

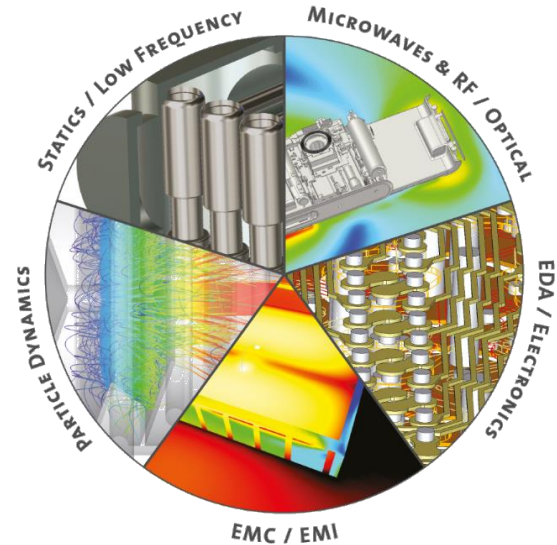
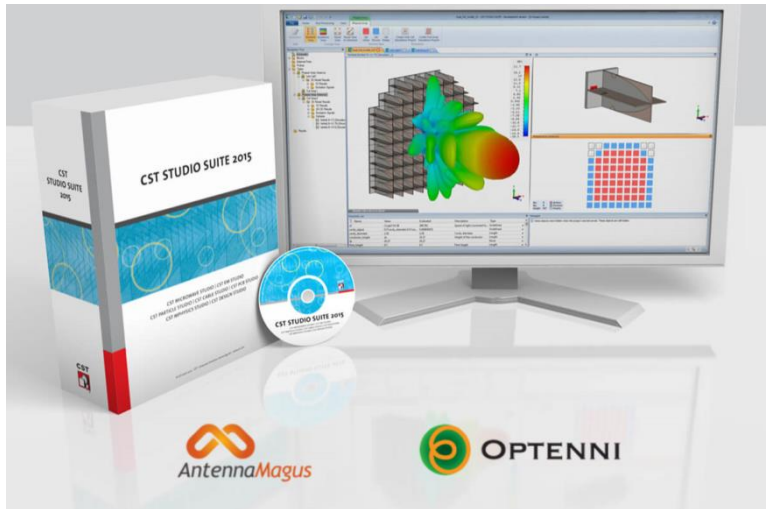
# HPC for 3D Electromagnetic Simulations From Workstation to Cluster & Cloud

Dr.-Ing. Felix Wolfheimer



# About CST AG

- Founded in 1992
- Complete Technology for 3D Electromagnetic Simulation
- 300 Employees
- Worldwide Support Network



Main Product: CST STUDIO SUITE®

# 3D EM Simulation Examples

Aerospace  
&  
Marine

Automation  
&  
Industrial  
Equipment

Automotive  
&  
Transportation

Consumer  
Electronics  
&  
Communication

Defense  
&  
Security

Education

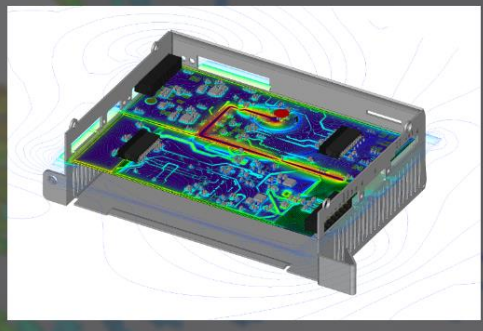
Energy

Fundamental  
Research

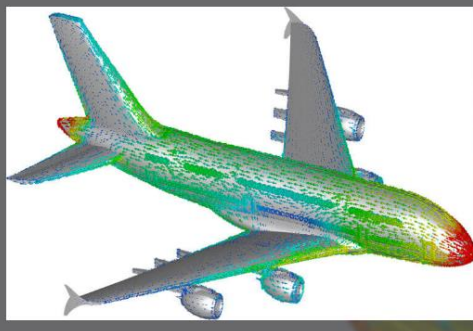
Healthcare

Semiconductors  
&  
Electronic  
Components

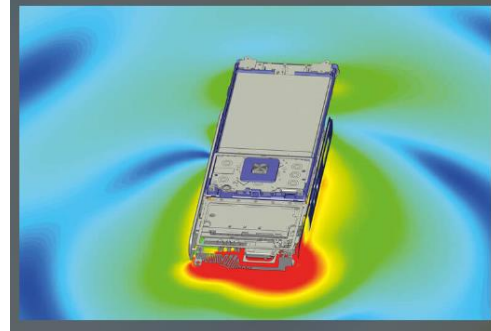
Emissions & Immunity



E3



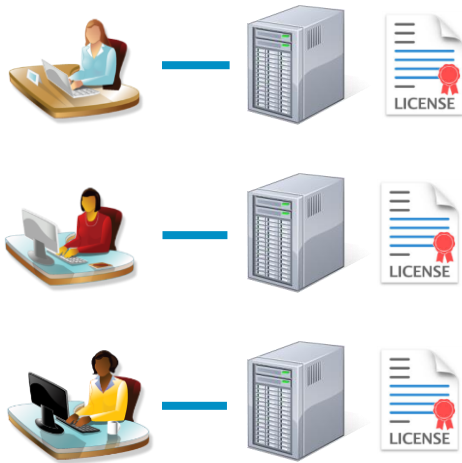
Antennas



# Moving to “The Cloud”

## Traditional Approach

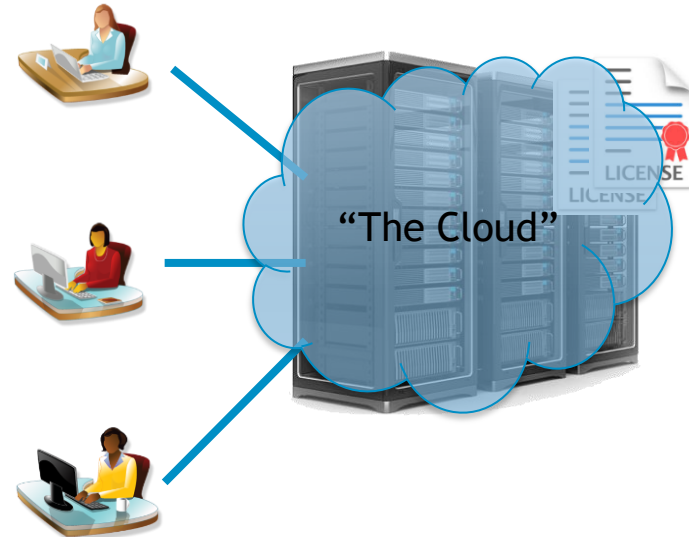
Each user “owns” his/her resources (workstation and license).



Still widely used in smaller companies and in very competitive environments.

## Cloud Approach

Users not in charge of the resources they use. Resources are centralized and shared.



Larger accounts tend to move in this direction.

1. Private cloud used exclusively for CST software.
2. Private cloud shared with other software.
3. Public cloud.

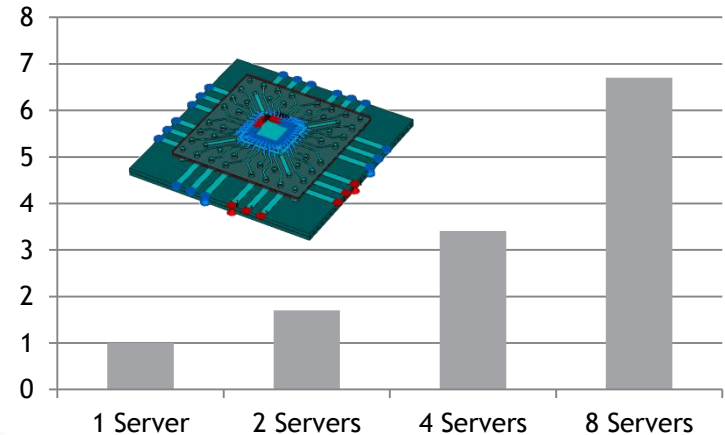
# CST Distributed Computing



Workload management system integrated in CST STUDIO SUITE.

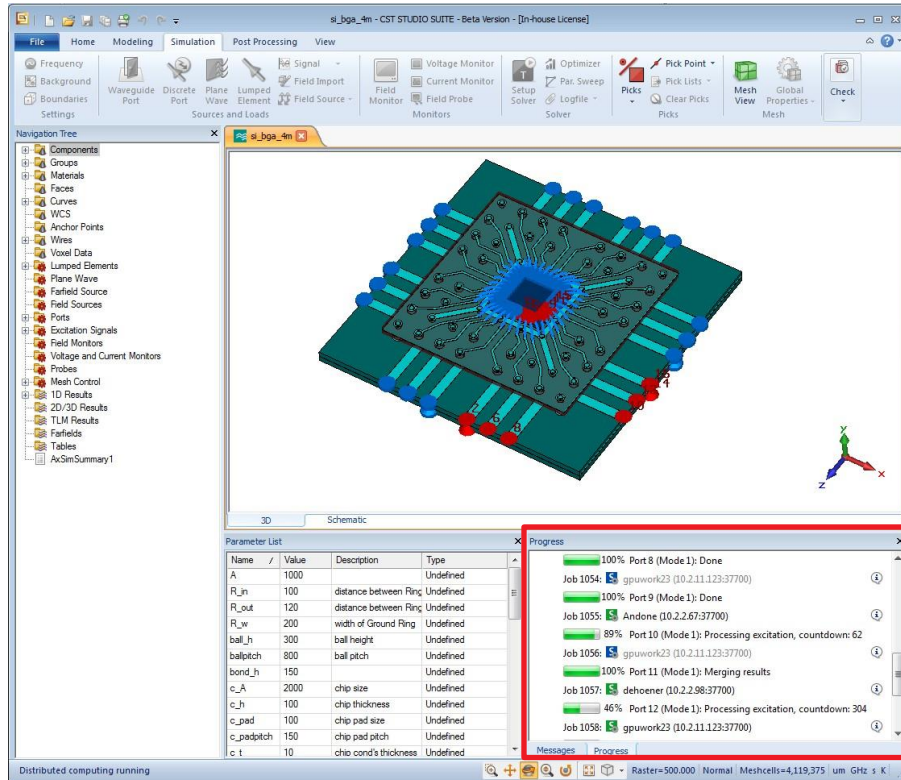
The DC Main Controller selects solver servers for the jobs and sends the simulation tasks to the selected machines.

Speedup



Distributed excitations (transient solver) on a cluster with eight nodes (dual Xeon E5-2643 v3).

# CST Distributed Computing



- Very **good utilization** of computational resources.
- Very **efficient parallelization** strategy for independent tasks.
- **Fully integrated with the CST STUDIO SUITE frontend.**
- Easy way to share computational resources in a **multi user environment.**

Simple “cloud” solution for private cloud when computational resources are used for CST exclusively.

# Private Cloud - Shared with Other Software

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- Workload managed by any scheduling system (no standard interface or configuration).
- Accessed companywide, i.e., often low network bandwidth for users who access via internet.
- Often complicated to use for a CAE engineer (command line only).
- In most cases Linux based.

# Private Cloud - Shared with Other Software

Support of centralized HPC environments is available on several levels of convenience for CST STUDIO SUITE:

1. Script collection for **convenient job submission and progress view on Linux systems** (supports all major scheduling systems). Flexible and open such that the user can make adjustments as required.

```
*****
*                                     Job Settings                               *
*****
* Please review all your settings made in the previous steps.                  *
*****

Model File       : ../../horn/horn.cst
Queue            : gpu
Solver           : MWS - Transient Solver
Number of GPUs  : 2

Cluster Acceleration: MPI Computing
Number of Nodes   : 2

Press <enter> to confirm or enter "back" to change settings: █
```



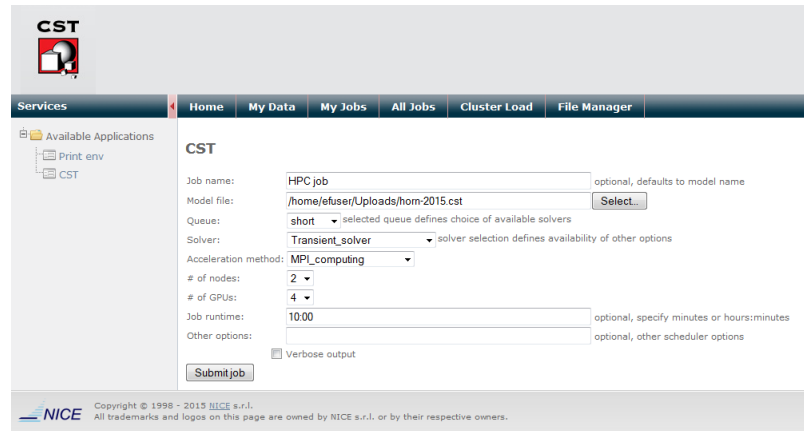
# Private Cloud - Shared with Other Software

Support of centralized HPC environments is available on several levels of convenience for CST STUDIO SUITE:

- Integration of CST STUDIO SUITE in the **EnginFrame** web portal solution provided by NICE is available. This allows for **job submission**, **monitoring**, and **post-processing** with **accelerated remote rendering**.



For more information on  
EnginFrame and DCV go to  
booth #740



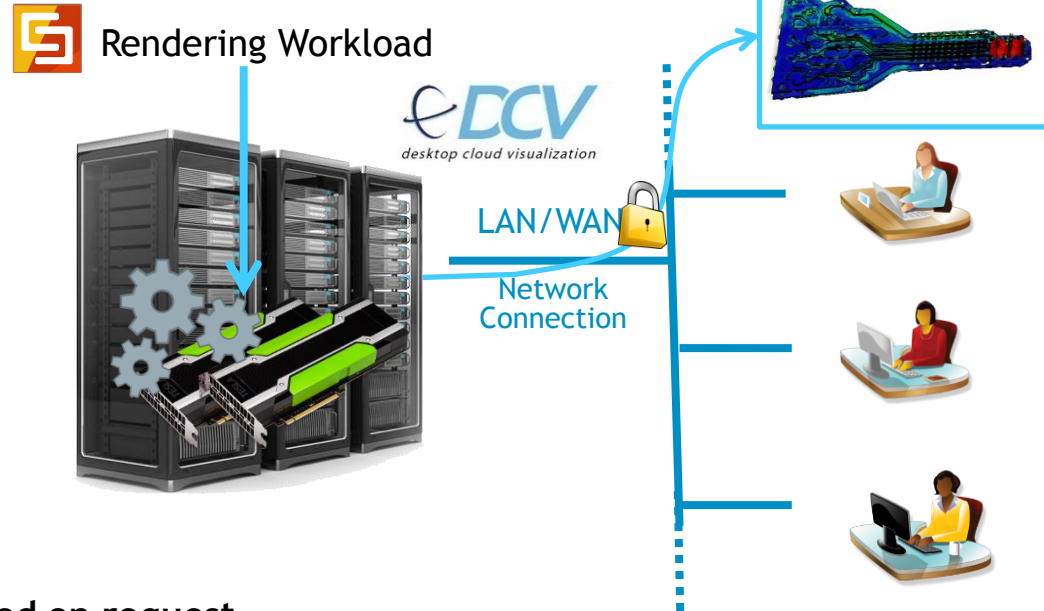
# Private Cloud - Shared with Other Software



Complete simulation workflow can be easily and conveniently managed via the EnginFrame web portal using the CST plugin for job submission and visualization.

## Key features:

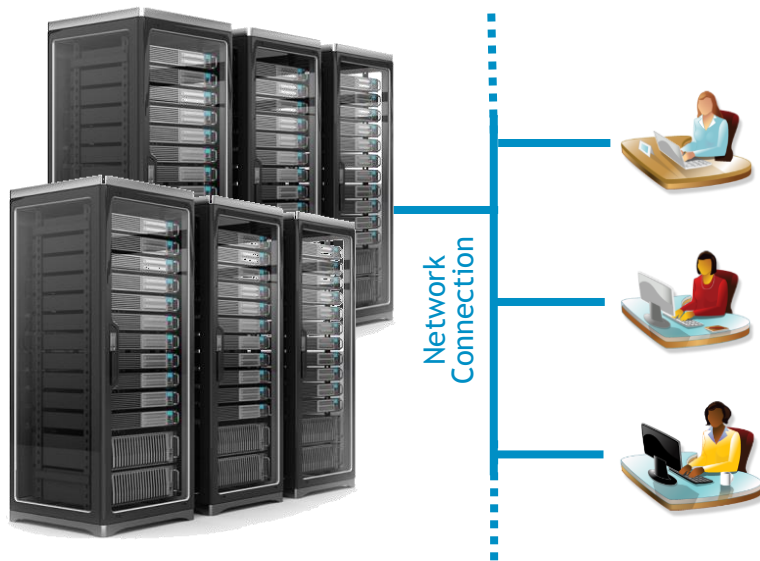
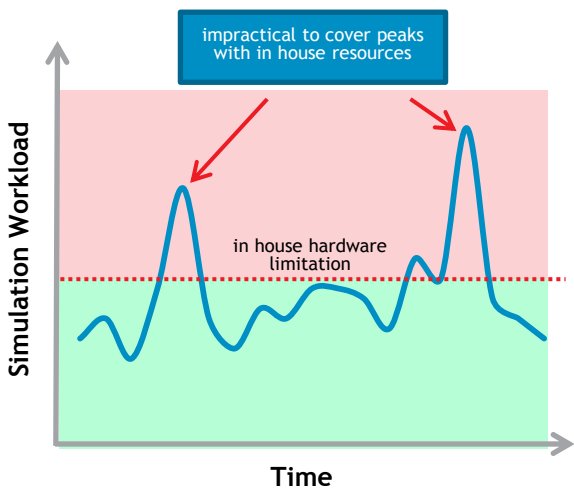
- Full GPU acceleration for Windows and Linux sessions on the cluster (remote visualization) using DCV.
- Dynamic quality adjustment to maximize frame rate in motion.
- Encryption using AES algorithm.



CST plugin for EnginFrame can be provided on request.

# Public HPC Cloud

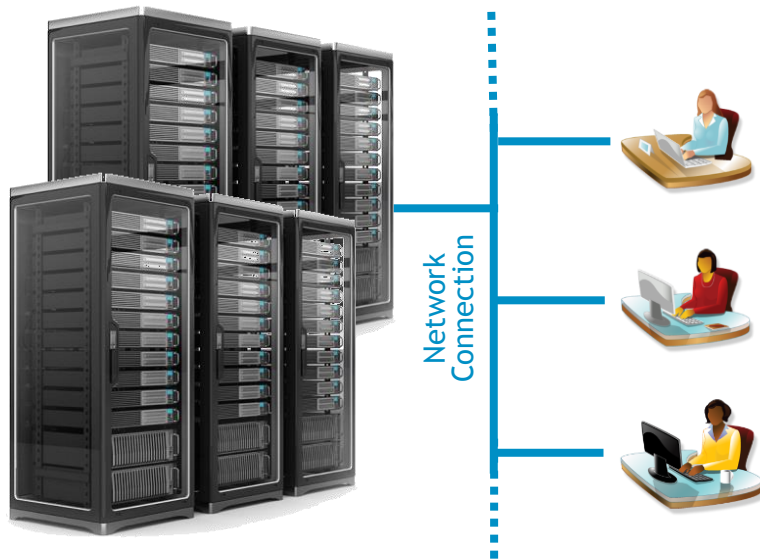
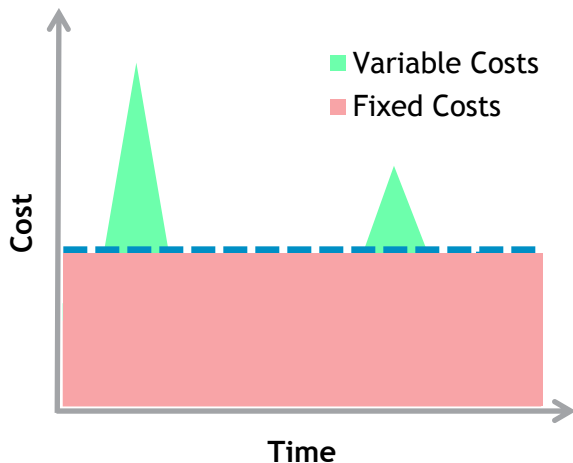
What makes "HPC in the Public Cloud" different from "normal" HPC?



- Scaling infrastructure up and down when needed.

# Public HPC Cloud

What makes "HPC in the Public Cloud" different from "normal" HPC?



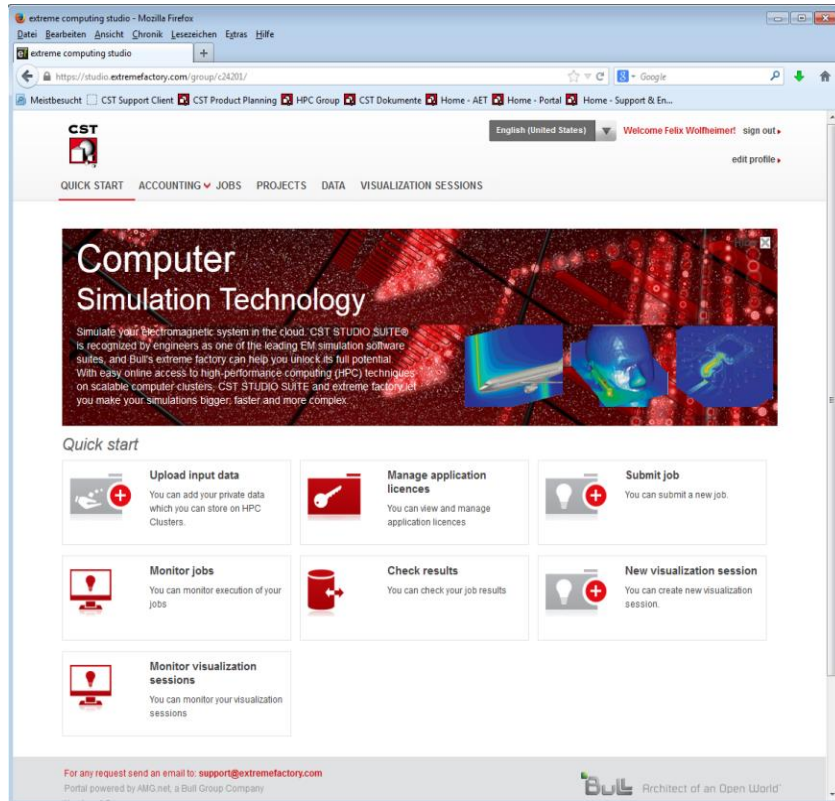
- Scaling infrastructure up and down when needed.
- Reducing fixed cost in favor of dynamic cost.

# Public HPC Cloud

What makes "HPC in the Public Cloud" different from "normal" HPC?



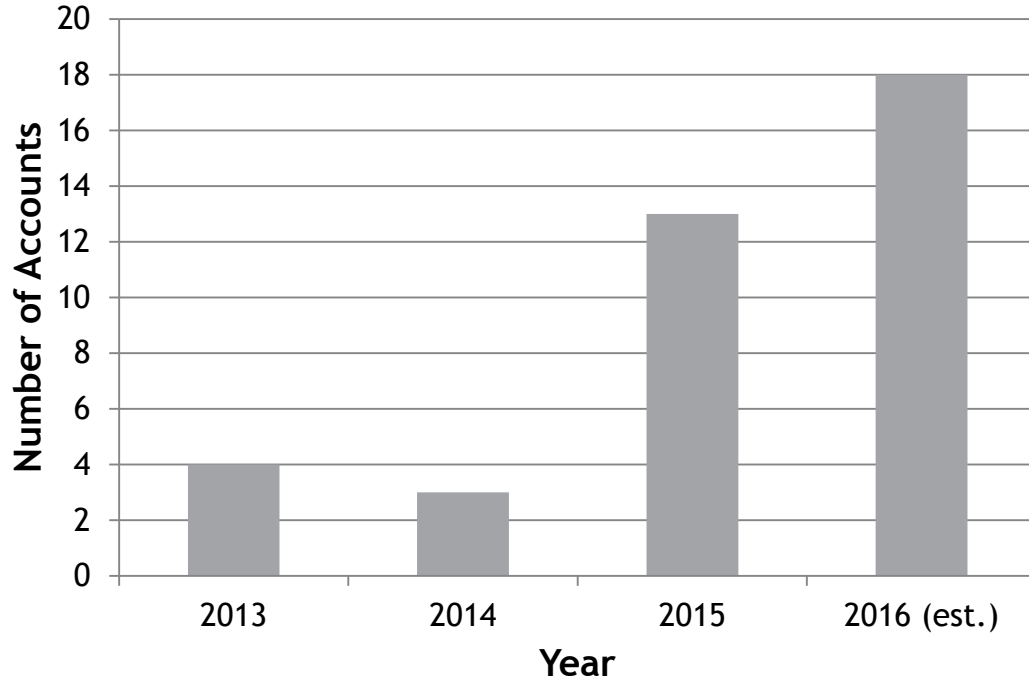
# Public HPC Cloud



The screenshot shows a web browser window displaying the CST Studio website. The browser's address bar shows the URL <https://studio.extremefactory.com/groups/242002/>. The website header includes the CST logo, a language selector for English (United States), and a user profile for Felix Wolheimert. A navigation menu contains links for QUICK START, ACCOUNTING, JOBS, PROJECTS, DATA, and VISUALIZATION SESSIONS. The main content area features a large banner for "Computer Simulation Technology" with a background image of a circuit board and simulation results. Below the banner is a "Quick start" section with six interactive cards: "Upload input data", "Manage application licences", "Submit job", "Monitor jobs", "Check results", and "Monitor visualization sessions". Each card includes an icon and a brief description of the action. At the bottom of the page, there is a footer with contact information and the Bull logo, which is described as the "Architect of an Open World".

- Partnership with HPC resource providers (Bull/Atos, Nimnix, Rescale).
- Special cloud licensing model available (credit based, pre-paid).
- Focus on usability (user friendly way of job submission, progress view and result view via remote visualization).
- Available hardware and technology is important (fast interconnect, hardware accelerators, amount of RAM).

# Public HPC Cloud Customer Requests



First public cloud offering established in 2013.

So far not a large number of accounts show interest in the public HPC cloud.

Interest gradually growing over time though.