Multi-Grain Coherence Directories
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Initial thought experiment:
How many entries does the directory require if it can dynamically refine the size of each entry?

Related Works:
Two recent proposals also track coherence for individual blocks and larger regions. Neither proposal precisely tracks individual blocks within regions, and their designs potentially require multiple lookups for a single request and are susceptible to corner cases that behave poorly.


What’s different about MGD?
✓ Explore more than two granularities
✓ Efficient, parallel lookups
✓ Explicit, precise information for all blocks
✓ No coherence protocol changes
✓ No new race conditions
✓ Robust performance

Methodology:
• 16-core chip-multiprocessor
• 64 KB L1 Instruction and Data caches
• 256 KB private L2 cache
• 16 MB distributed shared L3 cache
• 8-way set-associative directory

• Simics + Flexus full-system simulation
• SPARCv9 ISA, Solaris OS (version 8 or 10)
• Detailed timing of out-of-order cores and memory hierarchy
• Selection of 18 diverse applications
• SpecWeb, Parsec, TPC-C, TPC-H, CloudSuite


Final Result:
50% size reduction vs. baseline directory

Benefit of more granularities?

Number of Different Granularities

Relative # of Entries

Great (5) Apps
Good (14) Apps
Ugly (1) Apps

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