



# HPC and Cloud Computing for Military Training

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# HPC Heads to New Market

“Nothing is more important to the long-term health of the HPC industry than the 3D web.”



Justin Rattner, Intel Corp, CTO  
SC'09 Keynote, Portland, OR



Why did the Intel CTO say this?

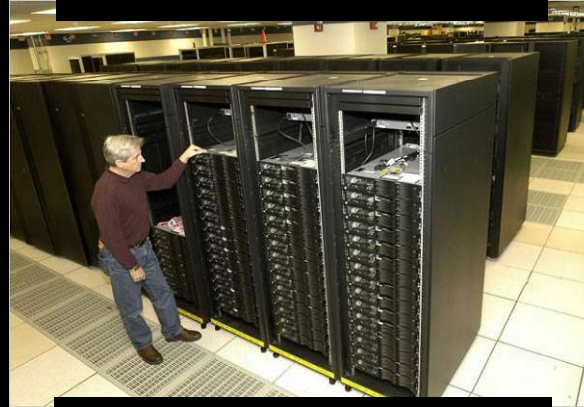
# Define “3D Web”

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

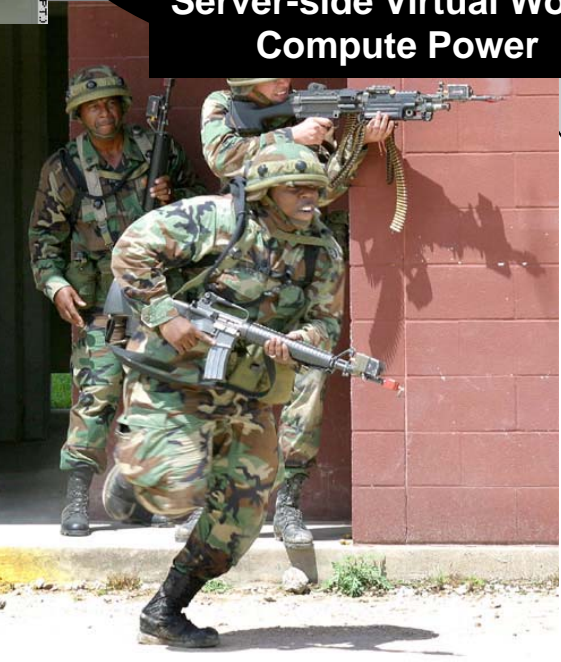
**CONSTRUCTIVE**

**VIRTUAL**

**HPC & Cloud**



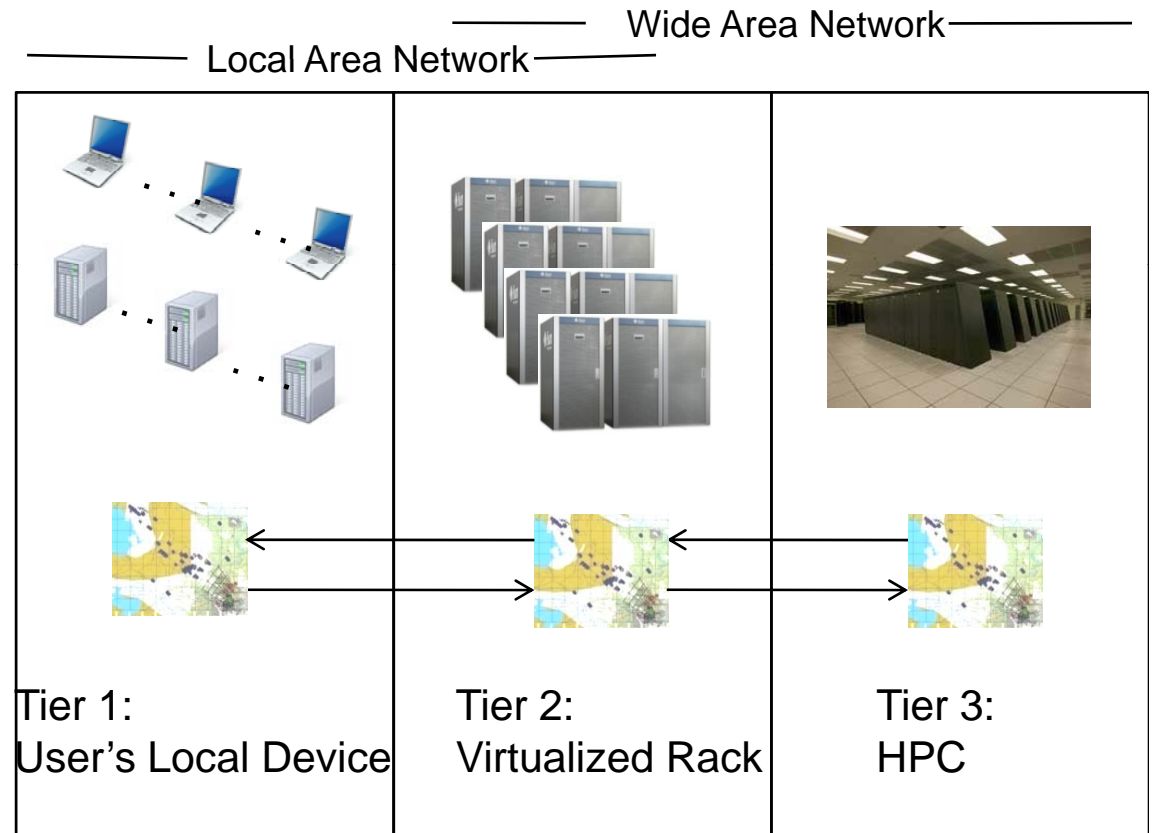
**Server-side Virtual World  
Compute Power**



**LIVE**

# CloudSAF CONOPS

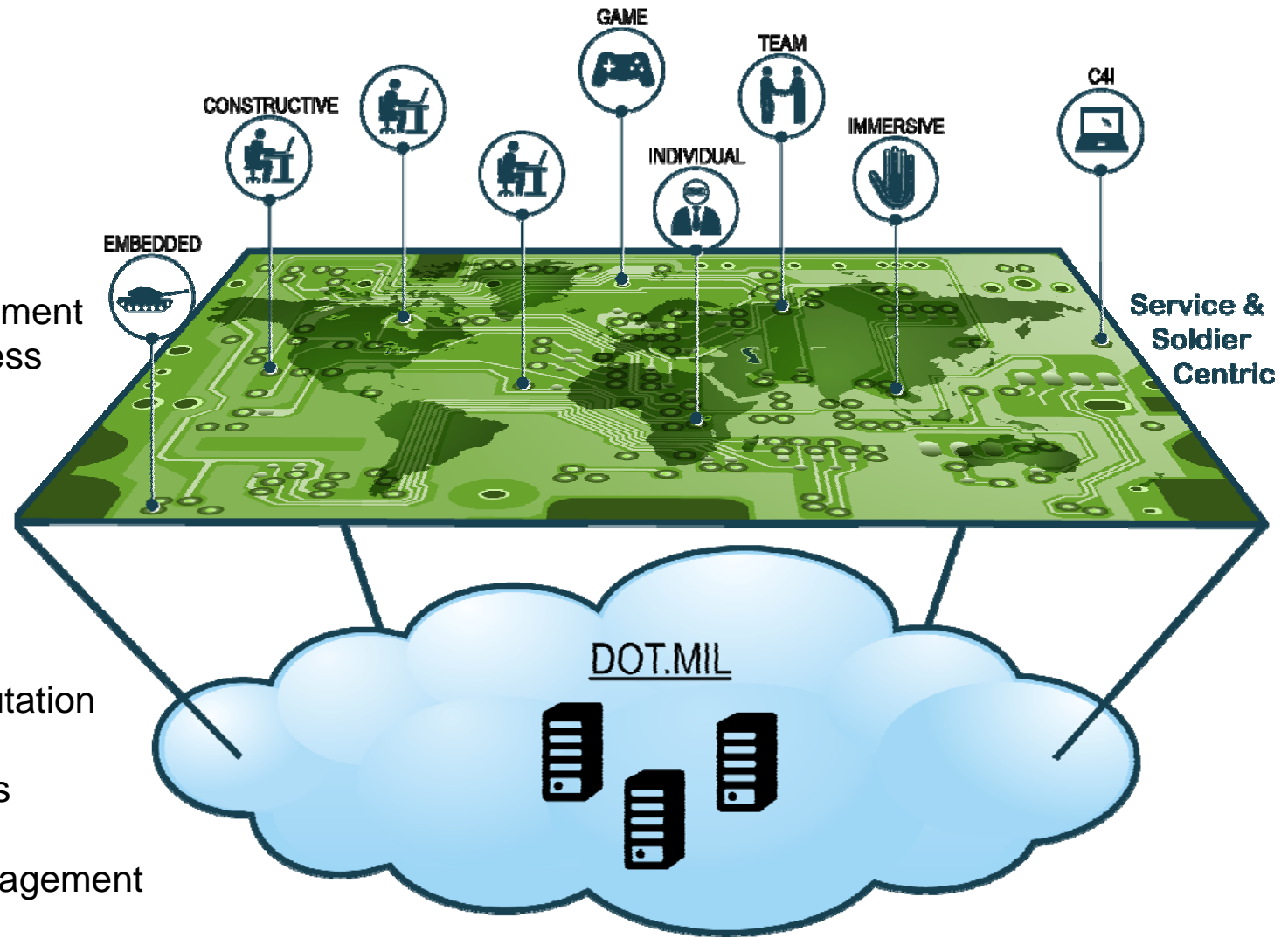
- Use Case 1: Independent
  - Many independent users within HPC environment
  - Each instance requires significant power for some part of its simulation (e.g. weather, comms, fly-out)
  - Simulation event is short-term with many instances turning on-off independently
- Use Case 2: Cooperative
  - Many users cooperatively involved in federation of SAFs within HPC environment.
  - High fidelity simulation spans the areas of many users
  - Simulation event is of longer duration, holding many people together for days



# Simulation in the Cloud

## NEW WORLD

- Soldier-centric
- Desktop Equipment
- Universal Access



## ENABLERS

- Massive Computation
- HPC
- Global Networks
- Cloud Services
- Distributed Management

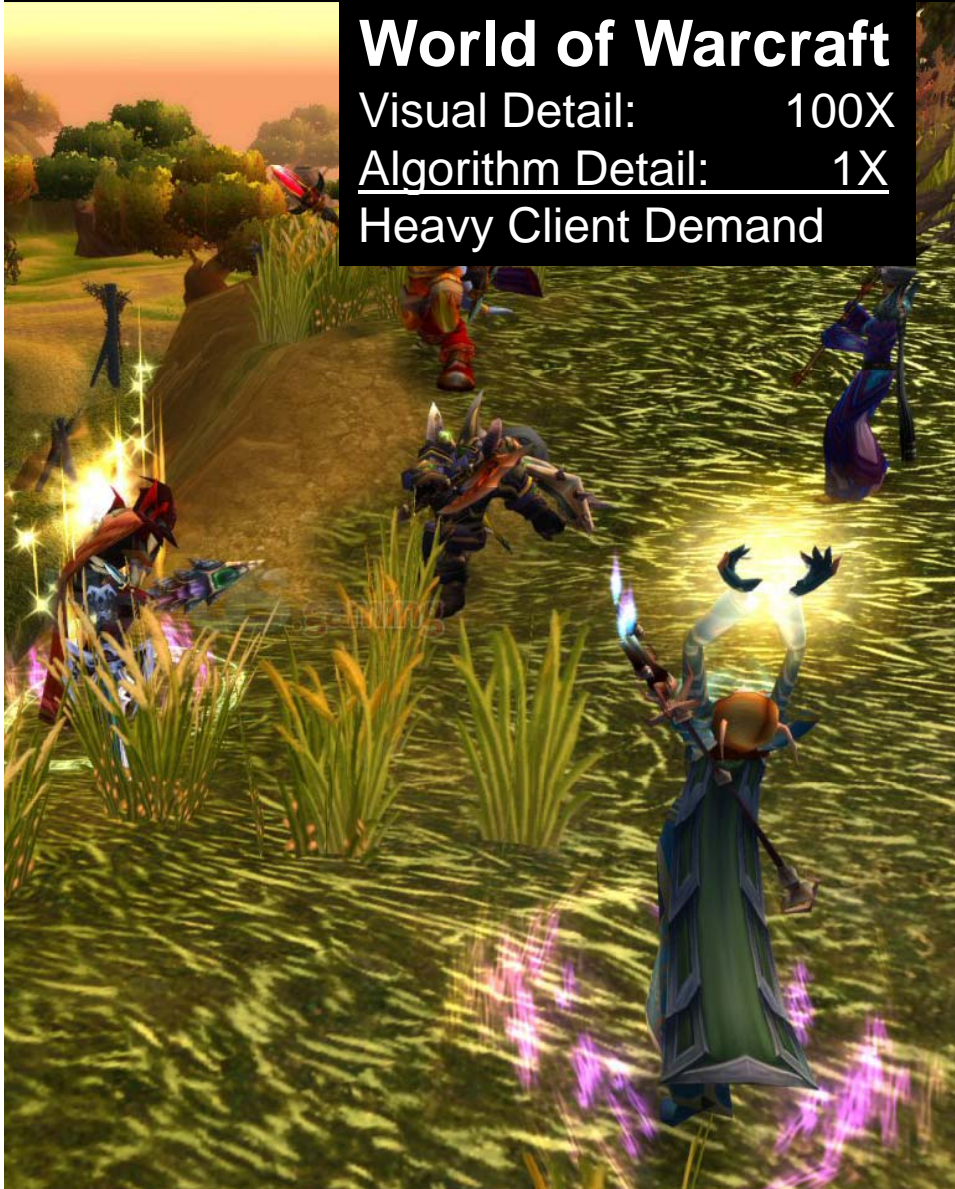
# MMOG vs. Simulation

## World of Warcraft

Visual Detail: 100X

Algorithm Detail: 1X

Heavy Client Demand

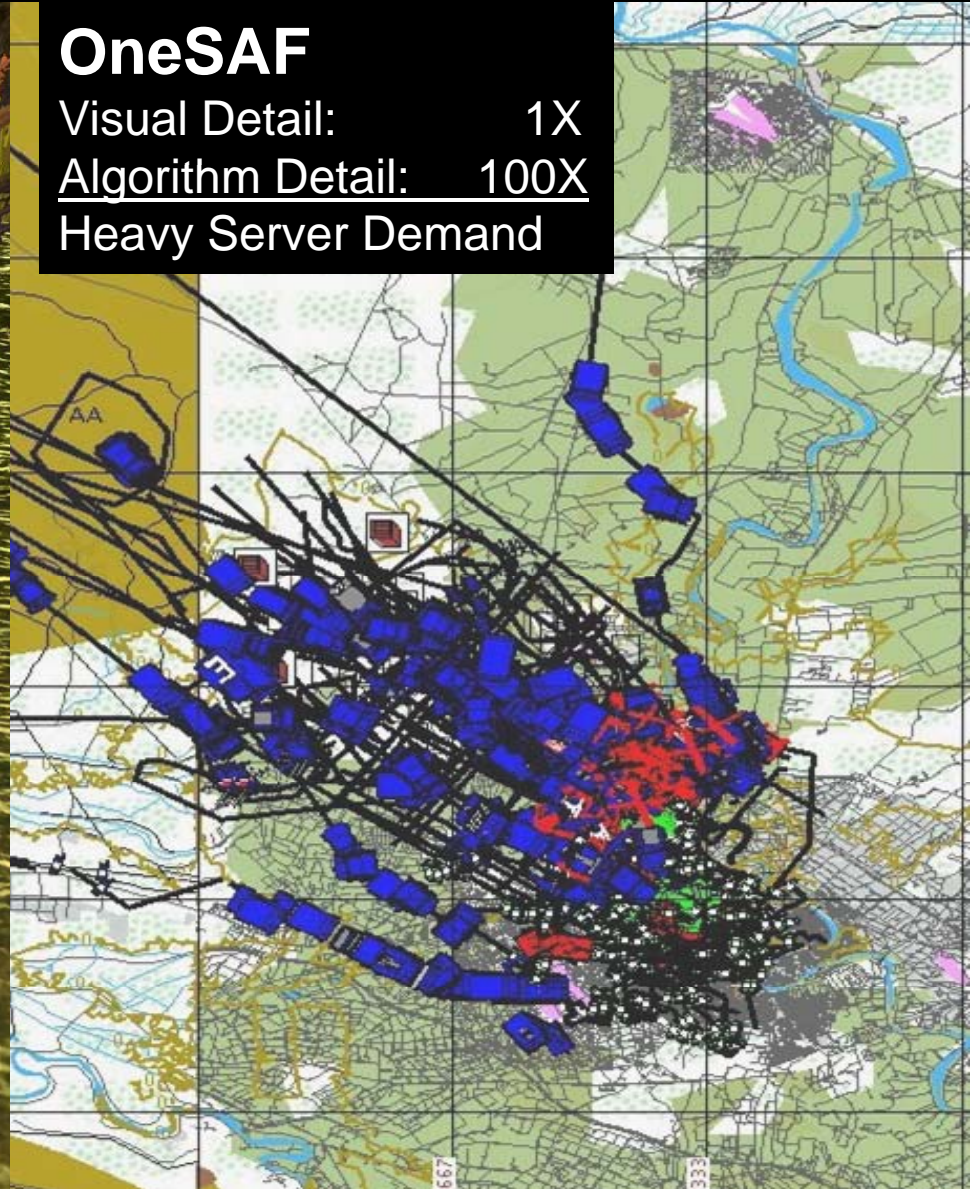


## OneSAF

Visual Detail: 1X

Algorithm Detail: 100X

Heavy Server Demand



# 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
- Physics-based objects, weather, and terrain
  - Put the “reality” in virtual reality
- Break the “one facility, one exercise” paradigm
  - Put the Sim Center in the cloud
  - Multiple simultaneous exercises supported from a single simulation center
- Reduce sim-to-sim lag
  - Host multiple sims on the same computer
- Break entity-to-processor mapping
  - Allow for high fidelity physical and cognitive models that require more than one processor to execute in real time

# Supercomputing BOF on Interactive Simulation

- 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.



# 10 Technical Challenges

<http://hpcsim.wordpress.com/>

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

# 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

Slides at:  
<http://www.peostri.army.mil/CTO>