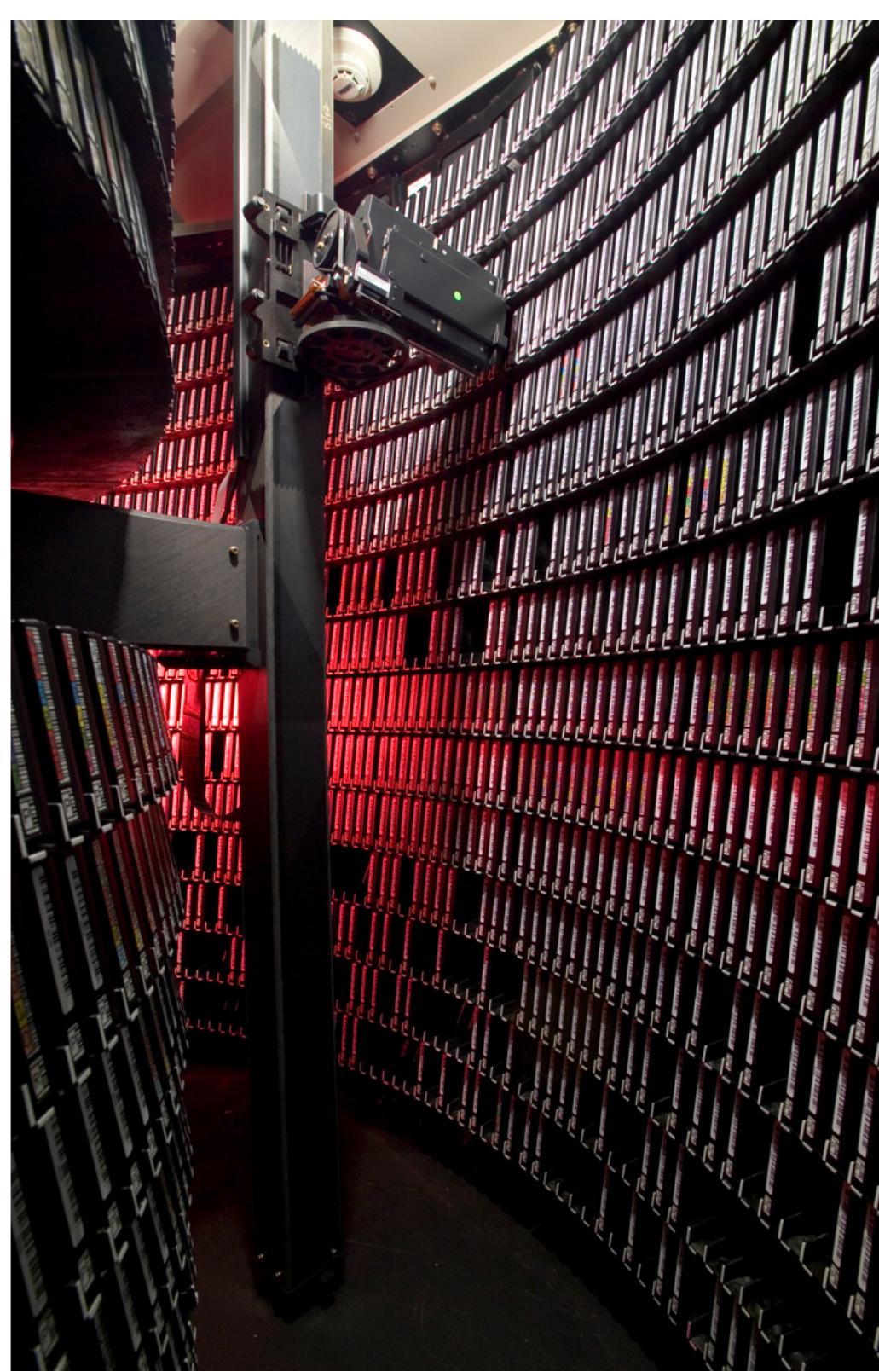
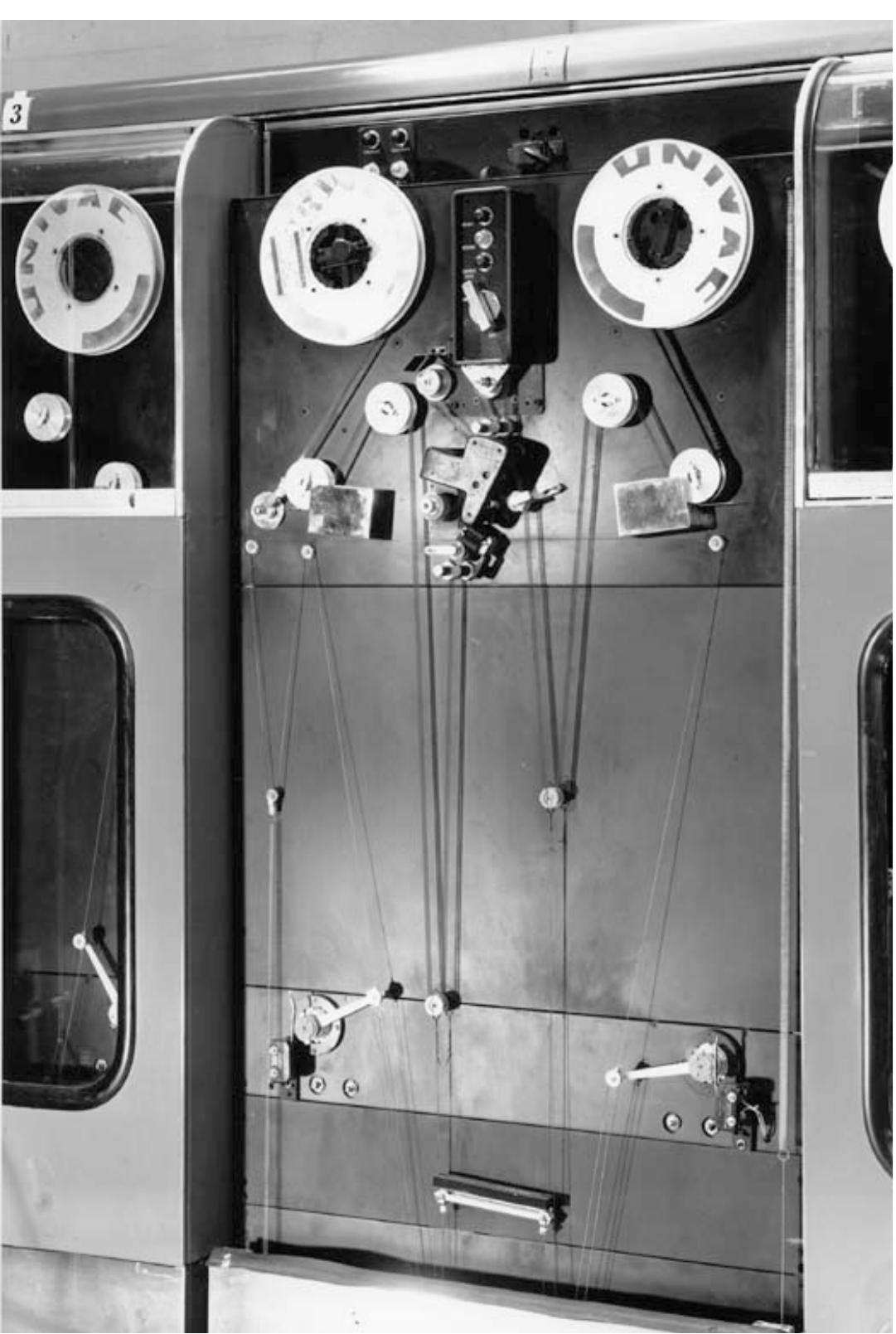
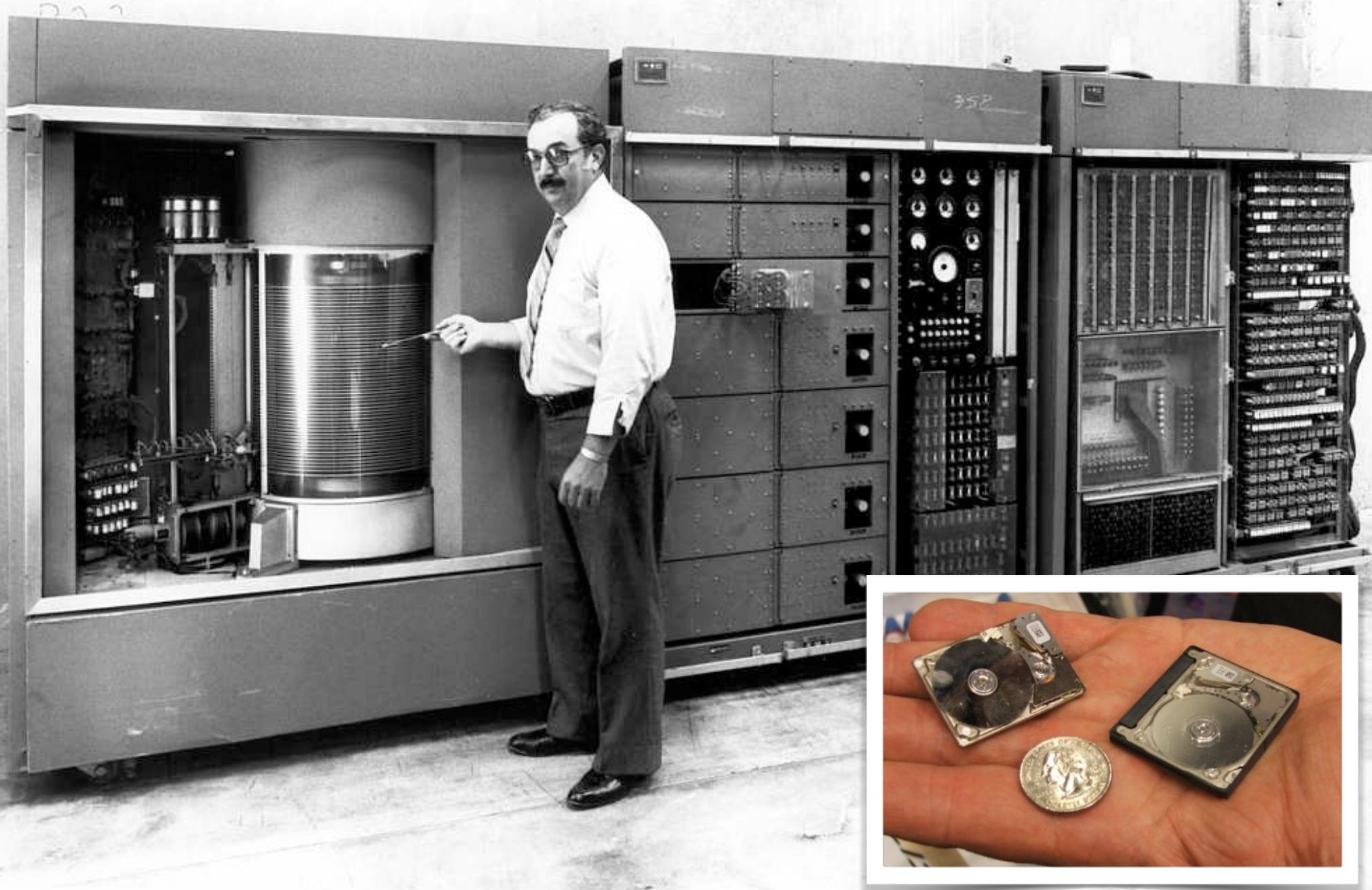


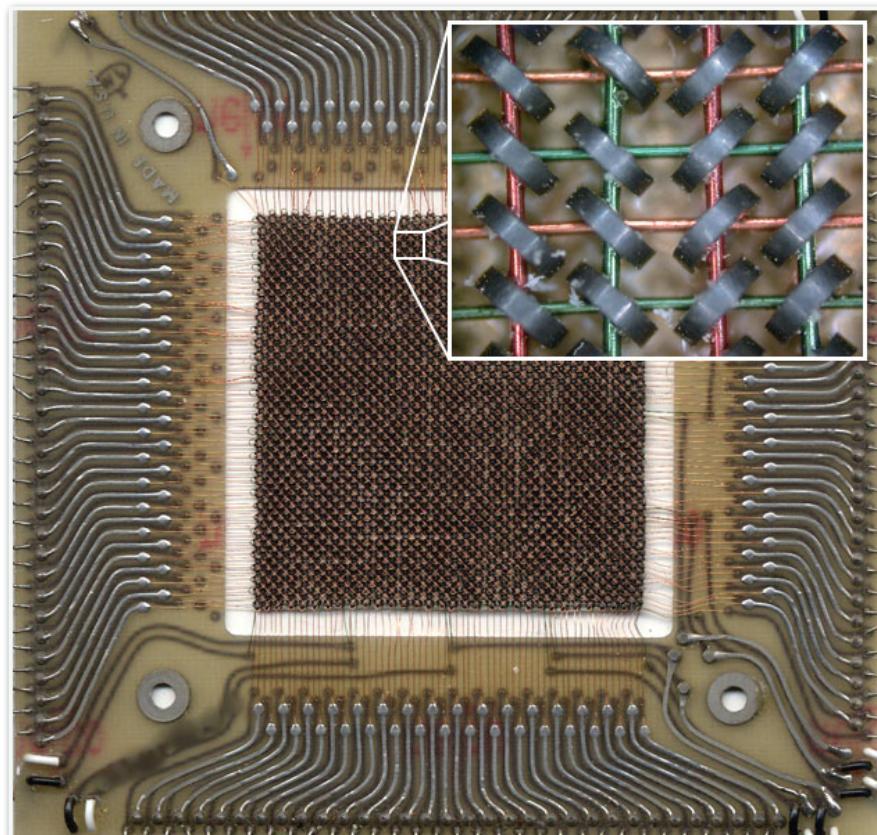
# CPE453: Operating Systems

## File & Storage Systems



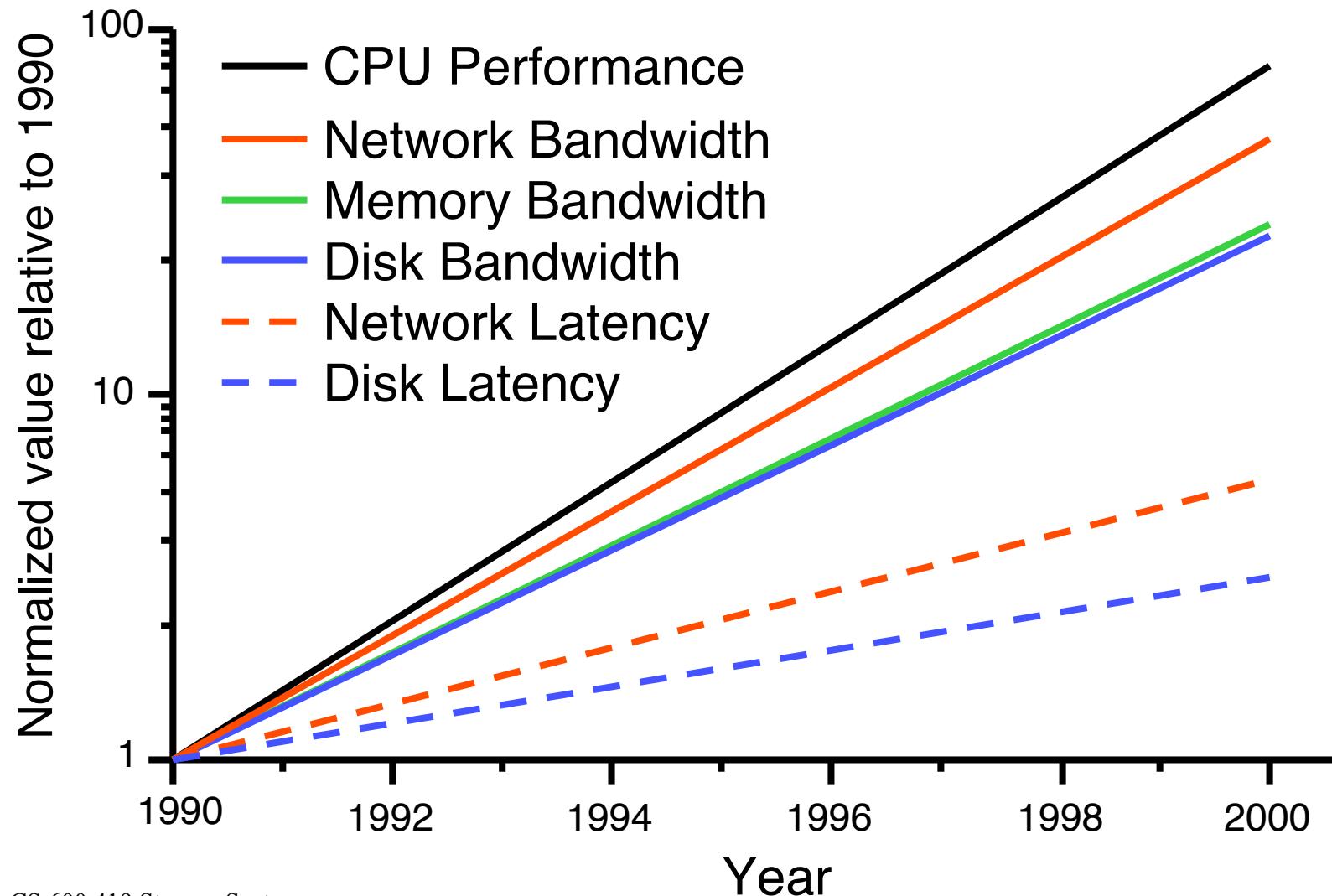






# Technology Trends

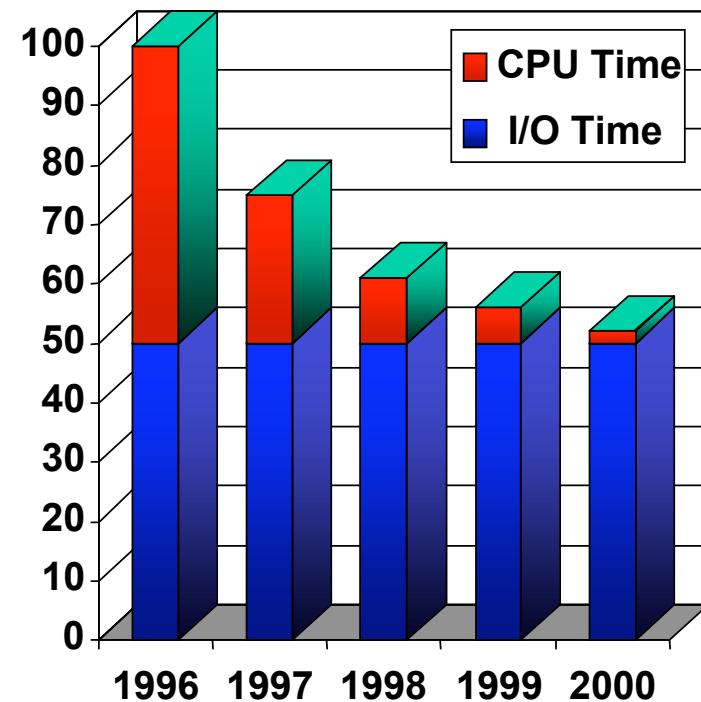
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# Consequence: storage performance dominates

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- Assume 50 seconds CPU & 50 seconds I/O
- 1998 - 1999
  - CPU improves by:  $N = 50/25 = 2$
  - Program performance improves by:  $N = 100/75 = 1.33$
- 1999 - 2000
  - CPU performance - factor of 2
  - Program performance  $N = 75/62.5=1.2$
- 2000 - 2001
  - CPU performance - factor of 2
  - Program performance  $N = 62.5/56.5 = 1.11$
- Example of Amdahl's Law



# Storage systems: fun quotes

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“I/O certainly has been lagging in the last decade”

- Seymour Cray, 1976

“Also, I/O needs a lot of work”

- David Kuck, 1988

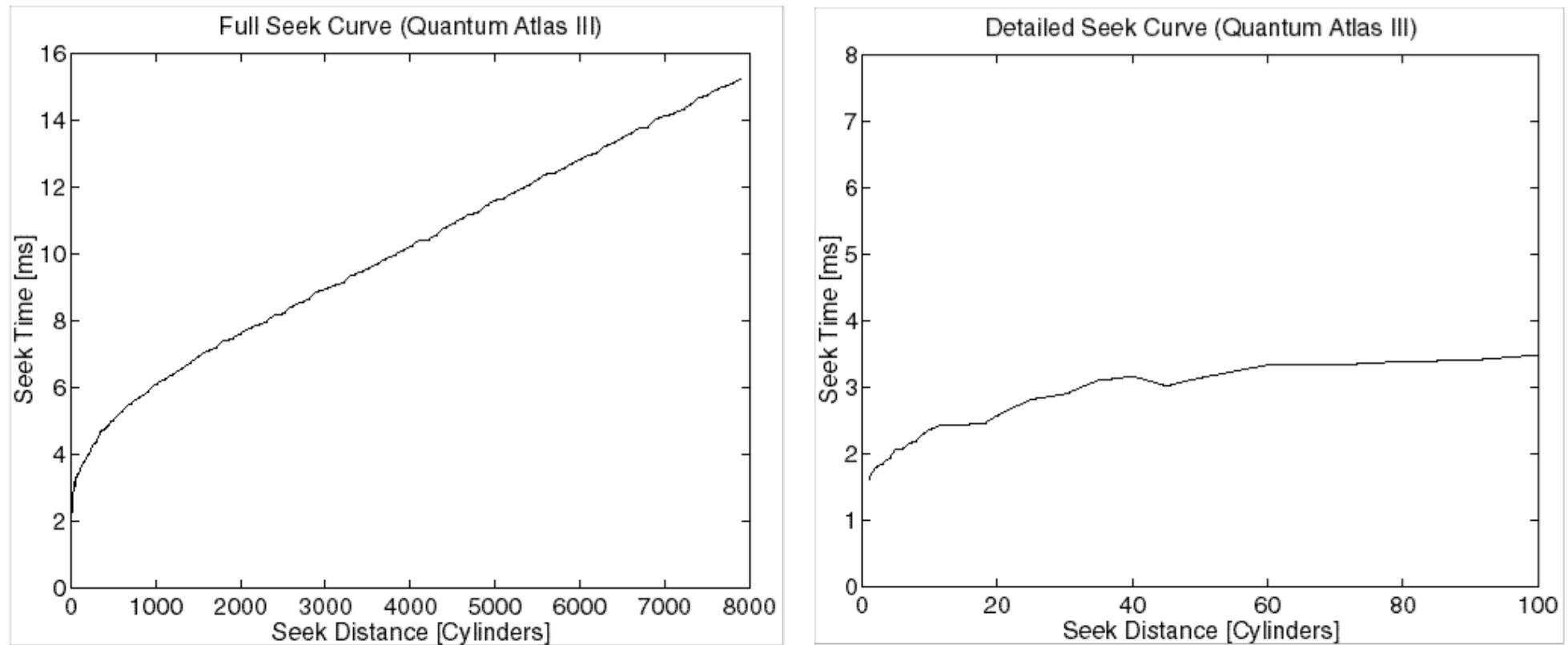
“Storage will dominate our business in a few years”

- Compaq VP, 1998

“In 3 to 5 years, we will start seeing servers as peripherals to storage”

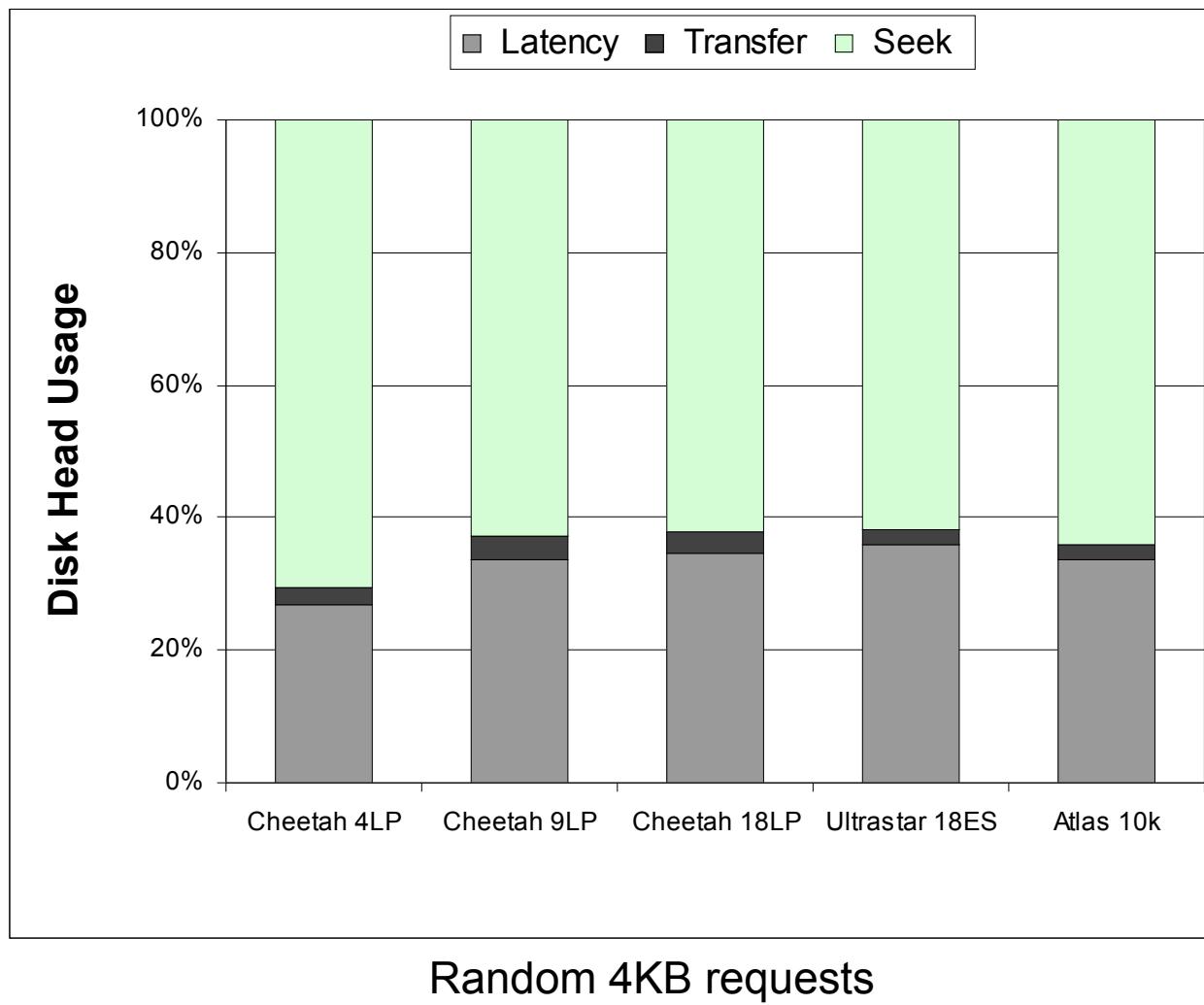
- SUN Chief Technology Officer, 1998

# Seek



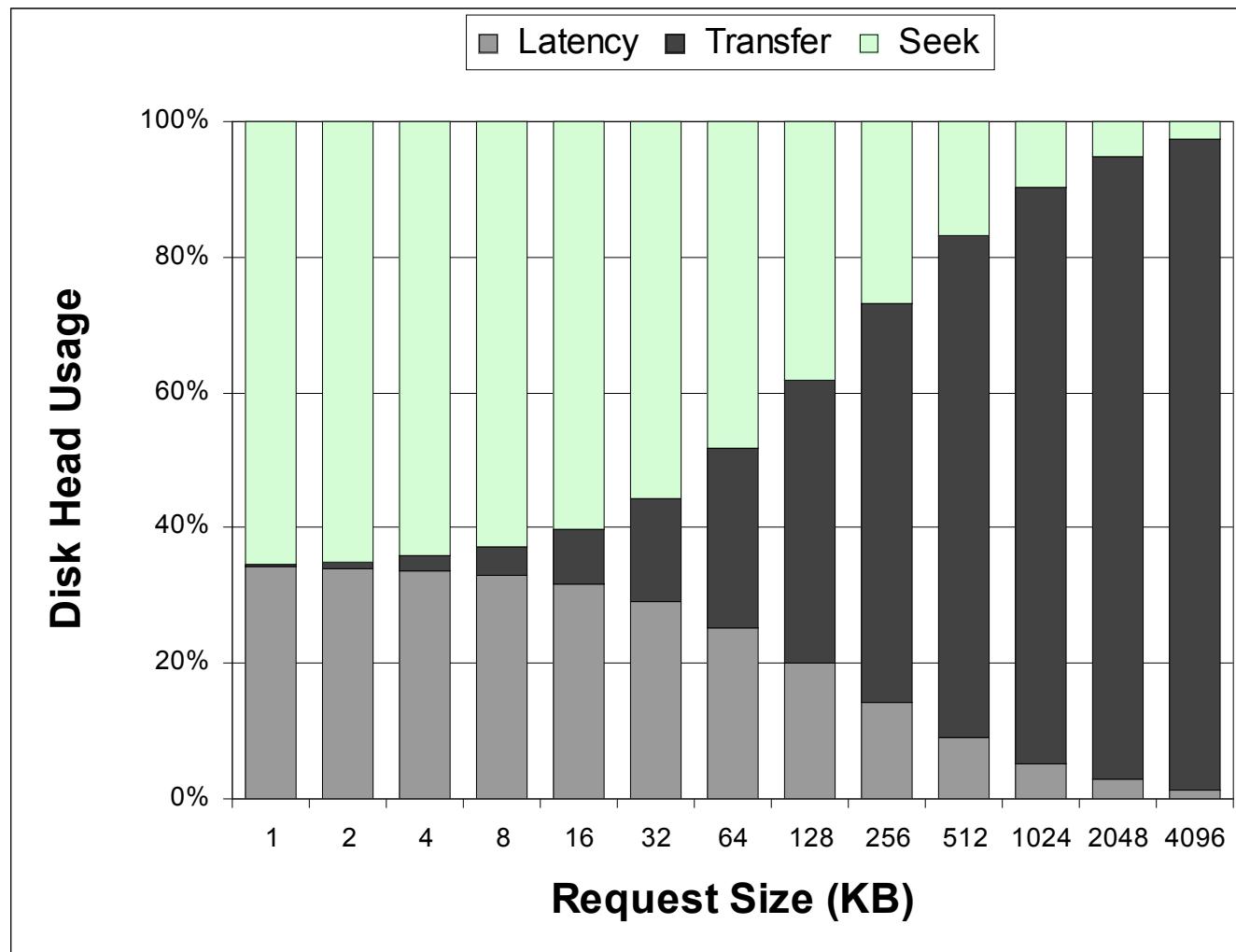
# Where does the disk head's time go?

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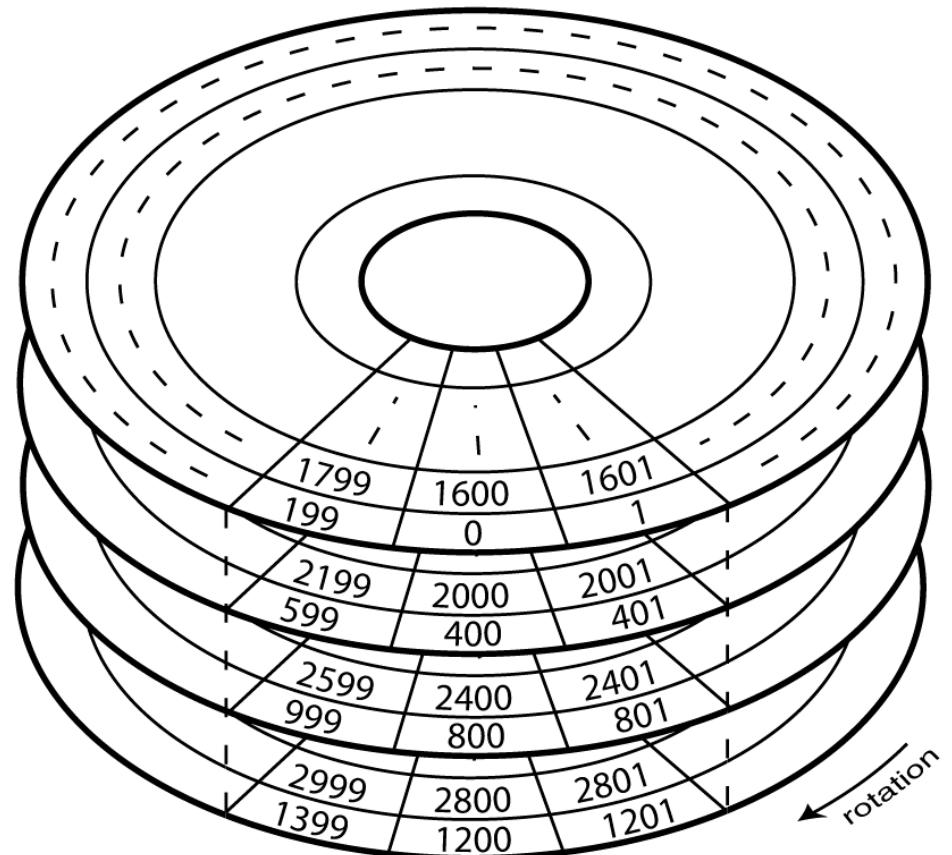
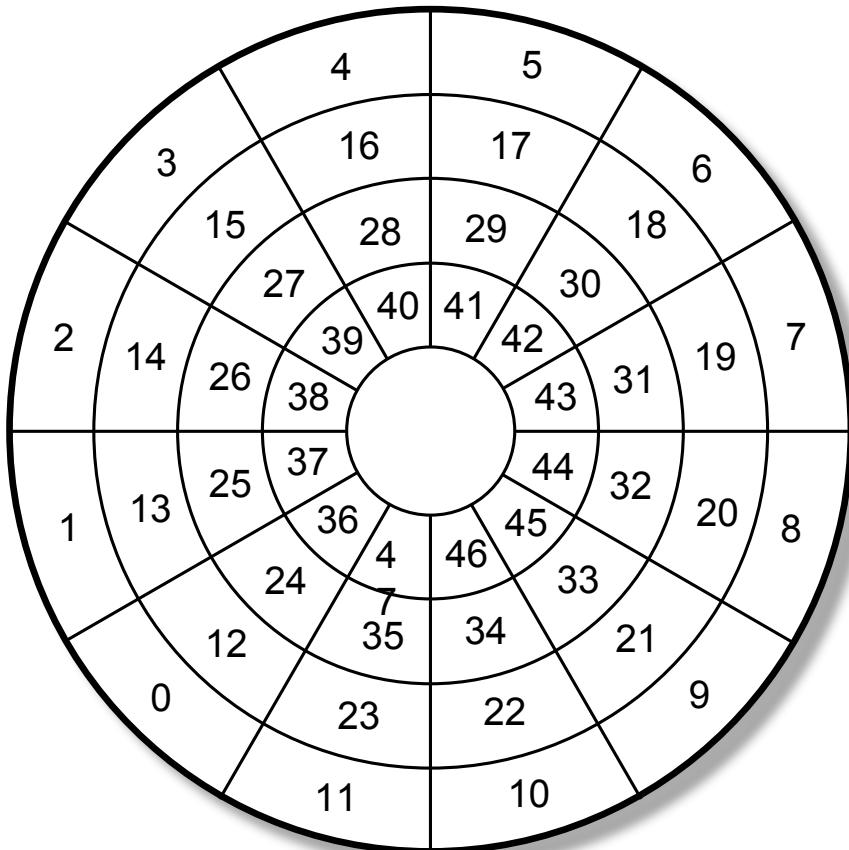


# Impact of Request Sizes

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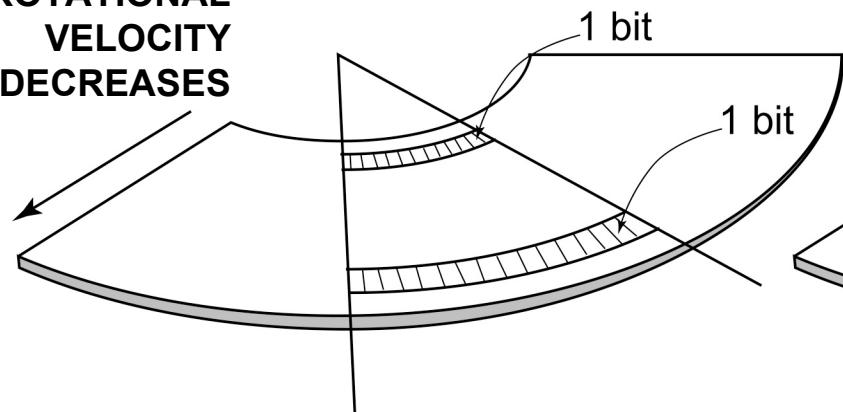


# A Simple Organization

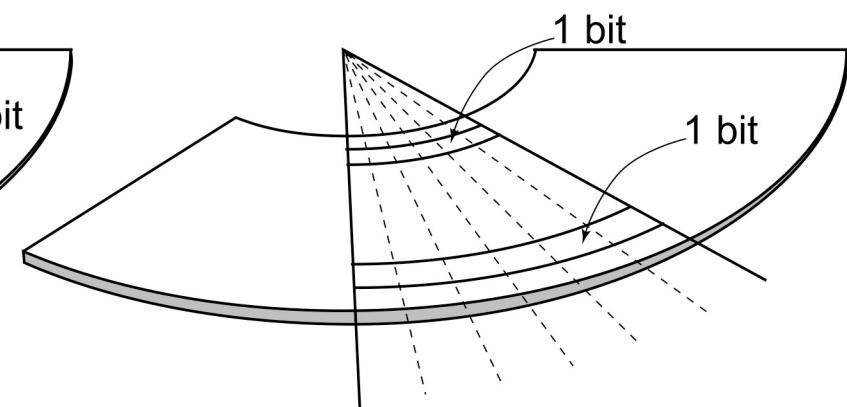


# Complication I: Zones

ROTATIONAL  
VELOCITY  
DECREASES

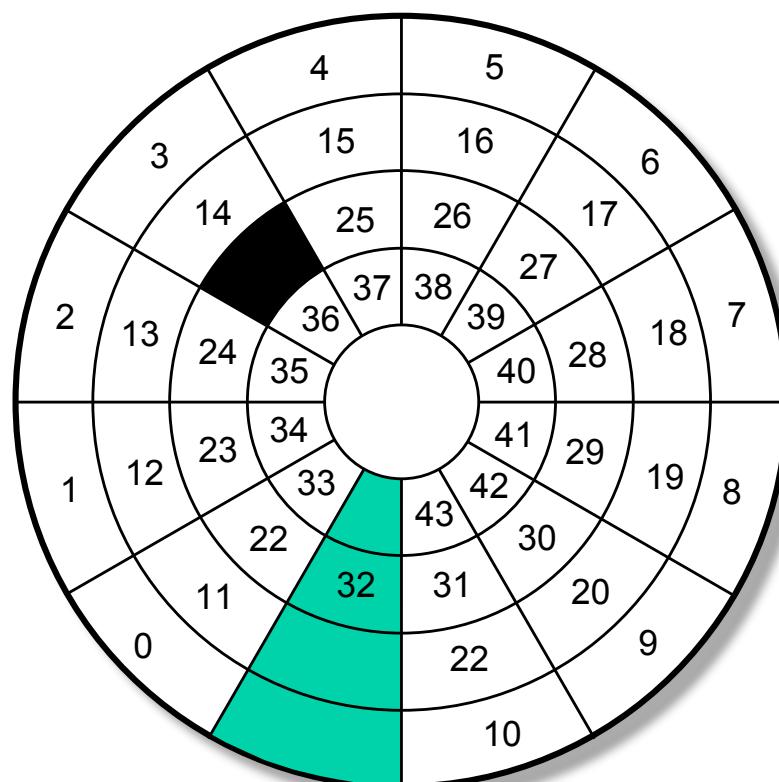
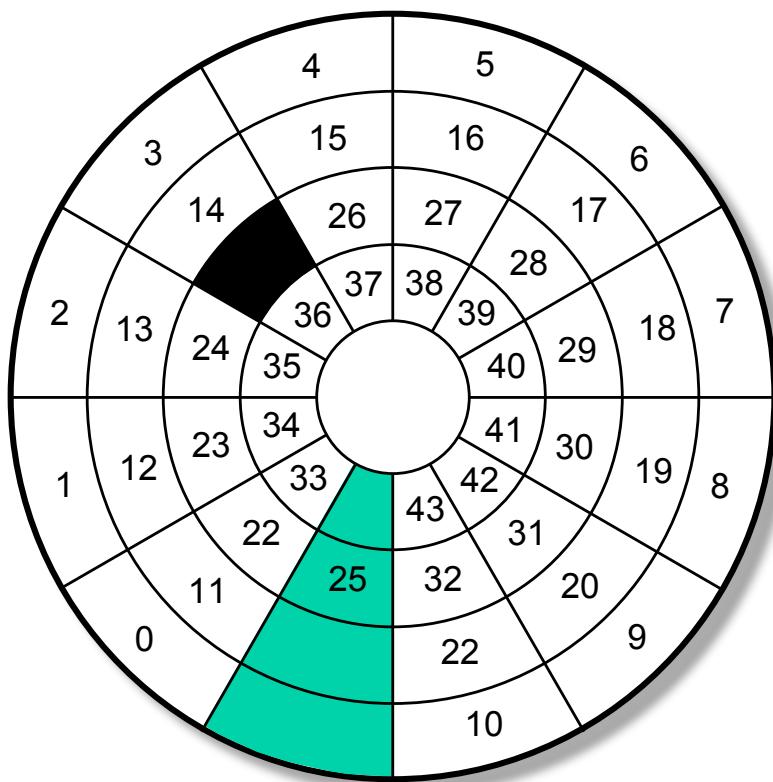


CONSTANT LINEAR VELOCITY (CLV)

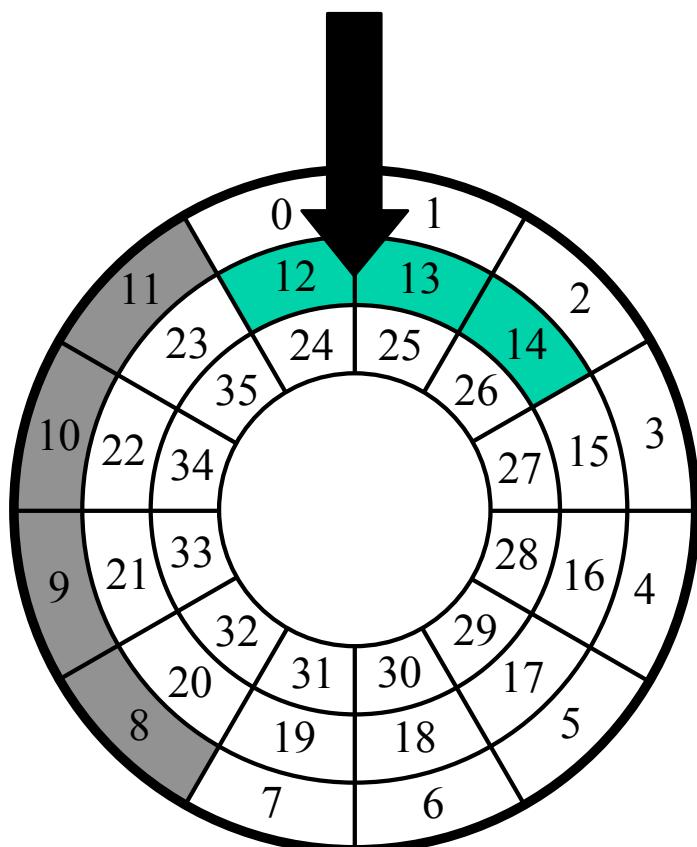


CONSTANT ANGULAR VELOCITY (CAV)

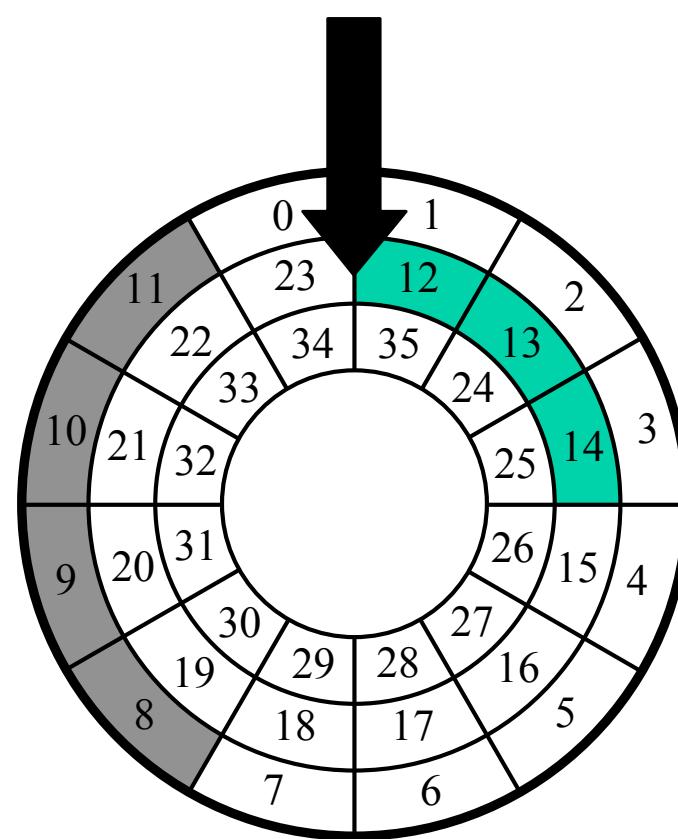
# Complication 2: Defects



# Complication 3: Skew

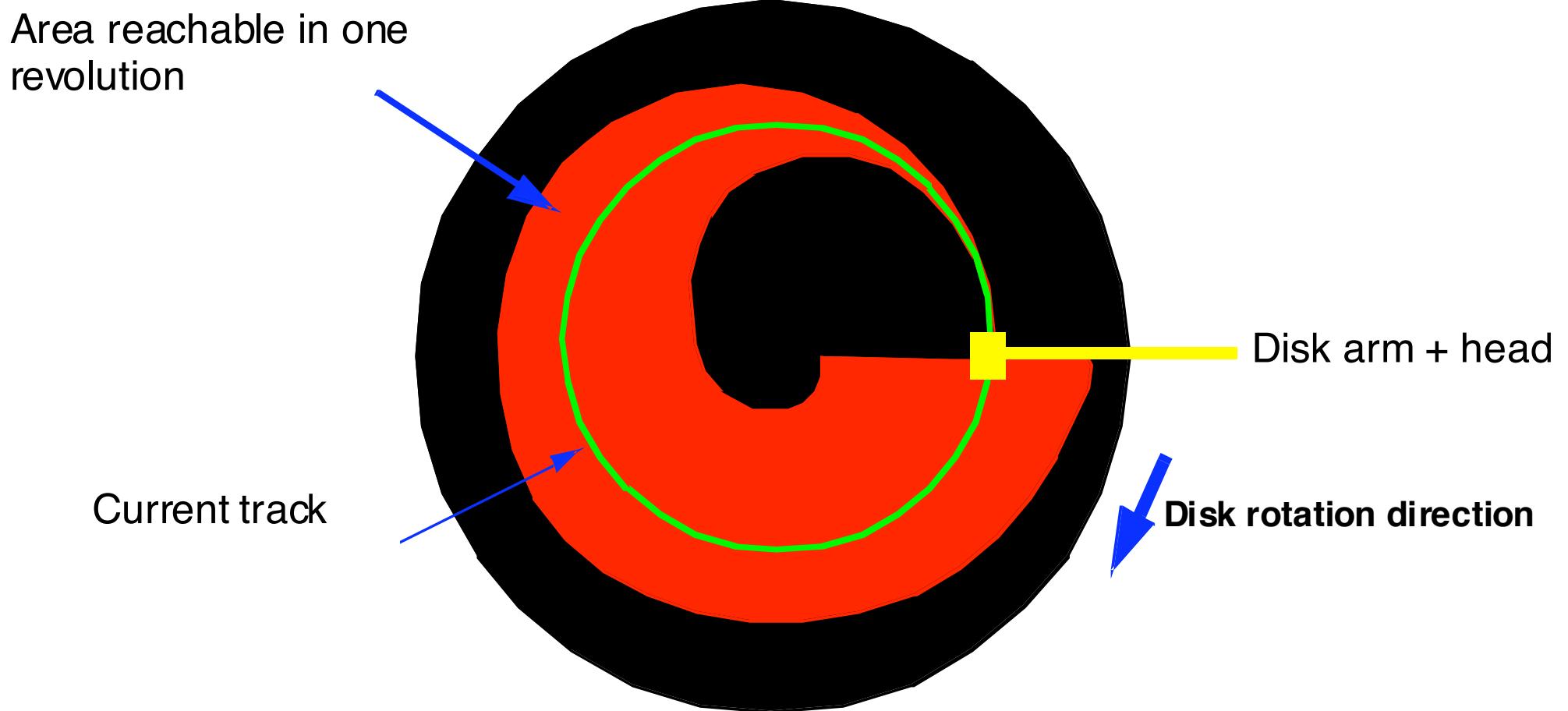


After track switch



After track switch

# Complication 3: Skew



- C. Ruemmler and J. Wilkes. An Introduction to Disk Drive Modeling. IEEE Computer, 27(3), 17-28, 1994.