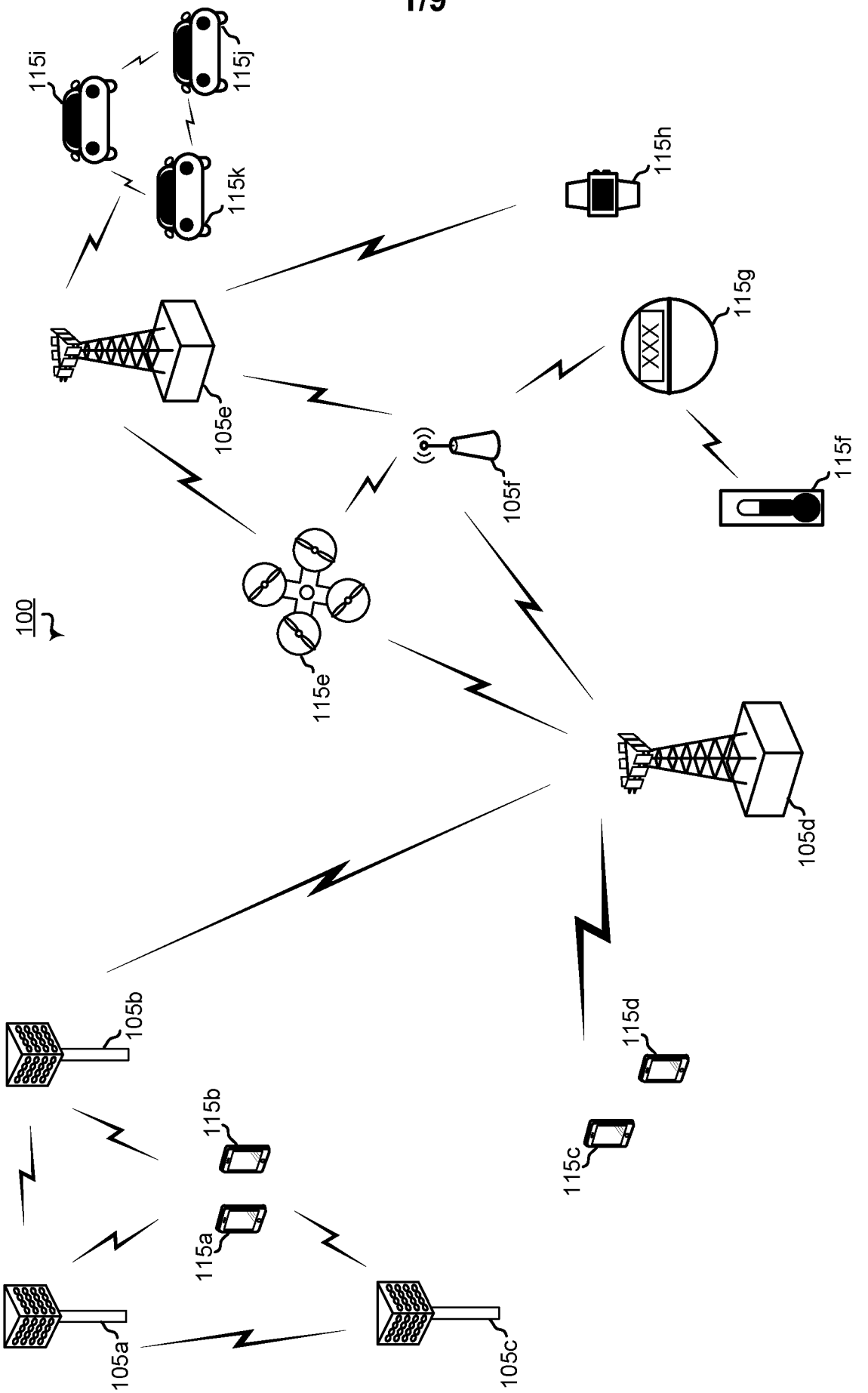
100
105a
105b
105c
105d
105e
105f
115a
115b
115c
115d
115e
115f
115g
115h
115i
115j
115k
XXX

FIG. 1

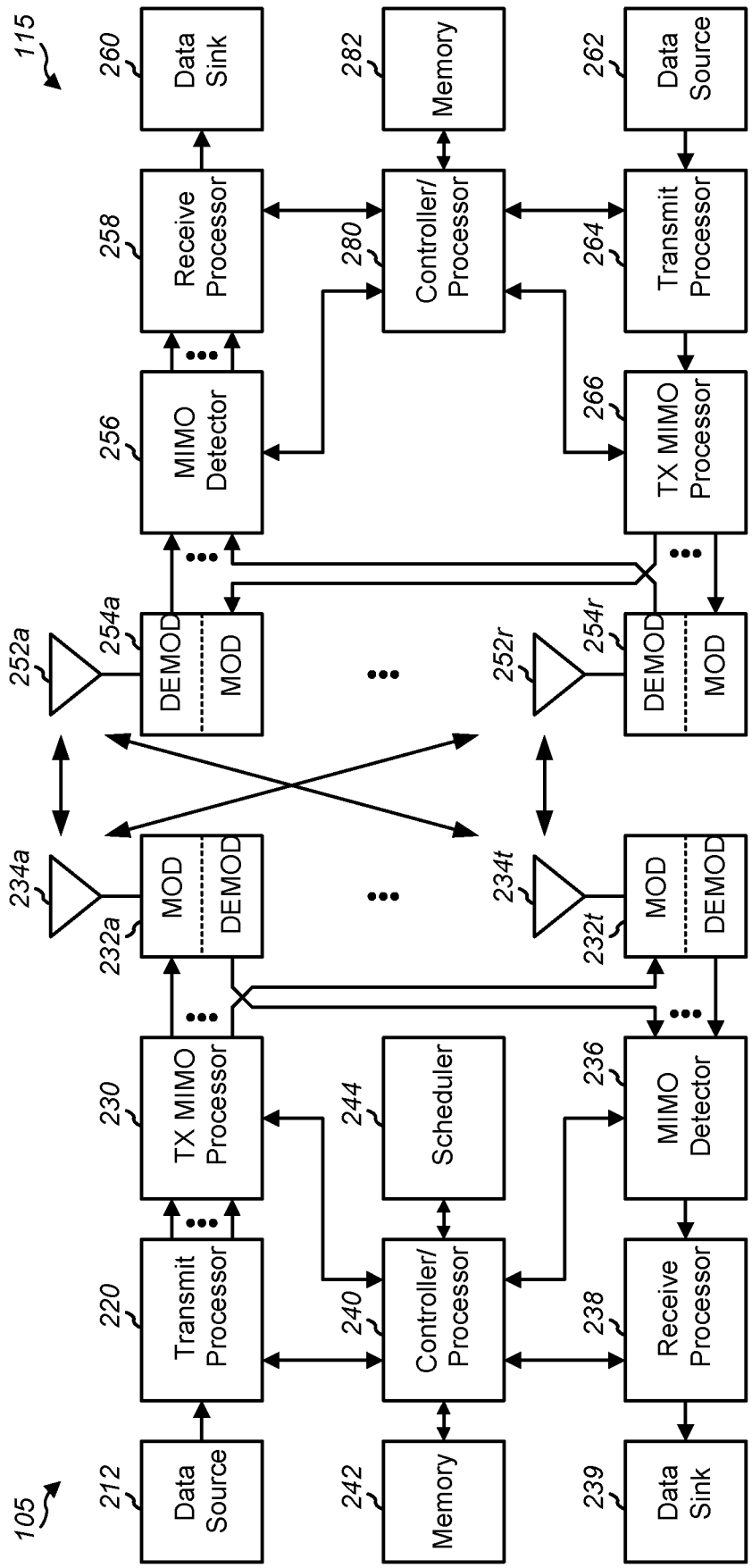
115
260
Data Sink
282
Memory
262
Data Source
258
Receive Processor
280
Controller/ Processor
264
Transmit Processor
256
MIMO Detector
266
TX MIMO Processor
252a
254a
DEMOD
MOD
252r
254r
DEMOD
MOD
234a
232a
MOD
DEMOD
234t
232t
MOD
DEMOD
230
TX MIMO Processor
244
Scheduler
236
MIMO Detector
220
Transmit Processor
240
Controller/ Processor
238
Receive Processor
105
212
Data Source
242
Memory
239
Data Sink

FIG. 2

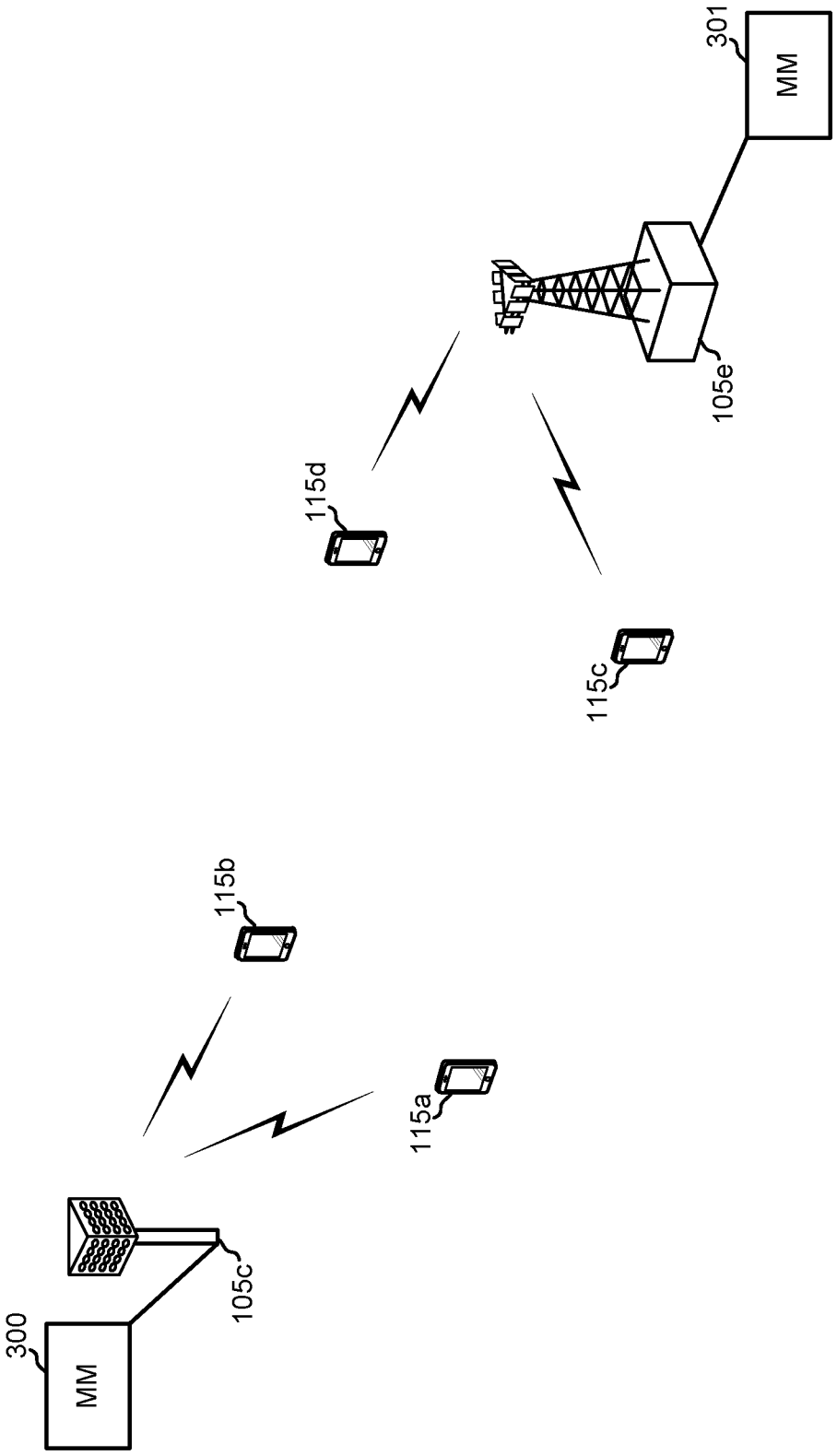

FIG. 3

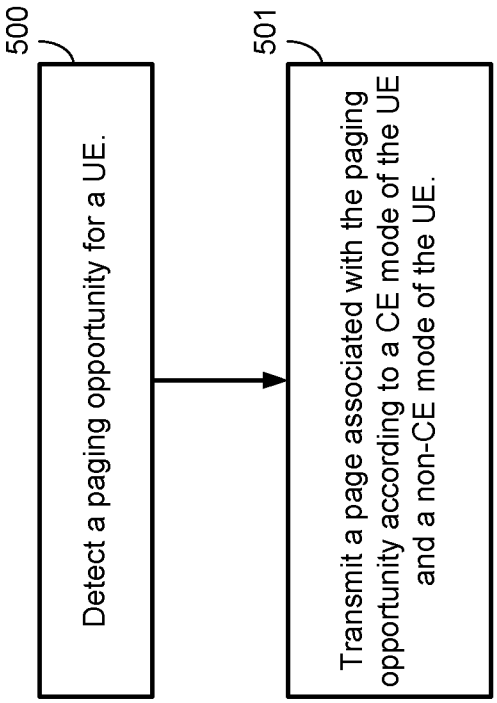
500
Detect a paging opportunity for a UE.
501
Transmit a page associated with the paging opportunity according to a CE mode of the UE and a non-CE mode of the UE.

FIG. 5

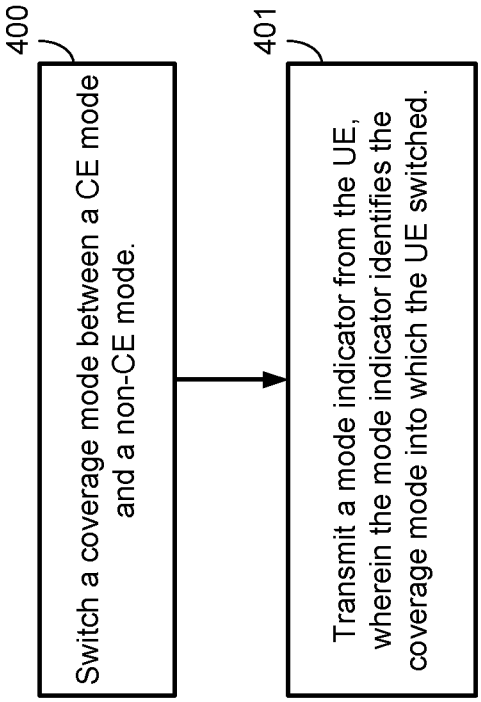
400
Switch a coverage mode between a CE mode and a non-CE mode.
401
Transmit a mode indicator from the UE, wherein the mode indicator identifies the coverage mode into which the UE switched.

FIG. 4

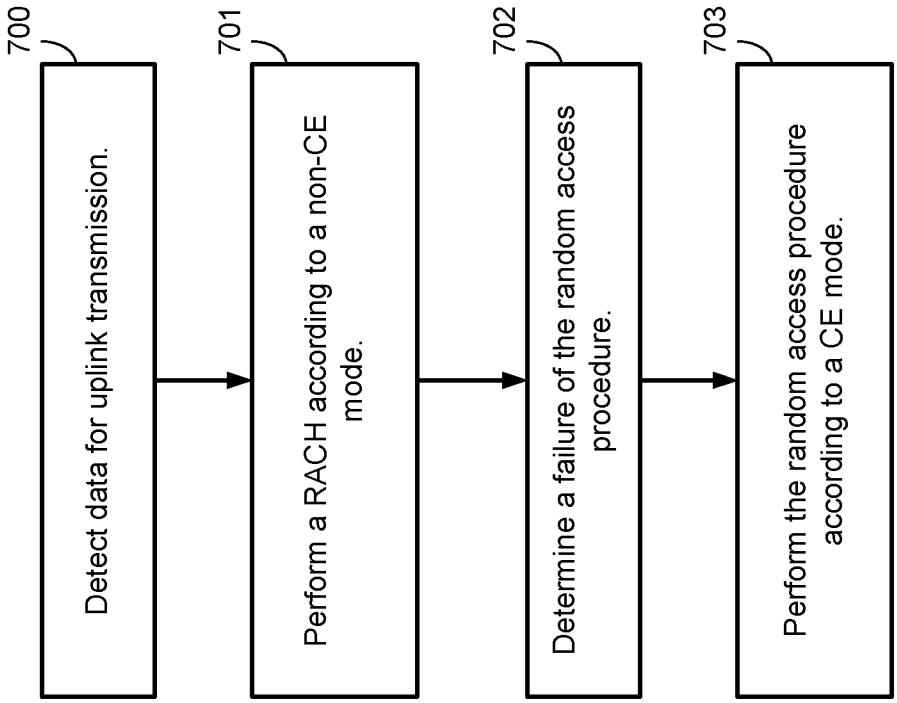
700
Detect data for uplink transmission.
701
Perform a RACH according to a non-CE mode.
702
Determine a failure of the random access procedure.
703
Perform the random access procedure according to a CE mode.

FIG. 7

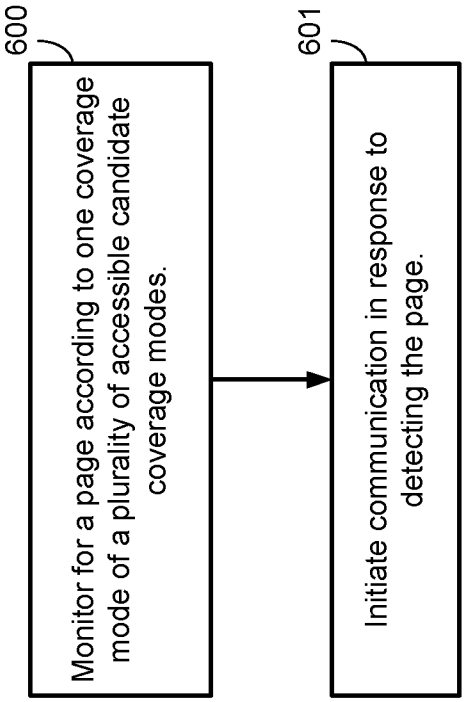
600
Monitor for a page according to one coverage mode of a plurality of accessible candidate coverage modes.
601
Initiate communication in response to detecting the page.

FIG. 6

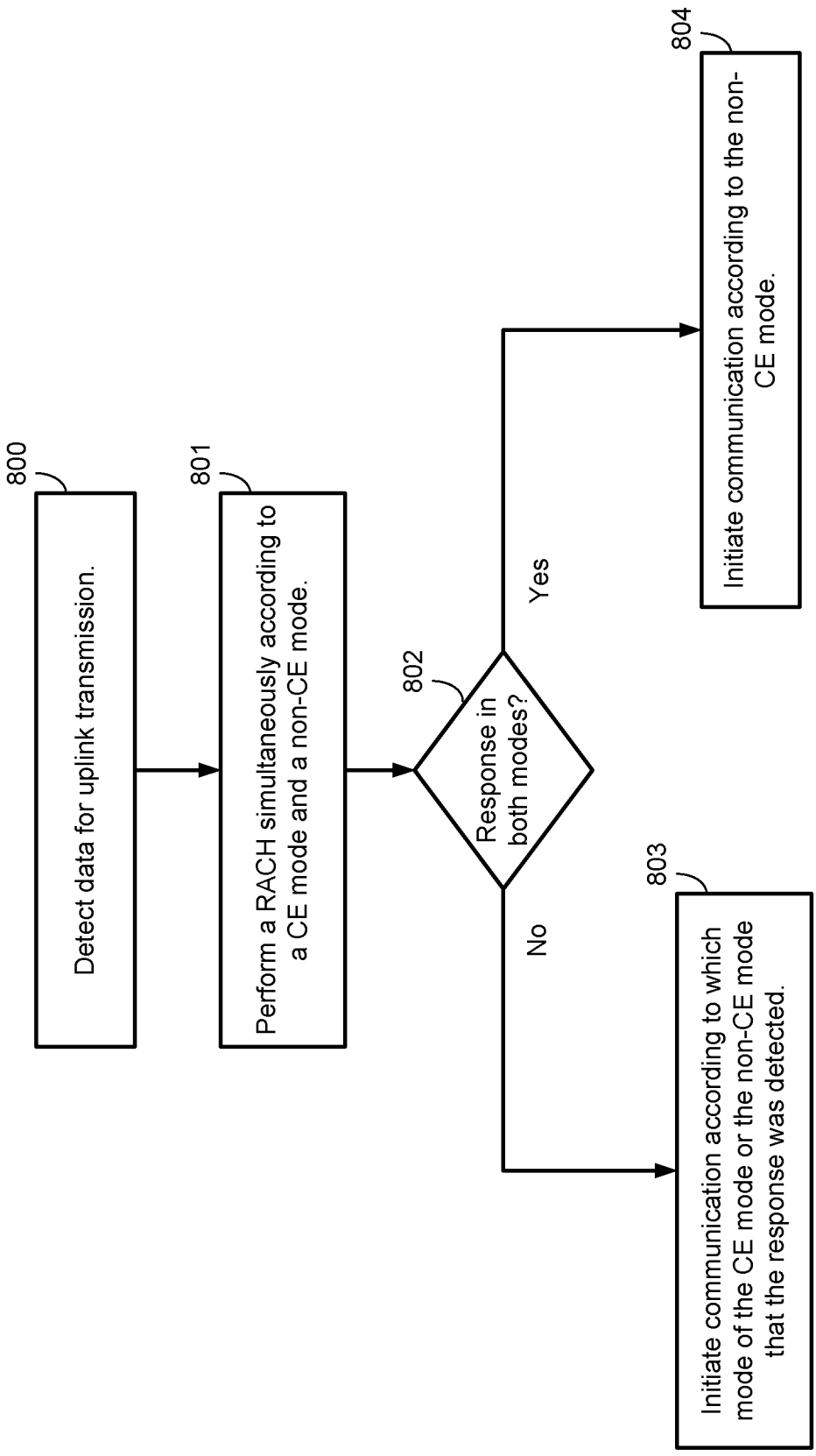
800
Detect data for uplink transmission.
801
Perform a RACH simultaneously according to a CE mode and a non-CE mode.
802
Response in both modes?
Yes
No
804
Initiate communication according to the non-CE mode.
803
Initiate communication according to which mode of the CE mode or the non-CE mode that the response was detected.

FIG. 8

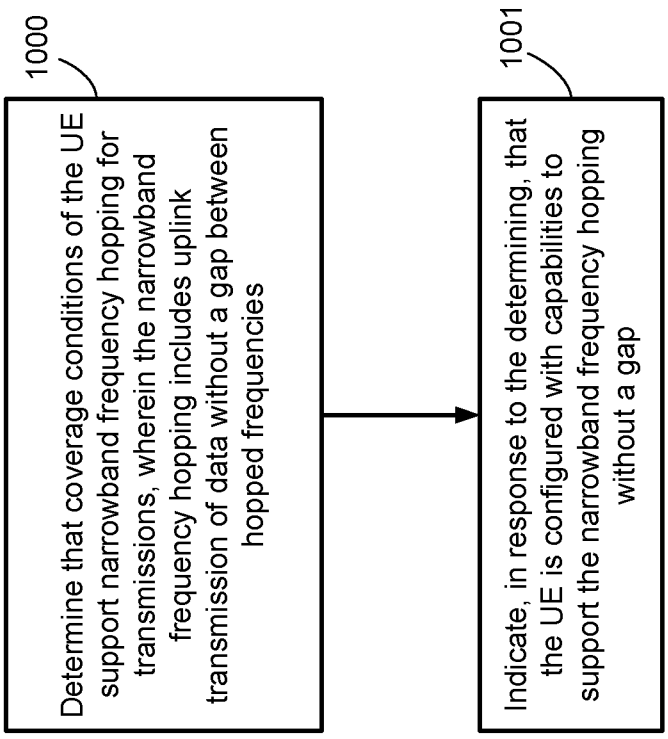
1000
Determine that coverage conditions of the UE support narrowband frequency hopping for transmissions, wherein the narrowband frequency hopping includes uplink transmission of data without a gap between hopped frequencies
1001
Indicate, in response to the determining, that the UE is configured with capabilities to support the narrowband frequency hopping without a gap

FIG. 10

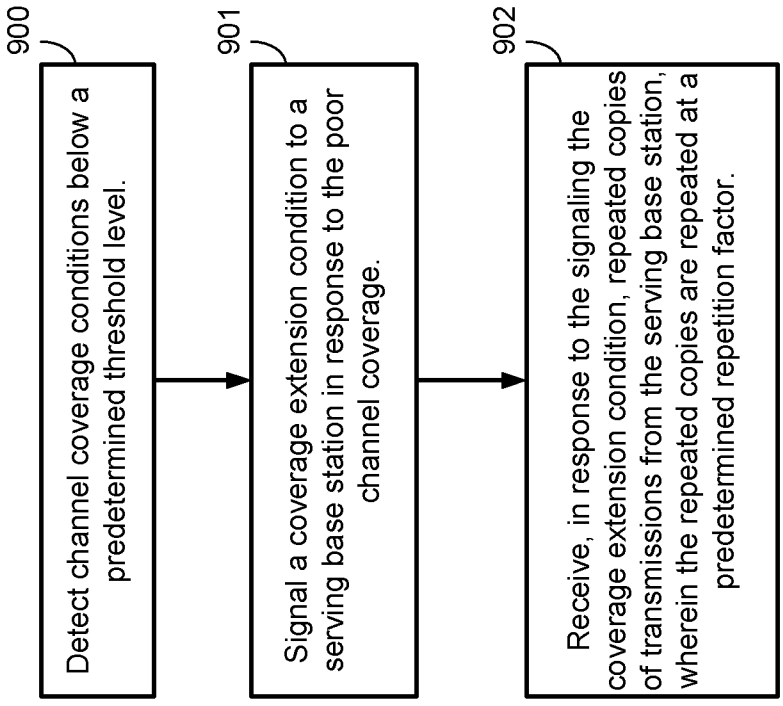
900
Detect channel coverage conditions below a predetermined threshold level.
901
Signal a coverage extension condition to a serving base station in response to the poor channel coverage.
902
Receive, in response to the signaling the coverage extension condition, repeated copies of transmissions from the serving base station, wherein the repeated copies are repeated at a predetermined repetition factor.

FIG. 9

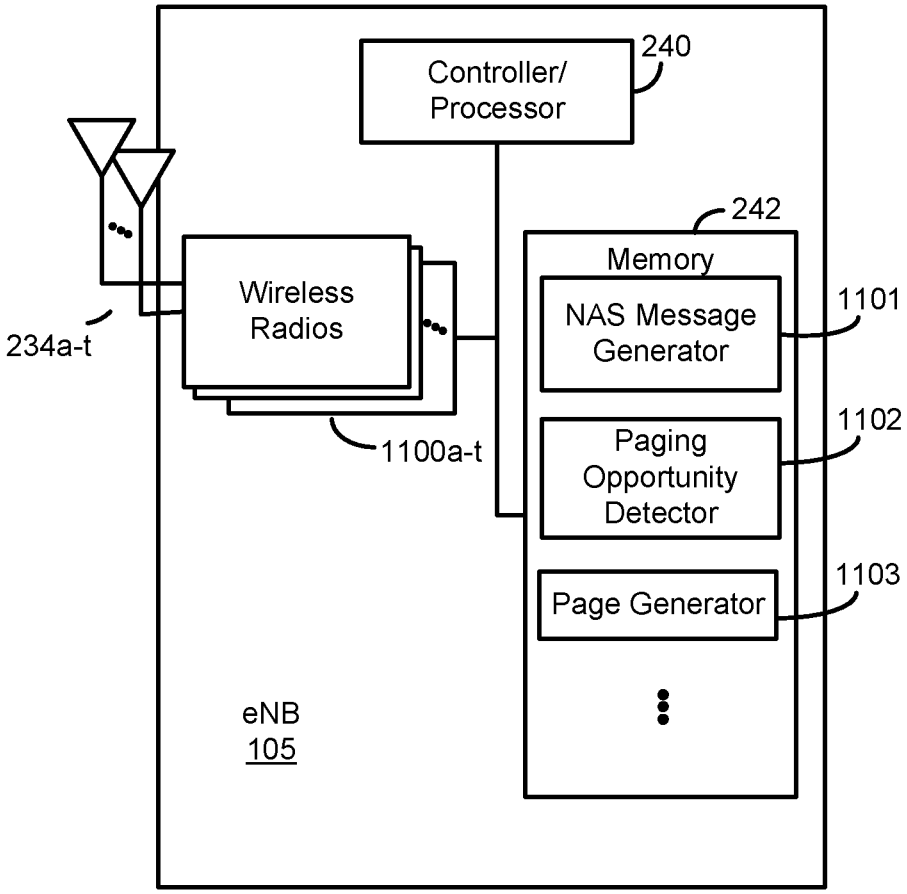
Controller/
Processor
240
242
Memory
NAS Message
Generator
1101
Paging
Opportunity
Detector
1102
Page Generator
1103
Wireless
Radios
234a-t
1100a-t
eNB
105

FIG. 11

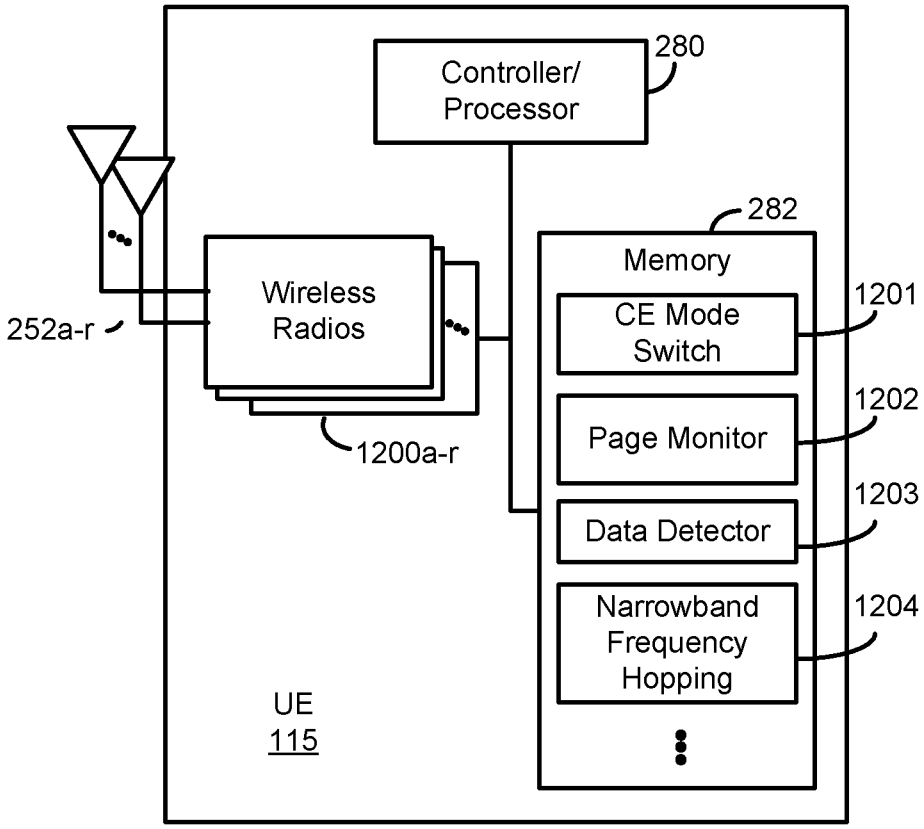
Controller/
Processor
280
282
Memory
Wireless
Radios
252a-r
1200a-r
CE Mode
Switch
1201
Page Monitor
1202
Data Detector
1203
Narrowband
Frequency
Hopping
1204
UE
115

FIG. 12