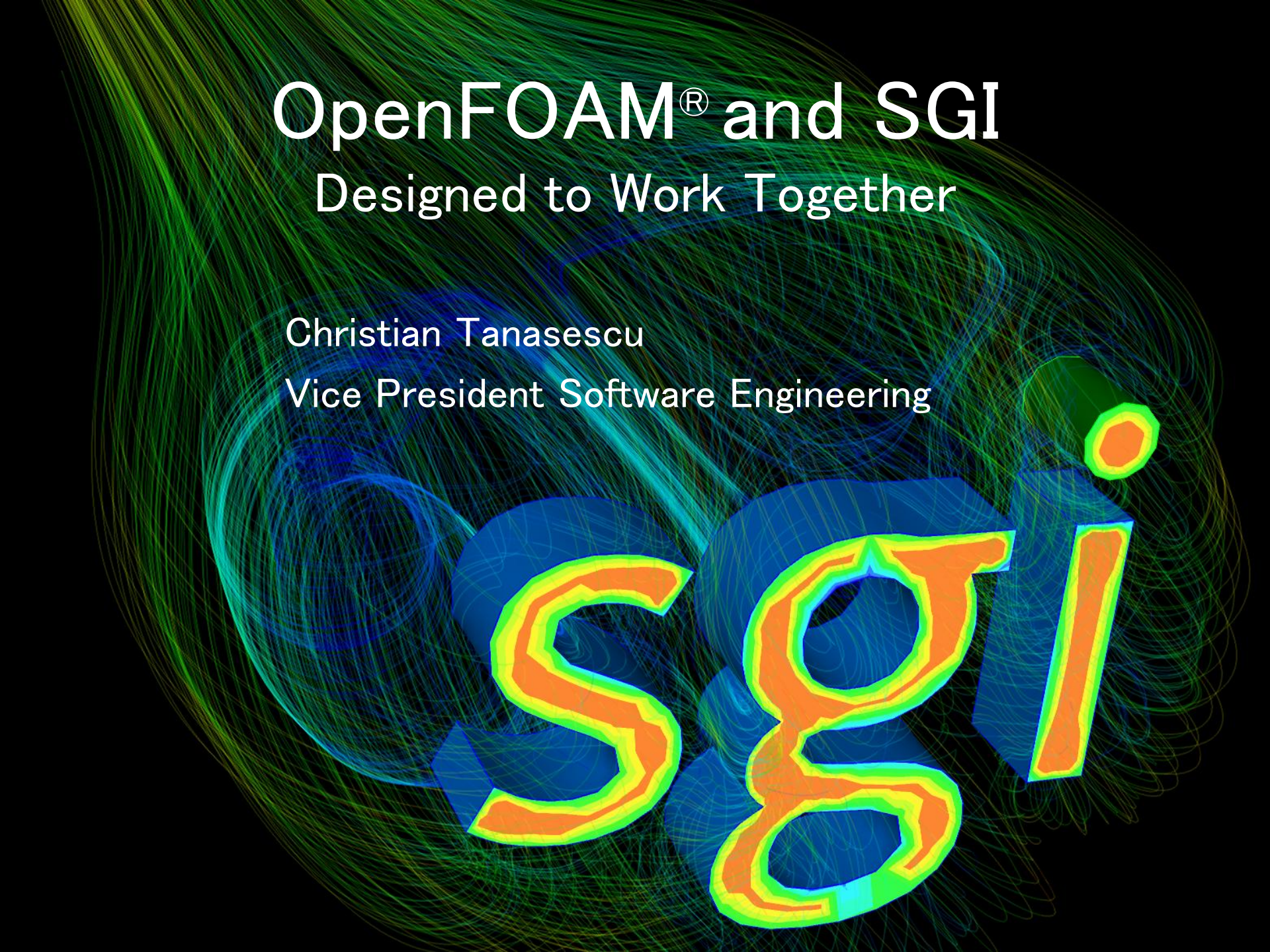
OpenFOAM® and SGI

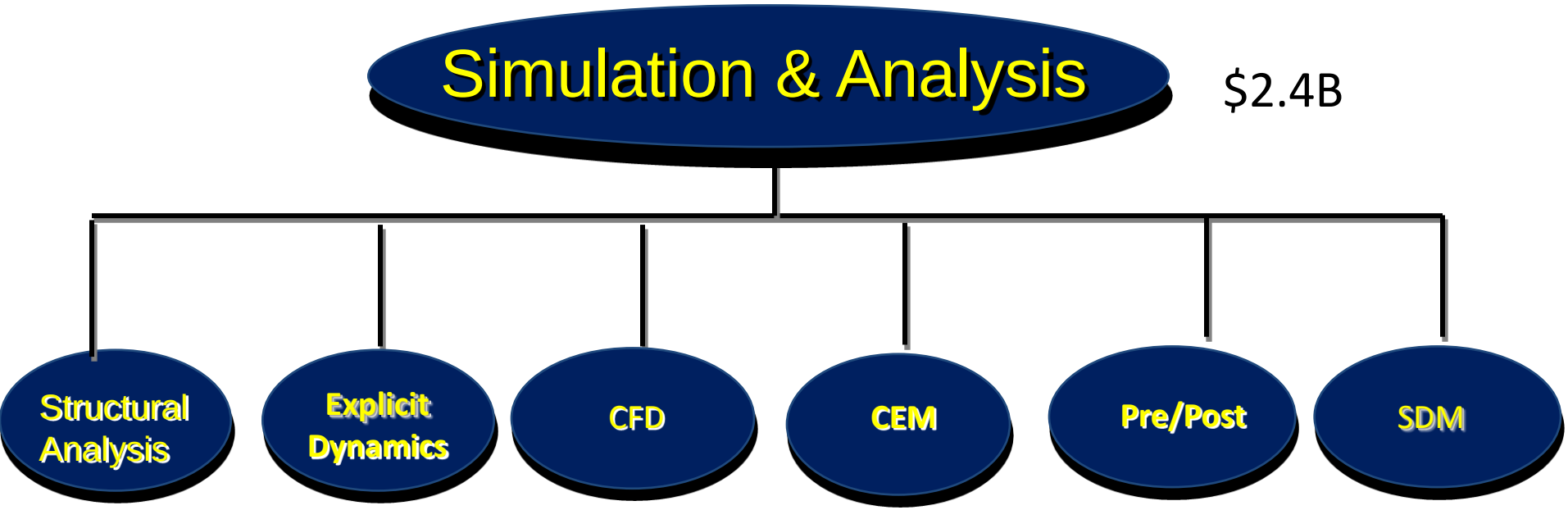
Designed to Work Together

Christian Tanasescu

Vice President Software Engineering



Simulation and Analysis Application Segments



MSC.Nastran
ANSYS
ABAQUS/Explicit
ADINA
Permas

LS-DYNA
PAM-CRASH
RADIOSS
ABAQUS/Exp
Madymo

FLUENT
StarCCM+
OpenFOAM
PowerFLOW
CFD++
Pam-Flow
CFD-ACE

FEKO
HMSS
ANSOFT
FMSlib
CST

ANSA
Hypermesh
Gambit
Patran

Hyperworks
ANSYS EKM
SimManager
ABAQUS/CAE

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SGI History with Open Source Communities

HPC Applications– OpenFOAM

Development Tools– Open64, Open SpeedShop, PCP

Run Time Libs– OpenSHMEM

Graphics– OpenGL® Performer, OpenGL, Open Inventor™

File System and Storage– Linux® FailSafe™, XFS™

Linux® Kernel– CPUsets,, Kernprof, NUMA

What SGI Announced

- SGI Corp. announced the acquisition of OpenCFD® Ltd.
- The entire OpenCFD team joined SGI as fulltime employees
- SGI has formed a non-profit foundation to make OpenFOAM® accessible to everyone globally and allow for community contributions
- The OpenFOAM foundation will have 9 Board of Directors, 4 SGI Directors and 5 Independent Directors
- SGI acquired the copyright of the OpenFOAM source code and contributed its ownership to the non-profit OpenFOAM foundation
- OpenFOAM is the leading Open Source CFD solution and 2nd most used CFD solver

What Others Are Saying

"… the acquisition of OpenCFD by SGI and the formation of the OpenFOAM Foundation will provide the long-term stability, resources and structure for the continued success of OpenFOAM …"

Rob Lewis, TotalSim – OpenCFD customer

"In terms of cost, OpenFOAM dramatically lowers the barrier of entry to world class CFD software … SGI now has the potential to significantly expand the CFD marketplace, not only to existing users, but to new users. This is truly an exciting development."

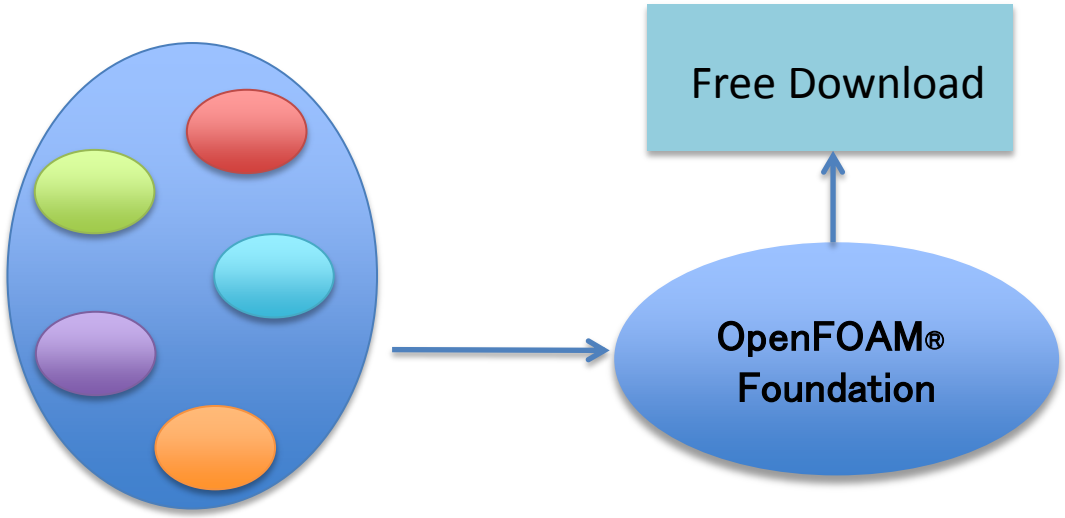
John O. Hallquist , Livermore Software Technology Corporation – ISV

"OpenFOAM has built a strong following as an open source CFD solution. SGI aims to give the free, open source version a permanent home where it can flourish, while adding a fee-based version with even fuller features and tighter integration with SGI offerings. This would be a win-win."

Steve Conway, IDC – Industry Analyst

A Bright Future for OpenFOAM®

- OpenFOAM will continue to be open and free!
- SGI is fully committed to continued development of OpenFOAM under the GNU Public License (GPL).
- OpenFOAM will continue to be customizable with full code transparency
- **We would like to hear from you on how best to support your needs.**



Open Source Projects
Develop, Contribute

Foundation
Review, Adopt,
Integrate, Release

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Why OpenFOAM?

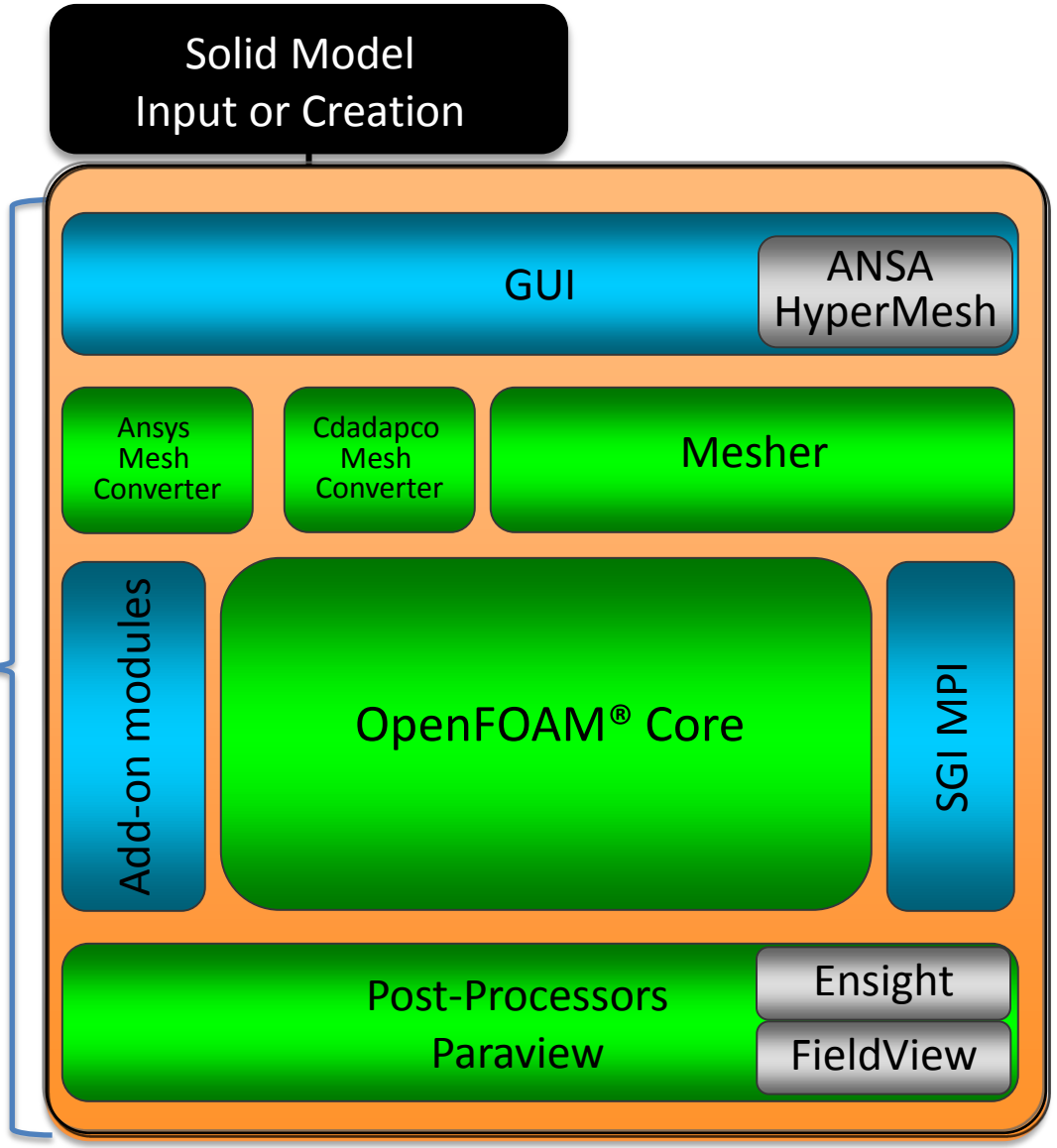
OpenFOAM moves beyond the traditional approach to CFD with rigid legacy frameworks to realize the following benefits:

- It is accessible
- It is transparent
- It is customizable
- It is extensible
- SGI makes it production ready

SGI OpenFOAM Package

- Low cost
- User friendly
- Integrated environment
- Fully user customization
- SGI direct support
- Tools designed to work together
- Highest scalability

Unified Software Environment



OpenFOAM Foundation

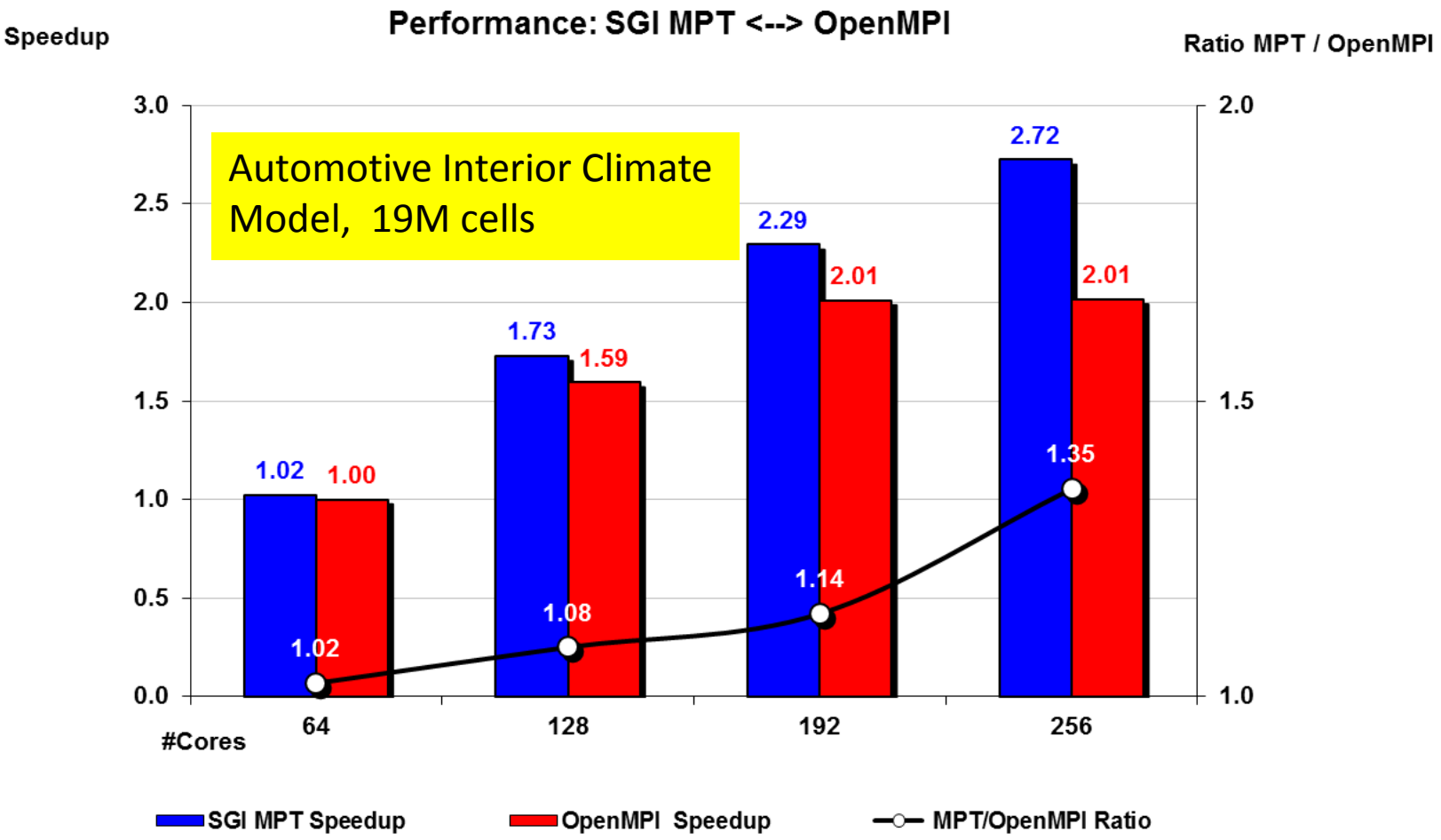
SGI Package specific

3rd Party

SGI OpenFOAM® Package
Value-add features

Features	OpenFoam Source Distribution	SGI Distribution	Result/Benefit w/ SGI Distribution
MPI	OpenMPI	SGI MPI	1. Highest scalability up to 100,000 cores 2. Optimized collectives (all-reduce is dominant in OF) 3. Fast start-up on large IB-based systems
Compiler	GCC	(soon) Intel	1. Better performance
Run-Time Core Placement	N/A	MPInside + MPIPlace	1. Optimize mapping of MPI threads on cores 2. CB3 topology aware tool to minimize communication overhead
Checkpoint Restart	apps-driven	SGI CPR and apps-driven	1. Protects against loosing compute cycles in case of system failures 2. Stop-Resume function accelerates execution by restarting on more cores
Dual Rail	N/A	SGI MPI	1. Improved job resiliency 2. Connection restarts when IB links are lost
Hybrid Execution	N/A	SGI MPI w/ OpenMP	1. Better use of multi-core processors 2. Reduce IB fabric communication overhead, hence, improving performance
SNB optimization	GCC	Intel Compiler w/ AVX	1. Better performance with SNB

OpenFOAM® 1.7.x Performance with SGI MPI



OpenFOAM with SGI MPI with up to 35% better performance

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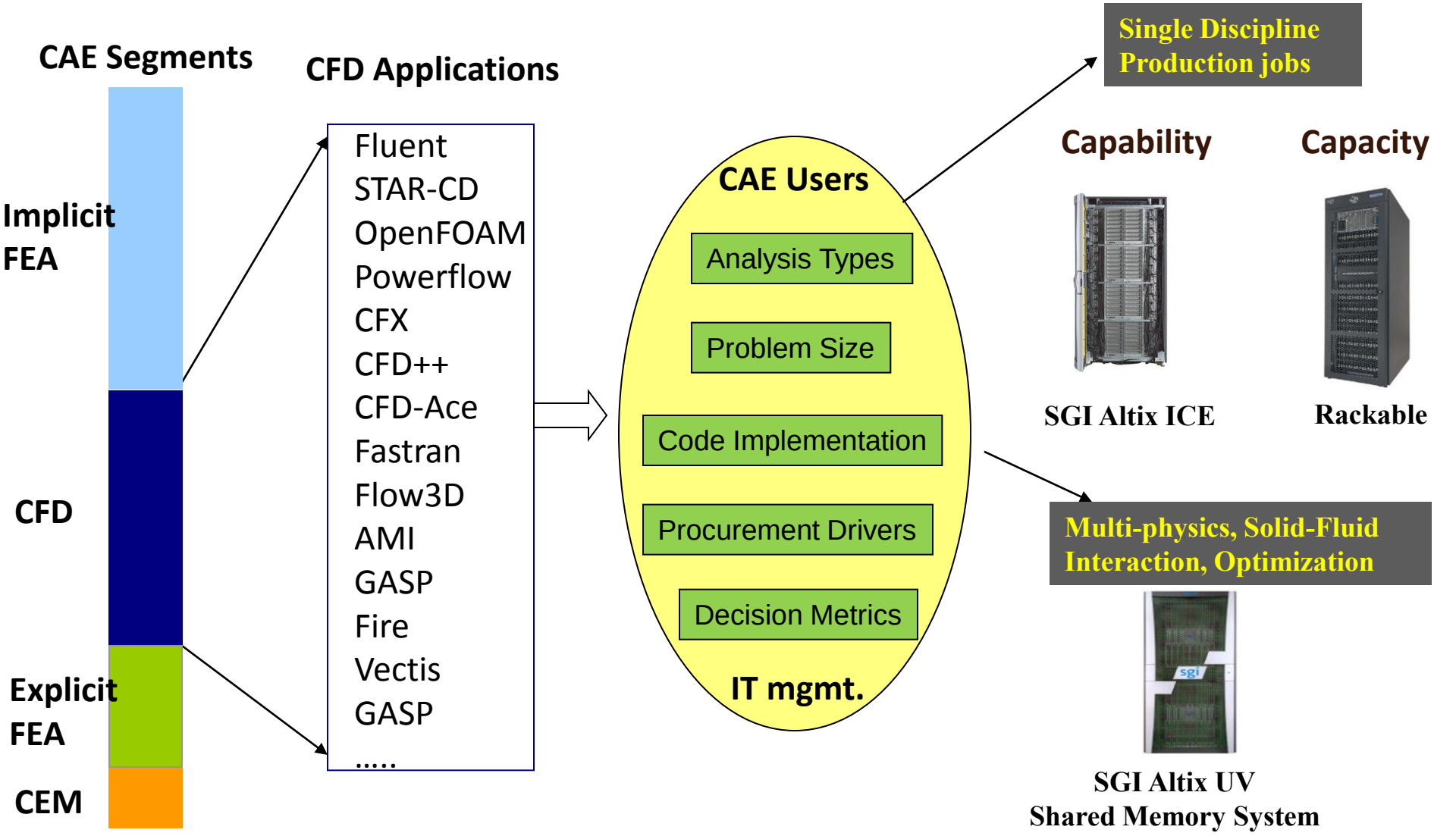
OpenFOAM® Release planning

- OpenFOAM Foundation
  - 1 or 2 version releases per year
  - Download source code from sourceforge.org, rpm for Ubuntu and OpenSUSE
- SGI OpenFOAM Package
  - quarterly releases (at the beginning, then TBD)
  - Packaged distribution, pre-installed, DVD and Supportfolio
- New features available immediately in SGI OpenFOAM Package
  - Patches and/or Maintenance Updates
  - Released in OpenFOAM Foundation as per schedule

SGI's Value Add for OpenFOAM®

- The SGI OpenFOAM Package provides a stable release train with additional features and capabilities.
- Beyond OpenFOAM Foundation source code it includes:
  - OpenFOAM packaged as RPMs, tested and ready to run
  - SGI MPI runtime library for best performance
  - Updated regularly including both feature additions and bugfixes
  - Qualification and addition of new OpenFOAM Foundation capabilities
  - Training and professional services for SGI and other environments
  - Available pay-as-you-go model via our HPC cloud offering- SGI Cyclone™
- Additional complimentary, value added components are planned in follow on releases of the SGI OpenFOAM package.

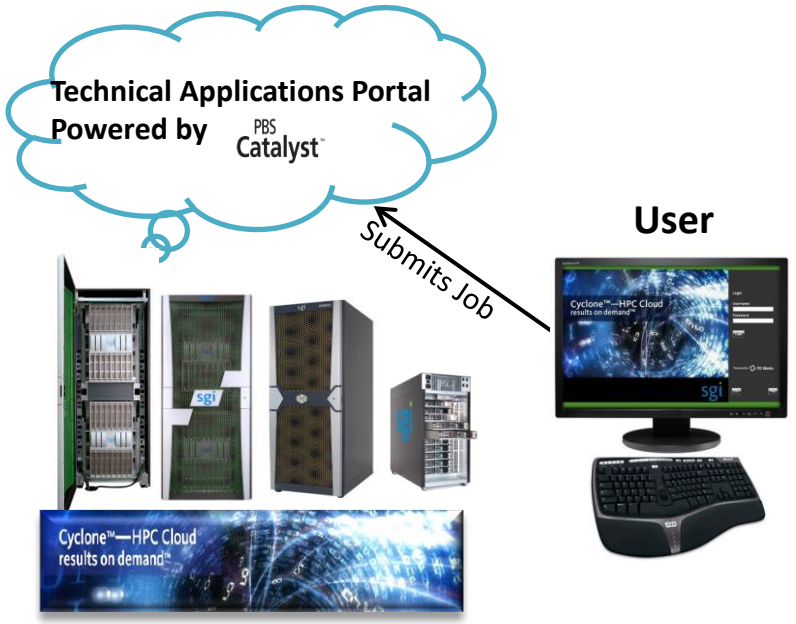
Typical CFD Workflow and Solution Choices



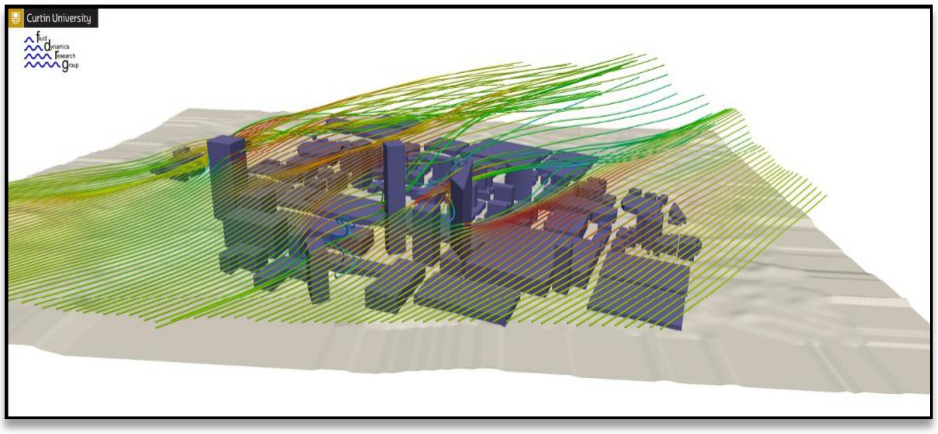
OpenFOAM® on SGI Cyclone™

Infrastructure as a Service (IaaS)	Software as a Service (SaaS)
▪ Customer downloads and installs ▪ Support is available from the community ▪ Customer pays for hardware core hours at negotiated rate	▪ SGI loads and tests SGI OpenFOAM Package and assists customer with initial setup ▪ Startup fee per project ▪ Service included ▪ Customer pays for hardware core hours at negotiated rate

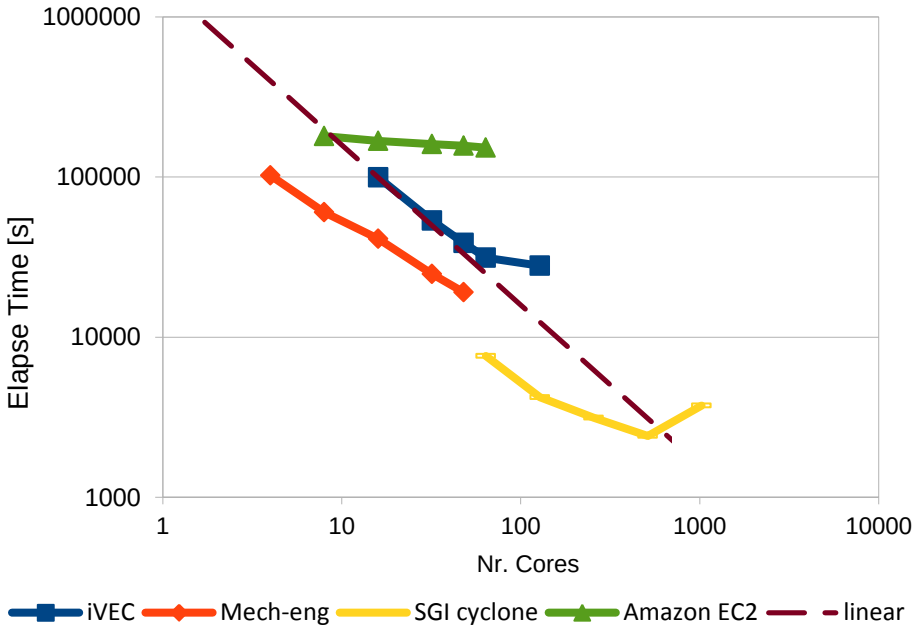
SGI OpenFOAM® Ready for Cyclone



- **Customer :** iVEC and Curtin University Australia
- **Problem:** Solving large scale CFD problems like simulating wind flows in the capital city of Perth.
- **Solution:** OpenFOAM scaled on SGI Cyclone better (1024 cores) and was 20x faster than on Amazon EC2.



Source: Dr Andrew King, Department of Mechanical Engineering Curtin, University of Technology, Australia



SGI OpenFOAM® in Summary

- Performance Optimized
- Production Ready
- Ease-of-use
- Proven domain expertise
- TCO Savings

TECHNICAL COMPUTING

HARDWARE. SOFTWARE. SERVICES.

DESIGNED TO WORK TOGETHER