
- A meeting in Aug 2000

- Talks for a NASA visit
  - Best practices in selected data centers

- There are 5 main items and 33 pages here

Roy Jenne
July 2001
A small group from NASA met at NCAR on Aug 29, 2000, to gather information about “best practices” in selected data centers.

Dennis Joseph and I gave some talks about our datasets, data philosophy, and charts to show how much data was sent to users during the past few years. These talks are available elsewhere.

Summary of pages:
Organization charts (2 pages), 3 talks with 25 pages, history 2 pages, this page and three more. Total of 33 pages.

Talks were also given by three other sections of our computing division, and those slides are presented here:

a. The Fast Computers (by George Fuentes)
   - Fast computers
b. The Mass Store System (by Gene Harano)
   - Mass storage
c. Nets (Networks) (by Marla Meehl)
   - Networks
d. The Organization of SCD (by Al Kellie, Director)
   - SCD: Scientific Computing Division

The briefing slides (Aug 2000) follow:

b. Fast Computers: 3 pages, 18 slides
c. NCAR Mass Store: 9 pages, 17 slides
d. Some Mass Storage history at NCAR (RJ, Oct 1999, 2 p)
e. Networks: 13 pages, 25 slides
f. One page at end
Data Support Activities During Year 2000

The Data Support Section (DSS) maintains a large, organized archive of computer-accessible research data that is made available to scientists around the world. The archive represents an irreplaceable store of observed data and analyses and is used for major national and international atmospheric and oceanic research projects. The DSS group started working in 1965 and has been working on large projects and building the data archives ever since.

There are now about 530 distinct datasets in the archive, ranging in size from less than 1 MB to over 1 TB. The total volume of data in the DSS archive was 2.4 terabytes in August 1990 and 13.9 terabytes in Aug 2000. We have been adding a lot of reanalysis data and other analyses. The change of data storage with time has been as follows:

### Data Stored for Data Support, and Total Mass Store

<table>
<thead>
<tr>
<th>Date</th>
<th>Data Support Section</th>
<th>Total NCAR Mass Store</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bit Files</td>
<td>Bit Files</td>
<td>Volume</td>
</tr>
<tr>
<td>13 Aug 1990</td>
<td>61,335</td>
<td>---</td>
<td>14,430</td>
</tr>
<tr>
<td>4 Aug 1991</td>
<td>65,518</td>
<td>715,000</td>
<td>19,400</td>
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<tr>
<td>3 Aug 1992</td>
<td>80,538</td>
<td>1,060,000</td>
<td>27,270</td>
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<td>Aug 1993</td>
<td>103,314</td>
<td>1,351,271</td>
<td>36,280</td>
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<tr>
<td>15 Sep 1994</td>
<td>119,703</td>
<td>1,849,466</td>
<td>47,423</td>
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<tr>
<td>14 Feb 1995</td>
<td>123,877</td>
<td>1,966,990</td>
<td>52,456</td>
</tr>
<tr>
<td>24 Jan 1996</td>
<td>137,680</td>
<td>2,486,471</td>
<td>67,590</td>
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<tr>
<td>28 Aug 1996</td>
<td>143,340</td>
<td>2,888,639</td>
<td>78,964</td>
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<tr>
<td>28 Feb 1997</td>
<td>151,509</td>
<td>3,289,224</td>
<td>91,399</td>
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<tr>
<td>17 Oct 1997</td>
<td>159,945</td>
<td>4,046,678</td>
<td>110,359</td>
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<tr>
<td>2 Sep 1998</td>
<td>167,073</td>
<td>5,038,611</td>
<td>147,439</td>
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<tr>
<td>7 Sep 1999</td>
<td>185,608</td>
<td>6,737,448</td>
<td>206,885</td>
</tr>
<tr>
<td>25 Aug 2000</td>
<td>192,404</td>
<td>8,187,688</td>
<td>267,796</td>
</tr>
</tbody>
</table>

**Note:** Gene Harano says (in Sep'99) that the total NCAR mass store archives are increasing at a rate of about 5 Tbytes per month. This is consistent with the growth (see above) from 147.4 TB to 206.9 TB (or 59.5 TB) in the 12.2 months from Sep 1998 to Sep 1999. Also, in the 11.5 months from Sep 1999 to Aug 2000, the total mass store grew by 61 TBytes to 267.8 TBytes.

The DSS staff provides assistance and expertise in using the archive and help researchers locate data appropriate to their needs. Users may obtain copies of data by network access, on various tape media, or they may use data directly from the NCAR MSS to their computer program. DSS staff also assist scientists by providing data access programs (to read and unpack data), other software for data manipulation, and dataset documentation. At a later point we will present more information about the use of the DSS archives.
The current organizational structure of the Scientific Computing Division is given in the chart, below. You may go directly to each section by clicking on the section name at the top of each column in the chart.

### SCD Organization Chart

<table>
<thead>
<tr>
<th>Division Office</th>
<th>SCD Official Org</th>
<th>Chart Approved by</th>
<th>Date: 8/26/00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al Kellie, Director</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Pete Peterson, Deputy Director</td>
<td></td>
<td></td>
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<tr>
<td>Bernie O’Leary, Associate Director</td>
<td></td>
<td></td>
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<tr>
<td>Tom Engel, HPC Env.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Janice Kaur, A</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Rachelle Daily, AA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joan Fisher, AA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**3 people take care of office. Systems 2 take care of workstations and software. 2 take care of computer statistics. 6 handle user questions. There are almost 100 requests for computer time each year, and about 22.**

**Operations:** Four years ago they had 15 operators. Now it is 9.

This seems to be working out.

### Sections

<table>
<thead>
<tr>
<th>Computational Science</th>
<th>Data Support</th>
<th>Networking Engineering &amp; Technology</th>
<th>High Performance Systems</th>
<th>Operations &amp; Infrastructure Support</th>
<th>User Support Section</th>
<th>Visualization and Enabling Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steve Nusser, Mgr</td>
<td>Roy Juran, Jr.</td>
<td>Harris Mead, Mgr</td>
<td>Gene Harano, Mgr</td>
<td>Aaron Anderson, Mgr</td>
<td>Ginger Caldwell, Mgr</td>
<td>Brian Meredith, Mgr</td>
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<tr>
<td>Jennifer Delaurant, AA</td>
<td>Cecilia Bawer, AA</td>
<td>Susan Guastella, AA</td>
<td>DJ Hecker, AA</td>
<td>D. Bustamante, A</td>
<td>Jamie Young, AA</td>
<td>Tamara Ritter, Mgr</td>
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<tr>
<td>J. Dennis, SE</td>
<td>R. Comeaux, SE</td>
<td>S. Colburn, NE</td>
<td>B. Bateman, SE</td>
<td>E. Anderson, CO</td>
<td>D. Brown, SE</td>
<td>J. Boote, SE</td>
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<td>R. Harness, SE</td>
<td>D. Cullum, SE</td>
<td>J. Everett, NE</td>
<td>C. Faub, NE</td>
<td>M. Breslau, CO</td>
<td>D. Beyer, SE</td>
<td>D. Deane, SE</td>
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<td>R. James, SE</td>
<td>C. Shih, SE</td>
<td>F. Griesbe, NE</td>
<td>F. Querry, SA</td>
<td>E. Harrington, CO</td>
<td>B. Campell, SE</td>
<td>D. Drane, SE</td>
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<td>N. Jordan, BA (v)</td>
<td>W. Spangler, SE</td>
<td>G. Harris, NE</td>
<td>T. Hayden, NE</td>
<td>J. Harris, CO</td>
<td>J. Chapman, DA</td>
<td>F. Oare, SE</td>
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<td>S. Worley, SE</td>
<td>D. Mitchell, NE</td>
<td>L. Truex, NE</td>
<td>J. Kohler, CO</td>
<td>B. Cross, SE</td>
<td>S. Oss, SE</td>
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<td>J. Kokes, CO</td>
<td>M. Halsey, SE</td>
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<td>D. Rosen, SE</td>
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<td>S. Hay, GSH, GH</td>
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<td>H. Poppe, SE</td>
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<td>D. Valient, SE</td>
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<td>M. Black, SE</td>
<td>G. Woods, SE</td>
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<tr>
<td><strong>18 Staff</strong></td>
<td><strong>14.1 FTE</strong></td>
<td><strong>22 FTE</strong></td>
<td><strong>15 FTE</strong></td>
<td></td>
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</tbody>
</table>

**Legend**
- A: Administrator
- AS: Administration
- ASM: Assistant Manager
- C: Comp. Operator
- CG: Comp. Grp.
- CP: Comp. Prod.
- DB: Database
- EE: Exhibitor Coord.
- GM: Group Mgr.
- HP: High Performance
- Info. Tech.
- ISA: Info. Support
- NS: Network Support
- NSP: Network Security Admin.
- O: Operating
- P: Project
- PS: Project Support
- SA: Student Admin.
- SC: Scientist
- SE: Software Engineer
- SSA: Systems Admin.
- U: User

**Casual Staff**
- Cindy Adornetto
- Mary Bartis
- Abhishua Mooy
- Betty Thompson
- Rosemary Mitchell
- Laura Morrel
- Gene Schumacher

**Note:** Harano is now lead of systems. Ernec is moved from systems to the front office.

Oct 29, 2000
SCD High Performance Systems
by George Fuentes
February 29, 2000

IBM SP (Blackforest) Configuration

PRODUCTION system
- 1 SP Complex - 151 nodes (64 WH II CPUs @ 375 MHz; 512 MB memory/CPUs; 2.5 TB disk)
- 100 BaseT & GigE networks; HIPPI to MSS

System Configuration
- 4 nodes (16 CPUs) available for interactive use
- 8 nodes (32 CPUs) dedicated to GPPS filesystem I/O
- 135 total nodes (540 CPUs) dedicated to batch jobs

IBM Blackforest SP Complex

- Community and CSL System
- Running AIX 4.3.x and Parallel System Support Programs (PSSP), 3.1.1
- Very few problems reported
- Upgraded to Winterhawk II nodes on 5 May 2000

Upgraded from 2 to 4 proc. in each node

IBM SP (babyblue) Configuration

TEST / PRODUCTION system
- 1 SP Complex - 16 nodes (64 WH II CPUs @ 375 MHz; 512 MB memory/CPUs; ~250 GB disk)
- 100 BaseT & GigE networks; HIPPI to MSS

System Configuration
- 12 nodes (48 CPUs) dedicated to batch jobs
- 2 nodes (8 CPUs) available for disk I/O
- 2 nodes (8 CPUs) network I/O
IBM Babyblue SP Complex
- Babyblue, our test/production system
- OS and compiler/products test bed
- Friendly user testing/debugging
- Daytime/interactive; night time batch

Compaq ES40 Cluster
- System was delivered in mid-November 1999;
  Acceptance Test Period (ATP) started 31 January
  2000 at 0800 MST.
- ATP successfully completed 6 April 2000 at 1018
  MDT.
- Acceptance Test consisted of PCM, CCM, and
  MOZAR self-checking model runs; RAWIO
  tests; HiPPI tests; and network tests.

IBM Babyblue SP Complex
- Current operating system levels
  - Running AIX 3.3.3 and Parallel System
  Support Programs (PSSP) 3.1.1
  - Upgraded to Winterhawk II processors
    on 10 April 2000

Compaq ES40 Cluster
- Hardware is more stable
- Software still needs work
- Resource Management System (RMS)
  - User projects and priorities
  - Suspending/resuming jobs
  - Day/night configuration changes

Compaq - with Alpha chips

Compaq ES40 Cluster (prospect)
Configuration
Prospect An EVALUATION system
- 8 nodes (32 E6 CPUS @ 500 MHz; 1 GB memory/CPU)
- 1 TB of RAID 5 disk space
- 100 BaseT & GigE Networks; HiPPI to
  MSS
- Tru64 ("Digital Unix") 5.0 OS;
  AlphaServer SC Version V 1.0

SGI Origin2000 (4) System
Configuration
Utefe/8 Production Front End system
- 8 R10000 CPUs; 250 MHz
- 8 GB memory
- 160 GB's Fibre JBOD disk space
Ute/128 Production Batch system
- 128 R10000 CPUs; 250 MHz
- 16 GB's memory
- 350 GB's Fibre JBOD disk space

8 nodes, 4 processors
in each.
SGI Origin2000 (4) System Configuration

Mouache/4 Test/Production system
- 4 R10000 CPUs; 195 MHz
- 1 GB of memory
- 25 GB's Fibre JBOD disk space

Dataproc/16 Production/Data Analysis system
- 16 R10000 CPUs; 250 MHz
- 16 GB's of memory; 1 TB Fibre-Raid-3
- 741 GB Fibre JBOD disk space

Cray J90se's (2) System Configuration

O payroll/24 Production J924se
- 24 CPUs; 1024 Mwords of memory
- 150 GB’s of JBOD disk space

Chipeta/24 Production J924se
- 24 CPUs; 1024 Mwords of memory
- 150 GB’s of JBOD disk space

Batch System Utilization

<table>
<thead>
<tr>
<th>System</th>
<th>Theoretical Peak</th>
<th>Calculated Peak</th>
<th>Actual Sustained</th>
<th>% Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM SP/604</td>
<td>906.0</td>
<td>48.6</td>
<td>30.66</td>
<td>63.1%</td>
</tr>
<tr>
<td>IBM SP/64</td>
<td>96.0</td>
<td>4.3</td>
<td>2.10</td>
<td>48.9%</td>
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<tr>
<td>Compaq ES40/32</td>
<td>32.0</td>
<td>4.8</td>
<td>1.51</td>
<td>31.6%</td>
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<tr>
<td>Origin2000/128</td>
<td>64.0</td>
<td>7.04</td>
<td>5.17</td>
<td>69.9%</td>
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<tr>
<td>Cray J90se/24</td>
<td>4.80</td>
<td>1.49</td>
<td>1.36</td>
<td>91.4%</td>
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<tr>
<td>Cray J90se/24</td>
<td>4.80</td>
<td>1.58</td>
<td>1.37</td>
<td>91.1%</td>
</tr>
</tbody>
</table>

doesn't mean much

67.8 GFlops Total
Questions??

If I can assist/address issues that were not covered/answered today, please send me email at fuentes@iu.edu and I will make sure your requests are addressed.
NCAR MSS Overview

29 Aug 2000

Gene Harano
High Performance Systems Section
snow@ucar.edu

Outline

- NCAR MSS
- Statistics
- Growth
- File Services
- Summary
NCAR MSS

- Developed at NCAR starting in 1984
- Operational since 1986
- Based on the IEEE Mass Storage Model Version 2
- First to implement 3rd party transfers to optimize data movement

3rd Party Transfer

[Diagram showing control and data flow with labels: Control, Data, MFD, Control/ Data]
Mass Storage Services

Statistics

- MSS Statistics
  - 267 TBs stored in 8.2 M files (27 Aug 2000)
  - 5 TB/month net growth rate
  - 450,000 MSS host reads and writes/month
  - 20+ TBs moved/month on MSS hosts
  - 25 TBs moved/month internal migration and 2nd copy
  - 45 TBs moved/month = 17 MB/sec sustained
Historical perspective

- Historical trends show data stored is proportional to computational capacity
- SCD has been financially & technically able to grow MSS proportional to FLOPs (so far)

Projected MSS (Flat Budget)

<table>
<thead>
<tr>
<th></th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
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<tbody>
<tr>
<td>TFLOPs</td>
<td>0.02</td>
<td>0.04</td>
<td>0.05</td>
<td>0.12</td>
<td>0.18</td>
<td>0.24</td>
<td>0.48</td>
<td>1.04</td>
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<tr>
<td>Net Growth (TB/yr)</td>
<td>50</td>
<td>90</td>
<td>125</td>
<td>300</td>
<td>450</td>
<td>600</td>
<td>1200</td>
<td>2600</td>
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<tr>
<td>Archive Size (PB)</td>
<td>.15</td>
<td>.26</td>
<td>.39</td>
<td>.70</td>
<td>1.2</td>
<td>1.8</td>
<td>3.0</td>
<td>5.7</td>
</tr>
<tr>
<td># Silos</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>10</td>
<td>13</td>
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<tr>
<td>Archive (SqFt)</td>
<td>4360</td>
<td>4400</td>
<td>4100</td>
<td>4700</td>
<td>5400</td>
<td>5900</td>
<td>7400</td>
<td>8600</td>
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<td>MSS Annual Budget (1998 $)</td>
<td>$2.5M</td>
<td>$3.3M</td>
<td>$3.0</td>
<td>$5.5M</td>
<td>$4.9M</td>
<td>$4.3M</td>
<td>$7.6M</td>
<td>$8.1M</td>
</tr>
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</table>

Assumes: 10x increase in media densities (STK projection)
25x decrease in storage costs ($/GB) (STK projection)
## Projected MSS (Accelerated)

<table>
<thead>
<tr>
<th></th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
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<th>2005</th>
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<tbody>
<tr>
<td>TFLOPs</td>
<td>0.02</td>
<td>0.04</td>
<td>0.5</td>
<td>1.6</td>
<td>2.5</td>
<td>4.0</td>
<td>16.0</td>
<td>40.0</td>
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<tr>
<td>Net Growth</td>
<td>50</td>
<td>90</td>
<td>1260</td>
<td>4030</td>
<td>6250</td>
<td>10100</td>
<td>40300</td>
<td>101000</td>
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<tr>
<td>(TB/yr)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Archive Size</td>
<td>.15</td>
<td>.26</td>
<td>1.6</td>
<td>5.6</td>
<td>12.1</td>
<td>21</td>
<td>58</td>
<td>150</td>
</tr>
<tr>
<td>(PB)</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Silos</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>15</td>
<td>26</td>
<td>35</td>
<td>71</td>
<td>125</td>
</tr>
<tr>
<td># New Silos per month</td>
<td>-</td>
<td>.1</td>
<td>.25</td>
<td>.75</td>
<td>.92</td>
<td>.75</td>
<td>3.0</td>
<td>4.5</td>
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<td>Archive (SqFt)</td>
<td>4360</td>
<td>4400</td>
<td>4700</td>
<td>9500</td>
<td>15000</td>
<td>20000</td>
<td>40000</td>
<td>70000</td>
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<tr>
<td>MSS Annual Budget (1998 $)</td>
<td>$2.5M</td>
<td>$3.3M</td>
<td>$7.2M</td>
<td>$15M</td>
<td>$17M</td>
<td>$15M</td>
<td>$44M</td>
<td>$56M</td>
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</table>

Note: 43,560 square feet = 1 acre

### Curbing MSS Growth

- User Education
- Better Data Management Tools
- Charging (not yet implemented)
- Provide Front-end File Services
  - Cache temporary data
MSS File Services

- Shared File System is the key component for future services.
  - Heterogeneous Data Sharing
  - Seamless data access
  - Web tools
  - Hides the archive semantics

Future NCAR MSS File Services
Future MSS Services

File Services

WEB Enabled MSS Services

Archive

NCAR MSS Archive

SCD Computing Environment

Digital Libraries, DODS, etc.

Summary

• Balance MSS growth limitations with valuable new functionality.
The End

For more information
snow@ucar.edu
Some Mass Storage Devices at NCAR

Roy Jenne
18 Oct 1999

This briefly traces part of the history of mass storage at NCAR.

1. 1986: Install the First Mass Storage Silo at NCAR

   This first silo held about 5000 cartridges, as did later ones. The silo has a robot to mount the tapes. It used IBM 3480 tape cartridges and tape drives. The data rate was 3 Mbyte/sec. Each tape cartridge held 200 MB nominal, and an actual average of about 180 MB. This meant that the silo held almost one Tbyte.
   - In Oct 1986, NCAR installed the new Cray XMP computer with 4 processors (8.5 ns cycle time). This fast computer could deliver about 300 Mflops on a climate model and a steady 220 Mflops on the NCAR job mix (using all 4 processors).

2. Nov 1996: Install a STK Redwood Silo

   This was the second silo at NCAR. It became operational in April 1997. The tape drives are expensive for Redwood. They cost $110 k. It uses helical scan technology; the mass store people usually prefer linear track methods.
   - Drive cost $110 k each.
   - Each tape holds 50 Gbytes.
   - A full silo can hold 275 Tbytes, given some gain from compression.
   - The blank tapes cost $98 at first; now (Oct 99) they cost $45.
   - The silo holds 5000 tapes. So the media to fill the silo at the start costs nearly $500,000.
   Note: The tapes and tape drives in the present Redwood silo will gradually be replaced with Eagle drives to turn it into an Eagle silo.


   This Eagle silo was the third silo at NCAR. It arrived in Nov 1998. The tape drives cost only $25,000 each, much better than the Redwood, in cost. These Eagle tapes use linear track methods. The tape technology will improve in density, but NCAR can rewrite the same blank tapes. So in a few years, the same silo will hold 5 or 10 times as much data (now is 100 TB).
   - Drives cost $25k each. They are called 9040 drives.
   - The blank tapes cost $95 each in Nov 98, but they were down to $77 each by July 1999 when a second source started selling the tapes.
   - Each tape holds 20 Gbytes.
   - A full silo can hold 100 Tbytes.
   - The silo holds about 5000 tapes. So the media to fill the silo (at July 99 prices) costs about $385,000.
   - Capacity of silo (5000 tapes times 20 GB) is 100 TB.
   - So media cost is $3850 per TB.
   - The Eagle silo now (Oct 99) has 10 tape drives. NCAR will gradually add more drives (probably of a different type to read media that has a higher capacity.
   - Future guess: The silo of 2004 (made by some company) may hold about 1200 Tbytes.

4. Cost and Maintenance for a Silo (Oct 99 Information)

   In Oct 1999, one new silo (~5000 tape slots) costs $200k new, and two used ones cost $288k ($144k each). The silo maintenance is free the first year. Then it costs $1700 per month for two silos. This does not include maintenance for the drives.
5. What is the Same about NCAR’s Three Silos?

The three silos and the robots are identical. Also, the size and shape of all the tape cartridges used since 1986 are the same. But the 1986 tape cartridges held 200 MB and the new Eagle tapes (of 1999) hold 20 GB (factor of 100).

The silo No. 1 has the 1 GB tapes in it (so it holds about 5 TB total). This silo will gradually be converted to new Eagle tapes and to new Eagle tape drives.

6. The Tapes for the Eagle Silo

- The present tape cartridges hold 20 GB each. These are designed for fast access. There are actually two small tape reels within this standard size cartridge. Thus, the tape does not leave the cartridge. The tape is often part on one reel and part on another. Thus, the tape distance to find a dataset is shorter than with one reel, and the time to extract the tape and thread it is avoided. Note: The size of a cartridge is 10.7 cm by 12.3 cm by 2.4 cm thick.
- Storage Tek has a road map to get to higher tape densities.

7. How Much Will a Future Silo Hold?

The tape densities will keep increasing. Some companies will probably have a tape cartridge that holds 250 to 300 GB by year 2004.
- This would mean that a silo could hold about 1200 Tbytes.

8. The NCAR Future for Storage

We have 3 silos now. The total amount of data that we have is about 210 Tbytes (Oct 99).

<table>
<thead>
<tr>
<th>Date</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>The capacity in Oct 99 (3 silos)</td>
<td>~300 TB</td>
</tr>
<tr>
<td>Capacity by late 2000 (3 silos)</td>
<td>800 TB</td>
</tr>
<tr>
<td>Capacity by 2004 (5 silos)</td>
<td>6000 TB</td>
</tr>
</tbody>
</table>

Cost summary: Each silo costs about $150k (for a used silo option). Ten tape drives add $250k. The tape drives have to be upgraded to take advantage of a higher tape density. In July 1999, the media to fill one silo cost $385,000. The media will last 5 to 7 years; therefore, the media investment does not have to be renewed very often.
Introduction to NETS

Marla Meehl
NETS Manager

SCD Network Engineering and Technology Section (NETS)

August 29, 2000

Basic Contextual Information
Role of NETS in UCAR

- NETS is responsible for almost all of UCAR networking
  - Historical evolution for SCD to manage all UCAR networking
  - Important for NETS to remain in SCD (periodic discussion of moving NETS to UCAR administrative domain)
    » http://www.scd.ucar.edu/nets/intro/organizationlocation.html
- NETS has additional SCD networking responsibilities
- NETS advised by NCAB
  - NCAB: Network Coordination and Advisory Board
    » http://www.ucar.edu/ncab/
  - Reports to Information Technology Committee (ITC)
    » http://www.fin.ucar.edu/itc/
  - Technical representatives from all parts of UCAR
  - Successful NCAB paradigm proposed by ITC to be replicated for other UCAR-wide functions to be managed in an NCAR Division

NETS Responsibilities

- Types of networking supported for UCAR & SCD
  - All Local Area Networks (LANs)
  - All Metropolitan Area Networks (MANs)
  - All Wide Area Networks (WANs)
- Levels of networking supported for UCAR & SCD
  - Layer1: All physical cabling plant for UCAR/SCD
  - Layer2: All logical networking - VLANs/ELANs, etc. for UCAR/SCD
  - Layer3: All routing (99.9% IP) for UCAR/SCD
  - Layer4 & above support: a little for UCAR; a lot for SCD
What NETS Doesn't Do

• "NETS responsibility ends at the wallplate"
  - "wallplate" means "telecommunications outlet" and is the point at which building infrastructure network leaf-node cabling terminates
  - Other Divisions are responsible "past the wallplate"
    » This mainly means they do the host-networking part
    » NETS does consult on host configuration, performance, etc.
    » "Private" networking beyond the wall plates isn't forbidden
      • COMET AWIPS Satellite network
      • ATD aircraft network
      • ATD field projects
  - For SCD, NETS is involved with all aspects of networking:
    » Supercomputer networking
    » Host-based networking: routing, configuration, etc.
    » Special networking research projects
      • National Laboratory for Advanced Network Research (NLANR) Engineering, Earth System Grid (ESG), ARCS RGP Committee, Web100, etc.

What NETS Doesn't Do (cont.)

• NETS doesn't do DNS, email, security policy, etc.
  - NETS does implement security perimeters based on CSAC recommendations
• NETS doesn't do MSS networking: HiPPI, Fiber Channel, etc.
  - These use non-IP channel-extension protocols
• NETS doesn't do first-level NOC/operations
  - Handled by Computer Room Operators
  - They determine which Network Engineer to call
    **However, SCD does do all of the above**
• NETS doesn't "currently" do telephones and PBXs
  - NETS does install the telephone cabling in the backbone and to the wallplate
  - NETS does provide all telephone MAN service
How Networking is Paid For

- UCAR networking funding mechanisms
  - Space tax: all UCAR programs (including SCD) pay for networking via an annual "tax" based upon square footage occupied by the program
    » Occupancy Cost Pool (OCP)
    » Head count tax in FY 2001
  - Tax pays for "standard service" as defined by NCAB
    » Includes all LAN, MAN, and WAN networking necessary for, and benefiting, UCAR as a whole
    » Includes all UCAR cabling and core networking to the "wallplate"
    » Includes 100Mbps service to the office
    » Includes telephone wiring and inter-site telephone tie-lines
  - NETS charges back for anything beyond standard service
    » Host-connects greater than 100Mbps
    » "Rush" jobs (less than 1-week advance notice)
    » "Special" networking (e.g., satellite hookups)

- SCD networking funding mechanism
  - Line item in SCD budget

- NSF CISE funding for NLANR, Web100, and DOE funding for Earth System Grid

Magnitude of NETS Work

- NETS supports ~1,136 UCAR employees
  - Located in 9 buildings at 5 different sites
- NETS supports ~3,000 network-attached devices
- NETS supports ~114 IP subnetworks
- 69 dialup lines (via 3 all-digital PRI T1 links)
- ~100 pieces of network-equipment
  - routers, switches, monitorable repeaters, UPSs, etc.
- Building cabling
  - 1,360 standard "wallplates" installed
  - 920 "wallplates" to install by end of FY2001
- NETS consults with 63 UCAR member universities
  - Involves 700 users of just SCD facilities, with 345 projects involving 90 university facilities
Networking “Fun” Facts

- Total number of Ethernet switch ports available: 3840
- Total number of feet of backbone cable: 30,400 feet
- Total number of feet of wallplate cable:
  - Fiber: 260,000 feet
  - Twisted Pair Cabling (CAT3/CAT5/CAT6): 1,676,700 feet
    » Voice
    » Data
- Total cabling feet: 1,967,100 feet

Resources Available to NETS

- NETS budget (FY2000)
  - $3,072,700 UCAR funding to NETS
  - $198,391 SCD funding to NETS
- Total NETS staff: 18 people
  - Type of Staff
    » 1 Manager
    » 1 Assistant Section Head/Network Engineer
    » 8 Network Engineers
      • Perform design, operation, tuning, trouble-shooting, etc.
    » 5 Network Technicians
      • Mainly Layer 1 (cabling) construction
    » 1 Software Engineer
    » 1 Administrative/Support Staff
    » 1 Student Assistant
- Source of staff funding
  - 13 UCAR-funded staff
  - 1 FRGP-funded staff
  - 2 SCD-funded staff
  - 2 staff funded by outside funding (NSF NLANR Project; DOE ESG Project)
LANs

LAN Cabling

- Standard "wallplate" to each workspace
  - Connects to nearest telecommunications closet:
    » 4 data (CAT5/CAT6) cables
    » 2 fiber (62.5 micron Multimode) cable pairs
    » 2 voice/analog (CAT3/CAT5) cables
  - Only 60% of space meets this standard (1360 wallplates)
  - 920 new wallplates to be installed by end of FY2001
    » Required to support Fast Ethernet (100BaseX)
    » $2,000,000 project (approved by UCAR management)
- Closets connect to root closet with fiber bundles
  - ML root closet is in SCD machine room (ML 29)
  - FL root closet is in SCD machine room (FL2 3095)
- Network equipment goes in closets (~22 closets)
- Rewire on a 10 year cycle
LAN Design & Equipment

- Backbone UCAR LAN network is GigE (1000Mbps)
- Rest of network is switched Ethernet
  - VLAN-based (one VLAN per IP-subnet)
  - 10BaseX, 100BaseX, and 1000BaseX technology
  - 27 Cisco 5500 and 6509 Ethernet packet switches
- Routing
  - 4 Cisco 7507 routers
  - 3 Cisco MSFC routers
  - 1 Cisco 4700 router
  - 1 Cisco 2500 router
- UCAR is essentially an all-Cisco shop
- Replace equipment on a 3 year cycle

MANs
Basic MAN Networking

- Inter-site connectivity
  - ML is the UCARnet central hub
  - ML-FL
    » GigE link over BRAN fiber
    » Two T1 voice circuits over BRAN fiber
  - ML-JEFFCO
    » 10 Mbps TLS link (soon to be wireless or CRS)
    » One T1 voice
  - ML-PS
    » GigE link over BRAN fiber
    » Two T1 voice circuits over BRAN fiber
  - T1 (1.5 Mbps) link to Marshall site (soon to be wireless)
  - UCAR-owned fiber between all FL campus buildings (FL1, FL2, FL3, FL4, and UNAVCO)
    » GigE link inter-building
    » T1 voice

Basic MAN Networking

- Inter-agency connectivity (all using BRAN fiber)
  - ML-NOAA
    » OC12 (622Mbps)
  - ML-CU
    » GigE
  - ML-City of Boulder
    » OC3 (155Mbps)

- Remote Access to UCAR
  - 3 PRI T1 lines (69 56Kbps/ISDN lines)
  - Cisco 5300 Remote Access Server
  - Local and 1-800 Access
  - ADSL Megacentral on order
WANs

UCAR WAN Connections

• Front Range GigaPop (FRGP) Connectivity
  – OC3 from ML to FRGP in Denver
  – Commodity Internet Connectivity
    » OC3 connection to Qwest
    » OC3 to Cable and Wireless planned
    » OC3 to AT&T planned
  – OC3 connection to UCAID’s Abilene Internet2 network

• 6Mbps UUNET connection via NOAA

• OC-3 (155-Mbps) connection to NSF’s vBNS
Network Usage Statistics
netserver.ucar.edu/nets/Statistics/

Hourly
Abilene/Commodity/Intra-FRGP
Traffic

Page 10
Monthly
Abilene/Commodity/Intra-FRGP
Traffic

NETS Outside Projects
NETS Outside Projects

- NSF National Laboratory for Applied Network Research (NLANR)
  - http://www.nlanr.net/
- Web100
  - http://www.web100.org/
- DOE Earth System Grid Project
  - http://www.scd.ucar.edu/css/esg/

Current NETS Projects

- Millenium Infrastructure Network Technology - Foothills Lab (MINT-FL) Project (http://www.scd.ucar.edu/nets/projects/mintfl/)
- Millenium Infrastructure Network Technology - Mesa Lab (MINT-ML) Project (http://www.scd.ucar.edu/nets/projects/mintml/)
- Front Range GigaPop (FRGP) (http://www.frgp.net/)
- Web100 (http://www.web100.org/)
- National Laboratory for Applied Network Research (NLANR) (http://www.nlanr.net/)
- Update NETS Strategic Plan (http://www.scd.ucar.edu/nets/docs/reports/stratplan/strategy.html)
- 100BaseX standard service implementation and expansion
- Network Engineering Routing Design (NERD)
- Virtual Private Networks (VPNs)
- Wireless in the LAN, MAN and WAN
- ADSL
- Voice over IP Testbed
- BRAN Operational Guidelines and NOC Services
- Westnet (http://www.scd.ucar.edu/nets/projects/Westnet/)
- Earth System Grid (ESG) (http://www.scd.ucar.edu/css/esg/)
Useful URLs

- http://www.scd.ucar.edu
- http://www.scd.ucar.edu/nets
- http://www.ucar.edu/ncab/
- http://www.frgp.net
- http://www.branfiber.net/
- http://www.nlanr.net/
- http://www.ucaid.edu
- http://www.internet2.edu
- http://www.vbns.net
- http://www.qwest.com
The IBM SP kicks off a new era for SCD

Editor's note: The fall issue of the UCAR Quarterly will introduce NCAR's new IBM SP supercomputer to readers throughout UCAR’s member institutions. In this issue of SN Monthly, UQ editor Carol Rasmussen gives us a sneak preview of her feature story on the IBM SP. We're also including, on page 2, answers to a few questions that UCAR/NCAR/UOP staff may have. *Bob Henson

The Scientific Computing Division welcomed the newest member of its computing family with the arrival of an IBM RS/6000 SP at the Mesa Lab on 11 August. The $6.2 million machine arrived on schedule and without a hitch. Not only is the IBM machine NCAR’s fastest computer to date, it heralds a new kind of architecture for SCD: clustered, distributed-memory supercomputing.

With an initial delivery of 160 nodes, each containing two processors, the supercomputer offers a peak speed of 204 gigaflops, more than doubling SCD’s peak capacity. The SP also includes 512 megabytes of memory with each processor and 2.5 terabytes of disk space. Use of the new computer will be equally divided between NCAR’s community users and those in the Climate Simulation Laboratory.

For NCAR, the arrival of the SP "begins an aggressive transition to clustered shared-memory processors, following the computer industry," says SCD director Al Kellie.

The architecture of the IBM computer differs from that of vector computers such as NCAR’s CRAY C90 and also from that of a massively parallel machine like our SGI Origin 128.

Aaron Andersen (right) guides movers and the new IBM SP into the SCD machine room. (Photo by Carlye Calvin.)

This chart depicts major SCD computers from the 1960s onward, along with the sustained gigaflops (billions of floating-point calculations per second) attained by the SCD machines from 1986 to the end of fiscal year 1999. Arrows at right denote the machines that will be operating at the start of FY00. Possible upgrades to the IBM SP that arrived in August should further fuel SCD in the coming year. The division is aiming to bring its collective computing power to 100 Gflops by the end of FY00, 200 Gflops in FY01, and 1 teraflop by FY03. Inset: The IBM SP, code-named blackforest, in its new home. (Photo by Lynda Lester.)

A GRA eyes hurricanes and life
See Random Profile, p. 5

Filling NCAR, ACD shoes
See p. 6

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