Hard Disk (HD)

Solid State Disk (SSD)
Major Properties

- non-volatile
- robust, no moving parts
- ~100x faster random access
- plus: parallel accesses
Blocks vs Superblocks

block := 8KB

superblock := set of blocks
### Blocks vs Superblocks

<table>
<thead>
<tr>
<th>Block: 8KB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superblock: set of blocks</td>
</tr>
</tbody>
</table>

- Can only write to **empty**, freshly erased blocks.
- Erase happens at the level of superblocks, **not blocks**.
Example: Writing a Block

<table>
<thead>
<tr>
<th>SB 1</th>
<th>SB 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15</td>
<td></td>
</tr>
<tr>
<td>16 17 ...</td>
<td></td>
</tr>
</tbody>
</table>

1. Erase superblock
2. Write block
Writing a Block

if empty block available:
   write data to block

else:
   possibly reshuffle/garbage collect
   erase superblock
   write data to block
Write Amplification

\[
\text{write amplification} = \frac{\text{data physically written}}{\text{data logically written}} \geq 1
\]

Factors in:
- 8k/13
- super block erasure
- garbage collection
- wear leveling costs
- internal RAID
SSD Controller

similar tasks as the HD controller:

- mapping of logical addresses to physical addresses
- caching (128-512 MB)
SSD Controller

similar tasks as the HD controller:

mapping of logical addresses to physical addresses

caching (128-512 MB)

remapping of erroneous blocks

in addition:

RAID-like storage of data cross different chips in the drive

-> yet in conflict with erase-problem

garbage collection
Sequential and Random Speed Evolution

- **Seq. Read [MB/s]**
- **Seq. Write [MB/s]**
- **Read Acc. Time [ms]**
- **Write Acc. Time [ms]**

- **0.05 ms = 50 μs**

*Killing it with iron*
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