



# MAMMOTH TECHNOLOGY:

## *ADVANCEMENT BY DESIGN*

Kelly Scharf

January 20, 1998

THIC Conference - Del Mar, CA

1685 38th Street

Boulder CO 80301

+1-303-417-7205

+1-303-417-7080

kelly@exabyte.com





# Tape Technology History

- 1950s
  - Helical scan technology
    - Developed for the video industry
    - 2 inch wide tape
  - Linear technology
    - Primary data storage
    - Half-inch tape
    - Open reels
    - 7 track

1950

1960

1970

1980

1990

2000



# Tape Technology History

- 1960s /1970s

- Helical scan technology

- Width reduced to 1, 3/4, and 1/2 inch
- Improved media
- Instrumentation recorders

- Linear technology

- 1/2 inch tape
- 9 track
- Improved media
- Improved encoding

1950

1960

1970

1980

1990

2000



# Tape Technology History

- 1980s
  - Helical scan technology
    - Data storage on 8 mm and 4 mm tape
    - Dual azimuth recording
  - Linear technology
    - Half-inch tape, single reel cartridges
    - Quarter inch tape, dual reel cartridges
    - Serpentine recording

1950 1960 1970 1980 1990 2000



# Tape Technology History

- 1990s
  - Mammoth technology
    - Improved media
    - Improved head technology
    - Increased track density
    - Increased linear bit density
  - Linear technology
    - Improved media
    - Improved head technology
    - Increased track density
    - Increased linear bit density

1950

1960

1970

1980

1990

2000



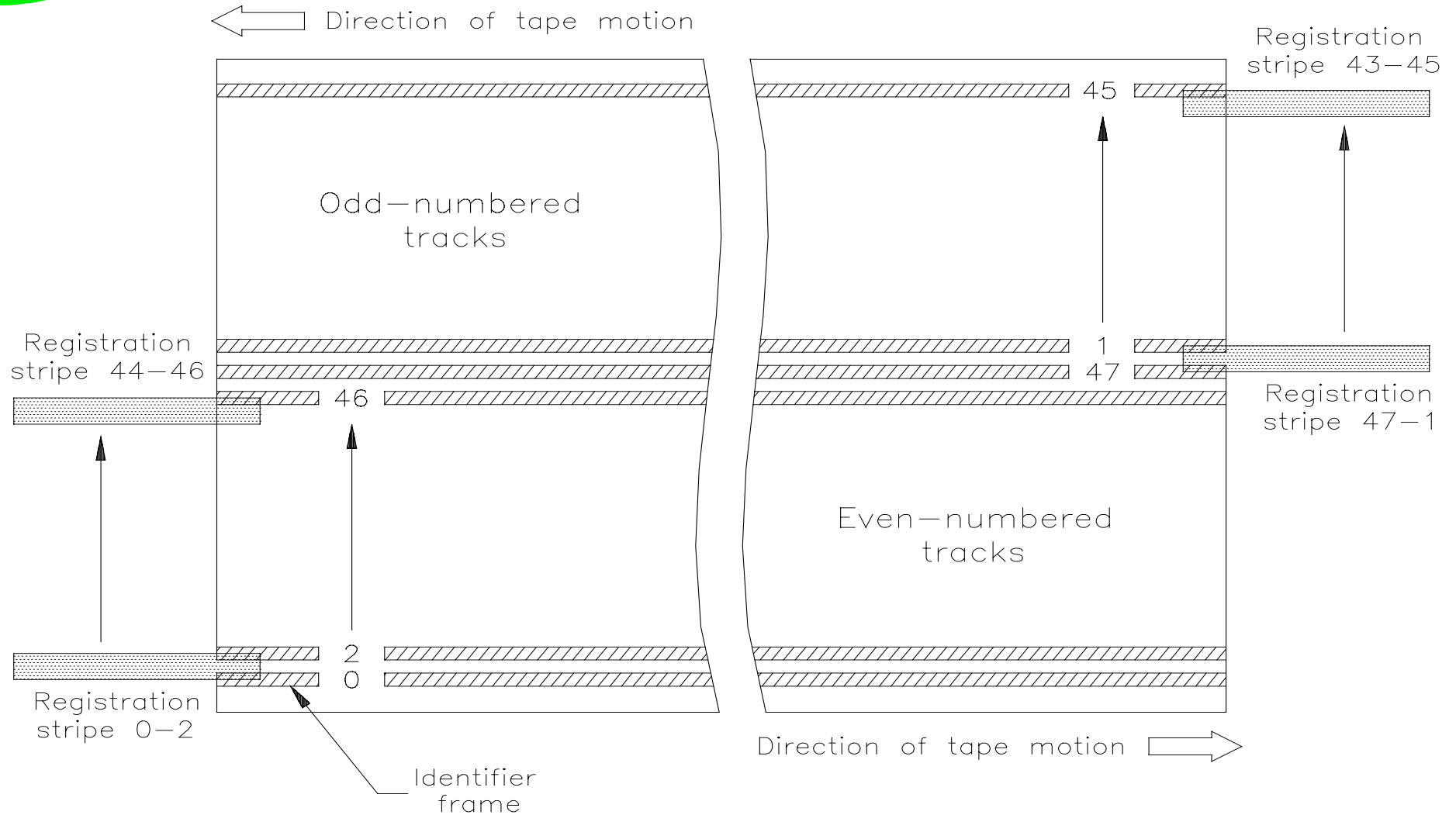
# Tape Technology Characteristics

	Helical Scan Technology	Linear Technology
Tape Speed	Low	High
Tape Tension	Low	High
Format Efficiency	Good	Limited
Linear Bit Density	High	High
Track Density	High	Low
Track Length	Short	Long



# Tape Technology

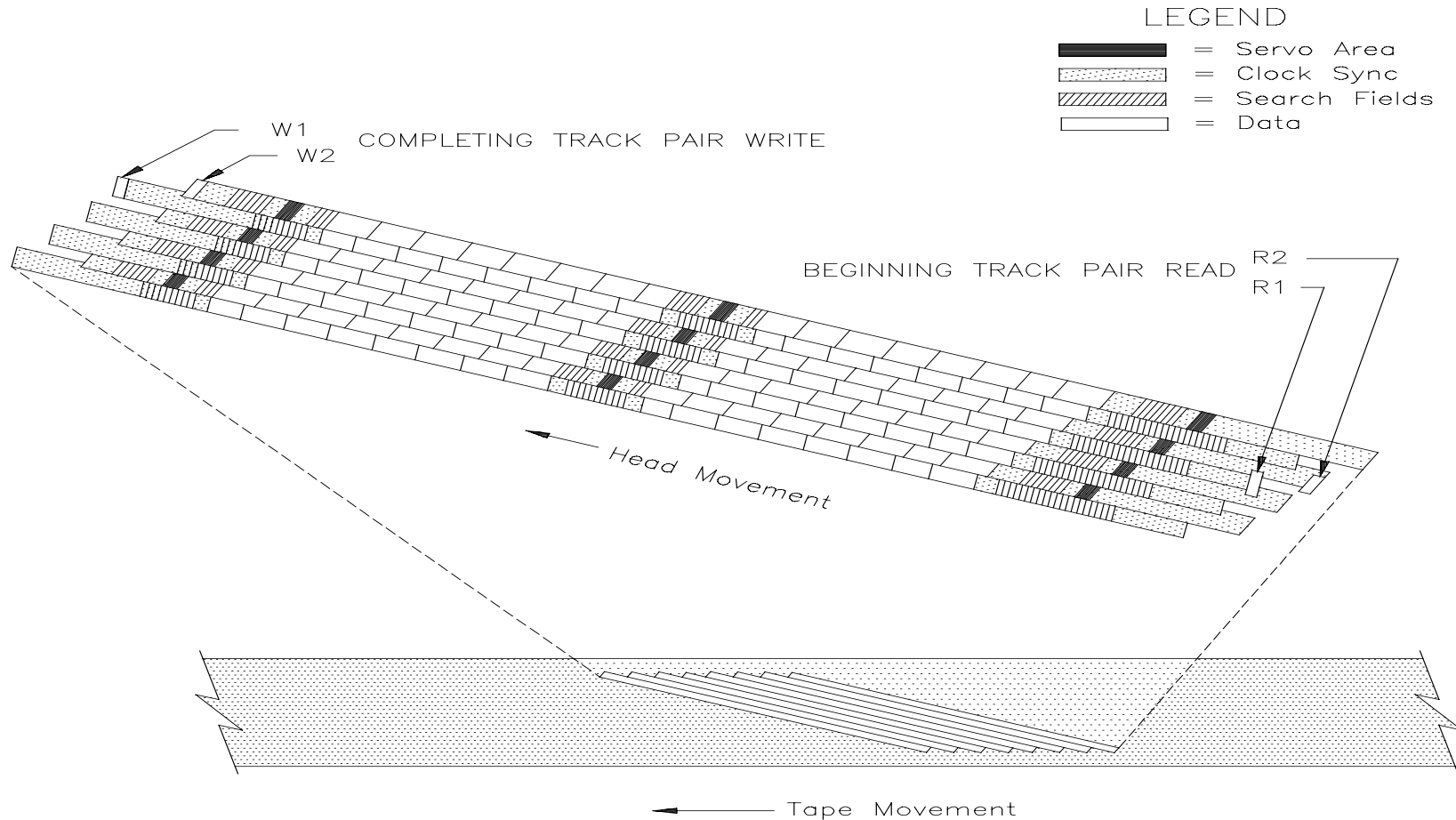
## Linear Characteristics





# Tape Technology

## Helical Scan Characteristics







# Tape Technology Future Requirements

- Demands for increased capacity
  - Tape area
  - Format efficiency
  - Linear bit density
  - Track density
- Demands for increased performance
  - Format efficiency
  - Linear bit density
  - Number of heads
  - Head to tape speed

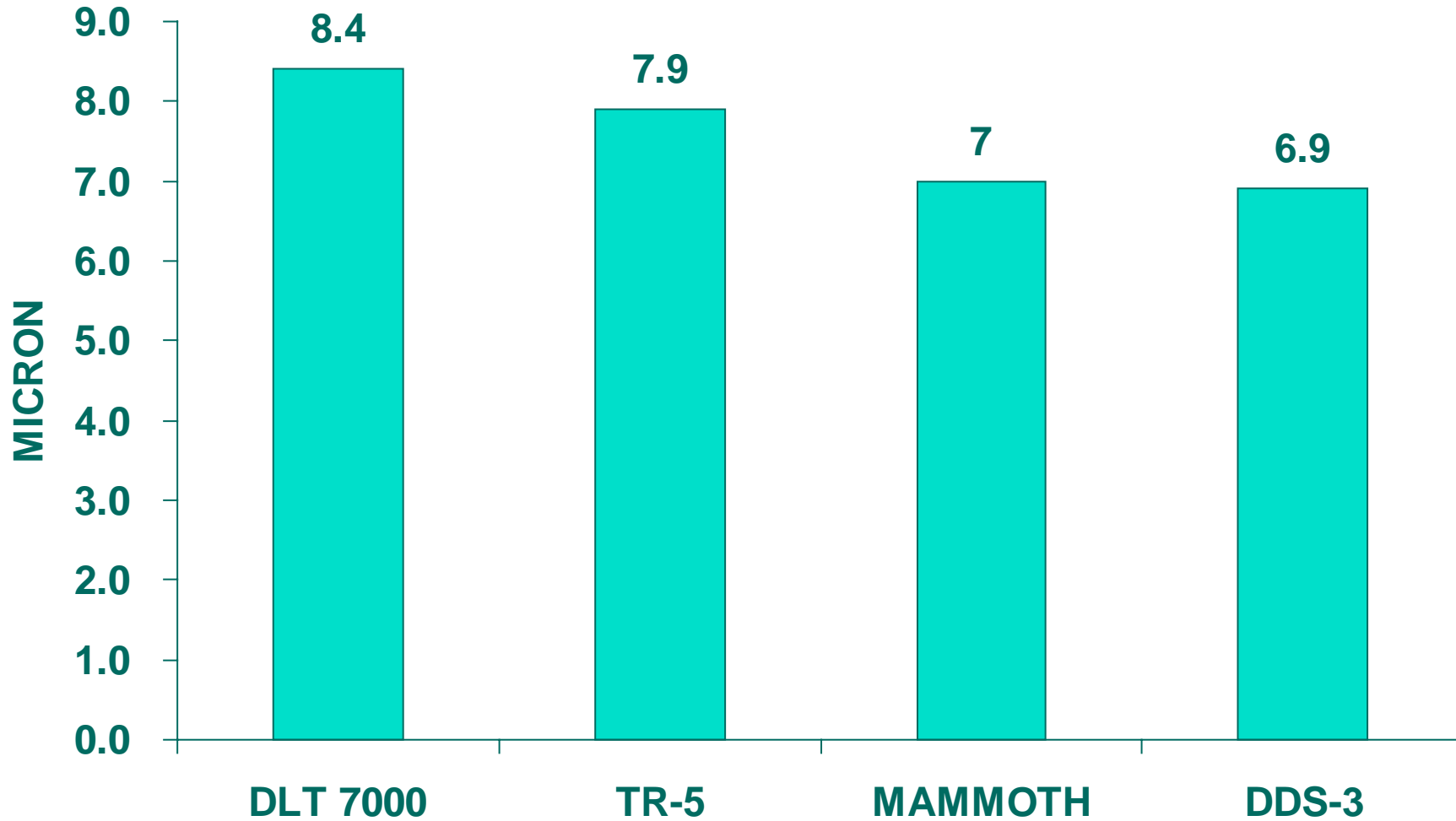


# Increase Capacity

- Option 1: Increase tape area
  - Limited by cartridge design
  - Thinner tape
- Easy for Mammoth Technology
  - Tape Speed - 1 inch/second
  - Tape Tension - 0.1 Newton
- Difficult for Linear Technology
  - High tape speed - 160 inches/second
  - High tape tension - 0.8 Newton



# Tape Thickness



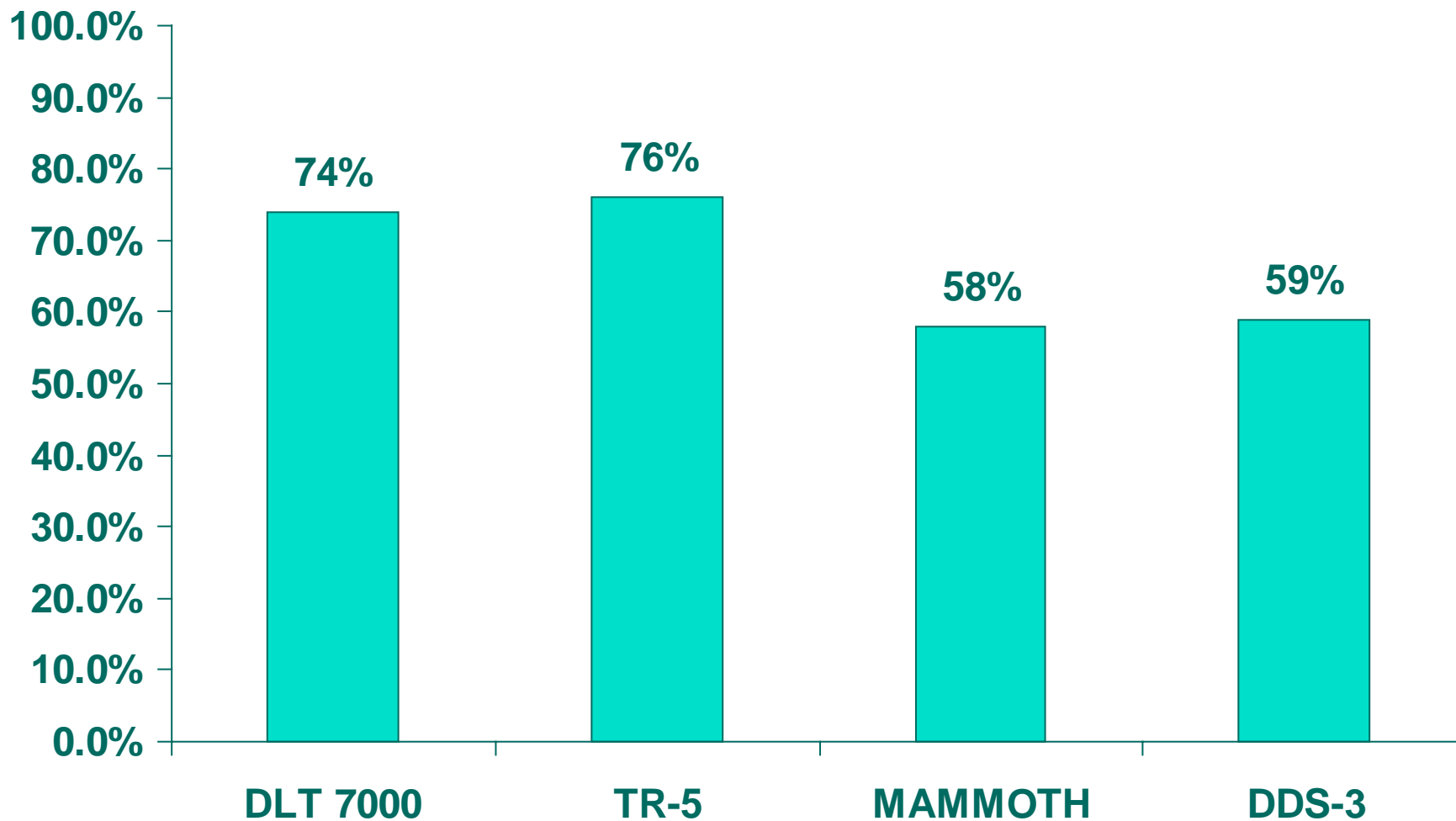


# Increase Capacity

- Option 2: Format Efficiency
- Mammoth Technology
  - Easy opportunity to increase capacity
- Linear Technology
  - Already at optimal



# Format Efficiency



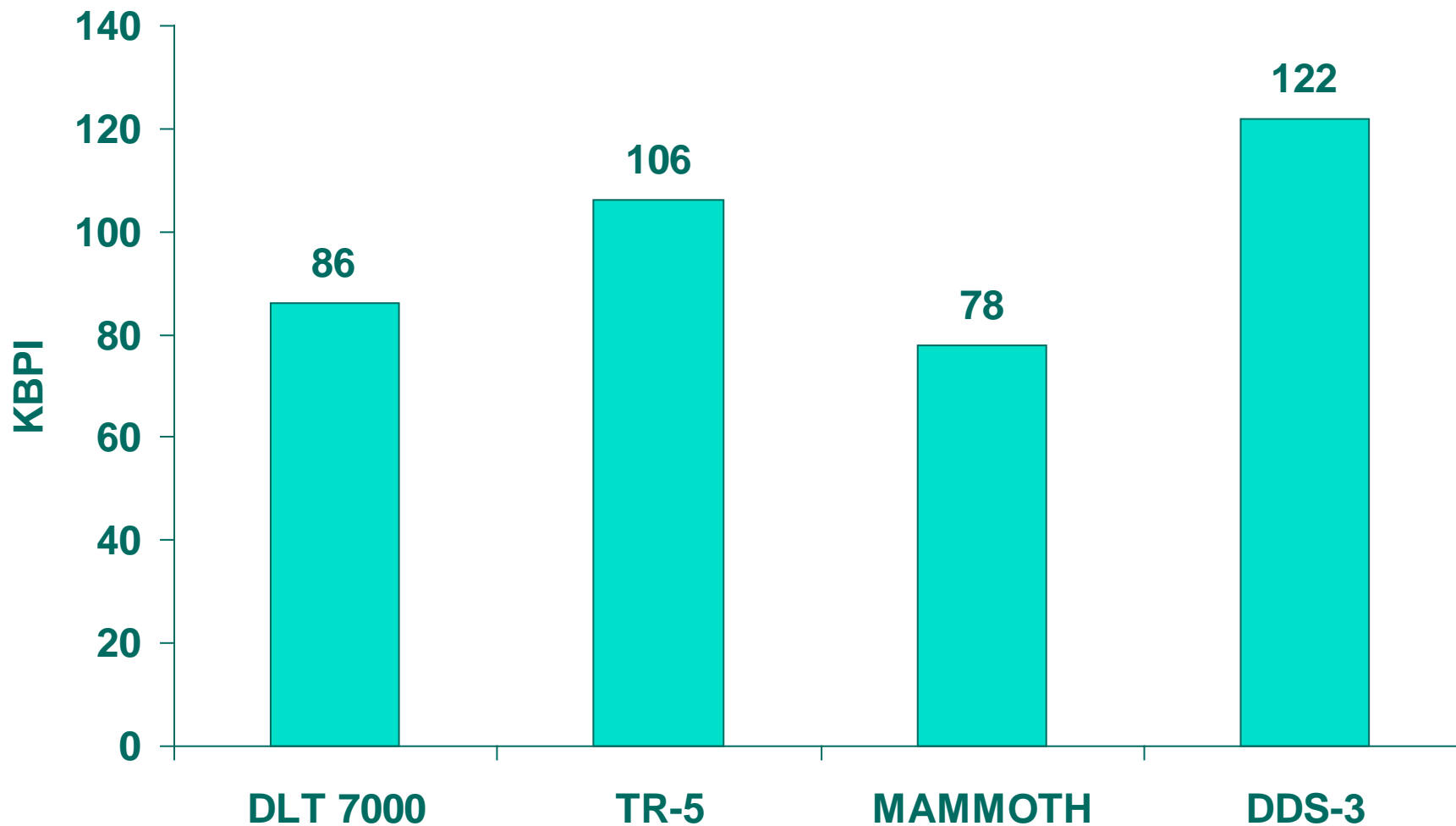


# Increase Capacity

- Option 3: Increase Linear Bit Density
  - Challenge equal for both technologies
- Easy for Mammoth Technology
  - AME Media
  - Powerful ECC exists
- Difficult for linear technology
  - MP Media
  - Increase ECC power



# Linear Bit Density





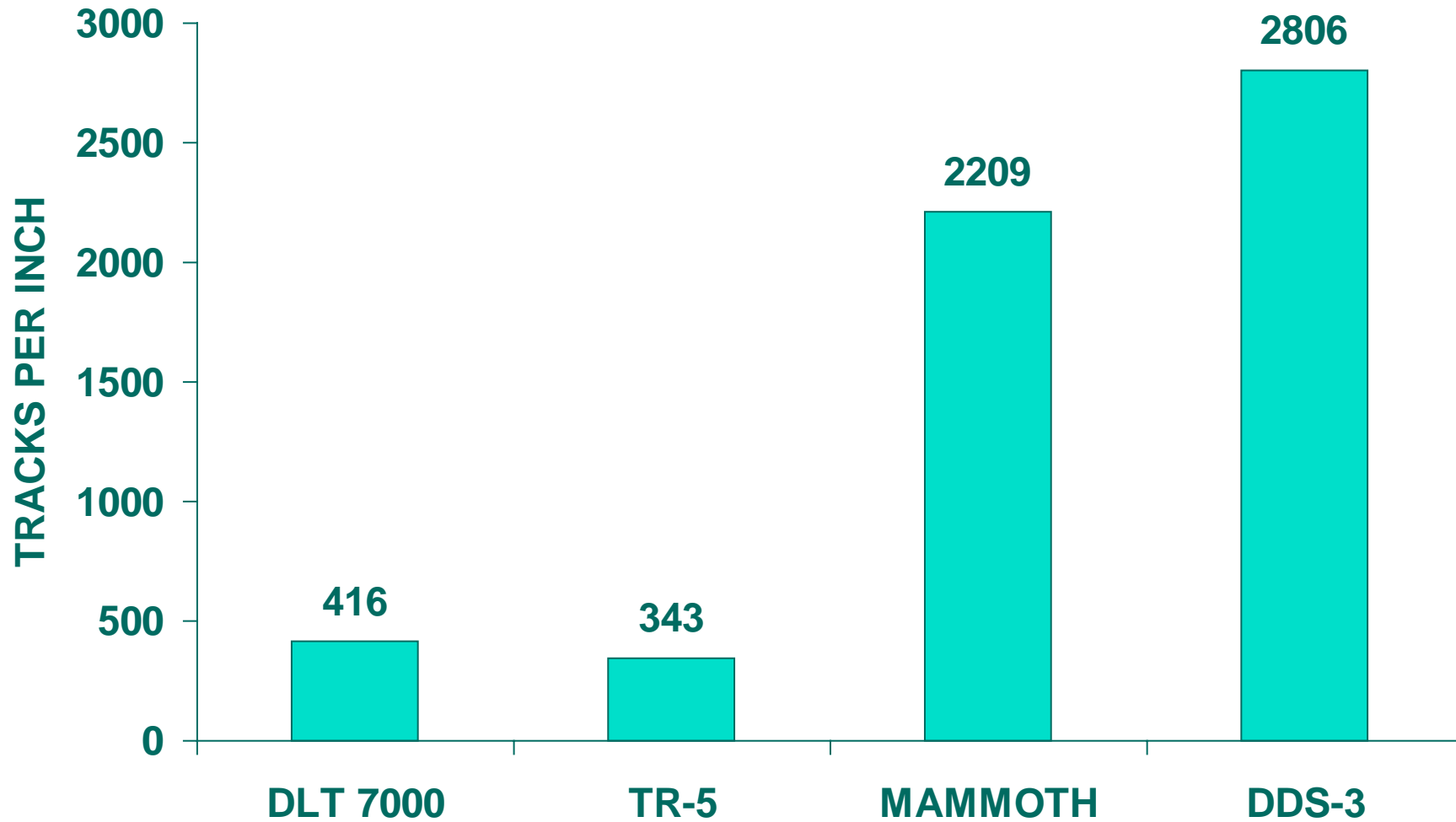
# Increase Capacity

- Option 4: Increase Track Density
  - Easy for Mammoth technology
    - Short tracks
    - Tracking servo already exists
    - Dual azimuth already exists
  - Difficult for linear technology
    - Long tracks
    - No tracking servo
    - Dual azimuth implementation





# Track Density





# Increase Capacity

	Helical Scan Technology	Linear Technology
Thinner Media	Easy	Difficult
Format Efficiency	Easy	Difficult
Increase Linear Bit Density	Easy	Difficult
Increase Track Density	Easy	Difficult



# Increase Performance Future Requirements

- Format efficiency
  - Same factors as increasing capacity
- Linear bit density
  - Same factors as increasing capacity
- Number of heads
- Head to tape speed

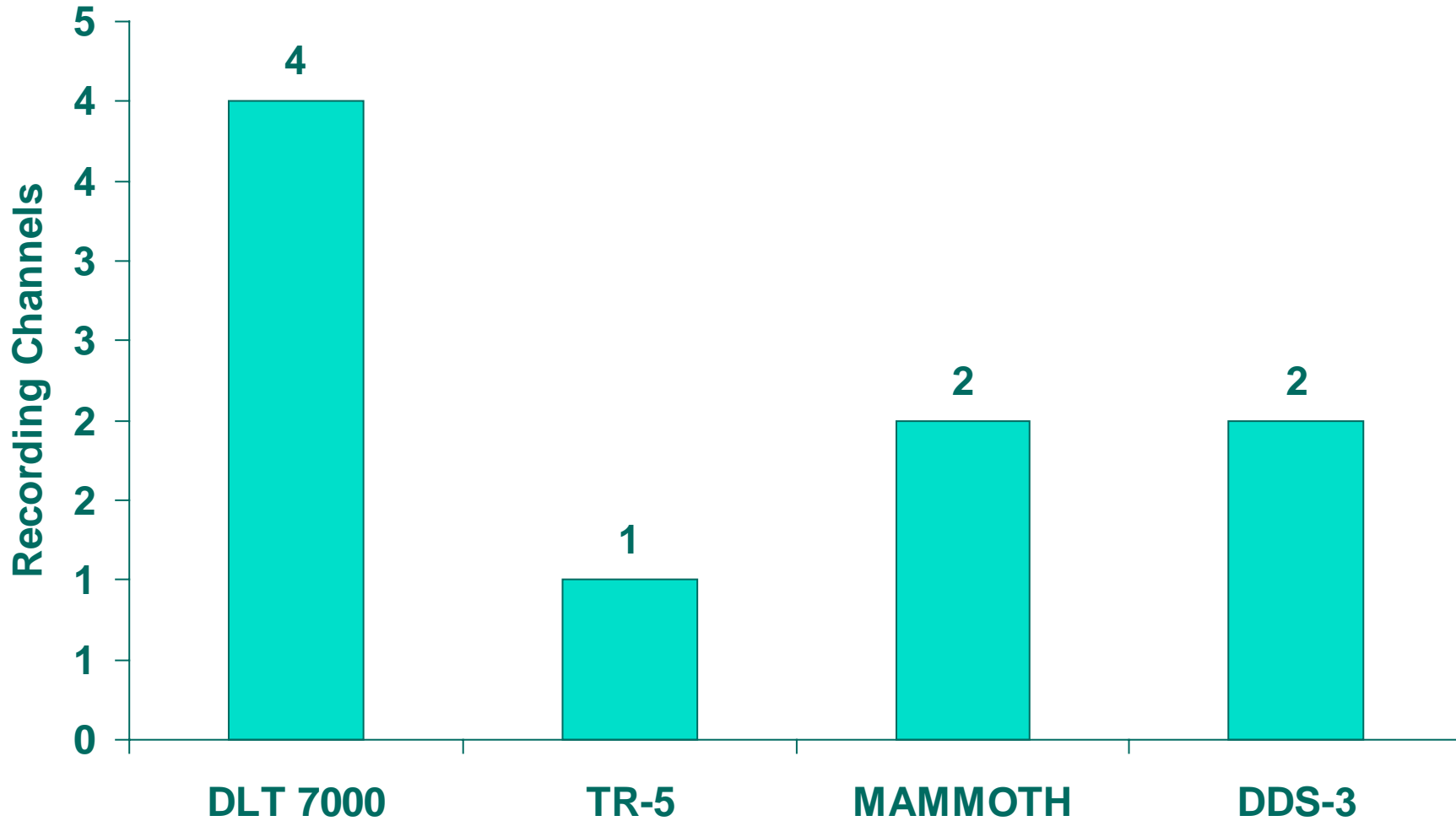


# Increase Performance

- Option 1: Increase the number of recording heads
- Less difficult for Mammoth technology
  - Scanner size
- Difficult for Linear Technology
  - Read after write - serpentine recording
  - Dual azimuth



# Recording Channels



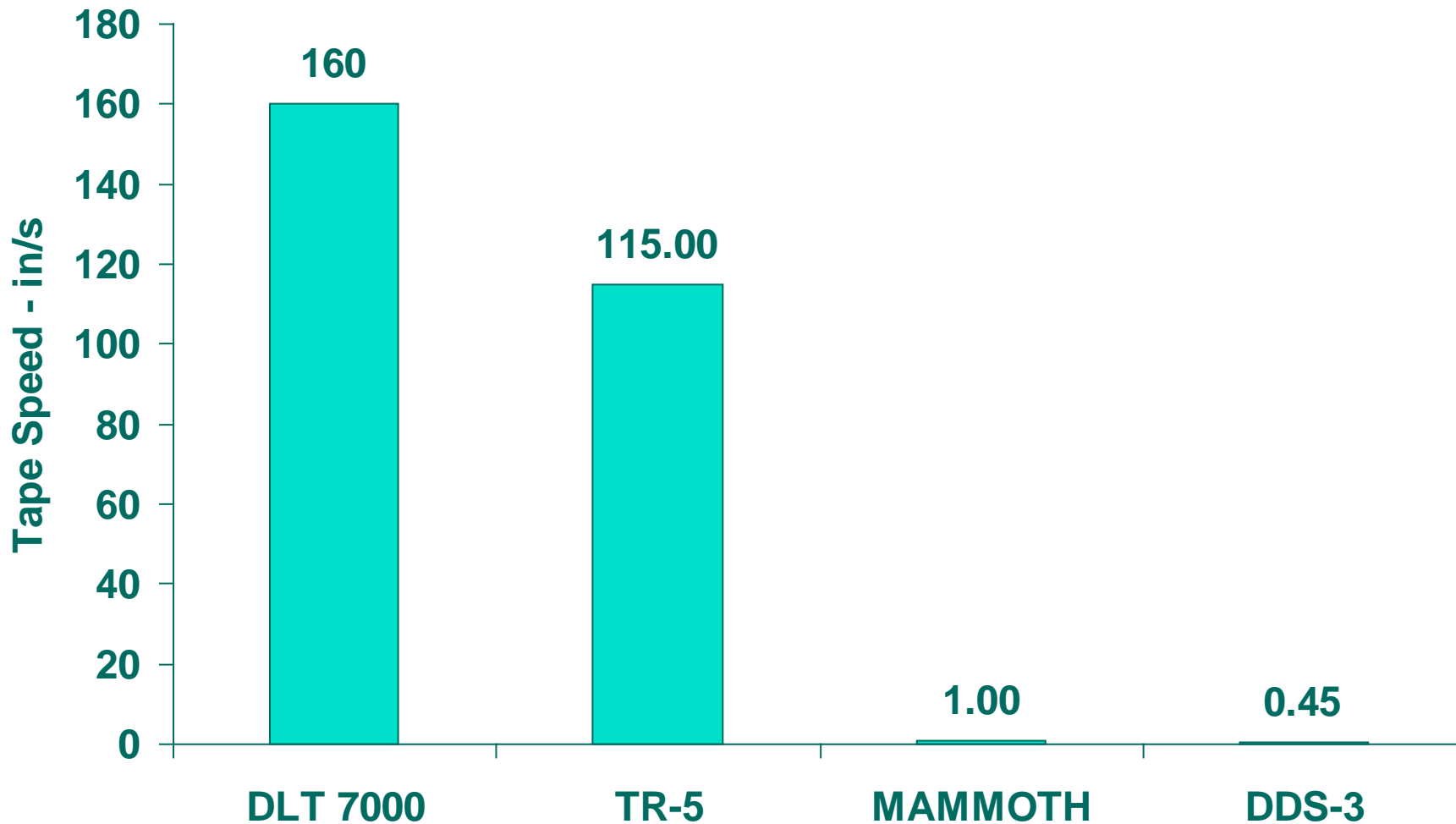


# Increase Performance

- Option 2: Increase head to tape speed
- Easy for Mammoth technology
  - Increase scanner speed
  - Low power consumption
- Difficult for Linear Technology
  - Media stress
  - High power consumption



# Tape Speed





# Increase Performance

	Helical Scan Technology	Linear Technology
Format Efficiency	<b>Easy</b>	Difficult
Increase Linear Bit Density	<b>Easy</b>	Difficult
Increase Number of Heads	<b>Easy</b>	Difficult
Increase Head to Tape Speed	<b>Easy</b>	Difficult



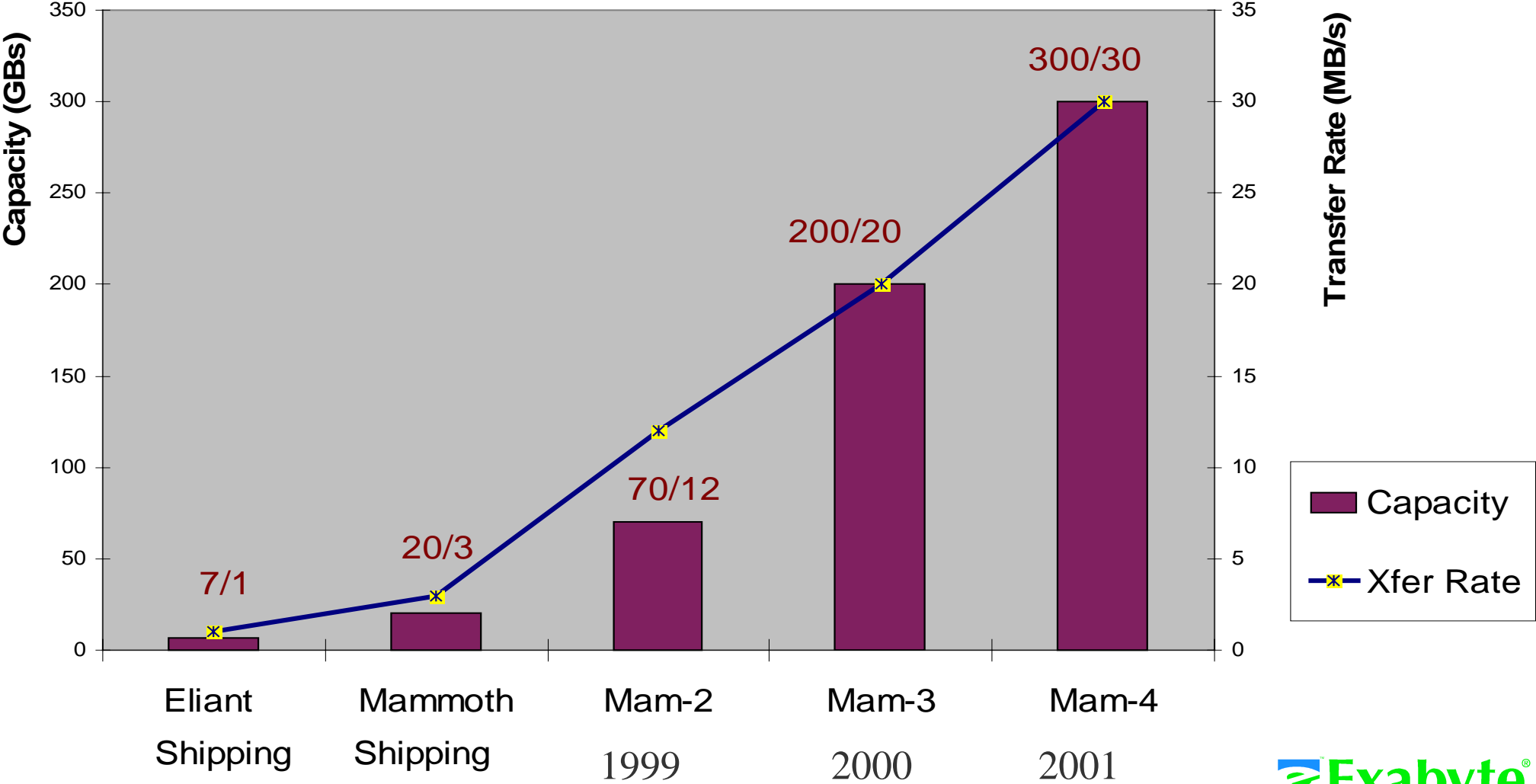


# Mammoth Technology: Advancement by Design

- Capacity and performance demands will continue to increase
- Technology characteristics will determine how these demands are met
- Mammoth technology will advance further and faster because of its superior technology



# Mammoth Technology Roadmap





*Thank You*