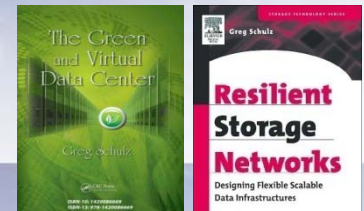# Industry Trends and Perspectives:
State of Storage V2.009

Greg Schulz, Founder & Sr. Analyst -The StorageIO Group

Author "The Green and Virtual Data Center" (Auerbach)

And "Resilient Storage Networks" (Elsevier)

www.storageio.com

Introduction
Who is Greg Schulz and StorageIO

- Former IT customer/user
  - Electrical power G&T utility, transportation, financial services
  - Servers, storage, networks, hardware and software (Cap. plan/BC/DR)
- Recovering Ex-vendor
  - Manufacturer and VAR, hardware, software and services
  - Storage (SSD, RAID, NAS, VTLs, tape, backup & archiving & HSM)
  - Storage networking (mainframe and open, LAN, MAN, WAN, SAN)
- Industry analyst and involvement with trade groups
  - Involved with SNIA and other trade and vendor groups
  - Worked for an analyst firm before founding StorageIO
  - Real-world analysis based on experience talking with people like you
- Author, presenter and blogger (www.storageio.com & www.storageioblog.com
  - Two solo books, contributed to several others
  - Thousands of articles, tips, columns, papers and reports
  - Present and keynote speaking on a global basis

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Industry Trends: Myths and Realties

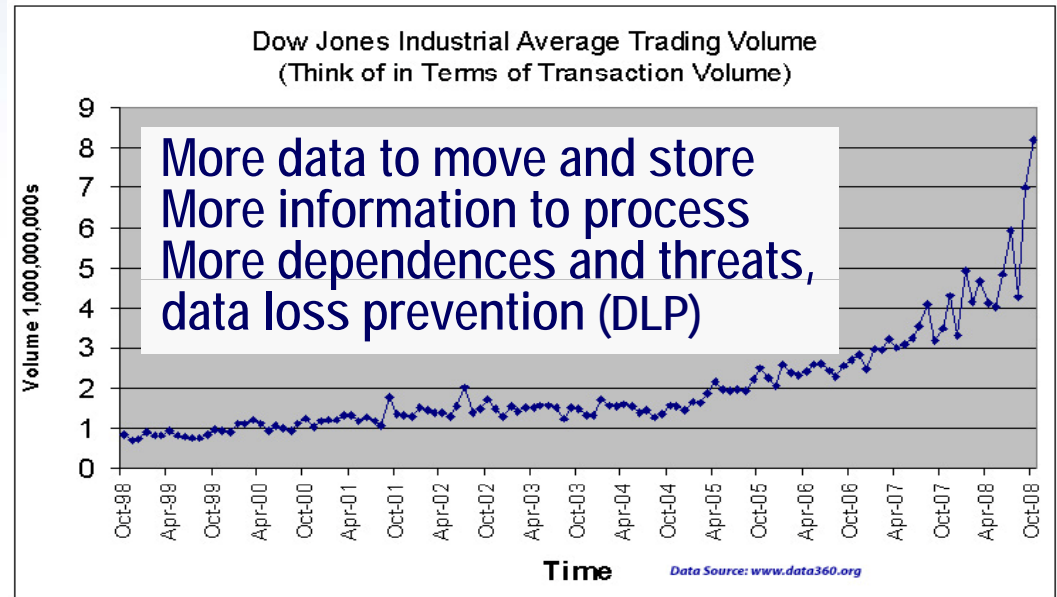## These are constantly changing and evolving

- Myth: Storage efficiency is all about capacity optimization
  - Reality – It is also about boosting performance and productivity

- Myth: Tape is dead, tape is root of data protection problems
  - Reality – Tape is alive co-existing with disk to disk backup

- Myth: BC/DR are only issues for large enterprises
  - Reality – Applicable to organizations of all sizes

- Myth: Energy efficiency is energy avoidance (e.g. turn things off)
  - Reality – Also about boosting effective performance/productivity

- Myth: Virtualization is only for consolidation
  - Reality – Also for emulation (e.g. VTLs) and management

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Industry Trends: Increased Threat Risks

More data, more risks, more reliance and more awareness

Threat Risks

- Headline news
- Non-headline news
- Local and Regional
- Acts of Nature
- Acts of man
  - Accidental
  - Intentional
- Technology
  - Failure
  - Miss-configuration

Dow Jones Industrial Average Trading Volume
(Think of in Terms of Transaction Volume)

More data to move and store
More information to process
More dependences and threats,
data loss prevention (DLP)

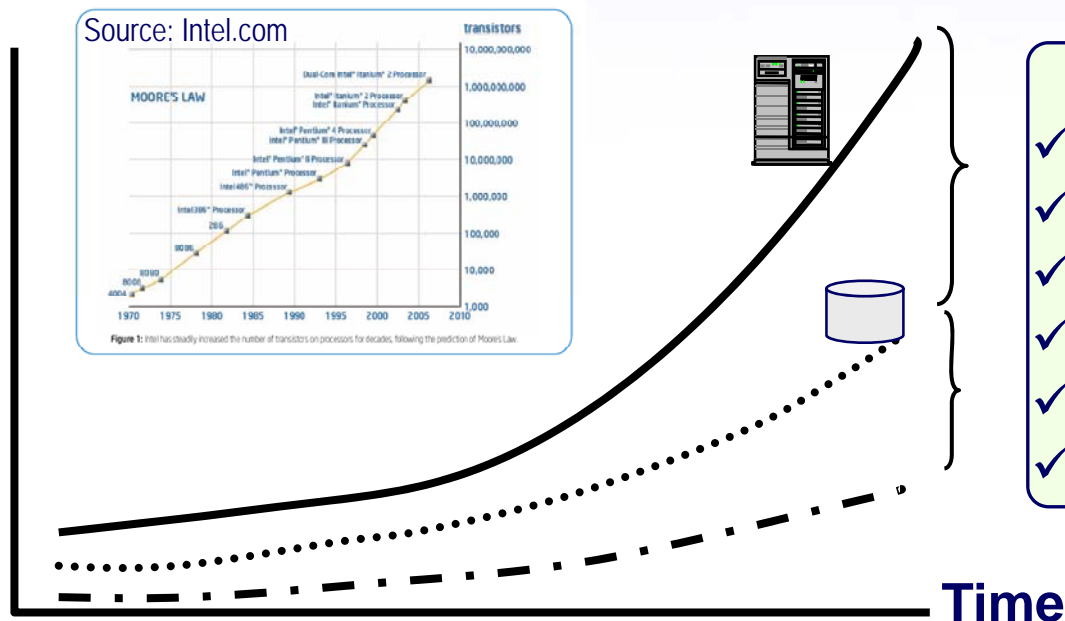Data Source: www.data360.org

Issues, challenges and drivers

- Issues no longer constrained to rich and famous
- Continued dependence on information services
- Reliance on Information and services availability
- Increased visibility and awareness of issues
- Regulation and compliance, data loss prevention

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Industry Trends: I/O Performance Gap
Disk I/O lags server performance and storage capacity

Sustaining IT and Business Growth, Maintaining QoS

Source: Intel.com

MOORE'S LAW

transistors

Figure 1: Intel has steadily increased the number of transistors on processors for decades, following the prediction of Moore's Law.

Action Items
- ✓ Address I/O issues/problems
- ✓ Storage & I/O optimization
- ✓ User fewer, yet fast devices
- ✓ Balance SSD (RAM & FLASH)
- ✓ Fast 15.5K SAS & FC disks
- ✓ Data footprint reduction

Time

—— **Server processor performance curve**

····· **Disk storage capacity curve**

— · **Disk storage performance curve (IOPS)**

See "Data Center Performance Bottlenecks" www.storageio.com

Source: "The Green and Virtual Data Center" (Auerbach)

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Industry Trends:ExpandingDataFootprint

Management: Counter impact of expanding data footprint
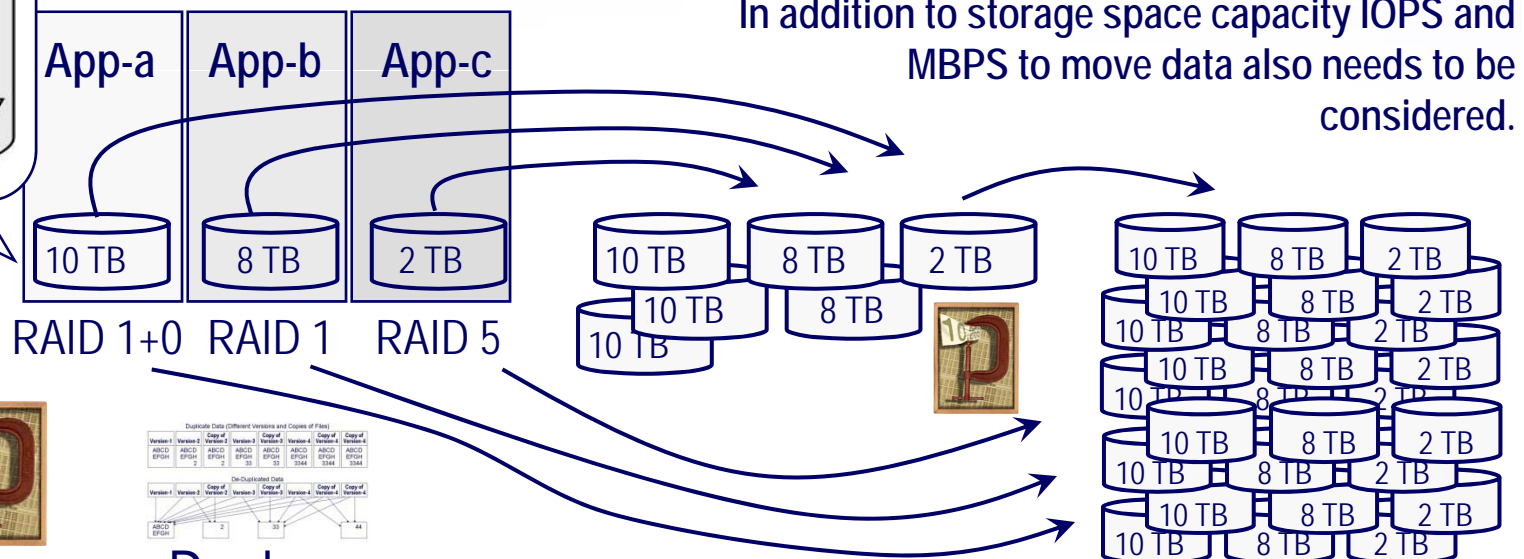
Sparse, Duplicate Files and Content

Duplicate Files and Content
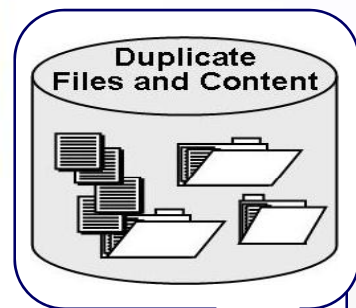
Original Data
Primary Database,
Email, File serving

Copies – Data Proliferation and expanding data footprint

DSS, Training, Test, Dev   Backup, BC, DR, HA,
QA, Operational, Needs   Archive, Compliance

In addition to storage space capacity IOPS and MBPS to move data also needs to be considered.

App-a | App-b | App-c

10 TB | 8 TB | 2 TB

RAID 1+0 RAID 1 RAID 5

10 TB | 8 TB | 2 TB
10 TB | 8 TB
10 TB

10 TB | 8 TB | 2 TB
10 TB | 8 TB | 2 TB
10 TB | 8 TB | 2 TB
10 TB | 8 TB | 2 TB
10 TB | 8 TB | 2 TB
10 TB | 8 TB | 2 TB
10 TB | 8 TB | 2 TB
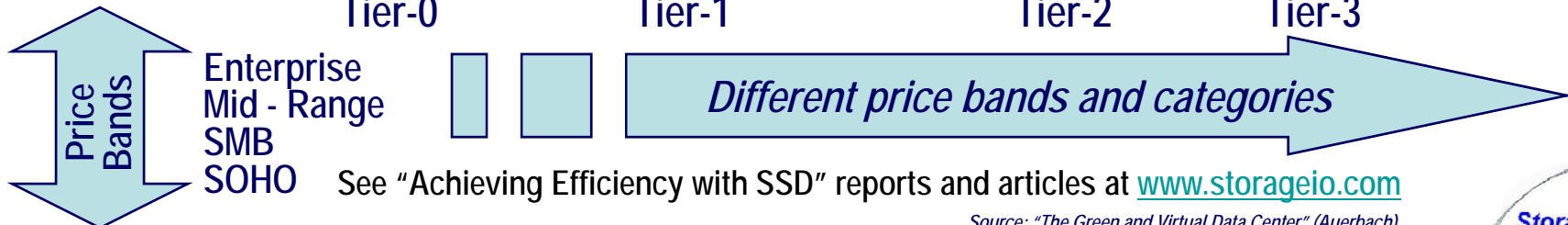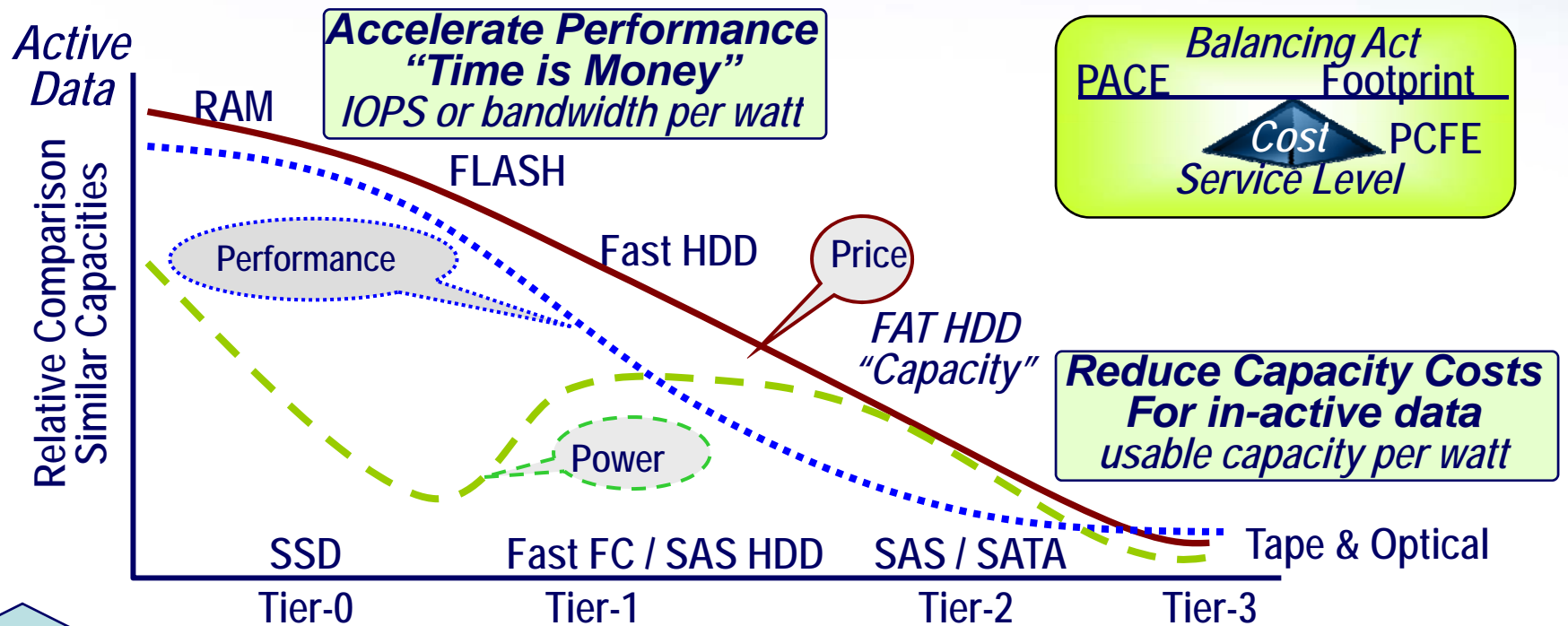
Archive   Compress   De-dupe

Challenge: More data to backup, protect and manage
Action: Reduce footprint impact: Archive, Compress, De-dupe, Tiered Storage

---

See "Business Benefits of Data Footprint Reduction" www.storageio.com

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Industry Trend: Tiered Resources
Balance Performance, Availability, Capacity, Energy (PACE)

Video/Audio	File Serving	Billing, E-Tail	Database, DSS	Email Messaging	CAD, EDA, SW Dev.	Spreadsheets PPTs, PDFs

Active Data

Accelerate Performance "Time is Money" *IOPS or bandwidth per watt*

Balancing Act
PACE ——— Footprint
Cost ◆ PCFE
Service Level

RAM

FLASH

Relative Comparison Similar Capacities

Performance

Fast HDD

Price

FAT HDD "Capacity"

Reduce Capacity Costs For in-active data *usable capacity per watt*

Power

SSD — Fast FC / SAS HDD — SAS / SATA — Tape & Optical

Tier-0   Tier-1   Tier-2   Tier-3

Price Bands

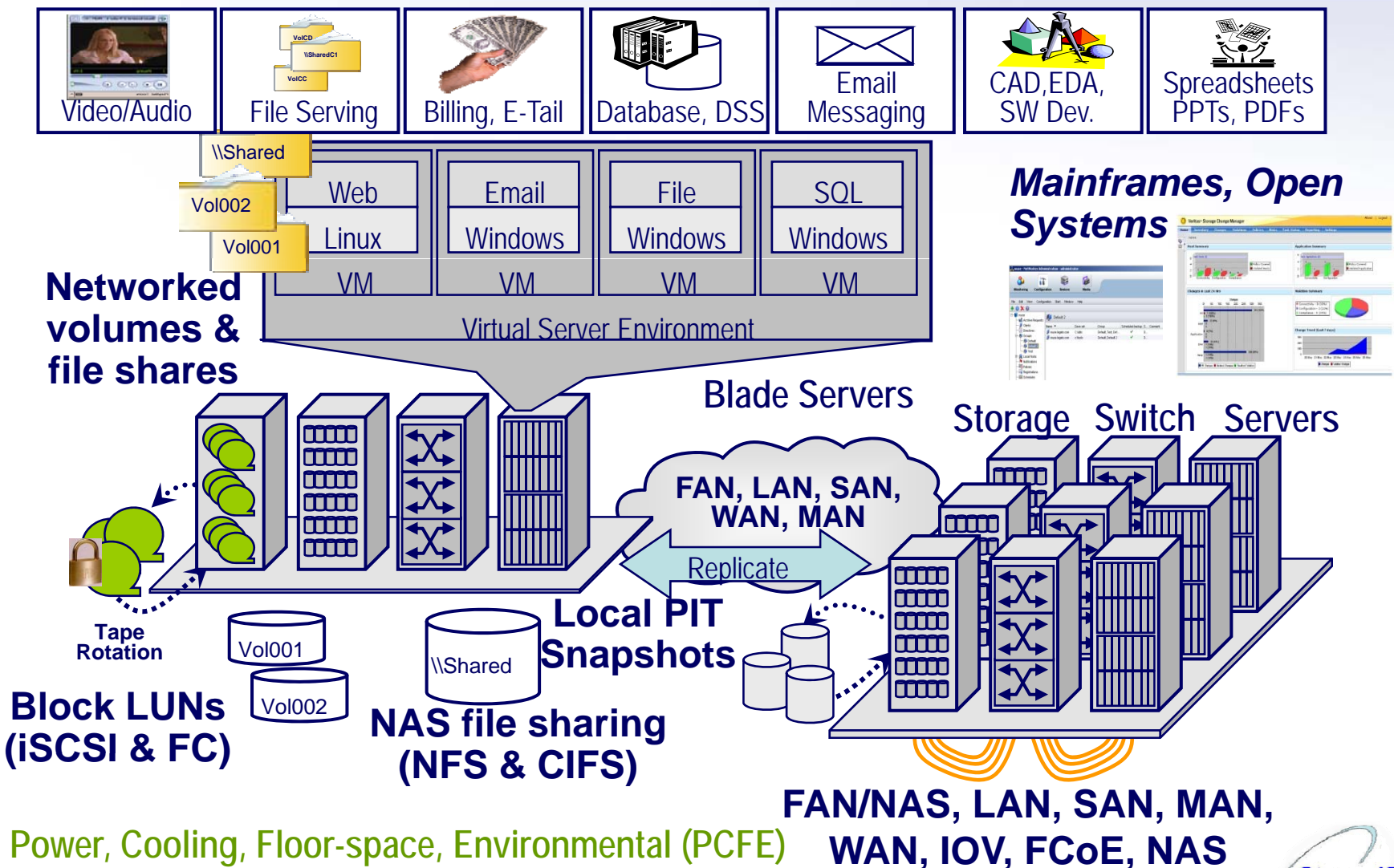Enterprise
Mid - Range
SMB
SOHO

Different price bands and categories

See "Achieving Efficiency with SSD" reports and articles at www.storageio.com

Source: "The Green and Virtual Data Center" (Auerbach)

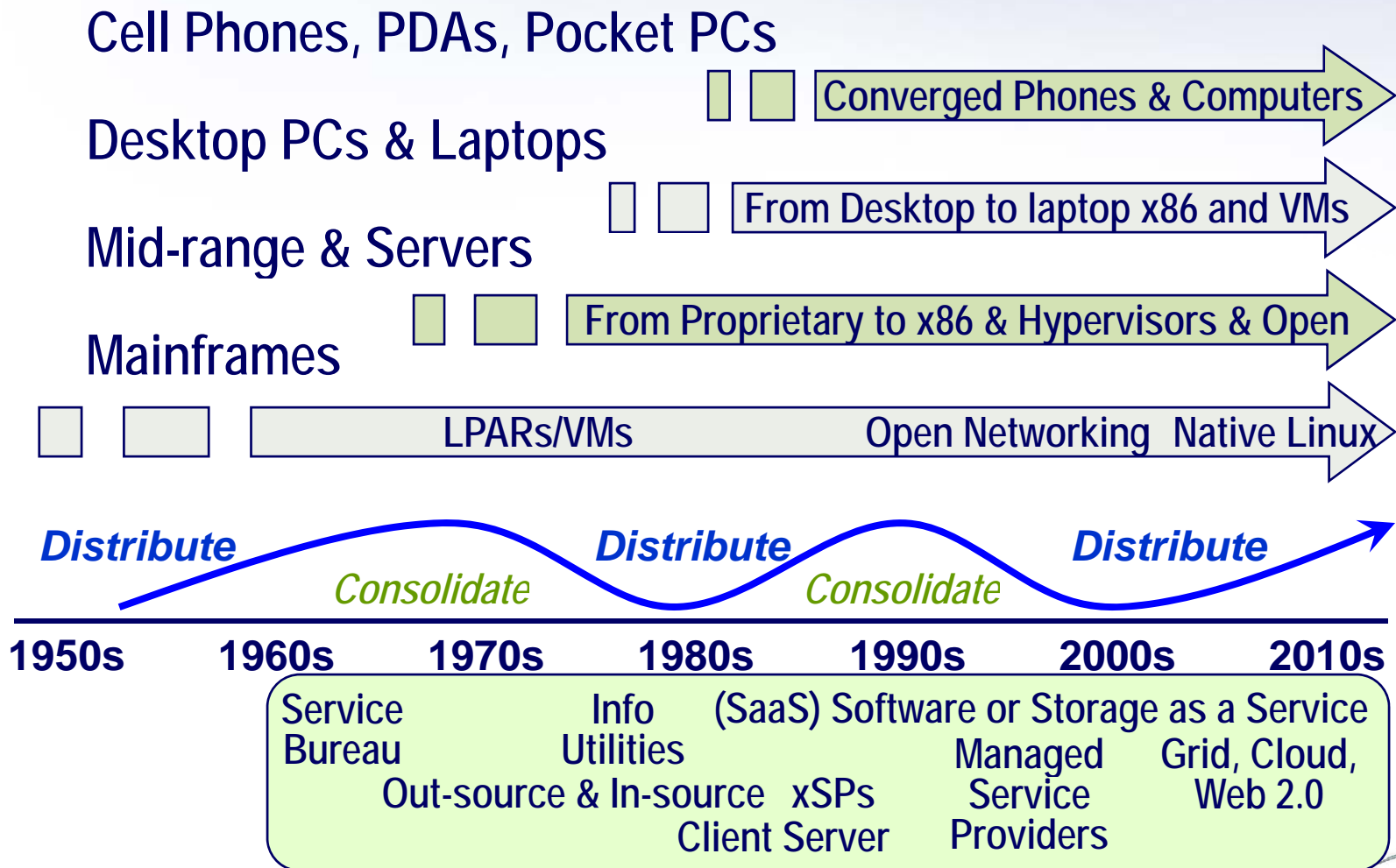StorageIO

Industry Trends: Virtualization

Current focus is consolidation of physical resources

Video/Audio	File Serving	Billing, E-Tail	Database, DSS	Email Messaging	CAD,EDA, SW Dev.	Spreadsheets PPTs, PDFs

\\Shared

Vol002

Vol001

Web Linux VM	Email Windows VM	File Windows VM	SQL Windows VM

Virtual Server Environment

Mainframes, Open Systems

Networked volumes & file shares

Blade Servers

Storage   Switch   Servers

FAN, LAN, SAN, WAN, MAN

Replicate

Local PIT Snapshots

Tape Rotation

Vol001

Vol002

\\Shared

Block LUNs (iSCSI & FC)

NAS file sharing (NFS & CIFS)

FAN/NAS, LAN, SAN, MAN, WAN, IOV, FCoE, NAS

Power, Cooling, Floor-space, Environmental (PCFE)

Source: "The Green and Virtual Data Center" (Auerbach)

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Industry Trends: Compute Continuum
We are in a consolidation phase (*Again!*)

Cell Phones, PDAs, Pocket PCs

Converged Phones & Computers →

Desktop PCs & Laptops

From Desktop to laptop x86 and VMs →

Mid-range & Servers

From Proprietary to x86 & Hypervisors & Open →

Mainframes

LPARs/VMs   Open Networking Native Linux →

Distribute   *Distribute*   *Distribute*

Consolidate   *Consolidate*

1950s	1960s	1970s	1980s	1990s	2000s	2010s

Service   Info   (SaaS) Software or Storage as a Service
Bureau   Utilities   Managed   Grid, Cloud,
          Out-source & In-source   xSPs   Service   Web 2.0
                    Client Server   Providers

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What's The "Buzz" Out There?
What I commonly hear from IT customers and others

- **Interoperability:** With scalability and stability, hardware and software
- **Cost avoidance:** Doing more with less, supporting growth, tactical vs. strategic
- **Tape is not dead (yet):** Being used for performance and capacity (larger sites)
- **Dedupe scalability concerns:** Compliance, RAS & performance (large sites)
- **Skepticism or confusion:** Green, FCoE, SSD, Clouds, Clusters & Grid
- **Limited "broad" adoption:** Thin provision, MAID, Storage Encryption
- **Expanding data footprint:** Impact on storage and management costs
- **Confusion of price band, tiers & categories:** SNIA taxonomy opportunity!
- **Concern over degrading service levels due to consolidation**
- **Reducing software footprint impact:** Software and application consolidation
- **Data protection and DLP:** For virtual and physical environments
- **Who will manage:** Virtual & converged networks, converged servers & storage

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Industry Trends: Lack of Innovation?
That depends on what your definition of innovation is!

What determines innovation?
- Ideas and technology?
- Number of existing startups?
- Level of marketing and awareness?
- Press/media and analyst coverage?
- Number of customer beta "seed" sites?
- Amount of paying Customer deployment?

Do these represent Innovation, you be the judge!
Proverbial "turn the crank", FCoE/CEE/DCE, MR-IOV/SR-IOV, Open source, server/storage convergence, green tech, transactional flash, tape, disk, grid, cluster, cloud, RAID, BC/DR/DLP/Data protection and other IRM software storage systems and architectures.

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Next Generation Data Centers
What the "Information Factory" of the future will look like

New and Emerging

Time Tested and Field Proven

Balance of new and old technologies

SSD (RAM & FLASH) Clusters & Grids Clouds, policy based automation and Virtualization, tiered access (FCoE, Object Access), DLP

Magnetic disks and tape, clusters and tiered storage, RAID, tiered data protection, encryption, tiered access (FC, iSCSI, SAS, NAS)

- Highly optimized, secure, resilient and flexible, dense resources, (beyond just consolidation), automated, efficient enabling more work and productivity to be done

- Clouds are complimentary to traditional IT resources as another tier of resource for IT service delivery

- Keep in mind that virtual, cloud, grid and SOA solutions require physical resources, software, tools, facilities and people!

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Cross Technology Domain Management
Server, storage, networking and software convergence

IRM = Software, tools, procedures, policies, best practices
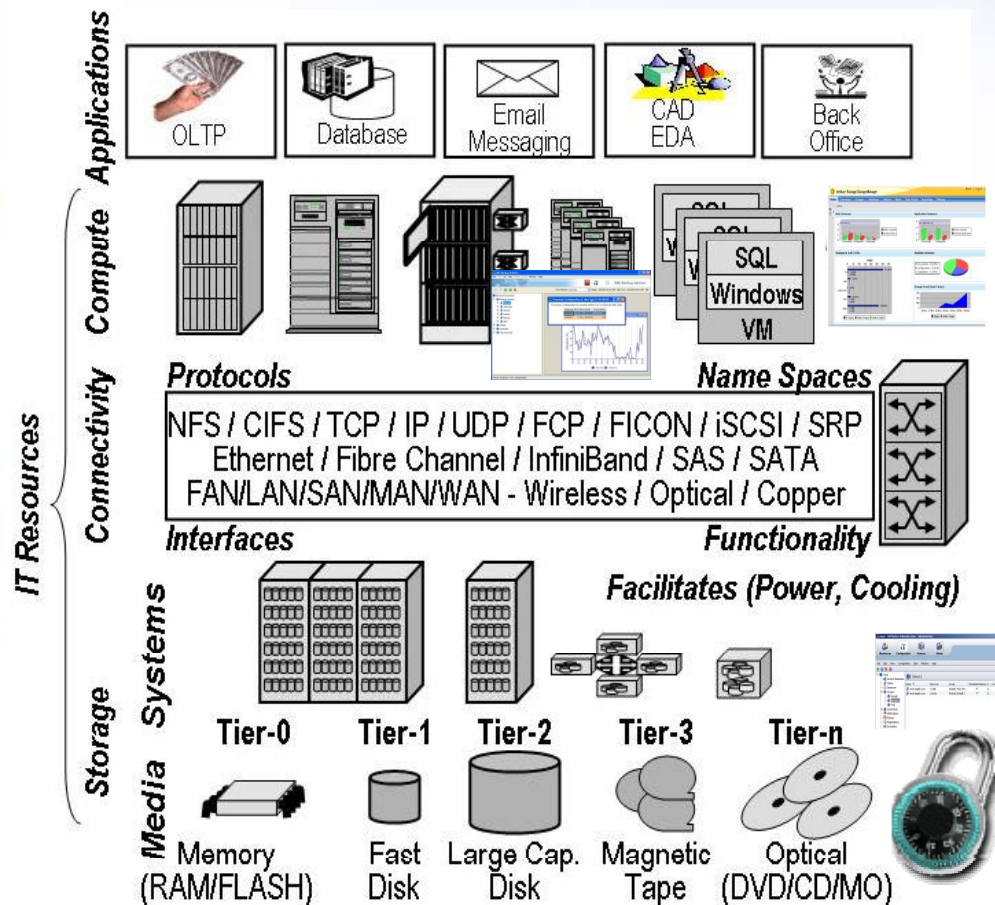
Infrastructure Resource Management (*IRM*) functions and activities
Processes and Tools

- Namespace and virtualization
- Measurements and metrics
- Monitoring and reporting
- Modeling, analysis, planning
- Resource usage and allocation
- Performance and capacity plan
- Thin provisioning and purposing
- Diagnostic and resolution
- Change & configuration validation
- Data protection and footprint reduction
- Policy management and service levels
- Facilities and asset management
- Logical and physical security
- Procurement and disposition

Source: "The Green and Virtual Data Center" (Auerbach)

See "Data Protection Options for Virtualized Servers" www.storageio.com

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Next Generation Data Centers
Zombie "Declared Dead" technologies still being bought & used

RIP – Dead or dying
Floppy disk drive, parallel SCSI , Y2K and DotCom SSPs, Britton Lee database machine, punch cards, etc…

Endangered List
Green Hype, Optical & CDs, FANs and SMIS among others

"Zombies" - Declared Dead
(vendors sell, customers buy)
Magnetic tape, magnetic disk, backup, IBM "z" mainframe, HDDs, DEC/Compaq/HP VMS, PC, Fibre Channel & FICON, RAID, Windows, storage arrays, printers, etc…

"Zombie Technologies" are profitable for vendors, productive for customers, boring for marketing (thus limited or no coverage)

Opportunity: *Make some news to remain relevant!*

Prediction: Tape will be "Trendy" in 2009

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Industry Trends: Shifting Landscapes
Changing data lifecycle and access patterns

Legacy and Transactional Data

Data Created — Data Goes Dormant

Activity
- Tier-0
- Tier-1
- Archive / ILM
- Tier-2
- Off-line
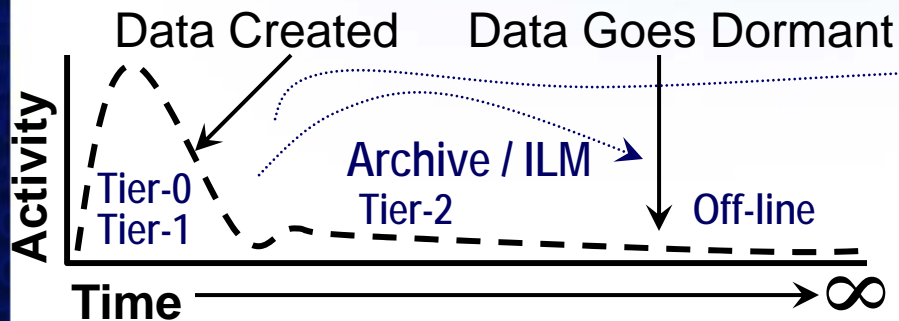
Time ∞

Profile = Data is created, worked with and then goes dormant after some period of time with probability of little to no future access or use
Examples = Database, Email, Transactional, general file serving, project oriented data
Action = Ideal candidate for archiving off of primary or on-line storage too off-line and removable media or MAID 2.0 & IPM based storage combined with purging or deletion of data no longer needed to meet compliance or other commitments

Web 2.0 and On-line Data

Data Created — Continued Access

Bulk Storage

Activity
- Tier-2

Time ∞
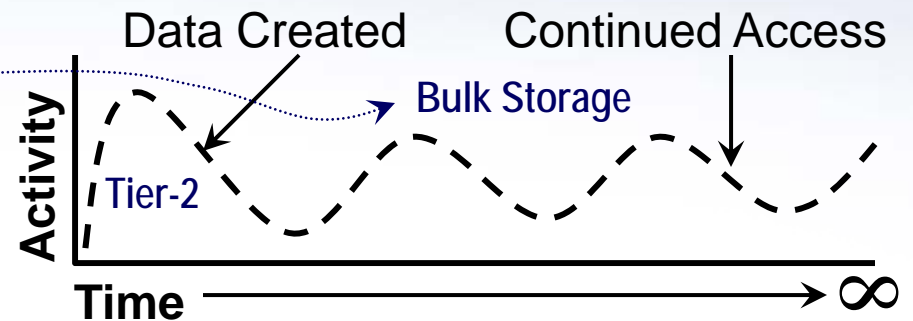
Profile = Data is created, worked with and then may go idle briefly, then accessed, then idle, then active, then idle, then active…
Examples = Web, Reference and lookup, fixed content, Web 2.0 and social networking, media and entertainment, some email, search, seasonal or event and research based data
Action = On-line storage with variable performance to meet changing workload demands, bulk and clustered storage, IPM enabled storage and storage caching

Source: "The Green and Virtual Data Center" (Auerbach)

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Industry Trends: Virtualization (Next Phase)
Life beyond consolidation: Abstract, Emulate and Management

Issues That Inhibit Consolidation:
- QoS and performance barriers
- Politics and financial constraints
- Competitive or legal purposes
- Security and compliance

Total server and storage market size

Tomorrow

Non-consolidated servers or storage

Consolidation applies only to a fraction of <u>all</u> servers or storage

A huge market and IT virtualization opportunity!

Action
- **Emulation**
- **Abstraction**
- **Aggregation**
- **Migration**

Consolidated servers and storage using virtualization

Today

Market and IT opportunity = Life beyond consolidation
Using server or storage virtualization for IT resource management enabling abstraction and transparency for massive scaling, BC, DR & routine infrastructure resource management (IRM) operational functions

Source: "The Green and Virtual Data Center" (Auerbach)

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Industry Trends: Technology Alignment
Tiered IT Resources: Fix Performance Bottlenecks

Convergence and Interdependency
Servers + I/O Networking + Storage

The need for speed. Fast servers need fast I/O networks and fast storage mediums and devices. Slow storage and I/O networks causes fast servers to have to wait resulting in lost productivity and resource waste!

T0 = SSD (FLASH & RAM)
T1 = Fast 15.5K RPM HDD
T2 = High Capacity HDD
T3 = Tape, Optical, other

Most performance
Least capacity
Highest cost

Processor
Registers,
L1 & L2 Cache
Onboard memory

Quality of service (QoS)
and service level vs.
cost trade-offs

Server
Main memory RAM,
ROM, NVRAM, internal HDDs

External Storage
Cache appliance and cache on storage
SSD – RAM and FLASH-based
Fast 2.5" & 3.5" SAS and FC HDDs
Slower high-capacity SAS and SATA HDDs
Magnetic tape and optical storage media
Internet/Web and cloud-based storage services

Less energy/cooling
Most persistency
Less performance
Lowest cost

Source: "The Green and Virtual Data Center" (Auerbach)

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Industry Trends: Technology Alignment
Tiered IT Resources: Tape, Still Relevant, Changing Role

Changing Roles of Tape

Tape Compliments
Disk Based
Data Protection

Backup/Restore, BC/DR,
Archiving, Data Preservation, Bulk Data Movement

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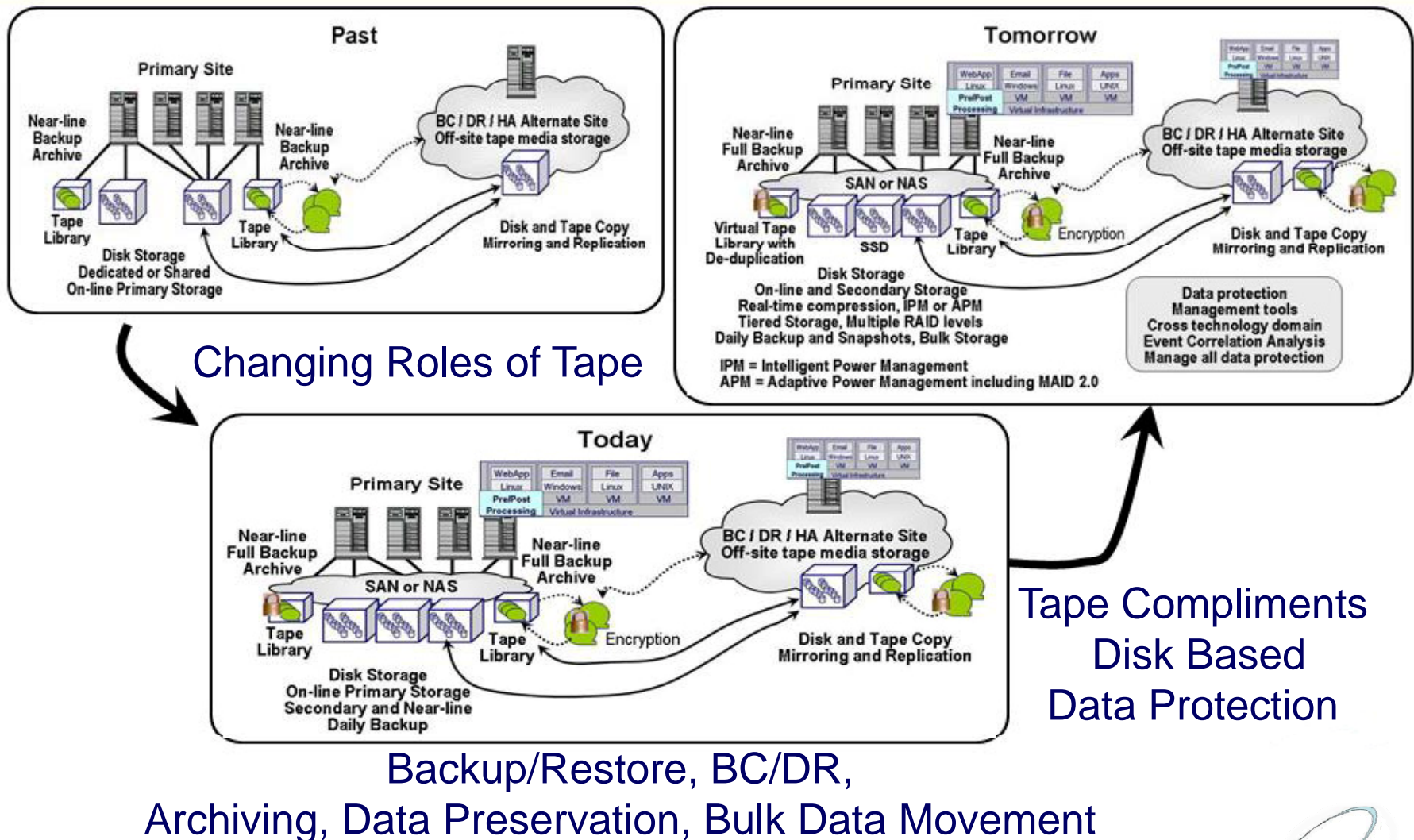
Industry Trends: Cloud Computing
Cloudy weather & confusion vs. clear skies & opportunity
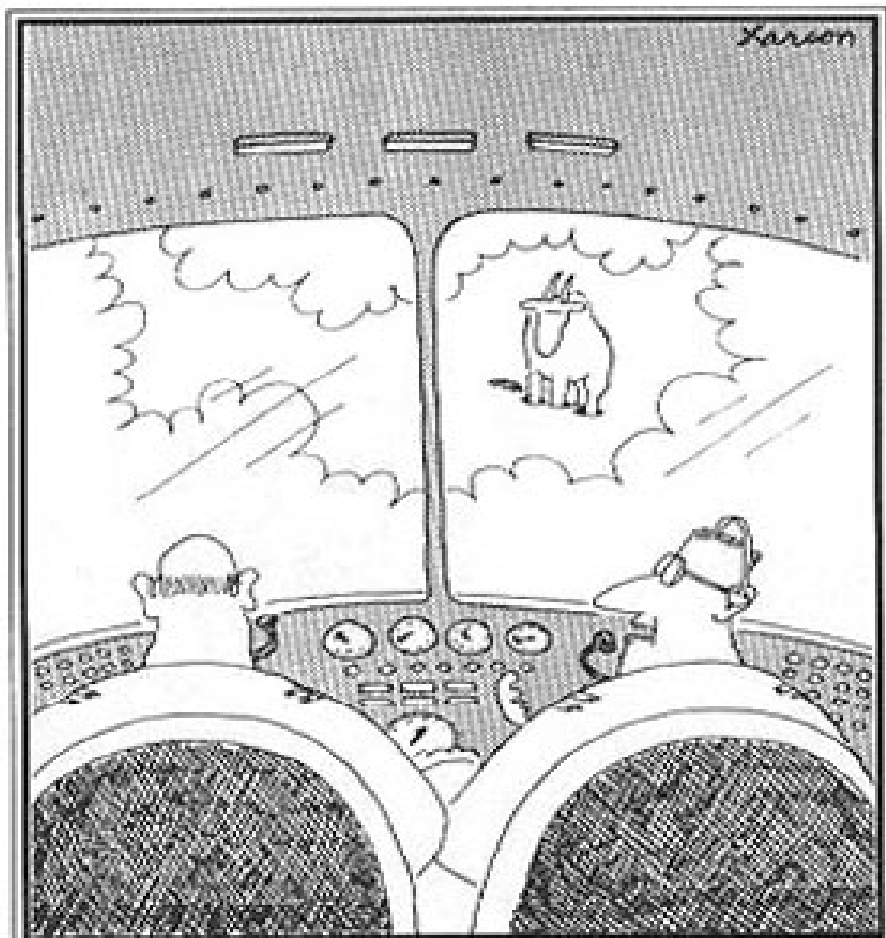
"Say . . . What's a mountain goat doing way up here in a cloud bank?"

Many types of clouds
- Scientific vs. commercial
- Services vs. solutions
- Architecture vs. products
- Public vs. private
- Protocols and personalities

Confusion and skepticism
- Lingering reminder of SSPs
- Replacement vs. complimentary
- BC/DR and availability

Opportunities & call to action
- Clarify - Avoid flying blind
- Position as a IT tiered resource
- Complimentary vs. competitive
- Protect & preserve, part of BC/DR

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Industry Trends: Converged Networking
I/O Virtualization (IOV) and Converged I/O Networking

I/O, I/O, Its Off To Virtual Work We Go…

Traditional Approaches
Separate networks & interconnects
(Fibre Channel, GbE, IBA, Etc.)
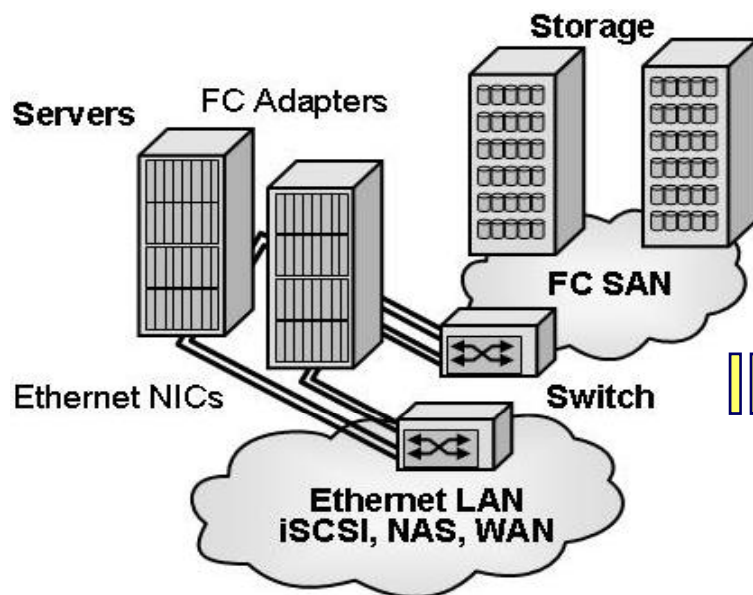
Evolving Approaches
Unified & converged interconnects
(Virtualized FC, GbE, FCoE, Etc.
Physical Data Center Ethernet or IBA)
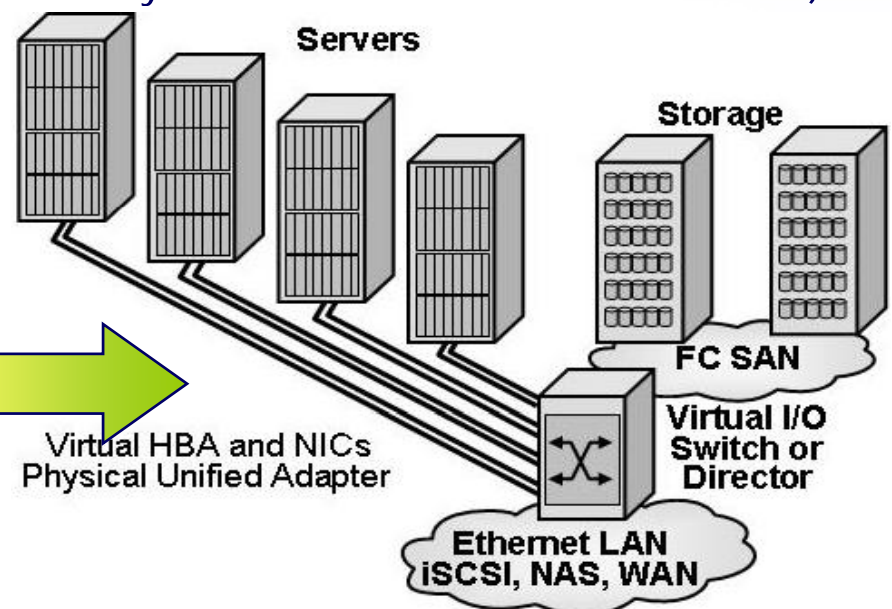
Need for speed: Consolidation, Reduce Response Time (Productivity), Support Growth

See "FCoE Overview" and "I/O, I/O, its Off To Virtual Work we Go" www.storageio.com

Green Computing: Shifting Focus

From green-wash to action, from energy avoidance to energy efficiency

"A little less conversation, a little more action please…" - Elvis

RIP: Green-wash and Green hype!

- **Green-hype**
  On endangered species list
  Less on perception
  More on substance

- **Closing the green gap**
  Economics vs. CO_2 only focus
  Sustain growth and service
  From energy avoidance to energy efficiency

Energy Avoidance
Power Down, Over Consolidate
Decrease Amount of Useful Work
Decrease Energy Used

Some Energy Efficiency
Faster Components, Same Power
Increase Amount of Useful Work
Same Amount Energy Used

Some Energy Efficiency
Lower Power Draw Components
Same Useful Work Done
Decrease Energy Used

More Energy Efficiency
Faster Components/Less Power
Increase Amount Useful Work
Decrease Energy Used

Use/Activity — Useful Work — Power Used
Time — Poor Efficiency Gap
Improved (Better) Efficiency & Economic Gap
Very Good Efficiency Gap

Source: "The Green and Virtual Data Center" (Auerbach)

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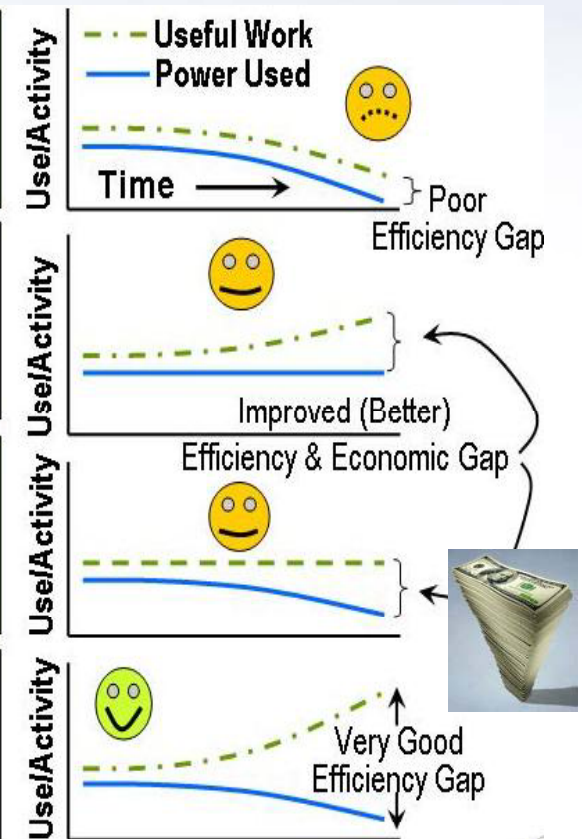
Green Computing: Shifting Focus - Continued

Boosting IT efficiency & productivity, addressing PCFE and other IT issues

Wheel of opportunity: PCFE optimization and IT productivity

Financial Incentives and Rebates

E-Waste EHS RoHS

Mask Or Move Issues

HVAC Alternative Energy

Consolidation

Boost Energy Efficiency

Reduce Data Footprint

Energy Avoidance

Tiered Servers Storage

Best Practices and Policies / Metrics
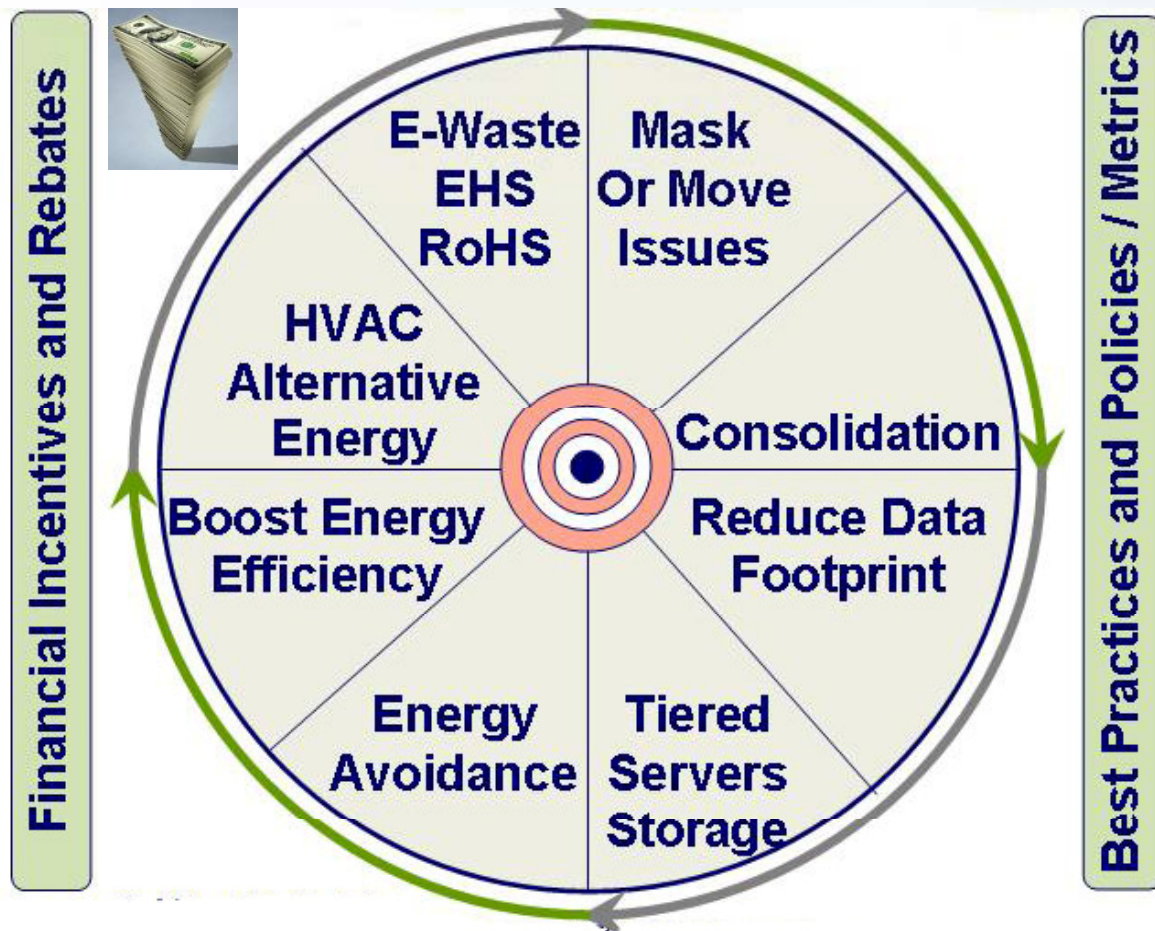
Policies, metrics, monitoring and best practices efficiency rebates

The Green and Virtual Data Center

Greg Schulz

CRC Press

ISBN-10: 1420086669
ISBN-13: 978-1420086669
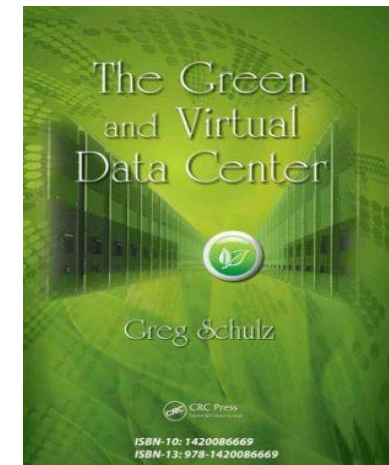
Also see SNIA and other venues for various tips

PCFE: Power, Cooling, Footprint, EH&S

Source: "The Green and Virtual Data Center" (Auerbach)

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Metrics and Measurements

Industry is busy as are EPA and others!

Different usage scenarios

Source: "The Green and Virtual Data Center" (Auerbach)

80 Plus, EPA, Greengrid, JDEC, SNIA, SPC and others
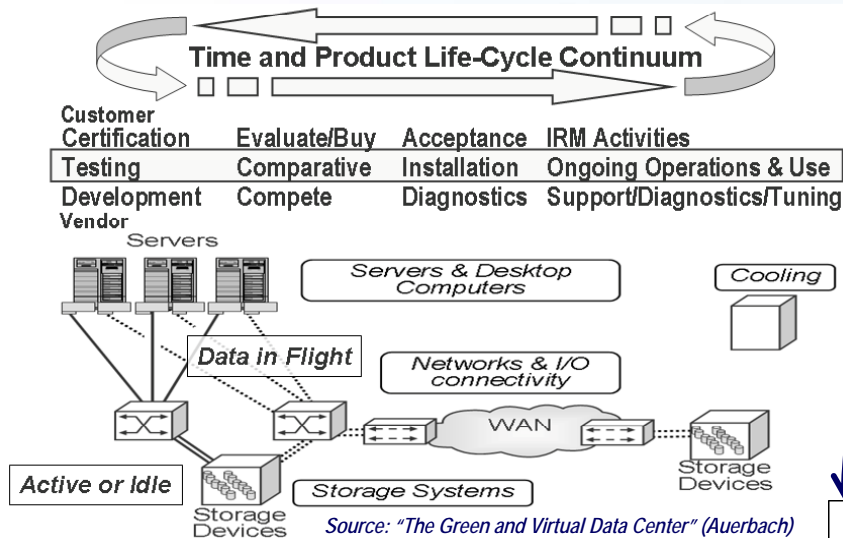
Different areas of focus
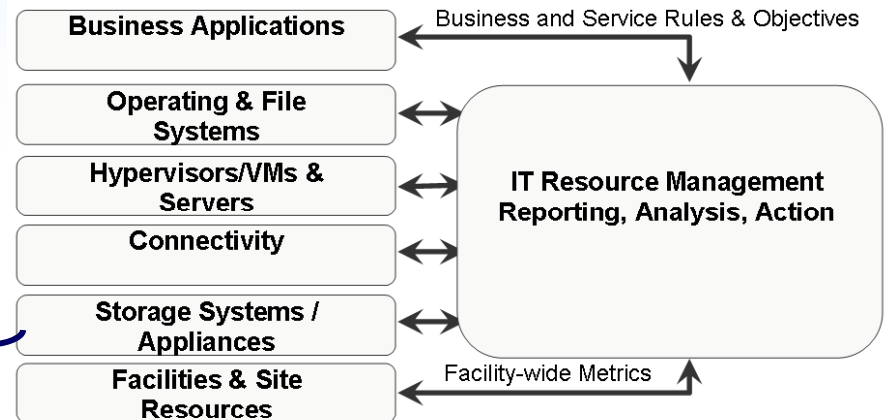
Source: "The Green and Virtual Data Center" (Auerbach)

SNIA metrics and taxonomy

www.storageio.com

What's Next?

Some predictions, opinions and perspectives

- ✓ Archiving escapes from the realm of compliance
- ✓ FCoE prime time "main event" in 2010/2011
- ✓ NAS gains DB popularity when using DIO/CIO
- ✓ OSD and Holographic appear at "some day isle"
- ✓ Object storage systems beginning to get mindshare
- ✓ SAS gets respect for HDD to storage, storage to server
- ✓ RAID remains relevant (Anyone remember DTDS+ ?)
- ✓ Coarser and integrated CDP gaining adoption
- ✓ FLASH and SSD make HDDs relevant, HDDs make tape relevant
- ✓ Small improvements on large basis have big benefits:
  - 2:1 compression on 100TB = 50TB vs. 20:1 dedupe on 5TB = 1TB
  - 4 watts savings per HDD x 1,000 HDDs = 4kW
- ✓ Networks are faster, however more data to move in less time
- ✓ Virtualization is driving need for cross technology domain IRM
- ✓ DLP and security integration across IRM domains
- ✓ More compliance / regulations including ETS and "Green" schemes

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General Comments
Basic Premises – Gain management insight and control

- IT data centers are information factories
  - Efficient equipment, management tools and resources needed
- Many approaches depending upon your customers issues
  - Do more with less: Shift from energy avoidance to efficiency
    - o Small improvements on large scale have big benefits!
    - o More IOPS or Transactions or Files processed per watt of energy
    - o More usable capacity in given footprint per watt of energy
- Avoid simply moving IT problems around
  - Solve problems and issues to enable IT and business growth
    - o Instead of race to replace tape, revamp data protection architecture
- Balance between futures and what works today
  - Leverage virtualization to bridge from the past to the future
  - Virtualization and cloud computing require real resources & people
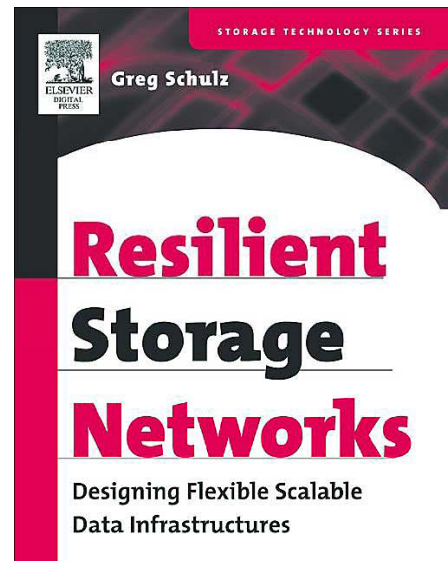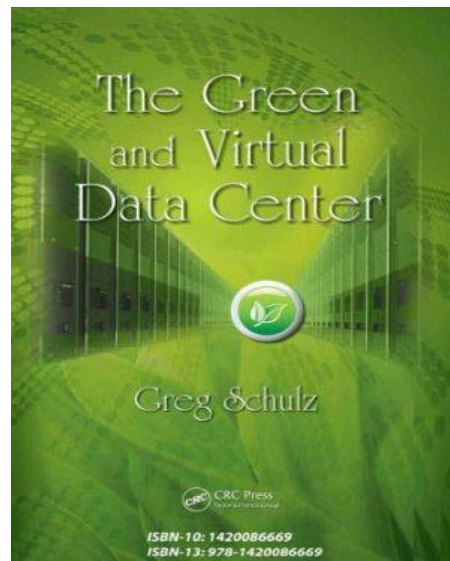
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Next to Closing Comments
So what's my point in all of this anyway?

- In general
  - **More of the same:** "Meet the new boss, same as the old boss" - The who

- 2009 will be a challenging year, there are opportunities
  - Execution and delivery on prior hype and announcements
  - Prepare for future growth and scaling requirements
  - Flexibility, adaptability, leveraging opportunities and challenges
  - Preparation for the next technology and economic phase
  - Optimization to support and sustain growth now and in the future

- What will be important this year
  - Flexibility, adaptability, affordability, value vs. low cost
  - Articulate vision and strategy for near term and long term
  - Educate, generate awareness, add value, be of assistance

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Closing Comments
Look at 2009 as a challenging opportunity

- Where you can learn more: **RSS**
  - www.storageio.com (Book info, white papers, articles, tips, videos)
  - www.storageioblog.com & www.twitter.com/storageio
  - www.thegreenandvirtualdatacenter.com

Order your copy of "The Green and Virtual Data Center" (Auerbach)
At Amazon and other global venues

Thank You
And, Let's Stay In Touch!

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www.storageio.com

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