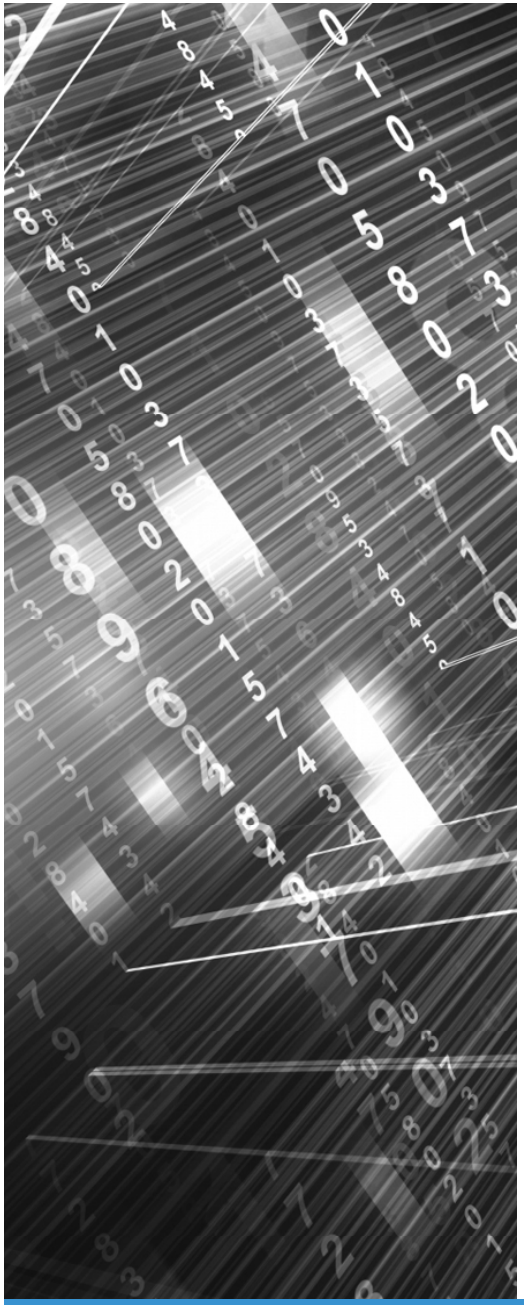

NEW CHALLENGES IN PERFORMANCE ENGINEERING

Dr. Amnon Naamad, EMC

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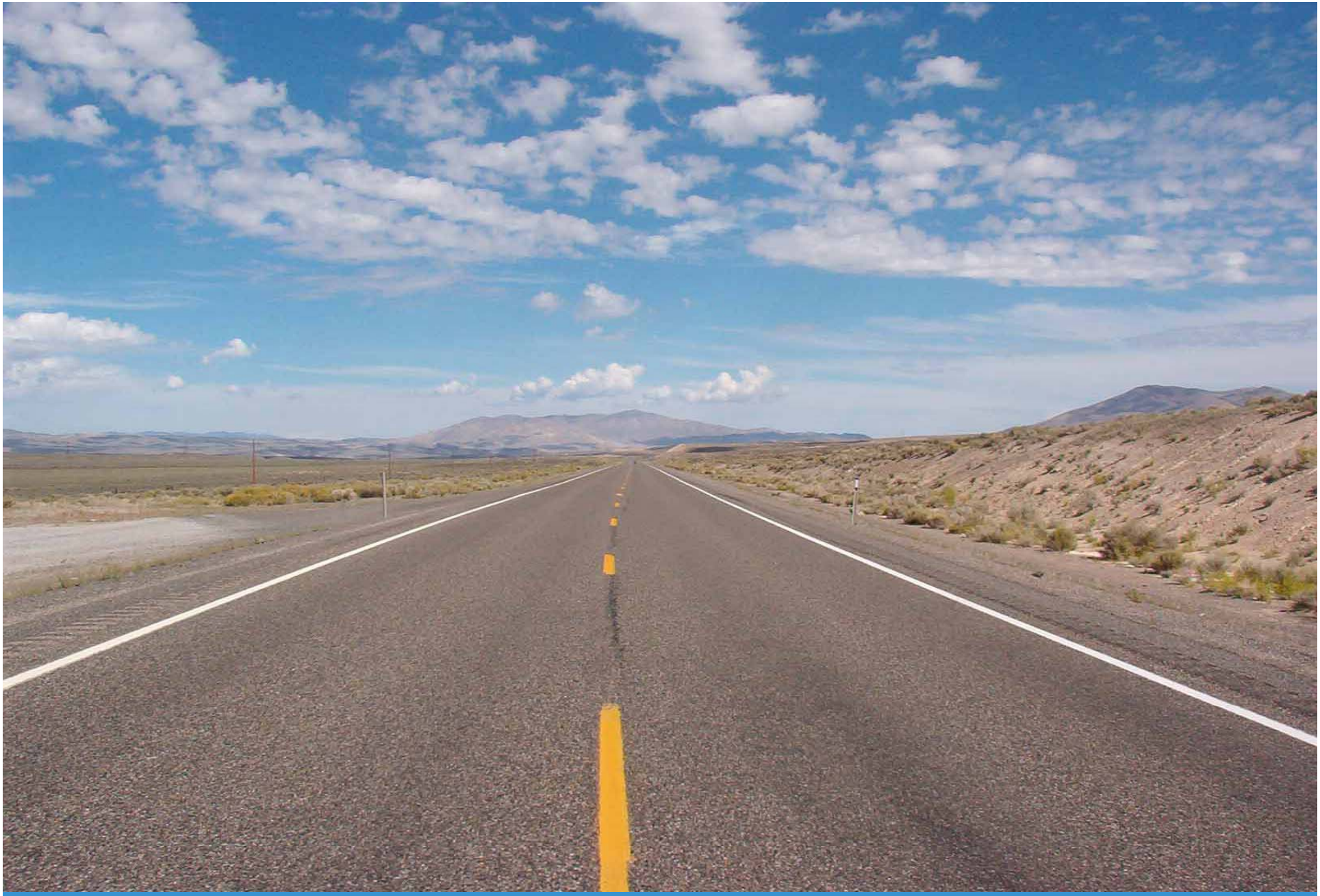


Data Center Change Drivers

- Older forces
  - Cost
  - HW improvement
  - Data growth
  - Consolidation
  - Green operations
- Newer forces
  - Major new innovations
  - New use paradigms

Data and Capacity Growth Trends

Period	Capacity Growth	Actual Max Capacities
1970 – 1990	14X	1.6 GB → 22 GB
1990 – 2000	90X	22 GB → 2 TB
2000 – 2010	1000X	2 TB → 2 PB

Major New Technological Innovations

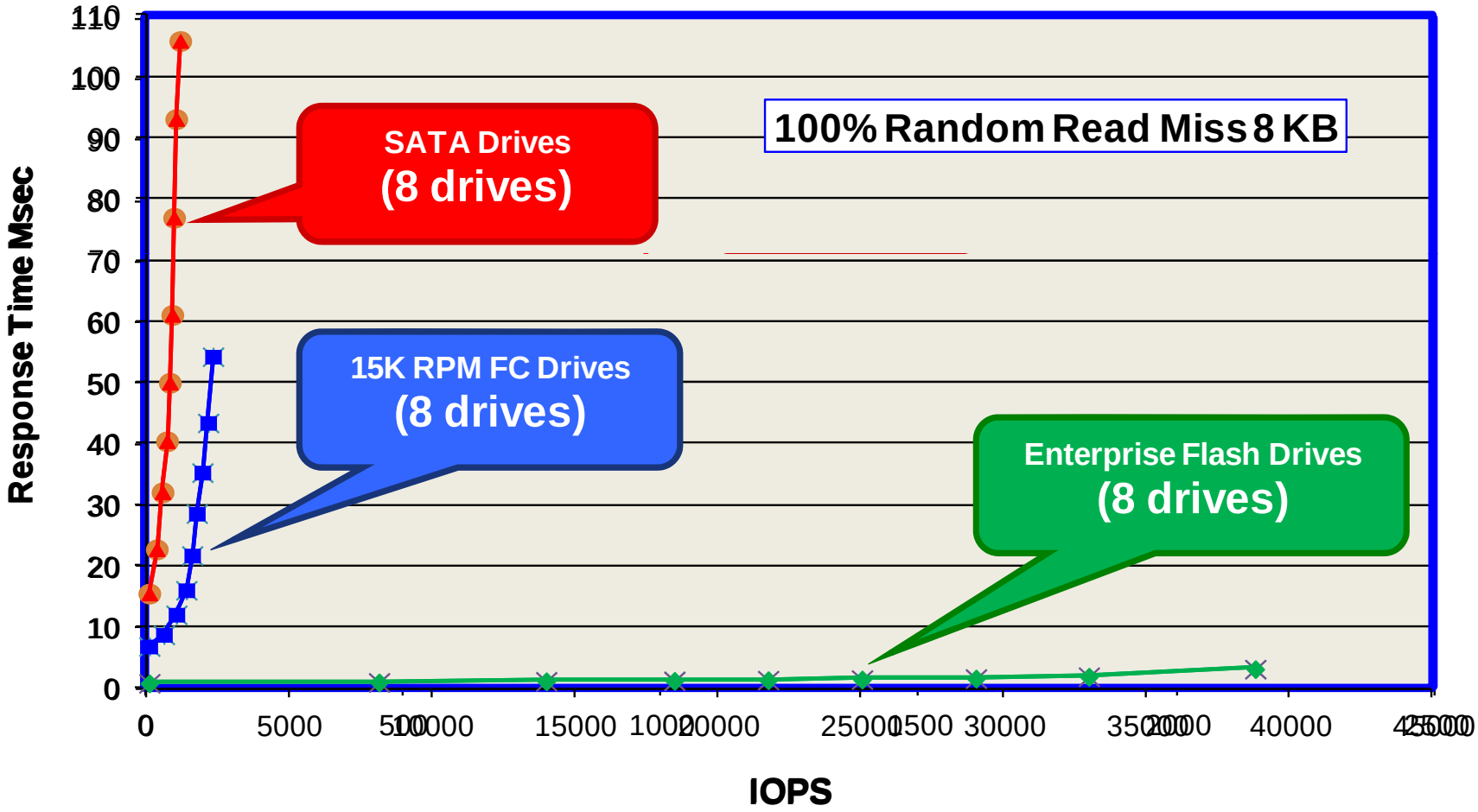
Flash Drives & Memory

Large, Inexpensive Drives

Server, Storage Virtualization

EFDs are in a League of Their Own

Significantly More IOPS per Drive at Much Lower Response Time



New Use Paradigms, New Expectations

Cloud & Service Providers

Big Data & Analytics

Globalization

Modeling Has Become Critical

- Common sense is insufficient
  - Product design
  - Product planning/configuration
  - Application placement
  - **TOO MANY LEVERS**
- Must be right the **first** time
  - In consolidated environments, making changes is difficult, risky, and expensive

Performance – More than Speeds & Feeds

THE CHALLENGE:

How to achieve SLAs efficiently and easily

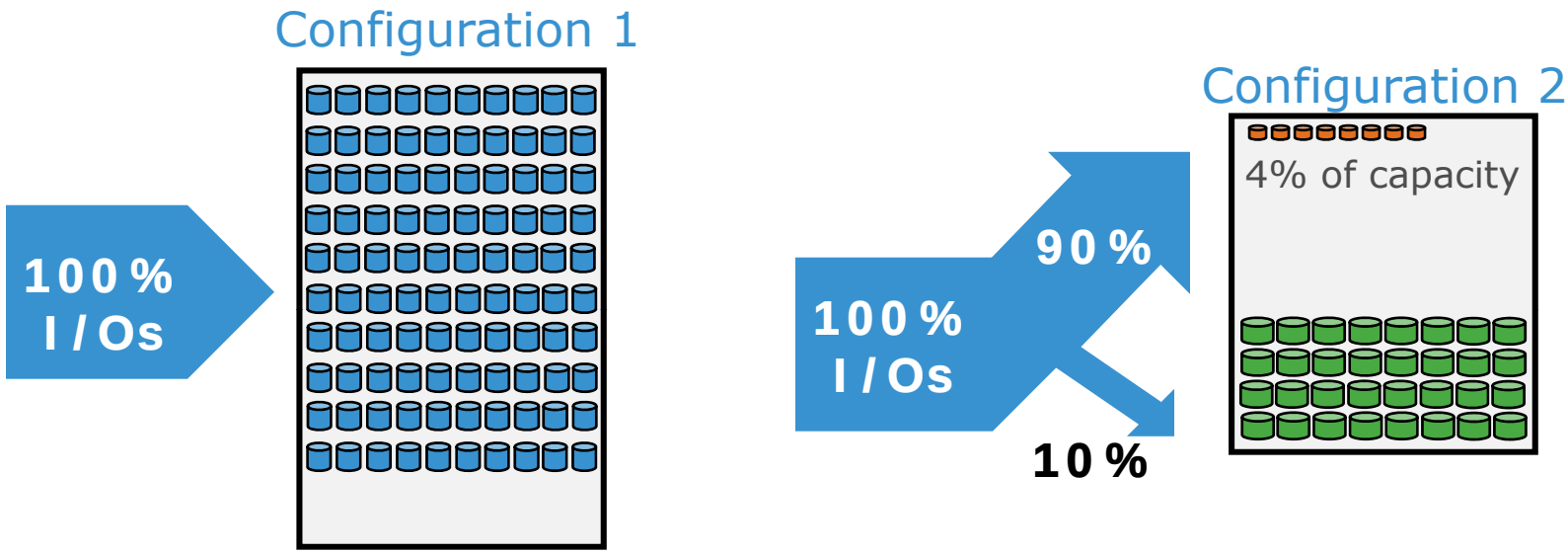
- Predictability
- High resource utilization
- Appropriate technology
- Performance/application
- Ease of management

Tiered Storage

2008 – Fundamental Storage Media Shift

Disk	Cost/GB	IOPS/GB	Response Time
15 K RPM	1	1	6 ms
Serial ATA (SATA) 7,200 RPM	1/3	1/6	12 ms
Enterprise Flash Drive (EFD)	8	30	< 1 ms

The Tiered Storage Opportunity



BENEFITS

- Costs reduced 30-40%
- Response time improved 70%
- Power consumption reduced 60-70%
- Management easier with automation

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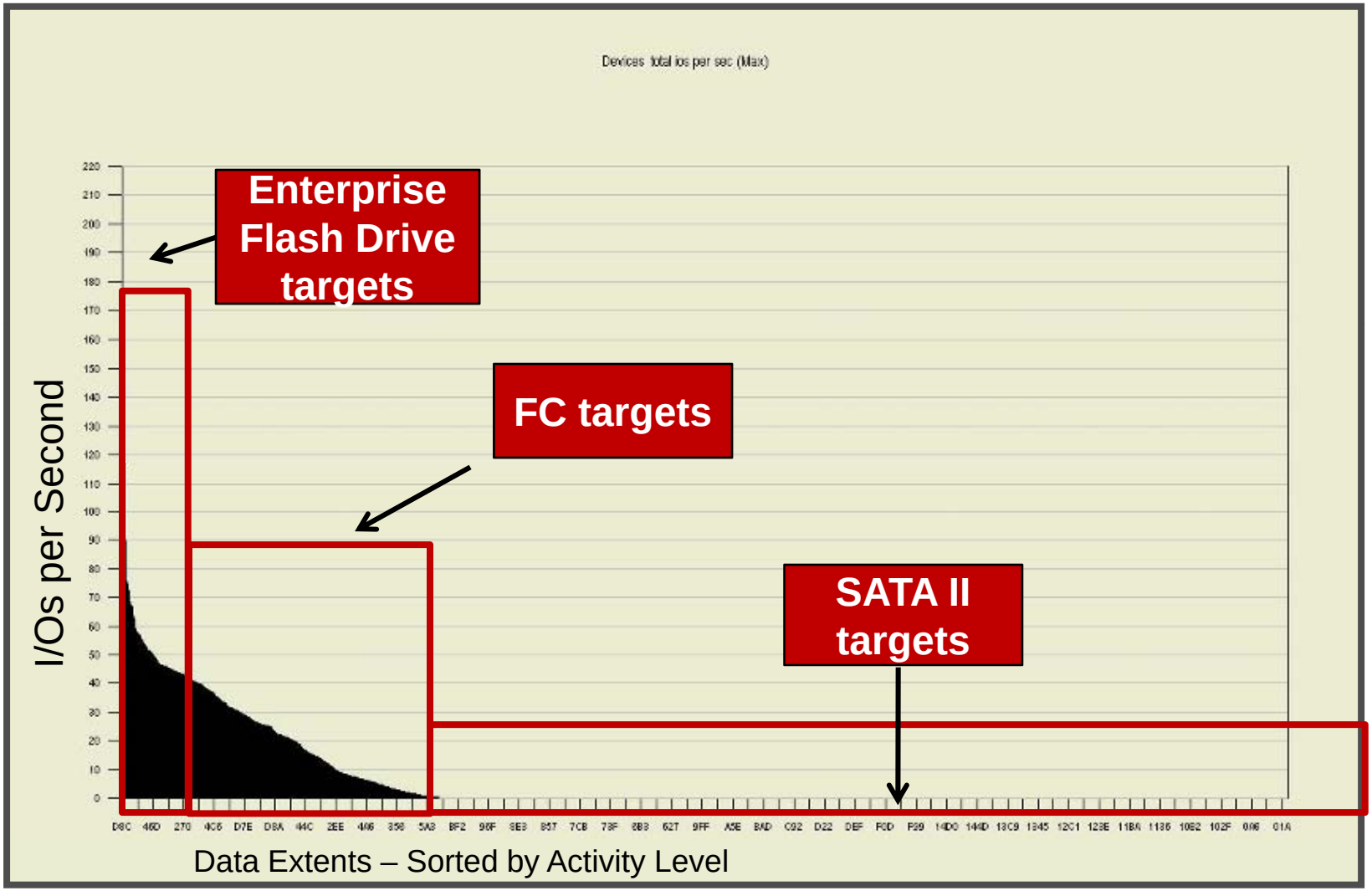
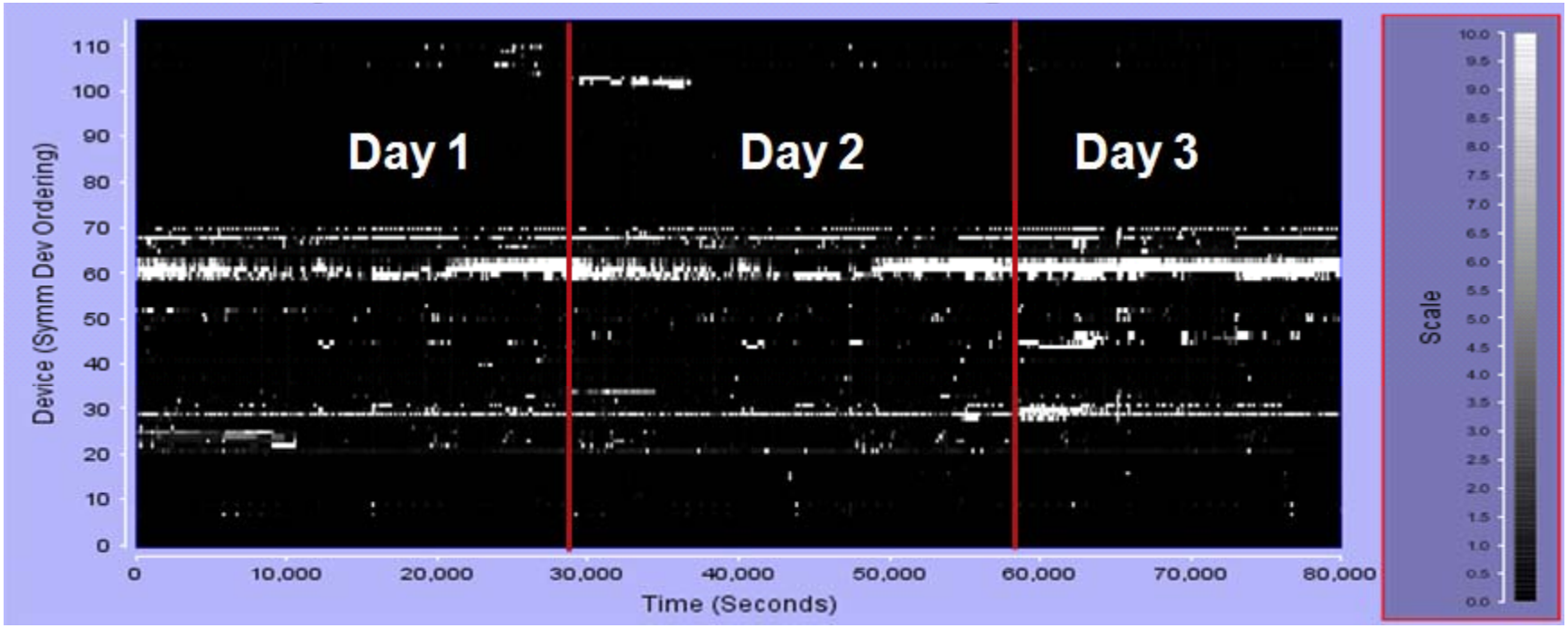
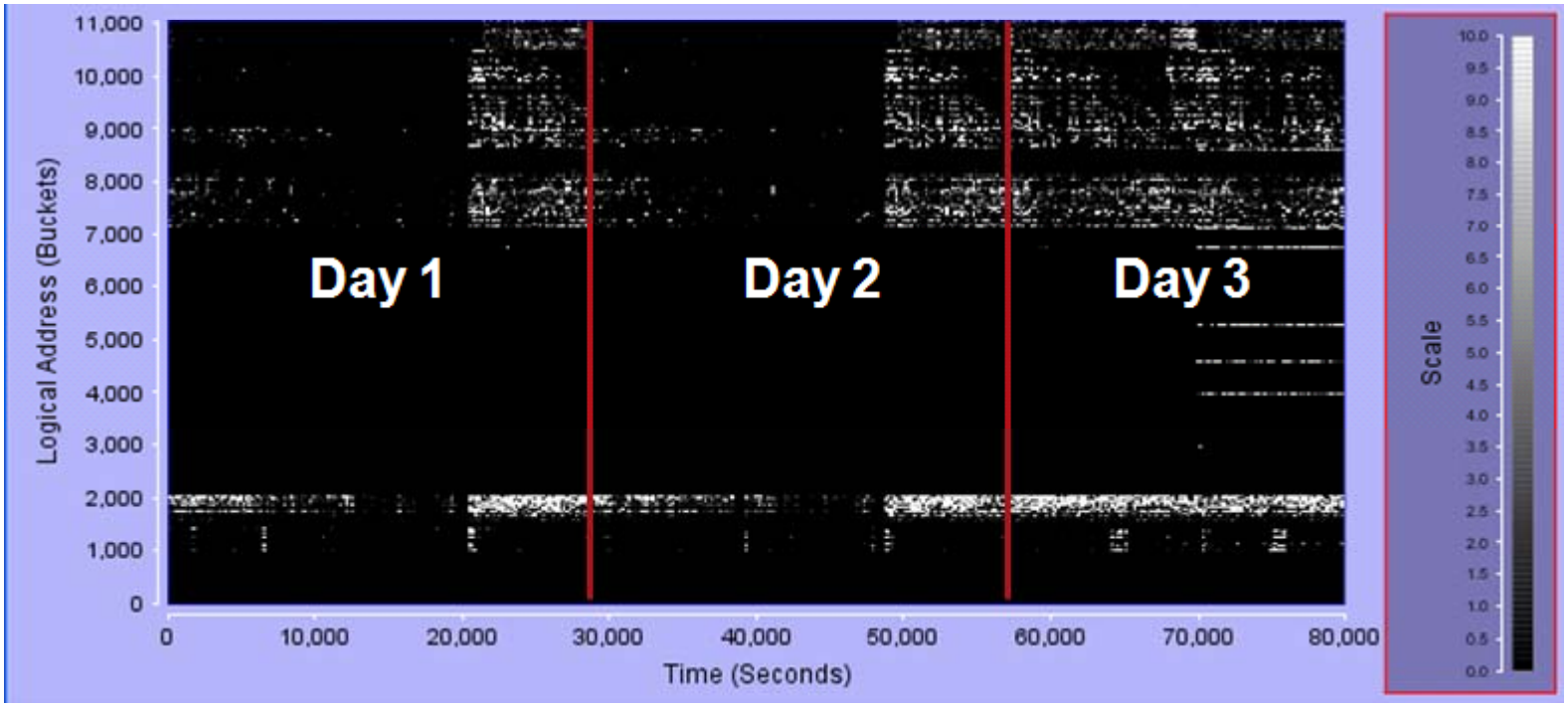
Measuring Asymmetry in Access Patterns – Skew



Volume Activity vs Time



One Volume –
Address Range Activity vs Time



Challenges for Performance Engineers

- Is this opportunity real?
  - How many customers can benefit from Automated Tiered Storage?
  - Is it worth the effort? Estimate the real value.
- Come up with effective algorithms
  - # of tiers?
  - Extent Size?
  - When to demote/promote?

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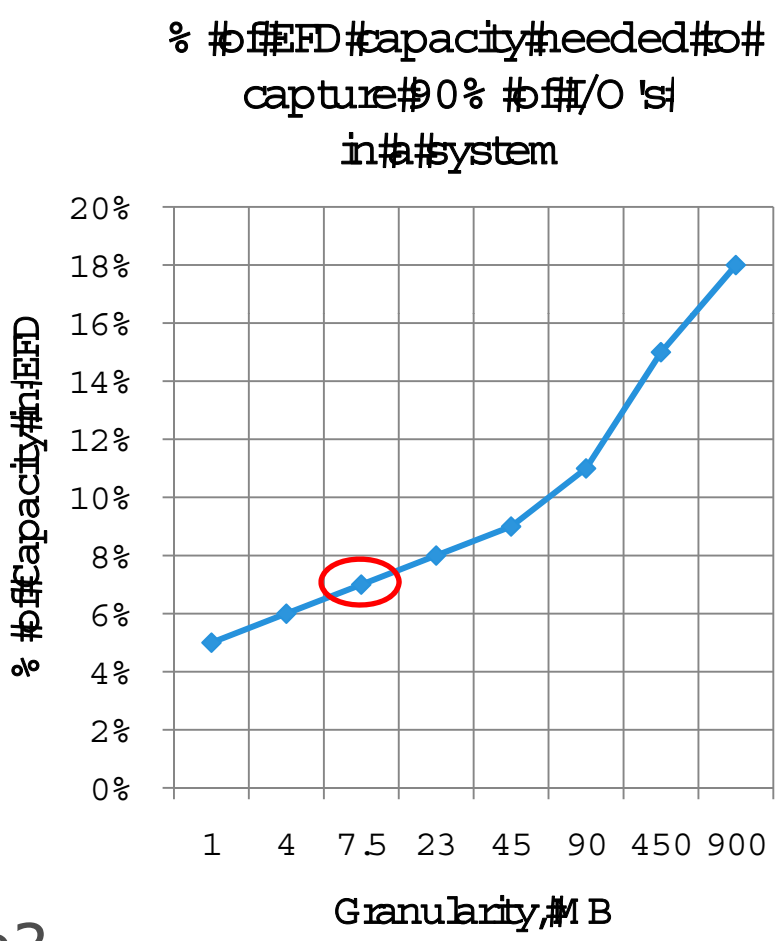
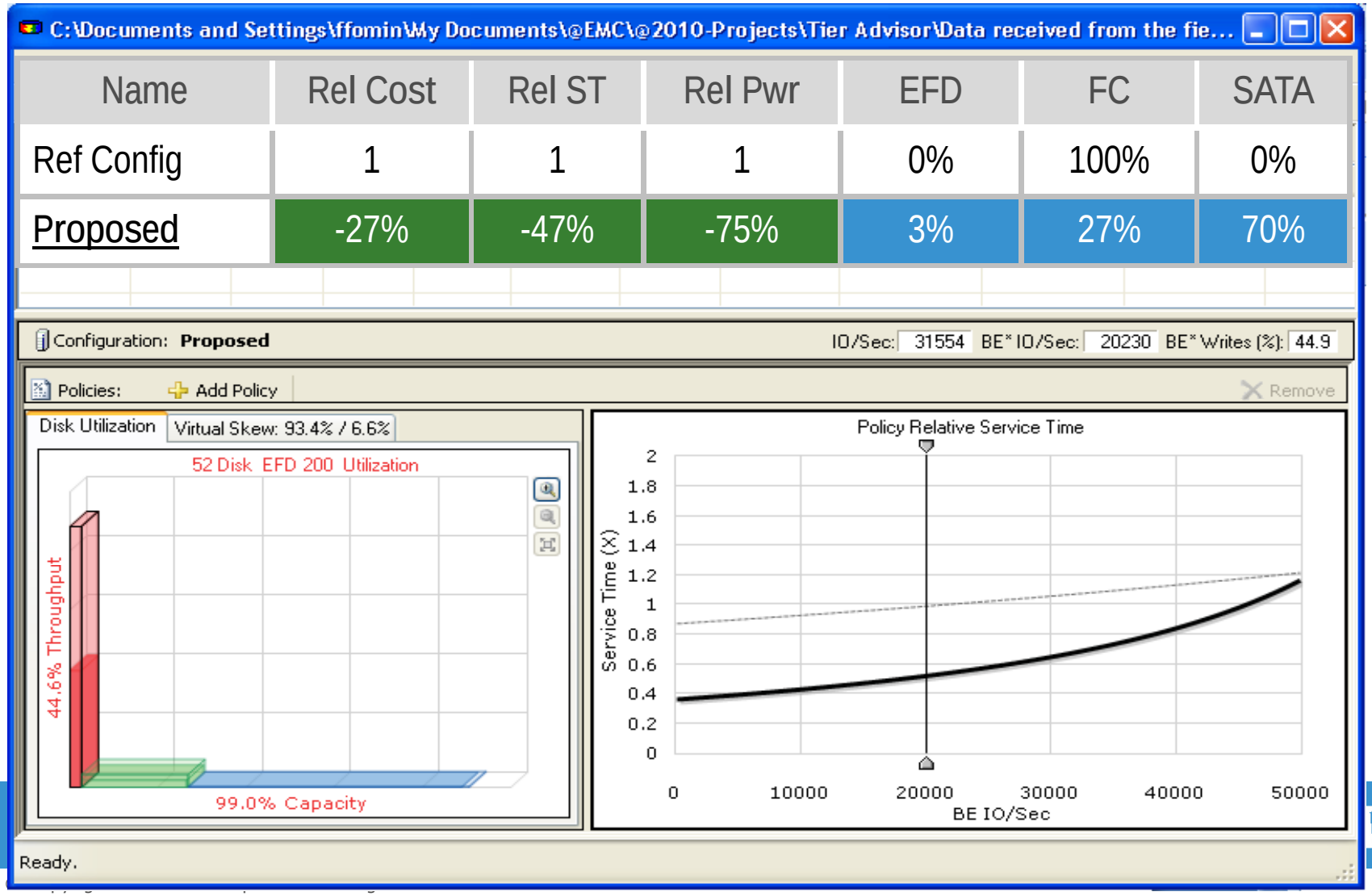


Done Well, Tiered Storage has Great Potential

Possible Tiered Configurations



More Challenges and Opportunities in Storage Tiering

- Proactive management
- Less expensive tiers
- Application awareness
- Tiering among several systems
- Server cache integrated with tiered storage
- Automatic improvement over time

Score Card

Name
Automated Tiered Storage

Evaluated by
Dr. Customer

Subject	Score
Predictability	60
High resource utilization	70
Appropriate technology	100
Performance/application	80
Ease of management	75

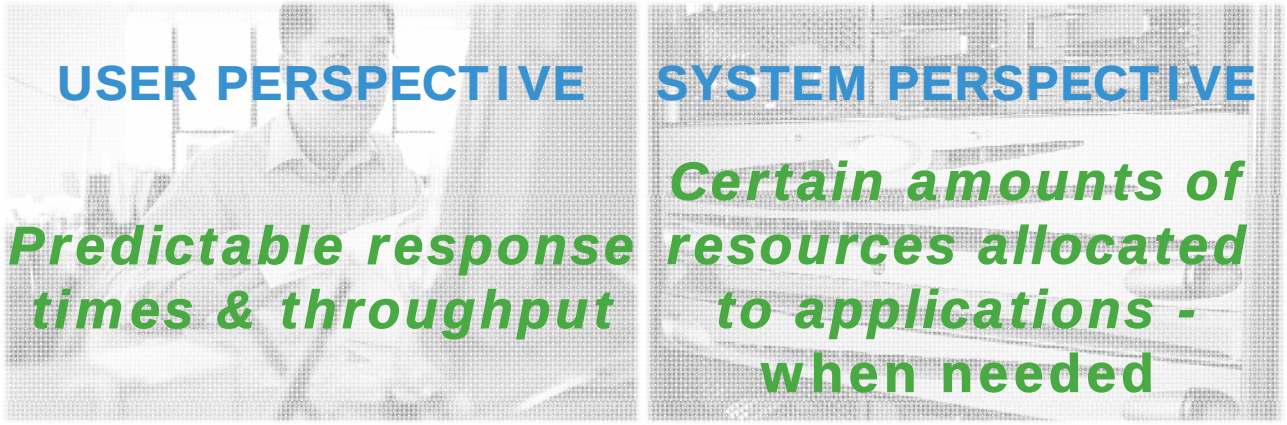
Quality of Service

Performance Mgmt

QoS

Predictability vs High Utilization

PREDICTABILITY



Predictability requires separation of resources

High utilization requires sharing of resources

Dynamic Cache Partitioning

Each application or each user is guaranteed to have a certain portion of the cache

- Only when it needs it

Any application can "donate" cache when it is not active or when it does not benefit from larger cache

Disk QOS is More Challenging

Disks Realities

- Disks can optimize the order in which I/Os are executed
- Optimization is more effective as the queue length increases
- As queue lengths increase, response time increase

The Challenge

- How to configure systems with Response Times and Throughput requirements, and how to set the policy …

Performance Management

New Expectations and Needs

Performance Management – not just monitoring / Reporting

Automatic Attainment of user-defined goals

- Requires a leap of faith, people need to think differently
- Smart algorithms that allocate resources to achieve these goals are needed
  - Multi dimension dynamic packing

SLAs from the application perspective

- How to describe business value, and then translate it to performance goals
- How to achieve the business goals

Performance Management products should improve automatically over time!!

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