



UNIFIED CAD/CAE SOLUTION ON AWS CLOUD

Introduction

Over the last few decades, CAD modeling has grown from a single-user CAD design product running on a microcomputer to a complex CAD design environment with multiple teams working simultaneously on the same design. Design firms, large and small, struggle to provide the adequate infrastructure that can support performance to satisfy even basic functionality.

In this digital world, cloud-based applications are rapidly becoming the new normal across all sectors.

Most enterprises from Fortune 500 to start-ups are migrating to the cloud for their infrastructure needs, but some segments are skeptical about it, CAD/CAE being one of them.

However, there's been growing interest in delivering CAD and CAE software via the cloud in the past few years — with plenty of debate over its strengths and weaknesses.

CAD and CAE software always need high-end workstations, requiring engineers to be in the office or enabled to access these workstations remotely. But there has to be a better way for engineers to work efficiently.

In partnership with AWS, Infosys decided to check the reality of hosting CAD software on the cloud and conducted a 'proof of concept (POC)'. We highlight our findings in this whitepaper.

Current CAD/CAE challenges across industries

While desktop-based CAD software has been a trusted partner to designers for decades, it has challenges related to business, people, and technologies.

It is always a struggle for businesses to scale the infrastructure rapidly

while keeping costs under control and preventing business disruptions. Engineers need to spend significant time to set up their systems with the required tools due to a complex installation process. Procuring licenses is also an

issue as they can remain unused in other workstations.

These challenges can be easily mitigated and a hassle-free user experience can be provided to the end-users with the cloud.

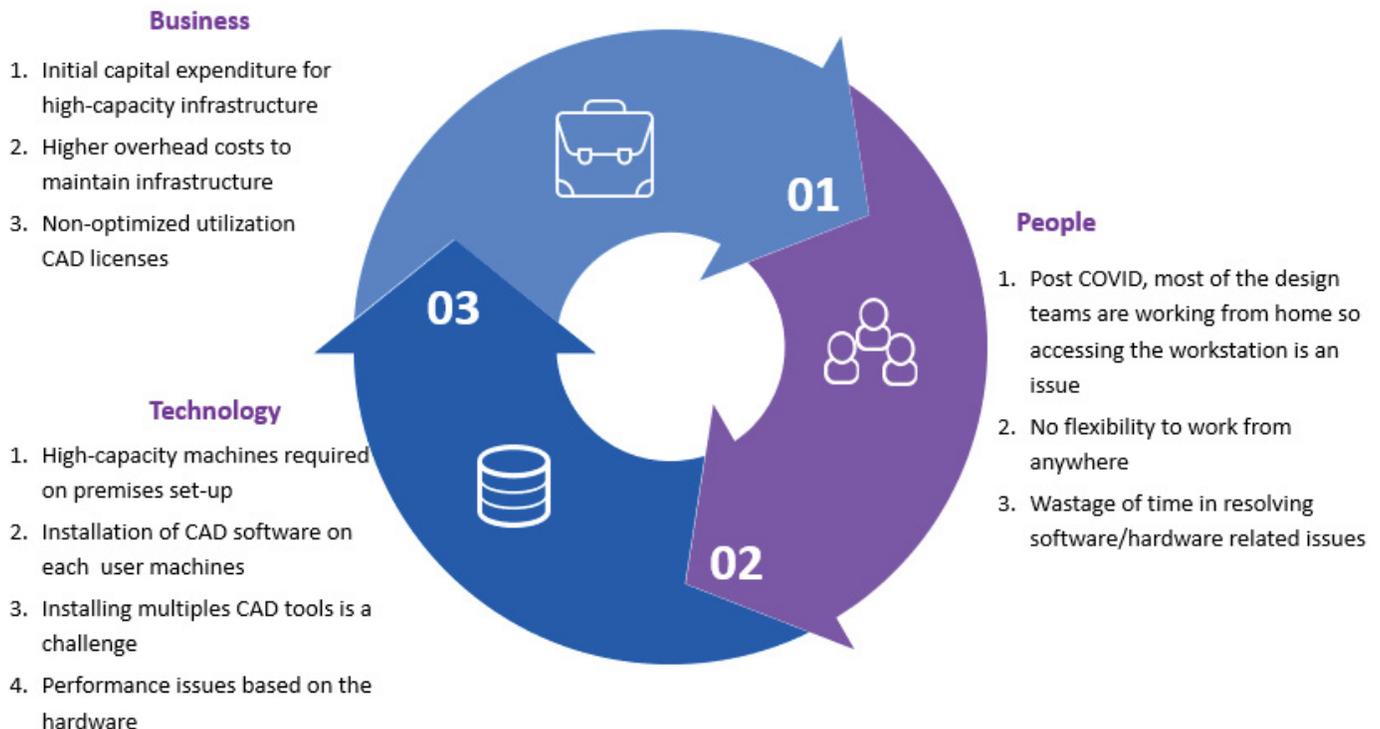


Figure 1: Challenges across CAD & CAE Industry

Current Landscape and Key Findings

Research from Business Advantage provides a glimpse of the current CAD on cloud landscape:

- Only ~ 15% of users are using CAD on the cloud
- 12% are considering implementing CAD on the cloud
- 39% are still evaluating
- 33% are not even aware of CAD on the cloud

The top three reasons for lower cloud adaption are:

- Data security (data stored outside my country)
- Data privacy
- Data security (data stored within my country)

According to SC Media's latest findings, in 2020-21 the public cloud

infrastructure-as-a-service (IaaS) workload will experience at least 60% fewer security incidents than those in traditional data centers.

As CAD users begin to trust cloud security, we expect adoption numbers to grow.

McKinsey has projected the cloud-based CAD market to grow 35% annually.

Digitalizing Product Development Process with CAD/CAE on Cloud

It's important that CAD not be left behind in the current digital wave and hence CAD on the cloud becomes imperative. Having CAD on the cloud can result in several benefits, as shown in figure 2.

With cloud, it's easy to scale up rapidly,

enabling engineering teams to get started rapidly. Enterprises don't have to worry about huge upfront investments as they can switch to a pay-per-use model.

It also helps teams to work from

anywhere and improves collaboration. With improved cloud security, enterprises can rest assured that their data is safe. As the software is managed on the cloud, there will be no upgrade and license management concerns.



Figure 2: Benefits of CAD on Cloud

Better User Experience and Collaboration

A key benefit of cloud-based CAD or CAE tools is that users can access their favorite CAD/CAE tool from anywhere and do not always have to be present in the office. This increases collaboration as well as user experience.

Data and tools are available at one place on the cloud. Further,

- No installs in the individual machine are required.
- No need to keep multiple copies on local machines.
- All work is saved on the cloud leading to a single global source of truth.
- Access is controlled through user groups, e.g., only manufacturing engineers get to see the final released models, design engineers are given access based on their role demands, approvers can approve the design on-demand and in real-time.

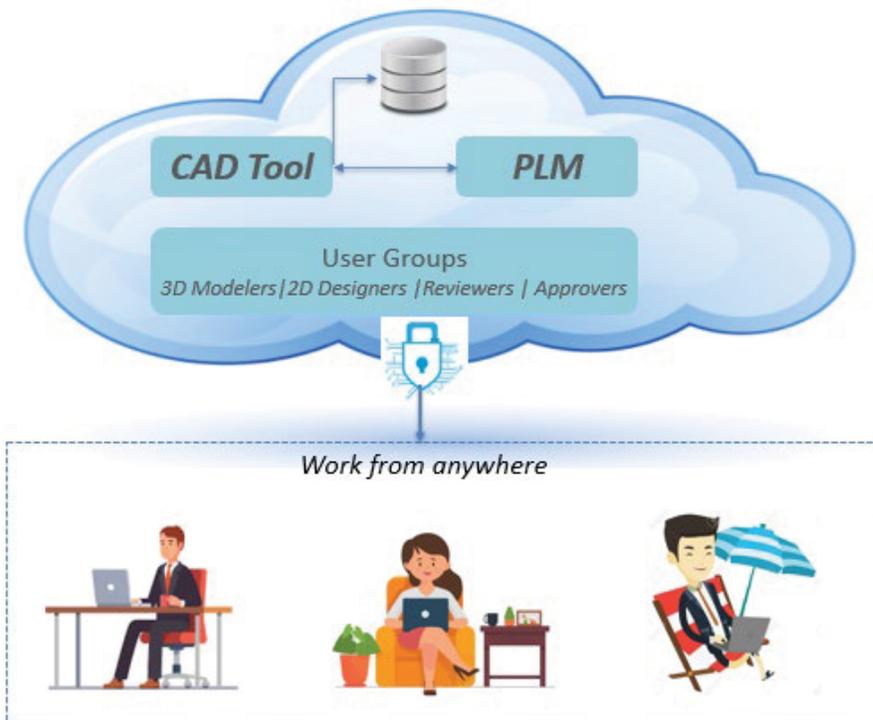


Figure 3: Improved Working Environment

Proof of Concept details

At Infosys, we decided to explore this uncharted territory with proof of concept. Currently there are no standard processes available on CAD installation on to the cloud. We at Infosys in partnership with AWS tried to create a process for such installations.

Currently, there are hardly any standard processes available on CAD migration to the cloud.

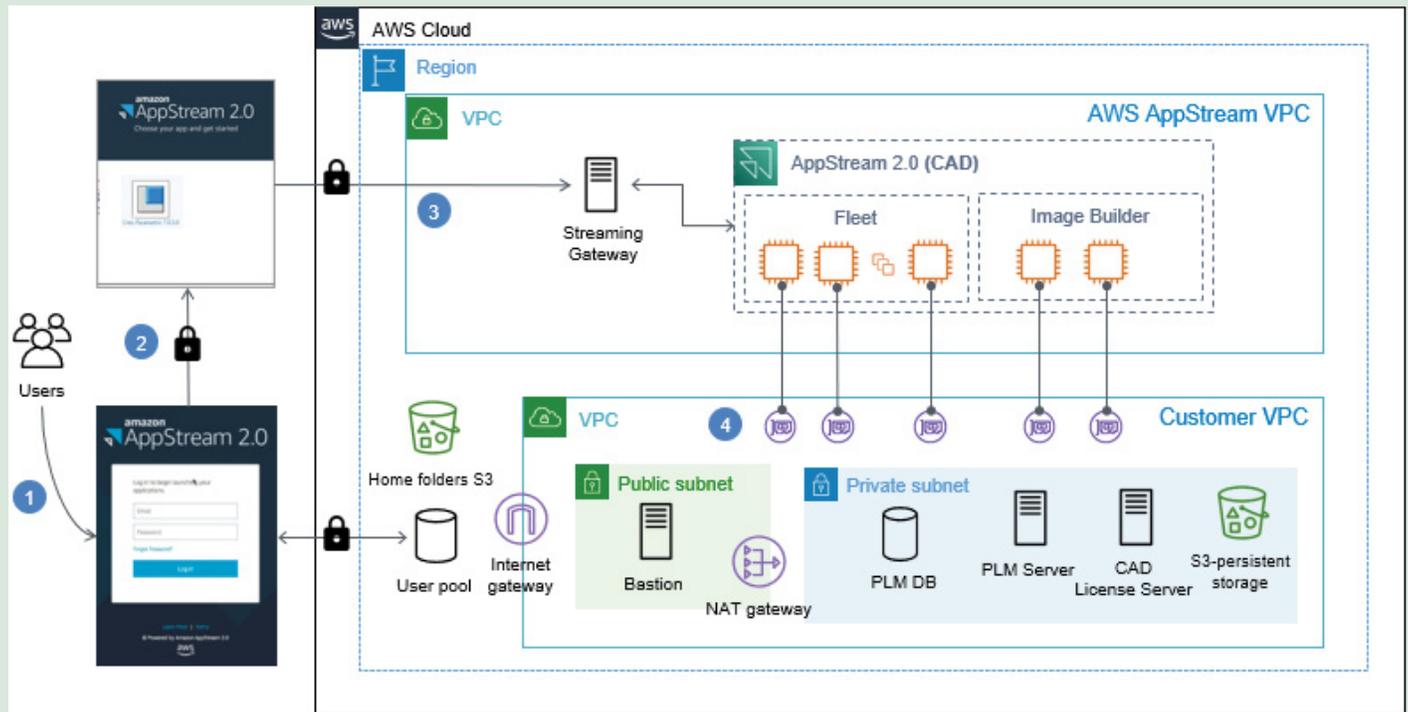
We chose PTC Creo as a CAD tool, PTC Windchill as a PLM system, and AWS as the cloud service provider for this POC.

The purpose of this POC was to check feasibility and benchmark performance against on-premises setup.



Reference Architecture

Bases on the documentation available on AWS site & our experts of AWS as well as Creo, we came up with a reference architecture as below for this POC. We then implemented this architecture on AWS, installed Creo & Windchill licenses to get started with actual benchmarking phase.



User Workflow

1. User is provided access to AppStream, and he then logs into the AppStream client
2. User authentication details inputs are sent over HTTPS and are SSL-encrypted
3. AppStream instance is launched with the available applications (Creo in this case)
4. Security Groups are used to control network access to the customer VPC

Services Used

Building CAD on AWS cloud solutions typically involves the following services -

Service	Usage
AppStream 2.0	Details in the upcoming section
EC2 Instances	Hosting CAD licenses, PLM server
RDS	SQL database
S3	Persistent storage
IAM/Cognito/WAF/Shield	Various security arrangements
VPC	Keep different instances on public or private subnets
Bastion Host / NAT Gateway	Internet access to instances in a private subnet

* These are just important service used for the POC, in addition, there are many other services those can be used based on the use case

Introduction to AWS AppStream 2.0

Amazon AppStream 2.0 is a fully managed non-persistent desktop and application virtualization service that allows users to securely access data, applications and resources anywhere, anytime, from any supported device. With AppStream 2.0, you can easily scale

your applications and desktops to any number of users across the globe without acquiring, provisioning and operating hardware or infrastructure. AppStream 2.0 is built on AWS, so you benefit from a data center and network architecture designed for

the most security-sensitive organizations. Each end user has a fluid and responsive experience because your applications run on virtual machines optimized for specific use cases, and each streaming session automatically adjusts to network conditions.

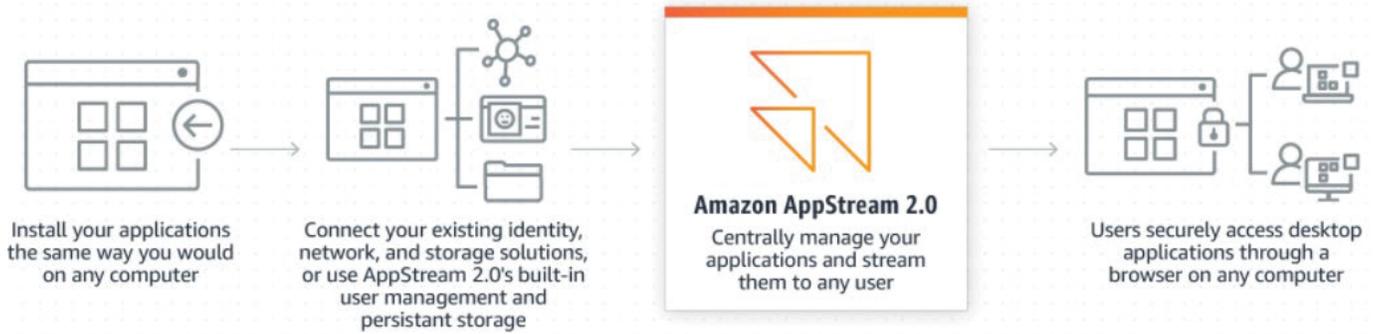


Figure 5: How AppStream 2.0 Works (Ref AWS)

Use case

As part of the use case, the user was asked to work on the selected model and conduct standard CAD operations. The user was then asked to check in and check-out the assembly in Windchill, check for performance and compare the performance with the on-premise set-up

As part of the POC, we used a medium-complex Creo model available publicly. The details of the model used are shown in the table.

Sl. No.	CAD Model Details	Performance	Model
1	Model complexity	Medium	
2	Creo part having features	41	
3	Number of subassemblies	11	
4	Number of parts under each subassembly	4	
5	Number of parts directly reporting to assembly	12	
6	Drawing with dimensions and number of sheets	50 Dim & 2 sheet	

Performance Benchmarking

With AWS architecture, our performance was as follows -

Sl. No.	Creo Operation	Performance
1	Time required to "open" part, subassemblies, assembly and drawing.	
2	Create part, assembly and drawing	
3	Edit feature, part, assembly	
4	Measure dimensions	
5	Rotate, pan, hide /unhide	
6	Create/edit section	
7	Create/edit explode	
8	Add part to assembly and apply constraints	
9	Drawing view placement, display	
10	Time required to "save to local" part, subassemblies, assembly and drawing	



Better/at par with on-prem



20% less speed



50% less speed

Conclusion

CAD on the cloud delivers the same or, at times, better performance than on-premises set-up. It will be a paradigm shift for enterprises to have their CAD/CAE workload on cloud but at the same time, enterprises should realize that waiting any longer to enable their Engineering teams to get started on CAD/CAE journey on the cloud isn't an option in this fast-paced industry.

Enterprises have various options to start their cloud journey.

- Hybrid model: Enterprises can split their workload between on-premise and cloud. This will help them use their current investments in hardware as well as the new workload on cloud. This will help the users to get used to cloud-based CAD/CAE tools
- Private cloud model: Those enterprises that are serious about data security can request a dedicated setup from AWS. AWS can also directly connect to the customer offices to reduce bandwidth issues due to the dependency network. This will have an additional cost impact, however.

- Polycloud model: If enterprises are on another cloud platform, they can still use AWS for their CAD/CAE workloads with seamless integration.

While there is no upfront investment as the cloud works on a 'pay as you go' model, the operating costs are currently high. Enterprises need to do due diligence on costing before switching to cloud.

Applications on cloud reduce the footprint of on-premises tools to that of a modern web browser, which provides an opportunity to prove the value of your

solution with minimal investment from a prospective buyer.

As end user devices get smaller and lighter, networks get better and faster, and workloads become more collaborative, it is worth rethinking the standard approach. For workloads from gaming to augmented reality to machine learning, developers are standardizing and optimizing compute-, GPU-, and memory-intensive processes into the core of cloud infrastructure. This approach is highly compatible with application streaming.



About the Authors

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Unmesh Jadhav is a Principal Consultant working with the IoT group of Infosys Engineering Services. He has over 20 years of experience focusing on configure-price-quote solutions, mechanical product design and application development projects. In addition, he is a cloud enthusiast and is continuously exploring new trends in cloud computing.

Unmesh works on consulting engagements for Infosys, where he helps clients solve their business problems and create roadmaps for the future.

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Raja Sekhar has more than 15 years of experience in architecting enterprise applications that focus on user experience, configure-price-quote solutions and data analytics applications. He is actively working on building/migrating web, mobile, legacy and CAD applications to cloud to maximize cloud's potential and provide the best user experience to customers.

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