

TOP500



Presentation of the 16th List

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SC2000, Dallas, TX, November 4-10, 2000

BoF Session, November 8, 5:30pm

TOP500

TOP500 BoF

- **Presentation of the 16th Top500 List**
- TOP500 Background Information and general Market Overview.
- Geographical Distribution
- Manufacturers
- Performance Development
- Architectures, Technology
- Future TOP500 Ideas and Plans

TOP500

TOP500 Motivation

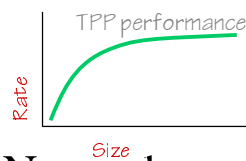
- Basis for analysing the HPC market
- Quantification of observations
- Detection of trends
 - Market
 - Architecture
 - Technology

TOP500

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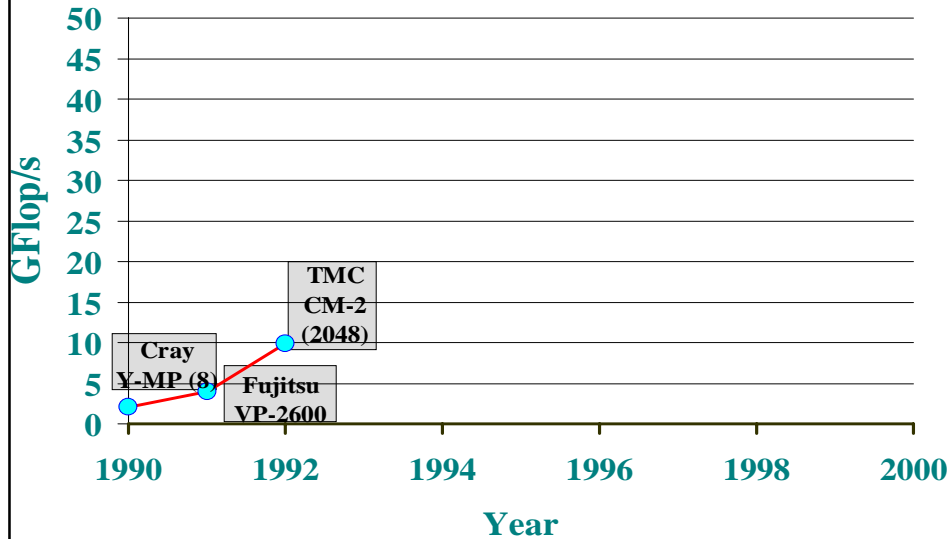
- Listing of the 500 most powerful Computers in the World
- Yardstick: Rmax from LINPACK MPP

$Ax=b$, dense problem



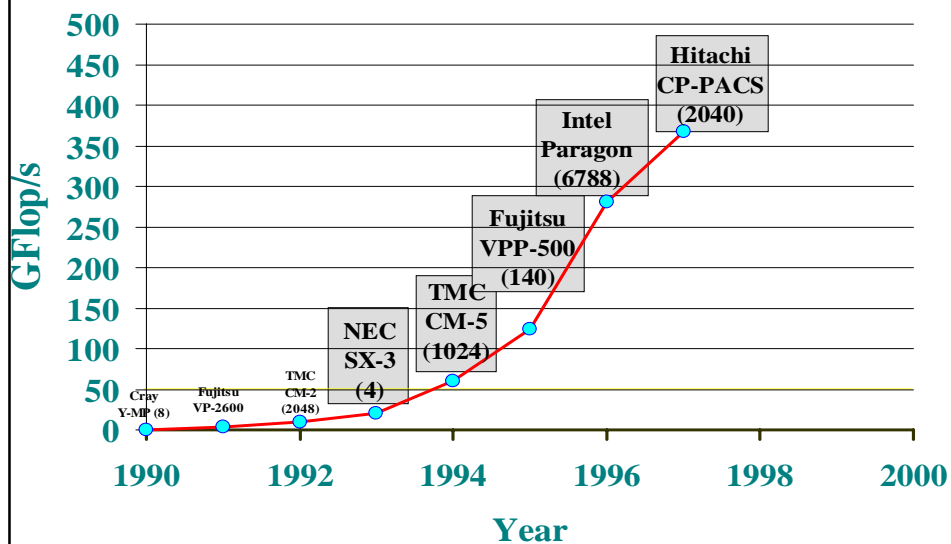
- Updated twice a year
 - SC'xy in the States in November
 - Meeting in Mannheim, Germany in June
- All data available from www.top500.org

Fastest Computer Over Time

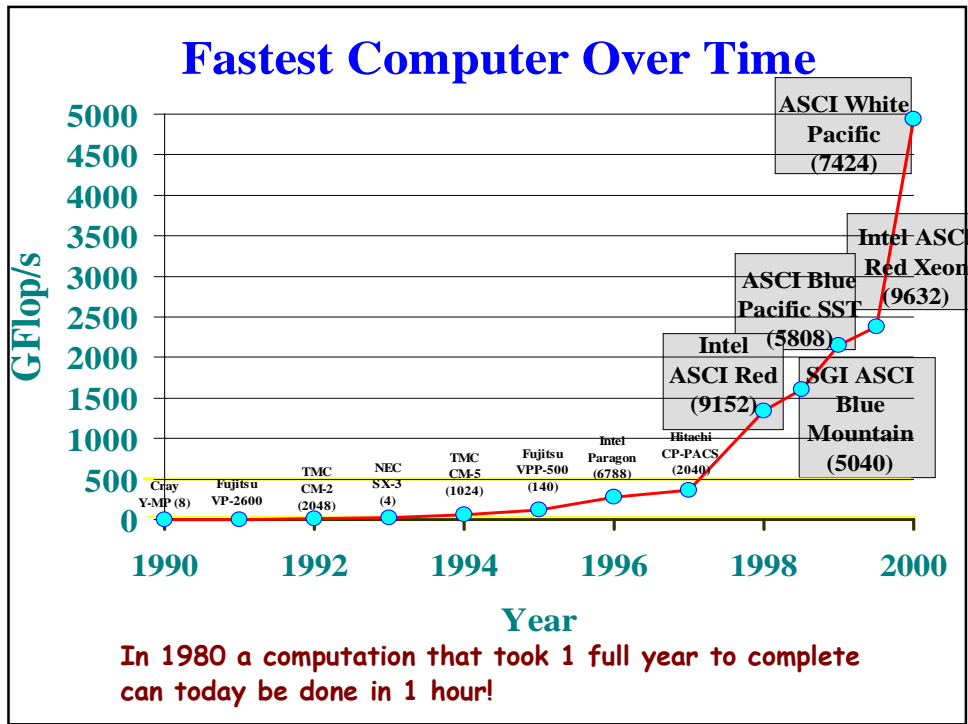


In 1980 a computation that took 1 full year to complete can now be done in 1 month!

Fastest Computer Over Time



In 1980 a computation that took 1 full year to complete can now be done in 4 days!



TOP500 Authors

- Started in spring 1993 by:



Hans W. Meuer



Erich Strohmaier

- Author since 6/1993 and “11/2000”



Jack Dongarra



Horst Simon

TOP500

TOP500 Status

- 1. List in June 1993
- Accepted by users and manufacturers
- 16. List on November 2, 2000



TOP500

TOP500 list - Data shown

- **Manufacturer** Manufacturer or vendor
- **Computer Type** indicated by manufacturer or vendor
- **Installation Site** Customer
- **Location** Location and country
- **Year** Year of installation/last major update
- **Customer Segment** Academic, Research, Industry, Vendor, Class.
- **# Processors** Number of processors
- **R_{max}** Maximal LINPACK performance achieved
- **R_{peak}** Theoretical peak performance
- **N_{max}** Problemsize for achieving R_{max}
- **$N_{1/2}$** Problemsize for achieving half of R_{max}
- **N_{world}** Position within the TOP500 ranking

TOP500

TOP10

Rank	Manufacturer	Computer	R_{max} [TF/s]	Installation Site	Country	Year	Area of Installation	# Proc
1	IBM	ASCI White SP Power3	4.93	Lawrence Livermore National Laboratory	USA	2000	Research	8192
2	Intel	ASCI Red	2.38	Sandia National Laboratory	USA	1999	Research	9632
3	IBM	ASCI Blue Pacific SST, IBM SP 604E	2.14	Lawrence Livermore National Laboratory	USA	1999	Research	5808
4	SGI	ASCI Blue Mountain	1.61	Los Alamos National Laboratory	USA	1998	Research	6144
5	IBM	SP Power3 375Mhz	1.42	IBM/Naval Oceanographic Office (NAVOCEANO)	USA	2000	Research	1336
6	IBM	SP Power3 375Mhz	1.18	National Centers for Environmental Prediction	USA	2000	Research	1104
7	Hitachi	SR8000-F1	1.04	Leibniz Rechenzentrum	Germany	2000	Academic	112
8	IBM	SP Power3 375MHz 8way	0.93	San Diego Supercomputer Center	USA	2000	Academic	1152
9	Hitachi	SR8000-F1	0.92	High Energy Accelerator Research Organization/ KEK	Japan	2000	Research	100
10	Cray Inc.	T3E 1200	0.89	Government	USA	1998	Classified	1084

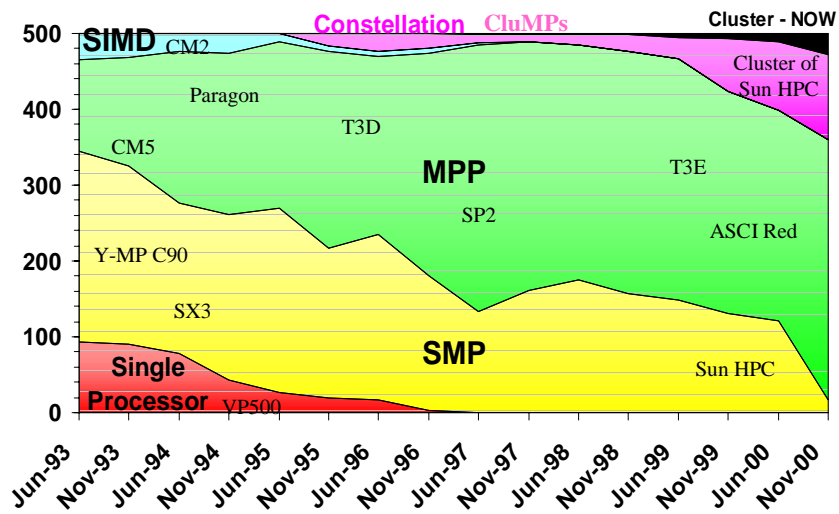
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Architectures



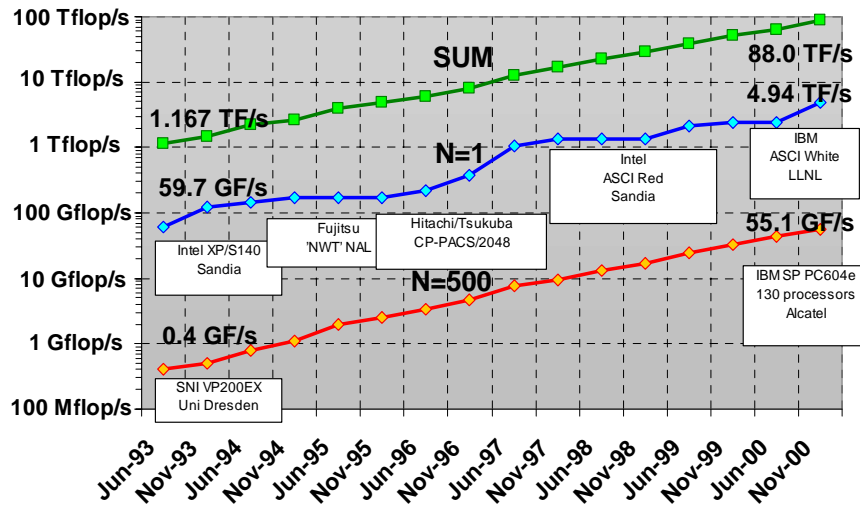
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Excerpt from TOP500

Rank	Manufacturer	Computer	Rmax [GF/s]	Installation Site	Country	Year	Area of Installation	# Proc
...
80	IBM	LosLobos	237	University of New Mexico	USA	2000	Academic	512
...
84	Self-made	Cplant Cluster	232	Sandia National Lab	USA	1999	Research	580
...
96	HPTi	ACL-276	196	NOAA	USA	1999	Research	276
...
126	Self-made	CLIC PIII	143	Technical University of Chemnitz	Germany	2000	Academic	528
...
413	Self-made	NT SuperCluster	63	NCSA	USA	1999	Academic	256

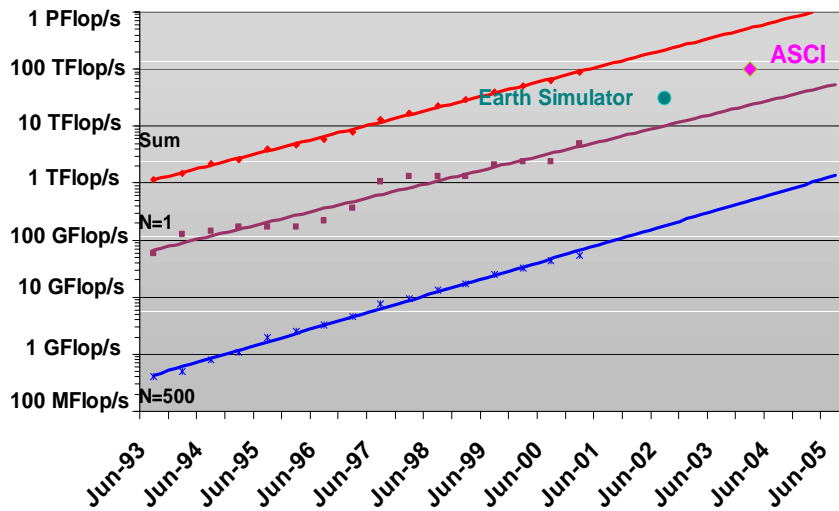
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Performance Development



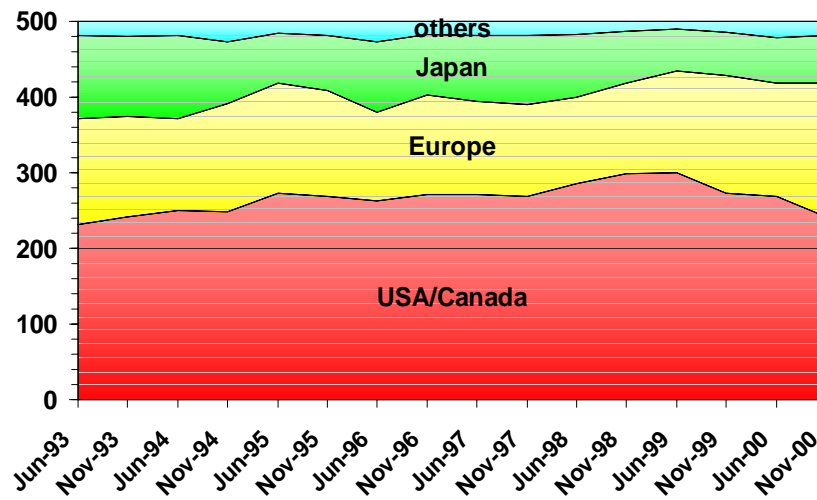
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Performance Development



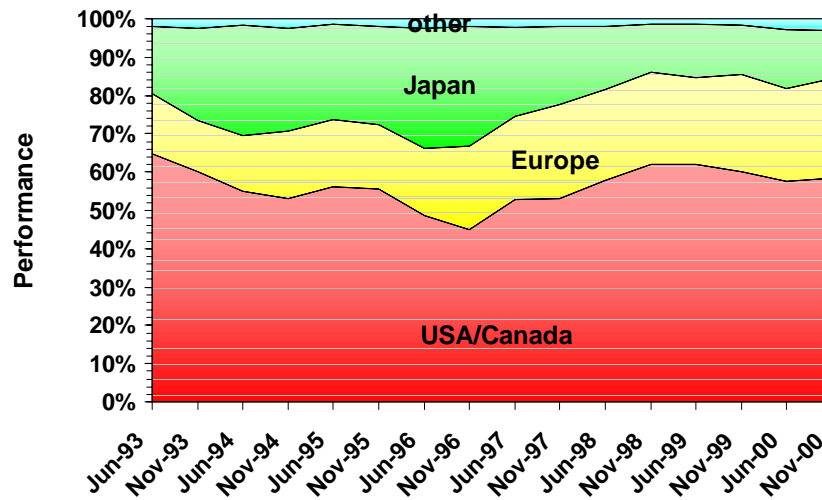
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Continents



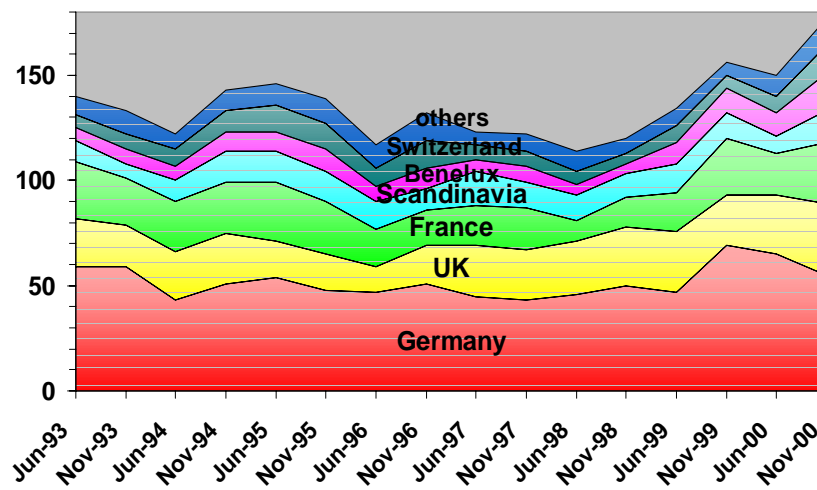
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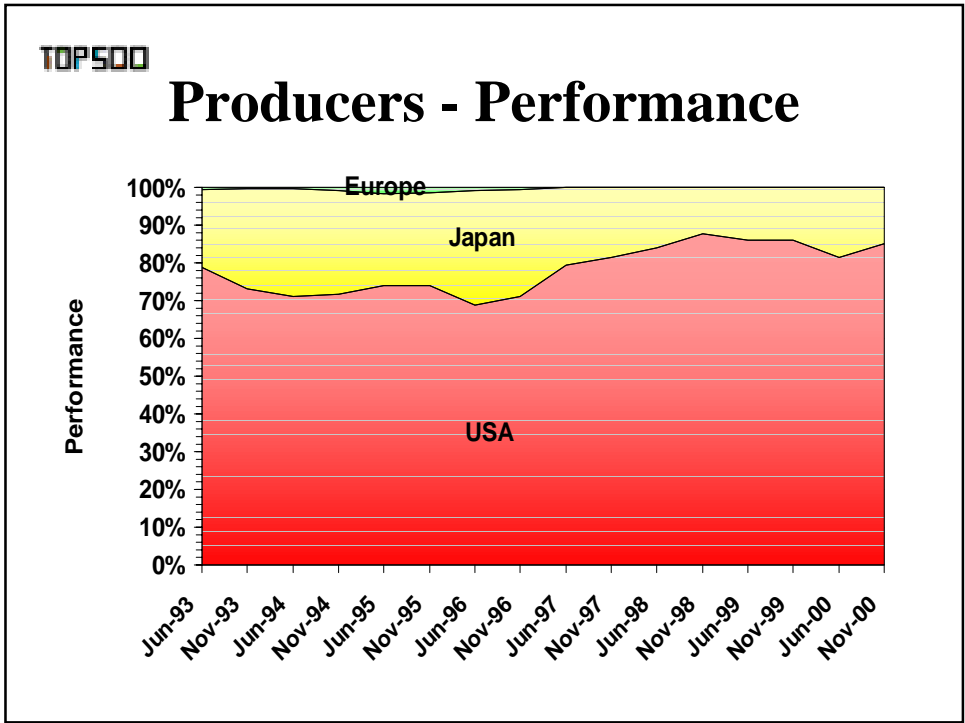
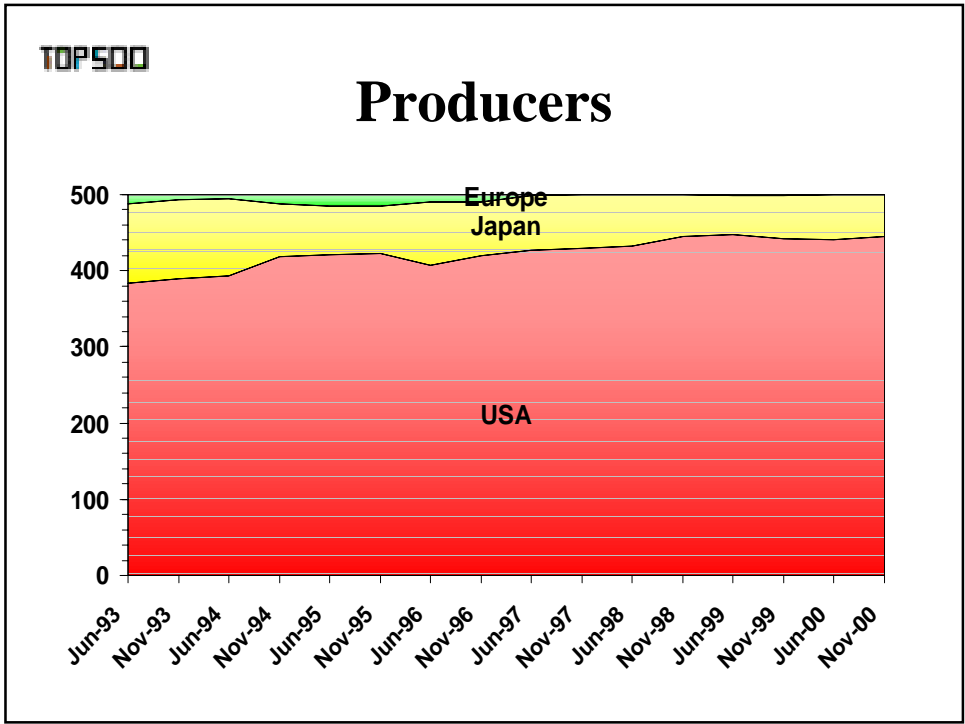
Continents - Performance



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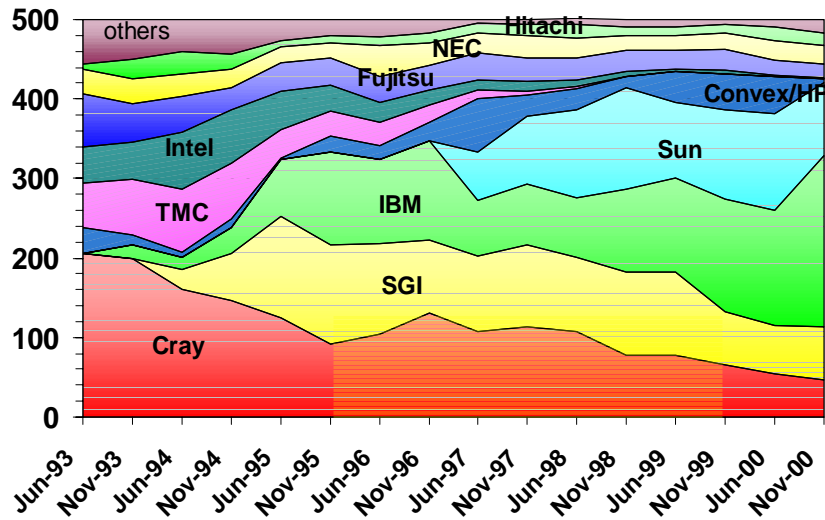
Europe - Countries





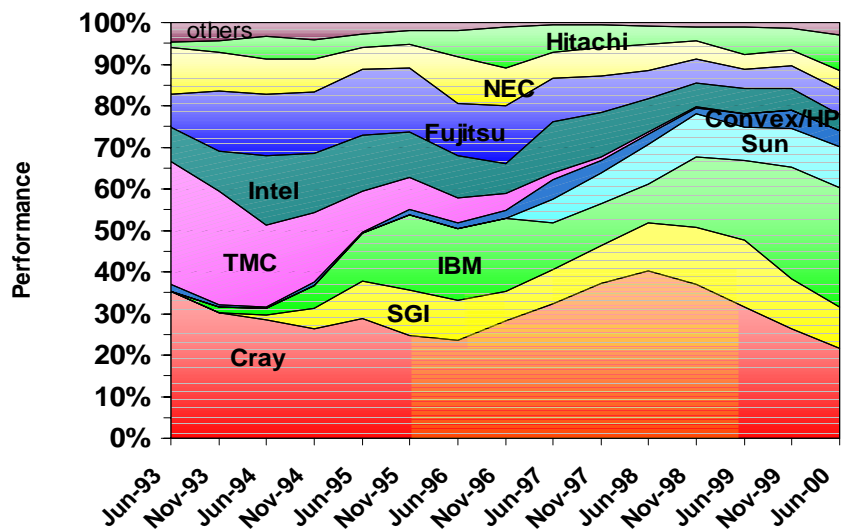
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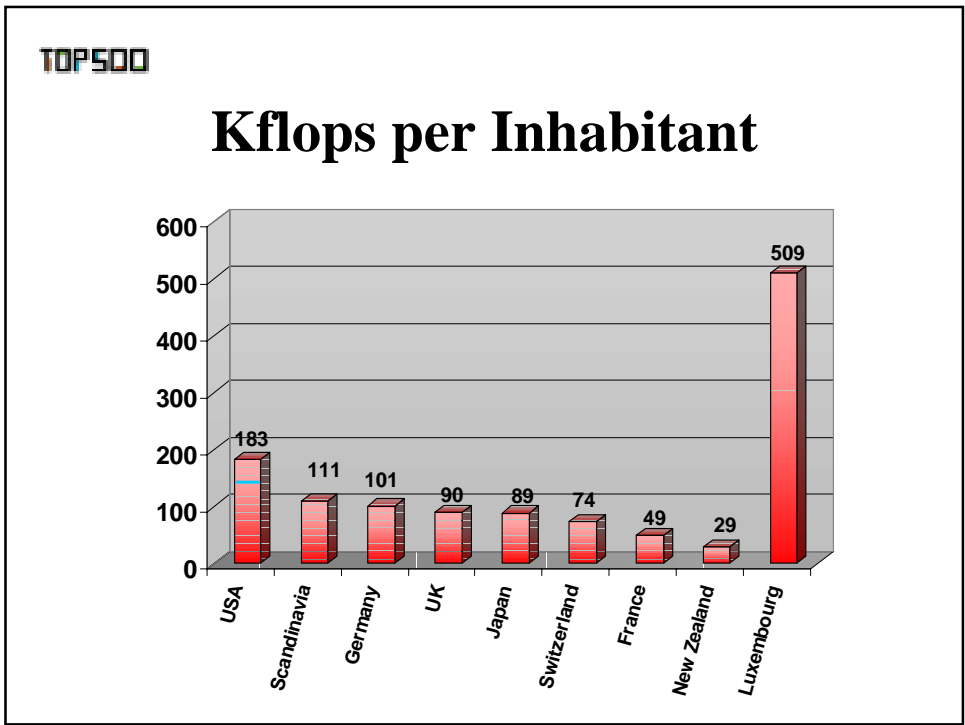
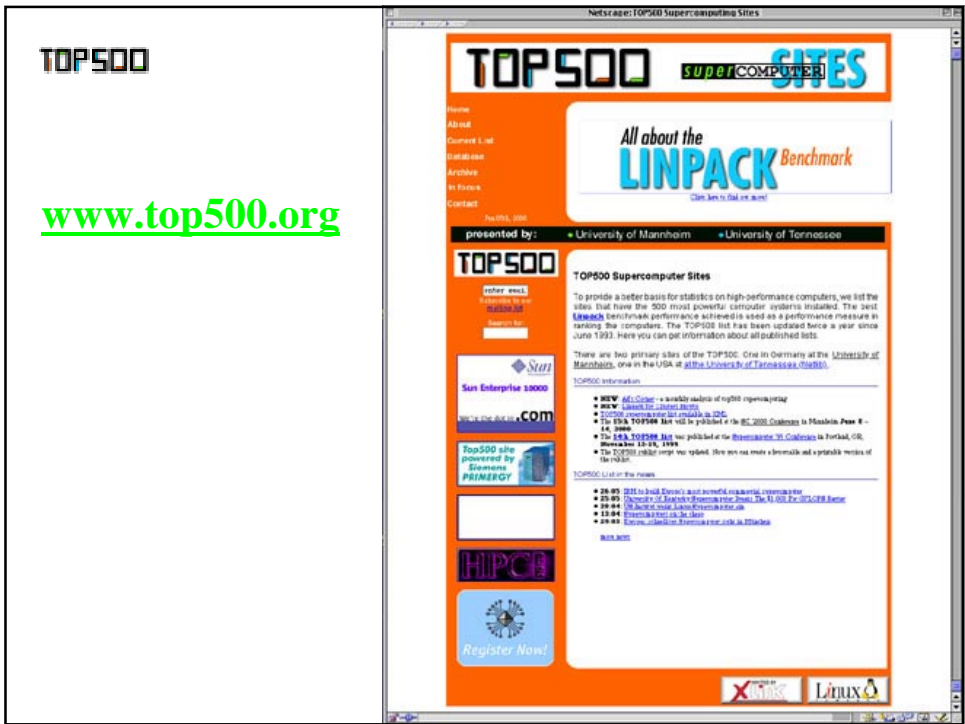
Manufacturer



TOP500

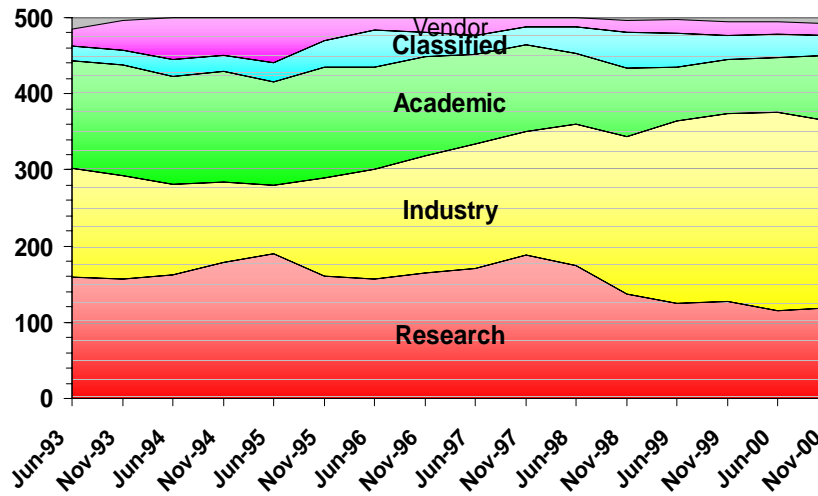
Manufacturer





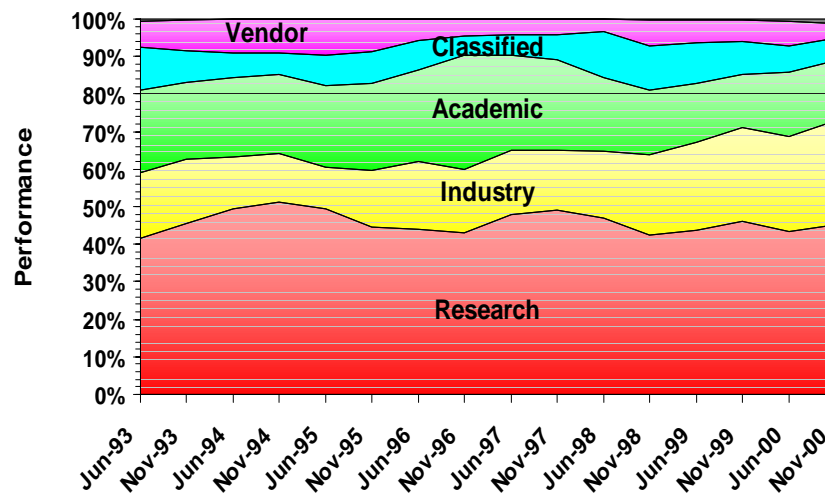
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Customer Type



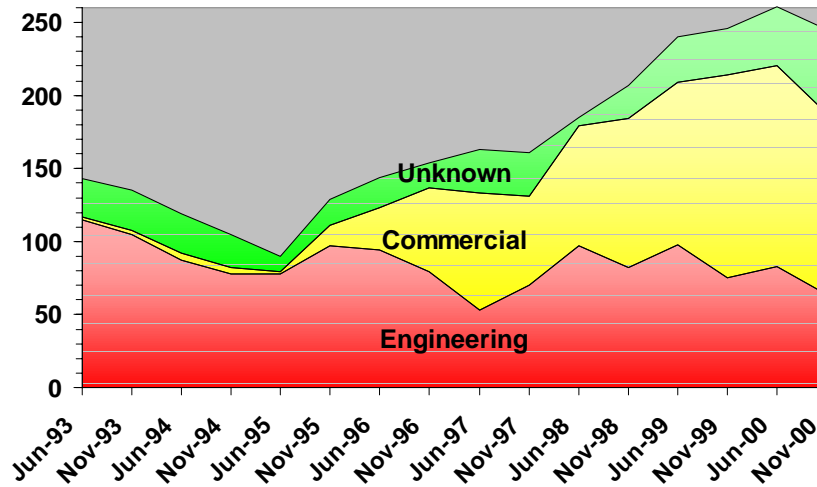
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Customer Types - Performance



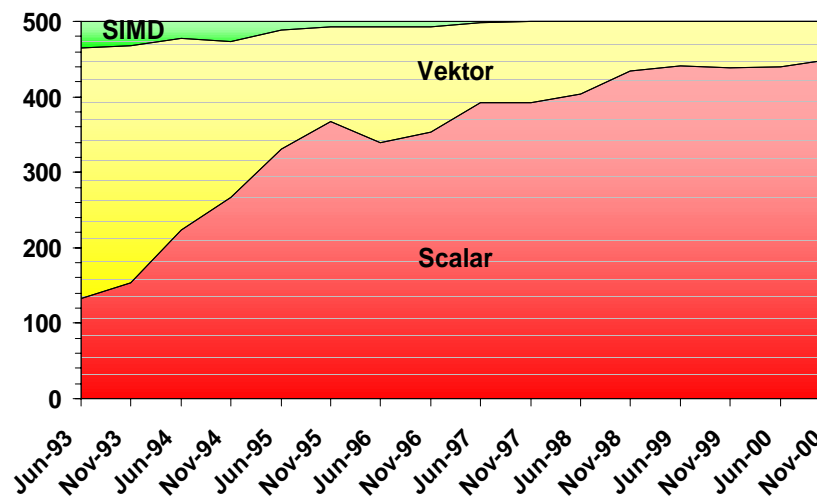
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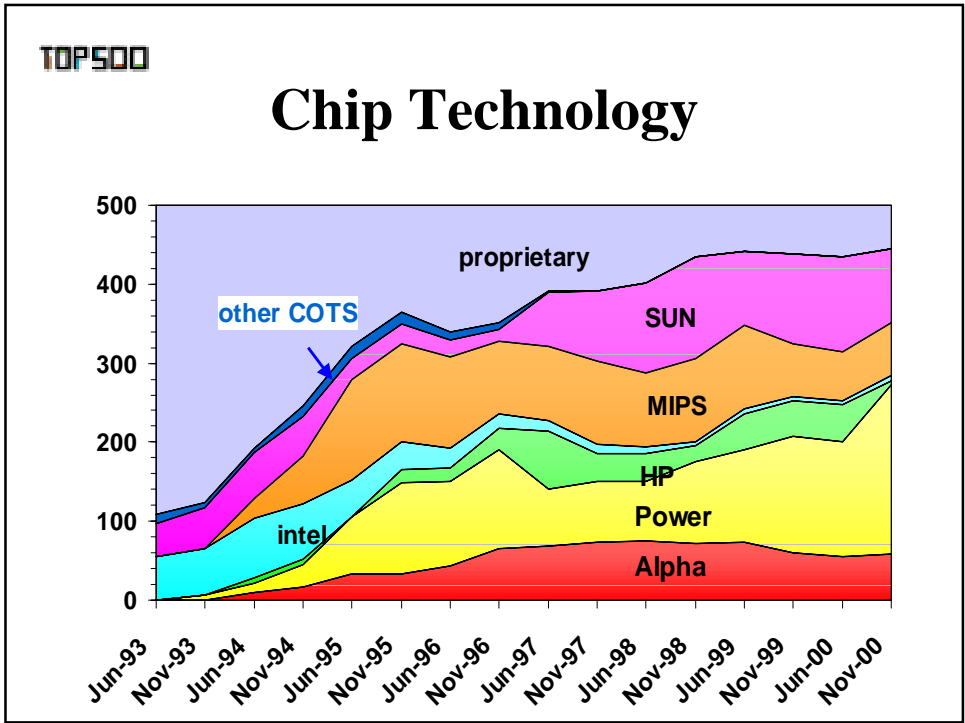
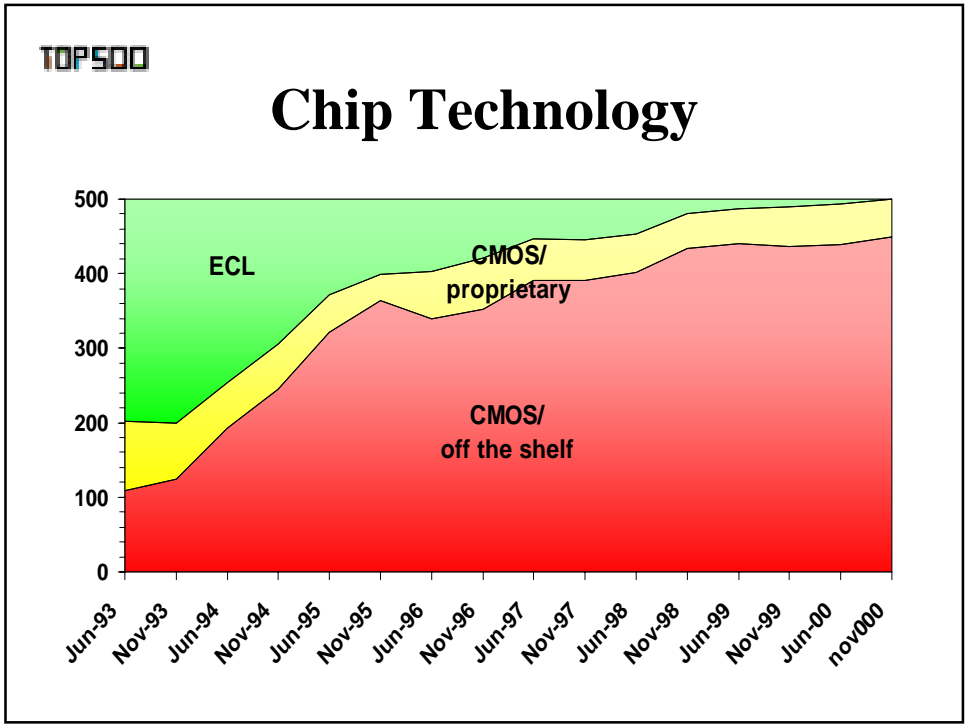
Industrial Customer Segments



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Processor Type





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TOP Centers

- Two approaches (No ‘classified’ centers):
- Sum up all TOP500 systems for each site
 - Snapshot only
- “Try” on historical perspective:
 - Sum up all systems over **all lists** * 0.5 years
= Total deliverable Linpack flop years
 - This give a ‘discounted’ credit for history

TOP500

TOP10 Centers - “snap-shot”

Rank	Site	$\sum R_{\max}$ [TF/S]	Current Best	Country
1	Lawrence Livermore National Laboratory	7.7	1, 3, 32, 36	USA
2	Sandia National Laboratory	2.38	2, 408	USA
3	Los Alamos National Laboratory	2.36	4, 19, 401	USA
4	Naval Oceanographic Office (NAVOCEANO)	2.17	5, 21, 326	USA
5	US Army Research Laboratory (ARL)	1.32	28, 138, 253- 258, 424, 425	USA
6	Charles Schwab	1.28	15, 34	USA
7	ECMWF	1.20	12, 90, 214	UK
8	National Center for Environmental Prediction	1.18	9	USA
9	Leibniz Rechenzentrum	1.14	11, 196	Germany
10	University of Tokyo	1.11	13, 85	Japan

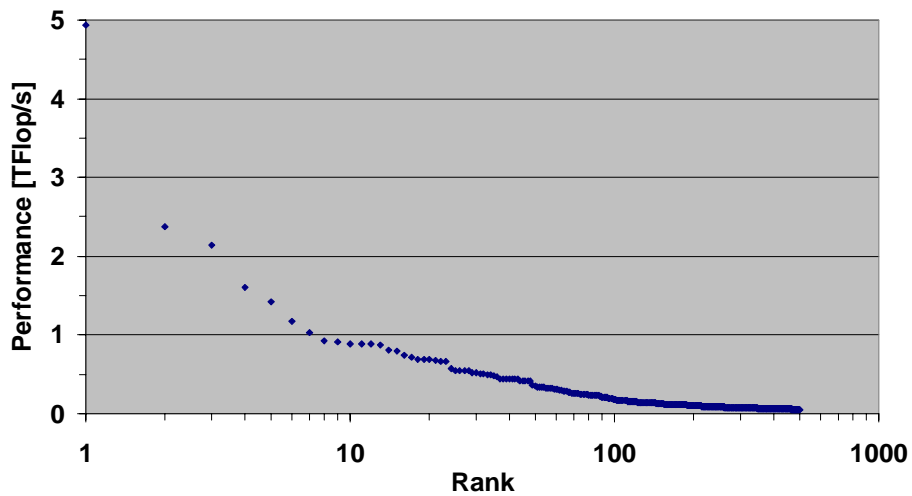
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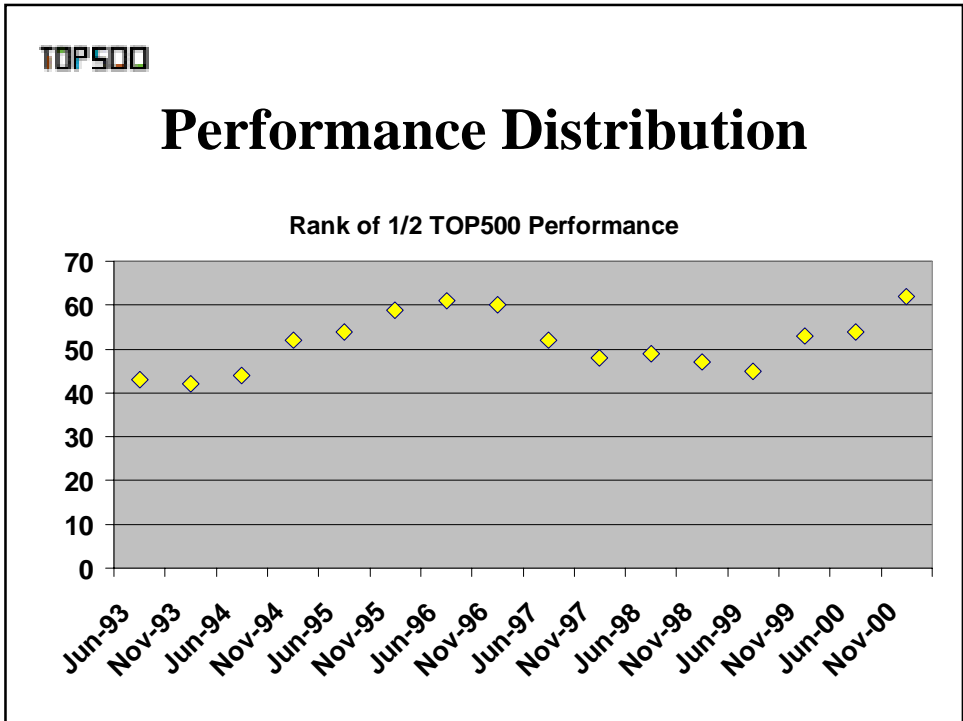
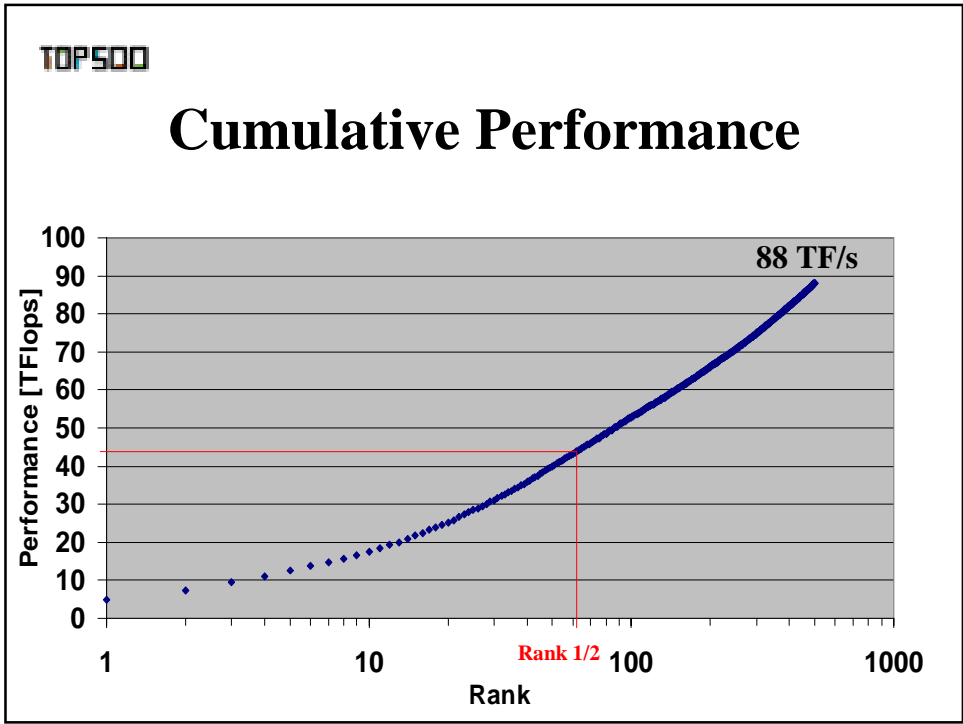
TOP10 Centers - “integrated”

Rank	Site	$\sum t \cdot R_{\max}$ [TFYears]	Current Best	Country
1	Sandia National Laboratory	8.0	2, 408	USA
2	Lawrence Livermore National Laboratory	7.5	1, 3, 32, 36	USA
3	Los Alamos National Laboratory	6.4	4, 19, 401	USA
4	University of Tokyo	3.3	13, 85	Japan
5	Naval Oceanographic Office (NAVOCEANO)	2.9	5, 21, 326	USA
6	United Kingdom Meteorological Office	2.7	26, 29	UK
7	Forschungszentrum Juelich (FZJ)	2.1	40, 83	Germany
8	NERSC/LBNL	2.0	42, 60	USA
9	Oak Ridge National Laboratory	1.9	17, 70, 402	USA
10	ECMWF	1.8	12, 90, 214	UK

TOP500

Performance Distribution





TOP500

What's new with the TOP500?

- **HPL**: High Performance Linpack
 - Antoine Petitet and Clint Whaley, ICL, UTK
 - icl.cs.utk.edu/hpl
 - Needs only
 - MPI
 - BLAS or VSIBL
 - Highly scalable and efficient for the whole range of system sizes we see

TOP500

What's new with the TOP500?

- New database interface at www.top500.org
 - More categories and variables to select or list
 - experimental cross-linked lists
- Ad's corner
 - (Ad Emmen)
- Architecture descriptions
 - (Aad van der Steen)

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What's next with the TOP500?

- What's now?
- New application areas of 'Supercomputers'
- New architectures for 'Supercomputers'
- 'Self-made' systems

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Implications

- Commercial DB systems
 - “don't care about floating point”
- New architectures - 'compute farms'
 - “not designed to run Linpack”
- “Self-made” cluster
 - no vendor to measure Linpack
 - every system is different

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TOP500 Plans

- Talks with experts since 3 years on how to 'resolve' these issues
- Q: "How can we provide better information for different application and architecture domains?"
- A: "Make additional lists"

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TOP500 Plans

- Keep current TOP500
 - Continuity, trends, 16 existing editions
 - 17th: **Supercomputer'2001**
Mannheim/Heidelberg, Germany,
June 21-23, 2001
- The current TOP500 will remain 'center' of future activities

TOP500

TOP500 Plans

- Assemble additional lists for special purposes - first try:
 - “[TOP100 \(commodity\) cluster](#)”
 - Jointly with TFCC
 - But what is a cluster ???
 - Which benchmark?
 - Initially without

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TOP500 Plans

- Collaborate with research centers (NERSC, ICL, ...) which develop new benchmarks
- Feedback about benchmarks
- TOP500.org will provide
 - free access to benchmark results and
 - possibilities for ‘re-ranking’

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TOP500 Future

- Eventually:
- Hierarchical structure
 - Master List (current TOP500?)
 - Domain specific sub-lists **ranked differently**
- Historical information about systems
- Access to benchmark and architecture information