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Tackling the Memory Bottleneck Problem for Large-Scale Network Simulation

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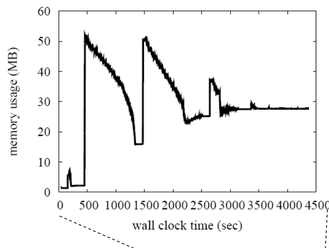
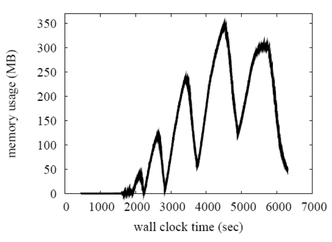
Motivation

- Need of large-scale network simulation:
  - BGP, Internet Worm, File-transfer C/S
  - Internet measurement topologies
    →Oregon Route Views 1997-2006 (~21460 ASes)
- Existing facilities:
  - Linux PC cluster
  - Distributed simulator (DaSSFNet)
  - Load balancing by topology partitioning (Metis)

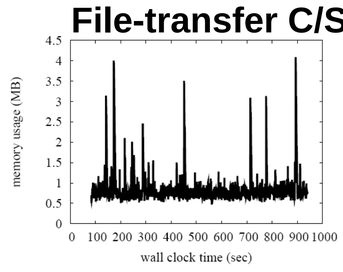
BGP

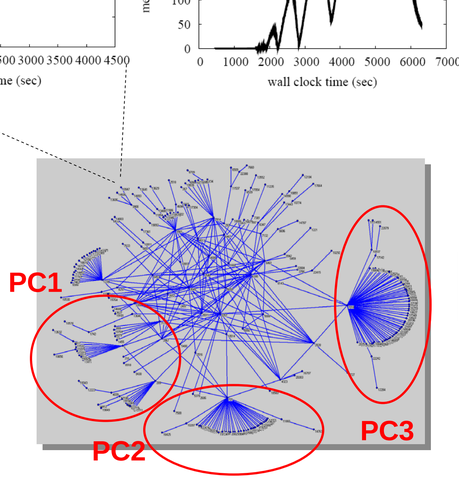


Internet Worm

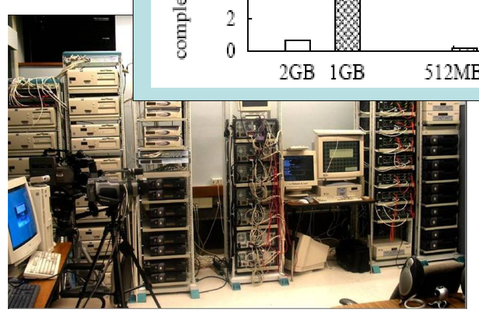


File-transfer C/S



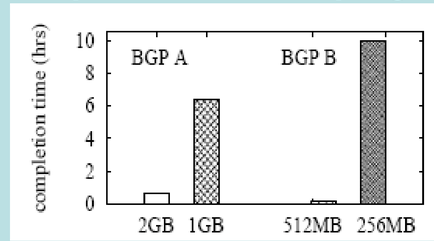


Metis



Linux PC cluster

Impact of VM Swaping

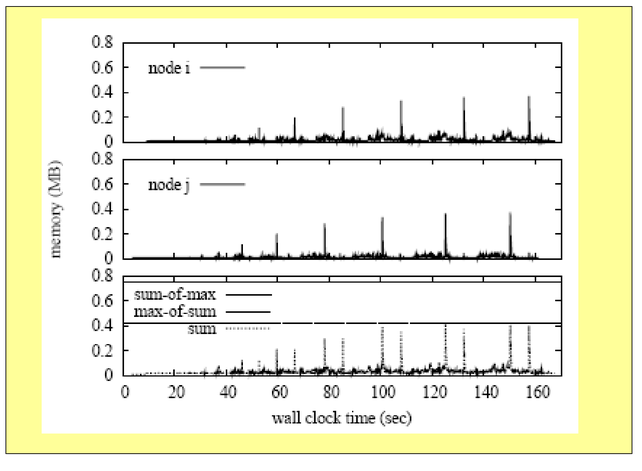


→ A memory-overloaded machine can slow down an entire simulation due to VM swapping.

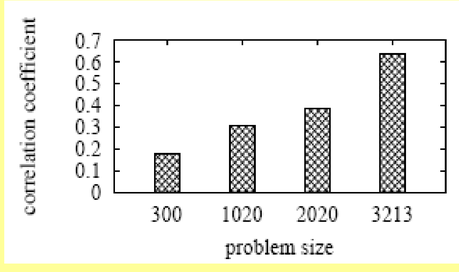
Memory Balancing

Estimation of Per-machine Peak Mem Usage

- Synchronization issue of per-node peak mem usage
- Estimation by the sum-of-max memory usage
- Measurement accuracy: law of large numbers



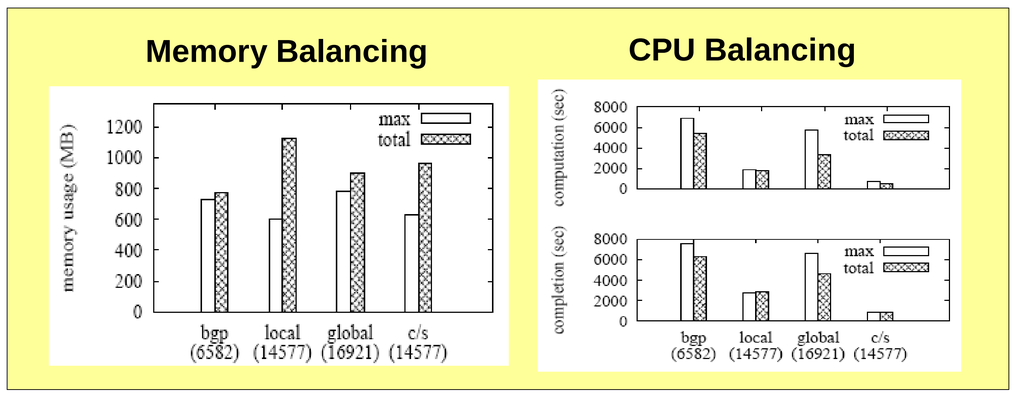
Law of Large Numbers
sum-of-max and max-of-sum



Trade-off with CPU balancing

- Per-node CPU cost estimation by the total number of messages processed over time
- Conflict of per-node max (M_i) vs. total (C_i)
- Effect of power-law topology and application behavior

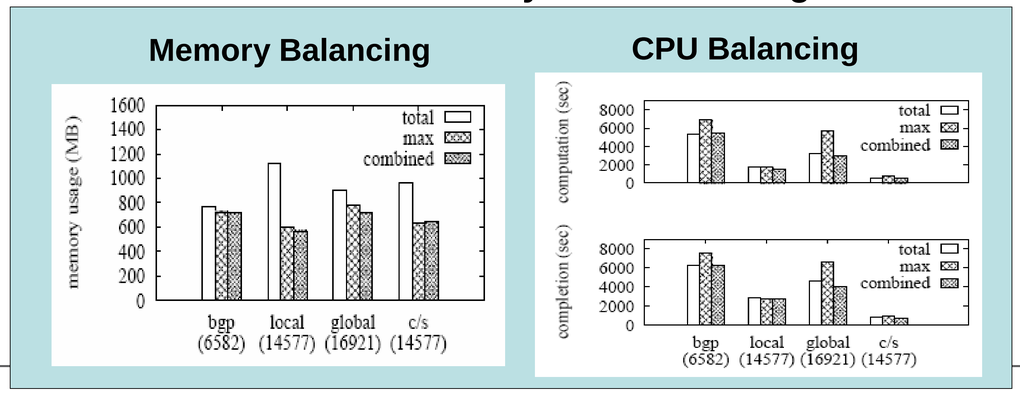
Trade-off between Memory and CPU Balancing



Memory-CPU balancing

- Multi-constraint optimization
  → for each node i, 2-D weight vector (M_i, C_i)
- High-correlation between per-node max (M_i) & total (C_i)

Combined Memory-CPU Balancing



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