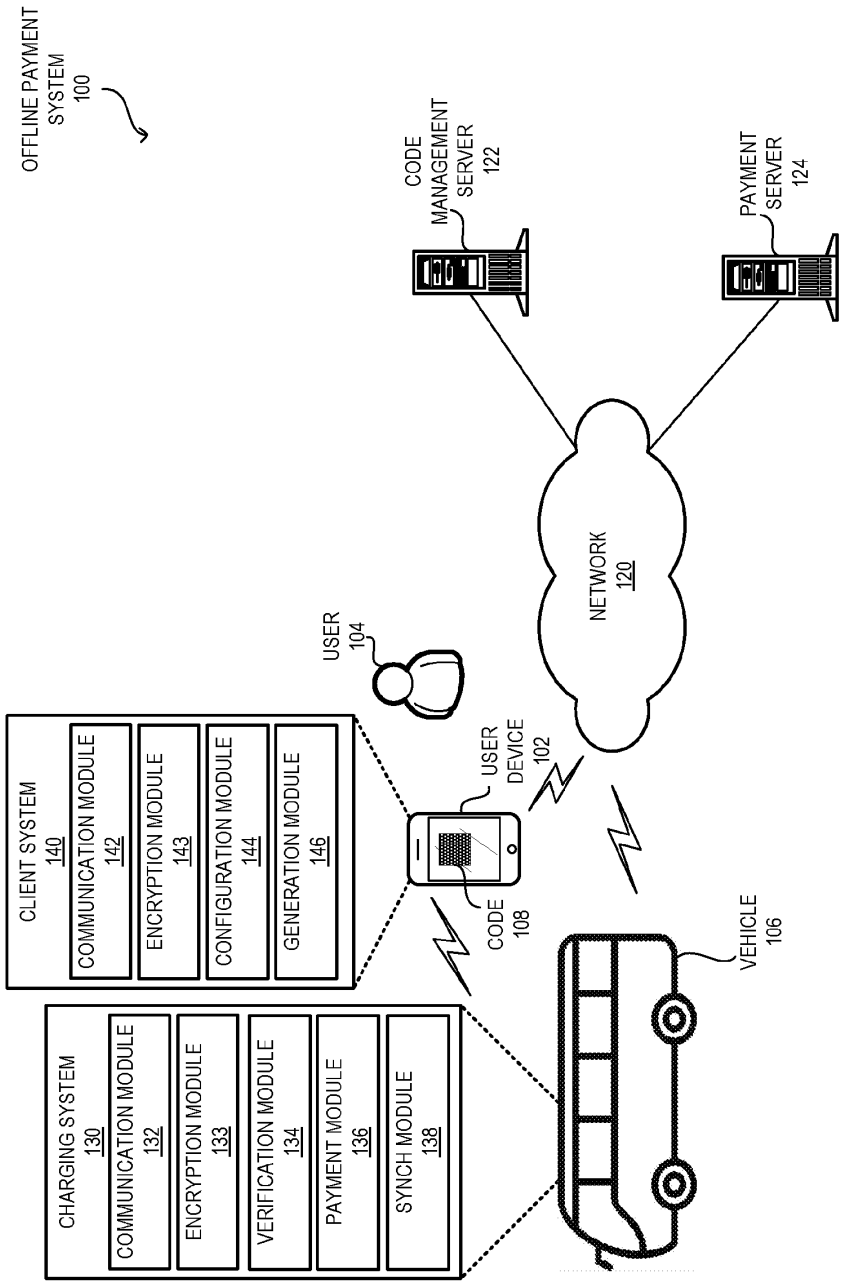
OFFLINE PAYMENT SYSTEM 100
CODE MANAGEMENT SERVER 122
PAYMENT SERVER 124
NETWORK 120
USER 104
USER DEVICE 102
CODE 108
VEHICLE 106
CLIENT SYSTEM 140
COMMUNICATION MODULE 142
ENCRYPTION MODULE 143
CONFIGURATION MODULE 144
GENERATION MODULE 146
CHARGING SYSTEM 130
COMMUNICATION MODULE 132
ENCRYPTION MODULE 133
VERIFICATION MODULE 134
PAYMENT MODULE 136
SYNCH MODULE 138

FIG. 1A

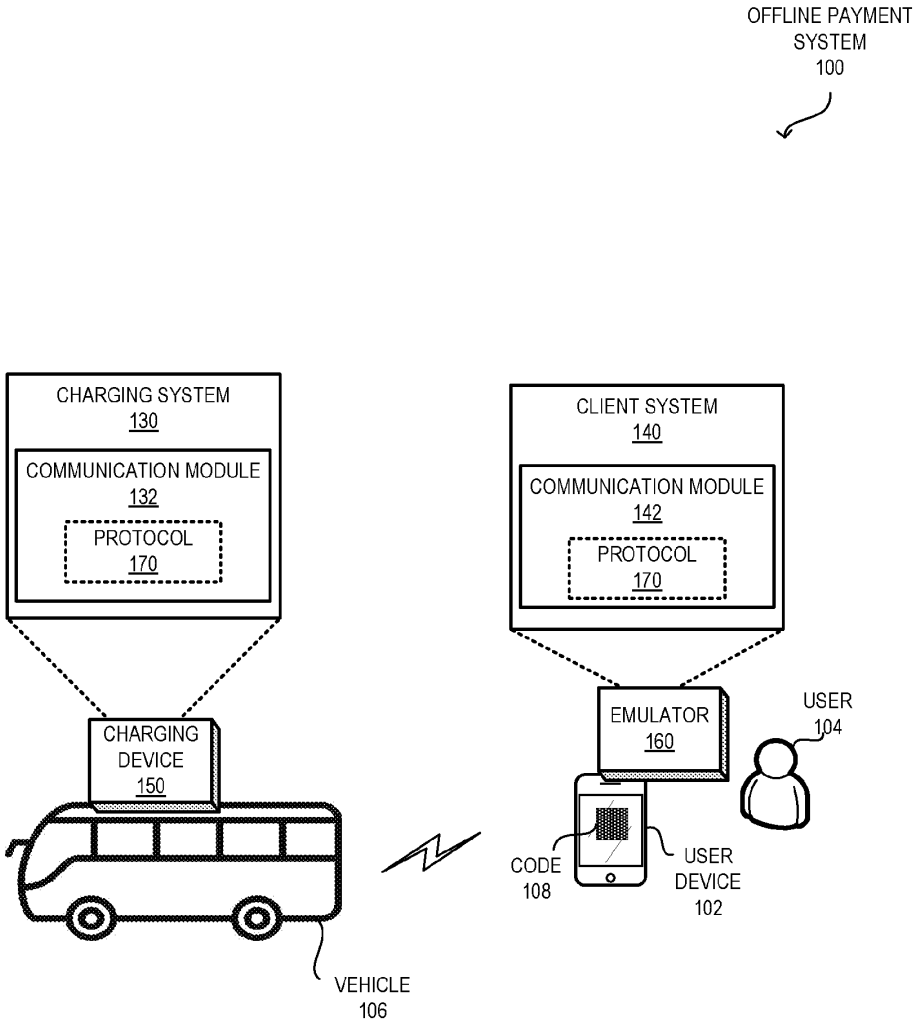
OFFLINE PAYMENT SYSTEM 100
CHARGING SYSTEM 130
COMMUNICATION MODULE 132
PROTOCOL 170
CHARGING DEVICE 150
VEHICLE 106
CLIENT SYSTEM 140
COMMUNICATION MODULE 142
PROTOCOL 170
EMULATOR 160
USER 104
CODE 108
USER DEVICE 102

FIG. 1B

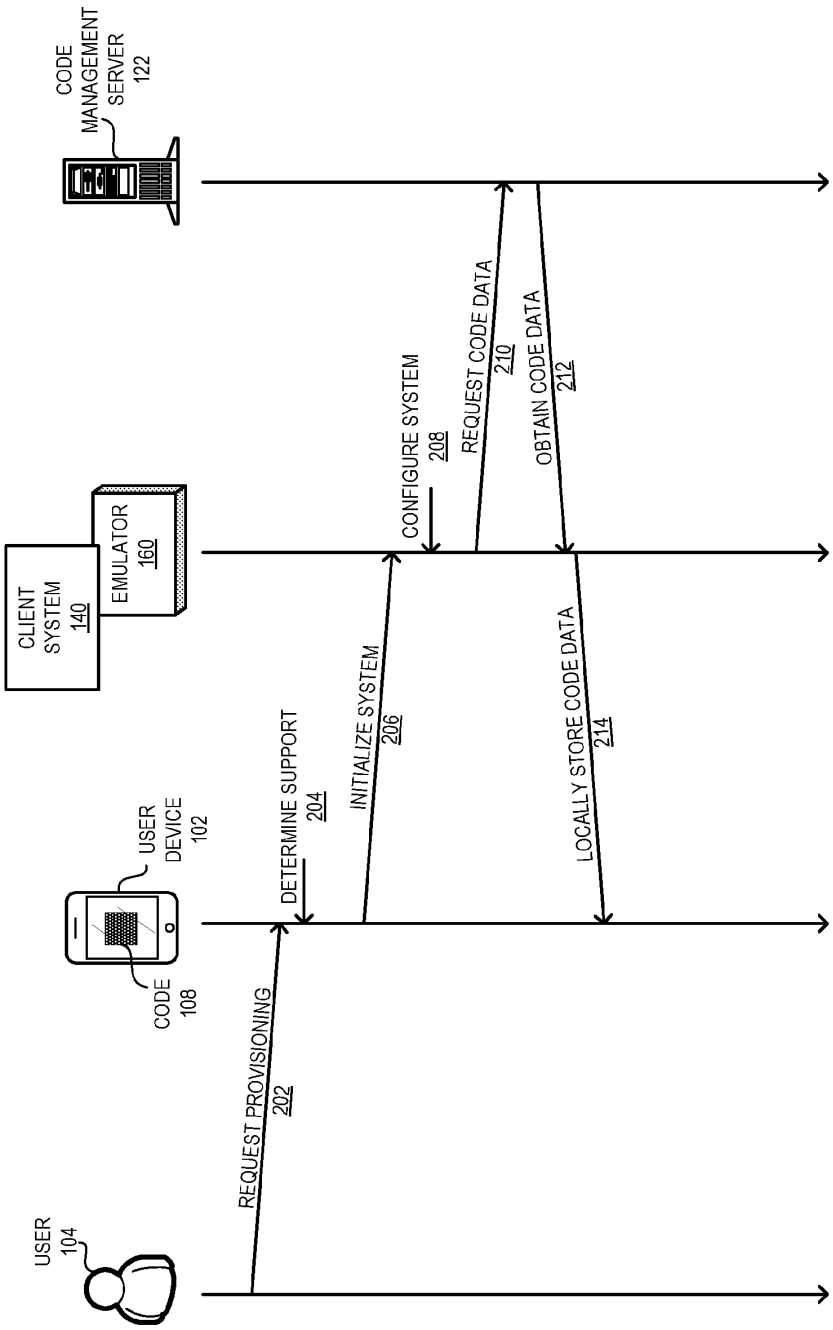
CODE MANAGEMENT SERVER 122
CLIENT SYSTEM 140
EMULATOR 160
USER DEVICE 102
CODE 108
USER 104
REQUEST PROVISIONING 202
DETERMINE SUPPORT 204
INITIALIZE SYSTEM 206
CONFIGURE SYSTEM 208
REQUEST CODE DATA 210
OBTAIN CODE DATA 212
LOCALLY STORE CODE DATA 214

FIG. 2

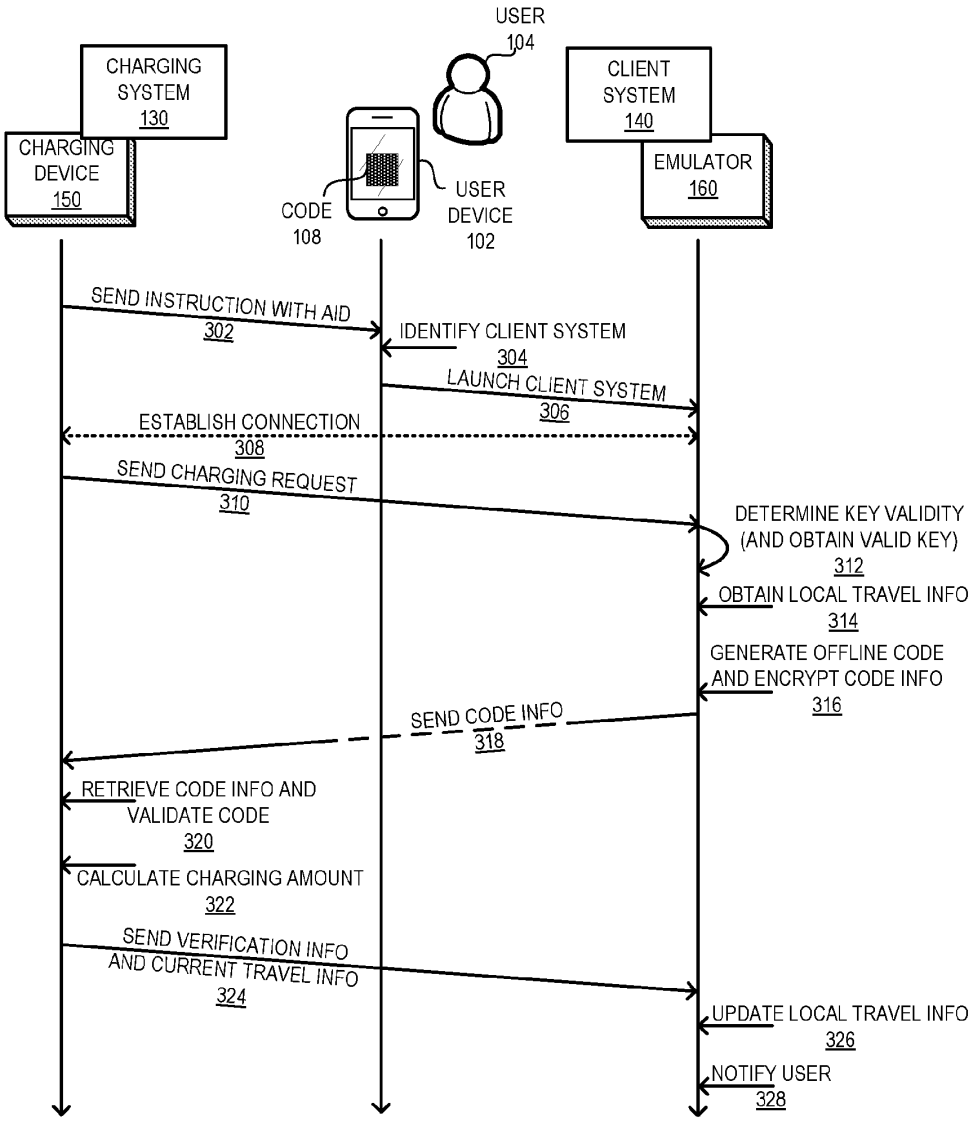
USER
104
CHARGING SYSTEM
130
CHARGING DEVICE
150
CODE
108
USER DEVICE
102
CLIENT SYSTEM
140
EMULATOR
160
SEND INSTRUCTION WITH AID
302
IDENTIFY CLIENT SYSTEM
304
LAUNCH CLIENT SYSTEM
306
ESTABLISH CONNECTION
308
SEND CHARGING REQUEST
310
DETERMINE KEY VALIDITY (AND OBTAIN VALID KEY)
312
OBTAIN LOCAL TRAVEL INFO
314
GENERATE OFFLINE CODE AND ENCRYPT CODE INFO
316
SEND CODE INFO
318
RETRIEVE CODE INFO AND VALIDATE CODE
320
CALCULATE CHARGING AMOUNT
322
SEND VERIFICATION INFO AND CURRENT TRAVEL INFO
324
UPDATE LOCAL TRAVEL INFO
326
NOTIFY USER
328

FIG. 3A

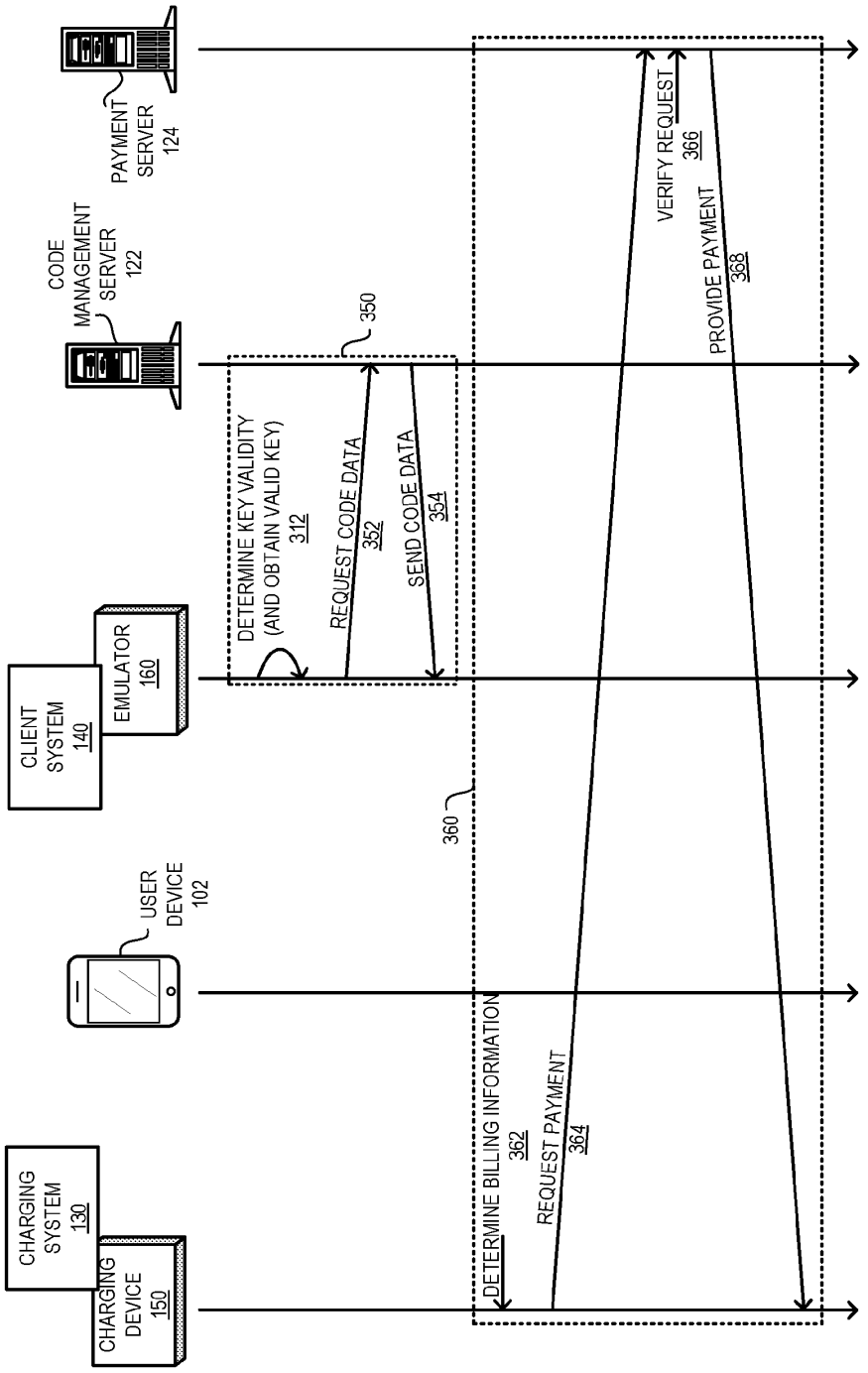
CHARGING SYSTEM 130
CHARGING DEVICE 150
USER DEVICE 102
CLIENT SYSTEM 140
EMULATOR 160
CODE MANAGEMENT SERVER 122
PAYMENT SERVER 124
360
350
DETERMINE KEY VALIDITY (AND OBTAIN VALID KEY) 312
REQUEST CODE DATA 352
SEND CODE DATA 354
DETERMINE BILLING INFORMATION 362
REQUEST PAYMENT 364
VERIFY REQUEST 366
PROVIDE PAYMENT 368

FIG. 3B

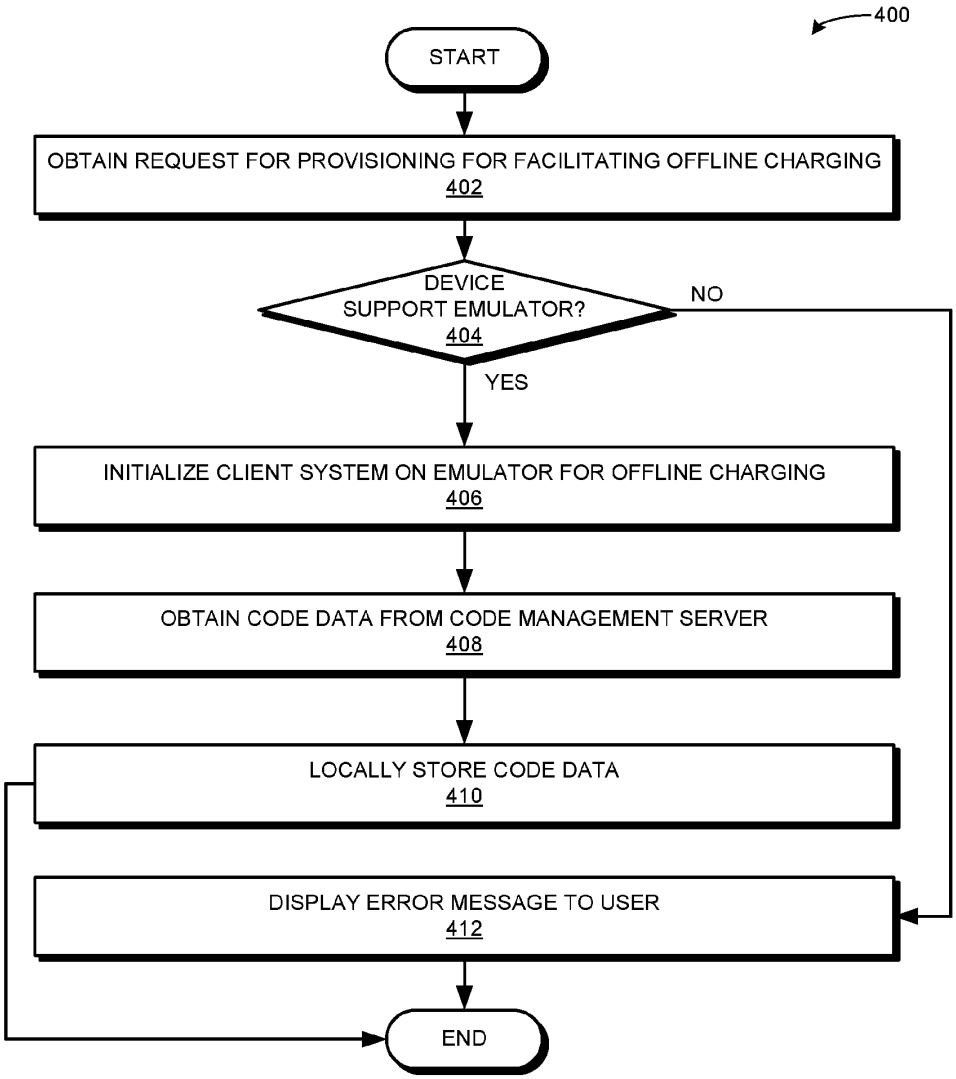
400
START
OBTAIN REQUEST FOR PROVISIONING FOR FACILITATING OFFLINE CHARGING
402
DEVICE SUPPORT EMULATOR?
404
NO
YES
INITIALIZE CLIENT SYSTEM ON EMULATOR FOR OFFLINE CHARGING
406
OBTAIN CODE DATA FROM CODE MANAGEMENT SERVER
408
LOCALLY STORE CODE DATA
410
DISPLAY ERROR MESSAGE TO USER
412
END

FIG. 4

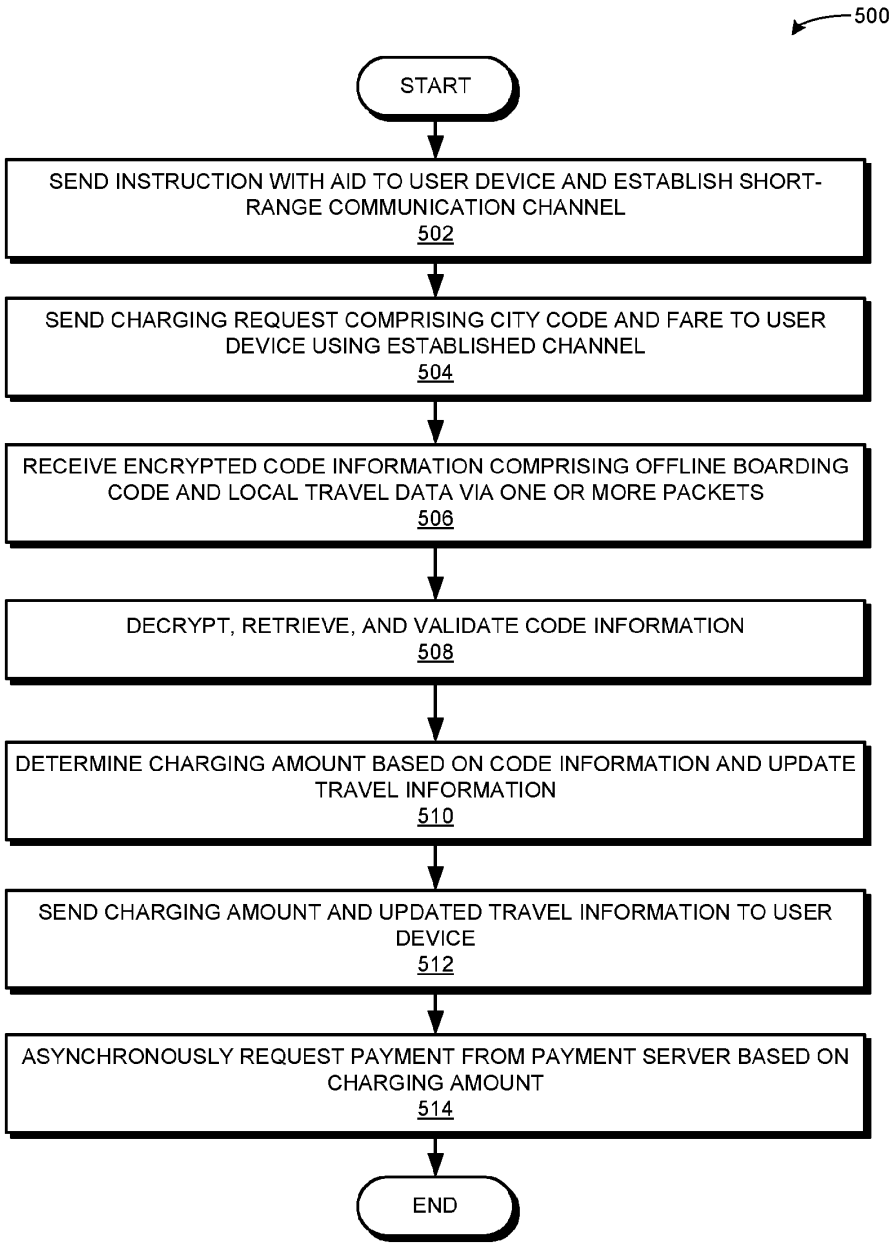
500
START
SEND INSTRUCTION WITH AID TO USER DEVICE AND ESTABLISH SHORT-RANGE COMMUNICATION CHANNEL
502
SEND CHARGING REQUEST COMPRISING CITY CODE AND FARE TO USER DEVICE USING ESTABLISHED CHANNEL
504
RECEIVE ENCRYPTED CODE INFORMATION COMPRISING OFFLINE BOARDING CODE AND LOCAL TRAVEL DATA VIA ONE OR MORE PACKETS
506
DECRYPT, RETRIEVE, AND VALIDATE CODE INFORMATION
508
DETERMINE CHARGING AMOUNT BASED ON CODE INFORMATION AND UPDATE TRAVEL INFORMATION
510
SEND CHARGING AMOUNT AND UPDATED TRAVEL INFORMATION TO USER DEVICE
512
ASYNCHRONOUSLY REQUEST PAYMENT FROM PAYMENT SERVER BASED ON CHARGING AMOUNT
514
END

FIG. 5A

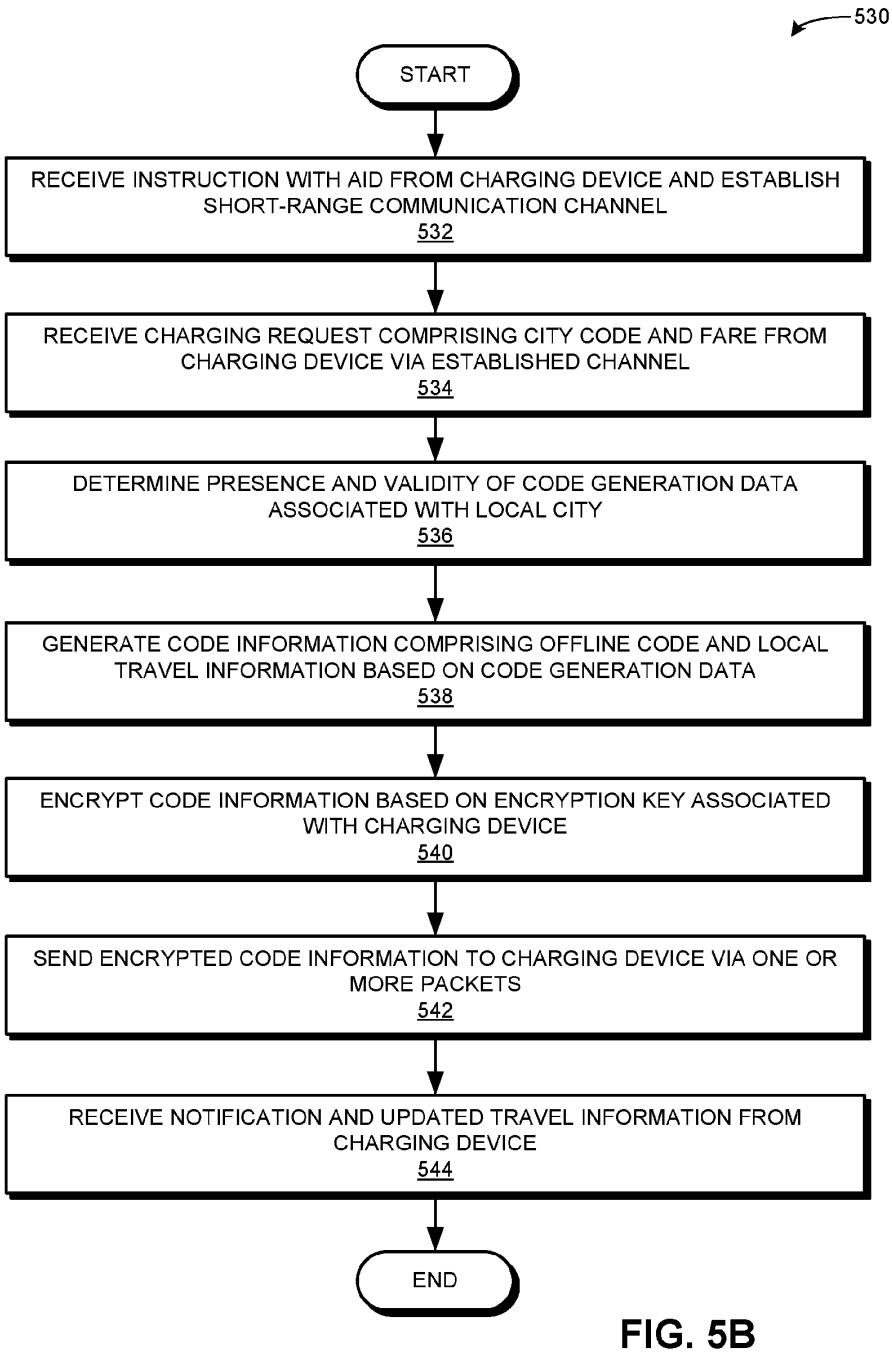
530
START
RECEIVE INSTRUCTION WITH AID FROM CHARGING DEVICE AND ESTABLISH SHORT-RANGE COMMUNICATION CHANNEL
532
RECEIVE CHARGING REQUEST COMPRISING CITY CODE AND FARE FROM CHARGING DEVICE VIA ESTABLISHED CHANNEL
534
DETERMINE PRESENCE AND VALIDITY OF CODE GENERATION DATA ASSOCIATED WITH LOCAL CITY
536
GENERATE CODE INFORMATION COMPRISING OFFLINE CODE AND LOCAL TRAVEL INFORMATION BASED ON CODE GENERATION DATA
538
ENCRYPT CODE INFORMATION BASED ON ENCRYPTION KEY ASSOCIATED WITH CHARGING DEVICE
540
SEND ENCRYPTED CODE INFORMATION TO CHARGING DEVICE VIA ONE OR MORE PACKETS
542
RECEIVE NOTIFICATION AND UPDATED TRAVEL INFORMATION FROM CHARGING DEVICE
544
END

FIG. 5B

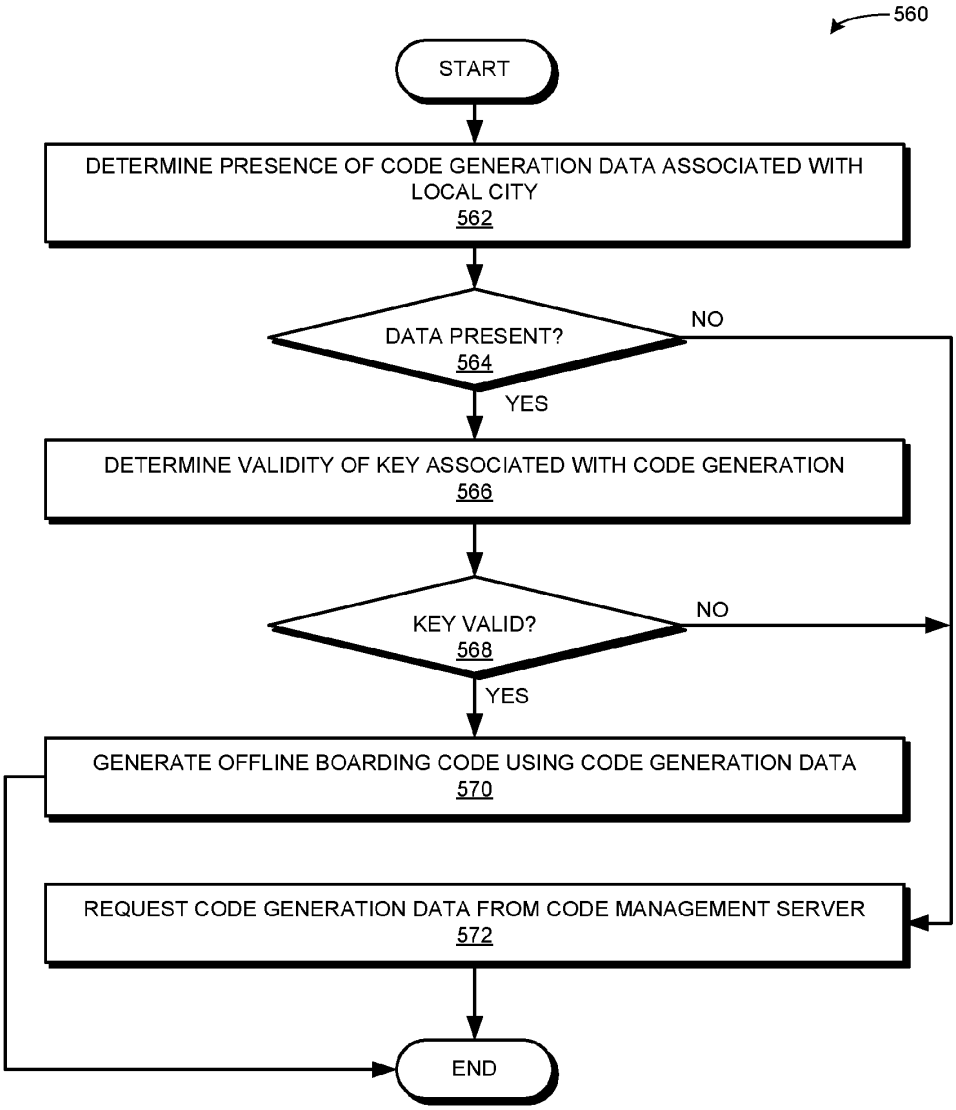
560
START
DETERMINE PRESENCE OF CODE GENERATION DATA ASSOCIATED WITH LOCAL CITY
562
DATA PRESENT?
564
NO
YES
DETERMINE VALIDITY OF KEY ASSOCIATED WITH CODE GENERATION
566
KEY VALID?
568
NO
YES
GENERATE OFFLINE BOARDING CODE USING CODE GENERATION DATA
570
REQUEST CODE GENERATION DATA FROM CODE MANAGEMENT SERVER
572
END

FIG. 5C

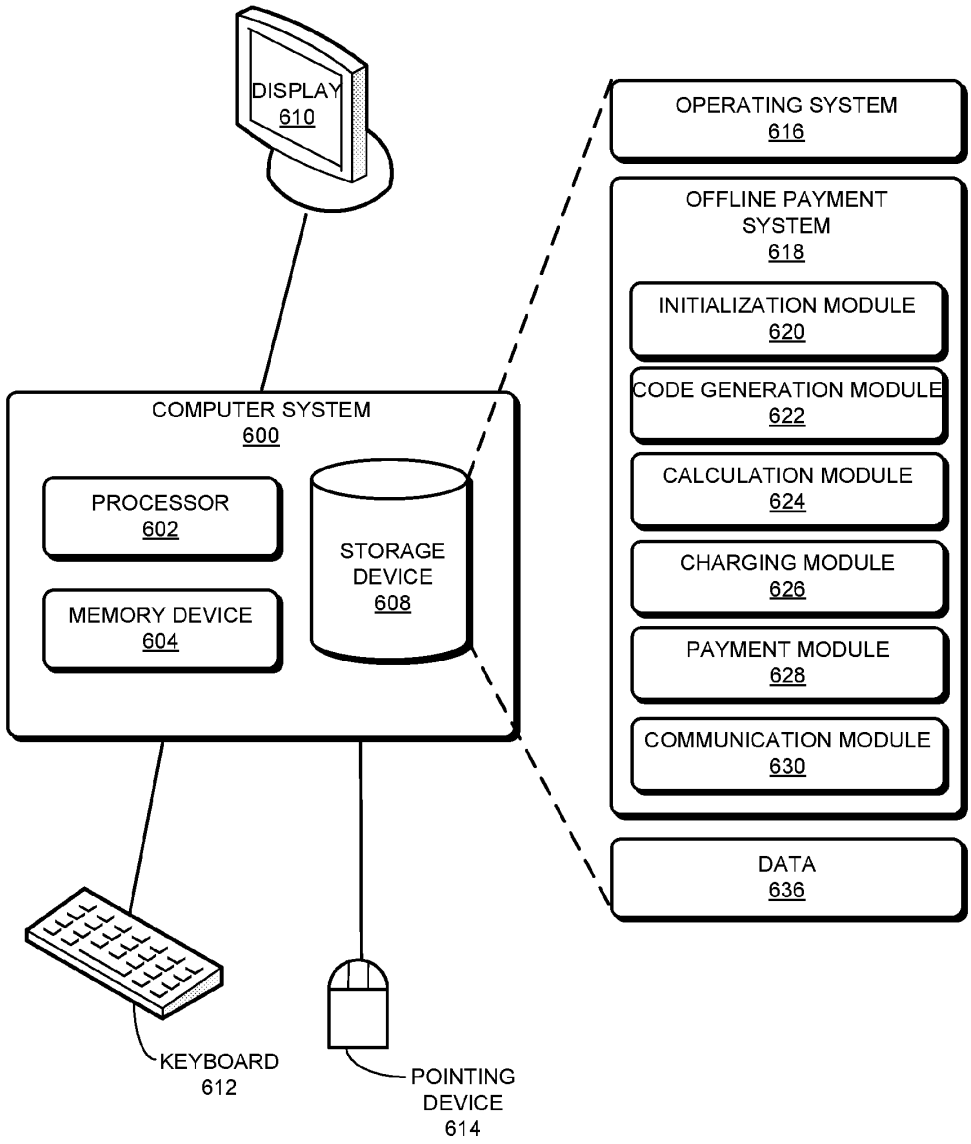
DISPLAY
610
OPERATING SYSTEM
616
OFFLINE PAYMENT
SYSTEM
618
INITIALIZATION MODULE
620
CODE GENERATION MODULE
622
CALCULATION MODULE
624
CHARGING MODULE
626
PAYMENT MODULE
628
COMMUNICATION MODULE
630
COMPUTER SYSTEM
600
PROCESSOR
602
STORAGE
DEVICE
608
MEMORY DEVICE
604
DATA
636
KEYBOARD
612
POINTING
DEVICE
614

FIG. 6

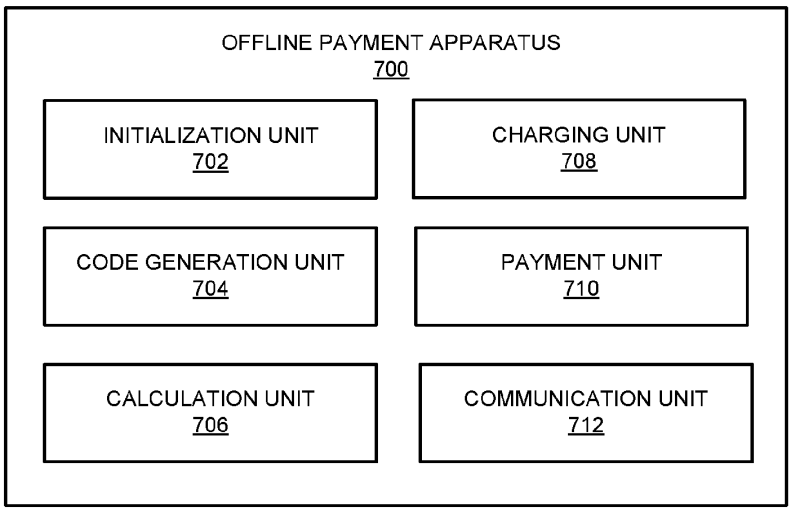
OFFLINE PAYMENT APPARATUS
700
INITIALIZATION UNIT
702
CHARGING UNIT
708
CODE GENERATION UNIT
704
PAYMENT UNIT
710
CALCULATION UNIT
706
COMMUNICATION UNIT
712

FIG. 7