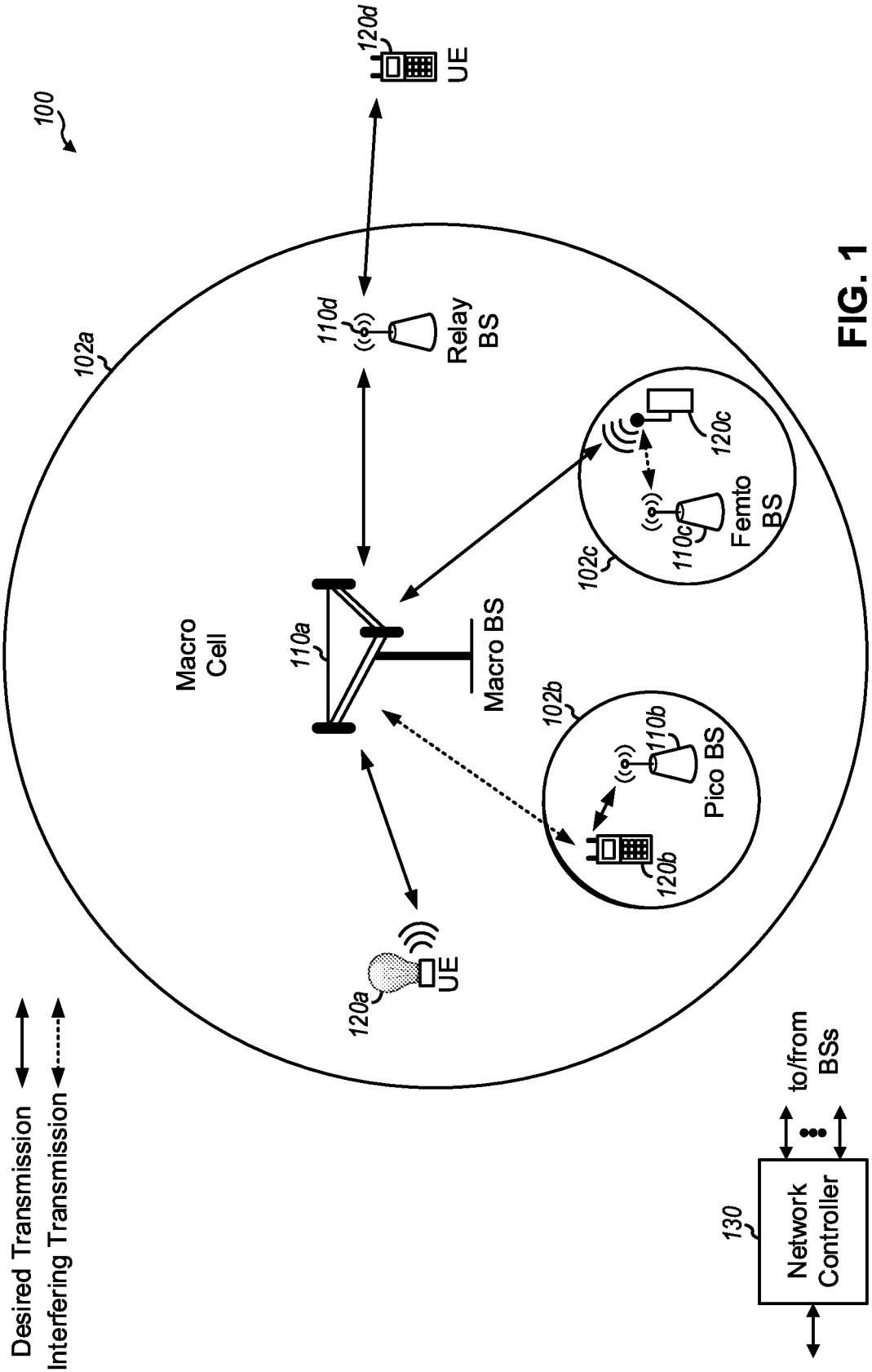

100
120d
UE
110d
Relay
BS
102a
Macro
Cell
110a
Macro BS
120c
Femto
BS
110c
102c
102b
110b
Pico BS
120b
120a
UE
Desired Transmission
Interfering Transmission
130
Network
Controller
to/from
BSs

FIG. 1

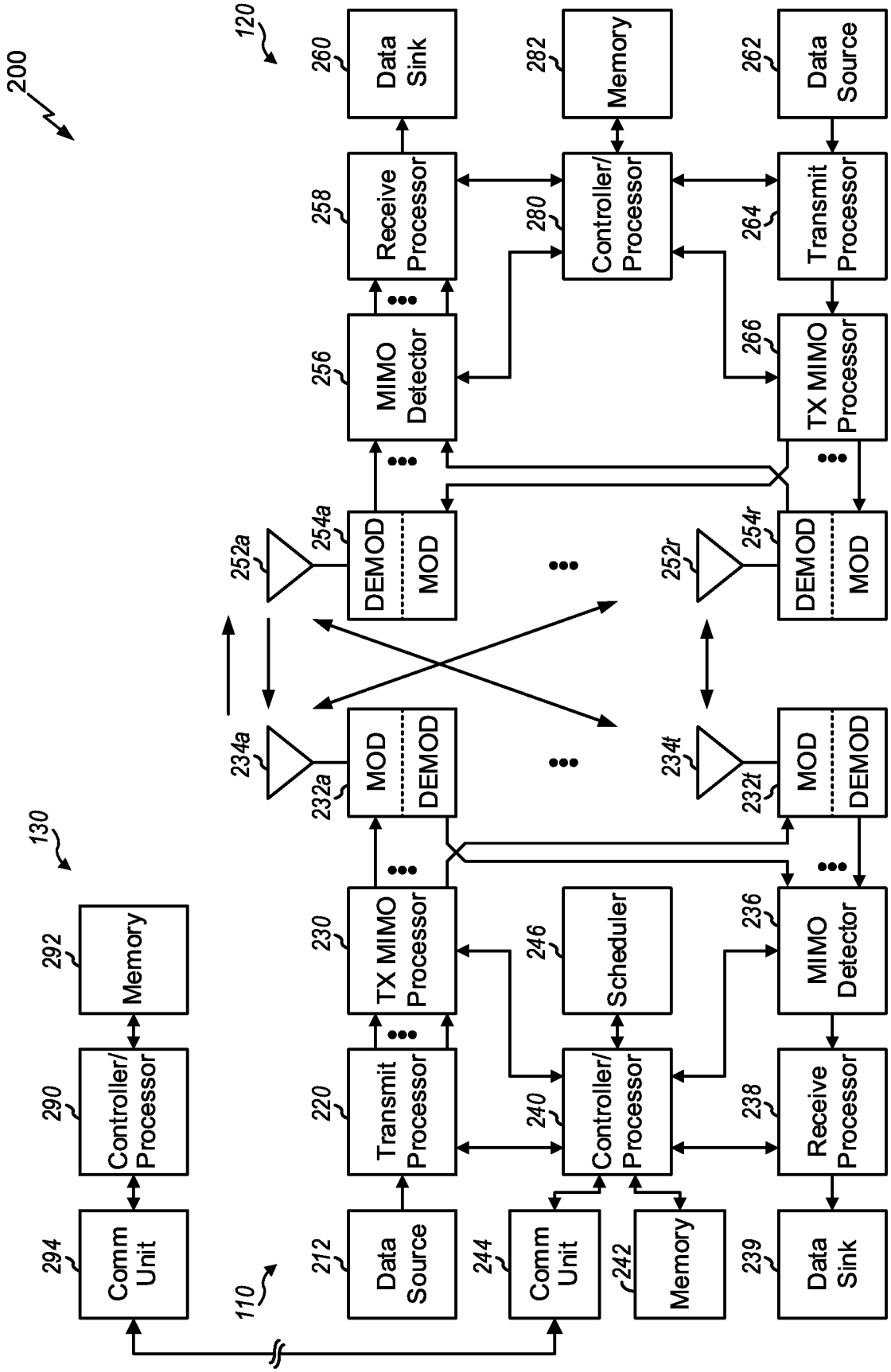

200
120
260
Data Sink
282
Memory
262
Data Source
258
Receive Processor
280
Controller/ Processor
264
Transmit Processor
256
MIMO Detector
266
TX MIMO Processor
252a
254a
DEMOD
MOD
252r
254r
DEMOD
MOD
234a
232a
MOD
DEMOD
234t
232t
MOD
DEMOD
130
292
Memory
230
TX MIMO Processor
246
Scheduler
236
MIMO Detector
290
Controller/ Processor
220
Transmit Processor
240
Controller/ Processor
238
Receive Processor
294
Comm Unit
212
Data Source
244
Comm Unit
242
Memory
239
Data Sink
110

FIG. 2

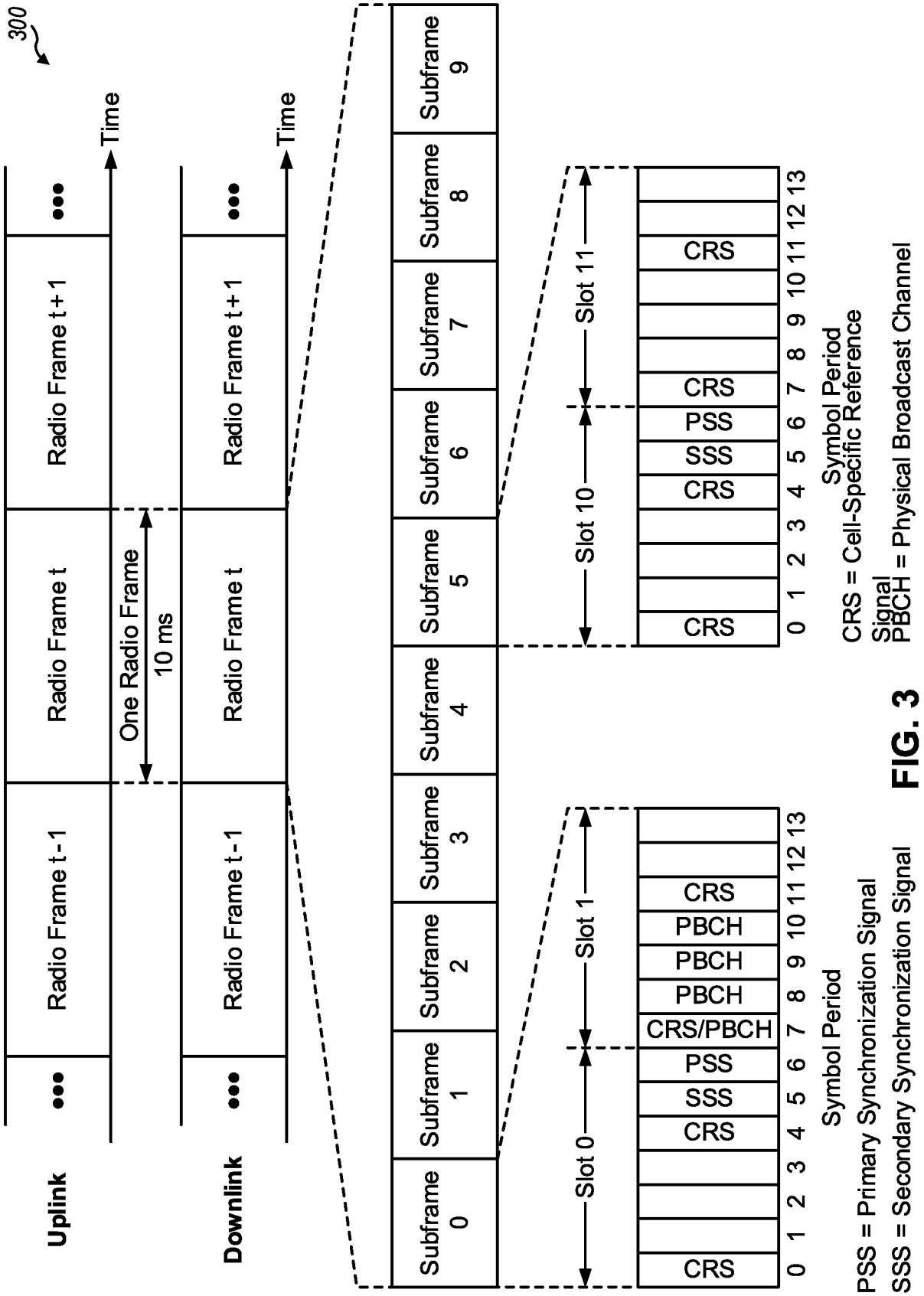

300
Uplink
Downlink
Time
Time
Radio Frame t-1
Radio Frame t
Radio Frame t+1
One Radio Frame
10 ms
Subframe 0
Subframe 1
Subframe 2
Subframe 3
Subframe 4
Subframe 5
Subframe 6
Subframe 7
Subframe 8
Subframe 9
Slot 0
Slot 1
Slot 10
Slot 11
Symbol Period
0 1 2 3 4 5 6 7 8 9 10 11 12 13
CRS
PBCH
CRS/PBCH
PSS
SSS
CRS = Cell-Specific Reference Signal
PBCH = Physical Broadcast Channel
PSS = Primary Synchronization Signal
SSS = Secondary Synchronization Signal

FIG. 3

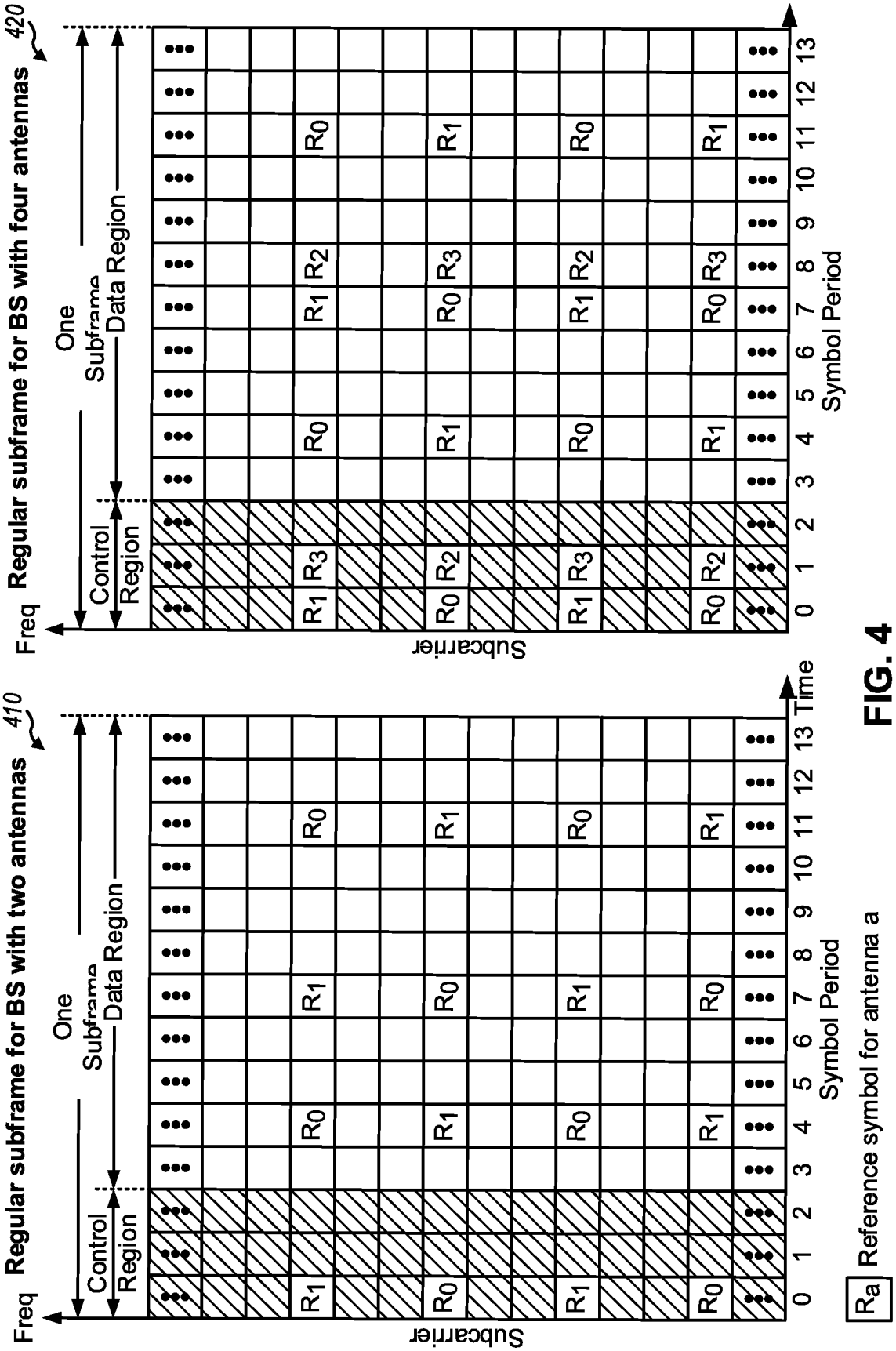

Regular subframe for BS with four antennas
420
Regular subframe for BS with two antennas
410
One Subframe
Data Region
Control Region
Freq
Subcarrier
Symbol Period
Time
0 1 2 3 4 5 6 7 8 9 10 11 12 13
R0
R1
R2
R3
Ra Reference symbol for antenna a

FIG. 4

FIG. 5

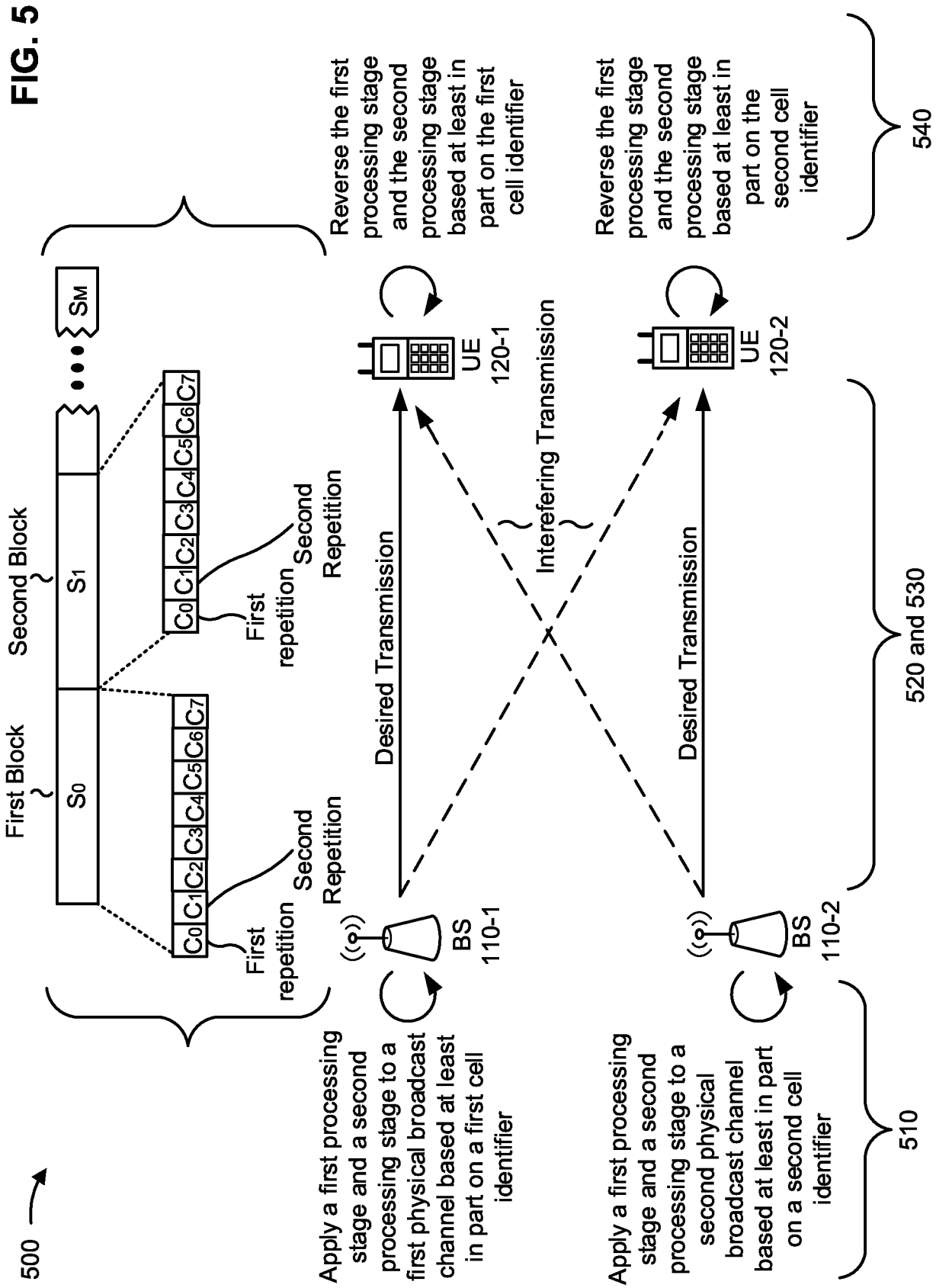
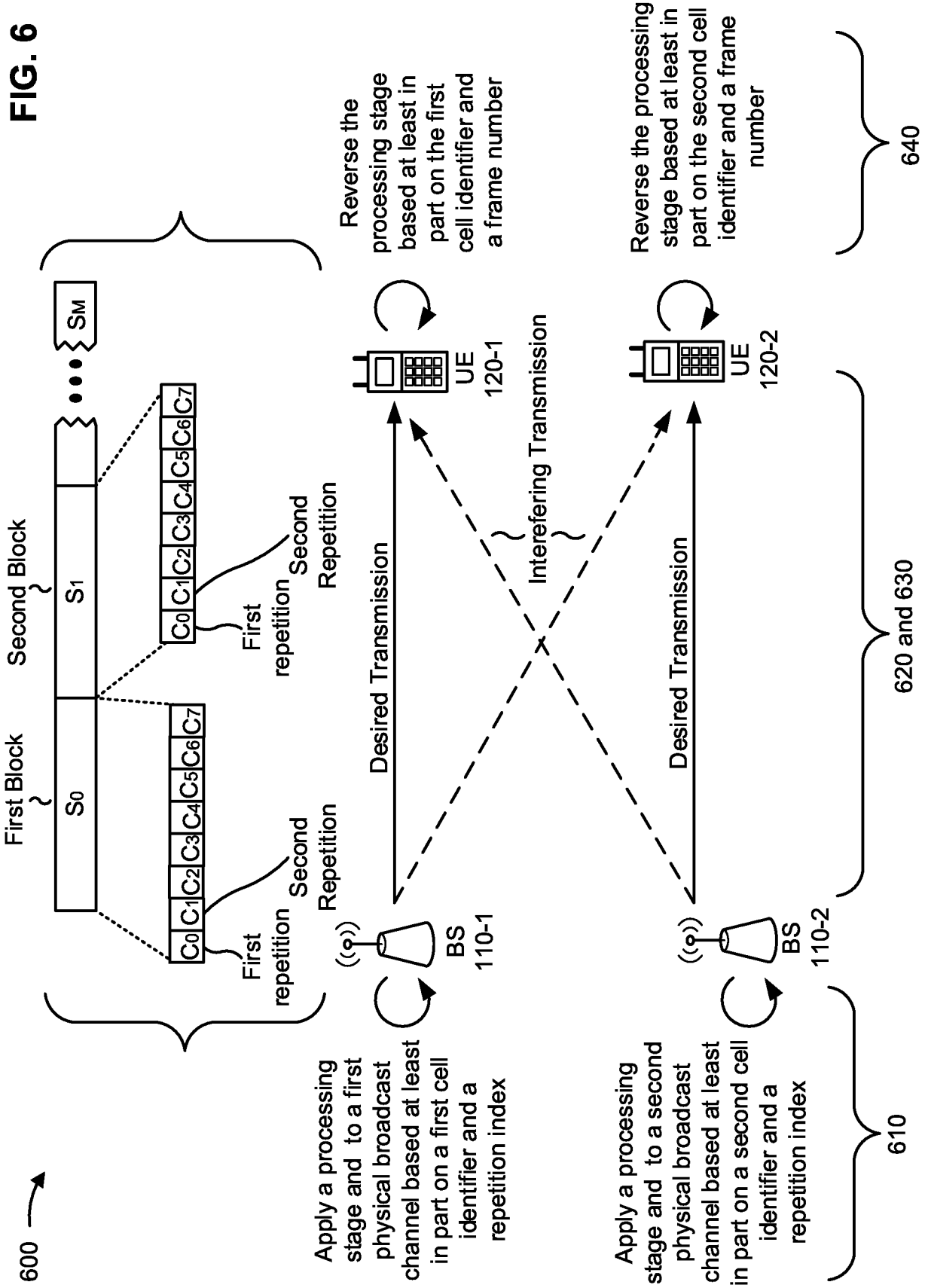

500
First Block
Second Block
S0
S1
SM
C0 C1 C2 C3 C4 C5 C6 C7
First repetition
Second Repetition
Desired Transmission
Interefering Transmission
BS 110-1
BS 110-2
UE 120-1
UE 120-2
Apply a first processing stage and a second processing stage to a first physical broadcast channel based at least in part on a first cell identifier
Apply a first processing stage and a second processing stage to a second physical broadcast channel based at least in part on a second cell identifier
Reverse the first processing stage and the second processing stage based at least in part on the first cell identifier
Reverse the first processing stage and the second processing stage based at least in part on the second cell identifier
510
520 and 530
540

FIG. 6


600
First Block
Second Block
S0
S1
SM
C0 C1 C2 C3 C4 C5 C6 C7
First repetition
Second Repetition
Desired Transmission
Interefering Transmission
BS 110-1
BS 110-2
UE 120-1
UE 120-2
Apply a processing stage and to a first physical broadcast channel based at least in part on a first cell identifier and a repetition index
Apply a processing stage and to a second physical broadcast channel based at least in part on a second cell identifier and a repetition index
Reverse the processing stage based at least in part on the first cell identifier and a frame number
Reverse the processing stage based at least in part on the second cell identifier and a frame number
610
620 and 630
640

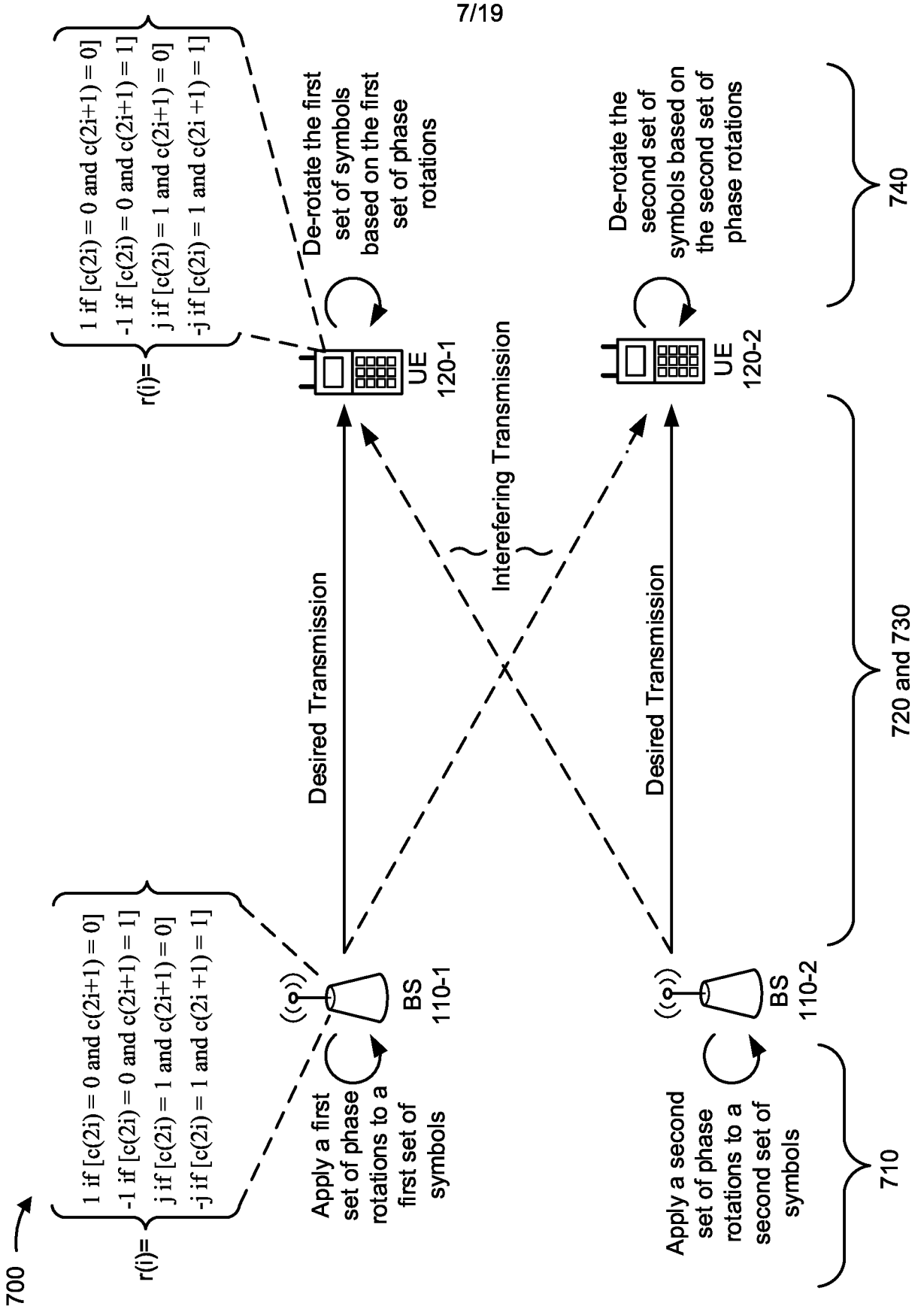

700
r(i)=
1 if [c(2i) = 0 and c(2i+1) = 0]
-1 if [c(2i) = 0 and c(2i+1) = 1]
j if [c(2i) = 1 and c(2i+1) = 0]
-j if [c(2i) = 1 and c(2i +1) = 1]
Apply a first set of phase rotations to a first set of symbols
BS 110-1
Desired Transmission
Interefering Transmission
UE 120-1
De-rotate the first set of symbols based on the first set of phase rotations
Apply a second set of phase rotations to a second set of symbols
BS 110-2
Desired Transmission
UE 120-2
De-rotate the second set of symbols based on the second set of phase rotations
710
720 and 730
740

FIG. 7

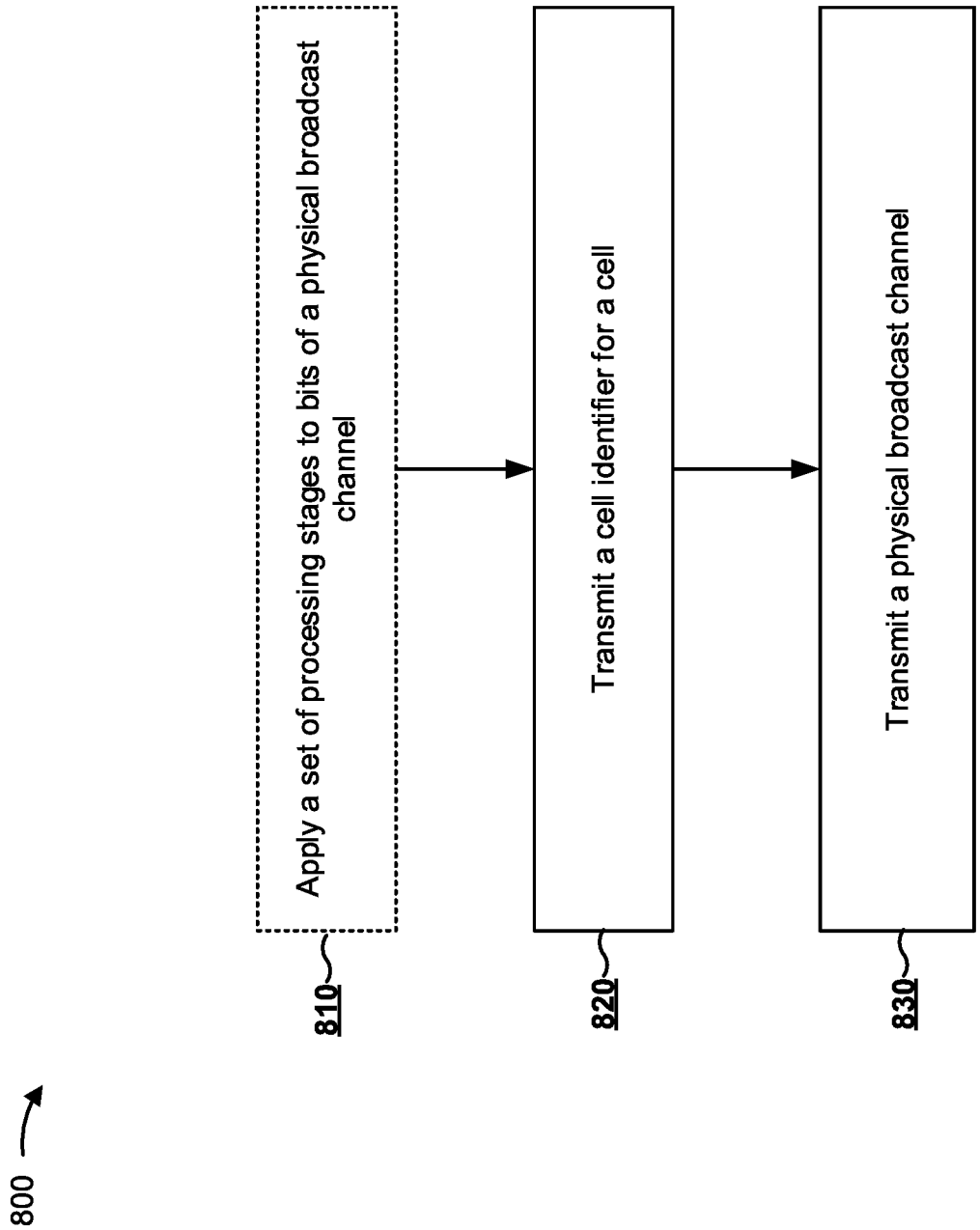

800
Apply a set of processing stages to bits of a physical broadcast channel
810
Transmit a cell identifier for a cell
820
Transmit a physical broadcast channel
830

FIG. 8

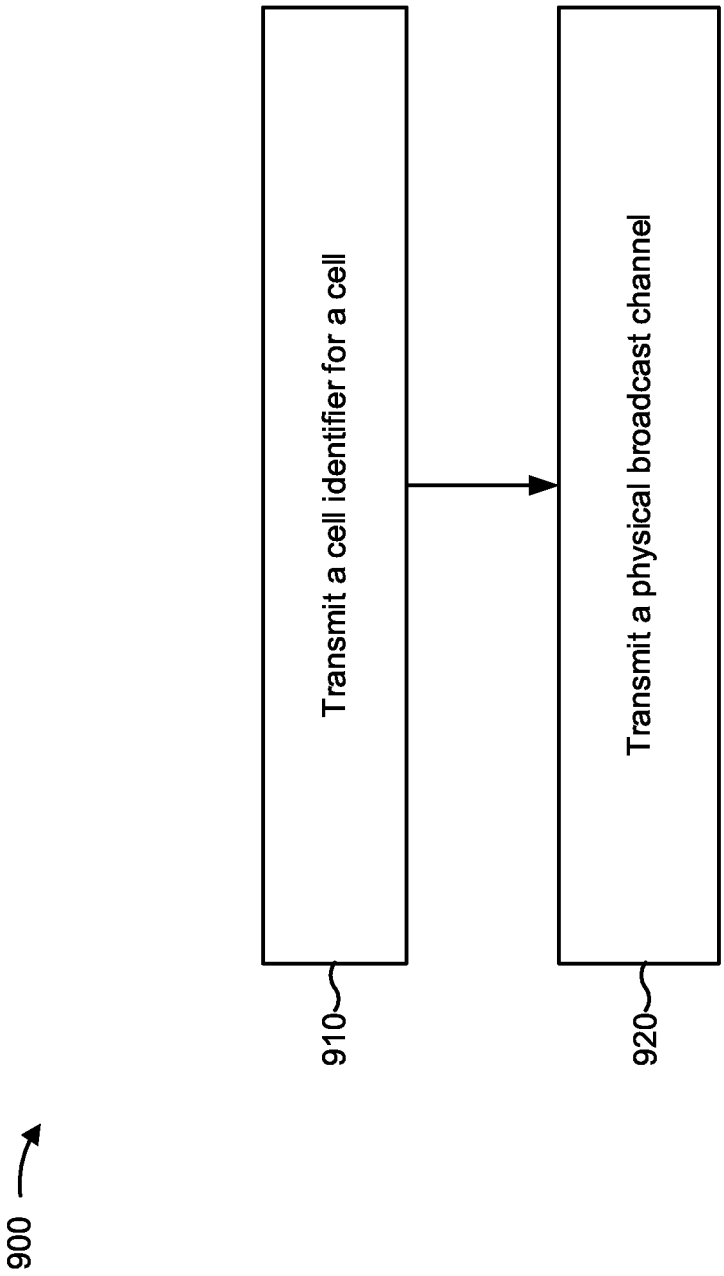

Transmit a cell identifier for a cell
Transmit a physical broadcast channel
910
920
900

FIG. 9

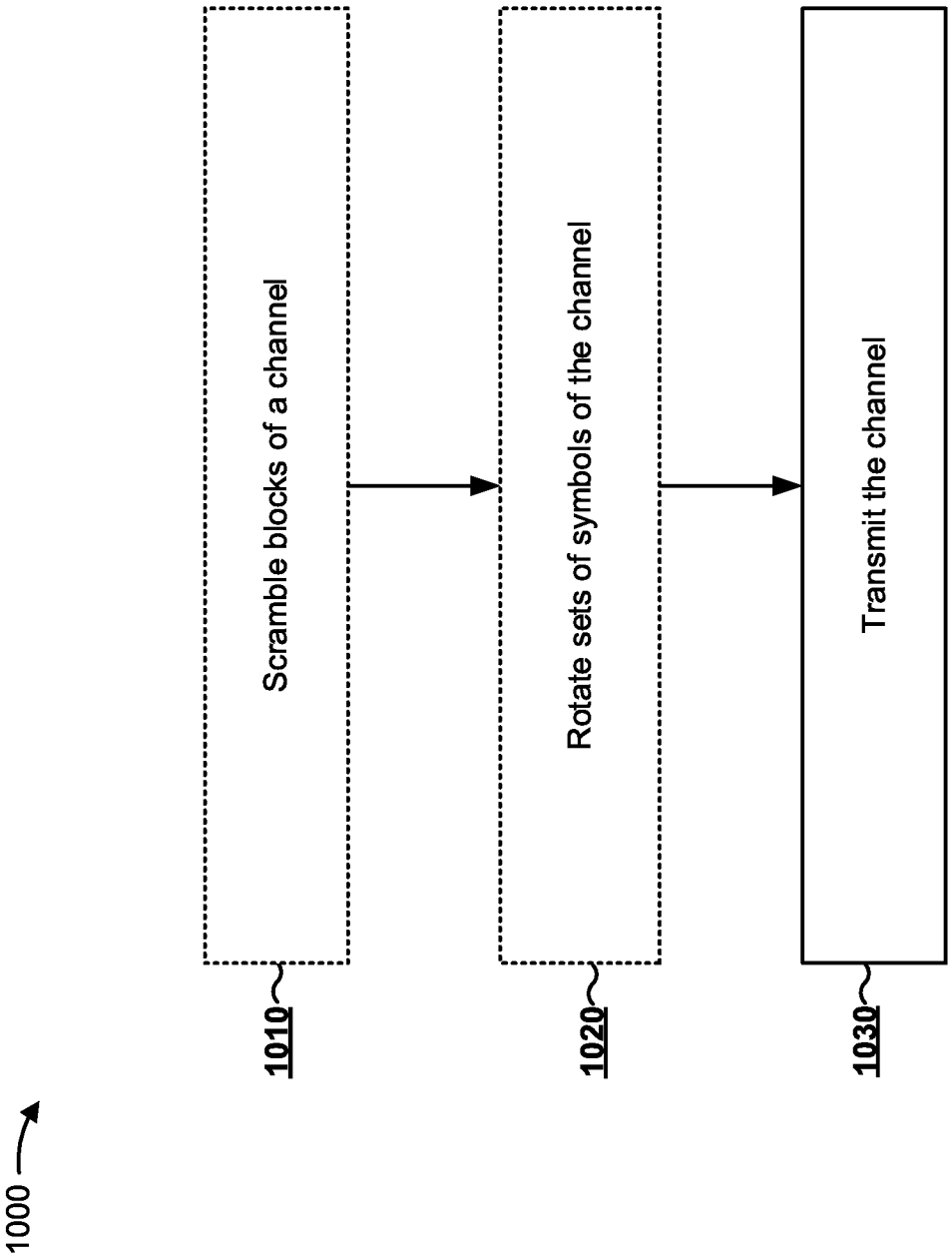

1000
Scramble blocks of a channel
Rotate sets of symbols of the channel
Transmit the channel
1010
1020
1030

FIG. 10

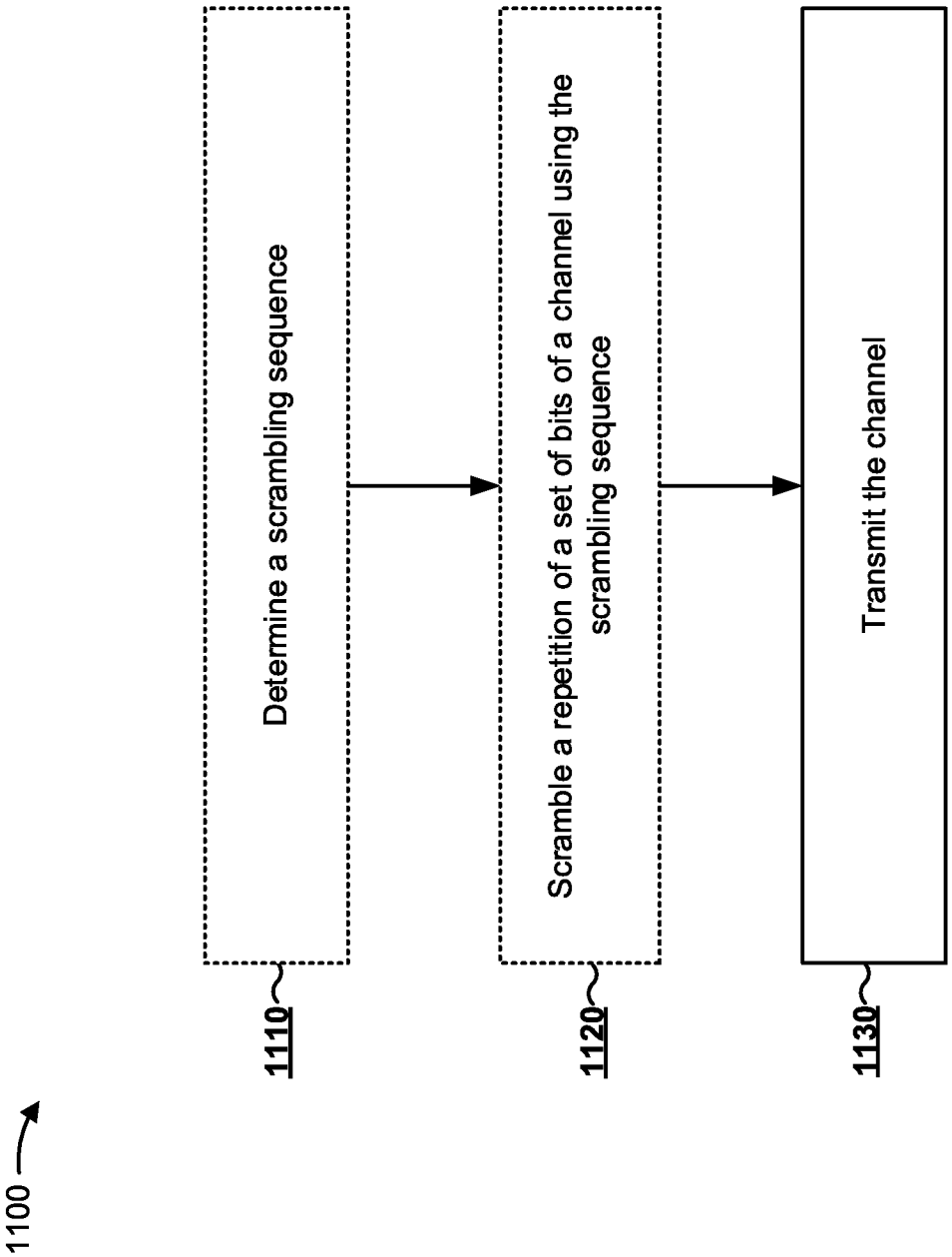

1100
Determine a scrambling sequence
1110
Scramble a repetition of a set of bits of a channel using the scrambling sequence
1120
Transmit the channel
1130

FIG. 11

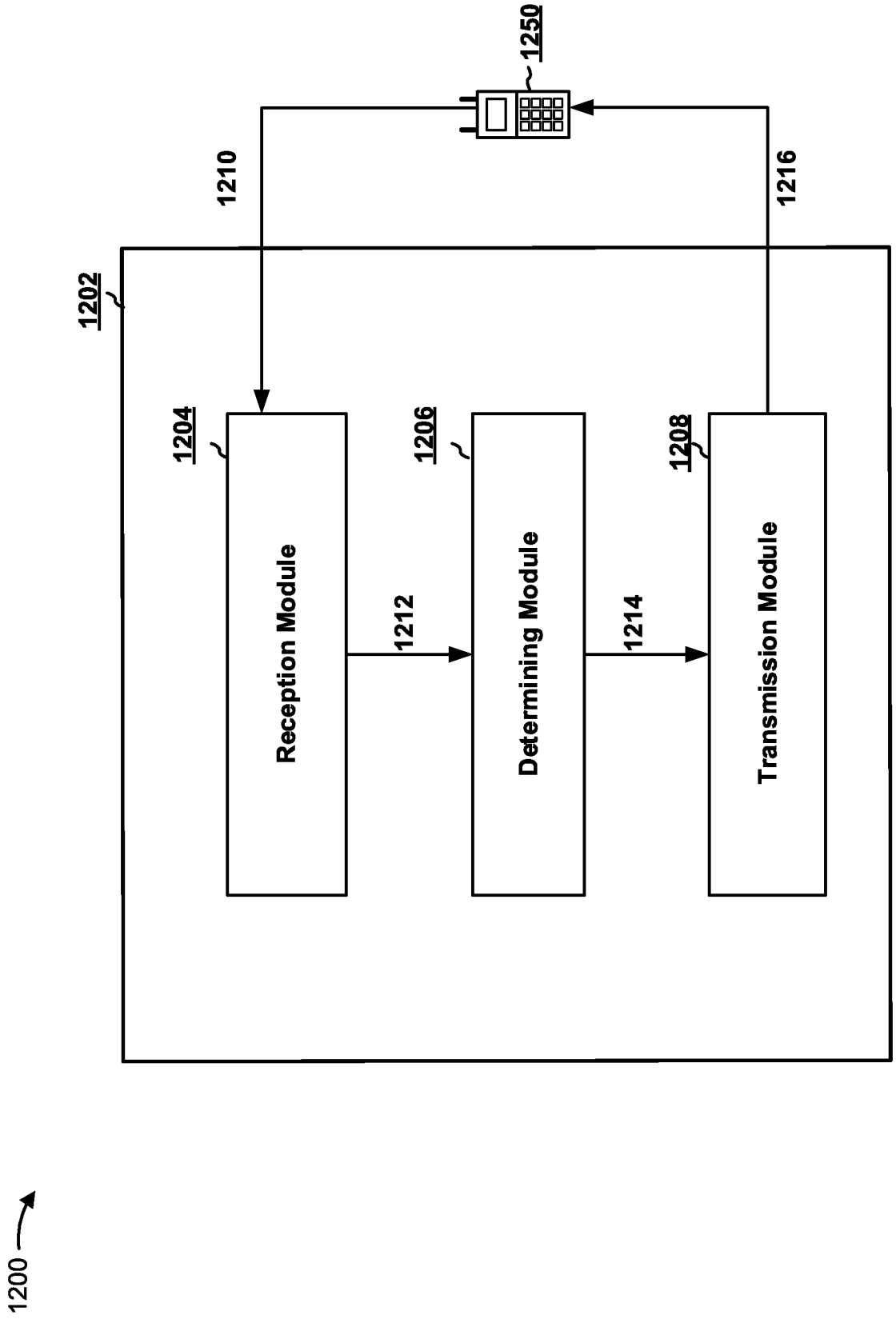

1250
1210
1216
1202
1204
1206
1208
Reception Module
Determining Module
Transmission Module
1212
1214
1200

FIG. 12

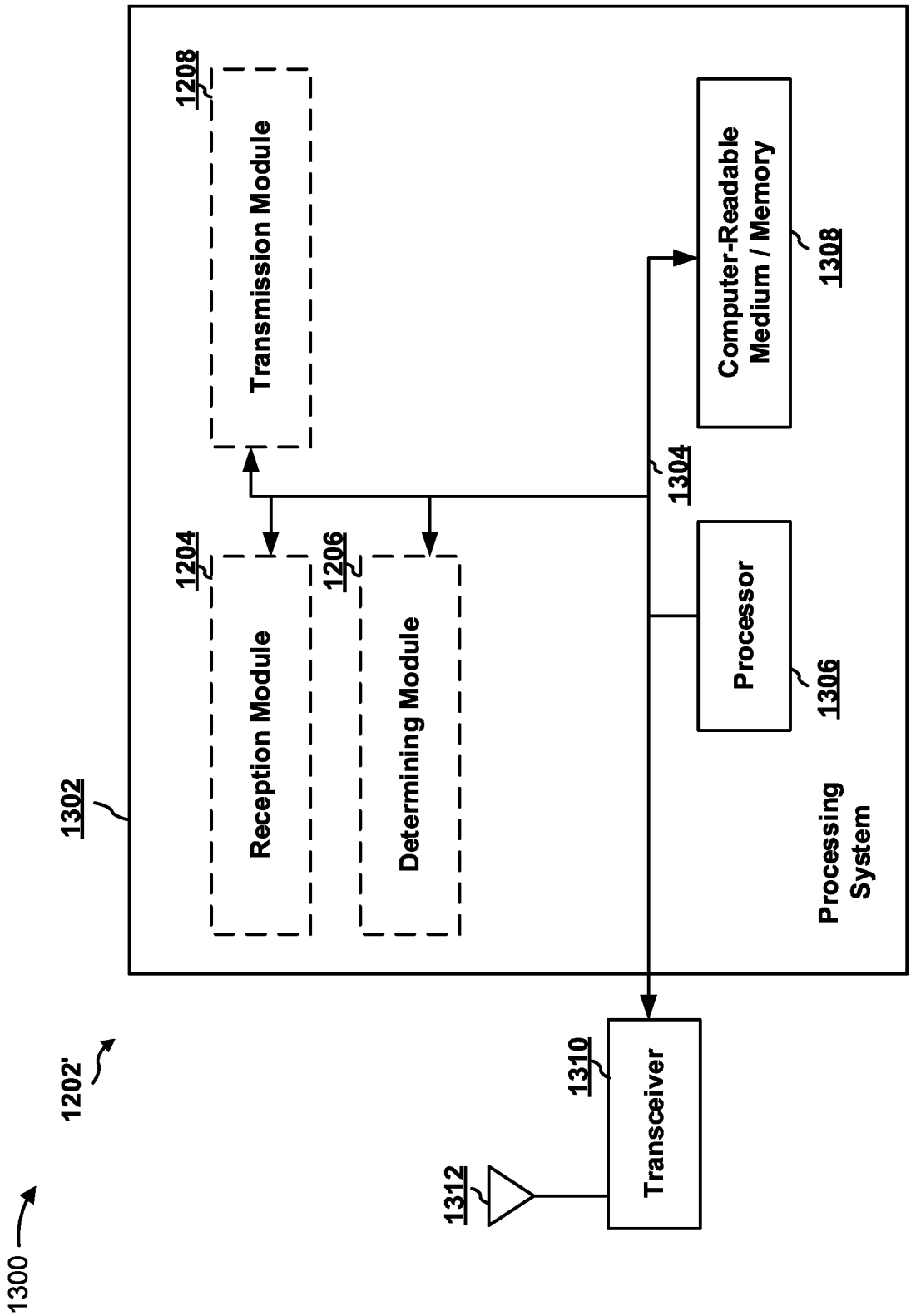

1300
1202'
1302
1208
Transmission Module
1204
Reception Module
1206
Determining Module
1304
Computer-Readable Medium / Memory
1308
Processor
1306
Processing System
1310
Transceiver
1312

FIG. 13

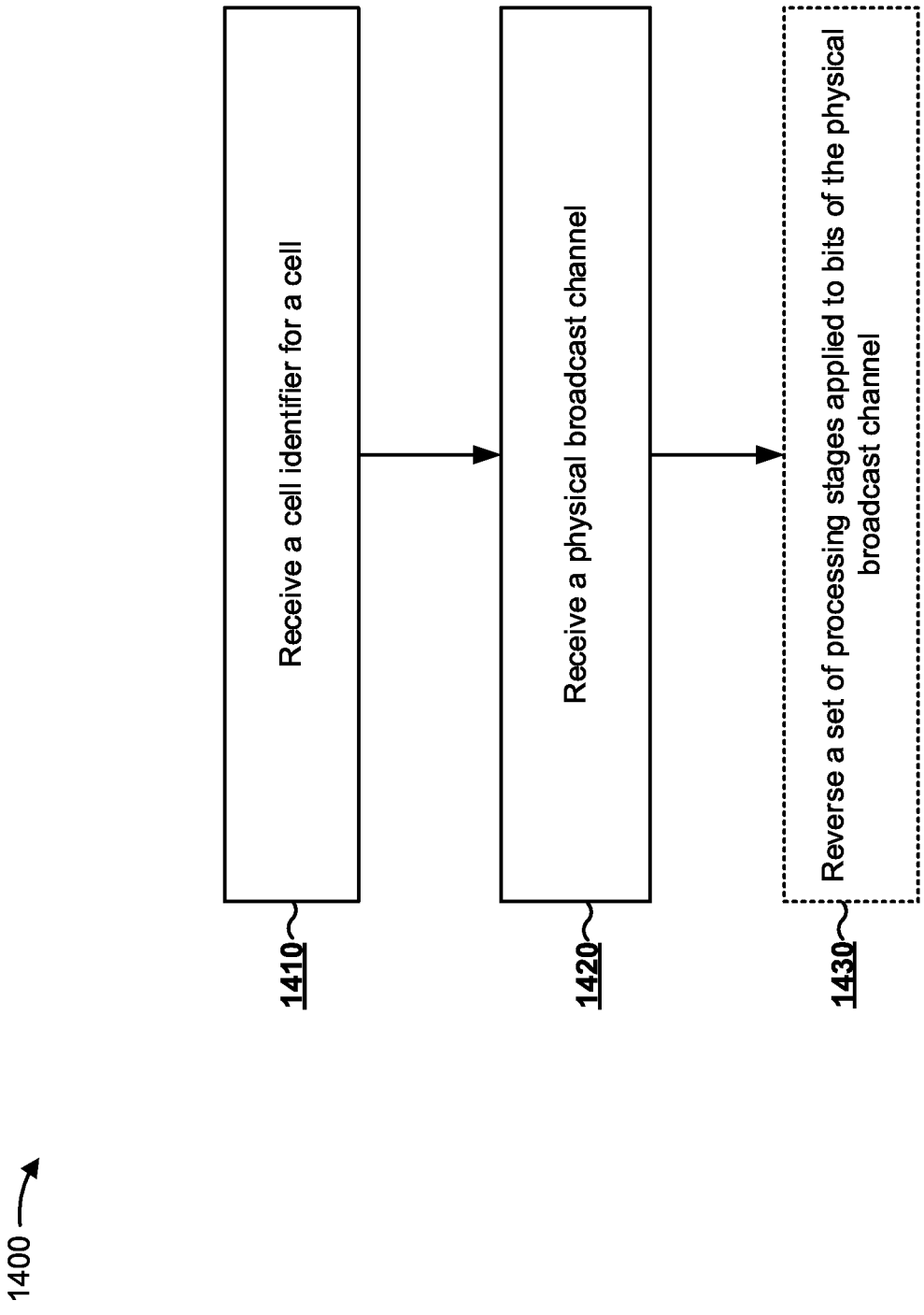

1400
Receive a cell identifier for a cell
1410
Receive a physical broadcast channel
1420
Reverse a set of processing stages applied to bits of the physical broadcast channel
1430

FIG. 14

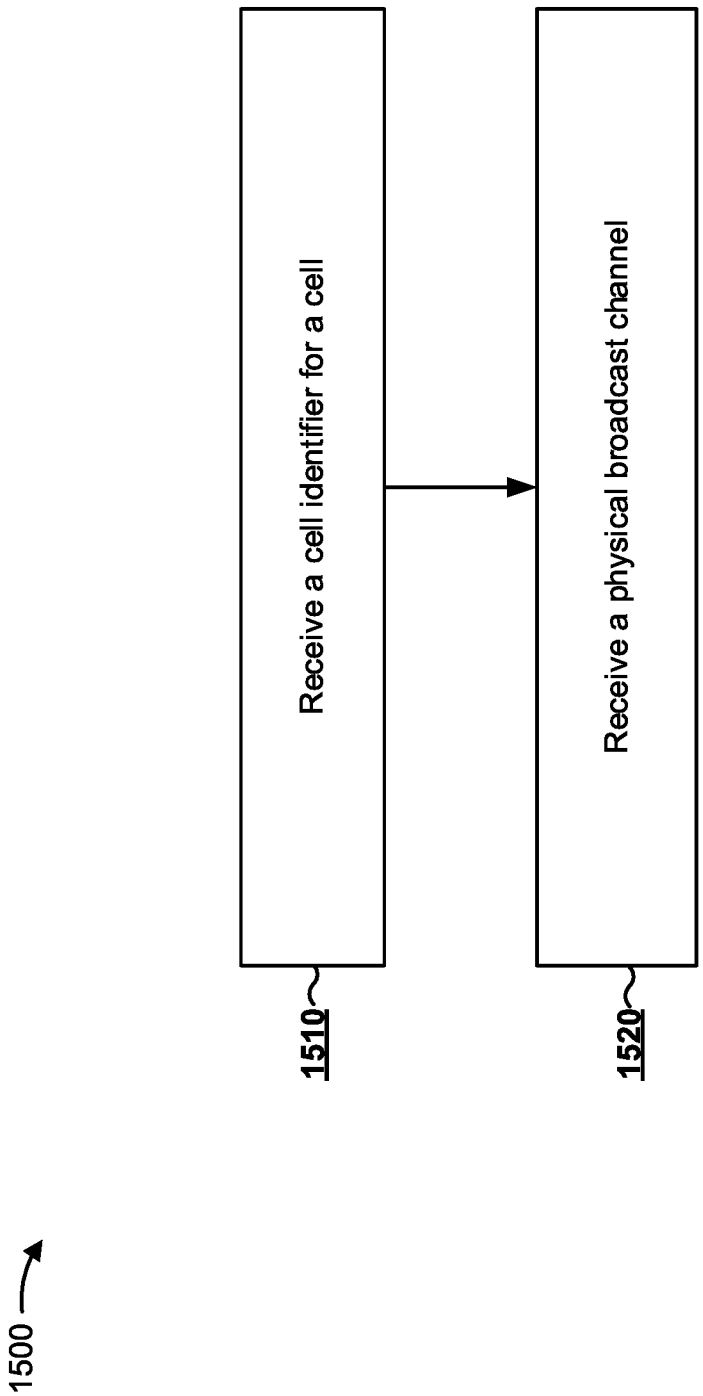

1500
Receive a cell identifier for a cell
1510
Receive a physical broadcast channel
1520

FIG. 15

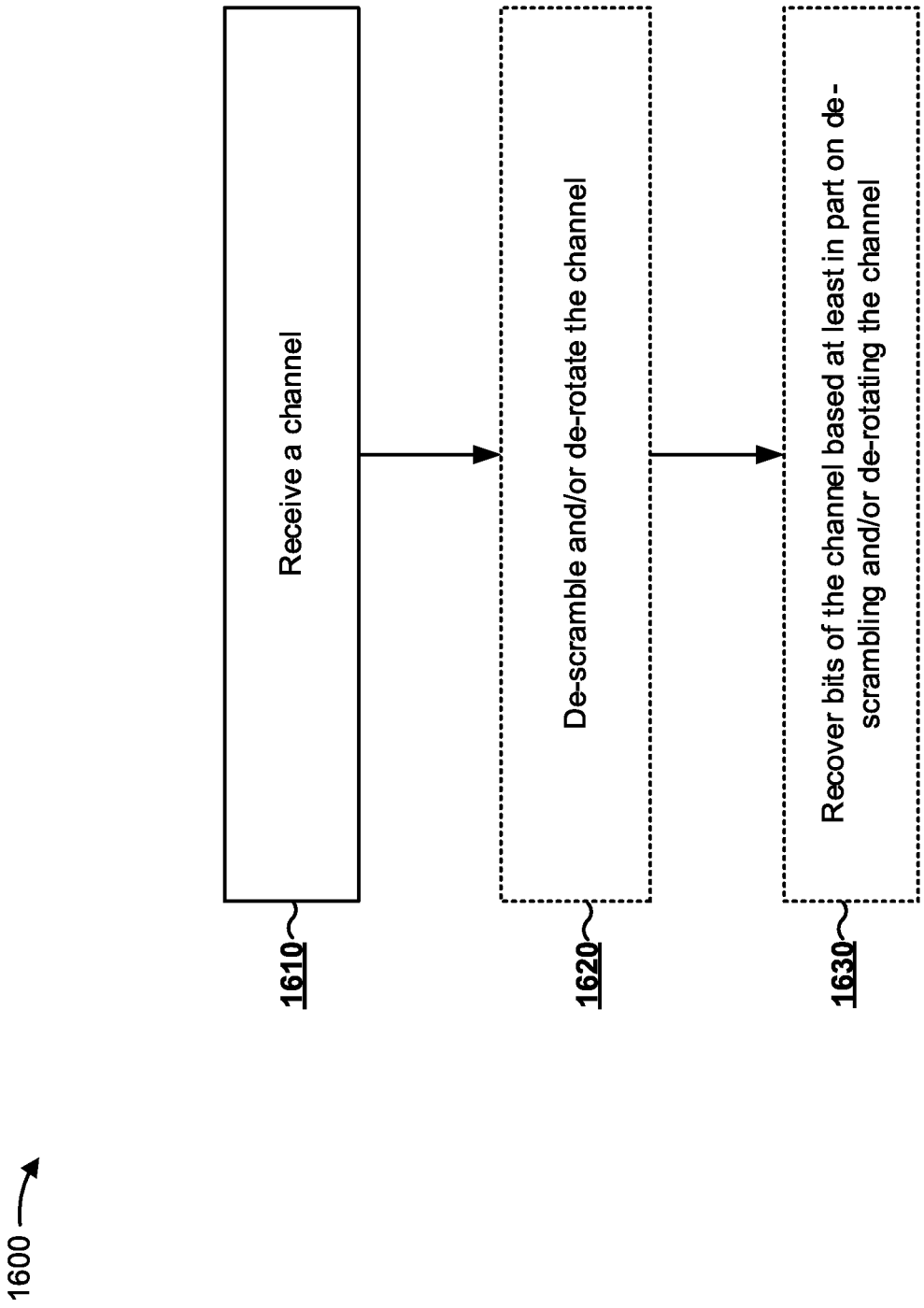

1600
Receive a channel
1610
De-scramble and/or de-rotate the channel
1620
Recover bits of the channel based at least in part on de-scrambling and/or de-rotating the channel
1630

FIG. 16

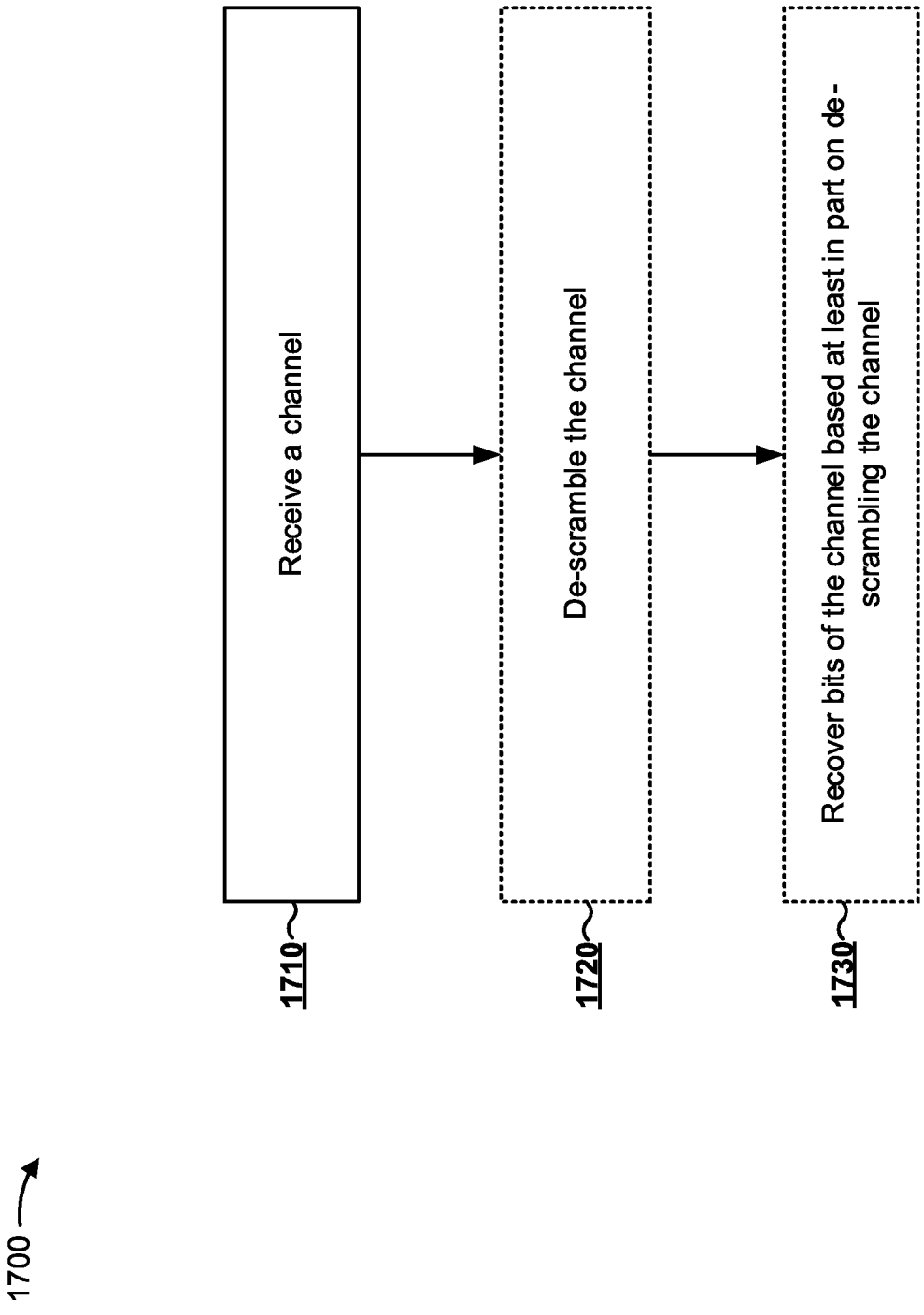

1700
Receive a channel
1710
De-scramble the channel
1720
Recover bits of the channel based at least in part on de-scrambling the channel
1730

FIG. 17

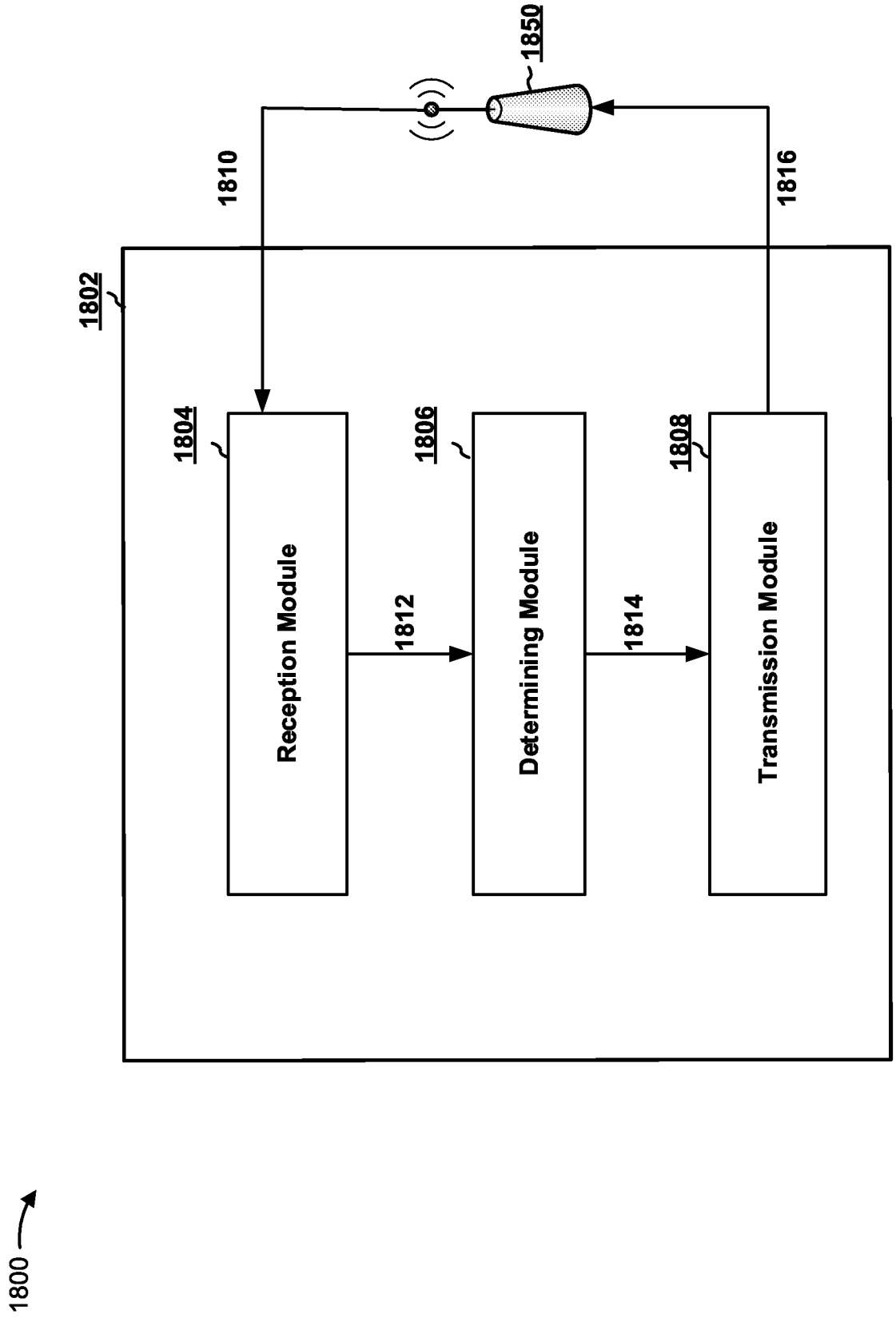

1850
1810
1816
1802
1804
1806
1808
Reception Module
Determining Module
Transmission Module
1812
1814
1800

FIG. 18

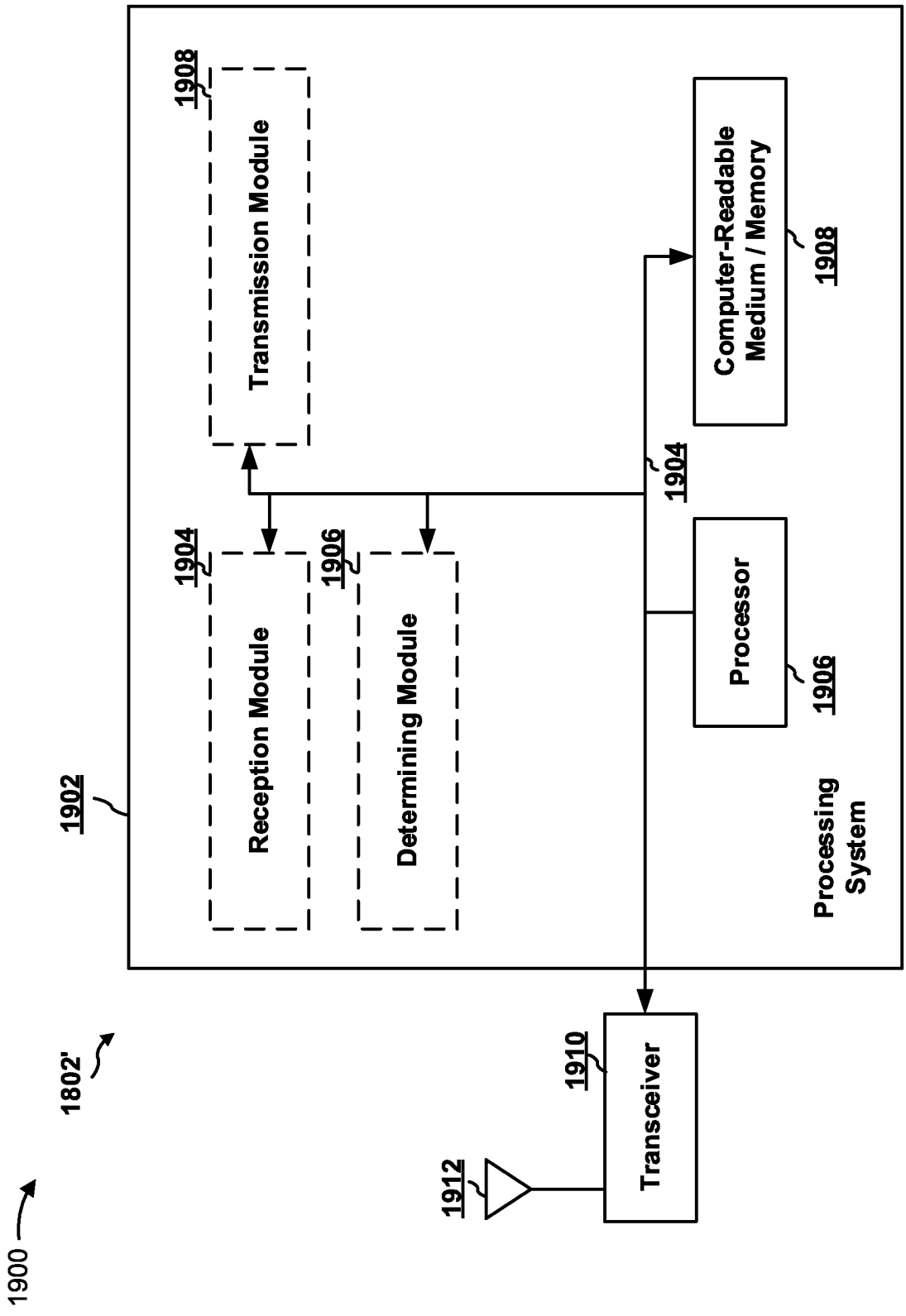

1900
1802'
1902
1908
Transmission Module
1904
Reception Module
1906
Determining Module
1904
Computer-Readable Medium / Memory
1908
Processor
1906
Processing System
1910
Transceiver
1912

FIG. 19