The HPC Challenge (HPCC) Benchmark Suite

Presented by

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HPCC: Components

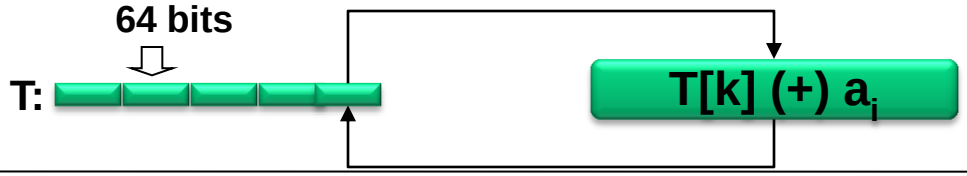
1. **HPL (High Performance LINPACK)** $Ax=b$

2. **STREAM**

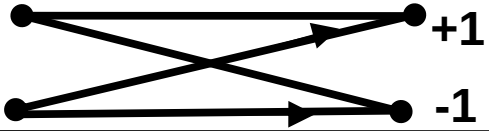
Name	Kernel	Bytes/iter	FLOPS/iter
Copy	A[i] = B[i]	16	0
Scale	A[i] = q * B[i]	16	1
Sum	A[i] = B[i] + C[i]	24	1
Triad	A[i] = B[i] + q*C[i]	24	2

3. **PTRANS** $A \leftarrow A^T + B$

4. **RandomAccess**



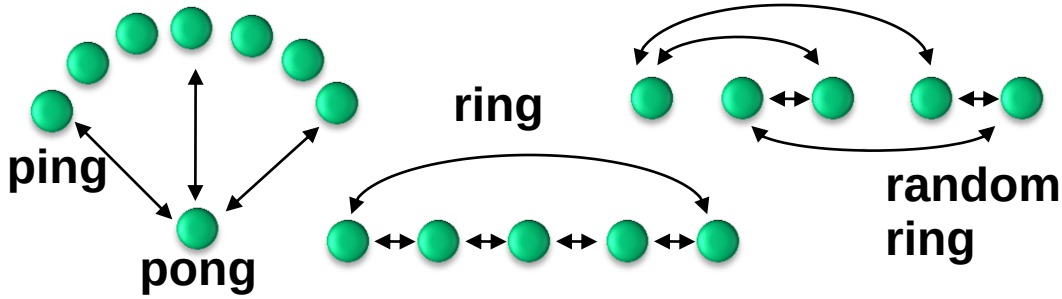
5. **FFT**



$z_k = \Sigma x_j \exp(-2\pi\sqrt{-1}\, jk/n)$

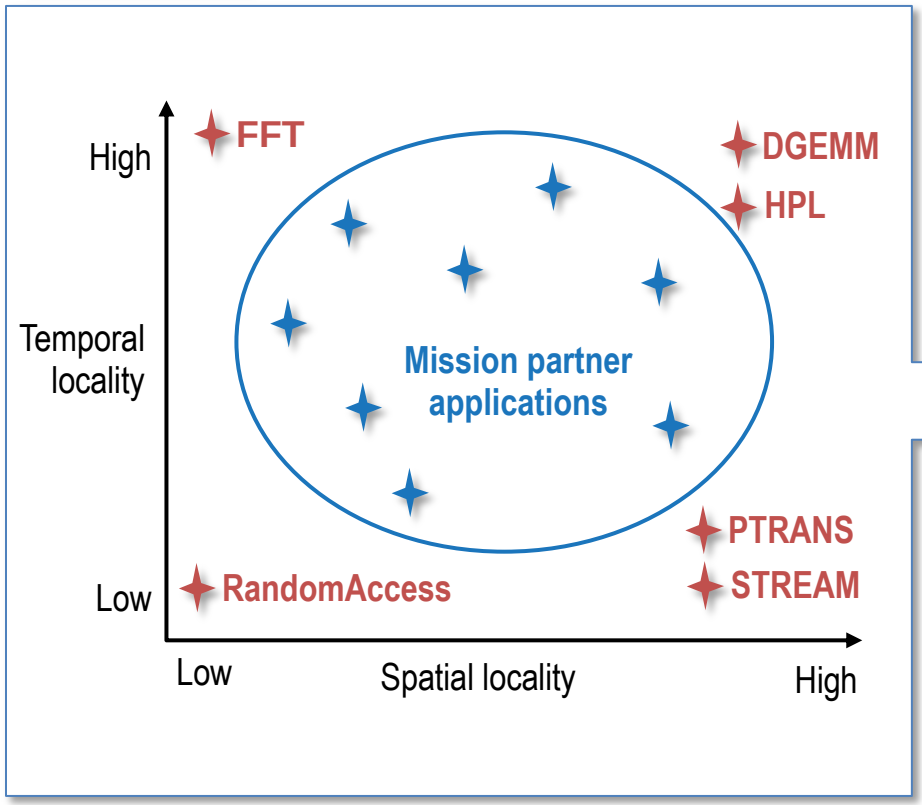
6. **Matrix-matrix multiply** $C \leftarrow s*C + t*A*B$

7. **b_eff (effective bandwidth/latency)**

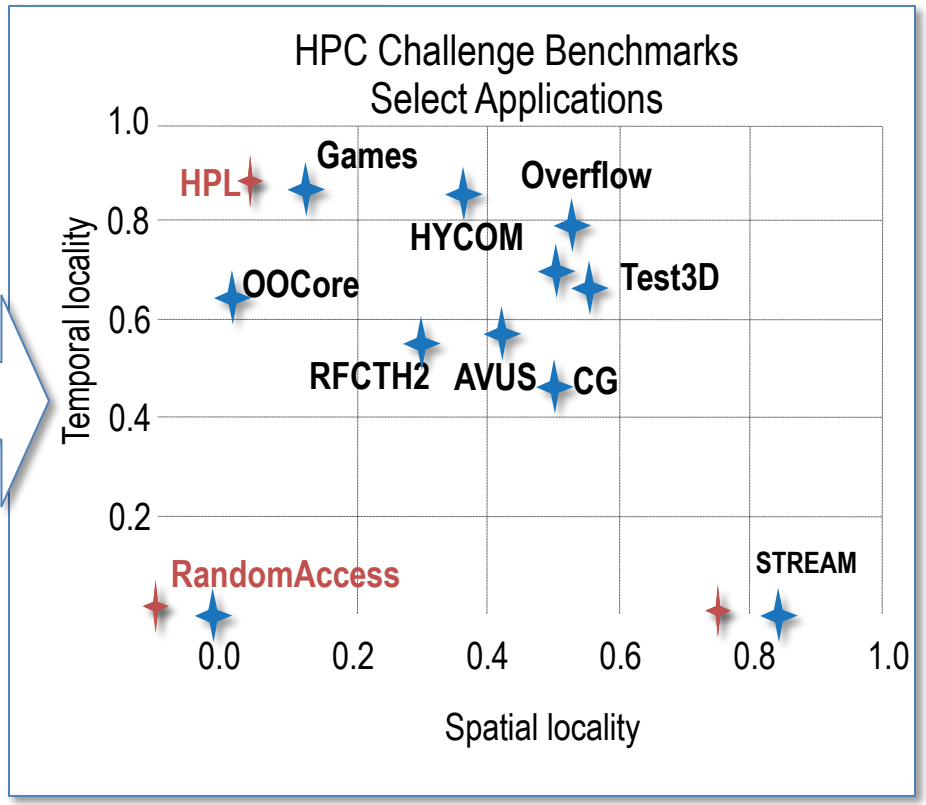


HPCC: Motivation and measurement

Concept



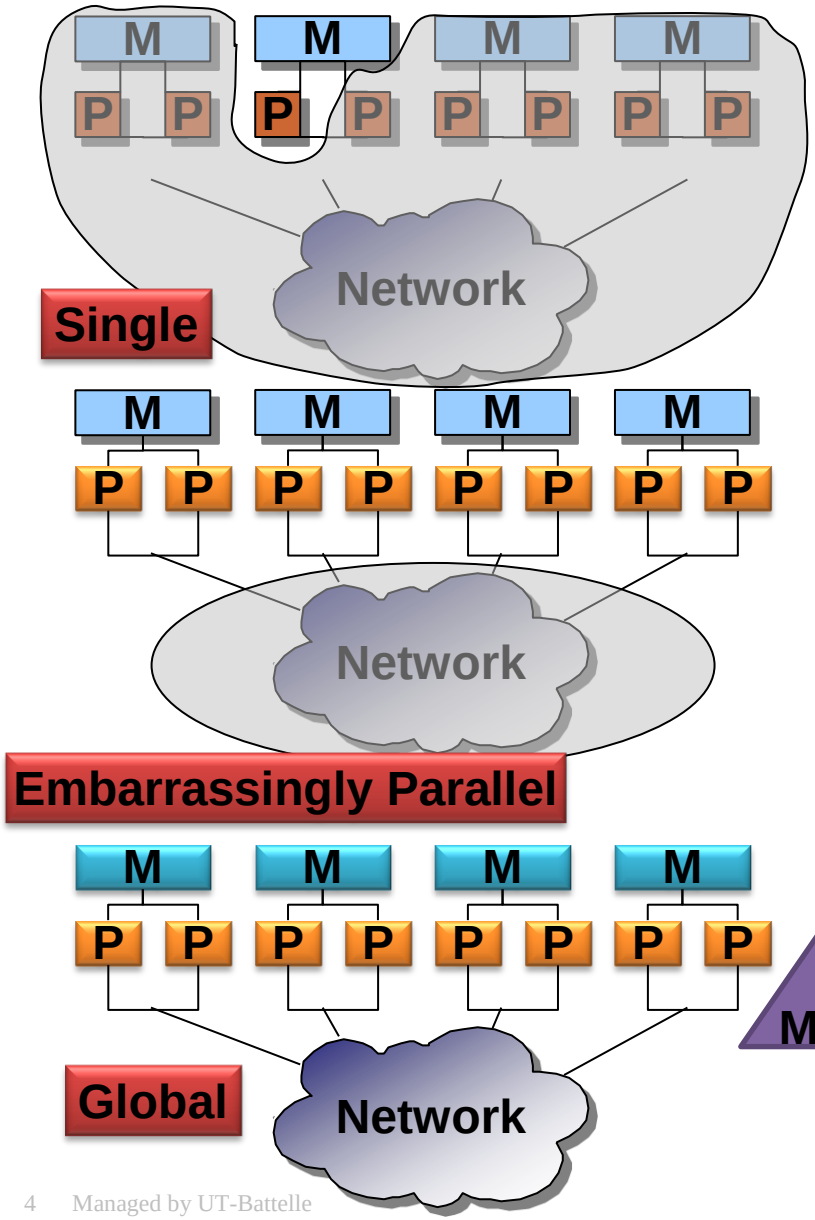
Measurement



Generated by PMaC @ SDSC

Spatial and temporal data locality here is for one node/processor

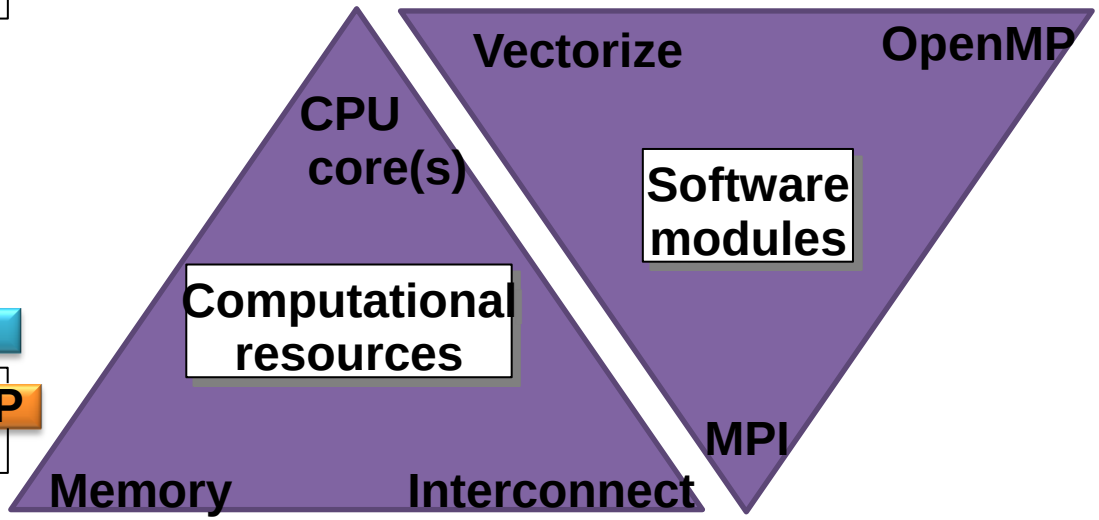
HPCC: Scope and naming conventions



G
EP
S

HPL
STREAM
FFT
...
RandomAccess
HPL

system
CPU
thread



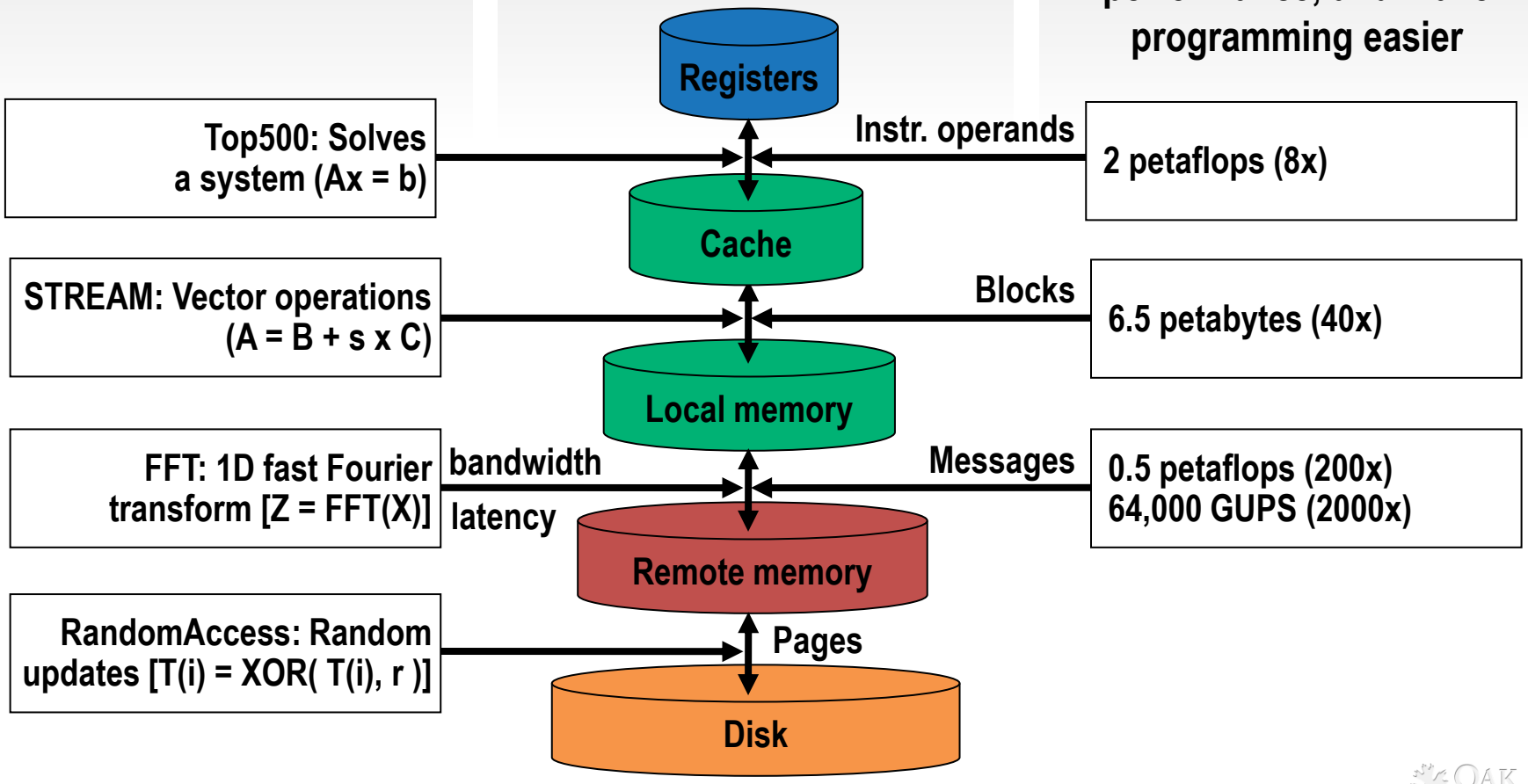
OAK RIDGE National Laboratory

HPCC: Hardware probes

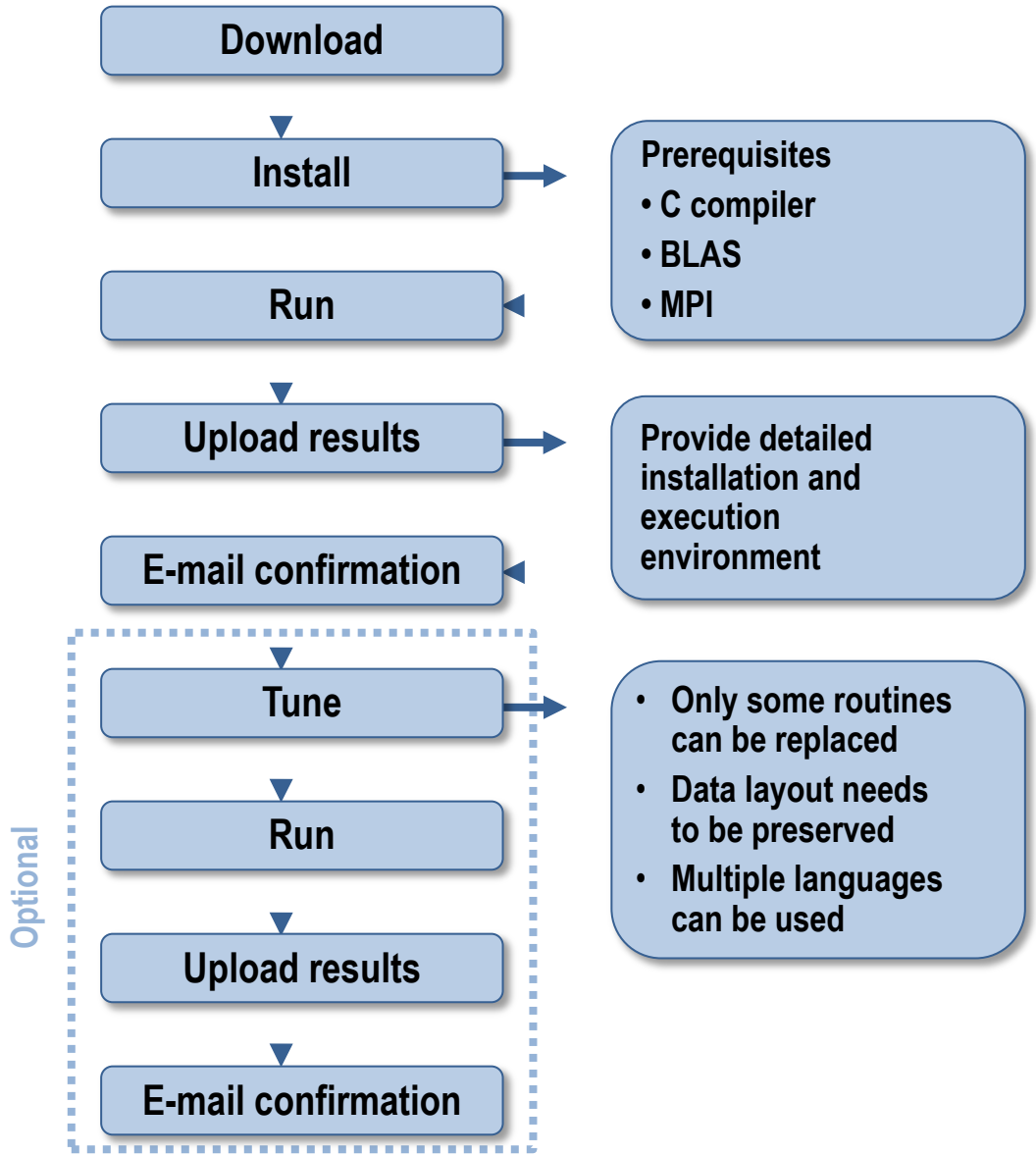
HPCS program has developed a new suite of benchmarks (HPC Challenge)

Each benchmark focuses on a different part of the memory hierarchy

HPCS program performance targets will flatten the memory hierarchy, improve real application performance, and make programming easier



HPCC: Official submission process



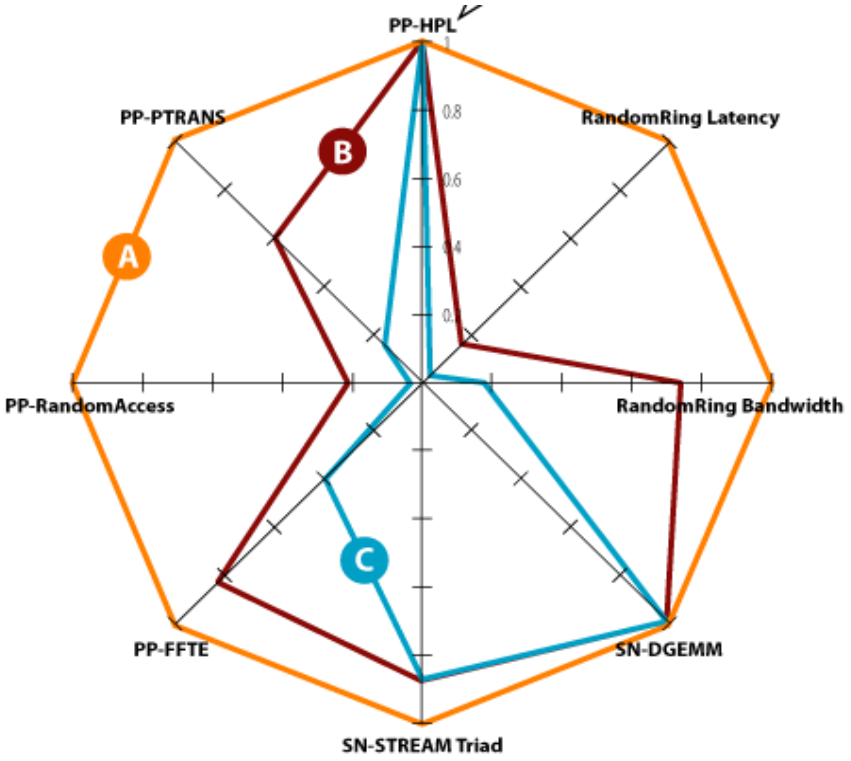
Results are immediately available on the Web site:

- Interactive HTML
- XML
- MS Excel
- Kiviat charts (radar plots)

HPCC: Comparing three interconnects

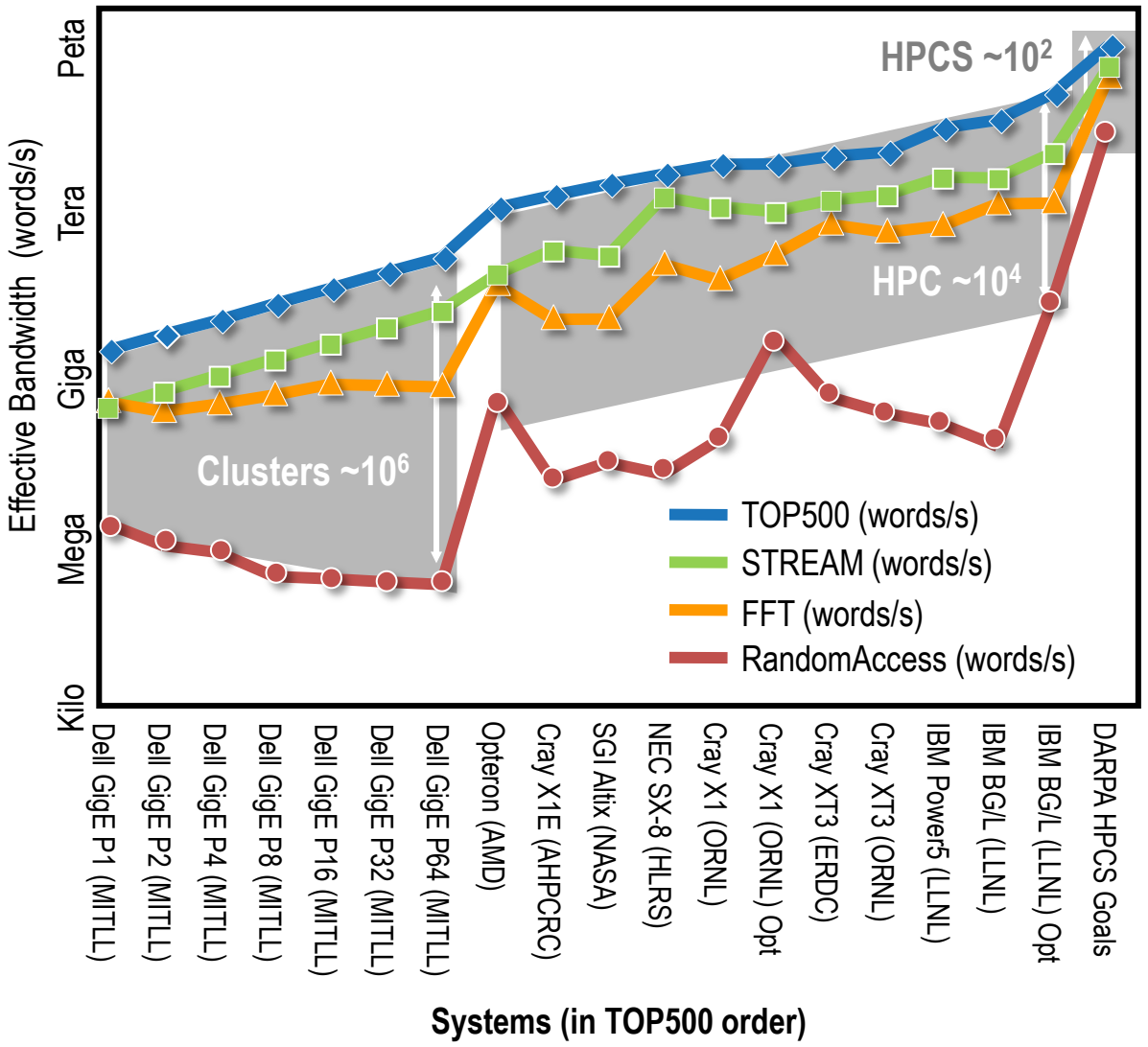
- 3 AMD Opteron clusters
  - Clock: 2.2 GHz
  - 64-processor cluster
- Interconnect types
  - Vendor
  - Commodity
  - GigE
  - G-HPL
  - Matrix-matrix multiply
- Cannot be differentiated based on
  - G-HPL
  - Matrix-matrix multiply
- Available on HPCC Web site
  - http://icl.cs.utk.edu/hpcc/

Kiviat chart (radar plot)



HPCC: Analysis of sample results

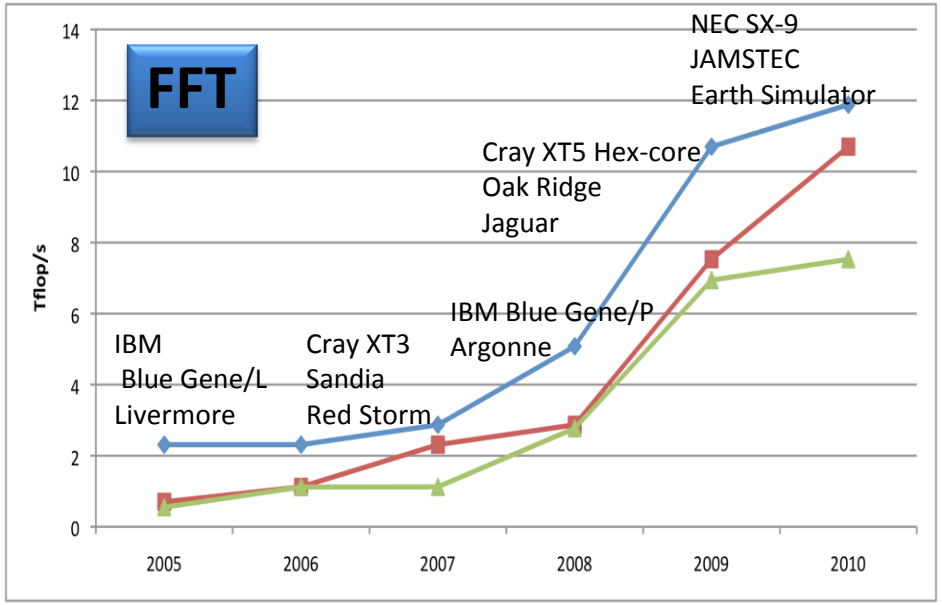
- All results in words per second
- Highlights memory hierarchy
- Clusters
  - Hierarchy steepens
- HPC systems
  - Hierarchy constant
- HPCS goals
  - Hierarchy flattens
  - Easier to program

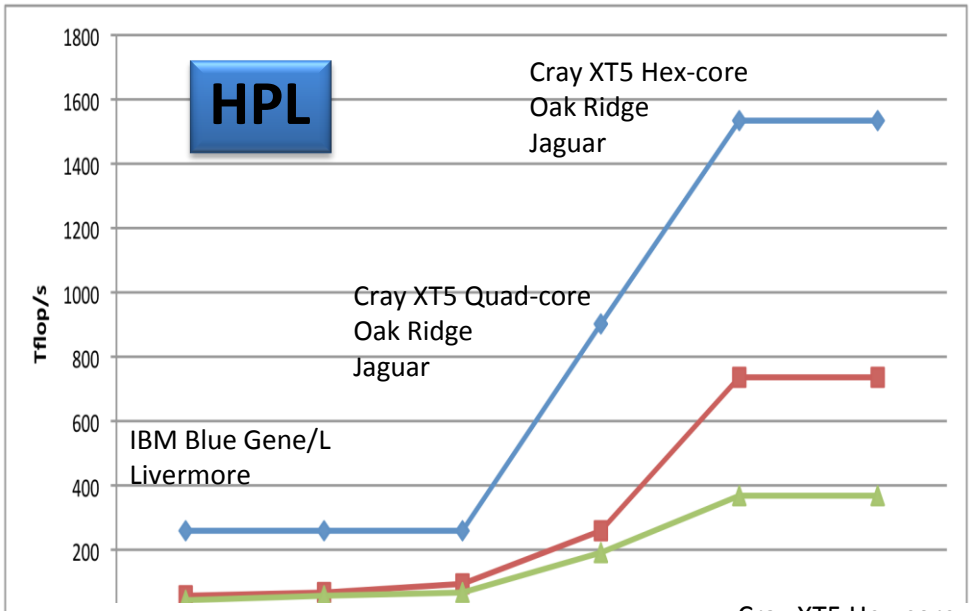


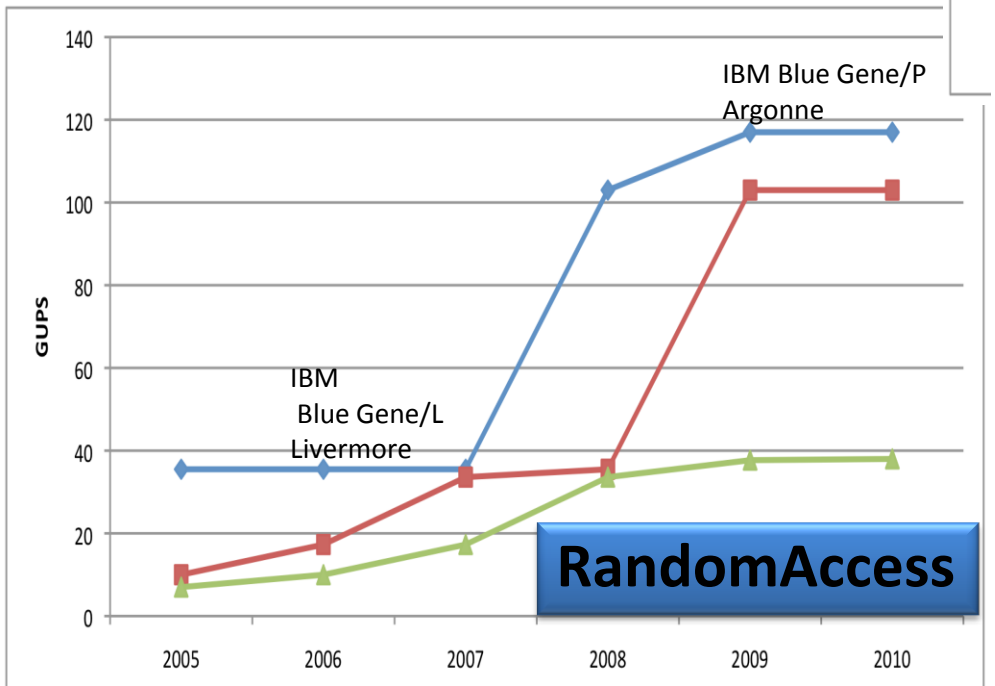
HPCC and TOP500 from June 2011

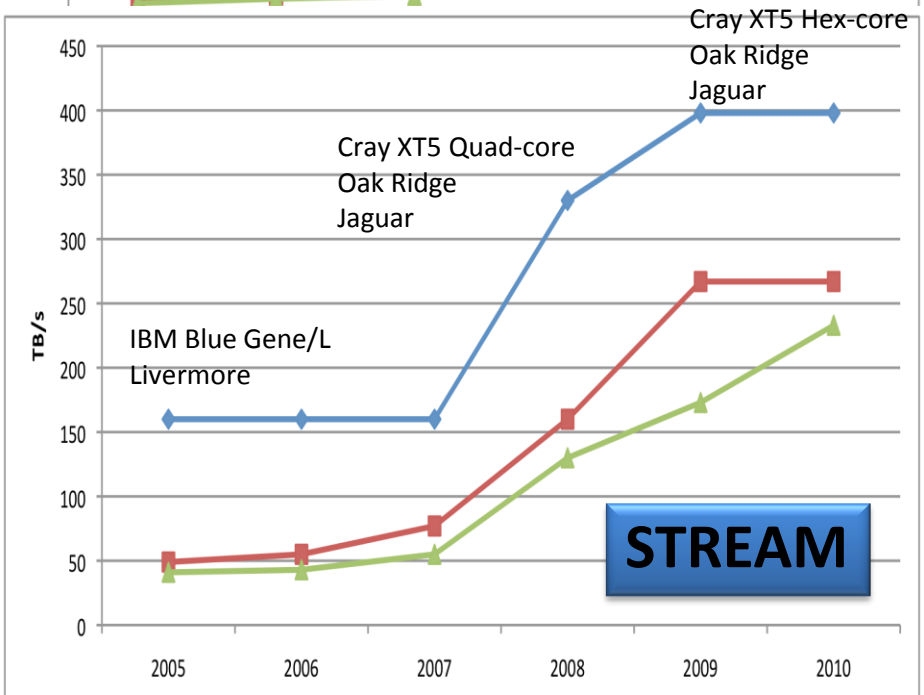
Rank	Name	Rmax Tflop/s	HPL Tflop/s	PTRANS GB/s	STREAM TB/s	FFT Tflop/s	GUPS	Latency micro-s	B-width
3	Jaguar	1759.0	1533.8	13723.2	398.3	10699	37.69	7.4	1.6
11	Kraken	919.1	736.3	1821.0	128.3	7530	18.50	7.2	1.6
18	Dawn	415.7	367.8	757.1	130.4	3201	117.13	4.7	0.4
15	Intrepid	458.6	191.3	670.0	130.4	5079	103.18	4.7	0.4
36	Red Storm	204.2	93.6	4993.6	77.1	2870	33.56	7.4	2.0
98	BGW	91.3	83.9	171.5	50.0	1235	21.61	4.7	0.2
123	ASC Purple	75.8	57.9	553.0	44.0	842	1.03	5.1	3.2
155	Columbia	66.6	46.8	91.3	21.1	230	0.25	4.2	1.4

HPCC Awards Class 1: Performance









Contact

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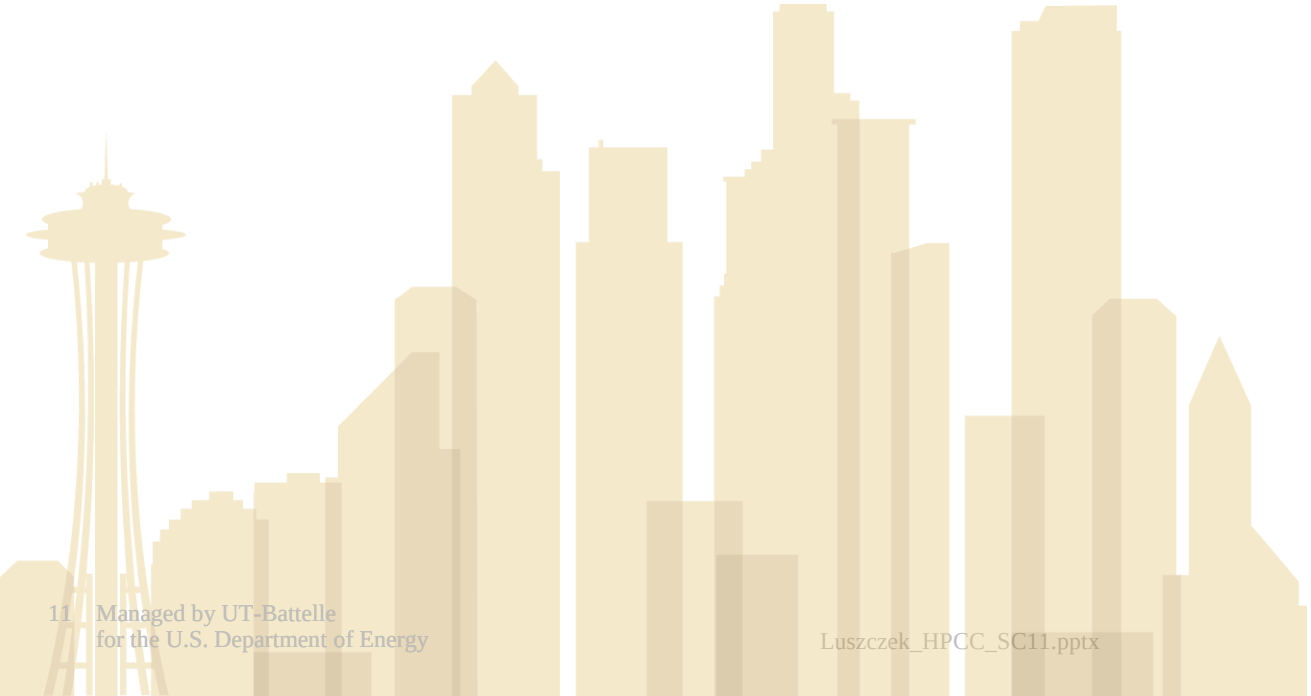
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