IBM System Storage™ TS1120 Tape Drive

Supporting Business Continuity and Information Lifecycle Management
IBM Tape Machine Type / Models

- **Tape Drives**
  - IBM TotalStorage 3580 Tape Drive Model
    - IBM TotalStorage 3580 Tape Drive Model L33
    - IBM TotalStorage 3580 Tape Drive Model L3H
  - IBM System Storage TS1030 Tape Drive
    - IBM System Storage TS1030 Tape Drive Model F3B (TS1030 tape drive, LTO Gen 3 tape drive; 3588 F3B)
  - IBM TotalStorage 3590 Tape Drive
    - Model E11 and E1A (3590 E11 and E1A)
    - Model H11 and H1A (3590 H11 and H1A)
  - IBM TotalStorage 3592 Tape Drive Model J1A (TS1120 tape drive, 3592 J1A)
  - IBM System Storage TS1120 Tape Drive (TS1120 tape drive; 3592 E05)

- **Tape Libraries**
  - IBM System Storage TS3100 Tape Library
    - IBM System Storage TS3100 Tape Library Express Model L2U (TS3100 tape library; 3573 L2U)
    - IBM System Storage TS3100 Tape Library Express Model L3S (TS3100 tape library; 3573 L3S)
    - IBM System Storage TS3100 Tape Library Express Model F3S (TS3100 tape library; 3573 F3S)
  - IBM System Storage TS3200 Tape Library
    - IBM System Storage TS3200 Tape Library Express Model L4U (TS3200 tape library; 3573 L4U)
    - IBM System Storage TS3200 Tape Library Express Model L3H (TS3200 tape library; 3573 L2H)
    - IBM System Storage TS3200 Tape Library Express Model F3H (TS3200 tape library; 3573 F3S)
  - IBM System Storage TS3310 Tape Library (TS3310 tape library)
    - IBM System Storage TS3310 Tape Library Module Model E5B (TS3310 tape library; 3576 L5B)
    - IBM System Storage TS3310 Tape Library Module Model E9U (TS3310 module; 3576 E9U)
IBM Tape Machine Type / Models

- IBM TotalStorage 3494 Tape Library
  - IBM TotalStorage 3494 Tape Library Frame Model L12 (3494 L12; L12)
  - IBM TotalStorage 3494 Tape Library Frame Model L14 (3494 L14; L14)
  - IBM TotalStorage 3494 Tape Library Frame Model L22 (3494 L22; L22)
  - IBM TotalStorage 3494 Tape Library Frame Model D12 (3494 D12; D12)
  - IBM TotalStorage 3494 Tape Library Frame Model D14 (3494 D14; D14)
  - IBM TotalStorage 3494 Tape Library Frame Model D22 (3494 D22; D22)
  - IBM TotalStorage 3494 Tape Library Frame Model D24 (3494 D24; D24)
  - IBM TotalStorage 3494 High Availability Frame Model HA1 (3494 HA1; HA1)
  - IBM TotalStorage 3494 Tape Library Frame Model S10 (3494 S10; S10)
- IBM System Storage TS3500 Tape Library
  - IBM System Storage TS3500 Tape Library Frame Model L23 (3584 L23; L23)
  - IBM System Storage TS3500 Tape Library Frame Model L53 (3584 L53; L53)
  - IBM System Storage TS3500 Tape Library Frame Model D23 (3584 D23; D22)
  - IBM System Storage TS3500 Tape Library Frame Model D53 (3584 D53; D52)
  - IBM System Storage TS3500 High Availability Option Model HA1 (3584 HA1; HA1)
- Virtualization
  - IBM Virtualization Engine TS7700
    - IBM Virtualization Engine TS7700 (TS7740 Node; 3957 V06)
    - IBM Virtualization Engine TS7740 Model CC6 (TS7740 Cache Controller; 3956 CC6)
    - IBM Virtualization Engine TS7740 Model Cx6 (TS7740 Cache Drawer; 3956 CX6)
IBM Tape Machine Type / Models

- IBM Virtualization Engine TS7500
  - IBM Virtualization Engine TS7510 (TS7510 Node; 3954 CV5)
  - IBM Virtualization Engine TS7510 Model SV5 (TS7510 Cache Controller; 3955 SV5)
  - IBM Virtualization Engine TS7510 Model SX5 (TS7510 Cache Module; 3955 SX5)
  - IBM Virtualization Engine TS7510 Software Version 1 Release 1 (TS7510 V1R1 Software)
- IBM TotalStorage 3494 Virtual Tape Server Model B10 and B20 (B10 / B20 VTS)
  - IBM TotalStorage 3494 Peer-to-Peer Virtual Tape Server (PtP VTS)
  - IBM TotalStorage Virtual Tape Frame 3494 Model CX1 (CX1)

Other tape products
- IBM TotalStorage 3953 Tape System
  - IBM TotalStorage 3953 Tape Frame Model F05 (3953 F05)
  - IBM TotalStorage 3953 Library Manager Model L05 (3953 L05)
- IBM System Storage 3952 Tape Frame Model F05 (3952 F05)
- IBM TotalStorage TS1120 Tape Controller Model C06 (3592 C06)

- The short names (e.g. TS1120, TS310) or machine types (e.g. 3592 J1A) are used from this slide on
Disclaimers

- Copyright© 2006 by International Business Machines Corporation.

- No part of this document may be reproduced or transmitted in any form without written permission from IBM Corporation.

- The performance data contained herein were obtained in a controlled, isolated environment. Results obtained in other operating environments may vary significantly. While IBM has reviewed each item for accuracy in a specific situation, there is no guarantee that the same or similar results will be obtained elsewhere. These values do not constitute a guarantee of performance. The use of this information or the implementation of any of the techniques discussed herein is a customer responsibility and depends on the customer's ability to evaluate and integrate them into their operating environment. Customers attempting to adapt these techniques to their own environments do so at their own risk.

- Product data has been reviewed for accuracy as of the date of initial publication. Product data is subject to change without notice. This information could include technical inaccuracies or typographical errors. IBM may make improvements and/or changes in the product(s) and/or programs(s) at any time without notice. Any statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only.

- References in this document to IBM products, programs, or services does not imply that IBM intends to make such products, programs or services available in all countries in which IBM operates or does business. Any reference to an IBM Program Product in this document is not intended to state or imply that only that program product may be used. Any functionally equivalent program, that does not infringe IBM's intellectually property rights, may be used instead. It is the user's responsibility to evaluate and verify the operation of any on-IBM product, program or service.
Disclaimers (continued)

- THE INFORMATION PROVIDED IN THIS DOCUMENT IS DISTRIBUTED "AS IS" WITHOUT ANY WARRANTY, EITHER EXPRESS OR IMPLIED. IBM EXPRESSLY DISCLAIMS ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT.

- IBM shall have no responsibility to update this information. IBM products are warranted according to the terms and conditions of the agreements (e.g. IBM Customer Agreement, Statement of Limited Warranty, International Program License Agreement, etc.) under which they are provided. IBM is not responsible for the performance or interoperability of any non-IBM products discussed herein.

- Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products in connection with this publication and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

- The provision of the information contained herein is not intended to, and does not, grant any right or license under any IBM patents or copyrights. Inquiries regarding patent or copyright licenses should be made, in writing, to:

  IBM Director of Licensing
  IBM Corporation
  North Castle Drive
  Armonk, NY 10504-1785
  U.S.A.
Trademarks

- The following terms are trademarks or registered trademarks of the IBM Corporation in either the United States, other countries or both.
  - IBM, System Storage, TotalStorage, System i, System p, System x, System z, Virtualization Engine
  - z/OS, z/VM, VM/ESA, OS/390, AIX, DFSMS/MVS, OS/2, OS/400, i5, FICON, ESCON, Tivoli
  - VSE/ESA, TPF, DFSMSdfp, DFSMSdss, DFSMSshsm, DFSMSmm

- Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

- Other company, product, and service names mentioned may be trademarks or registered trademarks of their respective companies.
Agenda

- Introduction
- Product Overview
- Potential Business Benefits
- Technology

Virtualize Everything
Commit to Openness
Collaborate to Innovate
Introduction
Over 50 Years of Tape Innovation

- **Starting in 1952**
  - IBM 726 Tape Unit
    - 7,500 cps
    - 100 bpi
- **and continuing in 2006**
  - IBM TS1120 Tape Drive
    - 100 MB/sec\(^1\)
    - 700 GB\(^1\)

\(^1\) represents maximum native performance or cartridge capacity
Tape’s Evolving Role

- Tape is an integral part of the storage hierarchy
  - Customers store 4-15X more data on tape than disk
- Tape is low cost
- Tape is intrinsically “On-Demand”
- Tape is removable and portable
- Tape provides high volumetric efficiency
- Tape media has a long life
- Tape is ideally suited for:
  - Information Lifecycle Management
  - Infrastructure Simplification
  - Business Continuance

Relative TCO Estimates for Enterprise Disk, SATA Disk and Tape

Sources: Disk IDC, 2003
SATA Disk – IBM estimate
Tape - IBM, based on technology roadmaps
Product Overview
TS1120 Tape Drive Overview

- 2nd Generation of 3592 enterprise tape drive roadmap
  - 104 MB/sec performance (up to 260 MB/s at 3:1 compression)
  - 100 / 500 / 700 GB native capacity cartridges (up to 300 GB / 1.5TB / 2.1TB at 3:1 compression)
    - Re-Writable and Write Once Read Many (WORM)
  - Supports data encryption and key management

- Attaches to
  - All IBM eServers (IBM System z™ via TS1120 Controller)
  - Selected HP and Sun Microsystems servers
  - Selected versions of Microsoft Windows™
  - Selected Linux editions

- Supported in
  - IBM 3494 and TS3500 tape libraries
  - IBM 3592 C20 silo compatible frame
  - IBM 7014 Rack
Platform Support

- **eServer Platforms**
  - System z™
    - zOS/OS/390®
    - zVM™
    - VSE / VSE/ESA with VGS
    - SuSE Linux Enterprise Server
  - System p™
    - AIX
    - SuSE Enterprise Server
  - System i™
    - OS/400®
    - i5
  - System x™
    - Supported Microsoft and Linux platforms

- **Other Vendor Platforms**
  - Sun Microsystems
    - Selected SUN Servers/ FC HBAs
    - Solaris 7, Solaris 8, Solaris 9
  - Hewlett Packard
    - Selected HP Servers/ FC HBAs
    - HP-UX 11.0, HP-UX 11.i
  - Microsoft Corporation
    - Windows NT™ Server Version 4
  - Linux
    - RedHat Enterprise Linux
    - SuSE Linux Enterprise Server 8
    - Turbolinux Enterprise Server 8
    - Conectiva Linux Enterprise Edition

* See [http://www-03.ibm.com/servers/storage/tape/resource-library.html#interoperability](http://www-03.ibm.com/servers/storage/tape/resource-library.html#interoperability) for current platform support
3592 Cartridge Media

- Cartridges are in rewritable and WORM
- Cartridges are available in three lengths
  - JJ and JR cartridges provide rapid access to data
  - JA and JW cartridges provide fast access to data or high capacity
  - JB and JX extended data cartridges provide higher capacity
- Cartridges can be formatted to either Gen 1 or Gen 2 formats\(^1\)
  - TS1120 tape drives can read or write Gen 1 or Gen 2 formats
  - 3592 J1A tape drives can read or write the Gen 1 format

<table>
<thead>
<tr>
<th>3592 Cartridge Media</th>
<th>TS1120 Tape Drive</th>
<th>3592 J1A Tape Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td><strong>Format</strong></td>
<td><strong>Capacity</strong></td>
</tr>
<tr>
<td>JJ / JR</td>
<td>Gen 1</td>
<td>60 GB</td>
</tr>
<tr>
<td></td>
<td>Gen 2</td>
<td>100 GB</td>
</tr>
<tr>
<td>JA / JW</td>
<td>Gen 1</td>
<td>300 GB</td>
</tr>
<tr>
<td></td>
<td>Gen 2</td>
<td>500 GB</td>
</tr>
<tr>
<td>JB / JX</td>
<td>Gen 2</td>
<td>700 GB</td>
</tr>
</tbody>
</table>

\(^1\) iSeries only supports writing cartridges native 3592 Gen 2 format
3592 JB/JX Media

- New, 700GB high capacity cartridges
  - Extended Data Cartridge: 3599 Models 014, 015, 016
  - Extended WORM Cartridge: 3599 Models 024, 025, 026
  - Available:
    - initialized and labeled
    - labeled
    - not initialized or labeled

- For use with TS1120 tape drives only
  - Does not support 3592 J1A or 3590 tape drives
  - Requires latest drive, library or subsystem firmware update

- Supports: TS3500 and 3494 tape libraries, TS7700 Virtualization Engine, TS1120 controller, 3592 J70 controller, 3592 C20 Silo compatible frame
TS1120 Tape Drive Operation

- **Five Servo Bands**
  - Servo bands recorded during manufacturing
  - Multiple servo locations within each band

- **Four Data Bands**
  - 128 / 224 tracks per band (512/896 tracks)
  - Drive takes 64 / 56 ‘passes’ to write a full tape

- **Data is written to tape eight or 16 tracks at a time**
  - Cartridges are available in two lengths or capacities
  - Cartridges are available in re-writable and write once read many (WORM)
Includes Advanced IBM Tape Technology

- Includes common* IBM tape drive technology
  - Flat Lapped Heads are designed to lower friction to improve head and tape cartridge longevity by enabling low wrap
  - Surface Control Guiding is designed to prevent edge damage and debris accumulation by eliminating edge guiding
  - Dual Stage Actuators are designed to support higher capacities by reducing vibration and enabling precise ‘head-to-track’ alignment
  - Improved SARS interface supports predictive drive and cartridge maintenance and supports customer access to performance and reliability metrics
  - Speed Matching reduces the speed of the drive to better match the attached servers ability to stream data
  - ‘Read after Write’ verification is performed during write operations to help guard against any non-reversible data compression failure

* shared with IBM LTO tape drives
Includes Advanced IBM Tape Technology (continued)

- Includes unique* IBM enterprise tape drive technology
  - A High Resolution Directory that indexes all host records and file mark positions supports fast, consistent locate times
  - A large data buffer (512 MB) and enhanced read-ahead buffer management that reduces random and skip forward sequential (short hop) locate times
  - Capacity Scaling supports of 3592 JA cartridge to be formatted to a short length to support fast access to data
  - Non volatile caching that reduces the impact of back-hitching caused by checkpoint and small block transfers

- Includes new IBM enterprise tape drive technology
  - A new String Search function allows a host application to offload search arguments to the TS1120 tape drive

* Unique to IBM TS1120 and 3592 J1A tape drives
Second Generation Technology Enhancements

- **Larger Data Buffer**
  - Increased from 128 MB to 512 MB and improved read-ahead algorithm
  - Improves random and ‘skip-search’ operations

- **Faster high speed space/locate**
  - Increased from 8 meters/sec to 10 meters/sec
  - Improves time-to-data and rewind operations

- **Faster load to ready time**
  - Load to ready time reduced by up to 33%
  - Improves time-to-data by up to five seconds

- **Enhanced Virtual Backhitch**
  - Up to 100% improvement in Virtual Backhitch Performance
  - Improves performance of small block and slow host data transfers
Supports Lightning Fast Performance

- Includes two 4 Gbit FC / FC-AL interfaces
- Uses existing 3592 cartridge media
  - JJ/JR cartridge media supports fast access
  - JA/JW cartridge media supports high capacity
  - New JB/JX extended capacity cartridge media
  - Capacity scaling function can also be used to support fast access on JA and JB media

### Average Tape Drive Performance Metrics

<table>
<thead>
<tr>
<th>Machine Model</th>
<th>TS1120</th>
<th>3592 J1A</th>
<th>3590 H1A</th>
<th>LTO Gen 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartridge Type</td>
<td>JB</td>
<td>JJ</td>
<td>JA</td>
<td>JJ</td>
</tr>
<tr>
<td>A Load</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>19</td>
</tr>
<tr>
<td>B Initial Search</td>
<td>45</td>
<td>11</td>
<td>33</td>
<td>12</td>
</tr>
<tr>
<td>C Average Access (A+B)</td>
<td>58</td>
<td>24</td>
<td>46</td>
<td>31</td>
</tr>
<tr>
<td>D Rewind</td>
<td>47</td>
<td>11</td>
<td>35</td>
<td>12</td>
</tr>
<tr>
<td>E Unload</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>20</td>
</tr>
<tr>
<td>F Mount/Demount (A+B+C+D)</td>
<td>128</td>
<td>58</td>
<td>104</td>
<td>63</td>
</tr>
</tbody>
</table>
Supports Lightning Fast Performance (continued)

- Reduces drive occupancy time and supports higher mount rates

![Tape Drive Occupancy Time](chart1)

![Tape Drive Hourly I/O Rate](chart2)

1 Tape drive occupancy times are measured
2 Tape Drive Hourly I/O rates are modeled
Supports Lightning Fast Performance (continued)

Veritas NetBackup 5.1 Incremental Restore
3592 R2 v. R1, JA Media (100% Scaled)

Results based on early lab measurements.
TS1120 Tape Drive Encryption

- High performance tape drive encryption
  - Cost effectively encrypt large quantities of tape data
  - Avoid Host MIPS encryption overhead
  - Minimize impact to existing processes and applications

- Variety of implementation methods
  - System managed
  - Library managed
    - TS3500 Tape Library
  - Application managed
    - IBM Tivoli® Storage Manager

- Supported in a wide range of environments including:
  - z/OS™, i5/OS™, AIX®, HP, Sun, Linux and Windows
TS1120 Performance with Encryption - Write

NE – TS1120 without encryption
EC – TS1120 with encryption
EE – TS1120 with encryption enabled
TS1120 Performance with Encryption - Read

**Low Compression Ratios, Jag-2 Format, JA Media (100% Scaled)**

Data Rate (MB/sec) vs. Block Size (KB)

- NE – TS1120 without encryption
- EC – TS1120 with encryption
- EE – TS1120 with encryption enabled

**High Compression Ratios, Jag-2 Format, JA Media (100% Scaled)**

Data Rate (MB/sec) vs. Block Size (KB)
TS1120 Capacity with Encryption

TS1120 Capacity Performance
256KB Transaction Sizes

- Short (JJ Media)
- J1A Emulation (JA)
- J2 Format (JA)
Open System Support

- The TS1120 tape drive with dual fiber ports is designed to
  - Dynamically reroutes I/O in the event of a host or device port failure*
  - Help improve performance through data path optimization

* Currently supported on AIX, Linux, and Solaris
TS1120 Controller Support (System z)

- Supports attachment of up to 16 TS1120 and/or tape drives
  - Supports intermix of TS1120 (in Gen 1 mode) and 3592 J1A tape drives
  - Does not support intermix of TS1120 (or 3592 J1A) and 3590 tape drives
- Requires supported ‘embedded’ or external SAN switch
- Allows attachment to ESCON® and/or FICON hosts
TS3500 Tape Library Support

- Supports open system and System z attachment
  - System z requires TS1120 controller and an external 3953 F05 frame
  - or VTS and an external 3953 F05 frame
- Supports both LTO and TS1120 technology
  - Frames are dedicated to a tape drive/media type
  - Frames can be intermixed in any order
- TS3500 L23 Frame
  - stores up to 260 3592 cartridges
  - houses up to 12 TS1120 and/or 3592 J1A tape drives
- TS3500 D23 Frame
  - stores up to 400 3592 cartridges
  - houses up to 12 TS1120 and/or 3592 J1A tape drives
3494 Tape Library Support

- Supported in three 3494 frame models
  - TS1120 and 3592 J1A tape drives may be intermixed in a frame
  - TS1120 (or 3592 J1A) and 3590 tape drives may not be intermixed in a frame
  - 3592, 3590 and 3490 cartridges may coexist in any 3494 frame

- L22 Library Control Frame
  - 1 - 4 TS1120 and/or 3592 J1A tape drives
  - 216 - 240 3592 cartridges
  - Up to 168 TB (native capacity)

- D22 Drive Frame
  - 1 - 12 TS1120 and/or 3592 J1A tape drives
  - 230 - 305 cartridges
  - Up to 213 TB (native capacity)

- A 3494 supports a maximum of 128 open system attached drives
3494 Tape Library Support (continued)

- **D24 Drive Frame for System z support**
  - 1 - 8 TS1120 and/or 3592 J1A tape drives
  - 275 - 345 cartridges
  - Up to 241 TB (native capacity)

- **3952 F05 Frame required**
  - 1 to 3 TS1120 controllers
  - Each supports up to 16 drives
  - Requires supported ‘embedded’ or external switch attachment

- 3494 L12/D12/D14 models can be upgraded to L22/D22/D24 models

- TS1120 support increases library native capacity to up to 4.39 petabytes*

- May protect investment in 3494 Tape Library

* based on 6,280 cartridge capacity with JB/JX media
TS7700 Virtualization Engine Support (System z)

- Supports 4 to 16 TS1120 and/or 3592 tape drives
  - TS1120 tape drives operating in native mode cannot be intermixed with 3592 J1A drives
  - Drives must be installed in a TS3500 tape library
    - Library is connected to the TS7700 via two 4 Gbit (FC 3488) switches in a 3953 tape frame
Virtual Tape Server Support (System z)

- Supports B10 and B20 models
  - Supports intermix of four to 12 TS1120 and/or 3592 J1A tape drives
    - TS1120 Tape Drives will operate in 3592 J1A emulation mode
    - 3592 J1A tape drives cannot be replaced with TS1120 tape drives
    - Supported models require
      - Two 2 Gbit (FC 3587) switches or
      - Two 4 Gbit (FC 3488) switches
  - B20 VTS Models support attachment of four to 12 TS1120 and/or 3592 J1A tape drives as well as up to six 3590 tape drives
  - A B10 VTS model will need to be upgraded to a B20 VTS model to support heterogeneous tape drive attachment
StorageTek Silo Attachment

- The TS1120 is supported in a StorageTek 9310 PowderHorn™
  - Requires 3592 C20 Frame
    - 1 - 20 TS1120 (and/or 3592 J1A) tape drives can be installed in a 3592 C20 frame
    - Up to 80 TS1120 (and/or 3592 J1A) tape drives can be installed in a silo
  - Increases single silo capacity up to 1.6 petabytes
- Supports open system attachment
- Supports System z attachment
  - TS1120 (and/or 3592 J1A) tape drives can be attached to a TS1120 controller in a 3952 F05 frame

* based on 5,500 cartridge capacity
Standalone Support

- Standalone support includes
  - An IBM 7014 rack can support
    - Up to 12 TS1120 (and/or 3592 J1A) tape drives
    - Limited to eight if a TS1120 controller is required for System z attachment
    - Up to eight additional drives can be supported in an adjacent IBM 7014 T00
  - An IBM 7014 T42 rack can support
    - Up to 16 TS1120 (and/or 3592 J1A) tape drives
    - Limited to 12 if a TS1120 controller is required for System z attachment
    - Up to four additional drives can be supported in an adjacent IBM 7014 T42
TS1120 Tape Drive Summary

- Designed to provide a tape drive technology that provides
  - One drive technology to meet all application requirements
  - Cartridges that can be formatted to as fast access or high capacity
  - Full (read/write) backward compatibility with the previous generation

- Designed to provide seamless integration and support
  - Attachment to IBM eServer and other open systems platforms
  - Integration into existing IBM and StorageTek tape libraries
  - Attachment to native Fabric and FC-AL SANs

- Designed to meet the demands of the on demand era
  - High Data Growth
  - Data sharing
  - Virtualization
  - Autonomic
Potential Business Benefits
Customer Benefits

- **Addresses business objectives**
  - Substantially improves business processes
  - Dramatically reduces Total Cost of Ownership
  - Provides outstanding investment protection
  - Hardens Business Continuance environment
  - Significantly improves operational efficiency
  - Protects vital data assets

- **Meets IT Management Objectives**
  - Allows the deployment of a single drive technology
  - Provides the performance to meet today's and future requirements
  - Provides the capacity to reduce the size / complexity of the tape environment
  - Includes autonomic features that improve availability and service actions
  - Reduces the cost of moving to homogenous FC Fabric / FICON infrastructure
Technology
Content

- Enterprise Tape Drive Roadmap
- IBM TS1120 Controller
  - Overview
  - WORM Support
  - Performance
- IBM TS1120 Tape Drive Technology
  - Shared Technology
  - Unique Technology
- Advanced Function
  - Capacity Scaling
  - Cartridge Segmentation
  - WORM Cartridge and WORM Operational Mode
- 3592 C20 StorageTek Silo Attachment
## Enterprise Tape Drive Roadmap

<table>
<thead>
<tr>
<th>Servo Bands</th>
<th>Servo Type</th>
<th>Tracks</th>
<th>Upgrade Available</th>
<th>Read Previous Generations</th>
<th>Write Previous Generation</th>
<th>Write Once Read Many</th>
<th>Virtual Backhitch</th>
<th>Native Capacity (GB)</th>
<th>Transfer Rate (MB/sec)²</th>
<th>FC-AL</th>
<th>FC Fabric</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Analogue</td>
<td></td>
<td></td>
<td>y</td>
<td>y</td>
<td>n</td>
<td>y</td>
<td>J Cartridge</td>
<td>10, 20, 30</td>
<td>9</td>
<td>1 Gbit</td>
</tr>
<tr>
<td></td>
<td>Digital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td></td>
<td>JA / JW Cartridge</td>
<td>60, 100</td>
<td>14</td>
<td>2 Gbit</td>
</tr>
<tr>
<td>3590 Tape Drive Generations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Gen 1</td>
<td></td>
<td>JB/JX High Capacity Cartridge</td>
<td>200, 500</td>
<td>40</td>
<td>4 Gbit</td>
</tr>
<tr>
<td>TS1100 Tape Drive Generations</td>
<td>Gen 1</td>
<td>Gen 2</td>
<td>Gen 3</td>
<td></td>
<td></td>
<td>Gen 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Statements of future IBM plans and directions are provided for information purposes only and are subject to change without notice.

²Uncompressed data.
TS1120 Controller Overview

- **3rd Generation Tape Controller**
  - Provides up to 626 MB/sec write performance
  - Supports single TS1120 tape drive datarate of up to 230 MB/sec

- Attaches to TS1120 (and/or 3592 J1A) tape drives

- Attaches to System z servers

- Supported on
  - z/OS®, z/VM®, TPF and OS/390®
  - VSE/ESA™ and VSE/ESA with VSE guest server (VGS)

- Supports tape drives installed in a
  - IBM TS3500 or 3494 tape library
  - IBM 3592 C20 frame attached to a StorageTek 9310 silo
  - IBM 7014 Model T00 or T42 frame
TS1120 Controller Description

- One to four FICON attachments
  - Single FICON TS1120 tape drive datarate of up to 230 MB/sec
- Two to eight ESCON attachments
- Supports attachment to ESCON® and/or FICON™ hosts
  - Ideal for mixed environments and facilitates migration
    - ESCON / FICON path group mixing supported
    - No need to statically determine ESCON / FICON mix
  - Reduces ESCON / FICON director port requirements
- Attaches up to sixteen TS1120 (and/or 3592 J1A) tape drives
  - Requires a supported ‘embedded’ switch¹ or
  - Attachment to a supported SAN Fabric switch¹

¹Switch support can be found at http://www.ibm.com/support/techdocs/atsmastr.nsf/webindex/FQ115356
3592 Cartridge Capacity Scaling Considerations

- Use ‘Capacity Scaling’ (60¹/100²/140³ GB capacity points)
  - Where retrieval response time of individual data sets is critical
    - Recall of migrated data sets
  - When recovery time for multiple datasets is critical
    - Recovering from ten ‘Capacity Scaled’ cartridges on ten tape drives is faster than recovering from two non - ‘Capacity Scaled’ cartridges on two tape drives

- Use full capacity cartridges (300¹/500²/700³ GB capacity)
  - Where retrieval response time is (usually) not critical
    - Full Volume Dumps
    - Tape transaction logs (master in / master out)
    - HSM ABARS
    - HSM Recycle target
  - WORM cartridges do not support ‘Capacity Scaling’

- Cartridges can always be ‘re-scaled’ if requirements change

¹ 3592 J1A tape drive and TS1120 tape drive in J1A emulation mode
² TS1120 tape drive in native mode with JA media
³ TS1120 tape drive in native mode with JB media
System z WORM Support

- Full support for zOS® V1R3 and above
  - Supports Content Manager and Image+
  - Supported by DFSMSrmm™ and ISV TMSs
  - DFSMShsm™ ABARS Application Backup/Recovery
  - DFSMSdfp™ OAM (Object Access Method)
    - Similar to WORM optical implementation
    - Object storage group name can now be appended

- Coexistence support for OS/390® V2R10 and above

- Supports three 3592 cartridges – JW, JR, JX
TS1120 Controller Availability Characteristics

- Redundant hot swap components include dual line cords, power supplies, cooling fans, and mirrored HDDs
- Redundant pathing allows
  - Two FC paths to supported SAN switch
  - Up to four FICON or eight ESCON paths to host
    - Supports dynamic I/O recover in the event of a failure
- Non-disruptive replacement of FICON / ESCON adapters
- Non-disruptive drive code updates
  - Proliferation to tape drives at unload
- Non-disruptive drive installation
  - Requires HCD ‘gen’ to support non-disruptive drive installation
- Controller automatically reboots on power loss
z/OS DFSMSdss Full Volume Dump

DFSMSdss Full Volume Dump at 3:1 Compaction

Aggregate Throughput (MB/sec)

>50% Higher Throughput

- 3590 A60 / 3590 H11
- 3592 J70 / 3592 J1A
- 3592 C06 / 3592 E05

Number of DSS Jobs

0 100 200 300 400 500 600

8 12
z/OS DFSMSdss Full Volume Restore

DFSMSdss Full Volume Restore at 3:1 Compaction

<table>
<thead>
<tr>
<th>Number of DSS Jobs</th>
<th>Aggregate Throughput (MB/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>350</td>
</tr>
<tr>
<td>12</td>
<td>350</td>
</tr>
</tbody>
</table>

- 3590 A60 / 3590 H11
- 3592 J70 / 3592 J1A
- 3592 C06 / 3592 E05
z/OS DFSMSShsm AutoMigrate

DFSMSHsm AutoMigrate to L2
3:1 Compaction

Aggregate Throughput (MB/sec):

- A60 attached to 3590 H11
- J70 attached to 3592 J1A
- C06 attached to 3592 E05

Number of HSM Tasks:

1 4 8 12

0 20 40 60 80 100 120 140
z/OS DFSMShsm AutoBackup

DFSMShsm AutoBackup
3:1 Compaction

Aggregate Throughput (MB/sec)

Number of HSM Tasks

~50% Higher Throughput

- A60 attached to 3590 H11
- J70 attached to 3592 J1A
- C06 attached to 3592 E05
TS1120 Controller Attachment Options

- 3592 FC 3488 provides a 20 port SAN switch
  - Supports single SAN attachment for up to 16 3592 tape drives
  - An additional (optional) 3592 FC 3488 can be ordered to support a redundant connection to attached drives

- 3592 FC 9492 / 3492 supports attachment to external switch
  - Supports single or dual attachment to customer provided SAN switch
  - Customer is responsible for configuring attachment and management
    - Connections must be zoned correctly
    - Failure to do so may lead to data integrity exposures
20 Port Switch Schematic

System z Host

TS1120 Controller

FICON
Primary FC
Secondary FC

One to four FICON channels
Two FC cables
Single Switch
Single fiber cable attachment to TS1120 tape drives

One to 16 TS1120 tape drives
Optional secondary 20 Port Switch Schematic

Dual Fabric SAN switches shown to illustrate 'best practices' for availability

- Two or four FICON channels
- Two FC cables
- Two switches

Dual fiber cable attachment to TS1120 tape drives

One to 16 TS1120 tape drives
Magnetoresistive Flat Lap Head

- Very small wrap angle reduces friction
  - Reduces debris generation
  - Less contamination
  - Extends drive life
  - Extends media life
- Atmospheric pressure holds moving tape to the head.
- No need to remove media from head for high speed search
- Less sensitive than high wrap designs to humidity, corrosion or sticktion

Traditional tape head design

IBM flat lap head design
Surface Control Guiding

- IBM-patented surface control guiding
  - Reduces tape edge damage
  - Decreases debris generation
  - Increases performance

Typical edge guiding

IBM surface control guiding

Grooved inner rollers

Smooth outer rollers
Dynamic Compression Look Ahead

- Analyzes incoming data stream in the tape drive buffer
- Dynamically selects compression or no compression
  - Avoids ‘expansion’ of data that does not compress
    - Scanned Objects (e.g. Adobe Acrobat files)
    - Video (e.g. MPEG streams)
    - Geoseismic Data
  - Optimizes the use of the cartridge
Speed Matching

- Drive dynamically compensates for slow server
- Automatically adjusts data rates to
  - 104, 85, 70, 55, 41 and 35 MBps for cartridges initialized in Gen 2 format
  - 54, 41, 36, 31 and 27 MBps for cartridges initialized in Gen 1 format
- Effectively minimizes backhitching
  - Extends the life of the media
  - Increases performance
  - Increases throughput
    - Adjust tape speed based on host data rate
    - Calculates effective host data rate (EHDR)
    - Optimizes data rate by selecting optimal EHDR
    - Forces speed changes mid-wrap if advantageous
    - Minimizes time to record data
3592 WORM cartridge media

- Three platinum colored WORM cartridges
  - JR cartridge has a native capacity of 60 GB (Gen 1 Format) or 100 GB (Gen 2 format) Capacity
  - JW cartridge has a native capacity of 300 GB (Gen 1 format) or 500 GB (Gen 2 format)
  - JX extended WORM cartridge has a native capacity of 700 GB (Gen 2 format)

- Designed to provide a non-alterable, non-rewriteable media
  - During the manufacturing process WORM flags are written to the cartridge media and to the cartridge memory (CM)
  - A robust algorithm uses the low level encoding to prevent tampering and
  - Semantics permit appending to labeled or unlabeled files or the creation of new labeled or unlabeled files
  - Cartridges include a worldwide unique name to allow applications to track and validate subsequent access to records stored on the WORM cartridges
3592 WORM Cartridge Media (Continued)

- Cartridges are designed to coexist in
  - IBM 3494 and TS3500 tape libraries
  - 3592 C20 frame in a StorageTek 9310 silo
  - Standalone IBM 7014 T00 and T42 frame

- Designed for long term record retention
- Designed to meet regulatory criteria

- Operation
  - TS1120 tape drive detects WORM cartridge
  - Selects WORM Operational Mode which is designed to
    - prevent overwrite or changes to existing customer data
    - supports appending new data following existing data
  - Data is read concurrently during the write operation to verify data integrity
  - Re-labeling of empty WORM cartridges is permitted
Thank You