10장. I/O Models

I/O blocking: Why ?

- CPU operates much faster than the disk or the network does
  - A very fast disk has 5 ms seek time
  - On a 500 MHz Pentium III machine, a task can execute about 1,250,000 assembler instructions during one seek time

Computer System들의 전형적인 수행 시간

항목	시간	사람의 시간으로 환산
Processor Cycle	0.5 ns(2GHz)	1초
Cache Access	1ns(1GHz)	2초
Memory Access	15ns	30초
Context Switch	5,000ns(5us)	167분
Disk Access	7,000,000ns(7ms)	162일
Time Quantum	100,000,000ns(100ms)	6.3년

주) 1ns = 10**-9초, 1us = 10**-6초, 1ms = 10**-3초

When to Block ?

- When to Block
  - Reading
    - No data has arrived yet
  - Writing
    - Internal buffers are full and waiting for transmission and your task requests more data to be sent
  - Connecting
    - accept( ) and connect( ) system calls find no pending connections in the listening queue

Alternatives to I/O Blocking

- While waiting for a system request to finish, the task could
  - Test the integrity of its data
  - Start and track other requests
  - Wait for several socket connections
  - Process some CPU-intensive calculations

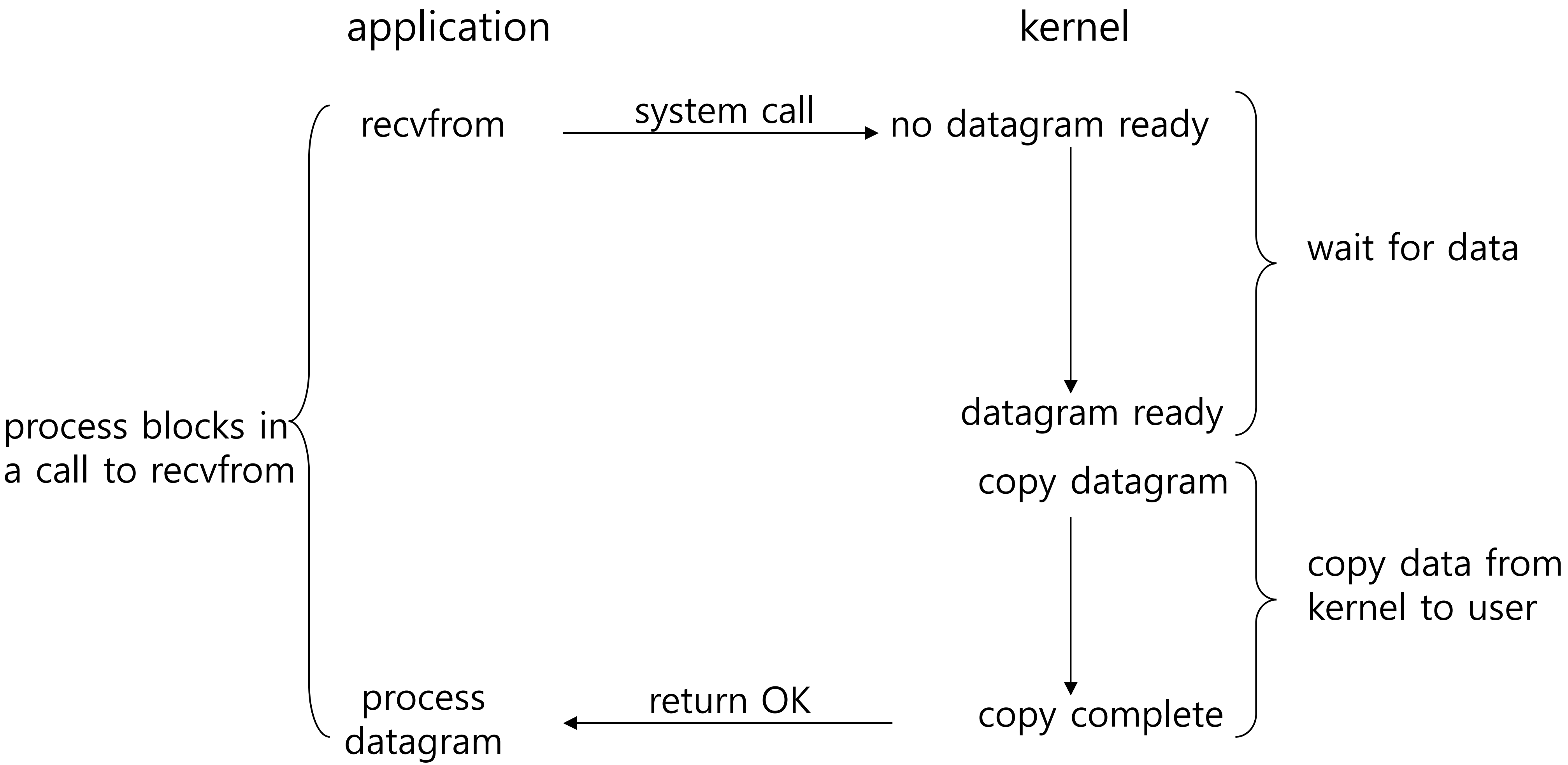
I/O Models

- Blocking I/O
- Non-blocking I/O
- I/O multiplexing
- Signal Driven I/O Model
- Asynchronous I/O

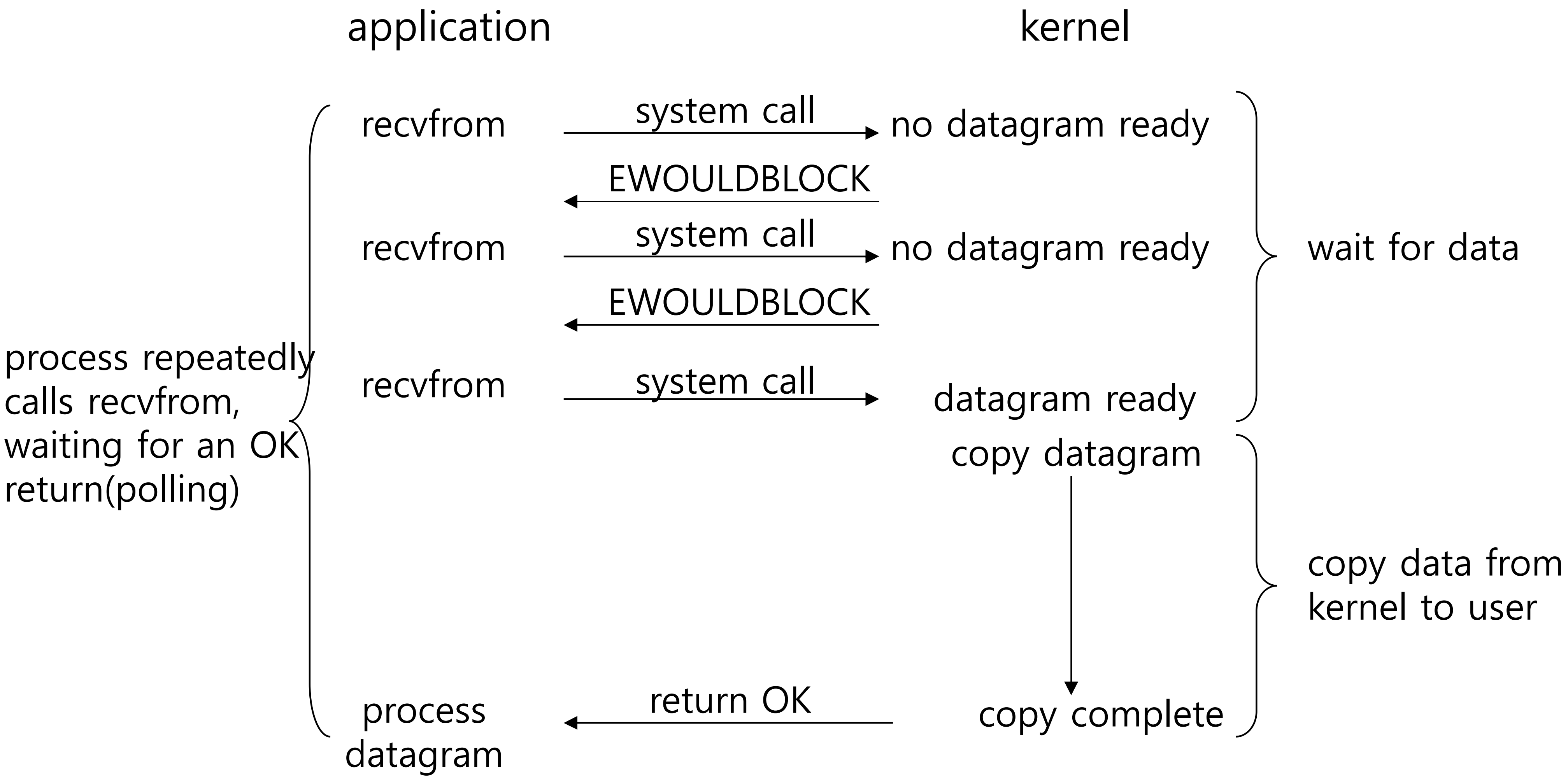
I/O Operation

- 입력 동작에는 2 단계가 존재
  - 데이터가 준비될 때까지 기다리는 단계
  - 준비된 데이터를 커널에서 사용자 프로세스로 복사하는 단계
- 네트워크 소켓의 경우
  - 패킷이 네트워크로부터 도착, 커널 버퍼로 복사 됨
  - 커널 버퍼로부터 응용 프로그램의 버퍼로 복사

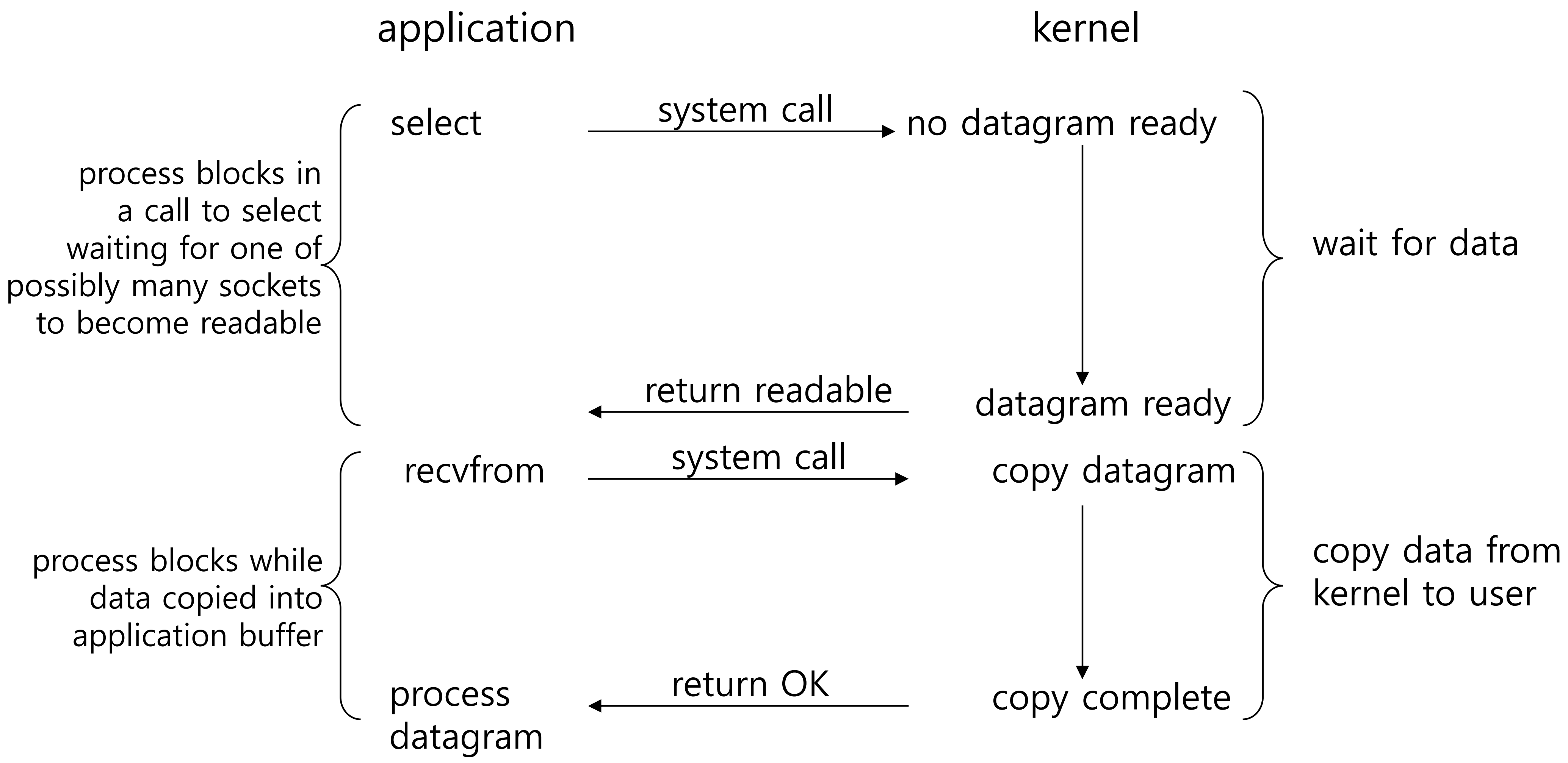
Blocking I/O Model



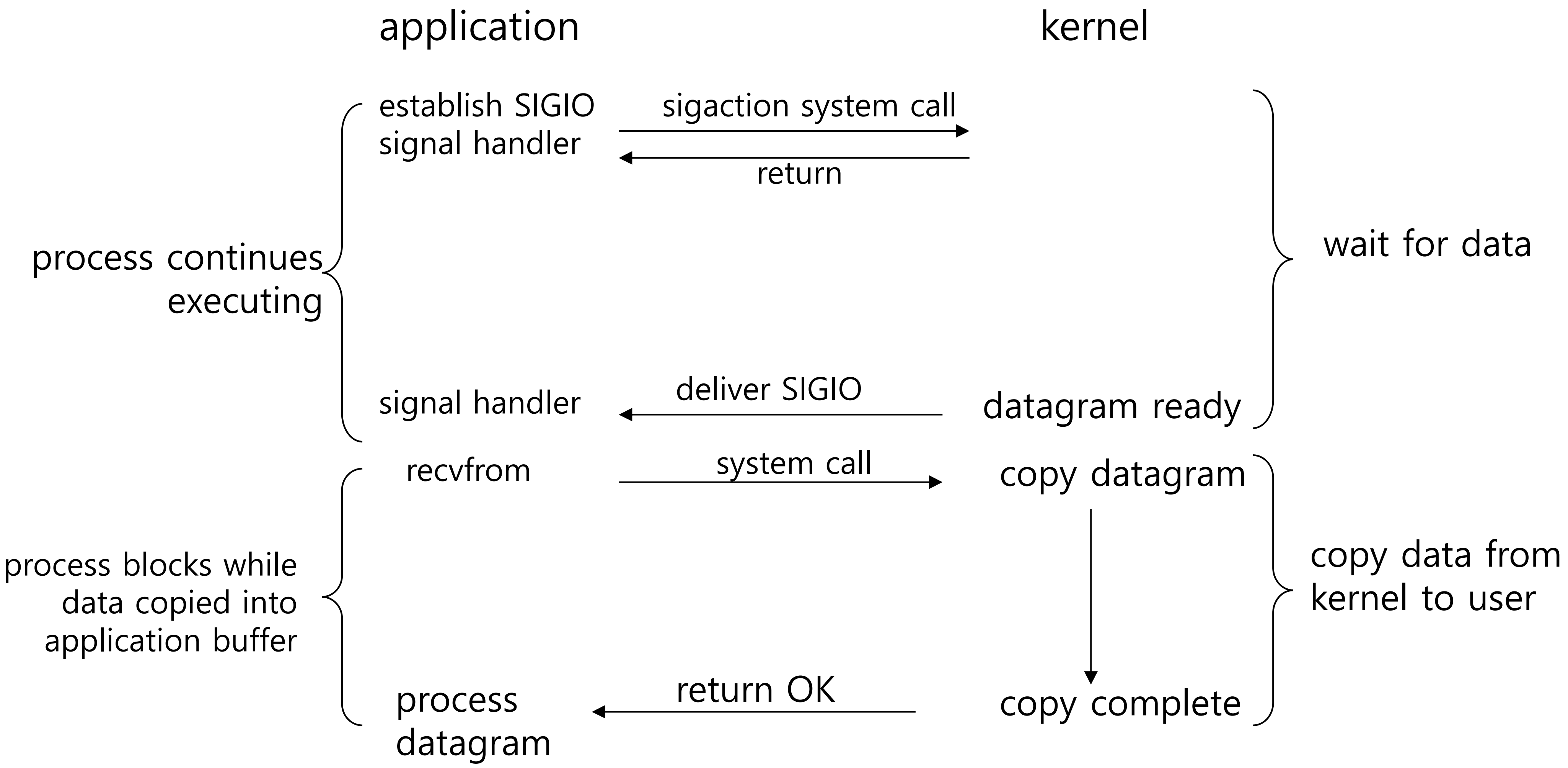
Non-blocking I/O Model



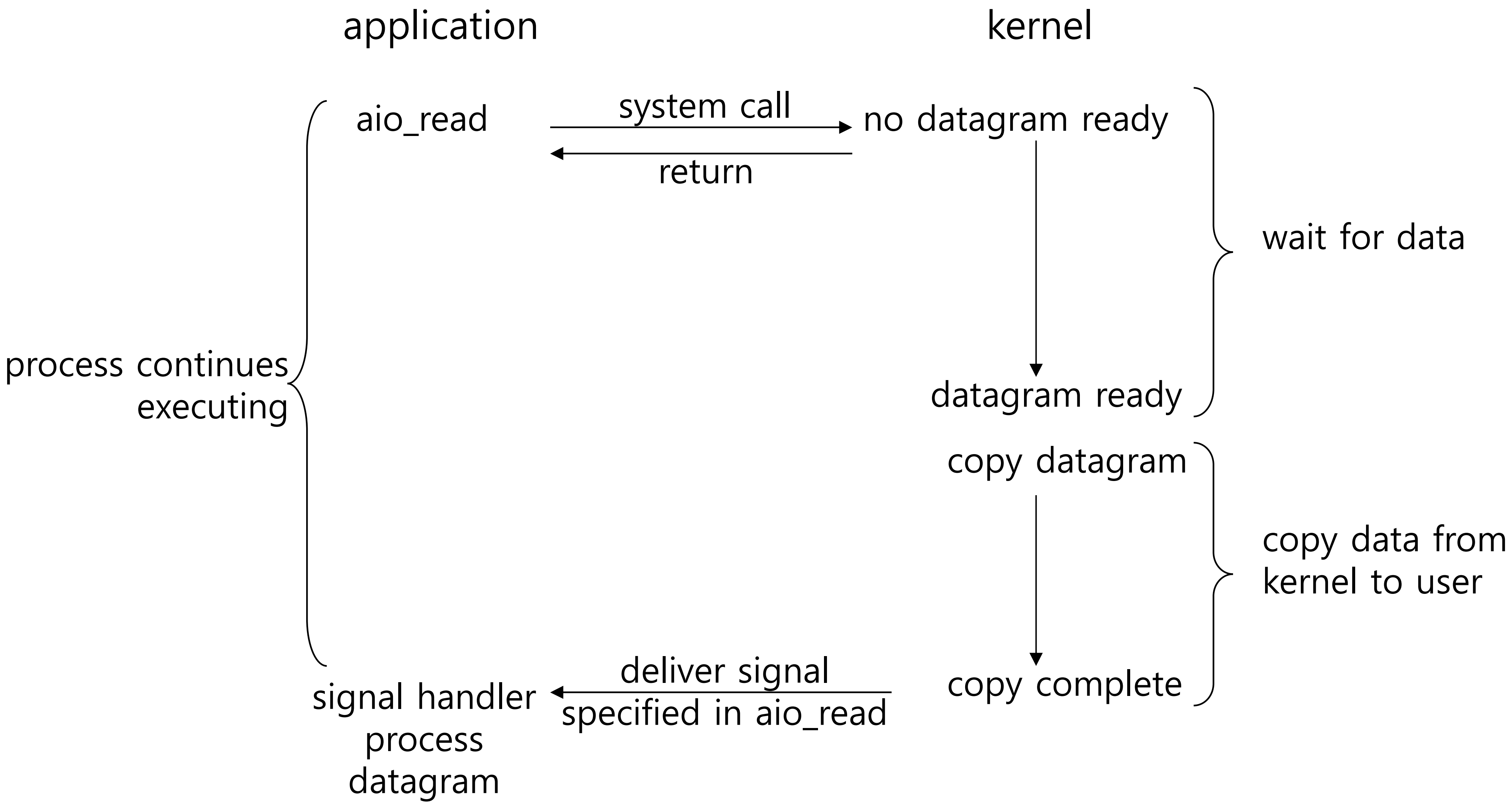
I/O Multiplexing Model



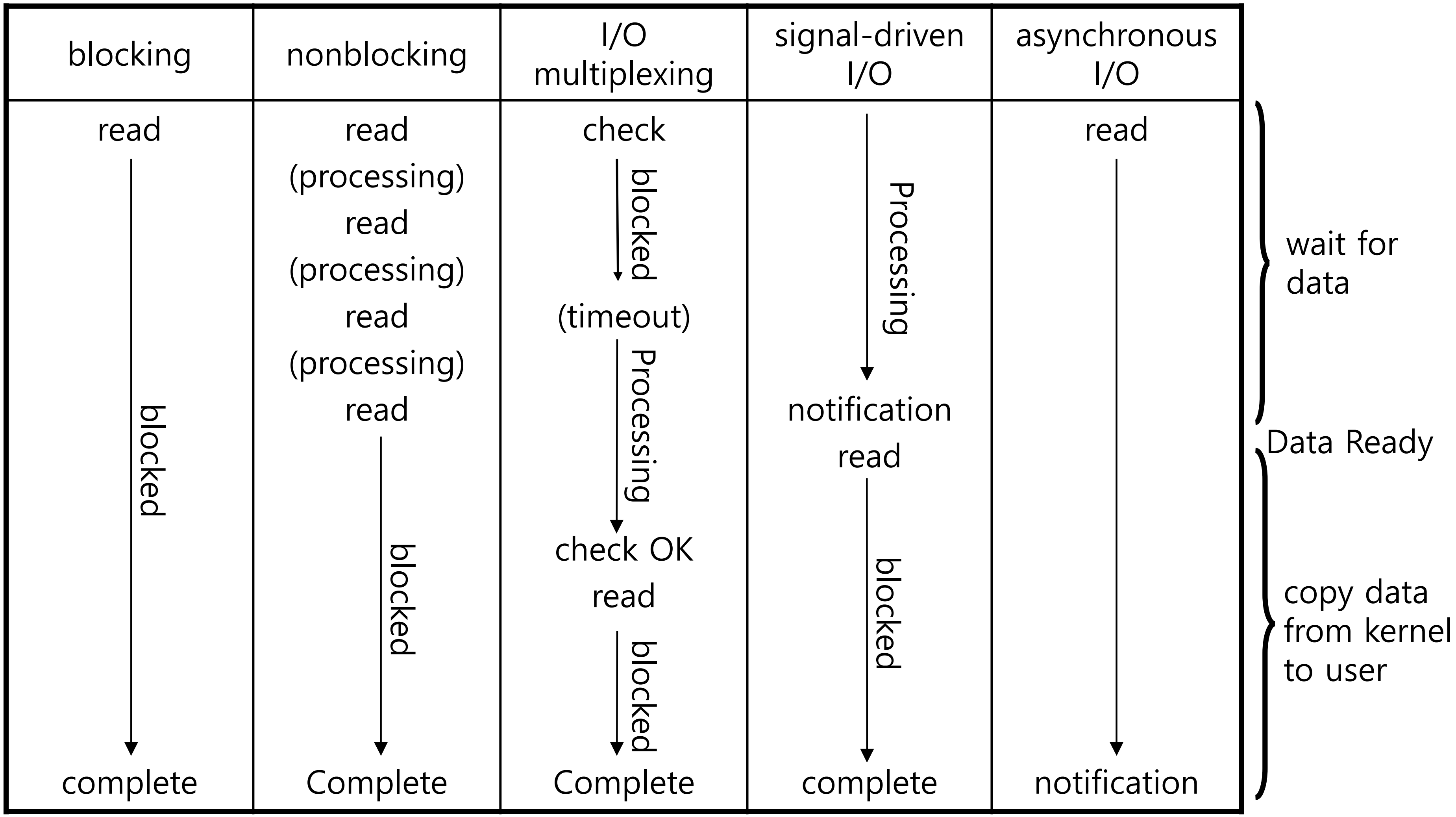
Signal-Driven I/O Model



Asynchronous I/O Model



I/O Model의 비교(read)



blocking	nonblocking	I/O multiplexing	signal-driven I/O	asynchronous I/O
read blocked complete	read (processing) read (processing) read (processing) read blocked Complete	check blocked (timeout) Processing check OK read blocked Complete	Processing notification read blocked complete	read notification

wait for data

Data Ready

copy data from kernel to user

I/O Model의 비교(write)

blocking	nonblocking	I/O multiplexing	signal-driven I/O	asynchronous I/O
write ↓ blocked complete	write (processing) write (processing) write (processing) write ↓ blocked Complete	check ↓ blocked (timeout) ↓ Processing check write ↓ blocked Complete	write partial ↓ Processing notification write remainder ↓ blocked complete	initiate ↓ notification

waiting for output buffer

Buffer Ready

buffers available