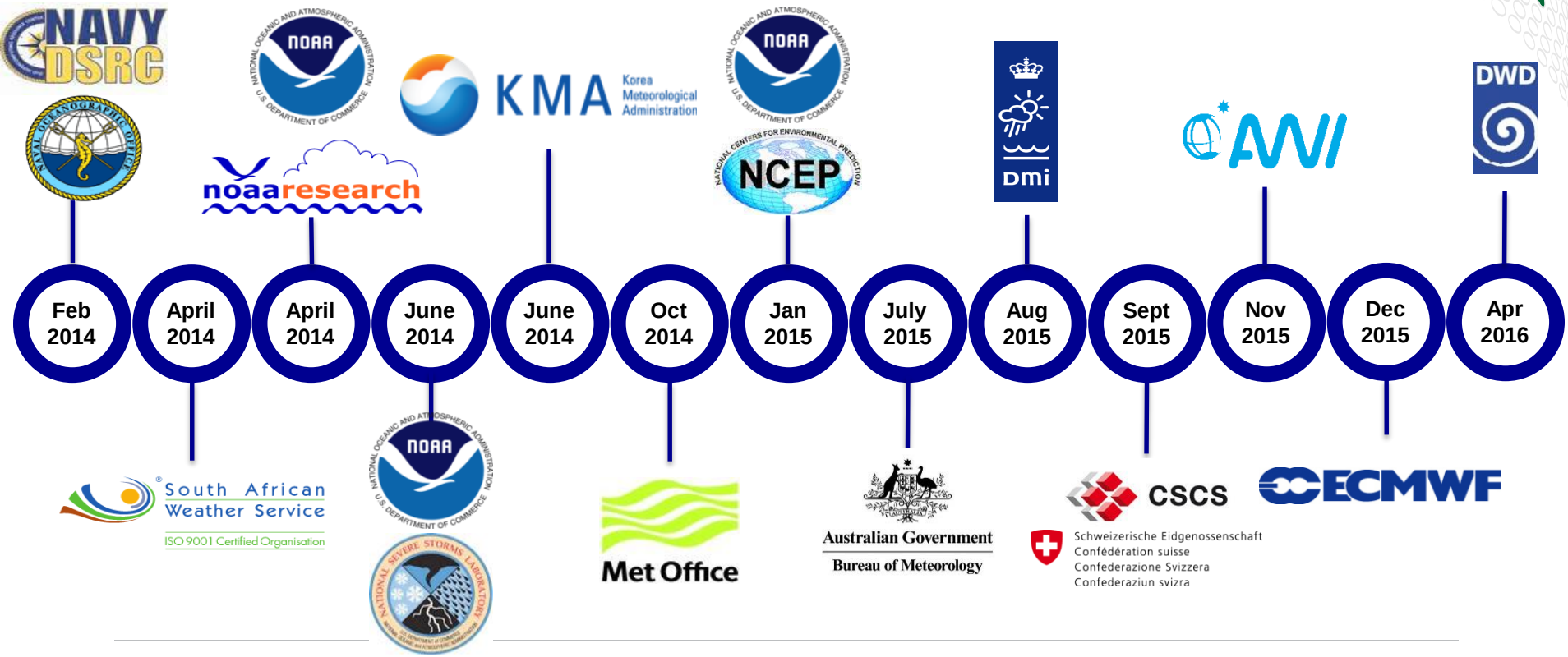
Hardware, software, compilers - Future trends from a vendor's perspective

Phil Brown
philipb@cray.com
Earth Sciences Segment Leader

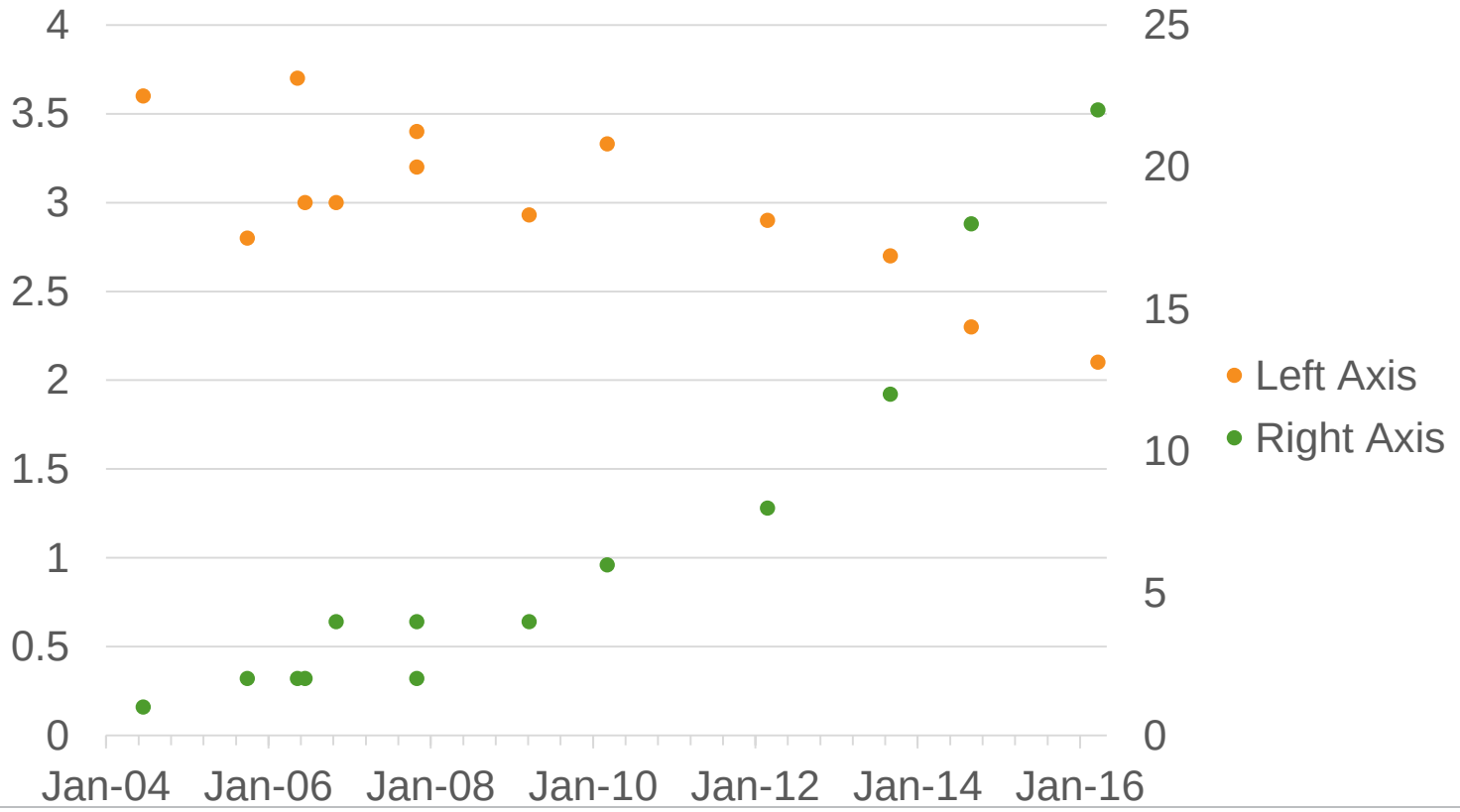
Topics

- **Introduction**
- **Challenges:**
  - Parallelism
  - Heterogeneous Memory/Storage Hierarchy
- **Ideas we might borrow from “Big Data”**

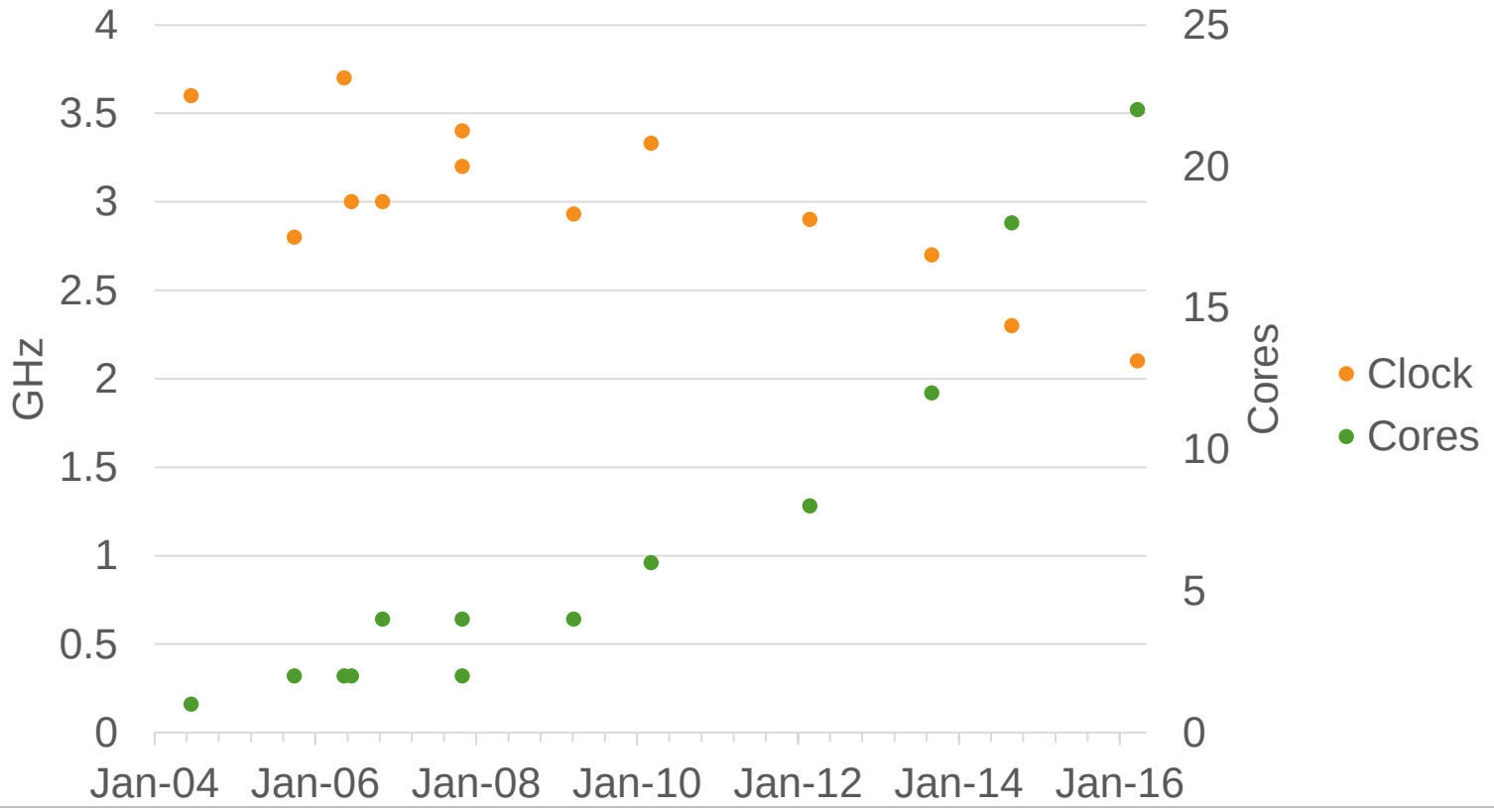
Cray Growth in Weather, Climate and Oceanography over the Last Two Years



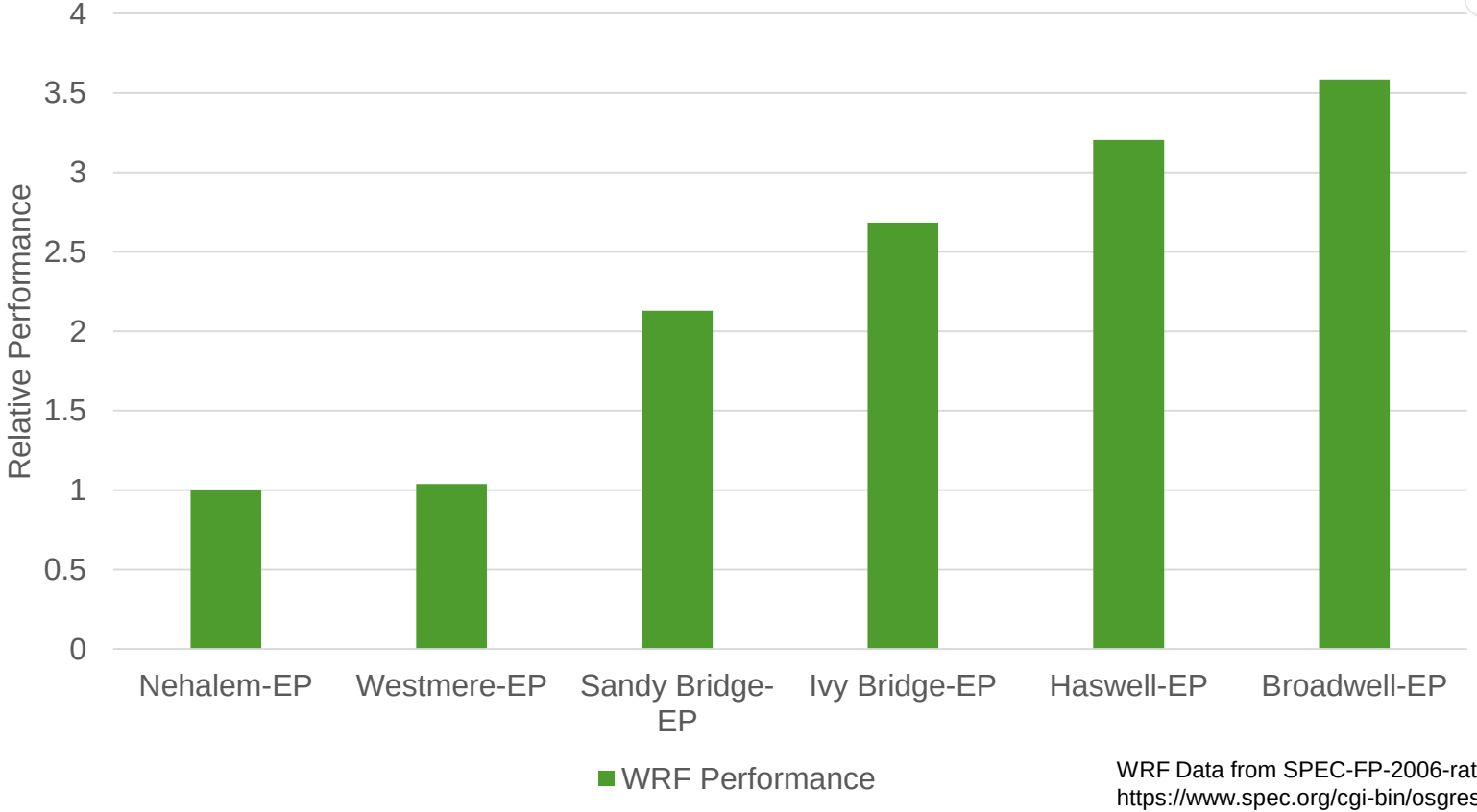
Guess the Data!



Clock vs Cores for Intel Xeon CPUs

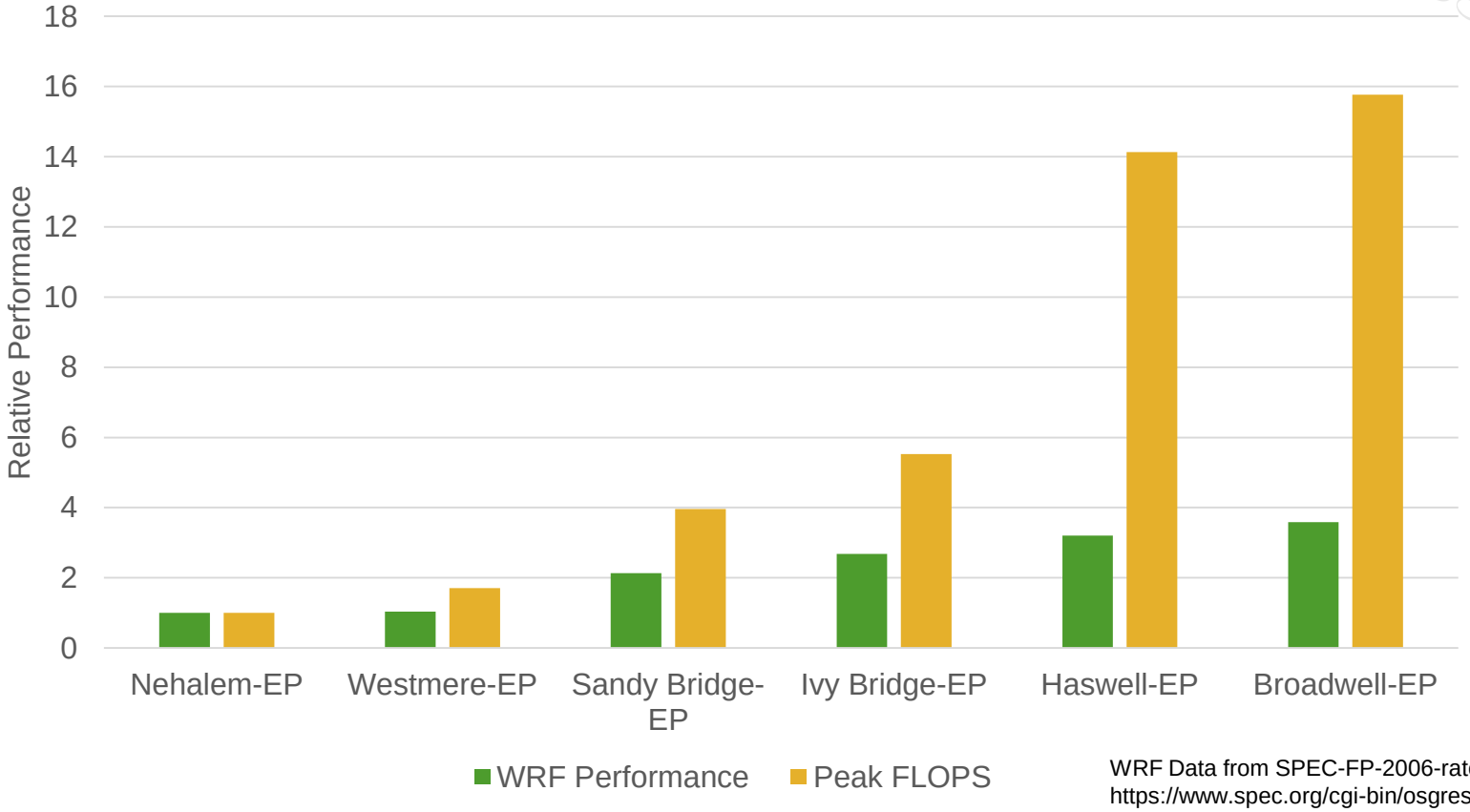


Historical Performance Trends



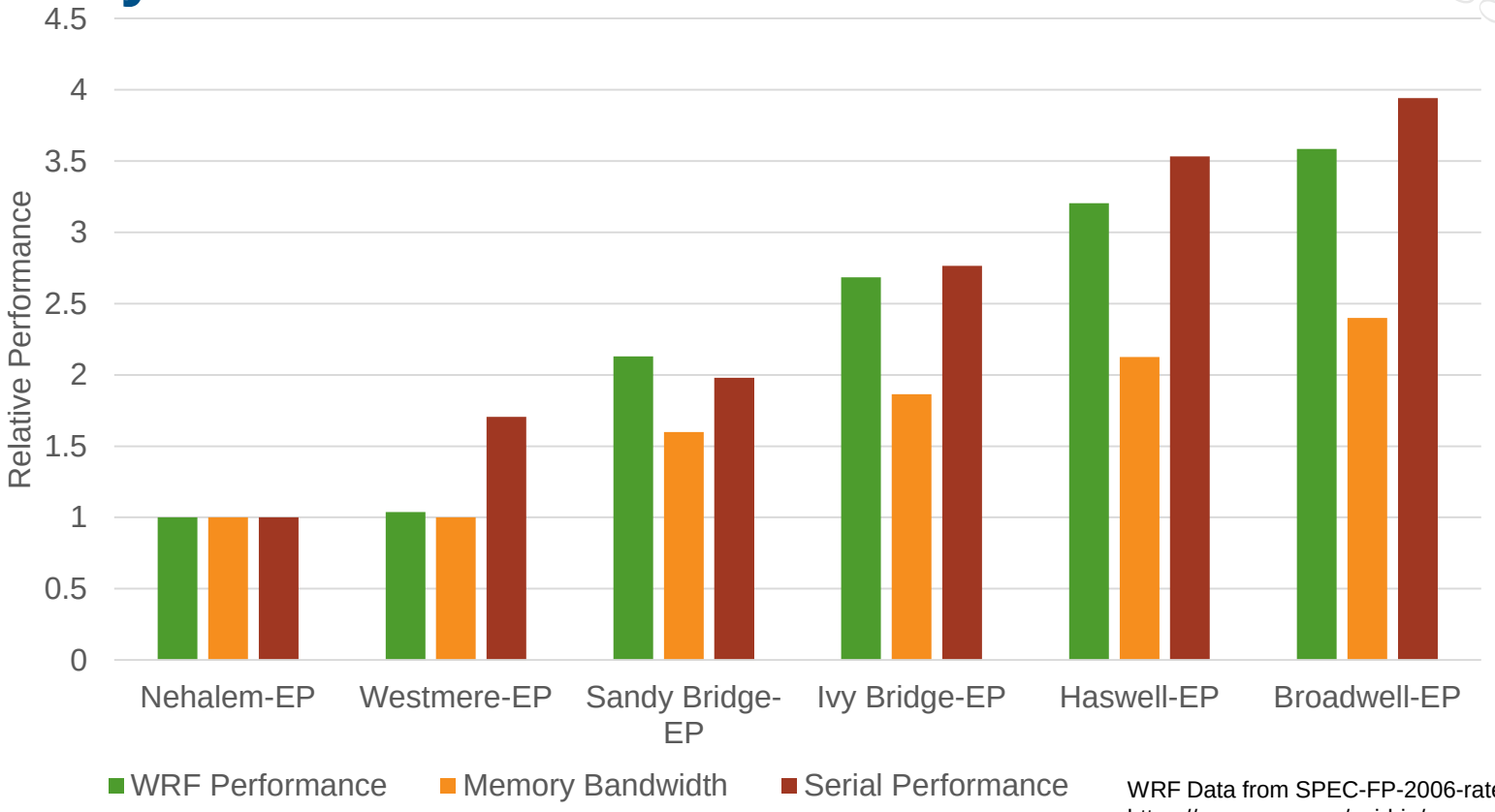
WRF Data from SPEC-FP-2006-rate:
https://www.spec.org/cgi-bin/osgresults?conf=rfp2006

FLOPs aren't the bottleneck!



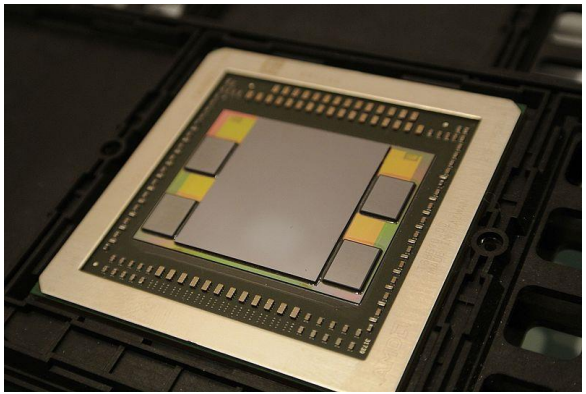
WRF Data from SPEC-FP-2006-rate:
https://www.spec.org/cgi-bin/osgresults?conf=rfp2006

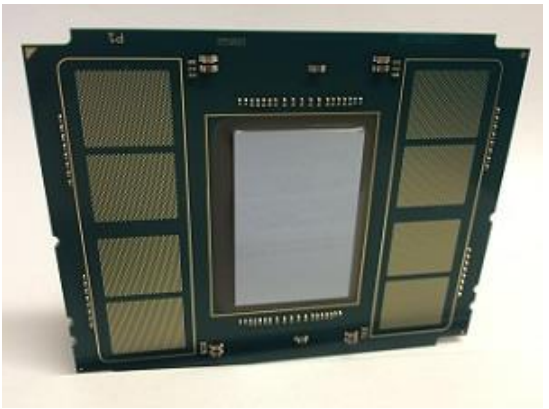
Memory Bandwidth & Serial Performance



WRF Data from SPEC-FP-2006-rate:
https://www.spec.org/cgi-bin/osgresults?conf=rfp2006

Next-Generation Memory Technologies





- **Benefits:**
  - Higher Memory Bandwidth
  - Lower Power Consumption per GB/s
- **Downsides:**
  - Lower Primary Memory Capacity
  - More Complicated Memory Hierarchy?

http://www.amd.com/en-us/innovations/software-technologies/hbm

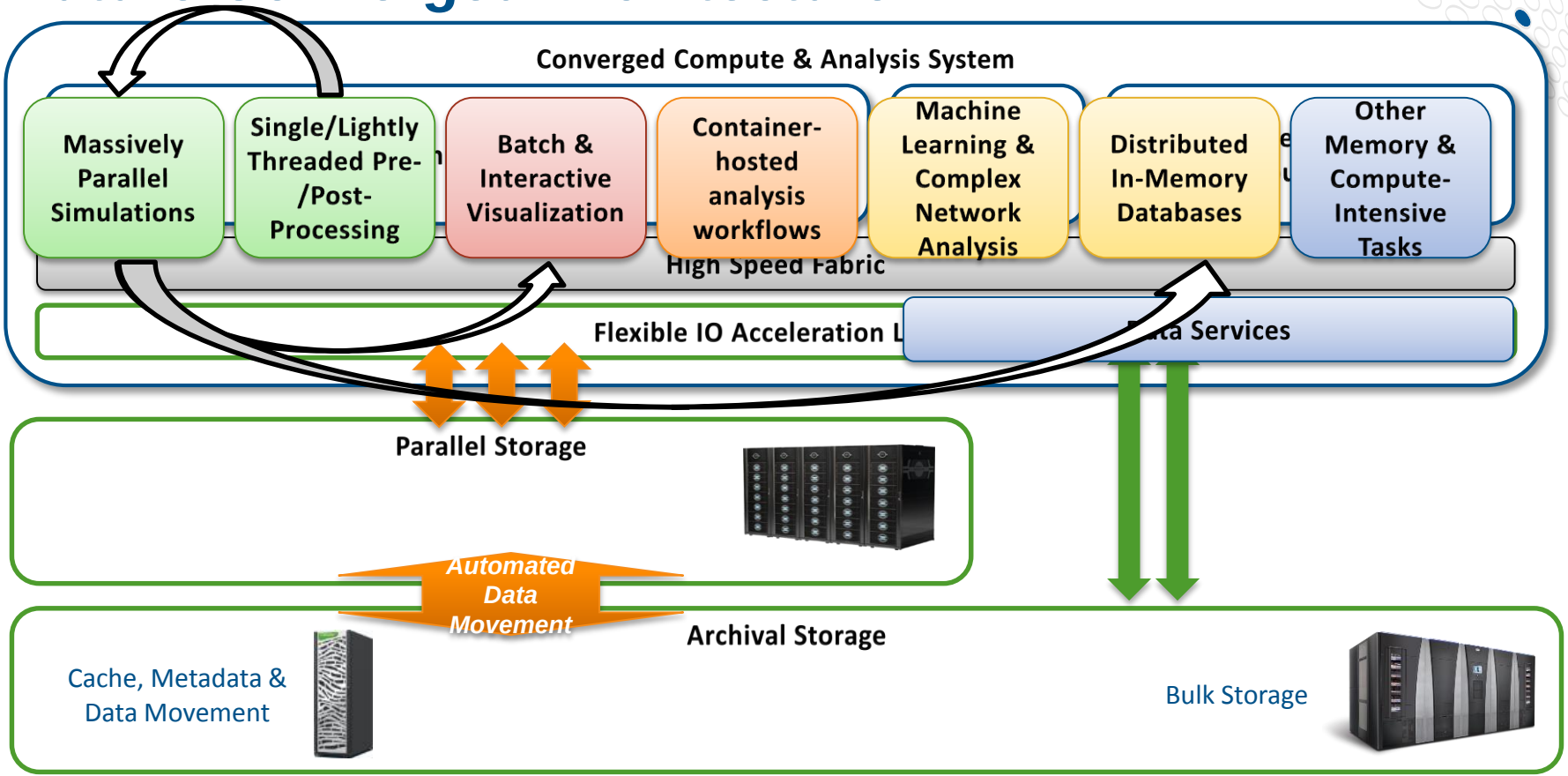
https://software.intel.com/en-us/articles/what-disclosures-has-intel-made-about-knights-landing

Exchange of ideas between Supercomputing & "Big Data"

- **Hyperscale web companies have developed many interesting technologies:**
  - Driven by data velocity, volume & variety, combined with resiliency requirements at scale

- **A number could be of particular interest in climate research:**
  - Containerization
  - Flexible & Scalable Data Analysis platforms
  - New Analysis Techniques (such as machine learning)

Future Converged Architecture




CRAY
COMPUTE | STORE | ANALYZE
Thank you!