Getting It All Together

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June 19, 1998

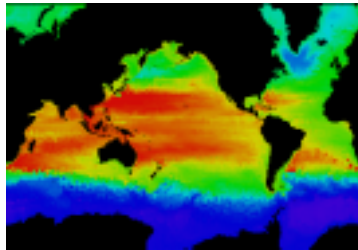Los Alamos
NATIONAL LABORATORY

Outline

- **A message from our sponsors**
- **Hardware schedule**
- **Software configuration**
- **MPI/HIPPI**
  - **scalability**
  - **concerns**
  - **superheros**
  - **outstanding issues**
- **Machine reliability and stability**
- **A non-subliminal message**

Partnership for Advanced Computing

ASCI: Accelerated Strategic Computing Initiative

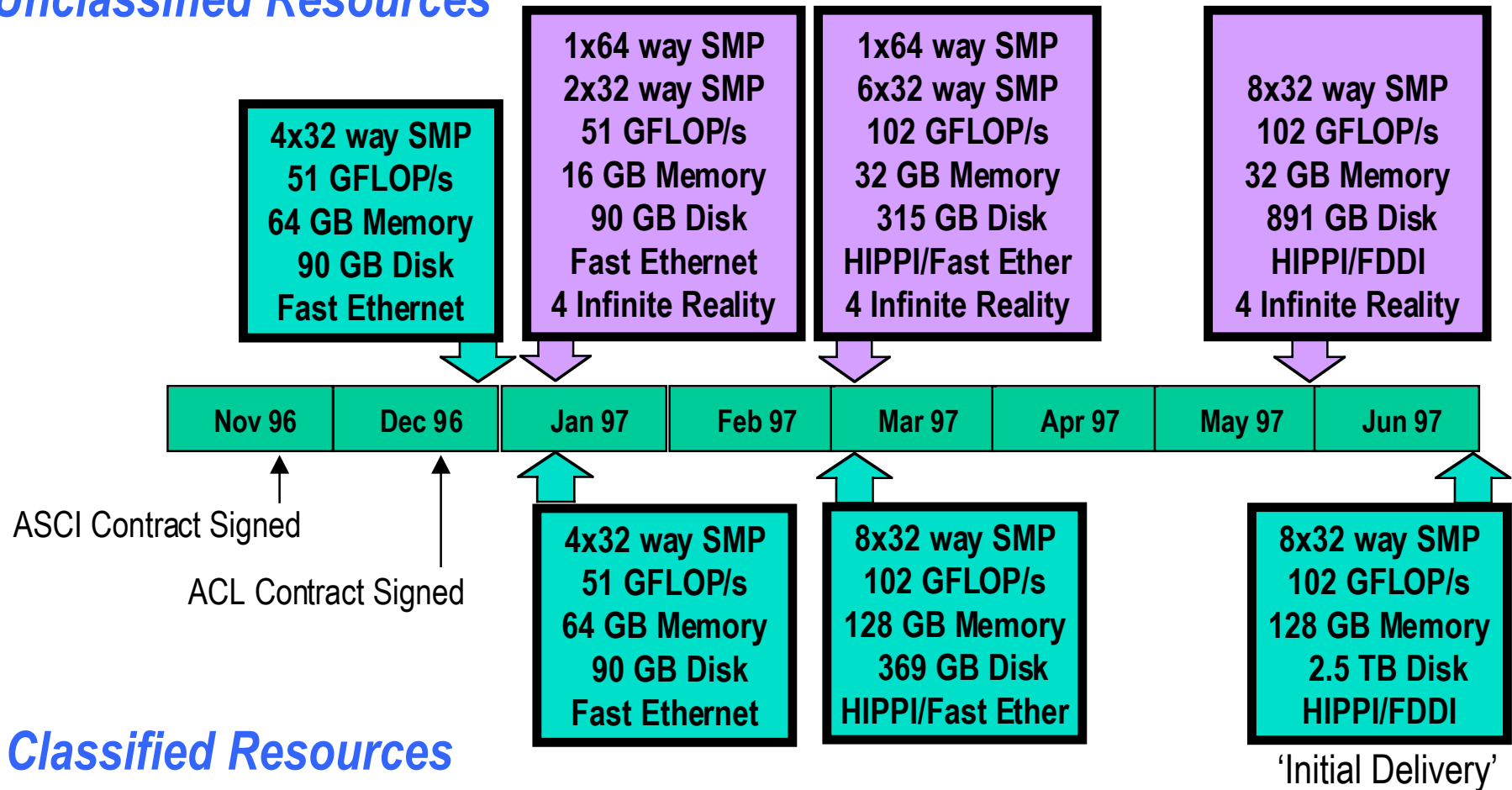CHAMMP: Global Climate Modeling Program

DOE HPCC Phase II Grand Challenges

Los Alamos National Laboratory LDRD

Hardware Schedule

Unclassified Resources

'Initial Delivery'

4x32 way SMP	1x64 way SMP	1x64 way SMP	8x32 way SMP
51 GFLOP/s	2x32 way SMP	6x32 way SMP	102 GFLOP/s
64 GB Memory	51 GFLOP/s	102 GFLOP/s	32 GB Memory
90 GB Disk	16 GB Memory	32 GB Memory	891 GB Disk
Fast Ethernet	90 GB Disk	315 GB Disk	HIPPI/FDDI
	Fast Ethernet	HIPPI/Fast Ether	4 Infinite Reality
	4 Infinite Reality	4 Infinite Reality	

Nov 96	Dec 96	Jan 97	Feb 97	Mar 97	Apr 97	May 97	Jun 97

ASCI Contract Signed

ACL Contract Signed

4x32 way SMP
51 GFLOP/s
64 GB Memory
90 GB Disk
Fast Ethernet

8x32 way SMP
102 GFLOP/s
128 GB Memory
369 GB Disk
HIPPI/Fast Ether

8x32 way SMP
102 GFLOP/s
128 GB Memory
2.5 TB Disk
HIPPI/FDDI

'Initial Delivery'

Classified Resources

Hardware Schedule (cont.)

Unclassified Resources

'Tech Refresh'

Contracted 'Final System'

| 6x128 way SMP |
| 300 GFLOP/s |
| 192 GB Memory |
| 1.7 TB Disk |
| HIPPI/FDDI |
| 4 Infinite Reality |

| **Additional** |
| 1 x 1024 way SMP |
| 1 TFLOP/s |
| 256 GB Memory |
| 3.4 TB Disk |
| HIPPI6400/FDDI |
| 4 Infinite Reality++ |

CY97 **CY98** **CY99**

| Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |

| 16x 64 way SMP |
| 400 GFLOP/s |
| 256 GB Memory |
| 6.7 TB Disk |
| HIPPI/FDDI |

| 48x128 way SMP |
| 3 TFLOP/s |
| 1.5 TB Memory |
| 76 TB Disk |
| HIPPI6400/Gb Ether |

Classified Resources

'Tech Refresh'

'Final System'

ACL
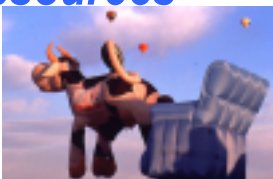
Software Configuration

- **Load Sharing Facility (LSF) access to machines**
- **Kerberos-5 authentication with ticket forward/refresh**
- **DCE/DFS local storage**
- **HPSS archival storage**
- **Module-based MIPSpro compilers and MPI software**
  - **Pros:**
    - **Very nice for providing multiple revs of compilers/libs**
    - **Can you fit your OS onto a 9G drive w/o them?**
  - **Cons:**
    - **Installable/patched without -Vrulesoverride:on?**
    - **Not all software is 'module aware' (e.g. cvd/workshop)**

MPI/HIPPI Scalability

- **Major ASCI code groups running across 1000+ nodes**
  - lots of medium-sized MPI messages (65 bytes – 16 Kbytes)
- **Parameter space study with environment variables**

$$4096 * 16K \leq 16K +$$

$$\#hosts * \begin{pmatrix} 128 * \$MPI\_MSGS\_PER\_HOST \\ + \\ 16K * \$MPI\_BUFS\_PER\_HOST \end{pmatrix}$$

$$+$$

$$\#procs * \begin{pmatrix} 128 * \$MPI\_MSGS\_PER\_PROC \\ + \\ 16K * \$MPI\_BUFS\_PER\_PROC \end{pmatrix}$$

ESSENTIAL Communications

MPI/HIPPI Scalability (cont.)

$$4096 * 16K \leq 16K +$$

$$\#hosts * \begin{pmatrix} 128 * \$MPI\_MSGS\_PER\_HOST \\ + \\ 16K * \$MPI\_BUFS\_PER\_HOST \end{pmatrix}$$

$$+$$

$$\#procs * \begin{pmatrix} 128 * \$MPI\_MSGS\_PER\_PROC \\ + \\ 16K * \$MPI\_BUFS\_PER\_PROC \end{pmatrix}$$

- **Code team debug cycle:**
  - **run with default settings until code crashes:**
    - **'ERROR: unable to pin memory on HIPPI' (out of _BUFS_)**
    - **'ERROR: out of message packets' (out of _MSGS_)**
  - **set _PER$_{PROC}$ environment variables to 0**
  - **minimize $MPI_MSGS_PER_HOST and maximize $MPI_BUFS_PER_HOST subject to the constraint**

MPI/HIPPI Concerns

- **What can be done about high latencies w/ HIPPI 800?**
  - **Tradeoff for bandwidth in hardware design of the NIC**
  - **On–box MPI overhead: 10–15 usec   (kaf@cray.com)**
  - **Cross–box MPI overhead: 119 usec   (kaf@cray.com)**
  - **Addressed in the HIPPI 6400 NIC**
  - **Myrinet NIC shows promise on PC clusters**

MPI/HIPPI Concerns (cont.)

- **Should we be concerned about bit error rates?**
  - **Connector/cable problems are much more prevalent, but ...**
  - **HIPPI bypass means 'bypass'**
    - **LANL code groups <u>now</u> run with CRC checks by default**
    - **Fixed with HIPPI 6400 having CRC checks in hardware**

'Patch Man', 'App Woman'
and
'Boy Cable'

in

'The Bit Riddle'

Outstanding MPI/HIPPI Issues

- **Suspect HIPPI firmware problem**
  - MPI error (misrouted headers?) detected on receiving end
  - Manifested when MPI is running out of resources
    - Accomplished by carefully setting ENV variables
- **Sample test code fails once in 100–200 runs**
  - Reproducible on 5 x 63 nodes
  - Cannot be simply placed into an infinite loop
  - Cannot flood the HIPPI devices to generate the failure
- **Estimated 500 – 1000 debug hours already spent**

Reliability and Stability

- **Open and Secure 'Tech Refresh' Systems:**
  - All too frequent hardware fallout
    - All boxes currently undergoing power supply upgrades(4 hr each)
    - Non-fatal memory errors monitored, swapped on multiple occurrences
  - Average between 10 – 15 unscheduled interrupts per week
- **Reassurance from SGI that 'Final Delivery' Systems are more reliable**
- **A plan to help ensure arrival of good hardware on site:**
  - Systems team to run intensive code on each 'phase' of the delivery
    - Met with opppositioin by SGI but ...
    - Already successful in finding router problems on 1 of 4 x 128

A Non-subliminal Message

- **http://www.hr.lanl.gov/html/jobs/regjobs.html**
  Keyword Search : 983176

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