

IS MLC READY FOR THE ENTERPRISE?

Esther Spanjer

Director, SSD Technical Marketing

esther.spanjer@smartstoragesys.com



IS MLC READY FOR THE ENTERPRISE?

Esther Spanjer

Director, SSD Technical Marketing

esther.spanjer@smartstoragesys.com



Meet Tom



Meet Tom

38 YEARS OLD, MARRIED, 2 KIDS



Meet Tom

38 YEARS OLD, MARRIED, 2 KIDS

DEGREE IN COMPUTER SCIENCE



Meet Tom

38 YEARS OLD, MARRIED, 2 KIDS

DEGREE IN COMPUTER SCIENCE

**IT MANAGER AT LARGE DATA
CENTER THAT PROVIDES
CLOUD HOSTING SERVICES**



Meet Tom

38 YEARS OLD, MARRIED, 2 KIDS

DEGREE IN COMPUTER SCIENCE

**IT MANAGER AT LARGE DATA
CENTER THAT PROVIDES
CLOUD HOSTING SERVICES**

**HAS WORKED HERE FOR 5 YEARS,
SLATED FOR PROMOTION TO
DIRECTOR OF IT**

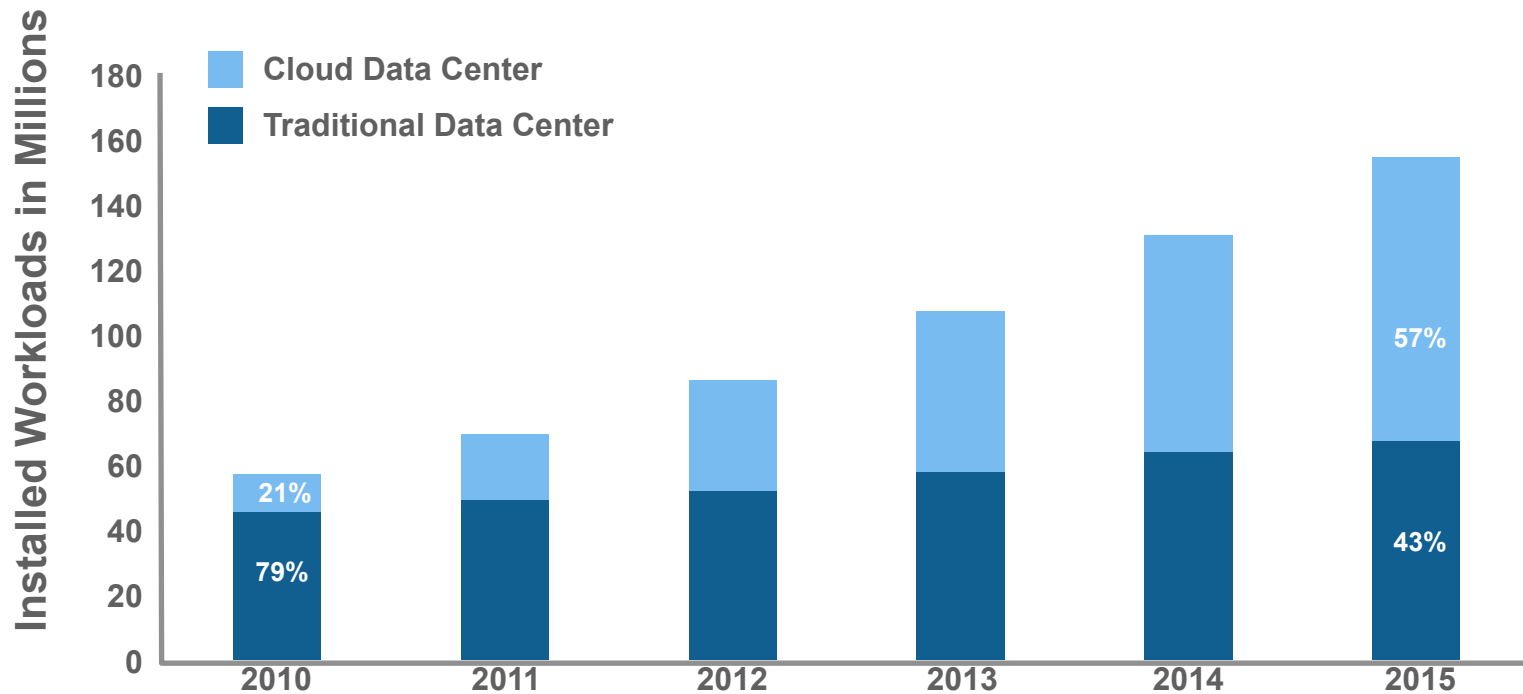


Tom's New Assignment



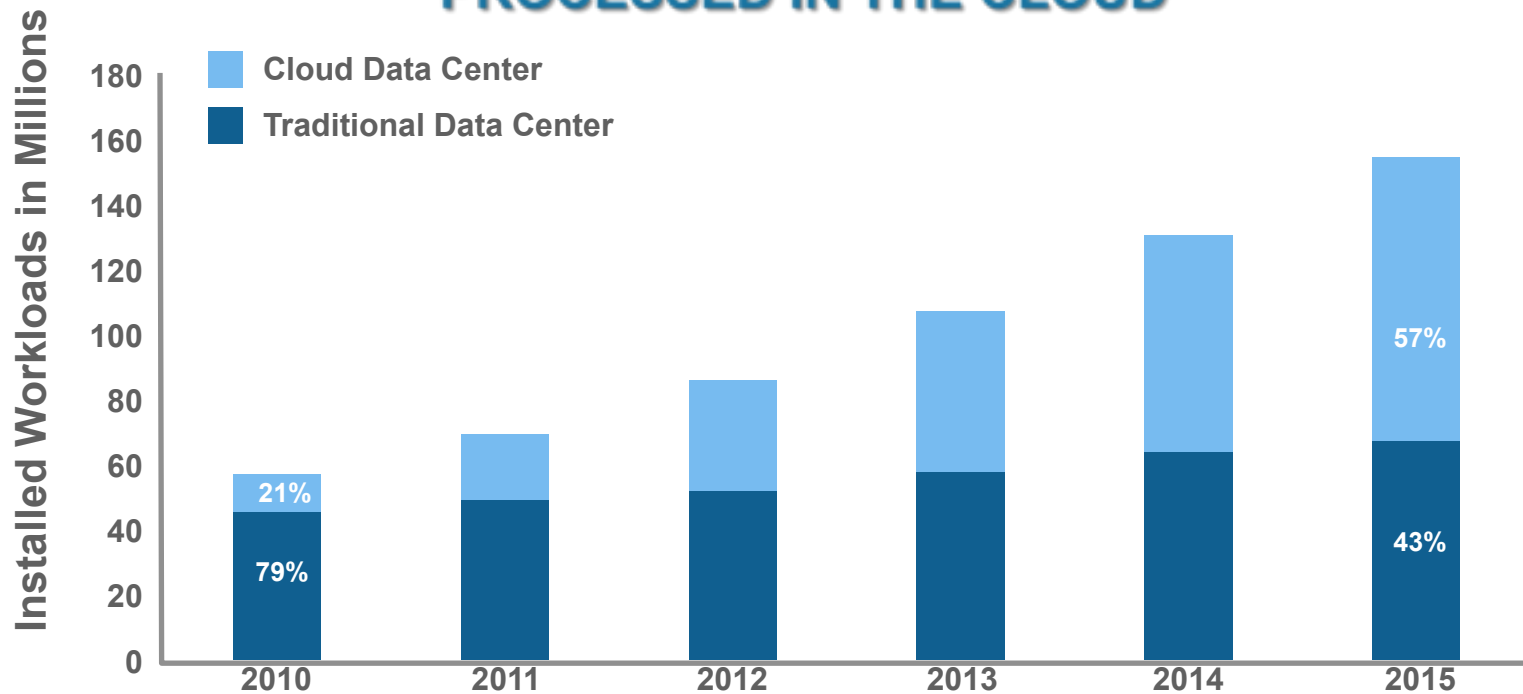
**DATA CENTER READINESS FOR INCREASED USER
ACCESS AND PERFORMANCE DEMANDS**

The demands on the datacenter



The demands on the datacenter

BY 2014, >50% OF ALL WORKLOADS WILL BE PROCESSED IN THE CLOUD



Tom runs some experiments JetStress 2010 Benchmark

4x 15K SAS HD



VS.



Drives for OS and logging:
C: 1x drive RAID-0 for OS
D: 3x drives RAID-5 for log files

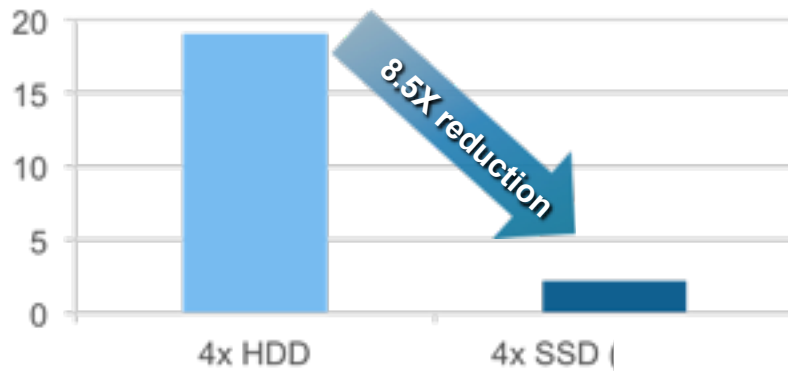
4x Client MLC SSD



- **Hardware Configuration:** IBM System x 3850 x5, 4 x 2.27GHz CPU, and 64GB RAM
- **OS:** Windows Server 2008 R2 Enterprise x64
- **Application:** Windows Server 2008 R2 Enterprise x64, Jetstress 2010 Database Benchmark

JetStress 2010 Benchmark Results

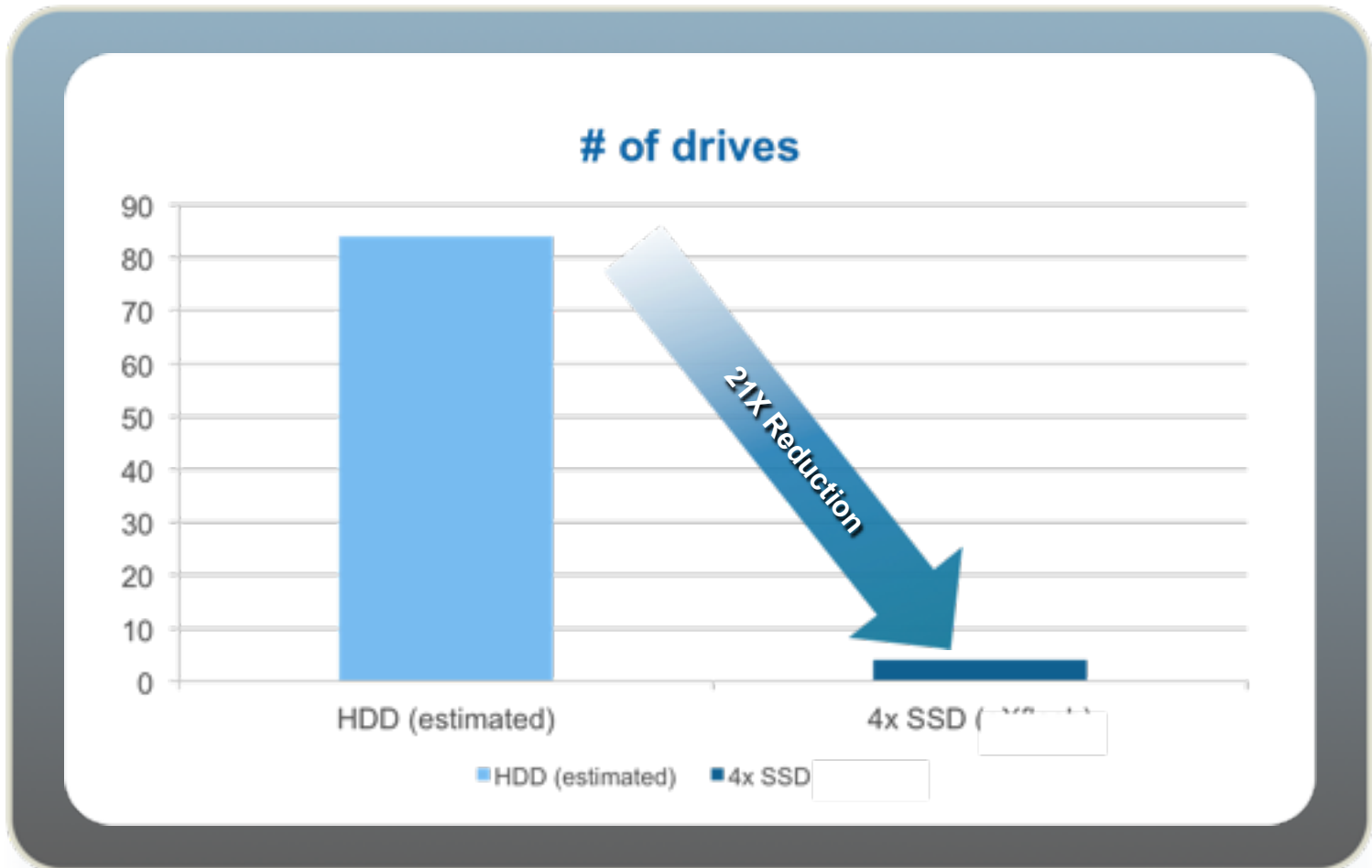
I/O Database Reads Average Latency (ms)




Achieved Transactional I/O per Second



JetStress 2010 Benchmark Results




Client MLC SSDs are the solution!

A man in a white shirt and blue tie is smiling and giving a thumbs up in a server room. The server racks are filled with hardware, and the scene is brightly lit.

**TOM REPLACES THE HDDs WITH
CLIENT MLC SSDs IN HIS
STORAGE RACKS**

Client MLC SSDs are the solution!



**TOM REPLACES THE HDDs WITH
CLIENT MLC SSDs IN HIS
STORAGE RACKS**

**HIS BOSS PRAISES HIM THAT HE
INCREASED COMPUTING POWER
WITHOUT INCREASING FOOTPRINT**

Client MLC SSDs are the solution!

**TOM REPLACES THE HDDs WITH
CLIENT MLC SSDs IN HIS
STORAGE RACKS**

**HIS BOSS PRAISES HIM THAT HE
INCREASED COMPUTING POWER
WITHOUT INCREASING FOOTPRINT**


**TOM IS PROMOTED TO
DIRECTOR OF IT!**



One year later...



One year later...

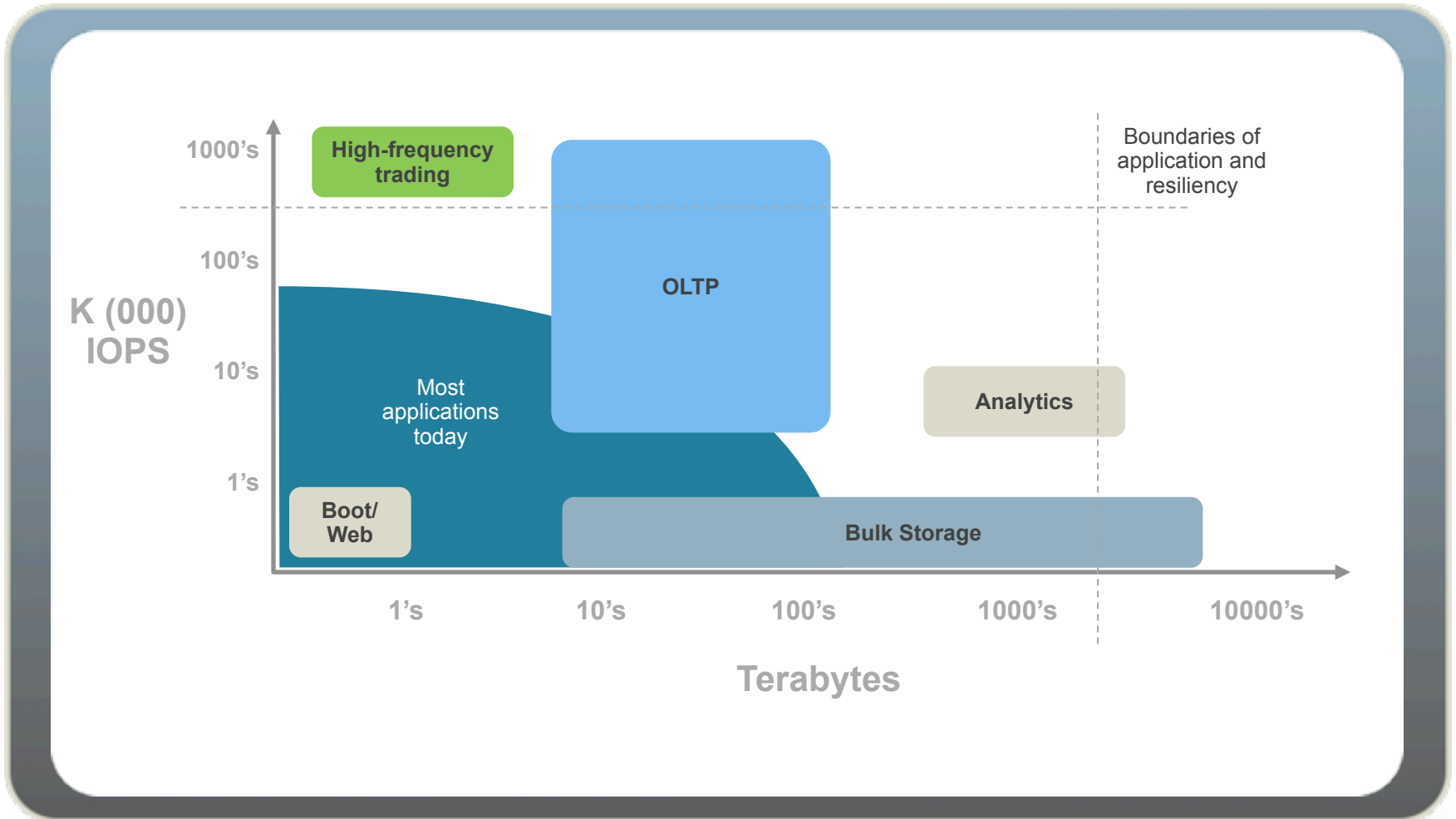


**CAN TOM KEEP
HIS JOB?**

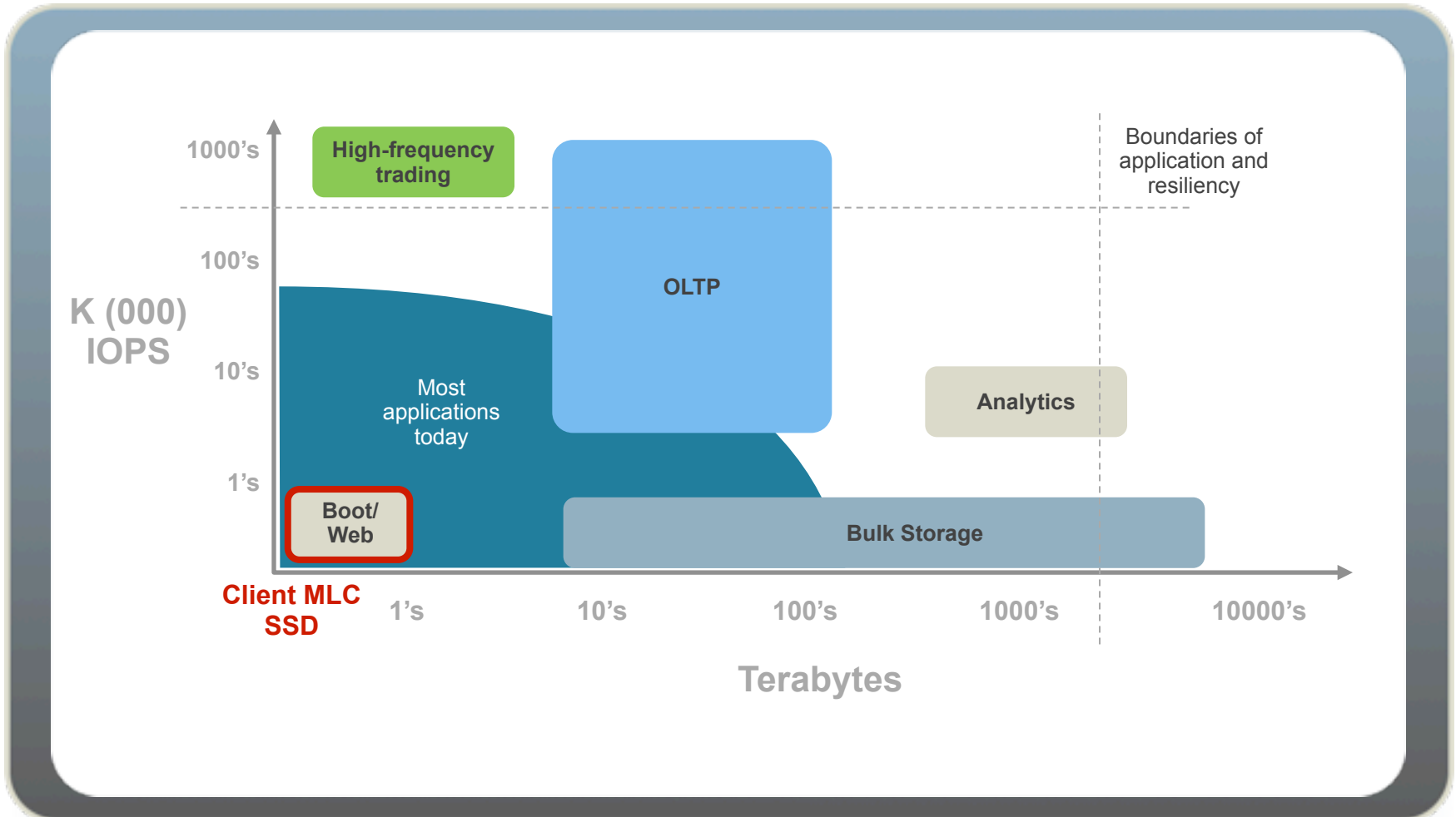


**ARE MLC SSDs NOT GOOD ENOUGH FOR
HIS ENTERPRISE ENVIRONMENT?**

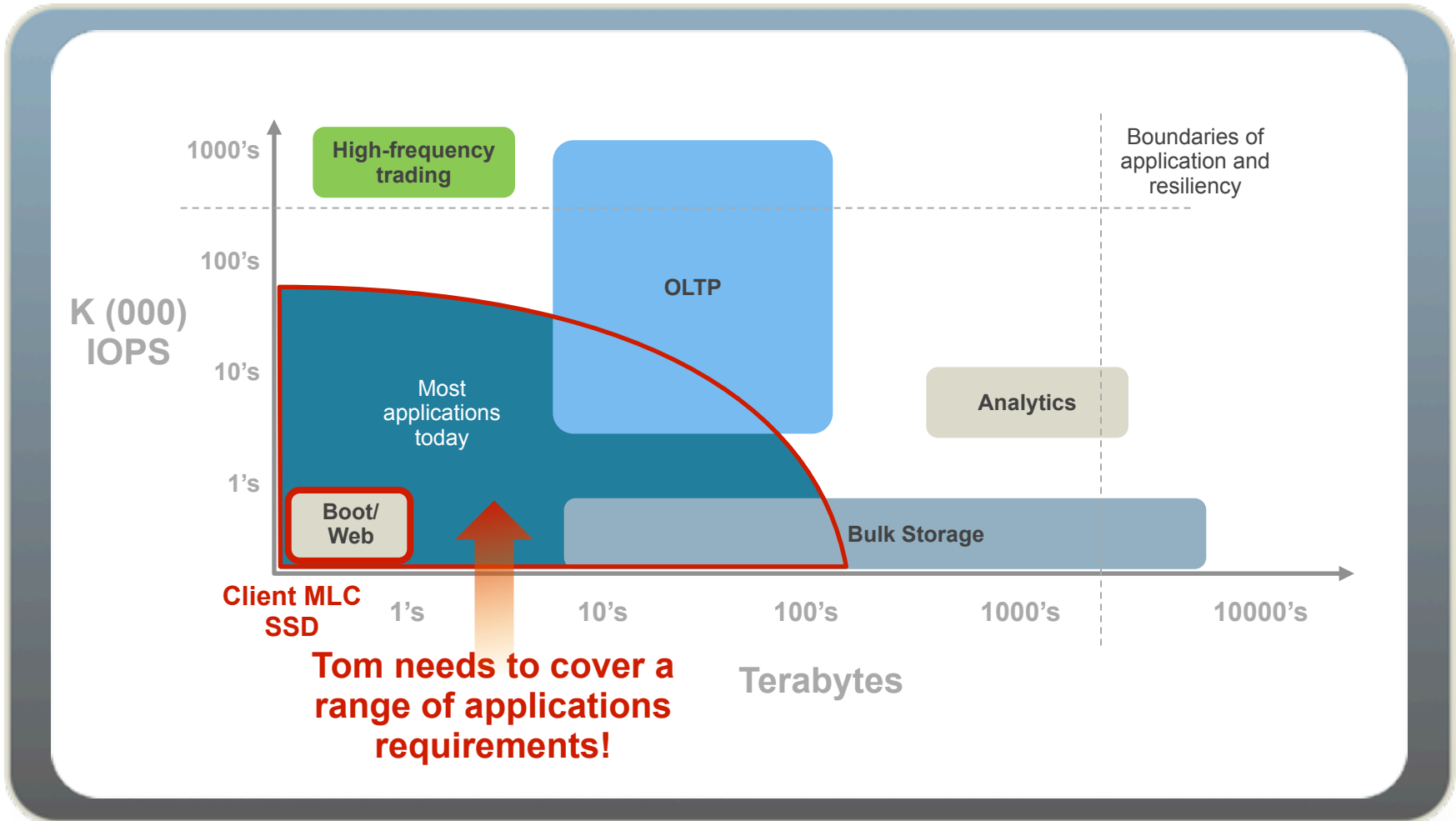
Wide Range of Applications



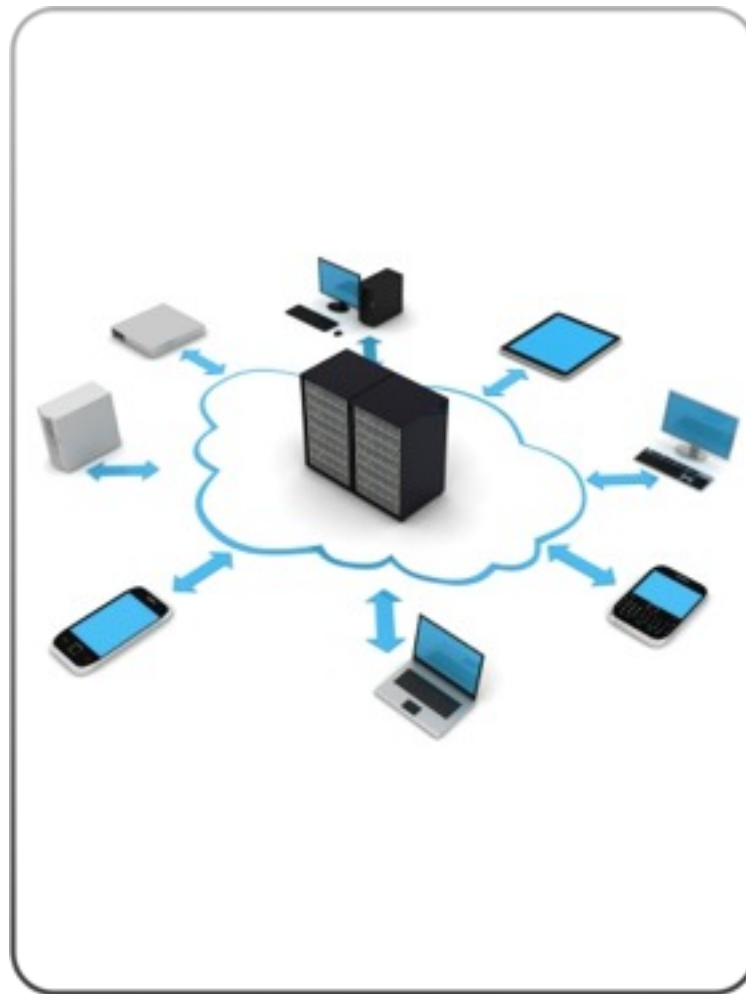
Wide Range of Applications



Wide Range of Applications



Lets do the Math



Lets do the Math

WEB SERVER

95/5% Read/Write

4, 8, 64KB transfer size

75% seq/25% random

240GB MLC SATA

Drive Life
1.6 Years



Lets do the Math

WEB SERVER

95/5% Read/Write
4, 8, 64KB transfer size
75% seq/25% random
240GB MLC SATA

Drive Life
1.6 Years



EXCHANGE SERVER

67/33% Read/Write
4KB transfer size
100% random
240GB MLC SATA

Drive Life
0.3 Years

Lets do the Math

WEB SERVER

95/5% Read/Write
4, 8, 64KB transfer size
75% seq/25% random
240GB MLC SATA

Drive Life
1.6 Years



EXCHANGE SERVER

67/33% Read/Write
4KB transfer size
100% random
240GB MLC SATA

Drive Life
0.3 Years

SQL LOGGING

100% Write
8KB transfer size
100% sequential
240GB MLC SATA

Drive Life
0.08 years

Lets do the Math

WEB SERVER

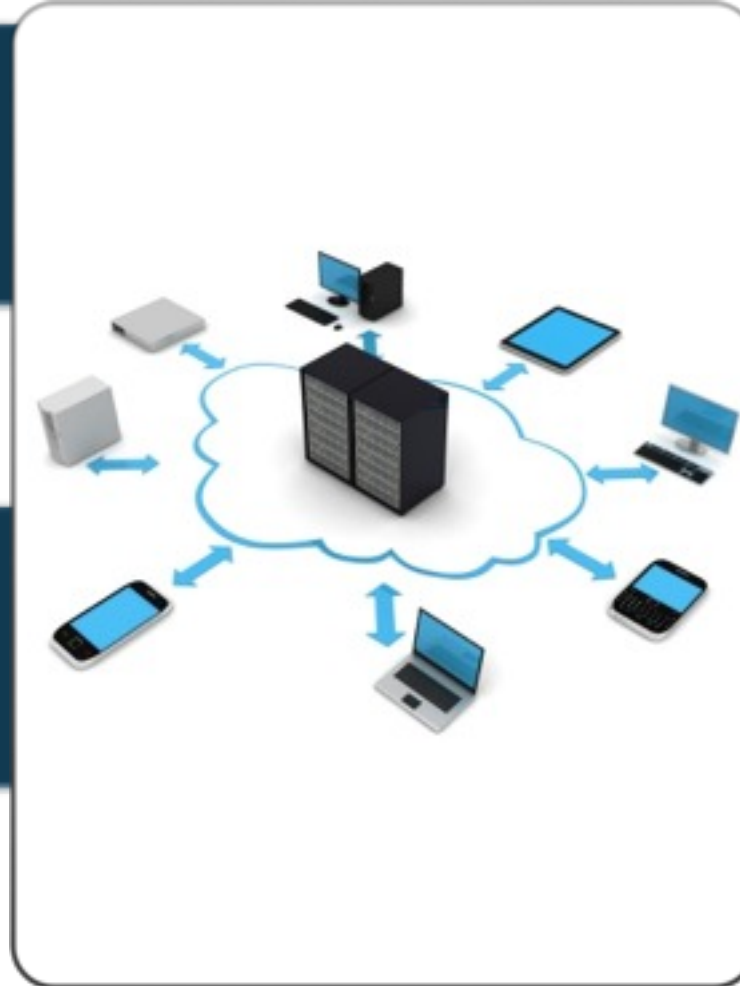
95/5% Read/Write
4, 8, 64KB transfer size
75% seq/25% random
240GB MLC SATA

Drive Life
1.6 Years

VIDEO ON DEMAND

100% Read
512KB transfer size
100% random
240GB SATA

Drive Life
 ∞ years



EXCHANGE SERVER

67/33% Read/Write
4KB transfer size
100% random
240GB MLC SATA

Drive Life
0.3 Years

SQL LOGGING

100% Write
8KB transfer size
100% sequential
240GB MLC SATA

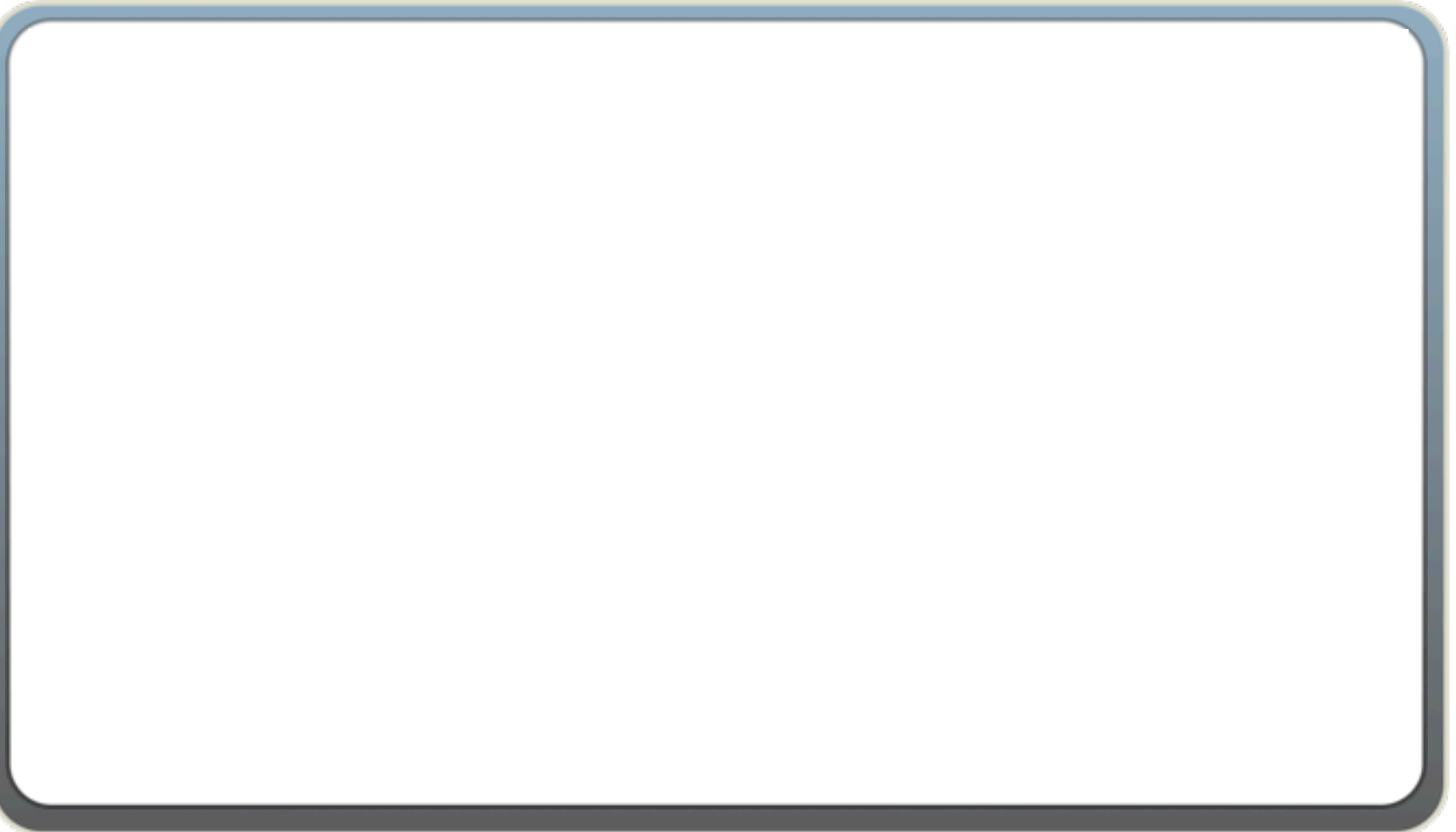
Drive Life
0.08 years

Tom Starts To Learn About Endurance

MLC, eMLC, SLC,
OVERPROVISIONING,
DWPD, WRITE
AMPLIFICATION....



Write Amplification vs. OP



Write Amplification vs. OP

◆ OP=7%
WA=8.60

Write Amplification vs. OP

◆ OP=7%
WA=8.60

◆ OP=28%
WA=2.73

Write Amplification vs. OP

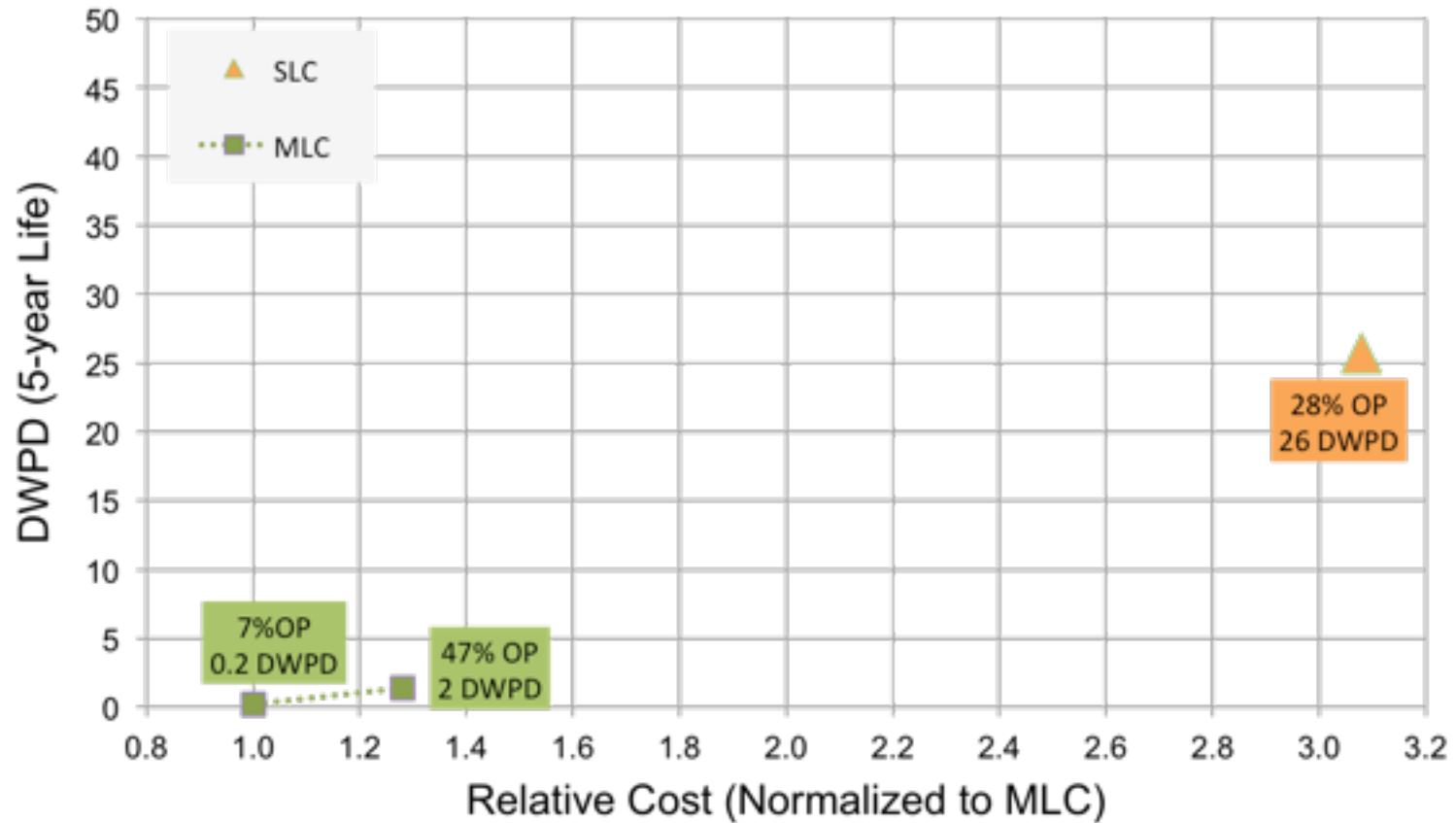
◆ OP=7%
WA=8.60

◆ OP=28%
WA=2.73

OP=156%
WA=1.22

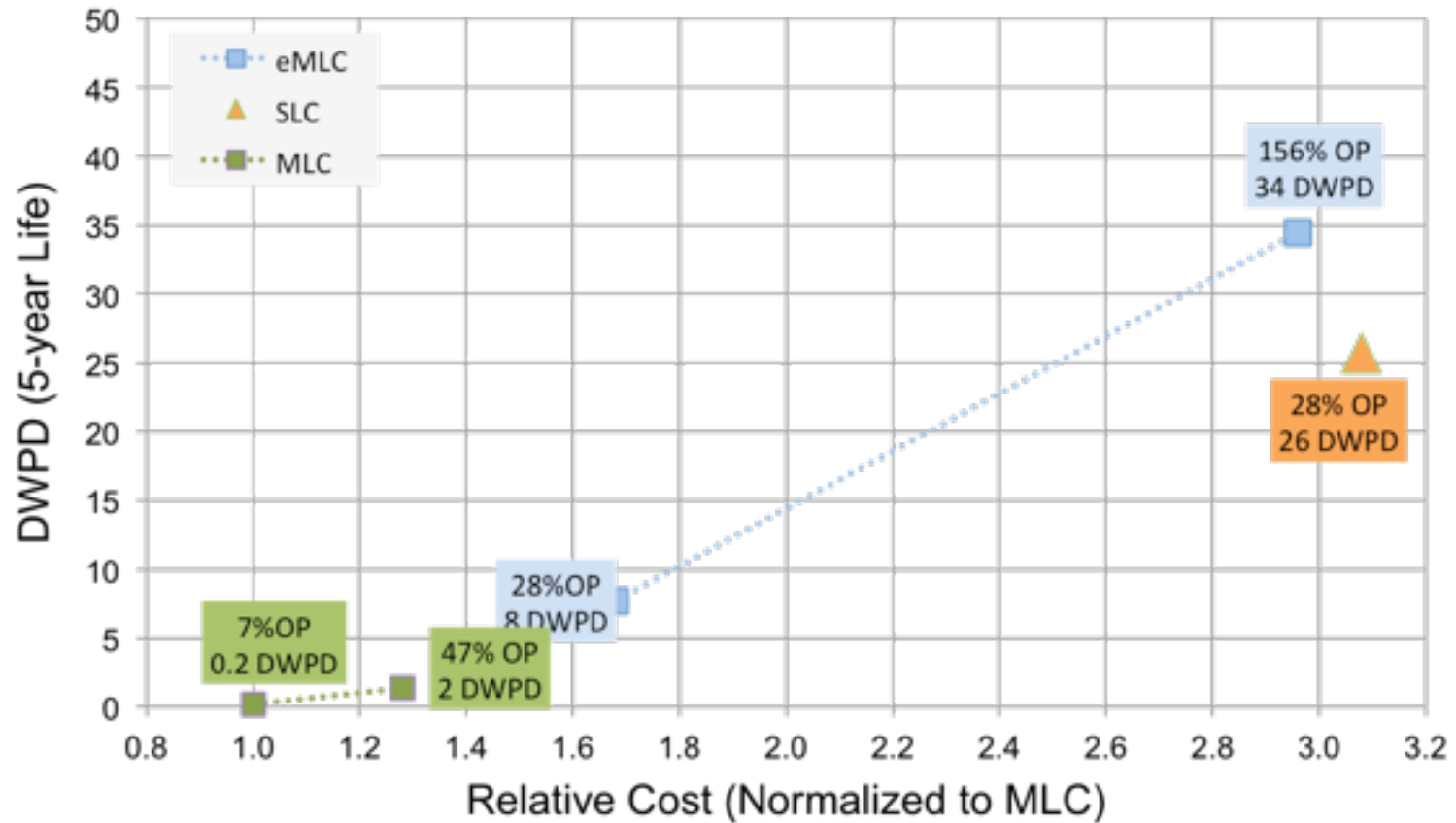
◆

Endurance vs Cost



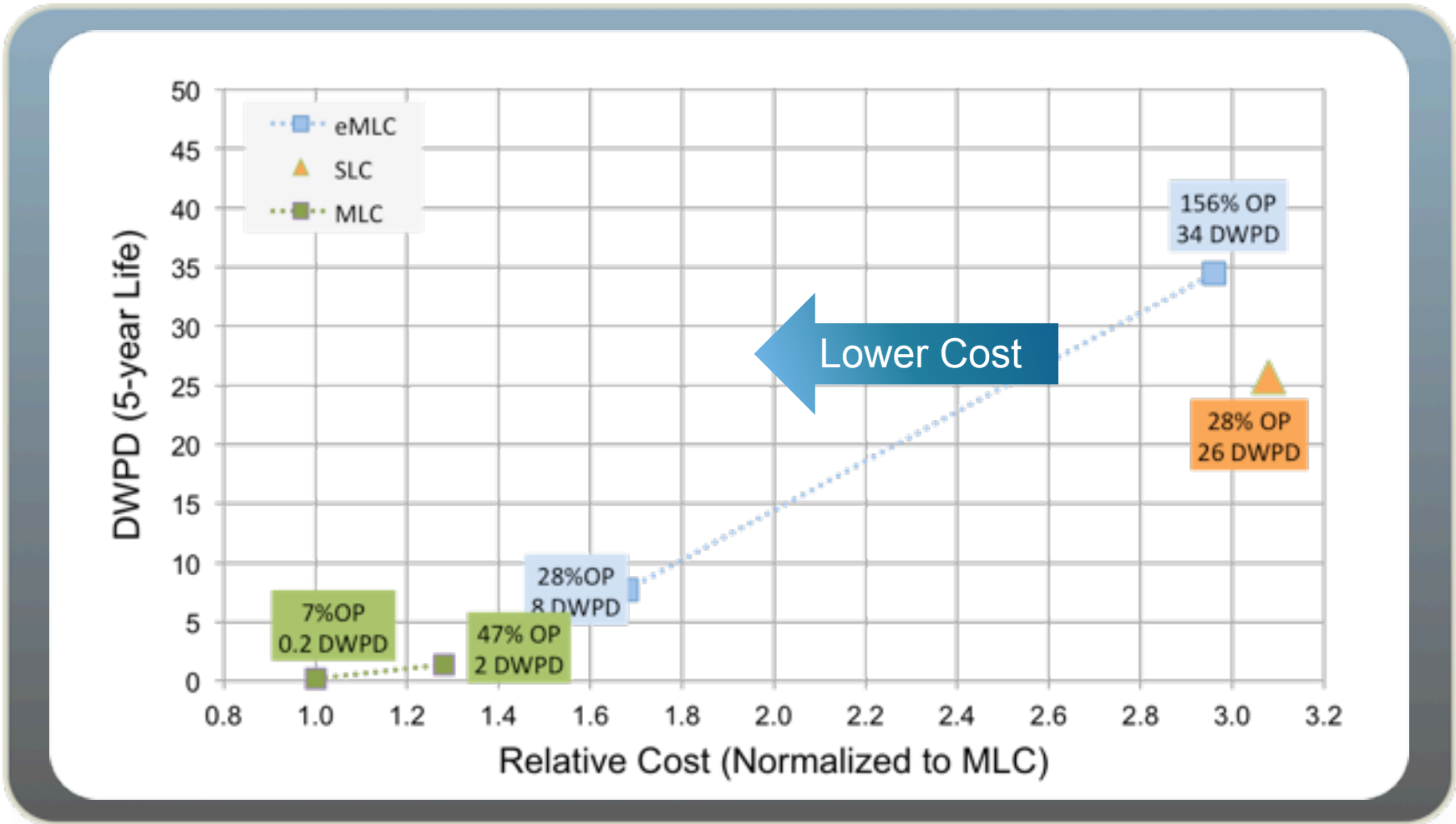
Note: Assumes reduced WA for increased OP

Endurance vs Cost



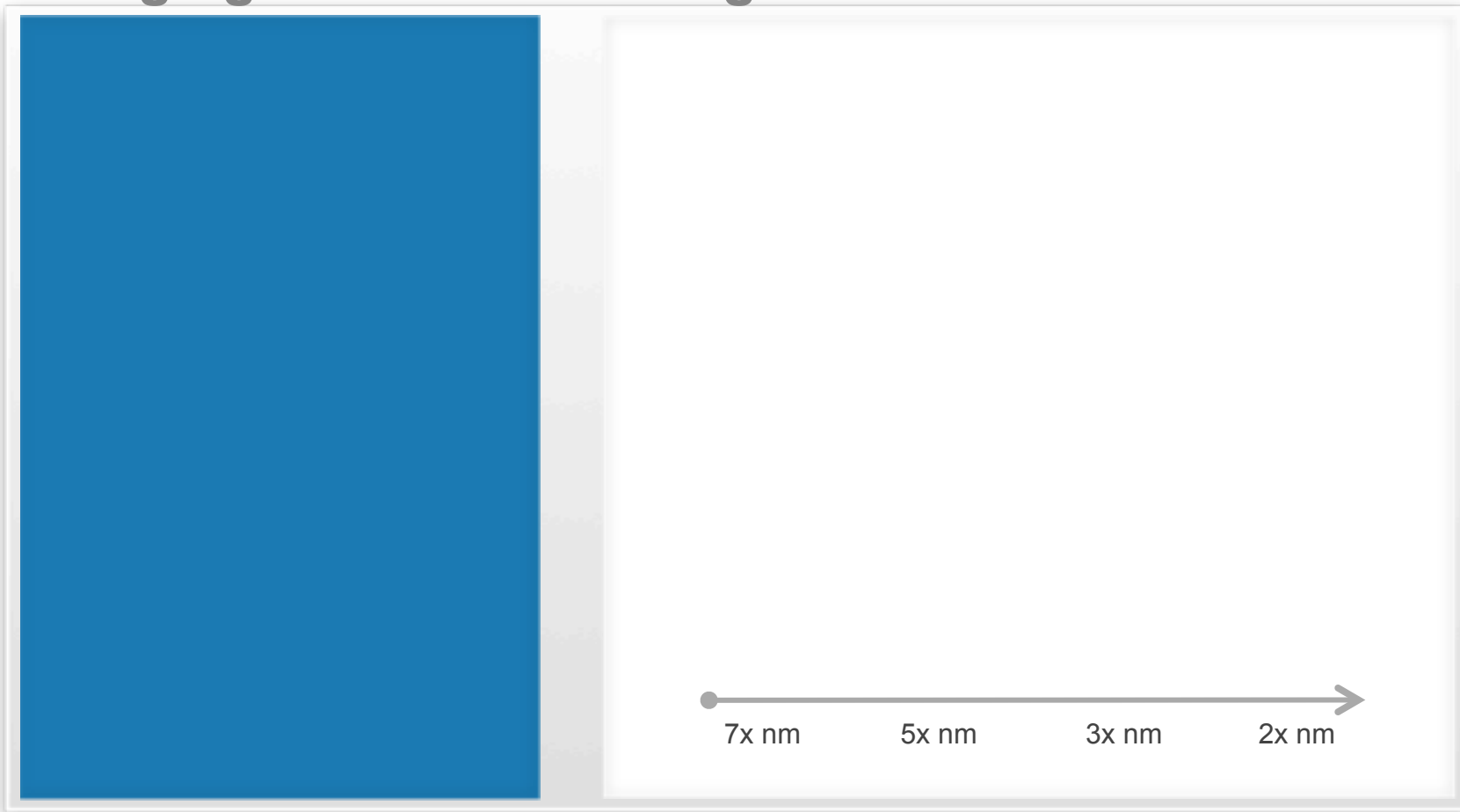
Note: Assumes reduced WA for increased OP

Endurance vs Cost

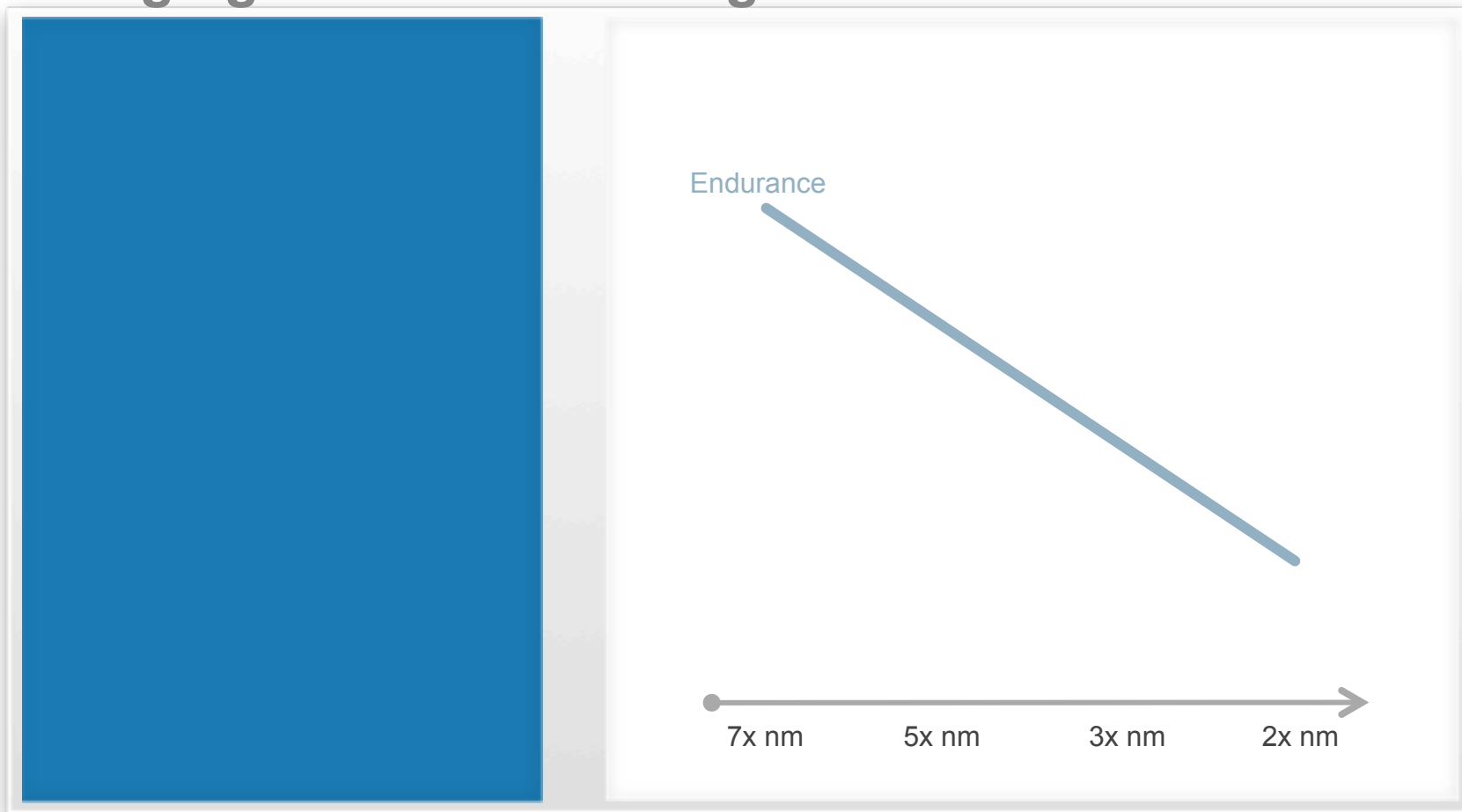


Note: Assumes reduced WA for increased OP

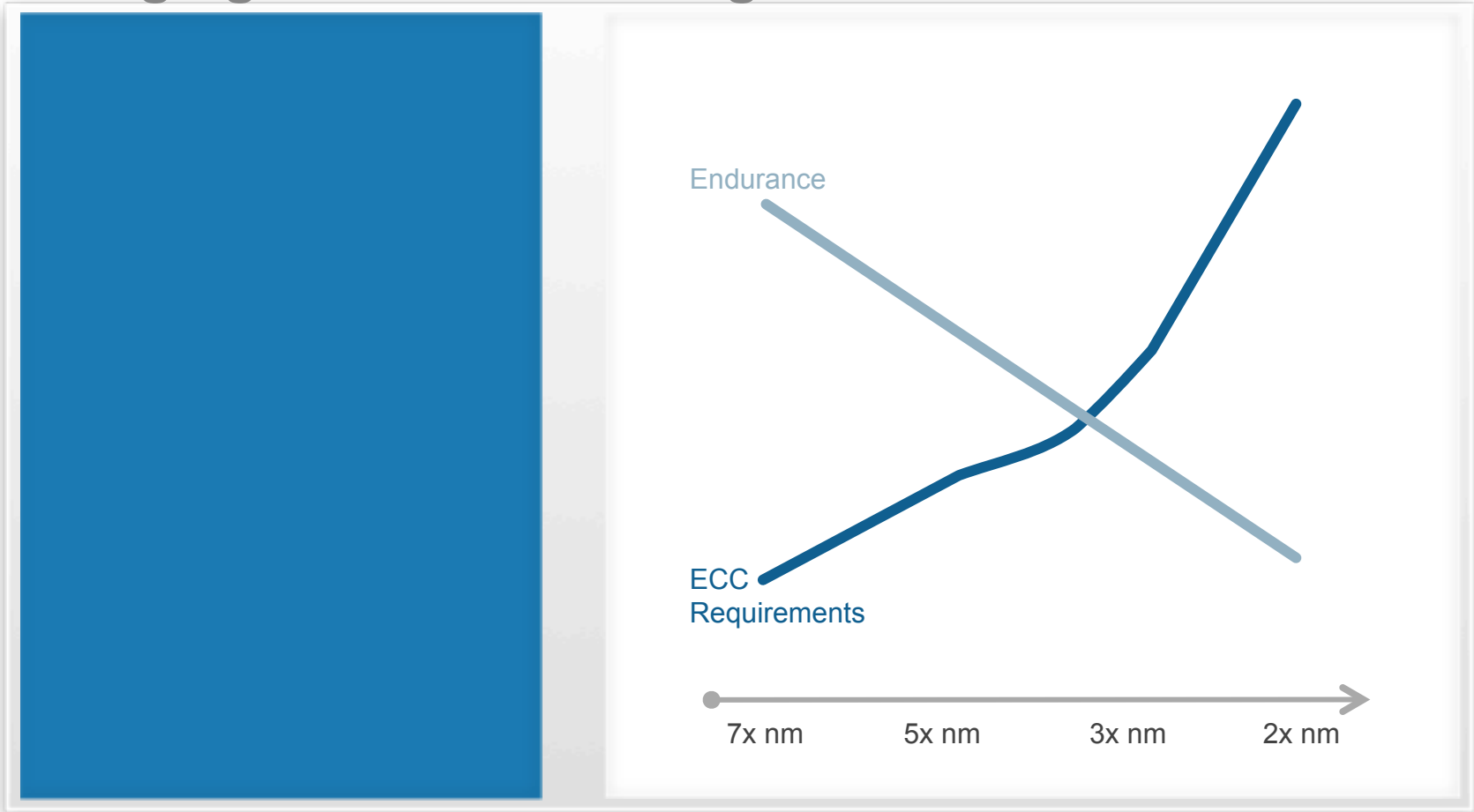
Managing Endurance through ECC



Managing Endurance through ECC

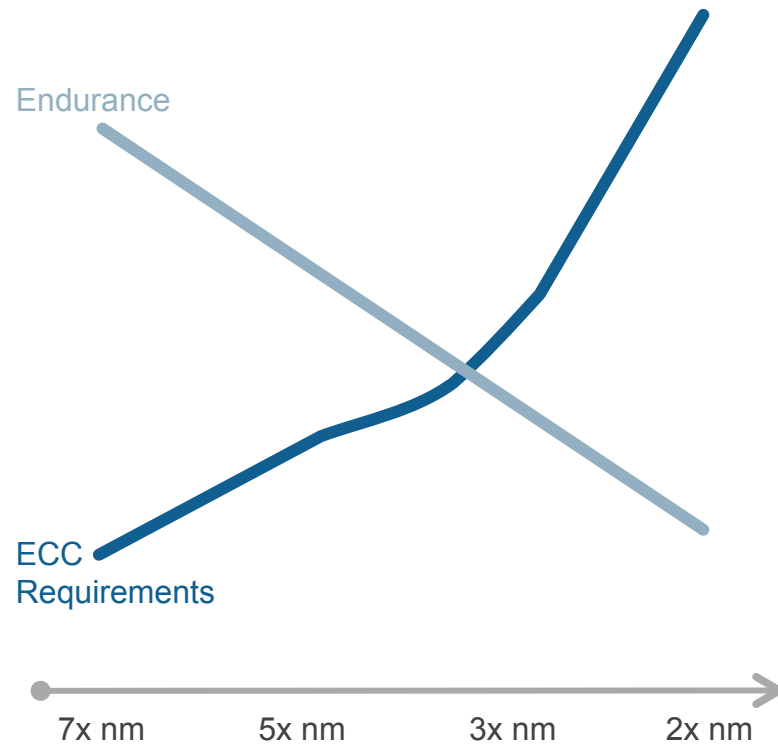


Managing Endurance through ECC



Managing Endurance through ECC

Comprehensive error recovery can lead to performance degradation and latency problems



Managing Endurance through ECC

Comprehensive error recovery can lead to performance degradation and latency problems



Endurance

ECC Requirements

7x nm

5x nm

3x nm

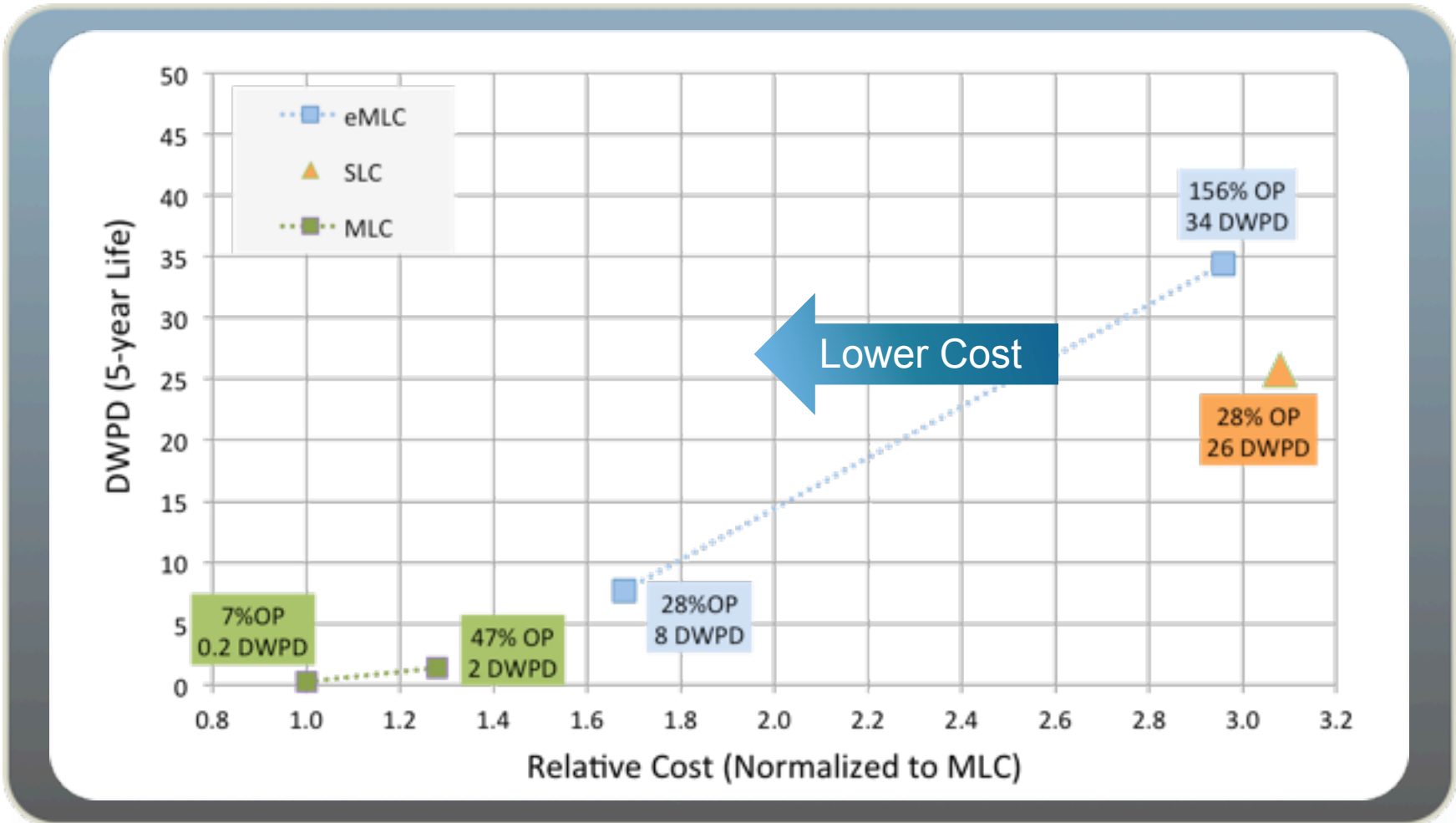
2x nm

TRADITIONAL APPROACH OF ADDING ECC CAPABILITY IS NOT SUFFICIENT

Managing Endurance Through Physics

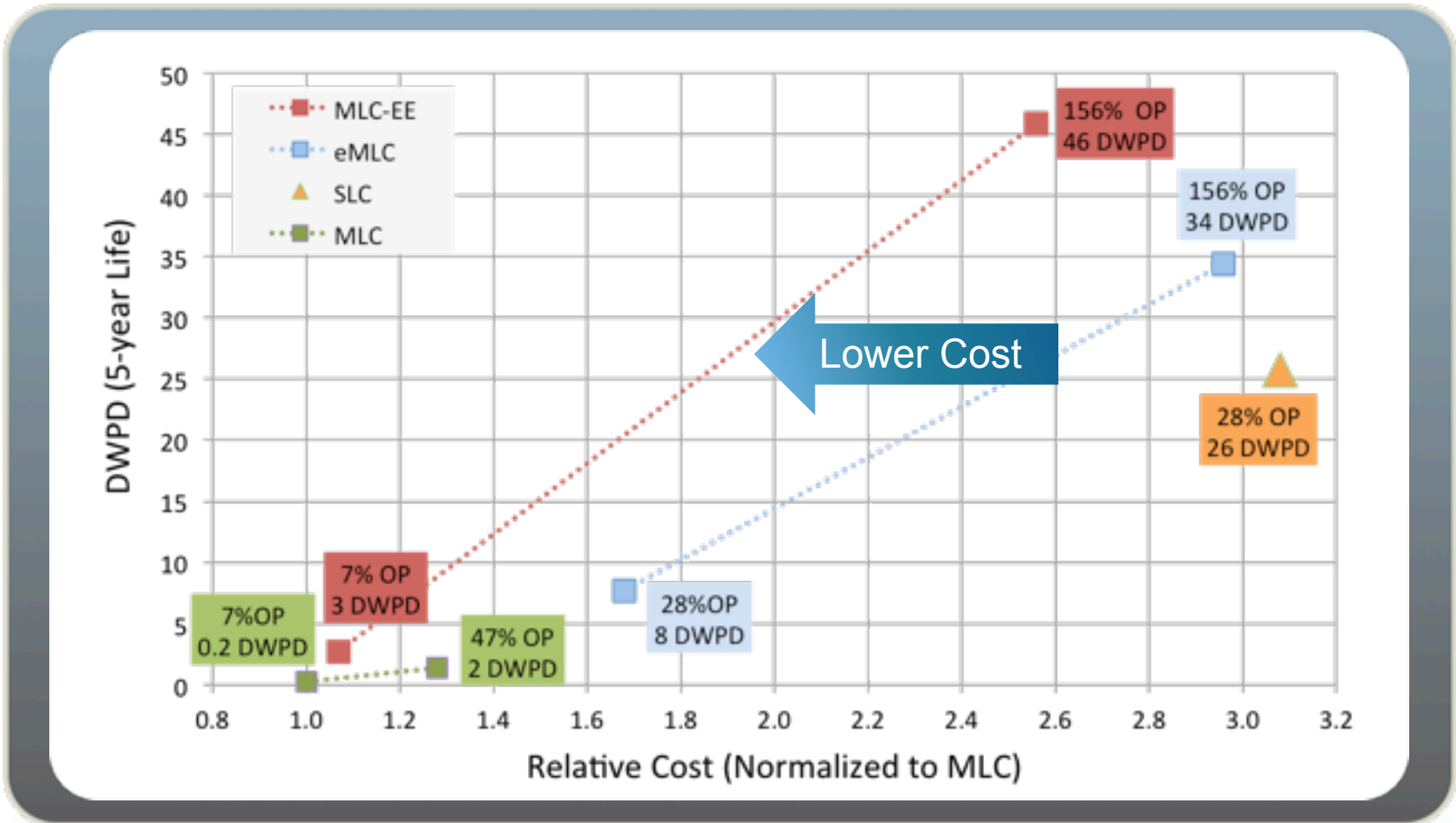


Endurance vs Cost



Note: Assumes reduced WA for increased OP

Endurance vs Cost

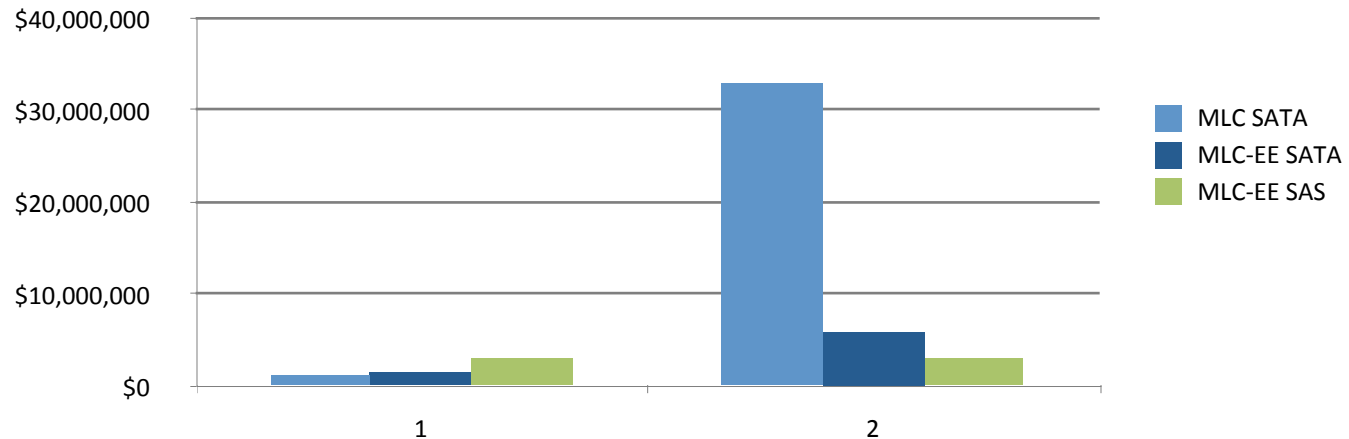


Note: Assumes reduced WA for increased OP

OLTP application - 5 Year TCO Model

1 Petabyte Install Base

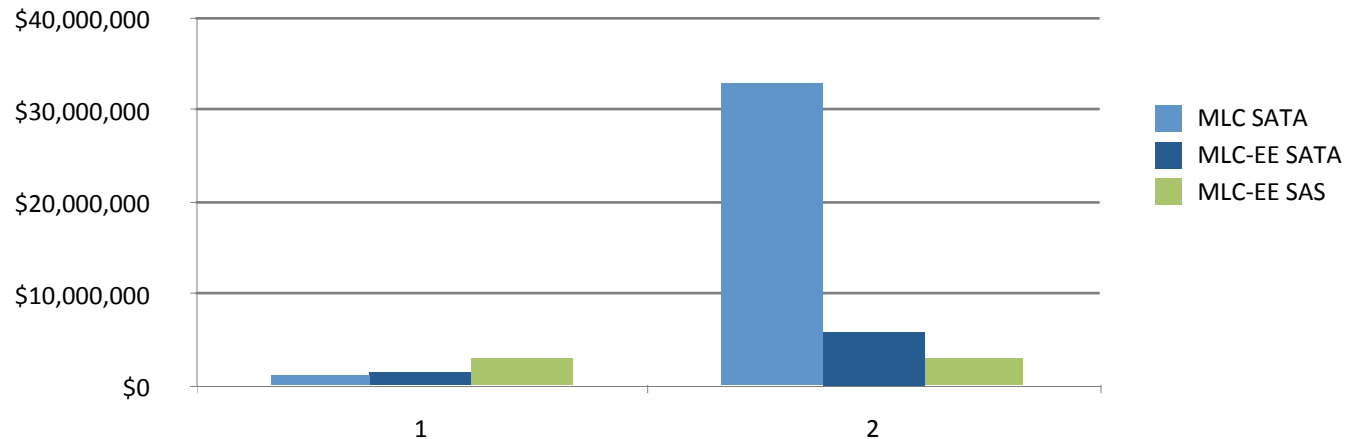
	MLC SATA	MLC-EE SATA	MLC-EE SAS
Acquisition Cost	\$ 240	\$ 300	\$ 600
Calculated Life (in years)	0.18	1.27	4.92
Replacement rate/year	5.48	0.79	0.20



OLTP application - 5 Year TCO Model

1 Petabyte Install Base

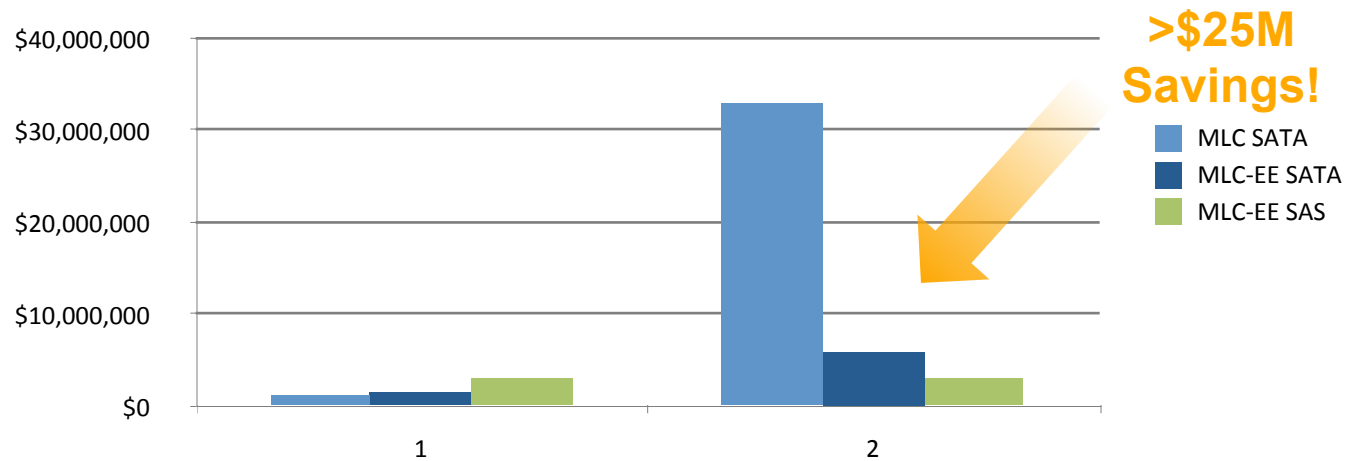
	MLC SATA	MLC-EE SATA	MLC-EE SAS
Acquisition Cost	\$ 240	\$ 300	\$ 600
Calculated Life (in years)	0.18	1.27	4.92
Replacement rate/year	5.48	0.79	0.20



OLTP application - 5 Year TCO Model

1 Petabyte Install Base


	MLC SATA	MLC-EE SATA	MLC-EE SAS
Acquisition Cost	\$ 240	\$ 300	\$ 600
Calculated Life (in years)	0.18	1.27	4.92
Replacement rate/year	5.48	0.79	0.20



The Moral of the Story




The Moral of the Story



**NO MORE WORRY ABOUT FLASH
WEAR OUT AND SYSTEMS FAILING**


The Moral of the Story



NO MORE WORRY ABOUT FLASH WEAR OUT AND SYSTEMS FAILING

NO MORE WORRY ABOUT DEGRADING PERFORMANCE

The Moral of the Story




NO MORE WORRY ABOUT FLASH WEAR OUT AND SYSTEMS FAILING

NO MORE WORRY ABOUT DEGRADING PERFORMANCE

NO MORE WORRY ABOUT HIGH TOTAL COST OF OWNERSHIP

The Moral of the Story



**NO MORE WORRY ABOUT FLASH
WEAR OUT AND SYSTEMS FAILING**

**NO MORE WORRY ABOUT
DEGRADING PERFORMANCE**

**NO MORE WORRY ABOUT HIGH
TOTAL COST OF OWNERSHIP**

TOM IS KEEPING HIS JOB!

THANK YOU !

SMART  STORAGE™
SYSTEMS

Making NAND Better

