

# The Drive to Improved Performance/watt and Increasing Compute Density

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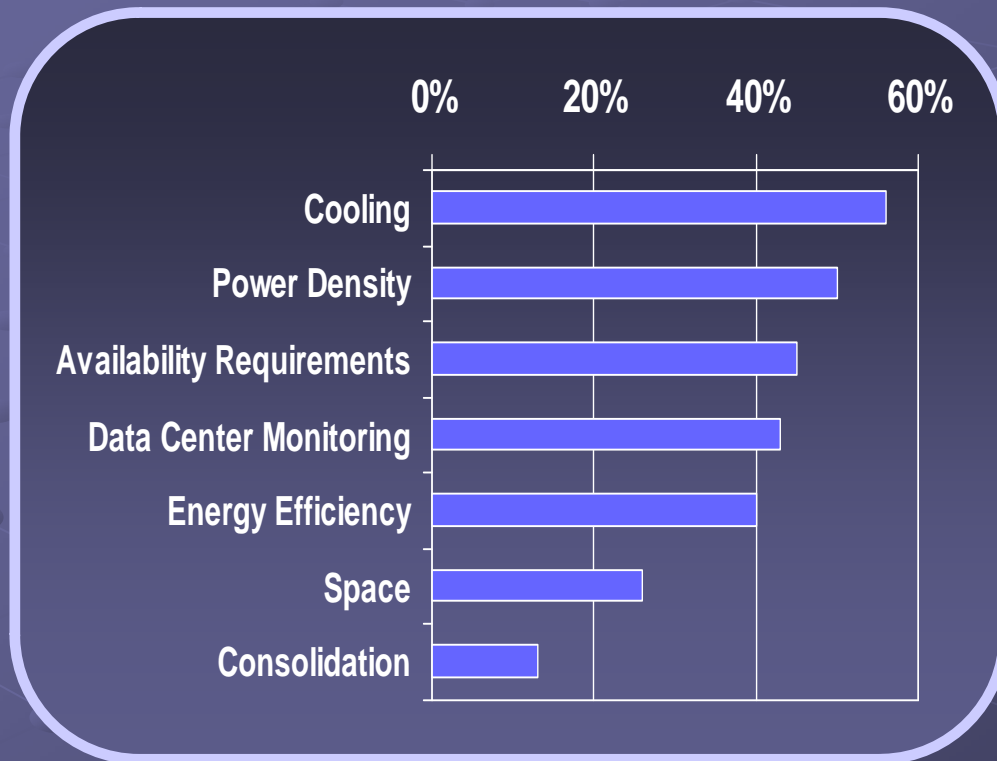
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# Green IT - #1 IT Issue

Power and Cooling Capacity *Limiting Growth*



Source: Liebert Data Center User Group, Spring 2008



“Intel and Google Join with Dell, EDS, EPA, HP, IBM, Lenovo, Microsoft, PG&E, World Wildlife Fund and Others to Launch Climate Savers Computing Initiative”

- Intel News Release, June 12, 2007

*Energy Costs and Cooling #1 Growth Limiters...*

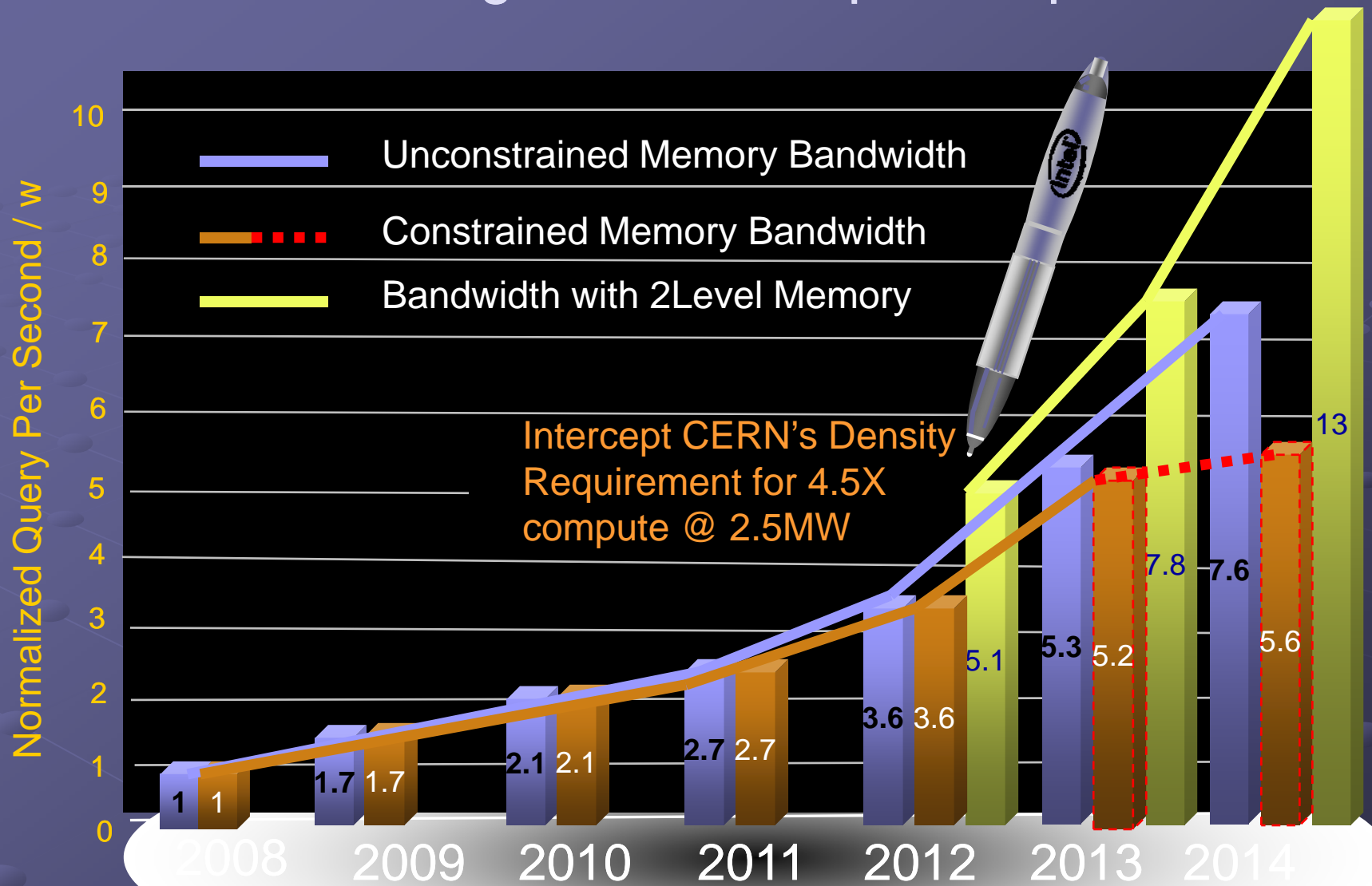
# CERN's Projected Computing Need vs. Power Density



Source: "Strategies for increasing data centre power efficiency," Dr. Andreas Hirstius, Sverre Jarp, Andrzej Nowak. CERN Openlab, 19 February 2008

**2008 to 2012: 4.5X (35% CAGR) computing density increase, but with thermal limit of 2.5 MW to possible 5 MW (requires new facility)**

# Limitations Driving Server Compute Improvements

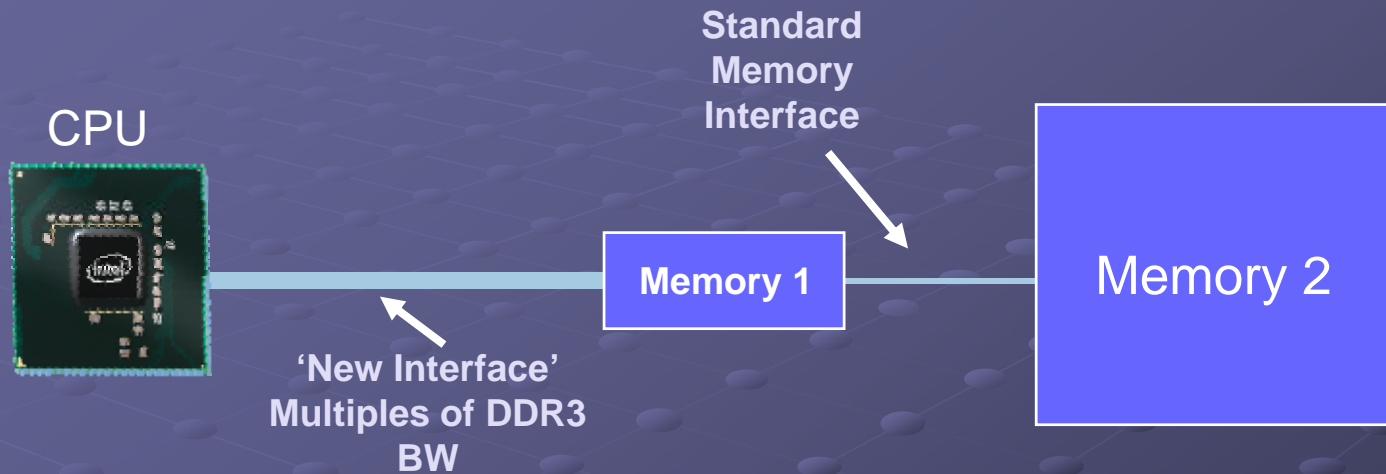


Assume: Constrained memory BW is pin limited with planned memory technology and frequency of the time frame. DDR3 speed up to 2133 MHz and 4 memory channels

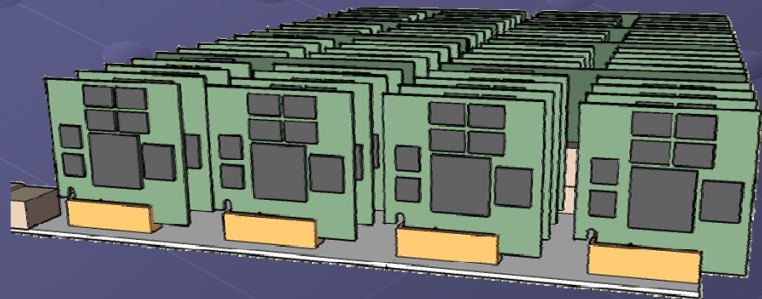
Source: Intel Future Computing density projection



# Technology Concepts



*2Level memory provides potential TCO improvement*



30-40W Low Power  $\mu$ Blade concept

*High density solutions for scale out workloads*

# Data Center Innovations

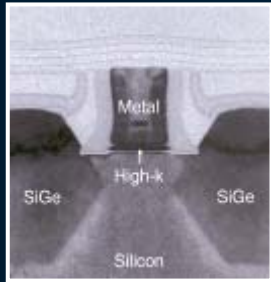


Containerized data centers

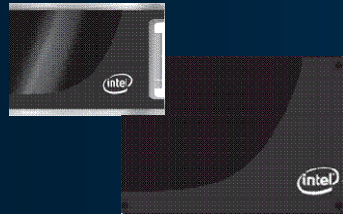


High density data centers

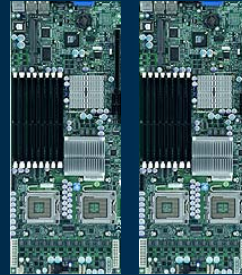
# Innovations to Increase Compute Density



Silicon Process



New Technology



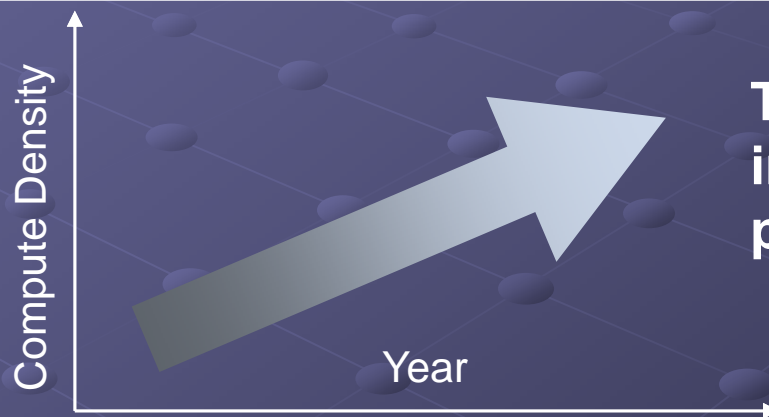
Small Form Factor



Power Management



Data Center Innovation



Target 50% yearly improvements in performance/watt

Source: Intel, based on Intel YoY improvement with SpecPower Benchmark

*Datacenter of the Future*



# Backup

