Hybrid Cloud Experiments with GENI for 'Simulation-as-a-Service'

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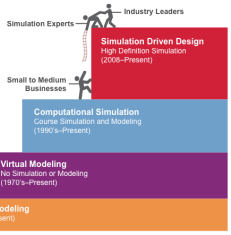
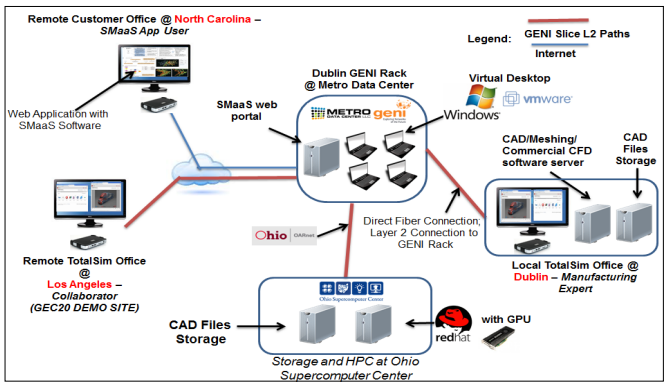
SMaaS Overview



- *Advanced Manufacturing* design today requires iterative/collaborative work among multi-site engineering experts in e.g., fluid/thermal analyses
- 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%
- Advanced Manufacturing 'Apps' marketplaces are emerging that allow small businesses to provide expertise-driven modeling & simulation web services (SMaaS) tailored to their customer needs based on:
  - PaaS with elastic HPC back-ends
  - Cloud networking
- ***GENI Relevance:*** 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*

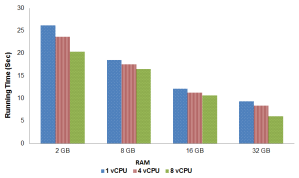
SMaaS Deployment Architecture

- GENI Rack at Metro Data Center (MDC) is hosting the TotalSim development environment and providing an overlay network infrastructure
  - 9 VMs installed over ESXi hypervisor
    - 6 Windows Server 2008 R2 VMs for Auth server/DHCP/DNS, VMware Horizon View, 1 CentOS 6.5 for SMaaS App web portal
    - 1 Ubuntu VM that works as a Gateway, 1 Windows 7 64 bit VM that hosts the master image for deploying new VMs
- TotalSim connectivity to Ohio Supercomputer Center for HPC/Storage, and their remote office in California; Exemplar customer in North Carolina
  - Layer 2, 1 Gbps path through OARnet allows access to HPC resources and CAD files storage via GENI Rack hosted virtual desktop
  - GENI Rack Direct Fiber Connection to TotalSim's Storage and CAD Licenses supported by City of Dublin broadband investments



Performance Study Experiments

- Virtual desktop resource optimization for performance enhancement when Paraview modeling and simulation software is used
  - Studying impact on Open Time & Render Time for different vCPU and RAM
  - ThinApp versus Native performance comparison



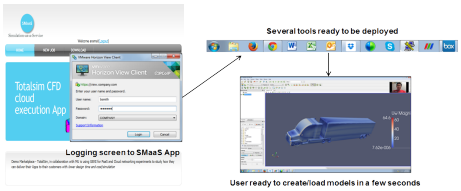
Application	Open Time (Sec.)	Render Time (Sec.)
Paraview (Native)	9.43	3.61
Paraview (ThinApp)	10.13	3.78

*System with similar characteristics

- *Example Outcome:* For a model of 3.8 GB file size stored in the GENI Rack and accessed remotely from a MU physical system, we observed ~10X Open Time improvement
  - 285 seconds Open Time with physical system; 26.15 seconds Open Time with VD

SMaaS App Collaboration

- Remote Office and Customer Collaboration using thin-client access to TotalSim development 'sandboxes' with "at-the-same-desk" user experience
  - Single sign-on and unified/secure access to datasets, Desktop Apps (e.g., Paraview) and Cloud Apps (e.g., WebEx) - *fosters Agile development lifecycles with quicker product delivery, reduced cost and increased productivity*



- Vertical Apps being developed for tailoring cloud-based modeling and simulation per customer design needs, by presenting familiar sets of inputs
  - Example App Demo: Simulation of the front wheel of a car that uses HPC and large data files - *without the hassle of using terminal based interfaces, multiple data copies or slow Internet file copy; run-by-run charge versus the customer owning and operating a complex CFD cluster environment!*

Step-1: App Login | Step-2: Schedule Jobs | Step-3: Monitor Status | Step-4: View Results

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