Independent Assessment Review

High Performance Computing & Communications Program

Testbed Integration Management Team Overview

Raphael R. Some

Team Manager

Jet Propulsion Laboratory

June 21-23, 2000

NASA Ames Research Center

Testbed Integration Management Team Members

- **Raphael R. Some (Team Manager)**
  REE, Jet Propulsion Laboratory
- **Alan Federman**
  LTP, Raytheon
- **Marjory Johnson**
  NREN, Raytheon
- **Dr. Phil Webster**
  ESS, Goddard Space Flight Center
- **Leigh Ann Tanner**
  CAS, AMTI

Testbed Integration Management Team Charter

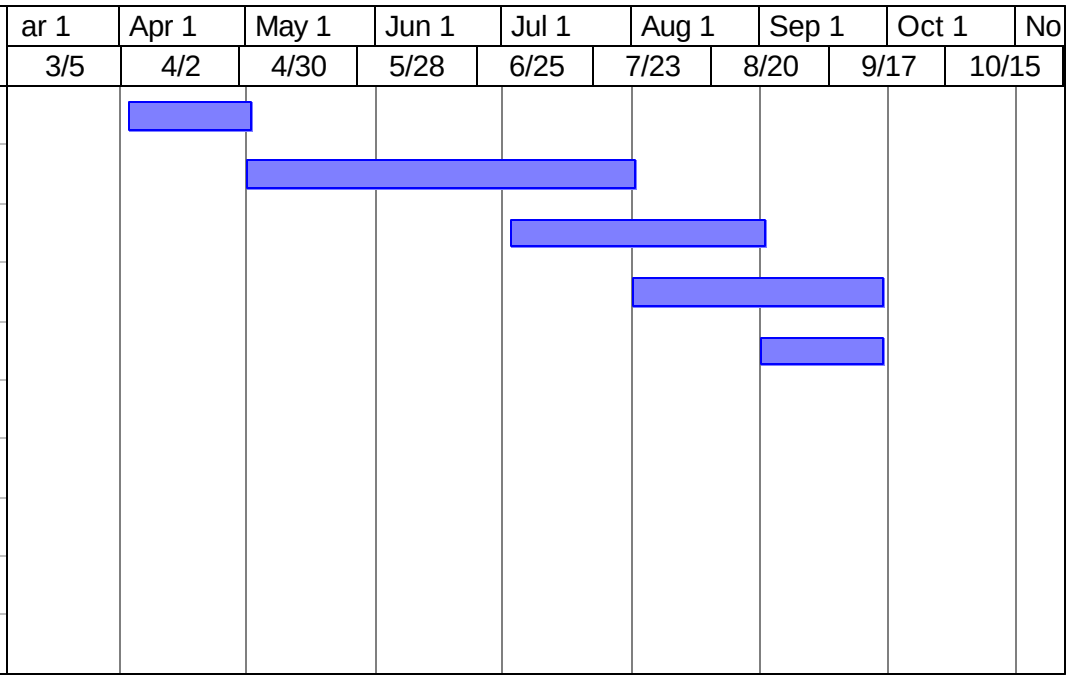
- **Keep abreast of current knowledge in high performance computing and communication activities, emerging technical trends and technologies:**
  - **Nationally**
  - **Internationally**
- **Provide, to the HPCC Program, an annual report of the HPCC Testbeds technical activities covering:**
  - **Testbed architectural requirements and implementations**
  - **Areas for potential increase in cross program collaboration**
  - **Promising new technologies and trends**
  - **Assessment of low pay-off activities**
  - **Evaluation of and recommendations for new technology thrusts**
- **Support the HPCC Program Office and Project Managers in Program Plan updates.**

Testbed Integration Management Team Methodology

- **To meet the requirements of our charter we have established the following methodology:**
  - **Define and catalog, on a per-testbed basis:**
    - Testbed usage
    - Current and projected:
      - System requirements
      - Architectures
      - System software
      - Performance
      - System upgrades
      - System loading
      - Issues and challenges
  - **Determine potential cross-program synergies.**
  - **Recommend new activities to enable and/or promote resource sharing, cross project synergies.**
  - **Recommend the cancellation of low ROI activities.**
  - **Establish a process to discover and examine new technologies and recommend new high ROI activities.**
  - **Publish the above results on a regular (12 month) basis.**

Application Integration Management Team Schedule

ID	Task Name
1	Initial Catalog
2	Catalog Refinement
3	Detailed Testbed Investigation
4	Testbed Evaluation/Conclusio
5	Annual Report



CAS Testbed

- **Through a general and extensible large-scale, heterogeneous computing environment, CAS will address NASA's needs in:**
  - **Computing**
  - **Data management**
  - **Real-time data source**
  - **Collaboration**

ESS Testbed

- **ESS Testbed activities are aimed at assuring that high-end scalable computer systems evolve in a direction leading to sustainable teraFLOPS performance for large scale scientific data processing.**
- **Evaluate the performance of large-scale Earth and space science simulation codes on state of the art massively parallel computer systems**
- **Develop data management tools for high-speed access management and visualization of data with teraFLOPS computers.**
- **Make available prototype, scalable, parallel architectures and massive data storage systems to ESS researchers.**
- **Develop environments to facilitate the sharing of information and software tools.**

LTP Testbed

- **LT Testbeds activity is aimed at assuring that high reliability internet connectivity for text, data and live video/audio be established anywhere in the world.**
  - **The Digital Audio Testbed allows streaming live video/audio produced in house (or available via conventional broadcast) to be sent at a baud rate as low as 28Kb(14kb audio only) anywhere there is internet connectivity. This allows us to bring NASA content to rural areas not served by NTV or cable.**
  - **The Wireless Internet provides the ability to originate broadcasts from anyplace accessible by Inmarsat. Other wireless technologies are also in test.**
  - **The Video/ISDN link provides the ability to establish a video conference center at any location serviced by ISDN telephone lines.**
  - **A combination of testbeds 2 and 3 allows Video Conferencing anywhere accessible by Inmarsat.**

NREN Testbed

- **The NREN is, in essence:**
  - **A virtual testbed linking various NASA testbeds in the form of a high performance network to be used by the NASA community and its partners.**
  - **The Advanced Network Test Lab (ANTL), is utilized for network protocol development and application testing.**
- **The NREN testbed supports the following work:**
  - **Network design and architecture enhancements to the backbone.**
  - **Network security implementation and activities.**
  - **Network monitoring enhancements.**
  - **IP Multicast tests.**
  - **Network Quality of Service tests.**
  - **High speed connectivity implementation issues.**
- **Due to simultaneous testing and hosting of several project platforms, the testbed connectivity is dynamic.**
  - **multiple end points/sites**
  - **local and wide area connections keep evolving**

REE Testbed

- **The REE testbed is used to support development in:**
  - **System architectures and configurations for spacecraft on board computing applications**
  - **Cluster management software for embedded systems**
  - **Porting of science application codes for the purpose of determining efficiency and scaling of onboard science applications in embedded cluster architectures and configurations**
  - **Fault detection and mitigation methods, with a concentration on high rate transient faults**
  - **Methods of Fault injection and error propagation tracing**

- **The REE Testbed is a continually evolving ensemble of COTS and custom-designed components. The testbed is used to develop cluster computing environments which can tolerate high rates of transient faults. To this end, it is required that the testbed support: high fidelity fault injection and error tracing; continuous reconfiguration, system crashes, hangs and resets. The only thing stable about this system is its instability!!**

Testbed Conclusions

Testbed Name	Milestone(s) Supported	Vendor	Model	"Sustained" Performance	Number of Processors	Processor Type	Total Memory	Total Memory Bandwidth	Attached Disk Space	Location	Date Acquired (Actual or Planned)	Date Retired (Actual or Planned)	How Retired	Total Acquisition Cost to Government	Total Acquisition Cost to NASA HPCC Program	Acquisition Method	Annual Maintenance Cost (Hardware) to NASA HPCC Program
				(Gflops)			(Mb)	(Mb/s)						($ Millions)	($ Millions)		($K-Thousand)
				(Linpack)													
Lomax	CAS (HPCCP 1.1, 2.2, 2.3, 5.3, 6.3)/ESS	SGI	Origin	196	512	R12000 300 Mhz	196,000	400 (to main memory per processor)	154.7 GB +1.48 TB RAID	Ames	Jun-99	TBD	TBD	17.05	9.30	SEWP II	$0.00 first year $1.2 M per year after 1 year
Steger	CAS (HPCCP 1.1, 2.2, 2.3, 5.3, 6.3)/ESS	SGI	Origin	101	256	R10000 250 Mhz	64,000	400 (to main memory per processor)	111.8 GB + 800 GB RAID	Ames	Feb-98	May-00	Turned over to CoSMO	9.70	4.85	SEWP II	$0.00 first year $555K per year after 1 year
Hopper	CAS (HPCCP 1.1, 2.2, 2.3, 5.3, 6.3)/ESS	SGI	Origin	25	64	R10000 250 Mhz	1,600	400 (to main memory per processor)	36 GB + 540 GB RAID	Ames	Dec-97	TBD	TBD	2.50	1.25	SEWP II	$0.00 first year $260K per year after 1 year
Whitcomb	CAS (HPCCP 1.1, 2.2, 2.3, 5.3, 6.3)/ESS	SGI	Origin	7	16	R10000 250 Mhz	12,288	400 (to main memory per processor)	27 GB + 132 GB RAID	Langley	Jun-98	TBD	TBD	0.36	0.36	SEWP II	$0.00 first year $60K per year after 1 year
Sharp	CAS (HPCCP 1.1, 2.2, 2.3, 5.3, 6.3)/ESS	SGI	Origin	10	24	R1000 250 Mhz (16) R1000 195 MHz (8)	4,000	400 (to main memory per processor)	128 GB	Glenn	Jun-98	Sep-01	TBD	0.36	0.36	SEWP II	$0.00 first year $60K per year after 1 year
Jsimpson	ESS (HPCC 1.1, 1.3)	Cray	T3E	607	1360	Alpha EV5.6 300 Mhz	162,000	1200 (to memory per processor)	2.2TB	GSFC	Apr 98 - Jan 00	CoSMO decision	Turn over to CoSMO	20.50	13.10	SEWP II	$1.0M per year
theHive	ESS (HPCC 2.2, 7.1)	various PC vendors	Linux cluster	15	200	Intel P6 200-500 Mhz	42,000	180 (to memory per processor)	1.0TB	GSFC	Sep 97 - Apr 99	FY02 - FY03	TBD	0.50	0.50	Small Purchase	$3K per year
REE Level Zero Testbed	REE (HPCC 1.2, 5.1)	CETIA	na - Assembled at JPL	7	6 Nodes/ 12 Processors	PPC 750	768 (128 per node)	Std PCI	53 GB	JPL	Jan 00	TBD	TBD	0.14	0.14	Fixed Price	No formal maintenance agreement
REE First Generation Testbed	REE (HPCC 1.2, 2.1, 5.1, 5.4, 6.2, 7.2)	Sanders, a Lockheed Martin Co.	n/a - Built to Spec	24	20 Nodes/ 40 Processors	PPC 750	2560 (128 per node)	Std PCI	161 GB	Sanders home facility, Nashua, NH	June 00 (Planned)	Mar 04 (Planned)	TBD	4.94	4.94	Fixed Price	$0.106/yr for first two years
TOTALS				992										56.04	34.79		

Testbed Conclusions cont.

Testbed Name	Milestone(s) Supported	Vendor	Model	"Sustained" Performance	Number of Processors	Processor Type	Total Memory	Network Bandwidth	Special requirements	Location	Date Acquired (Actual or Planned)	Date Retired (Actual or Planned)	How Retired	Total Acquisition Cost to Government	Total Acquisition Cost to NASA HPCC Program	Acquisition Method	Annual Maintenance Cost to NASA HPCC Program
				(Gflops)			(Mb)	(Mb/s)						($ Millions)	($ Millions)		($K-Thousand)
				(Linpack)													
Digital Adio Testbed	2000 Streams by FY 99	Real Networks, Sun, SGI	Real Server G2, Ultra 5, Sparc 20	Goal 5000 simultaneous video/audio streams	multiple servers	Sun, SGI	na	28Kb to 10Meg	na	distributed	1997	2002		0.10	0.10	SOR	40k
Wireless Internet	56kb Fy97, 128Kb FY 00	Saturn, Global, Cisco	Saturn-B, Global Communicator	54-128Kbs	support 2 IP addresses at remote site	Ethernet Equiped PC	na	56kb to 128kb	Portable, work off battery, generator	portable, ARC, GRC	1998	Jun-09		0.05	0.05	SOR	10k
Video/ISDN Link	384kb FY 00	Polycom	512	54-128-384kbs	na	Standard Cam Corder	na	56 to 384kb	na	portable, ARC, GRC	2000	Jun-09		0.05	0.05	SOR	10k

Testbed Conclusions cont.

- The program testbeds serve as the backbone for the projects within the HPCC program.
  - Support development and porting of science application codes (REE,CAS)
  - Verify and test system software (ESS, CAS, REE, NREN)
  - Link together the various testbeds within the HPCC Program Infrastructure in the form of a 'psuedo-testbed' (NREN)
  - Provides an infrastructure capable of addressing larger scale, diverse and transient problems (CAS)
- The Testbeds IMT has completed its initial review of the HPCC Testbed resources and will complete its catalog by 8/1/00.
- Following completion of the testbeds catalog, we will perform detailed reviews of the requirements vs current testbed systems to:
  - Identify and recommend opportunities for synergy and resource sharing among HPCC projects.
- In parallel with the above activities, we will review new technologies and recommend, to the HPCC Program office and the HPCC Project Managers, identified near term high ROI activities.
- By end of year, we will issue a report on our findings and define a continuing methodology for maintaining and continually assessing a knowledge base of activities and technologies related to HPCC testbed activities