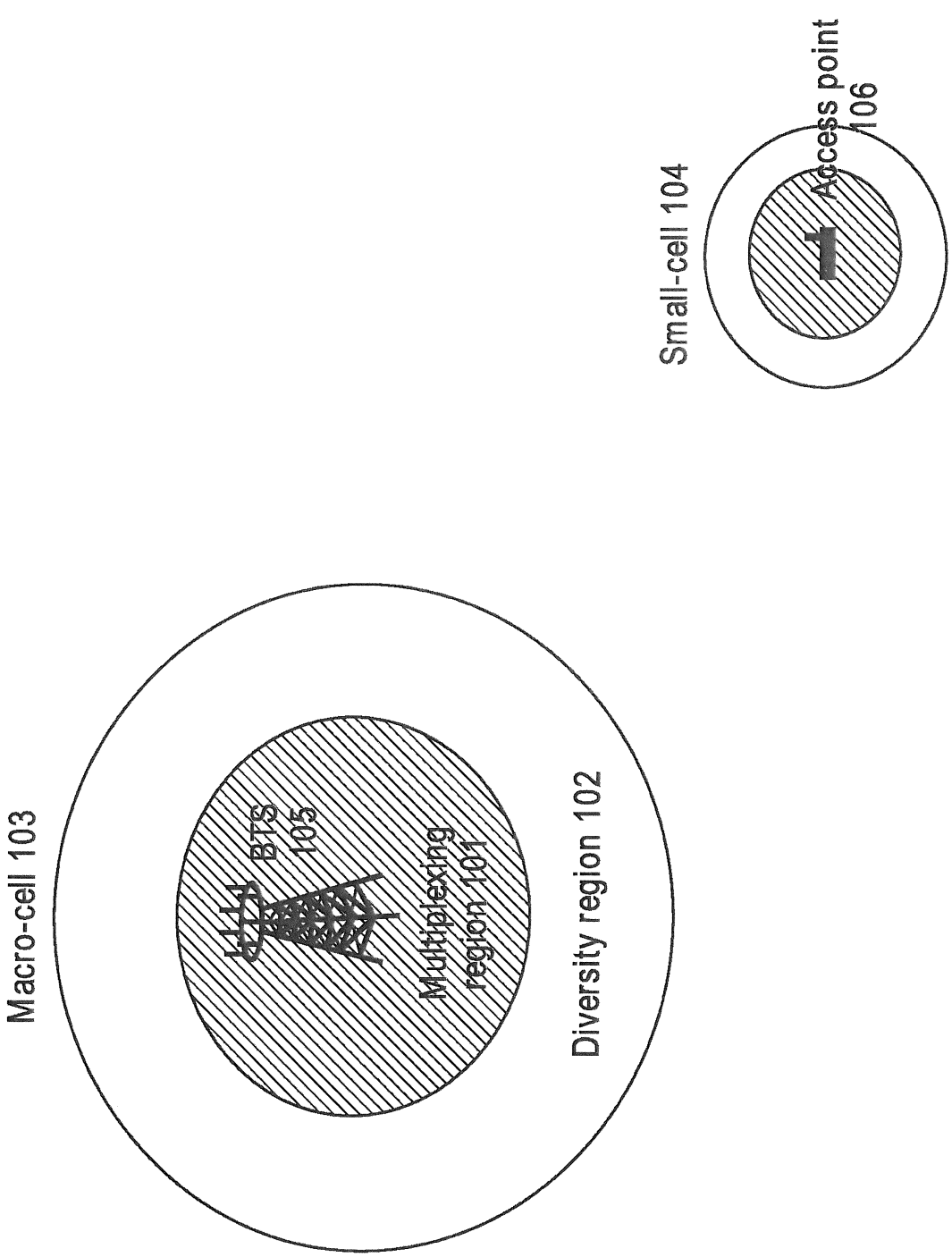
Macro-cell 103
BTS 105
Multiplexing region 101
Diversity region 102
Small-cell 104
Access point 106

FIG. 1

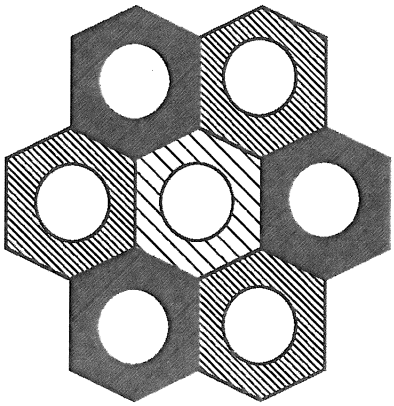

FIG. 2C

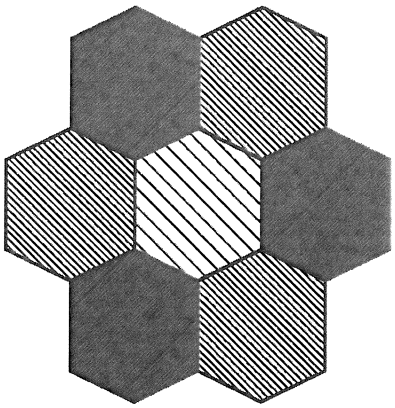

FIG. 2B

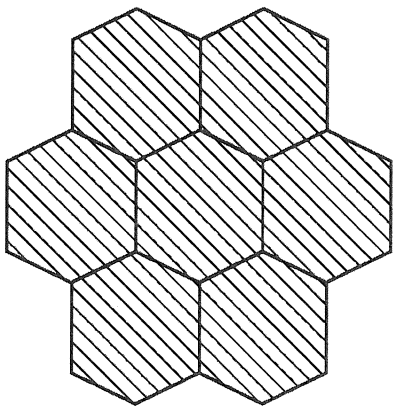

FIG. 2A

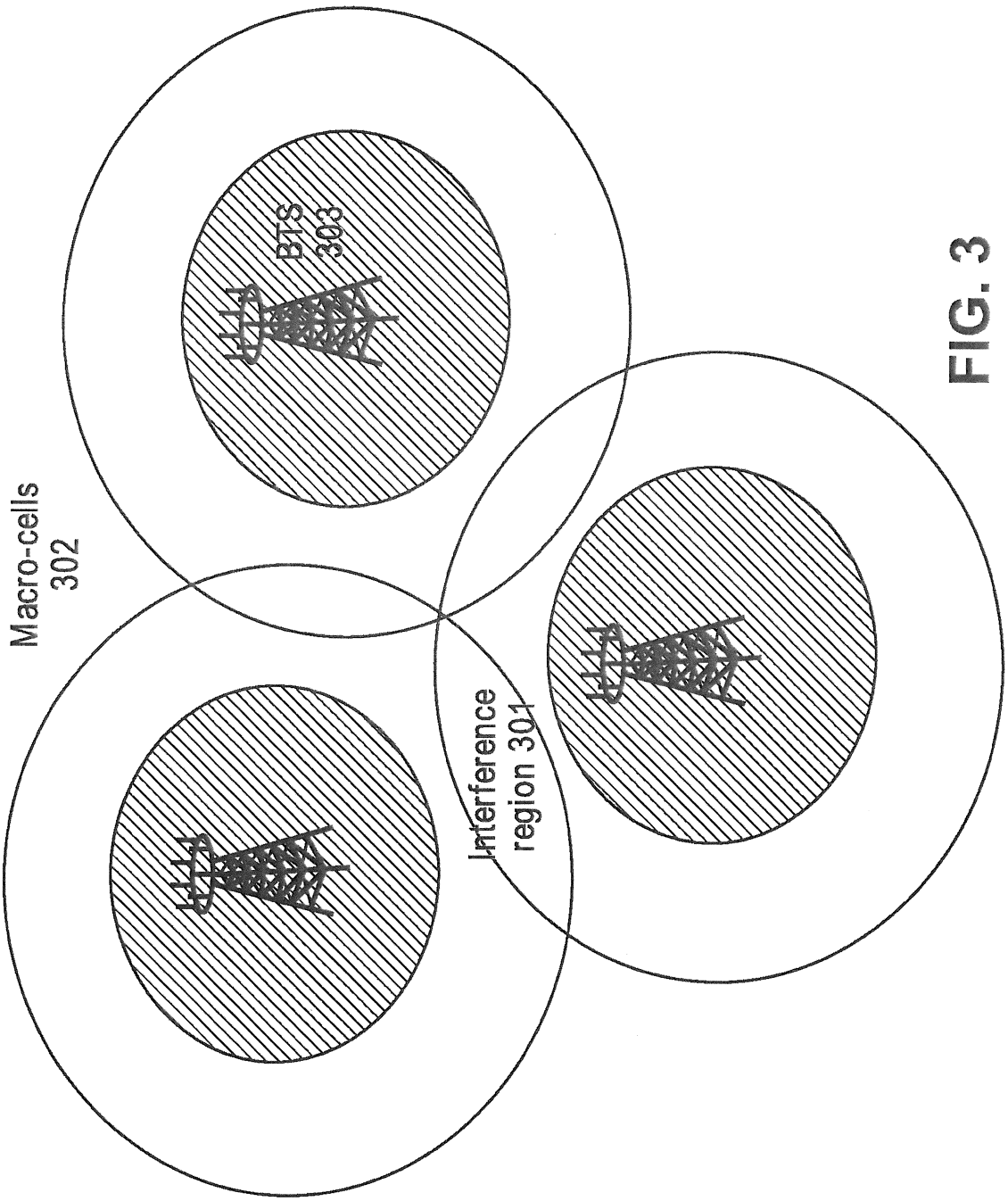

FIG. 3

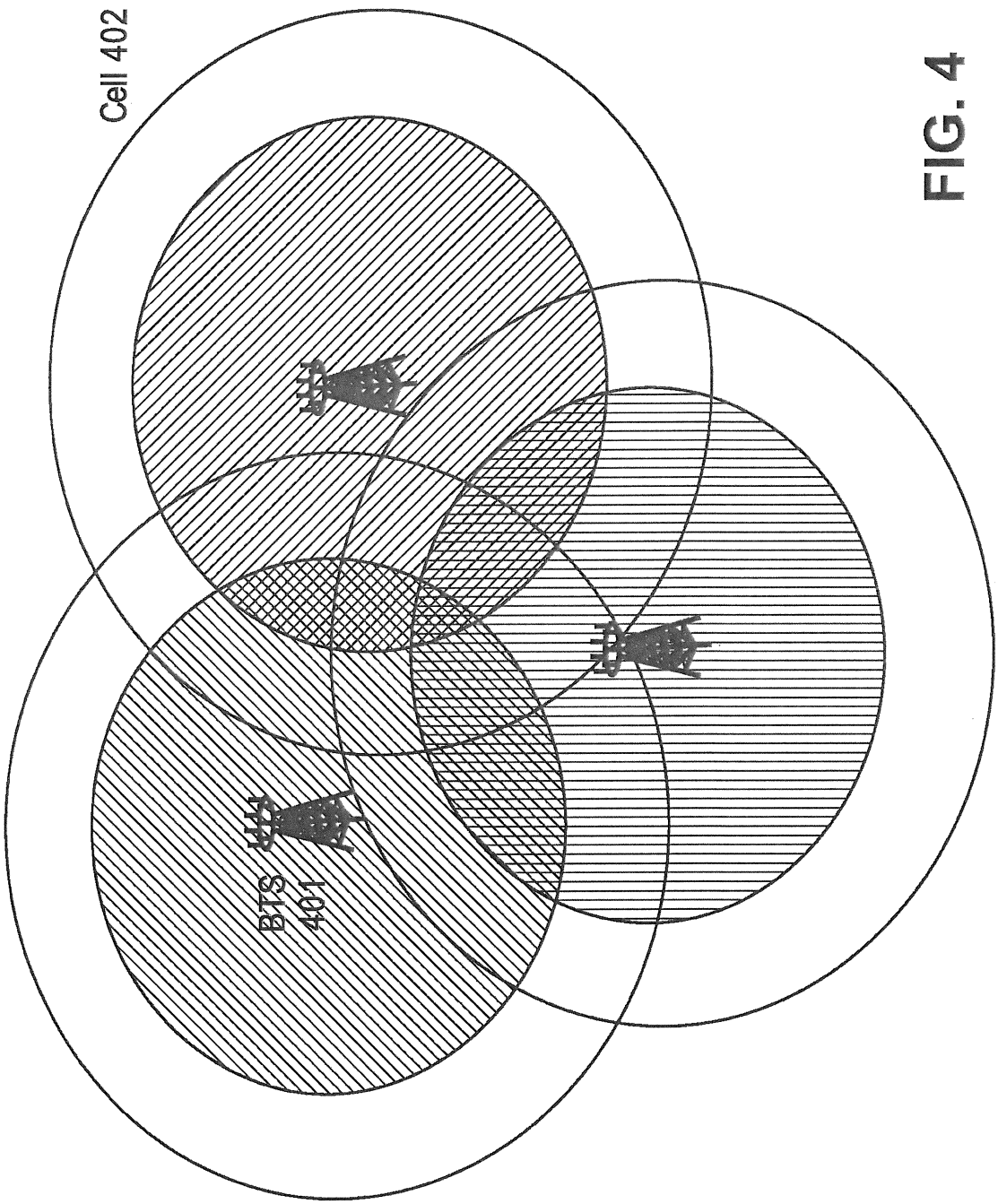

FIG. 4

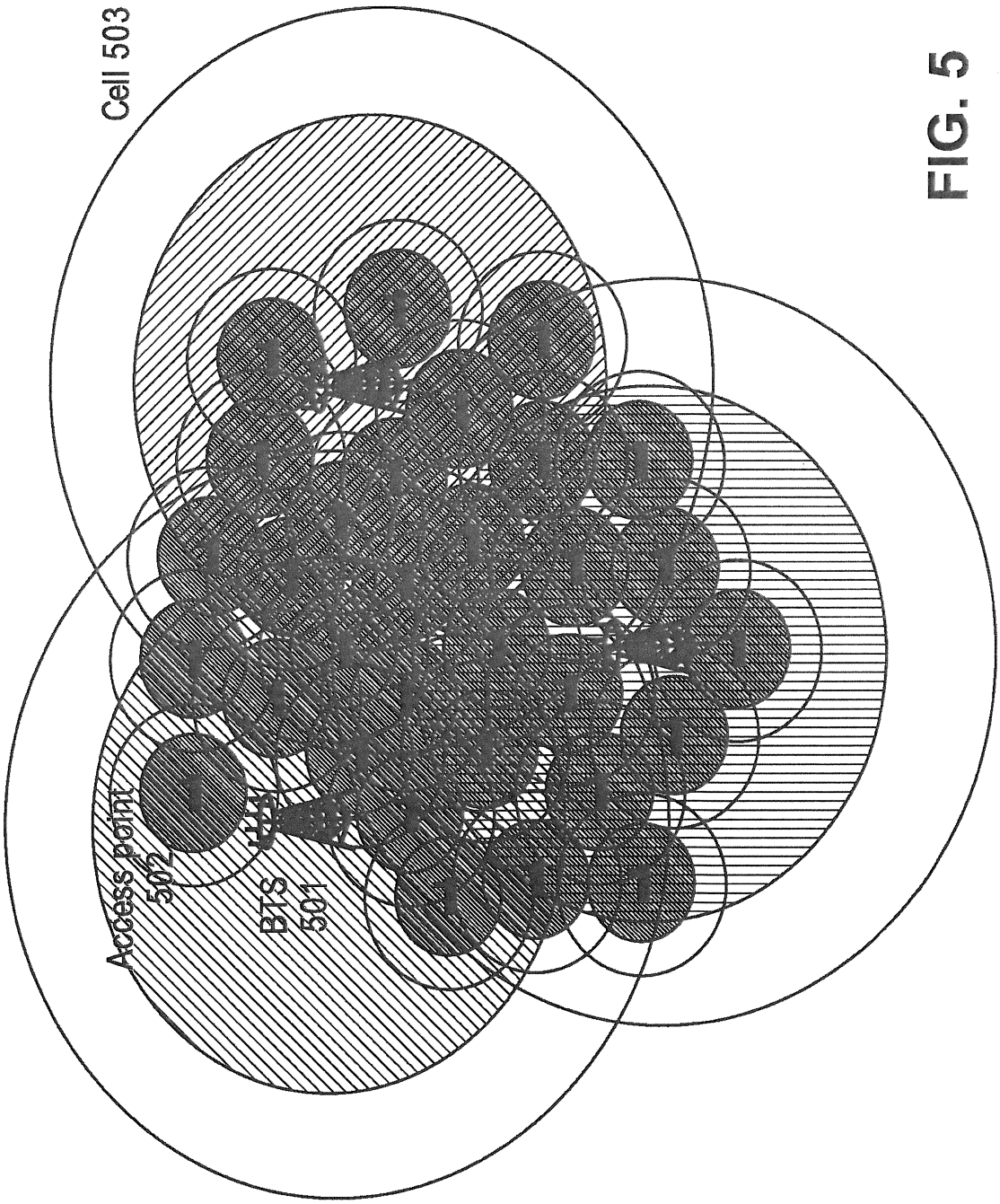

FIG. 5

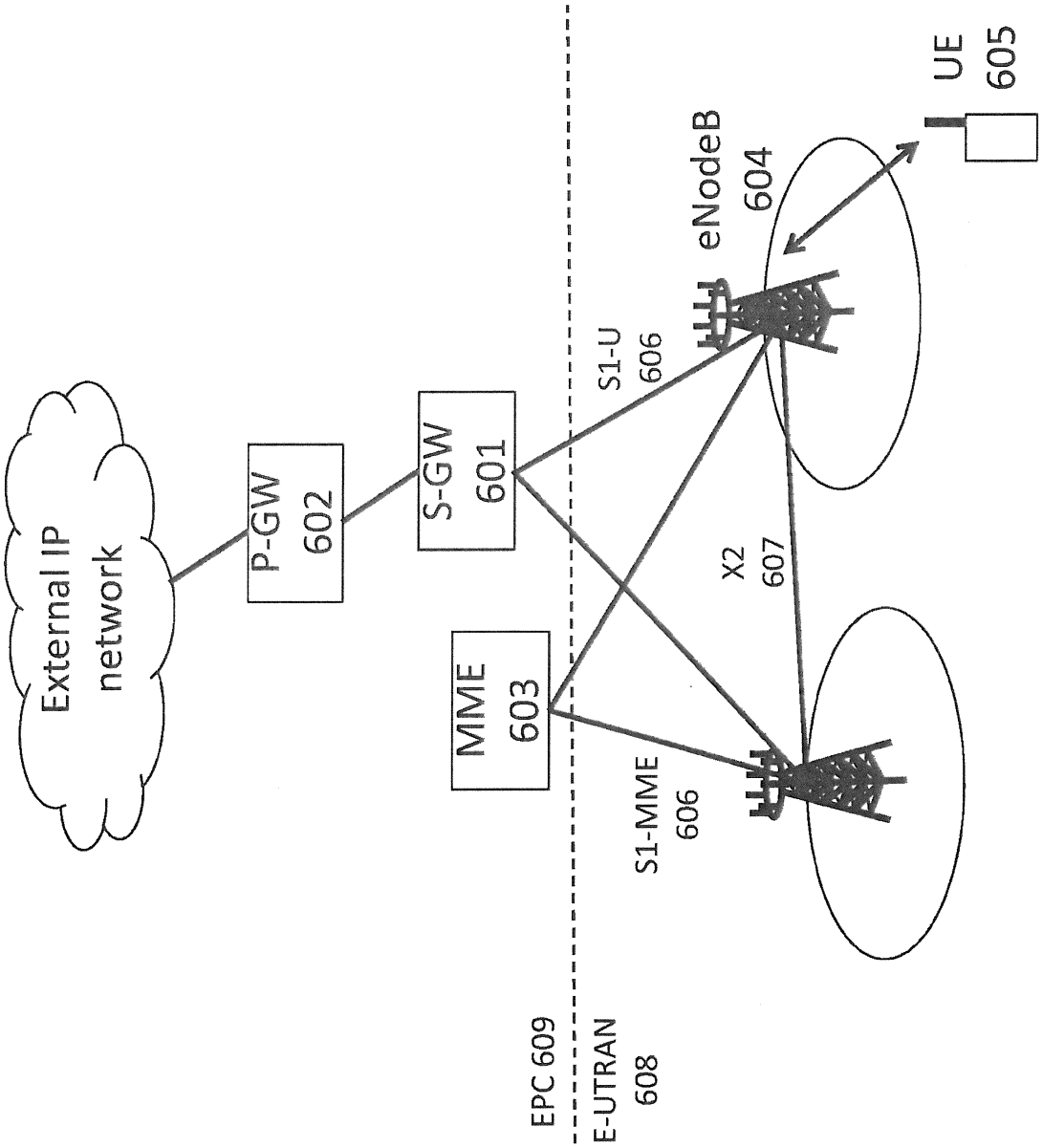
External IP network
P-GW 602
S-GW 601
MME 603
S1-U 606
S1-MME 606
X2 607
eNodeB 604
UE 605
EPC 609
E-UTRAN 608

Fig. 6

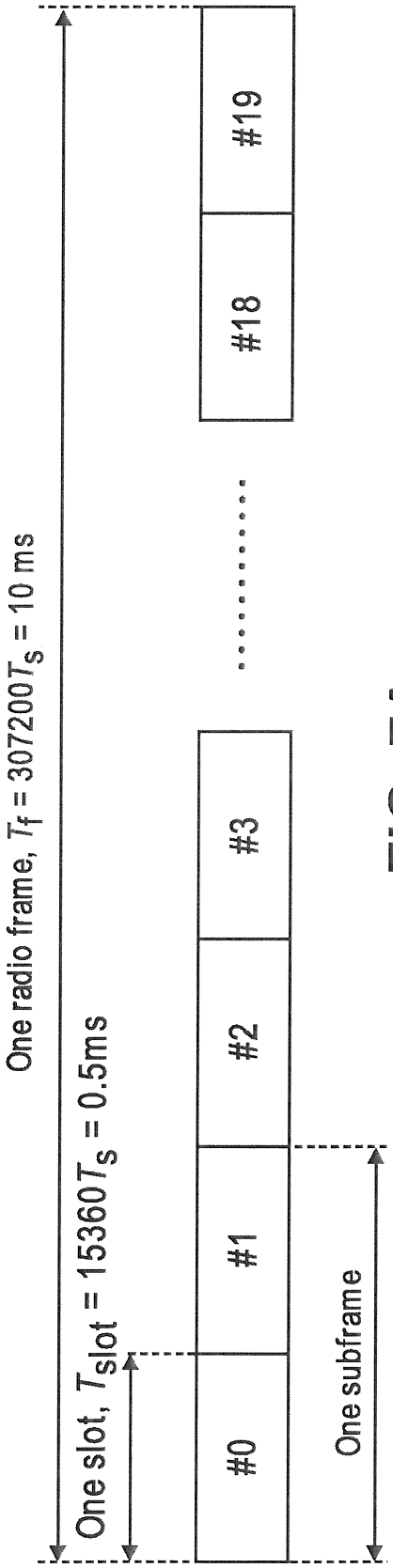
One radio frame, $T_f = 307200T_s = 10$ ms
One slot, $T_{slot} = 15360T_s = 0.5$ms
#0
#1
#2
#3
#18
#19
One subframe

FIG. 7A

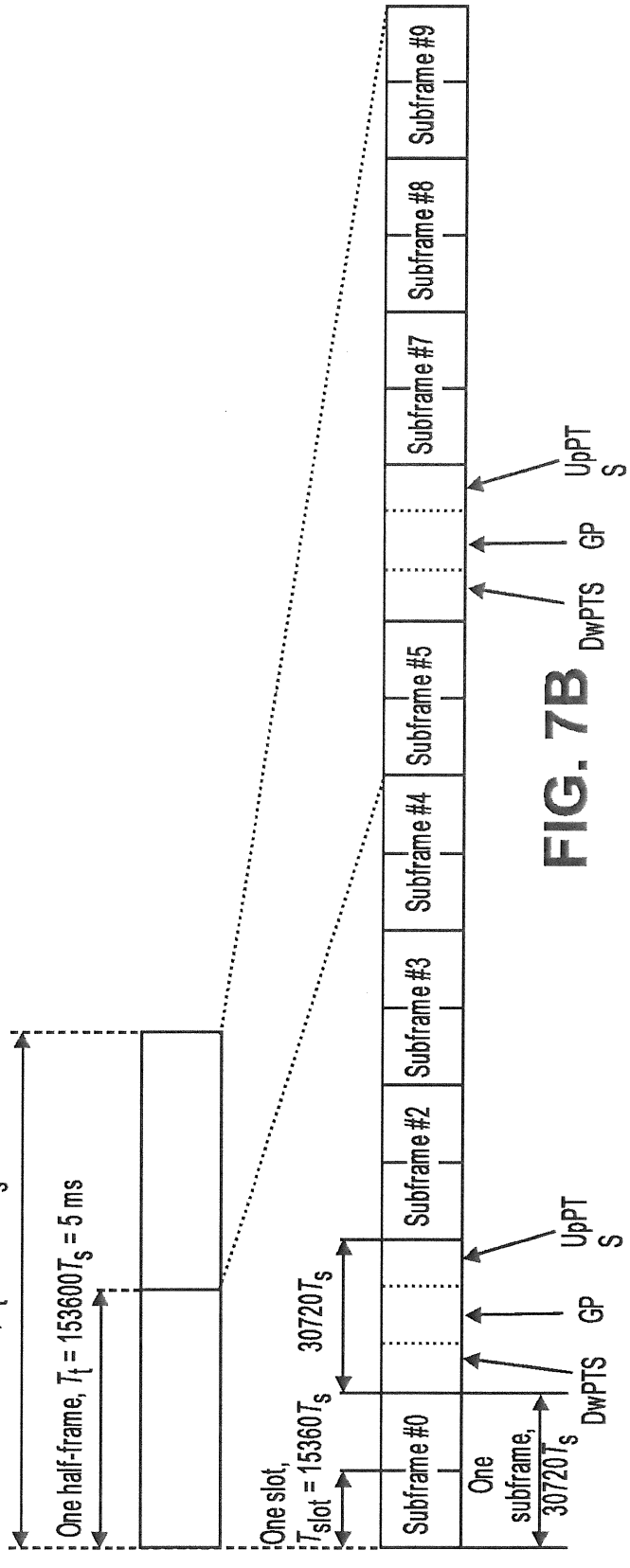
One radio frame, $T_f = 307200T_s = 10$ ms
One half-frame, $T_f = 153600T_s = 5$ ms
One slot, $T_{slot} = 15360T_s$
$30720T_s$
One subframe, $30720T_s$
Subframe #0
Subframe #2
Subframe #3
Subframe #4
Subframe #5
Subframe #7
Subframe #8
Subframe #9
DwPTS
GP
UpPTS

FIG. 7B

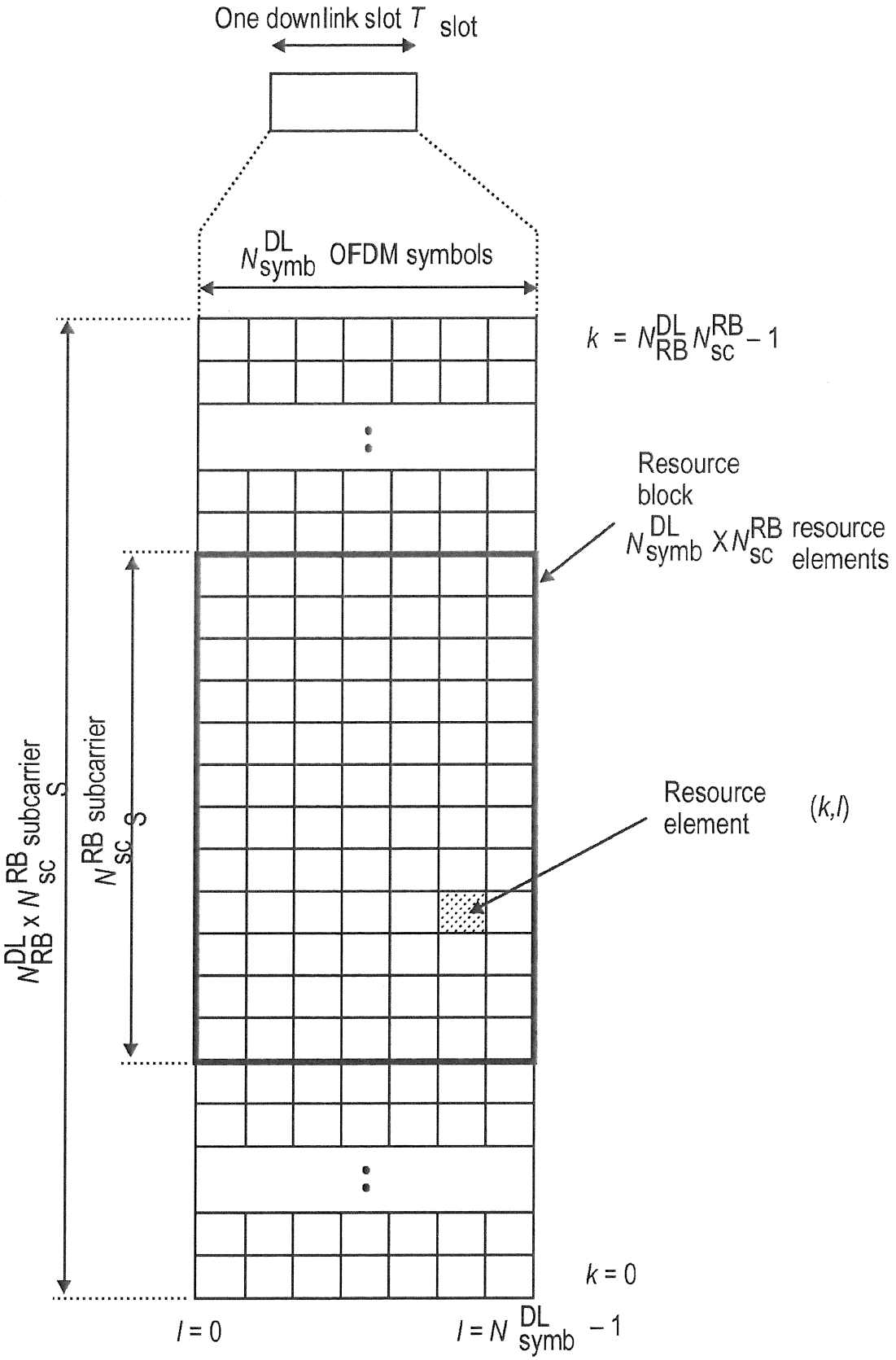
One downlink slot T_{slot}
N^{DL}_{symb} OFDM symbols
$k = N^{DL}_{RB} N^{RB}_{sc} - 1$
Resource block
$N^{DL}_{symb} \times N^{RB}_{sc}$ resource elements
Resource element (k,l)
$N^{DL}_{RB} \times N^{RB}_{sc}$ subcarriers
N^{RB}_{sc} subcarriers
$k = 0$
$l = 0$
$l = N^{DL}_{symb} - 1$

FIG. 8A

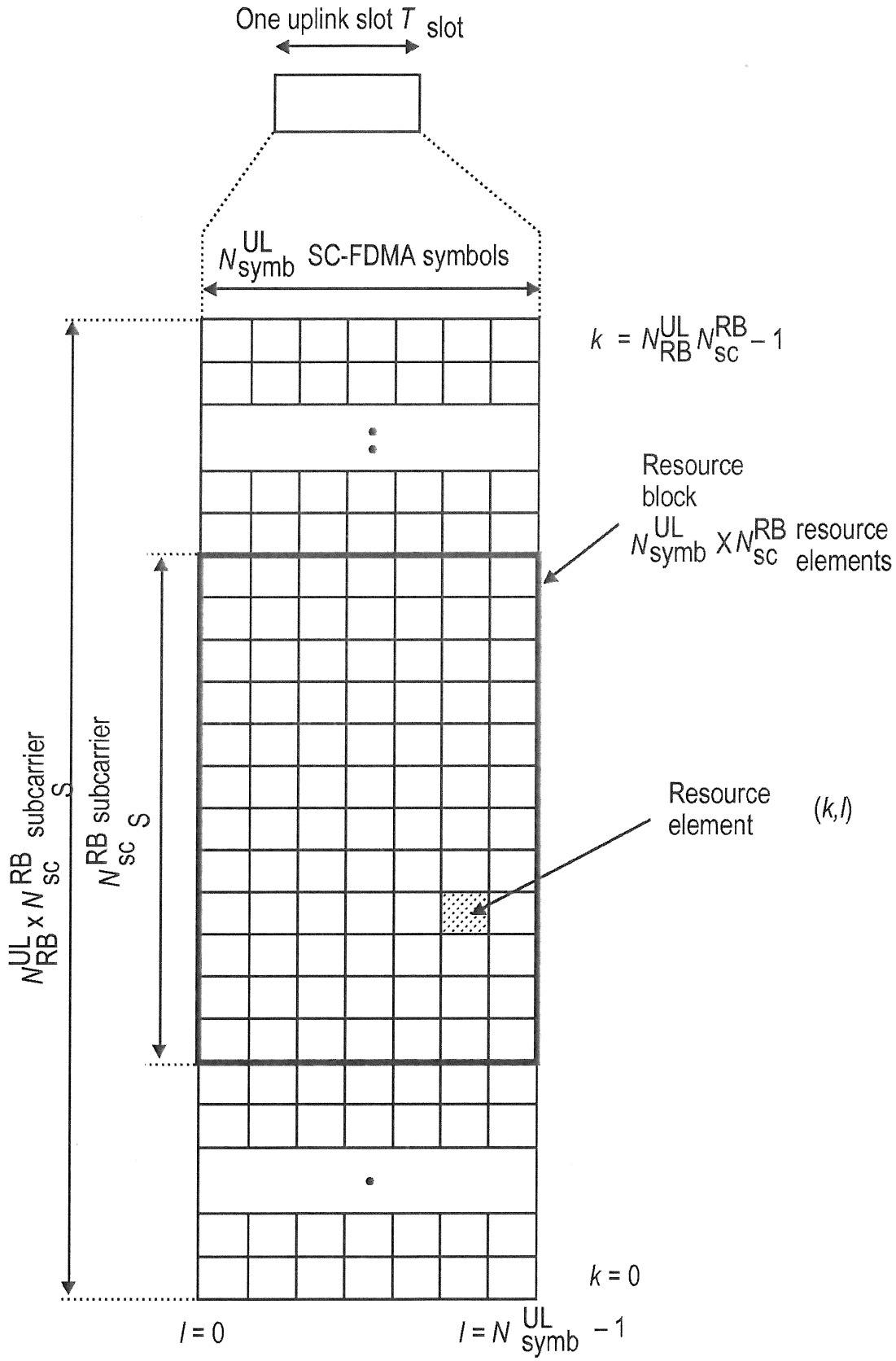
One uplink slot T_{slot}
N^{UL}_{symb} SC-FDMA symbols
$k = N^{UL}_{RB} N^{RB}_{sc} - 1$
Resource block
$N^{UL}_{symb} \times N^{RB}_{sc}$ resource elements
Resource element (k,l)
$N^{UL}_{RB} \times N^{RB}_{sc}$ subcarriers
N^{RB}_{sc} subcarriers
$k = 0$
$l = 0$
$l = N^{UL}_{symb} - 1$

FIG. 8B

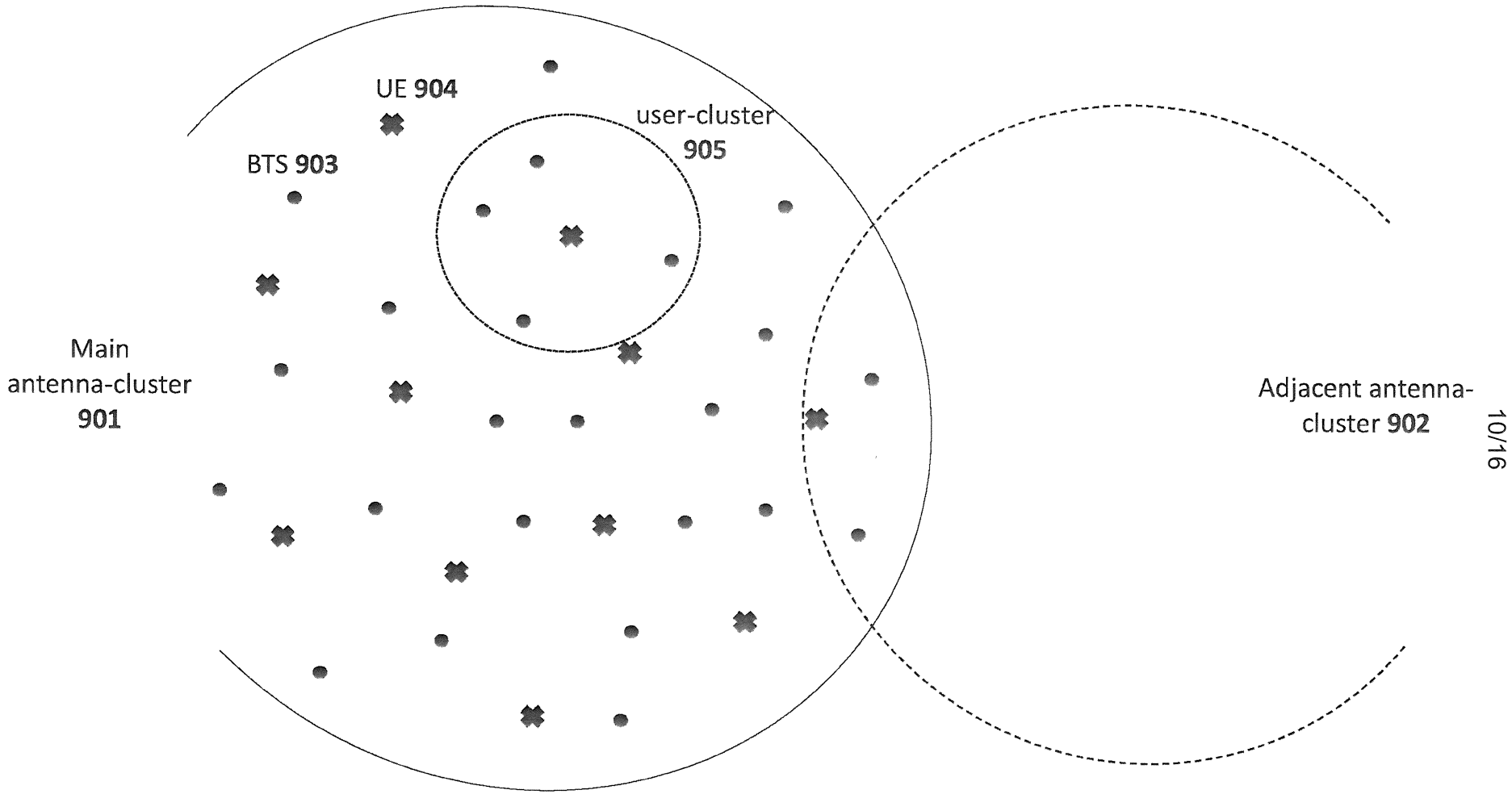
UE 904
user-cluster
905
BTS 903
Main
antenna-cluster
901
Adjacent antenna-
cluster 902

Fig. 9

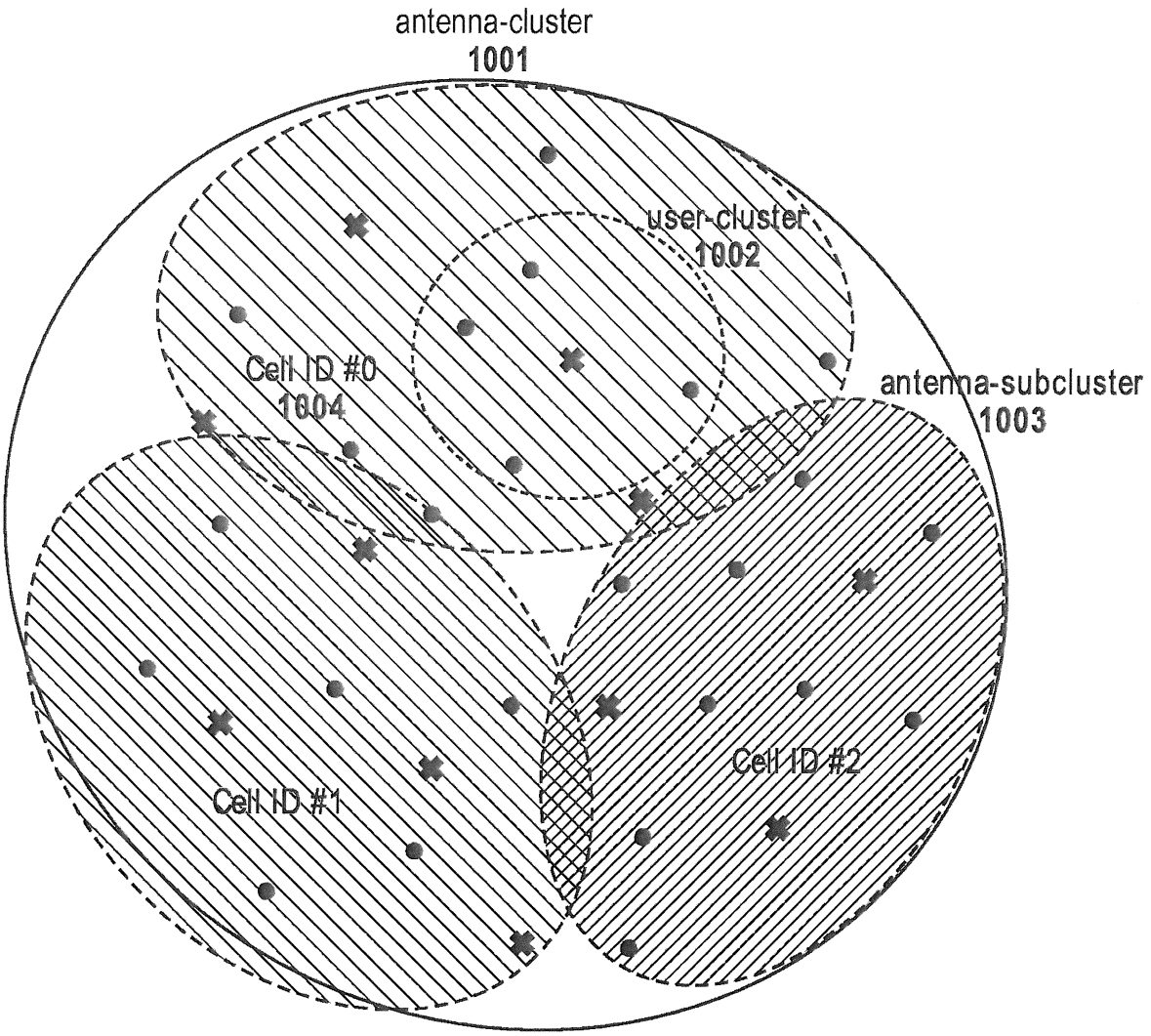
antenna-cluster
1001
user-cluster
1002
Cell ID #0
1004
antenna-subcluster
1003
Cell ID #1
Cell ID #2

FIG. 10

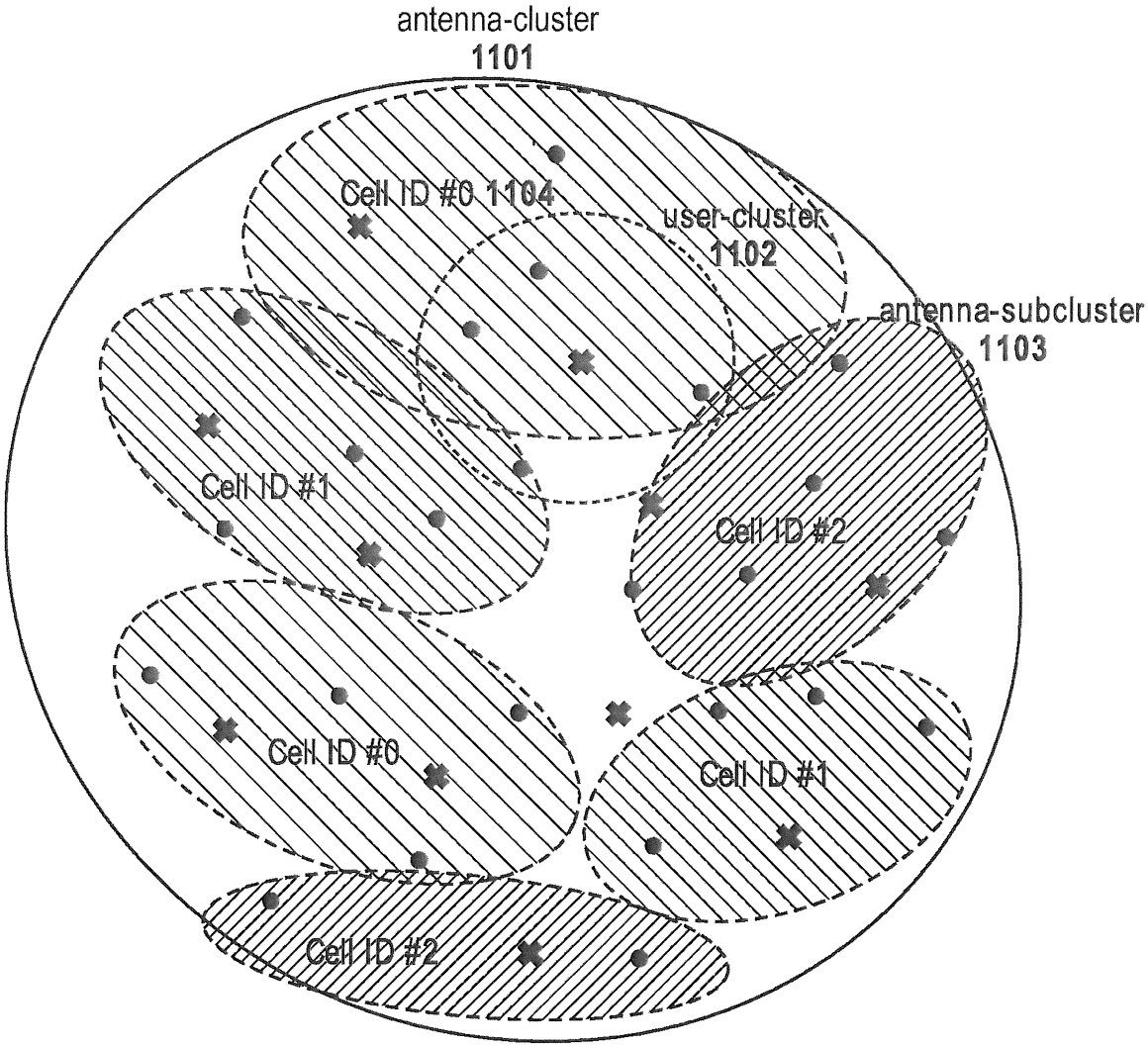
antenna-cluster
1101
Cell ID #0 1104
user-cluster
1102
antenna-subcluster
1103
Cell ID #1
Cell ID #2
Cell ID #0
Cell ID #1
Cell ID #2

FIG. 11

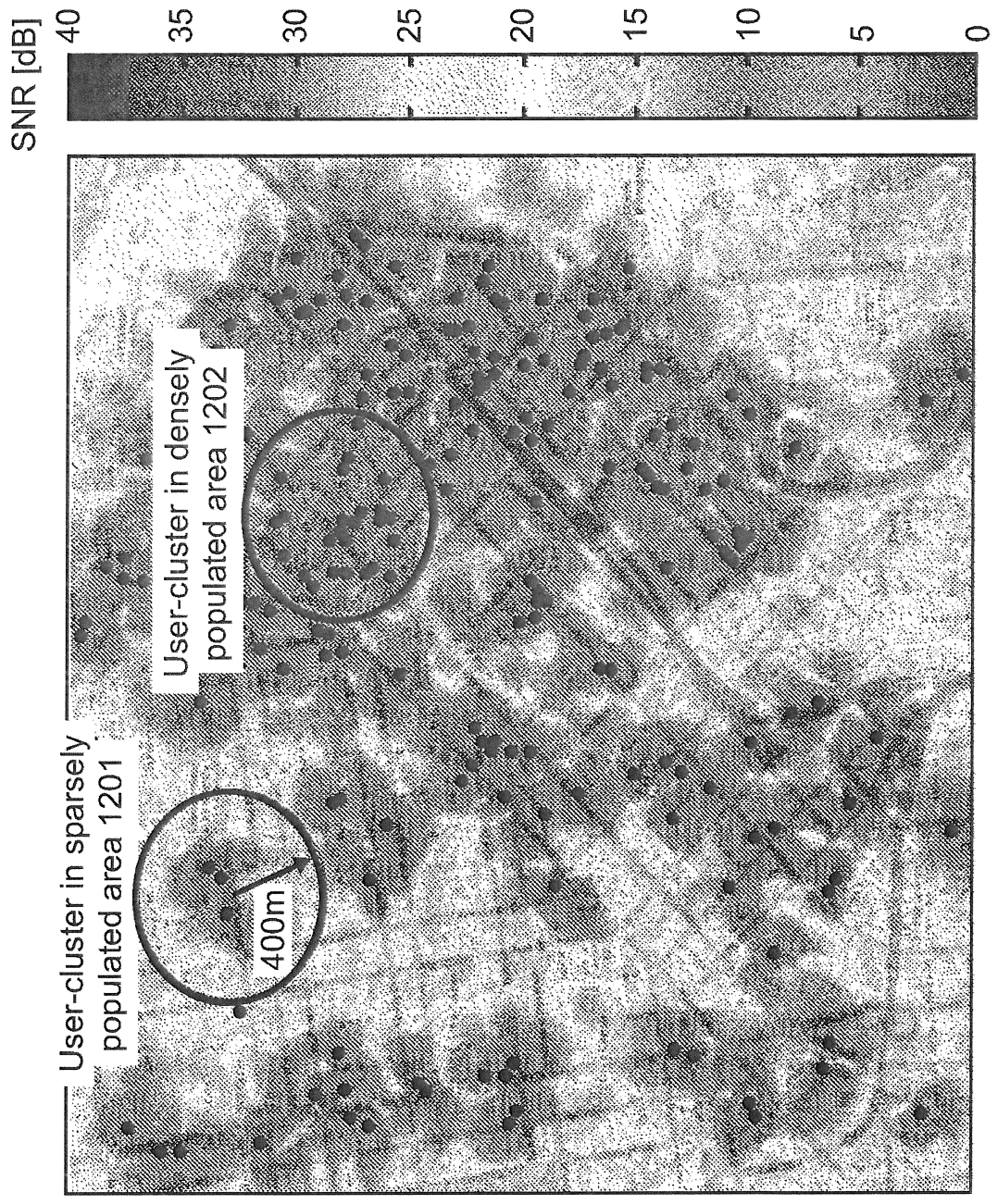
SNR [dB]
40
35
30
25
20
15
10
5
0
User-cluster in sparsely populated area 1201
400m
User-cluster in densely populated area 1202

Fig. 12

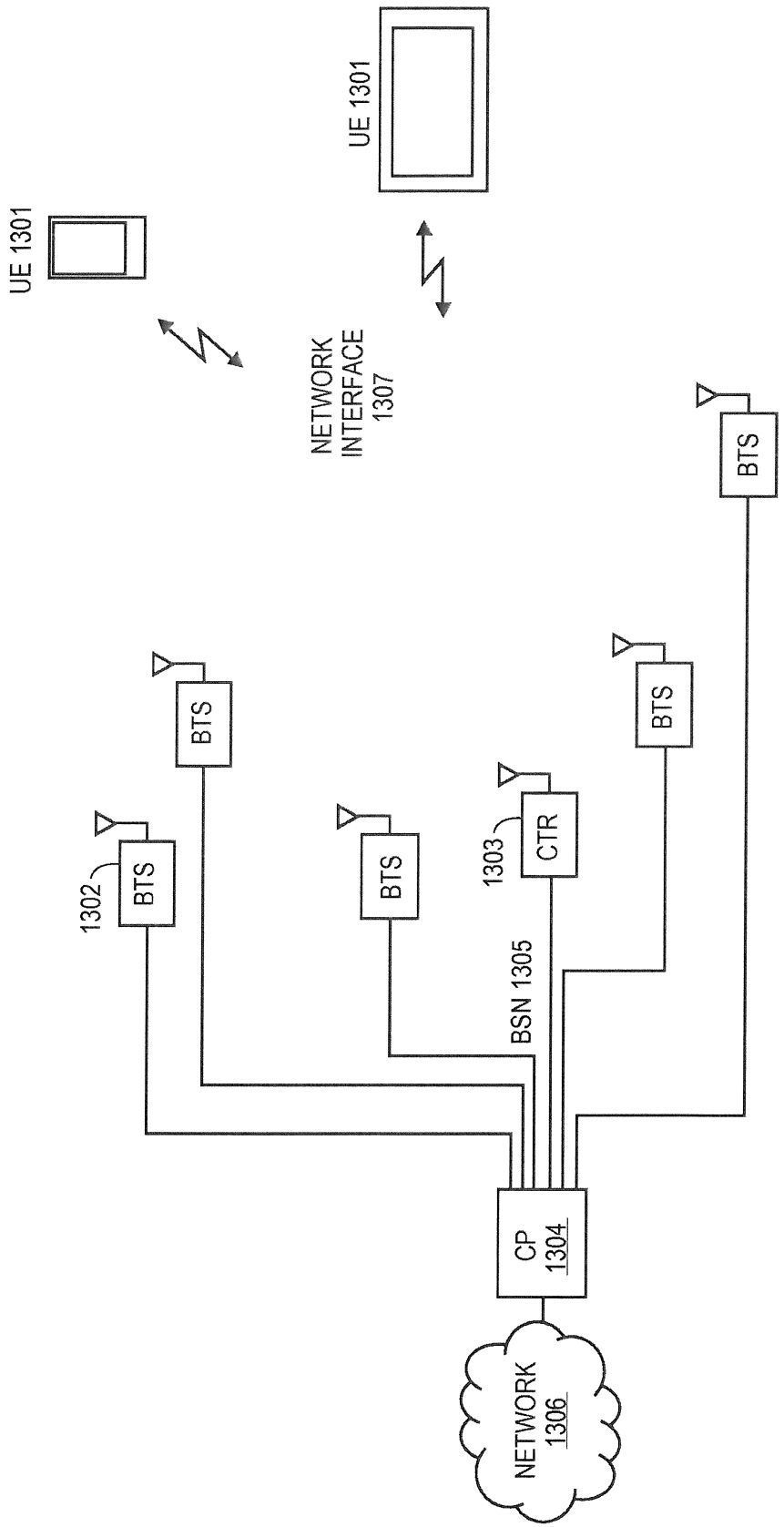
UE 1301
UE 1301
NETWORK INTERFACE 1307
BTS
BTS
BTS
BTS
1302
1303
CTR
BSN 1305
CP 1304
NETWORK 1306

FIG. 13

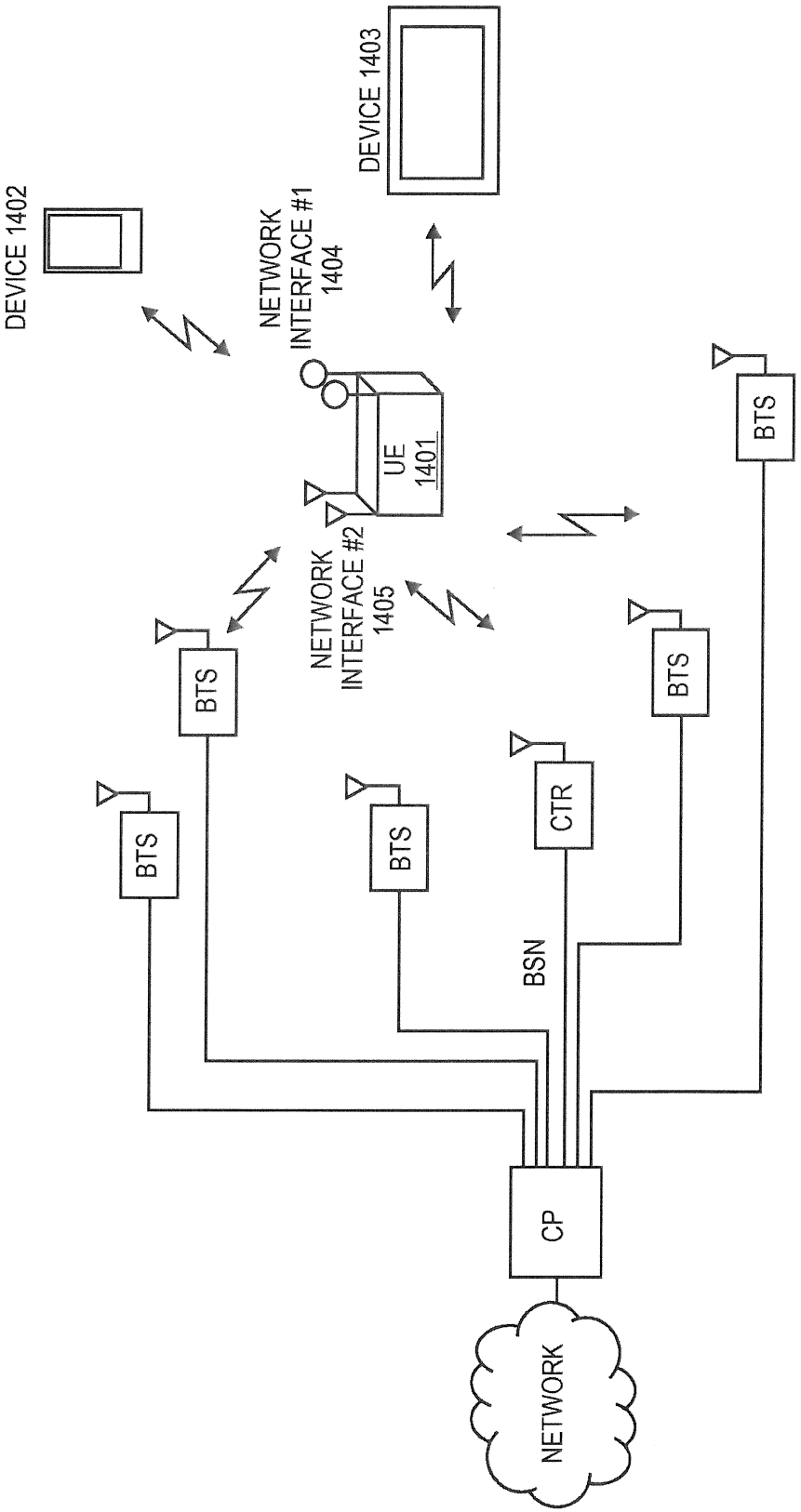
DEVICE 1402
DEVICE 1403
NETWORK INTERFACE #1 1404
UE 1401
NETWORK INTERFACE #2 1405
BTS
BTS
BTS
BTS
BTS
CTR
BSN
CP
NETWORK

FIG. 14

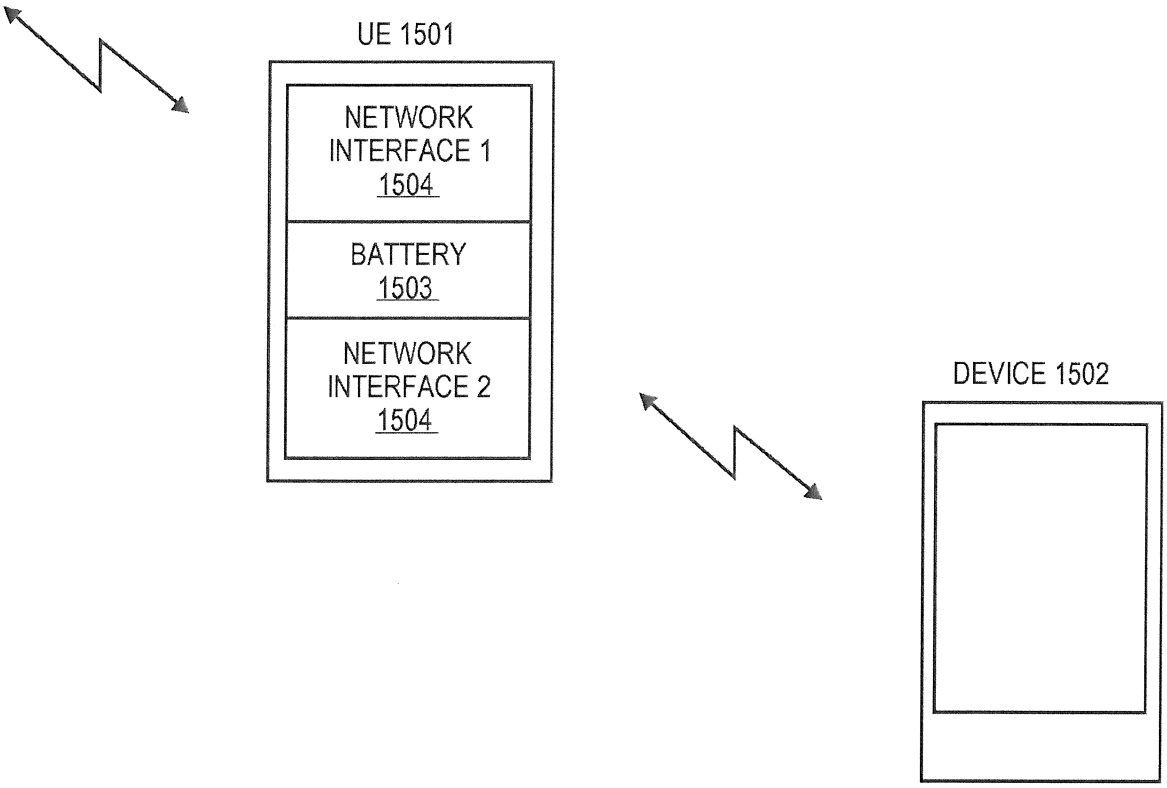
UE 1501
NETWORK INTERFACE 1 1504
BATTERY 1503
NETWORK INTERFACE 2 1504
DEVICE 1502

FIG. 15