Data Storage Types in Databases

Physical Data Model - Chapter 8
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Types of Persistent Storage

SSD - flash chip based storage
   Up to 2TB of data per drive
   Price per GB $0.45-0.30

Hard Disk - classic magnetic platter storage
   Up to 6TB of data per drive
   Price per GB ~ $0.03

Tape - magnetic tape storage
   Up to 6Tb of uncompressed data per tape
   Price per GB $0.01-0.008
Stratifying Data Storage

- **Leading Edge - Hot (Dynamic)**
  - NVDIMM
  - NVRAM
  - SSD
  - HDD

- **Legacy Storage - Cold (Static)**
  - SSD
  - HDD
  - Tape

### Storage Hierarchy – Persistent Memory

- **Hot Data**
  - Caching
  - Indexing
  - In-memory

- **Cold Data**
  - Data Warehouse
  - Archive

- **Tier 0**
  - Access to Host
  - Latency: 0.01 μs

- **Tier 1**
  - Database
  - Web Hosting
  - Latency: 10 μs

- **Tier 2**
  - Mail Servers
  - VOD Media Streaming
  - CRM
  - Surveillance
  - Latency: 100 μs

- **Tier 3**
  - Content Delivery
  - Backup
  - Latency: 1,000 μs
### Why does it Matter?

**Access Speed**
- **SSDs**: 0.1 ms
- **HDDs**: 5.5 – 8.0 ms

**Energy cost**
- **SSDs**: consume between 2 & 5 watts
- **HDDs**: consume between 6 & 15 watts

**Heat**
- **SSDs**: have an average I/O wait of 1%
- **HDDs**: average I/O wait is about 7%

**Reliability**
- **SSDs**: have a failure rate of less than 0.5% (This makes SSDs 4 - 10 times more reliable)
- **HDDs**: failure rate fluctuates between 2 – 5%

**Price per GB**
- **SSDs**: allow for much faster data access
- **HDDs**: during backup rises up to 400 – 500 ms

**Backup Rates**
- **SSDs**: allow for 3 - 5 times faster backups for your data
- **HDDs**: backups take up to 20 – 24 hours
Why does it Matter?

- LTO - Linear Tape Open
- Currently at Revision 7

### LTO Roadmap

<table>
<thead>
<tr>
<th>LTO</th>
<th>Shipment Year</th>
<th>Native Capacity</th>
<th>Compressed Capacity</th>
<th>Native Transfer Rate</th>
<th>Compressed Transfer Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTO-3</td>
<td>2005</td>
<td>400GB</td>
<td>800GB</td>
<td>80 MB/s</td>
<td>160 MB/s</td>
</tr>
<tr>
<td>LTO-4</td>
<td>2007</td>
<td>800GB</td>
<td>1.6TB</td>
<td>120 MB/s</td>
<td>240 MB/s</td>
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<tr>
<td>LTO-5</td>
<td>2010</td>
<td>1.5TB</td>
<td>3.0TB</td>
<td>140 MB/s</td>
<td>280 MB/s</td>
</tr>
<tr>
<td>LTO-6</td>
<td>2013</td>
<td>2.5TB</td>
<td>6.25TB</td>
<td>160 MB/s</td>
<td>400 MB/s</td>
</tr>
<tr>
<td>LTO-7</td>
<td>2015</td>
<td>6.0TB</td>
<td>15TB</td>
<td>300 MB/s</td>
<td>750 MB/s</td>
</tr>
<tr>
<td>LTO-8</td>
<td>TBD</td>
<td>Up to 12.8TB</td>
<td>Up to 32TB</td>
<td>Up to 472 MB/s</td>
<td>Up to 1180 MB/s</td>
</tr>
<tr>
<td>LTO-9</td>
<td>TBD</td>
<td>Up to 25TB</td>
<td>Up to 62.5TB</td>
<td>Up to 708 MB/s</td>
<td>Up to 1770 MB/s</td>
</tr>
<tr>
<td>LTO-10</td>
<td>TBD</td>
<td>Up to 50TB</td>
<td>Up to 125TB</td>
<td>Up to 1100 MB/s</td>
<td>Up to 2750 MB/s</td>
</tr>
</tbody>
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