

Virtualized High Performance Computing

Scientific and Engineering Agility

What is High Performance Computing?

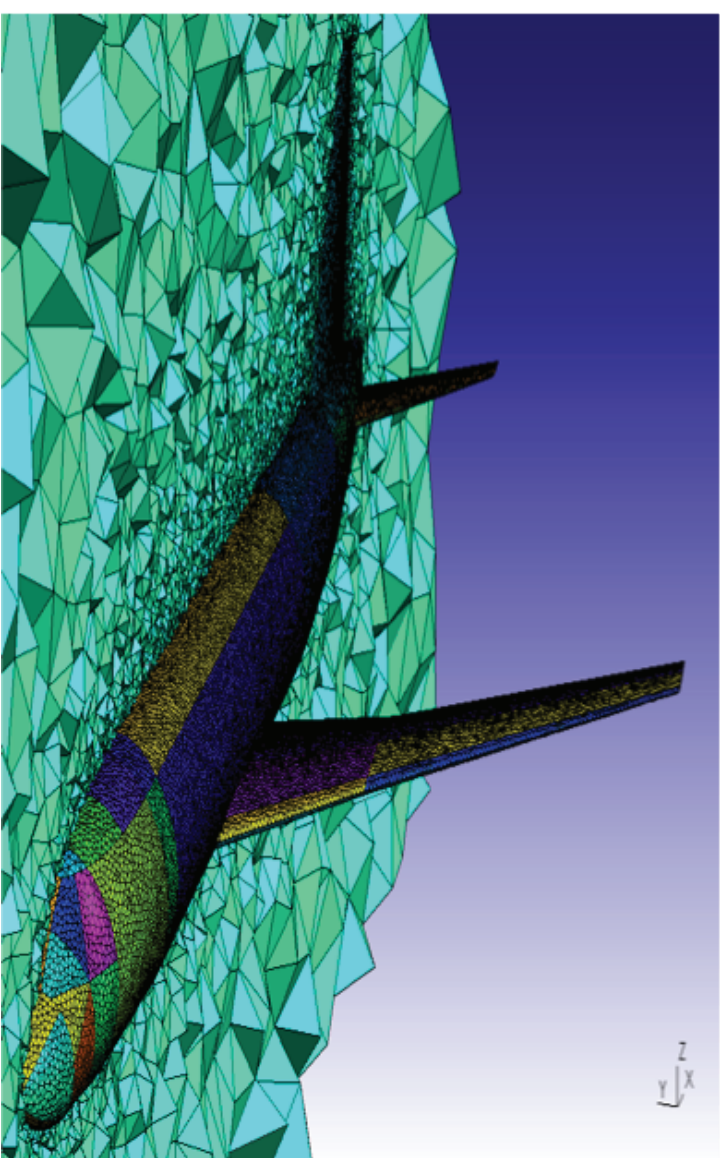
Applications & Systems

HPC applications are compute intensive, often scientific or engineering-related, often parallel, and usually involve large datasets.

Many VMware customers have HPC workloads in areas like Life Sciences, Electronic Design Automation (chip design), Computer Aided Engineering (aeronautics, automotive), Financial Services, Digital Content Creation (movie making).

HPC applications are often either throughput applications – many processes running concurrently and independently, or distributed parallel – many processes running concurrently and exchanging data repeatedly to co-operatively solve a problem too large to fit within a single host.

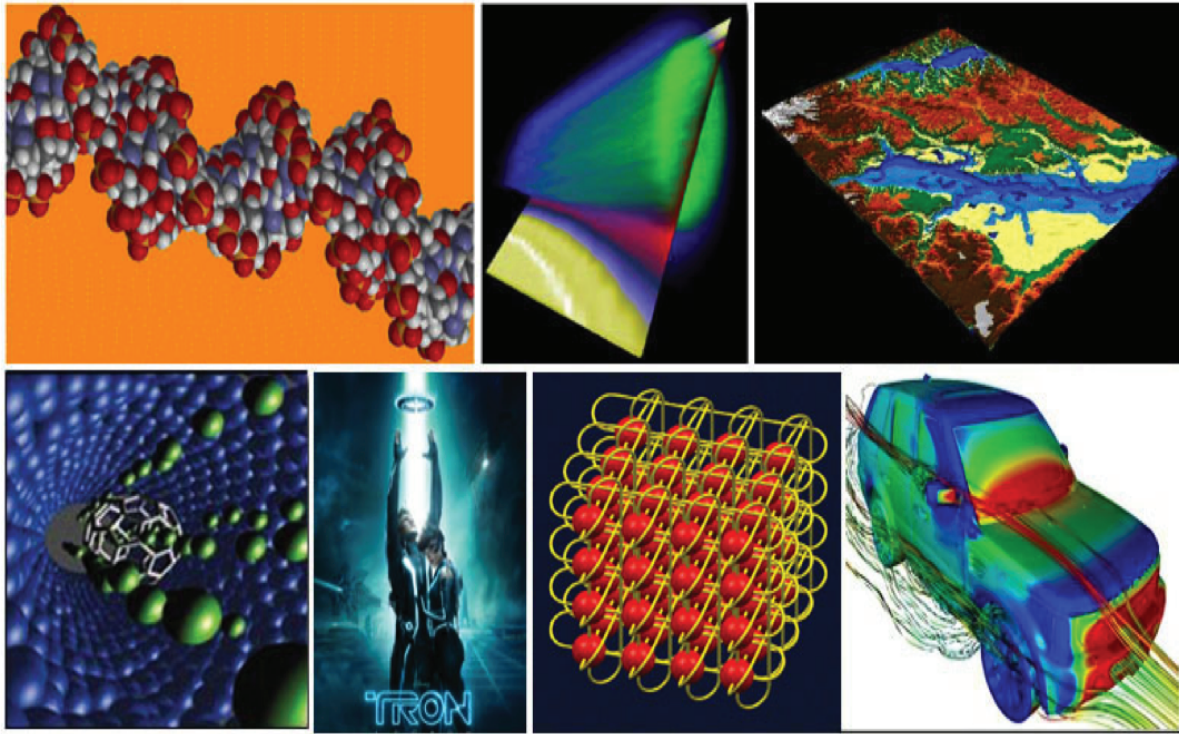
HPC systems are clusters – groups of a dozen to hundreds of thousands of hosts – that are administered and used as a single, large compute resource for running many HPC applications.



Source: geuz.org/gmsh

HPC Applications

- Science and Engineering:
 - Atmosphere, earth, environment
 - Bioscience, biotechnology, genetics
 - Physics - applied, nuclear, particle, condensed matter;
 - Electrical engineering, circuit design, microelectronics
 - Mechanical engineering - from prosthetics to spacecraft
 - ...
- Commercial:
 - Oil exploration
 - Pharmaceutical design
 - Financial and economic modeling
 - Advanced data visualization
 - ...

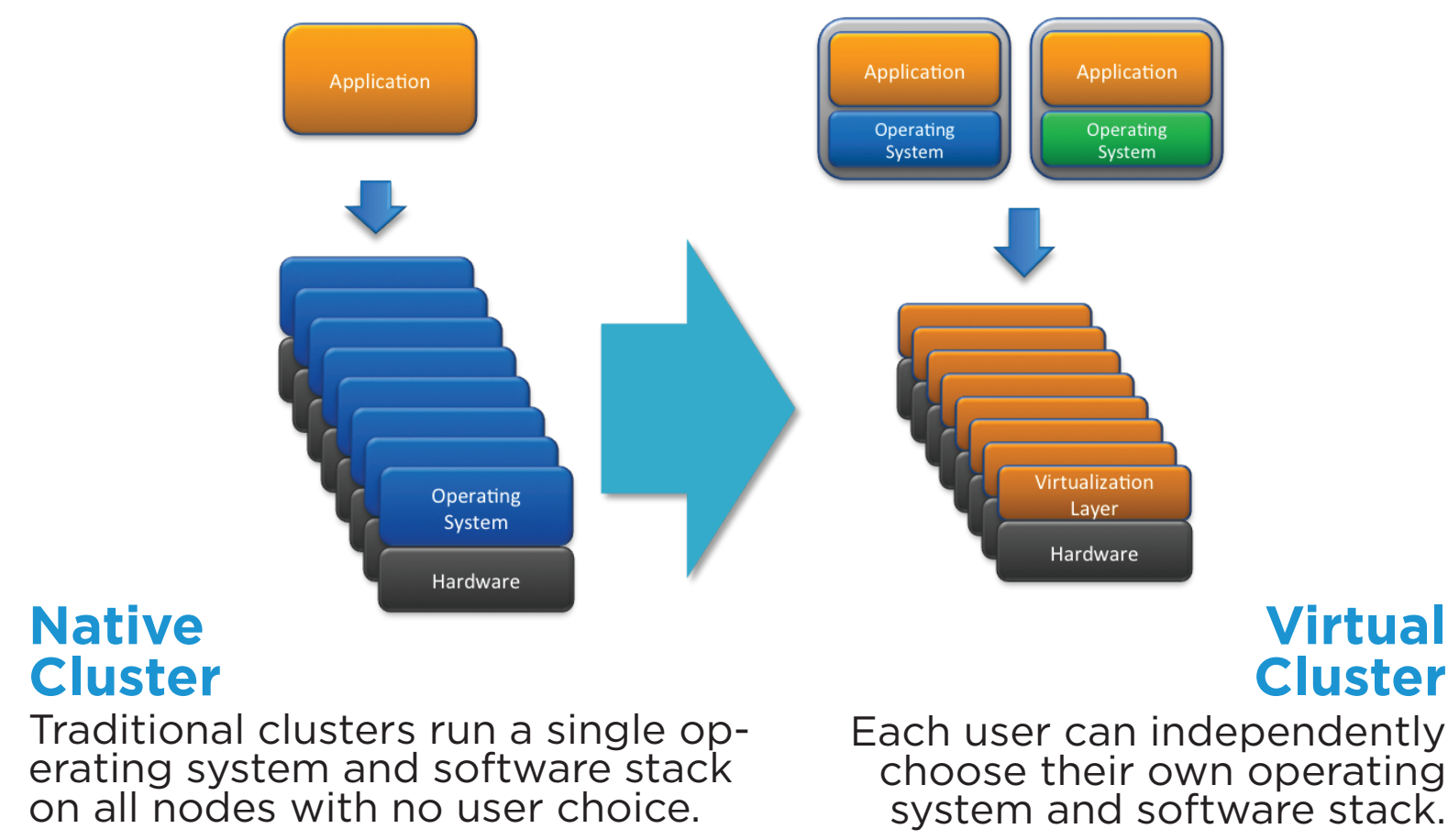


Various HPC Application Areas

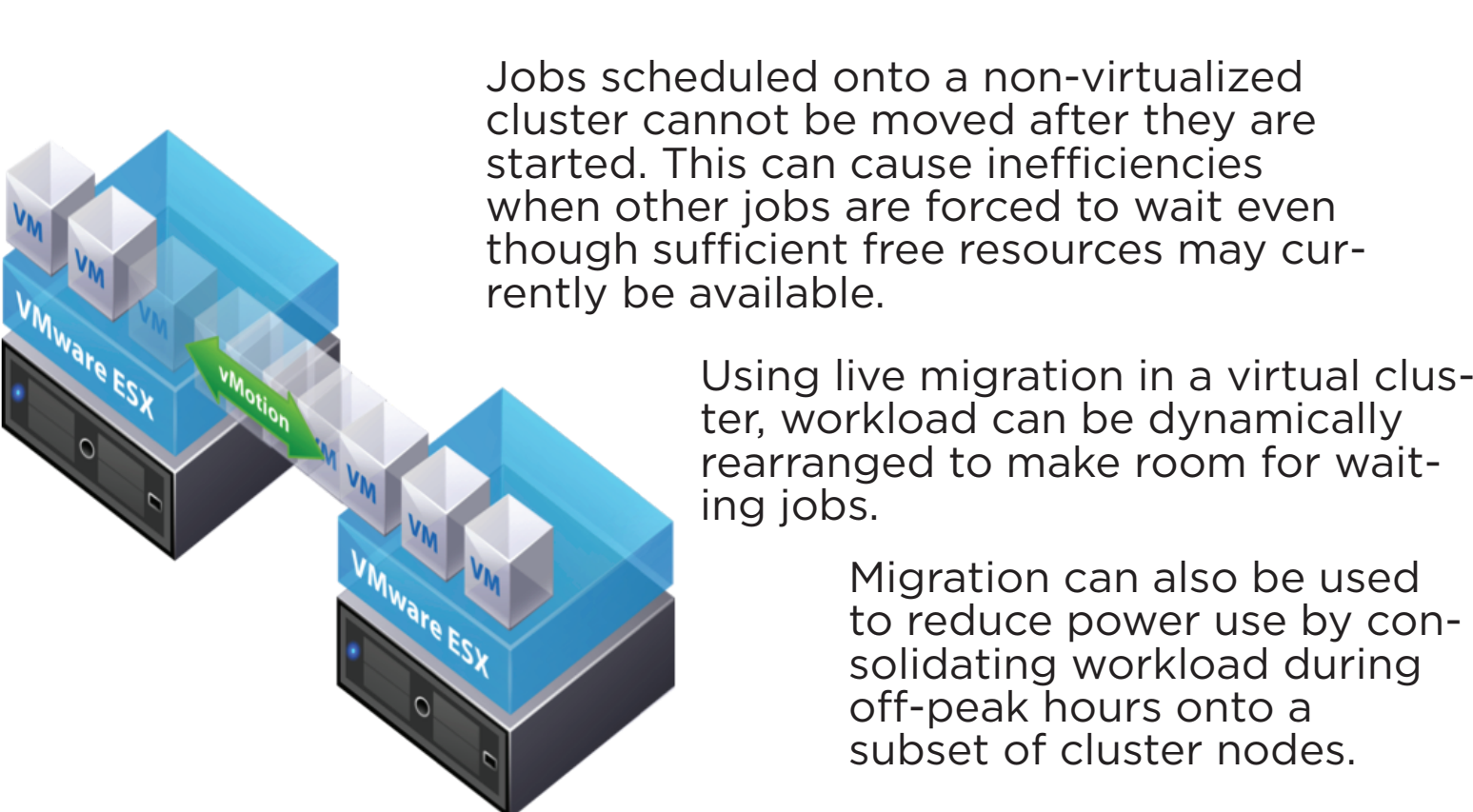
Source: https://computing.llnl.gov/tutorials/parallel_comp/ by Lawrence Livermore National Laboratory

Primary Benefits of Virtualization

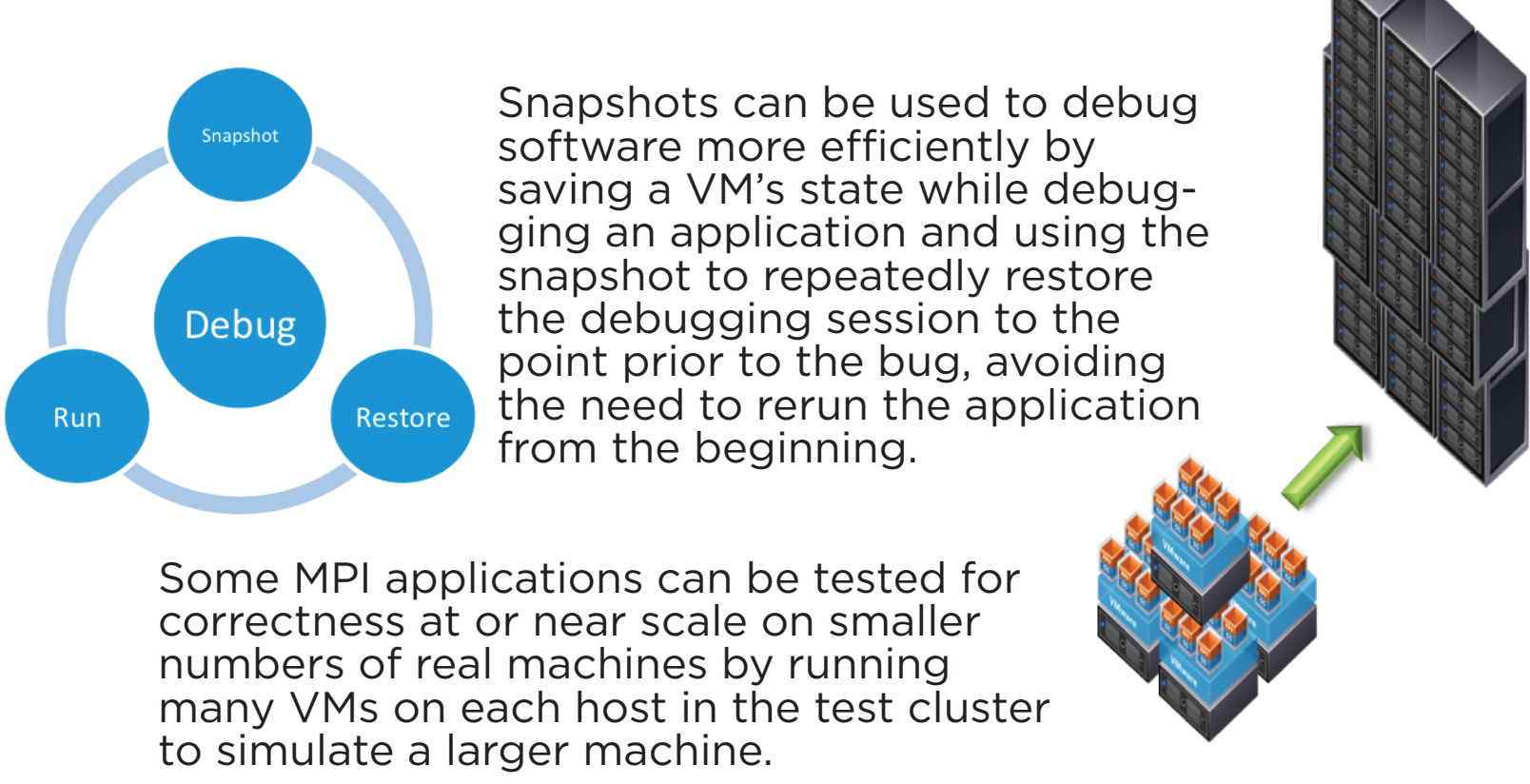
Heterogeneous Clusters



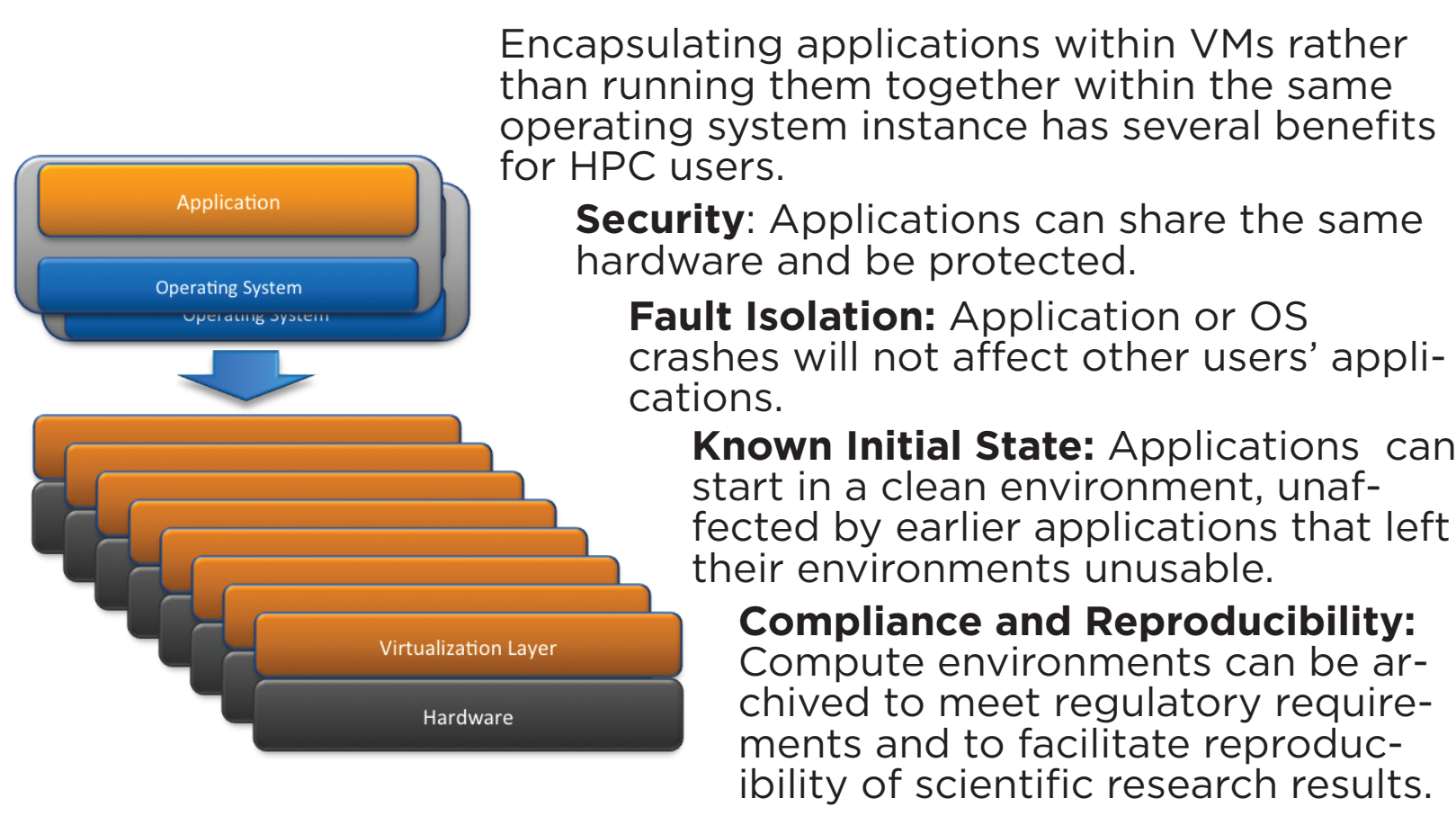
Dynamic Scheduling



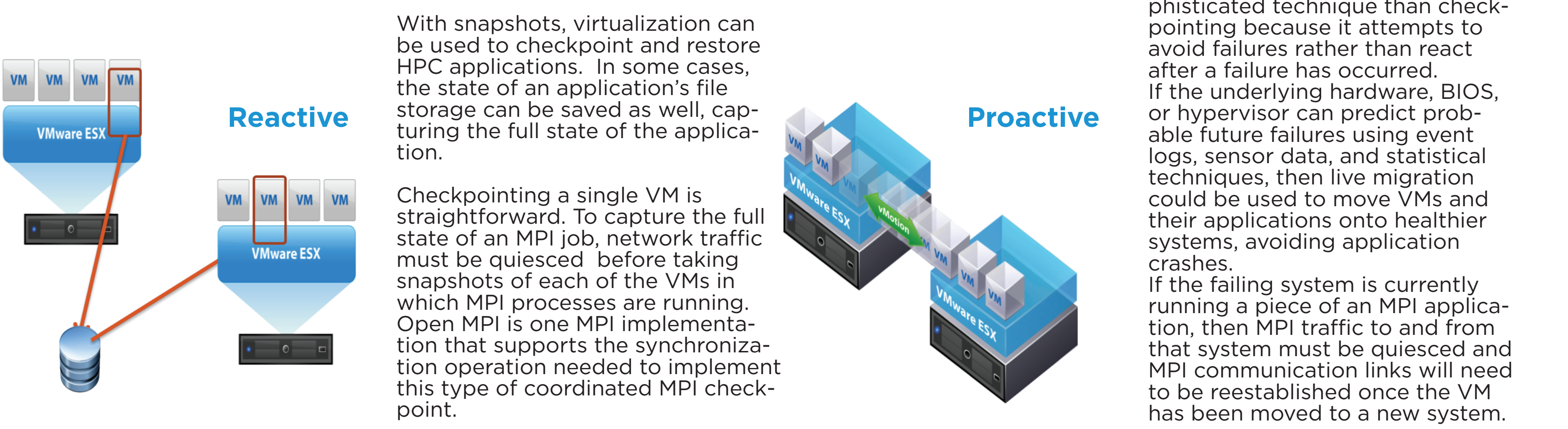
Software Development



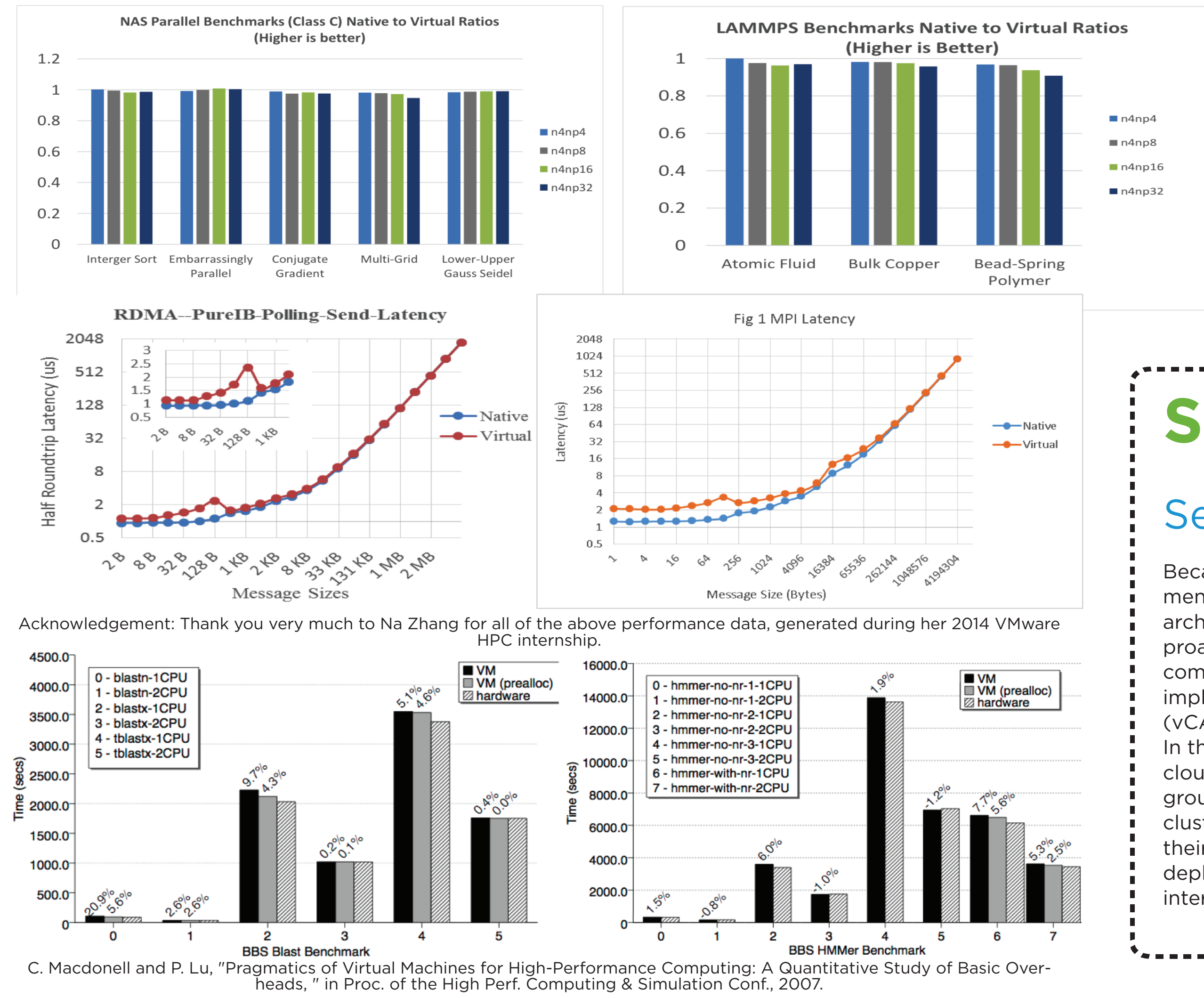
Workload Separation



Application Resilience



Performance



Acknowledgement: Thank you very much to Na Zhang for all of the above performance data, generated during her 2014 VMware HPC internship.

C. Macdonell and P. Lu, "Pragmatics of Virtual Machines for High-Performance Computing: A Quantitative Study of Basic Overheads," in Proc. of the High Perf. Computing & Simulation Conf., 2007.

Solution Architecture

Secure Private Cloud

Because HPC is a market with very broad requirements, it is not possible to create a single reference architecture that meets all needs. However, the approach shown here has proven interesting to both commercial and academic customers. It can be implemented with either vCloud Automation Center (vCAC) or with OpenStack. In this diagram, vCAC is used to create a private cloud with a self-service portal that allows research groups to "check out" a pre-configured virtual HPC cluster that has been sized to the requirements of their specific applications. This architecture has been deployed at one large customer site and we've had interest from others in this approach.

