

# Implementing Page Coloring in the Xen Hypervisor

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# 1 Introduction

- Objectives
- LLC causes contentions
- Page Coloring

## 2 The Xen Hypervisor

- Modifications

## 3 Experiments

- Bizip2 in Isolation
- Bizip2 and Libquantum

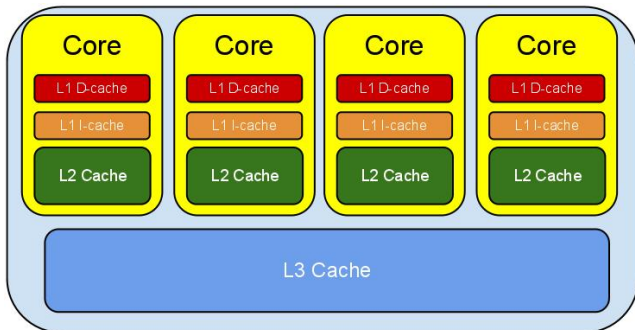
## 4 Possible Future Works

## 5 Thank You!

# Objectives

- Improve performance in Cloud Computing
- Improve performance predictability
- Reduce contentions on resources

# LLC causes contentions

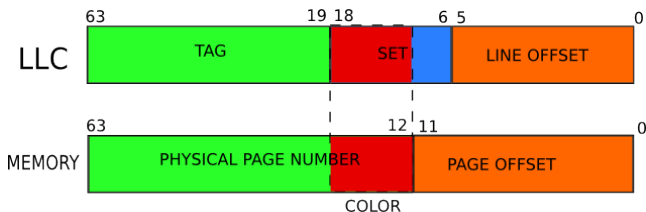


LLC is shared among cores so is an easy cause of contention.

# Cache Partitioning

- Partition cache through process to avoid contention
- Page coloring: the only software technique

# Page Coloring



- Each set has a color
- Page mapped on the same set have the same color
- A process own one or more colors
- OS assigns to processes only pages of their own colors

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# The Xen Hypervisor

- One of the most popular open source hypervisor
- Used for Cloud Computing
- Amazon's EC2 back-end

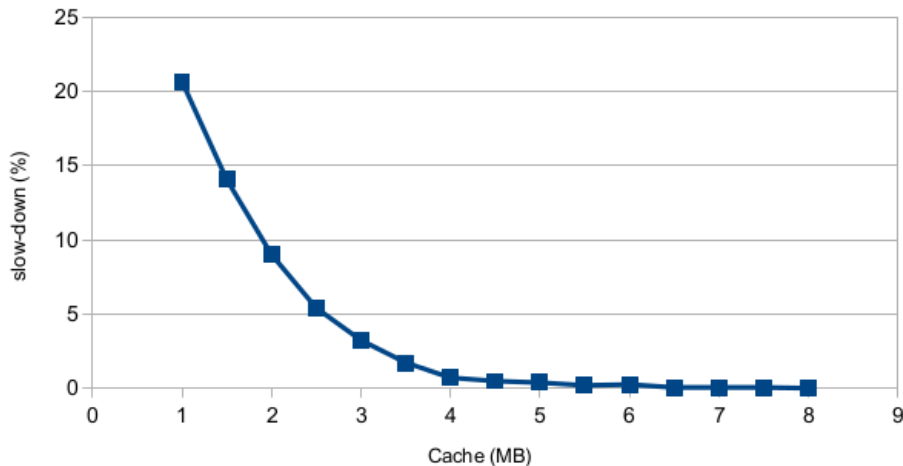


# Modifications

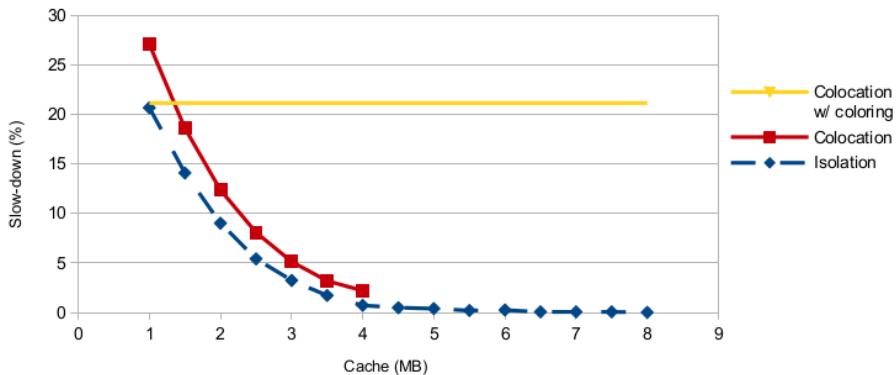
- Added color to domains' structure
- Added color-managing in domain manager
- Added color-managing in memory allocator data structure

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# Bizip2 in Isolation



# Bizip2 and Libquantum



# Bizip2 and Libquantum

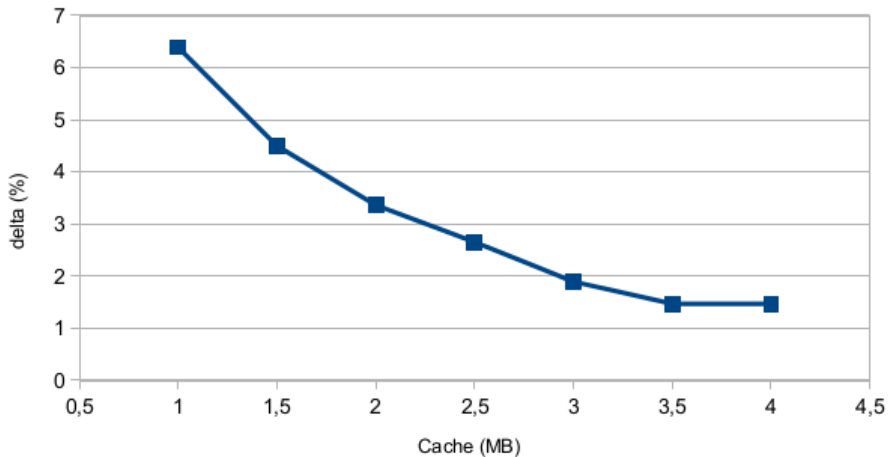


Figure : Delta between slowdown in isolation and slowdown in colocation

# Possible Future Works

- Refine initial implementation
- Reduce contention on bandwidth<sup>1</sup>

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<sup>1</sup>Marco Caccamo et al. “MemGuard: Memory Bandwidth Reservation System for Efficient Performance Isolation in Multi-core Platforms”. In: *Proceedings of the 2013 IEEE 19th Real-Time and Embedded Technology and Applications Symposium (RTAS)*. RTAS '13. Washington, DC, USA: IEEE Computer Society, 2013, pp. 55–64. ISBN: 978-1-4799-0186-9. DOI: 10.1109/RTAS.2013.6531079. URL: <http://dx.doi.org/10.1109/RTAS.2013.6531079>.

# Thank You!

