FIG. 1

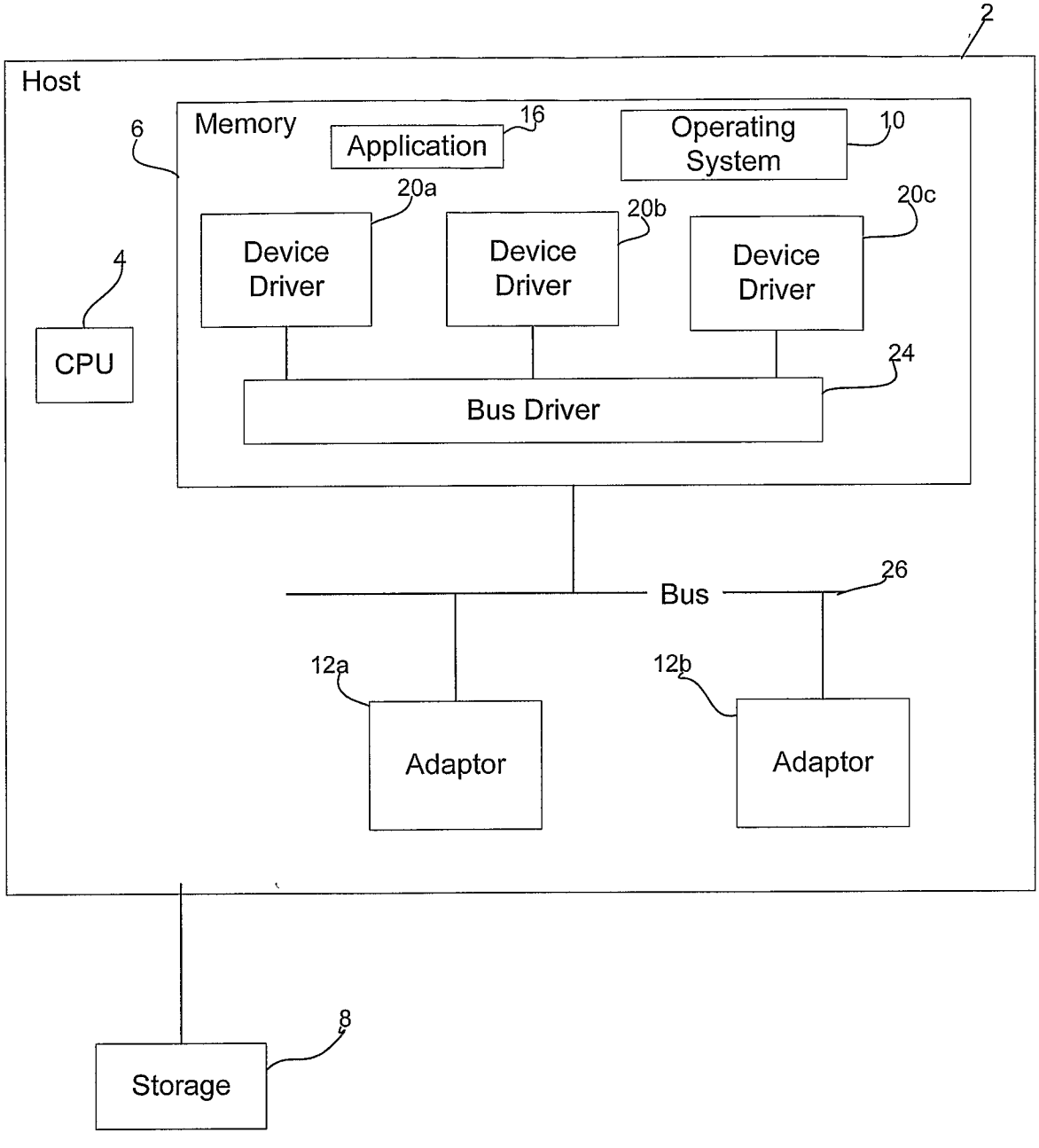
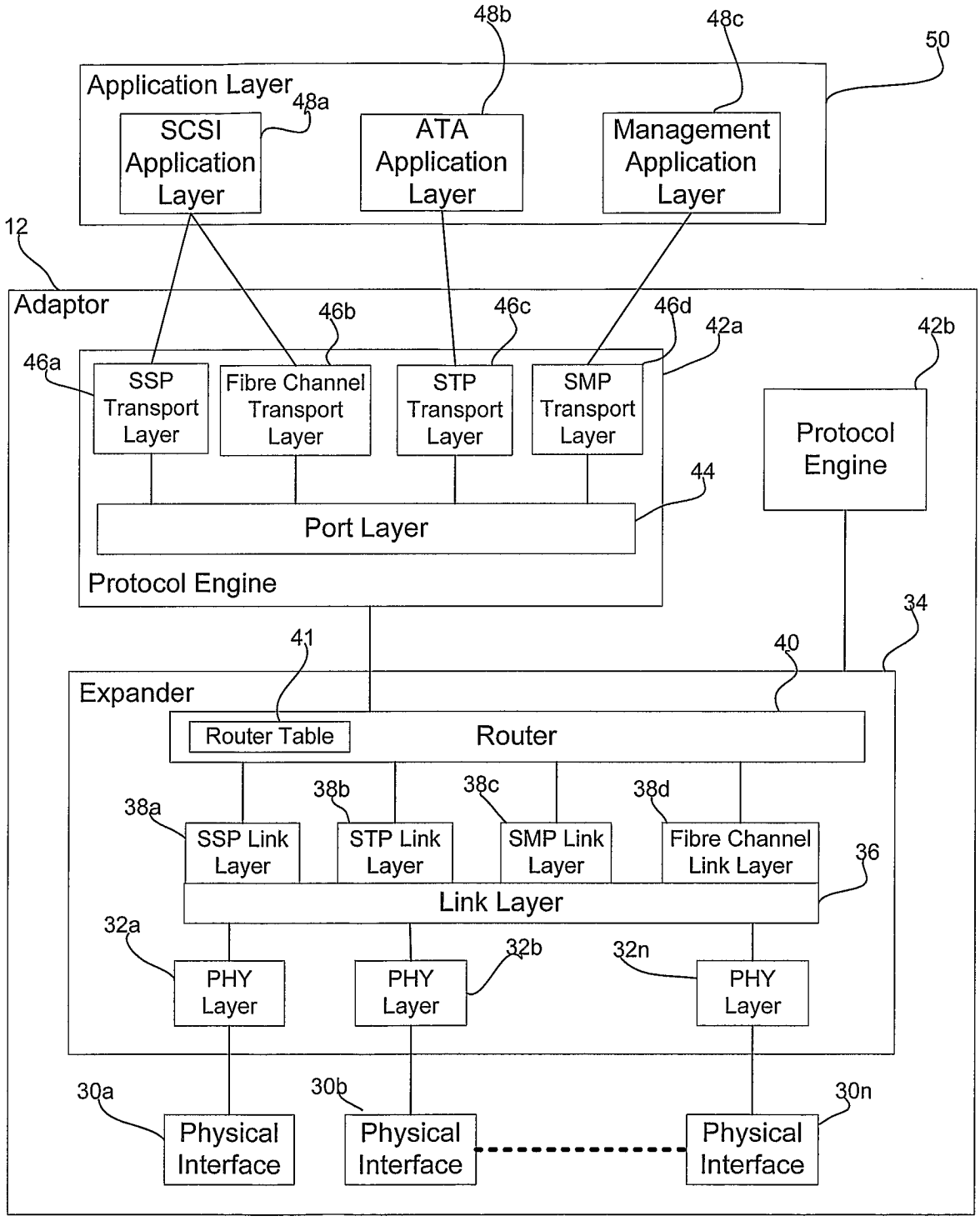

2
Host
6
Memory
Application
16
Operating System
10
20a
20b
20c
Device Driver
Device Driver
Device Driver
4
CPU
24
Bus Driver
Bus
26
12a
12b
Adaptor
Adaptor
8
Storage

FIG. 2


48b
48c
50
Application Layer
48a
SCSI Application Layer
ATA Application Layer
Management Application Layer
12
Adaptor
46b
46c
46d
42a
42b
46a
SSP Transport Layer
Fibre Channel Transport Layer
STP Transport Layer
SMP Transport Layer
Protocol Engine
44
Port Layer
Protocol Engine
34
41
40
Expander
Router Table
Router
38b
38c
38d
38a
SSP Link Layer
STP Link Layer
SMP Link Layer
Fibre Channel Link Layer
36
Link Layer
32a
32b
32n
PHY Layer
PHY Layer
PHY Layer
30a
30b
30n
Physical Interface
Physical Interface
Physical Interface

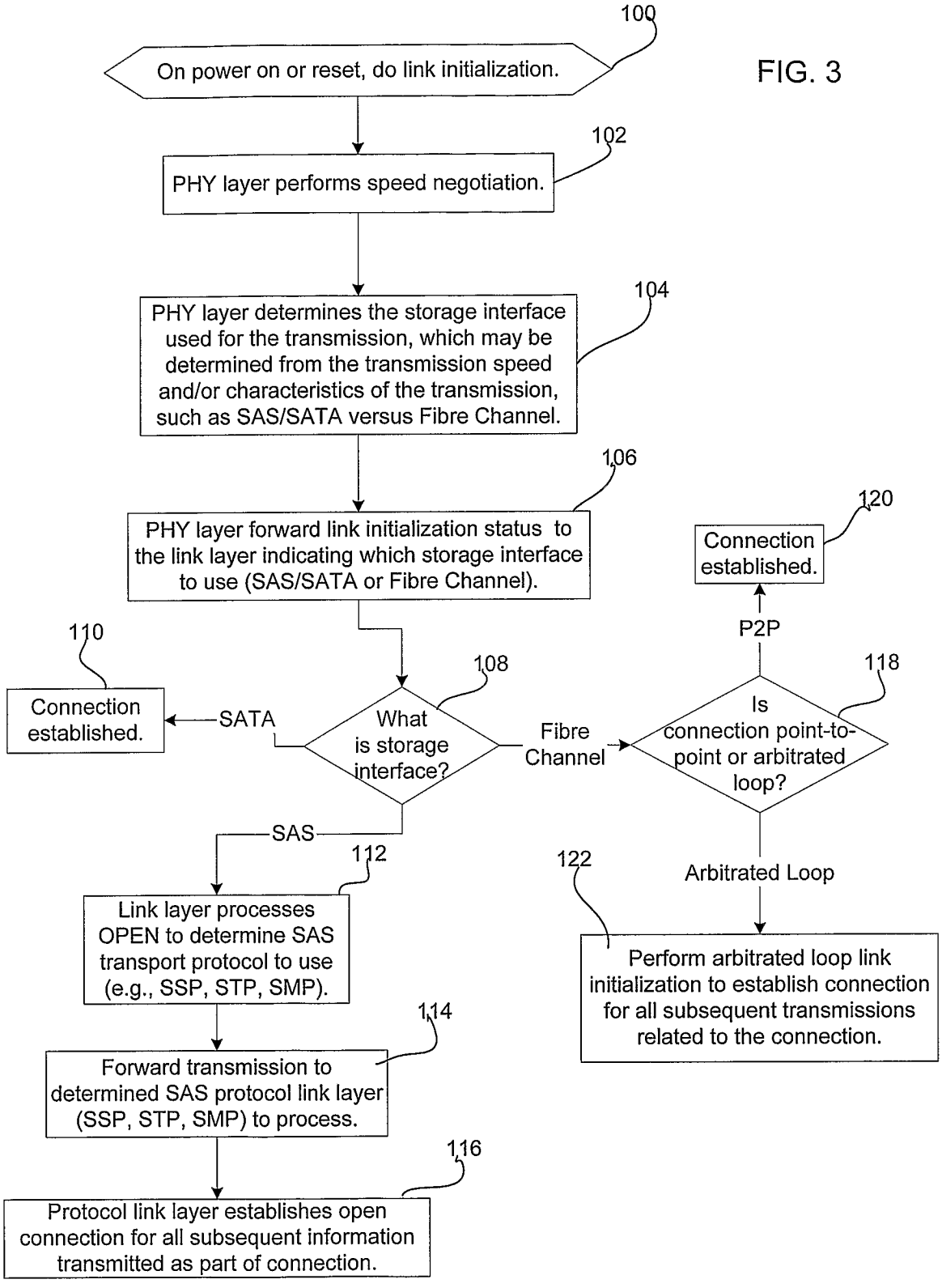
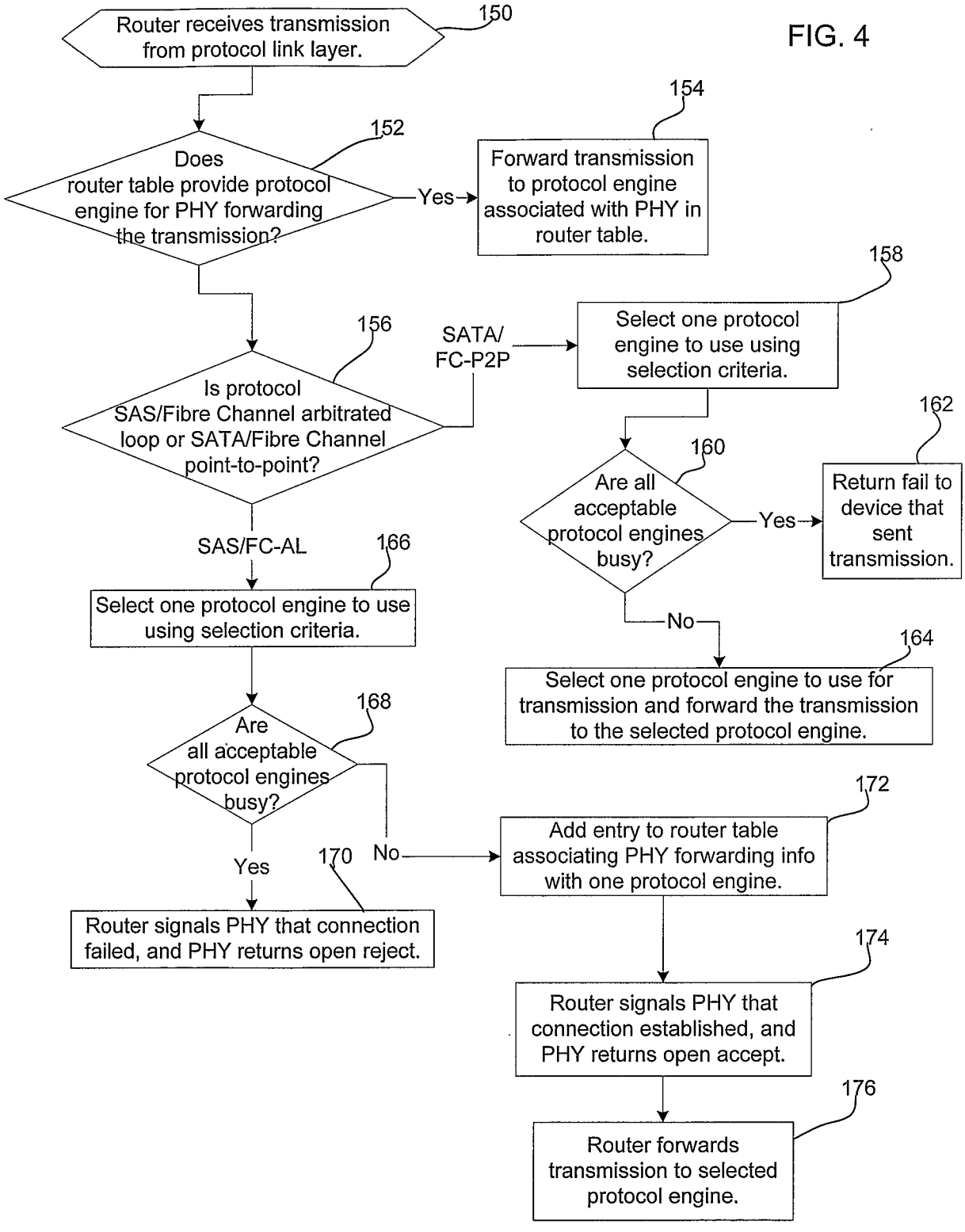

100
On power on or reset, do link initialization.
102
PHY layer performs speed negotiation.
104
PHY layer determines the storage interface used for the transmission, which may be determined from the transmission speed and/or characteristics of the transmission, such as SAS/SATA versus Fibre Channel.
106
PHY layer forward link initialization status to the link layer indicating which storage interface to use (SAS/SATA or Fibre Channel).
108
What is storage interface?
110
Connection established.
SATA
SAS
112
Link layer processes OPEN to determine SAS transport protocol to use (e.g., SSP, STP, SMP).
114
Forward transmission to determined SAS protocol link layer (SSP, STP, SMP) to process.
116
Protocol link layer establishes open connection for all subsequent information transmitted as part of connection.
Fibre Channel
118
Is connection point-to-point or arbitrated loop?
P2P
120
Connection established.
Arbitrated Loop
122
Perform arbitrated loop link initialization to establish connection for all subsequent transmissions related to the connection.

FIG. 3

FIG. 4


Router receives transmission from protocol link layer.
150
Does router table provide protocol engine for PHY forwarding the transmission?
152
Yes
Forward transmission to protocol engine associated with PHY in router table.
154
Is protocol SAS/Fibre Channel arbitrated loop or SATA/Fibre Channel point-to-point?
156
SATA/ FC-P2P
Select one protocol engine to use using selection criteria.
158
SAS/FC-AL
Are all acceptable protocol engines busy?
160
Yes
Return fail to device that sent transmission.
162
No
Select one protocol engine to use using selection criteria.
166
Select one protocol engine to use for transmission and forward the transmission to the selected protocol engine.
164
Are all acceptable protocol engines busy?
168
Yes
No
170
Add entry to router table associating PHY forwarding info with one protocol engine.
172
Router signals PHY that connection failed, and PHY returns open reject.
Router signals PHY that connection established, and PHY returns open accept.
174
Router forwards transmission to selected protocol engine.
176

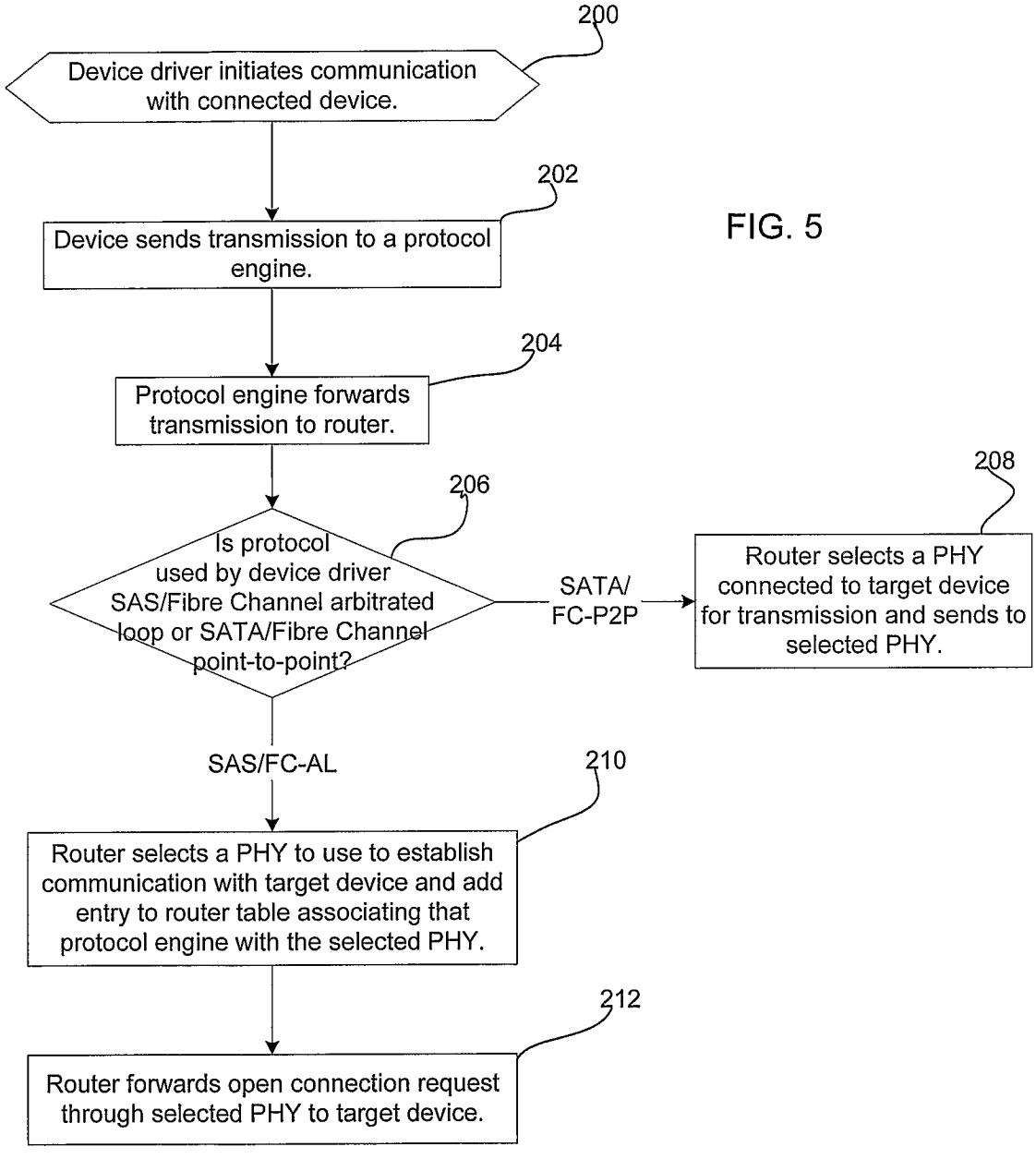
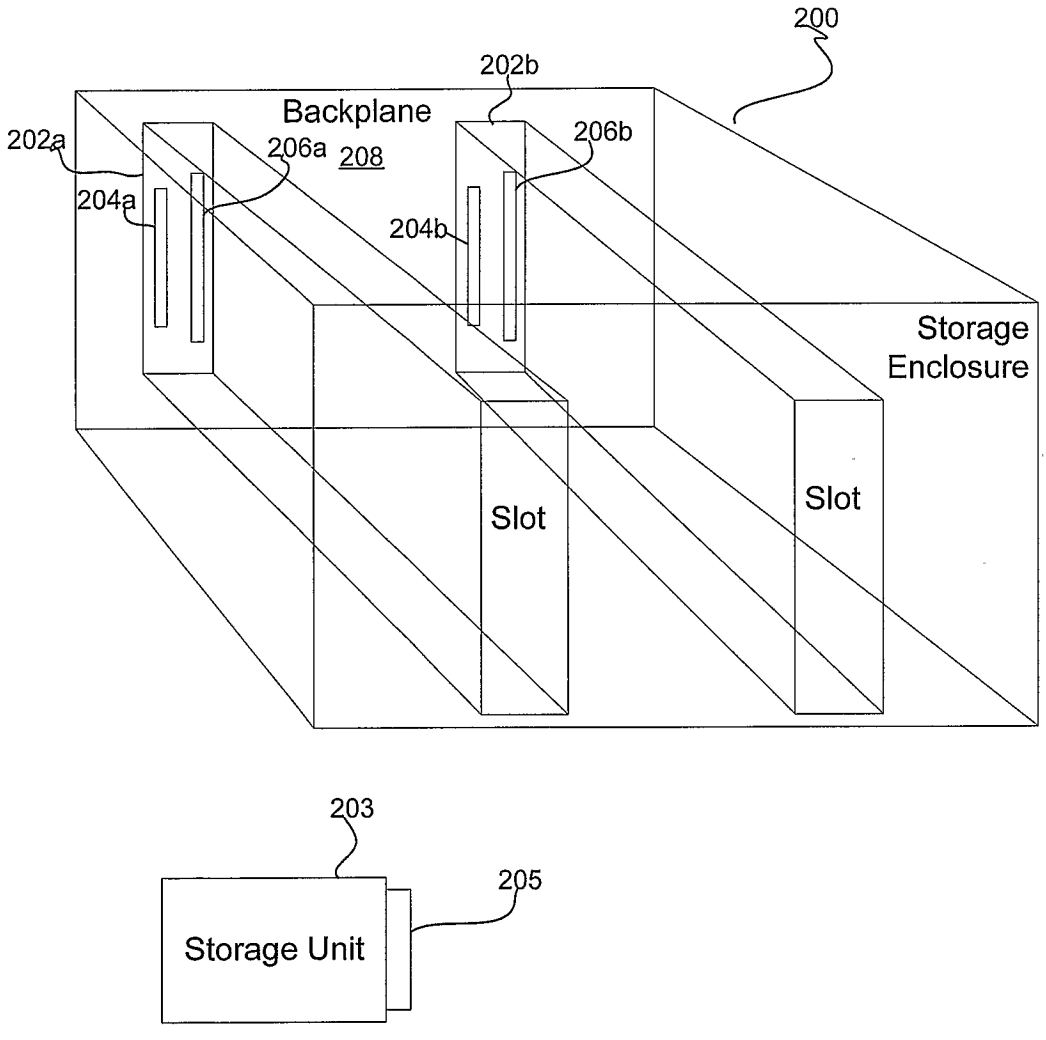

200
Device driver initiates communication with connected device.
202
Device sends transmission to a protocol engine.
204
Protocol engine forwards transmission to router.
206
Is protocol used by device driver SAS/Fibre Channel arbitrated loop or SATA/Fibre Channel point-to-point?
SATA/ FC-P2P
208
Router selects a PHY connected to target device for transmission and sends to selected PHY.
SAS/FC-AL
210
Router selects a PHY to use to establish communication with target device and add entry to router table associating that protocol engine with the selected PHY.
212
Router forwards open connection request through selected PHY to target device.

FIG. 5

FIG. 6


200
202b
Backplane
208
202a
206a
206b
204a
204b
Storage
Enclosure
Slot
Slot
203
205
Storage Unit

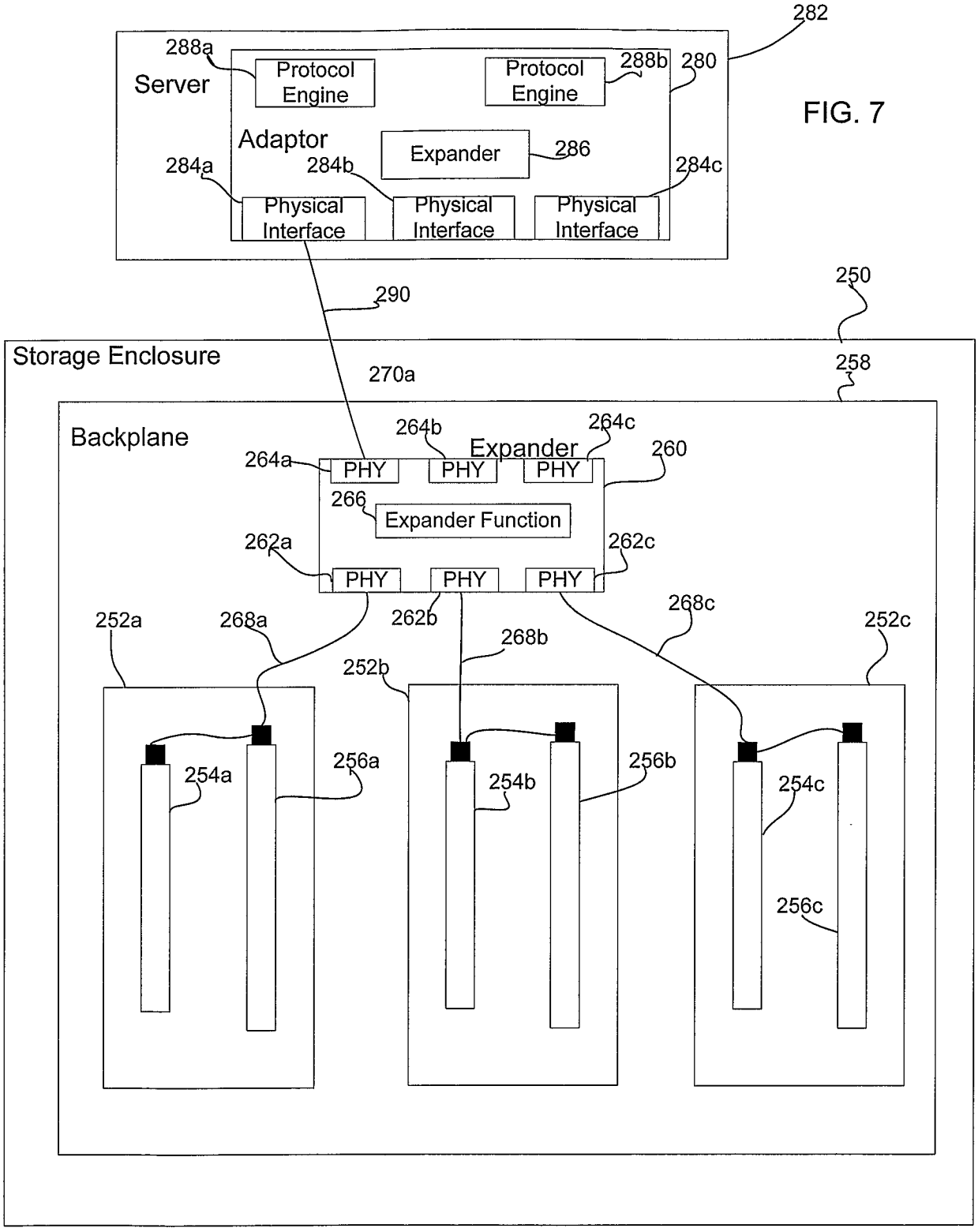

282
288a
Server
Protocol Engine
Protocol Engine
288b
280
Adaptor
Expander
286
284a
284b
284c
Physical Interface
Physical Interface
Physical Interface
290
250
Storage Enclosure
270a
258
Backplane
264b
264c
Expander
264a
PHY
PHY
PHY
260
266
Expander Function
262a
262c
PHY
PHY
PHY
262b
268c
252a
268a
268b
252c
252b
254a
256a
254b
256b
254c
256c

FIG. 7

FIG. 8

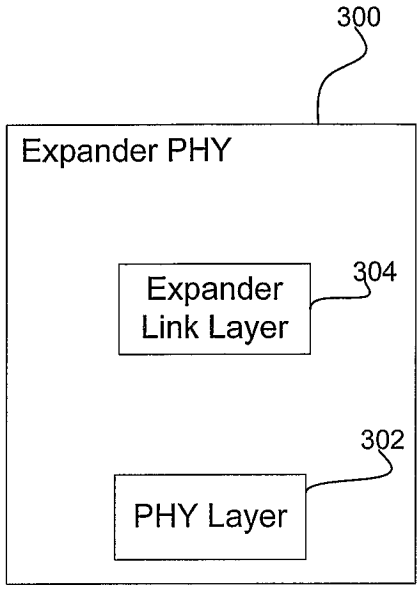


FIG. 9

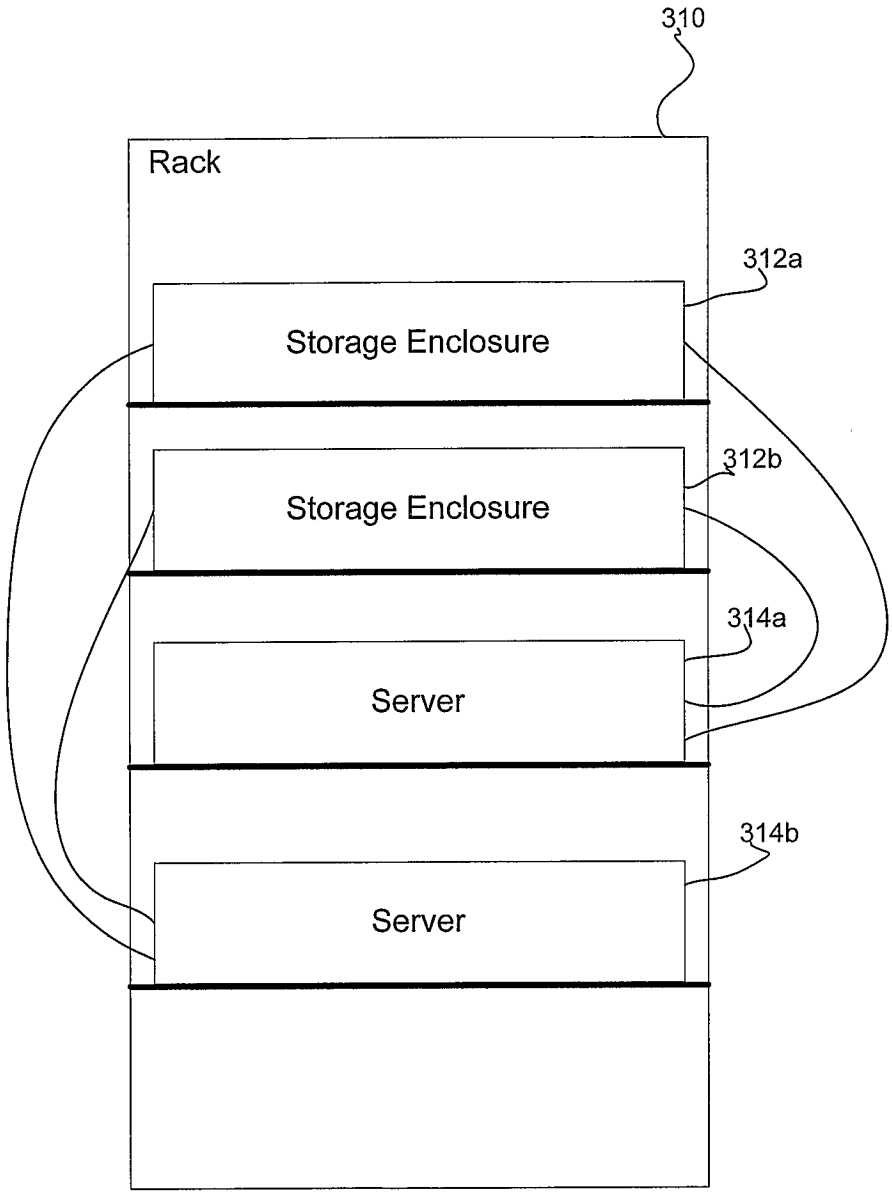

310
Rack
312a
Storage Enclosure
312b
Storage Enclosure
314a
Server
314b
Server

FIG. 10

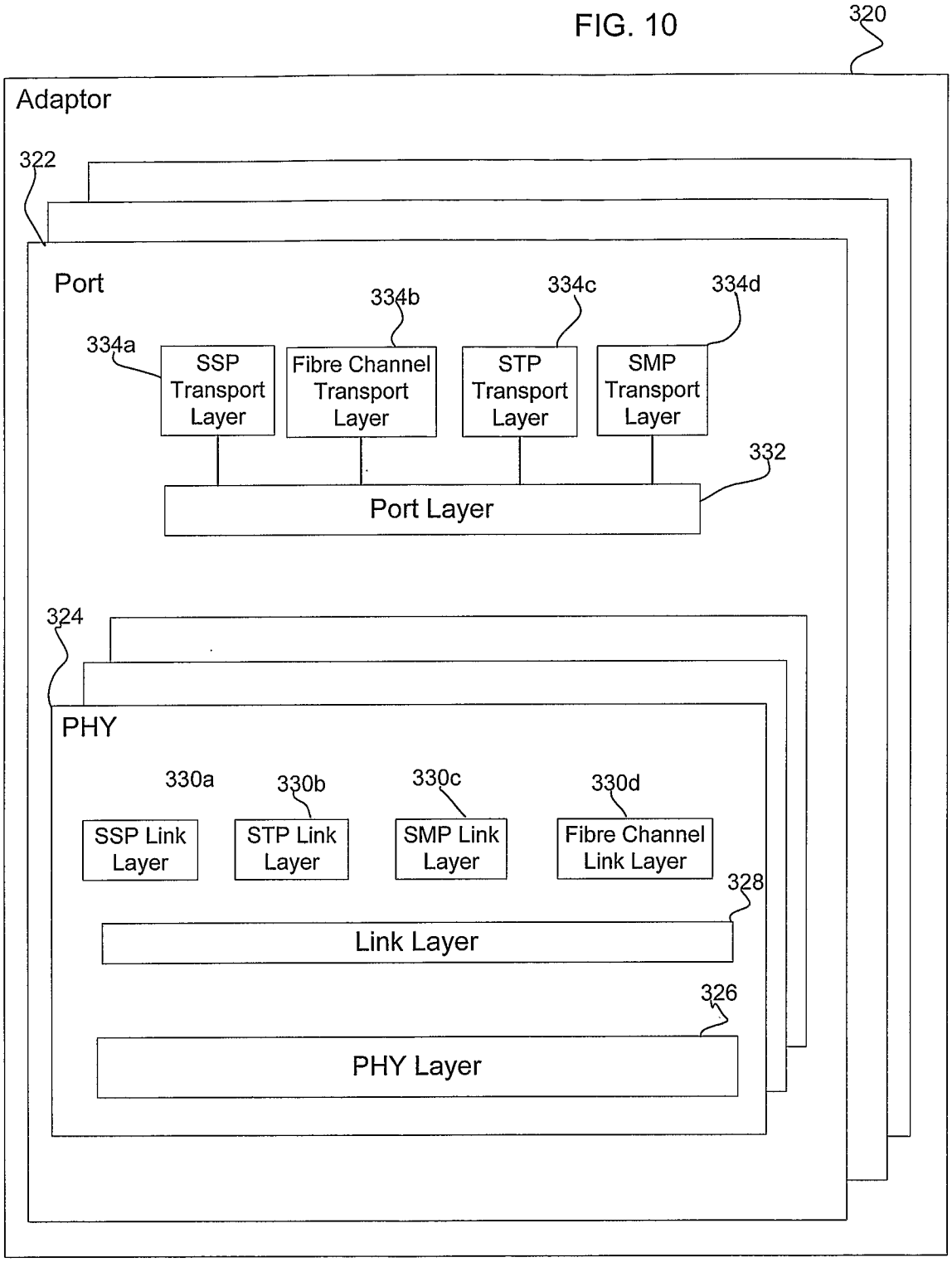
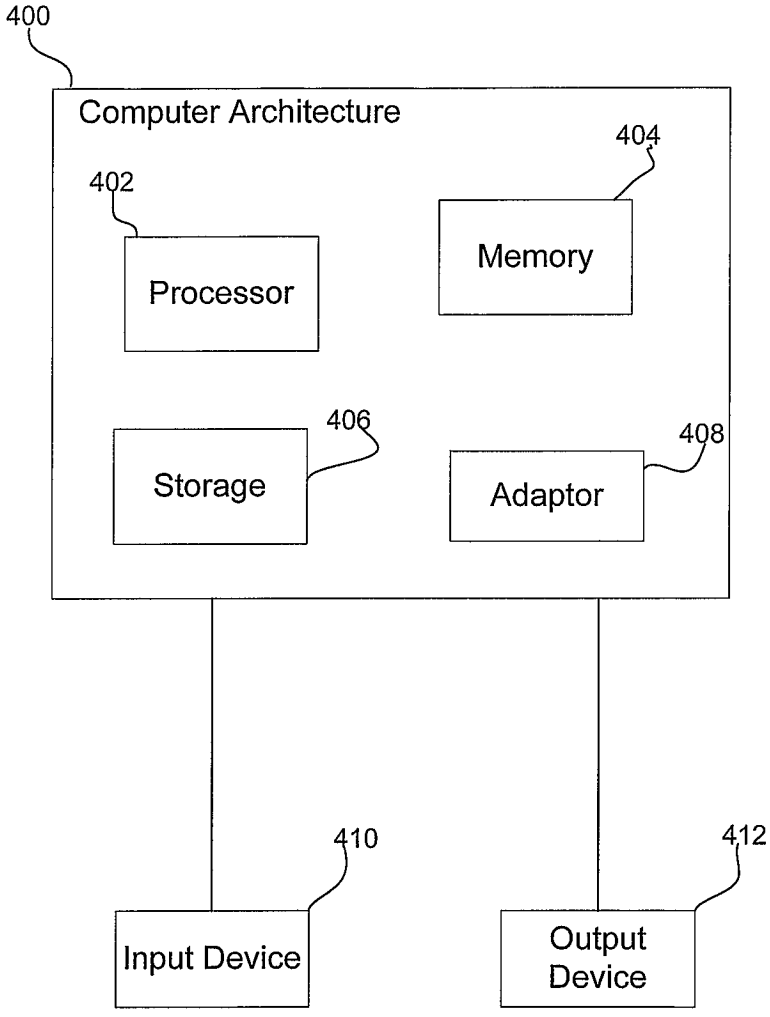

320
Adaptor
322
Port
334a
334b
334c
334d
SSP Transport Layer
Fibre Channel Transport Layer
STP Transport Layer
SMP Transport Layer
332
Port Layer
324
PHY
330a
330b
330c
330d
SSP Link Layer
STP Link Layer
SMP Link Layer
Fibre Channel Link Layer
328
Link Layer
326
PHY Layer

FIG. 11


400
Computer Architecture
402
Processor
404
Memory
406
Storage
408
Adaptor
410
Input Device
412
Output Device