

Data Allocation Strategies for the Management of QoS in Virtualised Storage Systems

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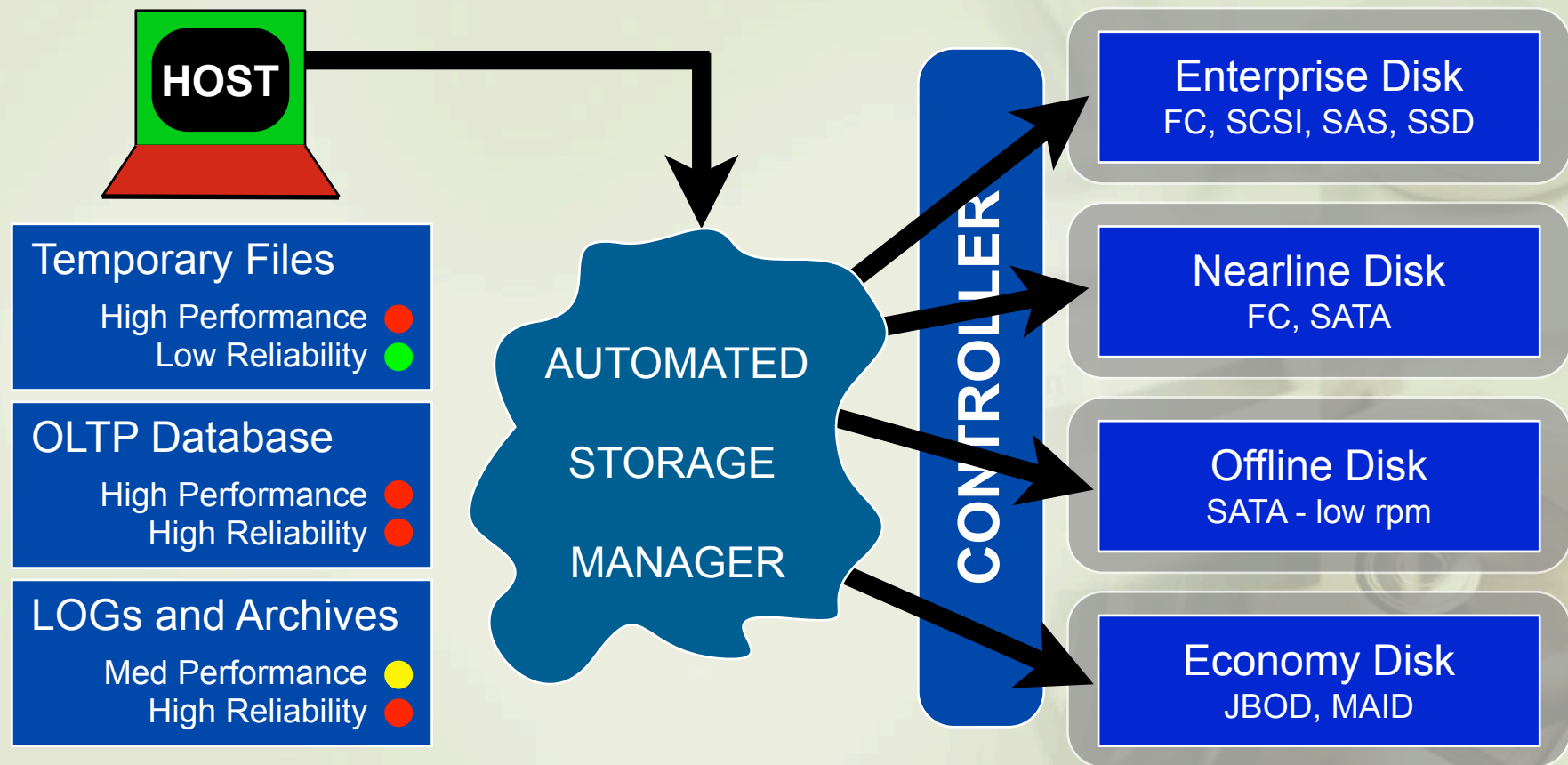
MSST 2011

Motivation

- Massive growth in digital information
 - IDC: nearly 45-fold annual data growth by 2020
- More stringent QoS demands
 - Application and compliance driven
- Management Nightmare
 - Multi-tier Virtualised Storage Systems
 - QoS delivered varies dramatically
 - Challenge: automating data management

A QoS-aware Storage Solution

- Users and applications define QoS required
- Storage tiers are profiled for QoS delivered



Intelligent Multi-tier Filesystem

- The Extended 3 iPODS Filesystem
 - Operates over multiple storage tiers (LVM)
 - Is two-way compatible with ext3fs
 - Supports relative QoS attributes on data
 - Users or applications set inode attributes:
 - `chattr +p file.dat`
 - Admins or profiling tools set BG attributes:
 - `echo "set BG:QoS" > /dev/ifm`
 - Allocates and maintains data appropriately

Intelligent Multi-tier Filesystem

- QoS Matching Score
 - Δ_i Diff between delivered and required QoS
 - p Provisioning factor
 - m_i QoS attribute multiplier

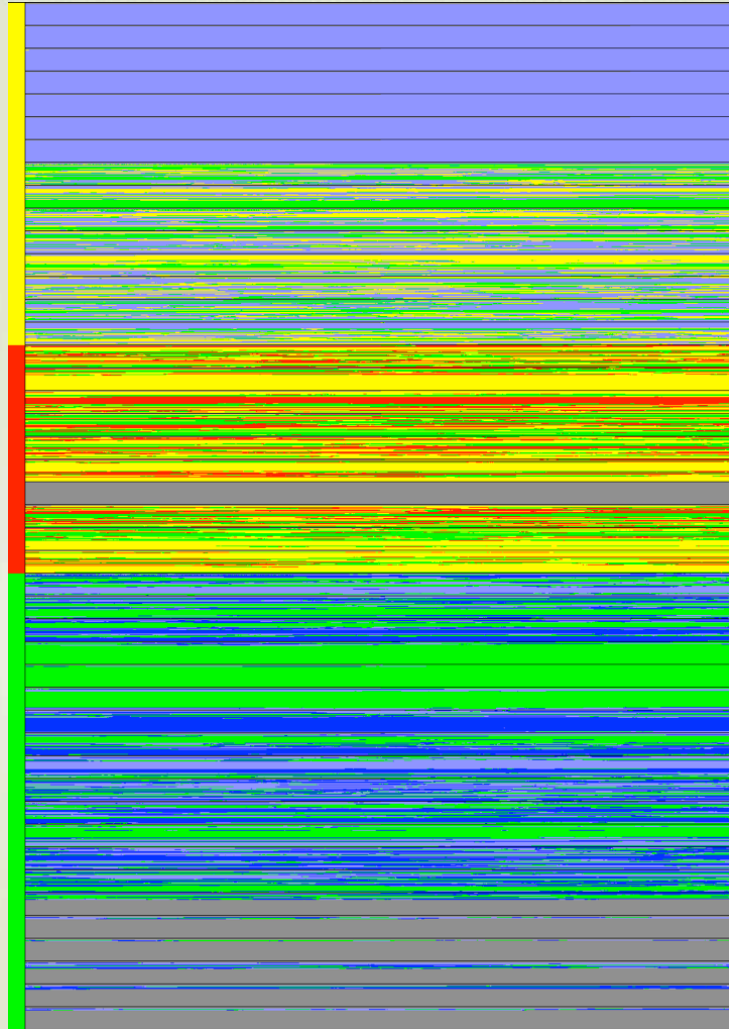
$\sum_{i \in \{attr\}} p \times \Delta_i \times m_i$, where

$\Delta_i = (dlv_i - req_i)$, and

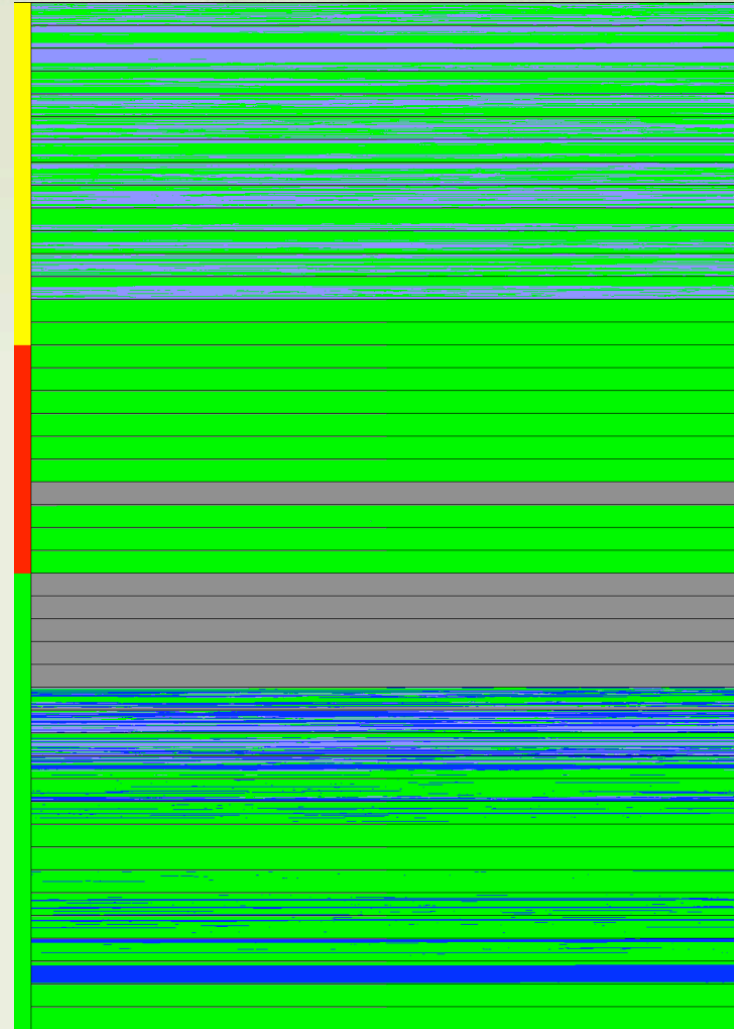
$$p = \begin{cases} -|c_1| & \text{if } \Delta_i < 0 \\ |c_2| & \text{if } \Delta_i \geq 0 \end{cases}$$

Closer to zero, the better!

Results - Allocation Bitmap

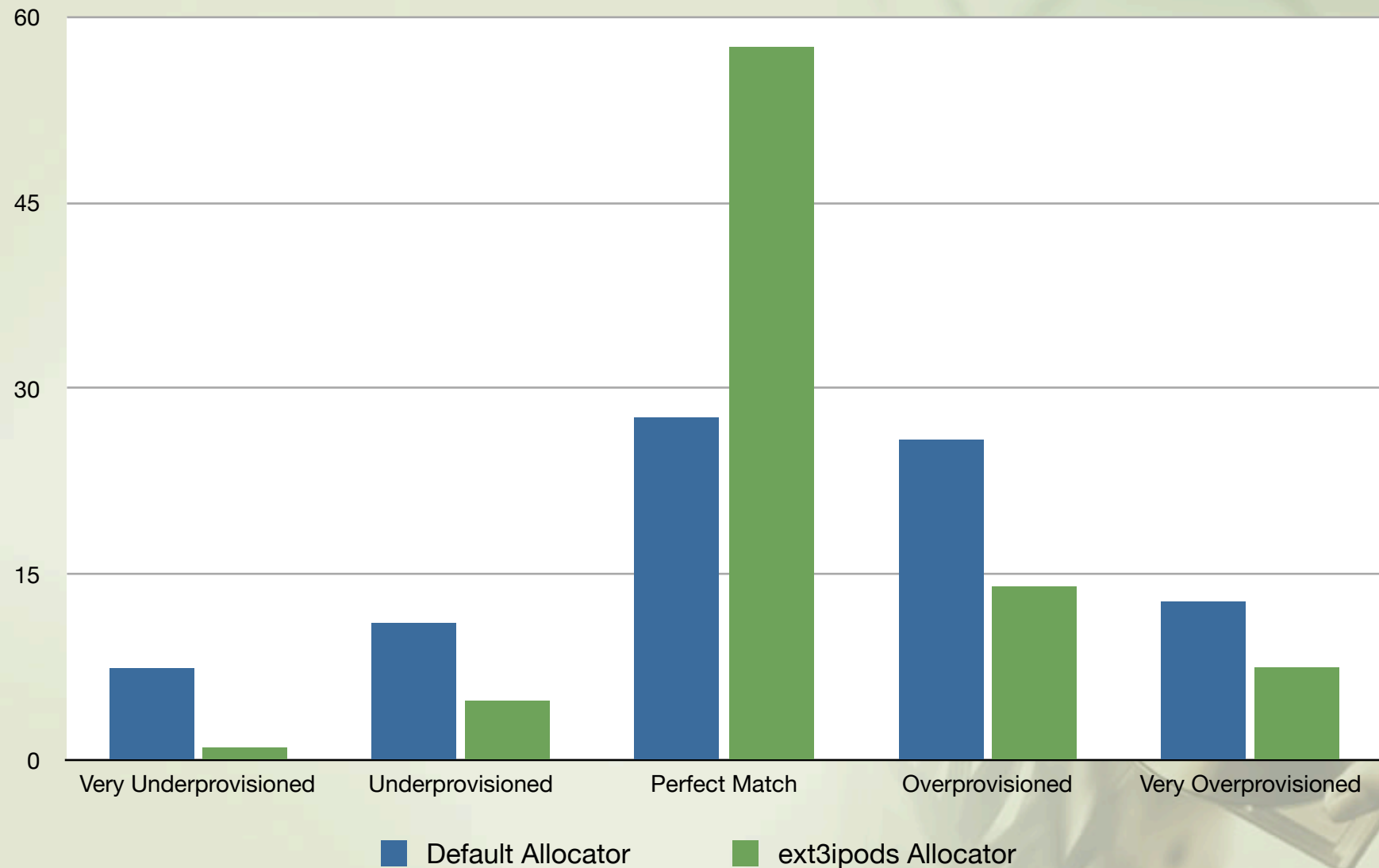


Default Allocator



ext3ipods Allocator

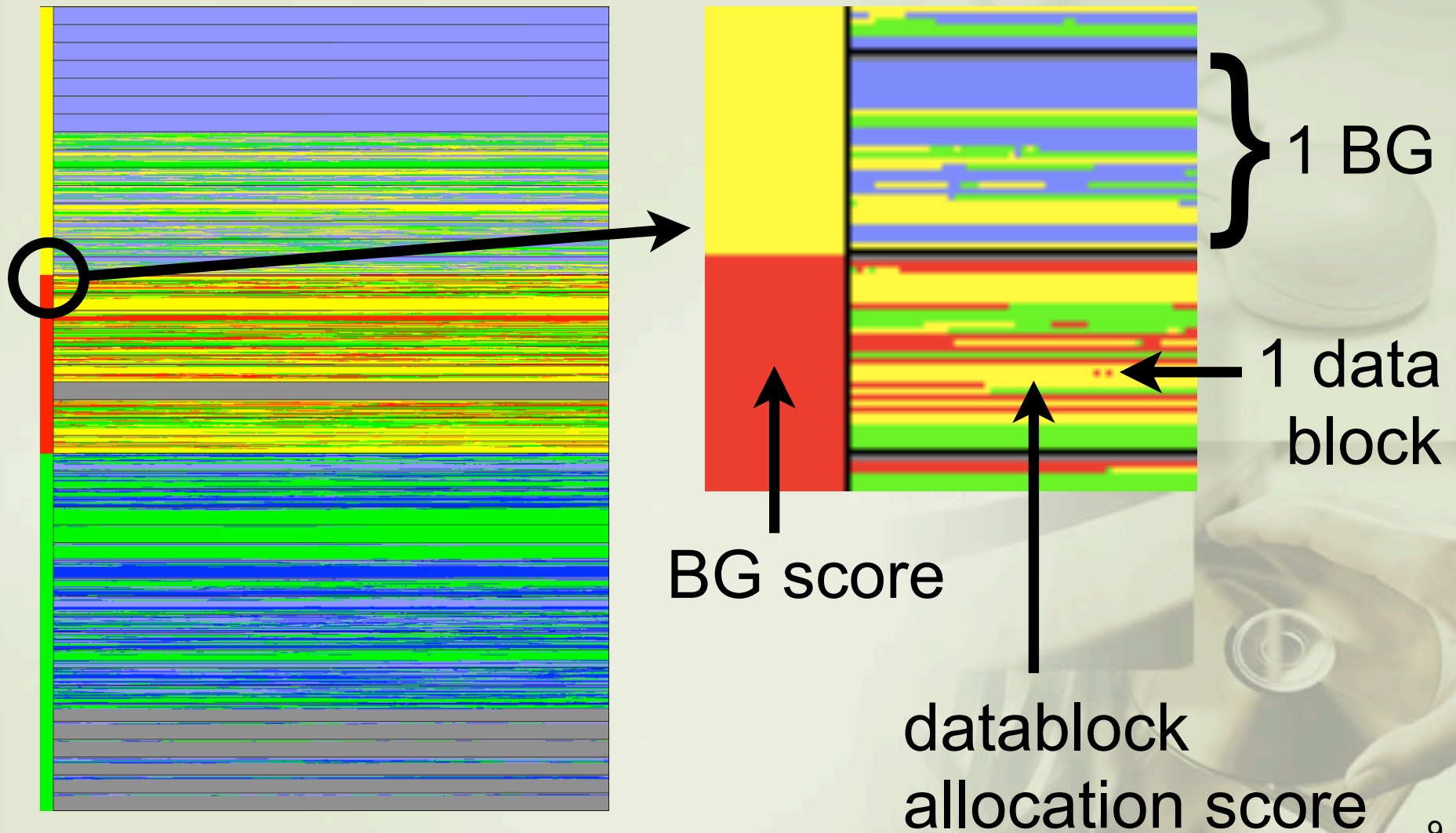
Results - Allocators Comparison



THANK YOU

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Results - Allocation Bitmap



Results - Layout Analysis

	Very Under Prov.	Under Prov.	Perf. Match	Over. Prov.	Very Over Prov.	Other Space
Write Perf.	6.4 % ↓ 0 %	6.2 % ↓ 0 %	21.3 % ↓ 64.0 %	35.3 % ↓ 14.4 %	15.8 % ↓ 6.5 %	15.1 %
Read Perf.	0 % ↓ 0 %	8.1 % ↓ 0 %	40.7 % ↓ 53.7 %	20.0 % ↓ 27.6 %	16.2 % ↓ 3.6 %	15.1 %
Rel.	15.8 % ↓ 2.9 %	19.1 % ↓ 14.4 %	21.3 % ↓ 55.0 %	22.4 % ↓ 0 %	6.4 % ↓ 12.6 %	15.1 %
Avg.	7.4 % ↓ 1.0 %	11.1 % ↓ 4.8 %	27.7 % ↓ 57.6 %	25.9 % ↓ 14.0 %	12.8 % ↓ 7.5 %	15.1 %