BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

COST-CONTAINMENT
RISK REDUCTION
IMPROVED PRODUCTIVITY

PRESENTED BY JON TOIGO
TOIGO PARTNERS INTERNATIONAL
DATA MANAGEMENT INSTITUTE

For every technology proposal…

- Value can be expressed in one of two distinct ways…

Technical Advantages
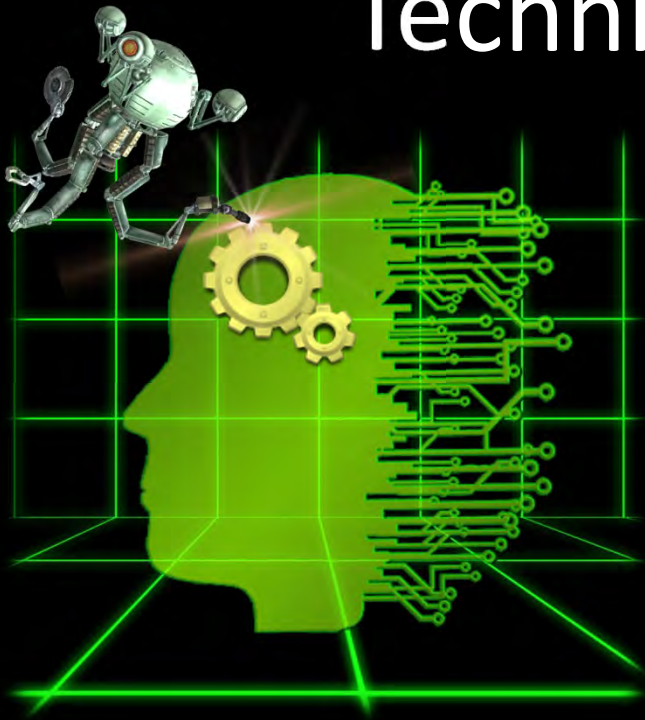
Media Partitioning T10000C Linear Tape File System

BIT ERROR RATE

LZ, IDRC, ALDC, DLZ1 LTO PRML NANOCUBIC

Sequential Access

Library

Streaming Rate

$\dfrac{\text{Bits}}{\text{mm}}$

Tape GMR

THROUGHPUT COMPRESSION WORM Tracks

READ/VERIFY

TS1120 Transfer Rate Robot Archive BOT

Speed matching

Reusability TapeNAS FUJIFILM

Native Data Capacity

Ba Fe Time to First Byte Durability

ENCRYPTION 3592 Wraps per Band ATOMM
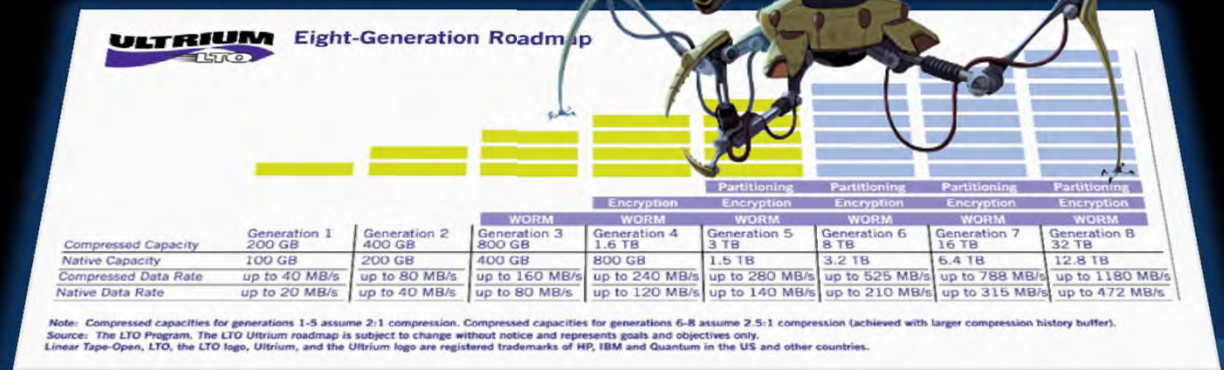
Cartridge Memory Ultrium

Engineering and Operational Efficiency

- Less input, more output
- Faster output, higher quality output
- Minimal resource/effort to resolve issues or produce goods/services
- Minimal redundancy or waste of resources/effort

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

With Respect to LTO Tape Storage...

- Native sustained transfer rate 140 MB/s
- 2:1 compressed transfer rate 280 MB/s
- Burst transfer rate SAS 600 MB/s max
- Average file access time 52 sec

- Power Consumption per Drive
    - 6.7 Watts Idle
    - 23.1 Watts Typical
    - 37.2 Watts Peak

- Native formatted capacity 1500 GB
- 2:1 compressed capacity 3000 GB
- Recording density 15.143 Kb/mm
- Encoding method 16 Channel 32/33 RLL NPML
- Data compression ALDC
- Interfaces available SAS

ULTRIUM LTO *Eight-Generation Roadmap*

	Generation 1	Generation 2	Generation 3	Generation 4	Generation 5	Generation 6	Generation 7	Generation 8
			WORM	WORM	WORM	WORM	WORM	WORM
				Encryption	Encryption	Encryption	Encryption	Encryption
					Partitioning	Partitioning	Partitioning	Partitioning
Compressed Capacity	200 GB	400 GB	800 GB	1.6 TB	3 TB	8 TB	16 TB	32 TB
Native Capacity	100 GB	200 GB	400 GB	800 GB	1.5 TB	3.2 TB	6.4 TB	12.8 TB
Compressed Data Rate	up to 40 MB/s	up to 80 MB/s	up to 160 MB/s	up to 240 MB/s	up to 280 MB/s	up to 525 MB/s	up to 788 MB/s	up to 1180 MB/s
Native Data Rate	up to 20 MB/s	up to 40 MB/s	up to 80 MB/s	up to 120 MB/s	up to 140 MB/s	up to 210 MB/s	up to 315 MB/s	up to 472 MB/s

Note: Compressed capacities for generations 1-5 assume 2:1 compression. Compressed capacities for generations 6-8 assume 2.5:1 compression (achieved with larger compression history buffer).
Source: The LTO Program. The LTO Ultrium roadmap is subject to change without notice and represents goals and objectives only.
Linear Tape-Open, LTO, the LTO logo, Ultrium, and the Ultrium logo are registered trademarks of HP, IBM and Quantum in the US and other countries.

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Moving on to "Enterprise Class"

Oracle T10000

- Capacity: T10000 T2 data cartridge (BaFe): 5 TB (StorageTek T10000C), T10000 T2 sport cartridge: 1 TB (StorageTek T10000C)
- Native sustained data rate (uncompressed) 252 MB/sec, (compressed) 360 MB/sec
- Average file access (excludes load/thread): 57 sec (17.5 sec for Sport Cartridge)

TS1130 with IBM 3592 Media

- Recording technique: Linear Serpentine
- Number of tracks 1152
- Native capacity uncompressed: 4 TB (using JC and JY WORM media), 500 GB using economy media,
- Native sustained data rate 650 MB/sec (compressed)

ULTRIUM 6 LTO
- 2.5TB native 6.25TB compressed
- 160MB/s native 400MB/s compressed

FUJIFILM LTO Ultrium DATA CARTRIDGE

ORACLE

IBM

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Tape Needs a Business Value Case.
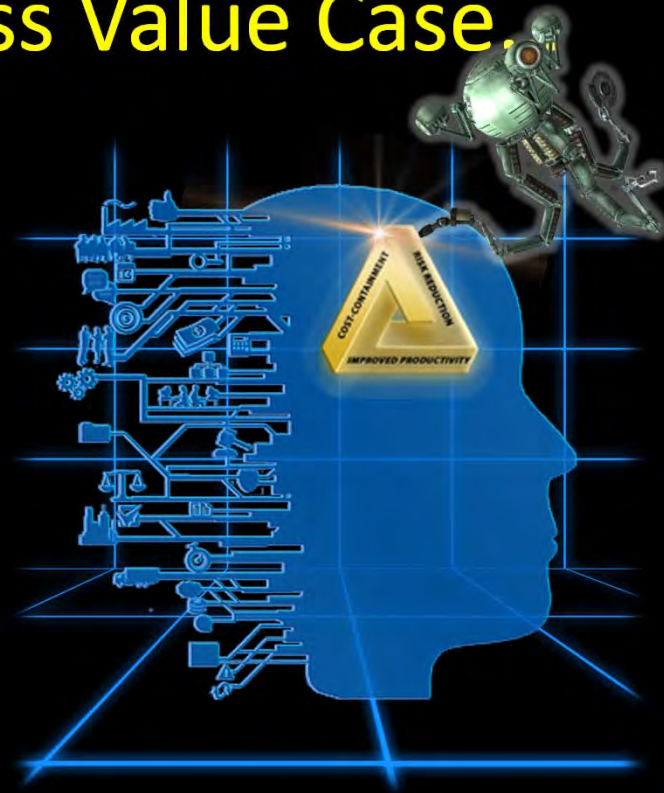
BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Cost-Containment

How will what you are proposing help the business to contain CAPEX and OPEX expenditures – preferably while increasing service levels?

COST-CONTAINMENT

RISK REDUCTION

IMPROVED PRODUCTIVITY
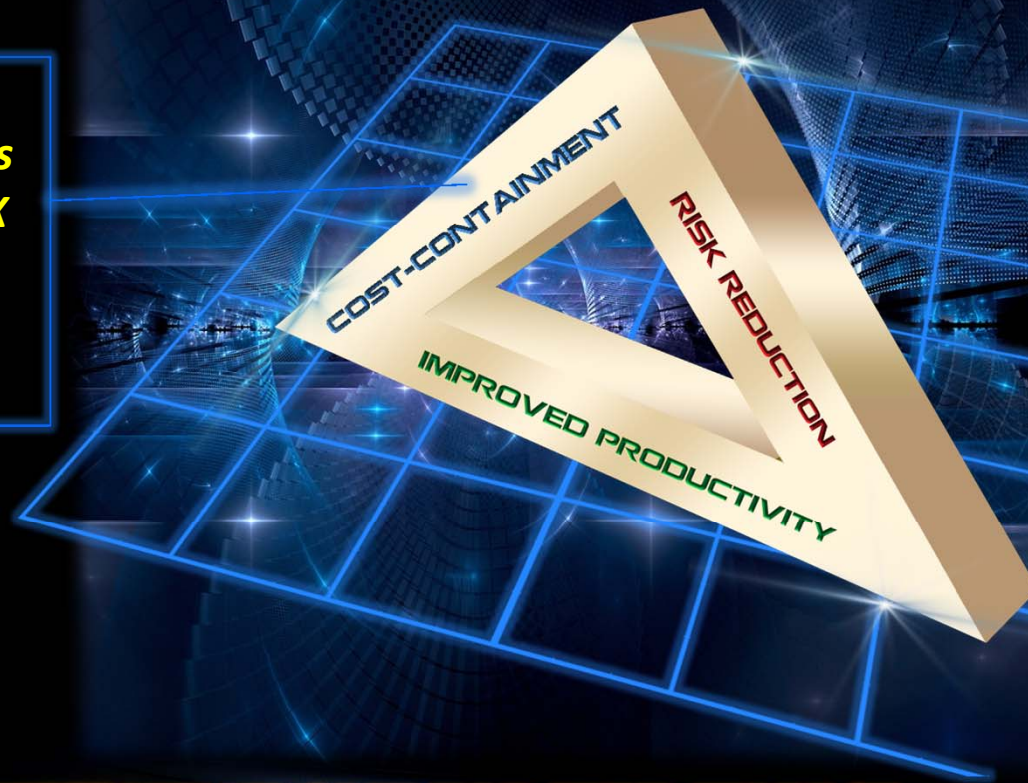
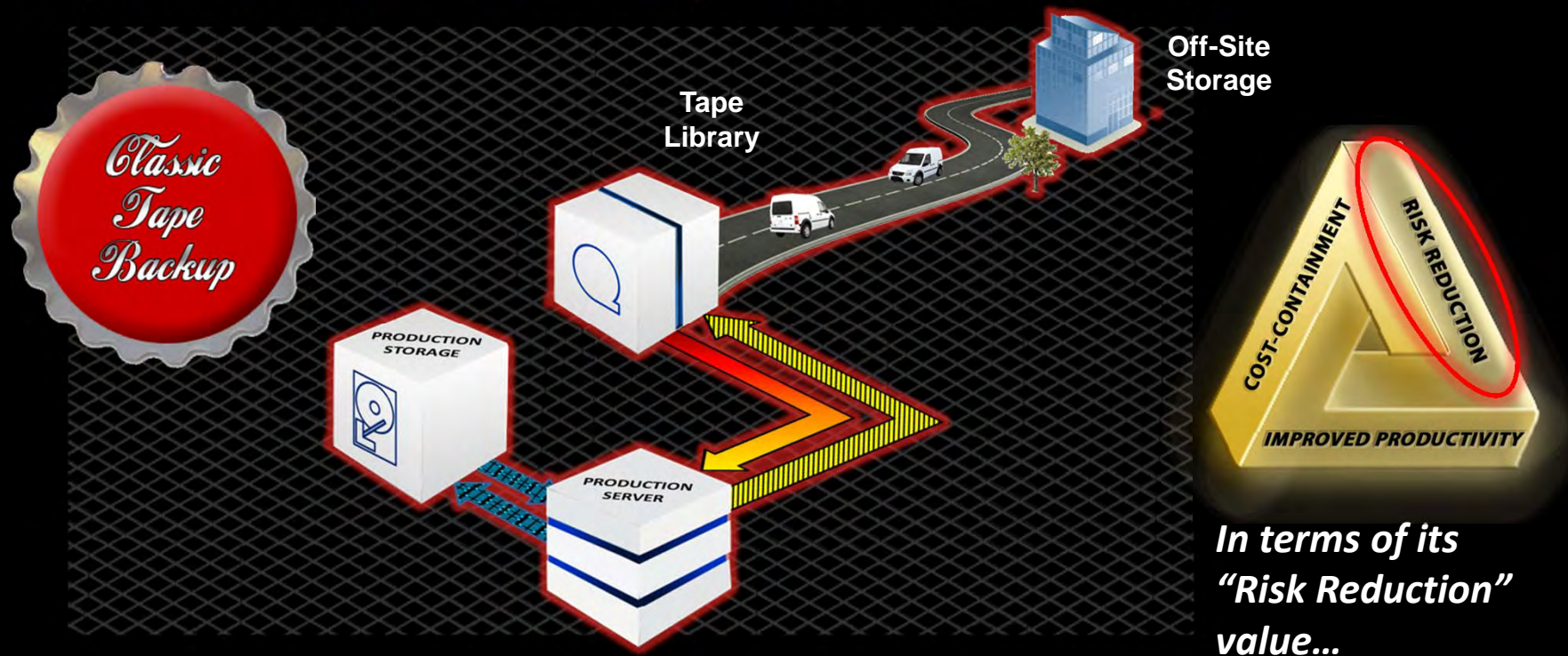BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Risk Reduction

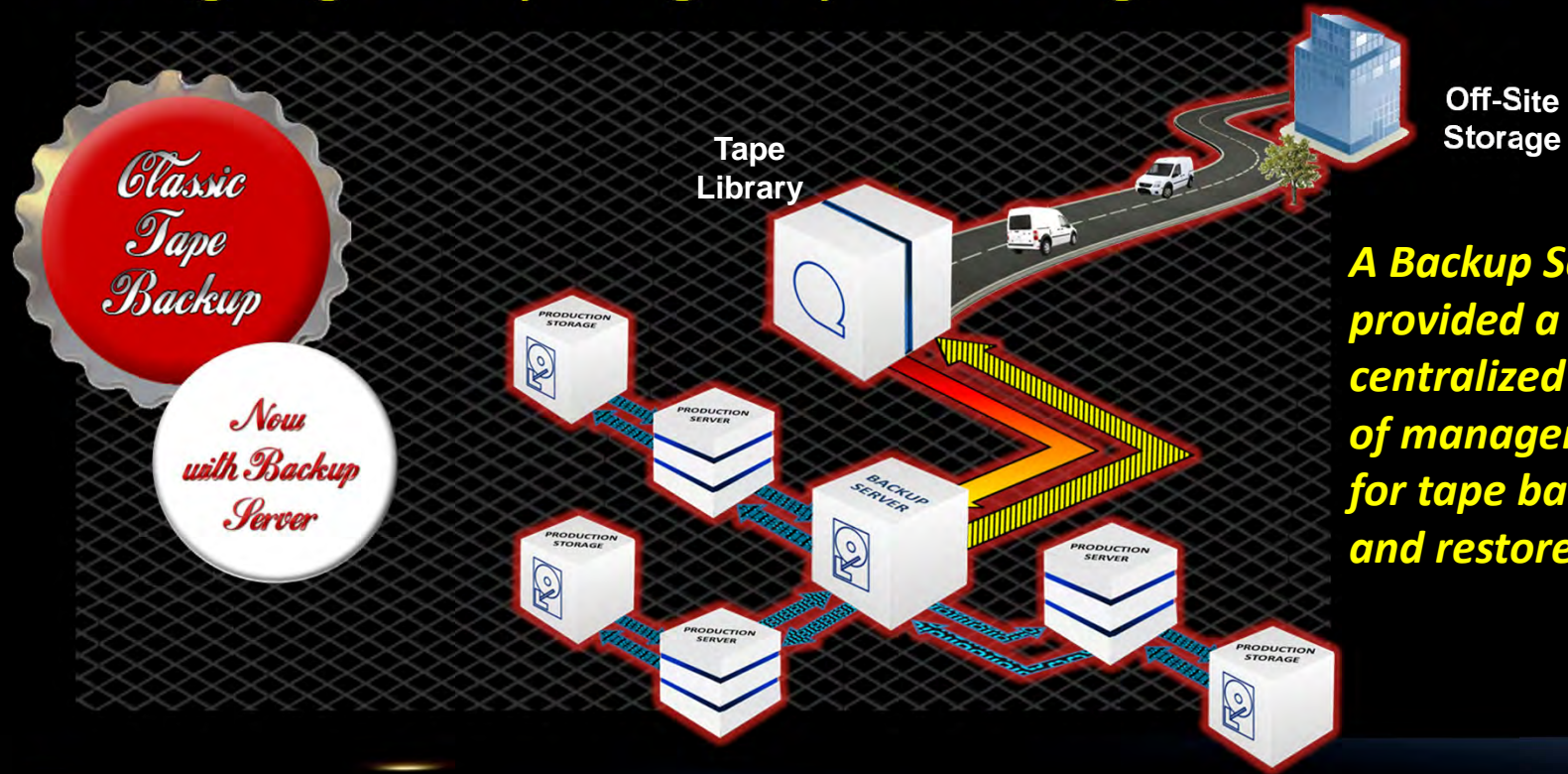How will what you are proposing reduce risks to the business – broadly defined to include legal, operational, financial and investment risk?

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Tape Value is Usually "Narrowly Framed"…

Off-Site Storage

Tape Library

Classic Tape Backup

PRODUCTION STORAGE

PRODUCTION SERVER

COST-CONTAINMENT

RISK REDUCTION

IMPROVED PRODUCTIVITY

In terms of its "Risk Reduction" value…

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Changing Only Slightly Through The Years...

Classic Tape Backup

Now with Backup Server

Tape Library

Off-Site Storage

A Backup Server provided a centralized point of management for tape backup and restore...

PRODUCTION STORAGE

PRODUCTION SERVER

BACKUP SERVER

PRODUCTION STORAGE

PRODUCTION SERVER

PRODUCTION SERVER

PRODUCTION STORAGE

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Eventually, adding Disk Buffering and VTL...

Classic Tape Backup

Enhanced with a Virtual Tape Library

Now with Backup Server

VTL

Tape Library

Off-Site Storage

30 days of local storage for fast restore of individual files...

PRODUCTION STORAGE

PRODUCTION SERVER

VIRTUAL TAPE LIBRARY

PRODUCTION STORAGE

BACKUP SERVER

PRODUCTION SERVER

PRODUCTION SERVER

PRODUCTION STORAGE

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Next, leverage WAN Links for Special Data…
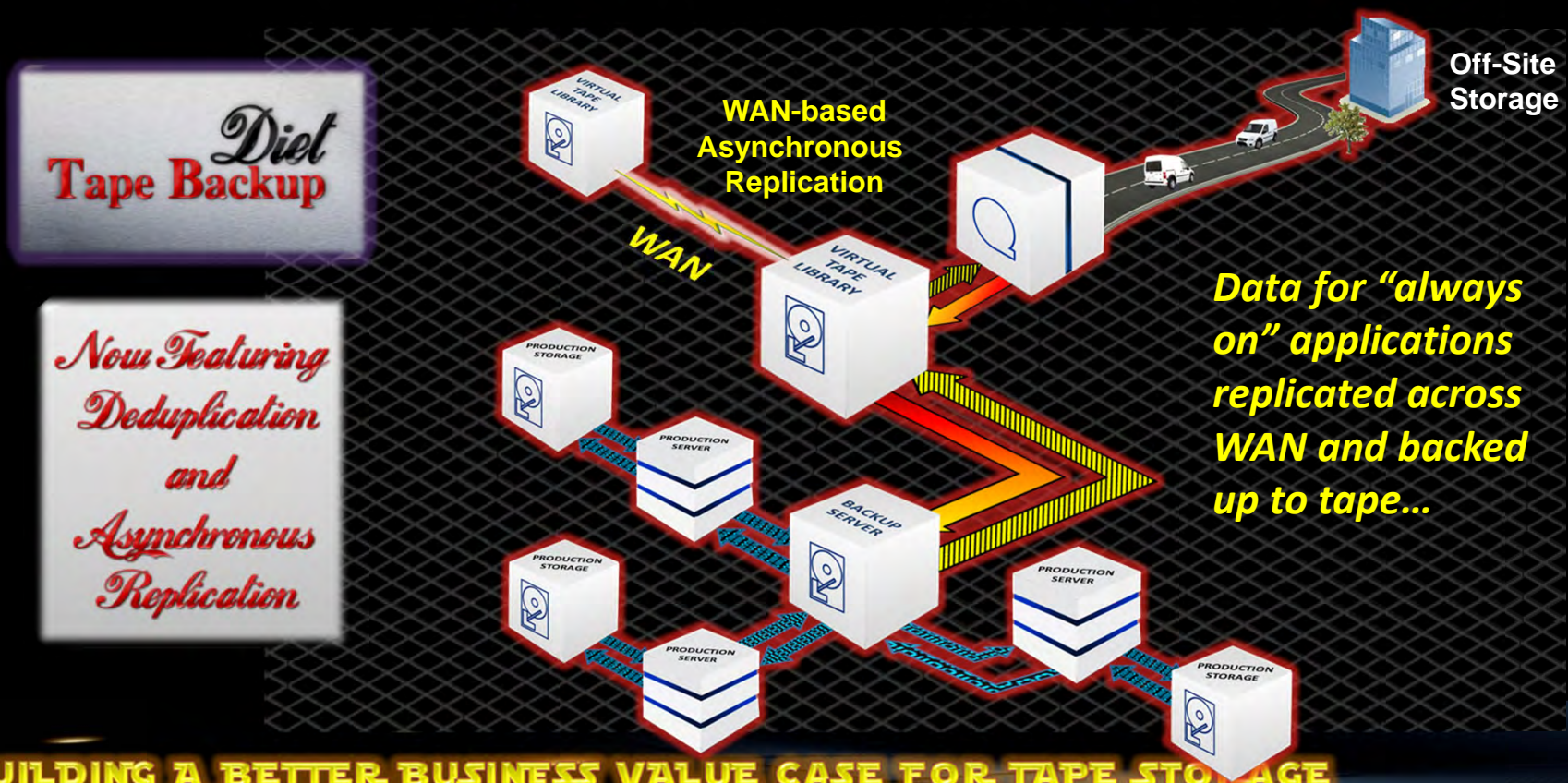
Giving Rise to a "Disk Only" Model…
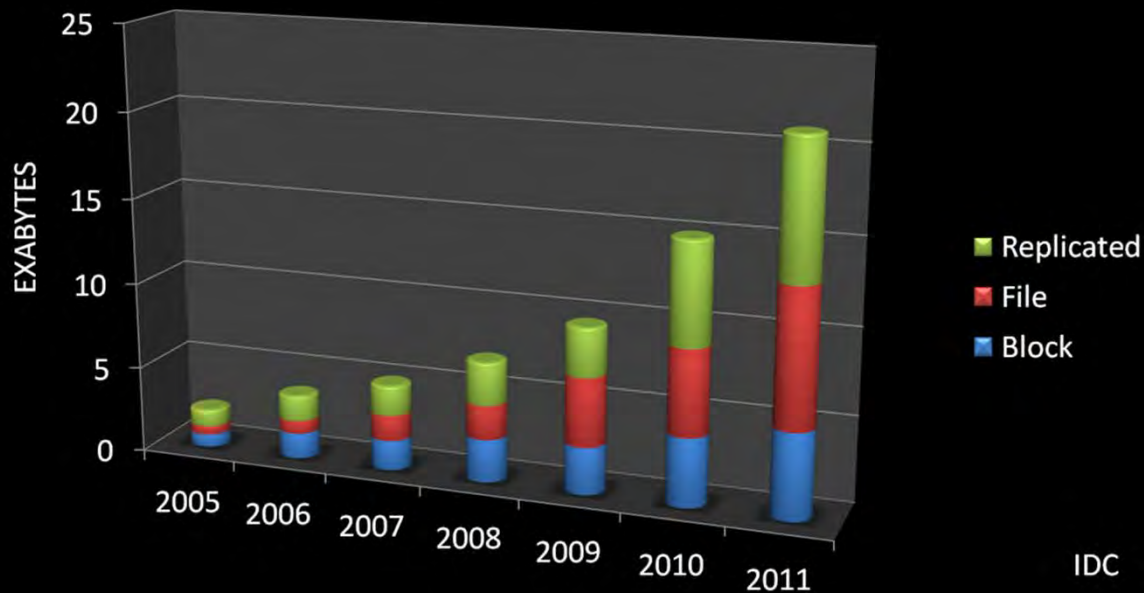

**Despite significant costs
and questionable efficacy
or fitness for purpose, VTL to
VTL replication catches on…**

*Classic
Tape Backup*
zero

VIRTUAL TAPE LIBRARY

WAN

VIRTUAL TAPE LIBRARY

PRODUCTION STORAGE

PRODUCTION SERVER

BACKUP SERVER

PRODUCTION STORAGE

PRODUCTION SERVER

PRODUCTION SERVER

PRODUCTION STORAGE

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

According to Analysts…

EXABYTES

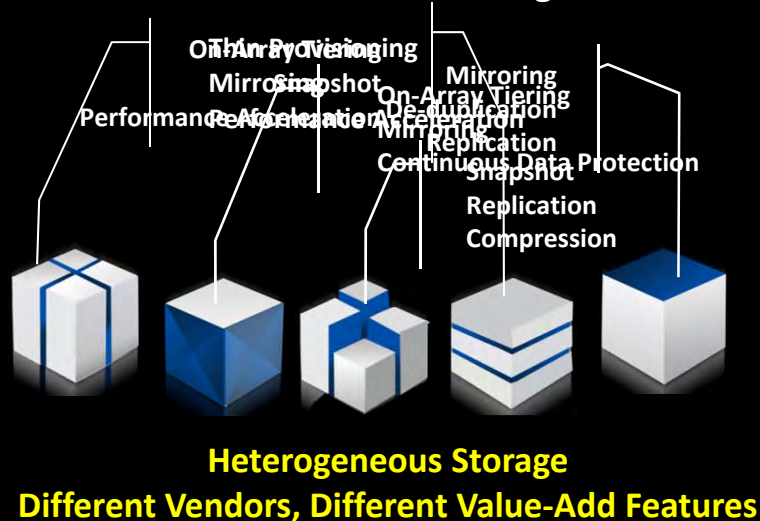- Replicated
- File
- Block

IDC

"Disk Everywhere" Dogma:
Using Half of Our Disk to Make Copies of the Data Stored on the Other Half…

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

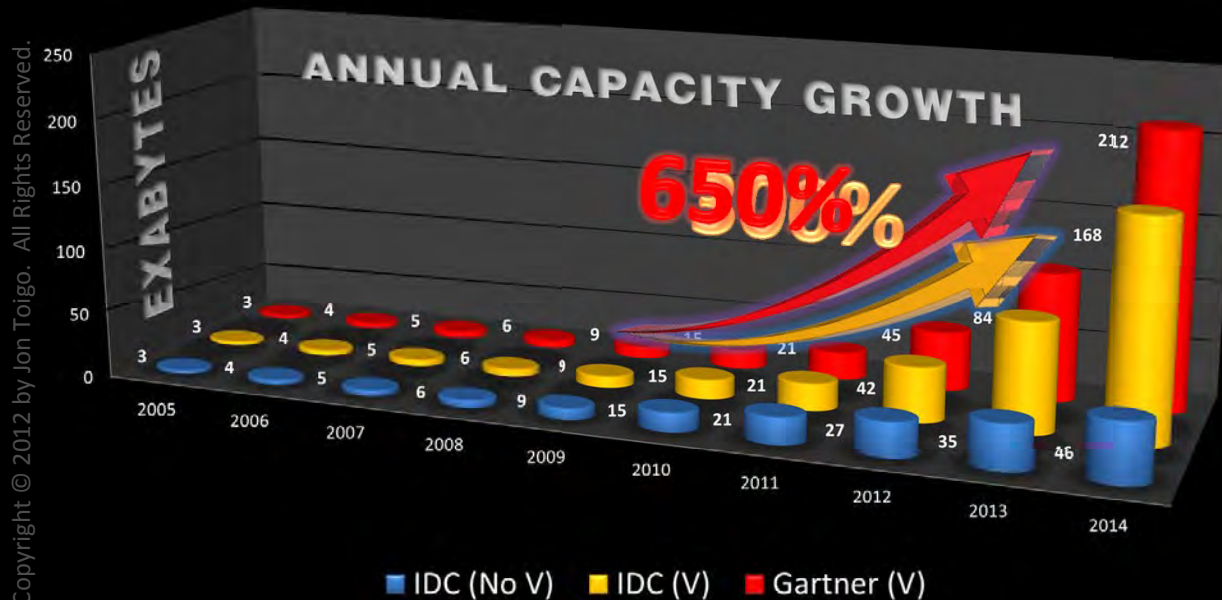# Combined with Internal Cost Dynamics of Storage Arrays…

- *The deconstruction of the traditional storage hierarchy continues … increasing cost*

On-Array Tiering
Thin Provisioning
Mirroring
Snapshot
Performance Acceleration
De-duplication
On-Array Tiering
Mirroring
Mirroring
Replication
Continuous Data Protection
Snapshot
Replication
Compression

Heterogeneous Storage
Different Vendors, Different Value-Add Features

High

Data Re-Reference Frequency

$$$

High speed/Low capacity

$$

Low speed/High capacity

$

Low speed/ Very high capacity

Low

Fast   **Slow**

Data Access Speed

- *And increasing management complexity by creating isolated islands of value-add storage functionality…*

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Which, In Turn, Helps To Drive
# Capacity Allocation Inefficiency and Cost...

ANNUAL CAPACITY GROWTH

650%

EXABYTES

250
200
150
100
50
0

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
IDC (No V)	3	4	5	6	9	15	21	27	35	46
IDC (V)	3	4	5	6	9	15	21	42	84	168
Gartner (V)	3	4	5	6	9	15	21	45	84	212

■ IDC (No V) ■ IDC (V) ■ Gartner (V)

Storage today is the greatest percentage of hardware budget...

33¢ → 75¢

And growing...

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If Cost-Containment is Job 1,
Tape Has a Great Story to Tell…
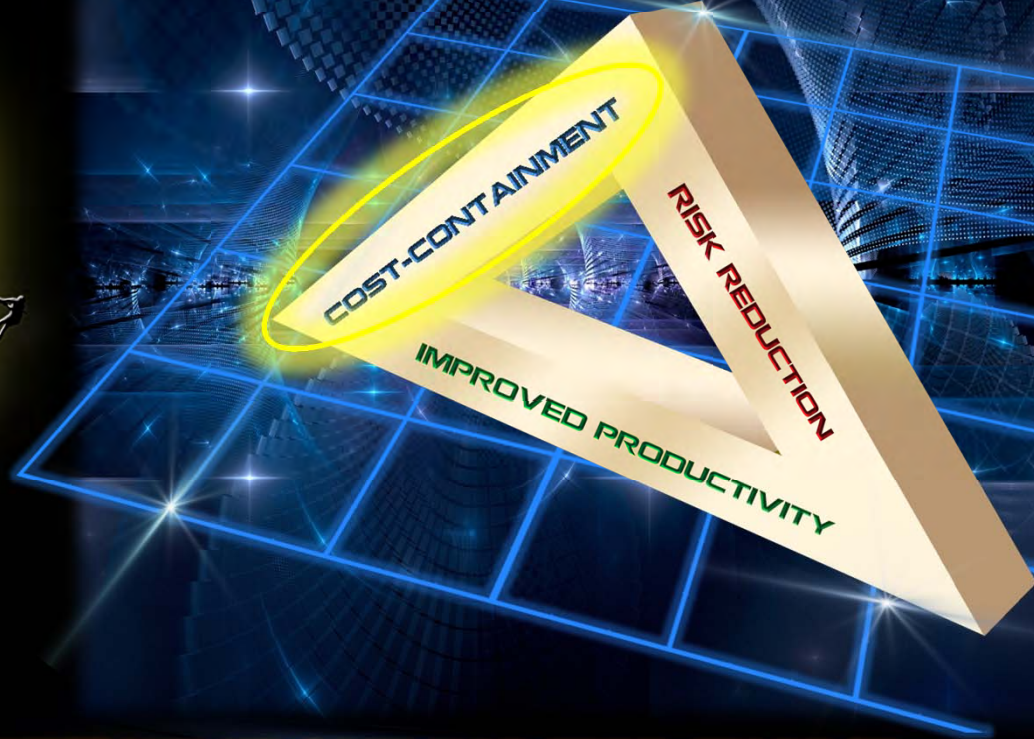
STORAGE CAPACITY

COST-CONTAINMENT

RISK REDUCTION

IMPROVED PRODUCTIVITY

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

(Spoiler Alert: Tape is Cheaper)

- *Disk doubles capacity about every 18 months, sheds 50% cost per GB about every 12 months...*

BUT

- *The cost of an array (a group of disks) accelerates at up to 120% per year...*

ACQUISITION AND OPERATIONS EXPENSE

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From the Media Cost Perspective…

"1 TB"
(1000 Gb/in²)
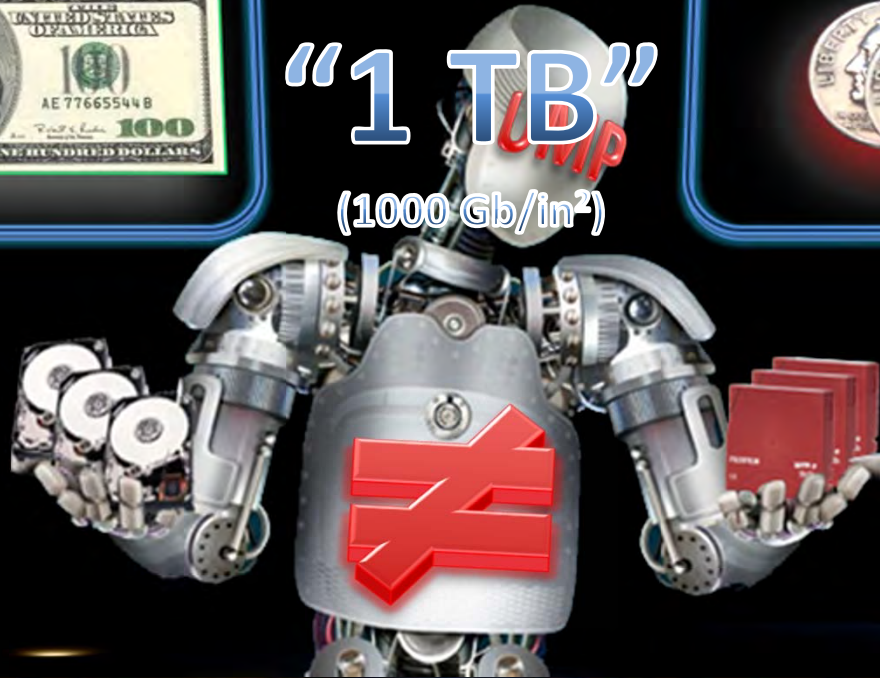
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Must Compare Systemic Costs

CAPEX

CAPEX

OPEX

OPEX

UMP

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE
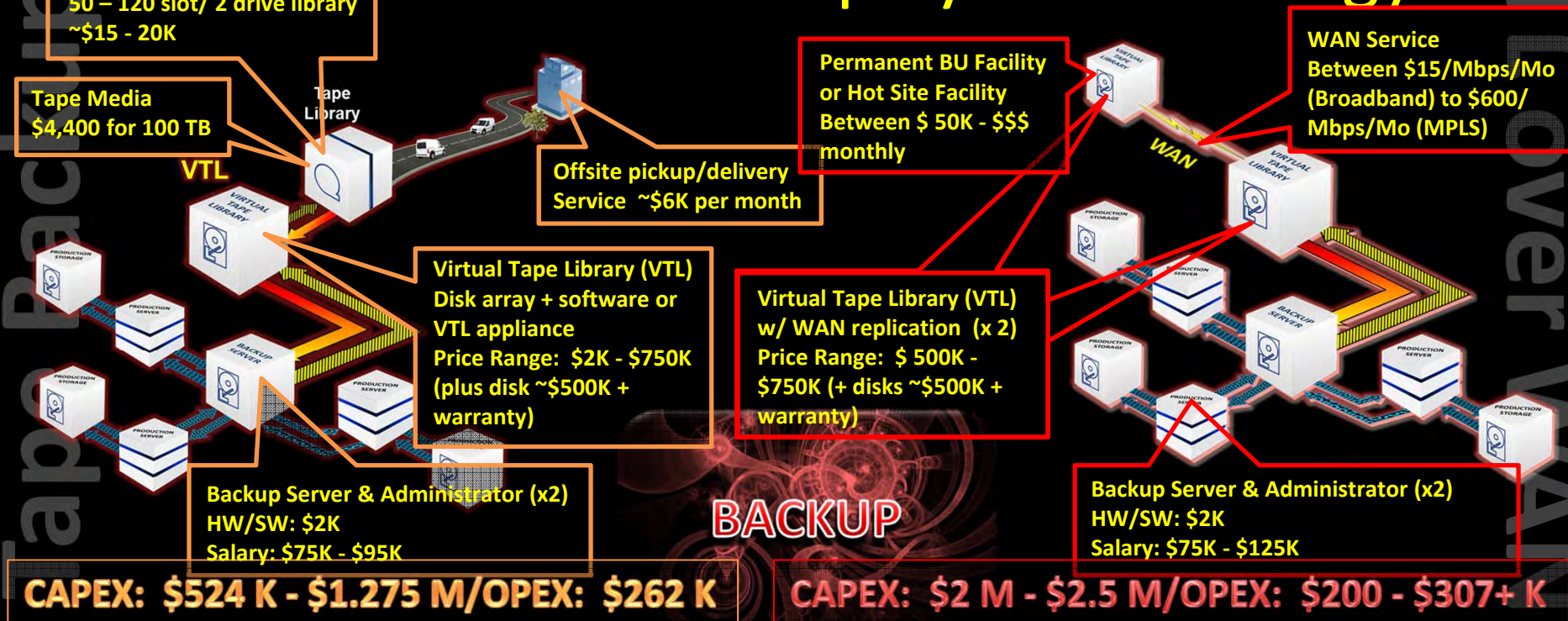
Yeah, Now We're Talkin': *Smackdown!*

DISK   TAPE

FITNESS TO PURPOSE

BACKUP

FILESTORE

ARCHIVE

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

A 100 TB Backup System Strategy

50 – 120 slot/ 2 drive library
~$15 - 20K

Tape Media
$4,400 for 100 TB

WAN Service
Between $15/Mbps/Mo
(Broadband) to $600/
Mbps/Mo (MPLS)

Permanent BU Facility
or Hot Site Facility
Between $ 50K - $$$
monthly

Offsite pickup/delivery
Service ~$6K per month

VTL

Virtual Tape Library (VTL)
Disk array + software or
VTL appliance
Price Range: $2K - $750K
(plus disk ~$500K +
warranty)

Virtual Tape Library (VTL)
w/ WAN replication (x 2)
Price Range: $ 500K -
$750K (+ disks ~$500K +
warranty)

WAN

Backup Server & Administrator (x2)
HW/SW: $2K
Salary: $75K - $95K

Backup Server & Administrator (x2)
HW/SW: $2K
Salary: $75K - $125K

BACKUP

CAPEX: $524 K - $1.275 M/OPEX: $262 K

CAPEX: $2 M - $2.5 M/OPEX: $200 - $307+ K

Tape Backup   VTL over WAN

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Let's Not Forget Network Latency…

WAN-BASED REPLICATION

RECOVERY DATA CENTER

PRIMARY DATA CENTER

NOMINAL TRANSFER RATES OF WAN SERVICES AND TIME TO TRANSFER 10 TB OF DATA

OC-192	2.25 H
OC-48	9 H
OC-12	144 H
T-3	480 H
T-1	10,220 H

ALL VENDORS OF WAN SERVICES SPECIFY TRANSFER RATES AS "NOMINAL" -- YOUR PERFORMANCE WILL VARY WIDELY BASED ON A NUMBER OF VARIABLES…

And It's Not Simply a Matter of Bandwidth

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Or Jitter…

Time is required by a router to serialize a packet onto a WAN link…

A gateway adds delay while determining what to do with a packet. A new and emergent behavior called "bufferbloat" can also increase latency by an order of magnitude or more.

A gateway receives multiple packets from different sources heading towards the same destination. Only one packet can be transmitted at a time, so the rest must queue…

The amount of time that a signal takes to propagate from node to node is cumulative…

SERIALIZATION
QUEUING
PROCESSING
PROPAGATION
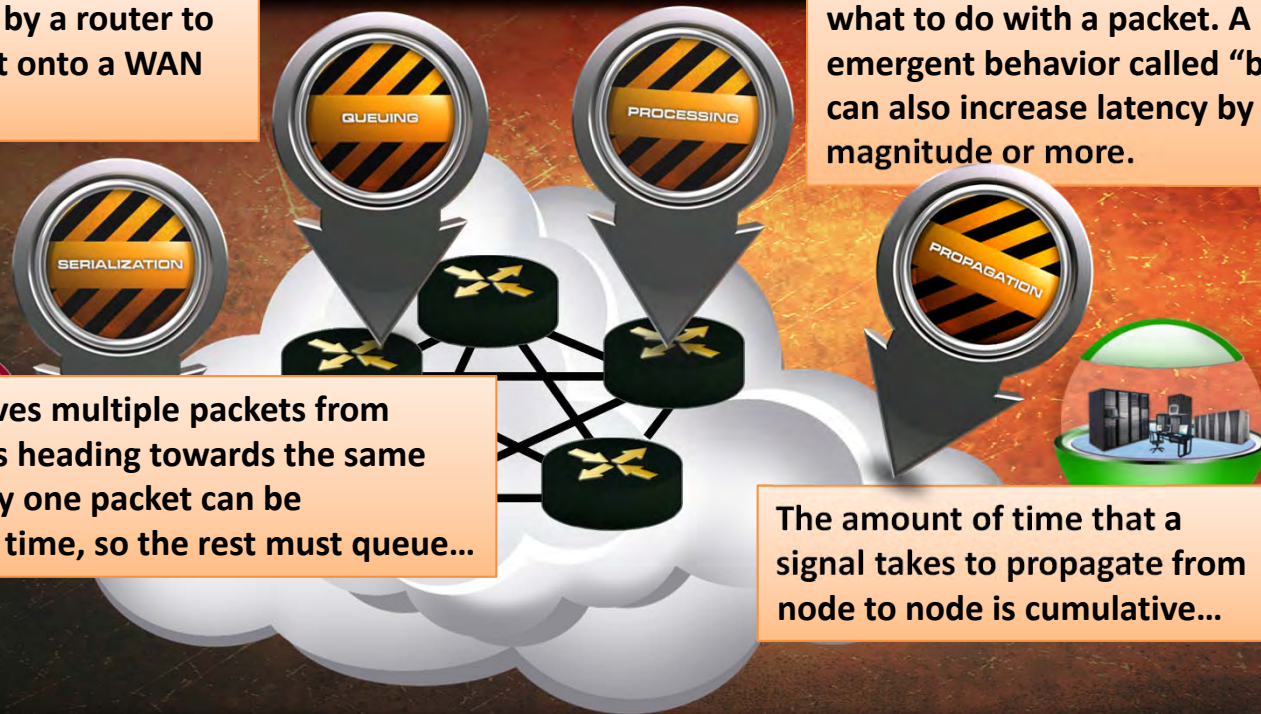
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And, No, Smaller Packets Don't Help...

De-duplicating data, compressing data, dividing data into smaller chunks is largely irrelevant to WAN transfer performance...

Traffic can only move so fast...

What About Tape's Fitness for Archiving?

- **Hearing more about this today, mainly because unmanaged data growth is driving capacity growth and cost, and current "silver bullet" technologies aren't working…**

De-dupe, Compression, Auto-Tiering:
Aimed at "Allocation Efficiency"

FITNESS TO PURPOSE

ARCHIVE
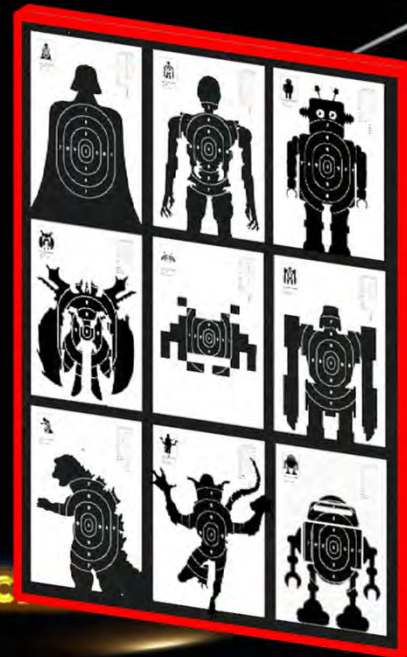
BUILDING A BETTER BUSINESS VALUE O... ...ORAGE

Non-Granular Data Movement is Not Enough

Managing Capacity May Help Cope with Storage Costs...*Temporarily*

THE REAL ISSUE IS _UTILIZATION EFFICIENCY_

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Utilization Efficiency?

Are we filling disk with the right data?

- 🟥 **30% Active**
- 🟦 **40% Inert**
- 🟨 **15% Dark Storage**
- 🟩 **10% Orphan**
- 🟪 **5% Contraband**

Maybe it's time to defrag...
(Or do a little data hygiene and archiving)

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Uh Oh. Not *ILM* Again…
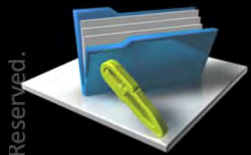
Good. Run reports to identify files that haven't been accessed or modified in 90 days. Provide lists to business unit managers for action.

Better. Implement file segregation schemes based on user roles and develop policies for handling files on a departmental level. Implement migration for older files, maybe to "TapeNAS."

Best. Get granular with data management. Work with senior management and business stakeholders to create a scheme for data classification and archive that everyone will observe. Necessary for effective continuity, compliance and security.

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE
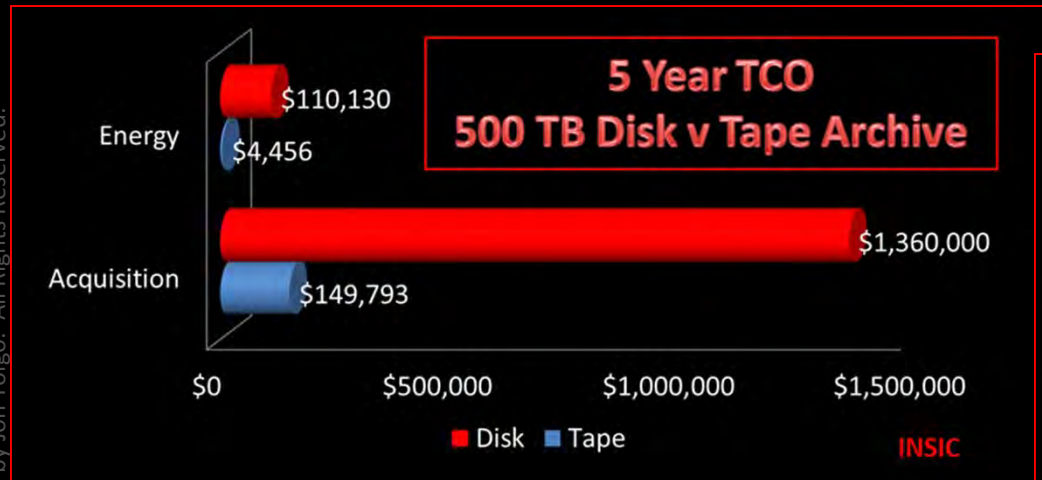
So, How Is Archival Data Stored Today?

Petabytes Capacity

350000
300000
250000
200000
150000
100000
50000
0

2010 2011 2012 2013 2014 2015

- Disk
- Tape
- Optical
- Cloud

Enterprise Strategy Group
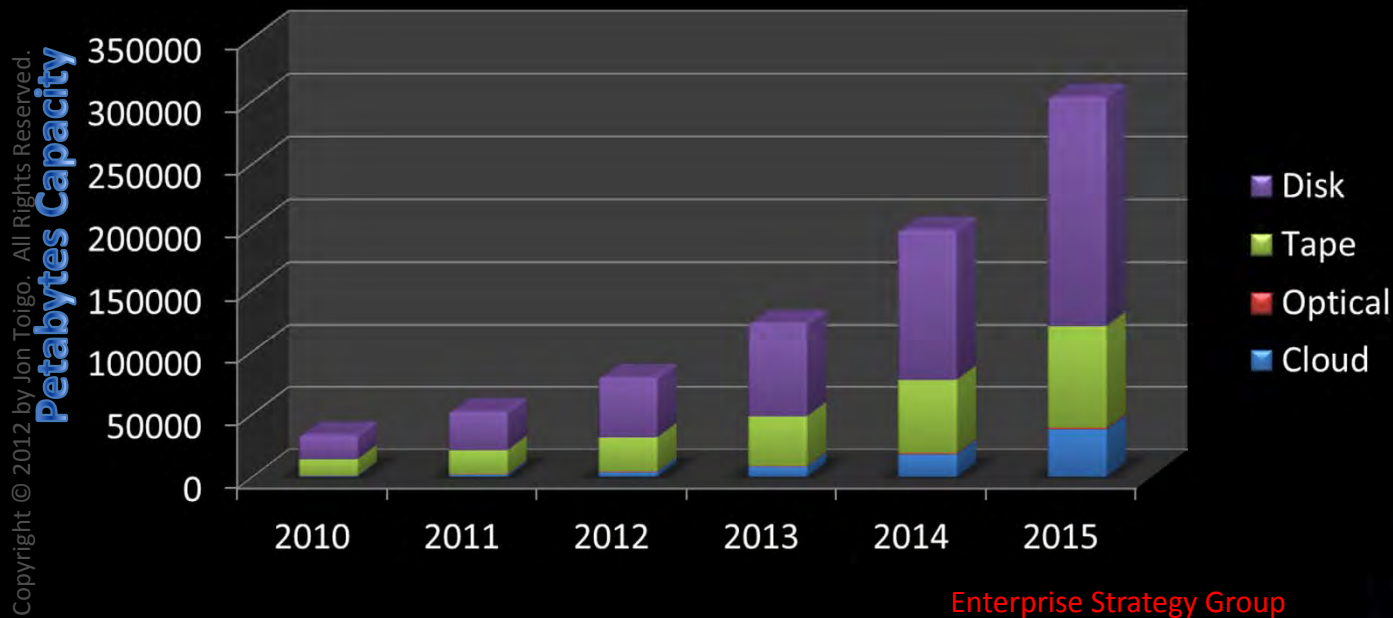
Similar to data protection trends: disk on the rise...

ARCHIVE

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Makes No Economic Sense…

5 Year TCO
500 TB Disk v Tape Archive

Energy — $110,130 / $4,456

Acquisition — $1,360,000 / $149,793

$0 $500,000 $1,000,000 $1,500,000

■ Disk ■ Tape

INSIC

TCO = $67,193,181

12-Year TCO Analysis

$60,000,000
$50,000,000
$40,000,000
$30,000,000
$20,000,000
$10,000,000
$0

■ Energy
■ Floor Space
■ Equip/Media/Maint

TCO = $4,458.228

DISK   TAPE

Clipper Group
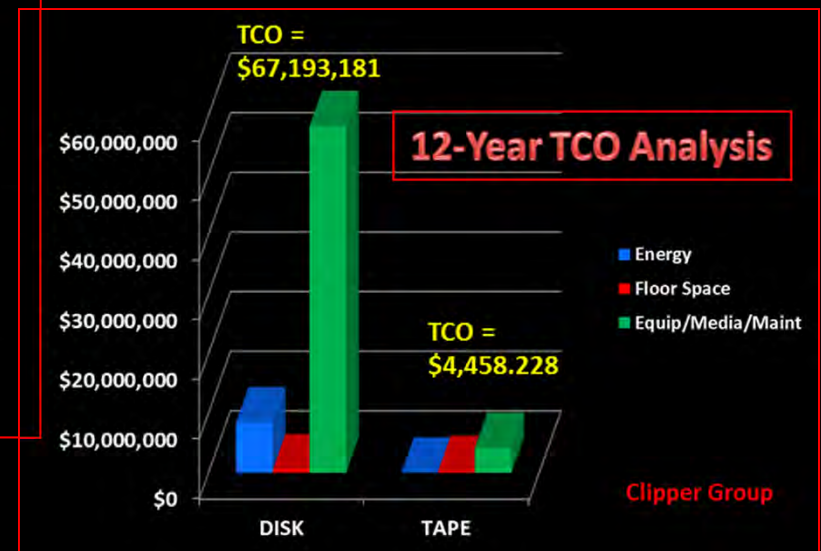
"The 12 year cost of energy for disk is greater
than the entire TCO for tape over the same period:
Disk is 500X more costly than tape, based on energy cost alone.*"*

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

"Deep" Archive versus "Active" Archive

DEEP

CORPORATE DATA ARCHIVE

ACTIVE

Historical data, intellectual property, data retained for regulatory compliance, conforming to an archive strategy…

Production data, usually files, with diminished or limited re-reference characteristics, stored economically…

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Why *Active Archive*? File Proliferation.

- The fastest growing type of data in most firms...

- Anonymous data: difficult to assess contents or business relevance without user involvement...

- Almost heretical to propose deletion...

- File systems are "self destructive:" prone to data loss...

FILES **53%**

DATABASE **20%**

EMAIL GROUPWARE **15%**

WORKFLOW **12%**
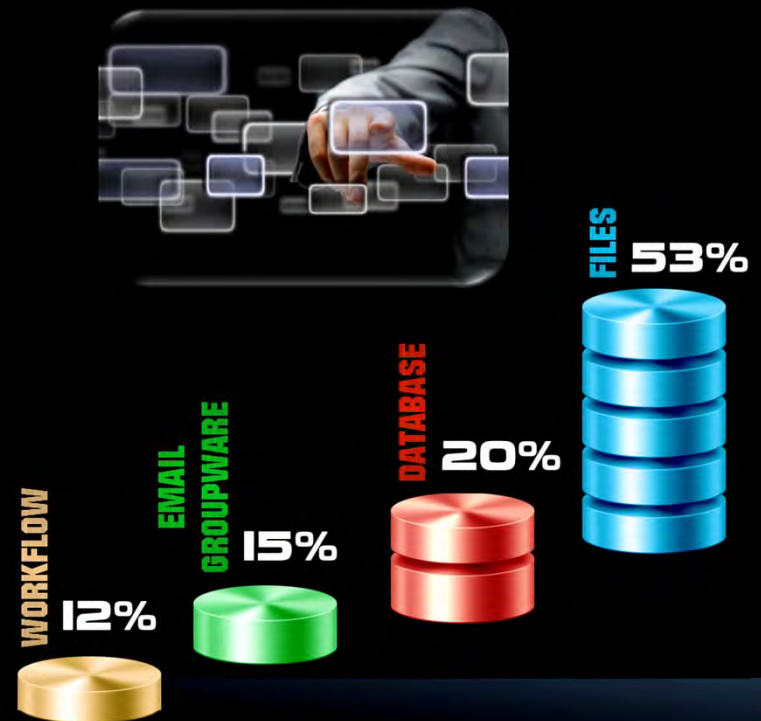
BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

A New/Old Role for Tape

- Disk-based file storage is too expensive for infrequently accessed files...

- Tape's original role was production data storage...

- Tape as "filestore" (aka "active archive") delivers lower TCO and energy costs...

FITNESS TO PURPOSE

FILESTORE

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Basic Concept

"CAPTURE STORAGE"

Using Disk for Long Term File Storage

NFS/CIFS/SMB ACCESS

LTFS Linear Tape File System

SERVER

CACHE DISK

CACHE DISK

OLDER FILES

TAPE LIBRARY

LTFS REQUESTS

"RETENTION STORAGE"

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

kWh 50 100 150 200

Part of an "Energy Optimized" Storage Infrastructure Strategy

Capacity per Watt

TapeNAS delivers less power-consuming mass storage for infrequently accessed files...
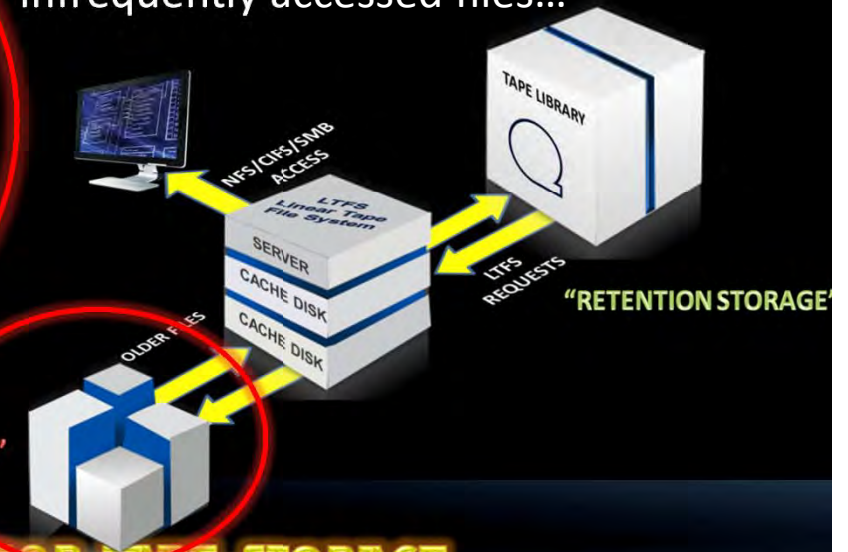
IOPS per Watt

Flash SSD-aided disk replacing massively parallel short-stroking disk arrays...

SSD

NFS/CIFS/SMB ACCESS

LTFS Linear Tape File System

SERVER

CACHE DISK

CACHE DISK

TAPE LIBRARY

LTFS REQUESTS

"RETENTION STORAGE"

"CAPTURE STORAGE"

OLDER FILES

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

SMS & HSM: Integrated Management

END USERS → DATA ← APPLICATIONS

LOGICAL

AUTOMATIC CLASS SELECTION

PROCESSING ATTRIBUTES

DATA CLASS
•Size
•Structure

STORAGE CLASS
•Performance
•Availability

MGT CLASS
•Migration
•Backup
•Retention

MEMORY
COUPLING FACILITY
DASD CACHE
DASD
TAPE

STORAGE GROUP

IBM
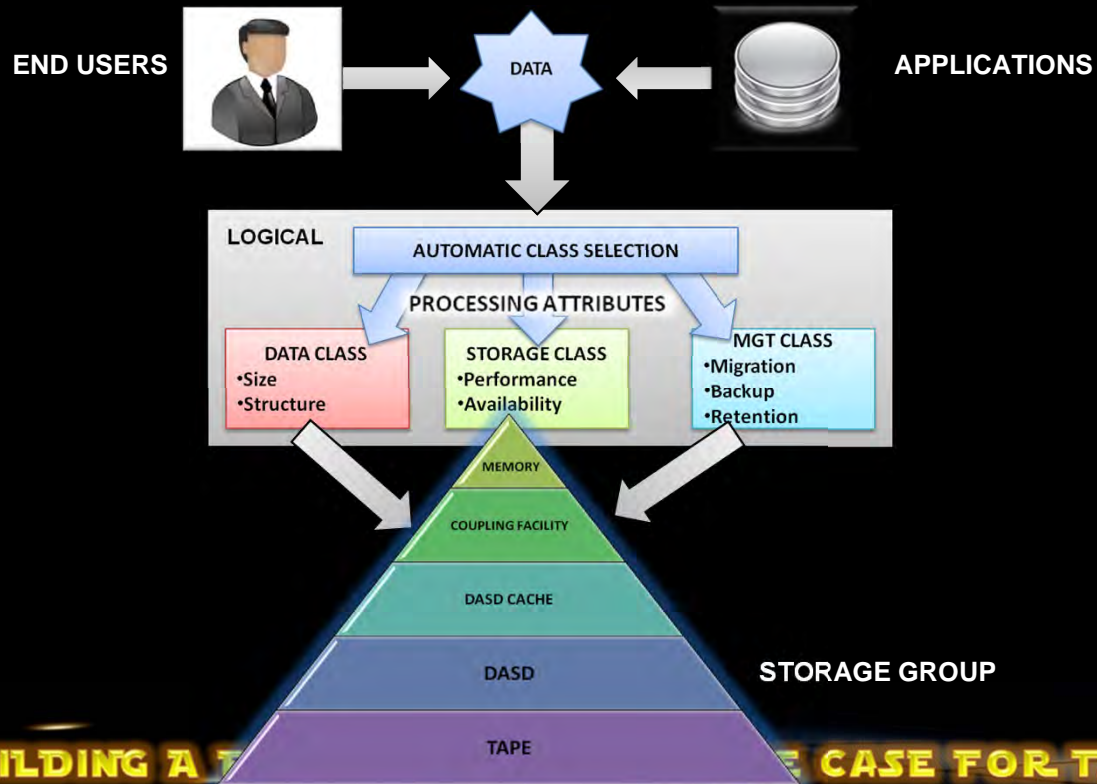
Then Came Distributed Systems Storage...

Thin Provisioning
Mirroring
Performance Acceleration

On-Array Tiering
Mirroring
Continuous Data Protection

On-Array Tiering
Snapshot
Performance
Acceleration

Mirroring
De-duplication
Replication

Snapshot
Replication
Compression

Isolated Islands of Storage Functionality

SRM

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE
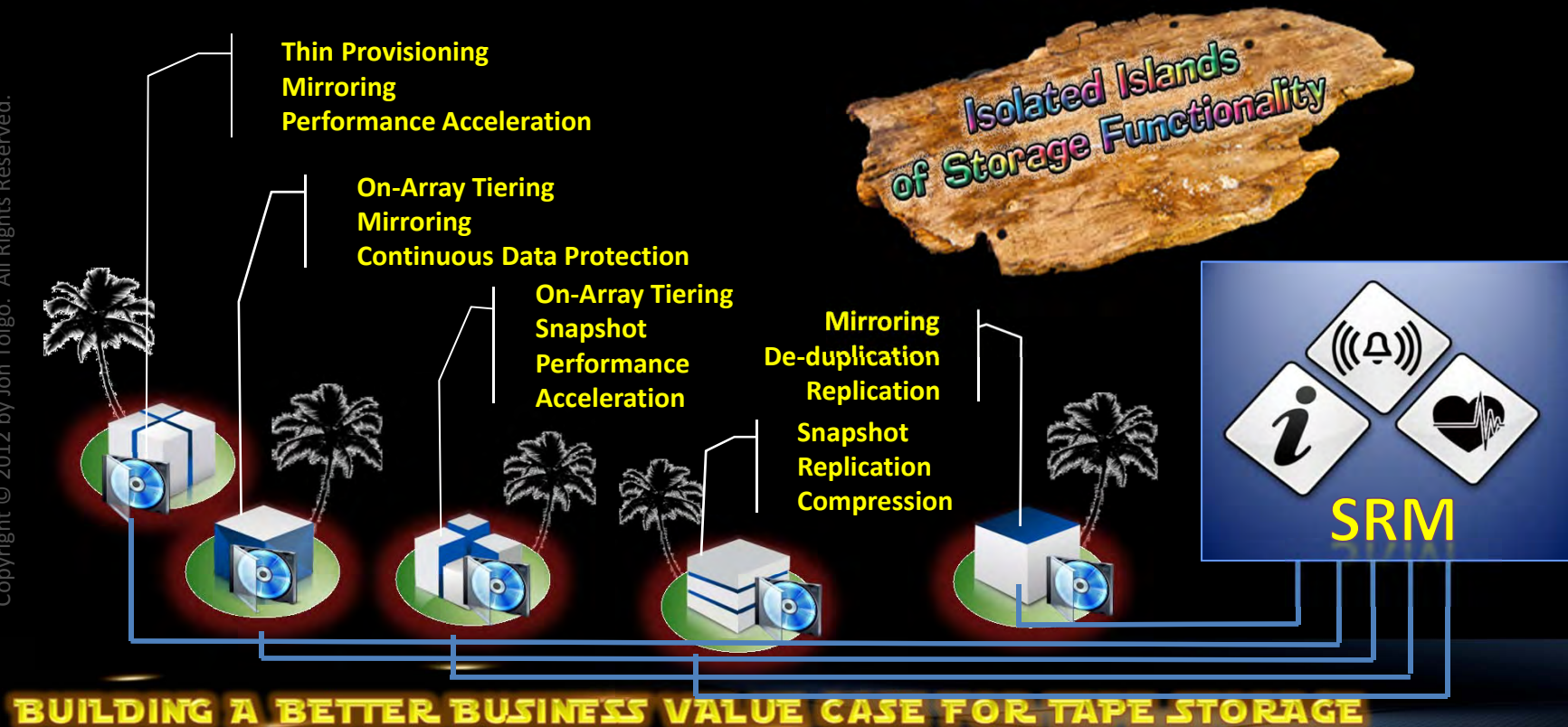
So-Called SANs Didn't Help

Isolated Islands of Storage Functionality (Now with "SANs")

SRM

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Need to Translate SRM into Services Management

Storage Services Management
(data protection, capacity, performance)

STORAGE MANAGEMENT TRANSLATES STORAGE INFRASTRUCTURE RESOURCES INTO A BUSINESS SERVICE
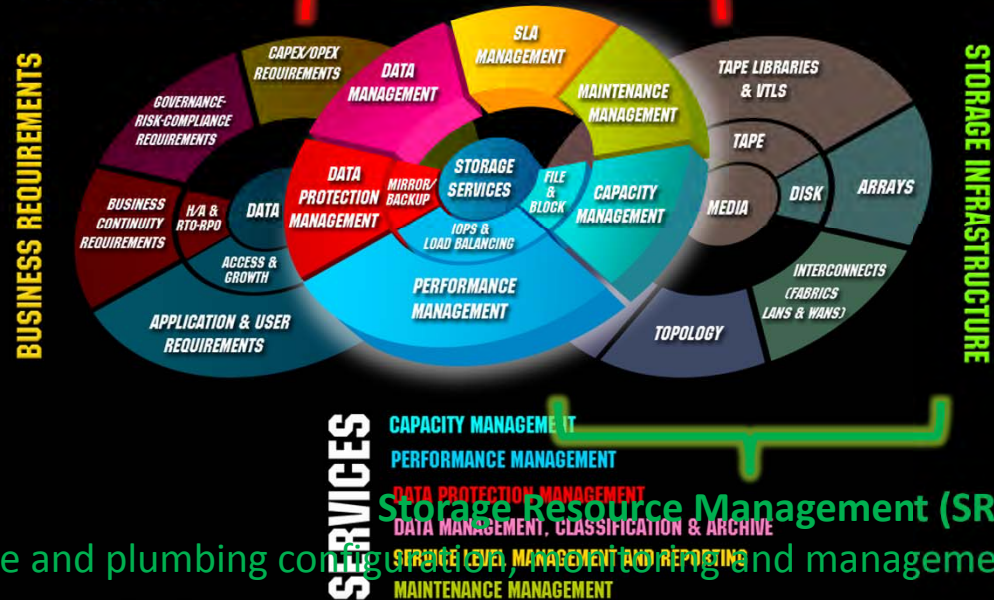
Storage Resource Management (SRM)
(hardware and plumbing configuration, monitoring and management)

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Summing Up Cost-Containment

Tape offers many ways to help your business to contain storage-related CAPEX and OPEX expenditures!

COST-CONTAINMENT

RISK REDUCTION

IMPROVED PRODUCTIVITY

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

What about Risk Reduction?

How will what you are proposing reduce risks to the business – broadly defined to include legal, operational, financial and investment risk?

RISK REDUCTION

COST-CONTAINMENT

IMPROVED PRODUCTIVITY

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Start with Risk of Data Loss…

Risk of Silent Corruption (Bit Error Rates)

1 in 10^{16}

1 in $10^{17} - 10^{27}$

*1 error in 67 TB
(1-in-90 SATA drives have
"Silent Corruption")*

*1 error in 12.5 PBs
(with error correction &
read/verify :
"infinitesimal")*

DISK

TAPE

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

What about Investment Risk?

Tape Technology Changes Less Frequently With Backward Compatibility Highly Prized

Churn of Disk Products Over the Years (with few clear upgrade paths)

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Less *Friction*

- As in the impact of transaction costs in a financial market (per 2009 Nobel Prize-winning Economist Oliver Williamson's usage)...
  - **Internal transaction costs:** expensive warranty & maintenance agreements, expensive replacement parts, requirement to take supplier-defined upgrade path, monopolistic relationship...
  - **External transaction costs:** cost of money, utility power costs and availability, regulatory mandates, natural forces, breakage, press and analyst views, taxes, etc.

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

The Friction in Disk Infrastructure

Internal Transaction Costs

- Proprietary controllers and value add software
- Signed drives and trays
- Razor/razorblade pricing of maintenance agreements
- Lack of backward compatibility
- Value Add obfuscates unified management

External Transaction Costs

- Marketing around brand name gear
- Supposed supply shortages of drives and components
- Consolidation in disk array industry
- Server virtualization
- Data burgeon
- Slow economic growth and budget austerity

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

A Couple of Truisms

Lock-in technologies carry Internal transaction costs that worsen over time. Limited rationality and opportunistic behavior often determine decision making and other behavior...

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

So, Avoid the Friction: Use Tape

Tape also avoids the *ECONOMIC FRICTION* that has become endemic to disk based storage hardware products.

Tape's "lubricity" is a function of a mature technology base, largely standardized, with improvements based on architecture rather than marketecture and shared through IP agreements.

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Maybe.

Technology is being leveraged to make fewer people more productive…
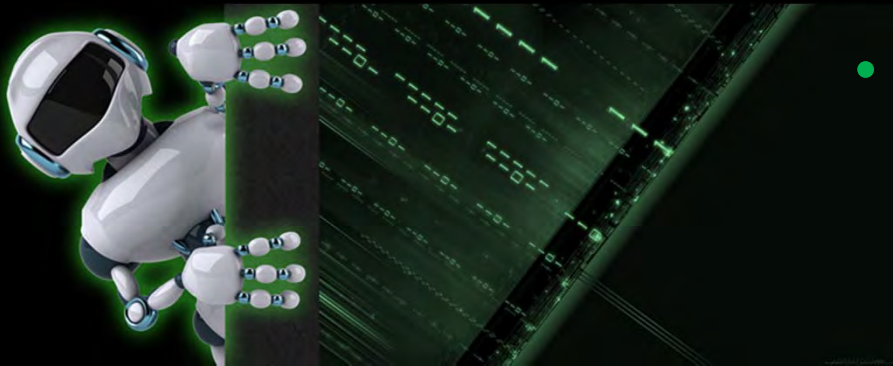**INCREASING DEPENDENCY**

IT budgets aren't growing but data growth hasn't slowed…
SLOWING DATA ACCESS & SYSTEM RESPONSIVENESS

Quest for "Agility" limiting time for planning and validation…
ENCOURAGING TACTICAL DECISION-MAKING

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Tape Can Certainly Help To Sort Out The Disk Junk Drawer

- Archiving older data can speed search and retrieval of active data
- Data in tape-based file stores (active archives) can be retrieved in an acceptable timeframe for most uses: reduce world wide wait with caching
- Caveat: tape storage doesn't fix non-intelligent data management

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Increased Dependency on Technology =
Increased Vulnerability to Even Short Term Outages

- Despite claims that risk drives expensive high availability (HA) strategies for data protection like disk-to-disk replication, tape-based approaches are preferable for most data
  - Restore timeframes surprisingly lax for most apps
  - Tape perceived as backstop to disk strategies in any case
  - Tape transport critical for successful on-line (cloud) backup services
- Plus, tape has multiple personalities and can be leveraged for backup, as well as archive and file store

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

For Tape to Deliver, Tactical Must Be Augmented by Strategic Thinking

Friction is driving irrational buying behavior and the embrace of questionable architectural models and product approaches within consumer and vendor shops.

Problems of data and storage mismanagement are not new, and it is good that some wish to address them…finally. **But haste makes waste.**

BUILDING A BETTER BUSINESS VALUE CASE FOR TAPE STORAGE

Let's Go

Questions?

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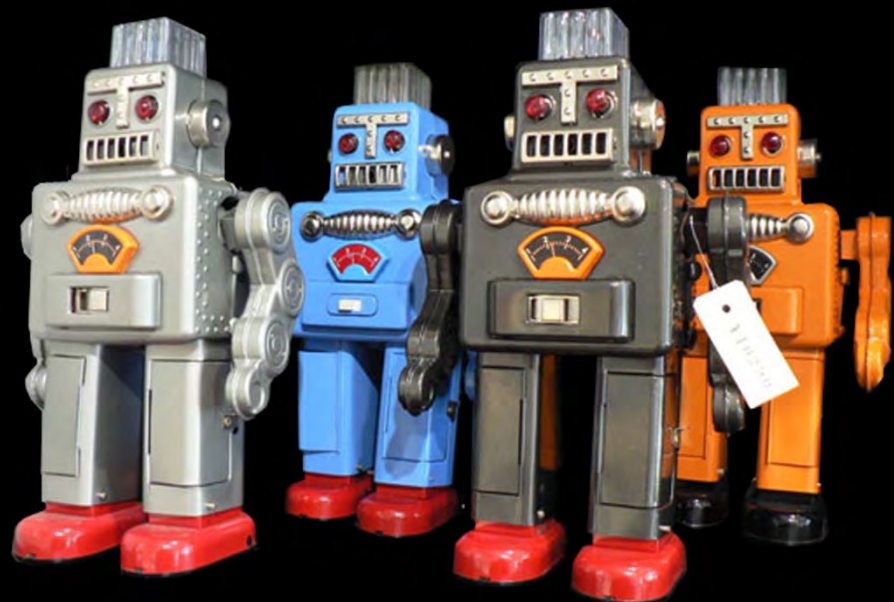
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Try not to become the tools of your tools.

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