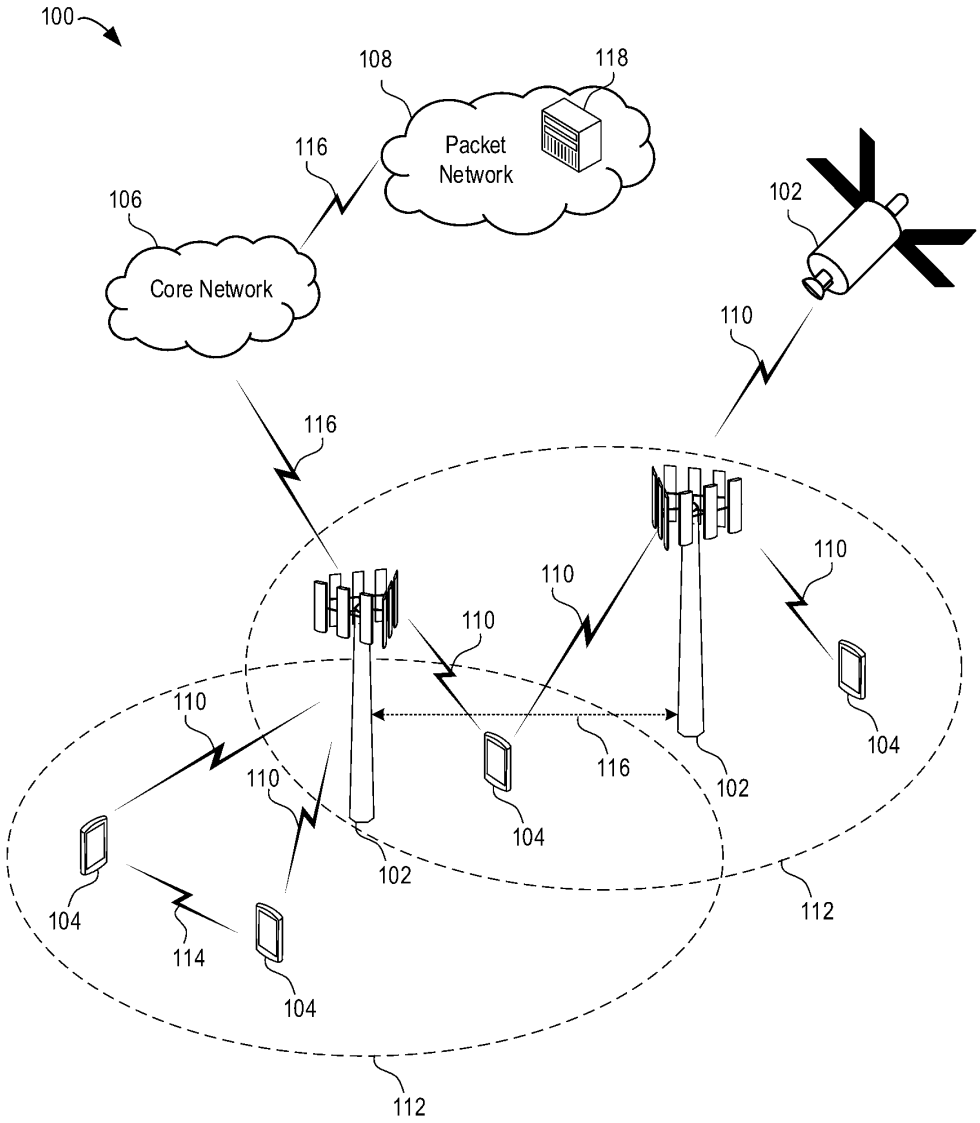

100
108
118
Packet Network
116
106
Core Network
102
110
116
110
110
110
110
104
116
102
110
104
102
104
114
104
112
112

FIG. 1

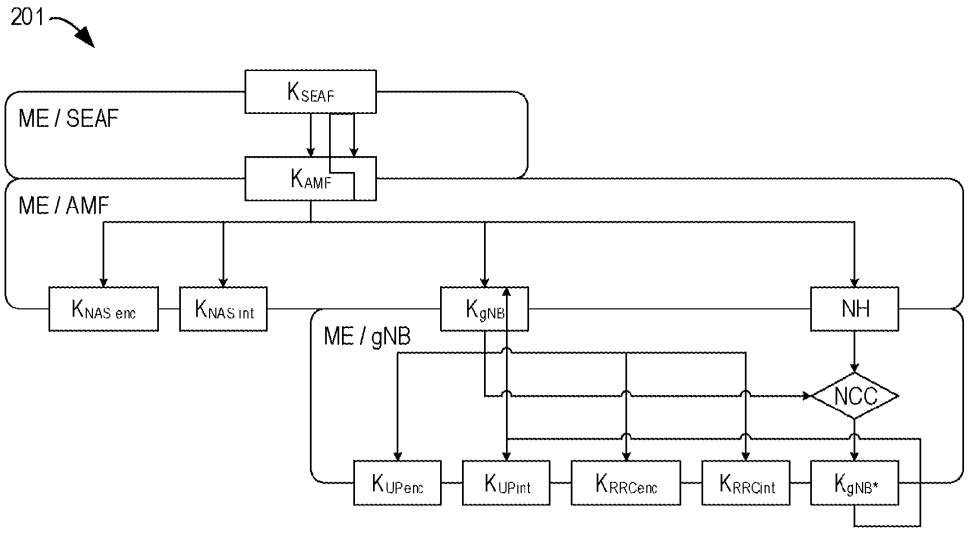
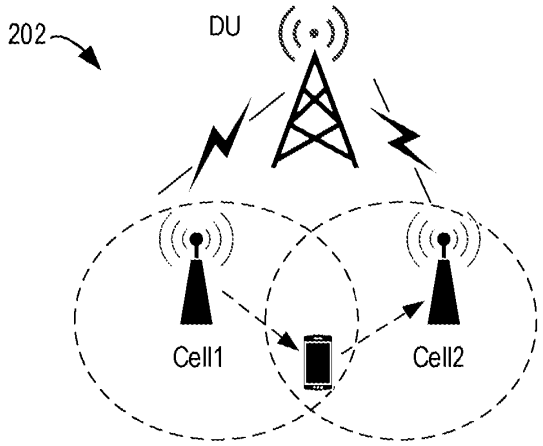
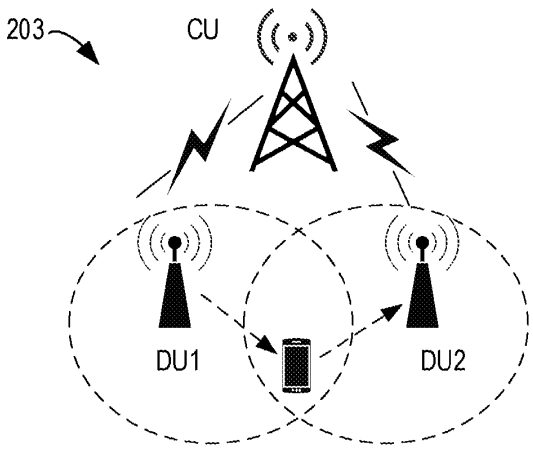


FIG. 2A



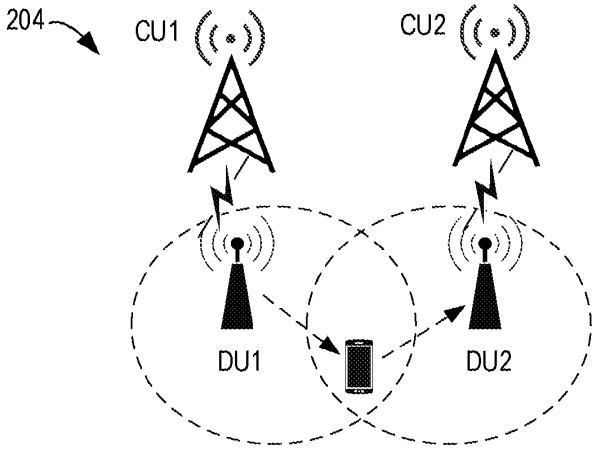
a) Intra-CU intra-DU LTM

FIG. 2B



b) Intra-CU inter-DU LTM

FIG. 2C



c) Inter-CU LTM

FIG. 2D

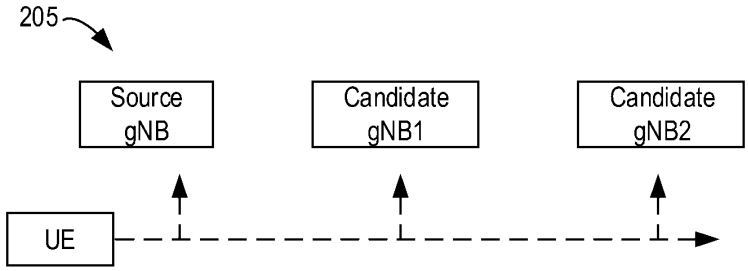

205
Source gNB
Candidate gNB1
Candidate gNB2
UE

FIG. 2E

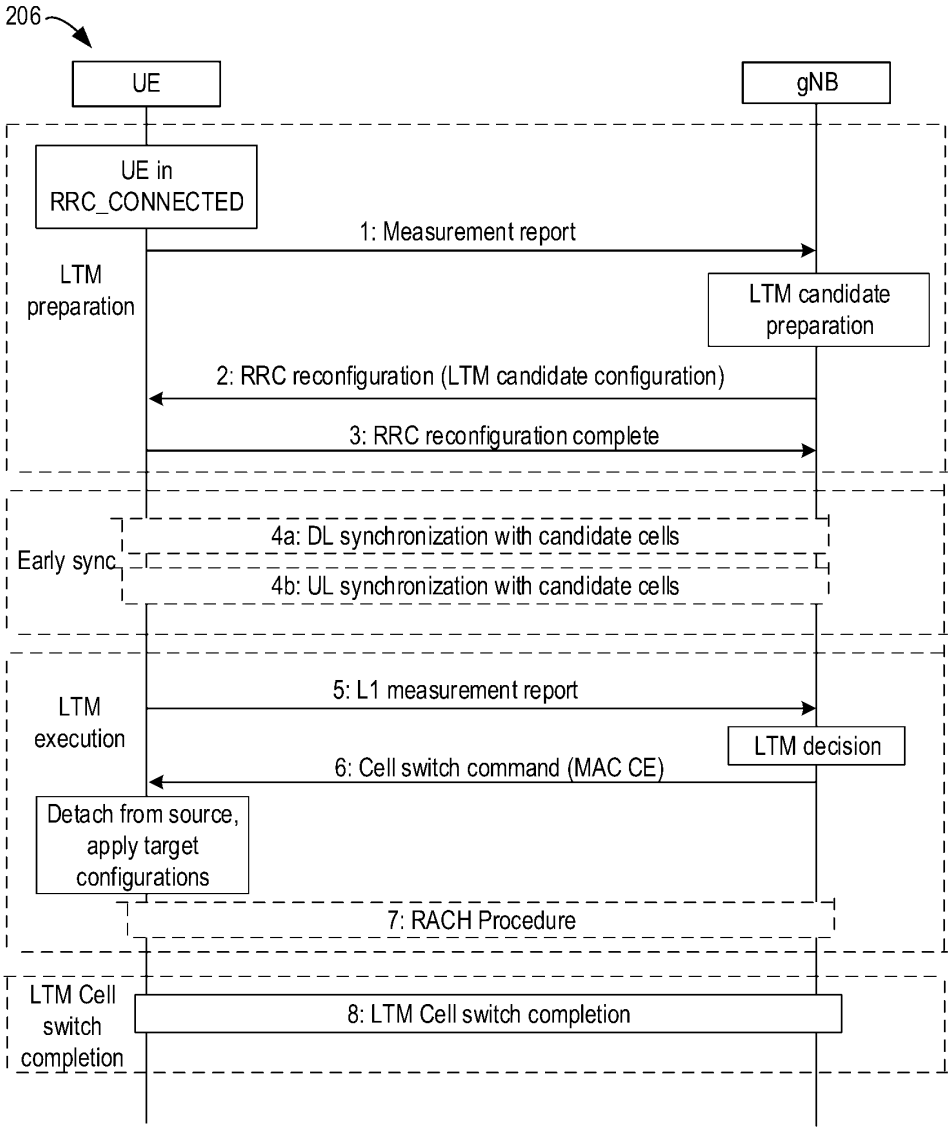

206
UE
gNB
UE in RRC_CONNECTED
1: Measurement report
LTM preparation
LTM candidate preparation
2: RRC reconfiguration (LTM candidate configuration)
3: RRC reconfiguration complete
Early sync
4a: DL synchronization with candidate cells
4b: UL synchronization with candidate cells
LTM execution
5: L1 measurement report
LTM decision
6: Cell switch command (MAC CE)
Detach from source, apply target configurations
7: RACH Procedure
LTM Cell switch completion
8: LTM Cell switch completion

FIG. 2F

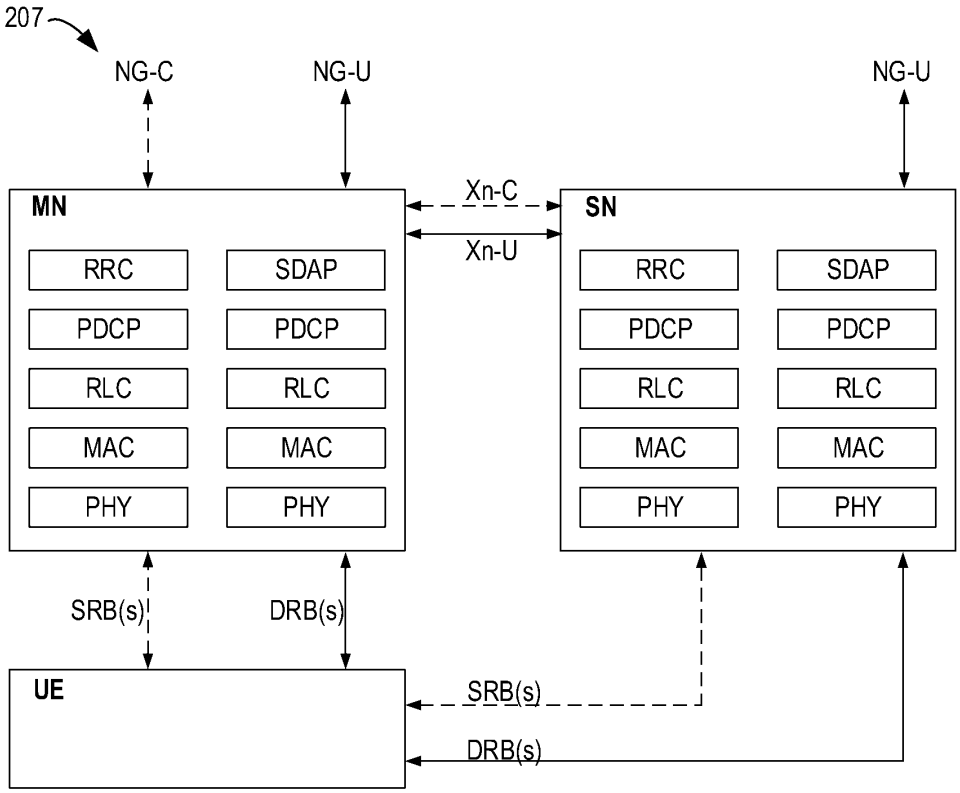

207
NG-C
NG-U
NG-U
MN
Xn-C
Xn-U
SN
RRC
SDAP
PDCP
PDCP
RLC
RLC
MAC
MAC
PHY
PHY
RRC
SDAP
PDCP
PDCP
RLC
RLC
MAC
MAC
PHY
PHY
SRB(s)
DRB(s)
UE
SRB(s)
DRB(s)

FIG. 2G

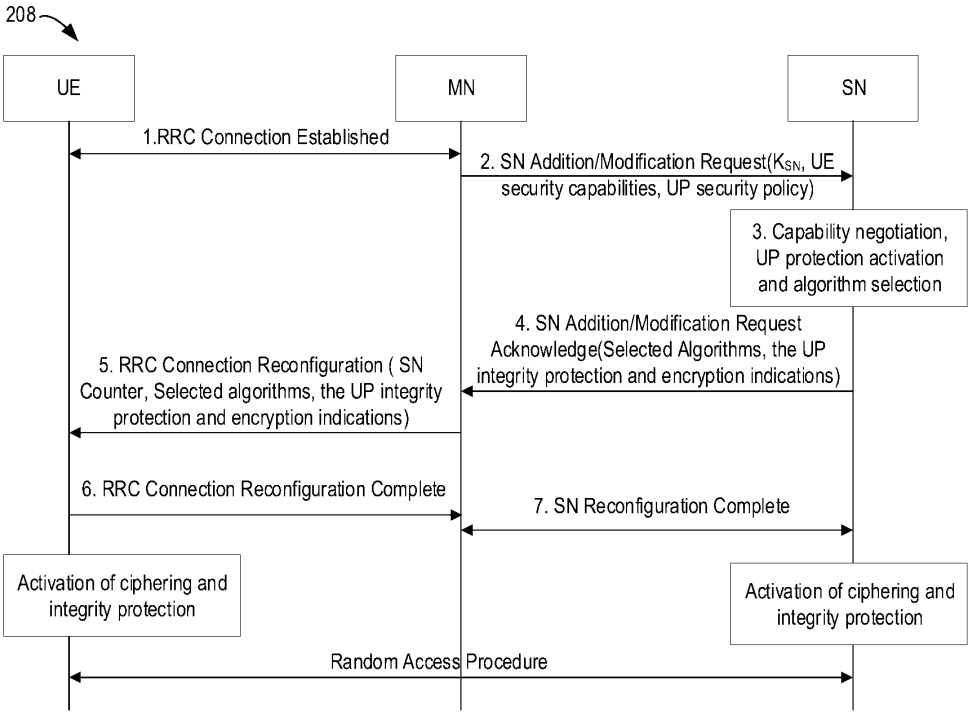

208
UE
MN
SN
1.RRC Connection Established
2. SN Addition/Modification Request(K_{SN}, UE security capabilities, UP security policy)
3. Capability negotiation, UP protection activation and algorithm selection
4. SN Addition/Modification Request Acknowledge(Selected Algorithms, the UP integrity protection and encryption indications)
5. RRC Connection Reconfiguration (SN Counter, Selected algorithms, the UP integrity protection and encryption indications)
6. RRC Connection Reconfiguration Complete
7. SN Reconfiguration Complete
Activation of ciphering and integrity protection
Activation of ciphering and integrity protection
Random Access Procedure

FIG. 2H

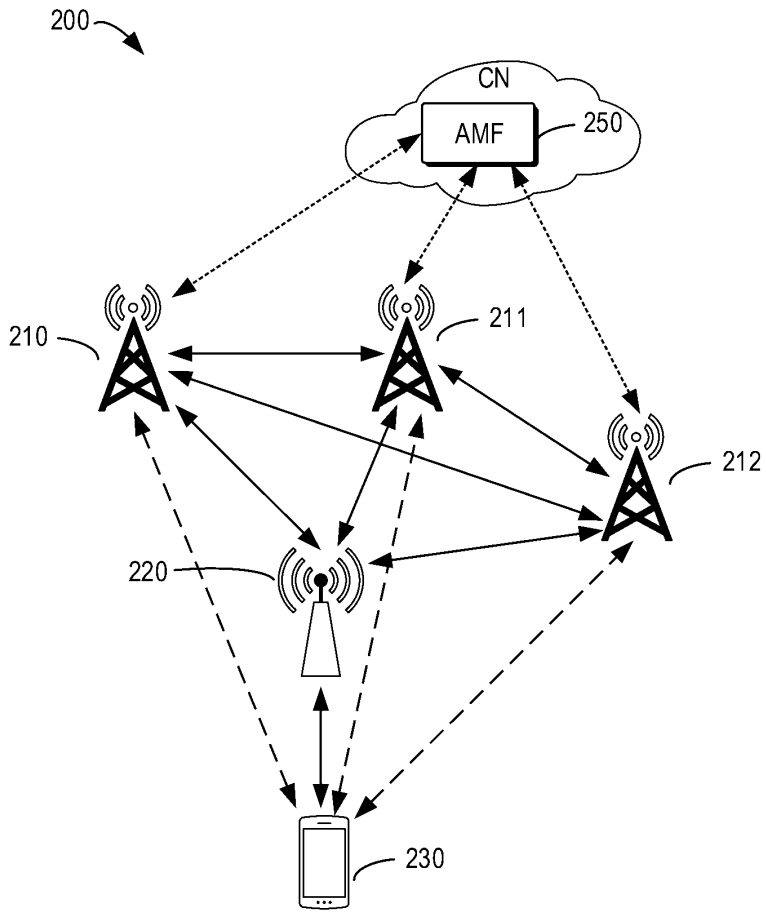


FIG. 2I

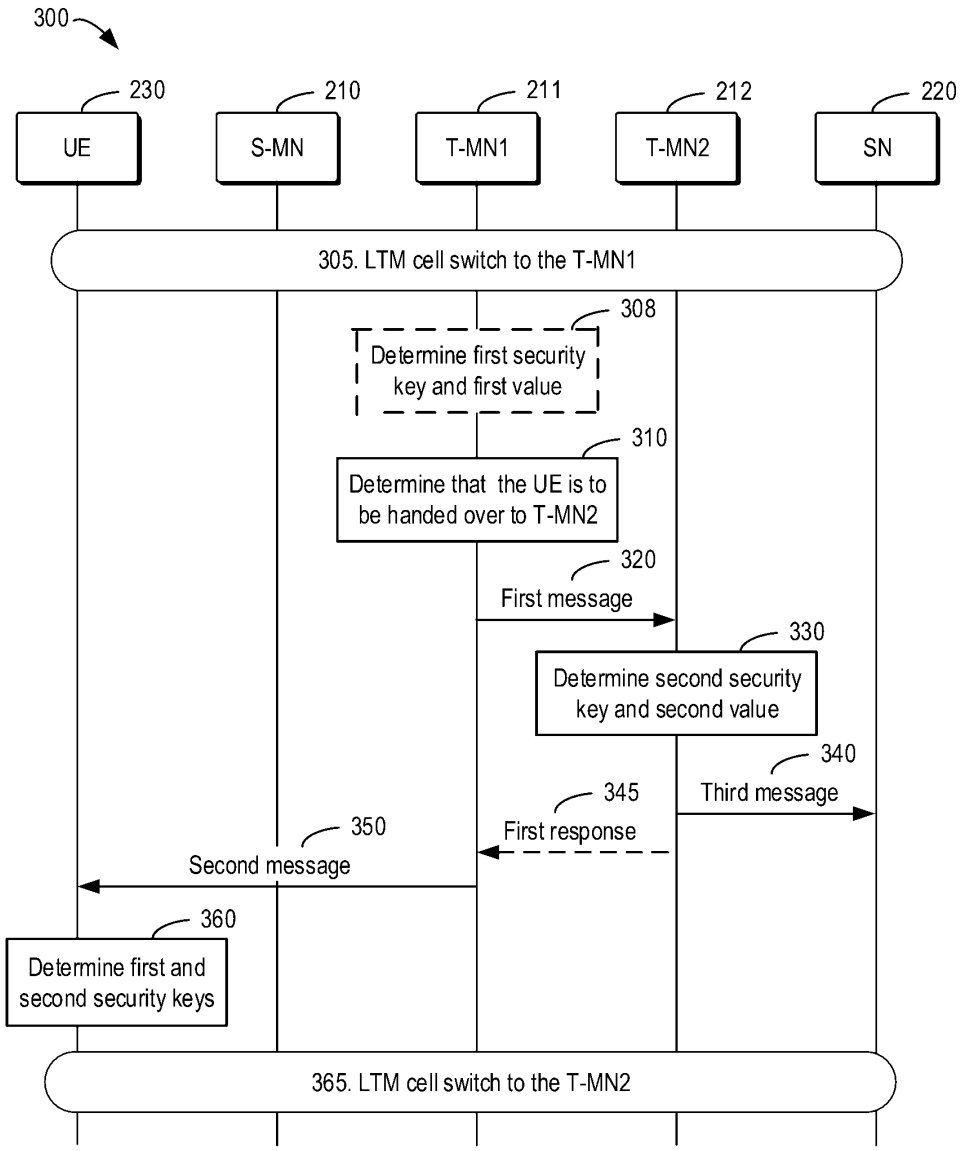

300
230
UE
210
S-MN
211
T-MN1
212
T-MN2
220
SN
305. LTM cell switch to the T-MN1
308
Determine first security key and first value
310
Determine that the UE is to be handed over to T-MN2
320
First message
330
Determine second security key and second value
340
Third message
345
First response
350
Second message
360
Determine first and second security keys
365. LTM cell switch to the T-MN2

FIG. 3

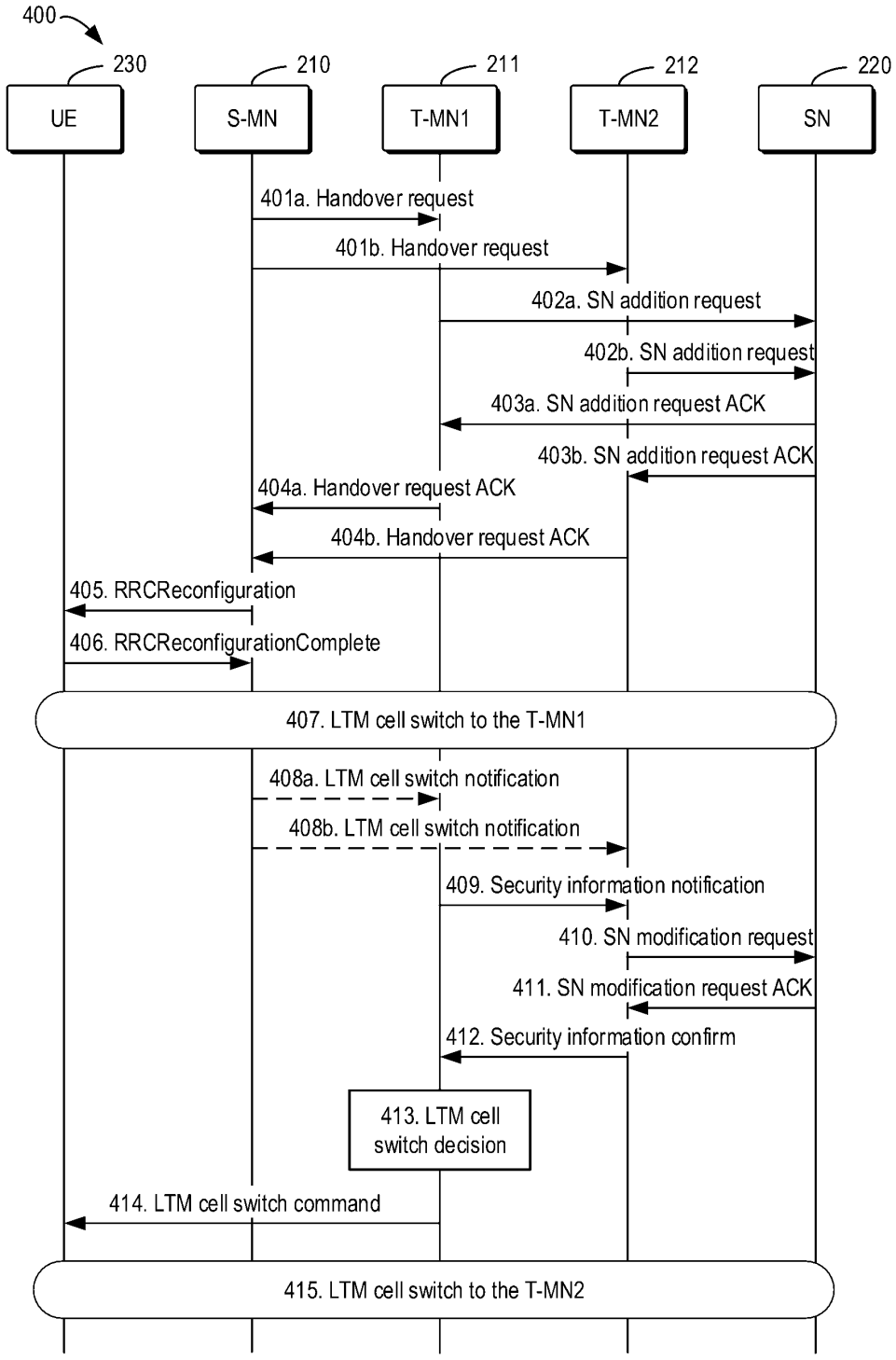

400
230
210
211
212
220
UE
S-MN
T-MN1
T-MN2
SN
401a. Handover request
401b. Handover request
402a. SN addition request
402b. SN addition request
403a. SN addition request ACK
403b. SN addition request ACK
404a. Handover request ACK
404b. Handover request ACK
405. RRCReconfiguration
406. RRCReconfigurationComplete
407. LTM cell switch to the T-MN1
408a. LTM cell switch notification
408b. LTM cell switch notification
409. Security information notification
410. SN modification request
411. SN modification request ACK
412. Security information confirm
413. LTM cell switch decision
414. LTM cell switch command
415. LTM cell switch to the T-MN2

FIG. 4A

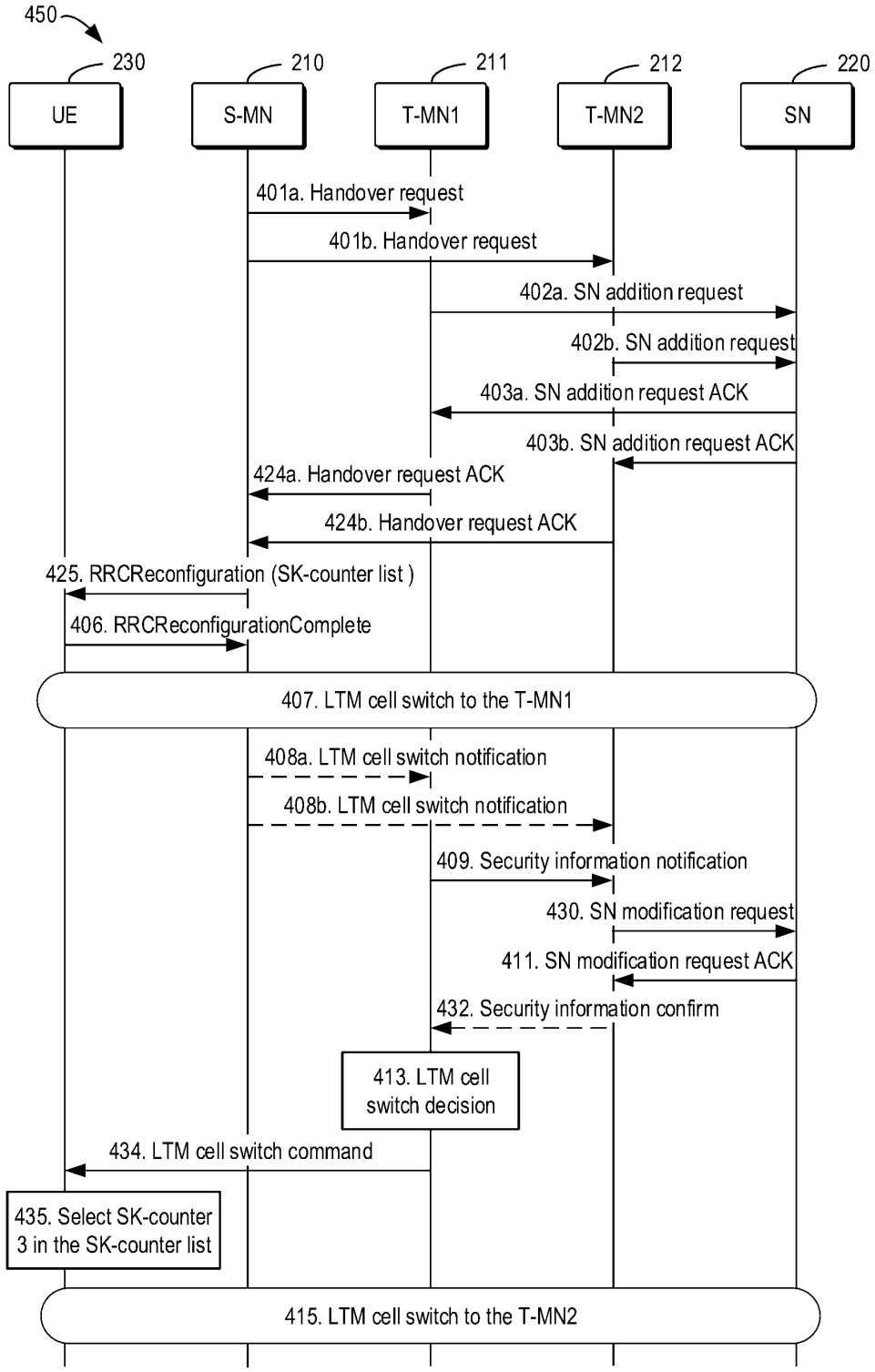

450
230
210
211
212
220
UE
S-MN
T-MN1
T-MN2
SN
401a. Handover request
401b. Handover request
402a. SN addition request
402b. SN addition request
403a. SN addition request ACK
403b. SN addition request ACK
424a. Handover request ACK
424b. Handover request ACK
425. RRCReconfiguration (SK-counter list)
406. RRCReconfigurationComplete
407. LTM cell switch to the T-MN1
408a. LTM cell switch notification
408b. LTM cell switch notification
409. Security information notification
430. SN modification request
411. SN modification request ACK
432. Security information confirm
413. LTM cell switch decision
434. LTM cell switch command
435. Select SK-counter 3 in the SK-counter list
415. LTM cell switch to the T-MN2

FIG. 4B

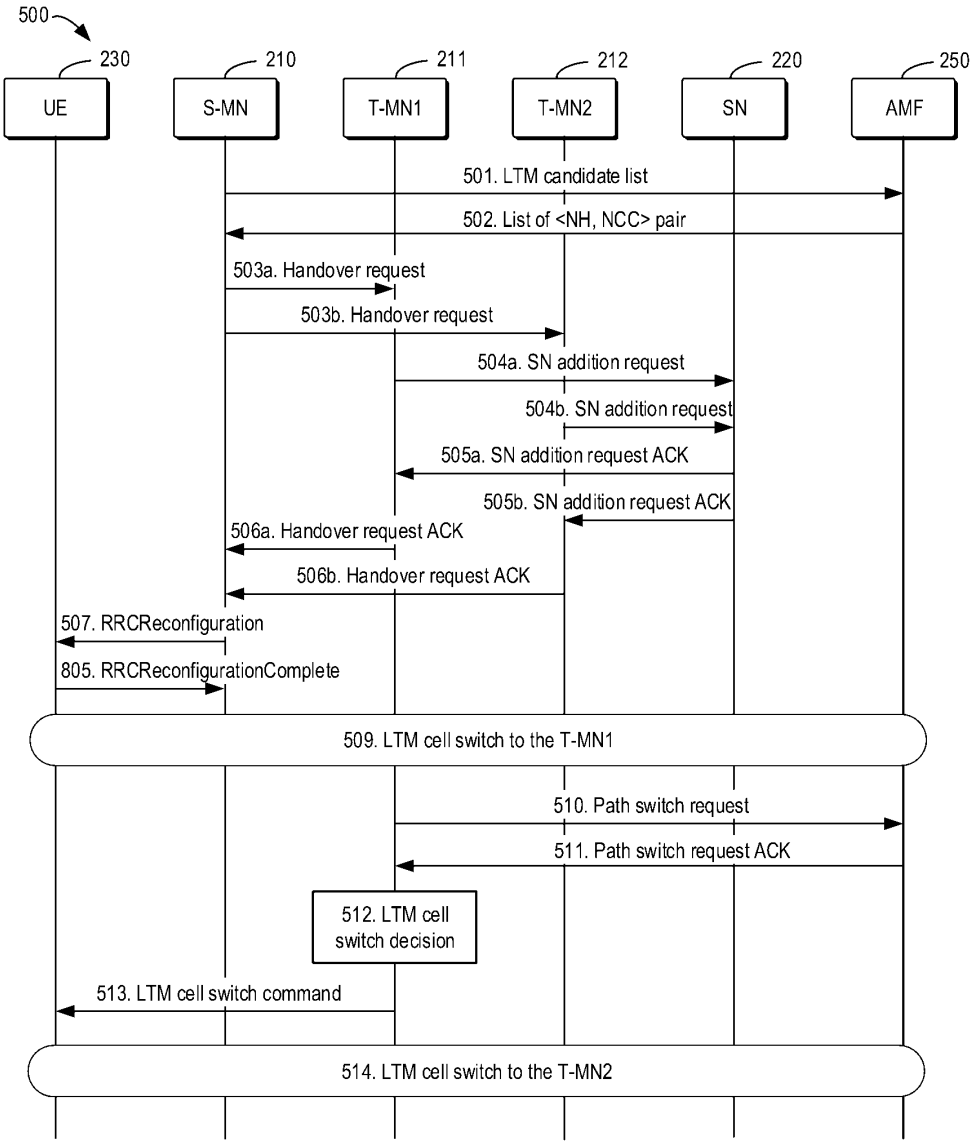

500
230
210
211
212
220
250
UE
S-MN
T-MN1
T-MN2
SN
AMF
501. LTM candidate list
502. List of <NH, NCC> pair
503a. Handover request
503b. Handover request
504a. SN addition request
504b. SN addition request
505a. SN addition request ACK
505b. SN addition request ACK
506a. Handover request ACK
506b. Handover request ACK
507. RRCReconfiguration
805. RRCReconfigurationComplete
509. LTM cell switch to the T-MN1
510. Path switch request
511. Path switch request ACK
512. LTM cell switch decision
513. LTM cell switch command
514. LTM cell switch to the T-MN2

FIG. 5

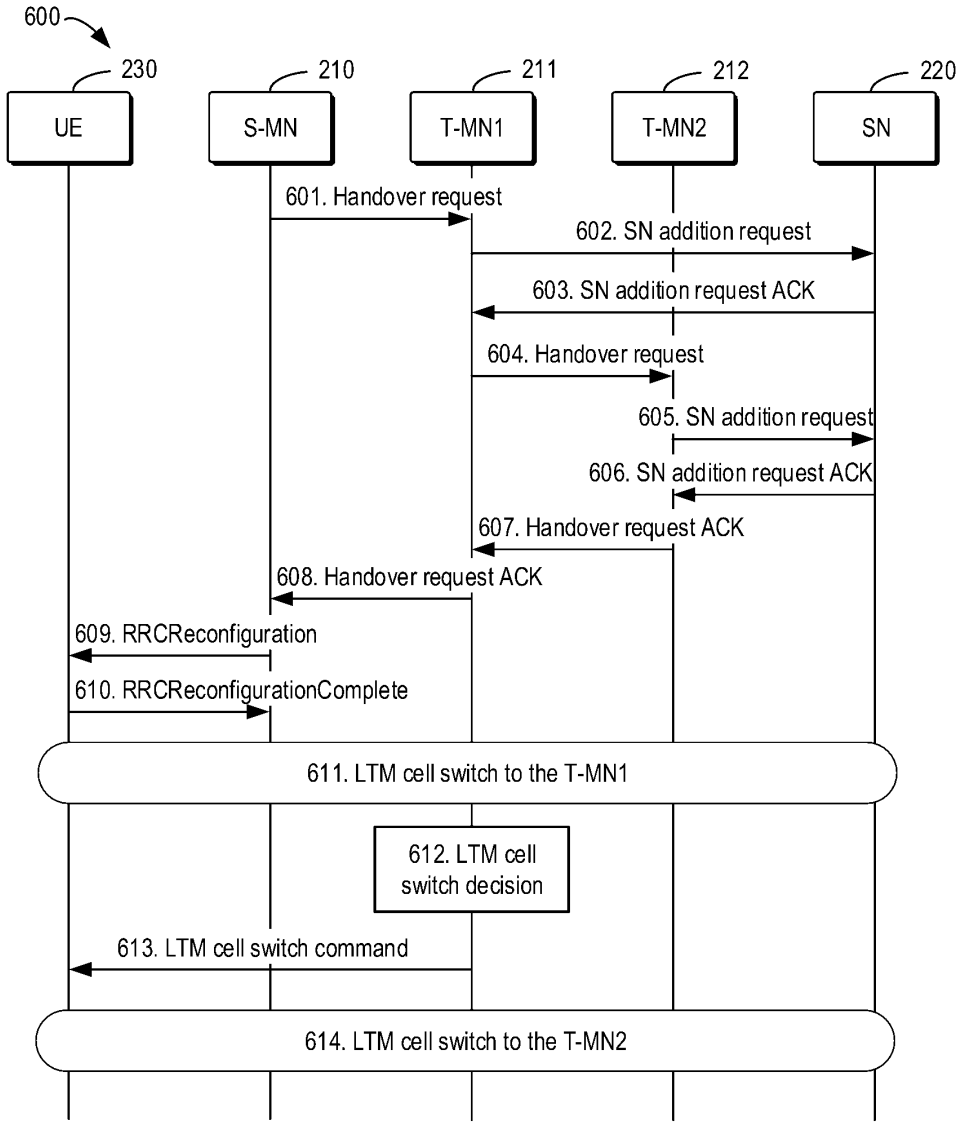

600
230
210
211
212
220
UE
S-MN
T-MN1
T-MN2
SN
601. Handover request
602. SN addition request
603. SN addition request ACK
604. Handover request
605. SN addition request
606. SN addition request ACK
607. Handover request ACK
608. Handover request ACK
609. RRCReconfiguration
610. RRCReconfigurationComplete
611. LTM cell switch to the T-MN1
612. LTM cell switch decision
613. LTM cell switch command
614. LTM cell switch to the T-MN2

FIG. 6

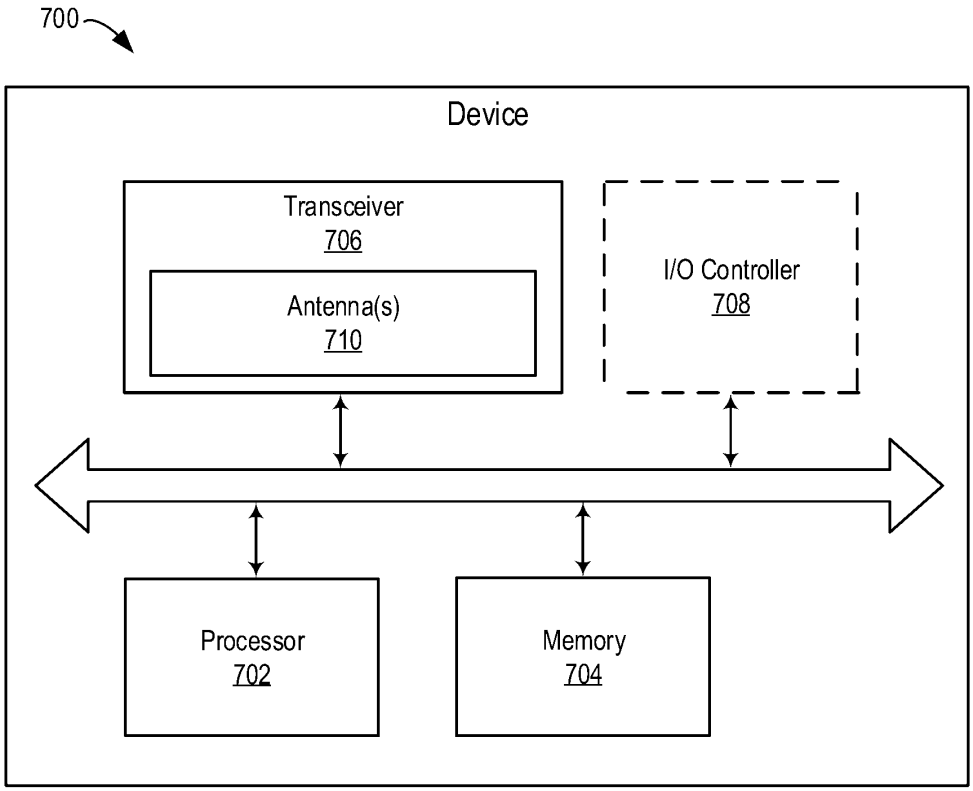

700
Device
Transceiver
706
Antenna(s)
710
I/O Controller
708
Processor
702
Memory
704

FIG. 7

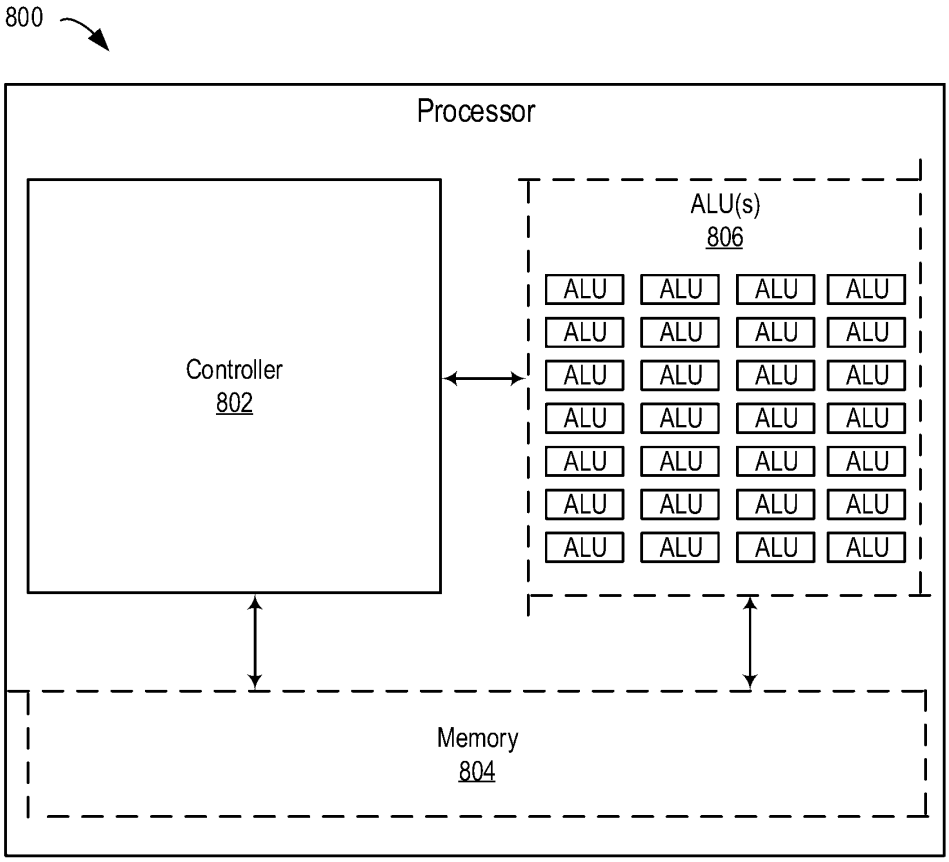


FIG. 8

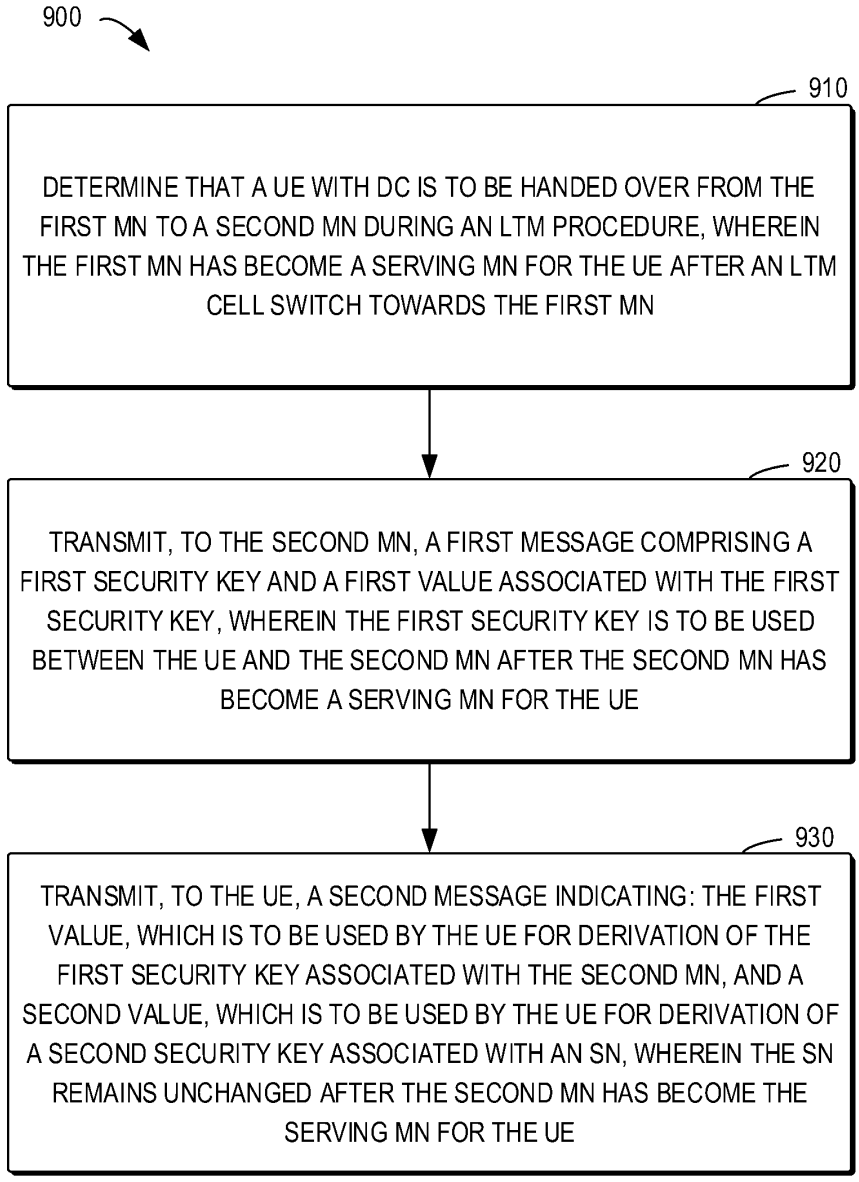

900
910
DETERMINE THAT A UE WITH DC IS TO BE HANDED OVER FROM THE FIRST MN TO A SECOND MN DURING AN LTM PROCEDURE, WHEREIN THE FIRST MN HAS BECOME A SERVING MN FOR THE UE AFTER AN LTM CELL SWITCH TOWARDS THE FIRST MN
920
TRANSMIT, TO THE SECOND MN, A FIRST MESSAGE COMPRISING A FIRST SECURITY KEY AND A FIRST VALUE ASSOCIATED WITH THE FIRST SECURITY KEY, WHEREIN THE FIRST SECURITY KEY IS TO BE USED BETWEEN THE UE AND THE SECOND MN AFTER THE SECOND MN HAS BECOME A SERVING MN FOR THE UE
930
TRANSMIT, TO THE UE, A SECOND MESSAGE INDICATING: THE FIRST VALUE, WHICH IS TO BE USED BY THE UE FOR DERIVATION OF THE FIRST SECURITY KEY ASSOCIATED WITH THE SECOND MN, AND A SECOND VALUE, WHICH IS TO BE USED BY THE UE FOR DERIVATION OF A SECOND SECURITY KEY ASSOCIATED WITH AN SN, WHEREIN THE SN REMAINS UNCHANGED AFTER THE SECOND MN HAS BECOME THE SERVING MN FOR THE UE

FIG. 9

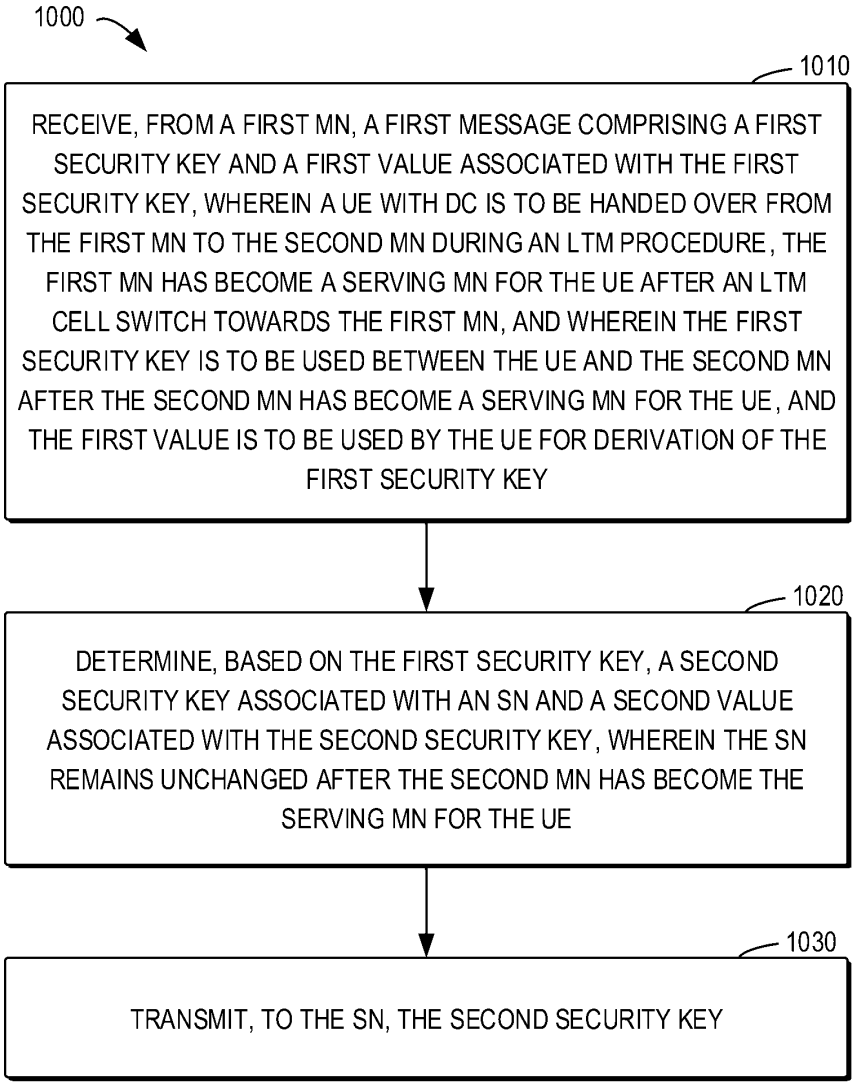

1000
1010
RECEIVE, FROM A FIRST MN, A FIRST MESSAGE COMPRISING A FIRST SECURITY KEY AND A FIRST VALUE ASSOCIATED WITH THE FIRST SECURITY KEY, WHEREIN A UE WITH DC IS TO BE HANDED OVER FROM THE FIRST MN TO THE SECOND MN DURING AN LTM PROCEDURE, THE FIRST MN HAS BECOME A SERVING MN FOR THE UE AFTER AN LTM CELL SWITCH TOWARDS THE FIRST MN, AND WHEREIN THE FIRST SECURITY KEY IS TO BE USED BETWEEN THE UE AND THE SECOND MN AFTER THE SECOND MN HAS BECOME A SERVING MN FOR THE UE, AND THE FIRST VALUE IS TO BE USED BY THE UE FOR DERIVATION OF THE FIRST SECURITY KEY
1020
DETERMINE, BASED ON THE FIRST SECURITY KEY, A SECOND SECURITY KEY ASSOCIATED WITH AN SN AND A SECOND VALUE ASSOCIATED WITH THE SECOND SECURITY KEY, WHEREIN THE SN REMAINS UNCHANGED AFTER THE SECOND MN HAS BECOME THE SERVING MN FOR THE UE
1030
TRANSMIT, TO THE SN, THE SECOND SECURITY KEY

FIG. 10

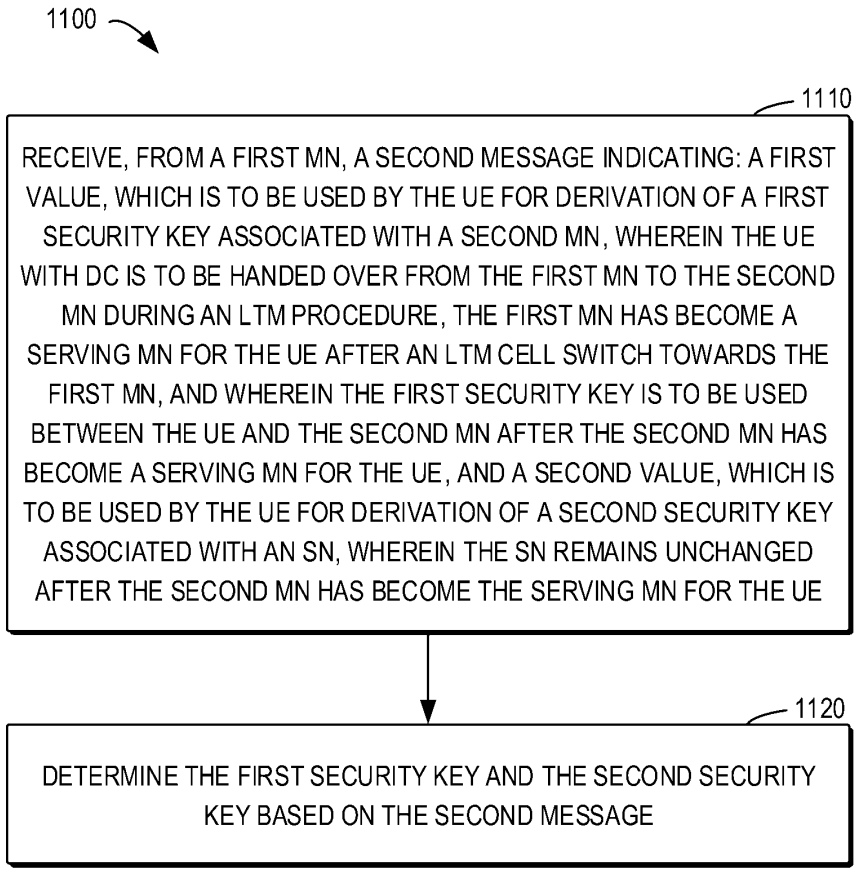

1100
1110
RECEIVE, FROM A FIRST MN, A SECOND MESSAGE INDICATING: A FIRST VALUE, WHICH IS TO BE USED BY THE UE FOR DERIVATION OF A FIRST SECURITY KEY ASSOCIATED WITH A SECOND MN, WHEREIN THE UE WITH DC IS TO BE HANDED OVER FROM THE FIRST MN TO THE SECOND MN DURING AN LTM PROCEDURE, THE FIRST MN HAS BECOME A SERVING MN FOR THE UE AFTER AN LTM CELL SWITCH TOWARDS THE FIRST MN, AND WHEREIN THE FIRST SECURITY KEY IS TO BE USED BETWEEN THE UE AND THE SECOND MN AFTER THE SECOND MN HAS BECOME A SERVING MN FOR THE UE, AND A SECOND VALUE, WHICH IS TO BE USED BY THE UE FOR DERIVATION OF A SECOND SECURITY KEY ASSOCIATED WITH AN SN, WHEREIN THE SN REMAINS UNCHANGED AFTER THE SECOND MN HAS BECOME THE SERVING MN FOR THE UE
1120
DETERMINE THE FIRST SECURITY KEY AND THE SECOND SECURITY KEY BASED ON THE SECOND MESSAGE

FIG. 11

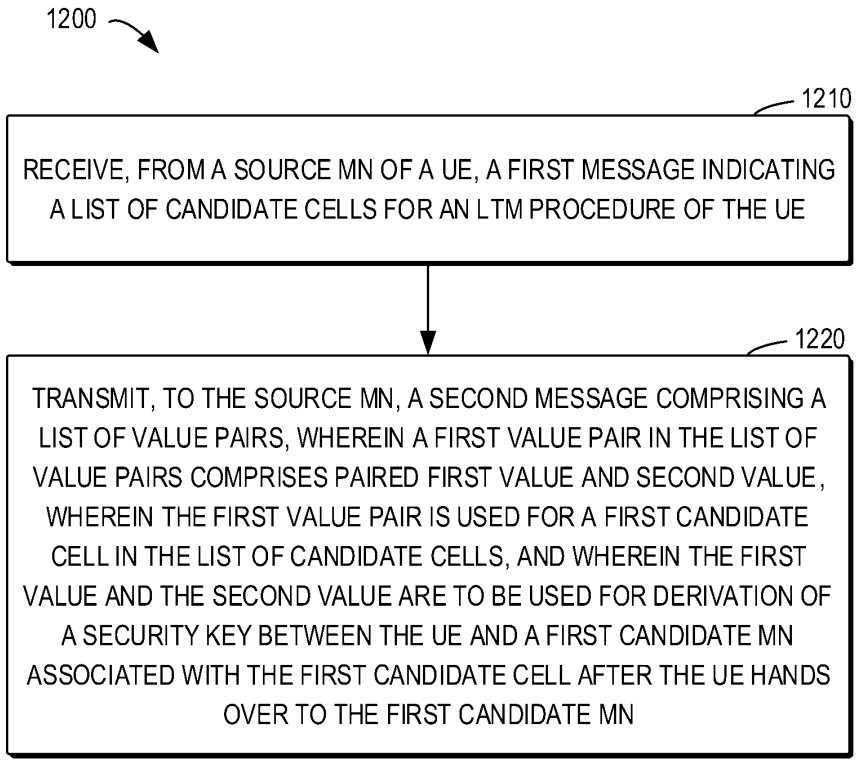

1200
1210
RECEIVE, FROM A SOURCE MN OF A UE, A FIRST MESSAGE INDICATING A LIST OF CANDIDATE CELLS FOR AN LTM PROCEDURE OF THE UE
1220
TRANSMIT, TO THE SOURCE MN, A SECOND MESSAGE COMPRISING A LIST OF VALUE PAIRS, WHEREIN A FIRST VALUE PAIR IN THE LIST OF VALUE PAIRS COMPRISES PAIRED FIRST VALUE AND SECOND VALUE, WHEREIN THE FIRST VALUE PAIR IS USED FOR A FIRST CANDIDATE CELL IN THE LIST OF CANDIDATE CELLS, AND WHEREIN THE FIRST VALUE AND THE SECOND VALUE ARE TO BE USED FOR DERIVATION OF A SECURITY KEY BETWEEN THE UE AND A FIRST CANDIDATE MN ASSOCIATED WITH THE FIRST CANDIDATE CELL AFTER THE UE HANDS OVER TO THE FIRST CANDIDATE MN

FIG. 12

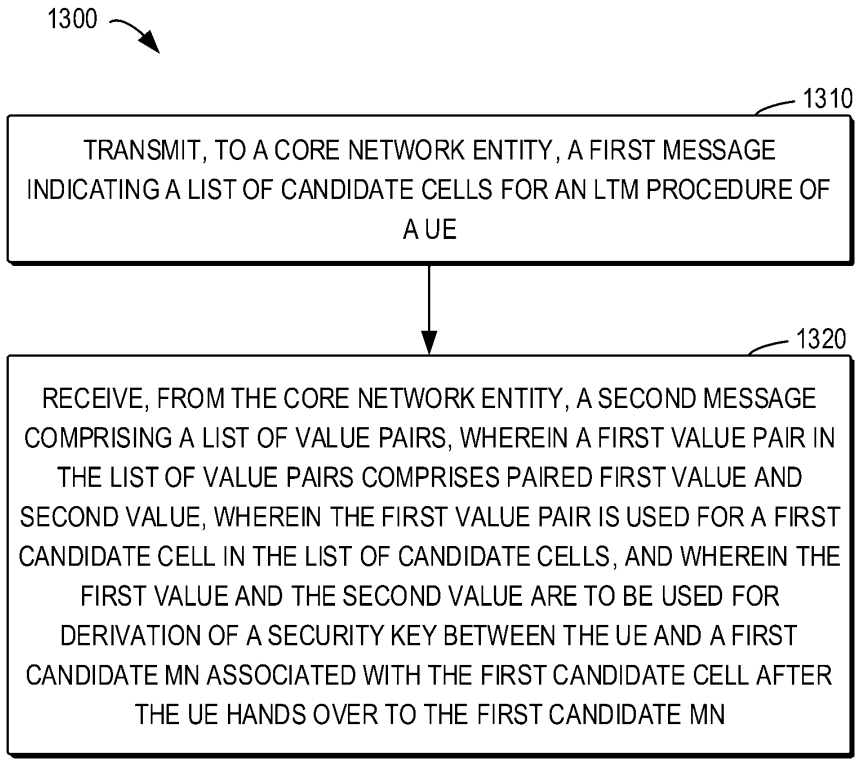

1300
1310
TRANSMIT, TO A CORE NETWORK ENTITY, A FIRST MESSAGE INDICATING A LIST OF CANDIDATE CELLS FOR AN LTM PROCEDURE OF A UE
1320
RECEIVE, FROM THE CORE NETWORK ENTITY, A SECOND MESSAGE COMPRISING A LIST OF VALUE PAIRS, WHEREIN A FIRST VALUE PAIR IN THE LIST OF VALUE PAIRS COMPRISES PAIRED FIRST VALUE AND SECOND VALUE, WHEREIN THE FIRST VALUE PAIR IS USED FOR A FIRST CANDIDATE CELL IN THE LIST OF CANDIDATE CELLS, AND WHEREIN THE FIRST VALUE AND THE SECOND VALUE ARE TO BE USED FOR DERIVATION OF A SECURITY KEY BETWEEN THE UE AND A FIRST CANDIDATE MN ASSOCIATED WITH THE FIRST CANDIDATE CELL AFTER THE UE HANDS OVER TO THE FIRST CANDIDATE MN

FIG. 13

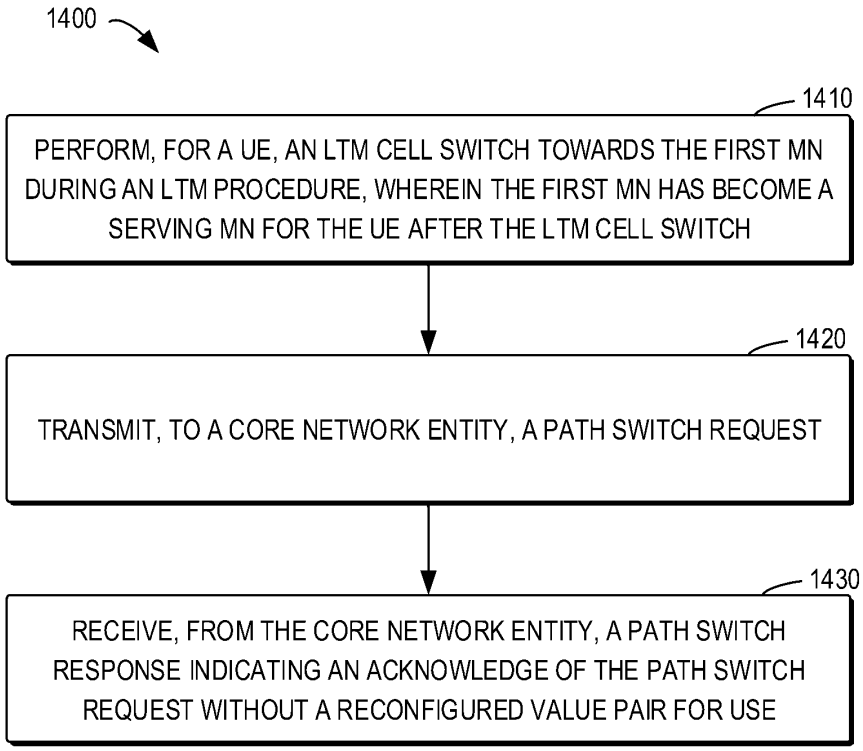

1400
1410
PERFORM, FOR A UE, AN LTM CELL SWITCH TOWARDS THE FIRST MN DURING AN LTM PROCEDURE, WHEREIN THE FIRST MN HAS BECOME A SERVING MN FOR THE UE AFTER THE LTM CELL SWITCH
1420
TRANSMIT, TO A CORE NETWORK ENTITY, A PATH SWITCH REQUEST
1430
RECEIVE, FROM THE CORE NETWORK ENTITY, A PATH SWITCH RESPONSE INDICATING AN ACKNOWLEDGE OF THE PATH SWITCH REQUEST WITHOUT A RECONFIGURED VALUE PAIR FOR USE

FIG. 14

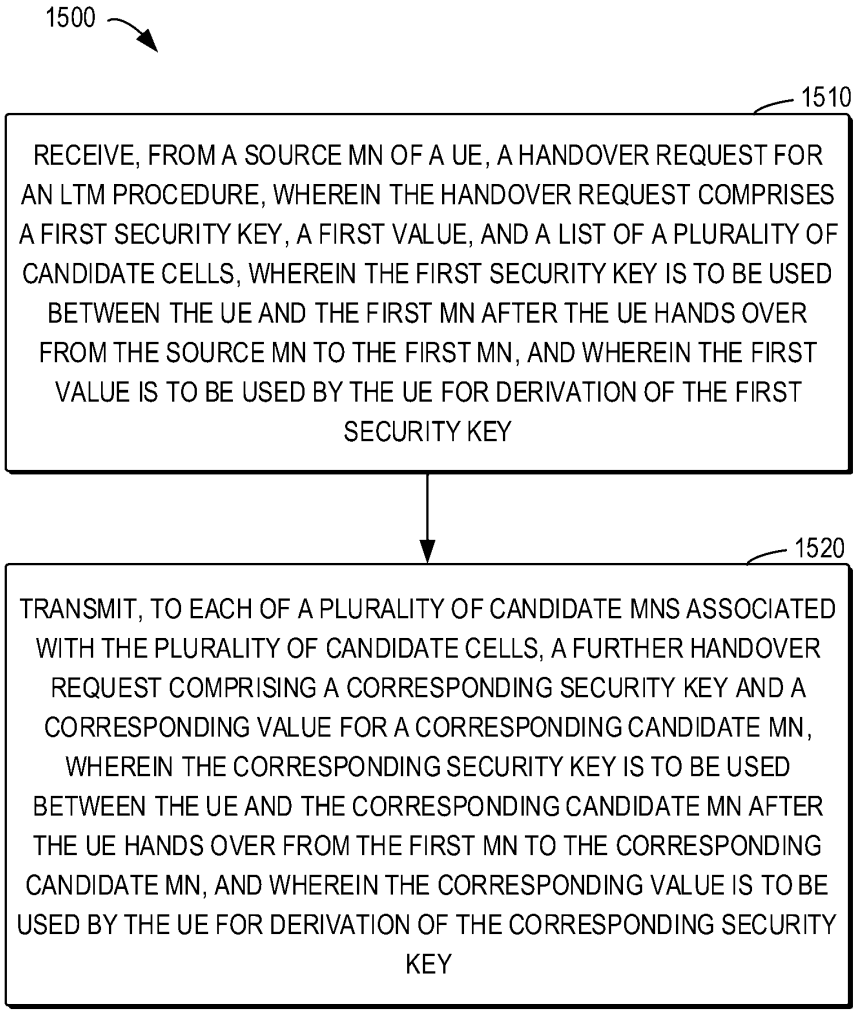

1500
1510
RECEIVE, FROM A SOURCE MN OF A UE, A HANDOVER REQUEST FOR AN LTM PROCEDURE, WHEREIN THE HANDOVER REQUEST COMPRISES A FIRST SECURITY KEY, A FIRST VALUE, AND A LIST OF A PLURALITY OF CANDIDATE CELLS, WHEREIN THE FIRST SECURITY KEY IS TO BE USED BETWEEN THE UE AND THE FIRST MN AFTER THE UE HANDS OVER FROM THE SOURCE MN TO THE FIRST MN, AND WHEREIN THE FIRST VALUE IS TO BE USED BY THE UE FOR DERIVATION OF THE FIRST SECURITY KEY
1520
TRANSMIT, TO EACH OF A PLURALITY OF CANDIDATE MNS ASSOCIATED WITH THE PLURALITY OF CANDIDATE CELLS, A FURTHER HANDOVER REQUEST COMPRISING A CORRESPONDING SECURITY KEY AND A CORRESPONDING VALUE FOR A CORRESPONDING CANDIDATE MN, WHEREIN THE CORRESPONDING SECURITY KEY IS TO BE USED BETWEEN THE UE AND THE CORRESPONDING CANDIDATE MN AFTER THE UE HANDS OVER FROM THE FIRST MN TO THE CORRESPONDING CANDIDATE MN, AND WHEREIN THE CORRESPONDING VALUE IS TO BE USED BY THE UE FOR DERIVATION OF THE CORRESPONDING SECURITY KEY

FIG. 15