IXPUG
INTEL EXTREME PERFORMANCE USERS GROUP

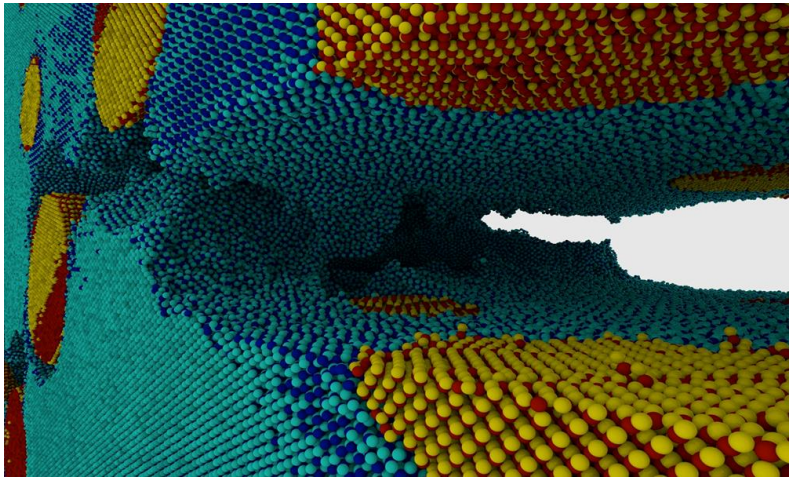
Updates on Software Defined Visualization

Johannes Günther, Senior Graphics Software Engineer

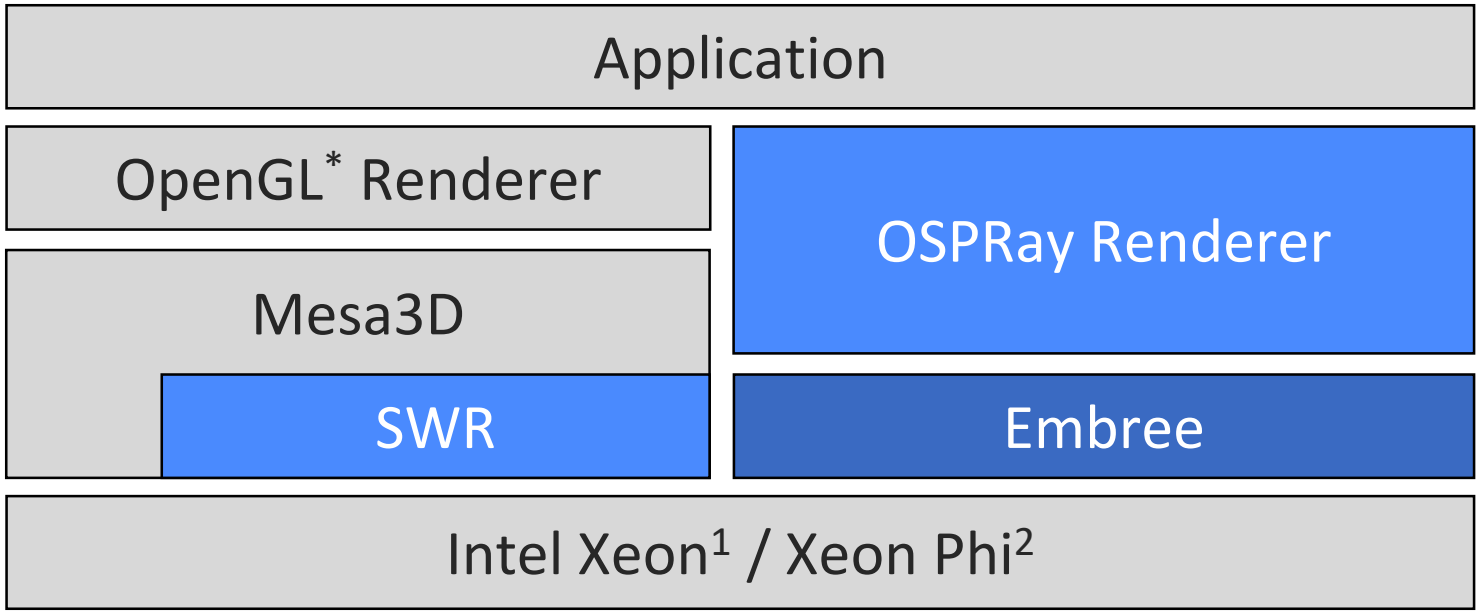
Intel DCG E&G Software and Ecosystem Development

Why Visualization?

- Analysis & Understanding
  - ➔ scale to
    - large data
    - low latency
- Communication
  - ➔ high quality renderings



Software Defined Visualization



[1] Intel® Xeon® processor, [2] Intel® Xeon Phi™ processor

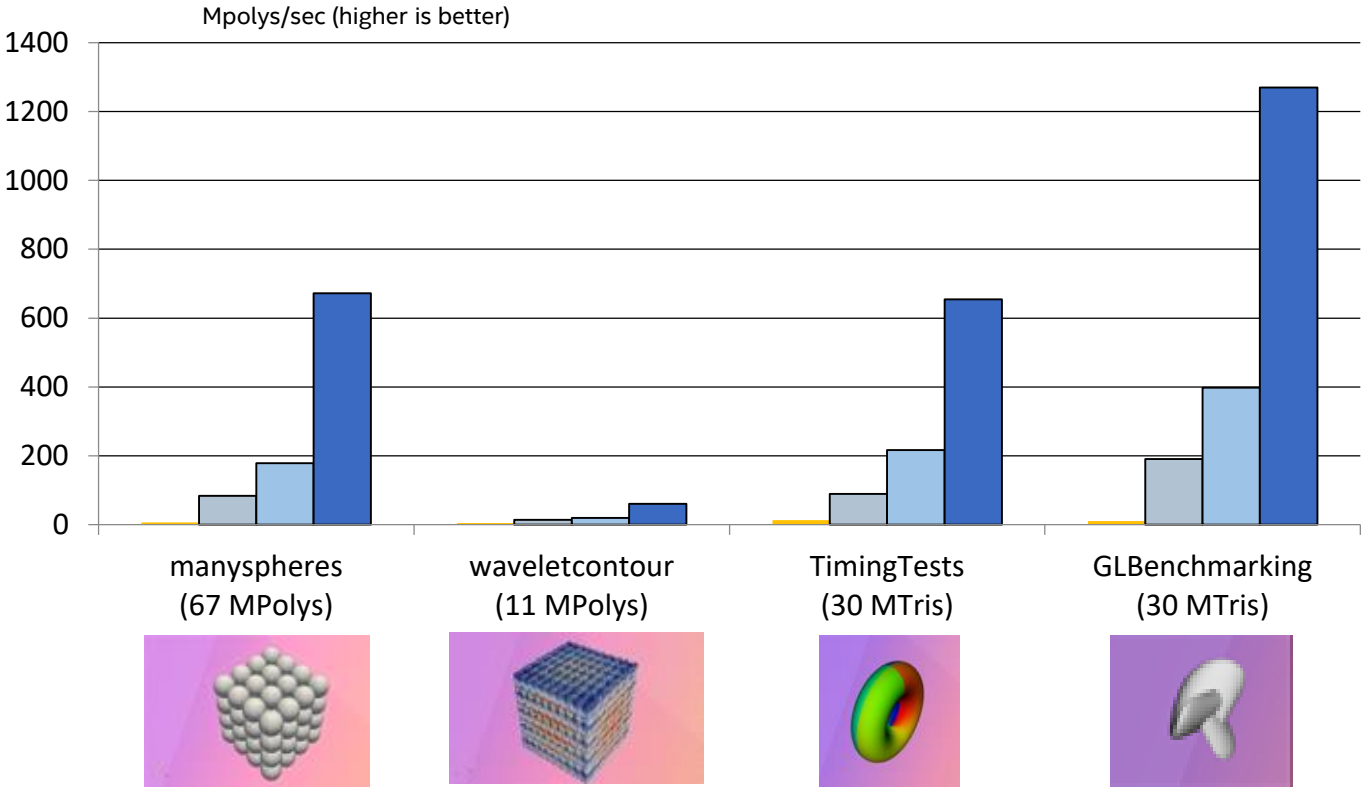
IXPUG
INTEL EXTREME PERFORMANCE USERS GROUP

SWR
Software Rasterizer

SWR Update

- Fully integrated into Mesa Open Source Project
  - Use SWR driver with `GALLIUM_DRV=swr`
- Maturity: 100% pass rate for VTK tests
- Support MSAA (Multi-Sample Anti-Aliasing)
- Continued performance improvements
  - Support for AVX-512

SWR Performance



- Intel® Xeon® Platinum 8180 Processor llvmpipe
- Intel® Xeon Phi™ 7210 Processor SWR Mesa 17.1
- Intel® Xeon Phi™ 7210 Processor SWR Mesa 18.0
- Intel® Xeon® Platinum 8180 Processor SWR Mesa 18.0

Source: Intel

SWR Upcoming

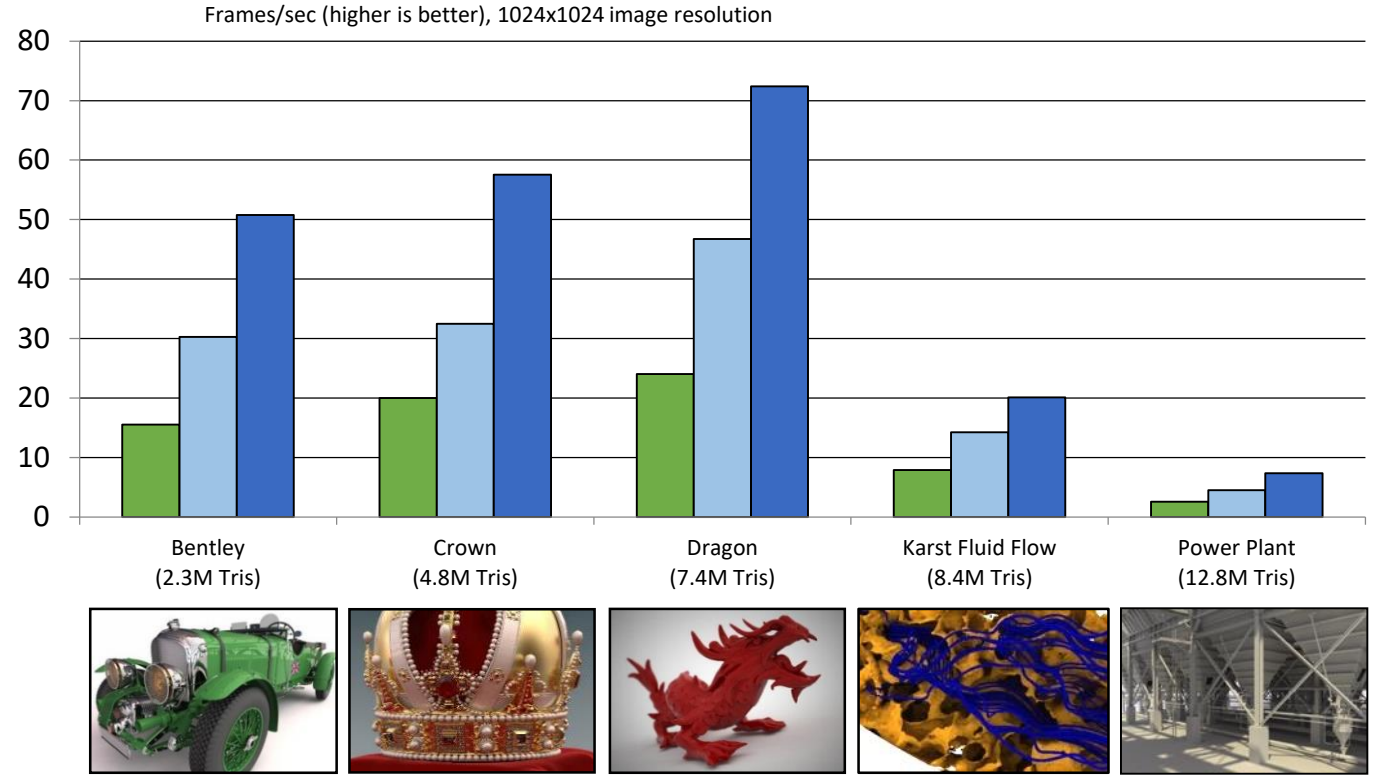
- Mesa v18.0 release imminent
- Finish AVX-512 optimizations
- Support OpenGL* 3.3
- Ongoing maintenance and new processor support

Embree
Ray Tracing Kernels

Embree Update

- v3.0
  - Streamlined API
  - Better instancing
- Bézier & B-spline curves / hair
- Memory usage down 50% (compact mode)
- Performance
  - Ray streams about 30% / 70%
  - Ray packets up to 25% / 50%
  - BVH build up to 10% (hair 2x)

Embree Performance



- NVIDIA Tesla P100 Coprocessor PCIe, 16 GB RAM
- Intel® Xeon Phi™ 7250 Processor 68 cores, 1.4 GHz
- Intel® Xeon® Platinum 8180 Processor 2 x 28 cores, 2.5 GHz

Embree 2.16.1, Intel® C++ Compiler 17.0.2, Intel® SPMD Program Compiler (Intel® ISPC) 1.9.1

NVIDIA* OptiX* 4.0.2, CUDA* 8.0.44

Source: Intel

Different Code Paths SKX vs. KNL

- Both AVX-512
  - But different subsets
  - …and different micro-architecture / implementation

- Different memory subsystems (does not matter much)

SKX vs. KNL, Areas

- Prefetching
- Mixed-width vector ops (4-wide/8-wide)
  - AVX-512VL instead of masked AVX-512F
- Much more 8-wide (because of AVX-512 frequency drop)
- min/max

Embree Upcoming

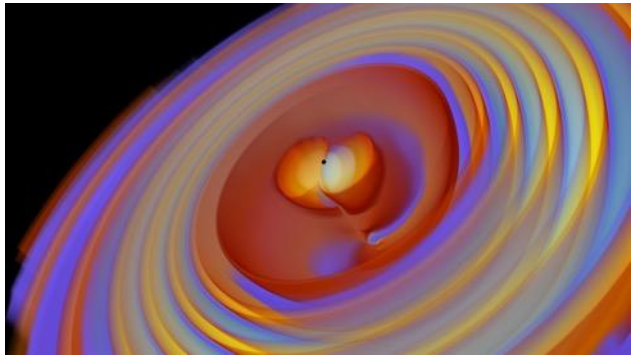
- Continued optimization
  - performance
  - memory consumption
- New geometry primitives
- Denoiser

IXPUG
INTEL EXTREME PERFORMANCE USERS GROUP

OSPRay
Ray Tracing Based Rendering Engine

Unstructured Volume Data Types

Unstructured tetrahedral and hexahedral meshes



"Colliding Black Holes" courtesy Juha Jaikka and Paul Shellard, The Stephen Hawking Centre for Computational Cosmology

Adaptive Mesh Refinement (AMR)

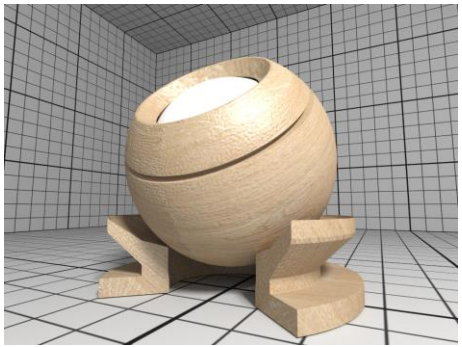
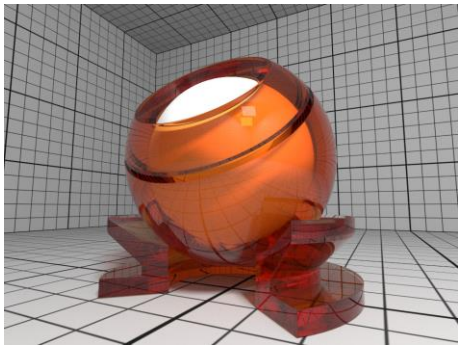
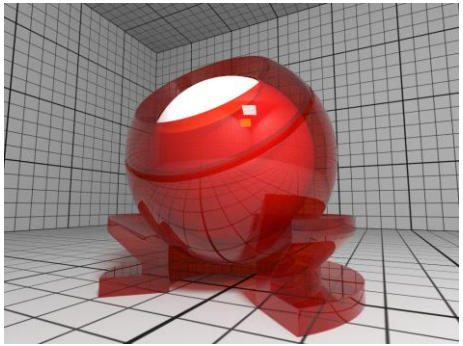
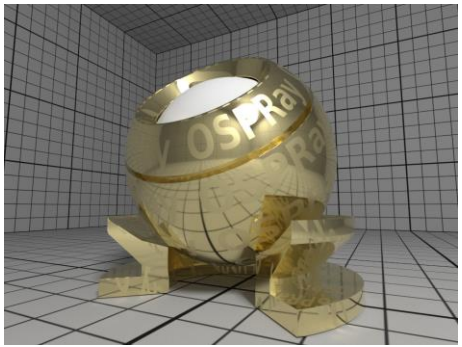
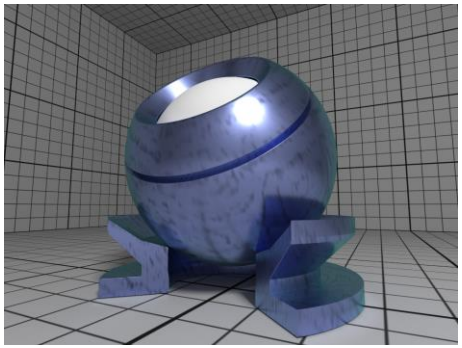
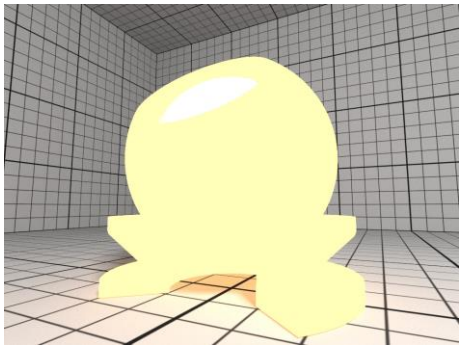
"Landing Gear" data courtesy Pat Moran, Cetin Kiris, Mike Barad, Tim Sandstrom, and many others, NASA AMES

Streamlines with Smoothing, per-vertex Radii

Photo-realistic Path Tracer

Available in upcoming ParaView v5.5!

New Materials (Path Tracer)

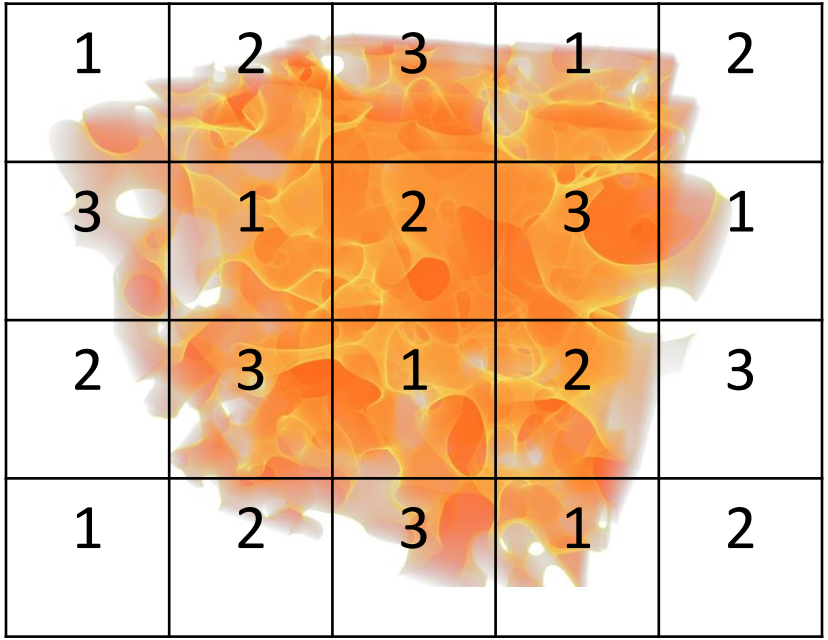
New Principled Material (Path Tracer)

- Generic & flexible Uber material
- Based on Disney's Principled BSDF

- SC'17 demo: The new Bentley* Continental GT
- Rendered @ 60-100 fps
- Multiple nodes of Intel Xeon Platinum 8160 processors

Load Balancing (MPI)

- Image split into tiles
- Previously: static mapping tile → node/rank (round robin)
- But: some tiles cheaper to compute (esp. path tracing)

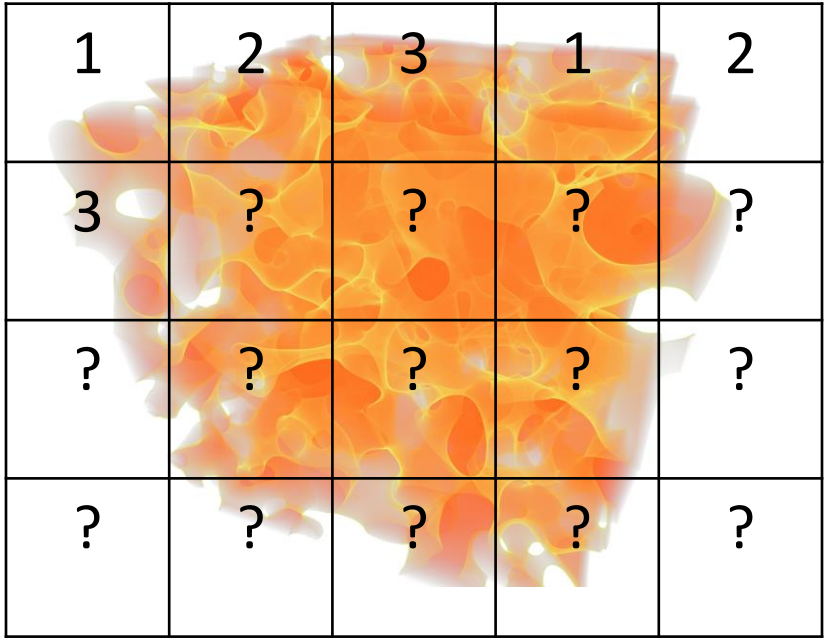


Dynamic Load Balancing

- Now: rank 0 tracks finished tiles, other ranks ask for next tile
- Hide fabric latencies by prefetching tiles (multiple in flight)

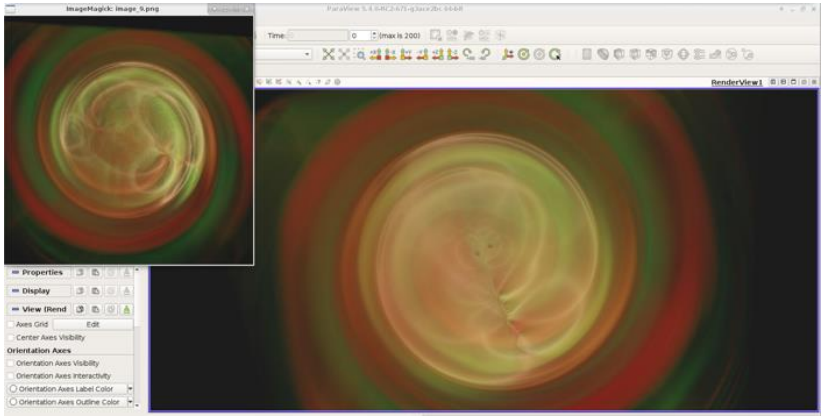
➔ Better scalability

2x-3x higher performance



MPI distributed device

- First support for in-situ, data-parallel cluster applications



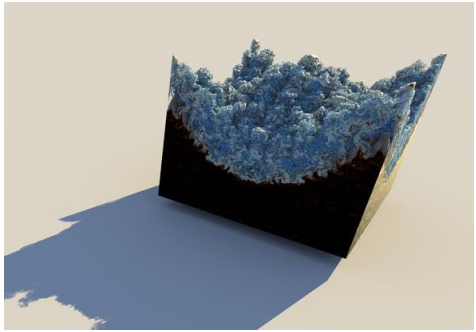
OSPRay Upcoming

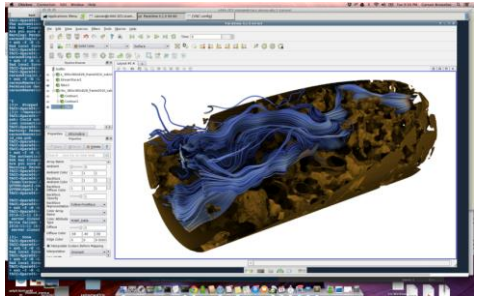
- Volume rendering also in path tracer
- Optimize data-parallel rendering
- Re-architecture for streaming computations
  - Better SIMD efficiency
  - Pure C++, drop ISPC

Wrap Up

Summary

- Software Defined Visualization
  - High(er) fidelity images
  - High(er) performance for interactive vis
- Take advantage
  - Directly → www.SDVis.org
  - Using Vis tools: ParaView*, VisIt, VMD*, …
- Collaboration, feature requests





IXPUG
INTEL EXTREME PERFORMANCE USERS GROUP

Thank You

Legal Notices and Disclaimers

- Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Learn more at intel.com, or from the OEM or retailer.
- No computer system can be absolutely secure.
- Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit **http://www.intel.com/performance**.
- Cost reduction scenarios described are intended as examples of how a given Intel- based product, in the specified circumstances and configurations, may affect future costs and provide cost savings. Circumstances will vary. Intel does not guarantee any costs or cost reduction.
- No license (express or implied, by estoppel or otherwise) to any intellectual property rights is granted by this document.
- Intel, the Intel logo and others are trademarks of Intel Corporation in the U.S. and/or other countries.
- *Other names and brands may be claimed as the property of others.
-