



# The High Performance Computing Environment at NCAR

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NCAR Scientific Computing Division

CAS2K5  
14 September 2005



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# NCAR Computing in a Nutshell

- Lots of Users
- Demand Exceeds Supply
- Will Double Computing Capacity in Jan 2006
- Will Double Single Application Capability in Jan 2006
- Entering Procurement Cycle
- Mass Store Growth is Exponential
- Research Datasets Delivered via Enterprise Solutions
- Computing Facility Requires Expanding



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# NCAR Scientific Community

- University
  - *68 Member Institutions*
  - *17 Affiliate Institutions*
- NCAR Scientific Programs
- Climate System Laboratory
  - *Multi-Agency*
  - *50% of allocated resources*



**To serve the computing, data management and research needs of the atmospheric and related sciences.**



# Fulfilling the Mission.....

Committed to a **balanced** and **sustained** investment in a **robust** cyberinfrastructure.

- High End Computing
- Data Management Systems
- Provision of Research Datasets
- Networking
- Computational Sciences
- Software Tools and Frameworks
- Visualization and Enabling Technologies
- Enterprise Services and Expertise
- Security

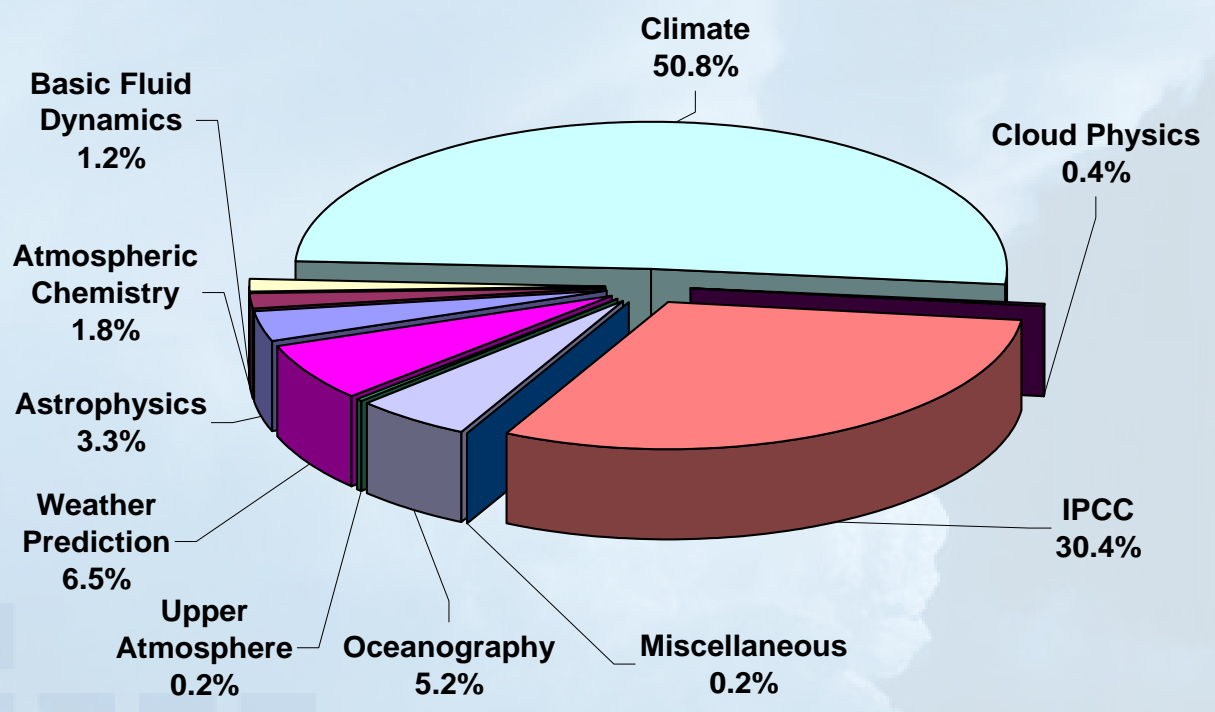
**Integrated to permit the effective and efficient scientific research.**



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# NCAR Computing Usage by Discipline

Jan 2004 – Jun 2005



# NCAR User Demographics

- Over 75 University Projects
  - Climate System Laboratory – 13 projects, over 30 subprojects
  - NCAR: 5 laboratories – 13 divisions/institutes
- High demand for computing resources.
- Resources distributed among many scientists and projects.



# Systems at NCAR (1)

System Name	Vendor System	# Frames	# Processors	Processor Type	GHz	Peak TFLOPs
Production Systems						
bluevista (HPS)	IBM p5-575	15	624	POWER5	1.9	4.742
bluesky (Colony)	IBM p690	50	1600	POWER4	1.3	8.320
lightning	IBM e1350	4	264	AMD Opteron	2.2	1.162
tempest	SGI Origin3800	5	128	MIPS	0.5	0.128
Research Systems, Divisional Systems & Test Systems						
frost (BG/L)	IBM BlueGene/L	1	2048	PowerPC-440	0.7	5.734
pegasus (AMPS)	IBM e1350	4	140	AMD Opteron	2.2	0.616
coral (IMAGe)	Aspen Systems	2	40	Intel Nocona	3.2	0.256
thunder	IBM p690	2	64	POWER4	1.3	0.333
bluedawn	IBM p690	1	16	POWER4	1.1	0.070

Delivered Aug 27



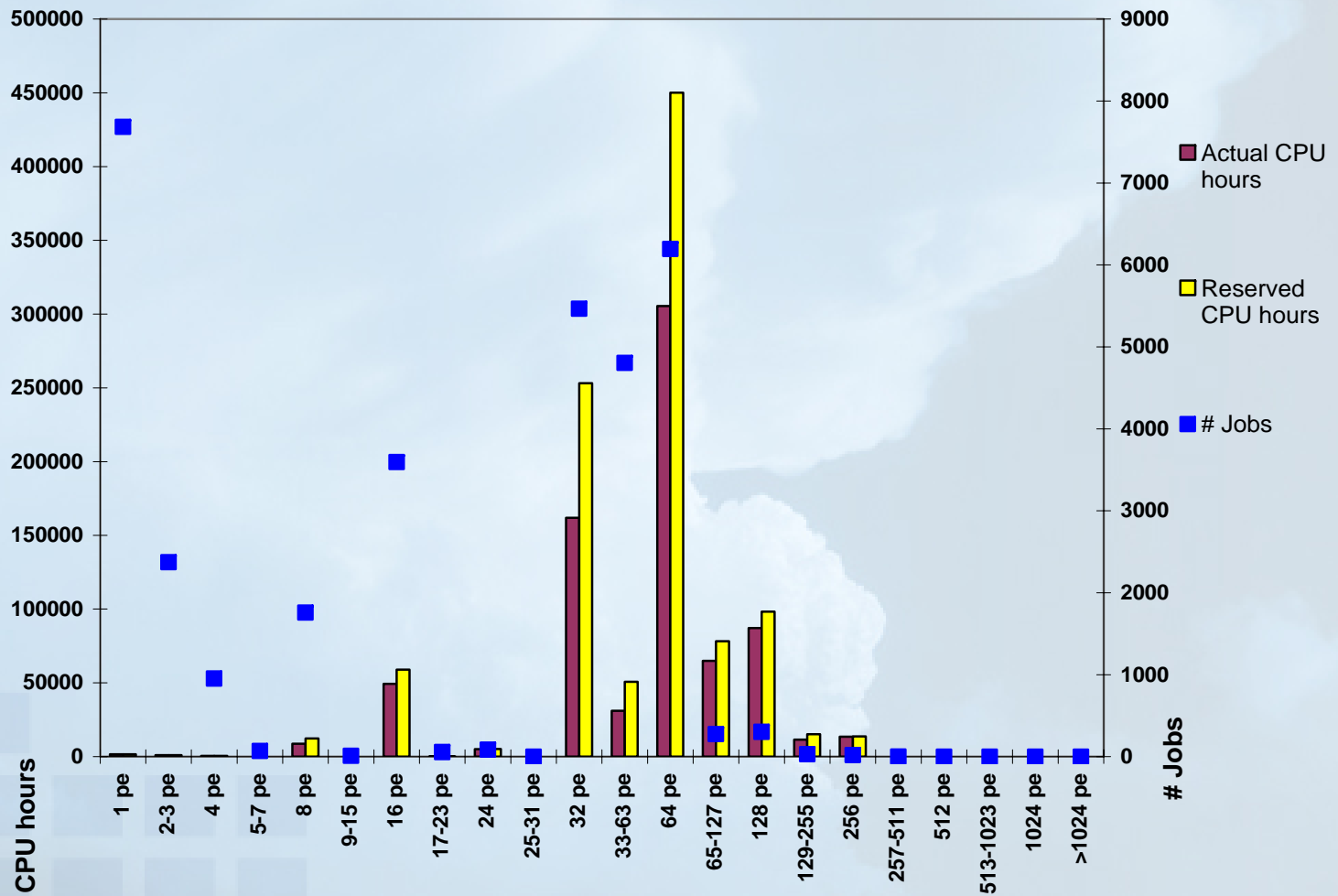
# Systems at NCAR (2)

System Name	Peak TFLOPs	Memory (Tbytes)	Disk (Tbytes)	Power Consumption (kWatts)	Code Efficiency	measured or estimated	Est'd Sustained GFLOPs	Est'd Sustained MFLOPs/Watt
<b>Production Systems</b>								
bluevista (HPS)	4.742	1.248	55.0	276	7.8%	est.	369.9	1.34
bluesky (Colony)	8.320	3.328	28.5	385	4.3%	meas.	355.3	0.92
lightning	1.162	0.544	7.8	54	5.8%	est.	67.4	1.24
tempest	0.128	0.064	7.9	50.0	9.8%	est.	12.5	0.25
<b>Research Systems, Divisional Systems &amp; Test Systems</b>								
frost (BG/L)	5.734	0.524	6.6	25.2	6.8%	est.	389.9	15.5
pegasus (AMPS)	0.616	0.288	5.6	28	5.8%	est.	35.7	1.28
coral (IMAGE)	0.256	0.088	6.4	9	5.0%	est.	12.8	1.42
thunder	0.333	0.128	1.2	15.5	5.1%	est.	17.1	1.10
bluedawn	0.070	0.032	0.7	6.5	4.3%	est.	3.0	0.46



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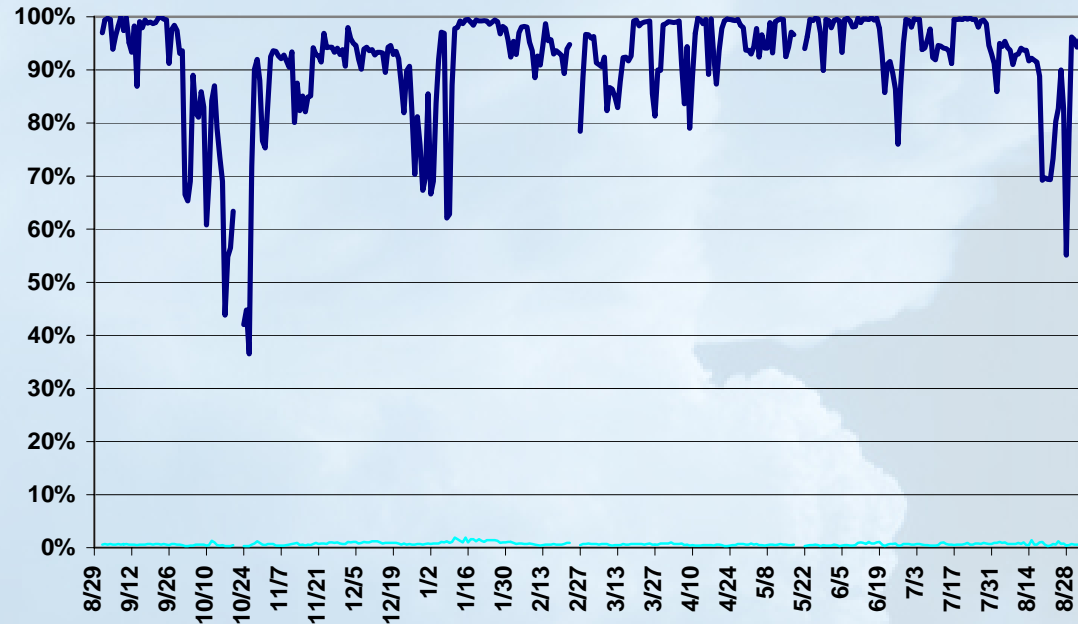
# IBM Power4 (bluesky) workload distribution – Jul '05





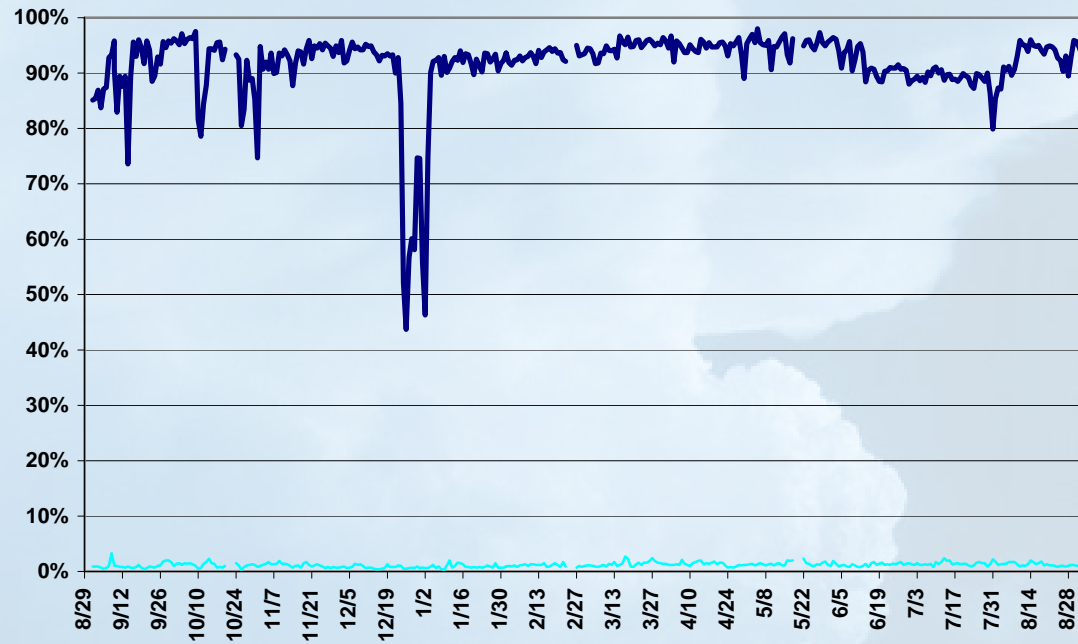
# Power4 Utilization: 32-way LPARs

bluesky 32-way LPAR Usage — Utilization — % System



# Power4 Utilization: 8-way LPARs

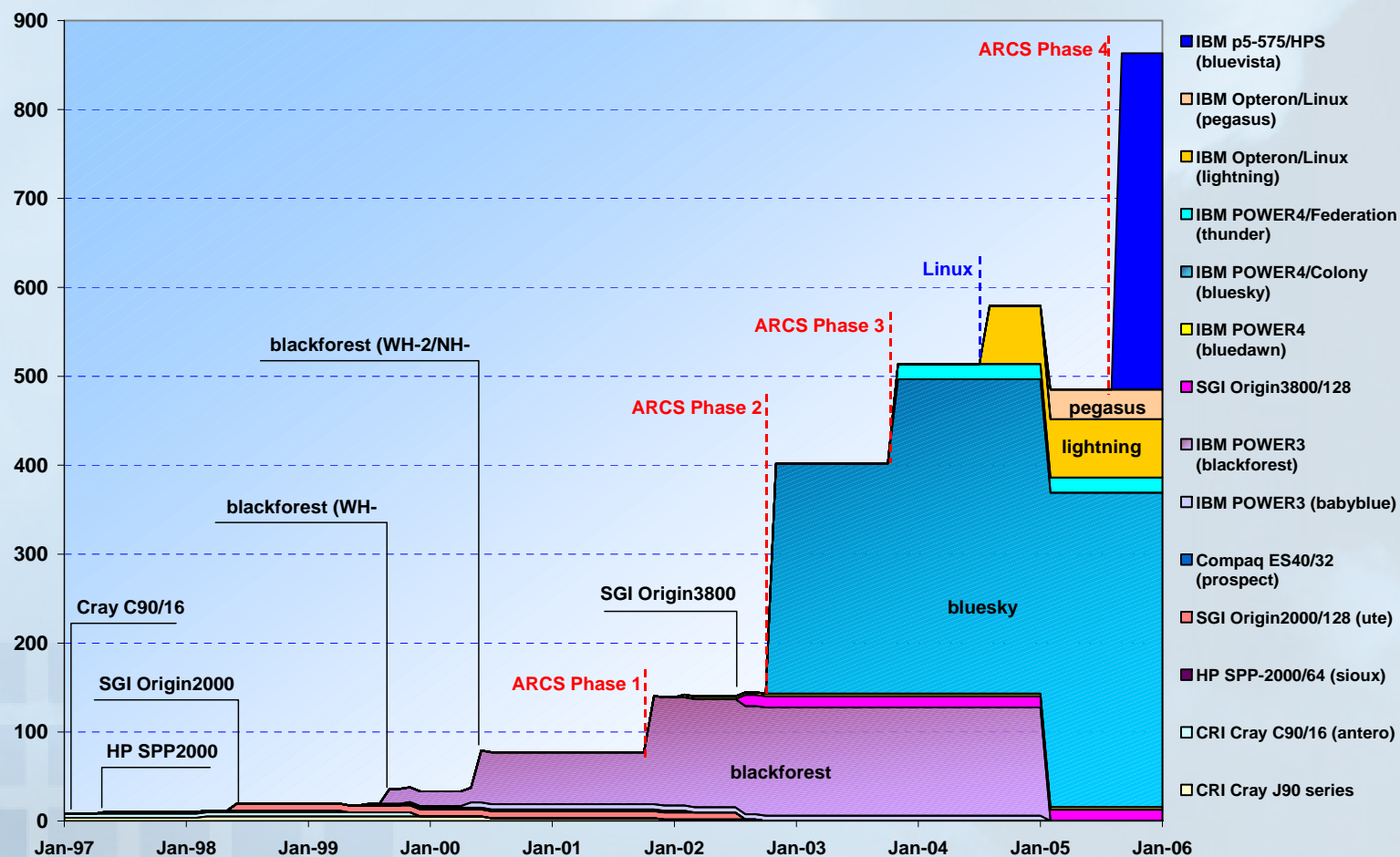
bluesky 8-way LPAR Usage      — Utilization      — % System





# Estimated Sustained GFLOPs at NCAR (Production Systems)

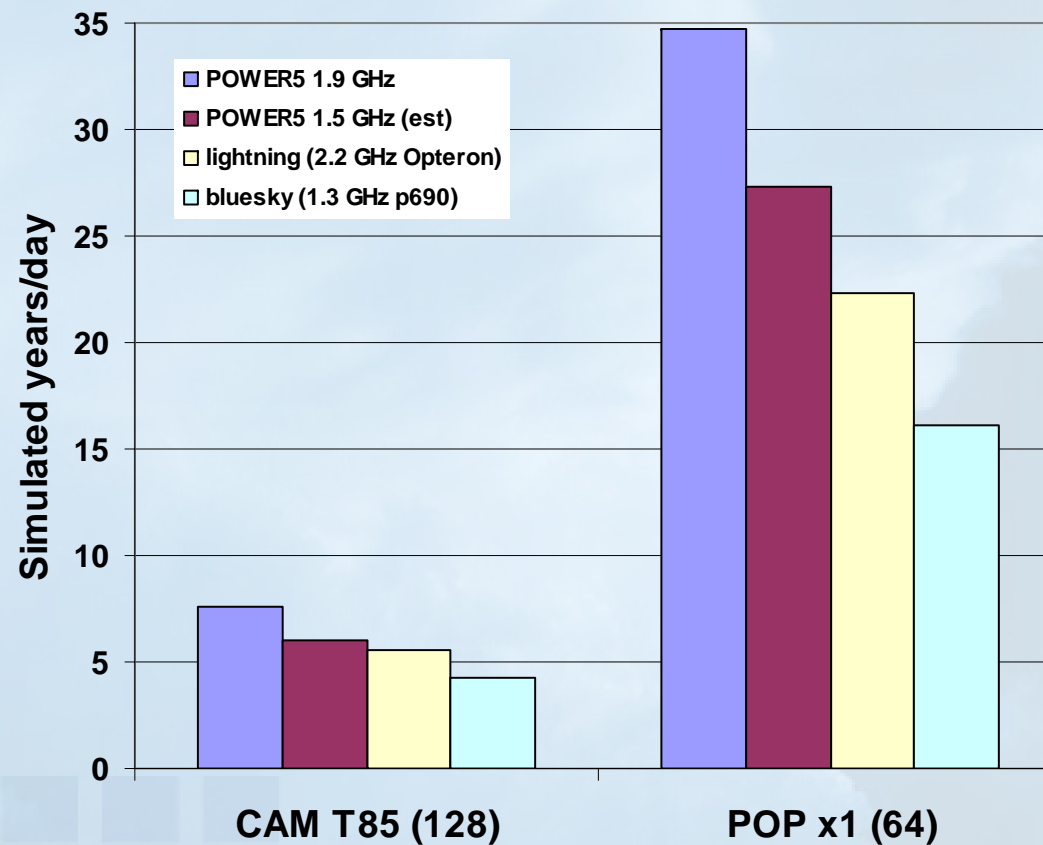
## Estimated Sustained GFLOPs at NCAR (Production Systems)



# IBM Power5 Application Performance



## POWER5 vs. Existing Systems

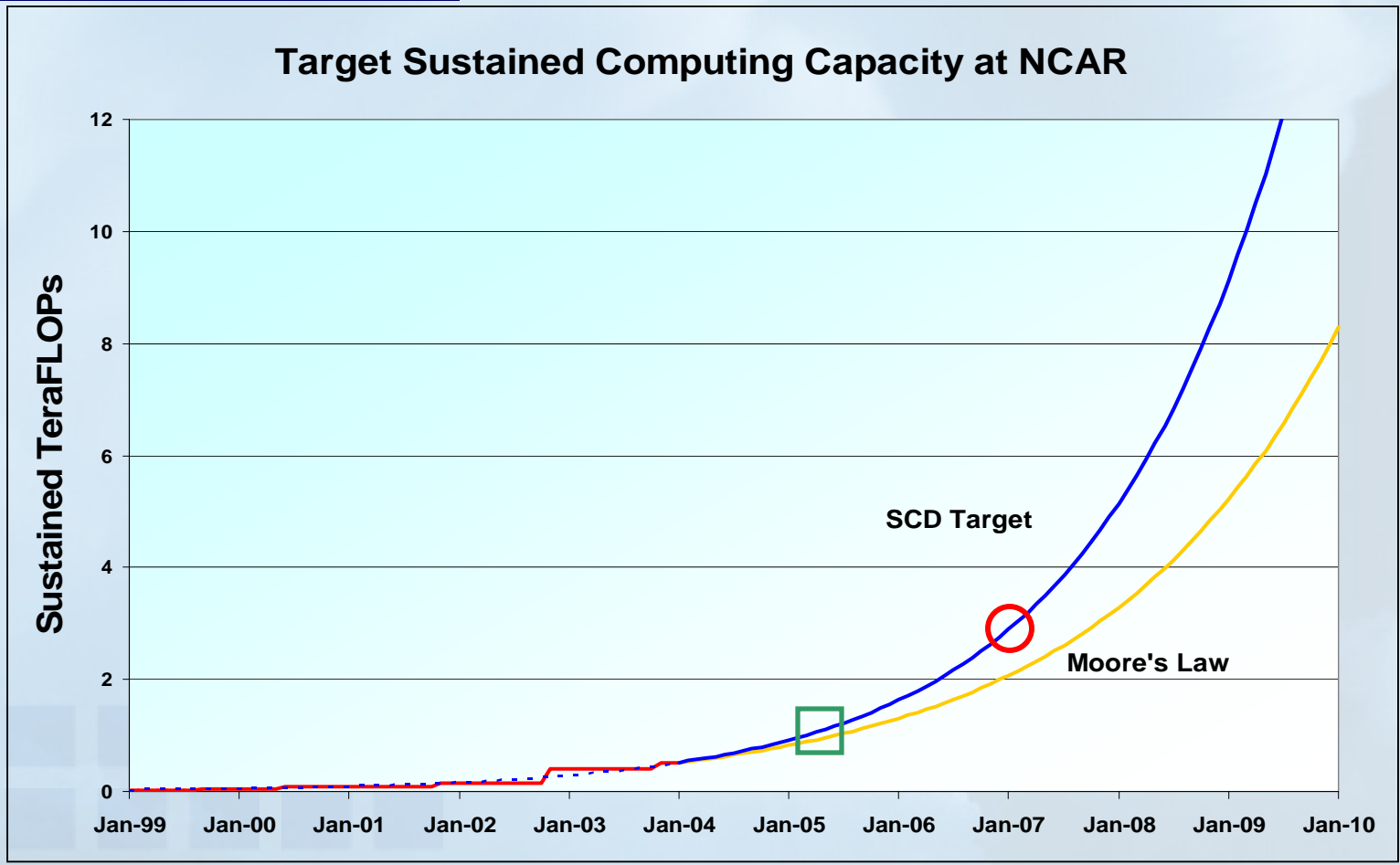


# NCAR: Integrated Computing Environment for Scientific Simulation (ICESS) Procurement



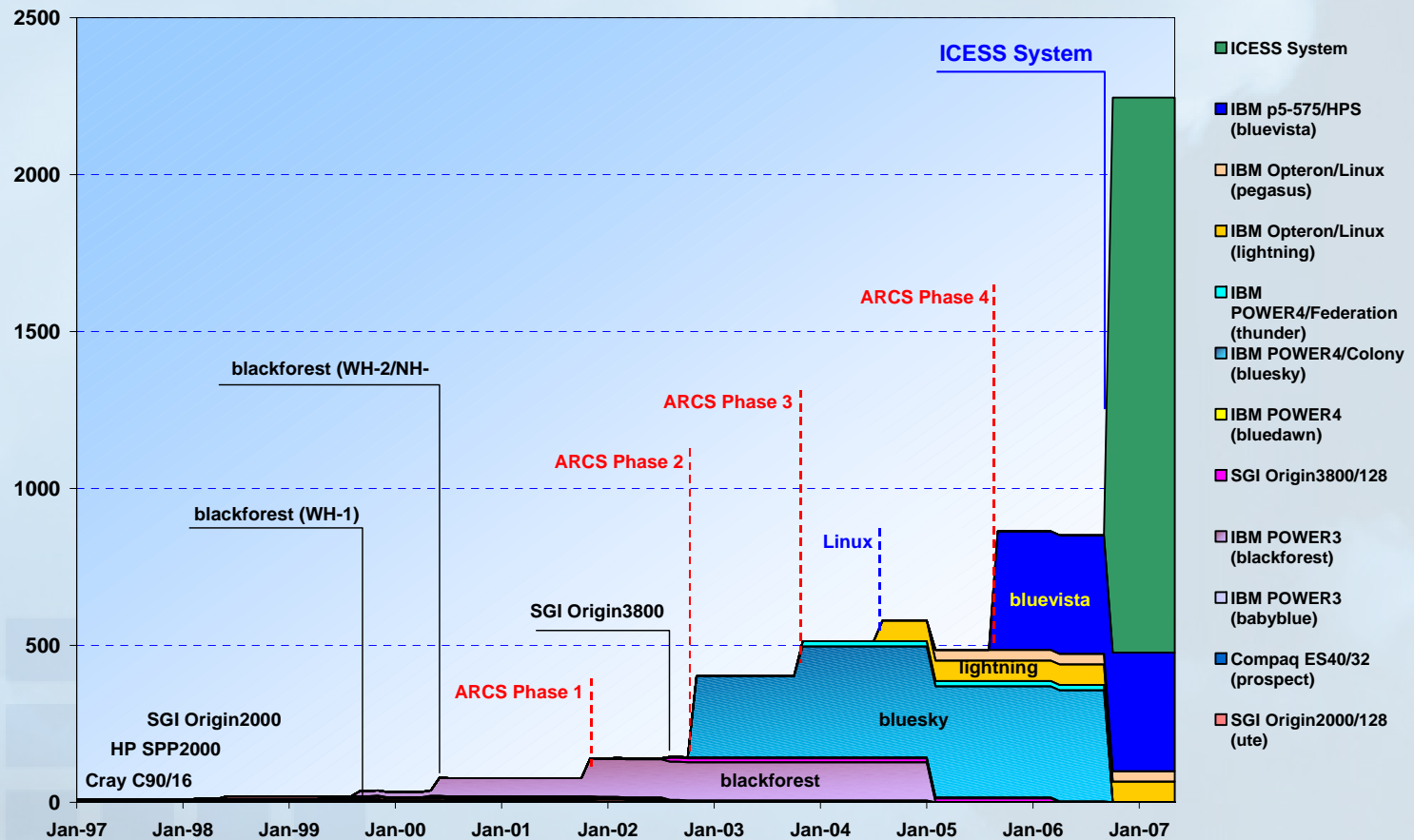
- Competitive procurement for to be initiated during Fall 2005
- Expectation: Meets or exceeds Strategic Plan
  - 5-6 “bluesky equivalents” by early 2007
- System delivery during Fall 2006
- System deployment during Winter 2006-2007
- Scientific community participation

# NCAR Target Capacity



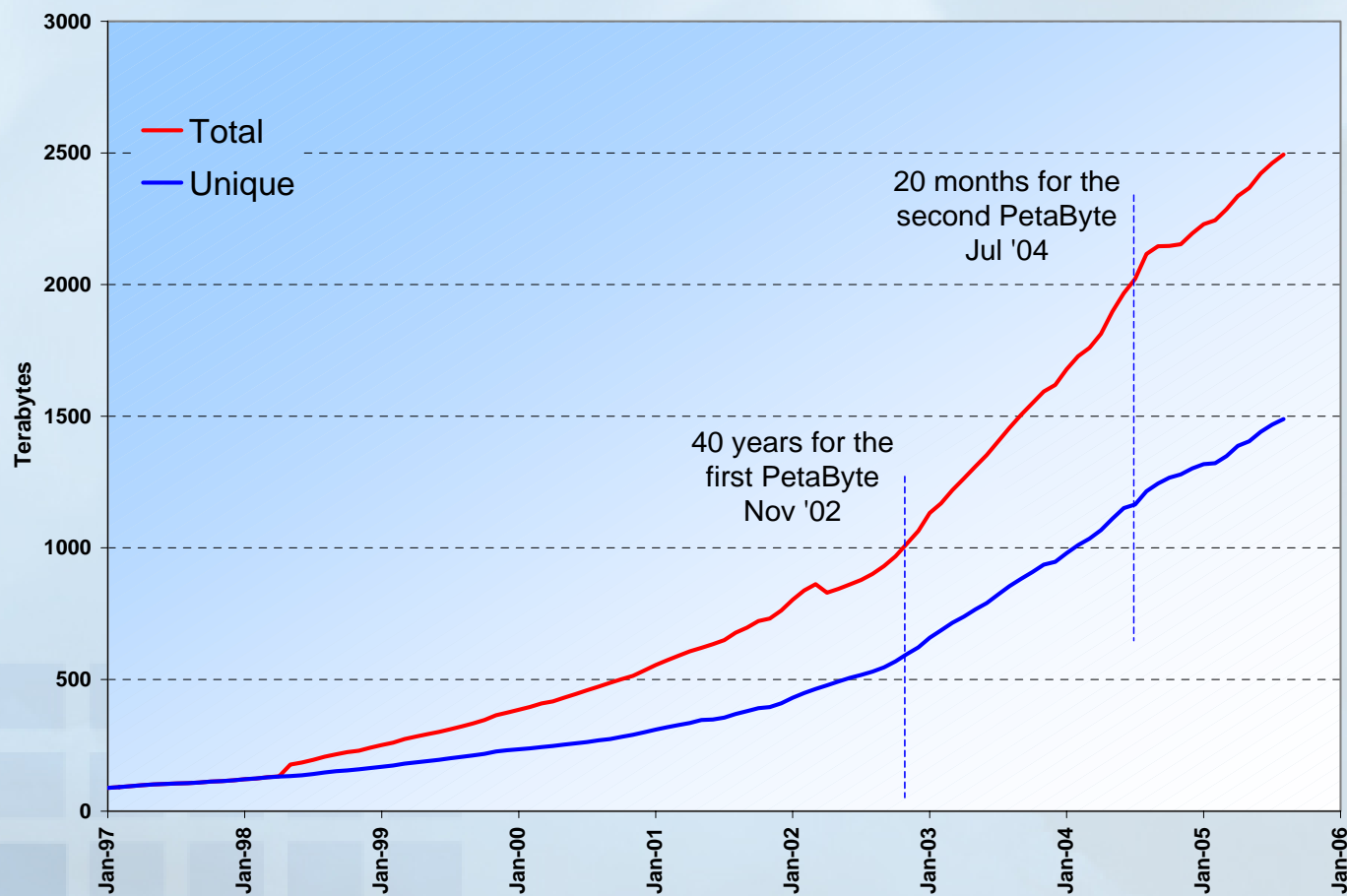
# NCAR Computing by Early 2007

Estimated Sustained GFLOPs at NCAR (with ICESSE)



# NCAR Mass Storage System

## NCAR MSS - Data Holdings



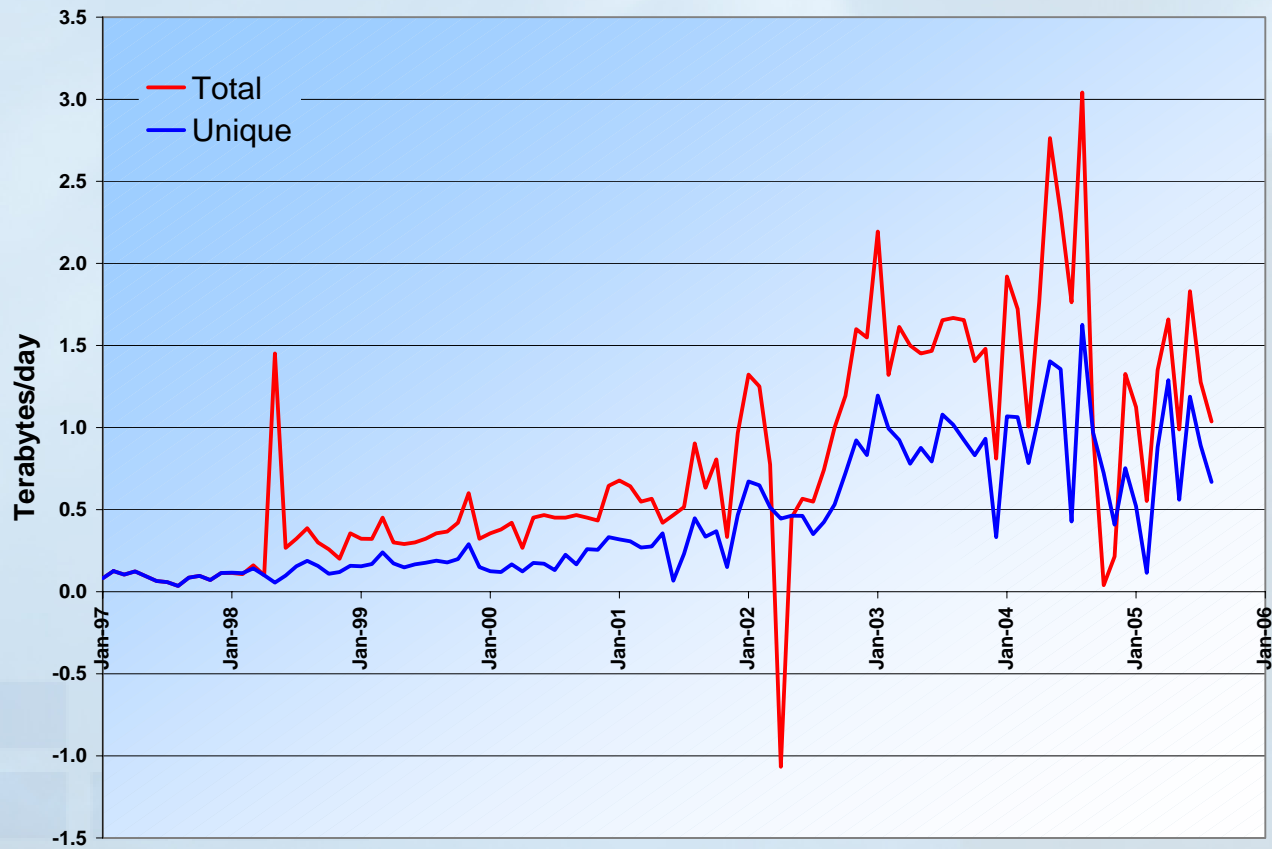


# MSS Growth Project

- **Recognition of growth – need for thoughtful control (cost!)**
  - *Significant increase in data import to MSS*
  - *Growth model is based upon local data creation*
  - *Level of Service – backup copy needed?*
- **Recognition of scientific need**
- **Strategic Approach**
  - *Charge for MSS use via computing charges*
  - *Study user patterns*
  - *Provide better tools for MSS auditing/cleanup*
  - *Proactively engage users → Assist, Educate*
  - *Change MSS Charging Model ???*

# MSS Net Growth Rate

## NCAR MSS - Net Growth Rate



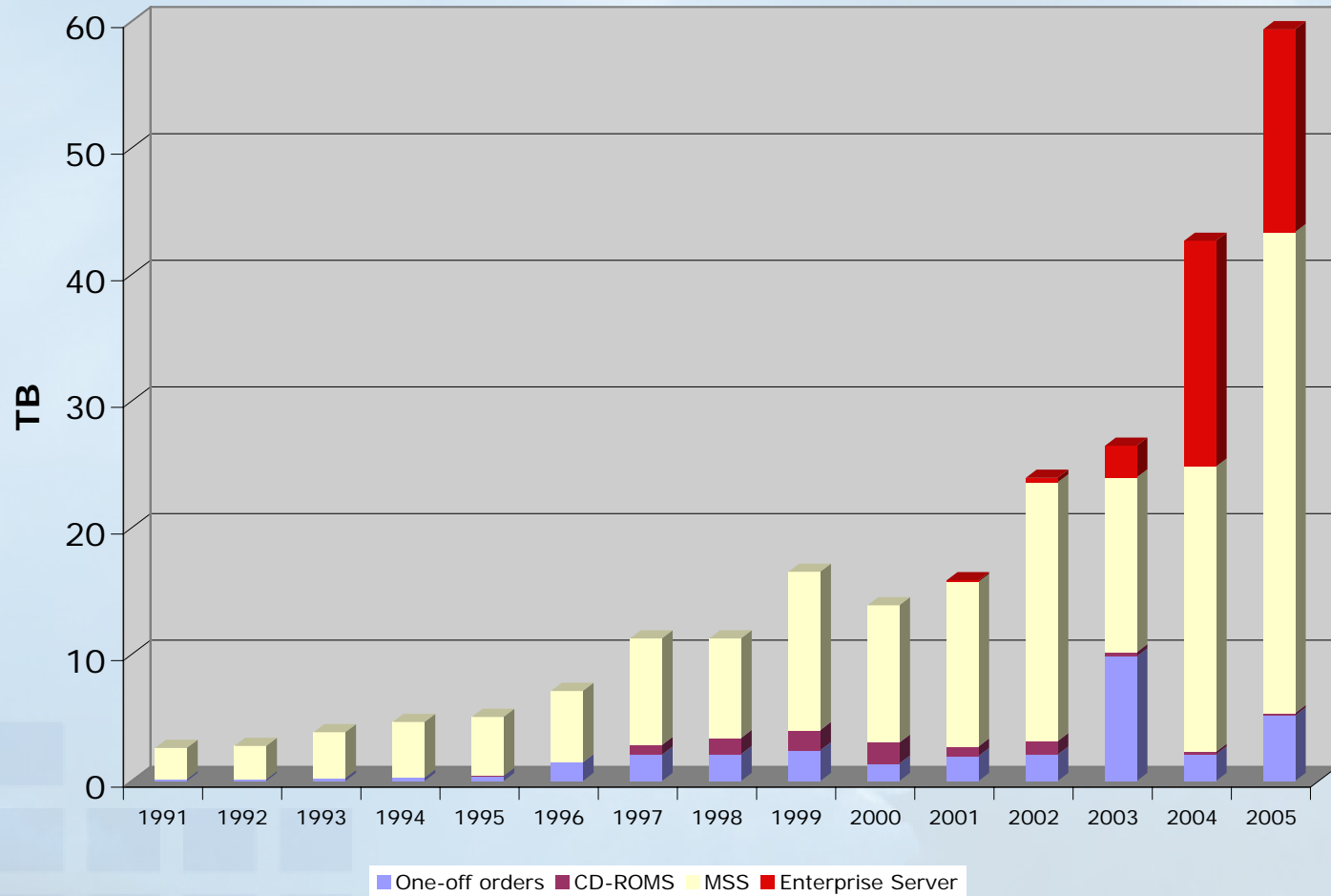
## Research Data - Feature Example

- ERA-40 data services from NCAR
- Two service channels
  - *NCAR MSS to local computing and for analysis*
  - *Enterprise data server to outside community*
- Accurate Metrics, since January 2005
  - *Based on: user registration, log files, database tech.*

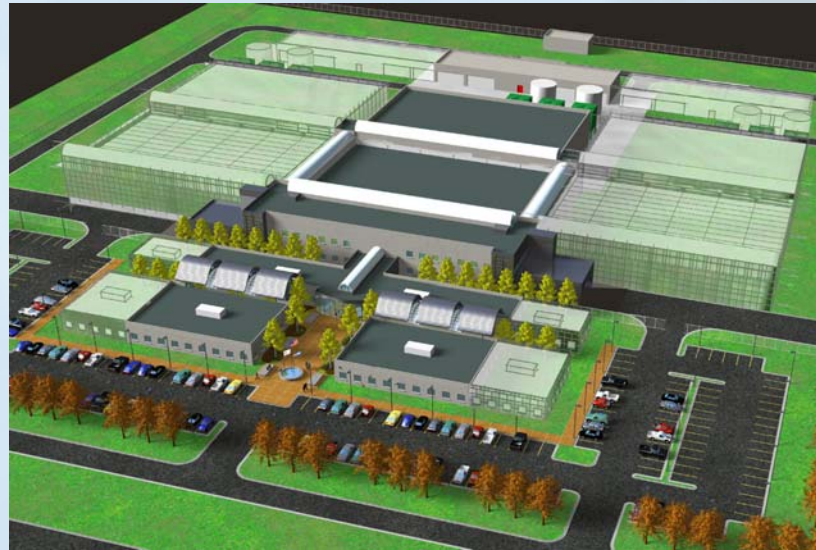
ERA-40 Data Services, January - August 2005 (...) 2005 annual estimate			
	Enterprise Server	NCAR MSS	Total
Unique Users	49 (65)	57 (75)	106 (140)
Number of Data Files (K)	13 (17)	40 (54)	53 (71)
Data Amount (TB)	5 (7)	21 (28)	26 (35)



# Evolution of research data access



# Challenge Beyond 2007



- **NCAR Data Center Expansion**
  - *NCAR center limits of power/cooling/space will be reached with ICESS procurement addition - 2007*
  - *2010 computing augmentation will exceed center capacity*
  - *Must plan now – actually started in 2004*
- New center requirements have been established
- Conceptual design for new center was recently completed
- Funding options being developed with parent organization UCAR



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# Questions



NCAR Scientific Computing Division

14 September 2005



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# The Future of Faster

Rich Loft

SCD Deputy Director for Research and Development

CAS2K5

Dinner Presentation

Tonight – 1800 Reception