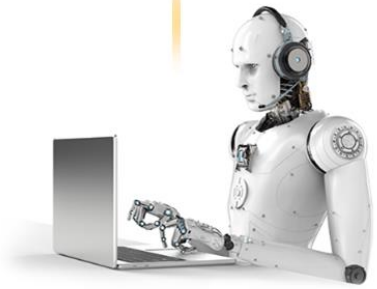
Autonomous

Ansys

CLOUD

5G Planning

STEM & e-learning



AI/ML

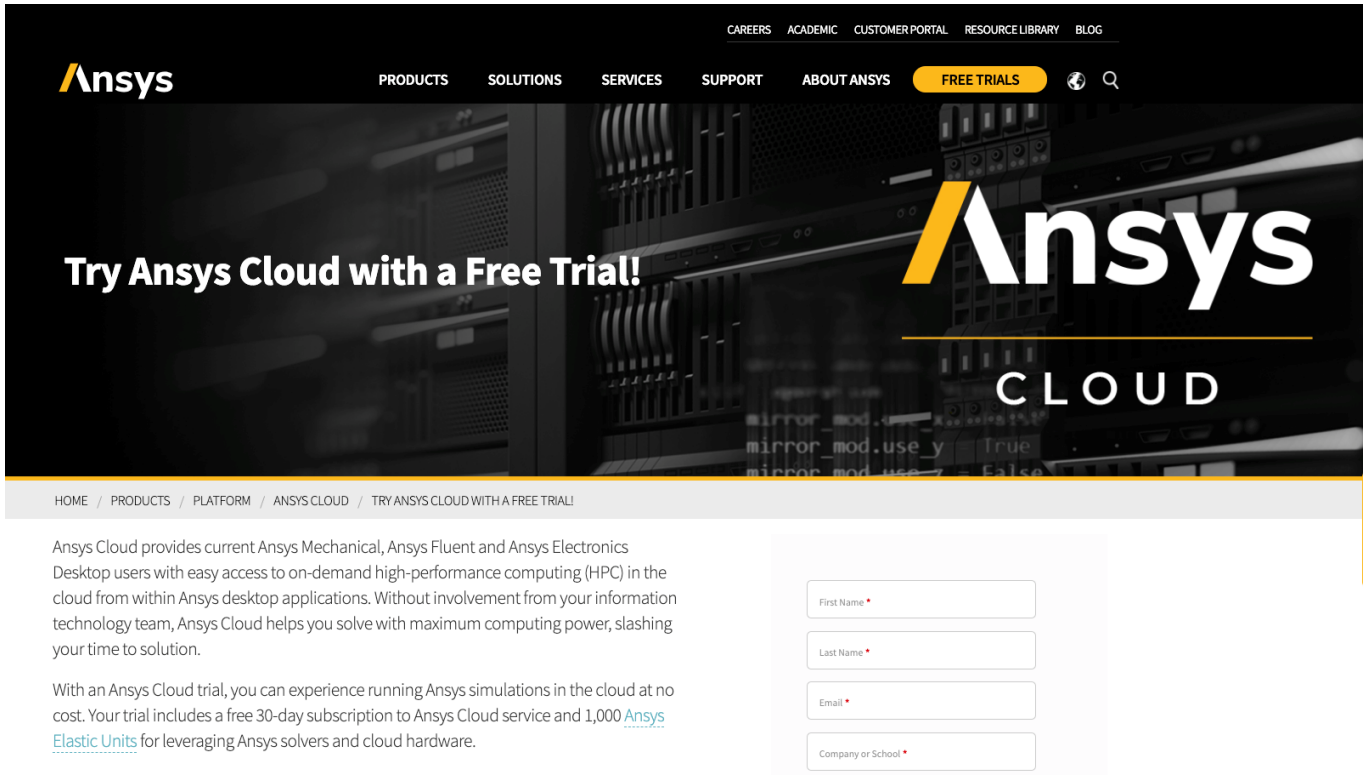
Digital Twins

- Microsoft partnership is key to Ansys’ digital transformation strategy
- Microsoft Azure selected for the Ansys Cloud platform
- ***Ansys Cloud*** services are foundational for all cloud-based applications

Ansys Cloud FREE Trial

30-Days - 1000 Ansys Elastic Currency Tokens

- **Solvers supported**: MAPDL, Ansys LS-DYNA, Fluent, and AEDT
- **What is included?**
  - Access to all machine configurations
  - VDI – remote desktop access
  - 1 TB Storage
  - Cloud Forum
  - Cloud portal
  - Cloud-based post-processor
  - 24/7 Support



Request your free Ansys Cloud trial today!

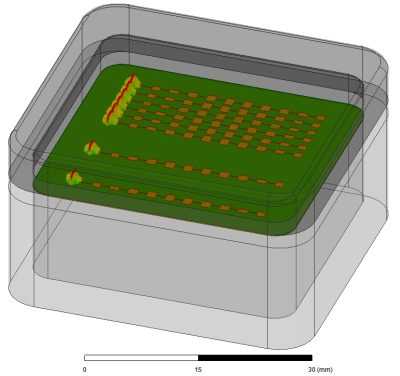
➔ www.ansys.com/cloud-trial

Bring your own Benchmark !!

Define your use case → Request a Cloud free trial → Run your own benchmark to compare local computing performance vs Cloud. → Measure your saving and send us the result to get some advice

Example : HFSS Frequency Sweep Extraction Scaling Benchmark

Hardware	Server				
Cores	16	16	32	128	256
RAM (GB)	256	224	448	1800	3600
Total time	3:42:13	2:15:59	1:58:28	1:15:00	1:10:23

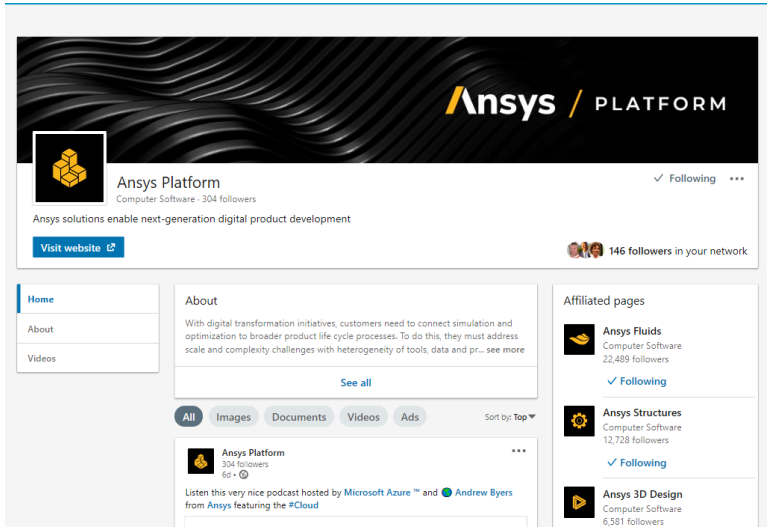


3.2x faster!

2 hrs. 31 min time savings!

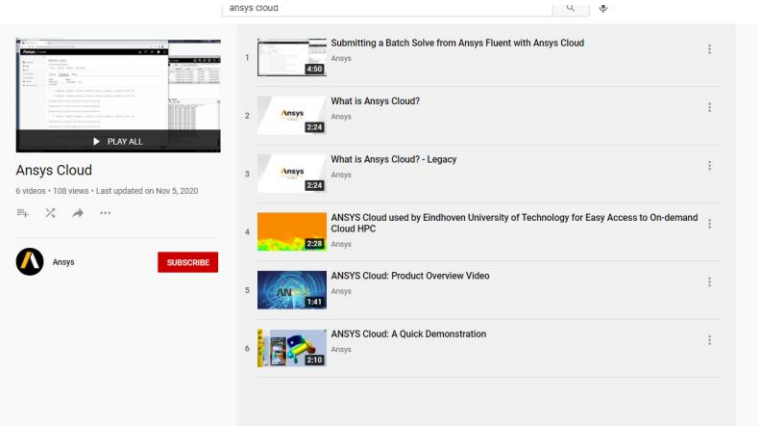
Follow us on Social !

Ansys Platform



Follow us on LinkedIn

Ansys Cloud



Subscribe to our YouTube Channel

Pricing & Packaging

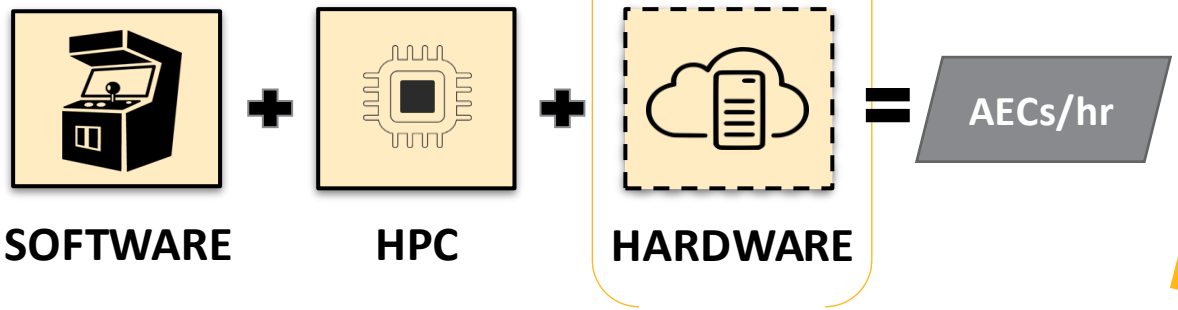
Ansys Cloud

NEW Ansys Elastic Currency/ Ansys Managed Hardware Solution

Ansys Elastic Currency (AEC)

AEC can license SW, HPC and HW

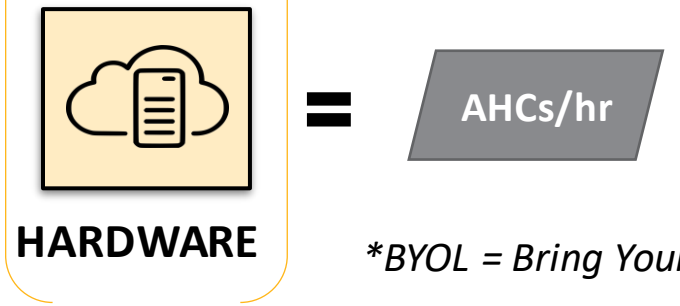
- SW + HPC + HW workflow on Ansys Cloud
- SW + HPC workflow on your existing hardware



Ansys Managed Hardware Solution(AHC)

AHC can license Ansys Cloud Hardware

- BYOL* + HW workflow on Ansys Cloud



BYOL = Bring Your Own License

- ✓ Successor to Ansys Elastic Unit (AEU): Similar cost, simplified pricing, and no WAN uplift
- ✓ AEC: Ansys Elastic Currency: Enables SW usage anywhere AND enables HW usage on Ansys Cloud
- ✓ AHC: Ansys Managed Hardware Solution: Same rates as AEC but focus HW usage on Ansys Cloud
- ✓ **All new sales will be AEC/AHC**. AEUs remain supported through end of term.

Packaging and Hourly Rates

Ansys Elastic Currency (5000) = 5000 AECs **OR**  **Ansys Managed Hardware Solution (5000) = 5000 AHCs**

OR — **Ansys Elastic Currency (AEC)**

Ansys Managed Hardware Solution (AHC)

Consumption Rates for HW

Node Type	Cores per Node	RAM per Node (GB)	GPU	Target Physics	Node Hourly Rate	Workload	Currency
Hardware Licensing							
H16r	16	112	-	Fluids	$**1.77**	Batch	AHC|AEC
H16mr	16	224	-	Mech, Elect	$**1.93**	Batch|Interactive	AHC|AEC
HC	44	352	-	All	$**7.14**	Batch|Interactive	AHC|AEC
HB	60	240	-	Mech, Fluids	$**5.14**	Batch	AHC|AEC
HBv2	120	480	-	Mech, Fluids	$**8.12**	Batch|Interactive	AHC|AEC
NV6	6	56	M60	All	$**2.36**	Batch|Interactive	AHC|AEC
NV12sv3	12	112	M60	All	$**2.80**	Batch|Interactive	AHC|AEC

Consumption Rates for SW and HPC

Product Category	Hourly Rates	Currency
Software Licensing		
Geometry Interfaces	$**2.5**	AEC
Optimization	$**5**	AEC
Pre/Post & 3D Design	$**10**	AEC
Solvers	$**20**	AEC
HPC Licensing		
HPC (n cores)	$int(5*n^0.57)	AEC

The Node Hourly Rates values vary by region (see full list).

The New Nodes, Clusters and Supported Solvers

VM SPECS			CLUSTER SPECS		SUPPORTED SOLVERS					
Node	Cores	RAM (GB)	Max Nodes	Max Cores	Max RAM (GB)	Mechanical	Fluent	Electronics	VDI	Discovery	SPEOS
H16r	16	112	4	64	448		YES		YES		
H16mr	16	224	4	64	896	YES		YES	YES		
HC	44	352	16	704	5,632	YES	YES	YES	YES		YES
HBv1	60	240	16	960	3,840	YES	YES		YES		
HBv2	120	480	8	960	3,840	YES	YES		YES		YES
NV6	6	56	1	6	56				YES	YES	YES
NV12sv3	12	112	1	12	112				YES	YES	YES

HPC Nodes in Ansys Cloud Full Price List (link)

Ansys Elastic Licensing - Hardware Consumption Rate Table							
Version							**5.0**
Specification	**Cloud Hardware Configuration**						
	H16r	**H16mr**	**HC**	**HB**	**HBv2**	**NV6**	**NV12sv3**
Cores per Node	16	16	44	60	120	6	12
RAM per Node (GB)	112	224	352	240	480	56	112
GPU	-	-	-	-	-	M60	M60
Target Physics for HPC	F	M,E	All	M,F	M,F	-	-
Target Physics for Interactive	-	All	All	-	F	All	All
Region	**Rate (AHC/node/hr or AEC/node/hr) per Hardware Configuration**						
	H16r	**H16mr**	**HC**	**HB**	**HBv2**	**NV6**	**NV12sv3**
Europe North	1.97	2.15				1.89	2.48
Europe West	2.09	2.28	6.42	4.62	9.59	2.13	2.92
India Central	2.02	2.21					3.27
Japan East	2.32	2.53	7.17		8.14	2.46	3.24
US East	1.83	2.00	4.94	3.56	7.38	1.78	2.34
US North Central	1.83	2.00				1.78	
US South Central			7.14		8.12	2.36	2.80
US West	1.97	2.15					2.34
US West 2			6.49		7.38		2.34

*AEU (Ansys Elastic Unit) consumption rates are 0.4 times the AEC/node/hr values above.

**For Electronics, Small = 1 compute node, Medium = 2, Large = 4, XLarge = 8, and XXLarge = 16.

Extra Slides

Ansys Cloud benchmarks & Security slides

CFD Benchmark – Electric Motor Case

Model Details

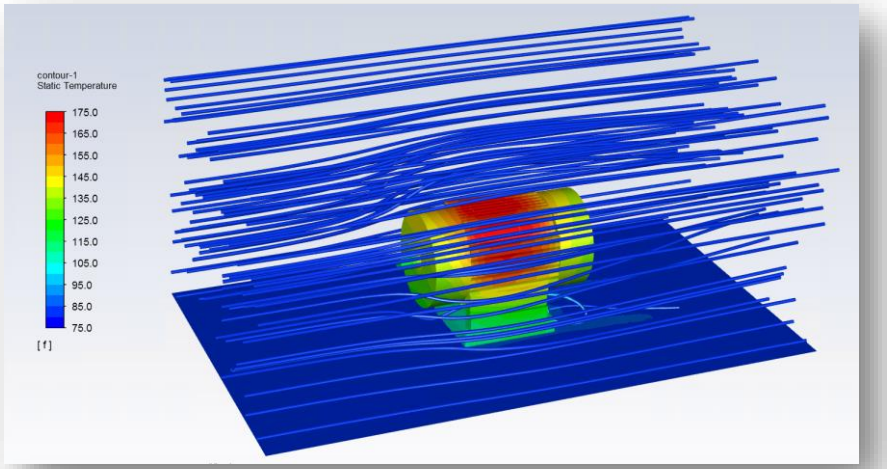
- 18 M Hybrid Conformal Mesh
- Maxwell losses input as volumetric sources
- Steady-state analysis
- Realizable k-e turbulence model
- Coupled Solver, Least-square cell-based gradients
- 1000 iterations

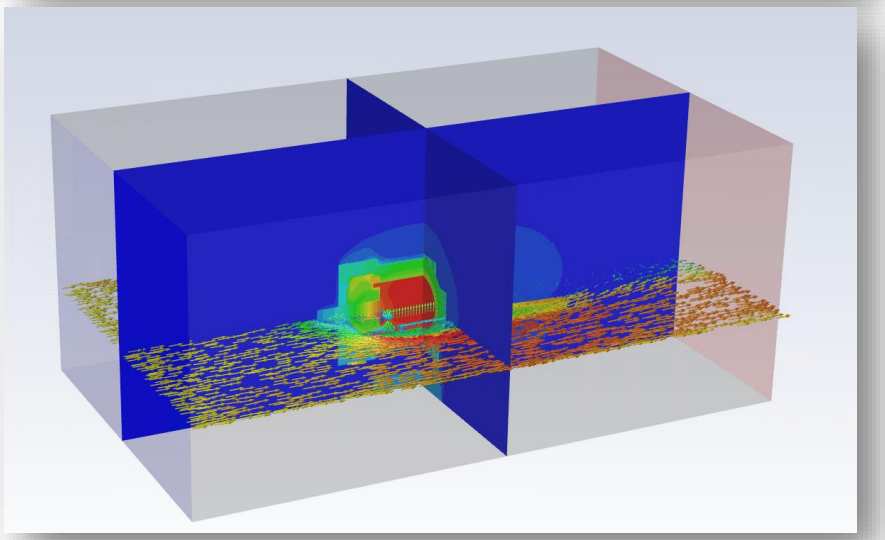
Desktop Machine

- 4 cores
- Intel® Xeon® CPU E5-2630 v3 @2.40GHz, 512 GB
- Hardware is about three years old
- Wall clock time: 9.7 hours

Ansys Cloud Solution

- Eight compute nodes, 110 GB per node
- 112 cores provided to Fluent
- Wall clock time: 31.6 minutes
- **18X faster on Ansys Cloud than standard desktop**





HFSS Frequency Sweep Extraction Scaling Benchmark 2020 R1

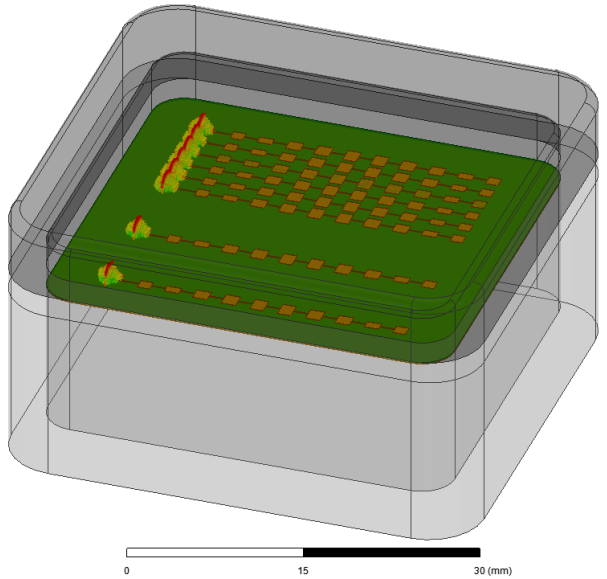
77GHz Automotive Radar with Package and Radome

Simulation specifications

- Medium sized problem
- Number of excitations: 8
- Total tetrahedra: 803k
- Matrix size: 5.3M

Frequency sweep time vs. Ansys Cloud cores

- From 3 hours 42 min to 1 hours and 10 minutes with Ansys Cloud



Hardware	Server	Small	Medium	Large	X-Large
Cores	16	16	32	128	256
RAM (GB)	256	224	448	1800	3600
Initial mesh time	0:02:53	0:02:09	0:02:06	0:02:10	0:02:06
IM Speed	1.00	1.34	1.37	1.33	1.37
IM memory (GB)	0.5476	0.588	0.5866	0.5938	0.5894
Adaptive mesh time	1:12:39	0:52:34	1:00:05	0:50:41	0:54:14
AM Speed	1.00	1.38	1.21	1.43	1.34
AM memory (GB)	57.32	49.88	49.26	72.87	99.67
frequency sweep time	2:26:41	1:21:16	0:56:17	0:22:09	0:14:03
FS Speed	1.00	1.80	2.61	6.62	10.44
FS memory (GB)	168.5	148.7	291.4	1162	2323
Total time	3:42:13	2:15:59	1:58:28	1:15:00	1:10:23
Total Speed	1	1.63	1.88	2.96	3.16

3.2x faster!

2 hrs. 31 min time savings!

AEDT Icepak Scaling Benchmark 2020 R1

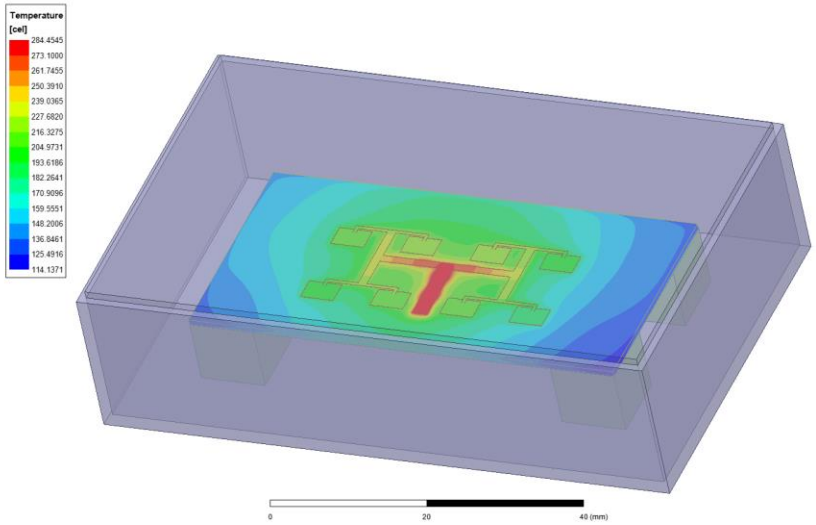
28GHz 5G Antenna Array and Radome

Simulation specifications

- Medium sized problem
- Number of excitations: 1
- Total cells: 335k

Icepak solution time vs. Ansys Cloud cores

- From 42 min to 29 minutes with Ansys Cloud



Hardware	Workstation	Small	Medium	Large	X-Large
Cores	4	16	32	128	256
RAM (GB)	64	224	448	1800	3600
Total Time	0:41:56	0:34:25	0:29:17	0:28:38	0:40:13
Memory (GB)	4.29	4.29	4.29	4.29	4.30
Total Speed	1.00	1.22	1.43	1.46	1.04

1.5x faster!
13 min time savings!

HFSS Frequency Sweep Extraction Scaling Benchmark

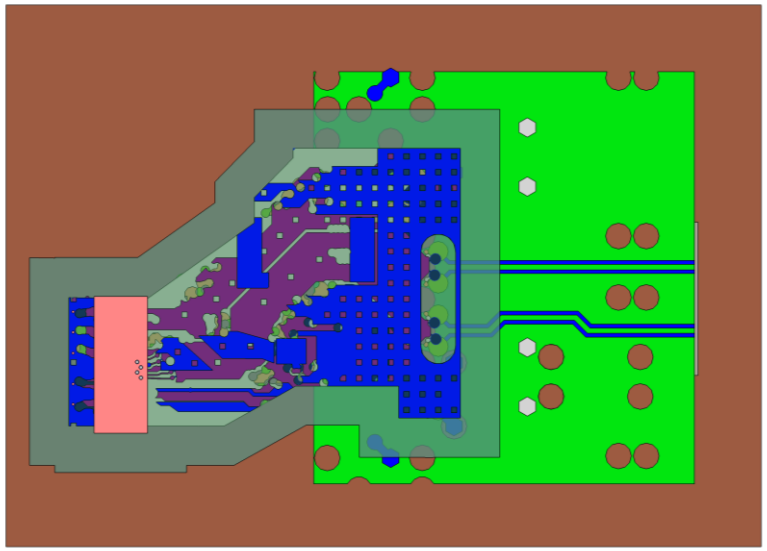
Package on PCB model

Simulation specifications

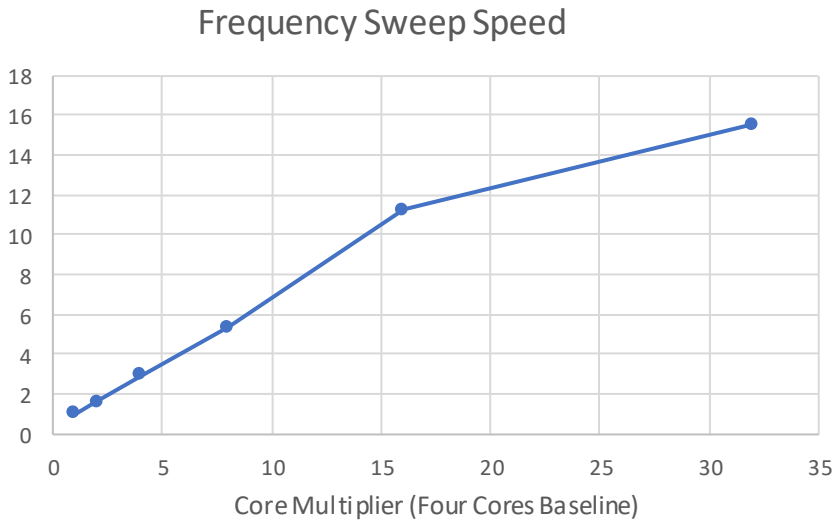
- Medium sized problem
- Number of excitations: 8
- Total tetrahedra: 700k
- Matrix size: 3.3M

Frequency sweep time vs. Ansys Cloud cores

- From 16 hours to 1.5 hours with Ansys Cloud



Hardware	Workstation		Small	Medium		Large
Cores	4	8	16	32	64	128
Initial mesh time	00:04:00	00:03:59	00:04:06	00:03:57	00:03:56	00:04:05
IM Speed	1,00	1,00	0,98	1,01	1,02	0,98
IM memory (GB)	1,632	1,633	1,632	1,63	1,631	1,631
Adaptive mesh time	00:29:58	0:25:52	00:24:53	00:34:10	00:30:56	00:32:52
AM Speed	1,00	1,16	1,20	0,88	0,97	0,91
AM memory (GB)	39,95	39,83	41,78	42,71	55	56,36
frequency sweep time	15:31:30	09:36:49	05:17:51	02:53:45	01:22:52	01:00:00
FS Speed	1,00	1,61	2,93	5,36	11,24	15,53
FS memory (GB)	107,8	106,4	154	265,2	735,2	1130
Total time	16:05:28	10:06:40	05:46:50	03:31:52	01:57:44	01:36:57
Total Speed	1	1,59	2,78	4,56	8,20	9,96



HFSS Benchmark – Intel Galileo Test Board

Model Details

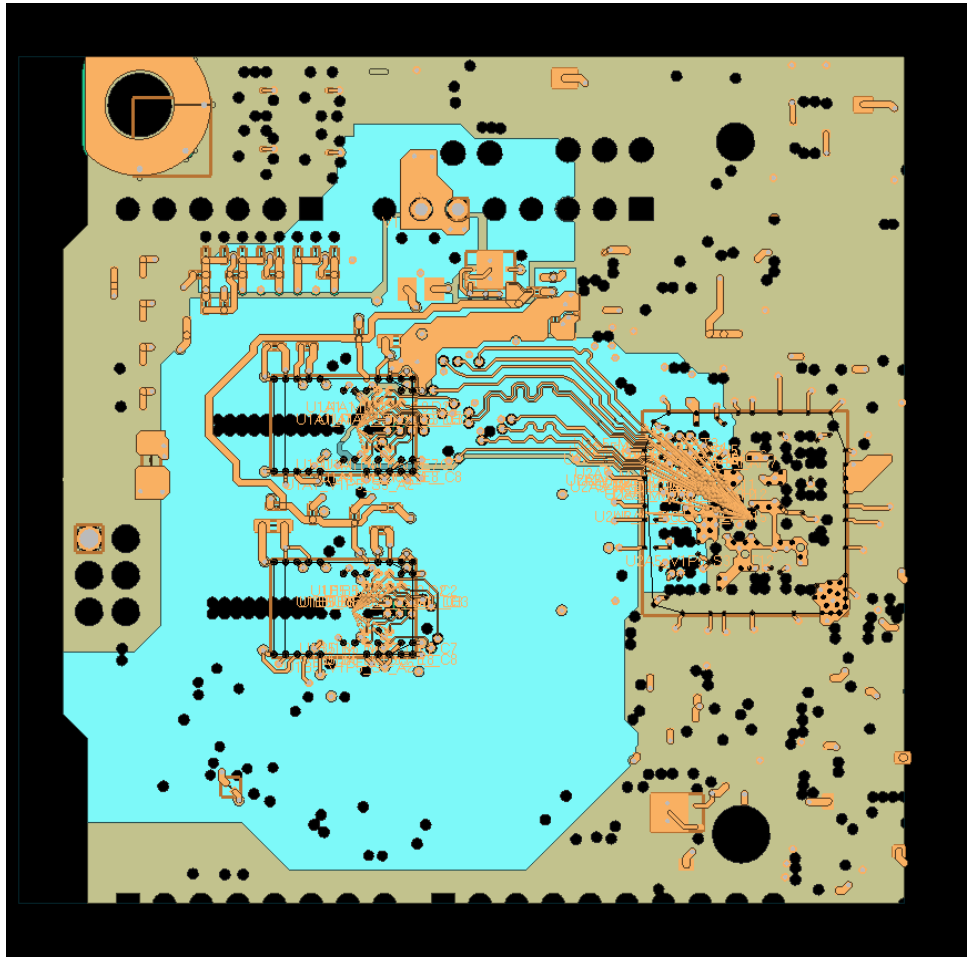
- Number of excitations: 44
- Total tetrahedra: 5.7M
- Matrix size: 35.6M
- Total shared memory: 323.6 GB

Desktop Workstation

- 32 cores, 512 GB RAM
- Total adaptive mesh time: 8:28:27
- Final adaptive pass matrix solve time: 01:02:43

Ansys Cloud Solution

- Eight compute nodes
  - 16 cores and 220 GB per node
- Total adaptive mesh time: 4:54:52
- Last adaptive pass matrix solve time: 00:30:22
- **2X faster than big workstation**



Ansys Cloud Security Overview

The system is segmented using individual firewalls and private subnets to ensure confidentiality and integrity.

Azure is organized into regions and geographies (Geos). Geographies are **fault-tolerant** to withstand complete **region failure** through their connection to Azure's dedicated high-capacity networking infrastructure.

Regions and Geographies

Data Residency

Ansys Cloud **will not store** customer data outside the customer-specified Geo. **Data residency persists based on the selected region.** Account information is stored in Azure Active Directory B2C and is fully GPDR compliant.

Ansys Cloud **will not delete any data** on an active account's behalf, and therefore **there is no data retention and deletion requirement**. Each customer is solely responsible for their data retention and deletion policy and procedure.

Data Retention and Deletion Policy

Ansys Cloud Security Overview

Availability

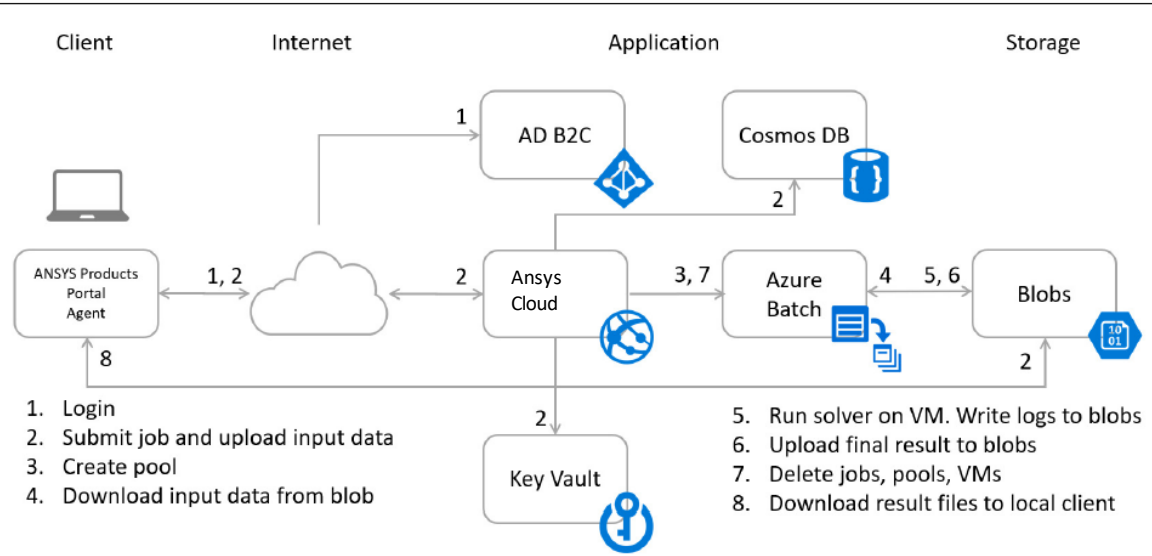
The Ansys Cloud Service application is deployed in multiple regions to achieve **high availability**.
In case of service interruption **no critical data is lost** due to replication.
In case of a hardware failure **Azure will restart** the Ansys Cloud service automatically on another hardware system. In case of a region outage our secondary backup region will **take over** and continue to serve the application.

Security controls are addressed by **Microsoft through their platform as a service (PaaS)** . For example, **anti-malware and system security** updates are both addressed **automatically** by Microsoft, with third party penetration test performed regularly.

Penetration testing

Ansys Cloud Security Overview

Architecture and data flow



All data, both in motion and at rest, is end-to-end encrypted. The encryption key pair is fully managed (with automatic key rotations) by Ansys authorized personnel for the end user by storing the public and private key in the Azure Key Vault. Only the Ansys Cloud application can access the key vault.

All access to Key Vault is controlled and audited on a periodic basis. To ensure data confidentiality, all simulation data are encrypted using a key pair (**AES 256 based)**

Supported standards :

- ✓ *Custom encryption : AES256*
- ✓ *HTTPS TLS1.2*

Ansys Cloud Architecture and Security Overview


Ansys