High Performance Computing Services in a WAN Environment

Distributed Object Group Metacomputing Architecture (DOGMA)

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Trends

- Telecommunication providers are expanding to offer additional features
  - Internet connectivity
  - Web page hosting
  - Messaging
  - Pager information (stock quotes/sports)

- Compute services can be offered by an administrator capable of harvesting idle cycles
Overview

- **Distributed Object Group Metacomputing Architecture (DOGMA) provides connectivity and programming environment**
- **DOGMA is a parallel computing environment which integrates the power of heterogeneous clusters of workstations with that of idle nodes attached to the Internet.**
- **Java provides common executable.**
- **DOGMA supports two programming API’s: MPI and Distributed Object Groups.**
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Code Servers

- Code servers allow application binary code to reside in multiple locations eliminating the need for a shared file system.
- Each code server serves up specific packages (and all sub-packages of that package).
As “transitory” nodes activate (when the machine moves out of idle mode), “migratable” objects move to available nodes. Semi-dedicated nodes allow all objects to complete execution before stopping DOGMA.
Many computers spend a large amount of time idle.

The DOGMA Screen provides a simple means of putting idle CPU cycles to work.

Two modes of operation for screen saver termination:

- **Transitory** - Objects must migrate off of the node in a fixed amount of time after which DOGMA shuts down.
- **Semi-Dedicated** - Screen saver shuts down, but DOGMA runs in the background until all objects on the node have completed.
Distributed Object Groups

- Simplify parallel programming.
- Provide asynchronous group method invocation.
- Allow arguments to be automatically partitioned.
- Data is partitioned according to the power of nodes on which the group resides.
- Return values can be automatically assembled.
- Alternatively an array of results may be returned.
- Support for multiple partitioning schemes.
Distributed Object Groups

DOG Master

DOG Elements
Computation

![Graph showing execution time versus blocksize for different compilers.](image)
Communication

![Graph showing throughput in Mbps vs. message size in bytes for different byte sizes: Java bytes, Win32 bytes, RMI bytes, and PVM 3.4 bytes.](image-url)
Jacobian
Gaussian Elimination

![Graph showing performance comparison between different systems and node counts. The x-axis represents the number of nodes, and the y-axis represents time in seconds. The graph compares different systems such as DOGMA, PVM, and MPI, with various node counts (400, 600, 800).]
Applications

- Web page indexing
- Image Processing
- Complex speech recognition
- Wall Street predictions
- Virtual Reality
- Scientific applications
Cost Model

- Credit users who make idle cycles available
- Charge for telecommunications network time
- Optimize communication routes for network utilization
Conclusions

- DOGMA provides functionality for integrating heterogeneous clusters with anonymous idle nodes.
- Performance is very competitive with traditional parallel programming environments.
- Compute services can be offered through Java based systems
- http://zodiac.cs.byu.edu/DOGMA