

### Deploying HPC for Interactive Simulation

#### Birds-of-a-Feather

12:15 – 1:15, Wednesday November 18th, Room D133-134

Approved for Public Release. Security and OPSEC Review Completed: No Issues. hpcsim.wordpress.com



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### Is this important to HPC?

"Nothing is more important to the longterm health of the HPC industry than the 3D web."



Justin Rattner, Intel Corp, CTO SC'09 Keynote (Yesterday)

Why did the Intel CTO say this?



### Define "3D Web"

- Visual
- Audible
- Real-time
- Interactive
- Dynamic Behavior (a.k.a. Simulation)
- Represents some portion of a real world

#### The focus of this BOF since 2007



## **BOF Summary**

- This BOF will discuss the problem-space and experiments that have been conducted in applying HPCs to interactive applications, such as military simulation.
- Traditional networks of computing assets are challenged to support simulation scenarios of sufficient breadth, fidelity, and number. Several organizations have turned to high performance computing for a platform that is powerful enough to run these interactive simulations.
- This BOF continues the discussions and community building from SC'07 and SC'08.





## **BOF** Objectives

- Identify the organizations and projects that are actively applying HPC to interactive simulations
  - e.g. training simulation, military experimentation, online computer games, fashion designers.
- Exchange lessons learned on the work that has been done.
- Build a community of practice in this area.
- Seek advice from the leaders in traditional HPC applications.
- Expose this application area to the larger HPC community.



## **Technical Challenges**

- 1. Interactive HPC exploring bandwidth sufficiency from the computational elements to multiple concurrent interactive external users.
- 2. HPC I/O Structure HPC processing architecture that best supports interactive users.
- **3.** Fault Tolerance auto restarting a job when a processor or process dies, and doing so without losing the partial data that was in the works.
- 4. Organizational Acceptance technical and organizational challenges of using a shared resource for interactive simulation, rather than dedicated commodity hardware.
- 5. Parallel Programming training the simulation industry in parallel programming techniques vs. the network and concurrent programming that has dominated for 20 years.
- 6. **Processing Hierarchy** introduction of a processing hierarchy in the logic of simulation architecture design.
- 7. "Cloud" Simulation using HPC as the server-side of a ubiquitous software service.
- 8. Load Balancing in Clouds load-balancing and task assignment in a network of HPCs and traditional workstations vice the current static allocations.
- **9.** Interactive User Security verification of users communicating with jobs on open ports.
- **10. Multiple concurrent executions** Having multiple versions of the code executing concurrently in their own virtual machine





## Benefits to Warfighter Training

- HPC as the server farm for interactive training simulation
  - **Constructive:** Primary host for training
  - Live & Virtual: Wrap-around play box
  - Games: Rich server-side models
- Break the "one facility, one exercise" paradigm
  - Multiple simultaneous exercises supported from a single simulation center
  - Put the Sim Center in the cloud
- Reduce sim-to-sim lag
  - Host multiple sims on the same computer
- Break the whole entity to processor mapping
  - Allow for high fidelity physical and cognitive models that require more the one processor to execute in real time
- Physics-based objects, weather, and terrain
  - Put the "reality" in virtual reality



## MMOG vs. Simulation

World of Warcraft

Visual Detail: 1,000X Algorithm Detail: 1X Heavy Client Demand

#### OneSAF

Visual Detail: 1X Algorithm Detail: 1,000X Heavy Server Demand

## Evolving the Simulation Center













## Selected Experiments

- WARSIM Port
  - HPCMO, ARL, SAIC
- Physics-based Environment for Urban Operations using OneSAF
  - HPCMO, STRI, SAIC, CERDEC, NRL
- Millennium Challenge Exercise Clutter using JointSAF
  - JFCOM, Maui SCC, Alion
- PEO-C3T C4ISR On-the-Move using OneSAF
  CERDEC, HPTi, SAIC, HPCMO



## Who Are You?

- Introductions all around
  - Name
  - Organization
  - Mission, Project, Assignment
- What should the next steps be?



# Building a Community

- Collecting Names & Email
- Blog: hpcsim.wordpress.com
- Lunch: If you are hungry, let's group up and find a place
  - J Café, 533 NE Holladay

