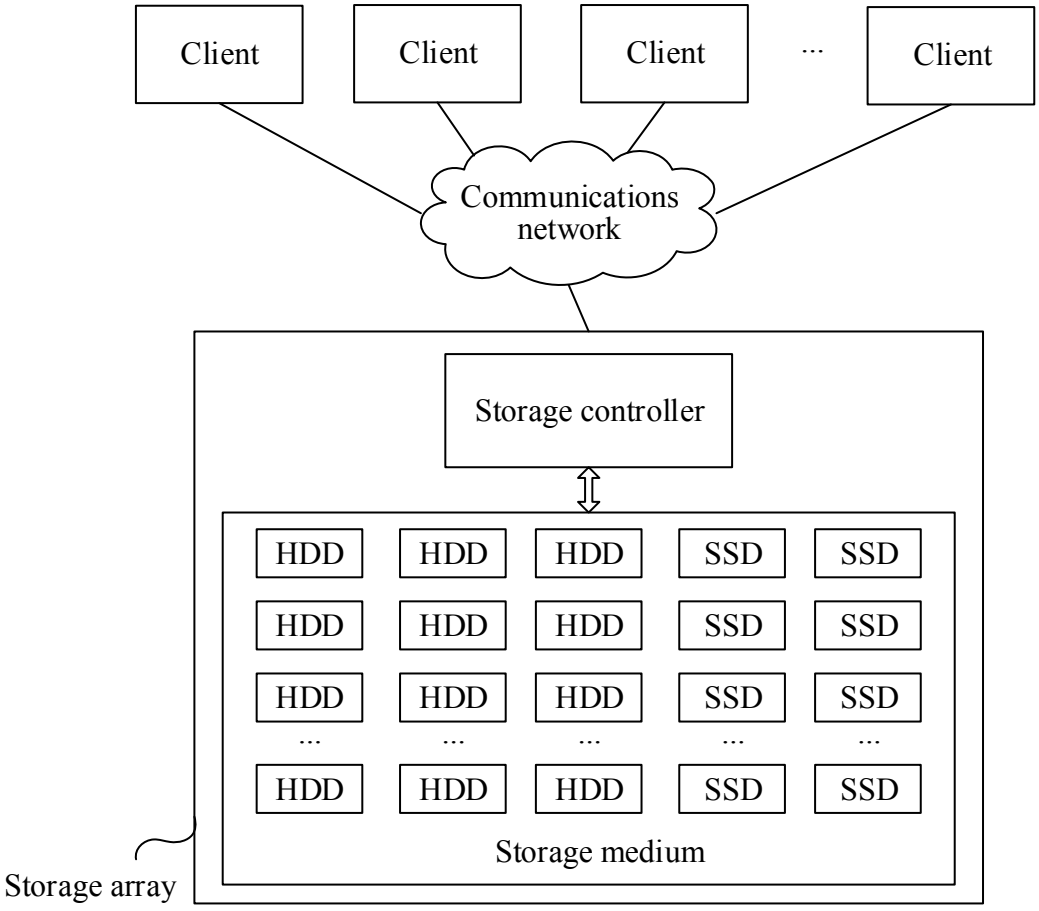
Client
Client
Client
...
Client
Communications network
Storage controller
HDD
SSD
Storage medium
Storage array

FIG. 1

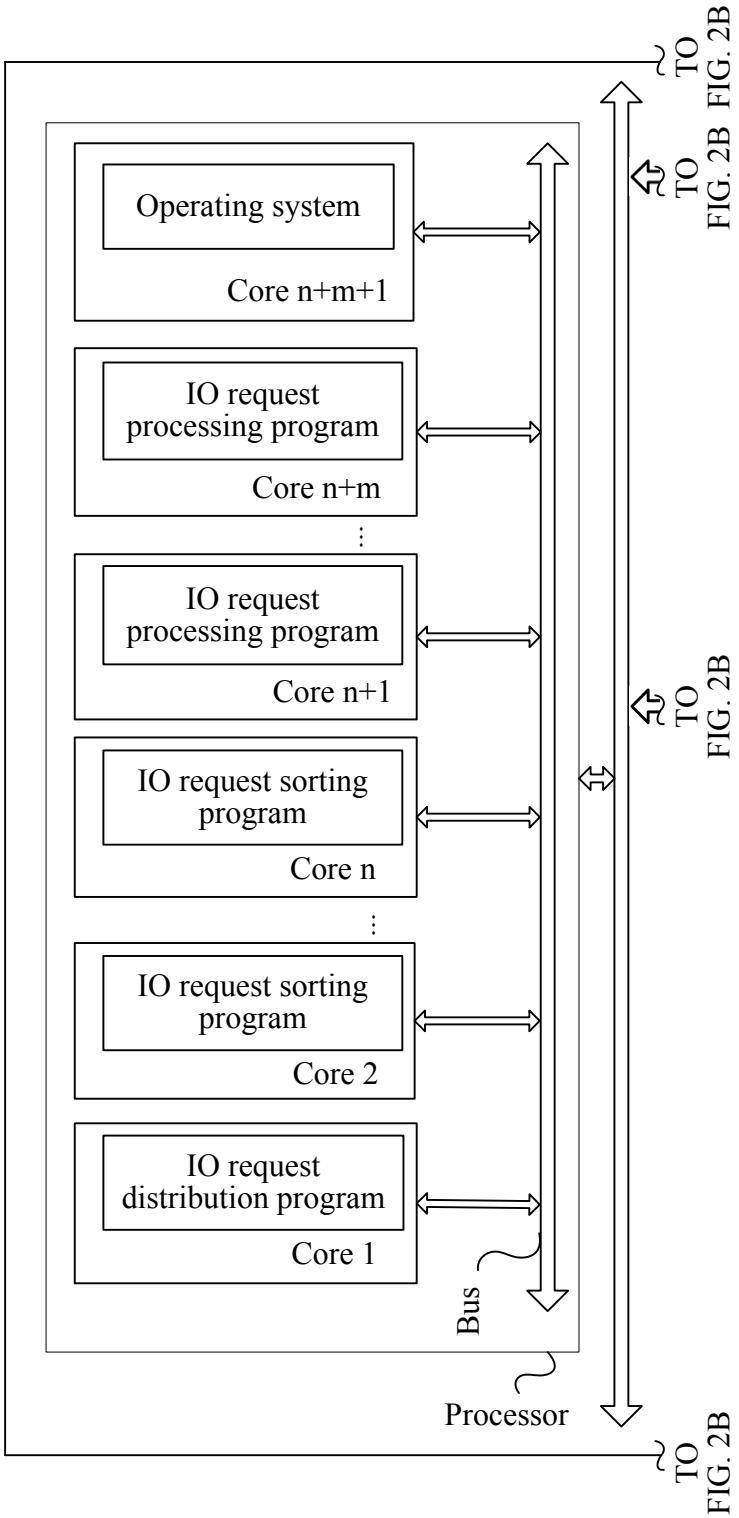
TO FIG. 2B
TO FIG. 2B
Operating system
Core n+m+1
IO request processing program
Core n+m
IO request processing program
Core n+1
TO FIG. 2B
IO request sorting program
Core n
IO request sorting program
Core 2
IO request distribution program
Core 1
Bus
Processor
TO FIG. 2B
TO FIG. 2B

FIG. 2A

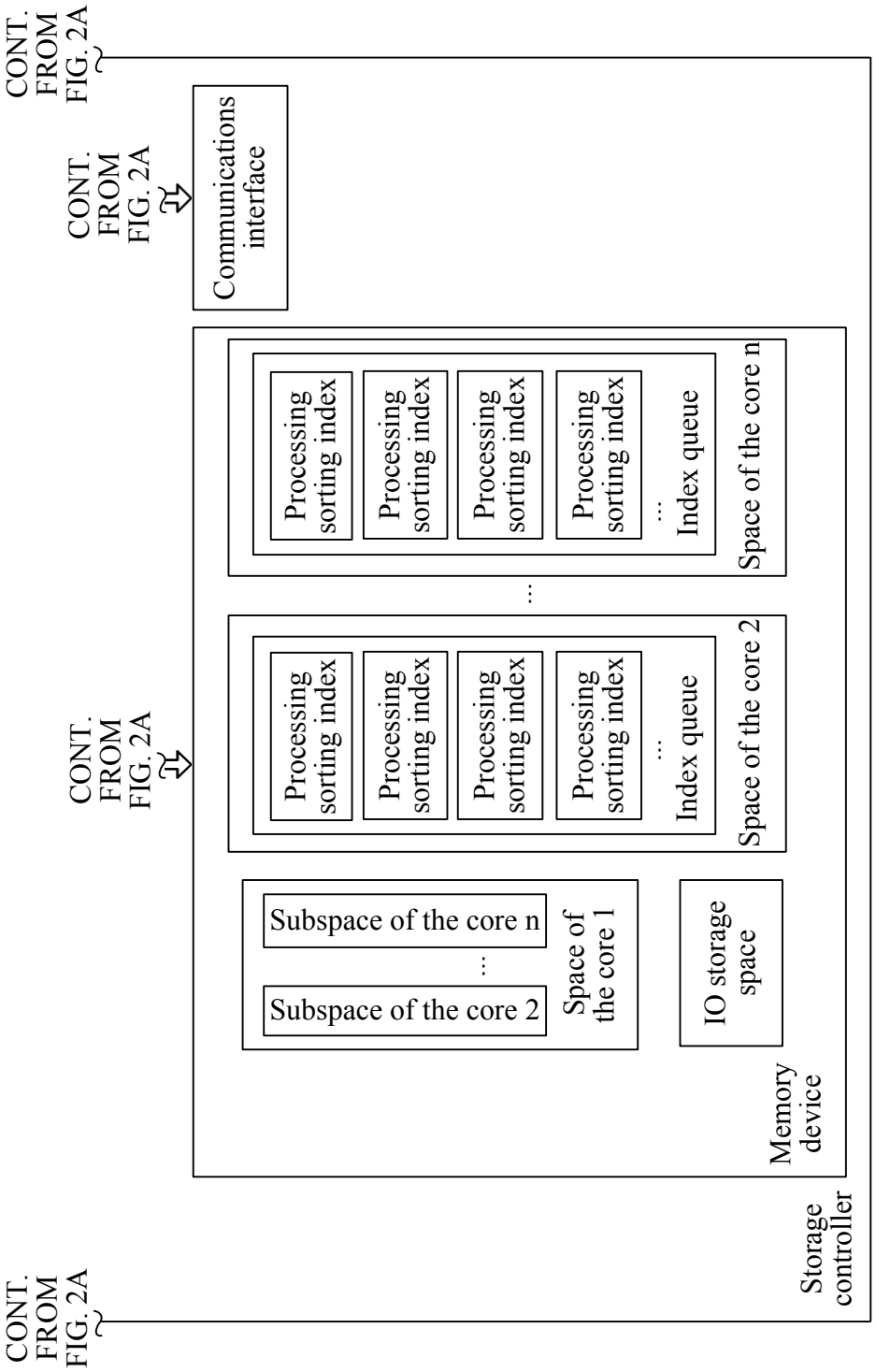
CONT. FROM FIG. 2A
CONT. FROM FIG. 2A
Communications interface
CONT. FROM FIG. 2A
Storage controller
Memory device
Space of the core 1
Subspace of the core 2
Subspace of the core n
IO storage space
Space of the core 2
Processing sorting index
Processing sorting index
Processing sorting index
Processing sorting index
Index queue
Space of the core n
Processing sorting index
Processing sorting index
Processing sorting index
Processing sorting index
Index queue

FIG. 2B

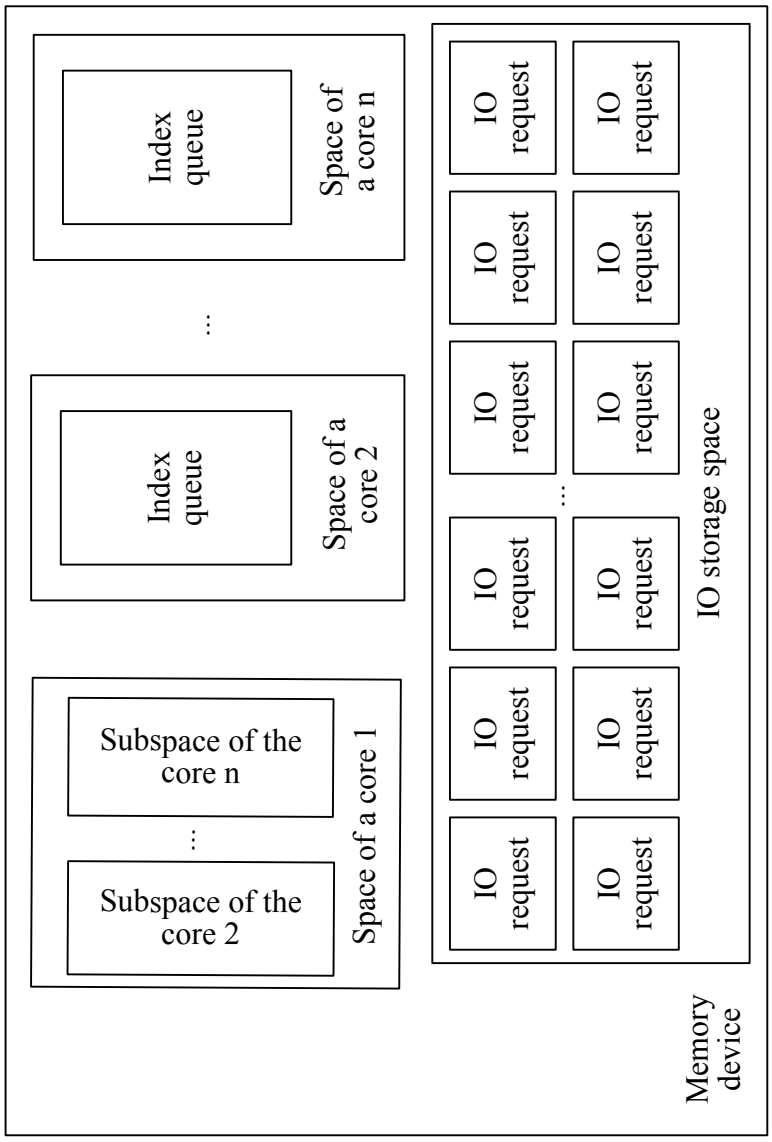
Memory device
IO storage space
IO request
Space of a core 1
Subspace of the core 2
Subspace of the core n
Space of a core 2
Index queue
Space of a core n
Index queue

FIG. 3

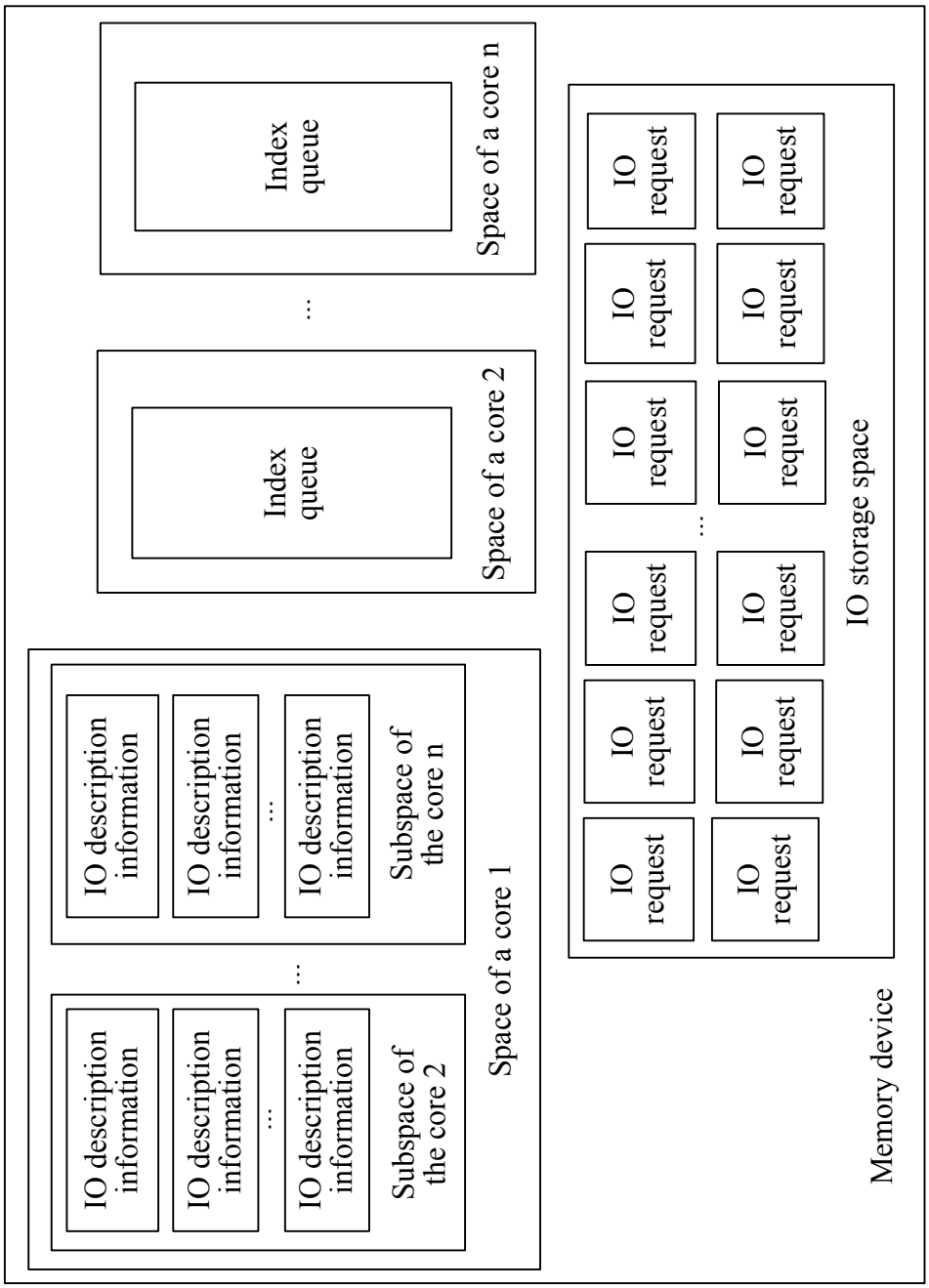
Memory device
Space of a core 1
Subspace of the core 2
IO description information
IO description information
...
IO description information
Subspace of the core n
IO description information
IO description information
...
IO description information
...
Space of a core 2
Index queue
Space of a core n
Index queue
IO storage space
IO request
IO request
IO request
IO request
...
IO request
IO request
IO request
IO request

FIG. 4

TO
FIG. 5B

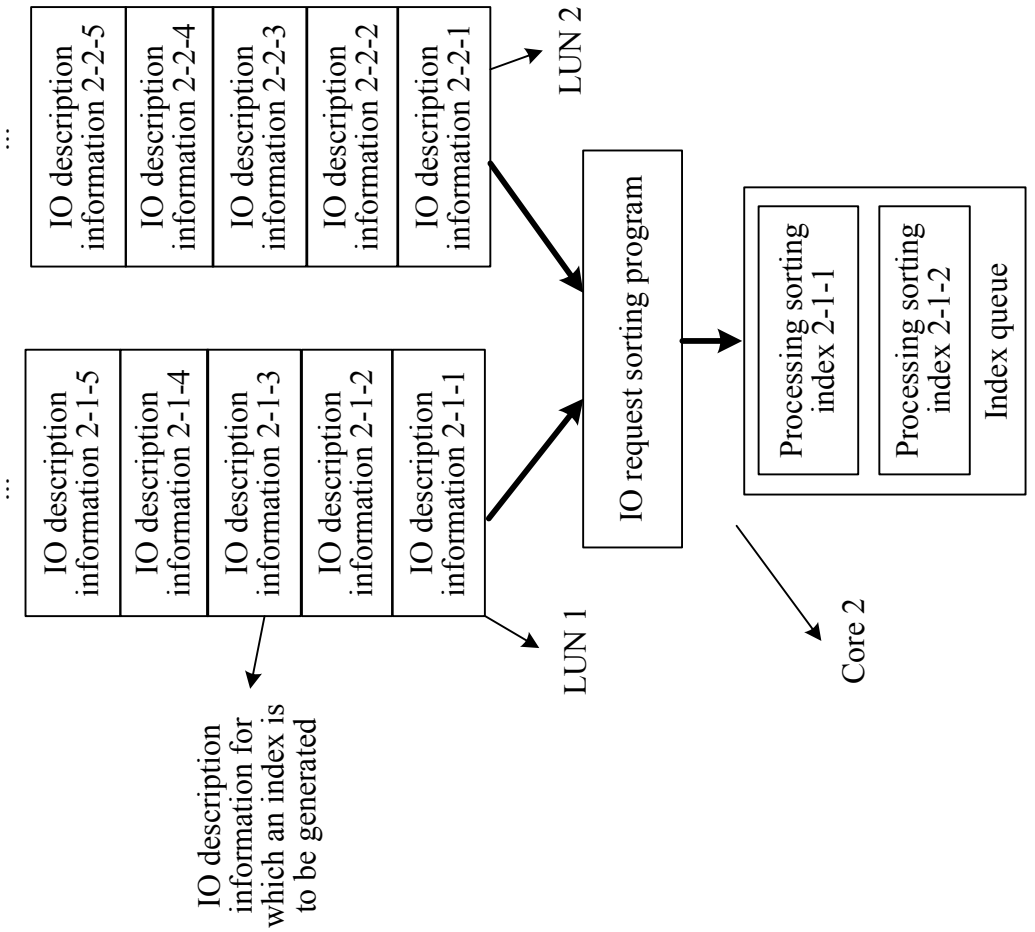

FIG. 5A

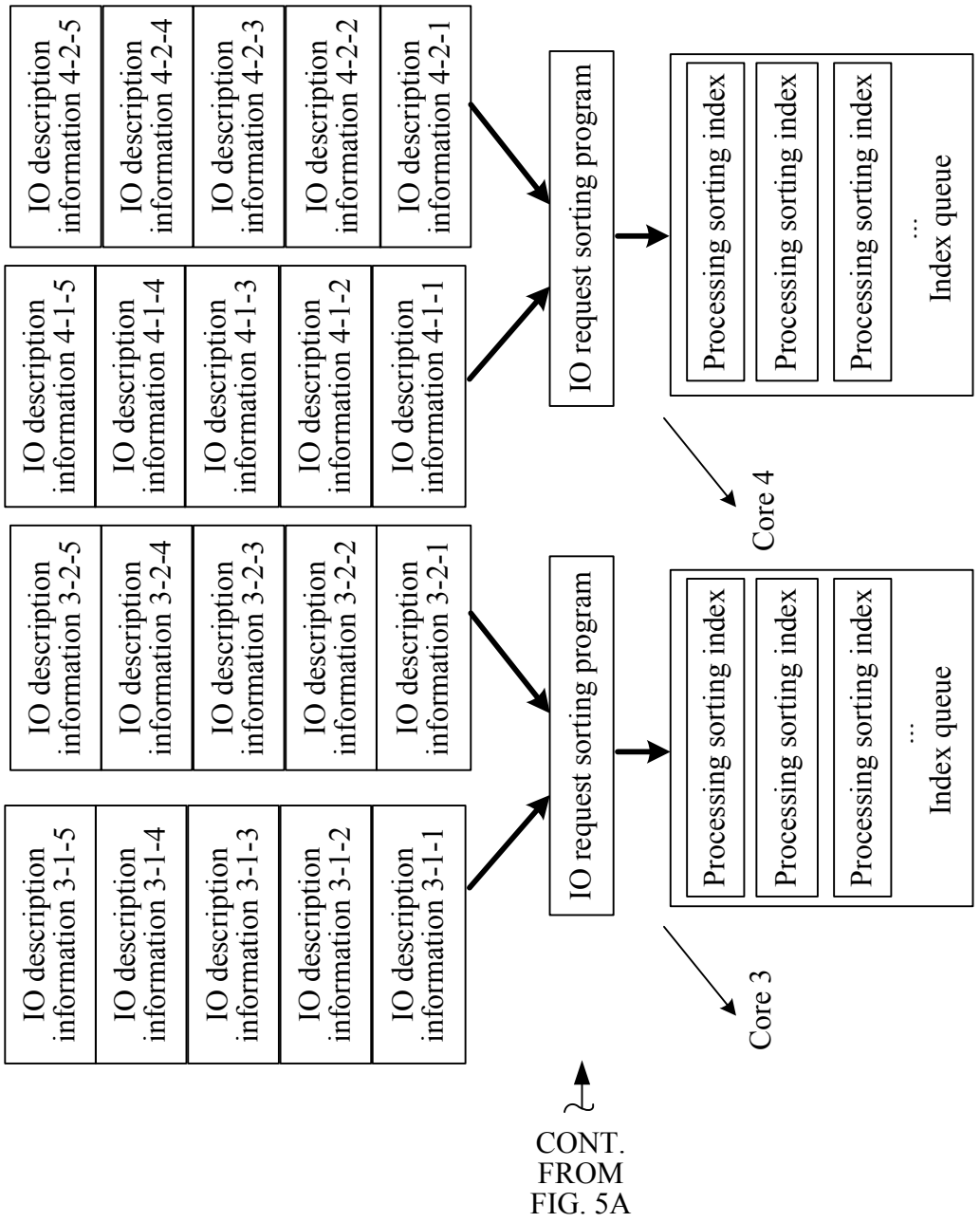
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
Processing sorting index
Processing sorting index
Processing sorting index
Index queue
Processing sorting index
Processing sorting index
Processing sorting index
Index queue
Core 3
Core 4
CONT. FROM FIG. 5A

FIG. 5B

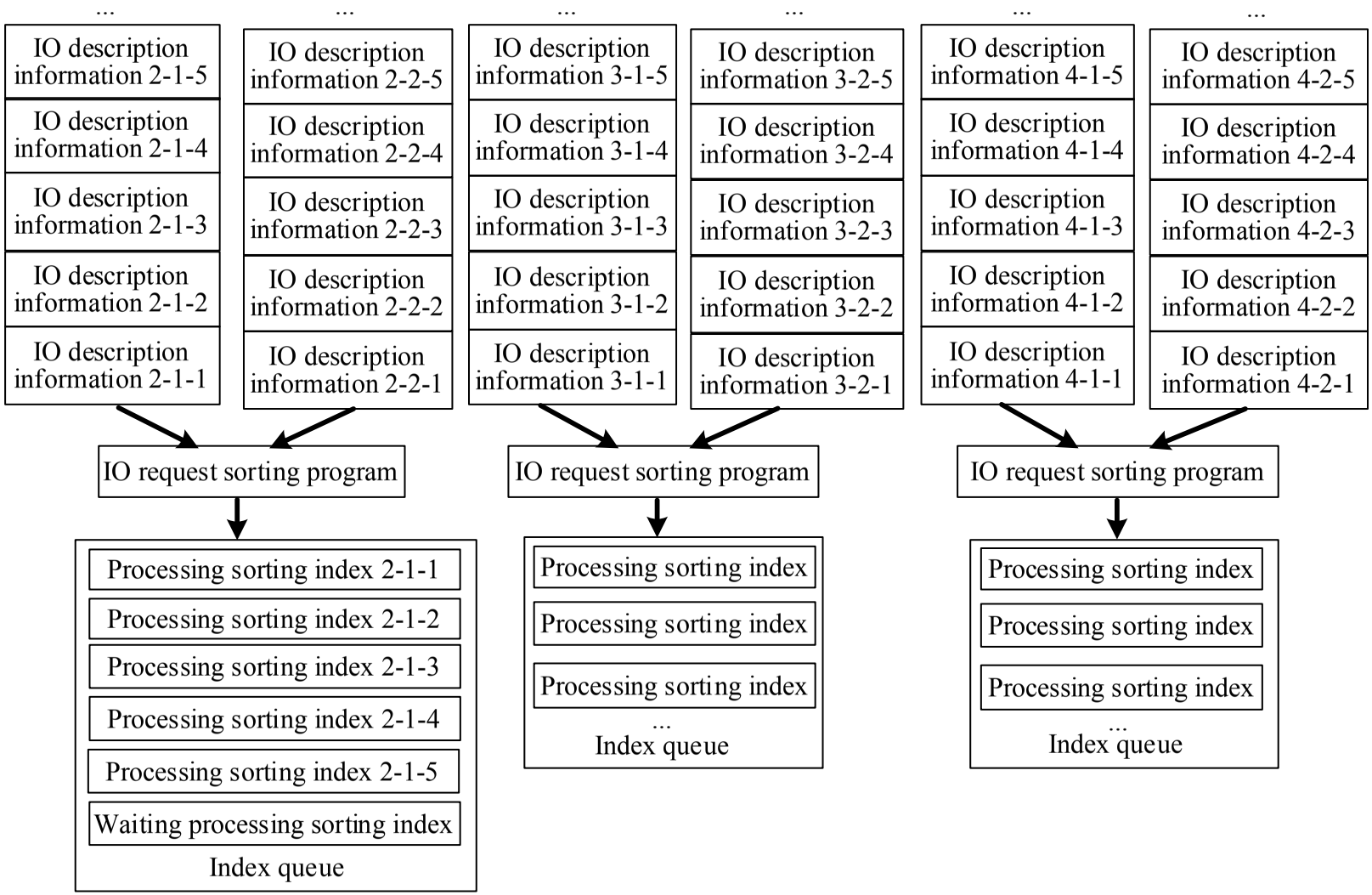
...
IO description information 2-1-5
IO description information 2-1-4
IO description information 2-1-3
IO description information 2-1-2
IO description information 2-1-1
...
IO description information 2-2-5
IO description information 2-2-4
IO description information 2-2-3
IO description information 2-2-2
IO description information 2-2-1
...
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
...
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
...
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
...
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
IO request sorting program
Processing sorting index 2-1-1
Processing sorting index 2-1-2
Processing sorting index 2-1-3
Processing sorting index 2-1-4
Processing sorting index 2-1-5
Waiting processing sorting index
Index queue
Processing sorting index
Processing sorting index
Processing sorting index
...
Index queue
Processing sorting index
Processing sorting index
Processing sorting index
...
Index queue

FIG. 6

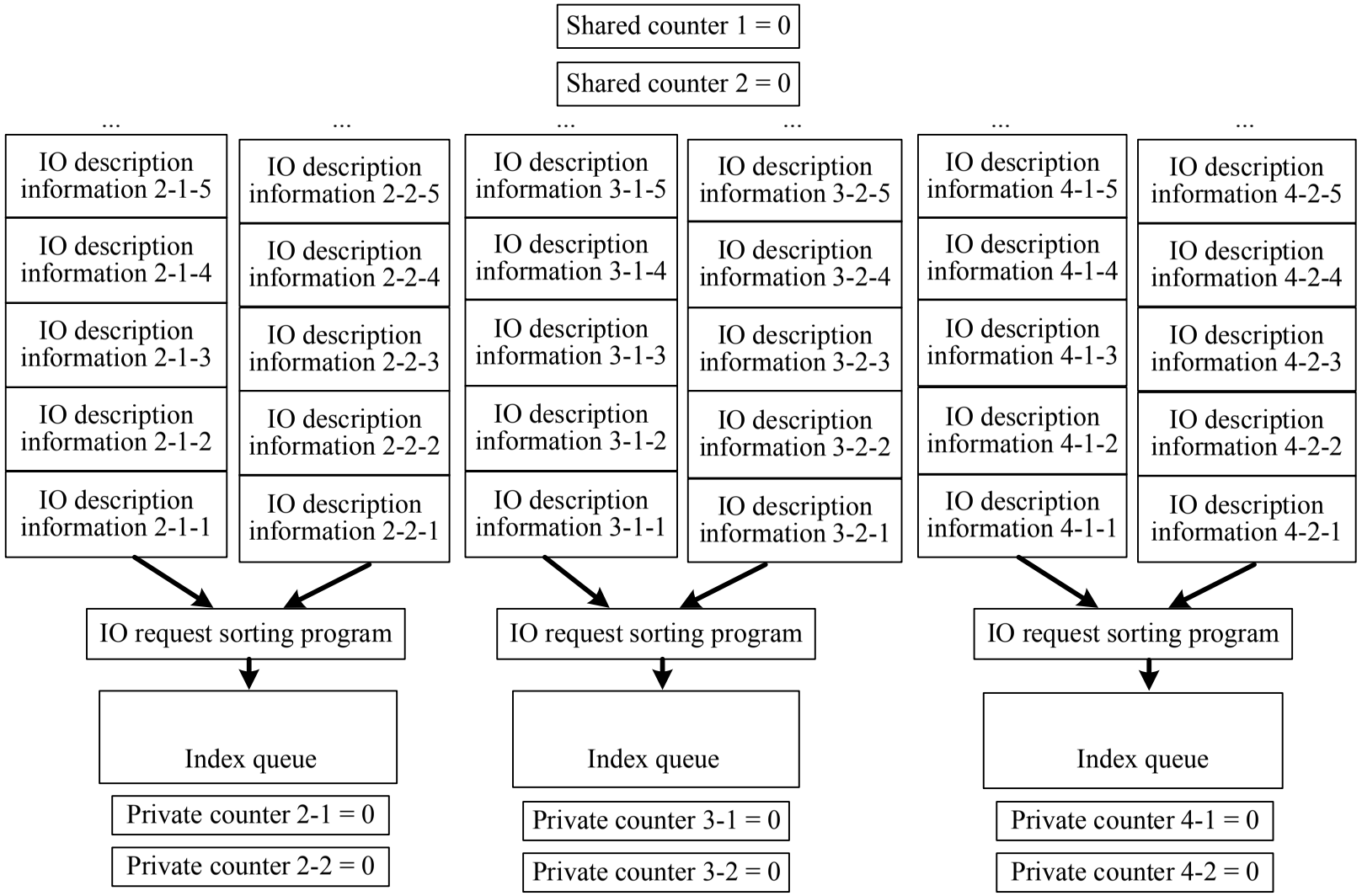
Shared counter 1 = 0
Shared counter 2 = 0
...
IO description information 2-1-5
IO description information 2-1-4
IO description information 2-1-3
IO description information 2-1-2
IO description information 2-1-1
IO description information 2-2-5
IO description information 2-2-4
IO description information 2-2-3
IO description information 2-2-2
IO description information 2-2-1
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
IO request sorting program
Index queue
Index queue
Index queue
Private counter 2-1 = 0
Private counter 2-2 = 0
Private counter 3-1 = 0
Private counter 3-2 = 0
Private counter 4-1 = 0
Private counter 4-2 = 0

FIG. 7-1

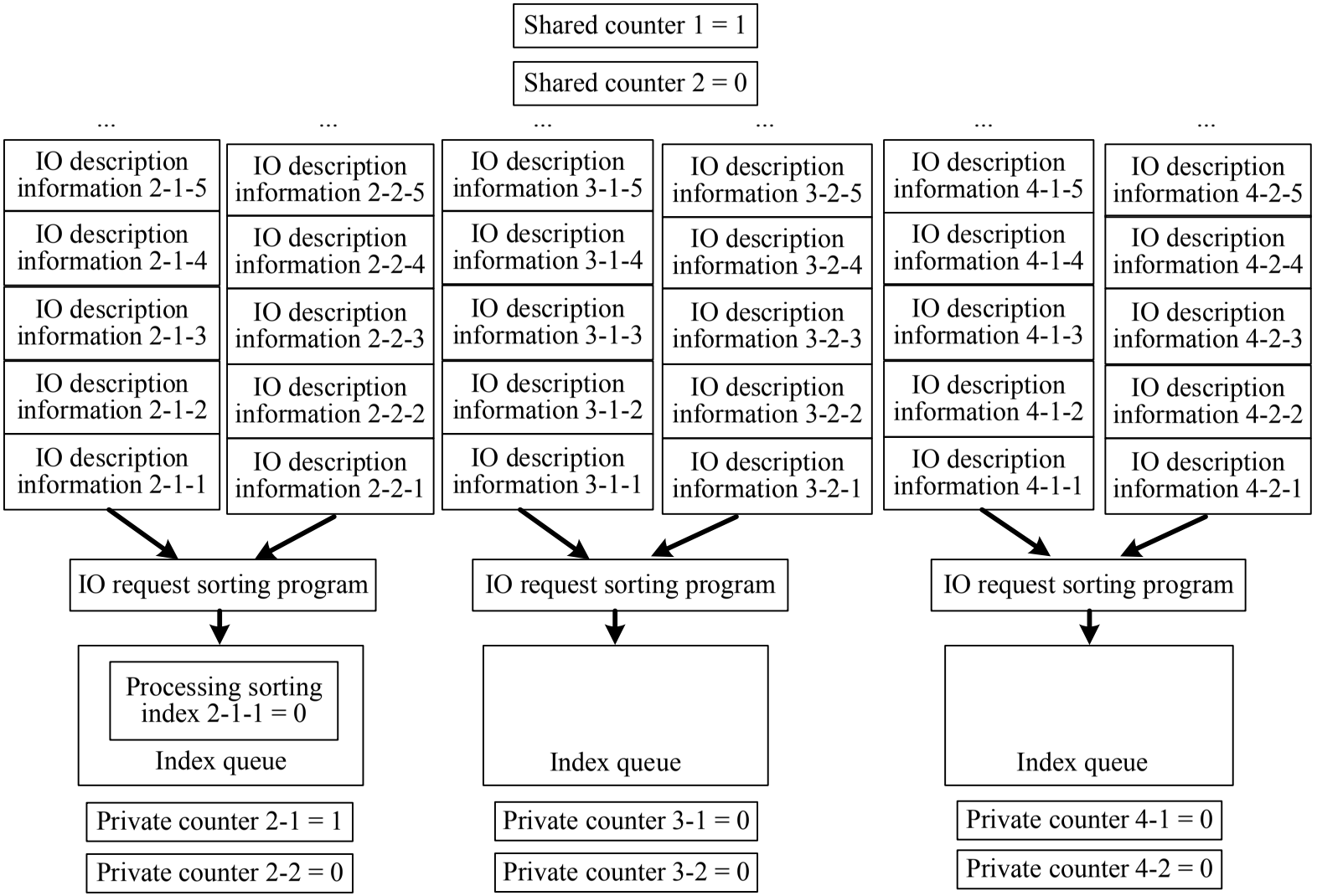
Shared counter 1 = 1
Shared counter 2 = 0
...
IO description information 2-1-5
IO description information 2-1-4
IO description information 2-1-3
IO description information 2-1-2
IO description information 2-1-1
IO description information 2-2-5
IO description information 2-2-4
IO description information 2-2-3
IO description information 2-2-2
IO description information 2-2-1
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
IO request sorting program
Processing sorting index 2-1-1 = 0
Index queue
Index queue
Index queue
Private counter 2-1 = 1
Private counter 2-2 = 0
Private counter 3-1 = 0
Private counter 3-2 = 0
Private counter 4-1 = 0
Private counter 4-2 = 0

FIG. 7-2

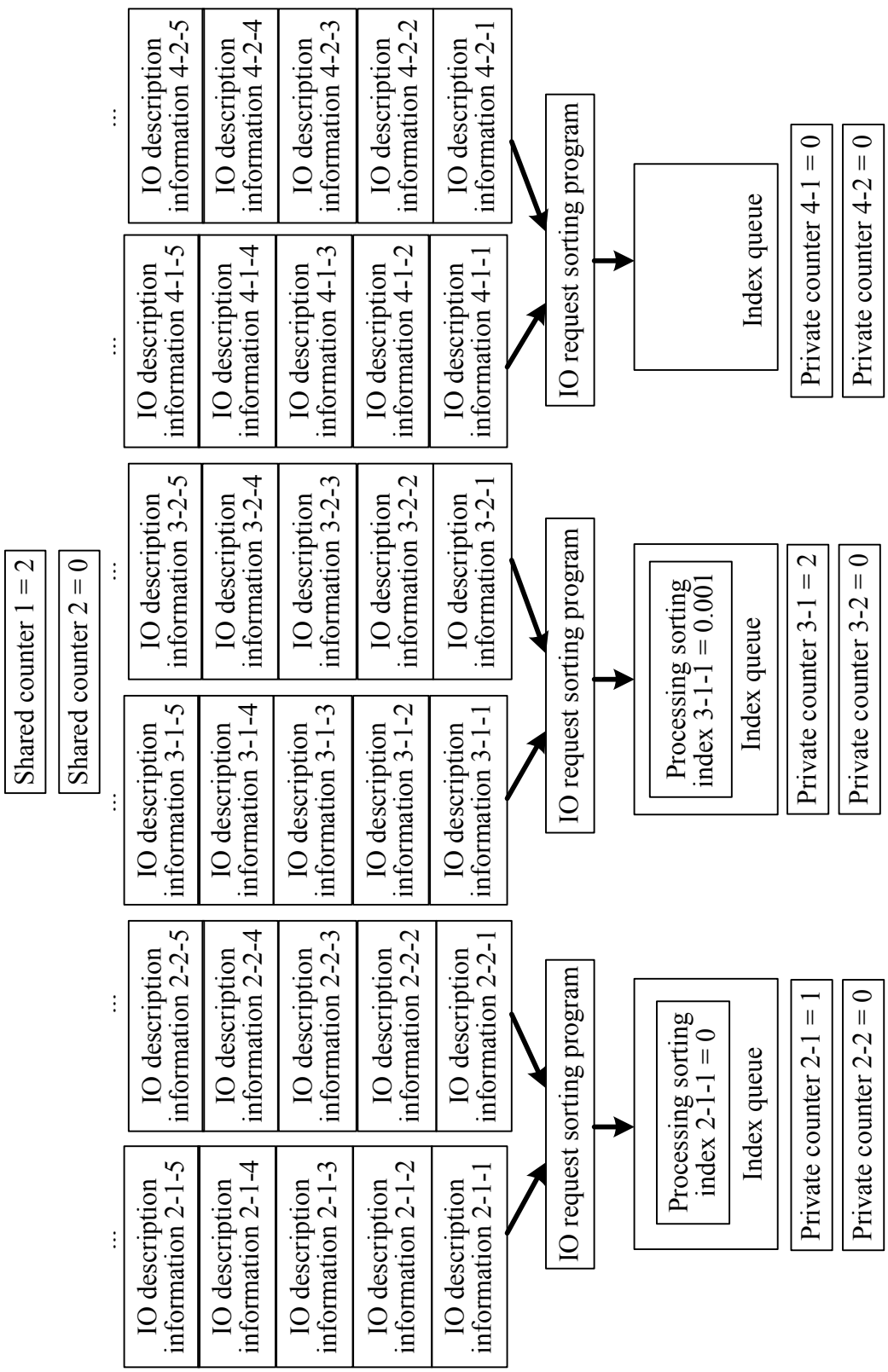
Shared counter 1 = 2
Shared counter 2 = 0
IO description information 2-1-5
IO description information 2-1-4
IO description information 2-1-3
IO description information 2-1-2
IO description information 2-1-1
IO description information 2-2-5
IO description information 2-2-4
IO description information 2-2-3
IO description information 2-2-2
IO description information 2-2-1
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
IO request sorting program
Processing sorting index 2-1-1 = 0
Index queue
Processing sorting index 3-1-1 = 0.001
Index queue
Index queue
Private counter 2-1 = 1
Private counter 2-2 = 0
Private counter 3-1 = 2
Private counter 3-2 = 0
Private counter 4-1 = 0
Private counter 4-2 = 0

FIG. 7-3

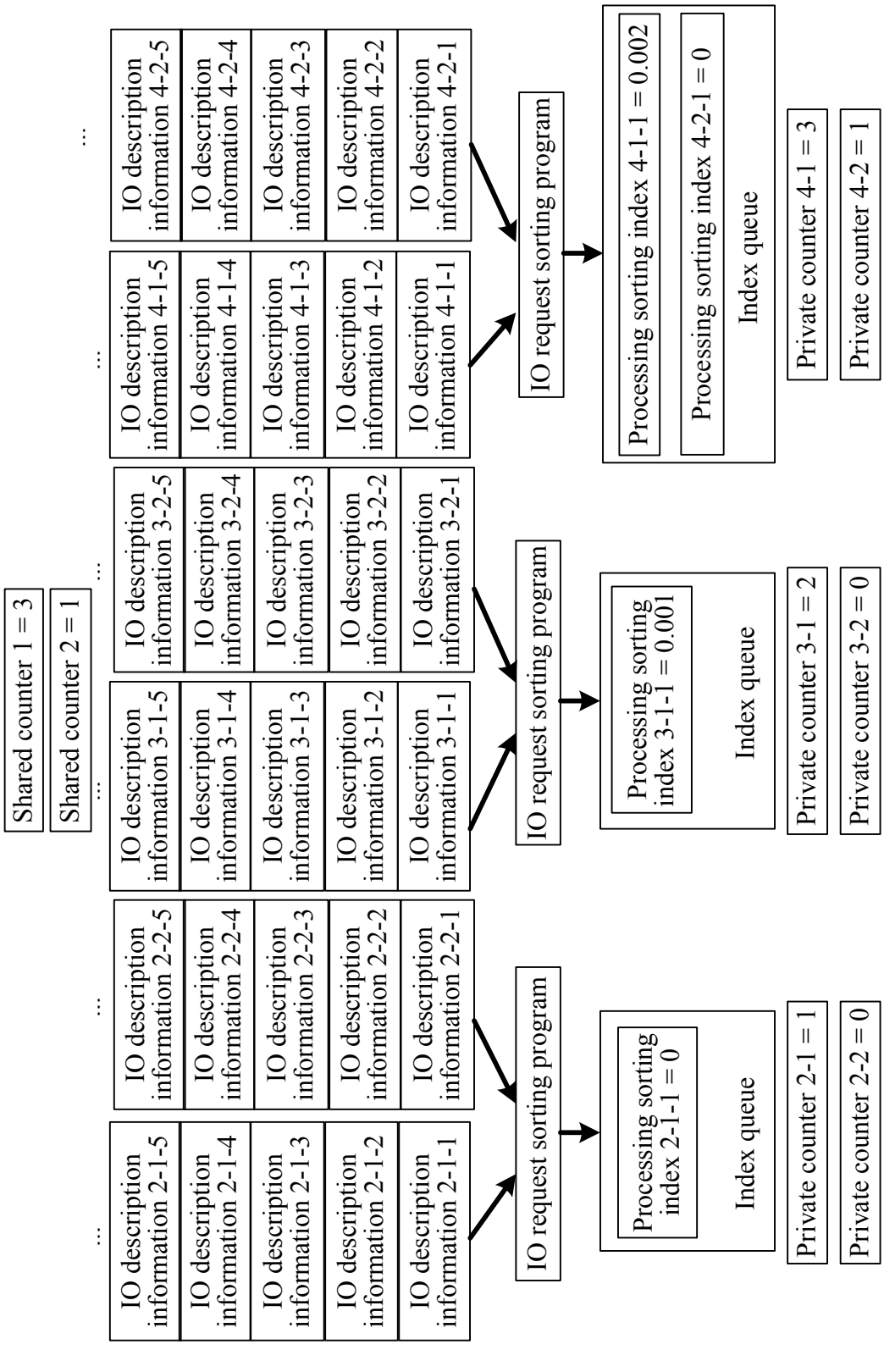
Shared counter 1 = 3
Shared counter 2 = 1
IO description information 2-1-5
IO description information 2-1-4
IO description information 2-1-3
IO description information 2-1-2
IO description information 2-1-1
IO description information 2-2-5
IO description information 2-2-4
IO description information 2-2-3
IO description information 2-2-2
IO description information 2-2-1
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
IO request sorting program
Processing sorting index 2-1-1 = 0
Index queue
Processing sorting index 3-1-1 = 0.001
Index queue
Processing sorting index 4-1-1 = 0.002
Processing sorting index 4-2-1 = 0
Index queue
Private counter 2-1 = 1
Private counter 2-2 = 0
Private counter 3-1 = 2
Private counter 3-2 = 0
Private counter 4-1 = 3
Private counter 4-2 = 1

FIG. 7-4

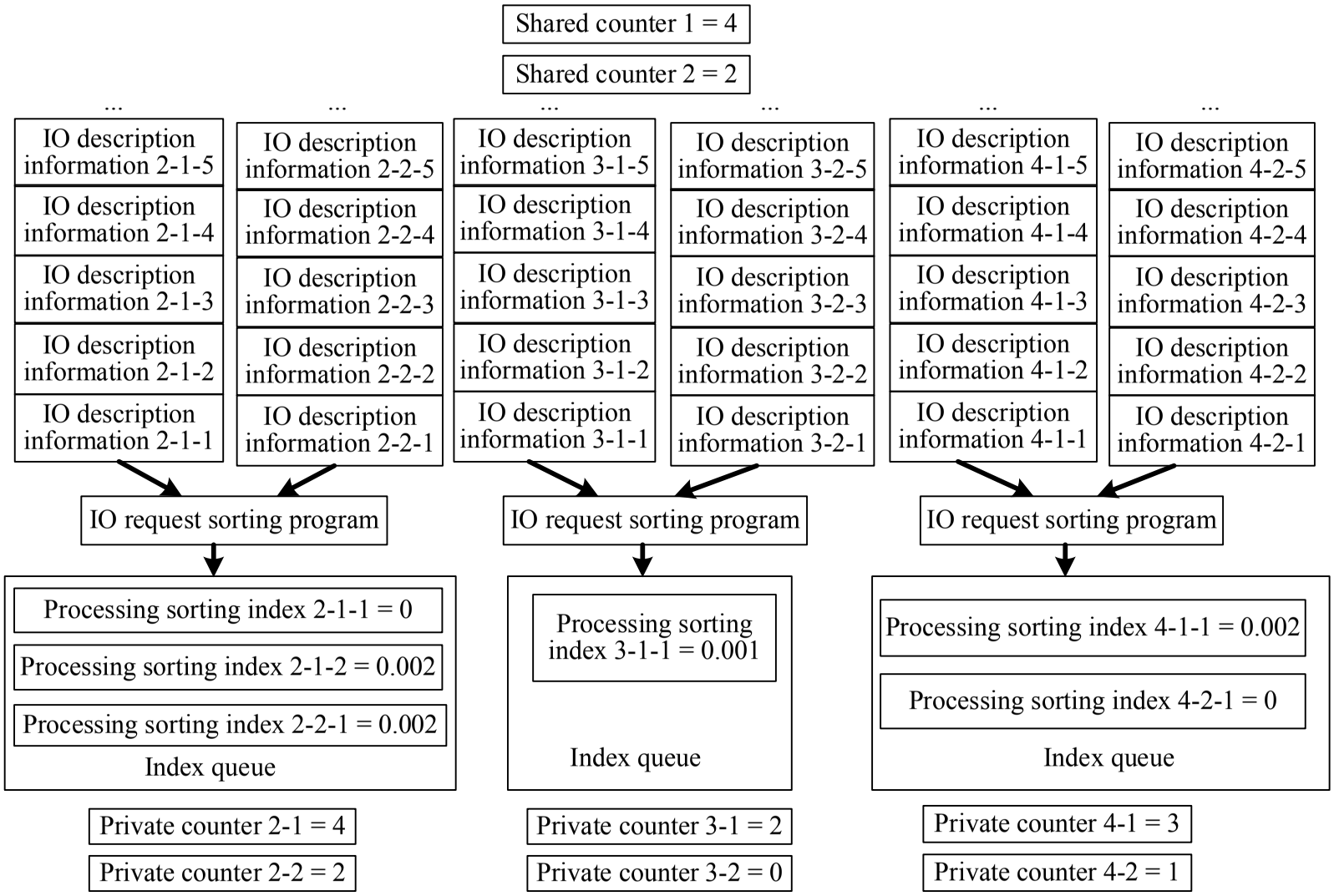
Shared counter 1 = 4
Shared counter 2 = 2
IO description information 2-1-5
IO description information 2-1-4
IO description information 2-1-3
IO description information 2-1-2
IO description information 2-1-1
IO description information 2-2-5
IO description information 2-2-4
IO description information 2-2-3
IO description information 2-2-2
IO description information 2-2-1
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
IO request sorting program
Processing sorting index 2-1-1 = 0
Processing sorting index 2-1-2 = 0.002
Processing sorting index 2-2-1 = 0.002
Index queue
Processing sorting index 3-1-1 = 0.001
Index queue
Processing sorting index 4-1-1 = 0.002
Processing sorting index 4-2-1 = 0
Index queue
Private counter 2-1 = 4
Private counter 2-2 = 2
Private counter 3-1 = 2
Private counter 3-2 = 0
Private counter 4-1 = 3
Private counter 4-2 = 1

FIG. 7-5

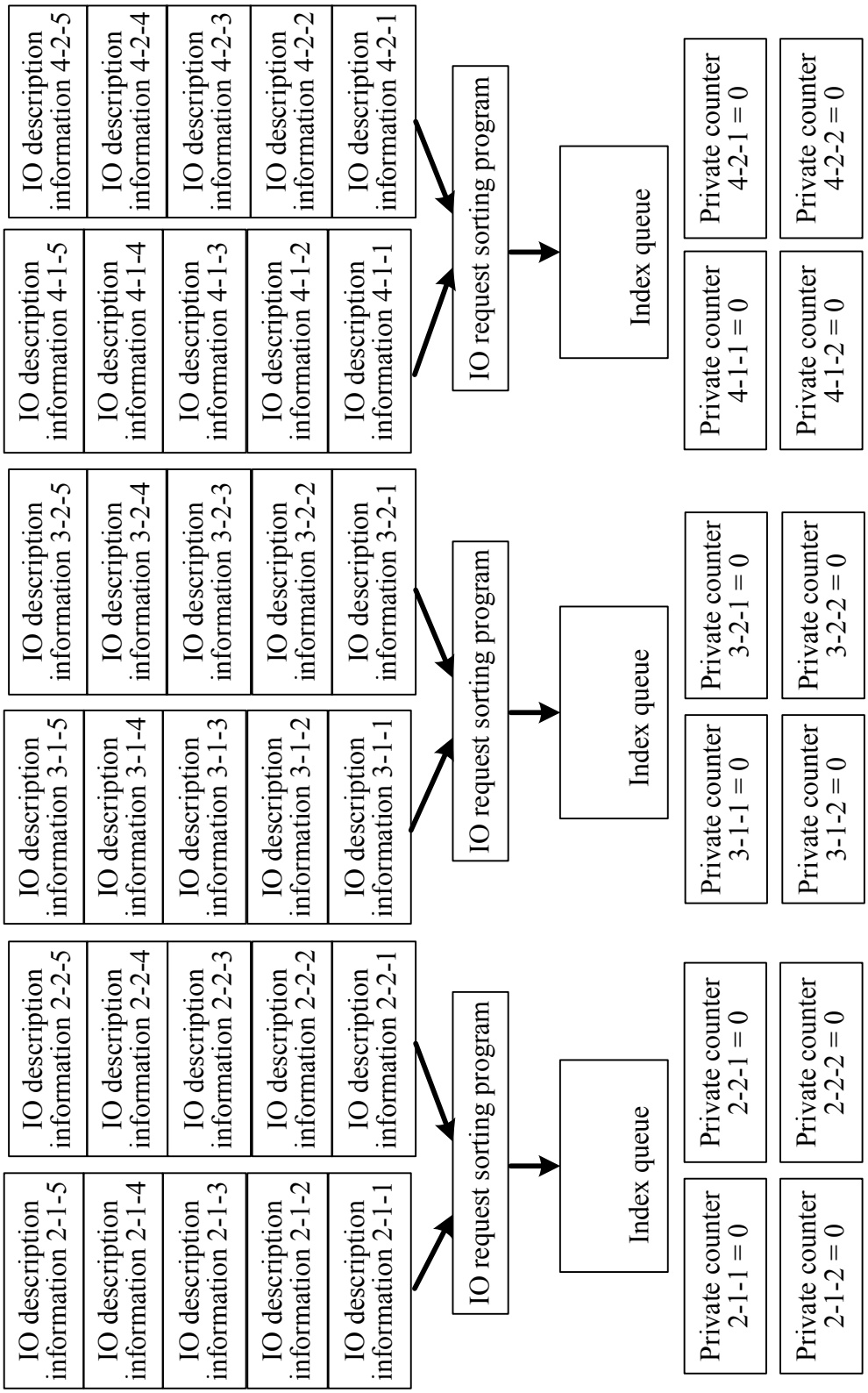
IO description information 2-1-5
IO description information 2-1-4
IO description information 2-1-3
IO description information 2-1-2
IO description information 2-1-1
IO description information 2-2-5
IO description information 2-2-4
IO description information 2-2-3
IO description information 2-2-2
IO description information 2-2-1
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
IO request sorting program
Index queue
Index queue
Index queue
Private counter 2-1-1 = 0
Private counter 2-1-2 = 0
Private counter 2-2-1 = 0
Private counter 2-2-2 = 0
Private counter 3-1-1 = 0
Private counter 3-1-2 = 0
Private counter 3-2-1 = 0
Private counter 3-2-2 = 0
Private counter 4-1-1 = 0
Private counter 4-1-2 = 0
Private counter 4-2-1 = 0
Private counter 4-2-2 = 0

FIG. 8-1

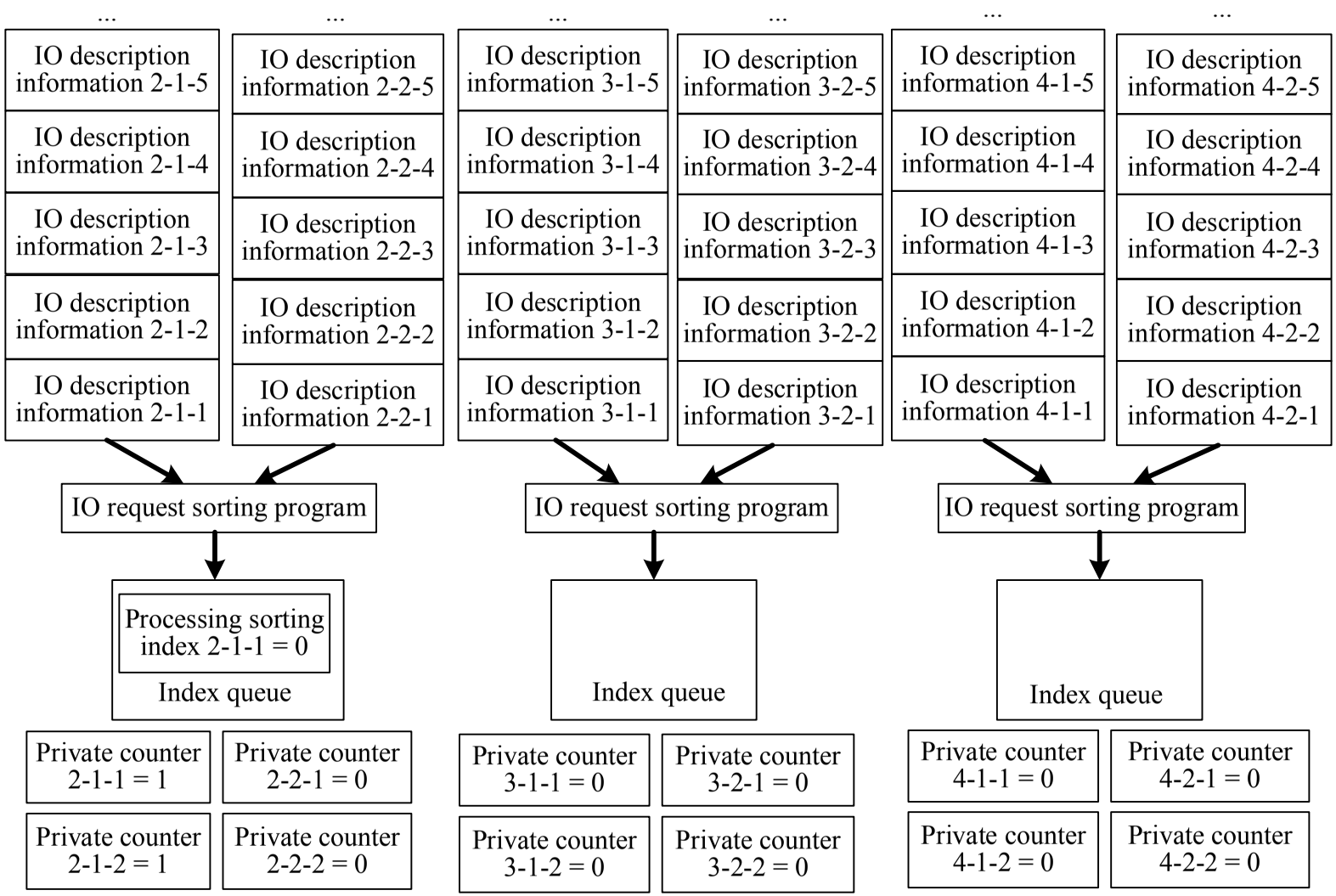
...
IO description information 2-1-5
IO description information 2-1-4
IO description information 2-1-3
IO description information 2-1-2
IO description information 2-1-1
IO description information 2-2-5
IO description information 2-2-4
IO description information 2-2-3
IO description information 2-2-2
IO description information 2-2-1
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
IO request sorting program
Processing sorting index 2-1-1 = 0
Index queue
Index queue
Index queue
Private counter 2-1-1 = 1
Private counter 2-2-1 = 0
Private counter 2-1-2 = 1
Private counter 2-2-2 = 0
Private counter 3-1-1 = 0
Private counter 3-2-1 = 0
Private counter 3-1-2 = 0
Private counter 3-2-2 = 0
Private counter 4-1-1 = 0
Private counter 4-2-1 = 0
Private counter 4-1-2 = 0
Private counter 4-2-2 = 0

FIG. 8-2

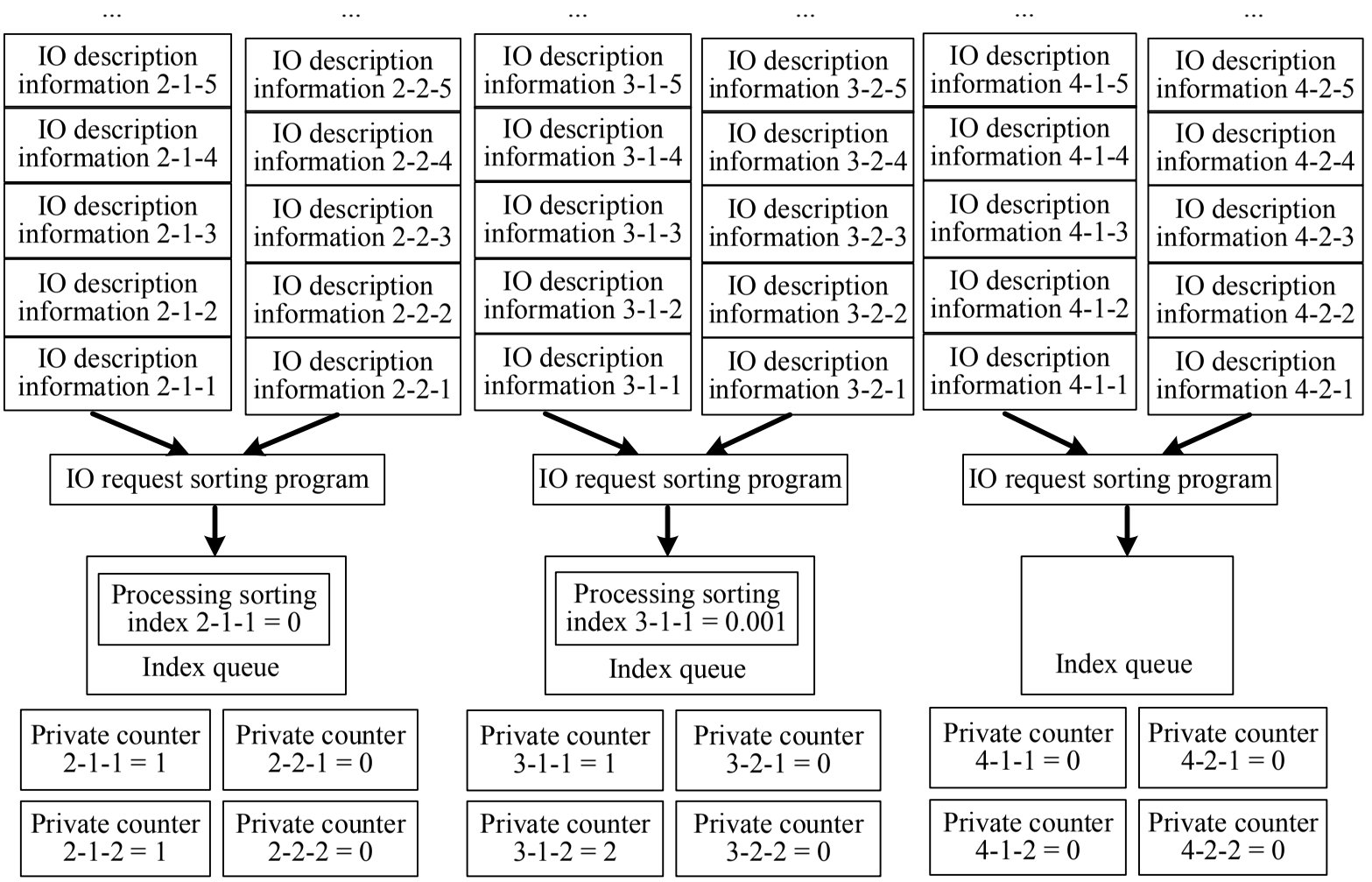
...
IO description information 2-1-5
IO description information 2-1-4
IO description information 2-1-3
IO description information 2-1-2
IO description information 2-1-1
IO description information 2-2-5
IO description information 2-2-4
IO description information 2-2-3
IO description information 2-2-2
IO description information 2-2-1
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
IO request sorting program
Processing sorting index 2-1-1 = 0
Index queue
Processing sorting index 3-1-1 = 0.001
Index queue
Index queue
Private counter 2-1-1 = 1
Private counter 2-2-1 = 0
Private counter 2-1-2 = 1
Private counter 2-2-2 = 0
Private counter 3-1-1 = 1
Private counter 3-2-1 = 0
Private counter 3-1-2 = 2
Private counter 3-2-2 = 0
Private counter 4-1-1 = 0
Private counter 4-2-1 = 0
Private counter 4-1-2 = 0
Private counter 4-2-2 = 0

FIG. 8-3

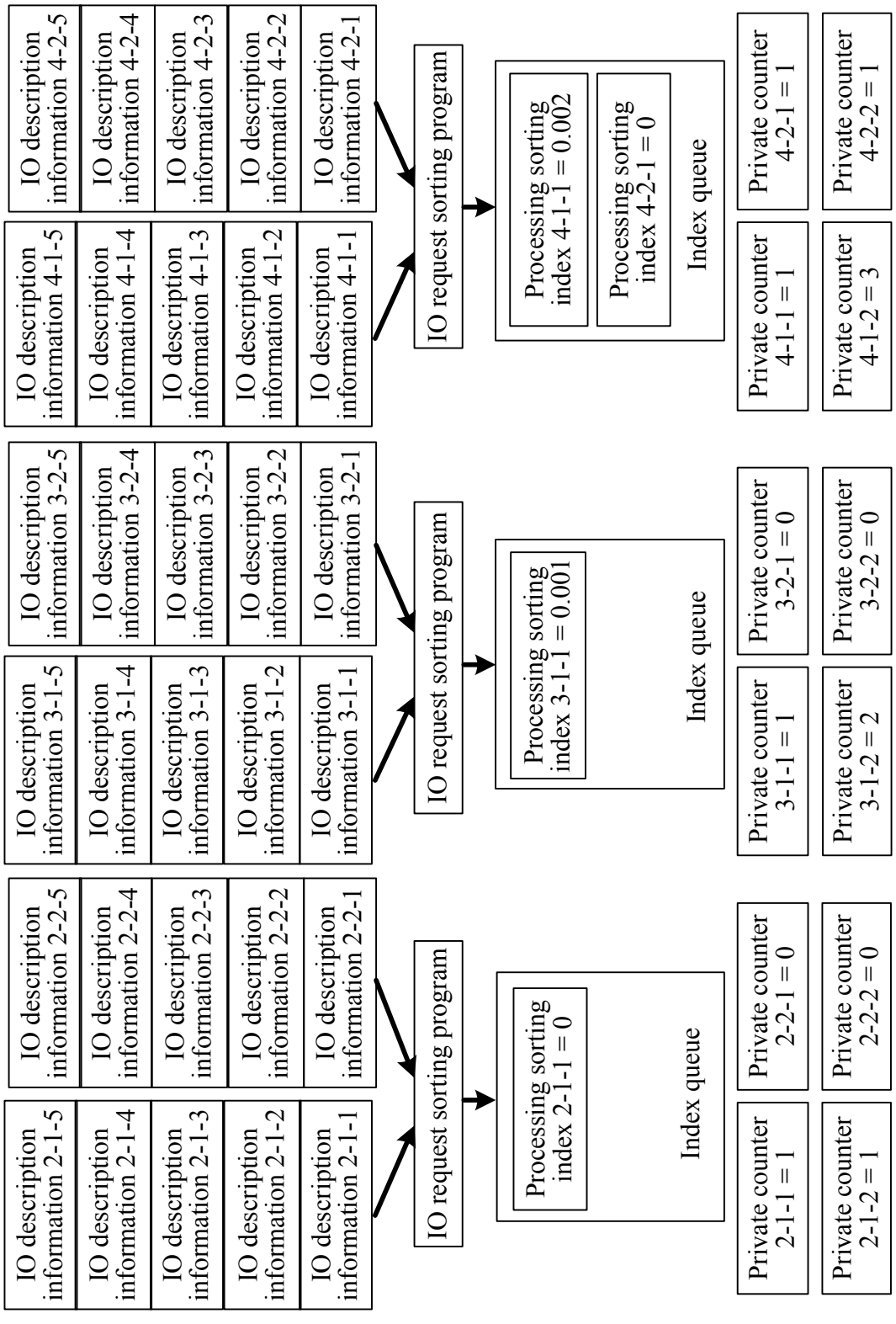
IO description information 2-1-5
IO description information 2-1-4
IO description information 2-1-3
IO description information 2-1-2
IO description information 2-1-1
IO description information 2-2-5
IO description information 2-2-4
IO description information 2-2-3
IO description information 2-2-2
IO description information 2-2-1
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
IO request sorting program
Processing sorting index 2-1-1 = 0
Processing sorting index 3-1-1 = 0.001
Processing sorting index 4-1-1 = 0.002
Processing sorting index 4-2-1 = 0
Index queue
Index queue
Index queue
Private counter 2-1-1 = 1
Private counter 2-1-2 = 1
Private counter 2-2-1 = 0
Private counter 2-2-2 = 0
Private counter 3-1-1 = 1
Private counter 3-1-2 = 2
Private counter 3-2-1 = 0
Private counter 3-2-2 = 0
Private counter 4-1-1 = 1
Private counter 4-1-2 = 3
Private counter 4-2-1 = 1
Private counter 4-2-2 = 1

FIG. 8-4

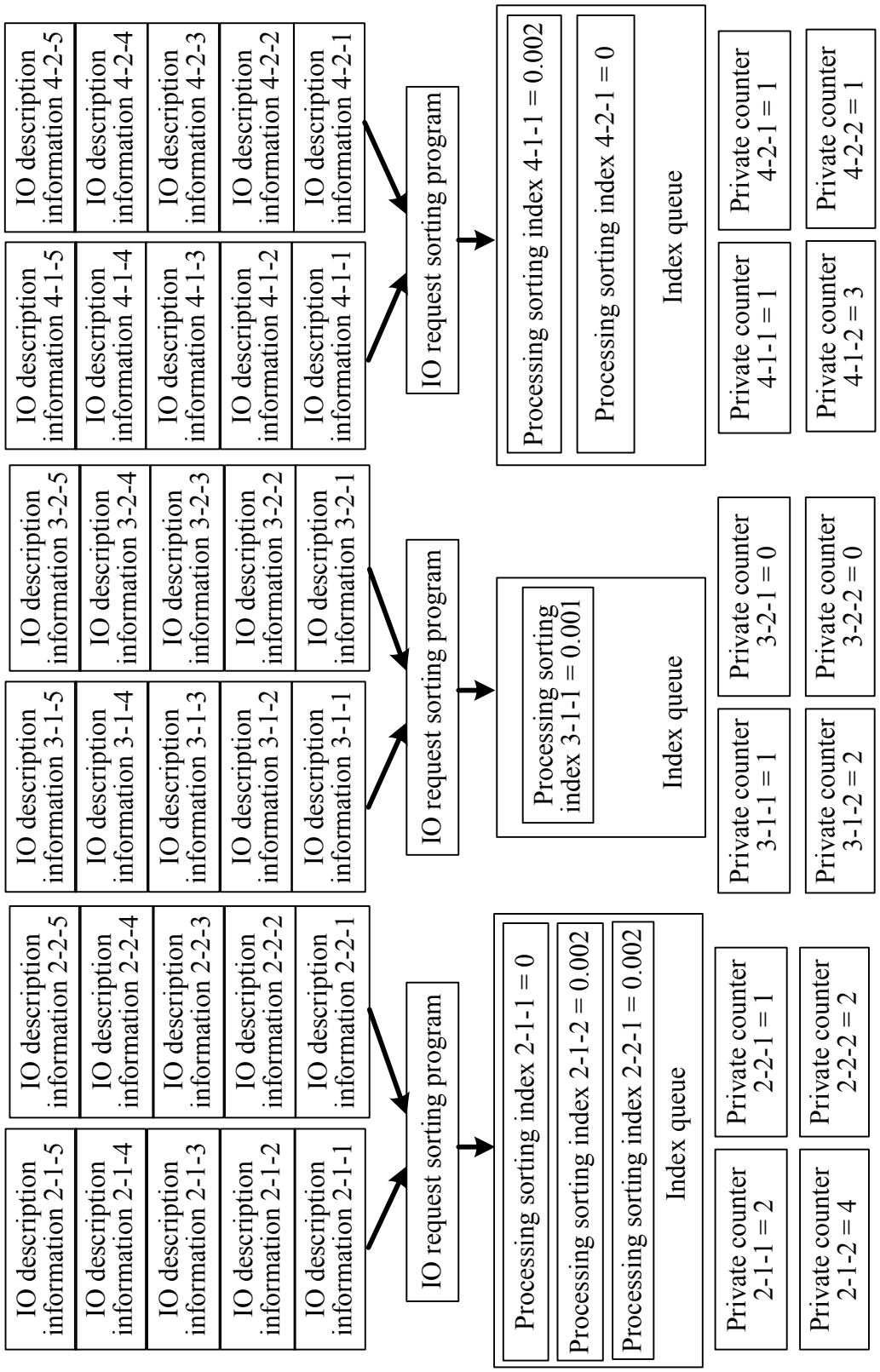
IO description information 2-1-5
IO description information 2-1-4
IO description information 2-1-3
IO description information 2-1-2
IO description information 2-1-1
IO description information 2-2-5
IO description information 2-2-4
IO description information 2-2-3
IO description information 2-2-2
IO description information 2-2-1
IO description information 3-1-5
IO description information 3-1-4
IO description information 3-1-3
IO description information 3-1-2
IO description information 3-1-1
IO description information 3-2-5
IO description information 3-2-4
IO description information 3-2-3
IO description information 3-2-2
IO description information 3-2-1
IO description information 4-1-5
IO description information 4-1-4
IO description information 4-1-3
IO description information 4-1-2
IO description information 4-1-1
IO description information 4-2-5
IO description information 4-2-4
IO description information 4-2-3
IO description information 4-2-2
IO description information 4-2-1
IO request sorting program
IO request sorting program
IO request sorting program
Processing sorting index 2-1-1 = 0
Processing sorting index 2-1-2 = 0.002
Processing sorting index 2-2-1 = 0.002
Index queue
Processing sorting index 3-1-1 = 0.001
Index queue
Processing sorting index 4-1-1 = 0.002
Processing sorting index 4-2-1 = 0
Index queue
Private counter 2-1-1 = 2
Private counter 2-1-2 = 4
Private counter 2-2-1 = 1
Private counter 2-2-2 = 2
Private counter 3-1-1 = 1
Private counter 3-1-2 = 2
Private counter 3-2-1 = 0
Private counter 3-2-2 = 0
Private counter 4-1-1 = 1
Private counter 4-1-2 = 3
Private counter 4-2-1 = 1
Private counter 4-2-2 = 1

FIG. 8-5