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ANALYZE

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

Phil Brown

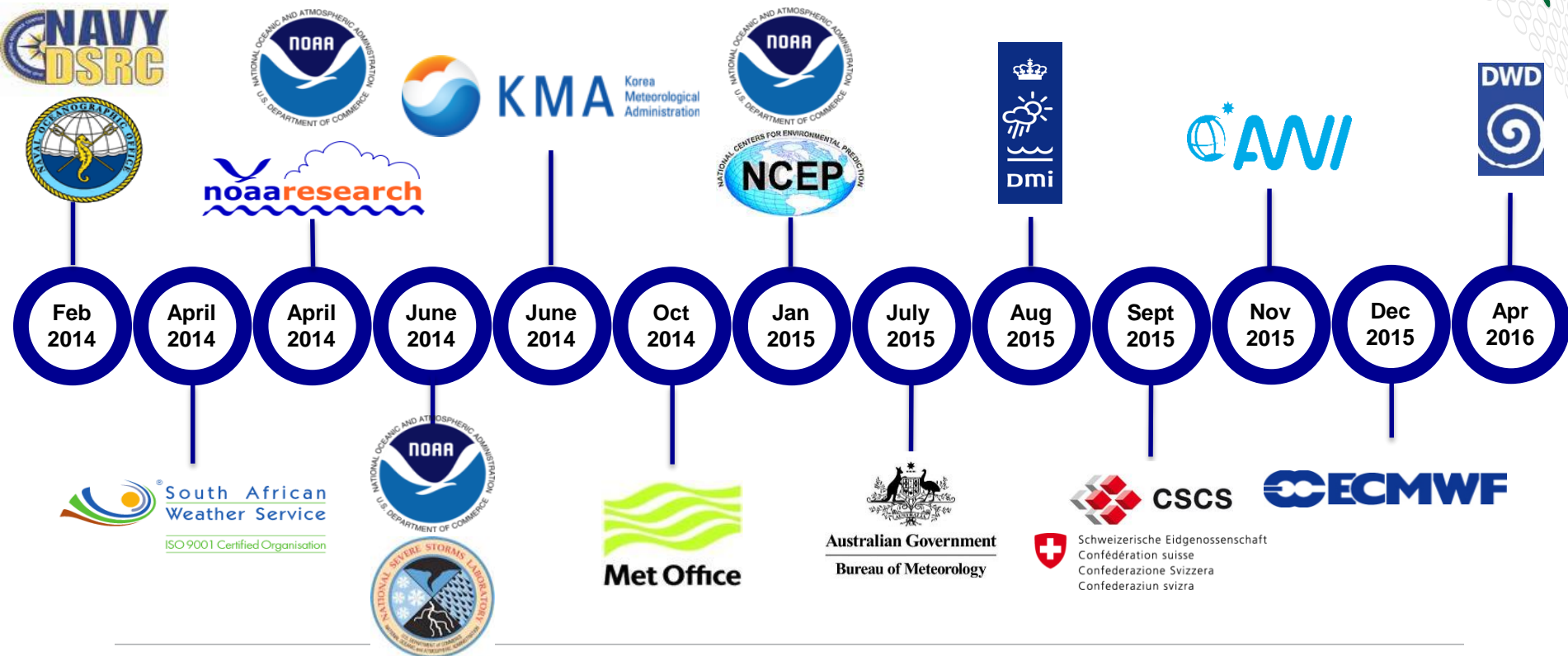
philipb@cray.com

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

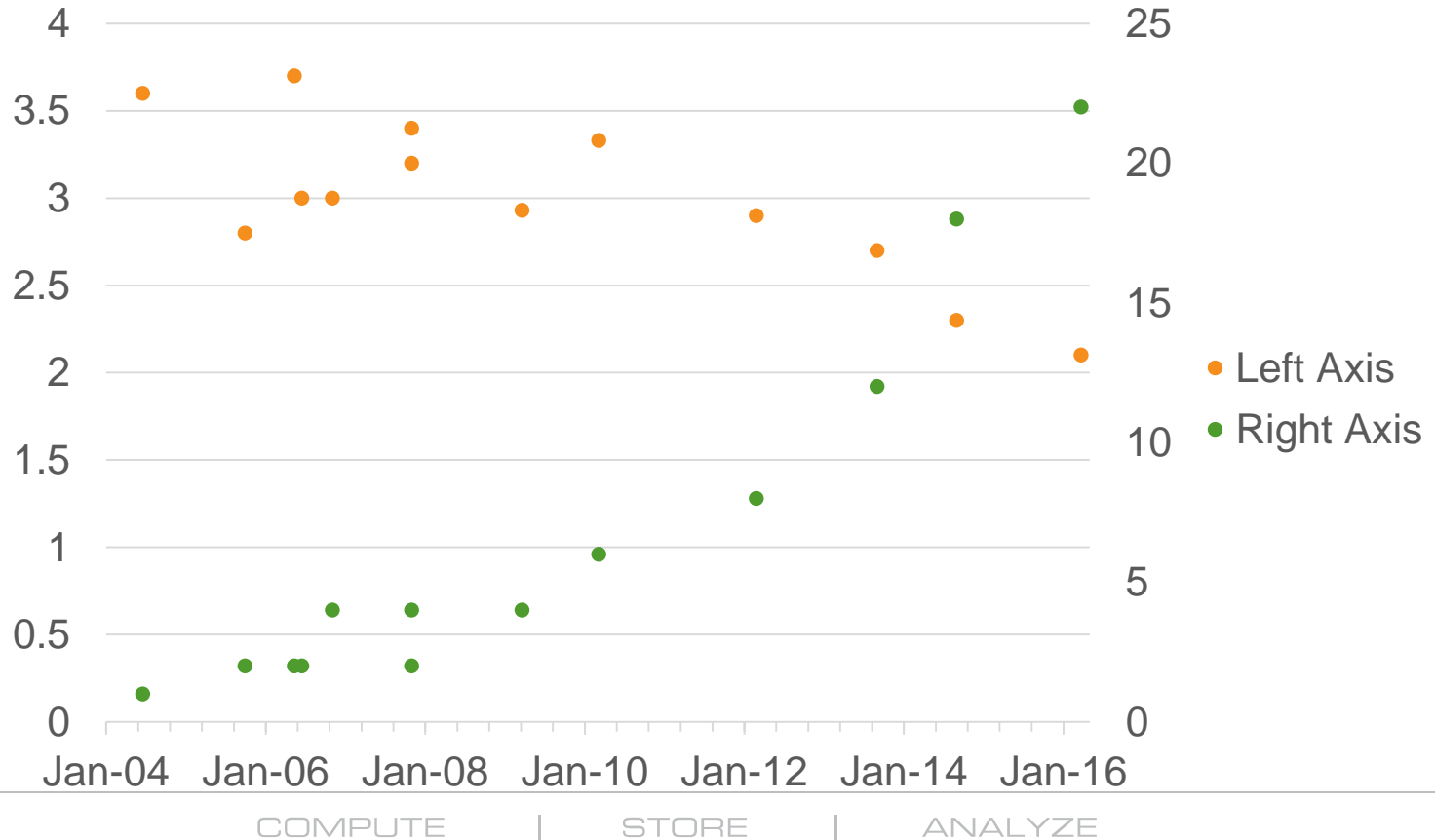


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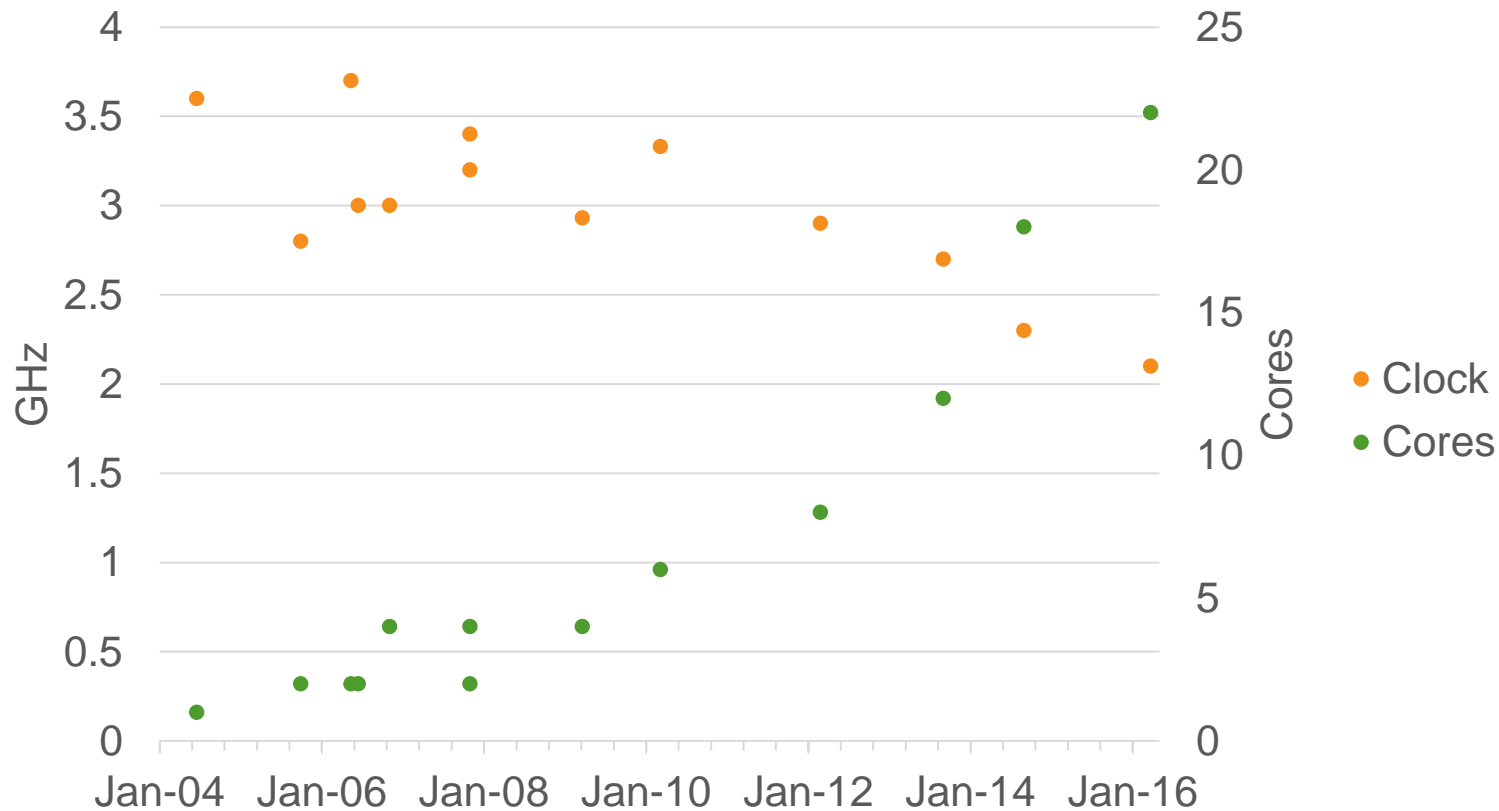
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Guess the Data!



Clock vs Cores for Intel Xeon CPUs

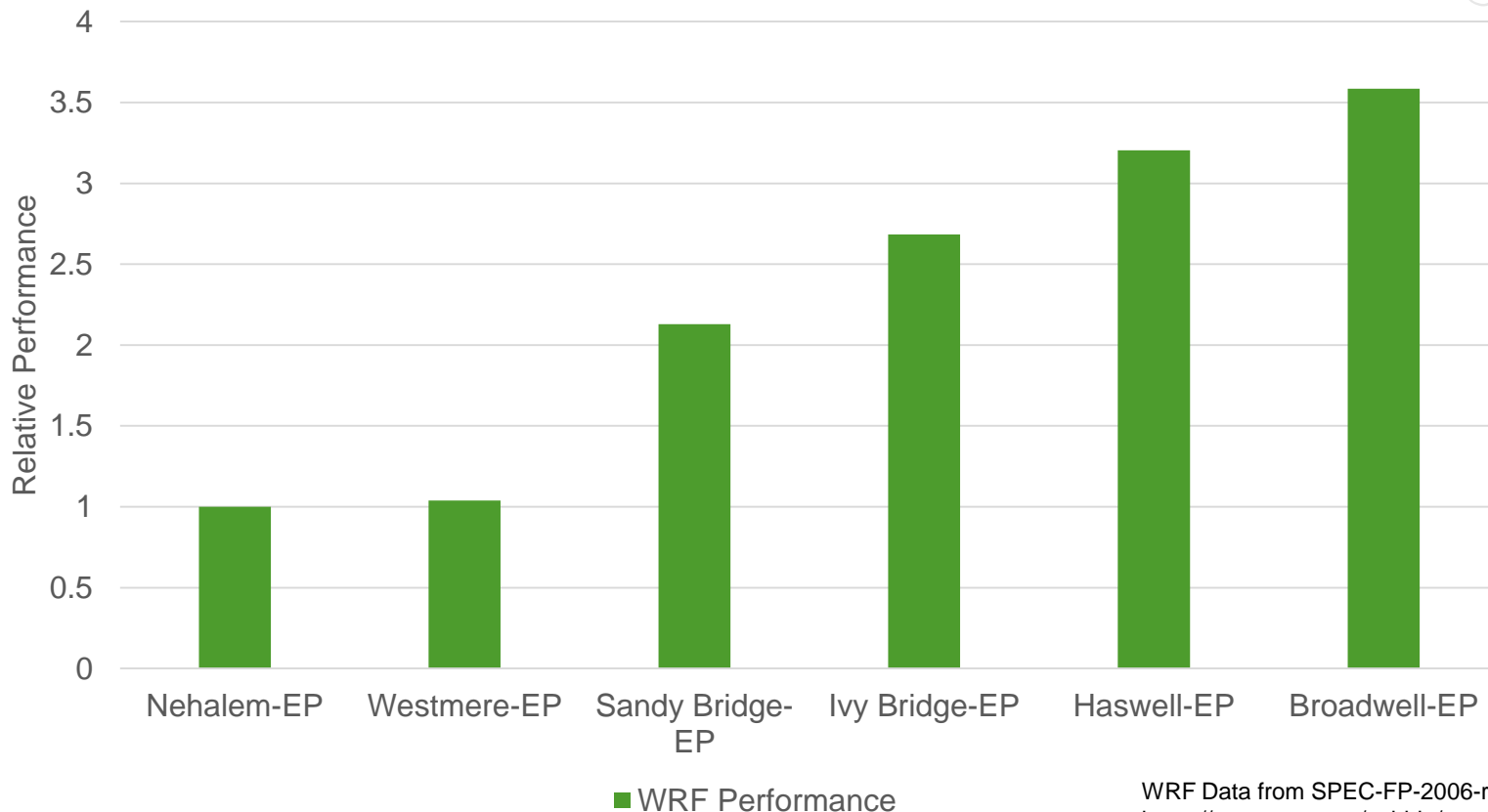
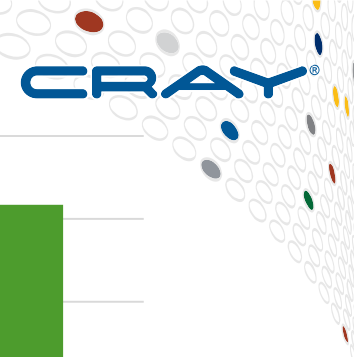


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Historical Performance Trends



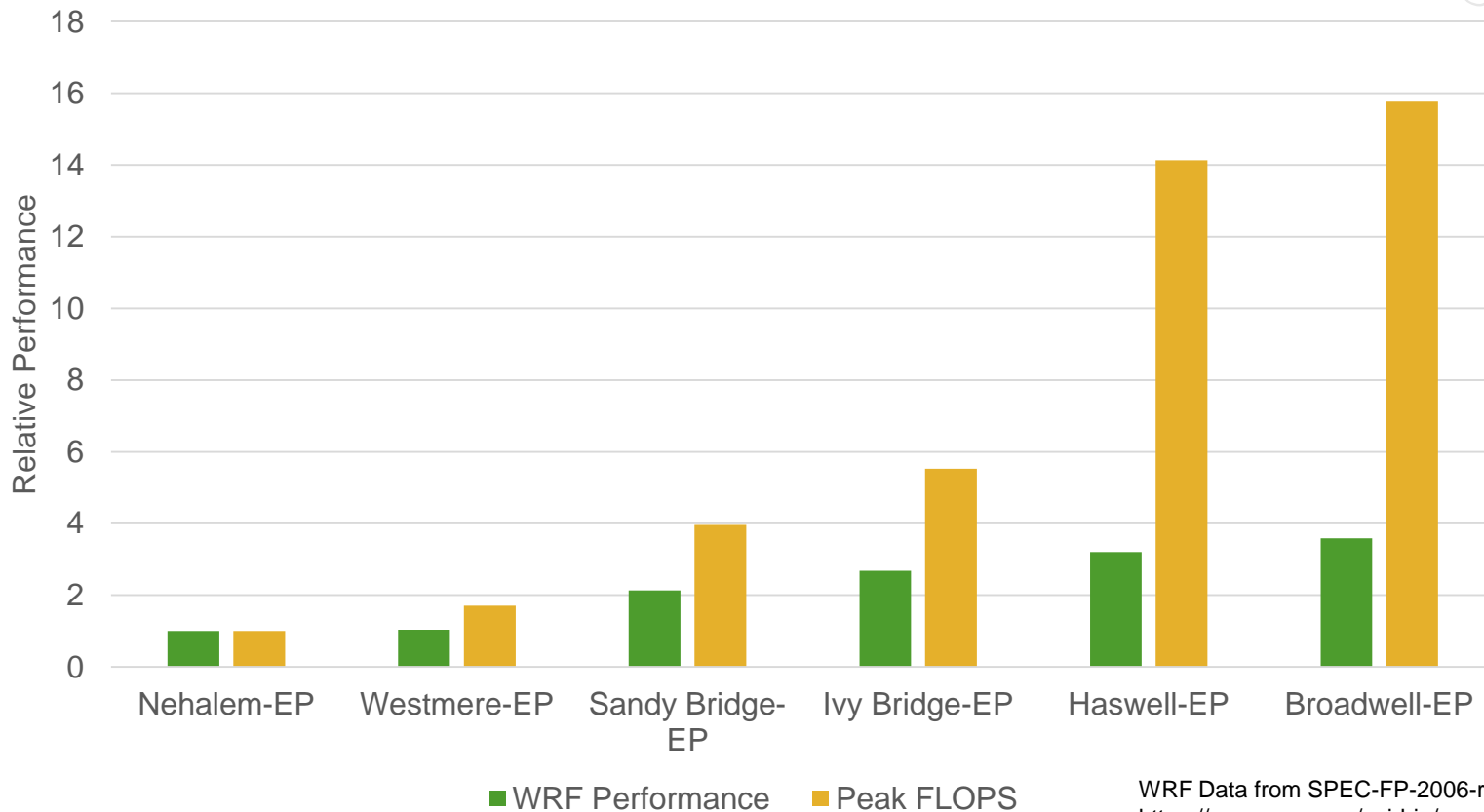
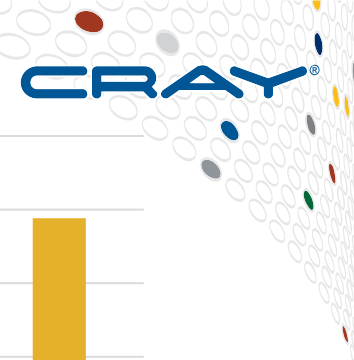
WRF Data from SPEC-FP-2006-rate:
<https://www.spec.org/cgi-bin/osgresults?conf=rfp2006>

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FLOPs aren't the bottleneck!



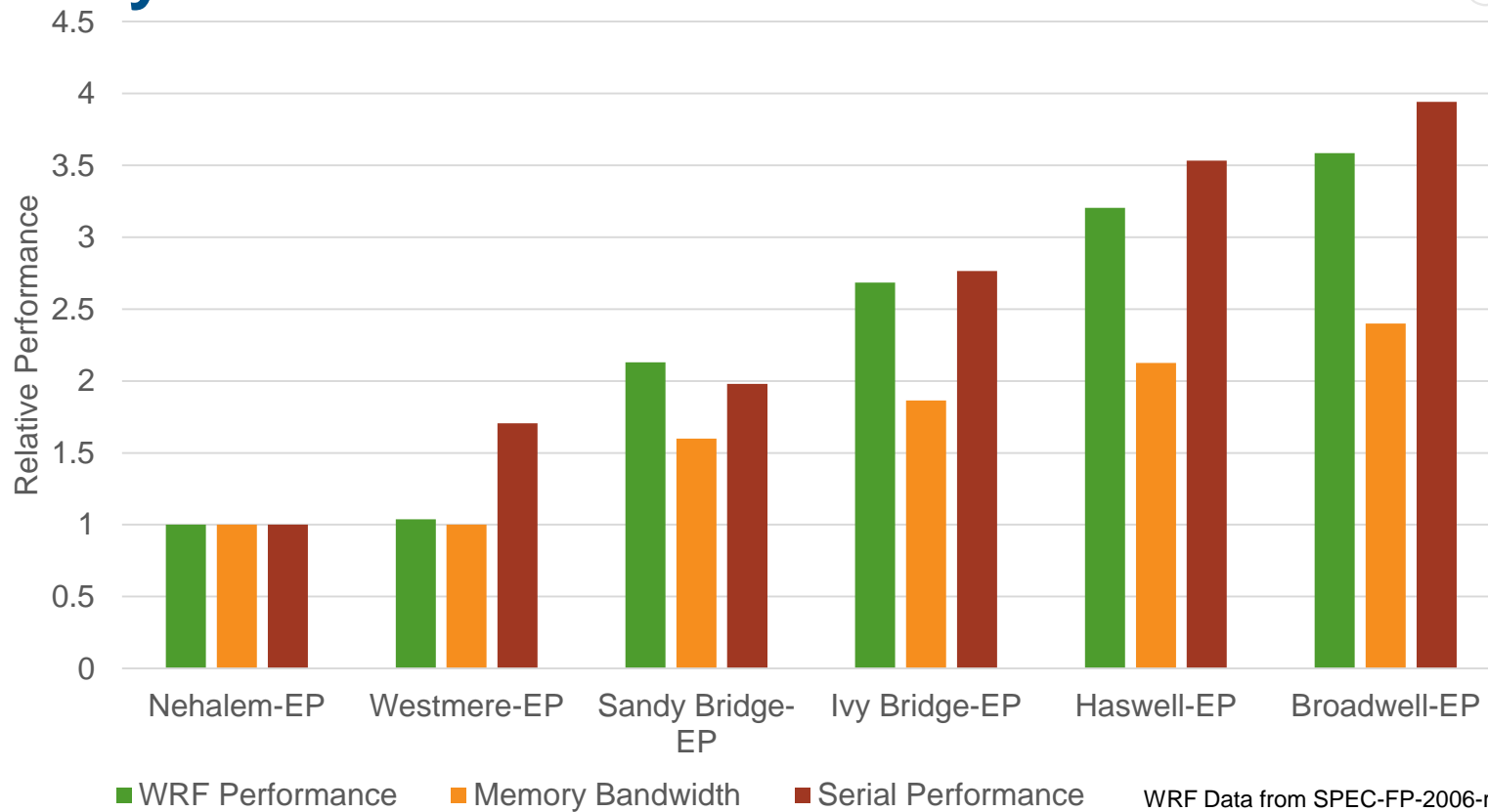
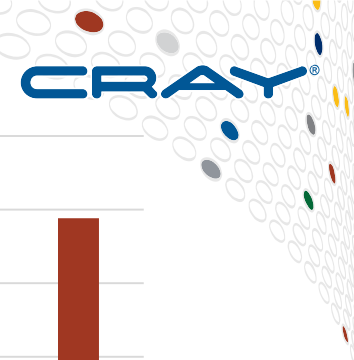
WRF Data from SPEC-FP-2006-rate:
<https://www.spec.org/cgi-bin/osgresults?conf=rfp2006>

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Memory Bandwidth & Serial Performance



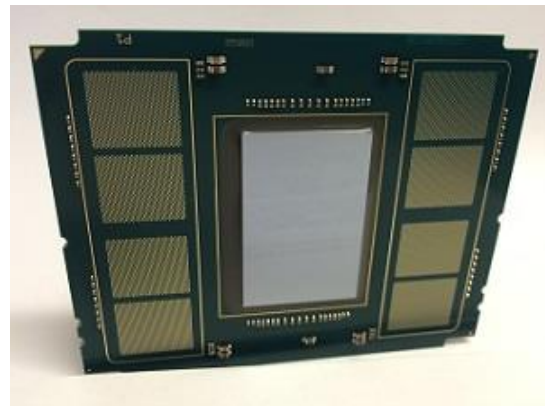
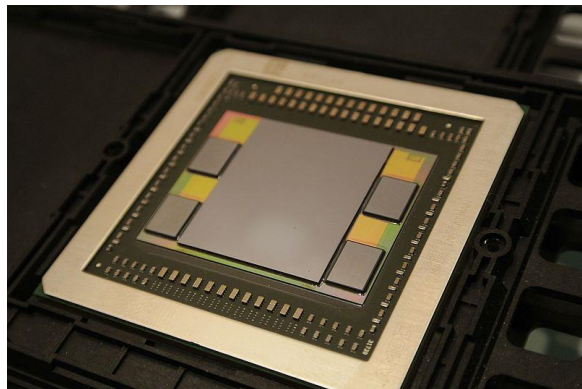
WRF Data from SPEC-FP-2006-rate:
<https://www.spec.org/cgi-bin/osgresults?conf=rfp2006>

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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>

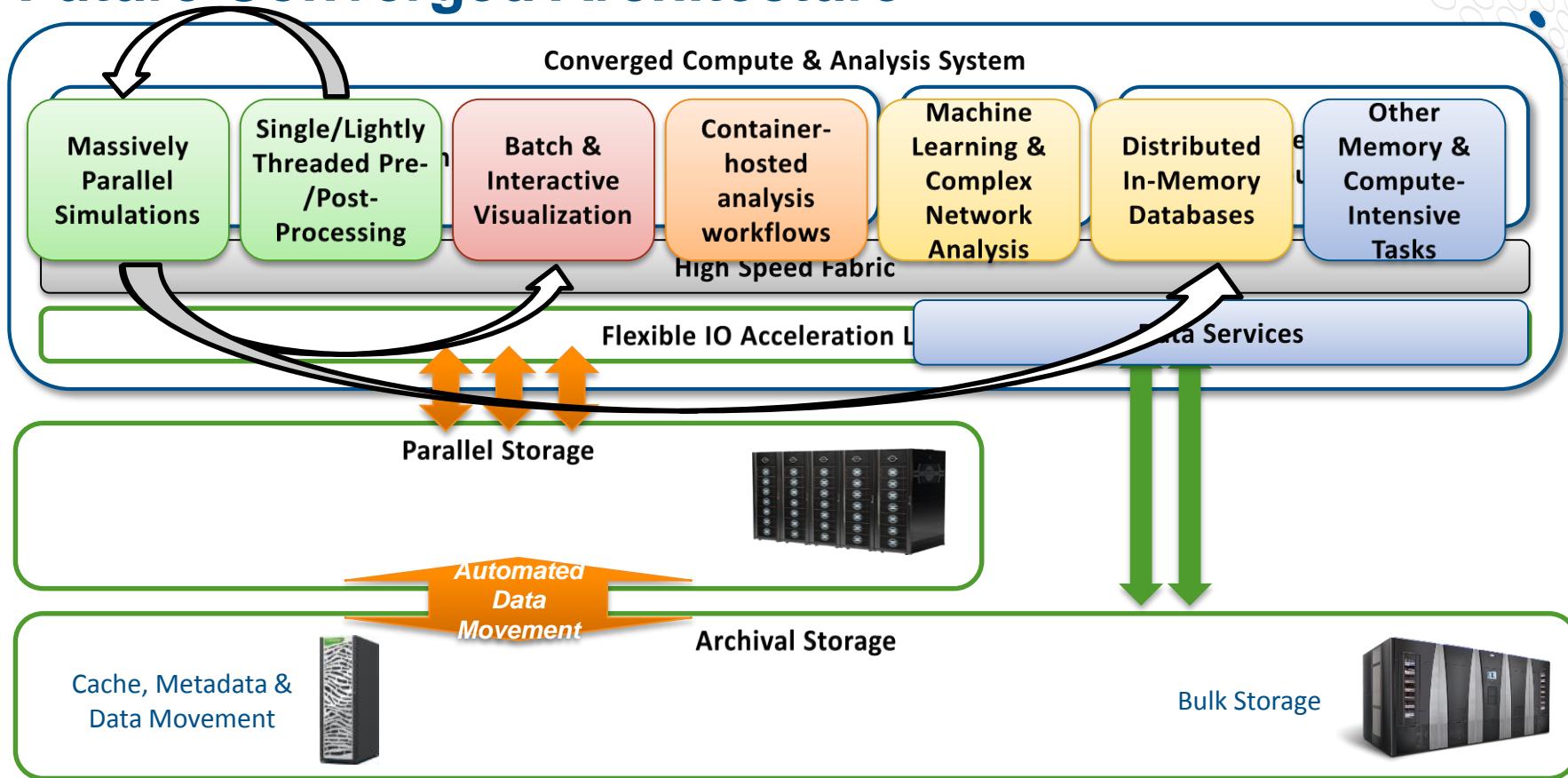
<https://software.intel.com/en-us/articles/what-disclosures-has-intel-made-about-knights-landing>

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



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The background of the slide is a dramatic, high-contrast image of a stormy sky. Dark, heavy clouds are illuminated from below, creating a bright, ethereal glow. A bright, jagged lightning bolt strikes down from the clouds in the lower-left quadrant. The overall color palette is dominated by deep blues, greys, and bright whites, with a hint of yellow/orange light on the right side.

Thank you!