



# HDD STORAGE TRENDS AND EMERGING TECHNOLOGY

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# Storage Trends and Emerging Technology

1. **Cloud storage and HDDs**
2. **HAMR Technology**
3. **Active Disks**

# Cloud Storage

## Cloud segment “drives” the storage industry

- About half of all bytes are now in the cloud
- High capacity, 7200RPM Drives predominate

## HDDs are quite suitable for Cloud vendors

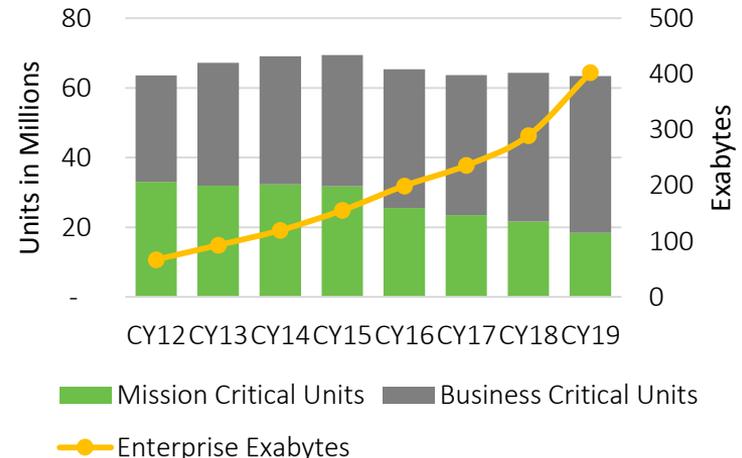
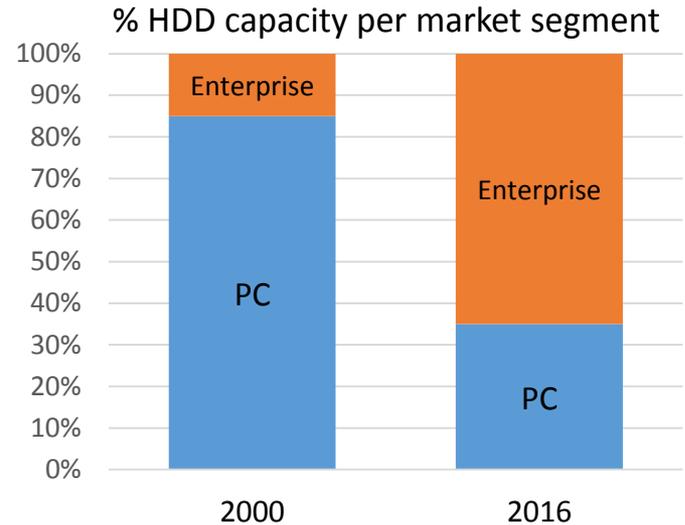
- Common apps (email, photos) work fine on HDDs
- Distribute storage across drives for performance
- Replicate across racks and sites for reli & perf.
- SSDs used as augmentation, e.g. metadata

## Cloud customers clamor for higher capacity drives

- Reduces their overall TCO, power, floorspace

## Cloud vendors have ~10-15 IOPs/TB floor

- Challenging to keep IOPs/TB above this threshold
  - Especially on drives >10TB capacity
- Active area for future drive architecture research

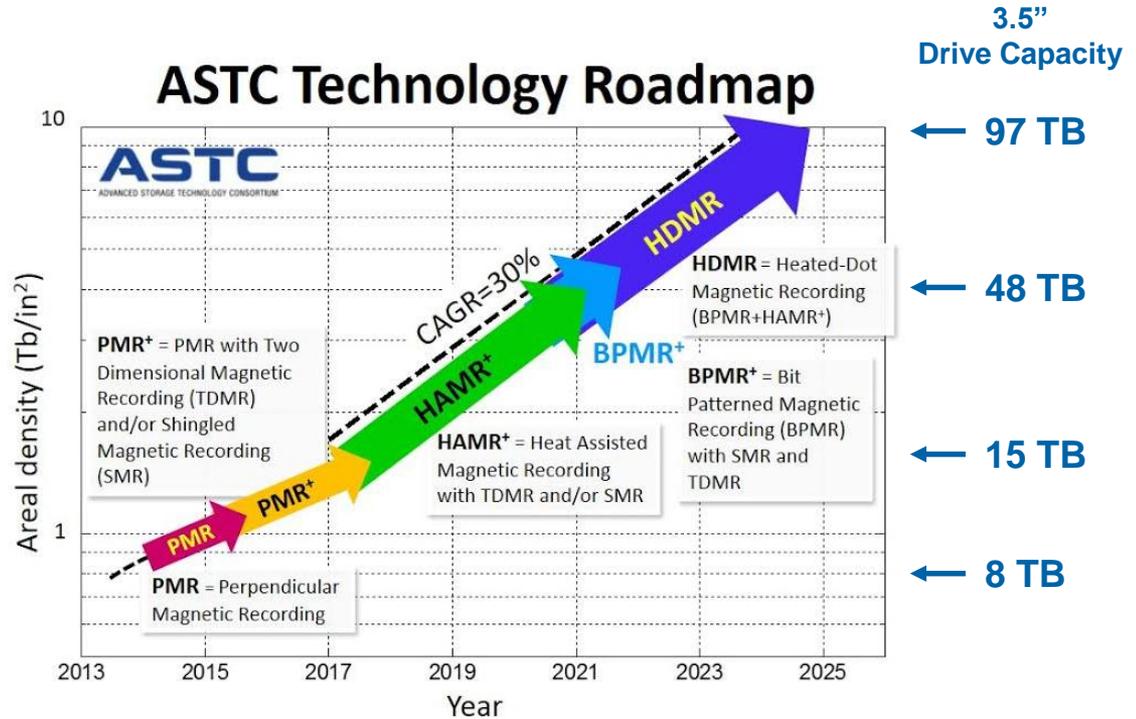


# ASTC Roadmap & Future Drive Capacity Projections

From the product manual for Seagate's ST8000NM0045 3.5" 7200 RPM Enterprise drive, a 6 disk/12 head drive has a capacity of 8TB with an areal density of 802 GBPSI.

We can use the ASTC roadmap to scale what kind of drive capacities are possible in the future for a product like this

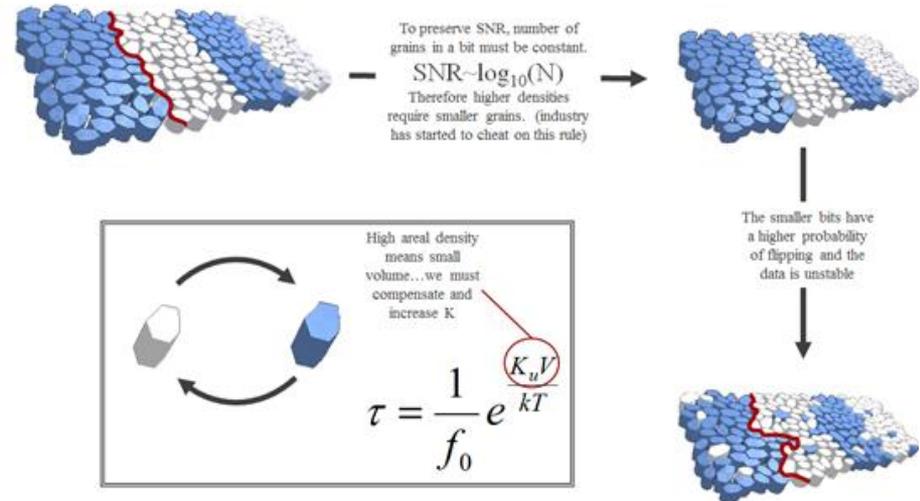
Technologies like helium filled drives will allow more heads and disks to be used in the same form factor. This will increase the capacity of they drives further.



# HAMR: Storing bits that “defy” the Superparamagnetic Limit

$\tau$  is the mean time it takes for a grain to flip due to thermal agitation. It depends on the attempt frequency,  $f_0$ , the energy holding the grain in place  $K_u V$ , and the thermal energy agitating the grain,  $kT$

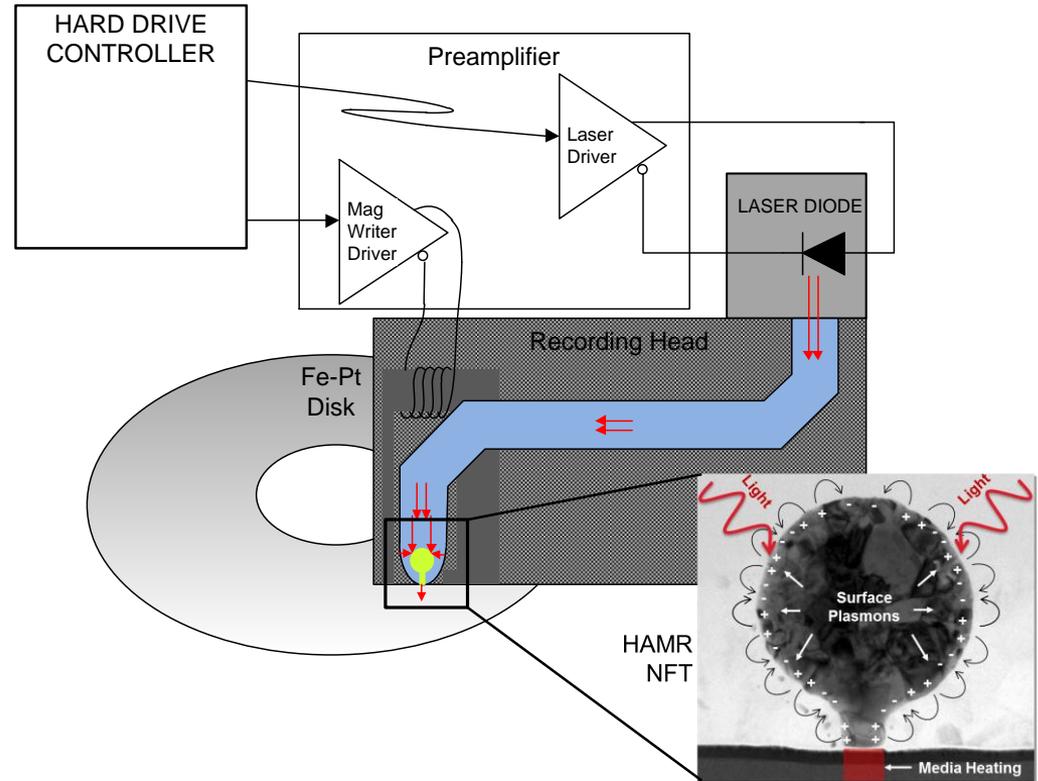
The volume of the grains,  $V$ , needs to decrease so we can continue to increase areal density. This means that either  $K_u$  needs to increase or we need to start scrubbing the data to refresh thermal stability



# How HAMR Works

## HAMR Technology Synopsis:

- We use a disk with high magnetic coercivity (e.g. FePt)
  - To magnetize this disk, we must apply heat
- Electronics send magnetizing current through a coil
- In addition, the controller now turns on a laser diode
- Laser light travels from the diode through a waveguide
- At the end of the waveguide is a gold disk with a peg – a “near-field transducer” (NFT)
- The NFT converts laser energy into a surface plasmon
  - Reduces the light’s relatively large wavelength to a much smaller spot
- The tip of the NFT peg radiates the surface plasmon into an FePt disk, causing localized heating
- The heating locally raises the disk temperature above its Curie point, permitting magnetic recording



# Active Disks

## Perform (offload) computational tasks into disks

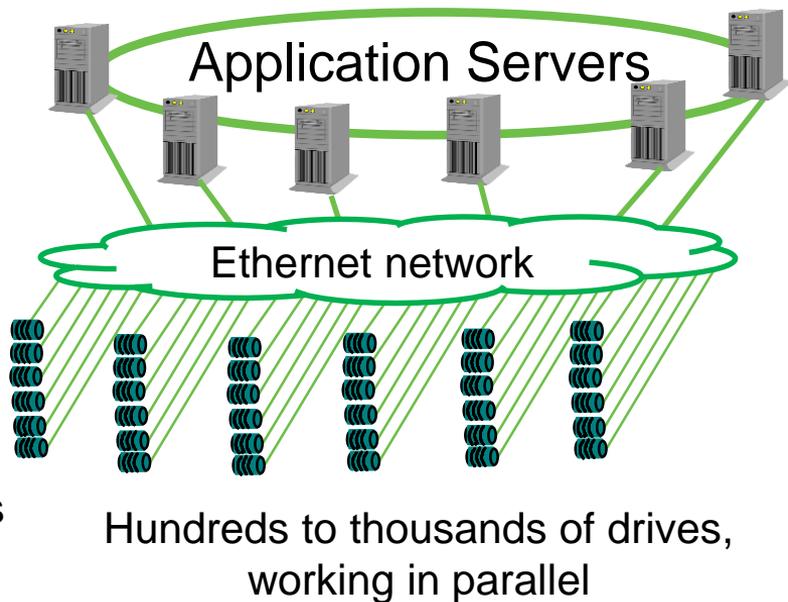
- Map-reduce
- Searching
- Data Maintenance

## Allows computer programs to operate on objects

- Distribute copies of programs to many drives
- Execute compute functions locally on drive
- Drives run applications in parallel
- Send results to application / host supervisory systems

## Net results

- Reduced host data transfers
- Reduced overall processing time



# Summary

**Cloud storage is defining the next generation of HDDs**

**HAMR extends HDD storage capacity for another generation**

**Active Disks: an emerging technology that allows for moving compute close to data**