The Future of Tape Storage
(Far from Dead)

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Director
Enterprise Tape Drive Engineering

www.drunkendata.com; The Data Management Institute, 2013

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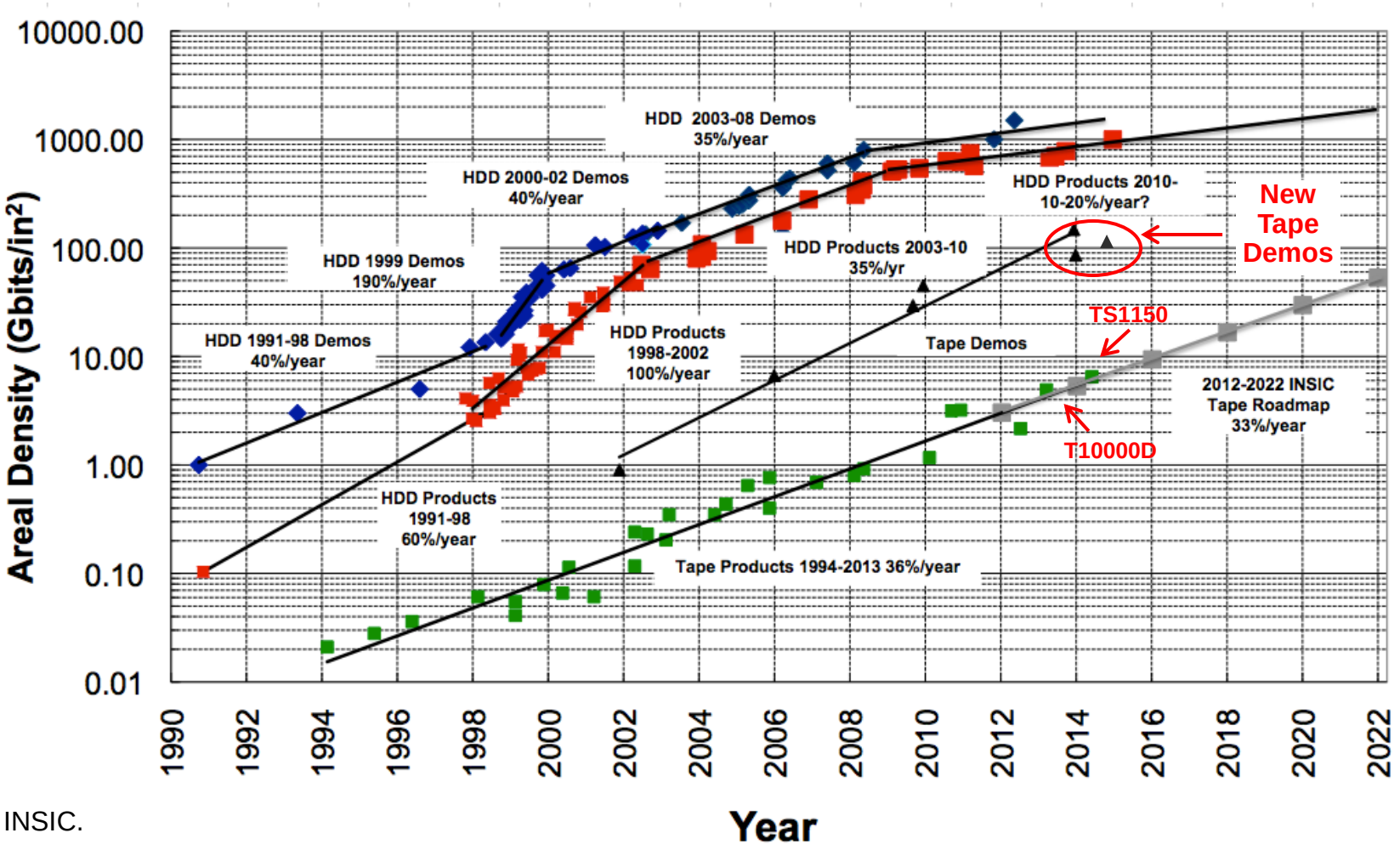
New Tape Demos on Areal Density Chart



Graph courtesy of INSIC.

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INSIC Shows Technology Path to 128 TB per Cartridge

Media Vendors Demonstrate Technology Needed to Achieve Roadmap Goals

Sputtered Media demo

Areal Density: 148 Gb/in^2

Cartridge Capacity: “185 TB”

Advanced BaFe demo

Areal Density: 123 Gb/in^2

Cartridge Capacity: “220 TB”

http://www.sony.net/SonyInfo/News/Press/201404/14-044E/

http://www.fujifilm.com/news/n150409_03.html

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What Does it Take to **Increase Capacity**?

Tape Area	Linear Density	Track Density

All three variables impact cartridge capacity

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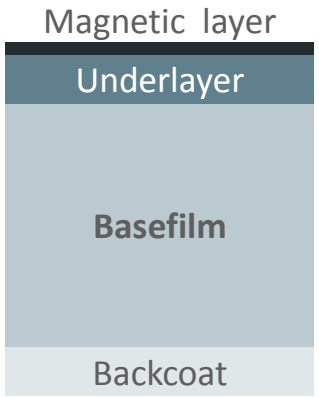
What Does it Take to **Increase Capacity**?

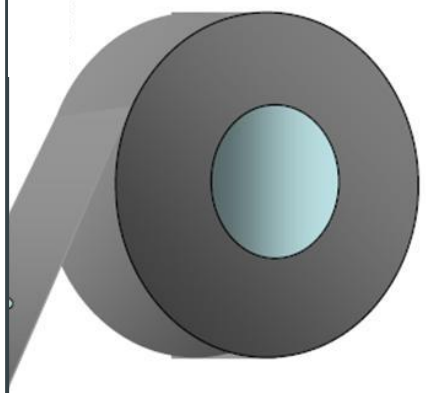
Tape Area | Linear Density | Track Density

Cartridge Form Factor

Tape Thickness



Tape Length



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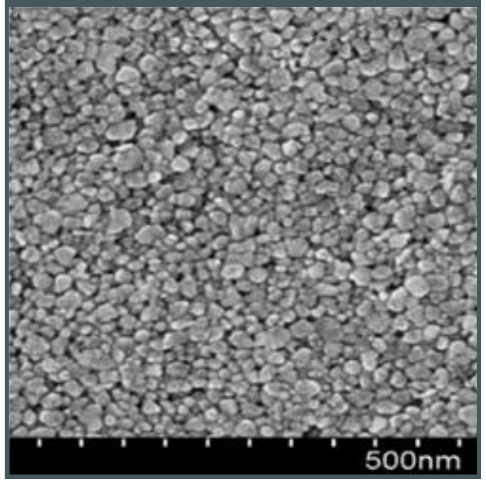
What Does it Take to **Increase Capacity**?

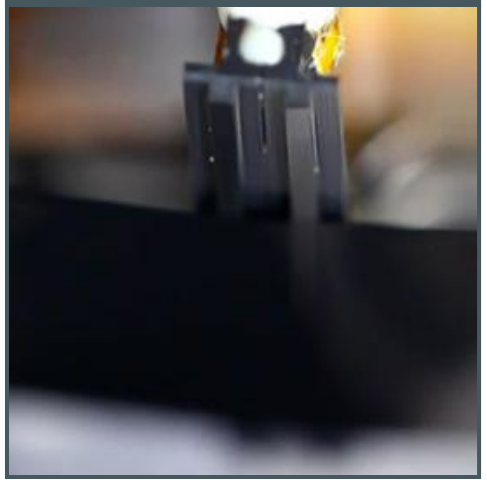
Tape Area | **Linear Density** | Track Density

Media



Read/Write Channel

Recording Head



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What Does it Take to **Increase Capacity**?

Tape Area | **Linear Density** | Track Density

Media | Read/Write Channel | Recording Head

- Smaller particles
- Improved magnetic properties
- Aligned particles (perpendicular orientation)
- Smoother, more uniform surface
- Higher signal to noise ratio

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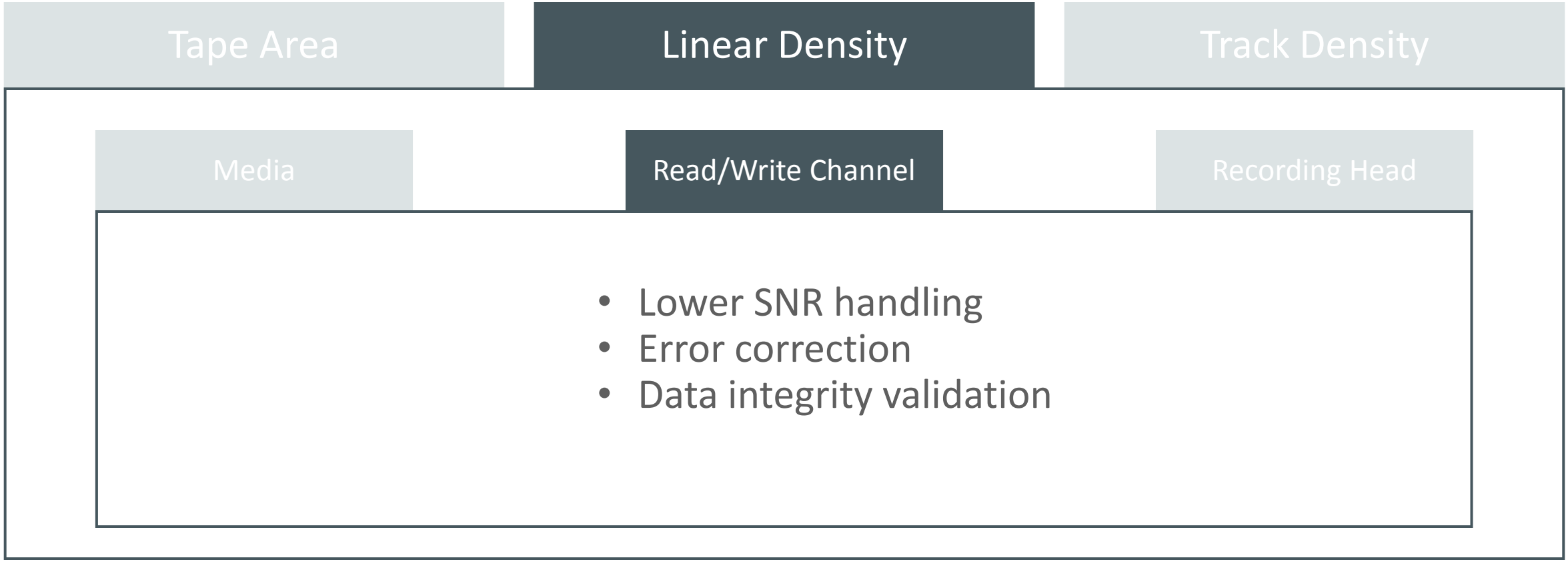
What Does it Take to **Increase Capacity**?



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What Does it Take to **Increase Capacity**?

Tape Area | **Linear Density** | Track Density

Media | Read/Write Channel | **Recording Head**

- Next gen GMR readers
- Efficient writers
- Head coating
- Contour design

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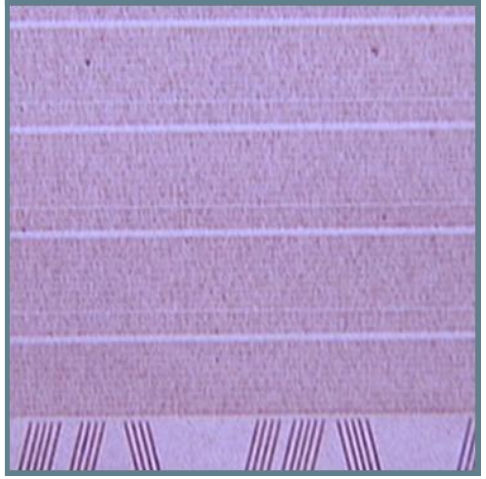
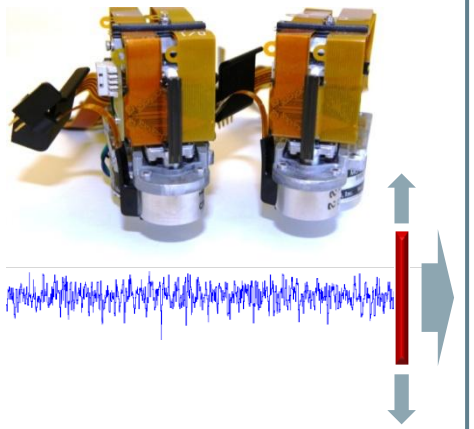
What Does it Take to **Increase Capacity**?

Tape Area | Linear Density | **Track Density**

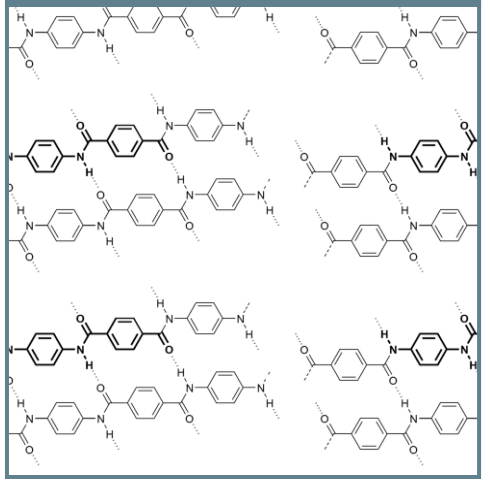
Track Pitch



Track Following



Basefilm Stability



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What Does it Take to **Increase Data Rate**?

Electronics	Data Format	Tape Velocity

All three variables impact data rate

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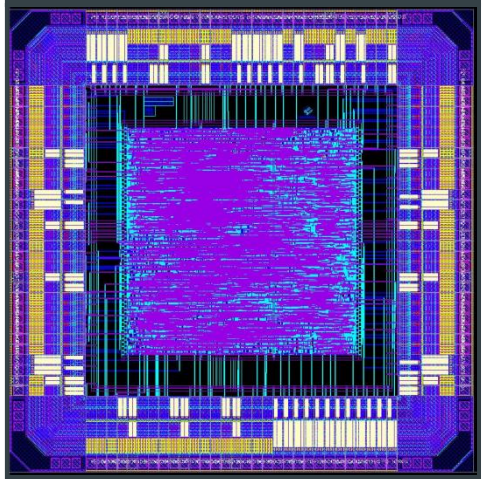
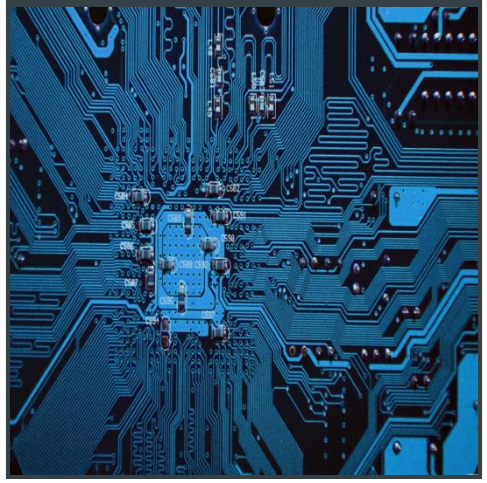
What Does it Take to **Increase Data Rate**?

Electronics	Data Format	Tape Velocity

Integrated Circuits



Printed Circuit Boards



New digital architecture with ASICs integration

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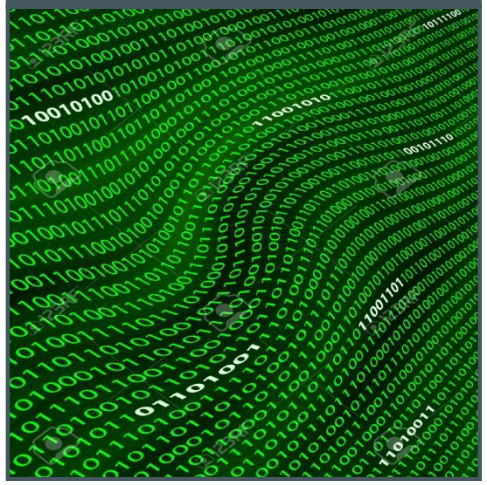
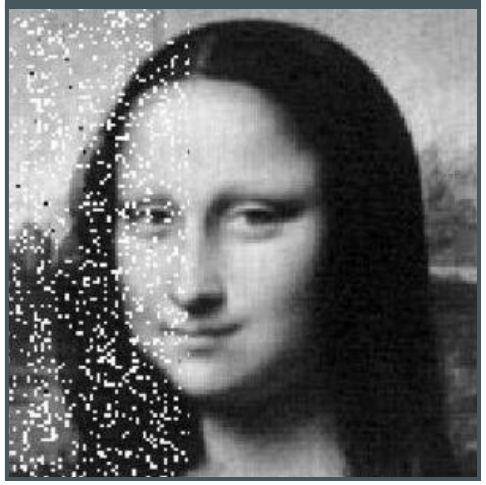
What Does it Take to **Increase Data Rate**?

Electronics | **Data Format** | Tape Velocity

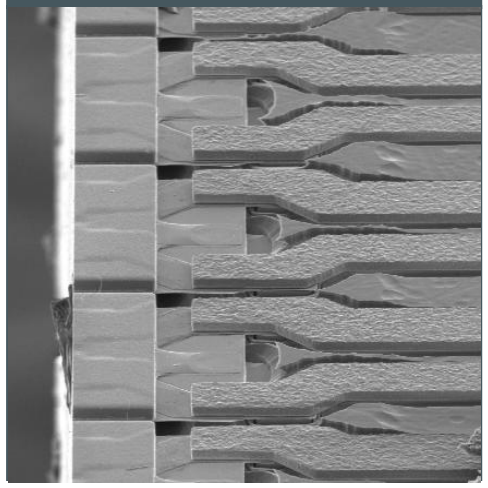
Format Efficiency



Error Correction Code



Channels (Devices)



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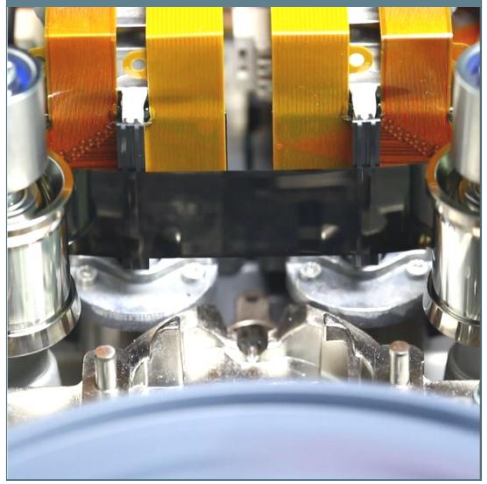
What Does it Take to **Increase Data Rate**?

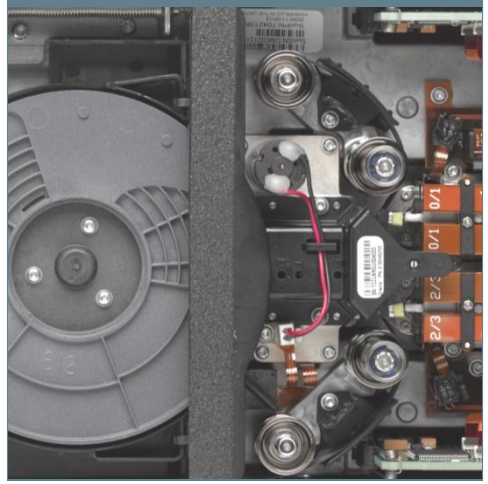
Electronics	Data Format	Tape Velocity

Nanometer scale position control at high speeds

Servo Tracking



Tape Path



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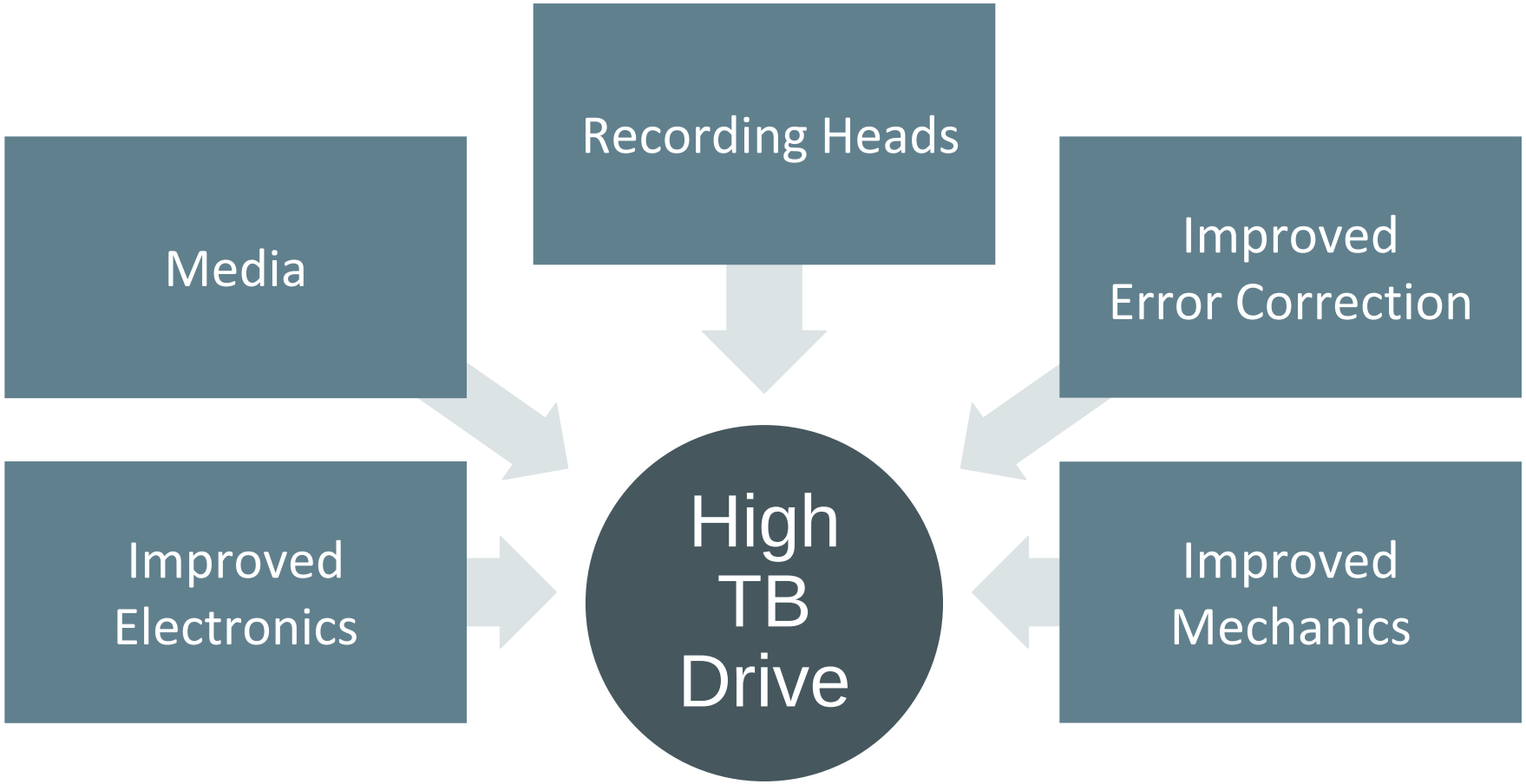
Focus Areas Moving Towards Higher Capacity Tape Drives



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Tape Technology Summary

Tape is the ideal archive media

- Tape will remain the most efficient, cost effective, and reliable technology for long term data storage
  - On premise or in the Cloud
- Lots of room for more capacity growth
  - No fundamental issues, just scaling

‘Reports of Tape’s death are greatly exaggerated’
- variation on Mark Twain

Mike Kramer, blog.bandl.com, 2011

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