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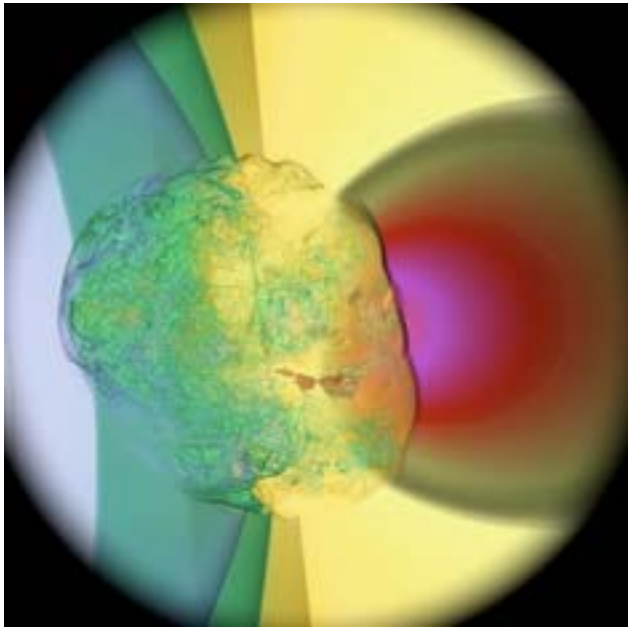
Massively Parallel Visualization on Leadership Computing Resources



Core-collapse supernova X component of velocity

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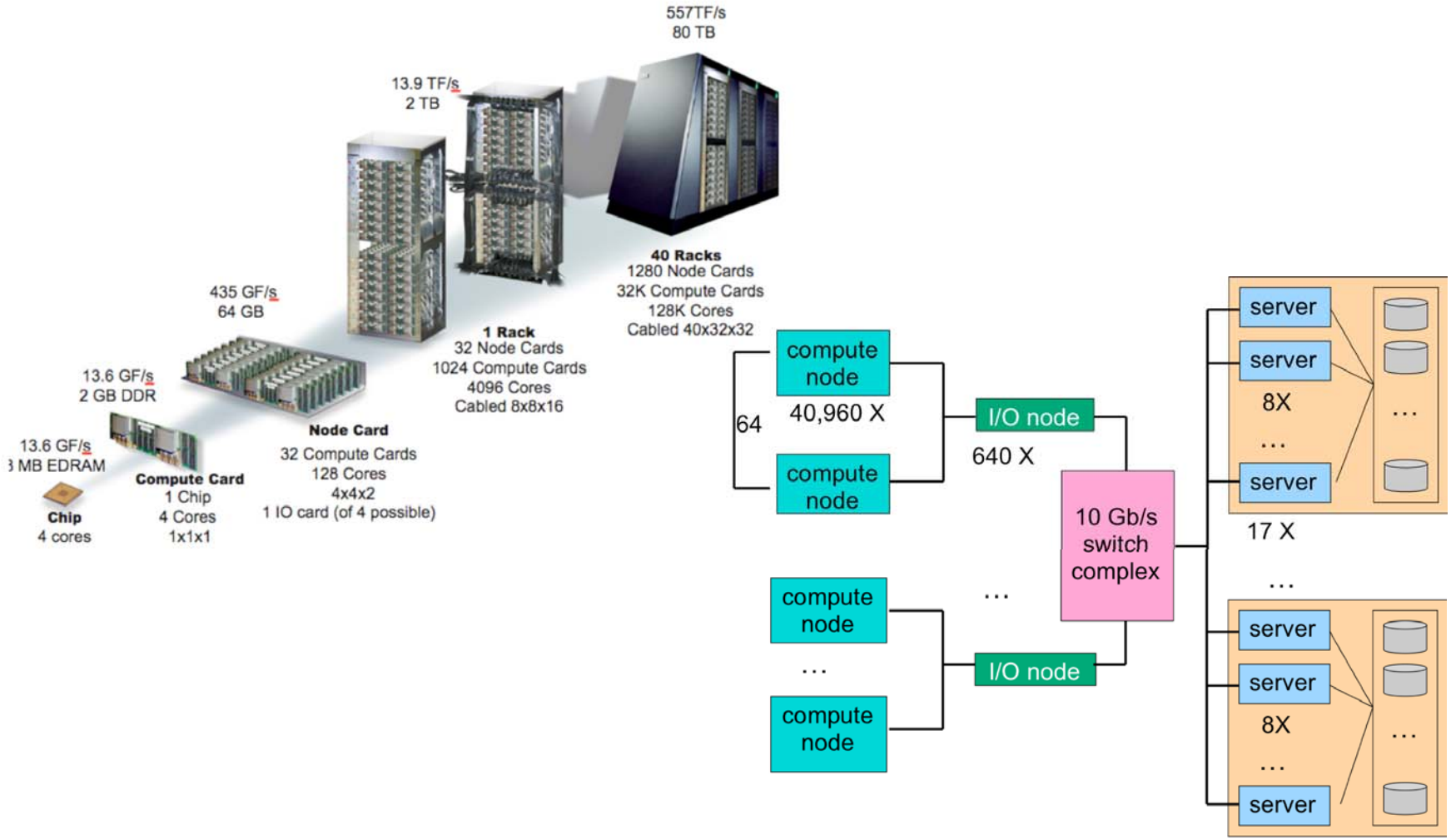
Mathematics and Computer Science Division

Leadership Resources

storage, not computation, limited



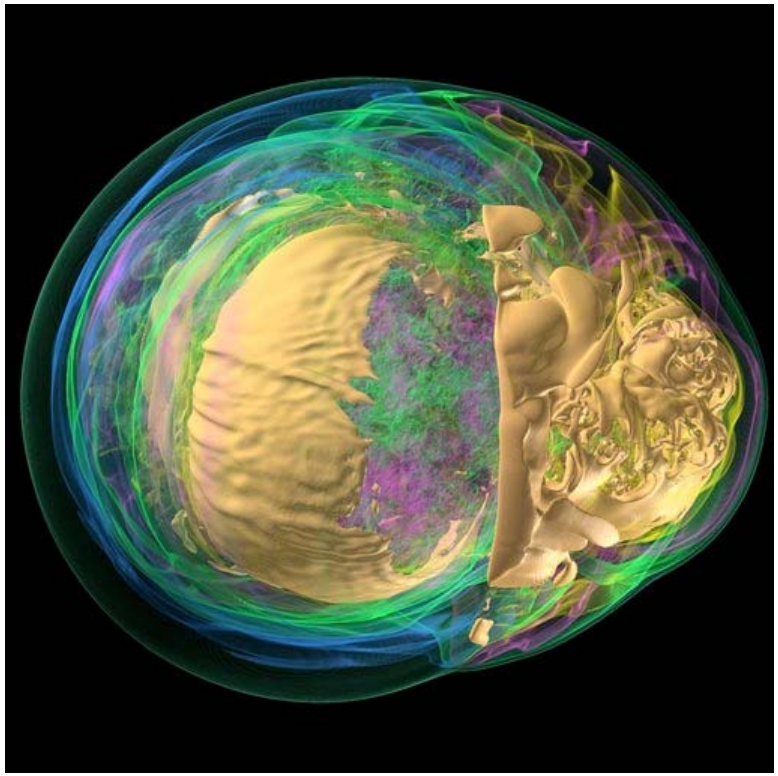
Take, For Example, Astrophysics Data

terabytes and growing

Core collapse supernova shock wave simulation, on a structured grid of 1120^3 data elements produces 27 GB per time step. Because this is a time-varying, multivariate dataset, the total is data size is > 5 TB

Same code (VH-1) will be used in CHIMERA, to produce petabytes of data soon

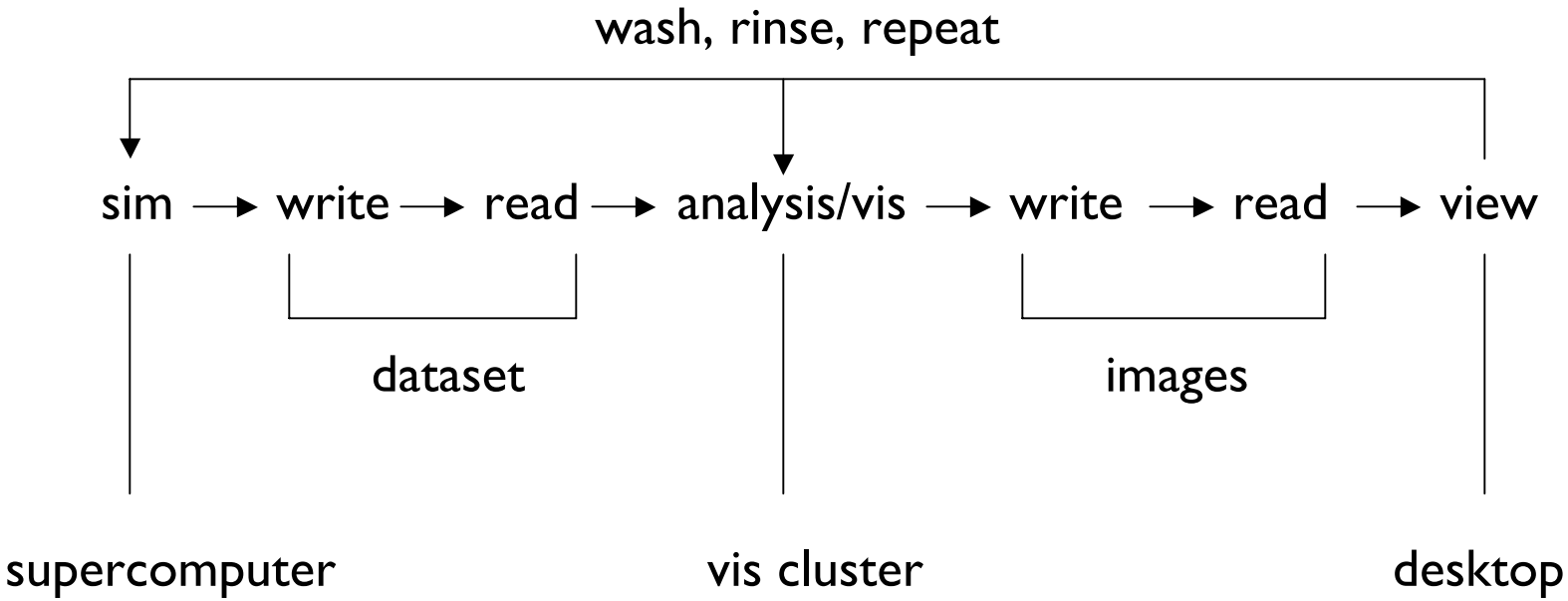
Datasets courtesy of John Blondin (NCSU) and Tony Mezzacappa (ORNL)



Volume rendering of entropy

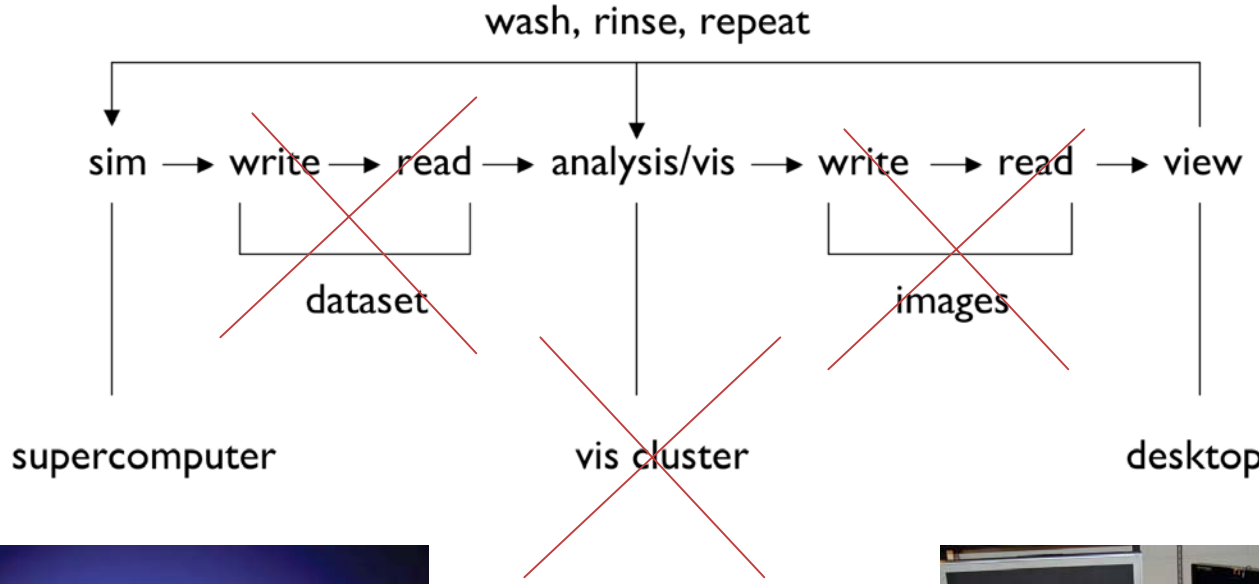
Large Data Problems in Traditional Analysis Workflow

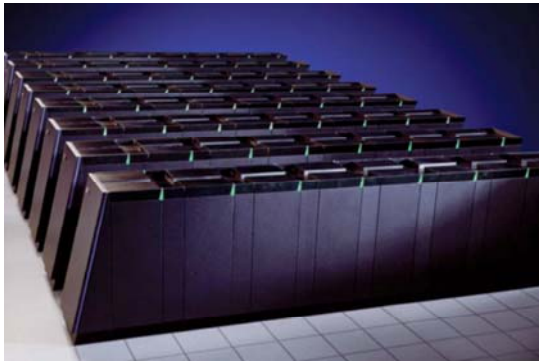
What's wrong with this picture?



Breaking the Visualization Pipeline

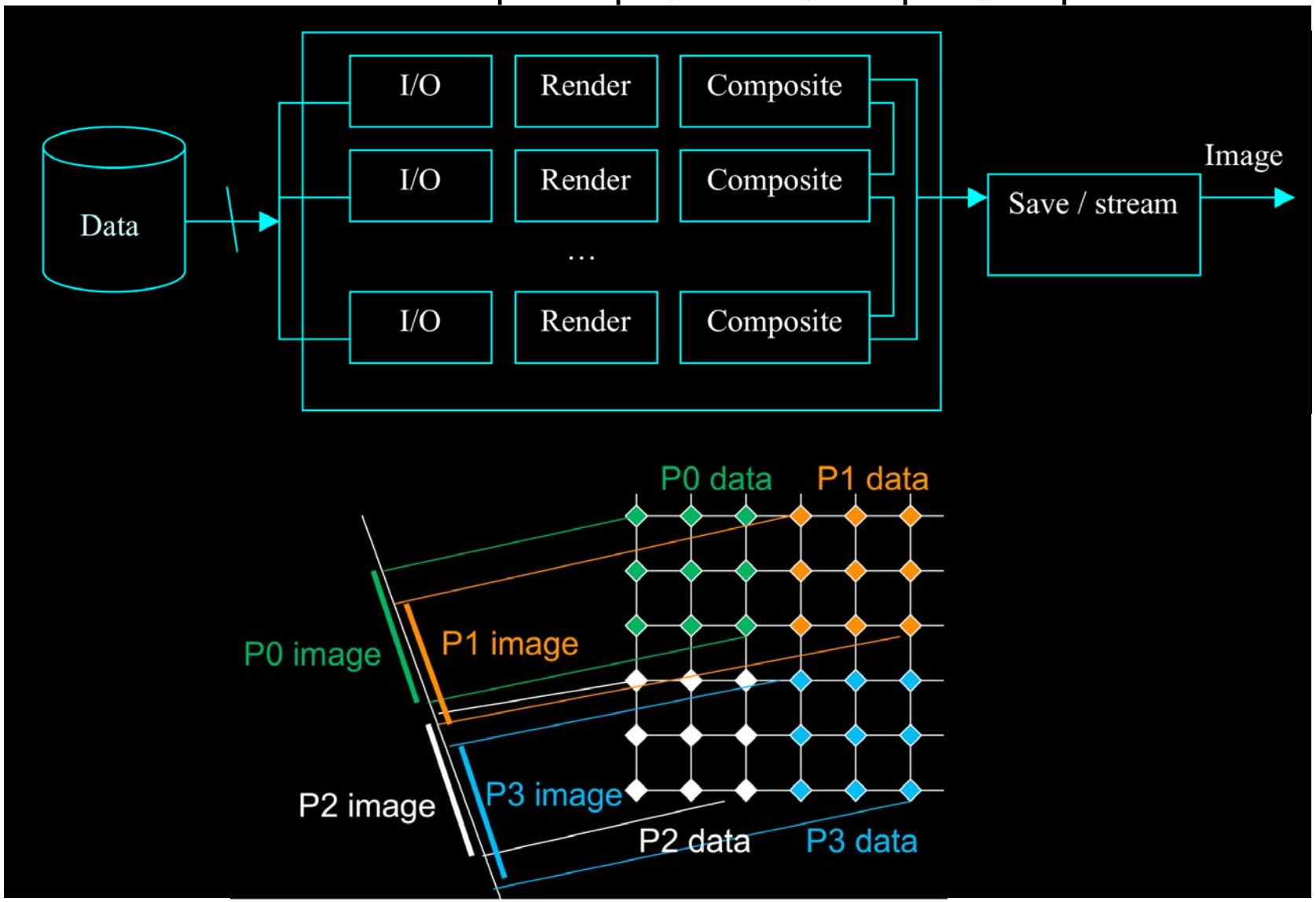
Relying on leadership infrastructure, parallel scalable algorithms, and interactive viewing techniques





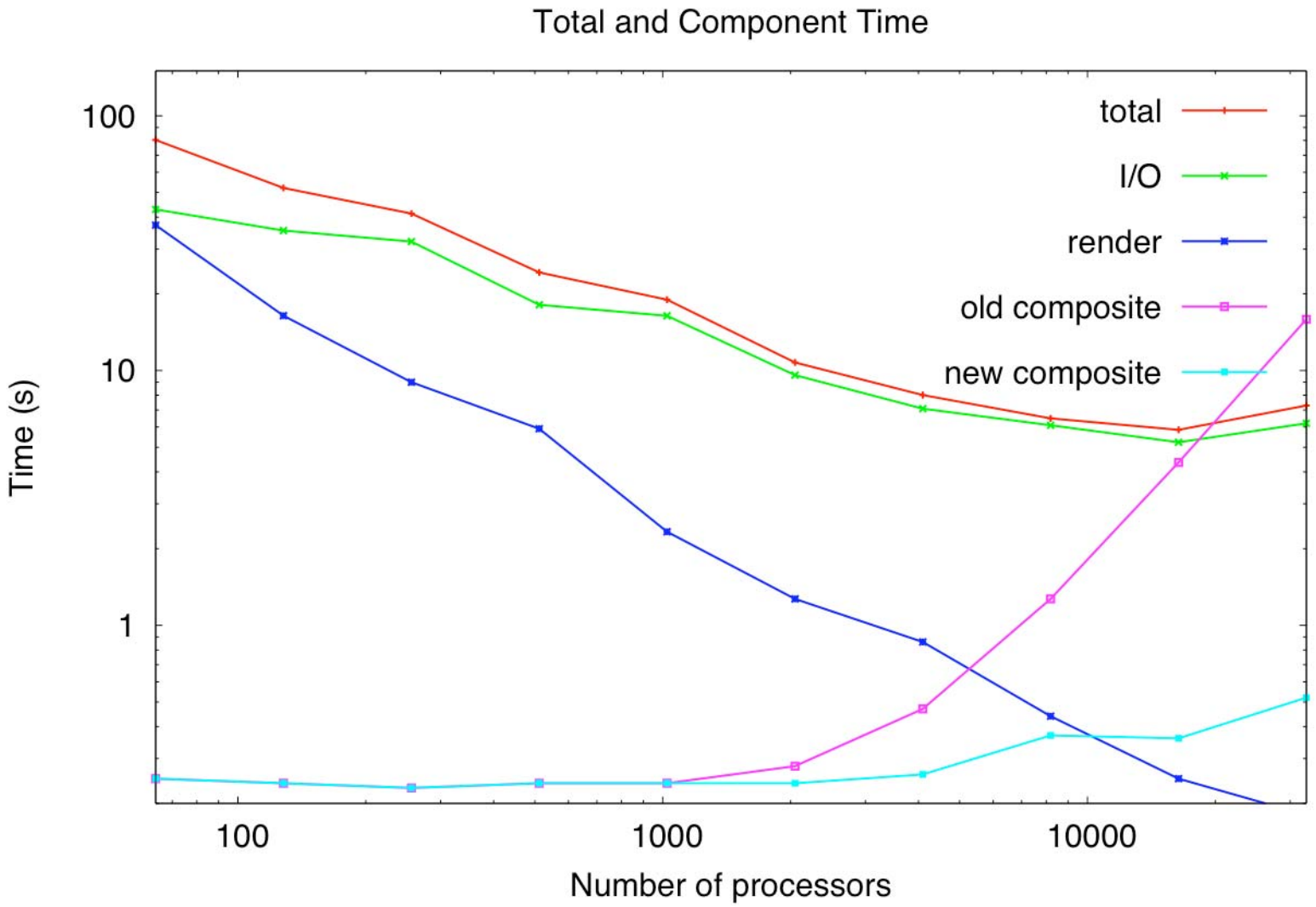
Parallel Volume Rendering

Divide and conquer: Input, render, compose, output.



Performance Results

Limiting the number of compositors improves compositing time by up to 30X.

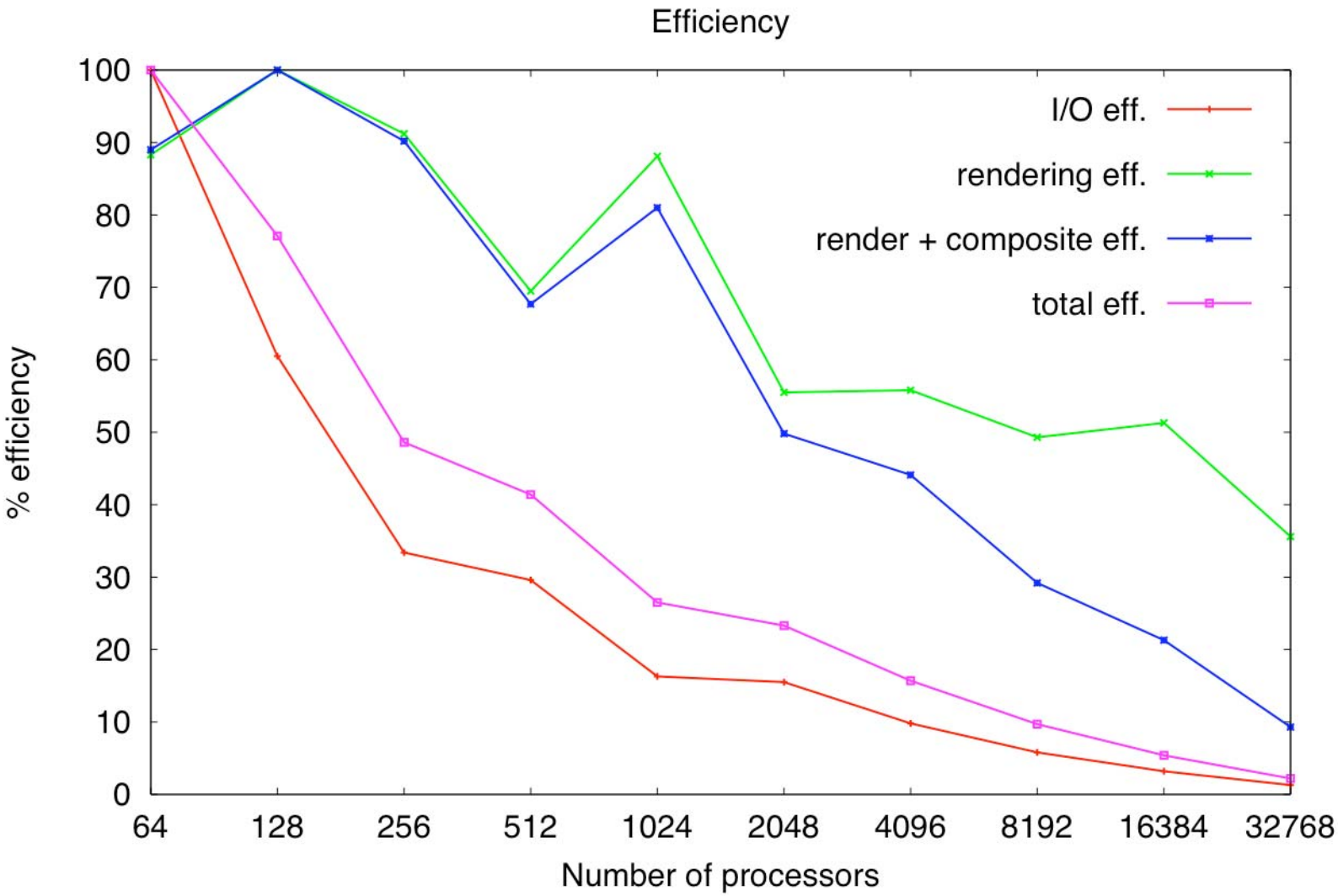


Time Distribution

Reading the data from storage dominates the total cost of a time step.

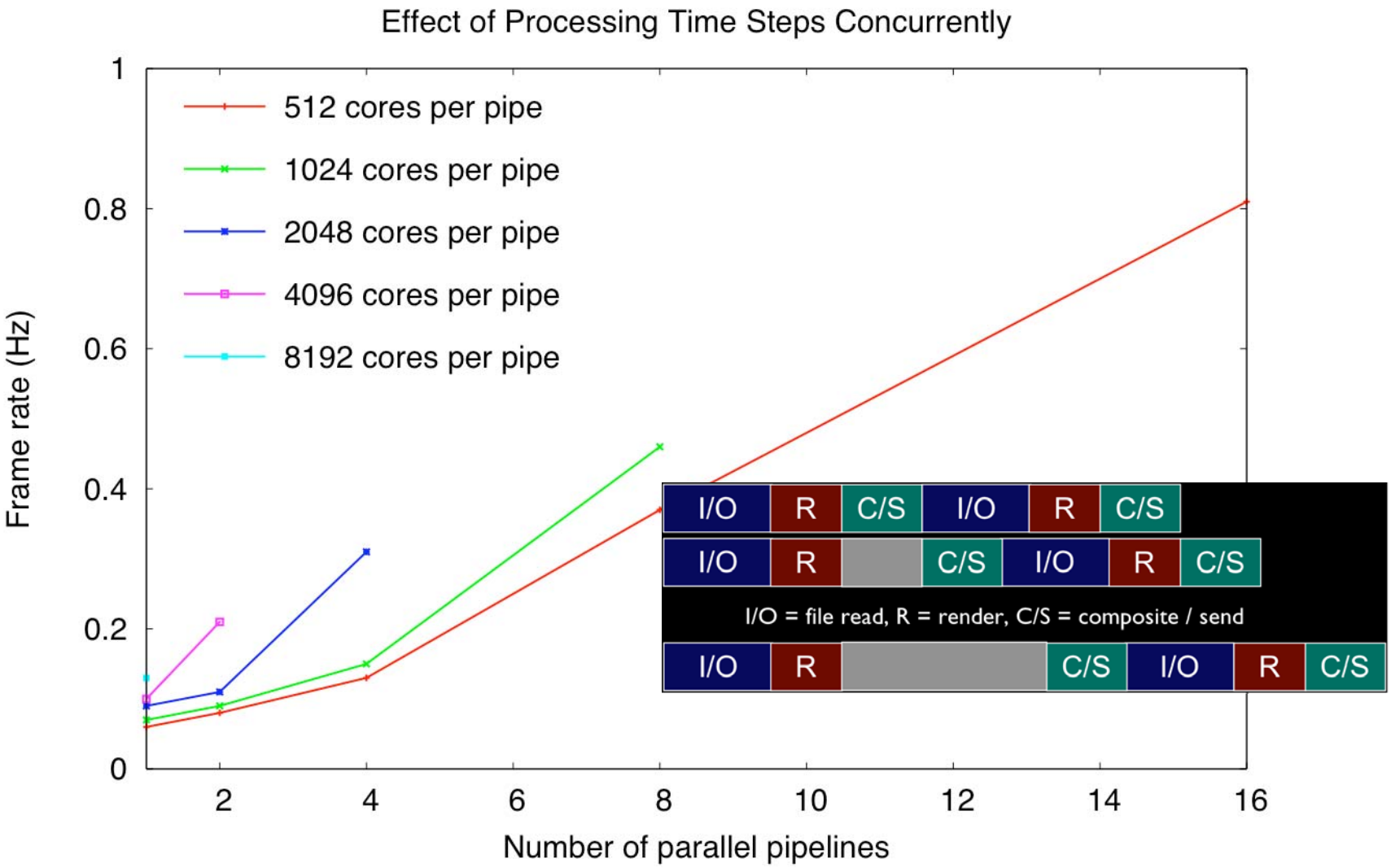
Efficiency

Welcome to the real world.



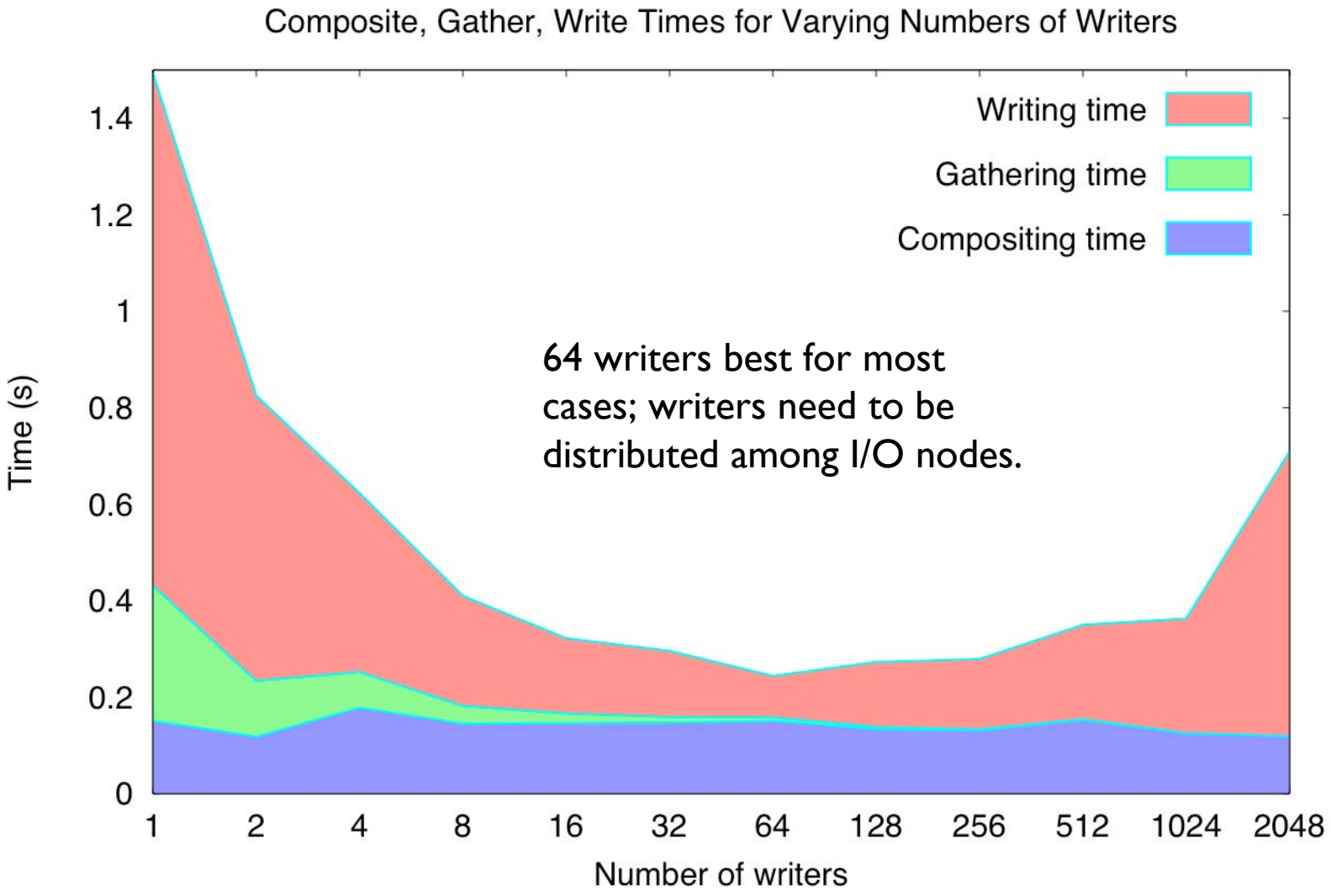
Multiple Parallel Pipelines

Hide I/O latency by extending concurrency between time steps.



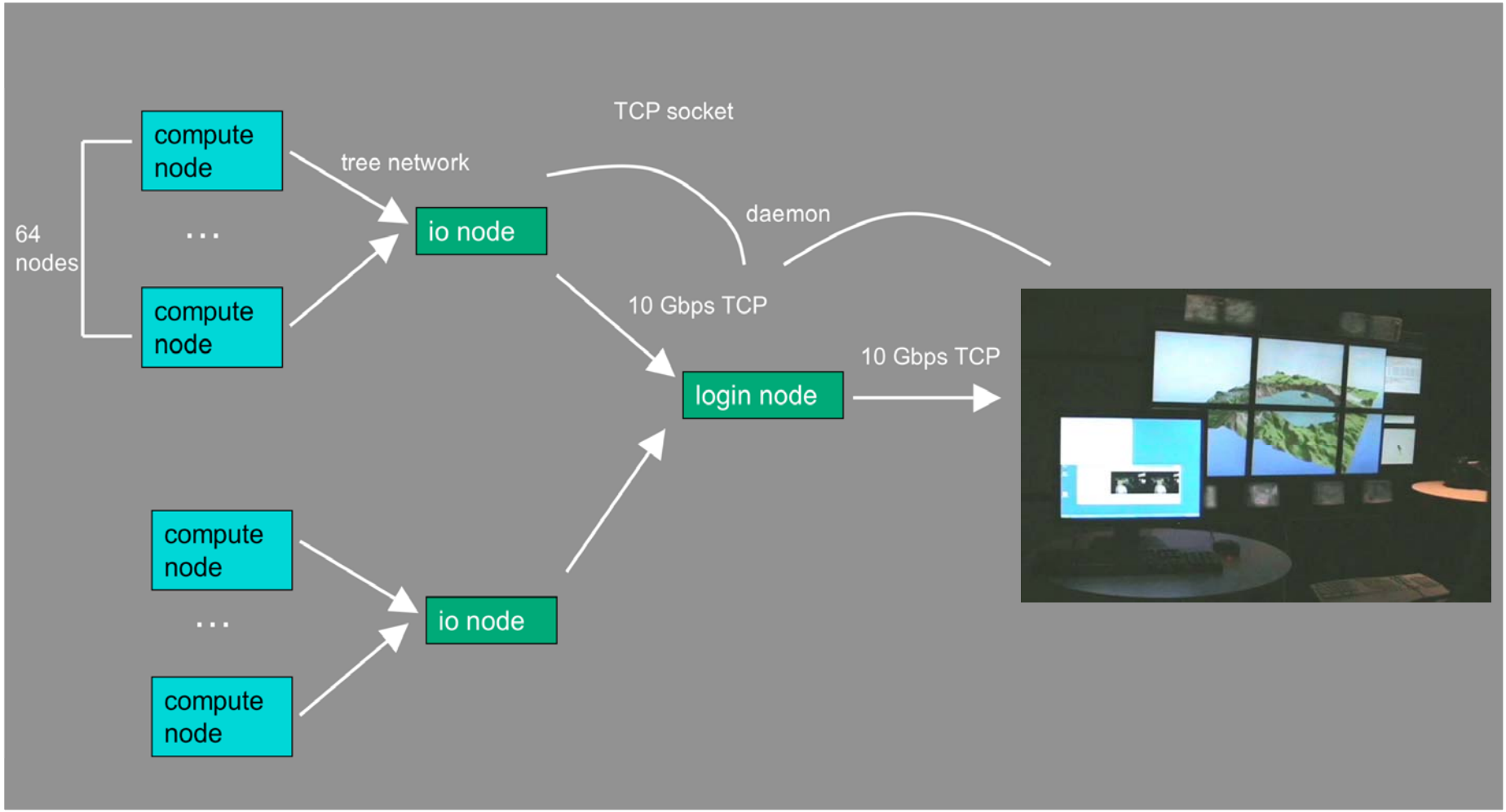
Multiple Writers Performance

Improve overall output time by selecting the optimal number of writers.



Getting the Results to the Scientist

Multipipe, multihop transmissions

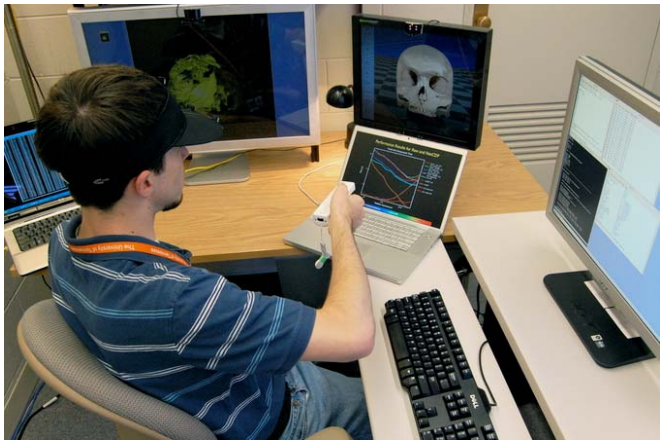


Improving Perception Through VR Techniques

Autostereo viewing and natural interactions, from display wall to desktop.

35-panel Varrier display at EVL

6-panel Varrier display at MCS Vis. Lab



Desktop Varrier and Dynallax displays in scientist's office

Visualization on Leadership Resources

Challenges, questions, looking ahead

	Technical	Nontechnical
Performance	Interactive rate	Leadership resource justifcation
Structure	Grid types	Conflicting decompositions
Linking	In situ API	In situ collaboration
Usability	Interaction model	Role of visual analysis in science discovery
Programming	Exploit multicores	Legacy code (and programmers)
Resources	Other architectures	Collaboration
Application	Adoption into tools	All of the above

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