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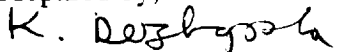September 24, 1997

Final Report for NAG3-1725

Performance Evaluation in Network-based Parallel Computing: Network of Workstations (NoWs) is emerging as a cost-effective alternative for many problems that require supercomputers or massively parallel computers. The objectives of this research were to establish a test-bed for clustered parallel computing and conduct performance evaluation of various clusters for a number of applications/parallel algorithms. In the following, a brief description of tasks and accomplishments is given:

1) Established a cluster of SUNSPARC workstations via downloading and installing PVM (Parallel Virtual Machines).
2) Defined a set of three basic applications/parallel algorithms (parallel search, parallel sort, and parallel matrix multiplication) and implemented programs in C under PVM environment.
3) Conducted performance evaluation (elapsed time or speedup) under various configurations and problem sizes.
4) Presented results and published an abstract in the Third NASA HBCUs' Research Conference, April 10-11, 1996 in Cleveland, Ohio.
5) Procured and installed a ForeRunner ATM (Asynchronous Transfer Mode) switch (BX-200 Fore Systems Inc.)
6) Established an ELAN or LANE (Emulated Local Area Network) of SUNSPARC workstations which are connected via the ATM switch. Each optical connection runs at 155 Mbps (OC-3). We could also run applications in IP over ATM mode.
7) Five undergraduate computer science students worked on this project during the past two years. Two students presented the poster session in the Third NASA HBCUs' Research Conference in April of 1996. One student presented a talk in a conference sponsored by OAI at Wright State University in the Spring of 1997. He worked on measuring latency and the effect of message size in a LAN running TCP/IP. Four of these students graduated in the last 1.5 years. Two students started promising careers with IBM and AT&T. The other two pursued graduate studies at Purdue and Wright State Universities.
8) We also conducted performance measurements using two of the basic applications namely parallel search and parallel sort on a remote IBM SP-2 system at OSC supercomputer center.

In brief, performance evaluation results reveal that overhead in communication between processes in a network-based parallel computing is the major restricting factor to performance improvement. That is, coarse-grain parallelism which require less frequent communication between processors will lend itself to higher performance in network-

based computing. In the future, we would like to continue our research in performance evaluation under newly established cluster of workstations which are connected through a high-speed ATM switch.

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