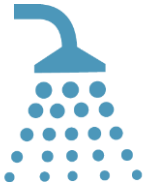
IBM® Tape Portfolio

Protecting Enterprise Critical Data

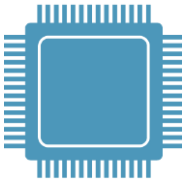
Welcome to the Cognitive Era:

A new era in technology, a new era in business



Data is transforming industries and professions

The world is being reinvented in code



Computing is entering a new Cognitive Era

Where code goes, where data flows, cognition will follow.

IT leaders must drive innovation at unprecedented speed and scale ….

…while maintaining their core businesses

Driving innovation:

IoT will connect **30 billion** devices by 2020

48% of shoppers want on-demand personalized promotions

65% of transactions with healthcare organizations will be mobile by 2018

Maintaining business:

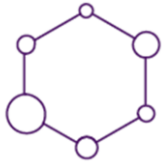
6.75 TBs of data will be created per person per day by 2018

Average cost of a data breach in 2020 will exceed **$150 million**

Average hourly cost of downtime is over **$1.6 million**

We believe mastering hybrid cloud means evolving IT infrastructure in three areas

Accelerate speed of innovation for new services



Integration for Mobile Services

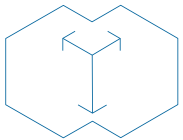
Tap into your ecosystem and extend infrastructure investments to drive innovation

Deliver real-time business visibility and insights

Data for Analytics Services

Integrate data from various sources and derive real-time insights from oceans of data

Ensure secure, compliant and predictable IT services



Operations for Service Predictability

Create an infrastructure and service management strategy based on business needs

What Tape Does Best

- ***Long term storage:*** Infrequently accessed data
- ***Multiple copies:*** Near-line and offline data
- ***Protection:*** Encryption, security and compliance
- ***Cost Reduction:*** Reduce space and lower power
- ***Defensibility:*** Unaffected by viral attacks

Over 60 years of tape innovations

In tape drive technology and software

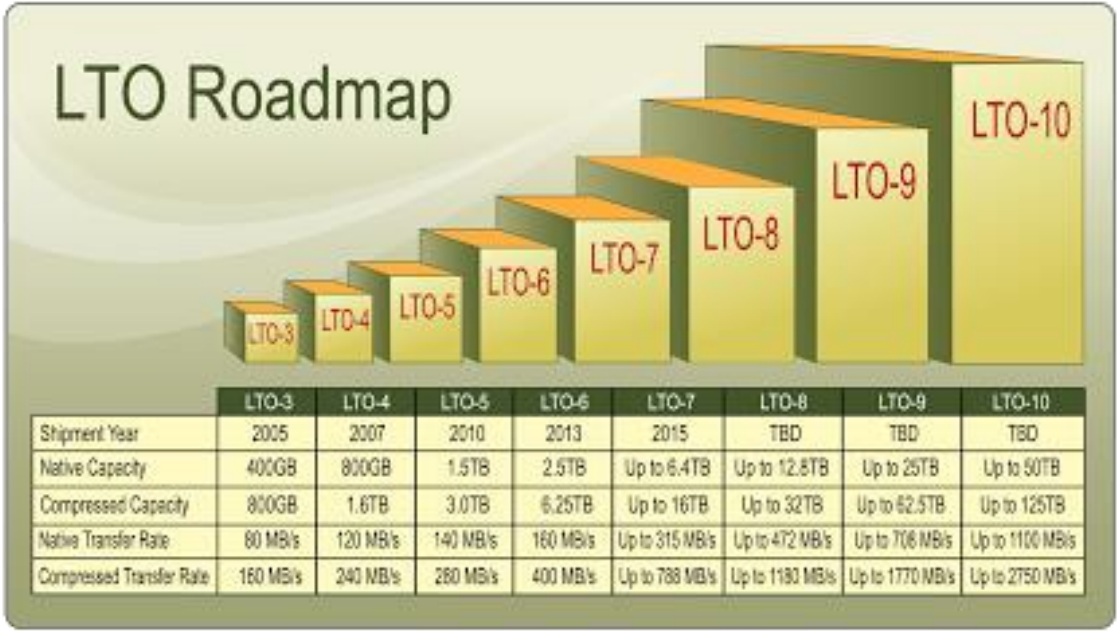
1952 IBM 726 1st magnetic tape drive
1959 IBM 729 1st read/write drive
1964 IBM 2104 1st read/back drive
1984 IBM 3480 1st cartridge drive
1995 IBM 3590
1999 IBM 3590E
2000 LTO Gen1
2002 LTO Gen2
2003 3592 Gen1
2004 LTO Gen3
2005 TS1120 (3592 G2)
2007 LTO-4
2008 TS1130 (3592 G3)
2010 LTO-5
2010 LTFS SDE
2011 LTFS LE
2011 TS1140 (3592 G4)
2012 LTFS SM
2012 LTO Gen6
2013 LTFS EE
2014 TS1150 (3592 G5)
2015 LTO-7

In tape automation and virtualization

1962 IBM Tractor System
1974 3850 MSS
1992 IBM 3495
1994 IBM 3494
1997 VTS G1
1999 VTS G2
2000 TS3500
2001 VTS G3
2005 TS3200 TS3300
2005 TS7510 VTL
2006 TS7740 (VTS Gen 4)
2007 TS3400
2007 TS7520
2007 TS7530
2008 TS2900 TS3500 High Density
2008 TS7650G
2008 TS7720
2009 TS7650 Appliance
2011 TS3500 Connector & shuttle
2010 TS7610 TS7680
2011 LTFS LE
2011 TS7740 TS7720
2016 TS7760
2014 TS4500 3584 Gen

Linear Tape-Open (LTO) Consortium

- HP, IBM and Quantum jointly oversee LTO development and roadmap
  - Open format specifications
  - Multiple sources of product and media
  - Compatibility between different vendors' offerings



	LTO-3	LTO-4	LTO-5	LTO-6	LTO-7	LTO-8	LTO-9	LTO-10
Shipment Year	2005	2007	2010	2013	2015	TBD	TBD	TBD
Native Capacity	400GB	800GB	1.5TB	2.5TB	Up to 6.4TB	Up to 12.8TB	Up to 25TB	Up to 50TB
Compressed Capacity	800GB	1.6TB	3.0TB	6.25TB	Up to 16TB	Up to 32TB	Up to 62.5TB	Up to 125TB
Native Transfer Rate	80 MB/s	120 MB/s	140 MB/s	160 MB/s	Up to 315 MB/s	Up to 472 MB/s	Up to 708 MB/s	Up to 1100 MB/s
Compressed Transfer Rate	160 MB/s	240 MB/s	280 MB/s	400 MB/s	Up to 788 MB/s	Up to 1180 MB/s	Up to 1770 MB/s	Up to 2750 MB/s

IBM LTO Tape Portfolio

	IBM LTO 7	TS2900	TS3100	TS3200	TS3310
Max capacity	6 TB	54 TB	144 TB	288 TB	2.45 PB
Max # drives	1	1	2	4	18
Max # cartridges	1	9	24	48	409

[1]Specifications per library and per 15 library complex

All capacities are native

TS3100 Tape Library Overview

- Single LTO drive tape library
  - Supports LTO Ultrium™ Generation 7 drives
    - –Up to two half height 6 Gbps SAS or 8 Gbps Fibre Channel or
    - –One full height 8 Gbps Fibre Channel
  - Also supports previous generation drives
- Capacity
  - 24 data cartridge slots
  - 144 TB of native storage capacity (360 TB with 2.5:1 compression) using LTO-7 drive and cartridges
- Features
  - Barcode reader and remote management
  - Removable tape cartridge magazines
  - Three year standard warranty
    - –Basic parts are customer replaceable units (CRU)

TS3200 Tape Library Overview

- Single LTO drive tape library
  - Supports LTO Generation 7 drives
    - Up to four half height 6 Gbps SAS or 8 Gbps Fibre Channel or
    - Up to two full height 8 Gbps Fibre Channel
  - Also supports previous generation drives
- Capacity
  - 48 data cartridge slots
  - 288 TB of native storage capacity (720 TB with 2.5:1 compression) LTO-7 drive and cartridges
- Features
  - Barcode reader and remote management
  - Removable tape cartridge magazines
  - Three year standard warranty
    - Basic parts are customer replaceable units (CRU)

IBM LTO Ultrium 7 Technology

- Drive specs
  - 300 MB/sec native data transfer rate (750 MB/sec with compression)
  - Up to 15 TB of capacity at 2.5:1 compression (6 TB native capacity)
  - Read/write LTO-6 media and read LTO-5 media
- Supports Application Managed Encryption for data security
- Supports direct access to data stored on tape with IBM Spectrum Archive™ featuring Linear File Tape System™ format
  - Provides simplified file system access at the operating system level
- Platform support
  - Selected IBM Power Systems™ servers and other Linux and Windows open system servers

IBM Enterprise Tape Systems Portfolio

Tape virtualization

TS7700 virtual tape family for z Systems (3957)

Tape automation

TS4500 tape library (3584)

TS3500 tape library and shuttle interconnection (3584)

Tape Drives

TS1150 (3592)

3592 JD media

Software

IBM Spectrum Archive

IBM Enterprise Tape Portfolio

Drive	TS1150
Native capacity	10 TB
Data rate	360 MBps

Libraries	TS4500	TS3500	Shuttle Complex
Max native capacity	175.5 PB	150 PB	2250 PB
Max # drives	128	192	2,700
Max # cartridges	17,550	15,000	225,000

Virtual Tape[1]	TS7760T
Max native cache capacity	1.32 PB 7.92 PB
Max # physical drives	16 96
Max # virtual drives	496 2,976
Max # virtual volumes	4M

[1]Specifications per single node and max config of 6-way grid

IBM Offers a Full Range of Enterprise Tape Automation Solutions

- Tape drives, libraries and virtual tape servers with advanced features satisfy your business requirements
  - High capacity
    - Tape drives up to 10 TB
    - Library scale out configurations up to 6.75 EB *
    - Virtual tape grid configurations to over 7.9 TB
  - Consolidation
    - Capacity on demand options
    - Partitioning
  - High availability
    - Replication for zero downtime
    - Automatic failover
    - Redundant features
  - Security
    - Encryption and WORM
  - Ease of administration
    - Easy to use GUIs
    - Remote management
    - Transparent access to tape data with Spectrum Archive
  - High performance
    - Drives up to 360 MBps
    - Virtualization I/O performance up to 69 GBps
  - Mainframe support
    - Optimized for IBM z Systems

*With 3:1 compression

TS1150 v LTO

- Higher capacity and speed
  - TS1150: 10 TB, 360 Mbps
  - LTO 7: 6 TB, 300 Mbps
- Access to data
  - High resolution directory and larger data buffer help to improve speed of tape processing
  - Media scaling allows cartridge to be formatted to a short length to support fast access to data
- Easier, cost effective technology upgrades
  - No need to buy new media when upgrading to new technology
    - “Up format” existing generation of media
  - Add more capacity with no new media investment

IBM Spectrum Archive™ Enhances the Value of Tape

- Spectrum Archive (Linear Tape File System): self-describing tape format to address tape archive requirements
  - Makes tape look and work similar to other removable media
    - Standard file system access to data
    - Cross operating system support
    - Drag and drop files
    - Ease of installation
  - IBM Spectrum Archive family of offerings include:
    - Singe Drive Edition
    - Library Edition
    - Enterprise Edition

IBM Spectrum Archive

Proven Solution: LTFS awarded Engineering EMMY Award

Spectrum Archive Enterprise Edition

- Spectrum Archive EE integrated with IBM Spectrum Scale enables IBM tape libraries to replace tier 2/3 storage
  - Storage virtualization with transparent tiering to tape
    - Lower TCO by up to 90%
    - Nearline access to tape based data
    - Centralized storage management
    - Ease of use for data storage between Flash and tape

Why IBM for Tape

- Industry leader in tape and data protection technologies and solutions
- Full line of tape solutions with advanced features
- #1 in tape market share for over 12 years[1]
- Storage Magazine Quality Award winner, IT Brand Pulse Market Leader Award
- IBM Spectrum Archive solutions make tape even easier to use
- IBM Systems and Storage products architected, designed and tested to work better together
- Complete solutions vendor offering servers, storage, software and services worldwide

[1] IDC Tape Tracker 2H2015

Thank You

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