Characterizing and Evaluating Desktop Grids: An Empirical Study

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Desktop Grid Background

- Set of (shared) network-connected resources
- High computational power at low cost
  - Reuse existing infrastructure of resources
- Successful deployment of compute-intensive applications
  - E.g. SETI@home, folding@home, fightaids@home
- Computing platform
  - Internet
  - Enterprise

Desktop Grid Resources

- Resources are extremely heterogeneous
  - E.g. in terms of CPU, memory, disk space, network connectivity, OS
- Resources are volatile

Goal & Approach

- Determine the utility of desktop grids for high throughput, task parallel applications
  - Develop performance model
  - Quantify utility in terms of cluster equivalence
- Measurements of resource availability
Related Work

- Monitored CPU availability [Wolski99, Wolski99+, Dinda98, Bolosky00, Arpaci95]
  - Difficult to determine effect on desktop grid behavior
    - OS idiosyncrasies
    - Ignores keyboard/mouse activity
      - E.g. hard to infer task failures

Method

- **Intrusive** measurements on *Entropia* desktop grid system
  - Fixed time-length tasks
  - Every 10 seconds the program writes the number operations completed to file
  - Output files assembled to produce a CPU availability trace
    - Interpolated gaps due to system overhead
  - ~220 machines at SDSC
  - Cumulative measurement period: 1 month

CPU Availability

![CPU Availability Graph]

Task Failure Rate

![Task Failure Rate Graph]
Performance Model

- $N$: number of hosts
- $s$: operations per task
- $f(s)$: failure rate
- $r$: average ops per sec for a host
- $g$: average system overhead per task
- $W(s)$: aggregate ops per sec

Optimal Task Size

$W(s) = N \times \frac{r(1-f(s))}{1+(r/s)g}$

Cluster Equivalence

- Compare utility of desktop grid with that of a dedicated cluster
  - High throughput, task parallel applications
- Determine $M/N$ cluster equivalence ratio
  - Given $N$-host desktop grid, what is equivalent $M$-node dedicated cluster

Cluster Equivalence

Measurement data
  - Captures temporal structure of resource availability
- Model of desktop grid work rate
- Quantify desktop grid utility for high throughput, task parallel applications using cluster equivalence metric

Contributions
Current and Future Work

- Traces of other desktop grids
  - Xtremweb, BOINC
- More detailed characterization
  - E.g. at host level
- Resource selection for rapid application turnaround