

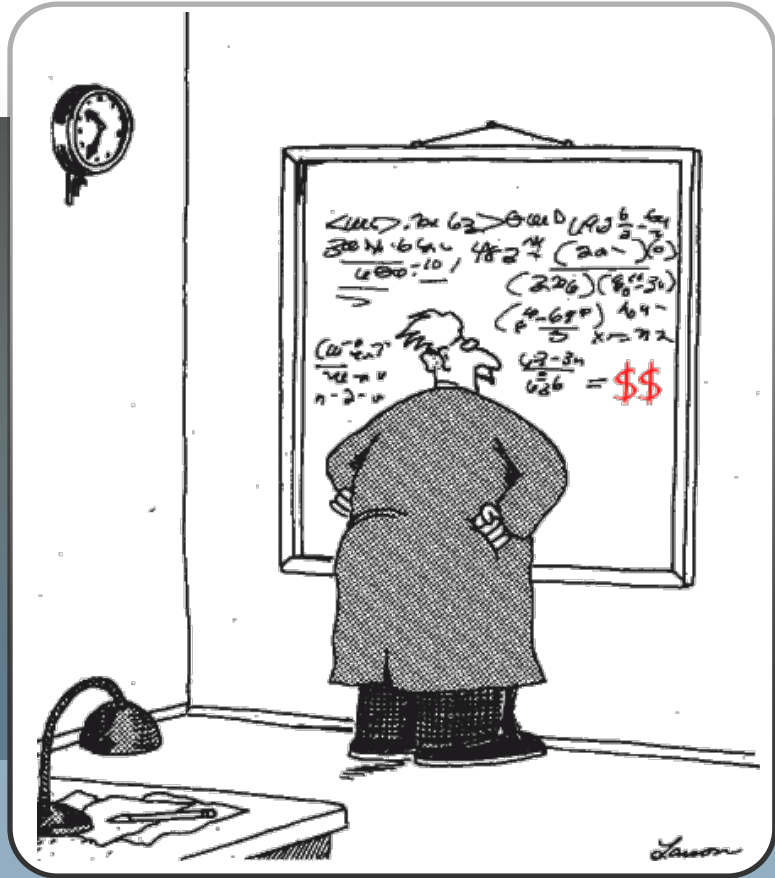
WHAT IS IN YOUR STORAGE DNA?

John Scaramuzzo
President SMART Storage Systems

SMART STORAGE[™]
SYSTEMS

=====
Making NAND Better

DISCOVERY OF THE CENTURY



TIME = \$\$\$

WHAT DOES FLASH ENDURANCE = ?

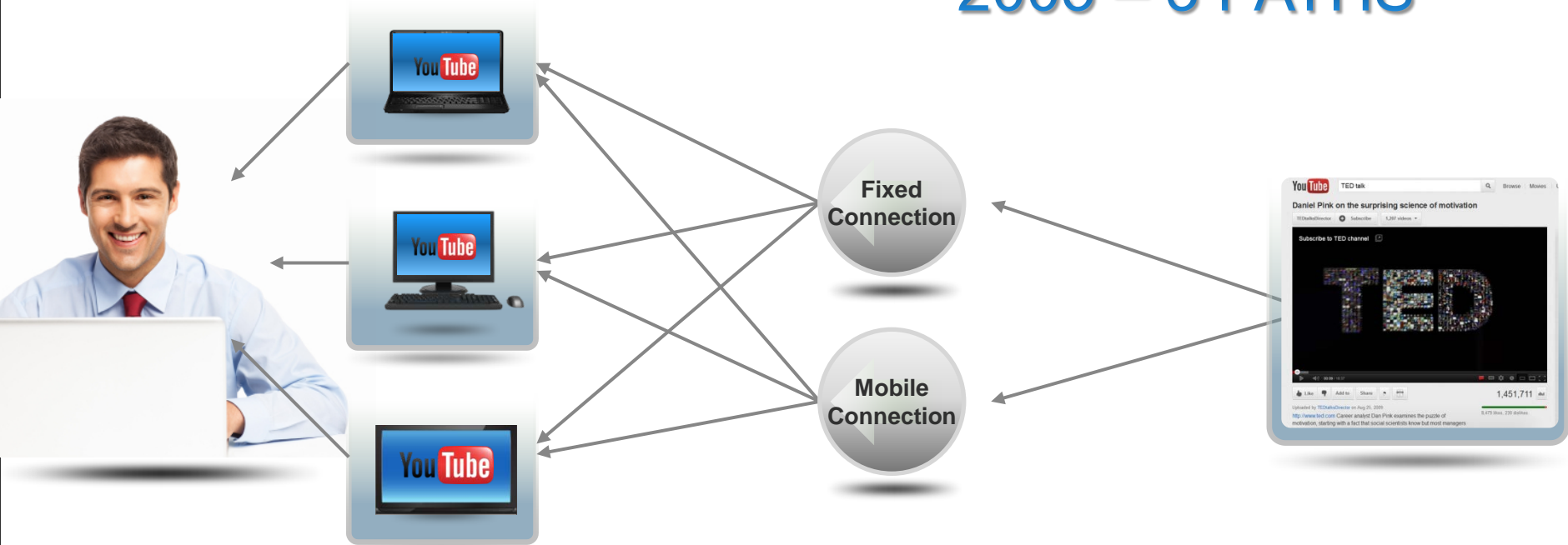


THE CONNECTED WORLD IS COMPLEX

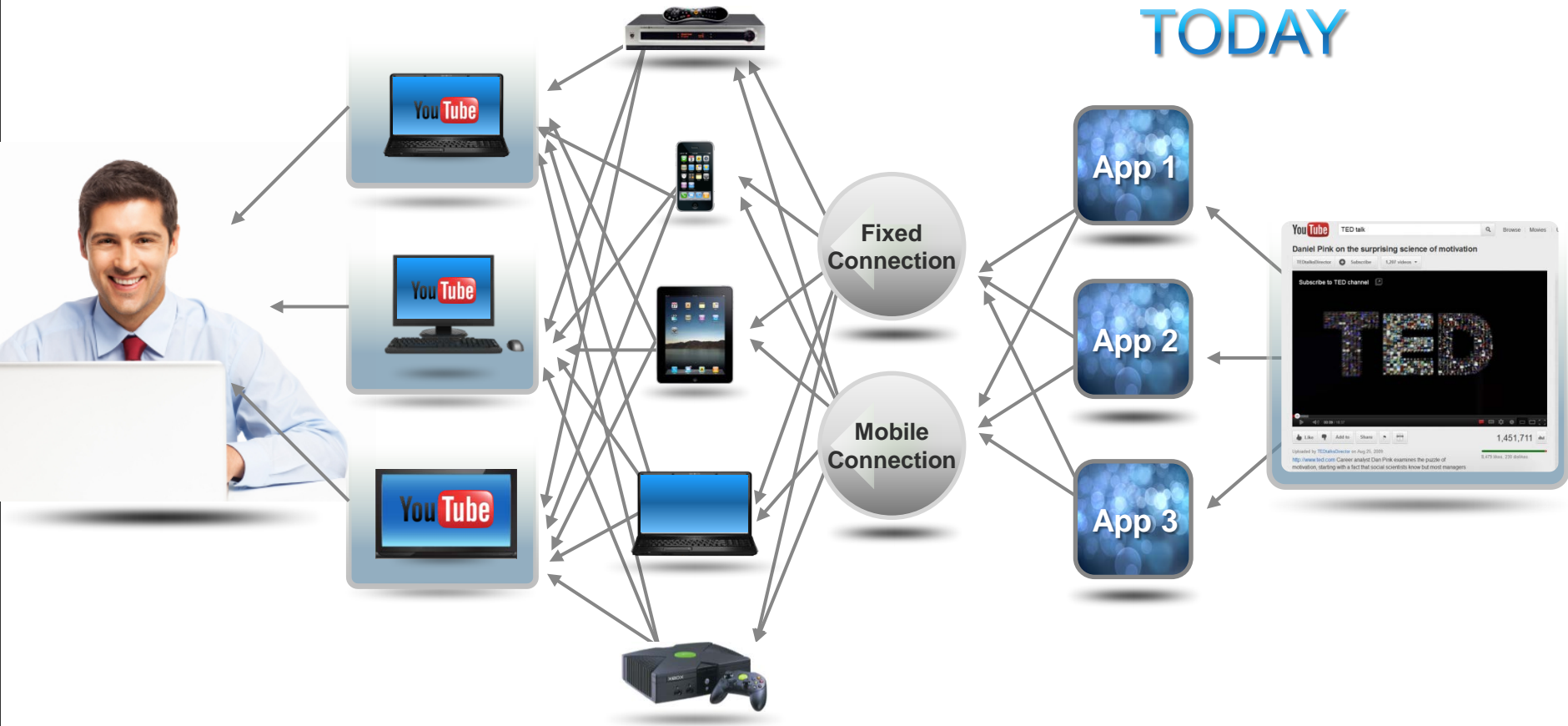


...AND IT'S GETTING MORE COMPLEX

2005 – 3 PATHS



...AND IT'S GETTING MORE COMPLEX



EXPLODING DATA GROWTH

**EVERY MINUTE, 72 HOURS OF VIDEO
ARE UPLOADED TO YOUTUBE**

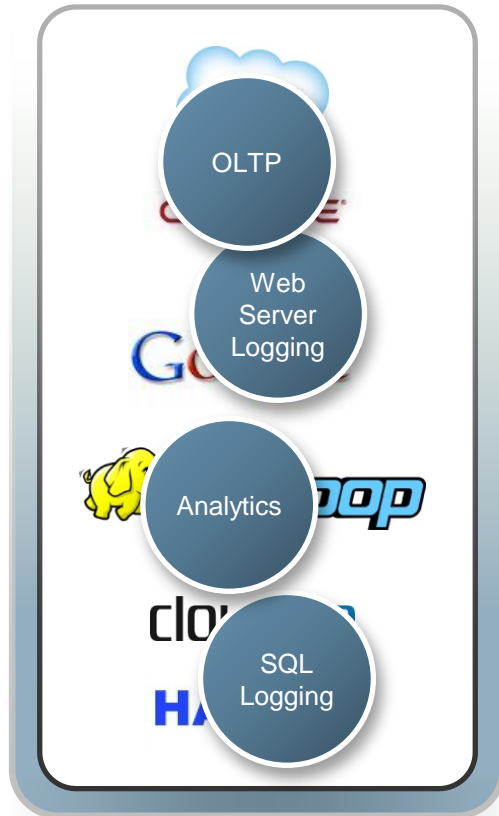
**EVERY HOUR, ENOUGH INFORMATION IS CONSUMED
BY INTERNET TRAFFIC TO FILL 7 MILLION DVDS**

EVERY DAY, 247 BILLION E-MAILS ARE SENT

**FACEBOOK HANDLES 40 BILLION
PHOTOS FROM ITS USER BASE**

**THE AMOUNT OF INTERNET TRAFFIC WILL REACH
667 EXABYTES ANNUALLY BY 2013**

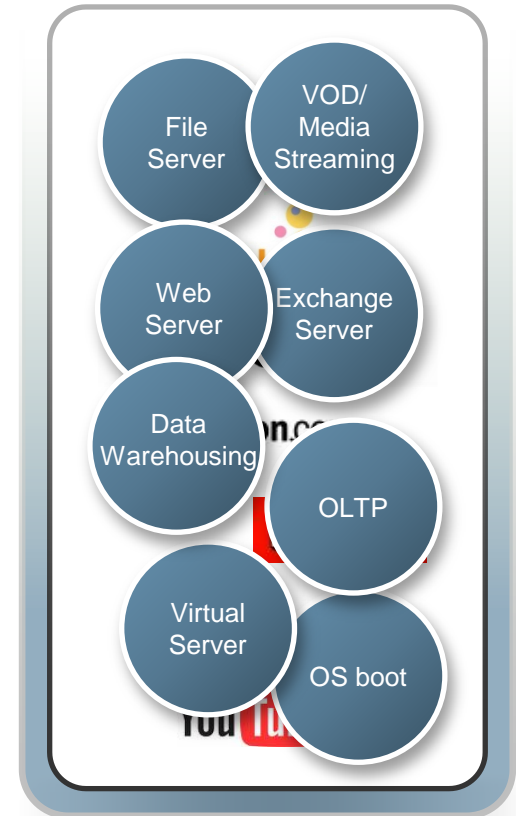
DRIVING THE NEED FOR FASTER STORAGE



**IN MEMORY
COMPUTE**

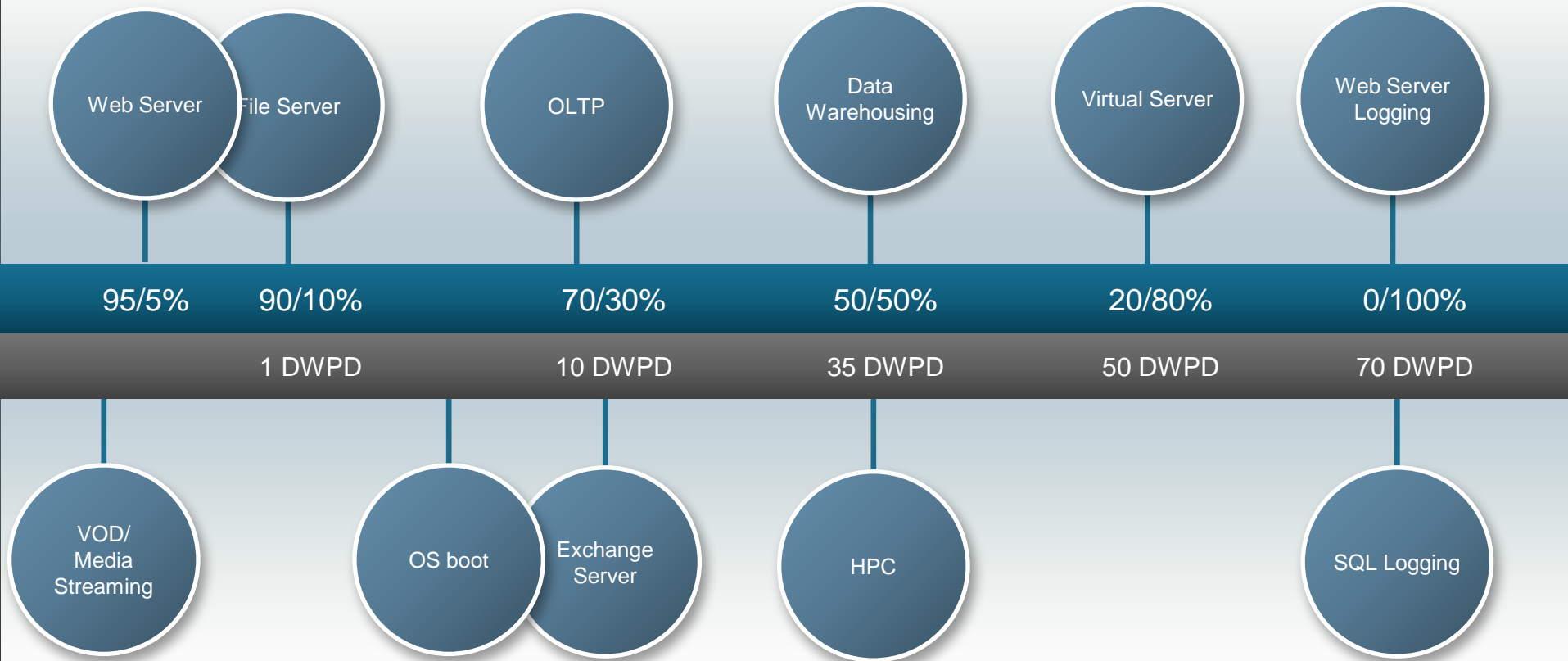


**LOW LATENCY
STORAGE**



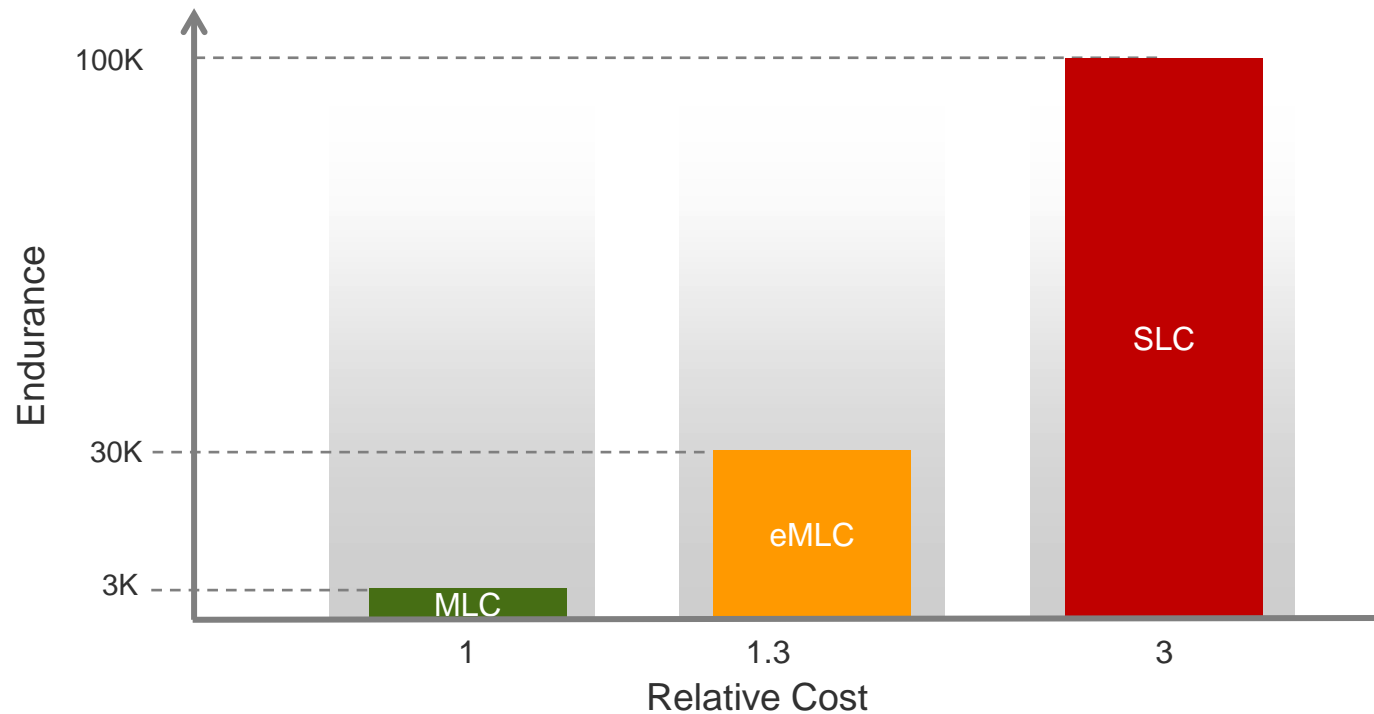
**DATA
CENTER/CLOUD**

WORKLOAD CONTINUUM



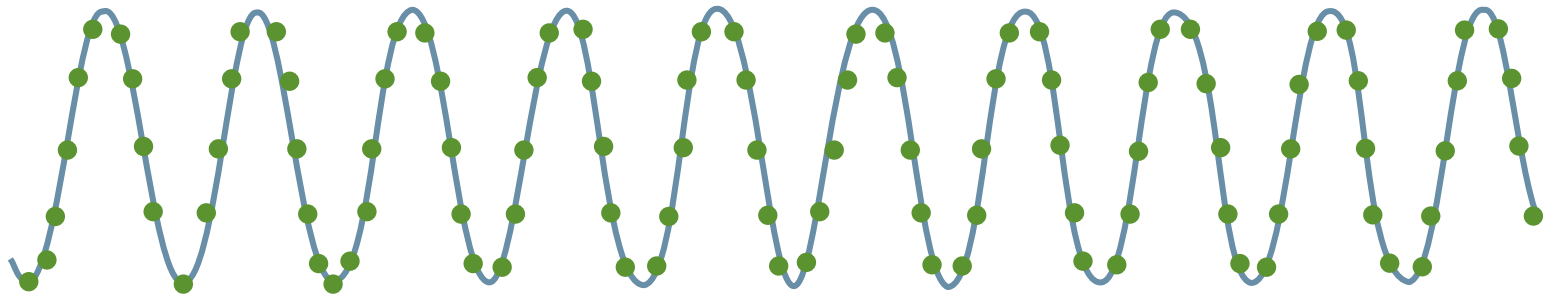
A WORKLOAD CONTINUUM REQUIRES AN ENDURANCE CONTINUUM

BUT WE LIVE IN A DISCRETE NAND WORLD

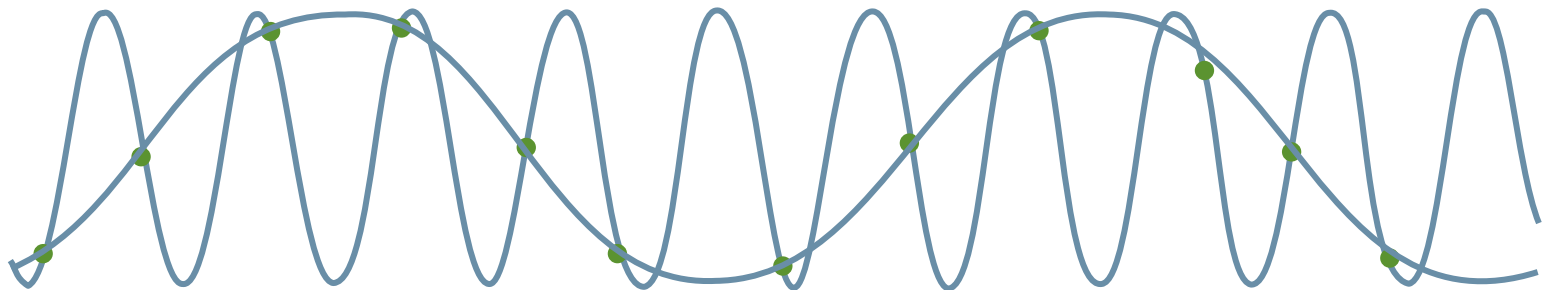


NAND VENDORS PROVIDE 3 ENDURANCE POINTS

RECALL SAMPLING THEORY...

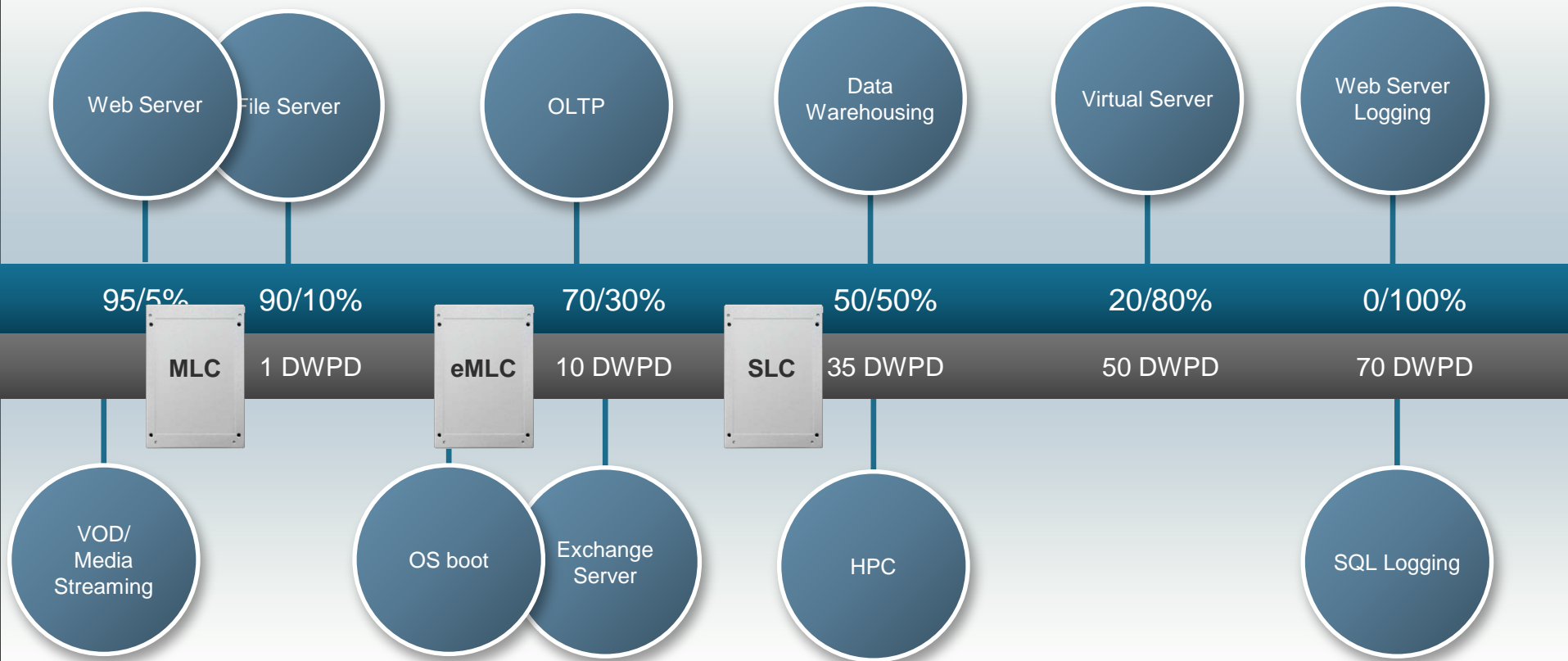


Adequately Sampled Signal



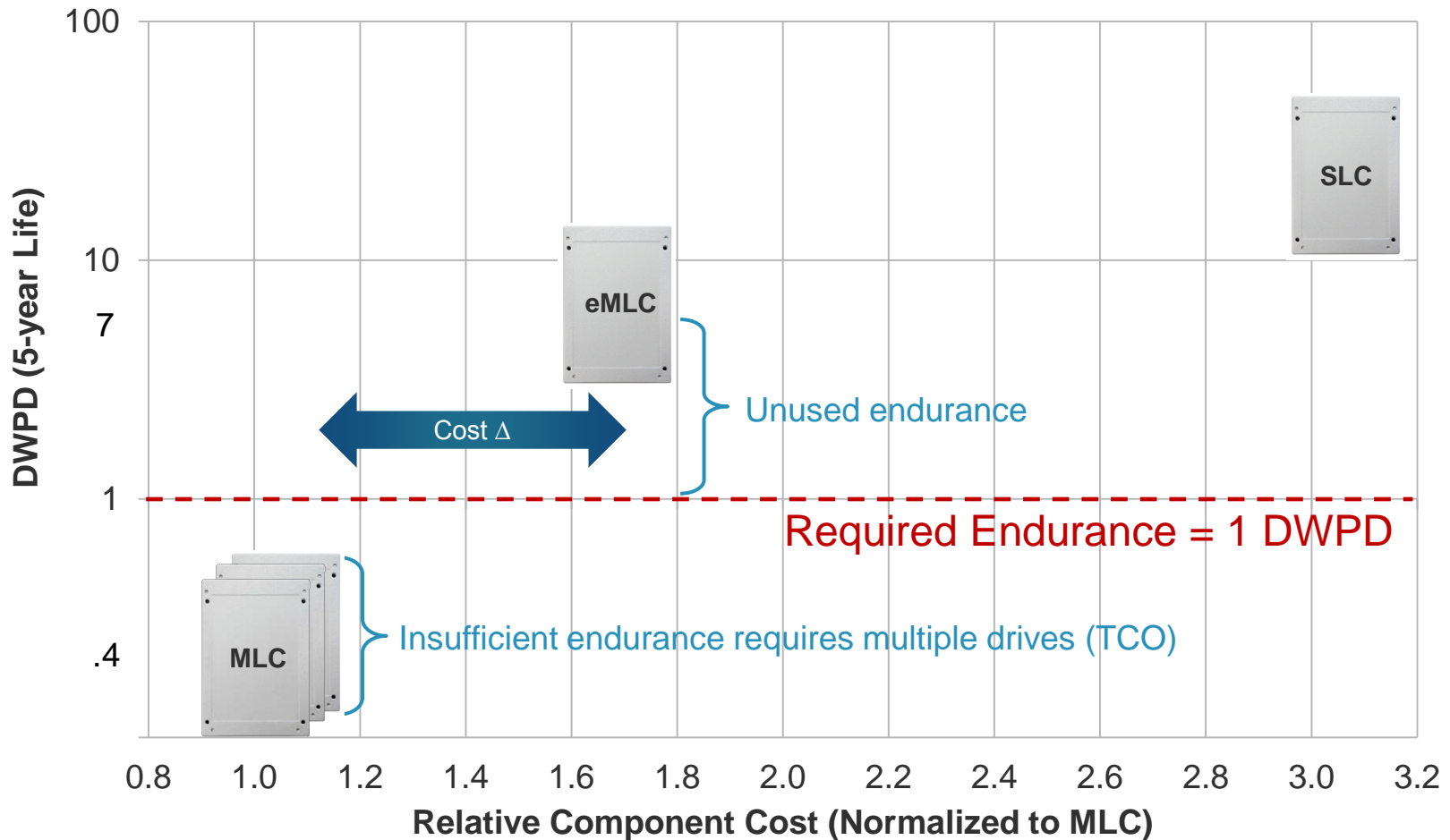
INADEQUATELY SAMPLED SIGNAL = LOSS OF INFORMATION

WORKLOAD CONTINUUM



INADEQUATELY SAMPLED ENDURANCE = LOSS OF ??

FILE SERVER: THE CONSEQUENCE OF DISCRETE ENDURANCE



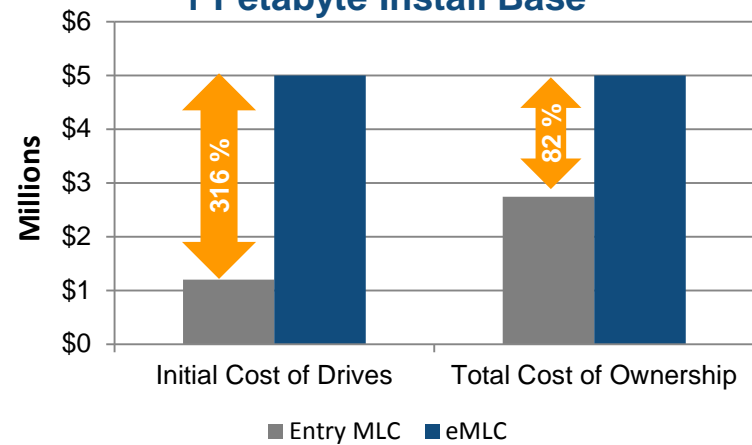
FILE SERVER: MLC OR EMLC?

**90/10% Read/Write
1 DWPD**

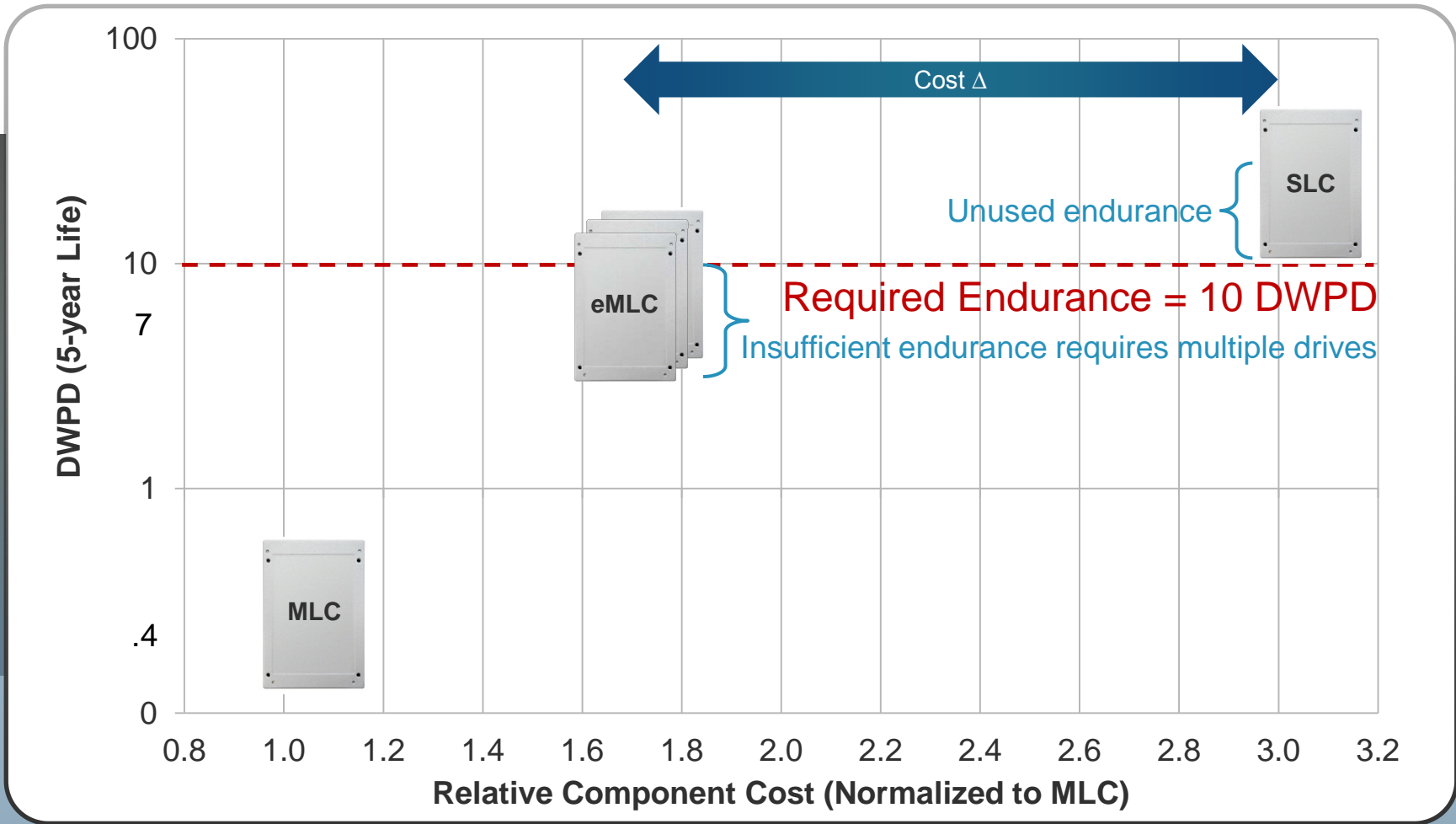


| | Entry MLC 200GB | eMLC 200GB |
|----------------------------|--------------------|---------------|
| Drive Acquisition Cost | \$240 | \$1,000 |
| Drive writes/day | 0.4 | 7 |
| Calculated Life (in years) | 2.2 | 30.4 |
| Replacement rate/year | 0.46 | 0.03 |
| 5 year cost of ownership | \$548 | \$1,000 |

1 Petabyte Install Base



OLTP: THE CONSEQUENCE OF DISCRETE ENDURANCE



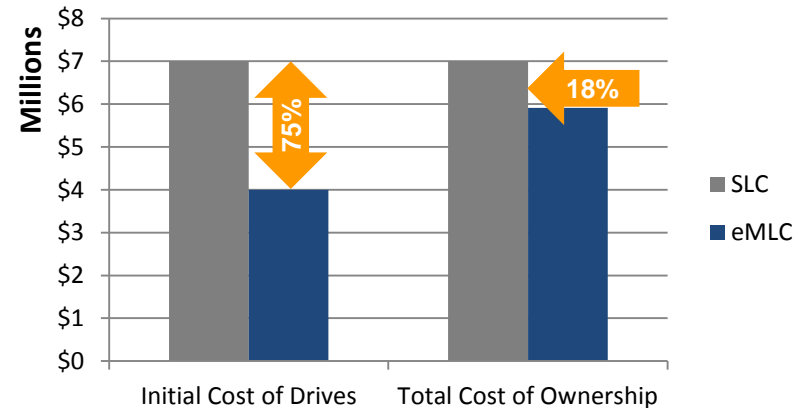
OLTP: SLC OR eMLC?

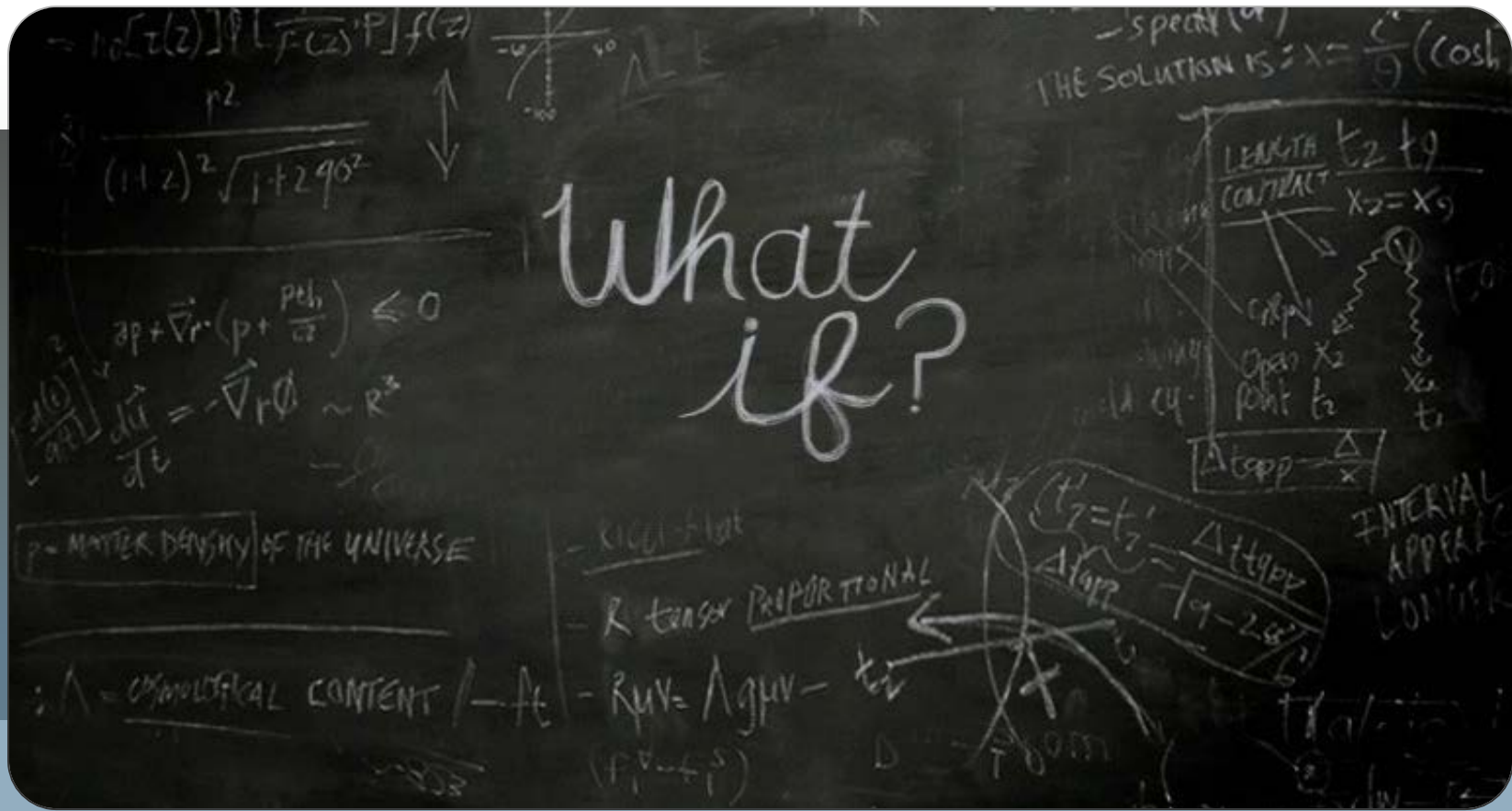
**70/30% Read/Write
10 DWPD**



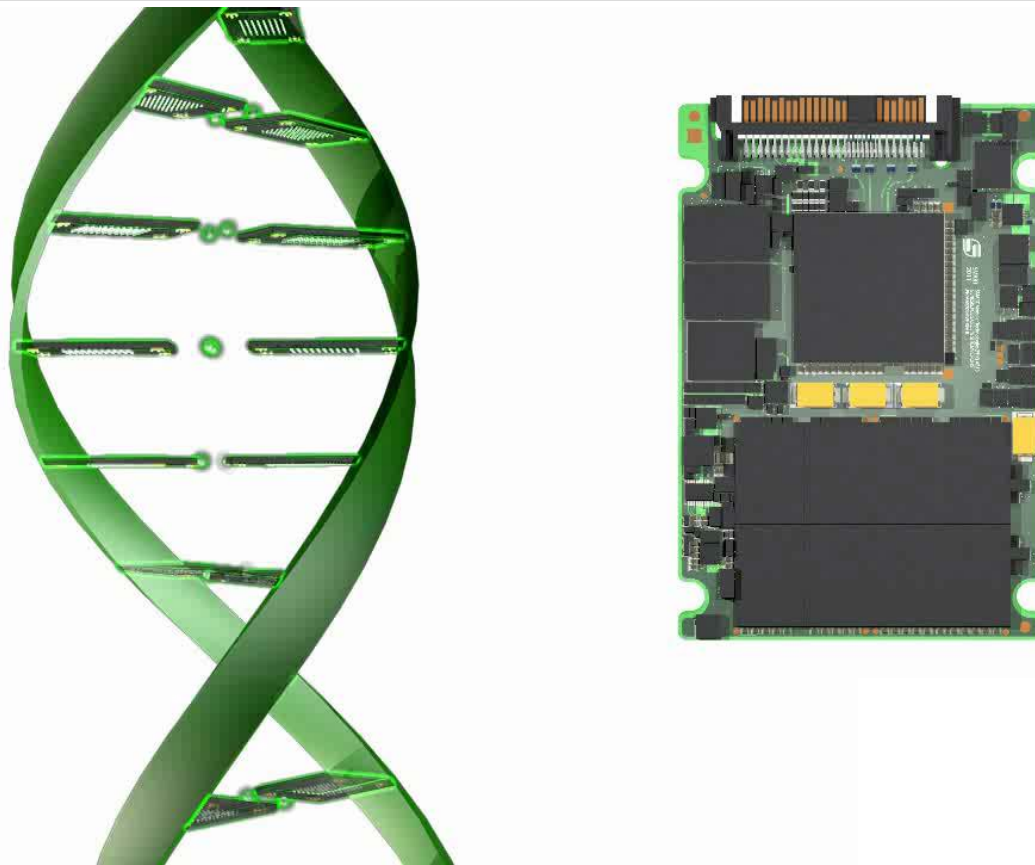
| | SLC 200GB | eMLC 200GB |
|----------------------------|--------------|---------------|
| Drive Acquisition Cost | \$1,400 | \$800 |
| Drive writes/day | 25.5 | 7 |
| Calculated Life (in years) | 12.3 | 3.4 |
| Replacement rate/year | 0.08 | 0.3 |
| 5 year cost of ownership | \$1,400 | \$1,182 |

1 Petabyte Install Base

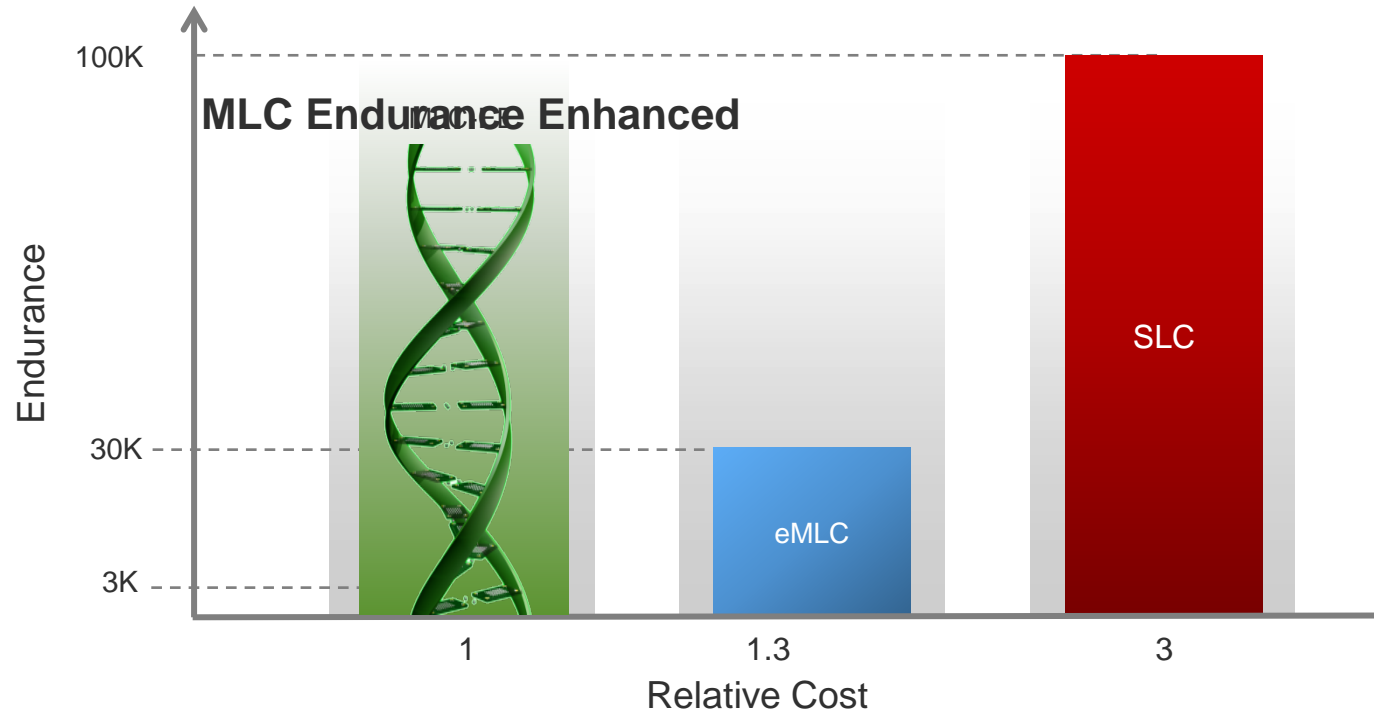




...WE CAN CHANGE THE DNA OF MLC NAND?

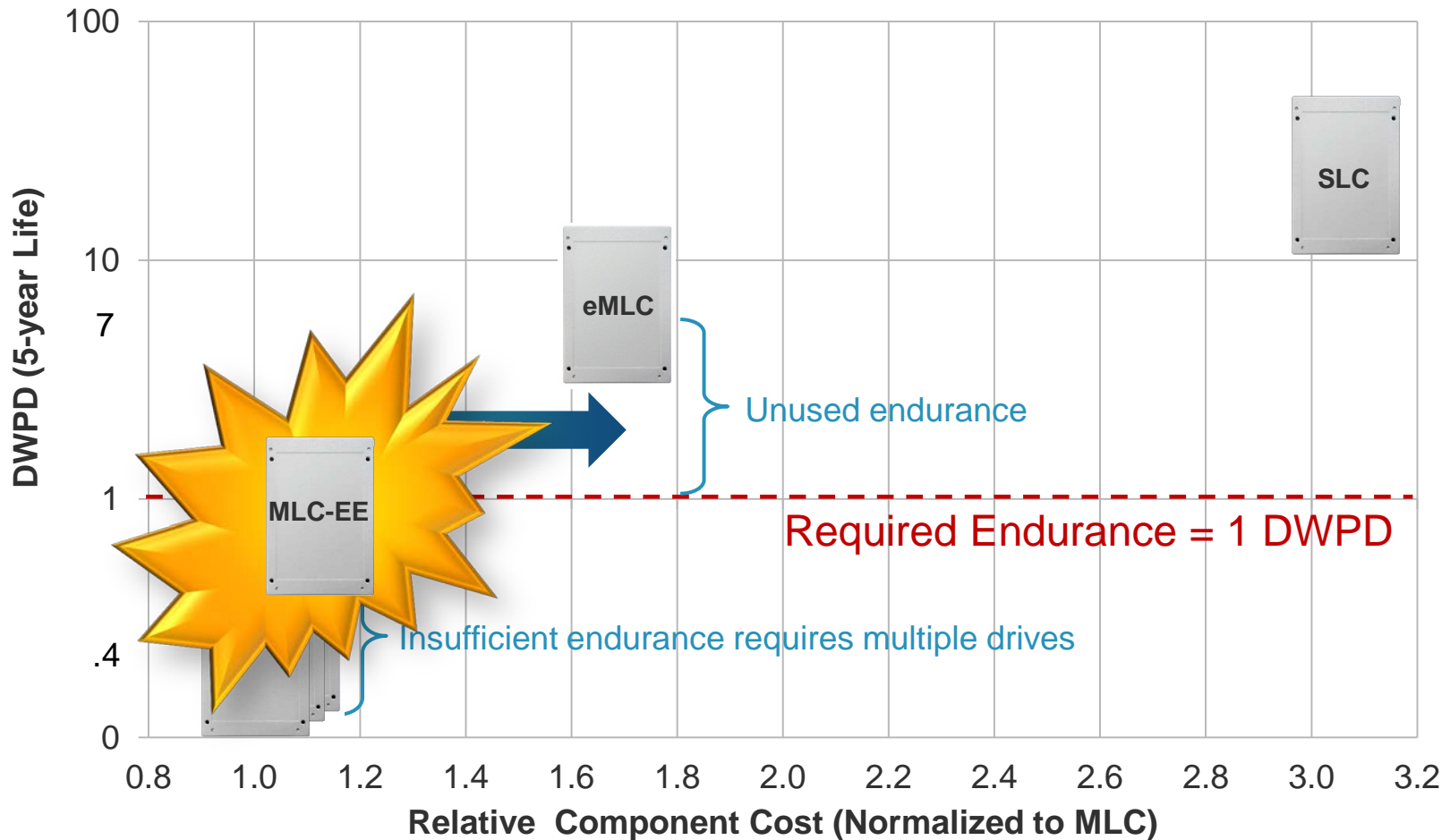


THEN...



WE CAN ACHIEVE OPTIMAL COST AT EVERY ENDURANCE POINT WITH MLC-EE

FILE SERVER: THE ADVANTAGE OF MLC-EE



FILE SERVER: MLC OR MLC-EE?

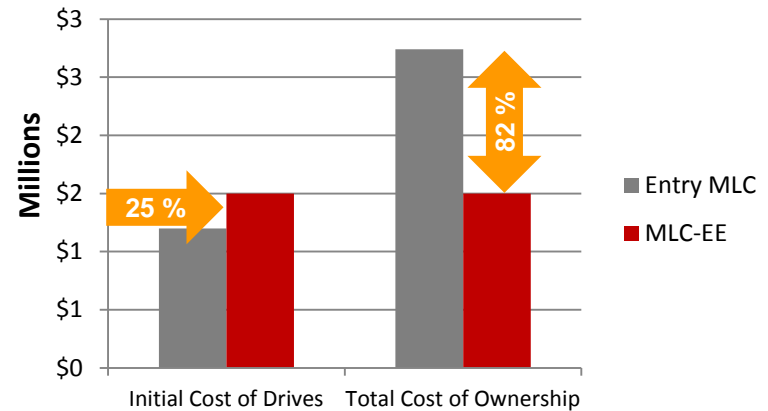
90/10% Read/Write



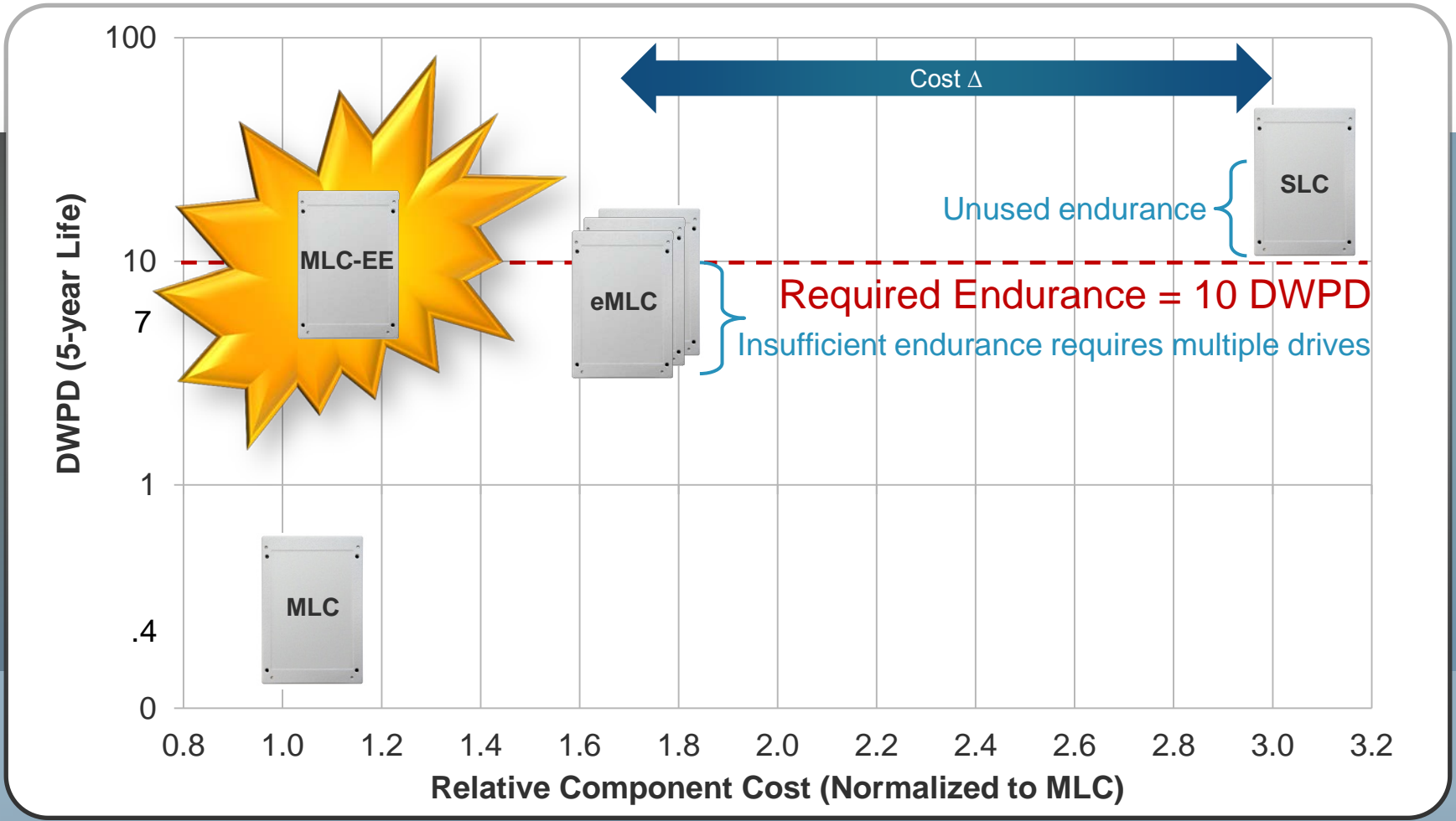
LOSS = MONEY

| | Entry MLC 200GB | MLC-EE 200GB |
|----------------------------|--------------------|-----------------|
| Drive Acquisition Cost | \$240 | \$300 |
| Drive writes/day | 0.4 | 1.2 |
| Calculated Life (in years) | 2.2 | 6.6 |
| Replacement rate/year | 0.46 | 0.15 |
| 5 year cost of ownership | \$548 | \$300 |

1 Petabyte Install Base



OLTP: THE ADVANTAGE OF MLC-EE



OLTP: eMLC VS MLC-EE

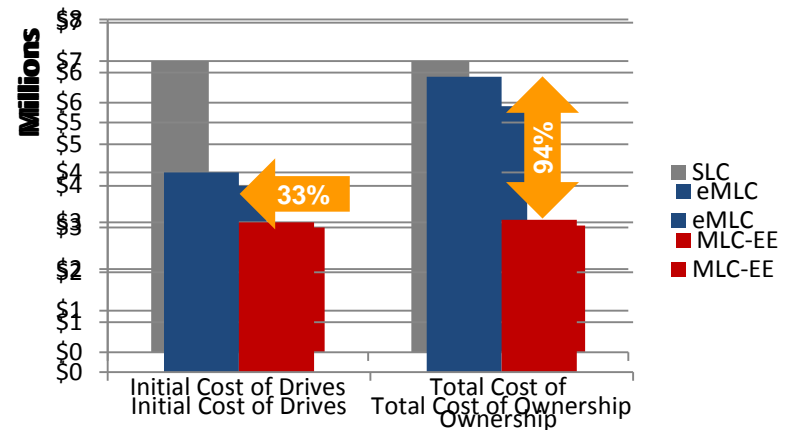
70/30% Read/Write



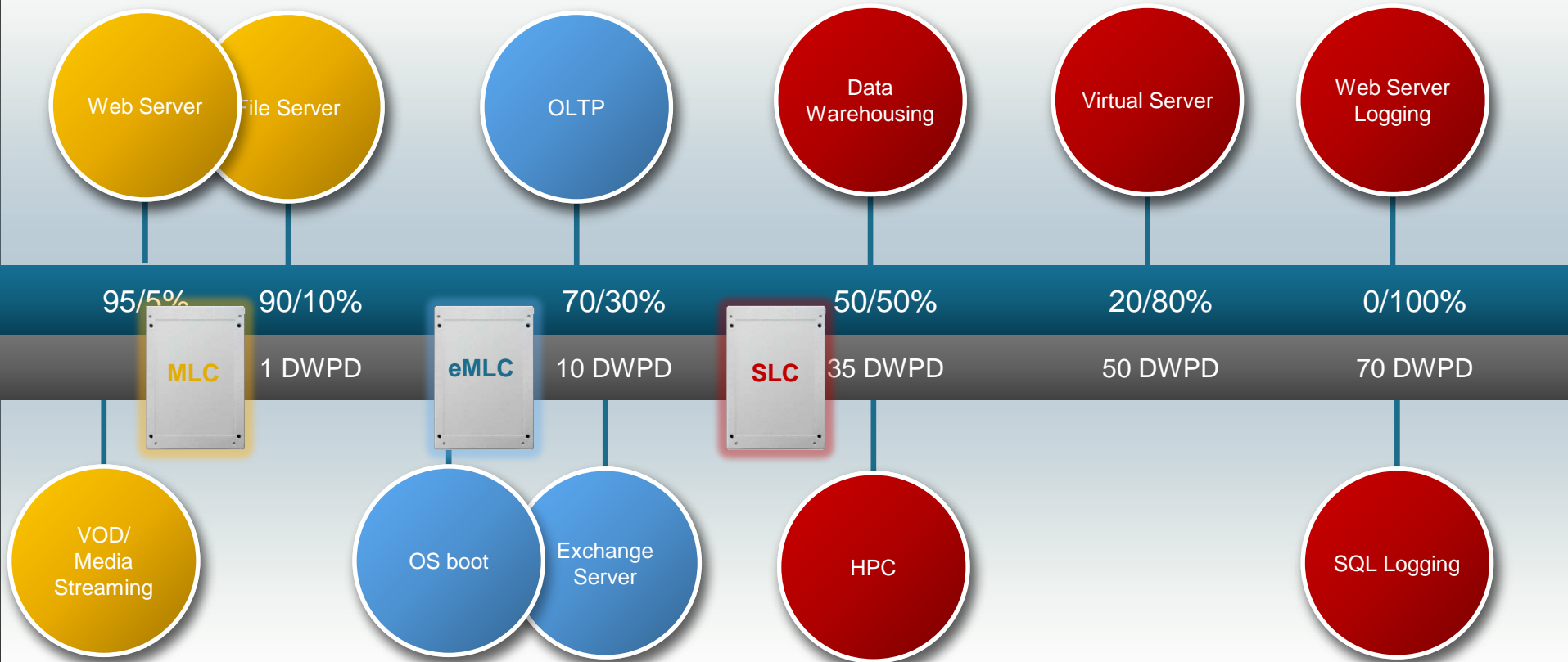
LOSS = MONEY

| | eMLC 200GB | MLC-EE 200GB |
|----------------------------|------------|--------------|
| Drive Acquisition Cost | \$800 | \$600 |
| Drive writes/day | 7 | 10.2 |
| Calculated Life (in years) | 3.4 | 4.9 |
| Replacement rate/year | 0.3 | 0.20 |
| 5 year cost of ownership | \$1,182 | \$609 |

1 Petabyte Install Base



WORKLOAD CONTINUUM

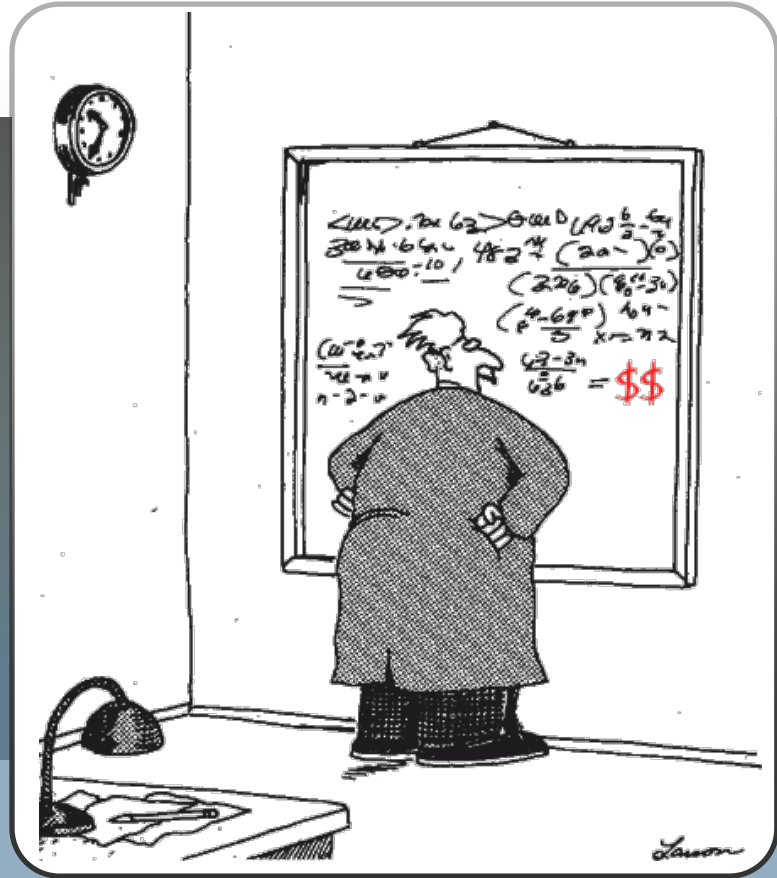


MLC-EE = ENDURANCE CONTINUUM

CONCLUSION



EINSTEIN'S LAST DISCOVERY



FLASH
ENDURANCE = \$\$\$

WHAT IS IN YOUR STORAGE DNA?

THANK YOU!

SMART STORAGETM
SYSTEMS

==== Making NAND Better

