Optimization Study for Multicores

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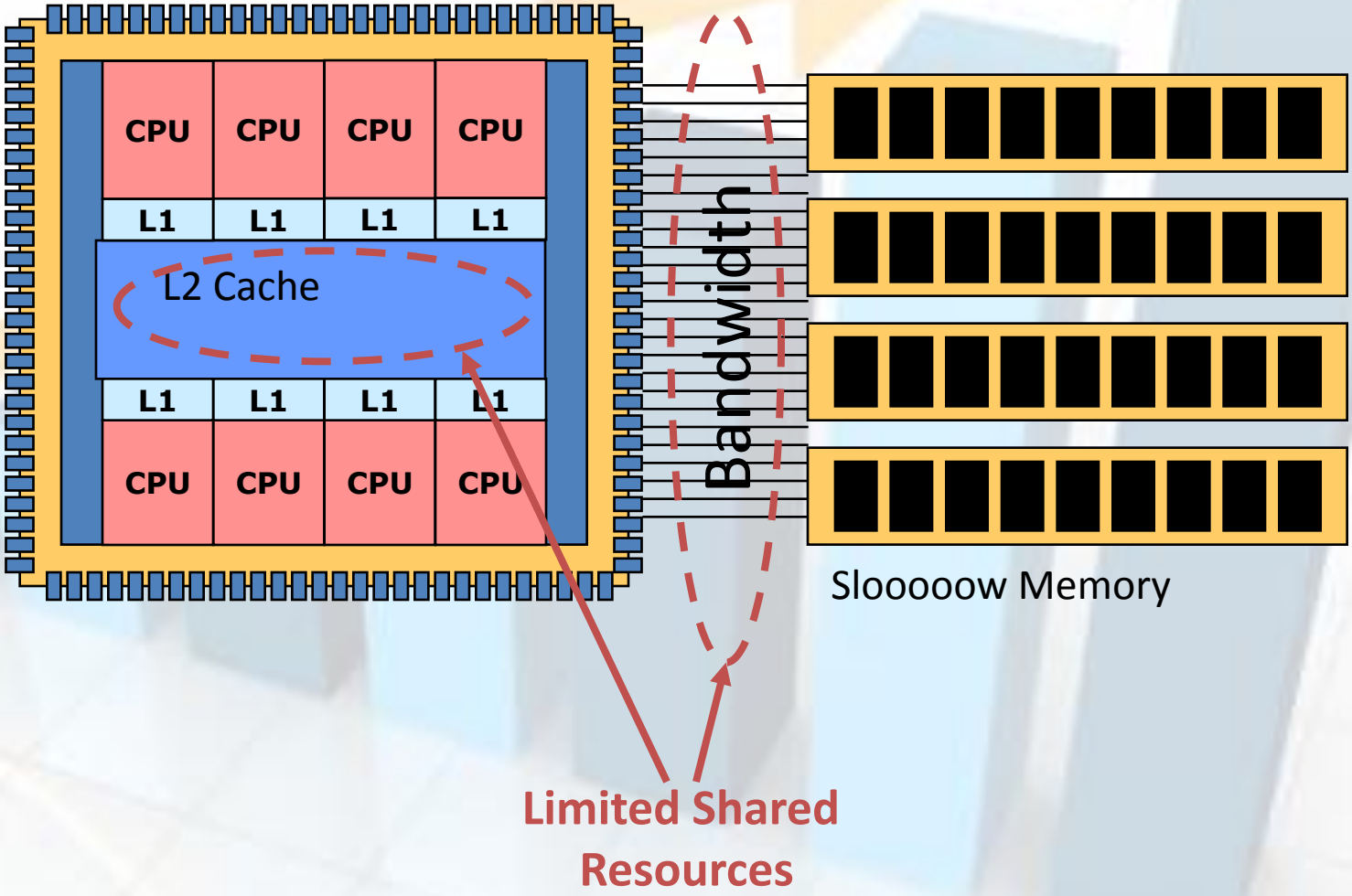
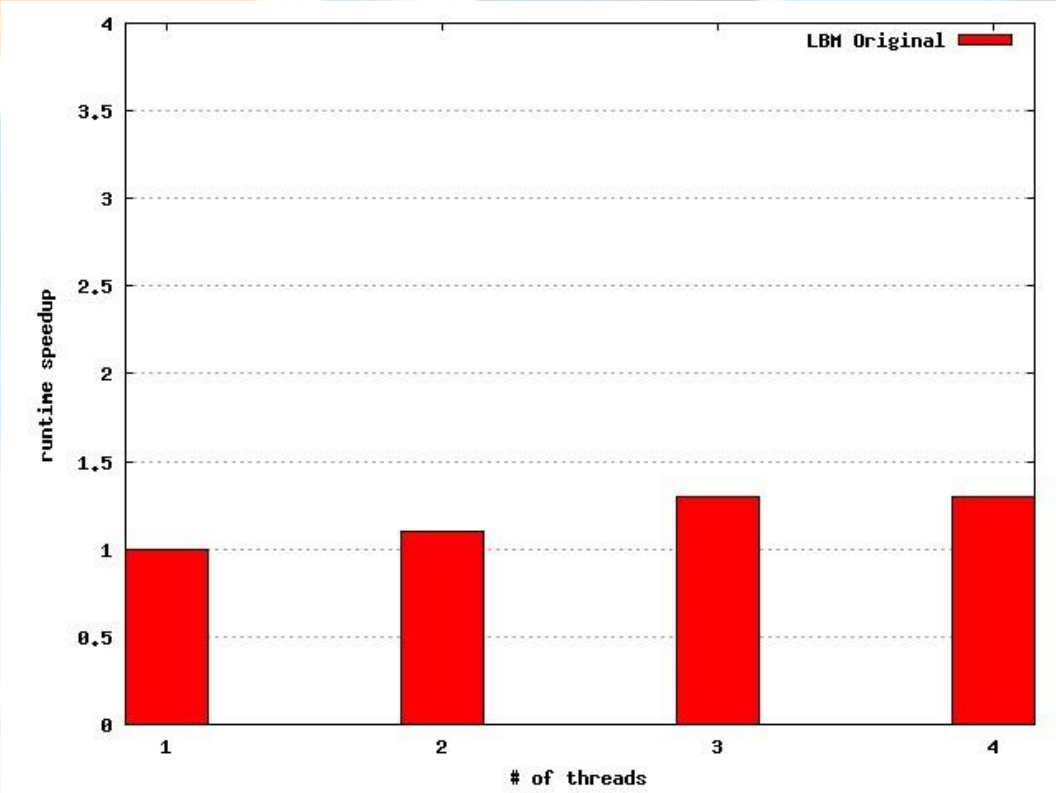
Memory Wall


CPU
CPU
CPU
CPU
L1
L1
L1
L1
L2 Cache
L1
L1
L1
L1
CPU
CPU
CPU
CPU
Bandwidth
Slooooow Memory
Limited Shared Resources

Case Study - LBM

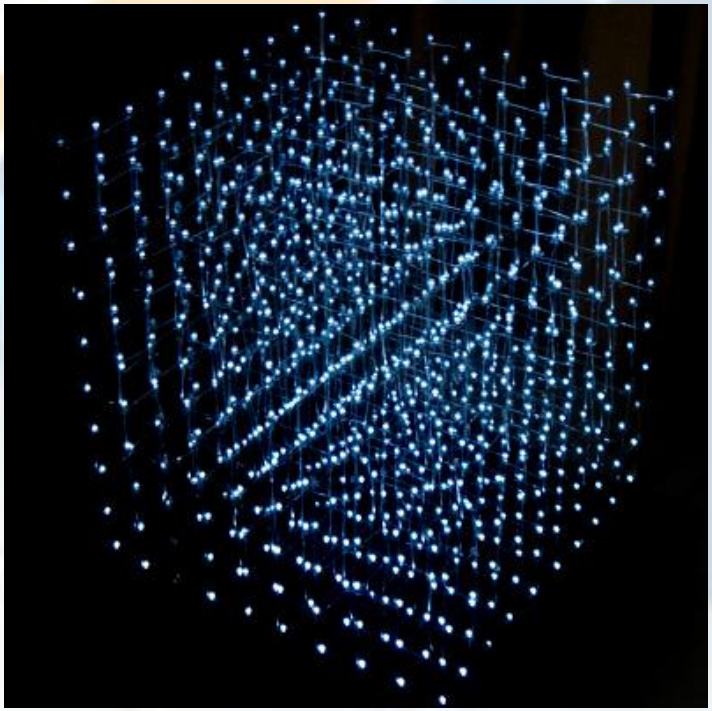
Multicore Performance

- Has extremely bad reputation for high bandwidth demand and low throughput



The Data Model

- Source and Destination data consists of more than 1 Million points in 3D space



Source and Destination datasets are identical

1.34 Million cells in XYZ plane

Each cell consists of 19 properties

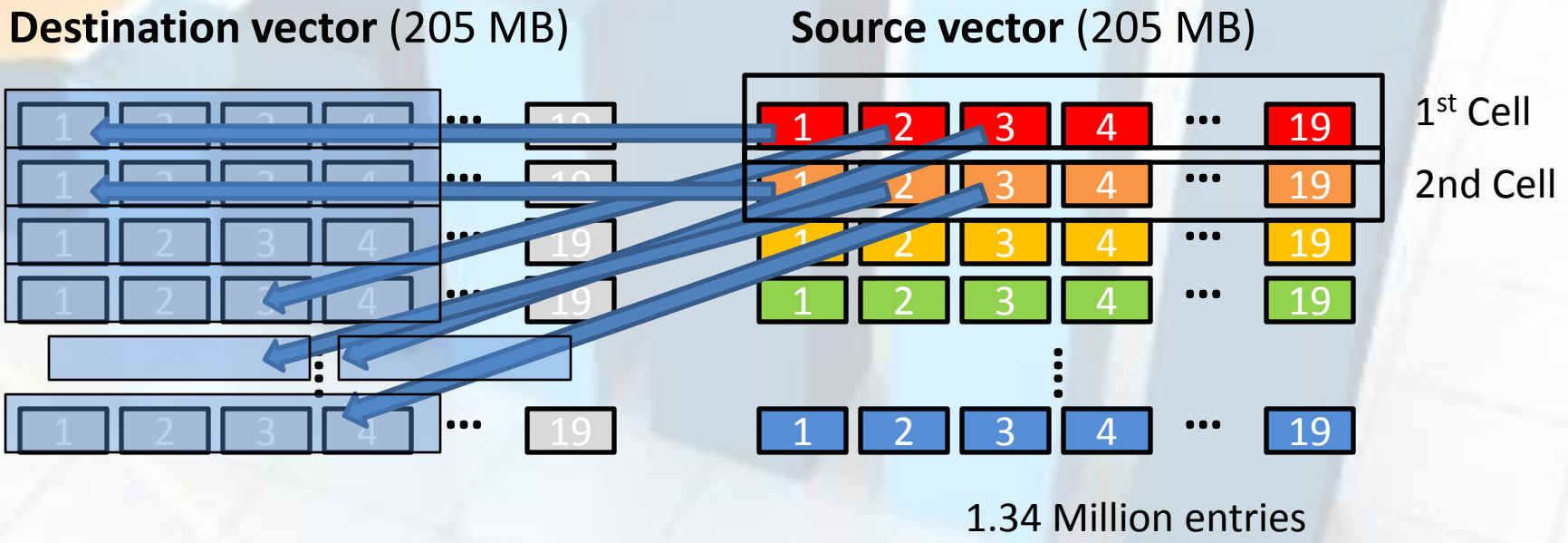
205 MB in size

Algorithm


Source
Variables:
{a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,q,r,s,t}
Destination
a
m
f
k
q

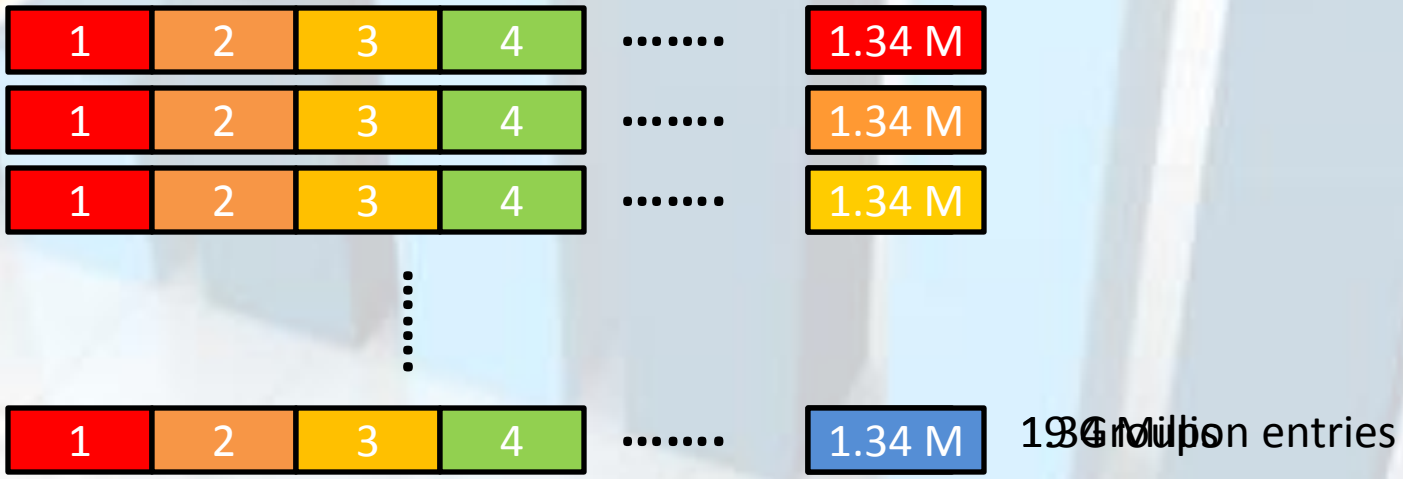
The Problem

- Accesses a huge grid (Array of Structures) almost randomly, with no data reuse



How do we solve it

- Change the way data is accessed i.e Rearrange data (AoS to SoA)



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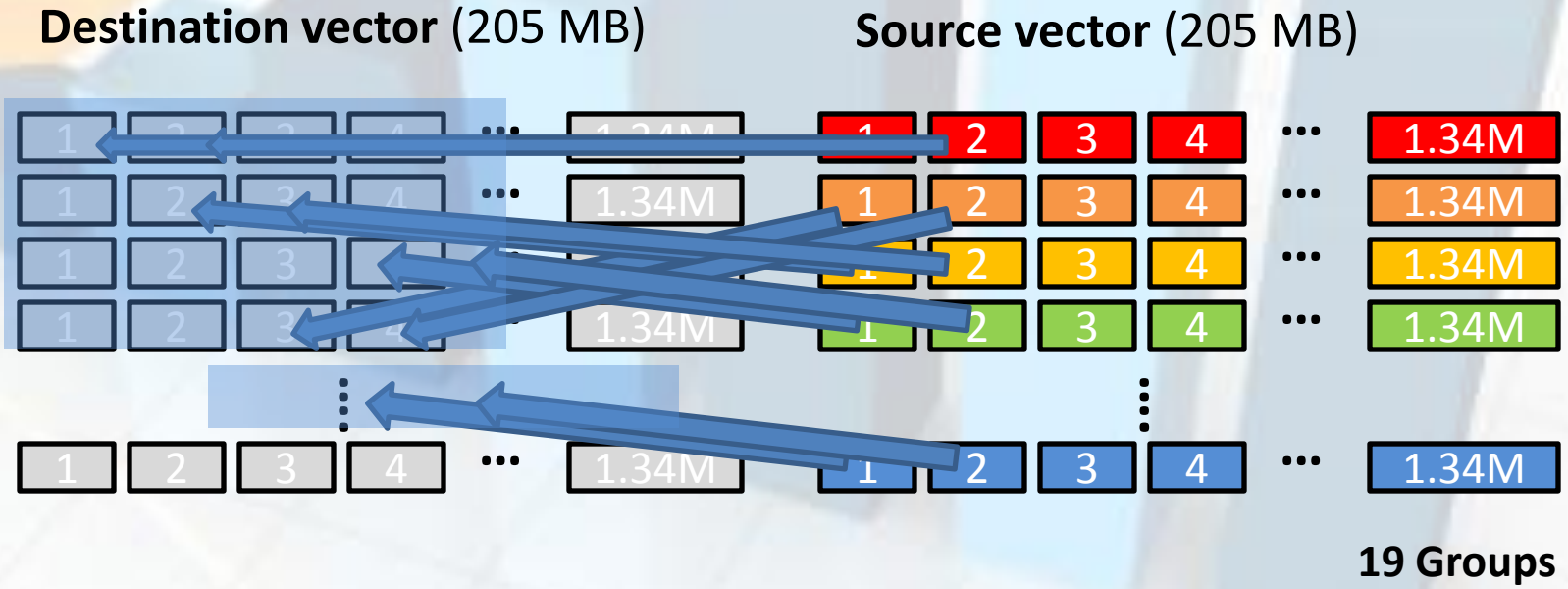
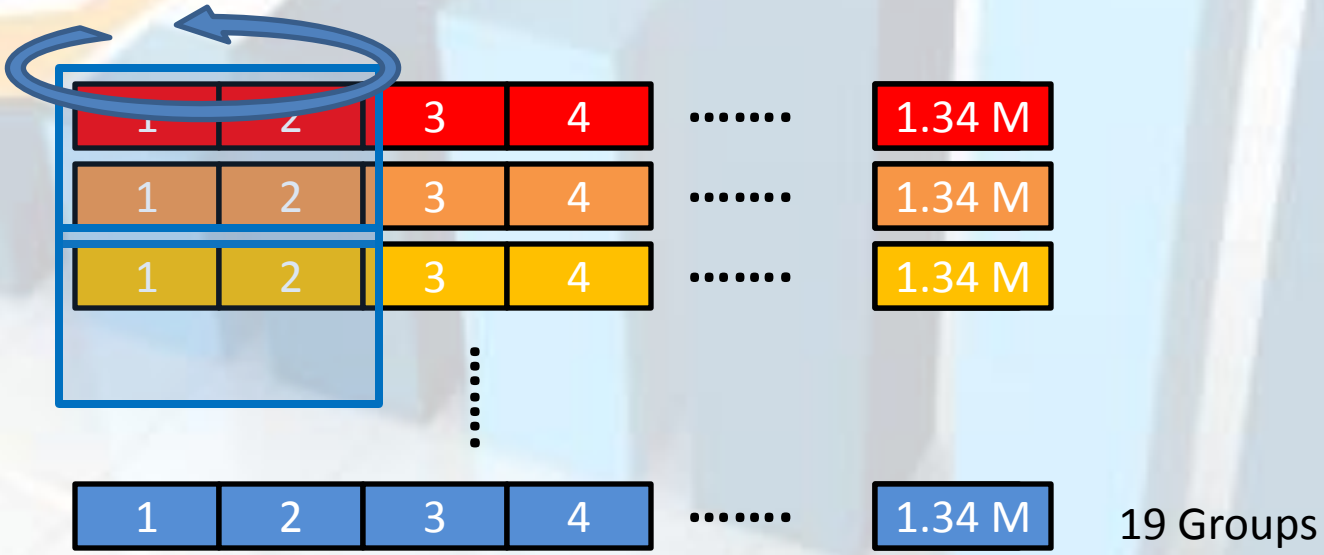
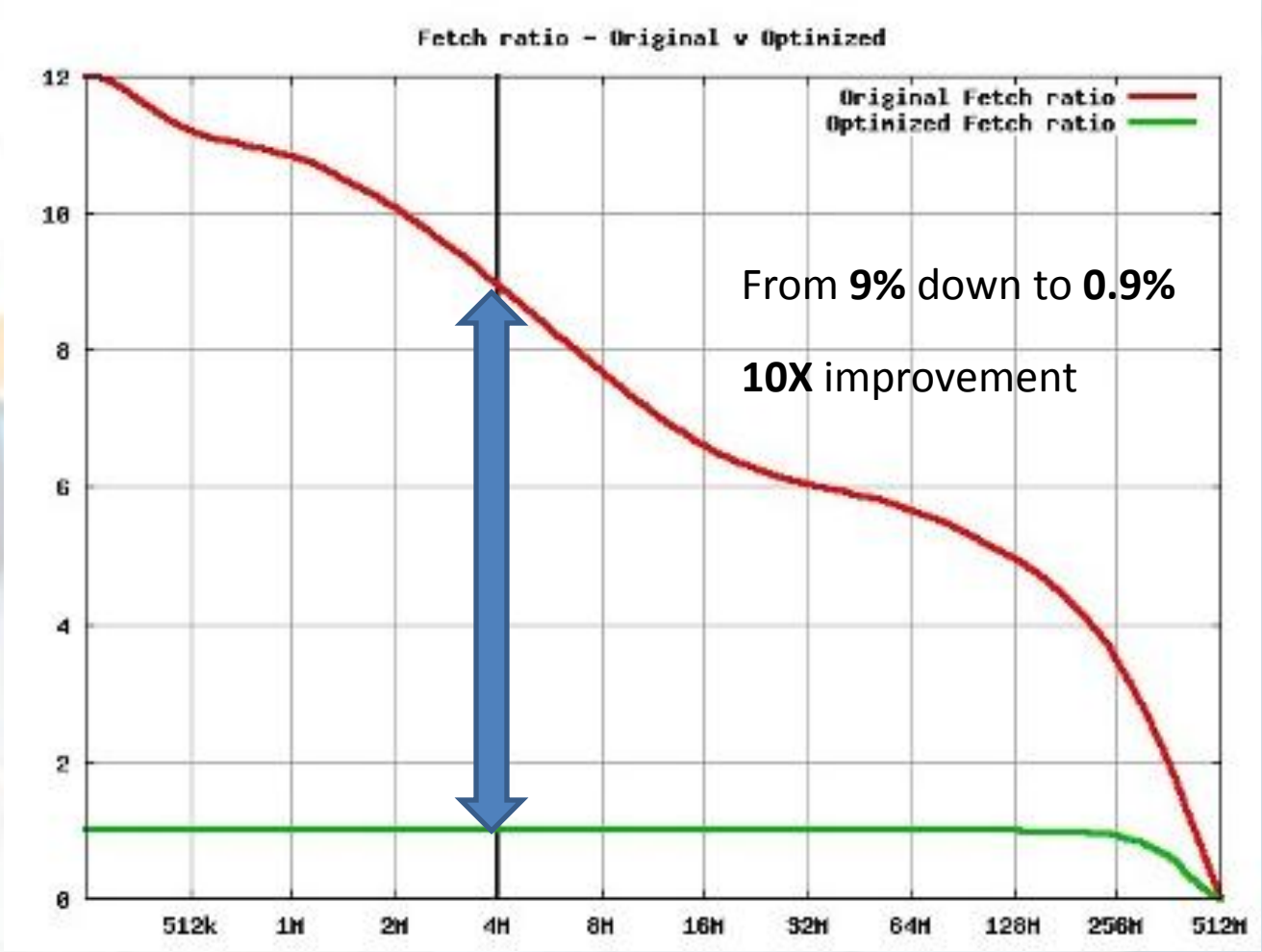


Blocking Optimization

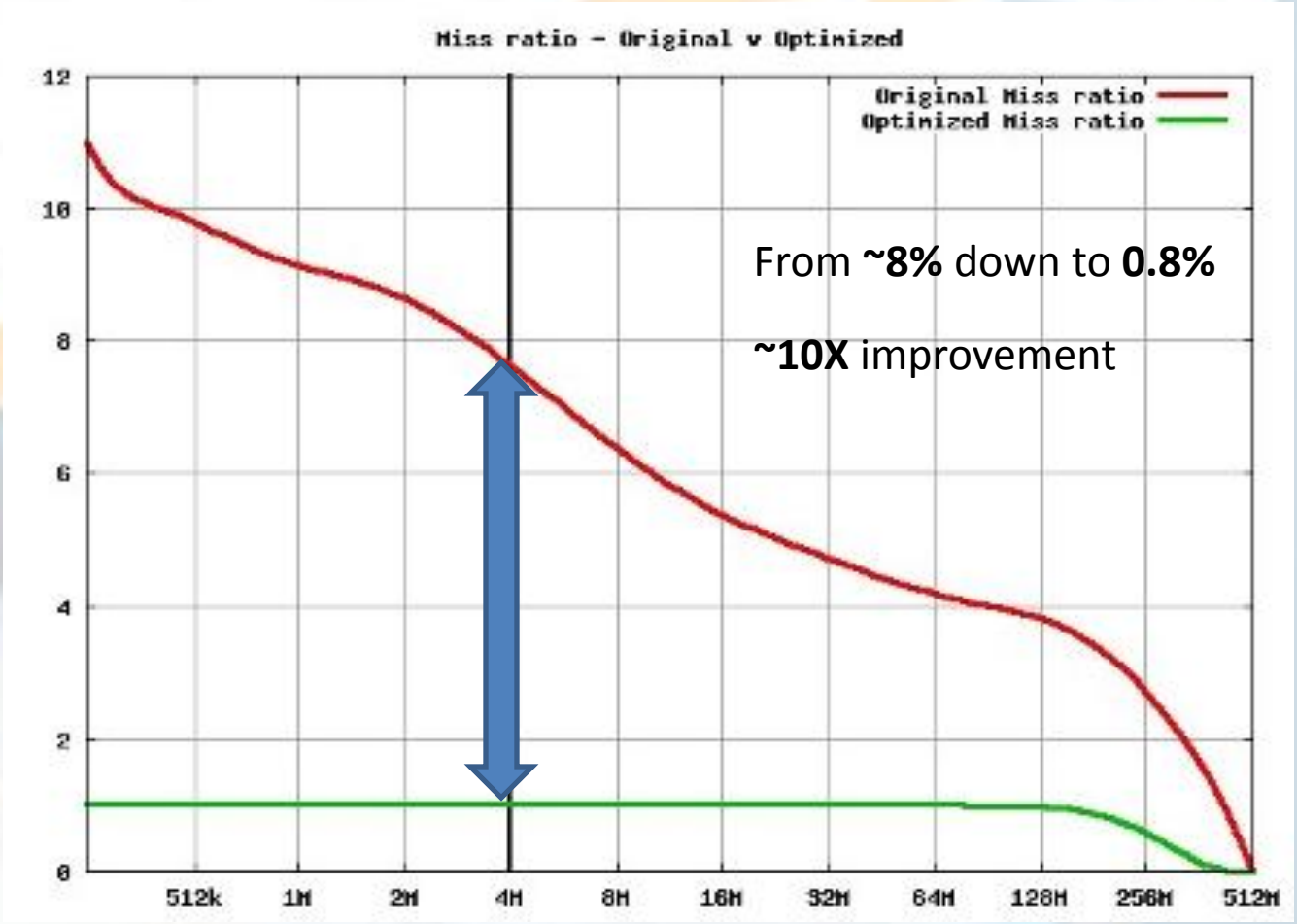
- Add blocking to improve hardware prefetching



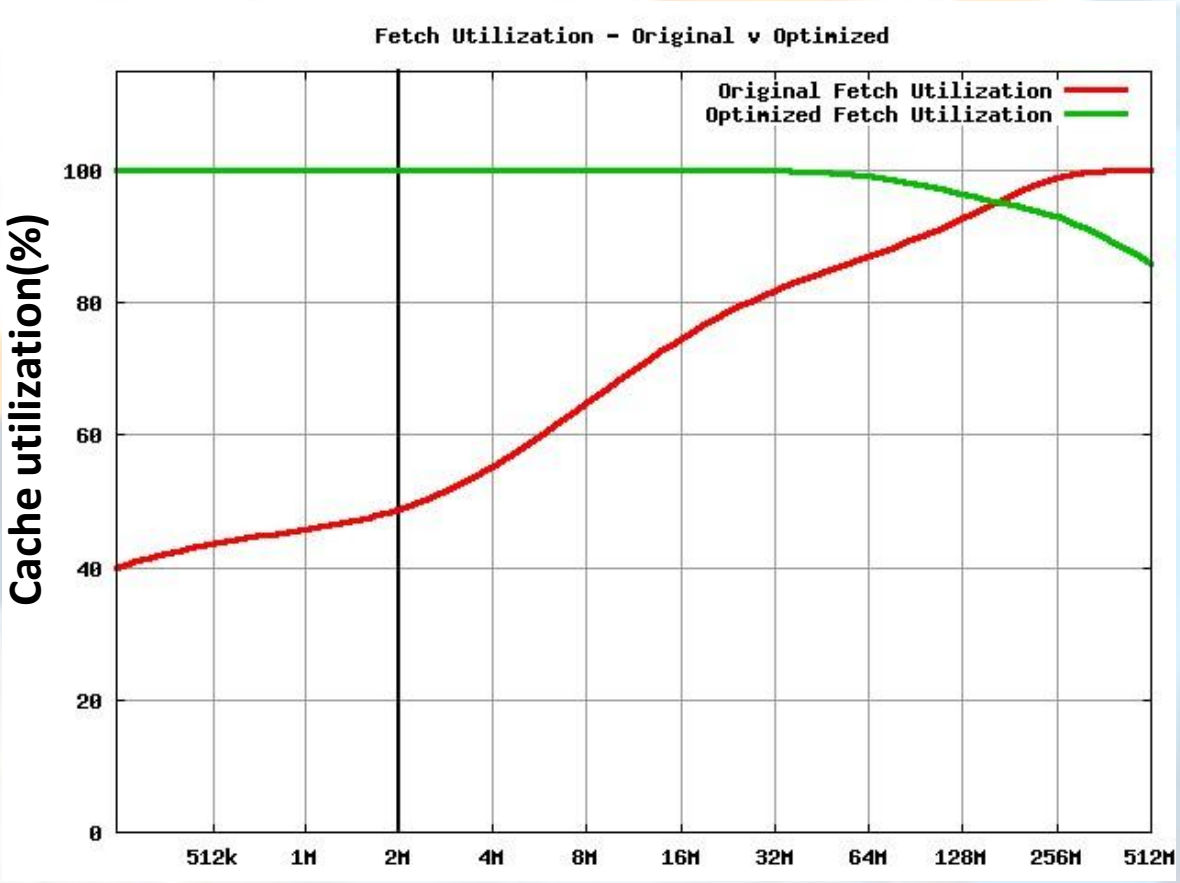
Fetch Ratio Comparison



Miss Ratio Comparison



Utilization Comparison

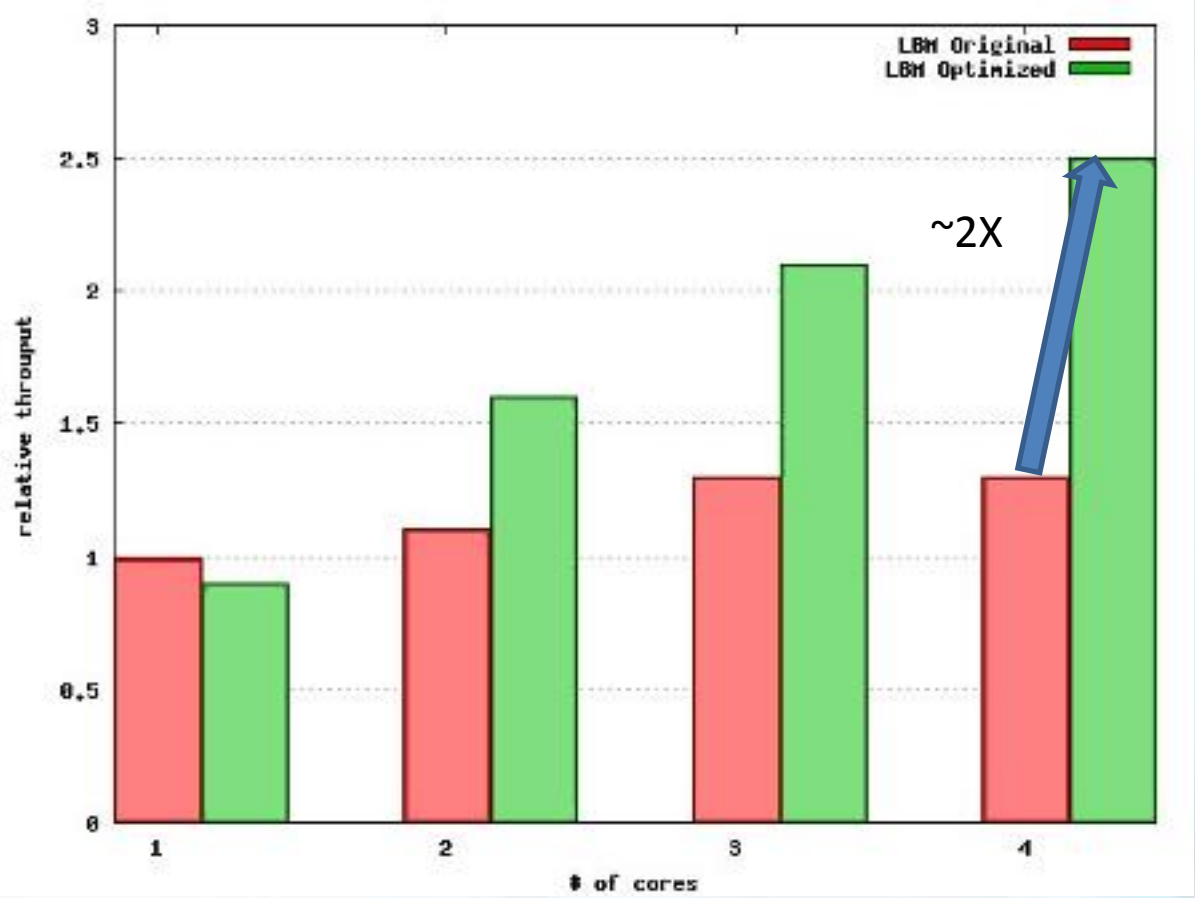


Cache Utilization

Always **100%**

Twice as good

Relative Throughput



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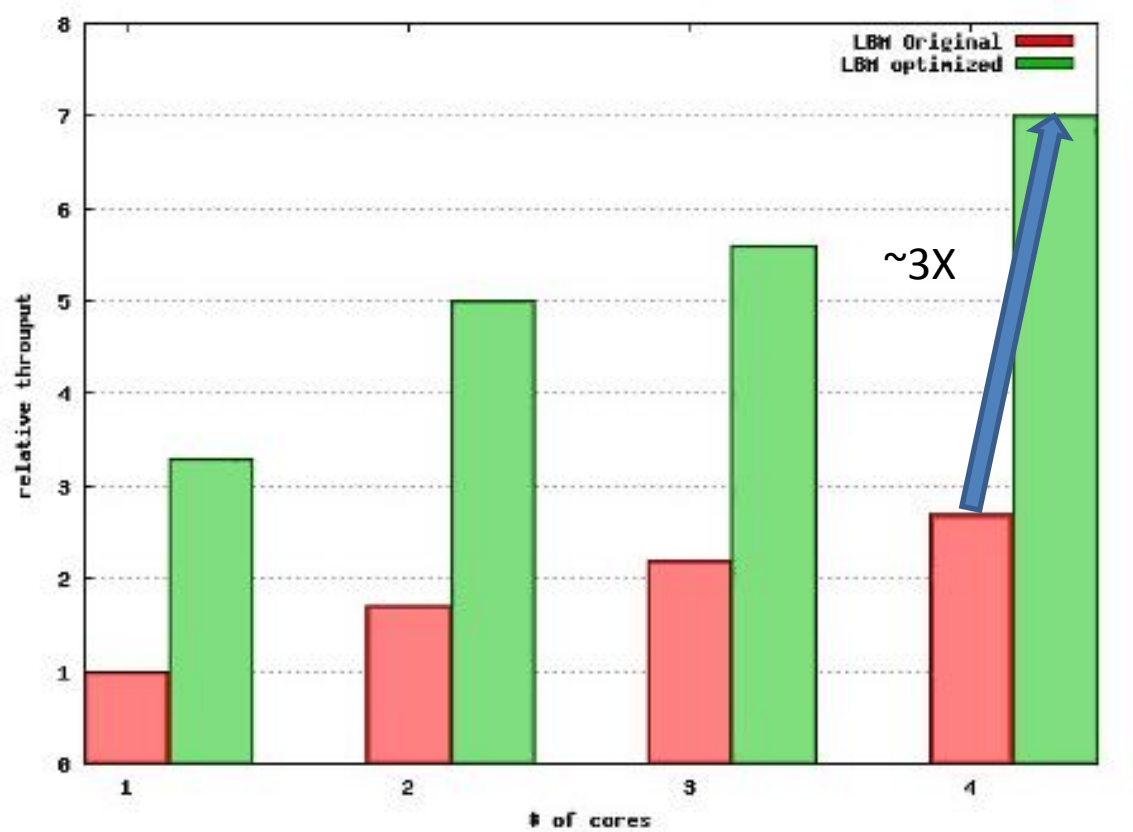
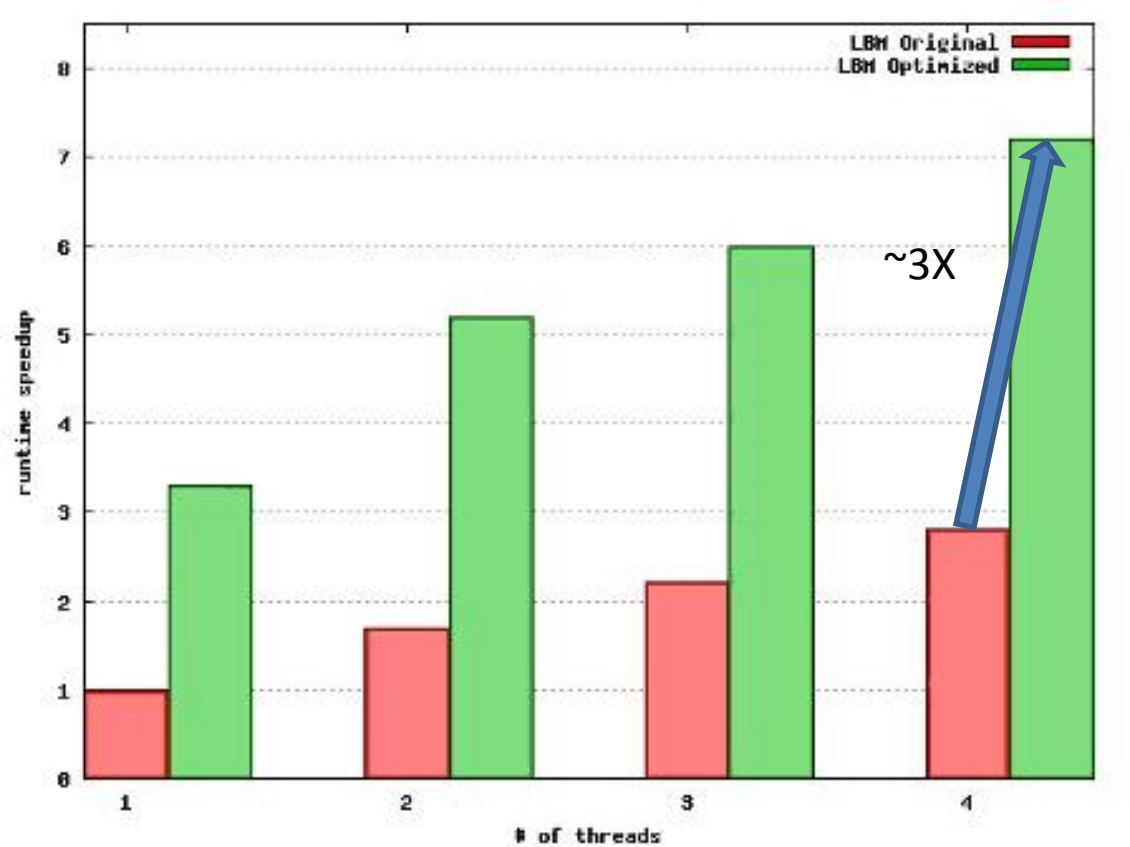
Relative Throughput



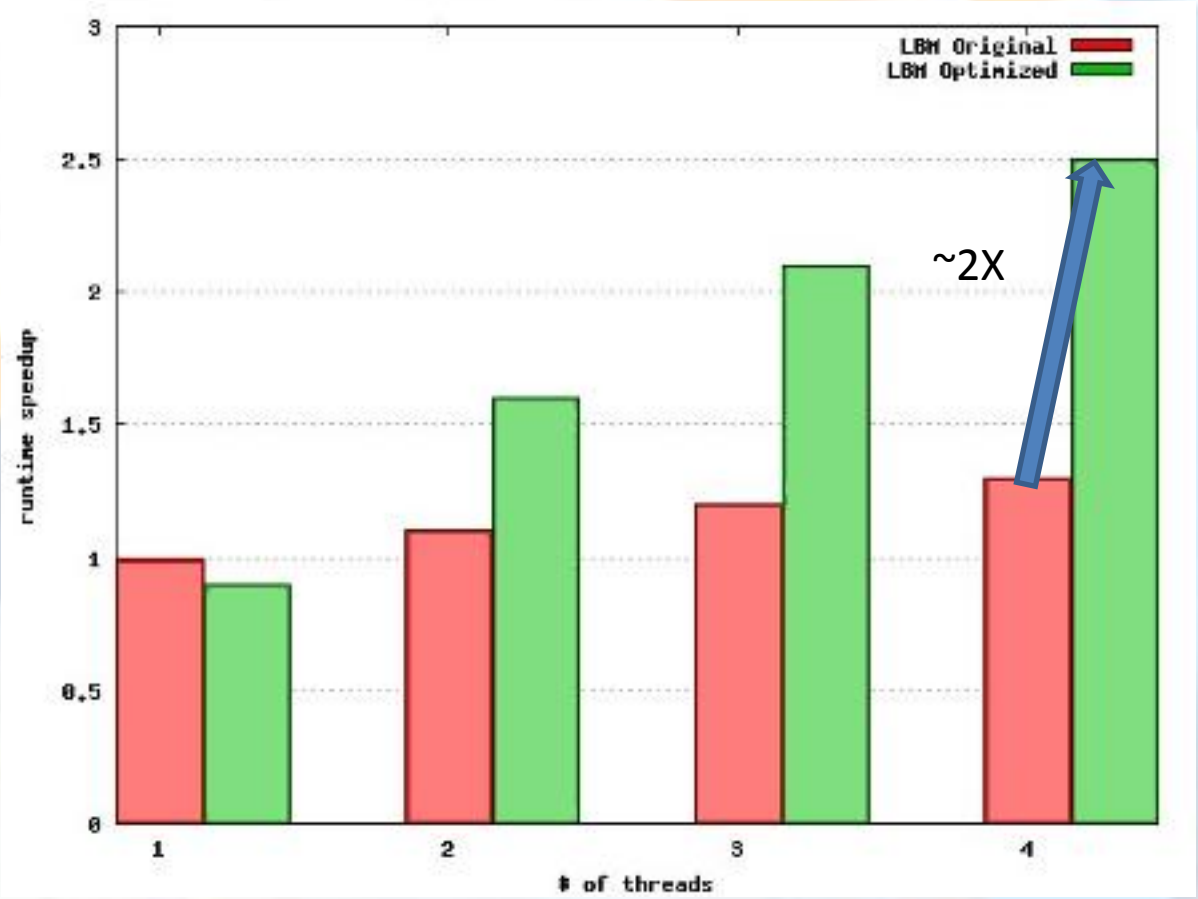
Intel Xeon E5345

Parallel Speedup



Intel Xeon E5345

Parallel Speedup



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More details in the paper
"Optimization study for Multicores"

Interested to see more - have a look at the Master Thesis Report
Google "Optimization Study for Multicores"

Questions?