Ginseng: Market-Driven LLC Allocation

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What is the Problem?
How should cache ways be allocated among virtual machines to optimize the aggregate benefit?

Resource-as-a-Service
• Fine resource granularity
• Fine time granularity
• Market-driven resource pricing

Cache Layout Reminder
Set 1: Way 1 - line, Way 2 - line, Way 3 - line, Way 4 - line
Set 2: line - line, line - line
Set 3: line - line, line - line

Cache Allocation Technology

COS 1
Way 1 - 0, Way 2 - 1, Way 3 - 2, Way 4 - 3
COS 2
Way 1 - 0, Way 2 - 1, Way 3 - 2, Way 4 - 3
COS 3
Way 1 - 0, Way 2 - 1, Way 3 - 2, Way 4 - 3
COS 4
Way 1 - 0, Way 2 - 1, Way 3 - 2, Way 4 - 3

A thread that is assigned to a COS is only allowed to store new cache lines in the ways determined by the COS. There is no reading limitation.

Cache Utilizers vs. Neutrals

Conclusions
• Ginseng efficiently allocates cache to selfish guests while maximizing their social welfare.
• The guests utilize their cache fast enough to allow such rapid changes in the allocation without any substantial effect on their performance.

Application Performance

Ginseng, Ginseng-Simulation, Perf. Maximizing, Ideal Static

Conclusions

Growing Number of VMs

All guests run Fast Fourier Transform with 1 high-valuation customer, 1 medium-valuation customers and 8 low-valuation customers.