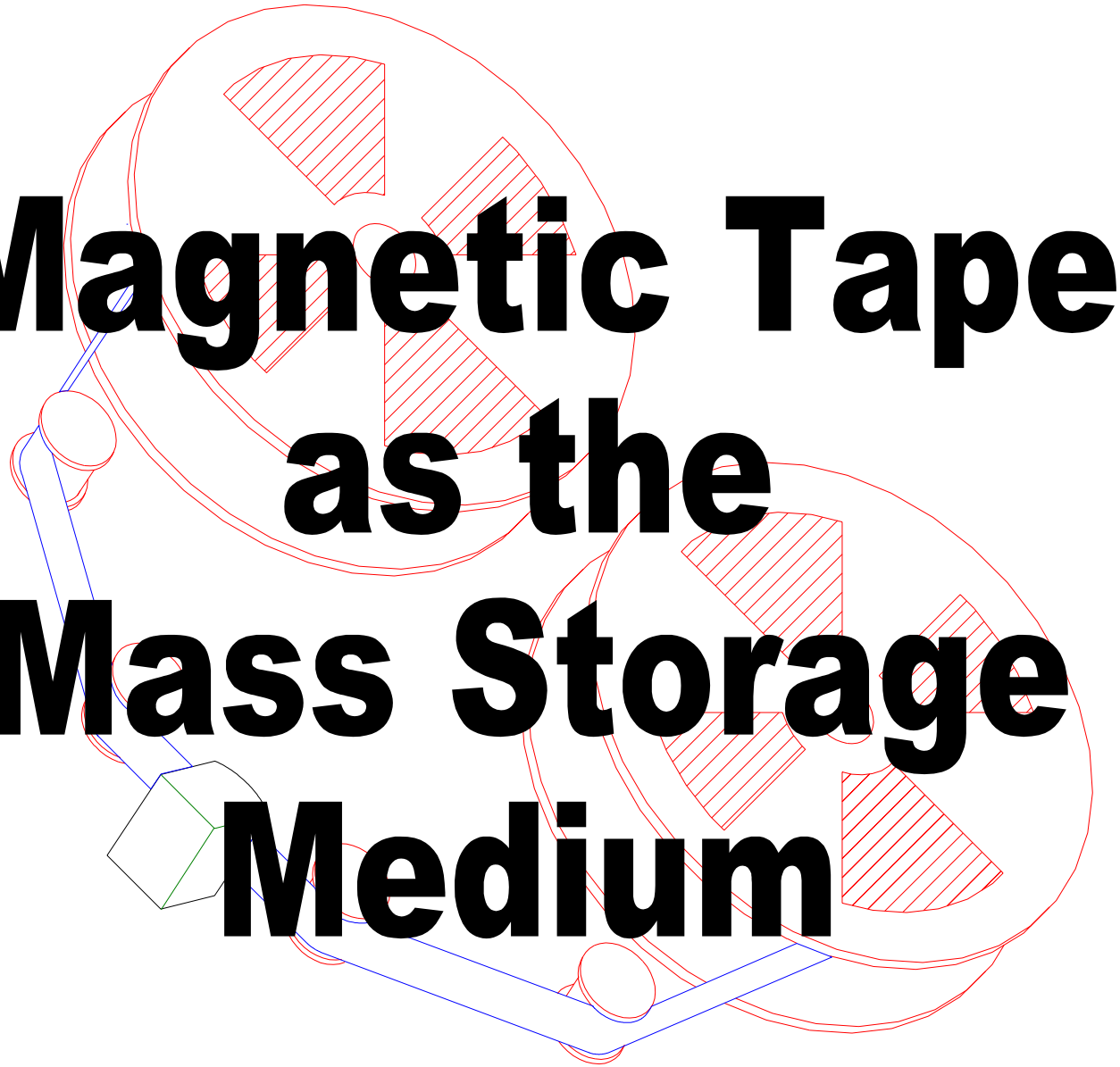


# Magnetic Tape as the Mass Storage Medium

# Next Decade's Competition

1. Magnetic Tape – Most Likely Candidate for the next decade.
2. "Optical" Tape
   - WORM
   - Phase Change
   - Optically Assisted Magnetic
3. Magnetic Disk
4. 3D, i.e., Holographic, 2-electron, etc.
5. Other ?

# Mass-Store Metrics

1. Magnetic Disk Drive Cost/bit
2. Total Volumetric Density
   - Not Areal Density
   - Archival Storage Density
3. Thru-put

# Technology Replacement Rules

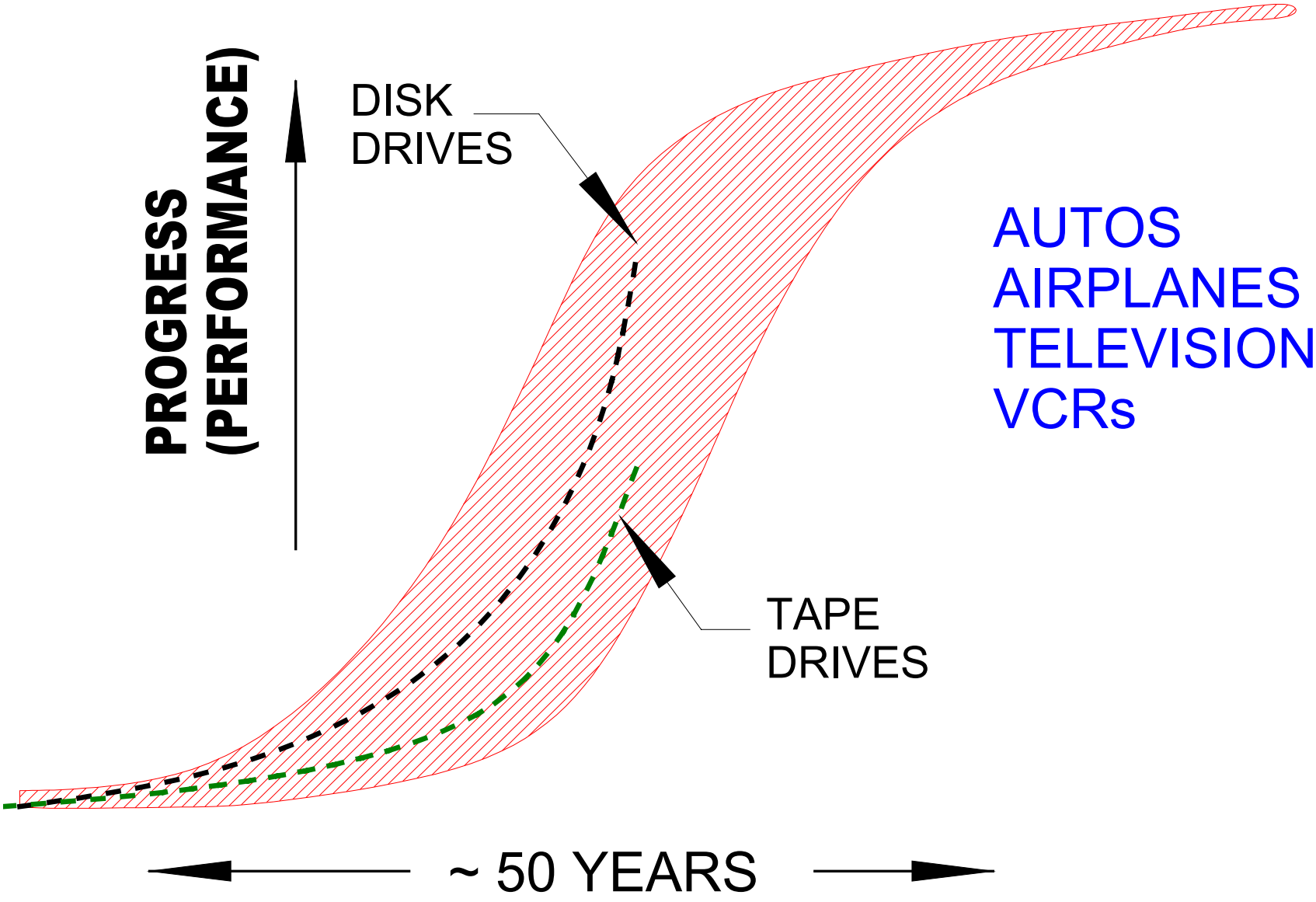
10 times the performance for the same cost

Or

1/10$^{th}$ the cost for the same performance

(excludes really good marketing)

# S-Curve of Progress

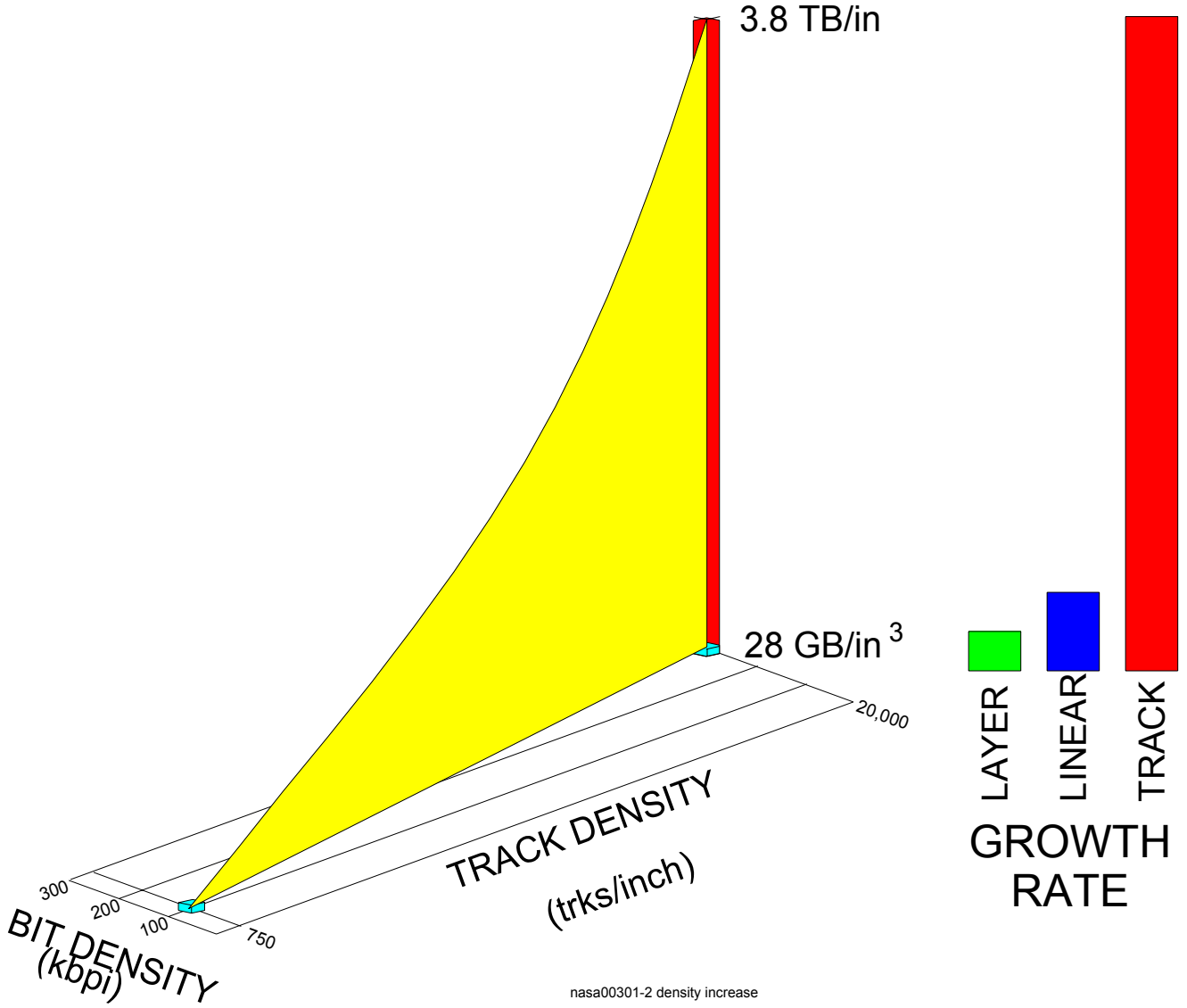


# Tape Density Migration

| | | |
|---|---|---|
| 100 kbpi | → | 300 kbpi* |
| 750 tpi | → | 20,000 tpi* |
| 3000 lpi | → | 5000 lpi |
| 75 Mb/in$^2$ | → | 6.0 Gb/in$^2$* |
| 28GB/in$^3$ | → | 3.8TB/in$^3$ |

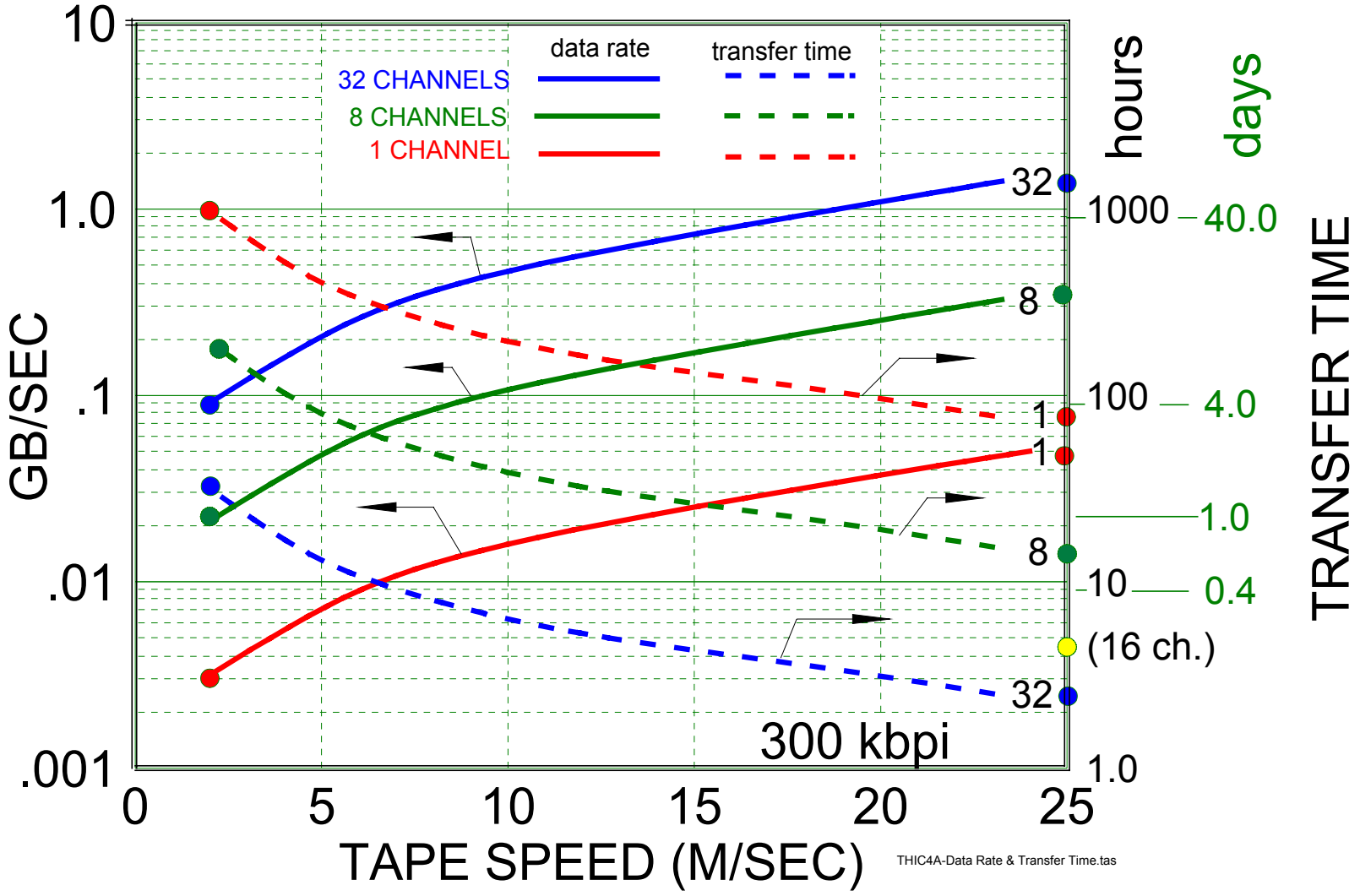
* National Storage Industry Consortium (NSIC) goal

# Data Density Growth

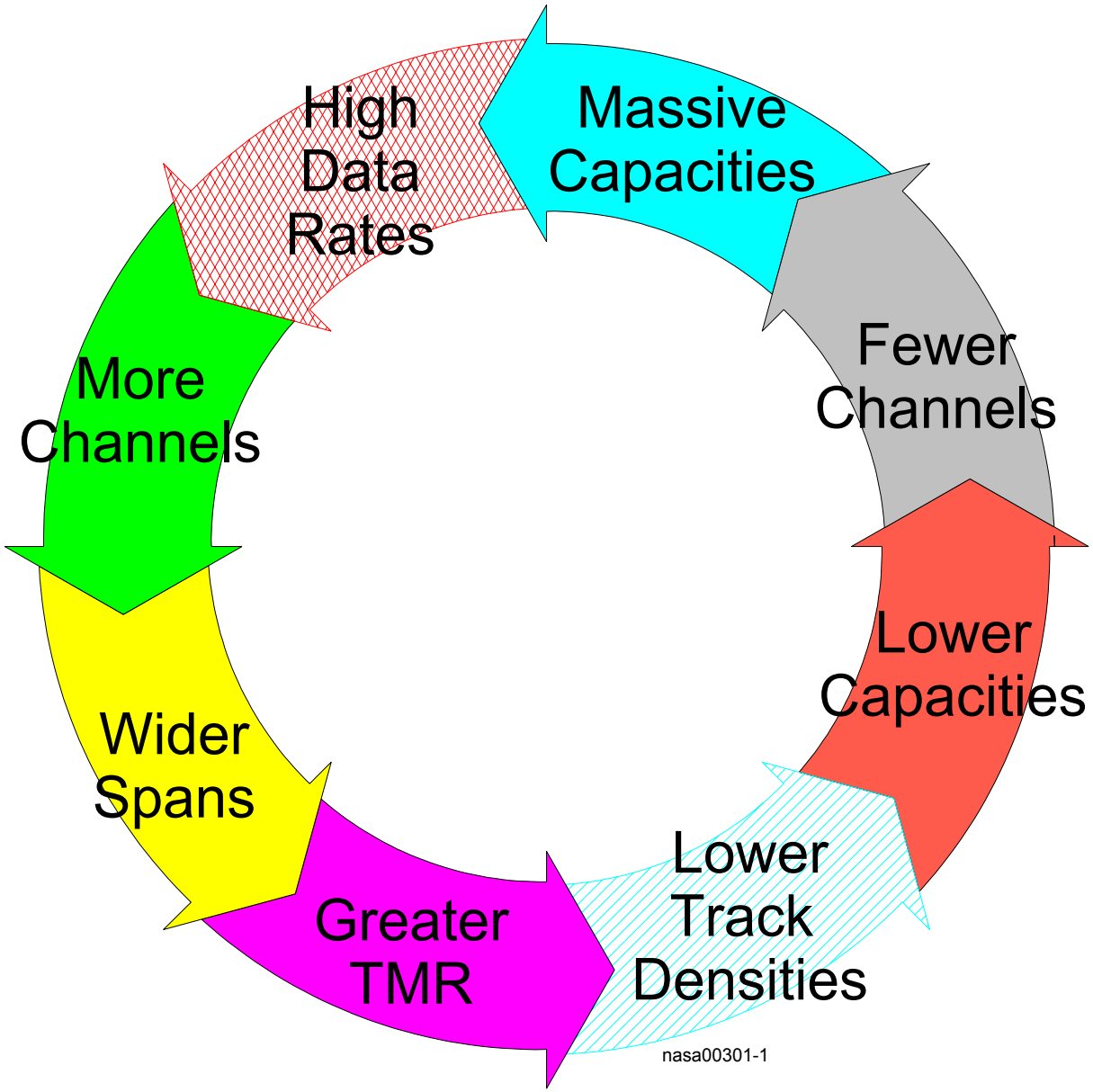



nasa00301-2 density increase

# Data Rate & Transfer Time for 10 TB of Data



# Data Rate/Capacity Paradox

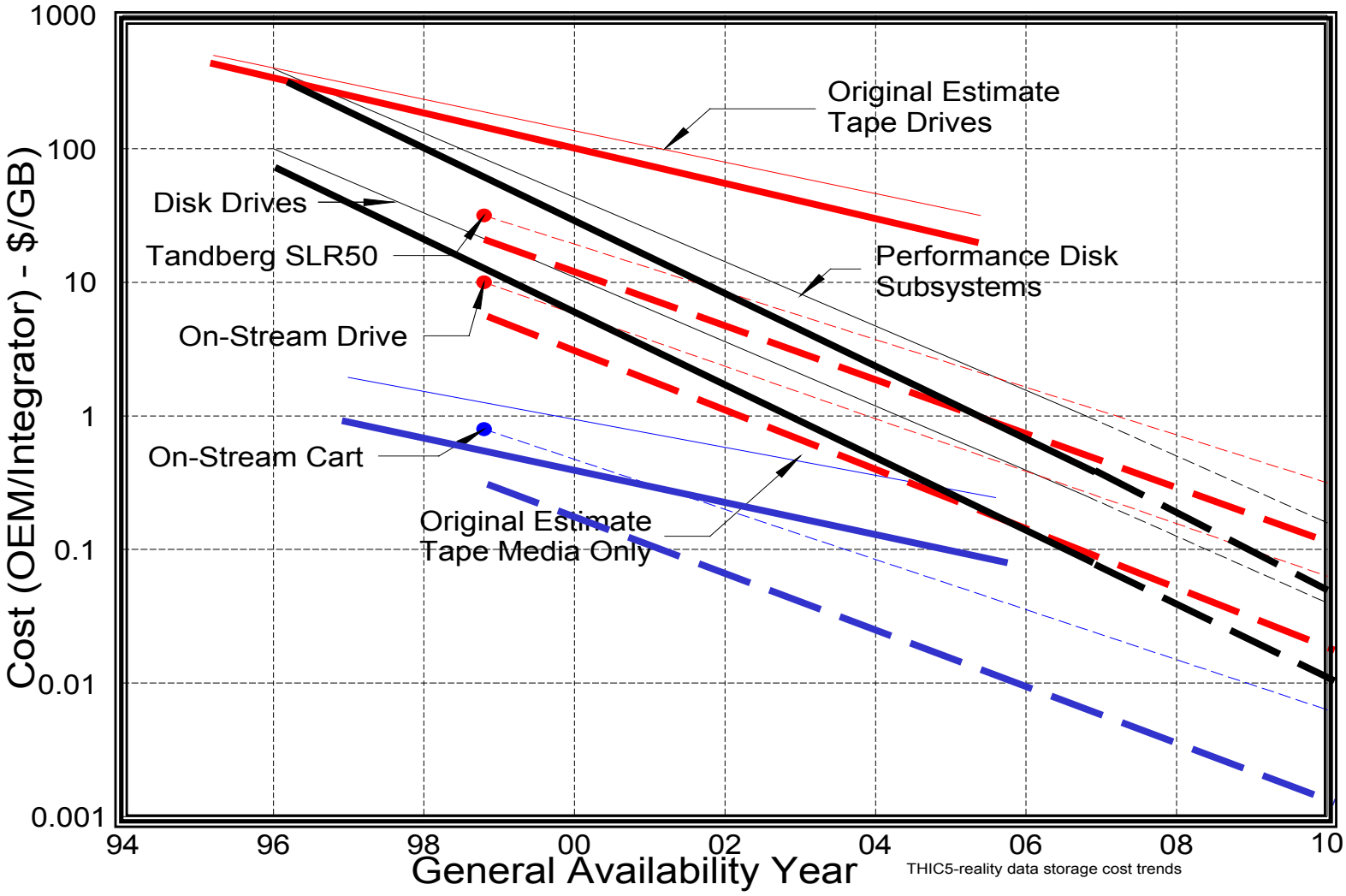


# Density Key for Tape

## Track Density

- Dimensionally Stable Substrate
- Closely Spaced Channels
- Low “noise” media
  - Maintain intrinsic SNR
  - Reduced surface roughness
- Mech. Alignment & Tolerance Compensation

# Cost Trends


1000
100
10
1
0.1
0.01
0.001
Cost (OEM/Integrator) - $/GB)
94
96
98
00
02
04
06
08
10
General Availability Year
Original Estimate
Tape Drives
Disk Drives
Tandberg SLR50
Performance Disk
Subsystems
On-Stream Drive
On-Stream Cart
Original Estimate
Tape Media Only
THIC5-reality data storage cost trends

# Magnetic Tape Summary

Terabytes per Cubic Inch

One Cent per Gigabyte