

CRAY

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EXPERIENCE



Computer Comparisons Using HPCC

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- **Comparisons using HPCC**
 - HPCC test used
- **Methods used to compare machines using HPCC**
 - Normalize scores
 - Weighted averages
- **Comparing current machines**
- **How would the “TOP 5” look?**
- **Conclusions**

- **How can HPCC be used to compare systems in use today?**
- **Current intention is to only provide information**
- **HPCC produces a lot of numbers, too many to do simple, whole machine comparisons**
- **A method to combine numbers into a single score is desirable**

- **To reduce the number of results to examine, take one or two subtest from each area**
- **HPL**
- **PTRANS**
- ***STREAM TRIAD**
 - **Take *STREAM TRIAD number and multiply by the number of CPUs to calculate aggregate bandwidth**
- **MPI (Global) Random Access**
 - **MPI version does a local sort, an ALL to ALL, and a local gather/scatter**
 - **UPC version is running on the CrayX1**

- **Random Ring Latency: Your neighbor is a random CPU in the machine**
 - Much more realistic than Ping Pong
 - Latency was by far the most difficult metric to interpret
- **Natural Ring Bandwidth: Your neighbor is the next MPI process**
 - Most data movement likely to be within a node and will **NOT** test the network

Methods to Compare Machines Using HPCC

- **Take scores from the HPCC website**
 - <http://icl.cs.utk.edu/hpcc/>
- **Additional Cray scores were added for comparison purposes in this presentation**
- **Remove “similar” entries**
 - If Architecture X with N CPUs is in there twice, remove second copy
 - Use optimized runs when available
- **Results in a list of 17 machines**

- **Normalize scores**
 - In each category take test result and divide by the combined power of all machines
 - Creates a unitless number
 - Equal to a percentage of total power
- **Combine all 6 unitless numbers into 1 number using one of two methods**
 - 50% HPL – 50% others
 - Still strongly emphasizes LINPACK, but at least others count for something
 - Every test equal
 - A question of what tests are included, not how to weight each test

HPCC: 100% HPL



Machine Name- #CPUS	Tflops
Cray X1- 252	2.35
Cray X1- 124	1.18
Linux Networx- 256	1.03
IBM Power4- 504	0.903
IBM Power4- 256	0.654
HP DEC Alpha- 484	0.618
Cray X1- 60	0.58
SGI Altix- 128	0.52

Results from <http://icl.cs.utk.edu/hpcc/>

HPCC: 50% HPL 50% other



Machine Name- # CPUS	HPCC Score	HPL Order
Cray X1- 252	25.6	1
Cray X1- 124	14.7	2
Cray X1- 60	8.23	7
Linux Networx- 256	6.63	3
Cray T3E- 1024	6.32	16
IBM Power4- 504	6.21	4
HP DEC Alpha- 484	5.27	6
Cray X1- 32	5.00	10

IBM Power4 256 CPU now #9; SGI Altix 128 CPU now #11

HPCC: Equal Weighting



Machine Name- # CPUS	HPCC Score	HPL Order
Cray X1- 252	26.5	1
Cray X1- 124	16.4	2
Cray T3E- 1024	10.2	16
Cray X1- 60	9.75	7
Cray X1- 32	6.43	10
HP DEC Alpha- 484	4.54	6
IBM Power4- 504	4.15	4
Linux Networx- 256	3.99	3

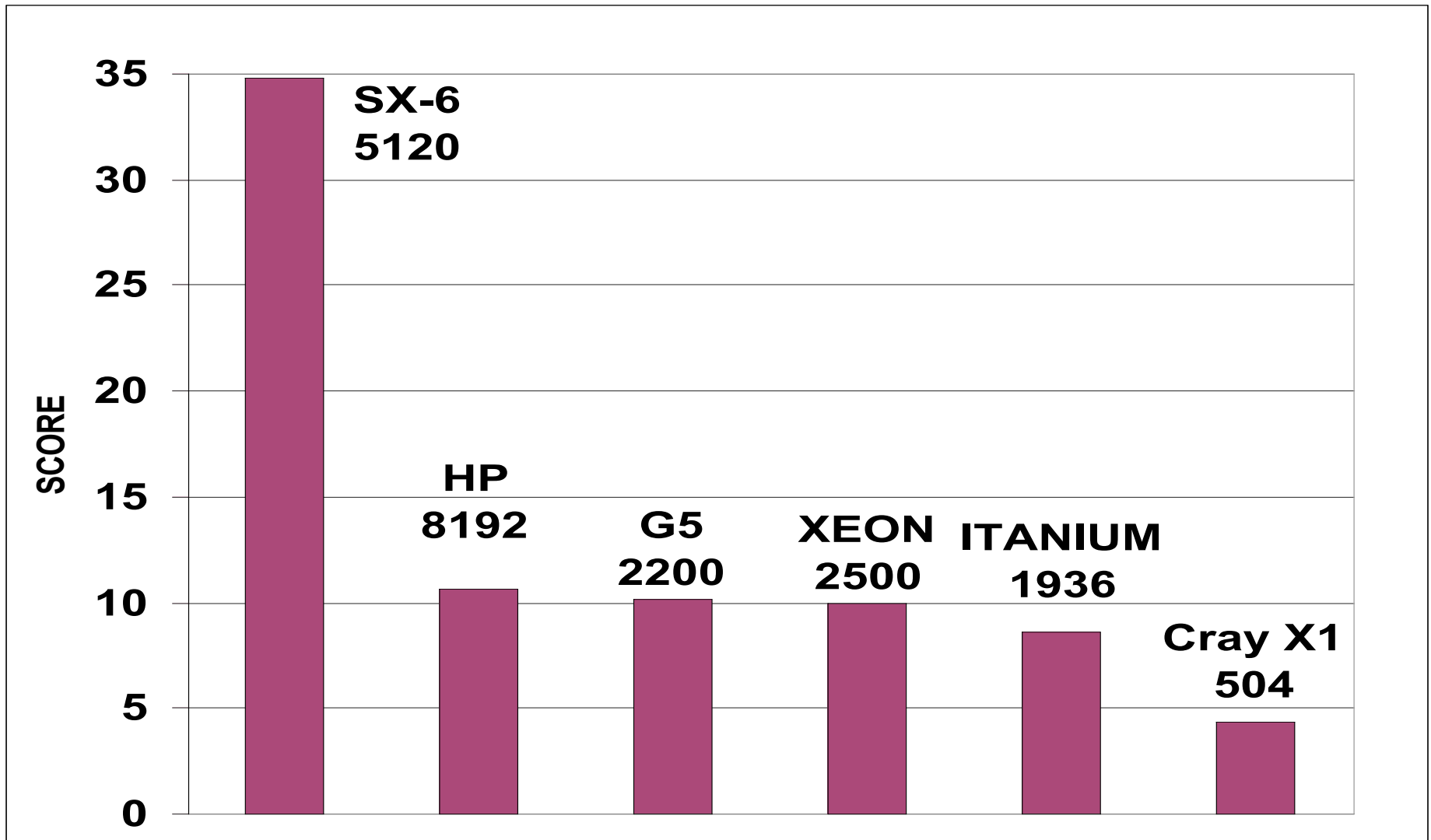
IBM Power4 256 CPU now #12; SGI Altix 128 CPU now #14

How would the “TOP 5” do?



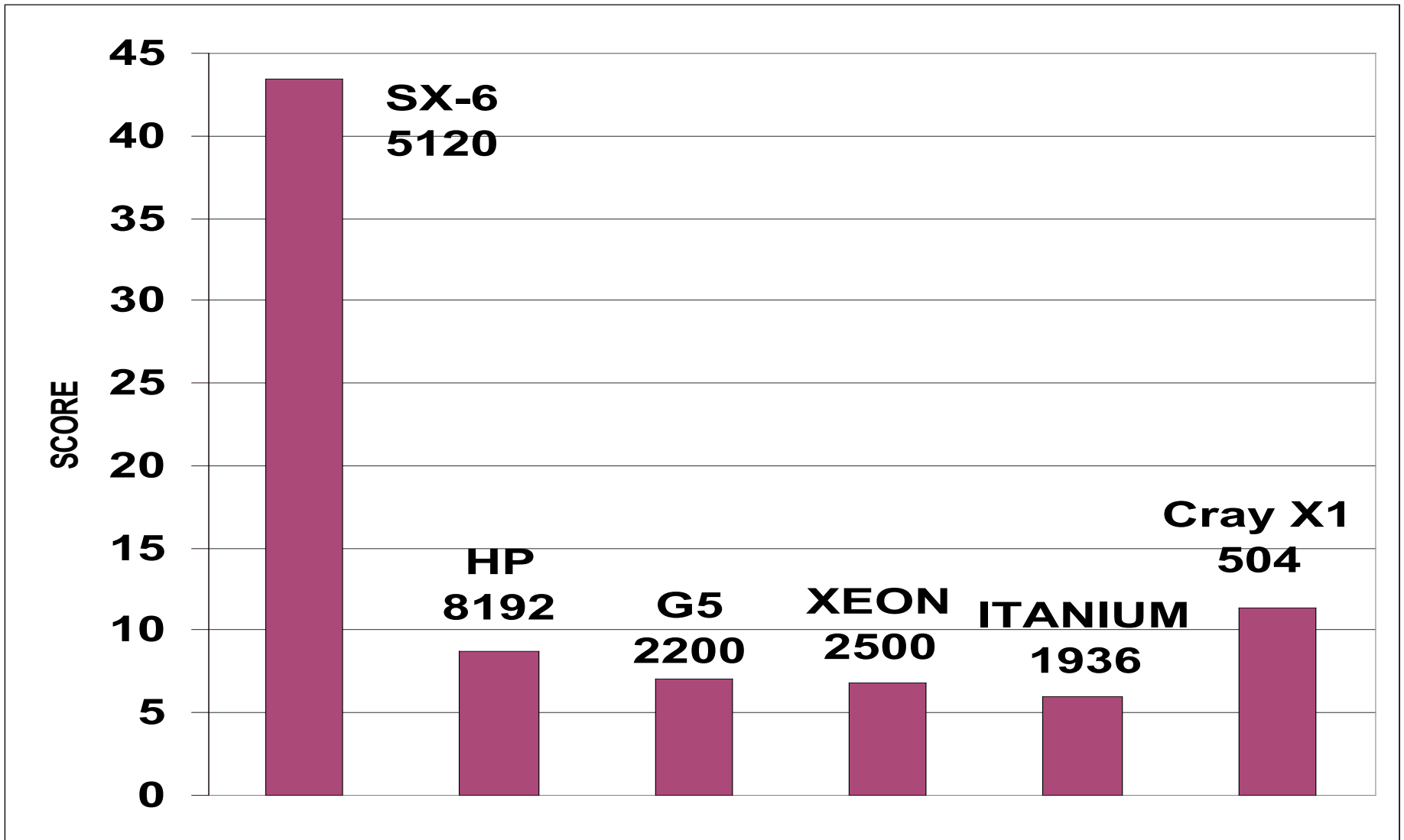
- Estimate HPCC numbers for the top 5 from current TOP 500 list
- Add a large CrayX1 using UPC for RandomAccess and Network Latency and Bandwidth tests
- Estimations of HPCC performance were made by:
 - HPL: use LINPACK number (real number)
 - PTRANS: scale linearly from similar machine (optimistic)
 - STREAM: scale linearly from similar machine on HPCC list (realistic)
 - MPI GUPS: Best estimate
 - Random Ring Latency: assume ~50% increase in latency for every 2X in machine size (realistic)
 - Natural Ring Bandwidth: scale linearly from similar machine (optimistic)
- If you disagree, **SHOW ME THE REAL NUMBERS!!!**

“TOP 5” Performance: 100% HPL



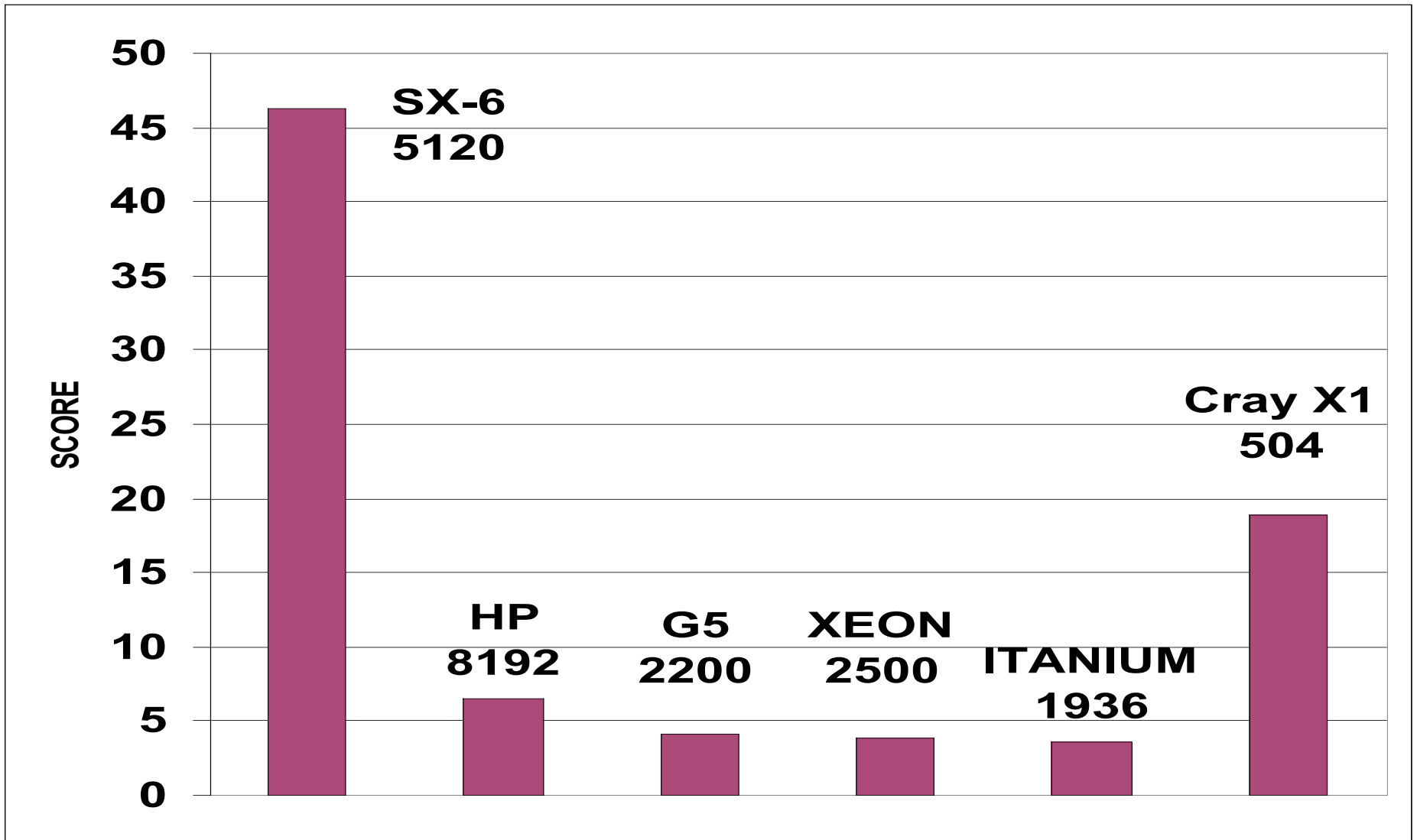
Based on LINPACK or estimated performance

“TOP 5” Perf: 50% HPL, 50% other



Based on estimated HPC performance

“TOP 5” Perf: Equal Weighting



Based on estimated HPC performance

“TOP 5” HPCC: Equal Weight



Machine Name- # CPUs	HPCC SCORE
SX-6 – 5120	46.2*
Cray X1- 504	18.9**
HP- 8192	6.50*
APPLE G5- 2200	4.11*
XEON Cluster- 2500	3.90*
Cray X1- 252	3.88
ITANIUM- 1936	3.52*

***Based on estimated HPCC performance**

****Uses some UPC**

- **Using only HPL (LINPACK) results in comparisons emphasizing only peak processor speed and number of CPUs**
- **HPCC results in too many numbers to be used directly, it is desirable to create a single score so machines can more easily be compared**
- **HPCC is a powerful new tool for examining machine performance using more challenging kernels**