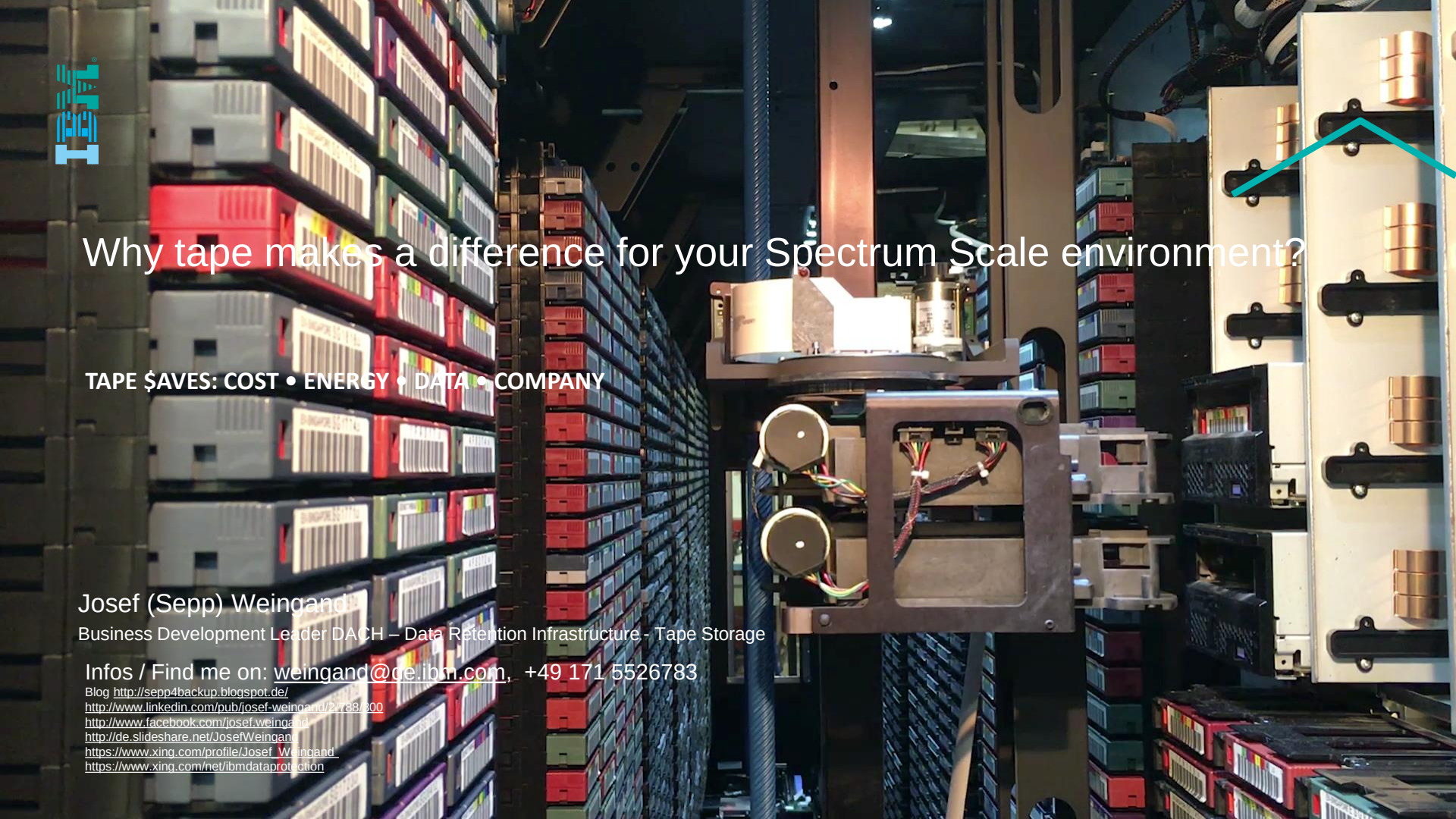


Why tape makes a difference for your Spectrum Scale environment?

TAPE $AVES: COST • ENERGY • DATA • COMPANY

Josef (Sepp) Weingand

Business Development Leader DACH – Data Retention Infrastructure - Tape Storage

Infos / Find me on: weingand@de.ibm.com, +49 171 5526783

Blog http://sepp4backup.blogspot.de/
http://www.linkedin.com/pub/josef-weingand/2/788/300
http://www.facebook.com/josef.weingand
http://de.slideshare.net/JosefWeingand
https://www.xing.com/profile/Josef_Weingand
https://www.xing.com/net/ibmdataprotection

Tape ?? Tape was already replace by VTL/Disk!?!

IBM Spectrum Scale

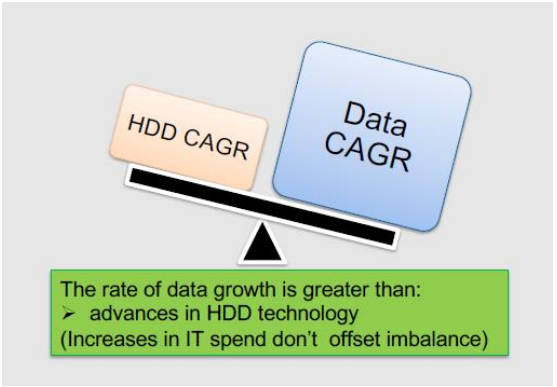
IDC StorageSphere
Tape growing faster than HDD!

Back in 2005…

Hmm wait… Tape is still around:

Back to future….

– Object & Cloud Storage will replace Tape?



So, why should I consider Tape for my Storage environment?

Tape Solve the storage imbalance between data growth and HDD CAGR

A New/Old Weapon Against Ransomware: **Tape Backup**

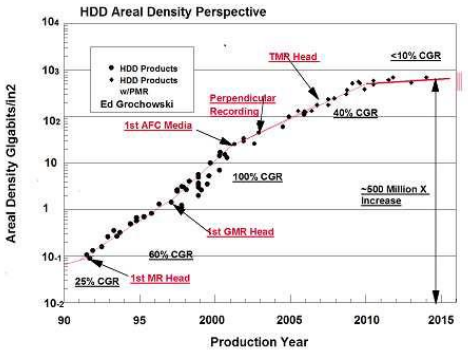
https://searchstorage.techtarget.com/IronMountainCloud/A-New-Old-Weapon-Against-Ransomware-Tape-Backup

HDD ?!?

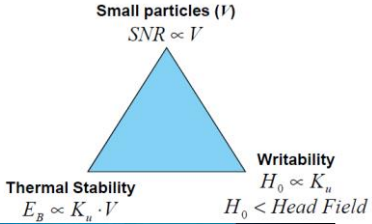
HDD has reached the limit of (known) materials to produce larger write fields:
- Areal density/capacity scaling achieved by shrinking the same basic technology to write smaller and smaller bits on disk

Technologies to go beyond the superparamagnetic limit:
- Shingling magnetic recording (SMR)
- Two dimensional magnetic recording (TDMR)
- Heat Assisted Magnetic Recording (HAMR)
- Microwave Assisted Magnetic Recording (MAMR)
- Bit Patterned Media (BPM)

Recent Capacity Scaling of HDD: Volumetric Density
- Slow down in areal density scaling partially compensated by adding more disks: conventional technology has reached space limit (~5 platters)
- Helium filled drive less turbulence thinner disks higher capacity
  - WD 6TB (2013) 6 platters; HGST 10TB Drive (2015) 7 platters - CAGR 29%
  - 14 TB 9 platters (2017) – CAGR18%
  - 15 TB 9 platters (2018) – CAGR 7%
  - 16 TB (2019) – CAGR 6%
- **Doesn't scale: No space for more heads and platters!**



Magnetic Media "Trilemma":



What Are The Options?

IBM Spectrum Scale

1) Hope for a storage technology breakthrough
– **Nothing coming near term**

2) Pour concrete, spend more $ on HDD
An answer IF the value of data is growing

3) Delete Data
Maybe, You go first.

4) Increase Storage Efficiency
Pay someone else to deal with it – ie. Cloud
Integrate Tape with Flash, HDD & Manage Data Placement –
Why Tape?

IBM Research Rüschlikon: Tape Technology Demonstration August 2017

IBM Spectrum Scale

Areal recording density : 201 Gb/in^2

15 x TS1160 areal density

→ 330 TB cartridge capacity

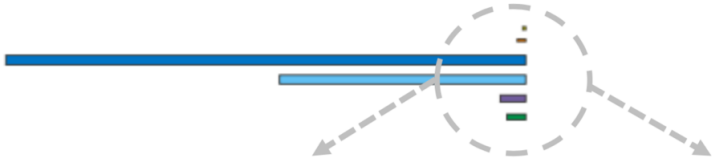
This demonstration shows that tape technology has the potential for significant capacity increase for years to come!

Cost advantage of tape will continue to grow!

Storage Bit Cells and Extendibility

IBM Spectrum Scale

- Scaled bit cells:



- Magnified 25x:

NAND Flash (3 bits) 2150 Gb/in^2
17.3 nm x 17.3 nm

HDD 1000 Gb/in^2
47 nm x 13 nm

LTO7 Tape ~4.3 Gb/in^2
2850 nm x 52 nm

Jag5A Tape ~9.6 Gb/in^2
1347 nm x 50 nm

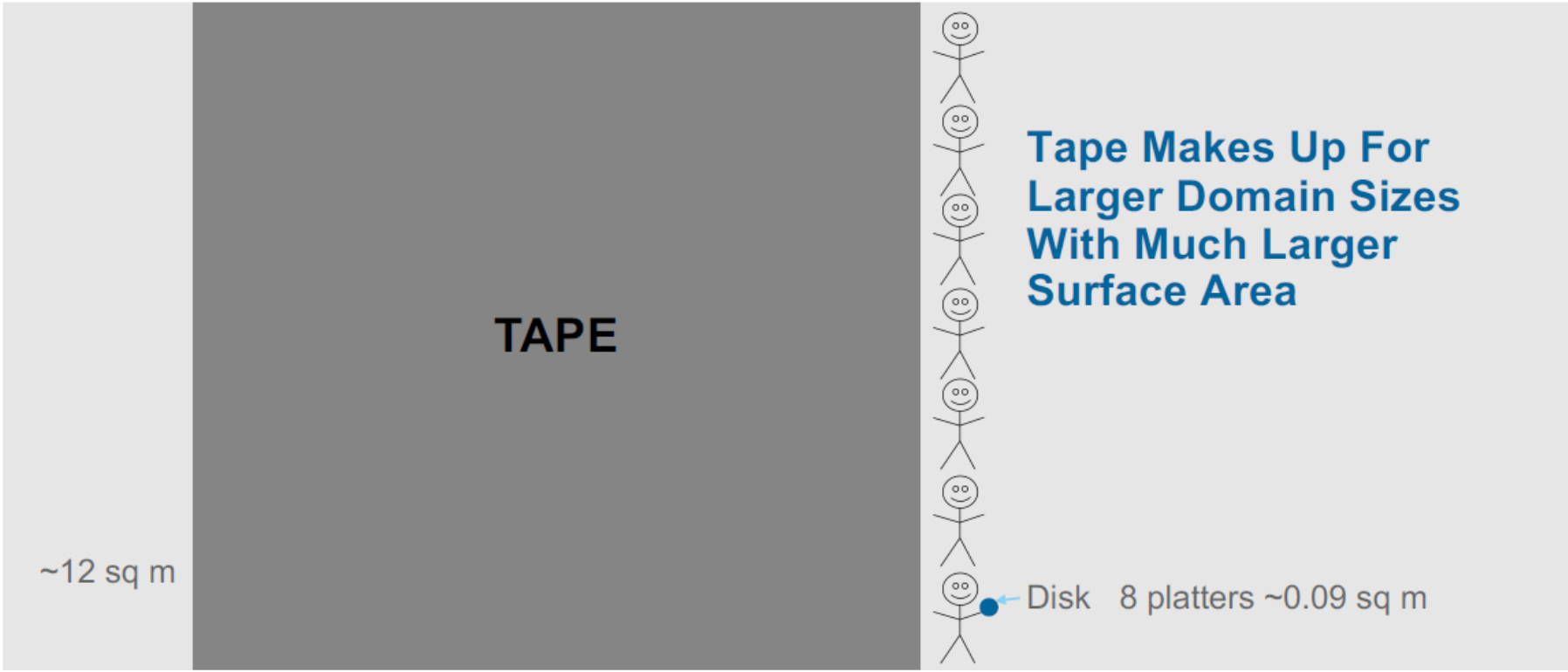
BaFe Demo 123 Gb/in^2
140 nm x 37 nm

Sputtered Demo 201 Gb/in^2
103 nm x 31 nm

Tape Technology Is Unique Among Storage Technologies As It Is **Not** Facing Fundamental Scaling Limitations….
…for at least the next 20 years

Tape vs HDD Surface Area

IBM Spectrum Scale



IBM's Tale of the Tape

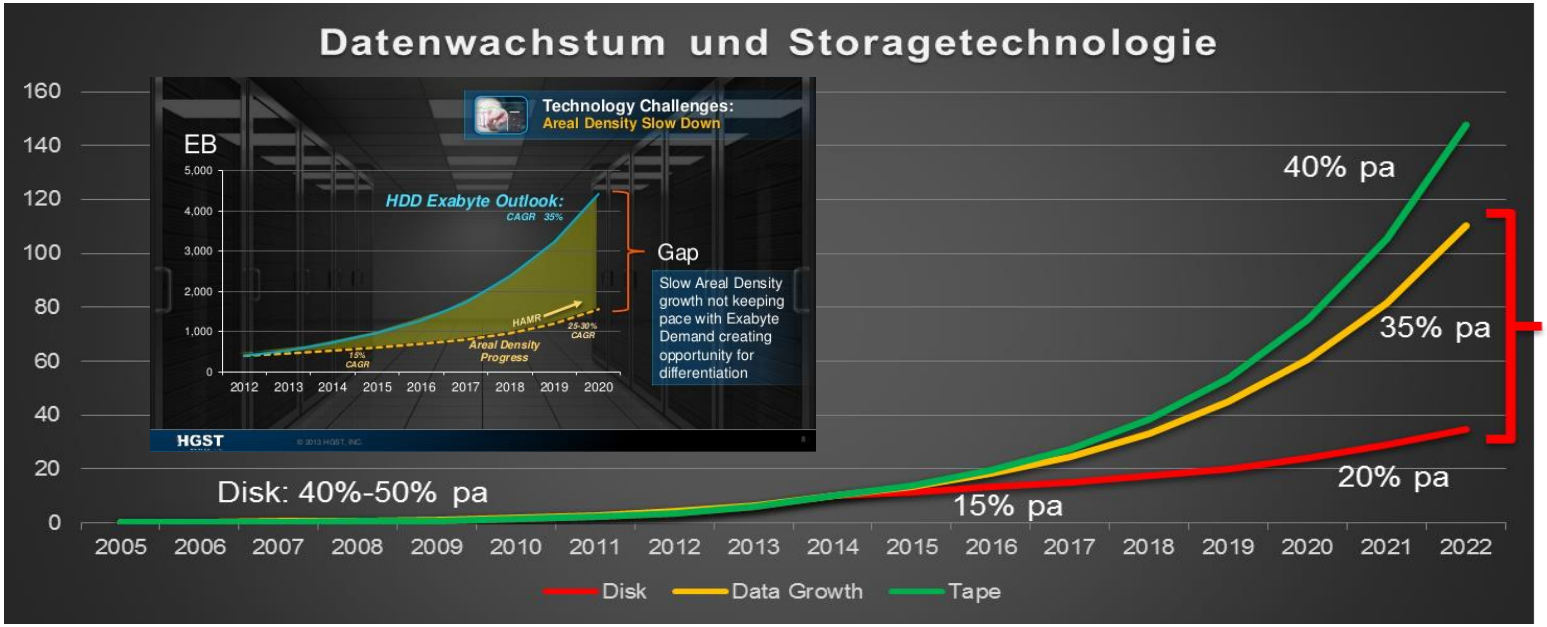
More than 60 years of tape innovation

Scale

	2006	2010	2014	2015	2017
Aerial Density (bits per sq inch)	6.67 Billion	29.5 Billion	85.9 Billion	123 Billion	201 Billion
Cartridge Capacity (Terabytes)	8	35	154	220	330
# of Books Stored	8 Million	35 Million	154 Million	220 Million	330 Million
Track Width	1.5 µm	0.45 µm	0.177 µm	0.140 µm	103 nm
Linear Density (bits per inch)	400'000	518'000	600'000	680'000	818'000
Tape Material	Barium Ferrite	Barium Ferrite	Barium Ferrite	Barium Ferrite	Sputtered Media
Tape Thickness (micrometers)	6.1	5.9	4.3	4.3	4.7
Tape Length (meters)	890	917	1255	1255	1098

#5thtaperecord

Data Growth and the GAP with HDD Technology



-> Tape Backup is not dead!

GAP: 3x

-> LTFS

Spectrum Archive

Until 2014 disk capacity growth outperform data growth.

Now Data Growth is much higher than disk capacity growth.

Close the GAP with TAPE

All HDD installed per year needs 155 000 KW and produce 4 795 837 200 kg CO2 (-> 1,4 Mio cars)

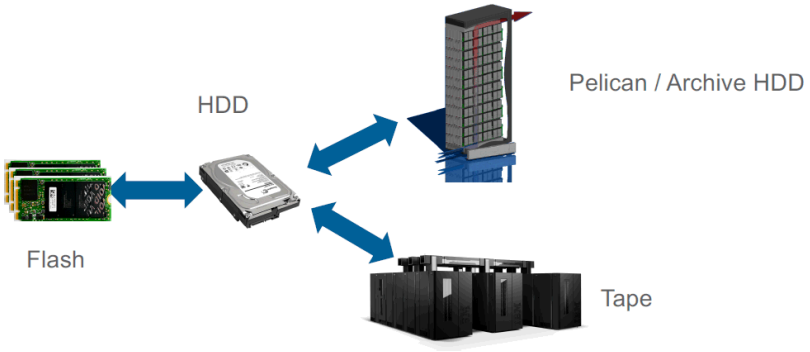
Stop the discussion “Tape is NOT dead“

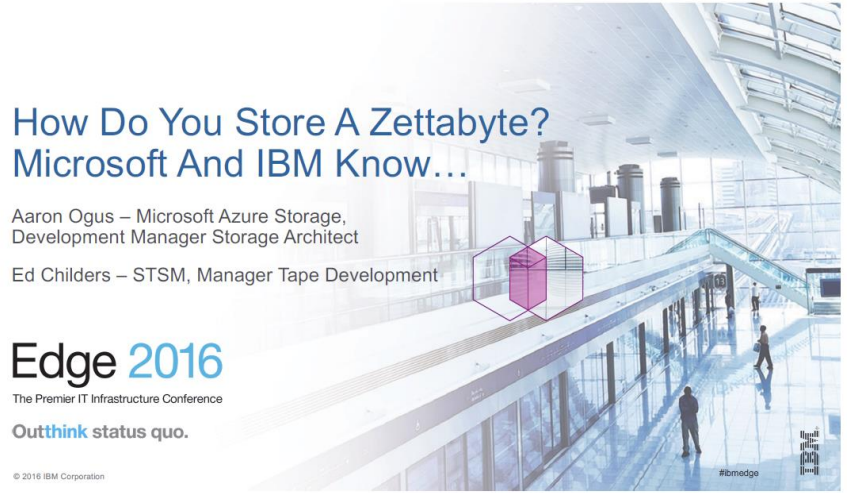
Microsoft Azure use Tape

Why Microsoft Azure will use Tape:

- The cheapest most economical way to store cold data, continued improvement with 30%+ CAGR and easiest roadmap.
- Cheaper-Separating the media from the reader/writer
  - Both Tape and Optical pull the media out of the reader/writer.
  - 1 expensive part, and service any amount of media.
  - Tape libraries can be more flexible in drive / media ratio

Moving data between Tiers can provide huge savings





Current and Future Service Cost *Estimates* under model using retail pricing

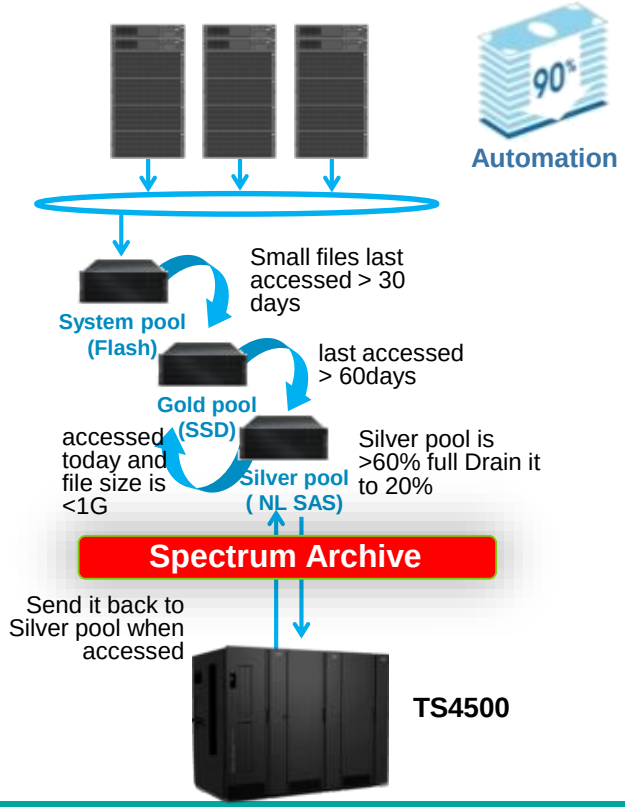
Flash	2015	2020
Cost / GB	3.45	0.71
Cost / ZB	$3.4 Trillion	$714 Billion
Cost / ZB / year	$1.15 Trillion	$238 Billion

HDD	2015		2020
Cost / GB	0.125		0.05
Cost / ZB	$125 Billion		$50 Billion
Cost / ZB / year	$41 Billion	Faktor ~4	$17 Billion

Tape	2015	2020
Cost / GB	0.06	0.013
Cost / ZB	$55 Billion	$13 Billion
Cost / ZB / year	$8 Billion	$1.9 Billion

Faktor ~2

IBM Spectrum Scale & Archive or Protect: Policy-based Cost Optimization



- **Powerful policy engine**
  - Example: File Heat measures how often the file is accessed.
  - As the file gets “cold” move it automatically to a lower cost storage pool
  - Information Lifecycle Management
  - Fast metadata ‘scanning’ and data movement
  - Automated data migration to based on threshold
- **Users not affected by data migration**
  - Single namespace
  - Persistent view of the data
- **Tape as the external pool of Spectrum Scale**

Highlevel Architecture

IBM Spectrum Scale

Customer application can run on Spectrum Protect NSD client or server nodes.

Supported platforms:
Customer application on NSD client:
AIX™, xLinux, pLinux, zLinux, Windows®
Customer application on NSD server:
Spectrum Protect: AIX™, xLinux, zLinux (4Q15)
Spectrum Archive: xLinux

IBM Spectrum Scale

Spectrum Scale NSD clients

Spectrum Scale NSD server

Supported platforms:
AIX™, xLinux, pLinux, zLinux, Windows®

Spectrum Protect for Space Management
Spectrum Protect Backup Archive Client

Supported platforms:
AIX™, xLinux, zLinux (4Q15)

IBM Spectrum Protect

Function:
- Backup, Restore
- Migration, Recall
- SOBAR

Spectrum Protect Server

Supported platforms:
AIX™, xLinux, pLinux, zLinux, HP, Sol, Windows®

Supported storage technologies

Disk, Optical, Tape Library, Object Storage

Both components use the same HSM logic and cannot be operated in one Spectrum Scale cluster

Spectrum Archive Enterprise Edition

Supported platform:
xLinux

IBM Spectrum Archive

Function:
- Migration, Recall

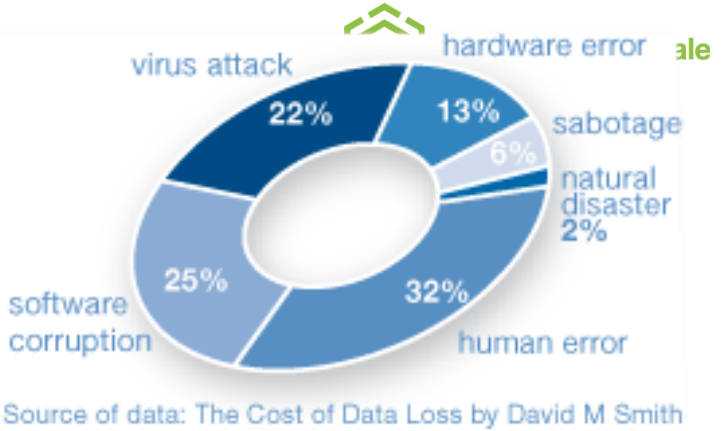
Supported storage medium:

LTFS compatible Tape Library

Why Backup and why Tape for Backup

For many organizations, backup is either breaking or broken

42% of small companies
have experienced data loss. **32%** lost files forever.



Companies Look to an Old Technology to Protect Against New Threats

Companies are once again storing data on tape, just in case
https://www.wsj.com/articles/companies-look-to-an-old-technology-to-protect-against-new-threats-1505700180

"You're never fully backed-up without an air gap"

Halten Sie Ihre Backup-Daten offline, um gegen Ransomware geschützt zu sein

http://www.searchstorage.de/tipp/Halten-Sie-Ihre-Backup-Daten-offline-um-gegen-Ransomware-geschuetzt-zu-sein

Bei den wenigen konkreten Ransomware-Attacken, die publik werden, zeigt sich: nur kalte Datensicherung schützt vor den Folgen eines erfolgten Angriffs. Nur, wenn Daten so gesichert wurden, dass sie systembedingt vor der Verschlüsselung oder dem Löschen geschützt sind, ist die Wiederherstellung und damit die Verhinderung einer Lösegeldzahlung möglich.

http://www.storage-insider.de/ein-backup-ist-kein-archiv-a-595016/?cmp=sm-fb-swyn&utm_source=facebook&utm_medium=sm&utm_campaign=facebook-swyn

ING-Bank: Serverausfall durch Probealarm

heise online 12.09.2016 10:55 Uhr – Lutz Labs vorlesen

Ein Rechenzentrum der rumänischen Niederlassung der ING-Bank ist am Wochenende durch den Test der Feuerlöschanlage ausgefallen. Grund war wohl der laute Knall der Gaspatronen.

Das Schlimmste, was einer Bank he
die Rechenzentren besonders gesch
gelöscht, sondern meistens mit Stic
Hardware zu beschädigen.

Löschanlagen-Ton zerstört Festplatten in schwedischem Rechenzentrum

https://www.heise.de/newsticker/meldung/Loeschanlagen-Ton-zerstoert-Festplatten-in-schwedischem-Rechenzentrum-4029730.html

Der Test einer solchen Löschanlage aber führte in einem rumänischen Rechenzentrum der ING-Bank zu einem Ausfall diverser Festplatten. Nach Angaben der Bank waren Kartentransaktionen, Transaktionen am Geldautomaten und Internet-Banking betroffen sowie die Website www.ing.ro am Samstag zwischen 13 und 23 Uhr nicht verfügbar.

Allianz: Cyberkriminalität weltweites Unternehmensrisiko Nummer eins

Teure Ransomware

…vor wenigen Jahren 10.000 bis 20.000 Euro übliche Summen, inzwischen werden zweistellige Millionensummen verlangt.

Attacks are becoming more costly and more likely

IBM Spectrum Scale

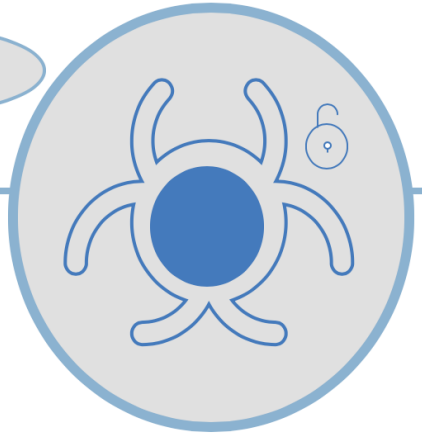
$3.86 million

Average total cost of a data breach in 2018

$200k/hr Downtime

$8 billion

Estimated global cost of WannaCry attack



$310+ million

Cost impact for one company impacted by NotPetya

196 days

Average amount of time hackers spend inside IT environments before discovery

1 in 4

Odds of experiencing a data breach over next two years

#3 Likely **#6 Impact**

* World Economic Forum 2018 Global Risks

NIST Cyber Resiliency Framework

IBM Spectrum Protect

Attacks are getting more aggressive

Hackers get access to your network

– Emutet (response of Email)

Hackers looks for valuable targets

– Hackers are in your network for an average of 196/206 days

Hackers destroy / encrypt backup data

– Container Pools, Storage Pools, Disk Backups

– Backup Appliances (e.g. DD)

– Snaps (SnapVaults, offline Snaps, etc.)

After that hackers encrypt (ransomware, cryptoLocker, etc) your online/production Data

Ransomware "NextCry" greift Nextcloud-Server an

Eine Linux-Malware attackiert Nextcloud-Server, um Dateien zu verschlüsseln und Lösegeld zu fordern. Einfallstor ist möglicherweise eine NGINX/PHP-FPM-Lücke.

Lesezeit: 2 Min. In Pocket speichern 183

BSI warnt vor gezielten Angriffen auf Unternehmen

- *„**Wir erleben derzeit die massenhafte Verbreitung von raffinierten Angriffsmethoden durch die Organisierte Kriminalität**, die bis vor einigen Monaten nachrichtendienstlichen Akteuren vorbehalten waren….“*, so BSI-Präsident **Arne Schönbohm**.

- ….Angreifer etwaige **Backups zu manipulieren oder zu löschen** und bringen dann selektiv bei vielversprechenden Zielen koordiniert Ransomware auf den Computersystemen aus. …aufwändige Vorgehen können Angreifer deutlich höhere …zunehmend auch IT-Dienstleister betroffen..

- **Es droht ein kompletter Datenverlust**
  …**gezielt lukrativere Ziele angreifen und u.U. Backups so manipulieren bzw. löschen, dass diese nicht mehr zur Wiederherstellung der Systeme .., können die Angreifer wesentlich höhere Lösegeldbeträge fordern**. **.., die über keine Offline-Backups verfügen, verlieren bei diesem Vorgehen alle Backups, selbst wenn diese auf externen Backup-Appliances liegen. Dem BSI sind mehrere Fälle bekannt, bei denen die Verschlüsselung aller Systeme sowie der Backup-Appliances nicht in eine Risikobewertung einbezogen wurde, weshalb die betroffenen Unternehmen alle Daten verloren haben.**

- https://www.bsi.bund.de/DE/Presse/Pressemitteilungen/Presse2019/BSI_warnt_vor_Ransomware-Angriffen-240419.html;jsessionid=79E52BD70F262A8D8DF94C72D4CCDE49.1_cid351 24.04.2019

BSI Leitfaden „Ransomware“:
- Dabei liefern Snapshots bzw. Backup-to-Disk …auch das Risiko, dass sie selbst der Verschlüsselung zum Opfer gefallen sind
- 5.2 Backups / Datensicherungskonzept: Ein Backup ist die wichtigste Schutzmaßnahme, mit der im Falle eines Ransomware-Vorfalls die Verfügbarkeit der Daten gewährleistet ist. ...Insbesondere müssen die Daten in einem Offline-Backup gesichert werden, da viele Ransomware-Varianten auch Online-Backups, … verschlüsseln.
- https://www.bsi.bund.de/SharedDocs/Downloads/DE/BSI/Cyber-Sicherheit/Themen/Ransomware.pdf;jsessionid=79E52BD70F262A8D8DF94C72D4CCDE49.1_cid351?__blob=publicationFile&v=6

If you don‘t use Tape in our Backup solution, you will lose all of our Data!
=> Act now and add Tape to your Backup architecture!

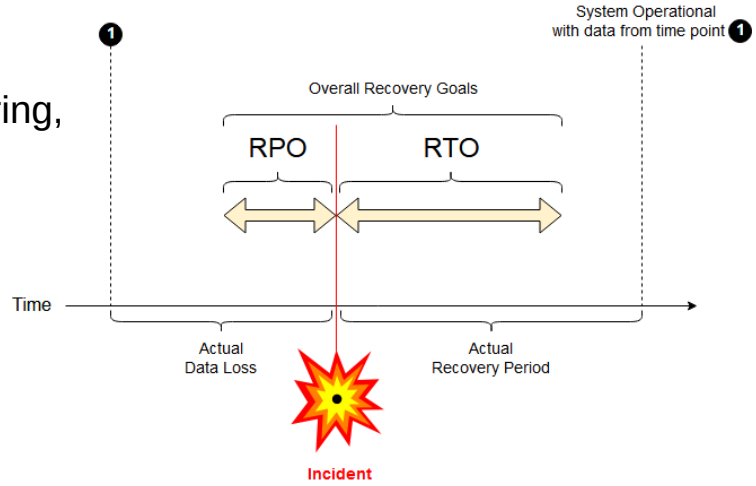
Rethink about RTO & RPO

IBM Spectrum Scale

The **recovery time objective (RTO)** is the targeted duration of time and a service level within which a business process must be restored after a disaster (or disruption) in order to avoid unacceptable consequences associated with a break in business continuity.

A **Recovery Point Objective (RPO)** is defined by business continuity planning. It is the maximum targeted period in which data (transactions) might be lost from an IT service due to a major incident.

- What is a Diaster?
  - Fire, Flood, a plan hits your DataCenter
- Therefore we used to use redundant Data Center with Mirring, Replication, etc.
  - No one was thinking about total data loss
- Now a days its real!
- **You need to prepare to restore ALL of your Data**
- Define a new RTO'
  - With one tape drive you may restore up to 1 TB/h
    - E.g. if you need to restore 500 TB with 4 tape Drives it takes at least 5 -14 days
      With 10 tape drives you may reduce it to 2 – 7 days
  - Consider performance bottlenecks in SP DB, CPU, Disk, etc.
  - Optimize your backup for restore from Tape!



IBM DP&R Storage / Produkte

IBM Spectrum Scale

IBM Spectrum Protect / IBM Spectrum Archive

Media

LTO 6
• 2500 GB
• 160 MB/sec

LTO 7
•6 TB
• 300 MB/sec

LTO8
• 12 TB
• 360 MB/sec

TS1140
• 4 TB
• 250 MB/sec

TS1150
• 10 TB
• 350 MB/sec

TS1155
• 15 TB
• 350 MB/sec

New

TS1160
• 20 TB
• 400 MB/sec

Tape Drives

1 HH

21 HH

128

TS2900
• 9 Slots

TS4300
• 40 – 280 Slots
• up to 21 Drives

New

TS4500
• 100 – 23 170 Slots

TSLM

Tape Libraries

Whats new!

Dezember 2015
Spectrum Archive (LTFS EE): Multiple Library Support
Spectrum Archive (LTFS LL): Free of charge

Mai 2016
TS4500 HA Support + Mainframe Support; TS7760 Neue VTS-Hardware

Mai 2017
TS1155 Tape Drive: 15 TB / 360 MB/sec

Juli 2017
TS4300 Tape Library: 272 Slots / 21 LTO Drives

October 2017
LTO 8: 12 TB / 360 MB/sec

November 2018
TS1160: 20 TB / 400 MB/sec

Feb/Marc 2019
TS4300: 40 Slots – 280 Slots

October 2019
TS1160 Ethernet Connection

D2D
•V3700, V5000,V7000, XIV, DS8000, GPFS/ESS, Flash

TS7700
• VTS für zOS

Tape Virtualization & D2D

Tape Drive History and Roadmap

IBM Spectrum Scale

LTO Generations	LTO-5	LTO-6	LTO-7	LTO-8	LTO-9	LTO10
Capacity (Native)	1.5 TB	2.5 TB	6 TB	12.0 TB	18 TB	Up to 36 TB
Other Format Capacities	800 GB (400 GB R/O)	1.5 TB (L5) (800 GB R/O)	2.5 TB (L6) (1.5 TB R/O)	9 TB (M8) 6 TB (L7)	12 TB (L8)	Up to 18 TB (L9)
Native Data Rate	140 MB/s	160 MB/s	300 MB/s	360 MB/s	Up to 400 MB/s	Up to 500 MB/s

2008 2010 2011 2013 2014 2015 2017 2017 2018

	TS1130	TS1140	TS1150	TS1155	TS1160	TS1170	TS1180
New Format Capacity (Native)	1 TB (JB) 640 GB (JA)	4 TB (JC) 1.6 TB (JB)	10 TB (JD) 7 TB (JC)	15 TB (JD)	20TB (JE) 15 TB (JD) 7 TB (JC)	Up to 40 TB (JF) Up to 25 TB (JE) 15 TB (JD)	Up to 80 TB (JG) Up to 50 TB (JF)
Other Format Capacities (Native)	700 GB (JB) 500 GB (JA) 300 GB (JA)	1 TB (JB) 700 GB (JB) (All JA R/O)	4 TB (JC)	7 TB (JC) 4 TB read only (JC)	10 TB (JD) 7 TB (JC) 4 TB (JC)	10 TB (JD)	
Native Data Rate	160 MB/s	250 MB/s	360 MB/s	360 MB/s	400 MB/s FC-16	Up to 500 MB/s FC-16	Up to 1000 MB/s FC-32, 25 GibE

Media Investment Protection
next tape drive generation re-writes JE-media with 50% more capacity **and reduce €/GB by 50%**

IBM TS1160 Tape Drive Overview

IBM Spectrum Scale

- **Provides customers with increased capacity and performance**
  - **20 TB** native capacity with new JE media (2x increase over TS1150), JE 5TB (Economy cartridge) and JE **20 TB** (WORM)
  - Performance increase: **400 MB/s** (1.1x increase over TS1150)
  - Supports dual **FC-** 16 Gb
    - 25 Gbit Ethernet in 2H19
  - Enryption AES-256/LZ-1 enhanced
  - Spectrum Archive and Spectrum Protect Support new TS1160 Tape Drive.

IBM TS1160 Ethernet Attached Tape drive

IBM Spectrum Scale

- **TS1160 (3592 60E)**
  - All the features of TS1160*
  - RDMA over Converged Ethernet (RoCE v2)
  - 10GbE Optical
  - Runs over traditional Ethernet Network
    - No modifications
    - RoCE HBA required in server
- Enterprise Ecosystem support
  - RHEL 7.6, 8.0*
  - *(post GA)
- TS4500 Automation
- Available 4Q2019
- Currently no SP Support
  - RFE http://www.ibm.com/developerworks/rfe/execute?use_case=viewRfe&CR_ID=137171

*No CPF

IBM LTO G8, G7 and G6 FH and HH Comparison

IBM Spectrum Scale

Function	IBM TS1160	IBM TS1155	IBM LTO 8 FH	IBM LTO 8 HH	IBM LTO 7 FH	IBM LTO 7 HH	IBM LTO 6 FH	T10000D
Capacity (Native)	20 TB	15 TB	12 TB	12 TB	6.0 TB	6.0 TB	2.5 TB	8 TB
Compressed Capacity	60 TB	45 TB	30 TB	30 TB	15.0 TB	15.0 TB	6.25 TB	
Data rate	400 MB/sec	360 Mb/sec	360 MB/s	300 MB/s	300 MB/s	300MB/s	160 MB/s	252 MB/sec
Compression data Rate (2.5:1)	900 MB/sec	750 MB/sec	750 MB/s	750 MB/s	750 MB/s	750 MB/s	400 MB/s	
Max Sustained transfer rate	1200 MB/sec	800 MB/sec	500 MB/s (SAS) 700 MB/s (FC)	500 MB/s (SAS) 700 MB/s (FC)	500 MB/s (SAS) 700 MB/s (FC)	500 MB/s (SAS) 700 MB/s (FC)	500 MB/s (SAS) 700 MB/s (FC)	
Host Interfaces	FC-16Gb	FC-8Gb Both dual ports	FC-8Gb Both dual ports	SAS-6Gb FC-8Gb Both dual ports	FC-8Gb Both dual ports	SAS-6Gb FC-8Gb Both dual ports	SAS-6Gb FC-8Gb Both dual ports	FC-16 Gb
Speed Matching	122 – 40 MB/s	110 - 36 MB/s	110 - 360 MB/s	100-300MB/s	100-300 MB/s	100-300MB/s	40-160 MB/s	120/250 MB/s
Buffer	2 GB	2 Gb	1 GB	1 GB	1 GB	1 GB	1 GB	2 GB
Media to Load / Unload	10 sec /	12 sec / 22 sec	15 sec / 24 sec	15 sec / 24 sec	15 sec / 20 sec	15 s / 20 s	12 s / 17 s	13 s / 23 s
Rewind speed	18 m/s	12,4 m/s	10 m/s	9 m/s	10 m/s	9 m/s	10 m/s	10-13 m/s
Locate speed	18 m/s	12,4 m/s	10 m/s	9 m/s	10 m/s	9 m/s	10 m/s	10-13 m/s
Average file access	45 sec	45 sec	59 s	60 s	56 s	60 s	62 s	50 sec
Media length	1163 m	1075m	960m	960m	960m	960m	846m	

TS3500 History

IBM Spectrum Scale

- L32/D32 Frames: 1. Generation (2000 to 2004)
  - L32/D32 does not support LTO7 and newer Tape Drives
    - TS3500 Library may not have any X32 Frame
- **End Of Service (EOS) for L32 & D32 was on June 30, 2017**
    - Currently no EOS planed for L22/D22/L52/D52/L23/D23/L53/D53
    - Highly recommended: upgrade all L22/D22/L52/D52 to L23/D23/L53/D53
- All L-Frames WFM, effective 6. Oktober 2017
- D23, D53, S24, S54 WFM September 2019
- New Drives still available
  - TS1160
  - Upgrade to TS4500…

TS3500 Shuttle

Library	Comment	GA	WFM Date	EOS Announcement	EOS Date
3584-L32	TS3500 Base-Frame LTO	23.08.2000	01.10.2004	19.07.2016	30.06.2017
3584-D32	TS3500 Drive-Frame Jaguar	23.08.2000	01.10.2004	19.07.2016	30.06.2017
3584-L22	TS3500 Base-Frame Jaguar	11.06.2004	16.06.2006	09.07.2019	**31.12.2020**
3584-D22	TS3500 Drive-Frame Jaguar	11.06.2004	16.06.2006	09.07.2019	**31.12.2020**
3584-L52	TS3500 Base-Frame LTO	11.06.2004	16.06.2006	09.07.2019	**31.12.2020**
3584-D52	TS3500 Drive-Frame LTO	11.06.2004	16.06.2006	09.07.2019	**31.12.2020**
3584-L23	TS3500 Base-Frame Jaguar	09.06.2006	07.10.2017		
3584-D23	TS3500 Drive-Frame Jaguar	09.06.2006	07.09.2019		
3584-L53	TS3500 Base--Frame LTO	09.06.2006	07.10.2017		
3584-D53	TS3500 Drive-Frame LTO	09.06.2006	07.09.2019		
3584-HA1	TS3500 HA Frame	04.03.2005	07.09.2019		
3584-S24	TS3500 HD Frame Jaguar	07.11.2008	07.09.2019		
3584-S54	TS3500 HD Frame LTO	07.11.2008	07.09.2019		

TS4500 Tape Library

IBM Spectrum Scale

Store over 350 PB

Transfer up to 184 TB/hour with 128 tape drives

Scale at up to 2 PB per square foot

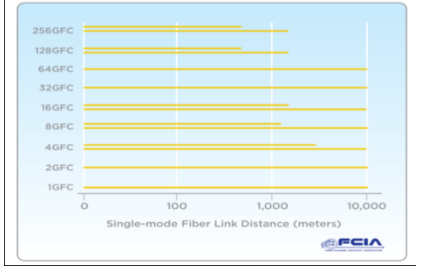
Simplify management

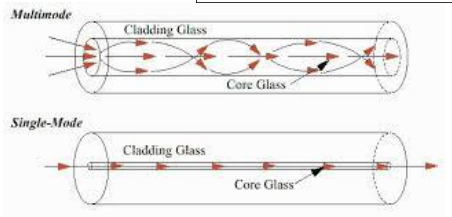
- Magazine I/O
- Integrated management
- Improved ease-of-use
- Extensible platform

–* All capacities are un-compressed

New LTO-8 – Single Mode Fiber

- Multimode fiber has a relatively large light-carrying core, 50 microns in diameter for OM3 fiber.
- Single-mode fiber has a small light-carrying core of 8 to 10 microns in diameter. It is normally used for long distance transmissions.
- Orderable for TS4500 as 3588 model F8S
  - Pre-req of new drive quad mounting kit feature codes 1531-1534 (replaces 1521-1524)
  - With these new drive mounting kits, the drive-to-patch-panel cables are now ordered separately as FC 1536 (MMF), FC 1537 (SMF), or FC 9713 (direct fiber - no patch panel cables)
- Announce 11/20/18, GA 12/7/18



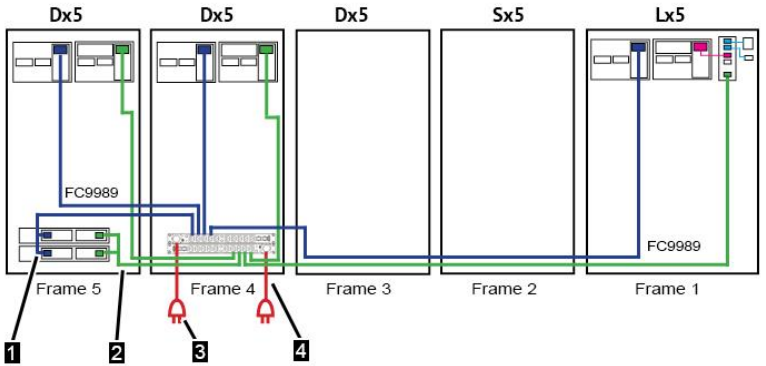


New PDU option (announce 11/20/18, GA 3/8/19)

IBM Spectrum Scale

Enhanced PDUs to address hyperscale datacenter requirements

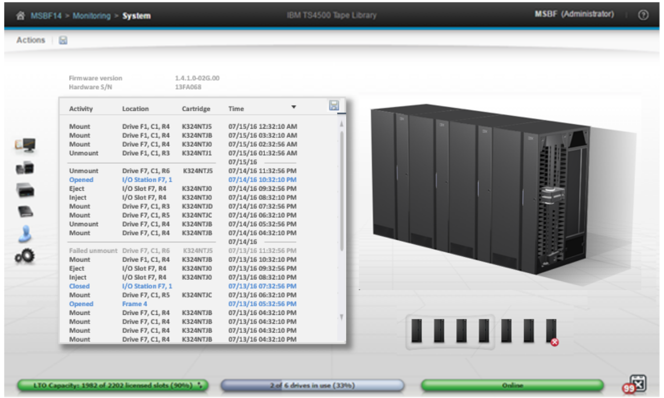
- Adds support for 3-phase power
- Can be installed in any TS4500 frame (FC 1952) or in the model TR1 top rack (FC 1752)
- Can supply power for 2 additional adjacent Frames
  - #9989
- #1952 - Enhanced PDUs
  - Provides two PDUs with **3-phase (wye) or single phase** input power, mounting hardware including rack brackets, and internal power cables to provide power to the local frame control assembly.
  - For single phase input power, must order one power cord feature #9954 thru #9958.
    - # 9956 IEC 309 Power Cord
  - For 3-phase input power, must order one power cord feature #9948.



TS4500 user centered design

User centered design process creates innovations in the user experience including the Management GUI and a new REST API

Co-creation with clients has resulted in roadmaps that address real issues of today's users.

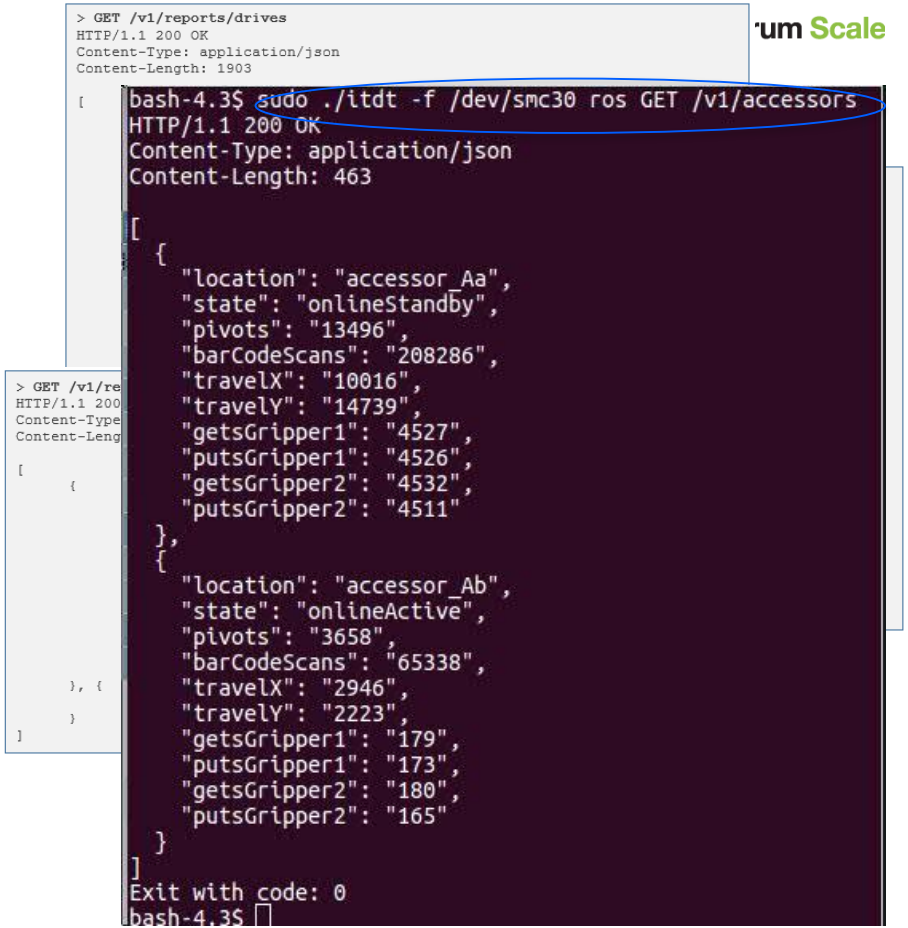


TS4500 REST API (December, 2019)

JSON resources include accessors, cartridges, drives, node cards, events, tasks, and hourly reports for drive and library health, performance, utilization, and environmentals.

New monitoring option - designed to provide detailed and actionable states for all resources in the library.

Innovative REST over SCSI (RoS) approach to be supported via ITDT v9.4



Why Tape

Data continues to grow exponentially while HDD scaling has stagnated
- < 10% CGR

Tape: Capacity growth 40% per year
- **today 20 TB … in 10 years 330 TB per cartridge**

Long media lifetime 30+ years

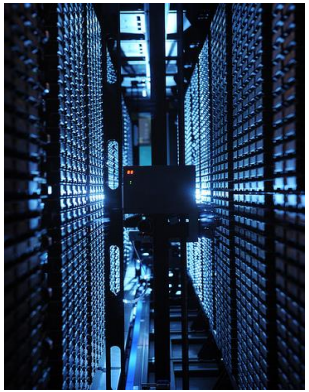
Reliability
- Orders of magnitude better error protection than disk
- Typically, no data loss in case of drive failure
- Tape is offline => Tape Air-Gap

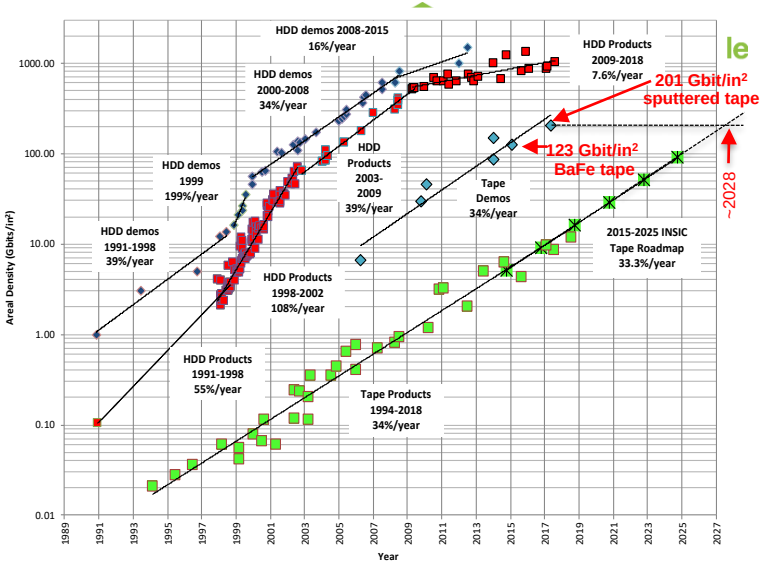
Tape ist fast
- 1,4 TB/h –with 20 Drives up to ~700 TB/d

Energy efficiency and protect the climate
- No power needed after data has been recorded

Tape saves space - 20 PB/m²

1/5 the cost of disk - will continue to grow 38x by 2025





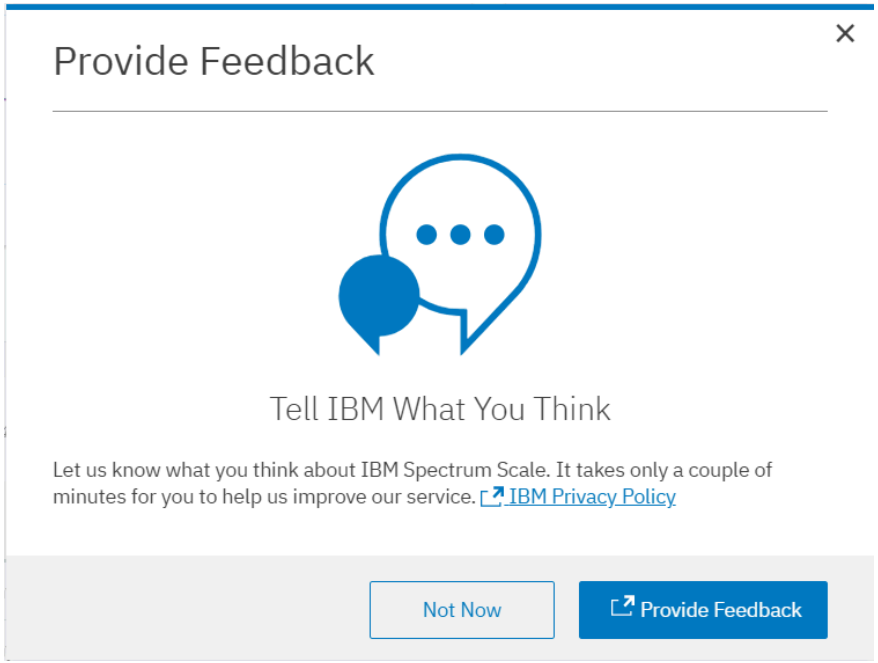
The main net advantage of tape is low cost !

Online disk data is exposed to corruption

Use offline tape storage for outstanding protection

The Last Line of Defense!

Thank you!



Please help us to improve Spectrum Scale with your feedback

- If you get a survey in email or a popup from the GUI, please respond
- We read every single reply