 University of Missouri



FACTORY OF THE FUTURE: ADVANCED MANUFACTURING APP MARKETPLACE

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GEC 23 Plenary Talk/Demo

June 2015

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OH·TECH | Ohio Technology Consortium
A Division of the Ohio Board of Regents



Talk/Demo Outline

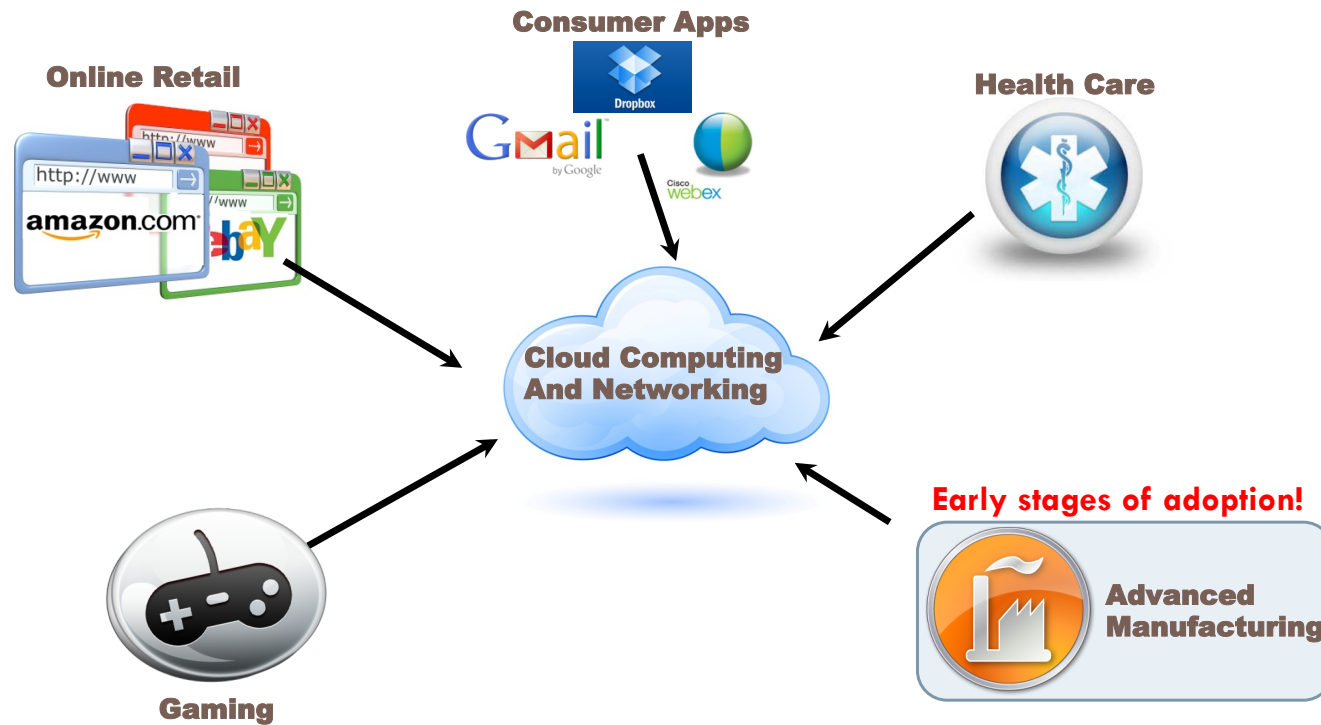


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- Project Motivation
 - Advanced Manufacturing and Cloud
 - GENI Relevance for TotalSim
- GENI Shakedown Experiment Demo
 - GENI as a Hybrid Cloud Resource for User Opt-in
 - App Runtime to manage Simulation-as-a-Service
 - App Cost pricing model
- Conclusion

Advanced Manufacturing and Cloud



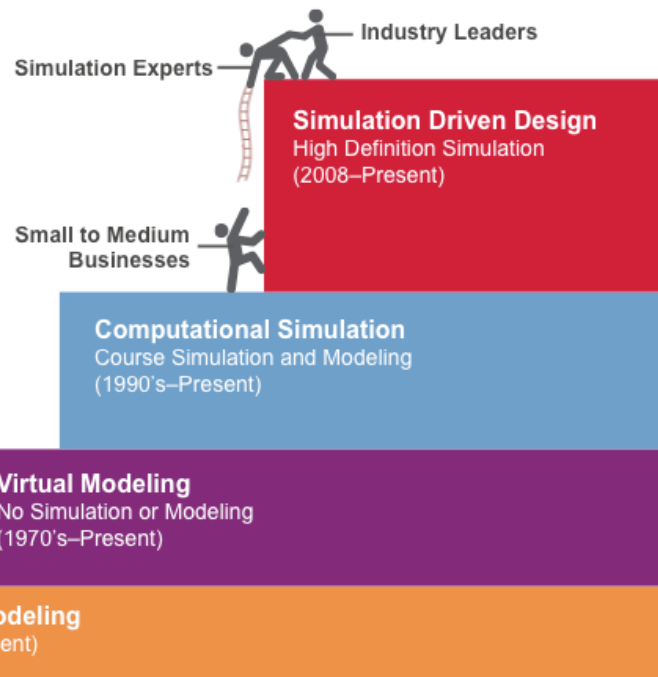
“Factory of the Future”

Simulation-as-a-Service (SMaaS) App in the Cloud



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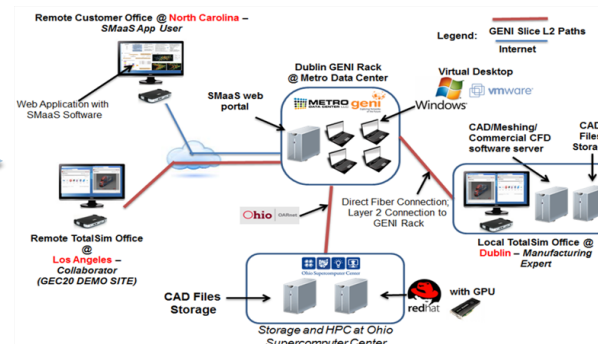
- Need to enable small businesses to easily adopt cloud-based technologies for their *workflows with data-intensive computation and networking*
- National Center for Manufacturing Science (NCMS) report suggests that access to technologies can reduce product design cycles by 66%



What is an Advanced Manufacturing App?

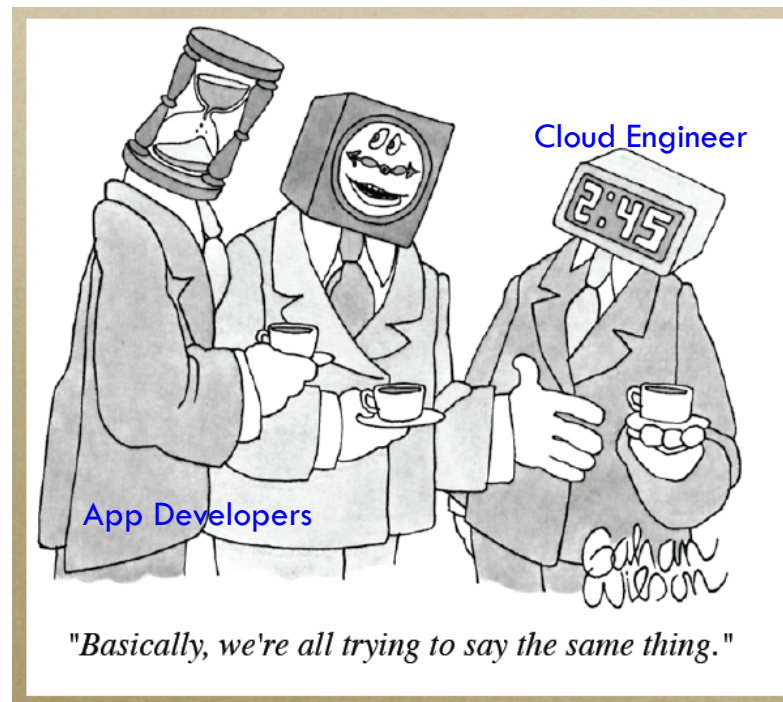
App Developer needs a Cloud Engineer to help with:

- Platform-as-a-Service (PaaS) management capabilities for design and development



SaaS App that uses a Cloud OS

Semantic Gap for App Deployment!





Aerodynamic and Computational Fluid Dynamics Experts

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- **TOTALSIM us – Dublin, Ohio**
 - Started Operations June 09
 - Sister Company to TotalSim Ltd.
 - Share Business model, IP, procedures
 - TS Ltd. owns ~50%
 - 13 Engineers – 5 MSc Aero
 - 576 cores in-house
 - Secure 10GB fiber connection to +15k cores at OSC
- **Ray Leto - President**
 - 20+ years Race Engineering, Aerodynamics, Simulation, and Management in Indy & Champ Car
 - 10k+ hrs of wind tunnel and 20yrs track testing experience
 - Focus on sim integration w/ physical testing and design
- **Naethan Eagles – Technical Director**
 - 5 years Aerospace, 3 years AdvantageCFD / BAR F1
 - 10 years Williams F1. Started CFD Dept.
 - Extensive background in management, and correlation.
 - Design in a continuous development environment
 - Focus on making tools work



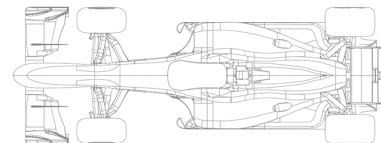
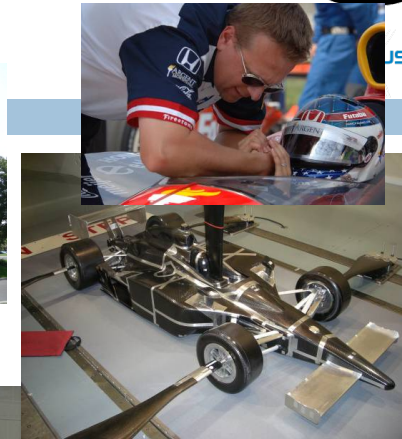
City of Dublin

OHIO, USA



OARnet

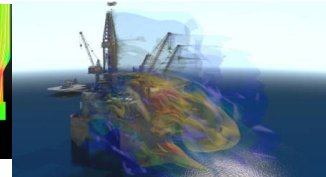
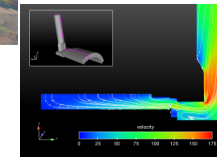
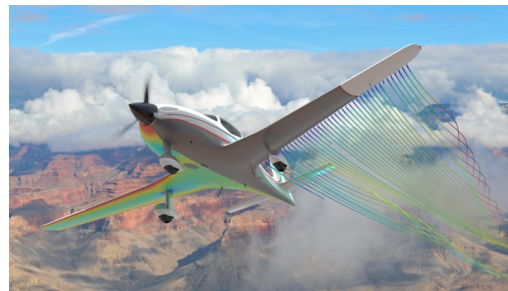
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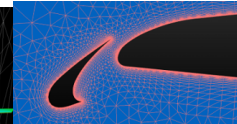
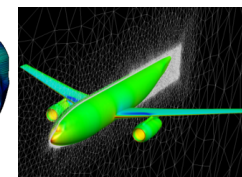
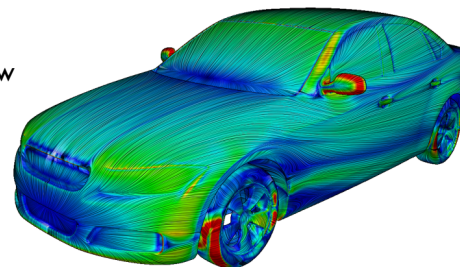
Industries:

- OE Automotive - Several OEM's
- Motorsports
- Heavy Equipment
- Truck and Trailer OE and Add-on
- Consumer goods
- Tier 1 Suppliers
- Aerospace



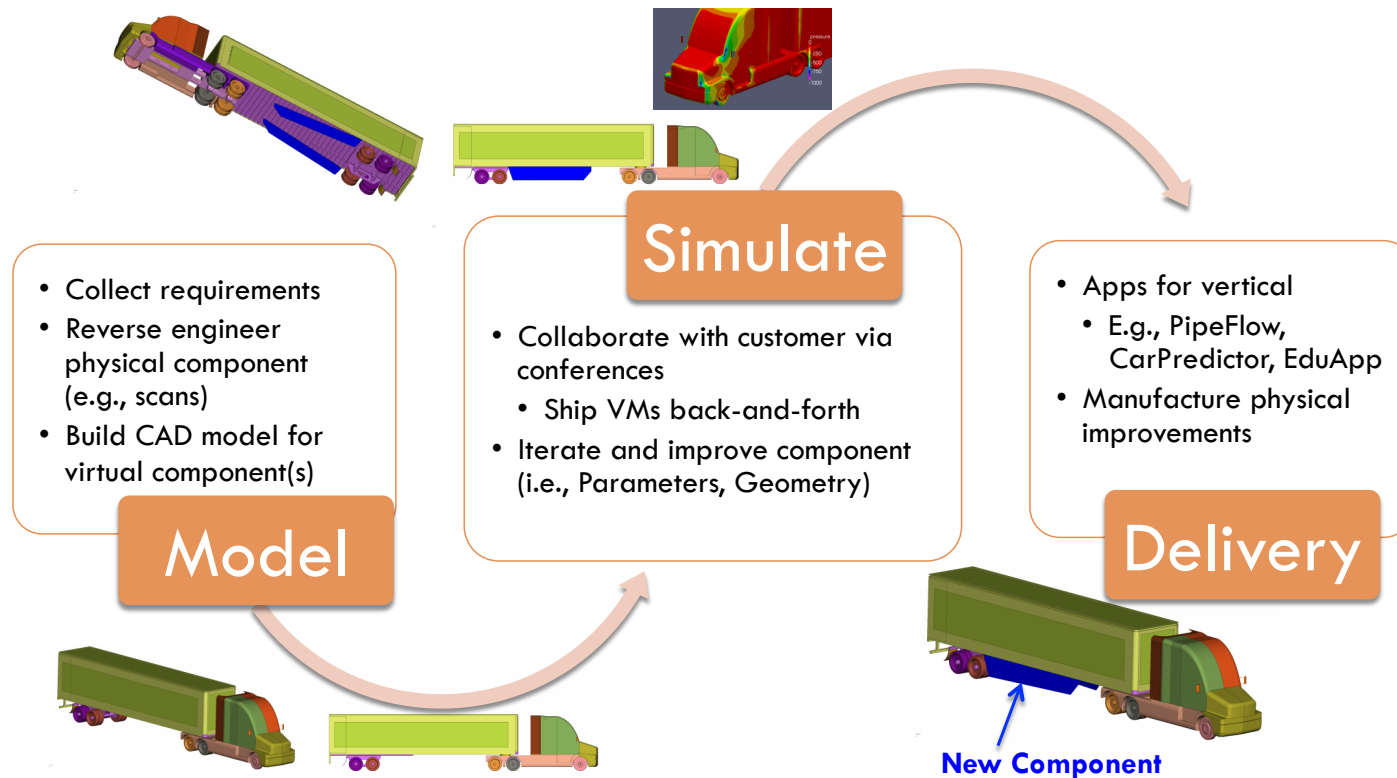
Software Support and Development:

- OpenFOAM®
 - All tools around TS-Foam, support development, new utilities, solvers and add-ons
- Vertical Apps
 - Dept. of Energy SBIR Award to develop CFD Apps
 - AweSim
 - GENI





Why Advanced Manufacturing needs Cloud transformation ?



GENI Relevance for TotalSim



Simulation-driven design for manufacturing success.

AweSim enhances competitiveness and efficiency for manufacturers by decreasing product development time, improving quality, and speeding up time to market. Rather than relying on costly and time-intensive physical testing, supercomputer powered modeling and simulation applications enable manufacturers to pare down the initial phases of product testing by eliminating undesirable prototypes before the physical testing process begins.



<p>Explore</p> <p>Discover how innovative modeling and simulation tools are changing the way you manufacture products and provide value to your customers.</p> <p>Browse & Discover</p>	<p>Evaluate</p> <p>Take a free test drive of a modeling and simulation application and discover how similar apps could be developed for your business.</p> <p>Free Test Drive</p>	<p>Simulate</p> <p>I understand the competitive advantage of modeling and simulation and I want to start using the AweSim App Store.</p> <p>Get Started</p>	<p>Learn</p> <p>Contact us about our comprehensive training programs for all of the apps in our App Store or for developing and selling your apps.</p> <p>Get Smart</p>
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TotalSim, in collaboration with MU is using GENI for PaaS and Cloud networking experiments to study how they can deliver their Apps to their customers with *lower design time and cost/simulation*



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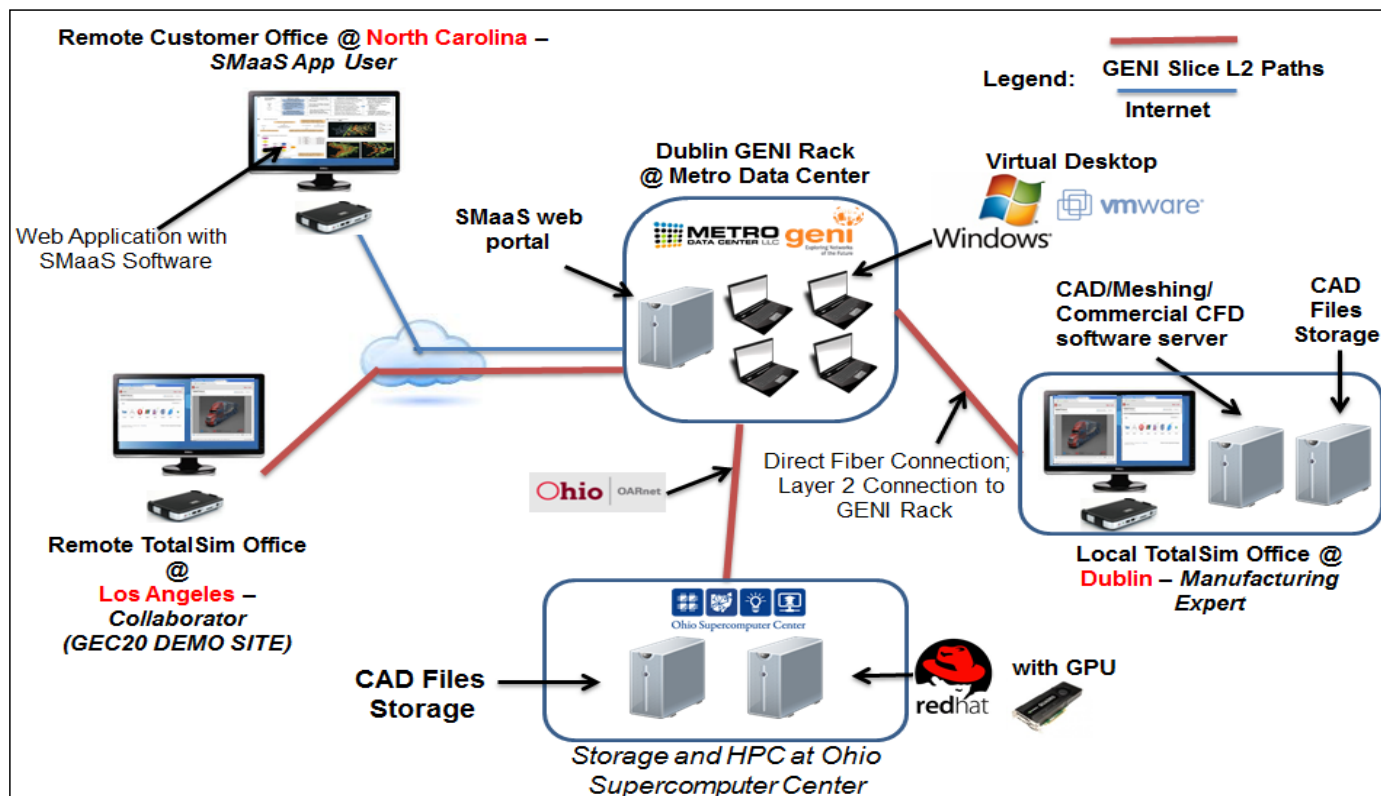


Ohio Supercomputer Center
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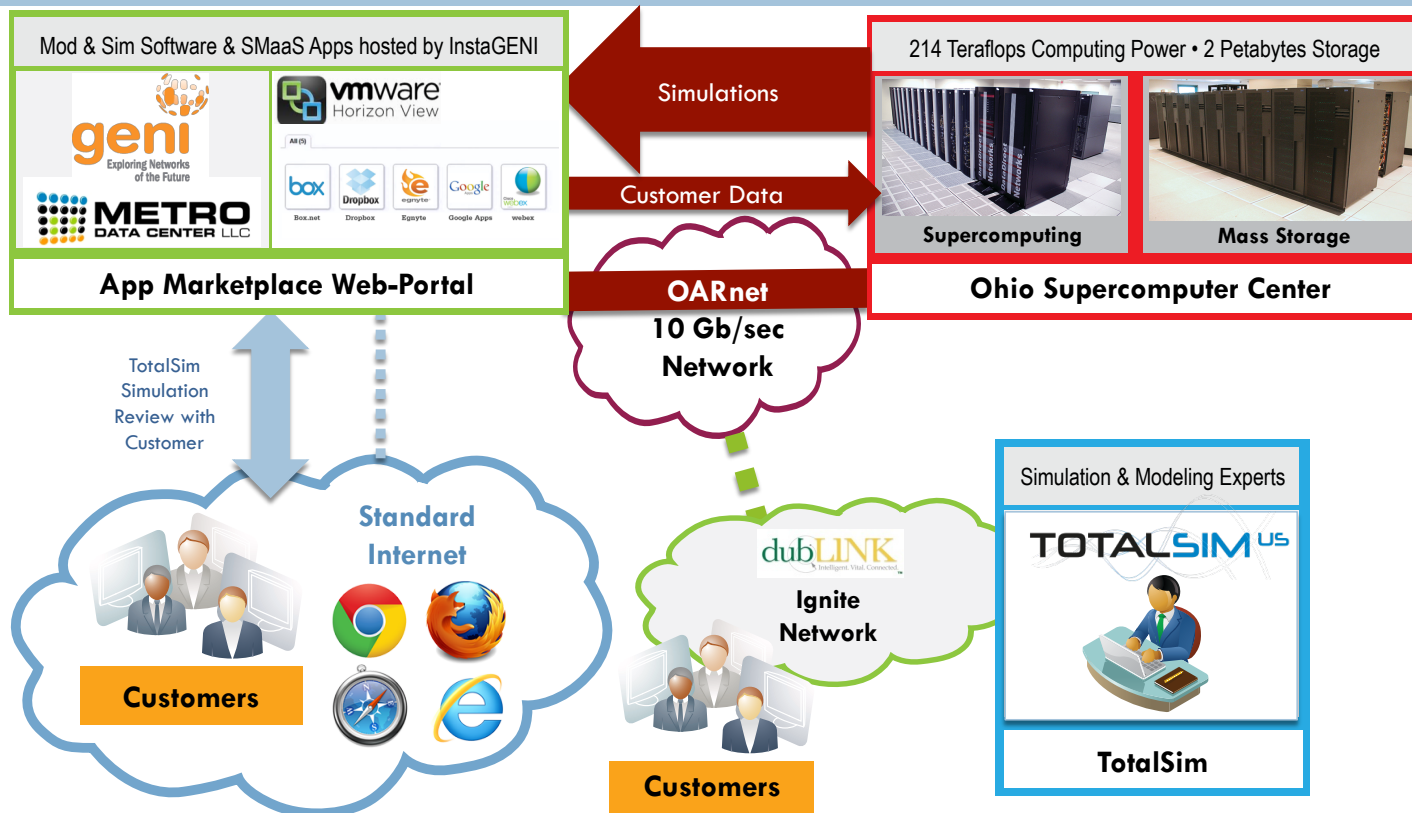


Hybrid Cloud Testbed setup with GENI



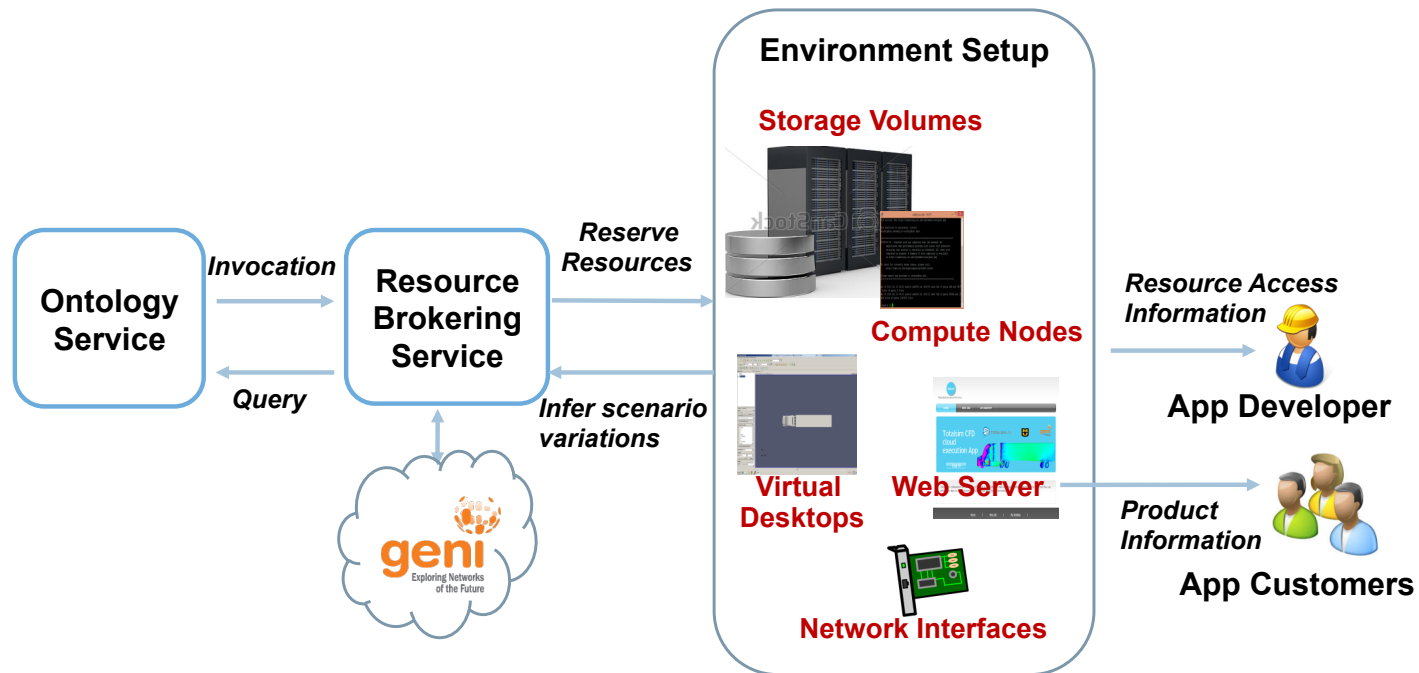


Hybrid Cloud Testbed setup with GENI



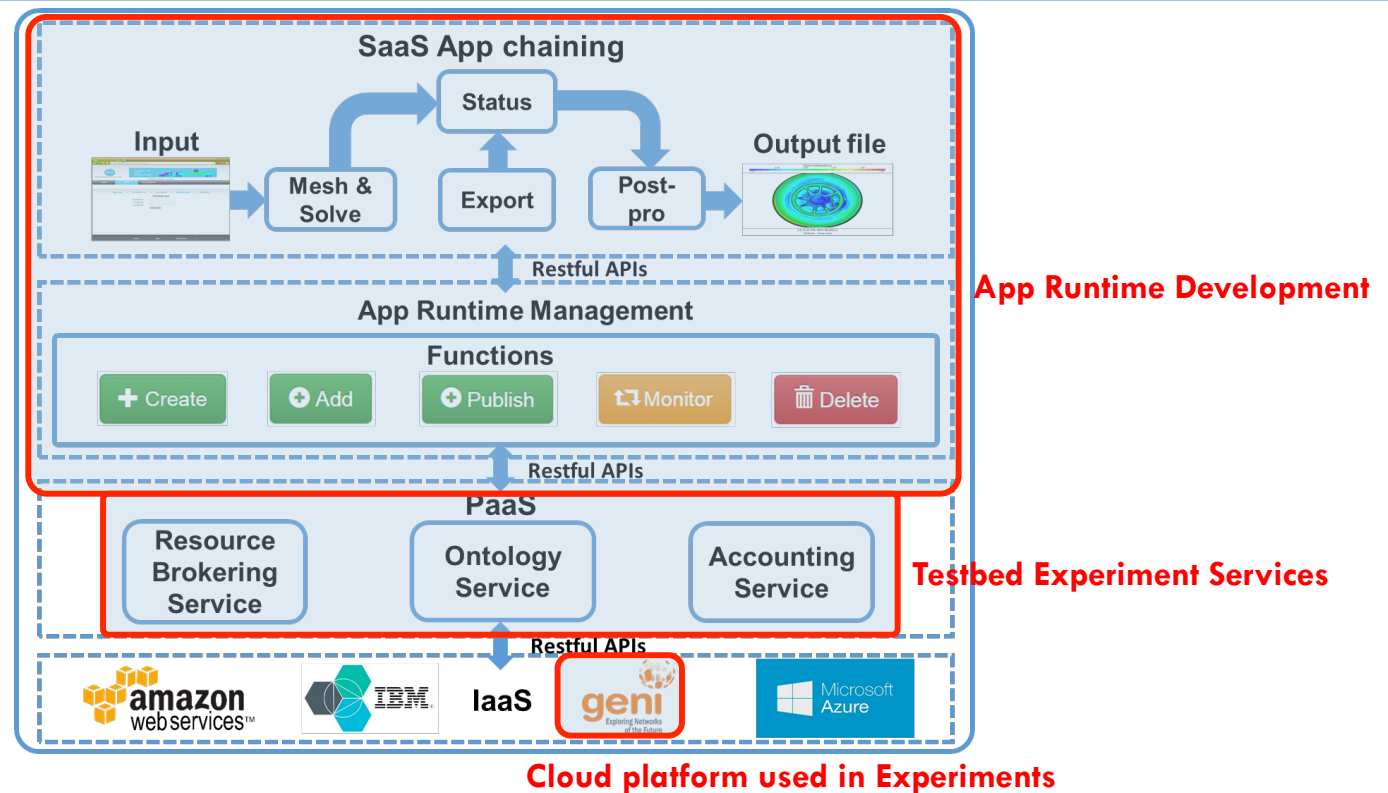


GENI as a Hybrid Cloud Platform



GENI allows TotalSim to study User Opt-in issues, understand how to right provision resources, experiment with cloud platform and networking configurations for App management, and understand how to price Apps

App Marketplace Architecture





Service Provider (SP) and Manufacturing Enterprise (ME) Costs

- ME uses SP environment and own expertise to create & sell new Apps
- SP incurs a monthly cost towards maintenance of environment
- ME incurs additional variable cost based on environment usage

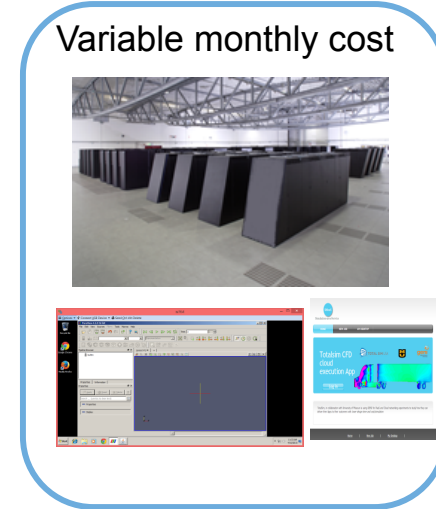
Acquisition cost



Fixed monthly cost



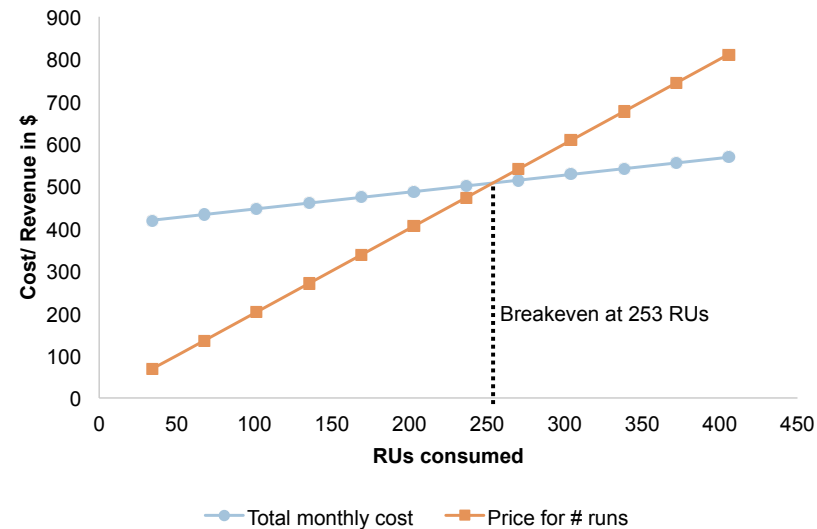
Variable monthly cost





Break-even Analysis example for ME

- RU approach – Breakeven curve, each RU consumed priced at \$2



Finding: Small-businesses can benefit from a pertinent Cloud Architecture and profit, with moderate usage and management effort

Qualitative comparison with AWS



Private Cloud	Public Cloud
Interaction with Personnel	Interaction with APIs
Order based queuing systems	On-demand usage i.e., no waiting
Hardware upgrades minimal	Latest hardware used
Limited scaling capabilities	Unlimited scaling potential
Cost for a simulation : \$0.87	Cost for a simulation : \$5.04

Conclusion



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- We developed an App Marketplace web framework to enable Manufacturing Enterprises to develop, deploy SMaaS Apps
 - ▣ AweSim for TotalSim, Agile Manufacturing, Factory of the Future

- Benefits of our App Marketplace Approach:
 - ▣ Better resource provisioning/utilization with low management overhead
 - ▣ Dynamic approach for Manufacturing App development/publishing
 - ▣ Faster path to market for innovative products!

Thank you for your attention!



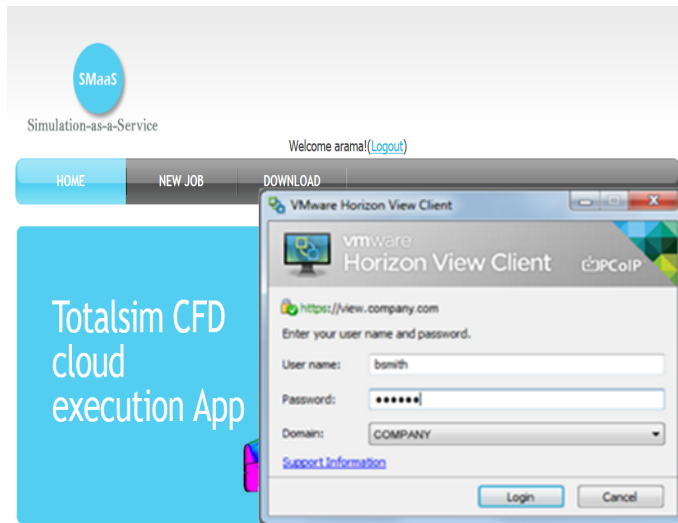
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Questions?

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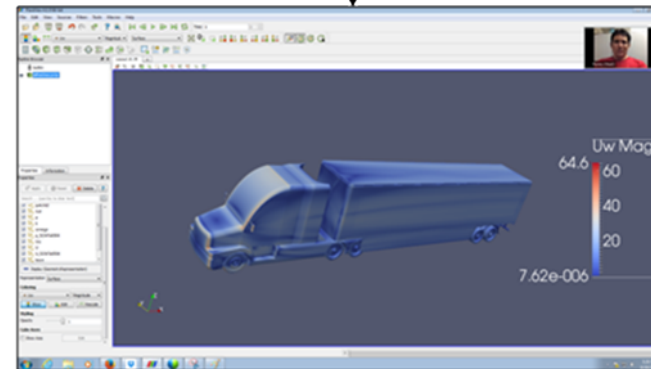
Demo: Virtual Desktop Infrastructure in GENI



Logging screen to SaaS App

Demo Marketplace - TotalSim, in collaboration with MU is using GENI for PaaS and Cloud networking experiments to study how they can deliver their Apps to their customers with *lower design time and cost/simulation*

Several tools ready to be deployed



User ready to create/load models in a few seconds



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Demo: App Runtime Manger in GENI

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The first screenshot shows the 'Run App' interface with a 'Provide input for App run' section containing three 'Cp1Mesh' input fields, each with a 'y' value and a 'Run App' button. The second screenshot shows the 'App Status' page with a table of 'Run status information' including Job ID, Job Name, Job Status, and Action. The third screenshot shows the 'View Results' page with a table of results including App Name, Date Created, and View Results links. The fourth screenshot shows a grid of 'CpPlots' images representing simulation results.

The first screenshot shows the 'Application Information' page with a table of application details including App Name, App Config, App Description, Cost, Publish app?, and Action. The second screenshot shows the 'Application Information' page with a table of application details including App Name, App Config, App Description, Publish app?, and Action. The third screenshot shows the 'Advanced Manufacturing App Marketplace' page with a table of application details including App Name, App Description, Cost per run, and Action.

YouTube Video of App Chaining Web-portal: <https://www.youtube.com/watch?v=yMjKX9mHPKA>